

Discovery Report

Bird Creek Watershed, HUC - 11070107

Osage, Rogers, Tulsa, and Washington Counties, State of Oklahoma

FEMA Contract EMT-2013-CA-0002

Mapping Activities Statement No.6

July 8, 2015



FEMA

Federal Emergency Management Agency
Department of Homeland Security
800 N. Loop 288
Denton, TX 76209

Table 1: Project Area Community List for Bird Creek Watershed

Community Name*	CID
<i>Osage County Communities</i>	
Osage Unincorporated Areas	400146
Avant, Town of	400147
Barnsdall, City of	400148
Hominy, City of	400151
Pawhuska, City of	400152
Skiatook, City of	400212
Wynona, City of	400454
<i>Rogers County Communities</i>	
Rogers County Unincorporated Areas	405379
Catoosa, City of	400185
<i>Tulsa County Communities</i>	
Tulsa County Unincorporated Areas	400462
Broken Arrow, City of	400236
Collinsville, City of	400360
Owasso, City of	400210
Sand Springs, City of	400211
Sperry, Town of	400213
Tulsa, City of	405381
<i>Washington County Communities</i>	
Washington County Unincorporated Areas	400459
Town of Vera	400335
<i>Native American Communities</i>	
Cherokee Nation	400605
Delaware tribe of Indians	400512
Muscogee (Creek) Nation	405384
Osage Nation	405455
United Keetoowah Band of Cherokee	405450

*Communities without CIDs are not included.

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Acronyms and Abbreviations

BFE	Base (1-percent-annual-chance) Flood Elevation
BCW	Bird Creek Watershed
CAV	Community Assistance Visit
CEO	Chief Elected Officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CID	Community Identification Number
CLOMR	Conditional Letter of Map Revision
CNMS	Coordinated Needs Management Strategy ¹
CRS	Community Rating System
CTP	Cooperating Technical Partner
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
eLOMA	Electronic Letter of Map Amendment
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FPA	Floodplain Administrator
FY	Fiscal Year
G&S	Guidelines and Standards for Flood Hazard Mapping Partners
GIS	Geographic Information System
HEC-1	Hydrologic Engineering Center – Hydrologic Model Program
HEC-2	Hydrologic Engineering Center – Hydraulic Model Program
HEC-HMS	Hydrologic Engineering Center – Hydrologic Modeling System
H&H	Hydrologic and Hydraulic
HMP	Hazard Mitigation Plan
HUC	Hydrologic Unit Code
HWM	High Water Mark
IDIQ	Indefinite Delivery Indefinite Quantity
LiDAR	Light Detection and Ranging System
LOMA	Letter of Map Amendment
LOMC	Letter of Map Change
LOMR	Letter of Map Revision
LOMR-F	Letter of Map Revision based on Fill
MAT	Mitigation Assessment Team
MDP	Master Drainage Plan

¹ CNMS file dated March 11, 2014, (CNMS_FGDB_Region_VI_20140311.gdb) was used for this report unless noted otherwise.

Bird Creek Watershed Discovery Report
HUC-8 11070107

MIP	Mapping Information Platform
MLP	Midterm Levee Inventory
MXD	ArcMap Document Extension
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NRCS	National Resource Conservation Service
NFIP	National Flood Insurance Program
NHD	National Hydrologic Dataset
NVUE	New Validated or Updated Engineering
OEM	Oklahoma Department of Emergency Management
ODEQ	Oklahoma Department of Environmental Quality
ODOT	Oklahoma Department of Transportation
OKC	Oklahoma City
OWRB	Oklahoma Water Resources Board
PDF	Portable Document Format File
PMR	Physical Map Revision
RAMPP	Risk Assessment, Mapping and Planning Partners
RCRA	Resource Conservation and Recovery Act
Risk MAP	Risk Mapping, Assessment, and Planning
RL	Repetitive Loss
RSC	Regional Service Center
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SHP	ESRI Shape File
SQ MI	Square Mile
SRL	Severe Repetitive Loss
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

I. Discovery Overview

The Federal Emergency Management Agency (FEMA) is currently implementing the Risk Mapping, Assessment, and Planning (Risk MAP) Program across the Nation. The purpose of Risk MAP is continued improvement of flood hazard information for the National Flood Insurance Program (NFIP), the promotion of increased national awareness and understanding of flood risk and the support of Federal, State, and local mitigation actions to reduce risk.

The vision and intent of the Risk MAP program is to, through collaboration with State, local, and tribal entities, deliver quality data that increases public awareness and leads to mitigation actions that reduce risk to life and property. To achieve this vision, FEMA has transformed its traditional flood identification and mapping efforts into a more integrated process of more accurately identifying, assessing, communicating, planning and mitigating flood risks. Risk MAP attempts to address gaps in flood hazard data and form a solid foundation for risk assessment, floodplain management, and provide State, local, and tribal entities with information needed to mitigate flood related risks.

The FEMA Region 6 office, in partnership with the Oklahoma Water Resources Board (OWRB) began the Discovery process in the Bird Creek watershed in March of 2014 to gather local information and readily available data to determine project viability and the need for Risk MAP products to assist in the movement of communities towards resilience. The watershed location can be seen in Figure 1.

Through the Discovery process, FEMA can determine which areas of the HUC8 Discovery watersheds may/will be funded for further flood risk identification and assessment in a collaborative manner, taking into consideration the information collected from local communities during this process. Discovery initiates open lines of communication and relies on local involvement for productive discussions about flood risk. The process provides a forum for a watershed-wide effort to understand how the included watershed community's flood risks are related to flood risk throughout the watershed. In Risk MAP, projects are analyzed on a watershed basis, so Discovery Meetings target numerous stakeholders from throughout the watershed on local, regional, State, and Federal levels.

In October 2013, FEMA approved Discovery for this watershed. During the phase of the work, FEMA and the State reached out to local communities to:

- Gather information about local and tribal flood risks and flood hazards.
- Reviewed current and historic mitigation plans to understand local and tribal mitigation capabilities, hazard risk assessments, and current or future mitigation activities.
- Include multi-disciplinary staff from within their community to participate and assist in the development of a watershed vision.

The results of the Discovery process are presented in a Discovery Report, a watershed scale Discovery Map and the digital data that were gathered or developed during the process. This document contains the Discovery Report. The digital data submitted (on a DVD) with this report contains correspondence, exhibits used at the Discovery meetings, geographic information system (GIS) data, mapping documents (PDF, shapefiles, personal geodatabases and ESRI ArcGIS 10.3 Map Exchange Documents [MXDs]), or other supplemental digital information. Graphics in this Discovery Report are available as larger format graphic files for printing and as GIS data that may be printed and used at any map scale.

A. Watershed Selection

For the Discovery process, watersheds are selected and analyzed at the HUC 8 level and evaluated using three major factors (or trifecta factors): population, topographic data availability and risk decile. Decile risk calculated from 9 parameters including total population density, historical population growth, predicted population growth, housing units, flood policies, single claims, repetitive losses, repetitive loss properties and declared disasters.

The Bird Creek Watershed (HUC 11070107) encompasses an area of approximately 1,137 square miles and extends across 4 counties in Northeast Oklahoma including portions of Osage, Washington, Rogers and Tulsa Counties. The watershed contains fourteen (14) communities, with Tulsa and its population of 391,322 far and away the largest city. The surrounding communities of Broken Arrow, Owasso and Sand Springs make up the next largest communities in population. Tribal Lands belonging to the Cherokee Nation, Muscogee (Creek) Nation, Delaware Tribe of Indians, United Keetoowah Band of Cherokee and Osage Nation are located in counties that intersect the watershed. No levees are recorded in the Federal Levee Inventory; however, three (non-federal) levees (Bird Creek 1, Bird Creek 2 and the Mingo Creek) are located in the watershed.

Table 2 provides a status update for each community's NFIP participation, CRS rating, and current Flood Insurance Rate Maps (FIRMs). Four (4) of the counties and twelve (12) communities are participating in the NFIP. Two (2) of the communities are not participating in the NFIP. Figure 1 also shows the locations of all communities in the watershed.

Table 2: NFIP Status of Bird Creek Watershed Communities²

County	Community Name	Community Identification Number (CID)	Participating Community?	CRS Rating	FIRM Date	FIRM Status	Population (2010 Census)
Osage	County Unincorporated Areas	400146	Yes	NA	12/17/2013	effective	24,318
	Avant	400147	Yes	NA	12/17/2013	effective	320
	Barnsdall	400148	Yes	NA	4/2/2008	effective	1,245
	Hominy	400151	Yes	NA	4/2/2008	effective	3,312

² Population represents total population for the community and not necessarily population in the watershed.

County	Community Name	Community Identification Number (CID)	Participating Community?	CRS Rating	FIRM Date	FIRM Status	Population (2010 Census)
	Pawhuska	400152	Yes	NA	4/2/2008	effective	3,414
	Skiatook	400212	Yes	NA	10/16/2012	effective	7,189
	Wynona	400454	No	NA	12/17/2013	effective	437
Rogers	County Unincorporated Areas	405379	Yes	NA	4/3/2012	effective	56,833
	Catoosa	400185	Yes	NA	4/3/2012	effective	6,367
Tulsa	County Unincorporated Areas	400462	Yes	NA	10/16/2012	effective	43,513
	Broken Arrow	400236	Yes	5	10/16/2012	effective	87,136
	Collinsville	400360	Yes	-	4/3/2012	effective	4,688
	Owasso	400210	Yes	-	4/3/2012	effective	26,031
	Sand Springs	400211	Yes	6	12/17/2013	effective	18,509
	Sperry	400213	Yes	-	10/16/2012	effective	878
	Tulsa	405381	Yes	2	12/17/2013	effective	391,322
Washington	County Unincorporated Areas	400459	Yes	-	9/26/2008	effective	10,794
	Vera	400335	No	-	9/26/2008	effective	182

The primary river in the watershed is Bird Creek, which flows in to the Verdigris on its southern end. The Verdigris joins the Arkansas River to flow southeast into the State of Arkansas, eventually joining the Lower Mississippi River and flowing to the Gulf of Mexico.

The watershed contains state and local parks scattered throughout the watershed. No national forests or parks, or military facilities, are located in the watershed. Additionally, no significant institutions, facilities, or installations are found within the watershed except for the Dick Conner Correctional Center, straight north of Hominy, which is a minimum-medium security prison holding 1,201 inmates. Areas that may be excluded from flood risk consideration, if they have significant acreages, include large cemeteries, U.S. Environmental Protection Agency (EPA) remediation sites (i.e., Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) sites), prison areas, and water quality or flowage easement areas. These areas contribute to the overall square mileage of the watershed, but are not places where communities plan for population growth and development.

Figure 1: Watershed and Communities

Bird Creek Watershed

Jun 05 2014



FEMA



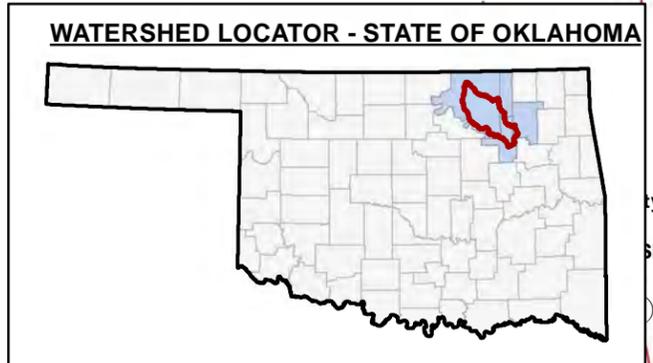
OWRB
WATER RESOURCES BOARD
FOR WATER SUSTAINABILITY

Congressional District Representatives

District 01: Rep. James Bridenstine (R)
District 02: Rep. Markwayne Mullin (R)
District 03: Rep. Frank Lucas (R)

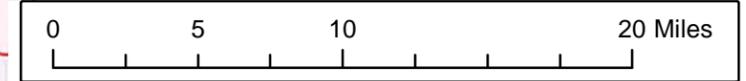
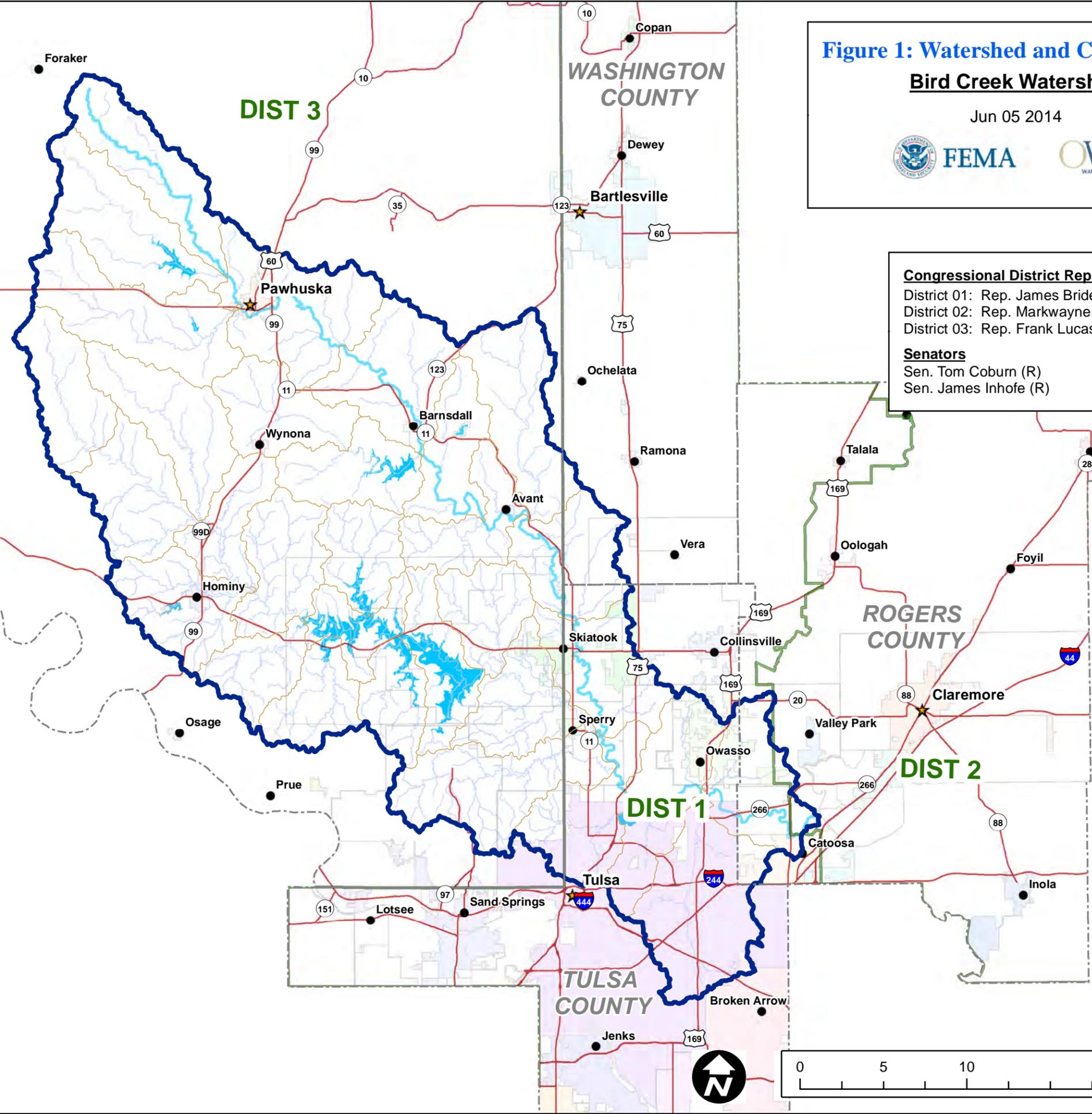
Senators

Sen. Tom Coburn (R)
Sen. James Inhofe (R)



Map Symbology

- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- Other Streams
- ▭ Congressional District Boundaries
- ▭ County Boundaries
- ⊕ Watershed Boundary: HUC 8
- ⊕ HUC 12 Basins



The Midterm Levee Inventory (MLI), Digital Flood Insurance Rate Map (DFIRM) database and Flood Map Desktop™ revealed no record of certified levees within this HUC-8. A listing of 57 was obtained from the U.S. Army Corps of Engineers (USACE) National Inventory of Dams is shown in Table 3. Dams under federal, state, local and utility jurisdiction are listed below.

Table 3: Bird Creek Watershed Dams

Name	Owner	Stream
96Th & Garnett Regional Detention Facility	City of Owasso	Ranch Creek Tributary A
Avant City	Avant Utilities Authority	Tributary of Candy Creek
Avant Utilities Authority	Avant Utilities Authority	Tributary of Candy Creek
Birch Lake	COE	Birch Creek
Bluestem Lake	City of Pawhuska	Middle Bird Creek
Codding Cattle Co.	Codding Cattle Co.	Tributary of Middle Bird Creek
Cooley Vettie	City of Tulsa	Tributary of Mingo Creek
R. Drummond	R. Drummond	Tributary of Baconrind Creek
Hominy	J. Dunkin	Penn Creek
Hominy Lake	City of Hominy	Claremore Creek
Lower Hominy	Otis Penn Jr & Mary M. Penn Stander	Penn Creek
Mohawk Water Treatment Plant	City of Tulsa	Unnamed Tributary of Bird Creek
Okla. Land & Cattle Co.	R.W. & Mary Nell Glasco	Tributary of Bird Creek
Okla. Land & Cattle Co.	John Zink Foundation	Tall Chief Creek
Oklahoma Centennial Dam	Oklahoma Centennial Botanical Gardens	Unnamed Trib of Turkey Creek/Bird Creek/Verdigris
Oknoname 113001	Thomas Joe & Jennifer Ann Teel	Tributary of Rock Creek
Oknoname 113002	J.F. Zinc	Tributary of Skiatook Lake
Oknoname 113007	R. Mcglaughlin	Tributary of Tucker Creek
Oknoname 113034	F. Matthews	Tributary of Bird Creek
Oknoname 113060	F.G. Drummond, Inc	Tributary of Boar Creek
Oknoname 113061	Jade Investments, Inc	Tributary of Penn Creek
Oknoname 113062	E. Kemohah	Tributary of Sunset Creek
Oknoname 113062	G. Ware	Tributary of Sunset Creek
Oknoname 113063	J.R. Drummond	Tributary of Bull Creek
Oknoname 113064	J.S. Marshall	Tributary of Bull Creek
Oknoname 113065	C. Marango	Tributary of Bull Creek
Oknoname 113066	S.B. Bost Properties, LP	Tributary of Wildhorse Creek
Oknoname 113067	J. Zinc	Tributary of Turkey Creek
Oknoname 113068	Charles D. & Durenda Jo Wilson	Tributary of Battle Creek
Oknoname 113069	G.W. Pease	Tributary of Battle Creek
Oknoname 113070	H. R. Collier	West Prong Quapaw Creek
Oknoname 113071	O.E. Andrews	Tributary of Bird Creek
Oknoname 113072	Fred & Betty Stoabs	Tributary of Dog Thresher Creek

Name	Owner	Stream
Oknoname 113073	Fred & Betty Stoabs	Tributary of Bird Creek
Oknoname 113090	W. W. Keeler	Tributary of Candy Creek
Oknoname 113092	Leona Rose Malone, Et al	Tributary of Dog Thresher Creek
Oknoname 113093	Thomas D. & Susan Gwen Marvin	Tributary of Dog Thresher Creek
Oknoname 113111	David L. & Arlene Parker	Clear Creek
Oknoname 113112	F. Faulkner	Tributary of Clear Creek
Oknoname 113113	C.S. Fletcher	Tributary of Clear Creek
Oknoname 113114	J. Drummond	Tributary of Bluestem Lake
Oknoname 113151	Ladd A. Drummond	Tributary of Middle Bird Creek
Oknoname 113152	F. Drummond	S. Bird Creek
Oknoname 113154	Leslie F. Drummond & Sons	Tributary of Clear Creek
Oknoname 113155	Fredrick Ford Drummond II	Tributary of Clear Creek
Oknoname 30119	Randi S. Wightam	Unnamed Trib Tucker Creek
Owasso	Larkin Bailey	Tributary of Ranch Creek
Pawhuska Lake Dam	City Of Pawhuska	Tributary Clear Creek
Recreation	City Of Tulsa	Tributary of Bird Creek
Skiatook Lake	COE	Hominy Creek
Sooner Land & Cattle Co.	Oklahoma Land & Cattle Co.	Tributary of Skiatook Lake
Southern Great Plains Field Station	U. S. Forest Service	Spring Creek
Stone Canyon	Cabo Development , LLC	Unnamed Tributary To Elm Creek
Tyann	Tyann Development	Tributary of Bird Creek
U.G. Butch	Charles Haney & Cathleen Newman	Tributary of Hominy Creek
Waxhoma	City Of Barnsdall	Tributary of Dog Thresher Creek
Yahola	City Of Tulsa	Tributary of Bird Creek

1. Population

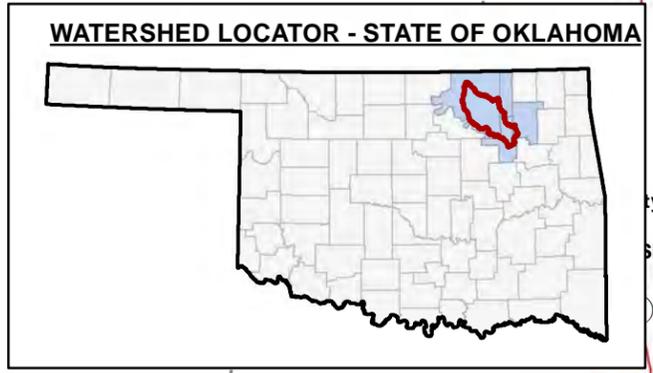
The population in this watershed totals 262,862 people, based on the 2010 census. The City of Tulsa is the watershed's highest population center (population: 391,322³). There are in total 14 populated areas inside this watershed. Figure 2 shows the population densities within the Bird Creek Watershed based on 2010 U.S. Census Data.

The highest population centers are found in the southern end of the watershed, with the City of Tulsa far and away the largest. The Cities of Broken Arrow and Owasso, both adjacent to Tulsa, are the next largest in population. Figure 3 identifies the relative percent urban cover for areas within the watershed.

³ Total population for the City of Tulsa includes areas outside of the watershed.

Figure 2: Population Density in the Watershed
Bird Creek Watershed

Jun 05 2014



Map Symbology

- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- ⊕ Communities
- - - County Boundaries
- ⬮ Watershed Boundary: HUC 8
- ⬮ HUC 12 Basins

CNMS Validation Status

- Unknown
- Unverified
- Valid

Population Density

- Low
- Medium-Low
- Medium
- High

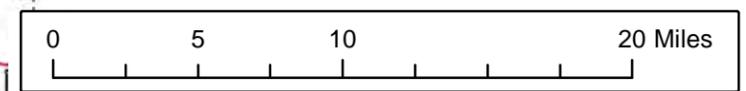
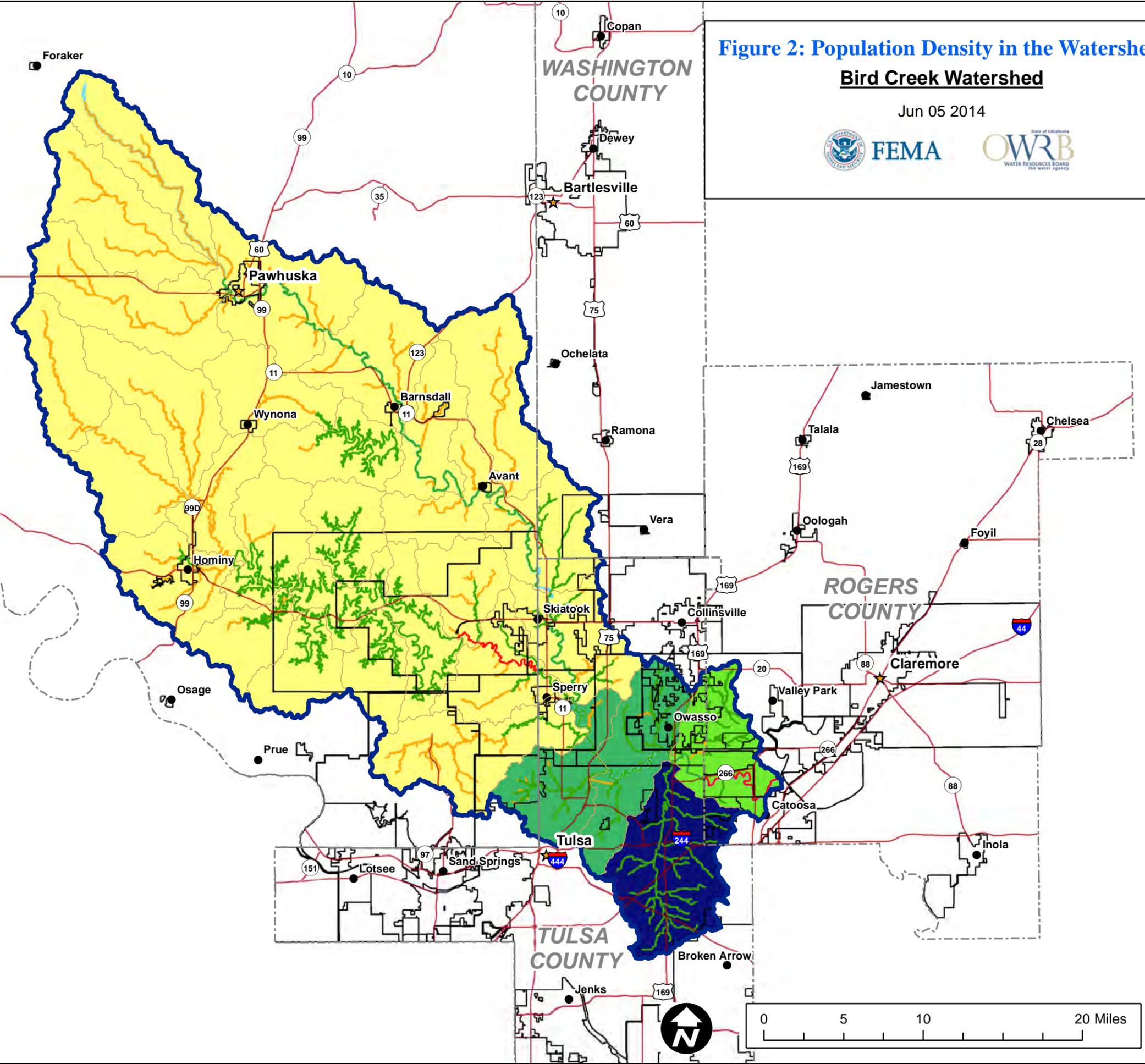
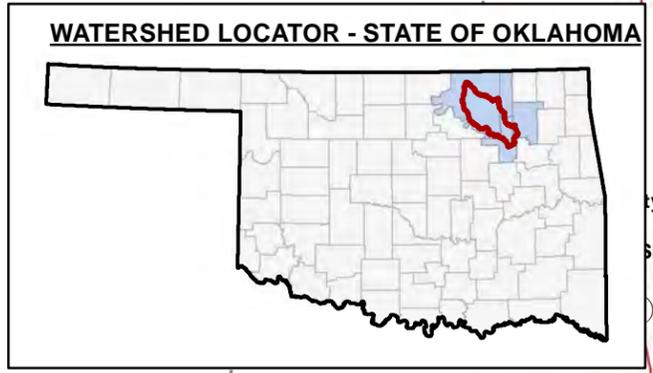


Figure 3: Percent Urban Coverage
Bird Creek Watershed

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Map Symbology

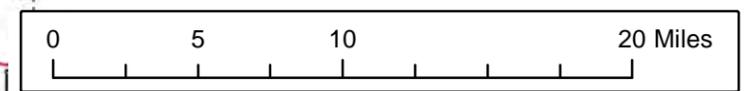
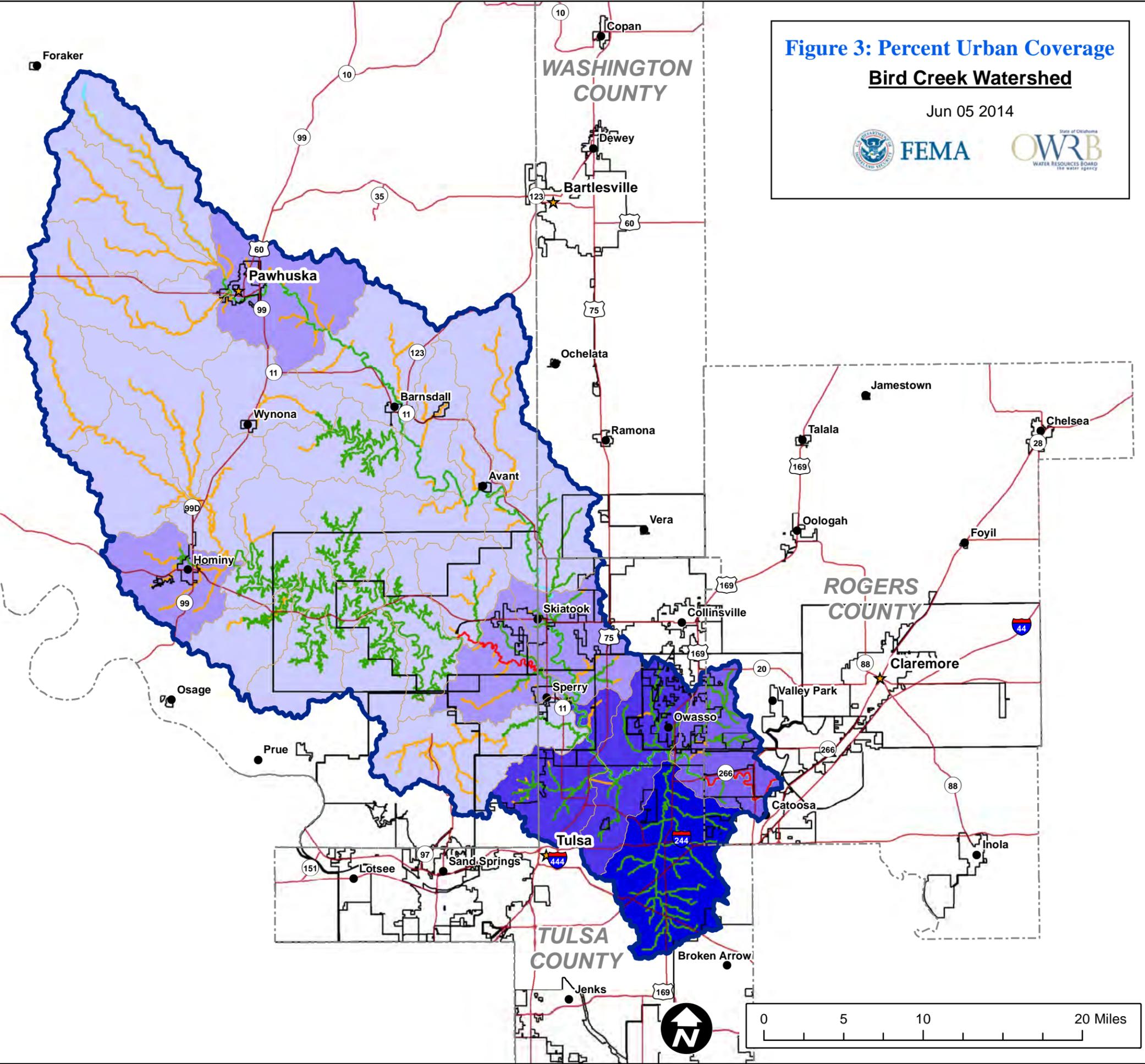
- Cities
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- Major Highways
- Bird Creek
- ⊕ Communities
- - - County Boundaries
- ⬮ Watershed Boundary: HUC 8
- ⬮ HUC 12 Basins

CNMS Validation Status

- Unknown
- Unverified
- Valid

Current Percent Urban Cover

- Low
- Medium-Low
- Medium
- Medium-High
- High



2. Land Use

Overall land use for the watershed has remained historically consistent, with the majority of the watershed used for agricultural purposes and classified as rural land (see Table 4). In the last five years, the areas of largest population historically continue to account for the greatest urbanization and population growth, thus representing a continuous and uniform growth in the southern end of Bird Creek Watershed. Figure 4 shows the changes in the percent urban coverage that have occurred in the watershed in the last five years.

Table 4: Land Use for Bird Creek Watershed

Land Use	Approximate Square Miles Within the Watershed
Incorporated Communities	135.6
Unincorporated Counties	1,001.8
Undevelopable Areas within watershed	
Lakes / Reservoirs / Detention ponds	24.4
Parks / Preserves	4.1
Military Areas / Reservations	0
Miscellaneous Non-Developable Areas	16.5

3. NFIP Insurance

Table 5 lists the number of NFIP insurance claims for the portions of the communities within the Watershed. Of the insurance claims filed within the watershed, 71% percent have been filed in the City of Tulsa and Tulsa County unincorporated areas of the watershed. Table 5 depicts the distribution of NFIP insurance claims within the Bird Creek Watershed.

Table 5: Total NFIP Insurance Claims for Bird Creek Watershed

Community	Claims
Osage County Unincorporated Areas	23
Town of Avant	2
City of Barnsdall	1
City of Hominy	0
City of Pawhuska	9
City of Skiatook	108
City of Wynona	N/A*
Rogers County Unincorporated Areas	57
City of Catoosa	5
Tulsa County Unincorporated Areas	257
City of Broken Arrow	91
City of Collinsville	3
City of Owasso	9

Community	Claims
City of Sand Springs	317
Town of Sperry	5
City of Tulsa	2,222
Washington County Unincorporated Areas	24
Town of Vera	N/A*
* Non-participating Community, no policy data available	

In addition to NFIP claims, there are several locations of Repetitive Loss (RL) or Severe Repetitive Loss (SRL) properties within the Bird Creek Watershed. Table 6 summarizes RL and SRL claims by county and community within the Watershed. These losses are also displayed on the Discovery Map included in the supplemental digital data.

Table 6: Repetitive or Severe Repetitive Loss within the Bird Creek Watershed

Community	Number of Properties	Total Claims	Average Claim Per Property
City of Pawhuska	1	2	\$11,257.08
City of Skiatook	28	116	\$27,727.19
City of Broken Arrow	7	31	\$24,132.53
City of Collinsville	3	6	\$15,914.50
City of Owasso	2	6	\$12,983.16
City of Sand Springs	40	110	\$18,790.32
Town of Sperry	6	21	\$13,486.03
City of Tulsa	153	413	\$83,669.10

The Bird Creek Watershed has a history of flooding as demonstrated by numerous flood-related presidential disaster declarations with 18 issued in the past 30 years. In addition, the Oklahoma State mitigation plan shows that historically (1986-2003) flash flooding has been particularly serious for the Bird Creek Watershed with the two highest confirmed flash flood counties in the entire state being Tulsa County (61 confirmed events) and Osage County (54 confirmed events). Table 7 lists representative flood-related disaster declarations for the four counties within the watershed. Single Claim information is illustrated in Figure 5.

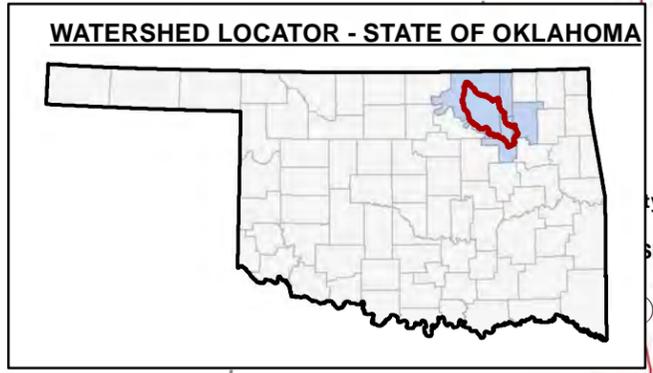
Table 7: Disaster Declarations in the Bird Creek Watershed

Watershed County Declared	Date of Declaration	Hazard
Osage	6/6/2011	Severe Storms, Tornadoes, Straight-line Winds and Flooding
	7/9/2008	Severe Storms and Flooding
Rogers	5/31/1984	Severe Storms, Flooding
Tulsa	5/12/1993	Flooding, Severe Storm, Tornadoes
	7/8/1959	Flooding
Washington	6/7/2007	Severe Storms, Tornadoes, and Flooding

Figure 4: Urban Change Last 5 Years

Bird Creek Watershed

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Map Symbolology

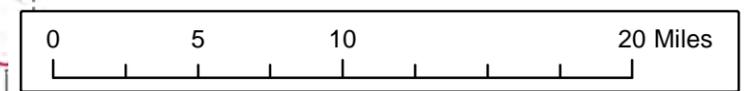
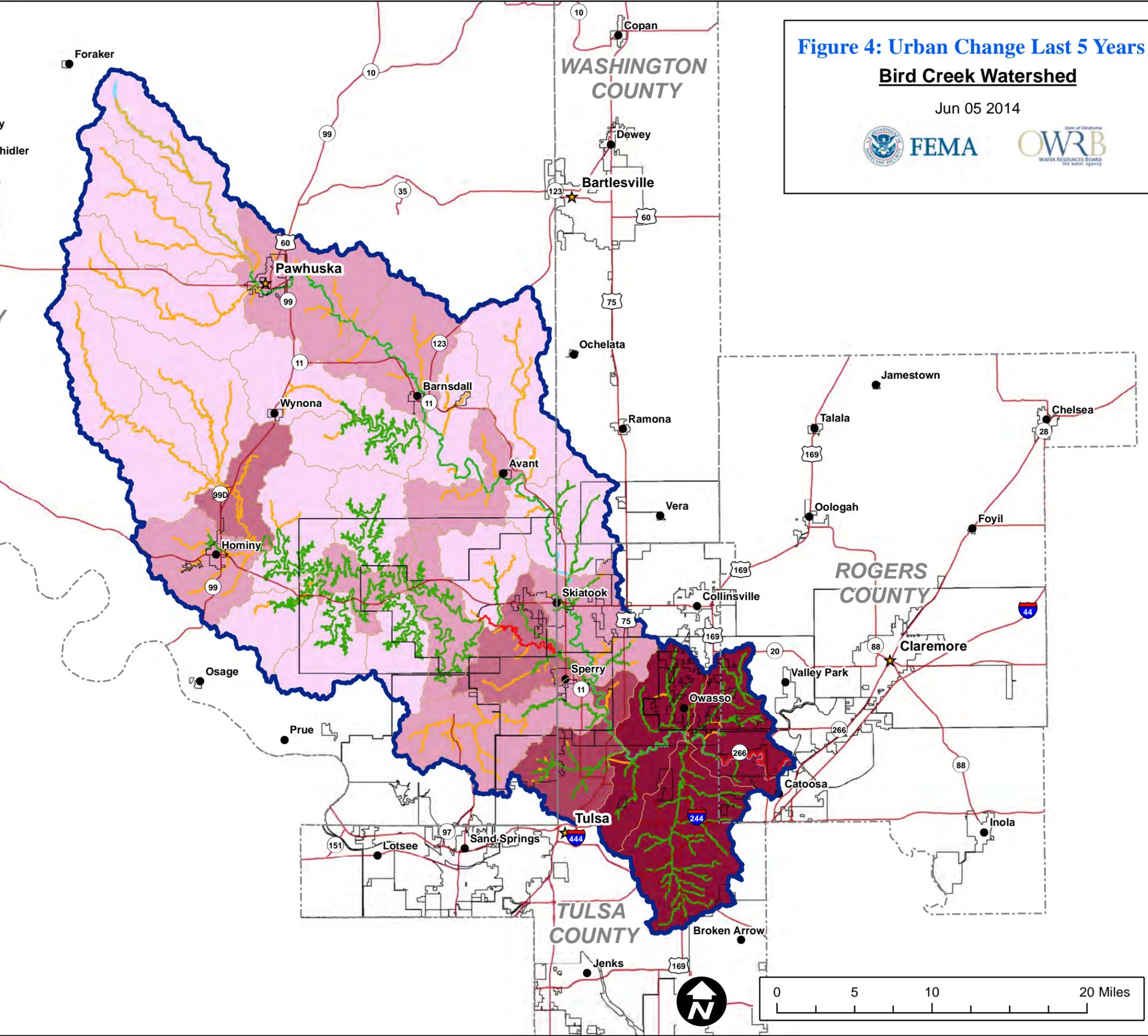
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- ⬮ HUC 12 Basins

CNMS Validation Status

- Unknown
- Unverified
- Valid

Relative Urbanization Last 5 Years

- Low
- Medium-Low
- Medium
- Medium-High
- High



WATERSHED LOCATOR - STATE OF OKLAHOMA

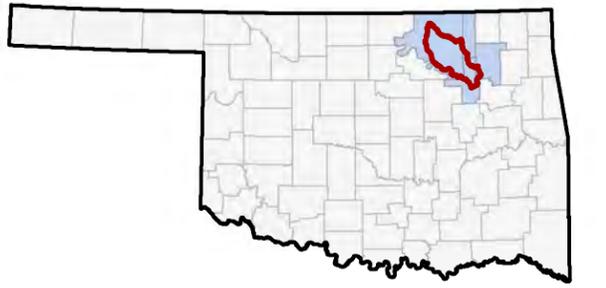


Figure 5: Single Claims in the Watershed

Bird Creek Watershed

Jun 05 2014



FEMA



OWRB
WATER RESOURCES BOARD

Claim Totals by Community	
Community	Number
Avant	2
Barnsdall	1
Broken Arrow	91
Catoosa	5
Collinsville	3
Owasso	9
Pawhuska	9
Sand Springs	317
Skiatook	108
Sperry	5
Tulsa	2,222

Claim Totals by County	
County	Number
Osage County	23
Rogers County	57
Tulsa County	257
Washington County	24

Map Symbolology

- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- ⊕ Communities
- ⬮ Watershed Boundary: HUC 8
- ⬮ HUC 12 Basins

CNMS Validation Status

- Unknown
- Unverified
- Valid

Claims

- None
- Low
- High

OSAGE COUNTY

WASHINGTON COUNTY

ROGERS COUNTY

TULSA COUNTY

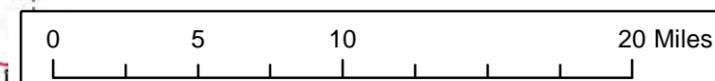
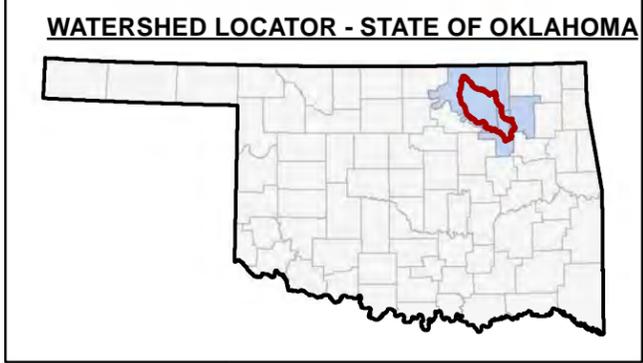


Figure 6: Risk Factors and Available Topographic Data
Bird Creek Watershed
 Jun 05 2014



Map Symbology

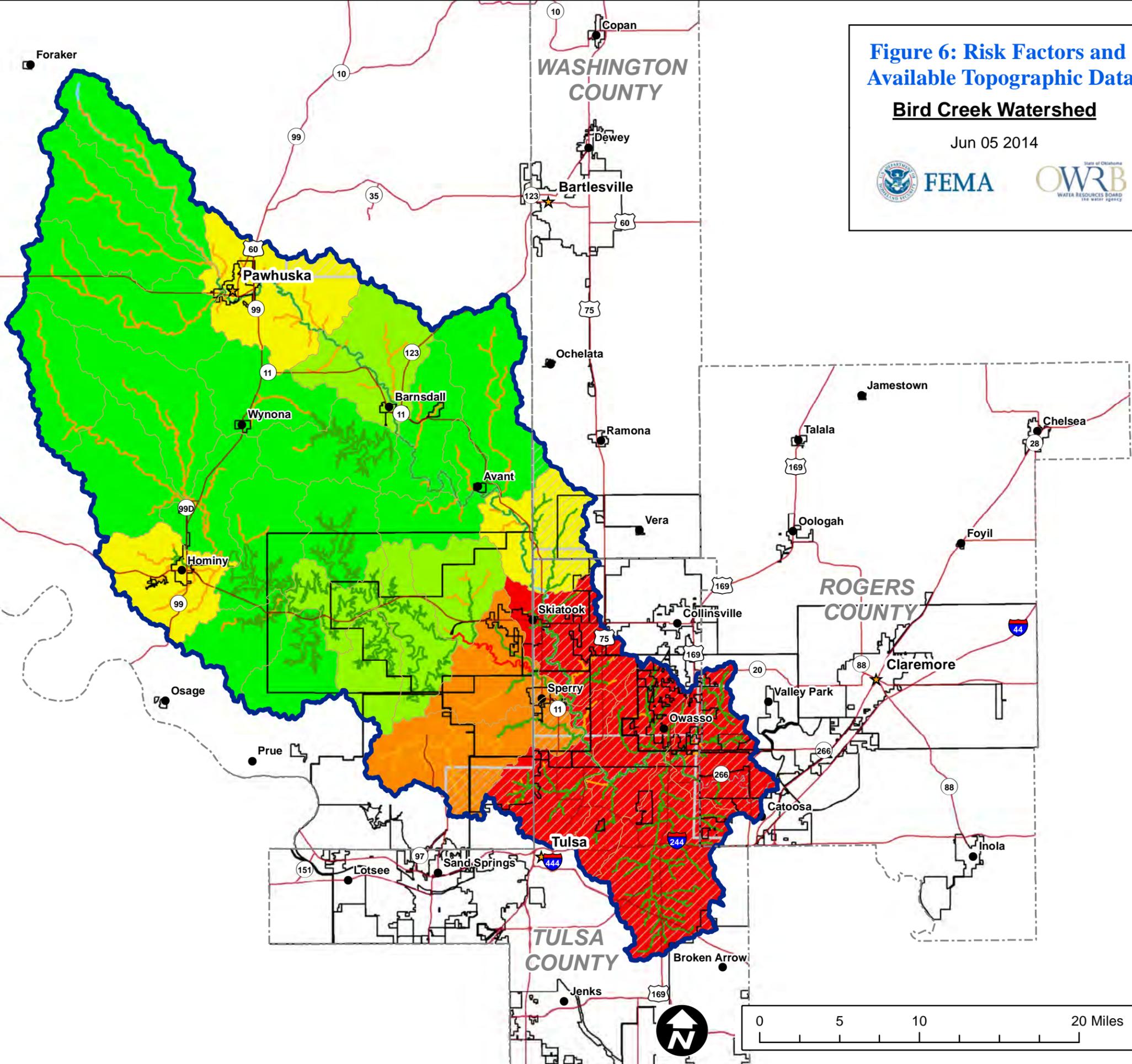
- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- ⊕ Communities
- - - County Boundaries
- ⬮ Watershed Boundary: HUC 8
- ⬮ HUC 12 Basins
- ▨ Existing Topographic Data

CNMS Validation Status

- Unknown
- Unverified
- Valid

Density Risk Decile

- Low
- Medium-Low
- Medium
- Medium-High
- High



4. Topographic Data

At this time, there are no pending planned acquisitions of topographic data for the counties in the watershed. Topographic coverage totals are at about 30% percent for the entire watershed. Areas that are noted to be lacking updated topographic information are most of Pawhuska, Wynona, Barnsdall, Hominy and Avant, and the unincorporated areas of Osage County. Only the U.S. Geological Survey (USGS) 10 meter Digital Elevation Model (DEM) data is available for these missing areas and is not suitable for detailed study modeling and floodplain mapping. See Figure 6.

5. Congressional Involvement

Senator James Inhofe is a long-standing member of the U.S. Senate Committee on the Environment and Public Works Committee which has oversight of FEMA. The Committee also has a Fisheries, Wildlife and Water subcommittee. Senator Inhofe has been influential in obtaining funding for the Bird Creek Watershed by way of improvements such as the Mingo Creek Local Improvement Project. The watershed is also strengthened politically by the activities of the watershed's Representatives. Representative Jim Bridenstine has been working on legislation to improve weather forecasting, and Representative Markwayne Mullin has been working on water infrastructure reform. Representative Mullin also has relevant committee assignments including the Subcommittee on Water Resources and the Environment, as well as the Subcommittee on Water and Power.

6. Streams and Waterways

Bird Creek is the principle riverine body, with Hominy Creek forming the principal tributary of Bird Creek. Bird Creek enters the Verdigris River immediately downstream from the Port of Catoosa, outside of the Bird Creek Watershed. The main tributaries of Hominy Creek in the project area are Tall Chief, Turkey, Gouin, Bull, Wildhorse, Boar, Sand, and Mahala Creeks. Skiatook Lake, which is situated on Hominy Creek, assists in providing flood protection on Bird Creek below the mouth of Hominy Creek. Protection is also shared by Birch Lake, which is located on an upstream tributary of Bird Creek. Downstream from Skiatook Lake, about 100,000 acres of land in the floodplain of Hominy Creek, Bird Creek, and the Verdigris River are affected by flood control operations of Skiatook Lake and Dam. The USGS provides a National Hydrologic Dataset (NHD) that can be used to identify stream miles that reflect drainage areas of one square mile from available topographic data. The NHD stream mileage may be used to gain a sense of the total potential stream miles for a watershed. Using the NHD, there are approximately 1161.64 miles of streams in the Bird Creek Watershed.

7. Coordinated Needs Management Strategy

The Coordinated Needs Management Strategy (CNMS) Inventory provides a snapshot of the status and attributes of currently studied streams existing within FEMA's floodplain study inventory. In general, the stream mileage shown in CNMS reflects streams with an approximately one-mile drainage area and that currently have effective Special Flood Hazard Areas (SFHA) designated for them. CNMS does not reflect the total potential of stream miles to be studied within a watershed.

In addition to listing the miles of studied stream within a watershed, CNMS documents certain physiological, climatological, or engineering methodological factors that may have changed since the date of the effective study. The stream miles shown in CNMS are attributed with an evaluation of a Validation Status and Status Type that allows an examination of the condition of a given study or group of studies. Studies which are considered Valid in CNMS are the only studies which contribute to the New Validated or Updated Engineering (NVUE) metric.

The NVUE metric is used as an indicator of the status of studies for FEMA's mapped SFHA Inventory. Those studies, which are categorized as 'unverified', typically indicate that there are some factor of change since the SFHA became effective or may have a deficiency warranting restudy. CNMS stream mileage categorized as 'Requires Assessment' require further input to determine their validity – often because they represent paper inventory or non-modernized studies. CNMS aids in identifying areas to consider for study during the Discovery process by highlighting needs on a map, quantifying them (mileage), and providing further categorization of these needs in order to differentiate factors that identify the needs.

Table 8 compares the NHD data to the CNMS data and summarizes the Validated NVUE stream mileage from CNMS for the watershed.

Table 8: NVUE Approximate Stream Mileage in the Bird Creek Watershed

NVUE Validation	Stream Miles
NHD Streams (NHD Medium Resolution)	1161.64
CNMS Streams (streams with effective SFHA)	808.76
Stream Miles not accounted for in CNMS	352.88
CNMS Valid Zone AE / AH / AO	456.01
CNMS Valid Zone A	355.09
CNMS Unverified Zone AE / AH / AO	18.89
CNMS Unverified Zone A	0
CNMS Zone AE / AH / AO Requiring Further Assessment or in the process of being studied	0
CNMS Zone A Requiring Further Assessment	333.86
All Stream Miles not accounted for in CNMS as there are no effective SFHAs (sum of the below)	352.88
Stream Miles not accounted for in CNMS that would fall in land that could be developed	352.88
Stream Miles not accounted for in CNMS that would fall in land that could not be developed	0

Within the Bird Creek Watershed and using these criteria from CNMS, approximately 0 miles of Zone A and 18.9 miles of Zone AE areas were identified as being unverified. Streams included in

the unverified grouping include Hominy Creek and Bird Creek with 0 miles of Zone AE flagged as requiring further assessment (or are in the current process of being studied with on-going projects). Additionally, 434.8 miles of Zone AH and Zone AE stream miles in the watershed were characterized as being Valid under the NVUE metrics.

B. Watershed Risk Factor Rankings

The level of flood risk can be calculated by two methods. Risk deciles are calculated from nine parameters, including total population density, historical population growth, predicted population growth, housing units, flood policies, single claims, repetitive losses (RLs), RL properties and declared disasters.

A risk decile is calculated at the watershed level by FEMA. The scale of risk decile ranking is 1 to 10, with 1 being the highest and 10 being the lowest ranking for a portion of the watershed. Table 9 lists the overall rankings of the Bird Creek Watershed when compared nationally and regionally to other HUC 8 watersheds.

Table 9: Watershed Risk Factor Rankings for Bird Creek Watershed

Bird Creek Watershed Selection Rankings			
National Risk Factor Rank:	310	Region 6 Risk Factor Rank:	NA
National Risk Decile:	2	Region 6 Risk Decile:	2
Average Annualized Loss:	\$26,647,000	Average Annualized Loss:	\$26,647,000
National Average Annualized Loss Rank:	NA	Region 6 Average Annualized Loss Rank:	NA
National Overall Rank:	NA	Region 6 Overall Rank:	NA

II. Discovery Efforts

A. Engagement Plan

1. Pre-Discovery Community Engagement

Table 7 provides the names of staff members that made up the Regional Project Team.

Table 10: Discovery Project Team for Bird Creek Watershed

Organization	Name/E-Mail	Responsibility
FEMA Region 6	Jerry Clark jerry.clark@fema.dhs.gov	FEMA Project Monitor
FEMA Region 6	Shanene Thomas shanene.thomas@fema.dhs.gov	FEMA Mitigation Planning and Tribal Liaison
FEMA Region 6	Danielle Brown danielle.brownz@fema.dhs.gov	Hazard Mitigation Grants Specialist
FEMA Region 6	Roberto Ramirez roberto.ramirez@fema.dhs.gov	Compliance & Natural Hazards
FEMA Region 6	Diane Howe, CFM diane.how@fema.dhs.gov	Risk Assessment/ Outreach Specialist
FEMA Region 6	Nitja McGrane nitja.mcgrane@fema.dhs.gov	Community Education and Outreach Specialist
OWRB	Gavin Brady gavin.brady@owrb.ok.gov	CTP PM State NFIP Coordinator
OWRB	Matt Rollins Matt.Rollins@owrb.ok.gov	State NFIP Specialist
OWRB	Yohanes Sugeng, PE ypsugeng@owrb.ok.gov	State Dam Safety Engineer
OEM	Annie Mack Vest annie.vest@oem.ok.gov	State Hazard Mitigation Officer
USACE	Jason Chrumka jason.a.chrumka@usace.army.mil	USACE Representative
NFIP Iservice	Carl Watts cwatts@nfip-iservice.com	Insurance Specialist
Meshek & Associates	Chris Duncan cduncan@meshekengr.com	Meshek Program Manager
Meshek & Associates	Ana Stagg astagg@meshekengr.com	Discovery Manager
Meshek & Associates	Will Gustafson wgustafson@meshekengr.com	GIS Specialist
Meshek & Associates	Johnson Bridgwater jbridgwater@meshekengr.com	Hazard Mitigation Planner
Meshek & Associates	Bethany Scott bscott@meshekengr.com	Discovery Coordinator

FEMA and the Regional Project Team were in contact with all Watershed stakeholders via letters, email, and phone calls before this Discovery meeting to request local participation. In addition to assisting with scheduling the meeting, locals were asked to help identify additional key people who should be included in the Discovery process and acquire any data that will assist in the risk

identification and assessment for the Bird Creek Watershed. A detailed list of Communities, local officials, federal, state and regional agencies that were invited to participate in the Discovery Process is included with the supplemental digital data accompanying this report.

In preparation for the Discovery meeting, the Regional Project Team:

- Gathered information about local flood risk and flood hazards
- Reviewed mitigation plans to understand local mitigation capabilities, hazard risk assessments, current or future mitigation activities, and areas of mitigation interest
- Encouraged communities within the watershed to develop a vision for the watershed's future
- Used all information gathered to determine which areas of the watershed may require further study through a Risk MAP project

The Regional Project Team began outreach efforts to the local governments within the Watershed, Congressional and public officials, to inform them of the Discovery process and to invite them to participate and contribute information about the Watershed about water resource concerns. The following are key steps that were taken before the Discovery workshops:

- Initial Coordination meeting with FEMA, the State of Oklahoma (NFIP and SHMO) and Meshek & Associates was held to set the stage for co-participation and sharing of the meeting.
- Established potential meeting times and locations.
 - Information and invitation letters were mailed to the CEO, and email invitations were sent to other key personnel communities and other local stakeholders.
 - Initial calls by CTP were made to request information that may be pertinent to the watershed.
 - CTP followed up via email with meeting information.
 - CTP followed up with phone calls to personally invite communities and remind them of the meeting details and logistics to ensure the major watershed players were present.
 - FEMA coordinated internally for meeting attendees to support the project
 - USACE was invited to actively participate as an active member of the project team.
 - Congressional briefing occurred before the meeting.

Discussions are being held with these agencies about potential partnership opportunities, as well as their help in identifying flood risk throughout the watershed.

Table 11: FEMA History of Engagement for Bird Creek Watershed

Community Name	Type of Engagement*	Date	Agency	Comments
Rogers County Unincorporated Areas	CAV	7/17/2013	OWRB	-
City of Catoosa	CAV	7/16/2013	OWRB	-
Tulsa County Unincorporated Areas	CAC	7/8/2012	OWRB	FIRM Map Adoption
City of Broken Arrow	CAC/ CAV	2/20/2012; 7/16/2013	OWRB	-
City of Owasso	CAC/ CAV	3/7/2012; 6/26/2012	OWRB	FIRM Map Adoption, CAV Meeting
City of Tulsa	CAC/CAV	3/13/2012; 6/24/2013	OWRB	FIRM Map Adoption, CAV Meeting

* Meetings or other FEMA engagement activities that have occurred in the watershed in the past 3 years.

Table 12: Mitigation Plan Status for Bird Creek Watershed

Community Name	Community Mitigation Action	Hazard Mitigation Plan Name	Plan Status	Plan Approved	Plan Expires
Osage County (includes Avant, Barnsdall, Hominy, Pawhuska, Wynona)	Property protection Property acquisitions Replacement of emergency dam spillways	Multi-Jurisdiction Multi-County Hazard Mitigation Plan	Approved	10/30/2013	10/29/2018
City of Skiatook	Identify at risk properties from the 100-year flood Ensure future urbanization and development does not increase flooding downstream Identify and maximize the natural and beneficial uses of the floodplain.	Skiatook Multi-Hazard Mitigation Plan	Approved	10/01/2014	10/01/2019
Rogers County (includes Catoosa)	Prevent roadbed flooding damages Warn and protect population Reduce repetitive property losses	Hazard Mitigation Plan of Rogers County	Approved	8/31/2010	8/30/2015
Tulsa County	Protect/inform/warn/educate the public Acquire rep/loss properties and limit building in high-risk areas Improve building construction to reduce exposure to flooding. Plan also calls for development of a separate "Flood & Drainage Annex" to the HM Plan.	Tulsa County Multi-Hazard Mitigation Plan	Approved Plan being updated (DR4109-22)	9/23/2010	9/22/2015
City of Broken Arrow	Maintain Floodplain Coordinator Develop Master Drainage Plan	Broken Arrow Multi-Hazard Mitigation Plan	Approved	7/2/2012	7/1/2017

Community Name	Community Mitigation Action	Hazard Mitigation Plan Name	Plan Status	Plan Approved	Plan Expires
	Develop pre- and post- flood plan for Arkansas River floodplain. Plan also calls for construction of storm water detention facilities; also partner with USACE to update H&H studies for Keystone Dam.				
City of Collinsville	Identify at risk properties from the 100-year flood Ensure future urbanization and development does not increase flooding downstream Identify and maximize the natural and beneficial uses of the floodplain.	Collinsville Multi-Hazard Mitigation Plan	Approved	11/12/2014	11/12/2019
City of Owasso	Identify buildings at risk from the 100-year regulatory flood. Ensure that development does not increase flooding downstream or have off-site adverse impacts. Identify and maximize the natural and beneficial uses of the floodplain.	City of Owasso, OK Multi-Jurisdictional Multi-Hazard Mitigation Plan Update	Approved	8/4/2014	8/4/2019
City of Sand Springs	Identify buildings at risk from the 100-year regulatory flood. Ensure that development does not increase flooding downstream or have off-site adverse impacts. Identify and maximize the natural and beneficial uses of the floodplain.	City of Sand Springs, OK Multi-Jurisdictional Multi-Hazard Mitigation Plan Update	Approved	10/20/2014	10/20/2019
Town of Sperry	Identify buildings at risk from 100-year floods. Buy properties that flood most frequently, clear the land, and put in green space or build detention ponds. Limit additional building in flood zone areas.	Town of Sperry, Oklahoma Multi-Hazard Mitigation Plan	Expired (Being added to Tulsa Co Plan which is being updated – DR 4109 – 22)	--	3/25/2013

Community Name	Community Mitigation Action	Hazard Mitigation Plan Name	Plan Status	Plan Approved	Plan Expires
City of Tulsa	Public Information & Education. Improve public awareness of flood and flash flood hazards in general and at specific high-risk locations; and give people knowledge about measures they can use to protect themselves, their property and their community. Preventive Measures. Expand mapping, regulations, and loss-prevention programs in areas with high risks and catastrophic potential Structural Projects. Obtain funding for and implement projects that can reduce flood and drainage hazards, with consideration for comprehensive solutions in accord with watershed-wide management plans.	City of Tulsa Multi-Hazard Mitigation Plan Update	Approved	9/2/2014	9/2/2019
Washington County (includes Vera)	To reduce the impact of repetitive flooding in flood-prone areas of Washington County. By encouraging development and implementation of programs to purchase, remove, and inhibit development and construction in flood-prone areas, and by addressing at-risk transportation routes.	Washington County Hazard Mitigation Plan	Expired. Currently being updated (DR4117-22)	-	8/19/2013
Cherokee Nation	-	-	Approved	3/15/2011	3/14/2016
Muscogee (Creek) Nation	-	-	Expired; currently updating	-	6/10/2013

Figure 7 displays the locations and types of mitigation grant activity in the Bird Creek Watershed which have been approved by FEMA. This map only shows approved grant activity. There may be additional grants being pursued at both the state and local level within the watershed.

WATERSHED LOCATOR - STATE OF OKLAHOMA



**Figure 7: Grant Map
Bird Creek Watershed**

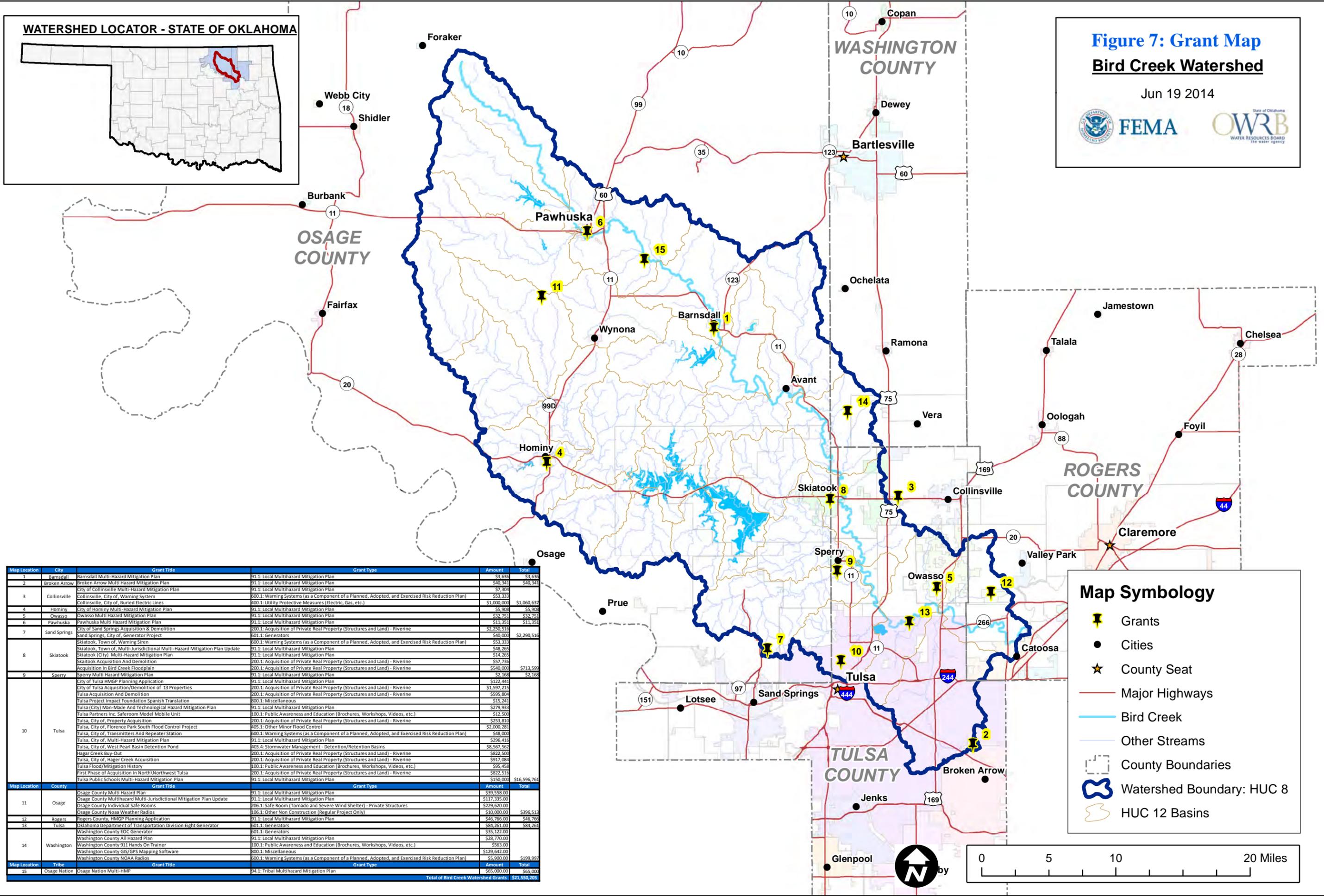
Jun 19 2014



FEMA



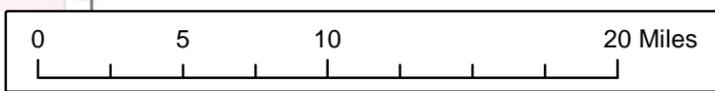
OWRB
State of Oklahoma
WATER RESOURCES BOARD
the water agency



Map Location	City	Grant Title	Grant Type	Amount	Total
1	Barnsdall	Barnsdall Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$3,636	\$3,636
2	Broken Arrow	Broken Arrow Multi Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$40,341	\$40,341
3	Collinsville	City of Collinsville Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$7,304	\$7,304
		Collinsville, City of, Warning System	200.1: Warning Systems (as a Component of a Planned, Adopted, and Exercised Risk Reduction Plan)	\$53,323	\$53,323
4	Hominy	Collinsville, City of, Buried Electric Lines	400.1: Utility Protective Measures (Electric, Gas, etc.)	\$1,000,000	\$1,060,637
		City of Hominy Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$5,908	\$5,908
5	Owasso	Owasso Multi Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$32,751	\$32,751
6	Pawhuska	Pawhuska Multi Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$11,351	\$11,351
7	Sand Springs	City of Sand Springs Acquisition & Demolition	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$2,250,516	\$2,250,516
		Sand Springs, City of, Generator Project	601.1: Generators	\$40,000	\$2,290,516
8	Skiatook	Skiatook, Town of, Warning Siren	200.1: Warning Systems (as a Component of a Planned, Adopted, and Exercised Risk Reduction Plan)	\$53,333	\$53,333
		Skiatook, Town of, Multi-Jurisdictional Multi-Hazard Mitigation Plan Update	91.1: Local Multihazard Mitigation Plan	\$48,265	\$48,265
		Skiatook (City) Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$14,265	\$14,265
		Skiatook Acquisition And Demolition	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$57,736	\$57,736
9	Sperry	Acquisition In Bird Creek Floodplain	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$540,000	\$713,599
		Sperry Multi Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$2,168	\$2,168
10	Tulsa	City of Tulsa HMGP Planning Application	91.1: Local Multihazard Mitigation Plan	\$122,441	\$122,441
		City of Tulsa Acquisition/Demolition of 13 Properties	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$1,597,215	\$1,597,215
		Tulsa Acquisition And Demolition	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$595,804	\$595,804
		Tulsa Project Impact Foundation Spanish Translation	800.1: Miscellaneous	\$15,241	\$15,241
		Tulsa (City) Man-Made And Technological Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$279,933	\$279,933
		Tulsa Partners Inc. Saferoom Model Mobile Unit	100.1: Public Awareness and Education (Brochures, Workshops, Videos, etc.)	\$12,500	\$12,500
		Tulsa, City of, Property Acquisition	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$253,810	\$253,810
		Tulsa, City of, Florence Park South Flood Control Project	405.1: Other Minor Flood Control	\$2,000,281	\$2,000,281
		Tulsa, City of, Transmitters And Repeater Station	600.1: Warning Systems (as a Component of a Planned, Adopted, and Exercised Risk Reduction Plan)	\$48,000	\$48,000
		Tulsa, City of, Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$296,418	\$296,418
		Tulsa, City of, West Pearl Basin Detention Pond	403.4: Stormwater Management - Detention/Retention Basins	\$8,567,562	\$8,567,562
		Hagar Creek Buy-Out	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$822,500	\$822,500
		Tulsa, City of, Hager Creek Acquisition	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$917,084	\$917,084
Tulsa Flood/Mitigation History	100.1: Public Awareness and Education (Brochures, Workshops, Videos, etc.)	\$95,458	\$95,458		
First Phase of Acquisition In North/Northwest Tulsa	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	\$822,516	\$822,516		
Tulsa Public Schools Multi-Hazard Mitigation Plan	91.1: Local Multihazard Mitigation Plan	\$150,000	\$150,000		
Map Location	County	Grant Title	Grant Type	Amount	Total
11	Osage	Osage County Multi Hazard Plan	91.1: Local Multihazard Mitigation Plan	\$39,558.00	\$39,558.00
		Osage County Multi-hazard Multi-Jurisdictional Mitigation Plan Update	91.1: Local Multihazard Mitigation Plan	\$117,335.00	\$117,335.00
		Osage County Individual Safe Rooms	206.1: Safe Room (Tornado and Severe Wind Shelter) - Private Structures	\$229,620.00	\$229,620.00
12	Rogers	Osage County Noaa Weather Radios	106.1: Other Non Construction (Regular Project Only)	\$10,000.00	\$396,513
13	Tulsa	Rogers County, HMGP Planning Application	91.1: Local Multihazard Mitigation Plan	\$46,766.00	\$46,766
		Oklahoma Department of Transportation Division Eight Generator	601.1: Generators	\$84,261.00	\$84,261
14	Washington	Washington County EOC Generator	601.1: Generators	\$35,122.00	\$35,122.00
		Washington County All Hazard Plan	91.1: Local Multihazard Mitigation Plan	\$28,770.00	\$28,770.00
		Washington County 911 Hands On Trainer	100.1: Public Awareness and Education (Brochures, Workshops, Videos, etc.)	\$563.00	\$563.00
		Washington County GIS/GPS Mapping Software	800.1: Miscellaneous	\$129,642.00	\$129,642.00
		Washington County NOAA Radios	600.1: Warning Systems (as a Component of a Planned, Adopted, and Exercised Risk Reduction Plan)	\$5,900.00	\$5,900.00
Map Location	Tribe	Grant Title	Grant Type	Amount	Total
15	Osage Nation	Osage Nation Multi-HMP	94.1: Tribal Multihazard Mitigation Plan	\$65,000.00	\$65,000
				Total of Bird Creek Watershed Grants	\$21,550,289

Map Symbology

- Grants
- Cities
- County Seat
- Major Highways
- Bird Creek
- Other Streams
- County Boundaries
- Watershed Boundary: HUC 8
- HUC 12 Basins



2. Pre-Discovery Congressional and Media Engagement

In order to achieve success with any Region 6 Risk MAP project, members of Congress and their staff members, as well as the media must be aware and understand the study process. Working with FEMA External Affairs to inform both legislators and the media will improve credibility and open the door to understanding risk in a more holistic, comprehensive manner. An initial contact briefing of the legislators will occur approximately 2 weeks prior to the Discovery meeting.

Table 13: Congressional Information for Bird Creek Watershed

U.S. Senator	Term Expiration	FEMA History of Engagement
James Inhofe	2020	<ul style="list-style-type: none"> ❖ July 30, 2013: “Udall, Inhofe Introduce Legislation to Allow FEMA to Proactively Fight Wildfires” ❖ May 21, 2013: “CNN Exclusive: Oklahomans on Disaster Relief Funding” May 10, 2012: Representatives from Mr. Inhofe’s office attended the congressional meeting on Mapping in Edmond, OK. ❖ September 21, 2011: Statement of Senator Inhofe on the floor of the Senate on the introduction of S. 1583, the Storm Shelter Tax Relief Act of 2011. ❖ May 25, 2011: Inhofe Offers Condolences; Pledges Help. March 29, 2011: Inhofe Defends Oklahoma Homeowners Against FEMA Floodplain Changes,
Thomas Coburn	2014	<ul style="list-style-type: none"> ❖ May 21, 2013: “Coburn: Legitimate Role for FEMA in Response to Oklahoma Tornadoes” ❖ May 21, 2013: “FEMA, Federal Partners Support Response to Severe Storms in Oklahoma” ❖ May 10, 2012: Four Representatives from Dr. Coburn’s office attended the congressional meeting on Mapping in Edmond, OK. ❖ January 2012: Grants and Federal Domestic Assistance ❖ September 15, 2011: Dr. Coburn Files Amendment #610 to Offset \$7 Billion FEMA Funding Bill ❖ March 28, 2011: Area school districts, governments consider FEMA disaster shelter grants.
U.S. Representative	Term Expiration	FEMA History of Engagement
Frank Lucas District Number 3	2015	<ul style="list-style-type: none"> ❖ June 7, 2013: “Oklahomans Unite Through Recent Storms”
Jim Bridenstine District Number 1	2015	<ul style="list-style-type: none"> ❖ April 1, 2014: “House Passes Bridenstine Weather Forecasting Improvement ❖ March 24, 2014: “Arkansas, Oklahoma Delegations Support Three Rivers Study”
Markwayne Mullin District Number 2	2015	<ul style="list-style-type: none"> ❖ “Leflore County to Get Disaster Relief Aid” ❖ November 13, 2014: “Congressman Mullin Named A WRRDA Conferee” ❖ October 23, 2013: “Congressman Mullin Votes for Water Infrastructure Reform” ❖ September 27, 2013: “Congressman Mullin Cites Local Effects of Water Infrastructure Reform” ❖ January 23, 2013: Congressman Mullin Receives Sub-Committee Posts”

Contact information for the community and additional stakeholders can be found with the supplemental digital data.

3. Tribal Engagement

Given the need for communication at the governmental level, it is important to note that Tribal Lands belonging to the Cherokee Nation, Muscogee (Creek) Nation, Delaware Tribe of Indians, United Keetoowah Band of Cherokee and Osage Nation are located in the counties that make up the Bird Creek watershed, with Osage County containing Oklahoma’s largest tribal reservation known as the Osage Nation. Communications with the tribes were directed by and through FEMA, with individual tribal invitations mailed out. In addition, tribal Emergency Managers and tribal floodplain administrators were included in outreach efforts.

B. Pre-Discovery Data Collection

The following provides a listing of the data collected prior to the Discovery Meeting.

Table 14: Data Collection for the Bird Creek Watershed

Data Types	Deliverable/Product	Source
Average Annualized Loss Data	Discovery Map Geodatabase	Jennifer Knecht, FEMA Region VI
Boundaries: Community	Discovery Map Geodatabase	University of Oklahoma Center for Spatial Analysis
Boundaries: County and State	Discovery Map Geodatabase	University of Oklahoma Center for Spatial Analysis
Boundaries: Watersheds	Discovery Map Geodatabase	USGS NHD
Census Blocks	Discovery Map Geodatabase	U.S. Census Bureau
Contacts	Table	Local Web Sites, State/FEMA Updates
Community Assistance Visits	Discovery Report	Oklahoma Water Resources Board
Community Rating System (CRS)	Discovery Report	FEMA’s “Community Rating System Communities and Their Classes”
Dams and Levees	Discovery Map Geodatabase	FEMA Mid-term Levee Inventory

C. Discovery Meeting

A 2-hour Discovery meeting/ workshop was held for Bird Creek Watershed as shown in Table 15. The site was prepared with a series of stations, envisioned to be an interactive setting for the Regional Project Team and Discovery Workshop attendees to listen, discuss and document any issues for the Watershed.

Table 15: Project Discovery Workshop Times and Locations for Bird Creek Watershed

Workshop	Date and Time	Location
1	June 24, 2014 9:30 a.m. – 11:30 a.m.	City of Skiatook Municipal Boardroom 220 South Broadway Skiatook, Oklahoma 74070

Discovery Team representatives greeted each attendee as they arrived. Attendees rotated around the following four Discovery Stations:

- Community Benefits and Grant Opportunities (*Grants Station*) – Maps of current floodplain-related grants; risk, needs and topographic availability; RL/SRL properties; letters of map change (LOMCs); urban changes over the last 5 years; and single claims. The station also had handouts on various FEMA grant programs.
- Mitigation Planning and Mitigation Activities (*Planning Station*) – Handouts on mitigation plans, understanding Risk MAP and determining risk.
- NFIP Community Actions (*Compliance and Mitigation Station*) – Effective FIRMs, Flood Insurance Study (FIS) and LOMCs; maps of RL/SRL properties; single claims; and urban changes over the last 5 years.
- Risk Identification and Communication (*Mapping Station*) – Maps of risk/need/topographic availability, LOMCs, population density in the watershed, urban change in the watershed, estimated dollar exposure of parcels near SFHA areas, high-water marks and low water crossings.

At each station, attendees were asked to actively contribute information about concerns in the Watershed by identifying a relevant location on the large watershed map and then providing a short explanation on the comment form. The activity at the stations was intended to be interactive where attendees and staff at the stations work together to listen discuss and document any topical items for the watershed. Members of the Regional Project Team (FEMA, State of Oklahoma and OWRB) were at the stations to answer questions and engage the attendees. During each workshop, Regional Project Team members requested that attendees provide any additional information within 2 weeks of the workshop.

Each station was equipped with a series of large-format watershed maps with an aerial photo of the Watershed displayed, along with community boundaries and road names to assist in identifying areas of concern. Additionally, the stations had several 11-inch by 17-inch laminated maps of the watershed with information related to that station's content.

Information sheets were collected at each station for locations that were identified and labeled on the Discovery watershed maps. These information sheets are included in the external files included with this report.

D. Discovery Implementation

The Discovery Workshop was attended by local stakeholders. A full list of attendees is provided in the sign-in sheets included with the supplemental digital data accompanying this report. Twenty-four attendees signed in and were greeted by Discovery Team representatives from FEMA, OWRB and Meshek & Associates. Communities represented during the meeting were as follows:

- Osage County
- Washington County
- City of Hominy

- Rogers County
- Tulsa County
- Cherokee Nation
- City of Tulsa
- City of Skiatook
- City of Owasso
- City of Sand Springs
- City of Catoosa

Additional attendees included personnel from the Skiatook Chamber of Commerce and the Tulsa Chamber of Commerce.

It should be noted that no community officials from Avant, Barnsdall, Pawhuska, Wynona, Broken Arrow, Collinsville, Sperry, Vera, the United Keetowah Band of Cherokee, Muscogee (Creek) Nation, Osage Nation, or the Choctaw Nation, attended the Discovery Workshops.

The Workshops afforded personal, interactive communication with attendees at each station. The Project Team interviewed attendees and discussed areas of positive mitigation and areas of continuing concern for the Watershed as a whole. As attendees visited each station, they not only discussed their own local concerns but also listened to the concerns of others in the Watershed.

Attendees were polled by the FEMA Project Monitor as they exited the Workshop. Verbal feedback from the attendees indicated they felt the Workshop was an opportunity to express their issues and concerns for the Watershed. Many attendees were appreciative of the chance to speak with the various Regional Project Team members from FEMA and the State of Oklahoma. The community perception conveyed to FEMA was that attendees felt more engaged in the process to determine where needs and projects may be identified.

E. Data Gathering Overview

Information about the Bird Creek Watershed was gathered both prior to the Discovery Workshop and interactively during the Workshop. Much of the data collected in pre-discovery was obtained from FEMA or other national datasets. Additional data was collected from OWRB, OEM, USACE, and local communities via their public web sites. Table 13 summarizes the data collected prior to the Discovery Workshop and the primary sources of the data.

During the pre-discovery process phone calls were made to local FPAs, Emergency Managers, and Mitigation planners to collect current and proposed mitigation actions. This data was collected in spreadsheets, and it will be used by FEMA to track mitigation actions within the region. The final spreadsheets are included in the supplemental digital data.

Table 16: Data Collection Summary – Pre-Discovery Workshop for Bird Creek Watershed

Data Location	Data Custodian	Data Set Description
Watershed-wide	FEMA	Effective FIRM and FIS and backup information available from FEMA’s Map Service Center and FEMA Library
Watershed-wide	FEMA	LOMC locations from FEMA’s Map Service Center and FEMA Library
Watershed-wide	FEMA, OWRB	Locations of RL/SRL properties and Claims
Watershed-wide	FEMA, OWRB	Location of Grants being funded
Watershed-wide	FEMA	Participation in the NFIP, Community Rating System (CRS) ratings
Watershed-wide	FEMA	Disaster Declarations
Watershed-wide	FEMA	CNMS information
Watershed-wide	FEMA	AAL data
Watershed-wide	FEMA, Community Officials	High water marks (HWMs) and associated reports
Watershed-wide	FEMA	Approved HMPs
Watershed-wide	FEMA, USGS	Location of available or planned areas of updated LiDAR or other topographic data
Watershed-wide	FEMA, U.S. Census, ODOT	Transportation features
Watershed-wide	FEMA, U.S. Census, USGS	Populated places and population characteristics
Watershed-wide	USGS	Watershed HUC (8 & 12) boundaries, NHD streams, stream gage information, land use and land cover
Watershed-wide	USDA	NAIP Imagery
Watershed-wide	Local FPAs, Mitigation Planners and Emergency Managers, FEMA	Mitigation Actions identified by local stakeholders and collected by phone call

At the Discovery Workshop stations, attendees completed data information sheets and placed stickers on the hard copy maps to identify the approximate locations of their concern within the Watershed. This information was later captured in GIS format (ESRI Personal Geodatabase, point features named “Other_Community_Concerns”) and the data from the forms was matched with each point location on the watershed maps. Data from all of the stations were compiled into a single data set. The watershed collection maps with the sticker locations as well as the individual comment forms are included in the supplemental digital data accompanying this report.

Table 17 summarizes the comments that were made at each of the stations. If the same comment was made at different stations by the same attendee, it is only listed once. If multiple attendees made the same comment, the “Information Provided By” column lists more than one attendee. Item numbers tie directly back to the GIS data and the data collection sheets. In addition, data

collected in pre-Discovery from calls with local community officials have also been placed in GIS format and are shown on the watershed collection. Discovery data collection continued after the Discovery Workshop as additional datasets were provided. This data set are also included in Table 17. Some comments collected at the Discovery Workshop reflect on areas outside of the Bird Creek Watershed. This information was collected for future use in future Discovery efforts and is noted below.

Table 17: Data Collection Summary for Bird Creek Watershed

	Flooding Source	Information Provided By	Comments
1	City of Catoosa	City of Catoosa	<ul style="list-style-type: none"> ❖ Discussed CRS and opportunity for joining program in the future. ❖ Community requested further CRS information. Potential follow to be scheduled by the State. ❖ Requested detailed information on existing RL and SRL claims in the City limit to assist planning of potential, future mitigation actions. ❖ Discussed Discovery figures and requested copies of maps.
2	Multiple	City of Catoosa	<ul style="list-style-type: none"> ❖ Community noted general concern over potential impact of development on flood risk. ❖ Noted specific concern over new development affecting Shadow Valley addition (NE of Hwy 167 and County Road E. 570). ❖ Requested the detailed study of Quarry Creek.
3	Municipal Lake	City of Hominy	<ul style="list-style-type: none"> ❖ Community requested assistance to improve spillway on dam.
4	Penn Creek	City of Hominy	<ul style="list-style-type: none"> ❖ Discussed flooding of low water crossing near N Regan Avenue (Osage Indian Reservation). ❖ Noted bank degradation SE of bridge on Highway 99 (N Eastern Ave. and Cotton Gin Road). ❖ Noted problems with low water crossing at Parkview Circle and Brady Street.
5	UT 1 of Penn Creek	City of Hominy	<ul style="list-style-type: none"> ❖ Requested detailed study of Zone A over Cotton Gin Road. ❖ Tributary overtops this county road during rain events – hindering emergency vehicle access to City subdivision at Ballard Road.
6	City of Owasso	City of Owasso	<ul style="list-style-type: none"> ❖ Requested assistance to coordinate a discussion with SHMO over grant opportunities. ❖ Noted interest in participating in the CRS program. Requested more information on the program. ❖ Reviewed NFIP claims records for Owasso. ❖ Request a copy of Rogers County Engagement Plan information reviewed, specifically as it relates to HMP information.
7	Ranch Creek, Ranch Creek Tributary A, Ranch Creek	City of Owasso	<ul style="list-style-type: none"> ❖ Noted flooding of Mingo Rd (110th and 116 St N) and between N 106th E Ave and Garnett Rd south of 11th St N.

	Flooding Source	Information Provided By	Comments
	Tributary B, and Sawgrass Tributary		<ul style="list-style-type: none"> ❖ Houses were constructed in the floodplain along 96th E Ave and E 111 St N. ❖ Communicated capacity and erosion problems of residential drainage conveyance from 96th St N to Garnett Regional Detention pond. ❖ Discussed construction of two new bridges at 86th St N and 116th St N. ❖ Noted multiple drainage and flooding problems in Hale Acres residential subdivision.
8	Elm Creek, Tributary H, Lake Valley Tributary, and Pine Valley Tributary	City of Owasso	<ul style="list-style-type: none"> ❖ Reported multiple flooding issues: <ul style="list-style-type: none"> ➢ Rogers County, between 86th and 91st St N and 145th and 161st E Ave. ➢ Flooding near south Coffee Creek, residences between E 100th and 101st St N. ➢ Flooding of 106th St N, east of HWY 169 between N 145th and 155th E Ave. ➢ Flooding of E 89th Street N and homes.
9	Ator Tributary	City of Owasso	<ul style="list-style-type: none"> ❖ Noted that large portion of this channel is unmapped. ❖ Weirs have been constructed in channel along YMCA to mitigate erosion.
10	Bird Creek, Bird Creek Tributary 5A, and Three Lakes Tributary	City of Owasso	<ul style="list-style-type: none"> ❖ Communicated that a new detention pond was recently constructed at the commercial development (96th St N and 129th E Ave). This facility will reduce flow rates below historic rates. ❖ Reported localized flooding and erosion issues: <ul style="list-style-type: none"> ➢ Commercial development south of 86th St N, east of HWY 169. ➢ Industrial park north of 76th St N, west of HWY169. ➢ Residential neighborhood and channel located along E 87th St N, between 123rd and 129th E Ave. ➢ Severe capacity loss due to soil deposition between 123rd E Ave and Three Lakes pond. ❖ Noted that Bird Creek backwaters causes wide flooding west of HWY 169 between 66th and 76th St N.
11	City of Sand Springs	City of Sand Springs	<ul style="list-style-type: none"> ❖ Discussed on-going mitigation grant—being used for acquisition in Meadow Valley. ❖ Discussed CRS program. City is concerned about potential change in classification from Class 6 to 7.
12	Bird Creek	City of Skiatook	<ul style="list-style-type: none"> ❖ Requested Turn around Don't Drown® signs and historical flood markers be posted at following locations: <ul style="list-style-type: none"> ➢ Between E 126th and E 136th St N <ul style="list-style-type: none"> ▪ Along N Hartford Ave, between E 131st and E 136th St N ▪ Along 13th E Ave, just north of E 126th St N ➢ Along Hwy 11, just south of E 136th St N ➢ Along Hwy 20, between Cincinnati and Peoria

	Flooding Source	Information Provided By	Comments
13	Bird Creek	City of Skiatook	<ul style="list-style-type: none"> ❖ Requested assistance for development of a flood forecast system for Bird Creek. ❖ Discussion focused on HWY 20 – sections of roadway is located in floodplain. ❖ Collaboration with NWS and Silver Jackets were discussed as potential mitigation actions.
14	City of Skiatook	City of Skiatook	<ul style="list-style-type: none"> ❖ Requested assistance to coordinate a discussion with SHMO over grant opportunities.
15	City of Tulsa	City of Tulsa	<ul style="list-style-type: none"> ❖ Discussed Discovery figures and requested copies of maps. ❖ Communicated interest in discussing Arkansas River and Riverside development with Creek Nation. ❖ Discussed FEMA participation in this process.
16	Brookhollow Creek Tributary and Coal Creek	City of Tulsa	<ul style="list-style-type: none"> ❖ Requested new studies for these area. ❖ Noted Brookhollow as the City's No. 1 priority. ❖ Several properties are currently mapped in the floodway but are above the BFE. ❖ Coal Creek LOMR under review. Hydrology and Hydraulics may be used as match for a future PMR. ❖ City Master Plan notes these streams as priorities for 2015-2020.
17	Flat Rock and Dirty Butter Creek	City of Tulsa	<ul style="list-style-type: none"> ❖ Noted that model methodology was no longer appropriate. ❖ New regression equation is available. ❖ Current channel shown outside effective SFHA. ❖ City Master Plan notes these streams as priorities for 2015-2020.
18	Lower Mingo, Upper Mingo, Upper Tupelo, Upper Mill Jones and Audubon, Cooley Creek	City of Tulsa	<ul style="list-style-type: none"> ❖ Mingo Creek was studied by USACE in 2003. ❖ City Master Plan notes these streams as priorities for 2015-2020.
19	Hominy Creek	Osage County	<ul style="list-style-type: none"> ❖ County questioned accuracy of current floodplain mapping downstream of Skiatook Lake Dam (SE between Hominy Creek and Javine Creek). ❖ No flooding has occurred in this area since dam built. A new study was requested to include dam.
20	Quapaw Creek, Black Dog Creek 2, Rock Creek 2, UT 1 and UT 2 to Hominy Creek, UT 1 to Rock Creek 2	Osage County	<ul style="list-style-type: none"> ❖ Discussed a compliance issue on tributary flowing in to Hominy Creek which has been turned over to Carl Watts with FEMA. ❖ Discussed Osage County joining the CRS "Users Group." County would like follow up on CRS training courses. ❖ Shared current Flood Insurance Policies and losses/ claims to date. ❖ County believes better coordination with Emergency Management needs to be discussed and an action plan formulated.

	Flooding Source	Information Provided By	Comments
21	Bird Creek	Rogers County	<ul style="list-style-type: none"> ❖ Multiple development projects along Bird Creek just east of county boundary between Tulsa County and Rogers County. <ul style="list-style-type: none"> ➤ Port of Catoosa planning to infill about 500 acres near Bird Creek (plan no rise) where Bird Creek and Verdigris converge. ➤ New development also includes Stone Canyon Office Industrial Park, near Hwy 266.
22	Bird Creek	Rogers County	<ul style="list-style-type: none"> ❖ Noted concerns regarding development in the floodplain – possibly based on inaccurate maps. Requested study to confirm accuracy of maps. Projects submittals have noted “no rise.” This may be impacted if maps are changed. ❖ Mentioned the great number of development (around the Rogers County portions of Bird Creek) may impact existing mapping – when combined. ❖ Requested area be restudied to better guide ongoing development.
23	USACE	Rogers County	<ul style="list-style-type: none"> ❖ Discussed that USACE studies may remove 500 sites from existing floodplain. ❖ Noted concern over this change.
24	Rogers County	Rogers County	<ul style="list-style-type: none"> ❖ Requested assistance to coordinate a discussion with OEM over grant opportunities. ❖ Communicated interest in participating in CRS.
25	City of Skiatook	Skiaotook Chamber of Commerce	<ul style="list-style-type: none"> ❖ Requested information regarding the Osage County Storm Shelter grant program. ❖ Discussed Discovery figures and requested copies of maps.
26	Bird Creek	Tulsa County	<ul style="list-style-type: none"> ❖ Request to review BFE for E. 46th St. N. over Bird Creek; ODOT is working on a new bridge design for this location and there is concern over the BFE being used for the design.
27	Outside Watershed	Washington County	<ul style="list-style-type: none"> ❖ Discussed an R/L structure on West 1500 Road (south side between 3950 and 3960).
28	Washington County	Washington County	<ul style="list-style-type: none"> ❖ Currently working to update HMP with Flanagan and Associates. ❖ County has completed outreach efforts. ❖ City of Bartlesville has requested to be included in the plan. If approved, the plan would change from sole-jurisdiction to multi-jurisdictional.

All supporting information, data and files for this report are included in the supplemental digital data submitted with this report. The directory structure is as shown the in the following list of the files, folders and associated data.

HUC-11070107\Discovery

- Metadata file
- \Project_Discovery_Initiation
- Community Contact List
- Engagement Plan
- Table M.2-1 Contact Information
- \Discovery_Meeting
- Meeting Agenda
- Meeting Minutes
- Discovery Meeting Information Collection Sheets
- Discovery Meeting Data Collection Maps
- Photos
- \Post_Discovery
- Discovery Report
- Discovery Map
- \Supplemental_Data
- Discovery GIS Database
- \Discovery Meeting Exhibits
- \Outreach
 - Mitigation Action Tracker (watershed data entered to date)
 - News Articles (news articles released relevant to the Discovery process in the watershed)
 - Other Data (data provided prior to, during, or after Discovery meeting by stakeholder(s))
 - Outreach Newsletters (Pre/Post Outreach newsletters that were emailed to invitees)

III. Watershed Findings

This watershed contains structures that are managed by the U.S. Army Corps of Engineers (USACE), Tulsa District. The watershed contains one minor and one significant water body managed by USACE, Tulsa District: Birch Lake, northwest of the Town of Avant, and Skiatook Lake, west of the City of Skiatook.

In addition to NFIP claims, there are several locations of Repetitive Loss or Severe Repetitive Loss within the Bird Creek Watershed. A concentration of these locations appears in the City of Skiatook, City of Tulsa, and Tulsa County within the Middle Bird Creek and Lower Bird Creek areas that make up the Bird Creek watershed. Figure 8 shows the approximate location of these losses.

A Physical Map Revision (PMR) was issued in October 2011 for Osage, Rogers, Tulsa and Washington Counties. This PMR revised approximately 809 miles of stream and included 13 miles of new detailed study, 63.5 miles of updated detailed (8.4 miles of MapMod) study, 21 miles of updated approximate study, 98 miles of redelineation, 279 miles of digital conversion and 334 stream miles of approximate conversion, not model backed.

Figure 8: Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Claims

Bird Creek Watershed

Jun 05 2014



FEMA



OWRB
Oklahoma Water Resources Board

Repetitive Loss/ Severe Repetitive Loss by Community			
Community	Number of Properties	Total Claims	Average Claims per Property
Osage County	1	4	4
Owasso, City of	1	4	4
Pawhuska, City of	1	2	2
Rogers County	1	2	2
Skiatook, Town of	16	67	4
Tulsa County	17	69	4
Tulsa, City of	47	151	3



Map Symbolology

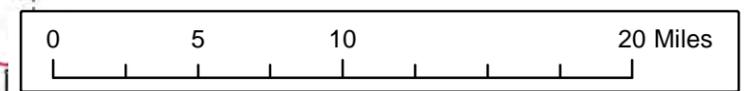
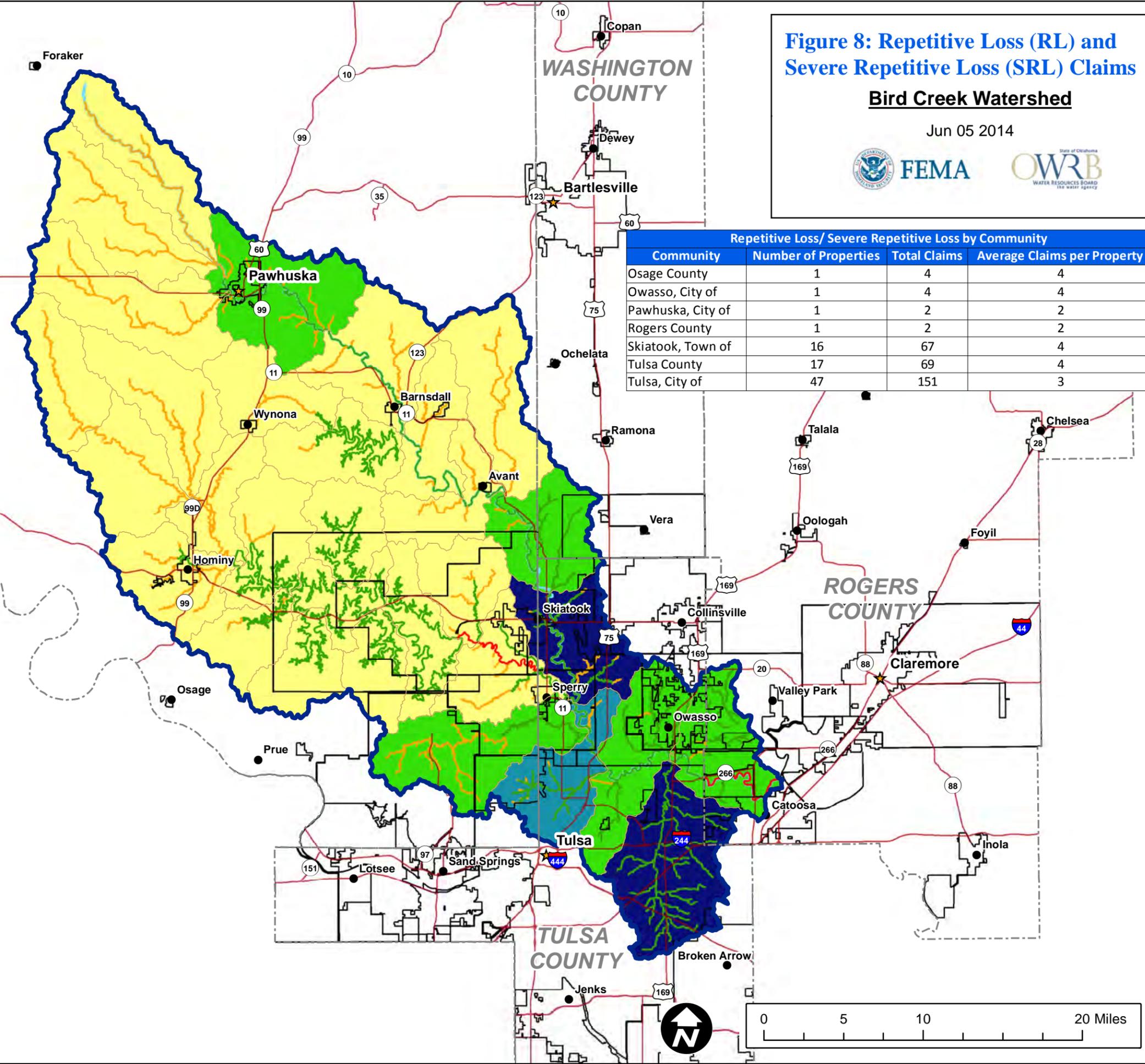
- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- - - County Boundaries
- ⬮ Watershed Boundary: HUC 8
- ⬮ HUC 12 Basins

CNMS Validation Status

- Unknown
- Unverified
- Valid

Total RL/ SRL Claims

- None
- Low
- High



Following the PMR, 457 miles were categorized as Valid, 18 miles as Unverified and 334 miles as Unknown. Of the Valid streams, however, over 60 percent of the floodplain mapping was based on old models (20 yrs+). A third of these streams are located in the City of Tulsa.

Letters of Map Amendment and Revisions are also distributed throughout the watershed, but appear to be concentrated in the Cities of Tulsa and Owasso. In Tulsa, amendments are concentrated around Mingo Creek and its tributaries. For Owasso, amendments are focused near Elm Creek and Bird Creek Tributary 5A. See Figure 9 for the location of these Letter of Map Change (LOMC).

A. Engineering Review of Community Comments

Any engineering related comments provided by the communities during the Discovery were initially validated. Comments were reviewed both in terms of hydrologic or hydraulic issues within the watershed and with any general floodplain or BFE related comments. Any supporting appeal or protest information, correspondence from communities, or anecdotal information was researched and expanded on as a concern if impacts to hydrologic analysis were substantiated.

B. Post-Discovery Hydrology

Two limited reviews of hydrologic information were performed for Discovery analysis within the Bird Creek watershed. The reviews were kept at a high level of informational research and were performed by senior engineering staff that relied on engineering judgment, some limited analysis, and regional experience. These reviews were focused on:

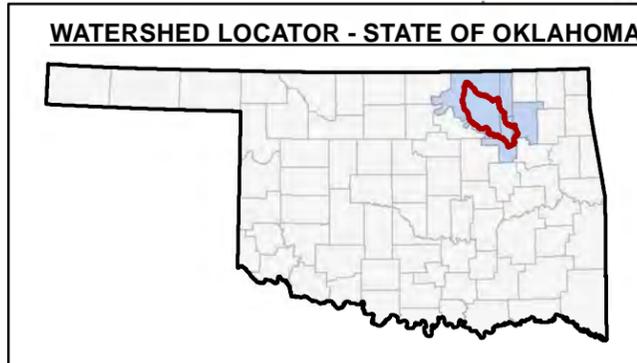
- Review of Peak Discharges in the watershed
- Limited Gage analysis for the watershed

For the watershed as a whole, the **one-percent** annual chance peak discharges were reviewed for all streams within a community and across community boundaries looking for discharge anomalies, places where LOMRs demonstrate that the effective discharges may be suspect on a more global basis. Any notes were added if these changes can be eliminated as a concern due to hydrologic factors including local flood control structures, detention, flow break outs, sinks or other natural or manmade factors that may significantly alter hydrology flows. Finally, a watershed wide high-level gage analysis was reviewed comparing the information on any available gages within the watershed that had appropriate historical information to the effective FIS, discharges for streams with gages. This analysis could potentially flag any anomalies that would indicate that the hydrology may be out of date, too high, or too low for sub-basin areas within the watershed.

1. Review of Peak Discharges

Peak discharges were reviewed based on available FIS reports, hydraulic models, flow gages and available LOMRs within the watershed at the crossing of SHFA areas at corporate limits (county, city and town). A comparison of discharges was made for the same streams across county

Figure 9: Letters of Map Change
Bird Creek Watershed
 Jun 05 2014



Map Symbology

- Cities
- ★ County Seat
- Major Highways
- Bird Creek
- - - County Boundaries
- Watershed Boundary: HUC 8
- HUC 12 Basins
- ◆ Letters of Map Revision (LOMR)
- ◆ Letters of Map Ammdement (LOMA)

CNMS Validation Status

- Unknown
- Unverified
- Valid

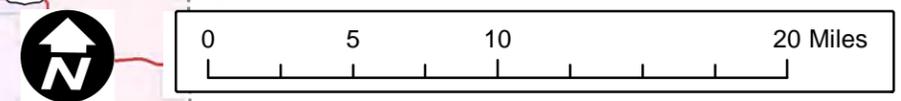
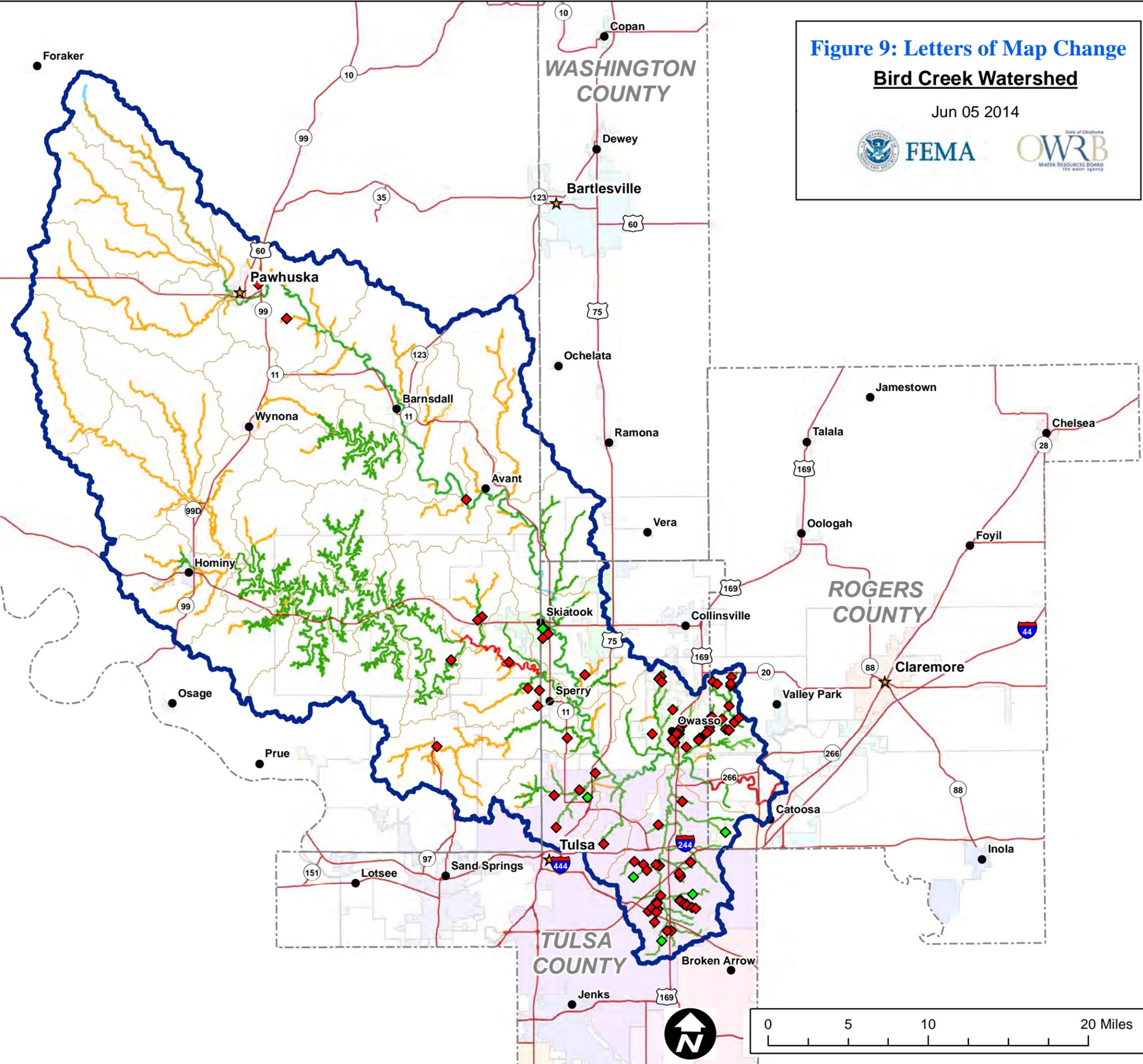


Table 18: Discharge Comparison at Community Limits for Bird Creek Watershed

Stream Name	County	Effective 1% annual chance discharge (cfs)	Effective discharges Source
Bird Creek	Osage/Tulsa	44,376/50,456	County FIS Floodway Tables
Bird Creek	Tulsa/Rogers	47,463/46,686	
Elm Creek	Tulsa/Rogers	12,422/6,630	
Hominy Creek	Osage/Tulsa	32,101/22,766	
Horsepin Creek	Osage/Tulsa	5,205/5,193	
Flat Rock Creek	Osage/Tulsa	12,360/11,310	
South Fork Horse Creek	Osage/Tulsa	1,471/1,461	
East Creek	Rogers/Tulsa	5,394/5,394	

boundaries as shown in Table 18, Discharge Comparison at Community Limits. No hydrology data is available for the streams with a Zone A designation, so these were not reviewed.

2. Frequency Analysis

Frequency analyses were performed for all the gages within the Bird Creek Watershed using Peak Q computer software. The comparison between discharges from FIS and gage analysis was made and listed in Table 19. The discharges from gage analysis are significantly different than the effective FIS discharges. Number of peaks in record at gages ranges from 24 to 36.

Table 19: Summary of Hydrologic Analysis for Bird Creek Watershed

Stream Name	Drainage Area from USGS Gage (mile ²)	Effective Discharge Source	Effective 1% annual chance discharge (cfs)	95% confidence limits lower (cfs) (Gage)	1% annual chance discharge from PeakQ (Gage)	95% confidence limits upper (cfs) (Gage)	Number of peaks in record
Bird Creek at Avant	369	Rogers County FIS	43,100	30,290	36,610	47,530	36
Flat Rock Creek at Cincinnati Ave at Tulsa	8.11	Tulsa County FIS	11,403	5,463	8,360	15,690	26
Coal Creek at Tulsa	8.23	Tulsa County FIS	7,096	5,998	8,409	11,770	25
Bird Creek Near Owasso	1,017	Tulsa County FIS	50,800	26,180	31,950	43,080	24
Bird Creek at SH-266 Near Catoosa	1,123	Tulsa County FIS	62,700	24,820	28,750	35,790	25

C. Post-Discovery Hydraulics and Floodplain Analysis

Analyses of the hydraulic and floodplain data were performed by reviewing the FIS report, hydraulic models and FIRMs. A search was performed for available models on FEMA’s Mapping Information Platform (MIP). Due to the scope of work, no request was made to the FEMA library to collect all hydraulic models available for this watershed. Instead, a limited search was performed for available models that were stored on FEMA’s MIP website.

The CNMS data notes Zone AE to represent approximately 55 percent of streams miles (454 miles). For the remaining Zone A streams, only a small fraction (less than 3%) are modeled backed. Modeled Zone A streams are Elm Creek, Quarry Creek, Tributary B, B-2 and F (Rogers County) for which Regression Equation and HEC-RAS models were developed.

Table 20 shows the hydrology and hydraulic methods used for Zone AE streams.

Table 20: Summary of Hydraulic Analysis for Bird Creek Watershed

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Alsuma Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Ator Tributary	Tulsa	Valid	1/1/2002	Other	Unknown
Audubon Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
B Creek	Osage	Valid	6/1/1979	Regression Equations	HEC-2
Bell Creek	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Bell Creek Tributary	Tulsa	Valid	3/1/1980	HEC-1	HEC-2
Birch Lake	Osage	Valid	8/1/1991	Other	Unknown
Bird Creek	Osage	Valid	1/1/2005	Gage Analysis	HEC-2
Bird Creek	Rogers	Unverified	3/1/1984	Gage Analysis	HEC-RAS 2.2 (September 1998)
Bird Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Bird Creek Tributary	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Bird Creek Tributary 5A	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Brookhollow Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Brookhollow Creek Tributary	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Catfish Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Charley Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Claremore Creek	Osage	Valid	6/1/1979	Regression Equations	HEC-2
Clear Creek	Osage	Valid	2/1/1979	HEC-1	HEC-2
Coal Creek (North Tulsa)	Tulsa	Valid	3/1/1980	HEC-1	HEC-2
Coal Creek Tributary	Tulsa	Valid	3/1/1980	HEC-1	HEC-RAS

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Cooley Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Cooley Creek Tributary	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Delaware Creek	Osage	Valid	8/1/1991	HEC-1	HEC-2
Delaware Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Delaware Creek Tributary	Tulsa	Valid	3/1/1980	HEC-1	HEC-2
Dirty Butter Creek	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Dirty Butter Creek Tributary	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Douglas Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Eagle Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Elm Creek	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 2.2 (September 1998)
Elm Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 3.1.3
Flat Rock Creek	Osage	Valid	3/1/1980	HEC-1	HEC-2
Flat Rock Creek	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Flat Rock Creek Tributary A	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Flat Rock Creek Tributary B	Osage	Valid	3/23/1999	HEC-1	HEC-2
Flat Rock Creek Tributary C	Osage	Valid	3/23/1999	HEC-1	HEC-2
Flat Rock Creek Tributary D	Osage	Valid	3/23/1999	HEC-1	HEC-2
Ford Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Fulton Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Hominy Creek	Osage	Unverified	8/1/1991	HEC-1	HEC-2
Hominy Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Horsepen Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Horsepin Creek	Osage	Valid	7/1/1996	HEC-1	HEC-2
Javine Creek	Osage	Valid	8/1/1991	HEC-1	HEC-2
Jones Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Lake Valley Tributary	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Little Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Mill Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Mingo Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Panther Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Penn Creek	Osage	Valid	6/1/1979	Regression Equations	HEC-2
Pine Creek Tributary	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Pine Valley Tributary	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Quapaw Creek	Osage	Valid	8/1/1991	HEC-1	HEC-2
Quarry Creek	Rogers	Valid	12/1/1978	Other	Unknown
Quarry Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Ranch Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Ranch Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Ranch Creek Tributary A	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Ranch Creek Tributary B	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Rock Creek #2	Osage	Valid	8/1/1991	HEC-1	HEC-2
Sawgrass Tributary	Tulsa	Valid	1/1/2002	Other	Unknown
Skalall Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Skalall Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
Skiatook Lake	Osage	Valid	8/1/1991	OTHER	Unknown
Skunk Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (September 1998)
South Fork Horse Creek	Osage	Valid	7/1/1996	HEC-1	HEC-2
South Fork Horse Creek	Tulsa	Valid	9/7/2001	HEC-1	HEC-2
Southpark Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Sugar Creek	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Three Lakes Tributary	Tulsa	Valid	1/1/2002	OTHER	Unknown
Tributary B	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary B-1	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary B-2	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary F	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary G	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary G-1	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary H	Rogers	Valid	3/1/2008	HEC-HMS	HEC-RAS 3.1.3
Tributary to Brookhollow Creek Tributary	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2
Tupelo Creek	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Tupelo Creek Tributary A	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Tupelo Creek Tributary C	Tulsa	Valid	1/1/1995	HEC-1	HEC-2
Valley View Creek	Tulsa	Valid	9/1/1979	Snyder Method	HEC-2

Table 21 identifies any recent LOMRs in the watershed that have impacted hydraulics and may have created disconnects up and downstream. It should be noted that although LOMRs may also affect watershed hydrology, no hydrologic computations were performed.

Table 21: LOMRs that Revise Hydraulics within the Bird Creek Watershed

Stream Name	Case Number	Basis of Request	Notes
Horsepen Creek	12-06-4005P	Base Map Changes Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes channel relocation, and culvert(s).
West Branch Haikey Creek	11-06-0831P	Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes channel relocation, culvert(s) and fill.
Jones Creek	12-06-1019P	Basemap Changes Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes channelization and culvert(s).
South Fork Horse Creek	10-06-0568P	Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes channelization, culvert(s), fill and bridge(s).
West Branch Haikey Creek, West Branch Haikey Creek Tributary	11-06-0831P	Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes channelization, culvert(s), and fill.
Mill Creek	12-06-4004P	Basemap Changes Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes culvert(s).
Little Creek	13-06-2978P	Base Map Changes Floodway Hydraulic Analysis New Topographic Data	LOMR that revised a Zone AE based on new topographic information and hydraulic analyses. Project includes culvert(s) and bridge(s).

D. Post-Discovery CNMS Analysis

Table 22 shows the detailed study streams in the Bird Creek Watershed that have failed one or more validation elements during the CNMS stream reach level validation process. The CNMS validation elements attempt to identify changes to the Physical Environment, Climate and Engineering Methodologies since the date of the Effective Analysis (different from the Effective issuance date). Table 23 provides definitions for each validation element as described in the CNMS Database User's Guide. According to the CNMS validation process, the studied reach is considered unverified or is assigned an unverified status, if one of seven critical elements fails, or if four or more of the 10 secondary elements fail during stream reach level validation.

The CNMS contains 356 records for 808.76 stream miles in this Watershed – subdivided in 355.09 miles of Zone A and 453.67 miles of Zone AE. Of this total, 456.01 stream miles are classified as Valid, 333.86 miles as Unknown, and 18.89 miles as Unverified. Of the Valid streams, 21.23 are Zone A and 434.78 miles are Zone AE. All Unverified (18.90 miles) streams are Zone AE.

Again, of the total Zone A streams, the majority (94%) are classified as Unknown – with only 21.23 miles noted as Valid and none as Unverified. Conversely, of the total Zone AE streams, 98 percent are considered Valid – with only 18.90 miles noted as Unverified and none as Unknown.

1. Osage County

Osage County encompasses over 50 percent of the watershed's stream miles (562.04 miles). Of this sum, 237.33 miles are model-backed, Valid Zone AE, 9.88 miles are Unverified, and 314.88 miles are Unknown Zone A. The majority of the Valid Zone AE streams resulted from Digital Conversion in 2010, with a small portion (48.02 miles) receiving Updated Studies during Map MOD. All Valid stream miles are model-backed. Main streams in the county include Birch Lake, Bird Creek, Claremore Creek, Hominy Creek, and Skiatook Lake.

Review under Discovery revealed that the following Valid stream contains null values for all Critical and Secondary Elements. The CNMS data should be completed and validation status confirmed (Valid or Unverified).

- Bird Creek

Additionally, the following Valid streams failed Critical Element C₃ indicating that Model methodology is no longer appropriate:

- B Creek
- Birch Lake
- Claremore Creek
- Clear Creek
- Flat Rock Creek
- Penn Creek
- Skiatook Lake

The CNMS data should be completed and validation status confirmed for all above listed streams. For those Valid AE streams that failed C₃, the status should be revised from Valid to Unverified or Unknown.

Table 22: CNMS Validation Status and Discovery Level CNMS Review for Zone AE for Bird Creek Watershed

Stream Name	County	Validation Status	Failed CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Ator Tributary	Tulsa	Valid		C3, S1, S3, S10	1/1/2002	12	C3	Unknown
Audubon Creek	Tulsa	Valid	S2		1/1/1995	19		
B Creek	Osage	Valid	S10		6/1/1979	35	C3, S10	Unknown
Bell Creek	Tulsa	Valid	S4		9/1/1979	34	C3, C5	Unverified
Bell Creek Tributary	Tulsa	Valid			3/1/1980	34	C3	Unknown
Birch Lake	Osage	Valid		C3, S1, S3, S10	8/1/1991	23	C3	Unknown
Bird Creek	Rogers	Unverified	C1, C2, S3, S4, S6		3/1/1984	30	C3	
Bird Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Bird Creek	Osage	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	1/1/2005	9		Unknown
Bird Creek Tributary	Tulsa	Valid	S4		9/1/1979	34	C3	Unknown
Bird Creek Tributary 5A	Tulsa	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	11/1/2005	8	C5	Unverified
Bird Creek Tributary 5A	Tulsa	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	11/1/2005	8		Unknown
Brookhollow Creek	Tulsa	Valid			1/1/1995	19	C5	Unverified
Brookhollow Creek Tributary	Tulsa	Valid			9/1/1979	34	C3	Unknown
Catfish Creek	Tulsa	Valid			1/1/1995	19	C5	Unverified
Charley Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Claremore Creek	Osage	Valid	S10		6/1/1979	35	C3, S10	Unknown
Clear Creek	Osage	Valid			2/1/1979	35	C3	Unknown
Coal Creek (North Tulsa)	Tulsa	Valid	S4		3/1/1980	34	C3	Unknown
Coal Creek Tributary	Tulsa	Valid			3/1/1980	34	C3	Unknown
Cooley Creek	Tulsa	Valid			1/1/1995	19	C5	Unverified
Cooley Creek Tributary	Tulsa	Valid			9/1/1979	34	C3	Unknown
Delaware Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Delaware Creek Tributary	Tulsa	Valid			3/1/1980	34	C3	Unknown
Dirty Butter Creek	Tulsa	Valid			9/1/1979	34	C3	Unknown
Dirty Butter Creek Tributary	Tulsa	Valid	S4		9/1/1979	34	C3	Unknown
Elm Creek	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6	C3	Unknown
Elm Creek	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Elm Creek	Tulsa	Valid		S3	1/1/2002	12		
Flat Rock Creek	Osage	Valid	S4		3/1/1980	34	C3	Unknown
Flat Rock Creek	Tulsa	Valid			9/1/1979	34	C3	Unknown
Flat Rock Creek Tributary A	Tulsa	Valid			9/1/1979	34	C3	Unknown
Flat Rock Creek Tributary D	Osage	Valid	S4		3/23/1999	15		
Ford Creek	Tulsa	Valid	S4		1/1/1995	19		
Hominy Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Hominy Creek	Osage	Unverified	C5		8/1/1991	23	C5	
Horsepen Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Horsepin Creek	Osage	Valid	S4		7/1/1996	18		
Jones Creek	Tulsa	Valid	S2, S4		1/1/1995	19	C5	Unverified

Stream Name	County	Validation Status	Failed CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Lake Valley Tributary	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6	C5	Unverified
Little Creek	Tulsa	Valid			1/1/1995	19	C5	Unverified
Mill Creek	Tulsa	Valid	S2		1/1/1995	19	C5	Unverified
Mingo Creek	Tulsa	Valid	S2		1/1/1995	19		
Panther Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Penn Creek	Osage	Valid	S4, S10		6/1/1979	35	C3, S10	Unknown
Pine Creek Tributary	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Pine Valley Tributary	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6	C5	Unverified
Quarry Creek	Rogers	Valid	S6	C2, S1, S10	12/1/1978	35	C3, C5	Unverified
Ranch Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Ranch Creek Tributary	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Ranch Creek Tributary A	Tulsa	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	11/1/2005	8	C5	Unverified
Ranch Creek Tributary B	Tulsa	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	11/1/2005	8		Unknown
Sawgrass Tributary	Tulsa	Valid		C3, S1, S3, S10	1/1/2002	12	C3	Unknown
Skalall Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Skalall Creek Tributary	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
Skiatook Lake	Osage	Valid		C1, C2, C3, S1	8/1/1991	23	C3	Unknown
Skunk Creek	Tulsa	Valid		S3	1/1/2002	12	C3	Unknown
South Fork Horse Creek	Osage	Valid	S4		7/1/1996	18		
South Fork Horse Creek	Tulsa	Valid	S2		9/7/2001	12		
Southpark Creek	Tulsa	Valid			1/1/1995	19	C5	Unverified
Sugar Creek	Tulsa	Valid			9/1/1979	34	C3, C5	Unverified
Three Lakes Tributary	Tulsa	Valid		C3, S1, S3, S10	1/1/2002	12	C3	Unknown
Tributary B	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary B-1	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary B-2	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary F	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary G	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary G-1	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary H	Rogers	Valid		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	3/1/2008	6		Unknown
Tributary to Brookhollow Creek Tributary	Tulsa	Valid			9/1/1979	34	C3	Unknown
Tupelo Creek Tributary C	Tulsa	Valid			1/1/1995	19	C5	Unverified
Valley View Creek	Tulsa	Valid	S2		9/1/1979	34	C3	Unknown

Table 23: CNMS Category Descriptions

Element Name	Issue being identified by the Element	Element Description
C1	<i>Major change in gage record since effective analysis that includes major flood events</i>	Failure of this element happens when a major change in the gage record occurs after the date of the Effective Study.
C2	<i>Updated and effective peak discharges differ significantly based on confidence limits criteria</i>	Failure of this element indicates that the updated and effective peak discharges differ significantly from the current confidence limits criteria since the date of the Effective Study.
C3	<i>Model methodology no longer appropriate</i>	This element fails when the model methodology used no longer meets current guidelines and specifications.
C4	<i>Major flood control structure added or removed</i>	Failure of this element indicates the addition or removal of a major flood control structure (i.e., certified levee or seawall, reservoir with more than 50 acre-ft storage per square mile).
C5	<i>Current channel reconfiguration outside effective SFHA</i>	Failure of this element indicates the streamline is seen on imagery as outside the SFHA and cannot be explained by a minor mapping error, which could be corrected through base fitting.
C6	<i>More than five new or removed hydraulic structures</i>	This element fails when more than five new or removed hydraulic structures that impact the BFEs have not been identified.
C7	<i>Significant channel fill or scour</i>	Failure of this element indicates a significant channel or scour has been identified.
S1	<i>Use of rural regression equations in urbanized areas</i>	This element attempts to flag studies in current urban areas where rural regression equations were used for the effective study hydrology.
S2	<i>Repetitive losses outside the SFHA</i>	This element fails when repetitive losses have been noted outside of the SFHA. Repetitive losses determined to be from an unmapped source, or due to local drainage issues are not considered.
S3	<i>Increase in impervious area in subbasin of more than 50 percent</i>	Failure of this element identifies a significant increase in impervious area (due to urban development since the study date) based on best available land use/land cover data sources.
S4	<i>More than one and less than five new or removed hydraulic structures (bridge/culvert) impacting BFEs</i>	This element identifies addition or removal of more than one, but less than five hydraulic structures along the studied streams since the date of the Effective Study.
S5	<i>Channel improvements / shoreline changes</i>	Failure of this element indicates the FIRM, Imagery, or other data input sources show channel improvements since the study date.
S6	<i>Better topographic or bathymetric data available</i>	Failure of this element indicates better topographic or bathymetric data has been made available since the Effective Study date.
S7	<i>Changes to vegetation or land use</i>	Failure of this element indicates there have been significant changes in land use or vegetative cover since the date of the Effective Study.
S8	<i>Failure to identify primary frontal dune in coastal areas</i>	Failure of this element indicates that the primary frontal dune was not properly identified in coastal areas.
S9	<i>Significant storms with high water marks</i>	Failure of this element indicates that recent storm surge high waters marks were not identified.
S10	<i>New regression equations available</i>	Failure of this element indicates updates to regression equations since the date of study for studies that used a regression analysis for hydrology.

2. Rogers County

Rogers County has a total of 38.44 miles of streams in the Bird Creek Watershed. Of these, 9.41 miles are Zone A and classified as Valid, model-backed and updated on March 1, 2008. The County also contains 29.04 miles of Zone AE, of which 9.02 are classified as Unverified, none as Unknown and 20.02 miles as Valid. Major streams include Bird Creek, Elm Creek and Quarry Creek.

The following Valid Zone AE streams have null values for Critical and Secondary Elements:

- Elm Creek
- Lake Valley Tributary
- Pine Creek Tributary
- Pine Valley Tributary
- Quarry Creek
- Tributary B, Tributary B-1, Tributary B-2, Tributary F, Tributary G, Tributary G-1, and Tributary H

Further review during Discovery revealed that the following Valid streams failed Critical Element C3, indicating that Model methodology is no longer appropriate:

- Elm Creek
- Quarry Creek

Additionally, the following Valid streams failed Critical Element C5, indicating that the streamline is shown outside the SFHA:

- Lake Valley Tributary
- Pine Valley Tributary
- Quarry Creek

The CNMS data should be completed and validation status confirmed for all above listed streams. For those Valid AE streams that failed C3 and C5, status should be revised from Valid to Unverified or Unknown.

3. Tulsa County

Tulsa County has a total of 195.25 miles of streams in the Bird Creek Watershed. Of these, 19.04 miles are Zone A and classified as Unknown, Digital Conversion Approximate. The county's remaining 177.43 miles are Zone AE streams, and all classified as Valid. Main streams include Bird Creek and Tributaries, Mingo Creek, and Ranch Creek and Tributaries.

Null values are recorded for Critical and Secondary Elements for Bird Creek Tributary 5A and Ranch Creek Tributary A. During Discovery review, Tributary 5A and Tributary A failed Critical Element C5, indicating that the streamline is shown outside the SFHA.

Review under Discovery also revealed that the following Valid streams failed Critical Element C₃, indicating that Model methodology is no longer appropriate:

- Ator Tributary
- Bell Creek and Tributary
- Bird Creek and Tributary
- Brookhollow Creek Tributary
- Charley Creek
- Coal Creek (North Tulsa) and Tributary
- Cooley Creek Tributary
- Delaware Creek and Tributary
- Dirty Butter Creek and Tributary
- Flat Rock Creek and Tributary A
- Hominy Creek
- Horsepen Creek
- Panther Creek
- Ranch Creek and Tributary
- Sawgrass Tributary
- Skalall Creek and Tributary
- Skunk Creek
- Three Lakes Tributary
- Tributary to Brookhollow Creek Tributary
- Valley View Creek

Additionally, the following Valid streams failed Critical Element C₅, indicating that the streamline is shown outside the SFHA:

- Bell Creek
- Bird Creek Tributary 5A
- Brookhollow Creek
- Catfish Creek
- Cooley Creek
- Jones Creek
- Little Creek
- Mill Creek
- Ranch Creek Tributary A
- Southpark Creek
- Tupelo Creek Tributary C
- Sugar Creek

The CNMS data should be completed and validation status confirmed for all above listed streams. For those Valid AE streams that failed C₃, C₅, and/or three or more Secondary Elements, status should be revised from Valid to Unverified or Unknown.

4. Washington County

Washington County has a total of 11.83 miles of streams in the Bird Creek Watershed. All segments are Zone A, Valid, Update Approximate. No model information is contained in the CNMS. Main streams are Skalall and Tyner Creek.

Null values are recorded for all Critical and Secondary Elements for these tributaries. Review under Discovery did not reveal any additional information. The CNMS data should be completed and validation status confirmed for these streams.

5. Summary of CNMS Concerns

The CNMS contains validation status for a total of 809 stream miles. Of such, 456 miles are Valid, 334 miles are Unknown, and 20 are Unverified. All Unknown streams are Zone A, and Valid streams include 435 miles of Zone AE and 21 miles of Zone A.

Of the 435 miles classified as Valid, 97.4 miles have null values for all Critical and Secondary Elements. All Valid Zone A stream miles are classified as Model Backed, Updated Approximate, dated March 2008.

Bird Creek (9.0 miles) and Hominy Creek (9.9 miles) Zone AE streams are noted as Unverified due to failure of multiple Critical and Secondary Elements. These miles constitute all stream segments designated Unverified in the watershed.

Discovery revealed that approximately 277 miles of streams currently classified as Valid Zone AE have failed Critical Element C₃. Additionally, 34.6 miles of Valid AE failed C₅, indicating that the streamlines are shown outside the SFHA, and 3.8 miles failed both C₃ and C₅. Thus, the status for approximately 312 miles of Valid Zone AE should be revised to Unverified.

Additionally, no model information is provided for 11.8 miles of these Valid, Zone A streams. The attributes should be completed and stream segments assessed based on the validity of models used.

Lastly, Discovery also revealed that 26 miles of Valid Zone AE, Tulsa County, failed Secondary Element S₂, indicating that a number of repetitive losses have been recorded outside of the SFHA. These appear along Audubon Creek, Jones Creek, Mill Creek, Mingo Creek, and Valley View Creek of the City of Tulsa and South Fork Horse Creek of Tulsa County.

IV. Watershed Options

In conjunction with the assessment of risk, need, and the availability of topographic data, as well as the input of stakeholders within this Watershed, future projects within the Bird Creek Watershed are recommended. FEMA looks to promote mitigation action within the watershed. After internal and partner review of the communities within the watershed, the following are overarching opportunities identified to promote community action within the watershed.

Table 24 lists some potential needs in the Watershed and actions that could be taken under each of the four areas discussed during the Discovery meetings, including:

- Risk Identification and Communication – traditional flood studies and data updates
- NFIP Community Actions – insurance-related mitigation or information
- Mitigation Planning and Mitigation Actions – items related to planning updates
- Community Benefits and Grant Opportunities – outreach and disaster activities as well as non-flooding hazards like safe room information

Table 24: Potential Watershed Activities for Bird Creek Watershed

Risk Identification and Communication
<ul style="list-style-type: none"> - Provide community assistance for the update of studies in rapidly changing floodplain boundaries. Cities of Hominy, Owasso, and Tulsa and Counties of Osage and Rogers requested new studies to aid mitigate risk. <ul style="list-style-type: none"> • Bird Creek, Rogers County (reassess portions of stream noted as Valid which failed one or more Critical Elements). • Ator Tributary, Elm Creek, Bird Creek Tributary 5A, Pine Creek and Ranch Creek, City of Owasso. • Hominy Creek (Unverified), Osage County. Study Penn Creek and Unmapped Tributary, City of Hominy. • Audubon Creek, Brookhollow Creek, Cooley Creek, Coal Creek, Dirty Butter Creek and Tributary, Flat Rock Creek and Tributaries, Jones Creek, Mill Creek, Mingo Creek, and Tupelo Creek and Tributaries, City of Tulsa. • South Fork Horse Creek, City of Skiatook. Effective model is dated 1996. Much urbanization has occurred and continues in the watershed. City of Skiatook requested assistance for development of a flood forecast system for Bird Creek. - Promote participation in CTP Program. <ul style="list-style-type: none"> • City of Tulsa identified community priorities in descending order as: Brookhollow Creek, Dirty Butter Creek and Tributary, Flat Rock Creek and Tributaries, Cooley Creek, Mingo Creek, Audubon Creek, Tupelo Creek and Tributaries, Jones Creek, and Mill Creek. • City of Owasso identified community priorities in descending order as: Elm Creek, Bird Creek Tributary 5A, Ranch Creek, and Ator Tributary.

NFIP Community Action
<ul style="list-style-type: none"> - Deliver presentations on the CRS program to interested communities. Cities of Catoosa, Owasso and Rogers County communicated interest in joining the program. - Train communities on the electronic Letter of Map Amendment (eLOMA) process to facilitate LOMC submissions. - Increase communication with Tribes via Discovery and training workshops. Support State’s efforts to deploy a users’ group. - Support communities in the continued acquisition of RL and SRL properties within the SFHA. Cities of Skiatook and Sand Springs communicated significant progress in mitigation of repetitive losses. City of Owasso reviewed RL data for possible future mitigation actions. - Increase communication of HAZUS information. Provide support and training to communities for the use of data.
Mitigation Planning and Mitigation Actions
<ul style="list-style-type: none"> - Assist Collinsville, Owasso, Sand Springs, Skiatook, Tulsa, Muscogee (Creek) Nation, Sperry and Washington County in the update of HMPs. Current plans have expired. Facilitate prompt adoption of HMP updates. Mitigation Plans for Counties of Rogers and Tulsa expire in 2015. - Assist communities with preparation of Emergency Action Plan for small communities and private dam owners. Review availability of grants for small communities and private dam owners for repair and breach inundation mapping. - Train and assist communities on grants for repetitive loss properties and continued acquisition of RL and SRL properties within the SFHA throughout the Watershed. Communicate use of available non-regulatory products to identify risk and inform future mitigation actions. - Support and leverage communities flood studies. Foster and support continued communication with communities. Osage county requested to communicate with FEMA regarding bridges in the county.
Community Benefits and Grant Opportunities
<ul style="list-style-type: none"> - Community outreach improved. - Increased facilitation for HMP Grant applications. - Expedited the Grant approval process. - Improved flood risk mitigation. - Updated and current flood hazard information for communities. - Increased credibility of NFIP information. - Identified local drainage issues and possible solutions.

BFE = Base Flood Elevation
CAV = Community Assistance Visit
CFM = Certified Floodplain Manager
CLOMR = Conditional Letter of Map Revision
CNMS = Coordinated Needs Management Strategy
CRS = Community Rating System
DEM = Digital Elevation Model
FIRM = Flood Rate Insurance Map
FPA = Floodplain Administrator
G&S = FEMA’s Guidelines and Standards for Flood Hazard Mapping Partners
H&H = hydrologic and hydraulic

Hazus = Hazards U.S.
HMP = Hazard Mitigation Plan
LiDAR = Light Detection and Ranging System
LOMR = Letter of Map Revision
LSU = Louisiana State University
NFIP = National Flood Insurance Program
NVUE = New, Validated, or Updated Engineering
PMRS = Physical Map Revision
Risk MAP = Risk Mapping, Assessment, and Planning
RL/SRL = Repetitive Loss/Severe Repetitive Loss
SFHA = Special Flood Hazard Area
SRA = Sabine River Authority
USGS = U.S. Geological Survey

Table 25 provides specific evaluation guidelines for streams or areas that could benefit from additional study. Any FEMA-based metrics that would be met if the need or issue was addressed are noted, as well as any current FEMA map actions that would affect the activity. Any comments or concerns raised by a stakeholder during the Discovery process that could be tied to one of the needs or actions for the Watershed are also noted. Some needs/actions are listed that were not raised by any specific community but were identified as general improvements that could be made in the Bird Creek Watershed to meet general FEMA regional goals.

Needs are identified as being on the critical path as high, medium, or low priority or as a task that could be assigned to a State or local community to complete. These definitions are also included in Table 25.

- **High** – The local community would immediately benefit from the action and FEMA’s metrics would also be met.
- **Medium** – The local community would benefit over the longer term from the action and a portion of FEMA’s metrics may be met.
- **Low** – The local community activities can continue without this revision and FEMA’s metrics are not affected.
- **Community Action** – The activity would be more appropriate as a community-led action rather than a FEMA-led action.

Table 25: Metrics and Rankings of Needs for Bird Creek Watershed

Item	Description of Need		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Evaluation Guide					
	Location of Need/Project	Details				
	<p>Community Action – Activity would be more appropriate as a community-led action</p> <p>Low – Local community activities can continue without this revision, and FEMA’s metrics are not impacted</p> <p>Medium – Local community would benefit over the longer term from the action, and a portion of FEMA’s metrics may be met</p> <p>High – Local community would immediately benefit from the action, and FEMA’s metrics would also be met</p>					
A	Mitigation / HMP Updates	<ul style="list-style-type: none"> The following communities have expired HMP currently under update: <ul style="list-style-type: none"> City of Collinsville City of Owasso City of Sand Springs City of Skiatook City of Tulsa Muscogee (Creek) Nation The following communities have expired HMP: <ul style="list-style-type: none"> Town of Sperry Washington Count 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Impacts all communities Facilitate the application for HMP Grants Expedite the Grant approval process 	Community Action	
C	Mitigation / HMP Approval	<ul style="list-style-type: none"> Communities should update their HMP any time flood risks change. Communities should develop mitigation strategies in an on-going fashion. Update with mitigation successes to show work completed. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Impacts community Facilitate the application for HMP Grants Expedite the Grant approval process 	Community Action	
D	Outreach / Coordination for Dam Emergency Action Plan	<ul style="list-style-type: none"> OWRB has begun to request Emergency Action Plans for dams. OWRB to coordinate and assist communities with compliance. City of Hominy requested assistance to improve spillway on dam. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Community outreach improved 	Community Action	3
E	Outreach / Coordination for Discovery	<ul style="list-style-type: none"> OWRB to provide Discovery Reports. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Community outreach improved 	Community Action	1, 15
F	Outreach / Coordination for FPM	<ul style="list-style-type: none"> OWRB to extend outreach to support protection and beneficial use of floodplain areas. City of Skiatook requested assistance for new signage at several low water crossings. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Community outreach improved 	Community Action	12

Item	Description of Need		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Evaluation Guide					
	Location of Need/Project	Details				
	<p>Community Action – Activity would be more appropriate as a community-led action</p> <p>Low – Local community activities can continue without this revision, and FEMA’s metrics are not impacted</p> <p>Medium – Local community would benefit over the longer term from the action, and a portion of FEMA’s metrics may be met</p> <p>High – Local community would immediately benefit from the action, and FEMA’s metrics would also be met</p>					
G	Outreach / Coordination for Grant Opportunities	<ul style="list-style-type: none"> OWRB to provide information on grants for small communities / private owners for dam repair and breach inundation mapping. City of Owasso, City of Skiatook and Rogers County requested assistance to coordinate a discussion with SHMO over grant opportunities. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Community outreach improved 	Community Action	5, 14
H	Outreach / Coordination for Repetitive Loss Grant Opportunities	<ul style="list-style-type: none"> City of Catoosa requested detailed information on existing RL and SRL claims in the City limit to assist planning of potential, future mitigation actions. City of Skiatook is interested in mitigation of repetitive loss properties. City of Owasso reviewed NFIP claims records for possible future mitigation projects. City of Sand Springs has an on-going mitigation grant—being used for acquisition in Meadow Valley. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Community outreach improved 	High	1, 6, 11
I	Outreach / Coordination to enter CRS program	<ul style="list-style-type: none"> City of Catoosa communicated interest in participating in the program. City of Owasso noted interest in participating in the CRS program. Requested more information on the program. City of Sand Springs is concerned about potential change in classification from Class 6 to 7. Osage County joined the State’s CRS Users Group. Rogers County communicated interest in participating in CRS. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Potential decrease in flood insurance premiums Community outreach improved 	Community Action	1,6, 11, 17, 20
J	Outreach / Coordination to join NFIP program	<ul style="list-style-type: none"> OWRB to extend outreach for NFIP program. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Additional communities in NFIP Community outreach improved 	Community Action	13
K	Outreach / Flood Warning System	<ul style="list-style-type: none"> City of Skiatook requested assistance for development of a flood forecast system for Bird Creek. Collaboration with NWS and Silver Jackets were discussed as potential mitigation actions. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Identification of local drainage issues and possible solutions Grant application for assistance in mitigation Community outreach improved 	High	

Item	Description of Need		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Evaluation Guide					
	Location of Need/Project	Details				
	<p>Community Action – Activity would be more appropriate as a community-led action</p> <p>Low – Local community activities can continue without this revision, and FEMA’s metrics are not impacted</p> <p>Medium – Local community would benefit over the longer term from the action, and a portion of FEMA’s metrics may be met</p> <p>High – Local community would immediately benefit from the action, and FEMA’s metrics would also be met</p>					
L	HAZUS Outreach / Coordination	<ul style="list-style-type: none"> Provide information from the Average Annualized Loss Study. Introduction to HAZUS. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Communities become more familiar with the HAZUS program and are prepared to use Risk MAP products when they are issued. HAZUS can be used for HMP updates. 	Medium	
M	Updating the FIRM and FIS for Bird Creek, Rogers County. <ul style="list-style-type: none"> Significant urbanization changes and new structures impacting BFEs. Use of rural regression equations in urbanized areas. Model methodology no longer appropriate. New regression equations available. Effective model dated 1984. 	<ul style="list-style-type: none"> 10.9 miles of enhanced riverine floodplain analysis. 10.9 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 9.02 miles of new NVUE. 1.9 miles of new AE. Coordination with USACE for map revisions. Community outreach improved. FIRMs updated to reflect existing conditions. 	High	2, 18, 19
N	Updating the FIRM and FIS for Bird Creek, Tulsa County. <ul style="list-style-type: none"> Significant urbanization changes and new structures impacting BFEs. Effective model dated 1980. Repetitive losses outside the SFHA. Model methodology no longer appropriate. 	<ul style="list-style-type: none"> 5.25 miles of enhanced riverine floodplain analysis. 5.25 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> FIRMs updated to reflect existing conditions. Coordination with USACE for flood warning system deployment. 	Medium	10, 12, 22
O	Updating the FIRM and FIS for Bird Creek Tributary 5A, Tulsa County. <ul style="list-style-type: none"> Significant channel erosion. Flooding of HWY 169 due to backwater. Localized flooding and erosion issues in commercial development south of 86th St N, east of HWY 169. Problematic flooding and major channel erosion near industrial park north of 76th St N, west of HWY 169. Model methodology no longer appropriate. Current channel reconfiguration outside effective SFHA. 	<ul style="list-style-type: none"> 1.93 miles of enhanced riverine floodplain analysis. 1.93 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 1.93 miles of new NVUE. 1.93 miles of new AE. 	Low	10

Item	Description of Need		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Evaluation Guide					
	Location of Need/Project	Details				
	<p>Community Action – Activity would be more appropriate as a community-led action</p> <p>Low – Local community activities can continue without this revision, and FEMA’s metrics are not impacted</p> <p>Medium – Local community would benefit over the longer term from the action, and a portion of FEMA’s metrics may be met</p> <p>High – Local community would immediately benefit from the action, and FEMA’s metrics would also be met</p>					
P	Updating the FIRM and FIS for Hominy Creek and tributaries, Osage County. <ul style="list-style-type: none"> Better topographic data available. New studies requested for downstream Skiatook Dam. Unknown validation status for Zone A (no model information) Unverified 9.88 miles of Zone AE. Effective model dated 1991. 	<ul style="list-style-type: none"> 52.43 miles of riverine floodplain analysis. 52.43 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 52.43 miles of new NVUE. FIRMs updated to reflect existing conditions. 	Medium	17, 18
Q	Updating the FIRM and FIS for Brookhollow Creek and Tributary, City of Tulsa. <ul style="list-style-type: none"> LOMRs pending in the area. Effective model dated 1979. Better topographic data available. Model methodology no longer appropriate. Current channel reconfiguration outside effective SFHA. 	<ul style="list-style-type: none"> 6.20 miles of detailed riverine floodplain analysis. 6.20 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> No NVUE (study already valid in CNMS). 	High	16
R	Updating the FIRM and FIS for Ator Tributary, City of Owasso. <ul style="list-style-type: none"> New studies requested to assess changes in flood risk. Better topographic data available. New channel improvements. Digital Conversion Approximate. Model methodology no longer appropriate. Effective model unknown. 	<ul style="list-style-type: none"> 0.4 miles of enhanced riverine floodplain analysis. 0.4 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> .25 miles of new NVUE FIRMs updated to reflect existing conditions. 	Low	9
S	Updating the FIRM and FIS for Elm Creek, City of Owasso. <ul style="list-style-type: none"> Changes in SFHAs mapping due to urbanization. Repetitive flooding outside of SFHA. New studies requested to assess changes in flood risk. Effective model dated 2000. Digital Conversion Approximate. Current channel reconfiguration outside effective SFHA. 	<ul style="list-style-type: none"> 11.95 miles of enhanced riverine floodplain analysis. 11.95 miles of floodplain mapping. 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 1.2 miles of new NVUE. Community outreach improved. FIRMs updated to reflect existing conditions. 	Medium	8

Item	Description of Need		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Evaluation Guide					
	Location of Need/Project	Details				
	<p>Community Action – Activity would be more appropriate as a community-led action</p> <p>Low – Local community activities can continue without this revision, and FEMA’s metrics are not impacted</p> <p>Medium – Local community would benefit over the longer term from the action, and a portion of FEMA’s metrics may be met</p> <p>High – Local community would immediately benefit from the action, and FEMA’s metrics would also be met</p>					
T	Updating the FIRM and FIS for the Ranch Creek and Tributaries, City of Owasso. <ul style="list-style-type: none"> • Significant channel erosion. • New study requested to assess change in flood risk and support mitigation of repetitive loss properties. • New bridge structures constructed at 86th and 116th Street North. • Repetitive street flooding (Mingo Road) • Significant flooding of residential structures in Hale Acres. • Model methodology no longer appropriate. • C5 Current channel reconfiguration outside effective SFHA. 	<ul style="list-style-type: none"> • 24.11 miles of enhanced riverine floodplain analysis. • 24.11 miles of floodplain mapping. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • 2.94 miles of new NVUE. • 2.94 miles of new Zone AE. • FIRMs updated to reflect existing conditions. 	Medium	7
U	Updating the FIRM and FIS for Penn Creek and Unmapped Tributary, City of Hominy. <ul style="list-style-type: none"> • Model methodology no longer appropriate. • New regression equations available. • Effective model dated 1979. • Noted significant channel erosion. • Requested detailed study of Zone A over Cotton Gin Road. • Current channel reconfiguration outside effective SFHA. 	<ul style="list-style-type: none"> • 2.96 miles of enhanced riverine floodplain analysis. • 2.96 miles of floodplain mapping. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • 1.99 miles of new NVUE. • 1.99 miles of new Zone AE. • FIRMs updated to reflect existing conditions. 	Medium	4, 5

A. Project Prioritization

Flood risk projects are intended to be initiated and cataloged at a HUC-8 unit. This means that when a project is initiated, all flood hazards within the HUC-8 will be evaluated to determine the project scope within that HUC-8 boundary. Evaluation means that risk, need, available data, and desired output products are assessed for the entire HUC-8. Evaluation does not mean the actual development of new or updated flood risk products, only the assessment of what products would be required to fulfill the identified needs in light of the level of risk. Unmet needs are cataloged in the Coordinated Needs Management Strategy Database (CNMS).

Once the entire HUC-8 has been evaluated, the Region will select the project tasks necessary to respond to the identified levels of risk and need. The Region is expected to maximize the amount and usefulness of project work to be performed in any HUC-8, but is not expected to perform every project task and meet all needs in every watershed. All scope within the HUC-8 boundary must be tasked/ordered at one time.

This section includes a review of the watershed and the data collected throughout the Discovery effort to identify, for FEMA Region 6, State, and Communities, project possibilities for the watershed to engage in the development of the next phase of the Risk MAP Process (Project Area Selection to Resilience Meeting). The identified watershed projects should be reviewed for NVUE, Risk Communication, and Mitigation Actions & Technical Assistance at a minimum.

Because it is desired that all future projects within a HUC-8 boundary be task-ordered at one time, all identified HUC 8 projects must be properly prioritized and evaluated prior to selection. This prioritization work is completed as part of Discovery. Prioritization is computed based on the following factors:

- Population Density
- Percent Urban
- Number of Repetitive Loss Properties
- Total Value of Repetitive Loss Claims
- Percent available Topographic Data
- Population Density in the Floodplain
- Effective Study Age
- Validation Status
- Available Local Funding

Project rankings are derived from computations made at the HUC12 level. Those projects extending over more than one HUC12 are assigned a weighted value computed based on percentage of stream length located in each HUC 12 watershed. Table 26 shows the priority of projects for the Bird Watershed.

Table 26: Bird Creek Watershed Project Prioritization

Study Name	Length (mi)	Weighted Ranking	Zone	Current Validation Status
Brookhollow Creek, City of Tulsa	6.20	78.93	AE	Valid
Cooley Creek, City of Tulsa	7.04	78.93	AE	Valid
Mingo Creek, City of Tulsa	16.51	78.93	AE	Valid
Audubon Creek, City of Tulsa	1.89	78.93	AE	Valid
Tupelo Creek and Tributaries, City of Tulsa	4.93	78.93	AE, A	Unknown, Valid
Jones Creek, City of Tulsa	3.30	78.93	AE	Valid
Mill Creek, City of Tulsa	3.30	78.93	AE	Valid
Flat Rock Creek and Tributaries, City of Tulsa	16.40	48.96	AE, A	Unknown, Valid
Dirty Butter Creek and Tributary, City of Tulsa	4.47	48.96	AE	Valid
Bird Creek, Rogers County	10.92	38.20	AE, A	Unverified, Valid
Elm Creek, City of Owasso	11.95	38.20	AE, A	Valid
Coal Creek, City of Tulsa	6.72	37.61	AE	Valid
Ranch Creek, City of Owasso	24.11	37.61	AE, A	Unknown, Valid
Ator Tributary, City of Owasso	0.40	37.61	AE	Valid
Bird Creek and Tributary 5A, City of Owasso	6.43	37.61	AE	Valid
Skiatook Lake, Osage County	131.09	34.43	AE	Valid
Horse Creek, City of Skiatook	1.12	34.43	AE	Valid
Horsepen Creek, Tulsa and Osage Counties	1.87	34.43	AE	Valid
Bird Creek, City of Skiatook	30.00	25.77	AE	Valid
Penn Creek and Unmapped Tributary, City of Hominy	2.96	14.91	AE, A	Unknown, Valid
Claremore Creek, Osage County	4.32	14.91	AE, A	Unknown, Valid
Hominy Creek, Osage County	36.80	11.81	AE, A	Unverified, Unknown, Valid

The above are estimates only. Detailed scope/length of project are derived in following phases of Risk MAP contingent of FEMA funding availability and community support and engagement.

Item	Need / Location of Project
A	Mitigation / HMP Updates
C	Mitigation / HMP Approval
D	Outreach / Coordination for HMP Approval
E	Outreach / Coordination for Dam Emergency Action Plan
F	Outreach / Coordination for Discovery
G	Outreach / Coordination for Grant Opportunities
H	Outreach / Coordination for Repetitive Loss Grant Opportunities
I	Outreach / Coordination to join CRS program
J	Outreach / Coordination to join NFIP program
K	Outreach / Flood Warning System, City of Skiatook
L	HAZUS Outreach / Coordination
M	Updating the FIRM and FIS for Bird Creek, Rogers County
N	Updating the FIRM and FIS for Bird Creek, Tulsa County
O	Updating the FIRM and FIS for Bird Creek Tributary 5A, Tulsa County
P	Updating the FIRM and FIS for Hominy Creek and Tributaries, Osage County
Q	Updating the FIRM and FIS for Brookhollow Creek and Tributary, City of Tulsa
R	Updating the FIRM and FIS for Ator Tributary, City of Owasso
S	Updating the FIRM and FIS for Elm Creek, City of Owasso
T	Updating the FIRM and FIS for Ranch Creek and Tributaries, City of Owasso
U	Updating the FIRM and FIS for Penn Creek and Unmapped Tributary, City of Hominy

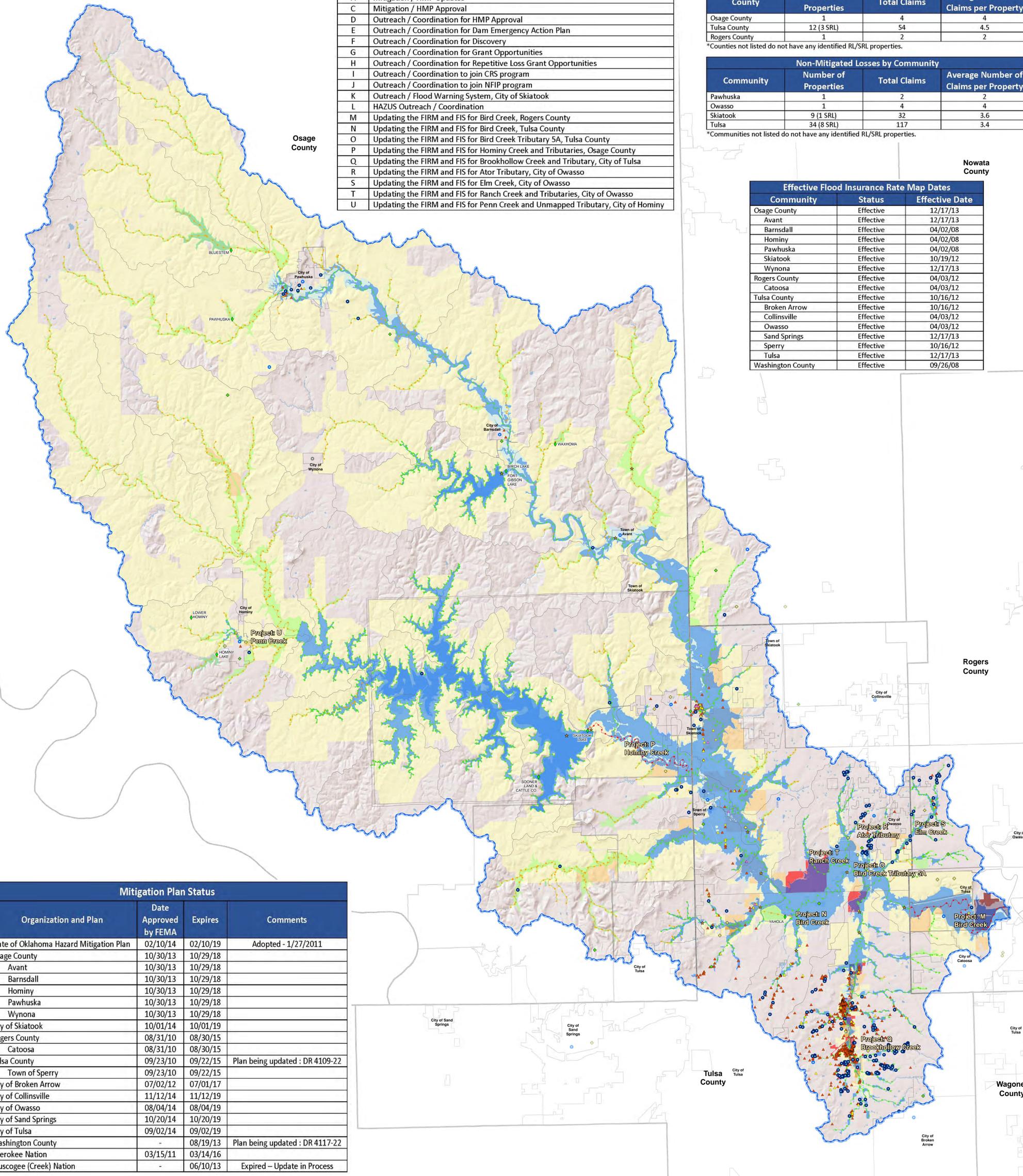
Non-Mitigated Losses by County (Unincorporated)			
County	Number of Properties	Total Claims	Average Number of Claims per Property
Osage County	1	4	4
Tulsa County	12 (3 SRL)	54	4.5
Rogers County	1	2	2

*Counties not listed do not have any identified RL/SRL properties.

Non-Mitigated Losses by Community			
Community	Number of Properties	Total Claims	Average Number of Claims per Property
Pawhuska	1	2	2
Owasso	1	4	4
Skiatook	9 (1 SRL)	32	3.6
Tulsa	34 (8 SRL)	117	3.4

*Communities not listed do not have any identified RL/SRL properties.

Effective Flood Insurance Rate Map Dates		
Community	Status	Effective Date
Osage County	Effective	12/17/13
Avant	Effective	12/17/13
Barnsdall	Effective	04/02/08
Hominy	Effective	04/02/08
Pawhuska	Effective	04/02/08
Skiatook	Effective	10/19/12
Wynona	Effective	12/17/13
Rogers County	Effective	04/03/12
Catoosa	Effective	04/03/12
Tulsa County	Effective	10/16/12
Broken Arrow	Effective	10/16/12
Collinsville	Effective	04/03/12
Owasso	Effective	04/03/12
Sand Springs	Effective	12/17/13
Sperry	Effective	10/16/12
Tulsa	Effective	12/17/13
Washington County	Effective	09/26/08



Mitigation Plan Status			
Organization and Plan	Date Approved by FEMA	Expires	Comments
State of Oklahoma Hazard Mitigation Plan	02/10/14	02/10/19	Adopted - 1/27/2011
Osage County	10/30/13	10/29/18	
Avant	10/30/13	10/29/18	
Barnsdall	10/30/13	10/29/18	
Hominy	10/30/13	10/29/18	
Pawhuska	10/30/13	10/29/18	
Wynona	10/30/13	10/29/18	
City of Skiatook	10/01/14	10/01/19	
Rogers County	08/31/10	08/30/15	
Catoosa	08/31/10	08/30/15	
Tulsa County	09/23/10	09/22/15	Plan being updated : DR 4109-22
Town of Sperry	09/23/10	09/22/15	
City of Broken Arrow	07/02/12	07/01/17	
City of Collinsville	11/12/14	11/12/19	
City of Owasso	08/04/14	08/04/19	
City of Sand Springs	10/20/14	10/20/19	
City of Tulsa	09/02/14	09/02/19	
Washington County	-	08/19/13	Plan being updated : DR 4117-22
Cherokee Nation	03/15/11	03/14/16	
Muscogee (Creek) Nation	-	06/10/13	Expired - Update in Process

MAP SYMBOLOLOGY

- Watershed
- HUC 12 Boundaries
- Dams
- USGS Gages
- Citizen Comment Locations
- LOMC Locations
- Mitigation Grant
- Single Claims
- Repetitive Loss
- Severe Repetitive Loss

Community Participation Effective Flooding

- Not Participating in NFIP
- Participating in NFIP
- AE; AH; AO
- A
- 500Y

CNMS Data

- Validated
- Unknown
- Unverified

Avg. Annualized Loss Total Loss

- Very Low
- Low
- Medium
- High
- Very High

Scale: 1 inch = 1.5 miles

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
Discovery Map
BIRD WATERSHED

OWRB the water agency

FEDERAL DEPARTMENT OF HOMELAND SECURITY
FEMA

Total Stream Miles	1,161
Studied Stream Miles	809
Detailed Study Miles	454
Approximate Study Miles	355
Total Population	686,488

HUC-8 Code: 11070107
Release Date: 6/10/2015

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