Discovery Report

Polecat-Snake HUC-8 Watershed 11110101

Creek, Muskogee, Okmulgee, Osage, Tulsa, and Wagoner Counties, Oklahoma

August 3, 2012

FEMA

Project Area Community List

Community Name	CID
Creek County Communities	
Creek County Unincorporated Areas	400490
Kellyville	400235
Kiefer	400393
Mannford	400399
Mounds	400408
Sapulpa	400053
Muskogee County Communities	
Muskogee County Unincorporated Areas	400491
Boynton	400120
Haskell	400124
Muskogee	400125
Taft	400128
Okmulgee County Communities	
Okmulgee County Unincorporated Areas	400492
Liberty	400547
Beggs	400345
Winchester	400566
Osage County Communities	
Osage County Unincorporated Areas	400146
Tulsa County Communities	
Tulsa County Unincorporated Areas	400462
Glenpool	400208
Jenks	400209
Sand Springs	400211
Tulsa	405381
Bixby	400207
Broken Arrow	400236
Tribes	
Cherokee Nation, Oklahoma	N/A
Muscogee (Creek) Nation, Oklahoma	N/A
Osage Tribe, Oklahoma	N/A
Wagoner County Communities	
Wagoner County Unincorporated Areas	400215
Porter	400434
Red Bird	400321
Tullahassee	400218
Coweta	400216

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Acronyms and Abbreviations

BFE	Base Flood Elevation
CAV	Community Assistance Visit
CEO	Chief Executive officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFS	Cubic Feet per Second
CID	Community Identification number
CLOMR	Conditional Letter of Map Revision
CNMS	Coordinated Needs Management Strategy
CRS	Community Rating System
DEM	Digital Elevation Model
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
HMP	Hazard Mitigation Plan
HUC	Hydrologic Unit Code
IDIQ	Indefinite Delivery Indefinite Quantity
LiDAR	Light Detection and Ranging System
LOMA	Letter of Map Amendment
LOMA-F	Letter of Map Amendment based on Fill
LOMC	Letter of Map Change
LOMR	Letter of Map Revision
MIP	Mapping Information Platform
MLI	Midterm Levee Inventory
MNC	Middle North Canadian
MXD	ArcMap map document extension
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NHD	National Hydrologic Dataset
NRCS	Natural Resources Conservation Service
NVUE	New Validated or Updated Engineering
OKC	Oklahoma City
OWRB	Oklahoma Water Resources Board
PS	Polecat-Snake

PDF	Portable Document Format file
PMR	Physical Map Revision
RCRA	Resource Conservation and Recovery Act
RSC	Regional Service Center
Risk MAP	Risk Mapping, Assessment, and Planning Program
RL	Repetitive Loss
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation officer
SHP	ESRI Shapefile
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
RCRA	Resource Conservation and Recovery Act
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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 the 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 necessary to reduce risk.

The vision and intent of the Risk MAP Program is to, through collaboration with State and local 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 an integrated process of more accurately identifying, assessing, communicating, planning, and mitigating flood risks. Risk MAP will address gaps in flood hazard data to form a solid foundation for risk assessment and floodplain management and will provide State and local entities with information needed to mitigate flood related risks.

The beginning step of the Risk MAP process is defined as Discovery and encompasses deployment of engagement activities in a watershed of interest. Watersheds are selected for Discovery based on risk, need, available topographic data, and other factors. The goal of the Discovery process is 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.

Through Discovery, FEMA can determine which areas of the 8-digit Hydrologic Unit (HUC-8) Discovery watersheds to examine for further flood risk identification and assessment in a collaborative manner, taking into consideration the information collected from local communities. Discovery opens lines of communication and relies on local involvement for productive discussions about flood risk. The process provides a forum for a watershed-wide discussion of how each included community's individual flood risks are related to the flood risks present throughout the watershed.

In October 2011, FEMA approved Discovery activities for the Polecat-Snake (PS) Watershed to be performed by the Oklahoma Water Resources Board (OWRB) under the Cooperative Technical Partner Agreement Number EMT-2011-CA-0007. On February 29, 2012, the OWRB, assisted by FEMA Region VI and its contractor Meshek & Associates, PLC (Meshek), held the Discovery Meeting in the City of Broken Arrow, Oklahoma.

During this meeting, the OWRB and FEMA reached out to the local communities to:

- Gather information about local flood risk and flood hazards;
- Review current and historic mitigation plans to understand local mitigation capabilities, hazard risk assessments, and current or future mitigation activities; and
- 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 was gathered or developed during this process. The digital data submitted during this process contain correspondence, exhibits used at the Discovery Meetings, Geographic Information System (GIS) data, mapping documents (PDF, shapefiles, personal geo-databases, and ESRI ArcGIS 9.3.1 MXDs), and other supplemental digital information. Any graphics shown in this report are available as larger format graphics files for printing and as GIS data that may be printed and used at any map scale.

i. Watershed Selection

The Polecat-Snake Watershed (PS), Hydrologic Unit Code (HUC) 11110101, is located Northeast Oklahoma and covers 1,322.2 square miles. The watershed stretches across six counties, twenty-two incorporated communities (cities and towns) and two other census-designated places. Three Native American Tribes – Muskogee (Creek) Nation, Osage Tribe, and Cherokee Nation, Oklahoma – m also have lands in the watershed. A map of the watershed is shown in Figure 1.

Based on the 2010 U.S. Census Bureau, the watershed population is approximately 449,351 and includes a portion of City of Tulsa, the second largest city in the state (population 391,322). This watershed is located in FEMA Region VI.

The watershed is located in what is called "Northeast Oklahoma Green Country." This name is derived from the more than 40 inches of rain the area receives each year on average, which makes the landscape considerably wetter and greener than the rest of state.

The Arkansas River, the primary river in this watershed, is a major tributary of the Mississippi River and flows to the east-southeast from Colorado to Kansas, Oklahoma, and Arkansas. It enters the PS Watershed downstream of Keystone Dam, just northwest of Mannford, Oklahoma, and flows southeasterly to exit the watershed at the confluence with the Verdigris River, east of the Muskogee Turnpike. Other significant flood sources in the watershed include Polecat Creek, Snake Creek and Cane Creek.

The Polecat-Snake Watershed begins at the Keystone Dam. The dam was constructed in 1964, is located approximately 15 miles west of downtown Tulsa, Oklahoma, and is the control structure for a 26,000 acre flood control lake operated by the U.S. Army Corps of Engineers (USACE). In a report entitled *Oklahoma Projects Information Sheet* released by the USACE in February 2011, the Keystone Dam was considered to be a "very high risk dam" due to potential consequences from seepage through its foundation and the abutments and the potential for overtopping as the result of a probable maximum flood. A major risk component is the proximity of major population centers and development in nearby Sand Springs and Tulsa, Oklahoma.

The following is a listing of dams under federal, state, local and utility jurisdiction located in the watershed. This list was obtained from the USACE, Tulsa District, in July 2012.

Dam Name	Owner Name
1. Aspen Pond Dam	City of Broken Arrow
2. Bixhoma Lake	City of Bixby
3. Boynton	Boynton Public Works Authority
4. Fair Oil Company Lake	Fair Oil Company
5. Heyburn Lake	USACE
6. Oknoname 037071	City of Kiefer
7. Oknoname 037078	USACE
8. Pretty Water	Mark A & Clinta J Armstrong
9. Public Service Co.	Public Service Co.
10. Rock Creek Reservoir	Bixby Utility Service Authority
11. Sahoma Lake	City of Sapulpa
12. Sapulpa Lake	City of Sapulpa
13. SCS-Cane Creek Site-01	Muskogee County Conservation District
14. SCS-Cane Creek Site-02	Muskogee County Conservation District
15. SCS-Cane Creek Site-03	Muskogee County Conservation District
16. SCS-Cane Creek Site-05	Okmulgee County Conservation District
17. SCS-Cane Creek Site-07	Okmulgee County Conservation District
18. SCS-Cane Creek Site-08	Okmulgee County Conservation District
19. SCS-Cane Creek Site-09	Okmulgee County Conservation District
20. SCS-Cane Creek Site-11	Okmulgee County Conservation District
21. SCS-Cane Creek Site-12	Okmulgee County Conservation District
22. SCS-Cane Creek Site-14	Okmulgee County Conservation District
23. SCS-Cane Creek Site-15	Okmulgee County Conservation District
24. SCS-Cane Creek Site-17	Okmulgee County Conservation District
25. SCS-Cane Creek Site-18	Okmulgee County Conservation District
26. SCS-Cane Creek Site-19	Okmulgee County Conservation District
27. SCS-Cane Creek Site-20	Muskogee County Conservation District
28. SCS-Cane Creek Site-21	Muskogee County Conservation District
29. SCS-Cane Creek Site-22	Muskogee County Conservation District
30. SCS-Cane Creek Site-24	Muskogee County Conservation District
31. SCS-Cane Creek Site-26a	Muskogee County Conservation District
32. SCS-Cane Creek Site-27	Muskogee County Conservation District
33. SCS-Cane Creek Site-29	Muskogee County Conservation District
34. SCS-Kadashan Bottom Site-2	Wagoner County Conservation District
35. SCS-Kadashan Bottom Site-3	Wagoner County Conservation District
36. SCS-Kadashan Bottom Site-4	Wagoner County Conservation District
37. SCS-Kadashan Bottom Site-5	Wagoner County Conservation District
38. SCS-Kadashan Bottom Site-6	Wagoner County Conservation District
39. Shell Creek Lake Dam	City of Sand Springs
40. Taft No.3	State of Oklahoma
41. Taylor Dam	Tulsa County
42. Tulsa River Parks	City of Tulsa

Figure 1: Watershed Locater Map

Polecat-Snake Watershed

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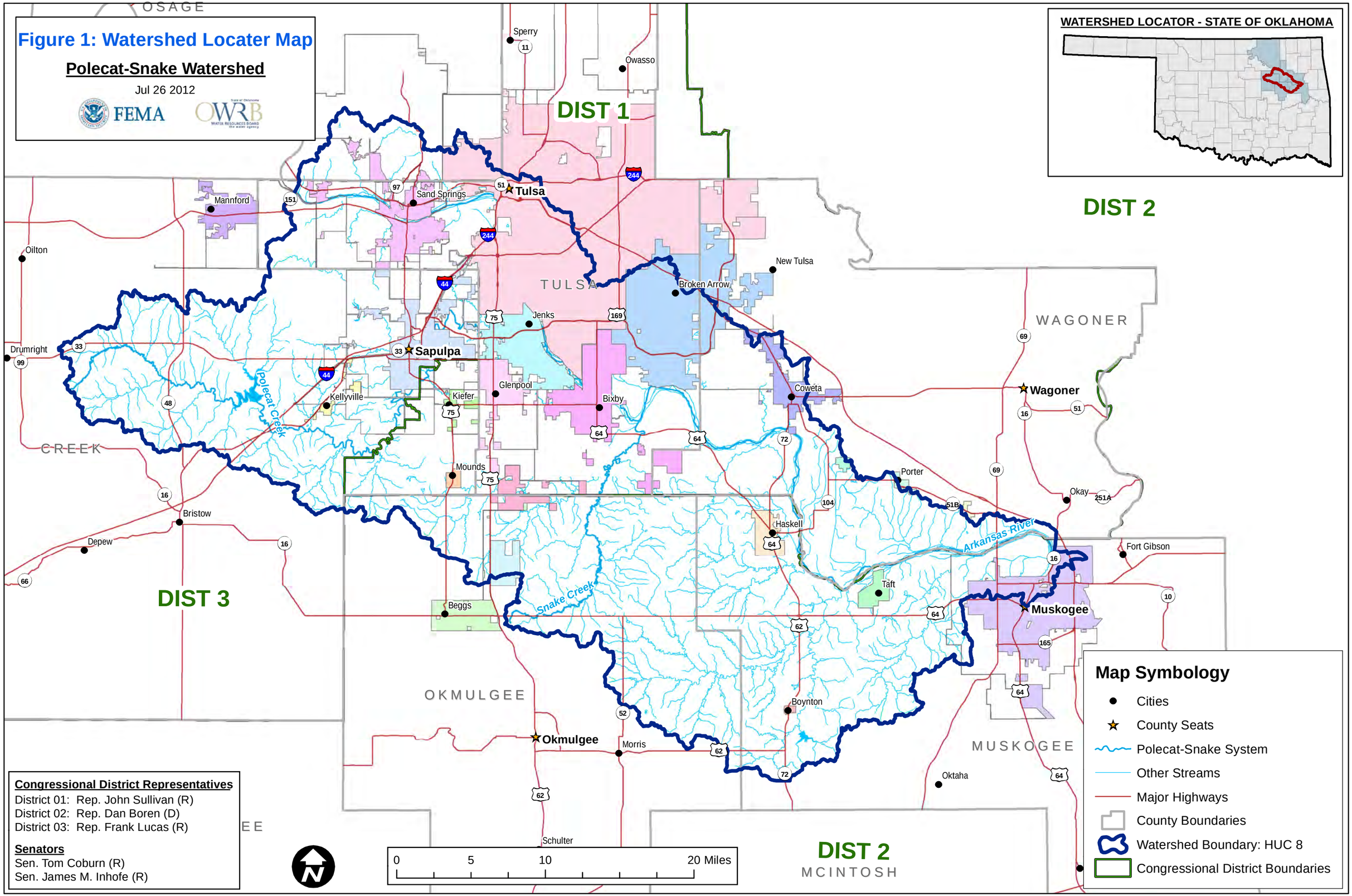

The Mid-Term Levee Inventory (MLI) contains records for the following levees in this watershed:

	Levee Name	Flooding Source
1.	Haikey Creek Levee	Haikey Creek
2.	Tulsa Levee 1	Arkansas River
3.	Tulsa Levee 2	Arkansas River
4.	Tulsa Levee 3	Berryhill Creek
5.	Tulsa Levee 4	Arkansas River
6.	Tulsa Levee 5	Arkansas River
7.	Tulsa Levee 6	Arkansas River
8.	West Bigheart Creek Levee 1	West Bigheart Creek
9.	Tulsa Levee 7	Arkansas River
10.	Tulsa Levee 8	Arkansas River
11.	West Bigheart Creek Levee 2	West Bigheart Creek
12.	West Bigheart Creek Levee 3	West Bigheart Creek
13.	Harlow Creek Levee 1	Harlow Creek
14.	Tulsa Levee 9	Arkansas River
15.	Harlow Creek Levee 2	Harlow Creek
16.	Harlow Creek Levee 3	Harlow Creek
17.	Harlow Creek Levee 4	Harlow Creek
18.	Jenks Levee 1	Arkansas River
19.	Jenks Levee 2	Hager Creek
20.	Jenks Levee 3	Hager Creek

The watershed contains populated areas as well as parks scattered throughout the watershed. No national forests or parks, or military facilities, are located in the watershed. 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.

Two Superfund Sites have been identified in the watershed. Both are located in Tulsa County and include:

- Compass Industries, Tulsa County, Oklahoma
- Sand Springs Petrochemical Complex, Tulsa County, Oklahoma

The Compass Industries is located on a bluff approximately 0.25 mile south and 200 feet above the Arkansas River in the area of Chandler Park. The nearest residence is 0.25 miles from the site, and it is just west of Tulsa, Oklahoma, with its urban population. This abandoned landfill, located in a former limestone quarry, was a city landfill from 1972 to 1976 under a permit which

did not include the disposal of industrial waste. Despite regulations, industrial waste was disposed in the landfill. The site cleanup was completed in June 1991 and removed from the National Priorities List (NPL) as of July 18, 2002.

The Sand Springs Petrochemical Complex is situated at the Old Sinclair Refinery in Sand Springs, Oklahoma, west of Tulsa, Oklahoma, and adjacent to the Arkansas River. The nearest residence and some up-gradient drinking wells are located within 0.5 miles of the site as well as population centers in Tulsa and Sand Springs, Oklahoma. The site encompasses 200 acres, two unlined sludge pits (about 10 feet deep), and a waste oil recycling facility. A Superfund Remedial Action was implemented in 1995, and the site was delisted from the NPL in 2000. Then, in 2001, the seepage of black sludge was discovered, and subsequent testing revealed contaminated soil up to 14 feet below the ground surface with an estimated 5,000 cubic yards in contaminated materials. Clean up occurred from October 2004 to January 2006, with the remediation report being approved by EPA on April 27, 2006. The Third Five Year Review Report, completed on July 20, 2010, found the remedy, to be protective of human health and environment. In May 2011, EPA found that the current local municipal ordinances and state requirements, in place, were sufficient, although changes in land use and institutional controls will continued to be reviewed in each future Five Year Review to determine their continued adequacy.

Table 1 shows the land use in the watershed. of the total 1,322.2 square miles of land in the PS Watershed, it is estimated that all areas, outside the 46.1 square miles of Undevelopable Areas (3% of the watershed), are available to be developed or have development and population currently in place. This results in approximately 97% of the watershed being subject to current or future development.

Table 1: Land Use within the Watershed

Land Use	Approximate Square Miles Within the Watershed
Incorporated Communities	266.9
Unincorporated Counties	1055.3
Undevelopable Areas Within Watershed (Sum of the Below)	46.1
Lakes/Reservoirs/Detention Ponds	34.7
Parks/Preserves	3.1
Military Areas	0.0
Miscellaneous Non- Developable Areas	8.3

The majority of the PS Watershed has been mapped for flood hazards in the past. Currently, all communities but Kellyville, Liberty, Mannford, Mounds, and Winchester participate in the NFIP. None of the Native American jurisdictions in the watershed participate in the NFIP. The effective dates for the current county-wide Flood Insurance Rate Maps (FIRMs) are shown in Table 2.

Table 2: Effective Flood Insurance Rate Map Dates

County	Status	Effective Date
Creek County	Effective	5/18/2009
Muskogee County	Effective	2/4/2011
Okmulgee County	Effective	1/6/2011
Osage County	Effective	4/2/2008
Tulsa County	Effective	8/3/2009*
Wagoner County	Effective	4/17/2012

* Tulsa County has been partially remapped. Revised FIRM panels released in May 2012 are scheduled to become effective on October 16, 2012.

As for streams within the watershed, the U.S. Geological Survey (USGS) provides the National Hydrologic Dataset (NHD), consisting of hydrologic spatial files that can be used to identify stream locations. The NHD stream mileage was used to approximate the total potential stream miles for the watershed. Artificial flow paths were removed from the count, and only natural flow paths were counted. A total of 2,203 miles of streams were calculated using the NHD.

Additionally, the Coordinated Needs Management Strategy (CNMS) database maintained by FEMA also provides mileage information for streams in FEMA's floodplain inventory. In general, the stream mileage shown in CNMS reflects streams that have effective Special Flood Hazard Areas (SFHAs) designated for them. Table 3 compares the NHD data to the CNMS data in the PS Watershed. It summarizes the status and attributes of studies in FEMA's floodplain inventory.

Table 3: Stream Miles in the Watershed

Source	Stream Miles
NHD Streams	2002.8
CNMS Streams (streams with effective SFHAs)	1351.6
NHD Stream Miles not accounted for in CNMS	651.2

NHD = National Hydrologic Dataset
CNMS = Coordinated Needs Management Strategy
SFHA = Special Flood Hazard Area

The CNMS database assists in evaluating the validity of data contained in FEMA's floodplain inventory – and its goal is to determine whether or not there is an adequate level of flood hazard risk recognized on that particular community's FIRM. This process evaluates the existing study alongside seventeen potential indicators that may have occurred since the date of the effective analysis. These indicators include changes in land use, new or removed bridges or culverts, changes in discharge or gage record, and significant channel fill or scour.

In addition to listing the number of miles of studied stream within a watershed, CNMS documents contain physiological, climatological, or engineering methodological factors that may have changed since the date of the effective flood studies. The stream miles shown in CNMS are attributed with a Validation Status and Status Type that allows an evaluation of the condition of a

given study or group of studies. Studies considered Valid in CNMS are the only ones that contribute to the New Validated or Updated Engineering (NVUE) metric.

Figure 2 shows areas of relatively higher urban change within the watershed. As previously mentioned, this is one factor that can be used to help determine if streams are Valid. Streams are Valid if they meet NVUE Criteria. See Section III.iv, "Post-Discovery CNMS Analysis", for more information. The NVUE metric is an indicator of the status of studies for the FEMA mapped SFHA inventory. The categorization of these studies as Unverified typically means that there has been some factor of change since the SFHA became effective, or the effective SFHA may have a deficiency, such as areas with more than five new or removed hydraulic structures (bridge/culvert) in the SFHA or hot spots of Repetitive Loss/Severe Repetitive Loss (RL/SRL) properties, warranting restudy. CNMS stream mileage categorized as “Requires Assessment” requires more input to determine their validity, often because they represent paper inventory or non-modernized studies.

CNMS aids in identifying areas to be considered for study during the Discovery process by highlighting needs on a map, quantifying them (by mileage), and providing further categorization of these needs. Table 4 summarizes the NVUE stream mileage from CNMS.

Figure 2: 10 Year View of Urban Change within the Watershed

Polecat-Snake Watershed

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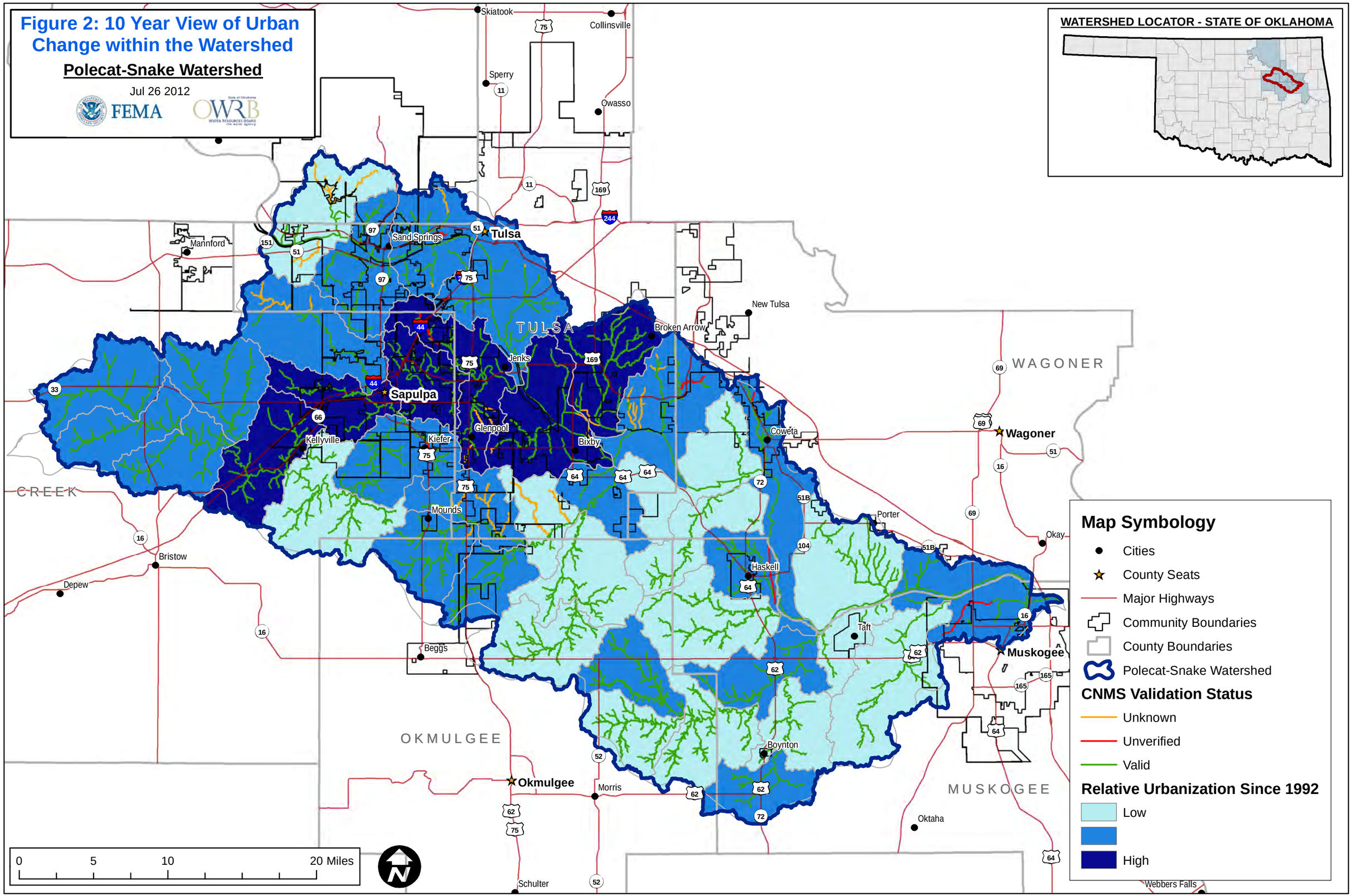


Table 4: NVUE Approximate Stream Mileage in the Watershed

NVUE Validation Status	Stream Miles
CNMS Valid Zone AE	390.2
CNMS Valid Zone A	854.7
CNMS Unverified Zone AE/AH	20.7
CNMS Unverified Zone A	0.0
CNMS Zone AE Requiring Further Assessment or in the process of being studied	0.0
CNMS Zone A Requiring Further Assessment	86.0
All Stream Miles not accounted for in CNMS as there are no effective SFHAs (sum of the below)	799.7
Stream Miles not accounted for in CNMS that would fall in land that could be developed	784.8
Stream Miles not accounted for in CNMS that would fall in land that could not be developed	14.9

NVUE= New Validated or Updated Engineering
CNMS= Coordinated Needs Management Strategy

An aggregated parcel summarization data set has been created for counties intersecting the PS Watershed. Coverage for this data set includes polygons approximately one river mile in length and derived from the extent of existing SFHAs and surrounding areas where FIRMs exist. The data set coverage uses a set width buffer around stream reaches where SFHAs do not currently exist.

Table 5 lists recent disaster declarations in the PS Watershed. Five of these disasters involve flood events over the last five years, which averages to one presidentially-declared disaster per year.

Table 5: Recent Disaster Declarations in the Watershed

Date of Declaration	Watershed Counties Declared	Hazard Type
5/5/2008	Muskogee, Okmulgee	Severe Storms, Flooding, Tornadoes
5/9/2008	Muskogee, Wagoner	Severe Storms, Flooding, Tornadoes
7/9/2008	Osage	Severe Storms, Flooding
2/17/2009	Muskogee	Severe Winter Storm
2/25/2010	Creek, Muskogee, Okmulgee, Osage, Tulsa, Wagoner	Severe Winter Storm
3/5/2010	Creek, Muskogee, Okmulgee, Wagoner	Severe Winter Storm
5/24/2010	Creek, Okmulgee, Osage	Severe Storms, Tornadoes, Straight-line Winds
5/13/2011	Creek, Okmulgee, Osage, Tulsa, Wagoner	Severe Winter Storm and Snowstorm
5/27/2011	Muskogee, Oklahoma	Severe Storms and Flooding
6/6/2011	Osage	Severe Storms, Tornadoes, Straight-line Winds, Flooding

Table 6 shows the status of all mitigation plans within the watershed. The Discovery process provides an opportunity for FEMA and State officials to touch base with local officials on the status of their mitigation plans. More information about mitigation plans for communities within the watershed is found in the Discovery Engagement Plan. The approved dates and expiration dates are currently not known for many of the county mitigation plans.

Table 6: Mitigation Plan Status

Organization and Plan	Date Approved by FEMA	Expires	Comments
State of Oklahoma Hazard Mitigation Plan	2/17/2011	2/16/2014	Adopted - 1/27/2011
Creek County Hazard Mitigation Plan	N/A	N/A	Being Written
Kellyville, Town of	N/A	N/A	In County Plan
Kiefer, Town of	N/A	N/A	In County Plan
Mannford, Town of	N/A	N/A	In County Plan
Mounds, Town of	N/A	N/A	In County Plan
Sapulpa, City of	03/31/2004	03/30/2009	Update In Progress
Muskogee County Hazard Mitigation Plan	07/14/2009	07/13/2014	NOI Submitted
Muskogee, City of	03/25/2008	03/24/2013	NOI Submitted
Okmulgee County Hazard Mitigation Plan	07/03/2007	07/02/2012	Update Status Unknown
Beggs, City of	10/01/2008	09/30/2013	
Winchester, Town of	N/A	N/A	Part of County Plan
Osage County Hazard Mitigation Plan	03/25/2008	03/24/2013	Update In Progress
Tulsa County Hazard Mitigation Plan	09/23/2010	09/22/2015	
Glenpool, City of	04/23/2004	04/22/2009	Update In Progress
Jenks, City of	05/22/2008	05/21/2013	
Sand Springs, City of	08/20/2008	08/19/2013	
Tulsa, City of	10/06/2009	10/05/2014	Update In Progress
Bixby, City of	11/15/2010	11/14/2015	
Broken Arrow, City of	10/08/2004	10/08/2009	Update In Progress
Liberty, Town of	N/A	N/A	No Plan
Wagoner County Hazard Mitigation Plan	06/29/2009	06/08/2014	
Coweta, City of	07/21/2011	07/20/2016	

Table 7 shows the number of NFIP insurance claims within the watershed, by community and county, since the jurisdiction entered the program. Claims for each community are for the whole community, including areas outside of the watershed.

The City of Tulsa has more claims than any other community. The City of Tulsa was the first CRS community to achieve a "2" in the nation and over the past 25 years has been proactive in implementing flood mitigation measures to avoid future flood losses. Communities with the majority of the remaining claims are Bixby, Broken Arrow, Muskogee, Sand Springs and Sapulpa, with Sand Springs having the next highest after the City of Tulsa.

Table 7: NFIP Insurance Claims by County and Community in the Watershed*

Community	Claims
Creek County, Unincorporated Areas	41
Kellyville, Town of	0
Kiefer, Town of	6
Mannford, Town of	0
Mounds, Town of	0
Sapulpa, City of	192
Muskogee County, Unincorporated Areas	18
Boynton, Town of	0
Haskell, Town of	0
Muskogee, City of	96
Taft, Town of	0
Okmulgee County, Unincorporated Areas	47
Beggs, Town of	0
Winchester, Town of	0
Osage County, Unincorporated Areas	22
Tulsa County, Unincorporated Areas	286
Glenpool, Town of	7
Jenks, City of	8
Sand Springs, City of	344
Tulsa, City of	2573**
Bixby, City of	238
Broken Arrow, City of	114
Liberty, Town of	0
Wagoner County, Unincorporated Areas	93
Porter, Town of	0
Red Bird, Town of	0
Tullahassee, Town of	0
Coweta, City of	63

* Claims for each community are for the whole community, including areas outside of the watershed.
**Nearly 60 percent of City of Tulsa area is located outside of this watershed.

In addition to NFIP claims, there are 211 Non-Mitigated Repetitive Loss/Severe Repetitive Loss (RL/SRL) properties in the PS Watershed. Almost half of these (46%) are in the City of Tulsa followed by Wagoner County (11%). Table 8 summarizes these claims by county and community within the watershed. Communities and/or counties not shown in Table 8 do not have identified RL/SRL properties. The total number of RL/SRL is 351 claims for the paid amount of $5,363,255.10. The average paid per claim is $14,350.03.

Table 8: Non-Mitigated Repetitive and Severe Repetitive Losses in the Watershed*

Non-Mitigated Losses by County**			
County	Number of Properties	Total Claims	Average Number of Claims per Property
Creek County (1 SRL)	8	18	2.3
Okmulgee County (2 SRL)	4	23	5.8
Tulsa County	5	13	2.6
Wagoner County	2	4	2.0
Non-Mitigated Losses by Community			
Community	Number of Properties	Total Claims	Average Number of Claims per Property
City of Bixby	8	20	2.5
City of Broken Arrow	6	22	3.7
City of Coweta	6	20	3.3
City of Glenpool	1	2	2.0
City of Haskell	1	2	2.0
City of Sand Springs (1 SRL)	16	48	3.0
City of Sapulpa (1 SRL)	13	38	2.9
City of Tulsa	61	141	2.3

* Communities and counties not shown do not have RL/SRL properties.
** Unincorporated areas.

During the Discovery process, watersheds are selected and analyzed at the HUC-8 level and evaluated using three major factors: population, topographic data availability, and risk decile. Risk decile is ranked 1 to 10, with 1 being the highest and 10 being the lowest. Risk decile is calculated using these nine parameters:

- Population density
- Historical population growth
- Predicted population growth
- Number of housing units
- Number of flood policies
- Number of single claims
- Number of repetitive losses
- Number of repetitive loss properties
- Number of declared disasters

Recent topographic data has been acquired for the City of Tulsa. Additionally, pending planned acquisitions of topographic data have been made for all of Creek and Okmulgee County and portions of Muskogee, Wagoner and Tulsa County.[1] Light Detection and Ranging (LiDAR) data was obtained for of Broken Arrow Creek in December 2011.

Figure 3 shows risk factors and topographic data availability for the watershed. This information, along with the rankings of smaller HUC-12 sub-watersheds, helps identify stream segments and locations where risk evaluation can be targeted. Additionally, to assist risk assessment, available parcel, population and NFIP claim information was correlated with stream miles derived from existing SFHA and NHD for mapped and unmapped streams, respectively. Taking this information into account may assist in the process of identifying additional areas of risk which may derive from unmapped streams adjacent to areas having a high level of risk exposure, or mapped streams with high levels of risk exposure just beyond existing SFHA bounds.

Table 9 shows the overall rankings of the PS Watershed compared to other HUC-8 watersheds nationally and regionally. The combination of these factors was important in the selection of this watershed for a Discovery project.

Table 9: Watershed Risk Factor Rankings

Polecat Snake Watershed Selection Rankings
National Risk Factor Rank: 191 National Risk Decile: 3 Average Annualized Loss: $ 59.9 million National Average Annualized Loss Rank: 168 National Overall Rank: 686
Region VI Risk Factor Rank: 156 Region VI Risk Decile: 3 Region VI Average Annualized Loss: $ 59.9 million Region VI Average Annualized Loss Rank: Unknown Region VI Overall Rank: 167

All background information in this report for population data, historical flooding, and community information was obtained from the Coordinated Needs Management Strategy (CNMS), effective Flood Insurance Study (FIS) reports, State and local hazard mitigation plans and data filed at FEMA Region VI.

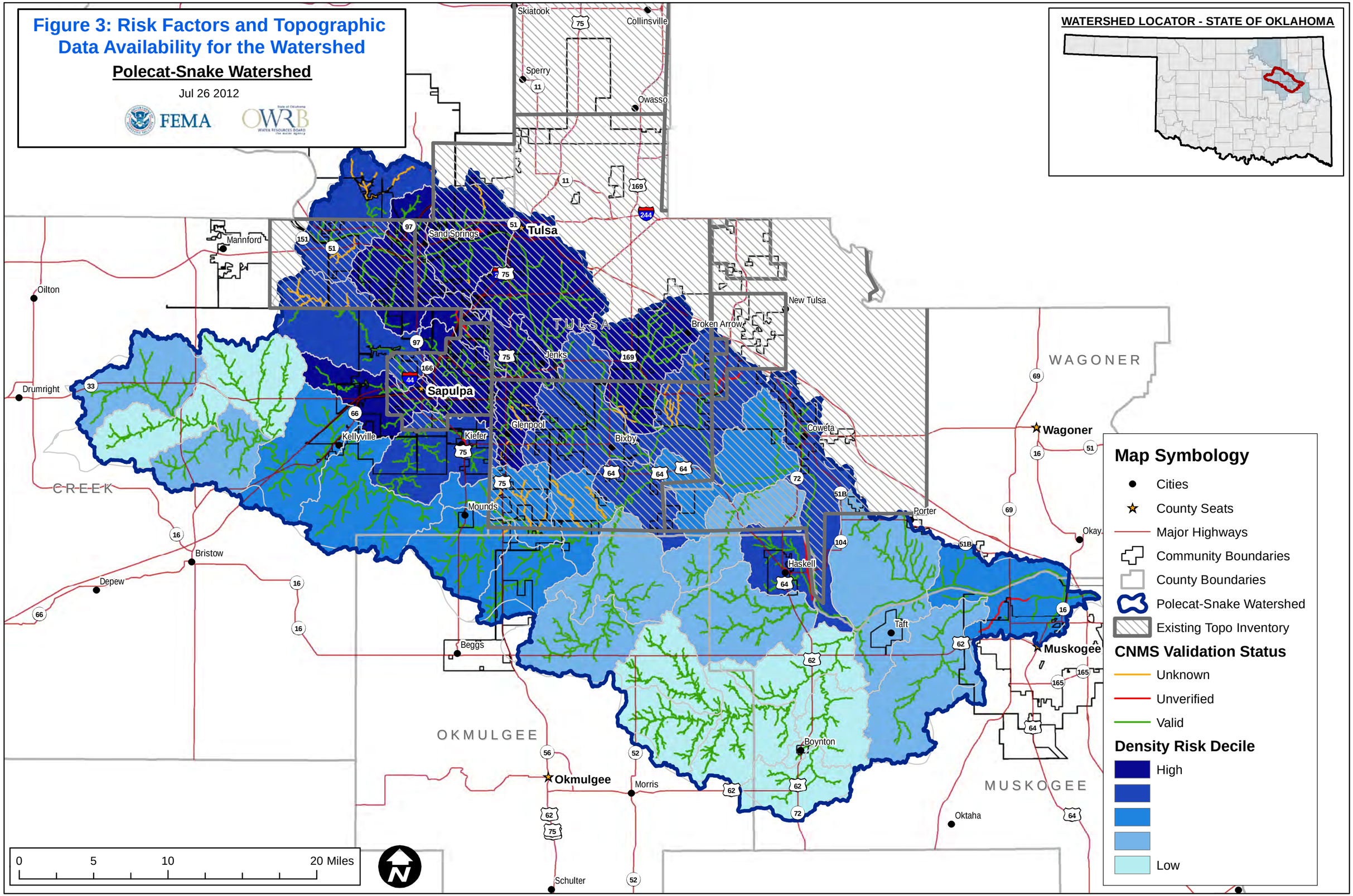
[1] Source: Oklahoma NRCS LiDAR Coverage, United States Department of Agriculture (NRCS 2-meter Priority Project Area for 2012).

Figure 3: Risk Factors and Topographic Data Availability for the Watershed

Polecat-Snake Watershed

Jul 26 2012

FEMA OWRB



II. Discovery Efforts

i. Engagement Plan

The PS Watershed Engagement Plan was prepared during Pre-Discovery by the Regional Project Team. The Regional Project Team was made up of the staff listed in Table 10 below.

Table 10: Regional Project Team

Name	Organization	Project Role
Ron Wanhanen	FEMA Region VI	Project Monitor – Engineering and Mapping Lead
Shanene Thomas	FEMA Region VI	Mitigation Planning Oversight
Don Davis	FEMA Region VI	Grants Specialist
Diane Howe	FEMA Region VI	Outreach Specialist
Roberto Ramirez	FEMA Region VI	Insurance Oversight
Joe Remondini	USACE	Flood Risk Engineer
Ben Robinson	Congressman Boren	Field Representative
Lynne Hill	Congressman Lucas	Field Representative
Richard Hedgecock	Congressman Sullivan	Field Representative
Michael Lee	Senator Inhofe	Field Representative
Connie Pearson	Senator Coburn	Field Representative
Kent Wilkins	OWRB	CTP Project Manager
Gavin Brady	OWRB	State NFIP Coordinator/Compliance Specialist
Matthew Rollins	OWRB	GIS Specialist
Robert Fabian	OWRB	State Dam Safety officer
Carl Watts	FEMA – Contractor	Insurance Specialist
Bill Penka	OEM	State Hazard Mitigation officer
Janet Meshek	Meshek & Associates	Discovery Project Manager
Ana Stagg	Meshek & Associates	CTP Project Manager
Brandon Claborn	Meshek & Associates	Project Engineer
Chris Duncan	Meshek & Associates	Project Engineer
Michael Couch	Meshek & Associates	GIS Specialist
Rita Henze	Meshek & Associates	Hazard Mitigation Planner
Lacie Jones	Meshek & Associates	Discovery Coordinator

FEMA = Federal Emergency Management Agency
USACE = U.S. Army Corps of Engineers
OWRB = Oklahoma Water Resources Board
OEM = Oklahoma Department of Emergency Management

The Engagement Plan is a tool that allows Project Team members to understand the history of the watershed and highlights recent engagements performed by FEMA Region VI Mitigation Division and OWRB. In addition to contact information for key stakeholders and organizations in the watershed, the Engagement Plan captures media outlet information, the location and summary of recent articles or news releases, a strategy for keeping Congressional liaisons involved in the Discovery process, and a history of communications. The various team members can use the Engagement Plan to strategize communications to the various groups within the watershed, to deliver the Discovery Meeting messages and vision, and to track hot topics or points of interest.

The Engagement Plan served as the initial repository for summary information about the watershed. Data for the PS Watershed were discussed in the Pre-Discovery Data Gathering section of the Engagement Plan to provide background for the selection process to proceed through the Discovery process. This plan served as a clearinghouse for information about mitigation planning, active and closed grants, insurance policy information, socioeconomic overviews of the communities, and a review of the recent mapping initiatives in the watershed. From this collective review of the watershed, the project team (1) identifies how communities – within a project area – ought to be engaged, and (2) selects from a high, medium, or low engagement strategy based on the risk, need, and political will of the communities.

ii. Pre-Discovery Efforts

The Project Team contacted watershed stakeholders via letters, telephone calls, emails, and an interactive web-media before the Discovery Meeting to request local participation and identify key people to include in the Discovery process. Stakeholders were also asked to provide any data that could assist in risk identification in the watershed.

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

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

The Project Team then began outreach efforts to the local governments in the watershed, along with Federal and State Congressional representatives, public officials (including floodplain managers, emergency managers, and planners), the USACE, State departments and Tribal communities to inform them of the Discovery process and invite them to participate and contribute relevant information. The following key steps were taken before the Discovery Meeting was held:

- OWRB's contractor, Meshek & Associates, PLC, organized the meeting dates, locations, and facilities.
- OWRB invited USACE and FEMA to participate as active members of the Project Team.

- Identified stakeholders included community policymakers and decision makers, floodplain administrators, federal, state and local officials, Tribes, interest groups, and others identified through the Discovery process.
- A website was established to allow electronic interaction between the Project Team and the stakeholders. Stakeholders were notified of the website and provided access to enter important data regarding known flood risk areas.
- The Project Team contacted stakeholders via telephone to inform them of the meetings and to request data. Phone calls to stakeholders were followed with a combination of emails, faxes, newsletters, U.S. mail, and the interactive website to maintained stakeholders engaged in the process. Stakeholders were requested and encouraged to identify and notify other stakeholders.
- Invitation letters, a watershed map, and a Data Questionnaire were emailed to stakeholders and the media.
- An invitation with meeting details was emailed to the membership of the Oklahoma Floodplain Managers Association (OFMA).
- The Project Team followed the initial contacts with regular emails to remind stakeholders of the meeting details and to further encourage attendance to the meeting.
- The website was updated routinely with meeting specifics and updated watershed information to maintained stakeholders informed of data collection progress.

Copies of key correspondence associated with Discovery are included with the supplemental digital data that accompanies this report.

iii. Discovery Meeting

One Discovery Meeting was held for the PS Watershed. The meeting time and location are shown below in Table 11.

Table 11: Project Discovery Meeting Time and Location

Date and Time	Location
February 29, 2012 9:00 AM-12:00 PM	Nienhuis Park Community Center 3201 N. 9th Street Broken Arrow, OK 74012-2856

The format for the Discovery Meeting was an informal “Come and Go” style with two brief presentations interspersed during the first and last hour of the three hour time period. Presentations consisted of one formal presentation and a second less formal presentation to provide attendees an overview of Risk MAP, its purpose and process, including the purpose behind the Discovery Meeting, and introduce the attendees to the different Discovery stations and Project Team. Large scale watershed maps, using aerial photography of the watershed overlaid with the local County and community boundaries and road names, were located along one wall and included the following information:

- Flood risk, need, and topographic data
- Population density
- Urbanization
- Stream miles mapped
- Current Letters of Map Change (LOMCs)
- RL/SRL claims
- Hazard mitigation grant activity
- Hazard Mitigation Plans

Every attendee received a packet of information including the following information:

- Understanding Risk in Watersheds - Discovery in PS Watershed
- Watershed Talking Points: Key Messages for PS Watershed
- FEMA Hazard Mitigation Assistance
- FEMA Unified Hazard Mitigation Assistance Grant Programs
- FEMA Mitigation Planning
- HUC-8 Polecat-Snake Watershed Locator Map
- FEMA New Levee Analysis and Mapping Approaches Being Mapped Fact Sheet
- Polecat-Snake Watershed Pre-Discovery Newsletter
- The Voice Newsletter
- FEMA What Is Risk MAP?
- Risk MAP Discovery Brochure
- FEMA Risk MAP Process Path
- FEMA Do You Have a Hazard Mitigation Plan?
- FEMA Tribal Mitigation Planning
- The Polecat-Snake Watershed Engagement Plan Executive Summary
- The Polecat-Snake Watershed List of Communities
- List of FEMA Acronyms and Abbreviations

Four Discovery stations, focusing on Grants, Planning, Compliance and Mitigation, and Mapping, were available for attendees to interact with knowledgeable staff. Each station was equipped with a copy of the NFIP “Answers to Questions About the NFIP”, March 2011, as well as comment sheets to document flood issues, areas of concerns, and any other information provided by individual attendees.

At each station, attendees were asked to contribute watershed information and issues on a comment form. Members of the Project Team were available at each station to answer questions and collect watershed and community-specific flood-related information and concerns. Attendees were also able to point out on the watershed maps any flood hazard concerns or issues and then mark them on the maps. After visiting a station, attendees rotated to the next station, and each attendee was encouraged to stop at all four stations. Attendees were encouraged to provide any relevant information (not brought with them to the Discovery Meeting) to the Project Team afterward.

Information sheets were collected at each station and the Discovery watershed maps were collected for future reference. These information sheets are included in the supplemental digital data that accompanies this report.

The four stations also had the following:

- *Mapping Station*: The Mapping station was divided into three mini-stations, each one equipped with a computer which provided attendees immediate access to a GIS web-based viewer and allowed attendees to identify quickly and easily localized flood problems, known areas of risk, concerns related to effective FIRMs, and any recent flood mitigation projects. Locations and areas of hazards and risks identified by attendees were then flagged within the watershed with an identification number and the data were input into the computer as well as logged on individual comment sheets also using the same identification number. OWRB staff assisted at the Mapping station.
- *Grants Station*: Community Benefits and Grant Opportunities – This station was manned by the Oklahoma State Hazard Mitigation officer (SHMO) who informed attendees of grant opportunities and availability as well as provided handouts on various FEMA grant programs.
- *Planning Station*: Mitigation Planning and Mitigation Activities – Experienced GIS staff and hazard mitigation planners were available at this station to answer attendee questions and collect information regarding the availability and status of hazard mitigation plans and/or emergency action plans, any GIS-based community data, land use data, hazard mitigation projects underway or constructed since the update of the hazard mitigation plans, any environmental issues, and tribal data.
- *Compliance and Mitigation Station*: NFIP Community Actions – The Oklahoma NFIP Coordinator and an NFIP representative were present at this station to explain available NFIP opportunities and insurance availability as well as collect current data from attendees and establish follow up visits with the counties, communities and tribes within the watershed.

iv. Data Gathering Overview

The Discovery Meeting was attended by local participants. A full list of attendees is provided in the sign-in sheets in the digital data that accompanies this report. The meeting was well attended with most local communities represented. Attendees included:

- Federal and State agencies
- Congressional
- Conservation District staff
- City Managers
- Emergency Management staff
- Community Planners

representatives

- County Commissioners
- Local Tribes
- Local Floodplain Managers
- Community Public Works staff

The meeting afforded personal, interactive communication with attendees at each station. The Project Team interviewed attendees and listened to areas of positive mitigation and ongoing concerns for the watershed.

Feedback from the attendees indicated that they felt this was an opportunity to express their concerns about the watershed and that they preferred the interactive stations rather than a lengthy presentation. Many attendees were appreciative of the chance to speak with the Project Team members from both FEMA and the State of Oklahoma. Some information that was collected was:

- Areas with local drainage or surface water flooding issues
- Places where bridges or roads are regularly flooded or closed due to flooding
- Places where structures flood and there is no current SFHA defined
- Places where the effective FIRM and FIS products were believed not to reflect actual conditions
- Areas that have been mitigated through buy-out or elevation of structures
- Areas of high urban change and planned growth
- Studies being conducted by others that could be of use in future mapping and mitigation activities

The information from the comment forms and the locations of the concerns were compiled into a spatial data set after the meetings. This spatial set is included in the digital data accompanying this report.

Data collected – from websites, outreach contacts and email solicitations prior to the Discovery Meeting – are summarized in Table 12.

Table 12: Data Collection Summary - Pre-Discovery Meeting

Data Location	Data Custodian	Data Set Description
Watershed-wide	FEMA	Effective FIRM and FIS and back-up
Watershed-wide	FEMA	Letter of Map Change (LOMC) locations
Watershed-wide	OWRB	Locations of Repetitive Loss/Severe Repetitive Loss (RL/SRL)
Watershed-wide	FEMA	Location of funded grants
Watershed-wide	U.S. Census Bureau	Populated area and population characteristics
Watershed-wide	FEMA	Location of available or planned areas of updated Light Detection and Ranging (LiDAR) or other topographic data
Watershed-wide	USGS	Watershed HUC boundaries, NHD streams, stream gage information
Watershed-wide	FEMA	Participation in the NFIP and the Community Rating System (CRS)
Watershed-wide	Community Representatives	Currently accepted HMP
Watershed-wide	FEMA	Disaster Declarations
Watershed-wide	FEMA	CNMS information

The availability of topographic data is an important factor in the selection and analysis of the watersheds. Preliminary research indicated that digital, updated topographic data are available for a large portion of the PS Watershed, mainly in the northeastern part of the watershed. During 2002, the USACE updated topographic data for two large areas in the northeastern part of the watershed, while the Indian Nations Council of Governments (INCOG) updated topographic data for another part of the northeastern watershed in 2007. In addition, between 2008 and 2010, the City of Tulsa updated its contours, and the City of Sapulpa updated contours in 2006.

Additionally, the National Resources Conservation Services (NRCS) plans to acquire topographic data for all of Creek and Okmulgee County and portions of Muskogee, Wagoner and Tulsa County in 2012. Light Detection and Ranging (LiDAR) data was obtained for of Broken Arrow Creek in December 2011.

Table 13 summarizes the comments and issues collected at the four stations during the Discovery Meeting. Scans of comment forms are included in the digital deliverables. Locations of concerns and other comments have been recorded in an ESRI spatial file and included in the digital deliverables. Some areas of concern identified at the meetings were determined to be outside the watershed and have been noted in the table.

Table 13: Summary of Data Collected During the Discovery Meeting and Post-Meeting

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
C1	City of Bixby	City of Bixby	• Project Team members explained the Risk Map program in general. • The City representative had no specific questions.
C2	City of Broken Arrow	City of Broken Arrow	• The City discussed its Hazard Mitigation Plan action items and areas that might be HMA acceptable projects.
C3	City of Jenks	City of Jenks	• The SHMO explained HMA assistance and the process. • The City of Jenks Hazard Mitigation Plan will expire as of 05/22/2013. • OEM explained the application process for a grant to update the plan.
C4	City of Sapulpa	City of Sapulpa	• The City had questions about funding opportunities to purchase additional flooded buildings. • The SHMO explained HMA assistance process, the availability of funding, the local cost share, timing, etc.
C5	City of Sapulpa	City of Sapulpa	• A consulting firm has prepared a repetitive loss plan that can be updated.
C6	City of Sapulpa	City of Sapulpa	• The SHMO explained about "in-kind" services.
C7	Congressman Dan Boren	Congressman Dan Boren	• The Congressman Field Representative addressed funding opportunities within Congressman Boren's district and Afton mapping issues.
C8	Fisher Creek	City of Sand Springs	• The SHMO discussed grant opportunities for the acquisition of an additional 30 houses currently located below the BFE in the Anderson Basin Meadow Valley. • The City is currently waiting on its local match (estimated $750,000) before applying for a grant.
C9	City of Sand Springs	City of Sand Springs	• The SHMO commented that the availability of $3,000,000 in grant funding would require a significant disaster beforehand.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
C10	Haikey Creek	City of Broken Arrow	• The City requested a Master Drainage Plan for Haikey Creek in cooperation with the City of Tulsa. • The Plan should include the evaluation of bridges, regional detention and a trail system.
C11	City of Broken Arrow	City of Broken Arrow	• The City expressed that H&H dams are its biggest concern currently. • OWRB has begun to request Emergency Action Plans and dam breach analysis for dams.
C12	US Army Corps of Engineers	US Army Corps of Engineers	• The SHMO explained that OEM manages non-disaster (small money) and HMGP grants and that PDM funding may be ending. • SRL grant have $9,000,000 in residual funds. • The standard application process, except for HMGP funds, is June through December. • USACE has been going to Miami, Oklahoma.
M1	Fisher Creek	Oklahoma Department of Transportation, Maintenance Engineer Division 8	• Highway 51 west of Sand Springs has some flooding issues at Fisher Creek.
M2	Fisher Creek	City of Sand Springs Project Administrator	• A phased buy-out is underway in Meadow Valley.
M3	Arkansas River	City of Sand Springs Project Administrator	• Remapping has occurred due to the levee decertification.
M4	Arkansas River	City of Sand Springs Project Administrator	• A lift station with a LOMR has been constructed since the effective maps were issued.
M5	Arkansas River	City of Sand Springs Project Administrator	• The Early Childhood Center has a LOMR since the effective maps were issued.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M6	Coweta Creek	City of Coweta, Community Development Director	• A new development near 111th Street and Highway 51 has been constructed.
M7	Rock Creek	City of Sapulpa	• Development, including a new subdivision and school, has occurred in the western portion of the City.
M8	City of Sapulpa	City of Sapulpa	• The City requested that Sapulpa Master Drainage Plan be incorporated into FEMA mapping.
M9	City of Sapulpa	City of Sapulpa	• There may be a future project with a change to a dam in the western portion of the City of Sapulpa.
M10	Rock Creek	City of Sapulpa	• There may be potential development in the floodplain near Wickham and 117th Street.
M11	Polecat Creek	City of Sapulpa	• Are there any LOMRs for Freedom Park?
M12	City of Sapulpa	City of Sapulpa	• The City asked about the adoption status of Sapulpa's Hazard Mitigation Plan and was informed that it is pending revisions requested by OEM.
M13	City of Sapulpa	City of Sapulpa	• A city-wide creek clearing project is needed.
M14	City of Sapulpa	City of Sapulpa	• Potential future development is likely in Sapulpa Town West.
M15	Polecat Creek	City of Jenks	• A LOMR is in progress for Reasor's.
M16	City of Jenks	City of Jenks	• The 2009 FIRM maps are correct; however, the 2010 maps are not accurate.
M17	City of Jenks	City of Jenks	• There are LOMA changes in the floodplain for new development.
M18	Wilmott Creek	City of Jenks	• The 2010 mapping has moved Wilmott Creek. • This did not occur with the 2009 mapping.
M19	Childres Creek	Town of Keifer	• The floodplain/floodway mapping in the area of the town lagoons is not correct; the lagoon dikes are higher than the Childres Creek BFE.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M20	Stream A - Childres Creek	Town of Keifer	• There is a new LOMR in process for Country Investments in the Town of Keifer. • There is a new channel for Stream A with revised floodplain limits. Stream A Zone A is being revised.
M21	Childres Creek	Town of Keifer	• Approximately 200 feet of Childres Creek channel was modified in location in the early 1980s by an individual without the town's permission, so a short portion of the creek is in a different location than shown on FEMA mapping. This needs updating.
M22	City of Bixby	City of Bixby	• Bixby currently has a FEMA grant to construct a new regional Stormwater Detention (in progress). • Two houses have been acquired.
M23	Haikey Creek	City of Bixby	• Haikey Creek has a flood improvement project with a CLOMR in progress. • The City also has a new dike/levee and will remove a portion of the land southwest of 126th and Haikey Creek.
M24	Arkansas River	City of Bixby	• The Bentley Park CLOMR has been issued. Construction is in progress, and a LOMR will be prepared.
M25	Bixby Creek	City of Bixby	• The City has reliable data for a downtown drainage project. • MapMOD did not include this project because supposedly the data “couldn't (be) read". Data are currently available to correct mapping.
M26	Snake Creek	City of Bixby	• The City engineer has data for the Ina Beck property - a channelization project in approximately 2010. • The maps have not been updated.
M27	Snake Creek	City of Bixby	• The old railroad bridge was removed in the 1980s or 1990s. • The model has not been updated to reflect the removal of the road bed which acts as a levee.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M28	Unmapped area (Snake Creek)	City of Bixby	• The new bridge constructed on East 203rd Street west of 145th has not been modeled.
M29	Snake Creek	City of Bixby	• A CLOMR for the Knight Industrial Park was issued in 2009. It is pending construction. The second phase of work occurred in approximately 2011.
M30	Fry Ditch	City of Bixby	• There is a CLOMR in progress for the Fry Ditch due to construction. The Jim Butler Construction Company is in charge of constructing the project. The project consists of widening an existing ditch to Fry Ditch. Fry Ditch will be widened on the west side until the bend. The details of the project are unknown past Fry Ditch. This widening project will increase the capacity of Fry Ditch to receive additional flow from the land on west side of Fry Ditch.
M31	City of Coweta	City of Coweta	• There is a new railroad overpass along Highway 51 and Highway 72 (Broadway).
M32	City of Coweta	City of Coweta	• The new Walmart stormwater detention is not in FEMA's hydrology model.
M33	City of Coweta	City of Coweta	• There are new lakes and a new development planned for a golf course (near East 113th Street and South 280th East Avenue); the development is in progress. The new housing area will increase impervious area, and a stormwater detention is planned for a golf course lake.
M34	Childres Creek	Town of Keifer	• A new bridge on Highway 75A and road widening project completed by the County during 2001 to 2004 in this area has not been modeled. • The centerline of Childres Creek is not properly mapped.
M35	Wagoner County	Wagoner County	• Zone A or Zone AE is needed in the area between 111th Street and 161st East Avenue and 193rd and 241st.
M36	Redbird Creek	Wagoner County	• Redbird Creek needs a Zone A or Zone AE.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M37	Coweta Creek	Wagoner County	• A tributary of Coweta Creek along Highway 51b is subject localized flash flooding.
M38	Yellow Water Ditch	Wagoner County	• The tributaries of Yellow Water Ditch need to be modeled.
M39	Congressman Dan Boren	Congressman Dan Boren	• After attending three Risk Map Discovery meetings, it is apparent previous LiDAR mapping of the Grand Lake Watershed and others produced incorrect information. • To regain the confidence of the public officials and constituents, new maps must be produced so that these areas have been correctly digitized and usable. Topographic mapping must be updated for the public and County officials to assist constituents with mapping issues that have turned their lives upside down.
M40	Aspen Creek	City of Broken Arrow	• In this area, the City H&H study and floodplains are newer than the effective model. Would like to submit to FEMA to convert the existing Zone A floodplains to Zone AE.
M41	Elm Creek	City of Broken Arrow	• In this area, the City H&H study is newer than Effective Model and floodplain mapping. Would like to submit to FEMA to convert the existing Zone A floodplains to Zone AE.
M42	Elm Creek	City of Broken Arrow	• At this location (Tucson Street over Elm Creek), there was a new bridge replacement in 2012.
M43	Elm Creek	City of Broken Arrow	• In this area, the City study has an AE designation that could replace the Zone As in several areas.
M44	Aspen Creek	City of Broken Arrow	• The City has MDP data with AE floodplains at this location that can replace the Zone As.
M45	Little Haikey Creek	City of Broken Arrow	• There is a mapping error around the Church at 91st Street and South Mingo Road.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M46	Haikey Creek	City of Broken Arrow	• Preparation of a Haikey Creek Watershed Master Drainage Study including recommendations on pedestrian trails linkages, regional stormwater detention, creek channelization, erosion repair, roadway culvert upgrades, wetlands inventory, stormwater quality issues, natural floodplain maintenance plan, flooding depth, etc would be very beneficial. • This heavily urbanized and populated watershed has detailed H&H and floodplain mapping that was prepared in 2009, but a multi-faceted master drainage plan would be helpful in floodplain management implementation in this watershed for Broken Arrow, Tulsa, Bixby, and Tulsa County.
M47	City of Broken Arrow	City of Broken Arrow	• Coordination of upcoming or recently completed major bridge or culvert upgrades hydraulic modeling on FEMA floodplains in Broken Arrow including Tucson Street over Elm Creek, Creek Turnpike 2012 Aspen Interchange Ramp Additions over Aspen Creek Tributary A1, Olive Avenue at Olive Creek, Aspen Avenue at Northern end of Aspen Creek.
M48	Polecat Creek	City of Sapulpa	• Polecat Creek floodplain is shown incorrectly for the Hickory South subdivision. New one-foot contours are available to map it correctly. This will eliminate several incorrectly-shown homes in the SFHA.
M49	Polecat, Nickel and Rock Creek's Tributaries	City of Sapulpa	• City of Sapulpa has new (city) regulatory floodplains adopted in 2011 that should be included in a new mapping project.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M50	Little Haikey Creek, Harlow Creek, Harlow Creek Overflow, Lower Fred Creek, East Branch Joe Creek, Split Flow, Little Joe Creek, South Fork Little Joe Creek, South Fork Joe Creek	City of Tulsa	• Harlow Creek Overflow is the only correctly-identified Unverified stream • All segments have centerlines that are outside of the SFHA for portions of their lengths. These should have failed Critical Factor 5.
M51	Crow Creek, Harlow Creek, Harlow Creek Tributary, Harlow Creek Overflow, South Fork Joe Creek, North Fork Little Joe Creek, Joe Creek, Mooser Creek, Mooser Creek Tributary, Hager Creek, Fry Ditch No. 2, Vensel Creek, Vensel Creek South	City of Tulsa	• Harlow Creek, the Harlow Creek Overflow and the West Branch of Joe Creek Zone A areas are shown to have an Unknown status for scour. • Based on the City of Tulsa Channel Maintenance System (CMS), the streams listed have significant scour and fail Critical Factor 7.
M52	Crow Creek East Branch Joe Creek Split Flow Little Joe Creek South Fork Little Joe Creek Broken Arrow Creek Harlow Creek Overflow South Fork Joe Creek West Branch Joe Creek North Fork Little Joe Creek Broken Arrow Creek Joe Creek West Branch Broken Arrow Creek Mooser Creek Tributary Red Fork Creek East Branch Joe Creek Mooser Creek Little Haikey Creek Tributary Hager Creek Little Haikey Creek	City of Tulsa	• These streams should have a Critical Factor 3 status of Unknown. • The hydrology method is shown as SNYDER METHOD, rather than HEC1. • The models are not available and so cannot be updated without a new study. For the most part, the effective models are from 1979 (over thirty years old) and are in urban areas. They are not adequate.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M53	Crow Creek	City of Tulsa	• Three Capital Improvement Projects are located in Crow Creek due to flooding problems: – FC08-019 - Crow Creek Storm Sewer - 27th St to Philbrook ($540,000): Construction of new storm sewer. Floodwaters have been recorded up to nearly 6 feet in structures. – FC08-020 - Crow Creek Channel - Crow Creek-Yorktown Diversion Channel ($1,035,000): Reduce the flooding to the Yorktown Apartments by construction of a diversion channel, & removal of LB1 Storm Sewer construction. – FC08-017 - Crow Creek Storm Sewer - Diversion Channel & Storm Sewer ($705,000): Construction of diversion channel to eliminate 100 year flooding & removal storm sewer construction upstream of confluence of main stem & Trib LB1.
M53	Fry Ditch No. 2	City of Tulsa	• Two Capital Improvement Projects are located in Fry Ditch No. 2 due to flooding problems: – FC08-024 - Fry Ditch No. 2 - Channel - Bridle Trails Detention ($16,500,000): Provide protection downstream of 101st Street S in Bridle Trails Estates. – CIP 2012-11 - Fry Ditch No. 2 - Bridge - 91st Street (West Culvert) ($286,000): Replace a RCB culvert under 91st St. S.
M54	Hager Creek	City of Tulsa	• One Capital Improvement Project is located in the Hager Creek watershed: – FC08-059 - Hager Creek Channel - Storm Sewer Relief Line - $6,020,000 - Alleviate flooding of 81st Street and ponding water in creek.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M55	Haikey Creek	City of Tulsa	• One Capital Improvement Project is located in the Haikey Creek watershed. – CIP2012-04 - Little Haikey Creek - C-07 Culvert ($366,000): Replace a RCB culvert under 81st.
M56	Joe Creek	City of Tulsa	• Three Capital Improvement Projects are located in the Joe Creek watershed: – FC11-005 - Joe Creek - Storm Sewer - 47th Street Storm Sewer Relief ($3,506,079): Relieve flooding of homes and streets. – FC08-029 - Little Joe Creek - LJ4 Culvert ($1,800,000): 2 - 10'x5' RCB Under 67th East Place. – FC08-029 - Little Joe Creek - LJ4 Culvert - $1,800,0002 - 10'x5' RCB Under 67th East Place.
M57	Mooser Creek	City of Tulsa	• Three Capital Improvement Projects are located in the Mooser Creek watershed: – FC08-036 - Mooser Creek - Mooser Creek - Channel & I-44 Culvert ($4,800,000): Channel & culvert under I-44 will reduce flooding on I-44. – FC08-038 - Mooser Creek - Steel Companies Channel Improvement – ($990,000): Channel improvements to ensure channel capable of containing storm water during regulatory events – FC08-037 - Mooser Creek - Bridge - Floodwall & Culvert Improvement ($2,370,000): Construction of 60' Bridge Replacement at 37th W. Ave., 4' High Retaining Wall From 37th W. Ave. to 57th Street & 12'-14'-12'x9' RCB Under W. 57th St.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M58	Vensel Creek	City of Tulsa	• One Capital Improvement Project is located in the Vensel Creek watershed: – FC08-049 - Vensel Creek - Vensel Creek Erosion Control ($7,500,000): Repair to creek channel due to erosion beyond the scope or normal maintenance.
N1	Adams, Aspen, Elm Creeks	City of Broken Arrow	• As of April of 2012, there is new regulatory floodplain for 40 acres in Adams Creek, Aspen Creek and Elm Creek. There is a project to submit. • The City of Broken Arrow prepared Aspen Creek and Elm Creek detailed hydrology and hydraulics data from recently prepared master drainage studies for FEMA to convert the existing Zone A floodplains to Zone AE.
N2	Haikey Creek East Branch and West Branch	City of Broken Arrow	• In this area, there are new LOMRs, such as a 144 Lot LOMR (East Branch) and Haikey Creek (West Branch).
N3	Adams and Elm Creeks	City of Broken Arrow	• Currently, there are three to four roadway projects in this area - 51st Street and 61st Street along 209th East Avenue, Tucson Street (Aspen and Elm Creek), 9th Street South of 51st Street (Adams Creek).
N4	Aspen Creek	City of Broken Arrow	• In this area, Zone As transition to Zone AE on Aspen Creek.
N5	White Church Creek	City of Broken Arrow	• New urbanization is occurring along White Church Creek.
N6	Haikey Creek East Branch	City of Broken Arrow	• The 2009 to 2012 topographic data is in effect for the East Branch model.
N7	City of Broken Arrow	City of Broken Arrow	• The City of Broken Arrow will provide a project list.
N8	City of Broken Arrow	City of Broken Arrow	• The City of Broken Arrow inquired as to how insurance rates are determined.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
N9	City of Broken Arrow	City of Broken Arrow	• Wagoner NFIP will become effective 09/17. A FEMA representative recommended that Broken Arrow hold a public meeting to educate its residents on the Preferred Risk Policy (PRP) and/or the process for being grandfathered.
N10	City of Broken Arrow	City of Broken Arrow	• Broken Arrow inquired as to how many survey points are needed in a LOMA and was referred to the instructions included with the LOMA form.
N11	Arkansas River	City of Sand Springs	• The City was concerned that the potential for levee decertification would create additional Zone AE mapping in a heavy commercial district. • The City was encouraged by Discovery Team members to contact the FEMA Levee District to determine dates and a plan of action.
N12	Coal Creek	City of Glenpool	• Glenpool may need a meeting for public input on the impact of Risk Mapping or other flood insurance issues.
N13	City of Sapulpa	City of Sapulpa	• The City representative was unaware of any issues but suggested further contact with Sapulpa's Floodplain Administrator.
N14	City of Sapulpa	City of Sapulpa	• The City needs to locate registration and authorization cards.
N15	City of Sapulpa	City of Sapulpa	• Discovery Team members suggested that an insurance information workshop could be offered if flood maps change in the future.
N16	Muscogee (Creek) Nation	Muscogee (Creek) Nation	• The tribe is considering NFIP participation and is looking to FEMA for updated GIS files.
N17	Arkansas River	City of Jenks	• A levee in Levee District #13 has been backfilled and has a LOMR.
N18	City of Jenks	City of Jenks	• Jenks needs a response letter from FEMA about the Appeal Process after the Tulsa County Community Coordination officers (CCO) Meeting.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
N19	City of Jenks	City of Jenks	• Discovery Team members offered technical assistance in providing insurance meetings.
N20	Arkansas River	Tulsa County	• The County levee certification will expire in 2012. • The County needs assistance with dialogue with the key players - the Levee District, Tulsa County, Sand Springs, and the City of Tulsa.
N21	Arkansas River	Tulsa County	• AMEC, the County's contractor, had a meeting with Levee District 12 for discussion. • Although there are no contracts at this time, Tulsa County is in the process of submitting an RFQ for levee repairs.
N22	Elm Creek	Tulsa County	• The County has six recently-approved LOMAs and one not approved in Elm Creek. • All structures in areas with LOMAs are elevated above the BFE with Elevation Certificates as documentation.
N23	Bird Creek	Tulsa County	• A bridge replacement at 56th Street East of Highway 169 (Bird Creek) was completed in 2010.
N24	Tulsa County	Tulsa County	• The County representative will check with other Tulsa County employees for more information and send a list of issues and provide additional data. .
N25		Tulsa County	• Outside the watershed - there is a LOMA in Crown Colony, east of Owasso.
N26	Tulsa County	Tulsa County	• Tulsa County will follow up with the Criteria List.
N27	Spoon Creek	Tulsa County	• The FIS does not consistently reflect backwater elevations. The profile for some backwater calculations does not match the values in the table.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
N28	Tulsa County	Tulsa County	• Tulsa County requested to receive information from FEMA about streams of concern. The County was informed that this information is available in pdf format but has not received any information as of this date.
P1	City of Broken Arrow	City of Broken Arrow	• Its Hazard Mitigation Plan is being reviewed by FEMA and supposedly FEMA has approved it. • The City was informed by Team Members that FEMA would not issue its final approval until the community adopted the plan.
P2	City of Broken Arrow	City of Broken Arrow	• The Broken Arrow Hazard Mitigation Plan is available on its FTP site.
P3	City of Broken Arrow	City of Broken Arrow	• The City participates in the Community Rating System (CRS) and has GIS and a Hazard Mitigation Plan.
P4	City of Broken Arrow	City of Broken Arrow	• City of Broken Arrow will appoint someone to follow up on the adoption of its Hazard Mitigation Plan by the community.
P5	URS	URS	• All maps should include the tribal parcels held in trust, since tribes represent "Nation(s) inside a nation" and govern themselves.
P6	URS	URS	• Tribes should have data that will be pertinent to Discovery.
P7	URS	URS	• The County Tax Assessor's office and FEMA Region 6 have data relevant to Discovery.
P8	URS	URS	• It was suggested that Osage County be checked for tribal parcel data. The parcels would be called "tribal land" on Osage County Maps. • Question: Is there a FIRM?
P9	City of Tulsa	City of Tulsa	• The most recent Hazard Mitigation Plan is dated 2008.
P10	City of Tulsa	City of Tulsa	• The City's Hazard Mitigation Plan is currently being updated.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P11	City of Tulsa	City of Tulsa	• Mapping is needed for areas of severe scour.
P12	USACE	USACE	• A new armory has been constructed near Highway 51 and Coweta.
P13	USACE	USACE	• The USACE received notice of the Discovery Meeting through an OFMA "outreach" email.
P14	Muscogee (Creek) Nation	Muscogee (Creek) Nation	• The tribe has a list of all tribal lands which is almost complete. • Staff will need authorization from the new Chief (taking office on March 1st) before releasing any information for Discovery. • The tribe is also updating its Macintosh County records with an estimated 60 tribal parcels.
P15	Muscogee (Creek) Nation	Muscogee (Creek) Nation	• The tribe has its Hazard Mitigation Plan in electronic format.
P16	Muscogee (Creek) Nation	Muscogee (Creek) Nation	• The tribe will have to check with its Roads Department on any bridge construction and other drainage improvements.
P17	Tulsa County	Tulsa County	• Tulsa County has a current Hazard Mitigation Plan.
P18	Tulsa County	Tulsa County	• The County will check if it has an Emergency Action Plan.
P19	Tulsa County	Tulsa County	• The County representative will provide a list of bridges.
P20	Tulsa County	Tulsa County	• The County will check on any mitigation projects since its last FIRM.
P21	City of Sand Springs	City of Sand Springs	• INCOG has data regarding Sand Springs land use and zoning use records.
P22	City of Sand Springs	City of Sand Springs	• Its Hazard Mitigation Plan was approved in 2008. • The City will provide an electronic copy.
P23	City of Sand Springs	City of Sand Springs	• The City knows it will need to budget funds now to update its Hazard Mitigation Plan in the near future.
P24	City of Sand Springs	City of Sand Springs	• The City would like to obtain a grant for additional floodplain acquisition.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P25	City of Sand Springs	City of Sand Springs	• The City participates in the CRS program and is rated a "6".
P26	City of Sand Springs	City of Sand Springs	• No flood improvements have occurred since the last FIRM. • The Emergency Action Plan (EAP) is an appendix to the Hazard Mitigation Plan.
P27	City of Sand Springs	City of Sand Springs	• The City's last acquisition project was a subdivision with 28 homes inside the floodway done prior to the latest FIRM.
P28	Tulsa County	Tulsa County	• Tulsa County is a member of the NFIP. • The preliminary FIRM is dated December 2010 and is currently undergoing a review and appeal process.
P29	Tulsa County	Tulsa County	• The County representative was not aware of any superfund sites.
P30	Tulsa County	Tulsa County	• The County representative was unaware if the County had an Emergency Action Plan or not.
P31	Tulsa County	Tulsa County	• The County representative was not aware of any recent drainage projects.
P32	City of Broken Arrow	City of Broken Arrow	• Discovery Team members explained, in detail, the Hazard Mitigation Plan adoption process for communities and schools.
P33	City of Sapulpa	City of Sapulpa	• The City representative asked about the status of its Hazard Mitigation Plan and was informed it was being revised based on comments received from OEM and would be ready for OEM's final review within the next 30 days.
P34	City of Sapulpa	City of Sapulpa	• The City has acquired 20 structures at Taft and Rock Creek.
P35	City of Sapulpa	City of Sapulpa	• The City representative was not sure if Sapulpa has an Emergency Action Plan or not.
P36	City of Sapulpa	City of Sapulpa	• The City does have a Master Drainage Plan completed 2010.

Issues and Concerns Collected During the Discovery Meeting and Post-Meeting			
Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P37	Congressman David Boren	Congressman David Boren	• The Congressman's representative stated that the Congressional districts will be updated after the 2012 election. • Marshall and parts of Rogers counties will be impacted by the new districting.
P38	Congressman David Boren	Congressman David Boren	• Congressman Boren's office specifically requested to be invited to the Verdigris Discovery Meeting.
P39	Congressman David Boren	Congressman David Boren	• Congressman Boren will be retiring after this term.
P40	City of Bixby	City of Bixby	• The City's Hazard Mitigation Plan was approved in November 2010. • The City has already provided the Hazard Mitigation Plan to Team Members for review as part of the Discovery process.
P41	City of Bixby	City of Bixby	• The City of Bixby will provide its land use data. The overall quality of the data is good.
P42	City of Bixby	City of Bixby	• No Master Drainage Plan exists for the entire City of Bixby. • Some areas, such as the downtown, have plans. • No new Master Drainage Plans have been completed.
P43	City of Bixby	City of Bixby	• The City of Bixby is not in the CRS program and is not interested in participating. • The program's cost outweighs its benefits.
P44	Osage County	Osage County	• INCOG currently has updated and submitted the County's Hazard Mitigation Plan to OEM for review.
P45	Osage County	Osage County	• FEMA should talk to the County Commissioner regarding area bridges.
P46	Osage County	Osage County	• FEMA should talk to INCOG regarding area bridges.

Supporting information, data, and files collected for this report are included in the supplemental digital data submitted with this report. The following list is a directory of the available files and

folders as well as the data found within each sub-folder. If a submittal was not applicable for the Polecat-Snake Watershed, a Readme Text file was included in its place noting that it was not included.

11110101\Discovery

- Transmittal Letter

\1-Project_Discovery_Inititation

- Engagement_Plan
- Community_Contact_List
- Project_Team_Information

\2-Discovery_Meeting

- Attendance_Record
- Meeting_Agenda
- Meeting_Summary
- \Correspondence
    - PCS Notification_and_Invitation_Letter
    - OK_Thank-You_Letter_DID_ATTEND
    - OK_Thank-You_Letter_DID_NOT_ATTEND

\3-Post_Discovery

- Mapping_Activity_Statement
- Polecat-Snake_Discovery_Meeting_Surveys
- Polecat-Snake_Discovery_Report
- \Discovery_Maps
    - Discovery Map Flood Risk
    - Discovery Map Flood Hazard
    - Geospatial Data Summary

\4-Supplemental_Data

- CTP_Discovery_Newsletter_PCS
- Polecat Snake_Engagement_Plan
- \Discovery_Meeting_Exhibits
    - Big_PCS_FloodRisk_36x36
    - Big_PCS_Grants_36x36
    - Big_PCS_HMP_Plans_36x36
    - Big_PCS_LOMX_36x36
    - Big_PCS_Mapping_Coverage_36x36
    - Big_PCS_Population_Density_36x36
    - Big_PCS_Rep_Losses_36x36
    - Big_PCS_Risk_Topo_36x36
    - Big_PCS_Urbanization_36x36
    - Big_PCS_Watershed_36x36
- \GIS

    - CNMS_Maps
    - Overview_Maps
    - Topic_Maps
- \Information_Collection_Sheets
    - Community_Benefits
    - Mapping_Station_1_Comments
    - Mapping_Statoin_2_Comments
    - Mitigation_Planning_And_Mitigation_Actions
    - NFIP_Community_Actions
- \Photos

III. Watershed Findings

Once the data was collected from the Discovery meeting, an analysis was performed to identify critical areas highlighted as concerns for future projects in the watershed. The analysis focused on areas within the watershed that had been identified as having mitigation action plans for the future. The details in this section supplement the documentation supporting the need for further mitigation actions or studies in particular streams, reaches, or communities in the watershed.

This section describes the riverine floodplain analysis as either basic or enhanced. The basic analysis will produce a model-backed Zone A floodplain delineation. The enhanced analysis will produce a model-backed Zone AE floodplain delineation. These types of analyses are discussed in more detail below as part of the evaluation of needs.

i. Engineering Review of Community Comments

All comments were filtered to determine which were engineering-related. Engineering-related comments provided by communities during the Discovery Meeting were then analyzed. These comments were reviewed in terms of hydrologic and hydraulic issues in the watershed as well as with any general floodplain or Base Flood Elevation (BFE) related comments. All comments were investigated to determine whether or not they would have any effect on the hydrology of the watershed.

One recurring issue identified by many communities was incorrect mapping or issues with mapping. Communities and counties having issues with current FIRMs are: City of Broken Arrow, City of Coweta, City of Jenks, City of Sand Springs, City of Sapulpa, City of Tulsa, Town of Kiefer, and Wagoner County.

Additional comments related to modeling issues with effective FIRMs and infrastructure projects not properly reflected on current maps. Particular attention should be given to Wilmott Creek, as the City of Jenks noted significant mapping errors in this area. Other areas of concern included potential for decertification of existing levee (Sand Springs and Tulsa County), and modifications performed to existing stormwater systems without record of change (i.e. Childres Creek channel modified by town residents without permit). Other reoccurring comment related to errors in backwater modeling and associated mapping. Spoon Creek was given as an example of this problem.

Lastly, the City of Broken Arrow communicated the availability of detailed hydrologic and hydraulic studies as well as updated floodplain mapping for several of its creeks. The updated data would enable the validation of several stream miles and facilitate the conversion of Zone As to Zone AEs.

ii. Post-Discovery Hydrology

Reviews of the hydrologic information were performed in the Polecat Snake Watershed after the Discovery Meeting. These reviews focused on:

- Peak discharges in the watershed
- Limited gage analyses in the watershed

The 1-percent-annual-chance peak discharges were reviewed for all streams across community and County boundaries. Areas with Letters of Map Revision (LOMRs) were specifically checked, because LOMRs can indicate that there are larger issues. Information obtained from USGS gages was checked against the effective FIS for consistency. This analysis could potentially flag anomalies that would indicate that the hydrology is out of date, too high, or too low for the watershed.

Peak discharges in the watershed were reviewed based on effective FIS reports, flow gages, and available LOMRs. Areas of special interest were county boundaries and locations of LOMRs and gages. Hydrologic models were not provided for areas studied by basic methods. Only enhanced models were reviewed.

iii. Frequency Analysis

Frequency analyses were performed for all gages in the Polecat Snake Watershed having more than 10 peaks. Frequency analyses were performed using the USGS PeakFQWin program. There are five locations in the Polecat Snake Watershed with USGS gages. All five of these gages have more than 10 years of record, making them suitable for analysis. A map of the gage sites is shown in Figure 4.

USGS gages having 10 or more years of unbroken records were analyzed using the USGS PeakFQWin 5.2 program to determine the 1-percent-annual-chance discharges. Some of the gages had peak flows that were tagged as being impacted by urbanization or regulation. The input parameters were modified to include these values in the calculations. These computed discharges were compared to the flow rates from effective studies. The comparisons are shown in Table 14.

All but one of the five locations has a flow rate in an effective FIS. The remaining location was studied by basic methods only and does not have a reported flow rate. The effective flow rates are approximately 45 percent higher than the computed flows from the frequency analyses with the exception of one. The effective flow rate at the Arkansas River near Haskell is approximately 10 percent lower than the computed flow.

The effective flow rates were also computed by performing a frequency analysis. A more detailed look at the previous study may be warranted to determine if the additional period of record has had an impact on the frequency analysis of the gage.

iv. Post-Discovery CNMS Analysis

As part of the Discovery process, a review of the CNMS validation elements was performed in accordance with the methodology specified in the CNMS Database User's Guide, Version 4.3, dated June 2011. Canadian, Oklahoma, and Woodward County were part of a detailed CNMS Phase III process.

Figure 4: USGS Stream Gage Locations

Polecat-Snake Watershed

Jul 26 2012

FEMA OWRB

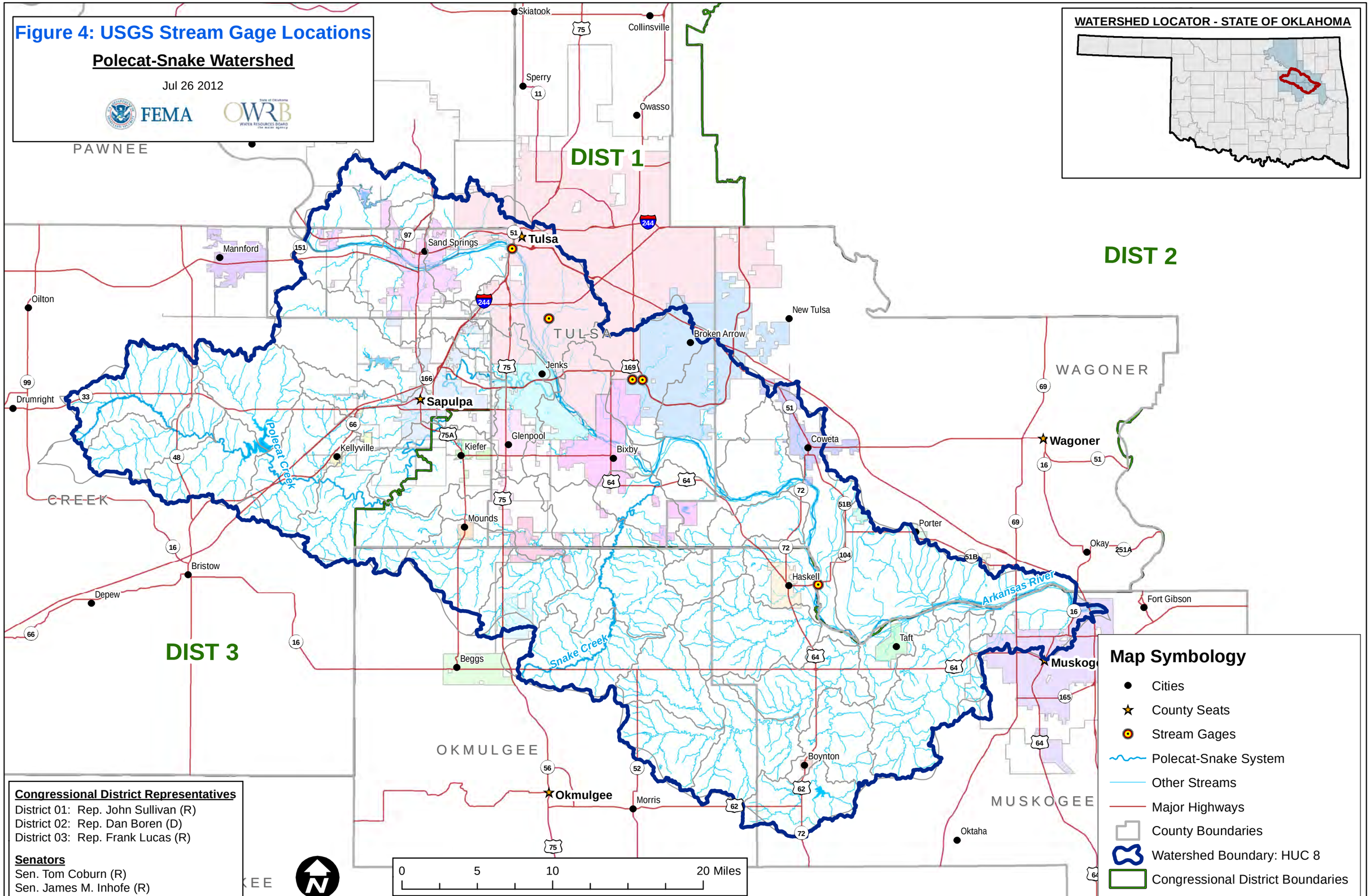


Table 14: Comparison of 1-Percent-Annual-Chance Peak Flows of Gage Frequency Analysis and Effective Discharges

Stream Name and Location	USGS Gage	Drainage Area from USGS Gage (square miles)	Effective Discharges Source	Effective 1% Annual-Chance Discharge (cfs)	95% Confidence Limits Lower (cfs) (Gage)	1% Annual-Chance Discharge from PeakFQWin (Gage)	95% Confidence Limits Upper (cfs) (Gage)	Number of Peaks on Record
Arkansas River at Tulsa, OK	07164500	62,074	Tulsa County FIS	205,000	89,740	111,100	145,500	47
Joe Creek at 61st Street in Tulsa, OK	07164600	12.2	N/A*	N/A*	11,390	13,730	18,350	22
Haikey Creek at 101st Street South at Tulsa, OK	07165562	17.8	Tulsa County FIS	20,254	8,241	11,490	18,980	24
Little Haikey Creek at 101st Street South at Tulsa, OK	07165565	5.45	Tulsa County FIS	6,075	2,113	2,607	3,502	24
Arkansas River near Haskell, OK	07165570	62,932	Tulsa County FIS	205,000	172,400	224,900	325,700	38

*Approximate Study. No effective discharge is available.
USGS = U.S. Geological Survey
cfs = cubic feet per second

Table 15 lists the detailed studied streams in the PS Watershed that have either failed one or more validation elements. It also notes studied streams which contain null[2] values for validation elements.

Table 15 also contains data retrieved from the City of Tulsa's CMS (Channel Management System) database which contains bank and bottom scour information for Tulsa streams. The stream segments that were identified as having significant scour problems in the City of Tulsa's study were included as failed CNMS Critical Element C7, noted as C7*, to identify these elements as from another source for ease in identifying them.

Table 16 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 following is a detail of the CNMS review findings per County:

Creek County, OK

Creek County was included in CNMS Phase 3. There are 348.2 total streams in the County. The stream segments that are listed as Flood Zone A and Valid were studied by approximate methods and contain this comment: "All Zone As included in final scoping shapefile, therefore "validated" since the scoping shapefile indicates they were all studied for this countywide." This accounted for 301.6 stream miles (87% of the total) and includes the following streams:

- Anderson Creek
- Biven Creek
- Browns Creek
- Childres Creek
- Clear Creek
- Deep Creek
- Dog Creek
- East Winkey Branch Creek
- Euchee Creek
- Figure Eight Creek
- Hoot Owl Creek
- Kenyon Creek
- Lake Heyburn
- Lake Jackson
- Lake Sahoma
- Little Polecat Creek
- Middle Duck Creek
- Mosquito Creek
- Mounds Lake
- Mountain Creek
- Neversweat Creek
- Nickel Creek
- North Duck Tributary 3
- Polecat Creek
- Polecat Creek Tributary 2
- Polecat Creek Tributary 4
- Polecat Creek Tributary 4-1
- Polecat Creek Tributary 4-2
- Pretty Water Lake
- Rock Creek
- Rowland Creek
- Sapulpa Reservoir
- Scholar Creek
- Skull Creek
- South Duck Creek
- Stream A
- Tiger Creek
- Turkey Creek
- Winkey Branch Creek

[2] The term null refers to CNMS elements which contained no information – or were empty.

Table 15: Current CNMS Validation Status and Discovery Level CNMS Review for Detailed Streams

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Biven Creek	Creek	Valid	S6	C7		8/1/1998	14		Unknown
Childres Creek	Creek	Unverified	C5, S10	C7		5/1/1980	33		Unverified
Childres Creek	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Middle Duck Creek	Creek	Valid	S10	C7		9/1/1980	32		Unknown
Nickel Creek	Creek	Unverified	C5, S4, S6	C7		8/1/1998	14		Unverified
Nickel Creek	Creek	Valid				9/1/2007	32		Valid
North Duck Creek	Creek	Valid	S10	C7		9/1/1980	5		Unknown
Polecat Creek	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Polecat Creek Tributary 2	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Polecat Creek Tributary 4	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Polecat Creek Tributary 4-1	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Rock Creek	Creek	Valid			C1-C7 and S1-S10	9/1/2007	5		Valid
Stream A	Creek	Valid	S10	C7		9/1/1980	32		Unknown
Arkansas River	Muskogee	Unverified	C2			7/1/1988	25		Unverified
Arkansas River (Upper Reach)	Muskogee	Valid	S3, S4, S10			7/1/1988	25		Valid
Haskell Creek	Muskogee	Unverified	S1, S3, S4, S10			7/1/1988	25		Unverified
Mosquito Creek	Muskogee	Valid	S10			7/1/1988	25		Valid
Pecan Creek	Muskogee	Valid	S10			7/1/1988	25		Valid
Virgle Creek	Muskogee	Unverified	S1, S3, S4, S10		C1-C7 and S1-S10	7/1/1988	25		Unverified
Duck Creek	Okmulgee	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Snake Creek	Okmulgee	Valid				11/1/2005	5		Valid
Big Heart Creek	Osage	Valid				2/1/1991	22		Valid
Euchee Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Euchee Creek Tributary	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Harlow Creek	Osage	Valid				9/1/1979	33		Valid
Harlow Creek Tributary	Osage	Valid				9/1/1979	33		Valid
Sand Springs Lake Tributary	Osage	Valid			C1-C7 and S1-S10	1/1/2005	8		Valid
Shell Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Ut 1 To Euchee Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Ut 1 To Shell Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Ut 2 To Euchee Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Ut 3 To Euchee Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Ut 4 To Shell Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
West Big Heart Creek	Osage	Valid			C1-C7 and S1-S10	1/1/2003	10		Valid
Anderson Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Anderson Creek Tributary	Tulsa	Valid	S4	S3		1/1/2002	11		Unknown
Anderson Creek Tributary A-1	Tulsa	Valid		S3		1/1/2002	11		Unknown
Arkansas River	Tulsa	Valid	S2	S3		1/1/2002	11		Unknown
Berryhill Creek	Tulsa	Valid		S3		1/1/2002	4		Unknown
Berryhill Creek Tributary	Tulsa	Valid		S3		1/1/2002	11		Unknown
Bigheart Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Bixby Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	11		Valid
Broken Arrow Creek	Tulsa	Valid				7/1/1983	7		Valid
Broken Arrow Creek	Tulsa	Valid			C1-C7 and S1-S10	7/1/1983	30		Valid
Cherry Creek (West Tulsa)	Tulsa	Valid		S3		1/1/2002	11		Unknown
Coal Creek (West Tulsa)	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Coal Creek Tributary A	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Coal Creek Tributary B	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Crow Creek	Tulsa	Valid	S2, S4			9/1/1979	33	C7*	Unverified
Duck Creek	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Duck Creek Tributary	Tulsa	Valid		S3		1/1/2002	11		Unknown
East Branch Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
East Branch Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	3/18/2010	3		Valid
East Branch Joe Creek	Tulsa	Valid				9/1/1979	33		Valid
East Branch Joe Creek Split Flow	Tulsa	Valid				9/1/1979	33		Valid
Euchee Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Euchee Creek Tributary 1	Tulsa	Valid		C3, S1, S10		1/1/2002	11		Unknown
Euchee Creek Tributary 2	Tulsa	Valid		C3, S1, S10		1/1/2002	11		Unknown
Fisher Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Fisher Creek Overflow	Tulsa	Valid	S4	S3		1/1/2002	11		Unknown
Fisher Creek Tributary	Tulsa	Valid		S3		1/1/2002	11		Unknown
Floral Haven Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Franklin Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Fred Creek	Tulsa	Valid			C1-C7 and S1-S10	12/30/2003	9	C7*	Unverified
Fry Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Fry Ditch No. 1	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Fry Ditch No. 1 Tributary	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Fry Ditch No. 2	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7	C7*	Unverified
Fry Ditch No. 2 Tributary	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Hager Creek	Tulsa	Valid	S4			9/1/1979	33	C7*	Unverified
Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7	C7*	Unverified
Haikey Creek	Tulsa	Valid				3/1/1980	33		Valid
Harlow Creek	Tulsa	Valid		S3		1/1/2002	11	C7*	Unverified
Harlow Creek Overflow	Tulsa	Unverified	C6			9/1/1979	33		Unverified
Joe Creek	Tulsa	Valid	S4			9/1/1979	33	C7*	Unverified
Little Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Little Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/16/2006	6		Valid
Little Haikey Creek	Tulsa	Valid				9/1/1979	33		Valid
Little Haikey Creek Tributary	Tulsa	Valid				5/1/1983	30		Valid
Little Joe Creek	Tulsa	Valid	S2, S4			9/1/1979	33		Valid
Little Sand Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Lower Fred Creek	Tulsa	Valid			C1-C7 and S1-S10	12/30/2003	9		Valid
Middle Branch Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Middle Branch Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	1/27/2007	6		Valid
Mooser Creek	Tulsa	Valid	S4			9/1/1979	33	C7*	Unverified

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Mooser Creek Tributary	Tulsa	Valid				9/1/1979	33		Valid
Nichols Creek	Tulsa	Valid				5/1/1990	23		Valid
Nickel Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7	C7*	Unverified
North Fork Little Joe Creek	Tulsa	Valid	S2, S4			12/1/1989	23		Valid
Old Joe Tributary To Fred Creek	Tulsa	Valid			C1-C7 and S1-S10	12/30/2003	9		Valid
Olive Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Park Grove Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Polecat Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Posey Creek	Tulsa	Valid		S3		1/1/2002	11		Valid
Posey Creek North Tributary 1	Tulsa	Valid		S3		1/1/2002	11		Valid
Posey Creek South Tributary 1	Tulsa	Valid		S3		1/1/2002	11		Valid
Posey Creek South Tributary 2	Tulsa	Valid		S3		1/1/2002	11		Valid
Prattville Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Prattville Creek Tributary 1	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Prattville Creek Tributary 2	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Prattville Creek Tributary 3	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Prattville Creek Tributary 4	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Red Fork Creek	Tulsa	Valid	S2, S4			9/1/1979	33	C7*	Unverified
Redfork Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Redfork Creek Tributary 1	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Redfork Creek Tributary 2	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
Rolling Meadows Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Sand Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Sand Springs Lake Tributary	Tulsa	Valid			C1-C7 and S1-S10	3/31/2010	3		Valid
Sand Springs Lake Tributary	Tulsa	Valid		S3		1/1/2002	11		Unknown
Shady Grove Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Shell Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Snake Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown
Snake Creek Tributary	Tulsa	Valid		S3		1/1/2002	11		Unknown
South Fork Joe Creek	Tulsa	Valid				9/1/1979	33	C7*	Unverified
South Fork Little Joe Creek	Tulsa	Valid				9/1/1979	33		Valid
Turtle Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
Unnamed Tributary To Coal Creek (West Tulsa)	Tulsa	Valid			C1-C7 and S1-S10	12/30/2009	3		Valid
Unnamed Tributary To West Branch Broken Arrow Creek	Tulsa	Valid			C1-C7 and S1-S10	12/24/2008	4		Valid
Vensel Creek	Tulsa	Valid				9/27/1999	13	C7*	Unverified
Vensel Creek South	Tulsa	Valid				9/27/1999	13		Valid
Vensel Creek Tributary D	Tulsa	Valid				9/27/1999	13		Valid
Vensel Creek Tributary H	Tulsa	Valid				9/27/1999	13		Valid
West Bigheart Creek	Tulsa	Valid		C3, S1, S3, S10		1/1/2002	11		Unknown
West Branch Broken Arrow Creek	Tulsa	Valid				7/1/1983	30		Valid
West Branch Haikey Creek	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
West Branch Haikey Creek Tributary	Tulsa	Valid			C1-C7 and S1-S10	11/1/2005	7		Valid
West Branch Joe Creek	Tulsa	Valid				9/1/1979	33		Valid
White Church Creek	Tulsa	Valid		S3		1/1/2002	11		Unknown

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Wilmott Creek	Tulsa	Valid	S4			8/17/1981	31		Valid
Arkansas River	Wagoner	Valid			C1-C7 and S1-S10	12/1/2007	5		Valid
Arkansas River	Wagoner	Valid			C1-C7 and S1-S10	12/1/2007	5		Valid
Broken Arrow Creek	Wagoner	Valid	S2, S4, S6	C7		5/1/1986	27		Unknown
Broken Arrow Creek Tributary	Wagoner	Unverified	C4, S3, S4, S5, S6, S7	C7		5/1/1986	27		Unverified
Coweta Creek	Wagoner	Valid	S2, S4, S6	C7		5/1/1986	27		Unknown
Coweta Creek Tributary A	Wagoner	Valid	S6	C7		5/1/1986	27		Unknown
Coweta Creek Tributary B	Wagoner	Unverified	S3, S4, S6, S7	C7		5/1/1986	27		Unverified
Middle Branch	Wagoner	Valid	S2, S6	C7		1/1/1985	28		Unknown
South Branch	Wagoner	Valid	S6	C7		1/1/1985	28		Unknown

* Denotes streams with significant scour as identified by the City of Tulsa's Channel Maintenance System (CMS).

Table 16: Failed Element for Streams

Element Name	Issue Being Identified by the Element	Element Description
C1	*Major change in gage record since effective analysis that includes major flood events*	Failure of this element happens when a major change in the gage record occurs after the date of the Effective Study.
C2	*Updated and effective peak discharges differ significantly based on confidence limits criteria*	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	*Model methodology no longer appropriate (one-dimensional vs. two-dimensional)*	This element fails when the model methodology used no longer meets current guidelines and specifications.
C4	*Major flood control structure added or removed*	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	*Current channel reconfiguration outside effective SFHA*	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	*More than five new or removed hydraulic structures*	This element fails when more than five new or removed hydraulic structures that impact the BFEs have not been identified.
C7	*Significant channel fill or scour*	Failure of this element indicates that significant channel fill or scour has been identified.
S1	*Use of rural regression equations in urbanized areas*	This element attempts to flag studies in current urban areas where rural regression equations were used for the effective study hydrology.
S2	*Repetitive losses outside the SFHA*	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	*Increase in impervious area in subbasin of more than 50 percent*	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	*More than one and less than five new or removed hydraulic structures (bridge/culvert) impacting BFEs*	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	*Channel improvements / shoreline changes*	Failure of this element indicates the FIRM, Imagery, or other data input sources show

Element Name	Issue Being Identified by the Element	Element Description
		channel improvements since the study date.
S6	*Better topographic or bathymetric data available*	Failure of this element indicates better topographic or bathymetric data has been made available since the Effective Study date.
S7	*Changes to vegetation or land use*	Failure of this element indicates there have been significant changes in land use or vegetative cover since the date of the Effective Study.
S8	*Failure to identify primary frontal dune in coastal areas*	Failure of this element indicates that the primary frontal dune was not properly identified in coastal areas.
S9	*Significant storms with high water marks*	Failure of this element indicates that recent storm surge high waters marks were not identified.
S10	*New regression equations available*	Failure of this element indicates updates to regression equations since the date of study for studies that used a regression analysis for hydrology.

of the Zone A streams listed above, another 118.6 stream miles (39% of the Zone A and 34% of the total stream miles) are listed as NP or No Point Annotation. They are all New Approximate studies and therefore Valid. These NP stream segments need assigned names within the CNMS database.

of the 46.6 miles of Zone AE streams, a segment of Childres Creek failed Critical Element C5 indicating that the streamline is mapped as outside of the SFHA and also failed Secondary Element S10 indicating that the study used regression methods. Critical Element C7 is listed as Unknown, indicating that there may be significant scour in the stream. The effective date of the models is 5/1/1980. No change to the Unverified status is recommended.

Nickel Creek also has an Unverified Status in the CNMS database because it failed Critical Element C5 indicating that the streamline is mapped as outside of the SFHA. It also failed Secondary Elements S4 and S6 indicating that there was more than one and less than five new or removed hydraulic structures as well as the availability of better topographic data since the Effective Study date. Critical Element C7 is Unknown, indicating that there may be significant scour in the stream. No change to the Unverified status is recommended.

The other segments of Nickel and Childres Creeks, as well as Polecat Creek, Rock Creek, Polecat Creek Tributary 2, Polecat Creek Tributary 4-1 and Polecat Creek Tributary 4 have Critical and Secondary Elements listed in CNMS with null values. However, they all are new detailed studies so no change to the Valid status is recommended

Recommended CNMS Status modifications from Valid to Unknown:
Biven Creek failed Secondary Element S6 indicating that there is better topographic data available. However, it lists Critical Element C7 as Unknown, indicating that there may be significant scour in the stream. The hydrology model is listed as OTHER, with "Hydro Model TP-40&49" listed in the comment column. Since TP40 and TP49 are publications identifying rainfall, Critical Element C3 should be Unknown as well. Both of these Unknown Critical Elements require that the validation status be changed to Unknown and the status type be changed to "To Be Assessed".

Middle Duck Creek, North Duck Creek, and Stream A failed Secondary Element S10, indicating that new regression equations are available, and are redelineations. However, they list Critical Element C7 as Unknown, indicating that there may be significant scour in the stream. This Unknown Critical Element requires that the validation status be changed to Unknown and the status type be changed to "To Be Assessed" for these three streams.

Muskogee County, OK

of the 233.3 total stream miles, all 205.3 miles of Zone A Muskogee County streams within the watershed are model-backed updated approximate studies, and therefore, Valid.

The remaining 28.0 stream miles are Zone AE streams. of these, 18 stream miles are listed as Valid status and the remaining 10.0 miles are listed as Unverified. All 28 stream miles are redelineations from a 1988 study using regression equations.

The Arkansas River stream segment in Muskogee County (4.6 miles) is listed as Unverified and has failed Critical Element C2 indicating that the updated and effective peak discharges differ significantly from the current confidence limits criteria since the date of the Effective Study. No change in validation status is recommended.

Both Haskell Creek and Virgle Creeks are listed as Unverified and failed Secondary Elements S1, S3, S4, and S10 indicating that rural regression equations were used in urbanized areas, an increase in impervious area in the subbasin of more than 50 percent, there are more than one and less than five new or removed hydraulic structures (bridge/culvert) impacting BFEs and new regression equations are available. No change in validation status is recommended.

The upper reach of the Arkansas River is listed as Valid but has failed Secondary Elements S3, S4, and S10, indicating a significant increase in impervious area, the addition or removal of more than one, but less than five, hydraulic structures along the studies streams since the date of the Effective Study and new regression equations are available. No change in validation status is recommended.
Mosquito Creek and Pecan Creek both failed Secondary Element S10 indicating new regression equations are available.

Recommended CNMS Status modifications from Valid to Unknown:
One Zone A stream (0.4 miles) named Unnamed Stream failed Critical Element C2, which would indicate that the updated and effective peak discharges differ significantly from the current confidence limits criteria since the date of the Effective Study, if it were a Zone AE stream. It states the hydrologic model is OTHER and the hydraulic model is HEC-2, yet is also states that it is a Valid model-backed updated approximate stream. Because of the inaccuracies noted, the validation status should be changed to Unknown and the status type to "To Be Assessed" for this stream segment.

Okmulgee County, OK

Okmulgee County has 269.0 stream miles of which 264.3 miles are Zone A streams. All streams are listed in the CNMS Database as Valid. One segment of Snake Creek (0.6 stream miles) is listed as Zone A but was studied in November 2005 Tulsa County study. This segment carried over to Okmulgee County. All remaining Zone A streams are New Approximate studies. No validation change is recommended.

The two Zone AE stream segments, Snake Creek (0.2 miles) and Duck Creek (4.3 miles), Studied November 2005 as part of Tulsa County study, were carried over to Okmulgee County, and are considered new detailed. Neither failed any Critical Elements or and Secondary Elements. While no validation status change is required, the CNMS data should be completed.

Only Coal Creek Tributary 2 and Coal Creek Tributary 2A (0.9 miles of streams) are model-backed. The remaining streams are not model-backed, and the study type is listed as New Approximate.

Osage County, OK

Osage County has a total of 26.6 miles of streams within the Polecat Snake Watershed. of these, 13.8 are Zone A streams. All of the Zone A streams are listed in the CNMS Database as Unknown Status and are not model-backed. The study type is Digital Conversion Approximate. No validation change is recommended.

Recommended CNMS Status modifications from Valid to Unknown:
The remaining 12.8 stream miles are Zone AE and are all listed as Valid Status. Big Heart Creek, Harlow Creek and Harlow Creek Tributary all are listed as Valid and did not fail any Critical or Secondary Elements. However, there has been considerable development in these subbasins since 1979, for Harlow Creek and Harlow Creek Tributary. BigHeart Creek has also had development since its effective date of 1991, and was apparently prepared using 1"=20' USGS contour maps. The validation status for all three streams should be changed to Unknown and the status types to "To Be Assessed".

Euchee Creek, Euchee Creek Tributary, Sand Springs Lake Tributary, Shell Creek, Unnamed Tributary 1 to Euchee Creek, Unnamed Tributary 1 to Shell Creek, Unnamed Tributary 2 to Euchee Creek, Unnamed Tributary 3 to Euchee Creek, Unnamed Tributary 4 to Shell Creek, and West Big Heart Creek all are listed as Valid and have null values in all Critical and Secondary Elements. These streams were studied by the City of Sand

Springs for inclusion in MapMod, however it is not clear as to whether the new detailed models described were prepared separately. The DFIRM data source cited is Meshek, the firm that prepared the study for the City of Sand Springs, however, the effective date is listed as 1/1/2003, prior to Meshek completing the modeling. While no validation status change is required, the CNMS data should be completed and corrected.

Tulsa County, OK

Within the watershed, Tulsa County has a total of 358.1 stream miles. The Zone A streams comprise 73.6 stream miles. One stream segment (0.7 miles), on Aspen Creek, is listed as Valid due to a LOMR. The remaining Zone A streams (72.9 miles) were prepared as digital conversion approximate. All have an Unknown status in the CNMS database. No change is recommended for the Zone A streams.

The Harlow Creek Overflow (1.5 miles) has an Unverified status. The hydrology model is listed as SNYDER METHOD, and should be corrected. The effective date is 9/1/1979. This segment failed Critical Element C6, indicating that there are more than five new or removed hydraulic structures.

of the 283.0 Valid detailed (Zone AE) stream miles, 279.3 stream miles are 5 years old or older, 196.5 stream miles are 10 years old or older, 52.1 stream miles are 20 years old or older and 36.6 stream miles are 30 years old or older. The CNMS database was not completed for the 86.5 stream miles that included the Updated Detailed and New Detailed Study Types, which are the models with effective dates from 2003 to present.

of the 52.1 streams that are 20 years or older, 44.9 (86%) are in the City of Tulsa and 12.4 (24%) are in the City of Broken Arrow, the two most populous communities in this HUC 8. This represents about 38% and 4% of the total Valid stream mileage in Tulsa County, respectively.

An effective date of 1/1/2002 was listed for 139.8 miles of the 279.3 Zone AE miles, because the study date is not known. These are Digital Conversion Detailed study types. There are 58.2 miles of redelineated streams.

Crow Creek, East Branch Joe Creek Split Flow, Little Joe Creek, North Fork Little Joe Creek, Red Fork Creek and the Arkansas River all fail Secondary Factor S2, indicating that there are repetitive losses outside the SFHA.

Crow Creek, Little Joe Creek, North Fork Little Joe Creek, Joe Creek, Red Fork Creek, Mooser Creek, Hager Creek and Wilmott Creek, all redelineated, failed Secondary Element S4, indicating that there are more than one and less than five new or removed hydraulic structures (bridge/culvert) impacting BFEs.

Duck Creek also has Secondary Factors S1, S3 and S10 listed as unknown, indicating that it is unknown whether or not rural regression equations were used in urbanized areas, an increase in impervious area in the subbasin of more than 50 percent has taken place, and new regression equations available.

Recommended CNMS Status modifications from Valid to Unverified:
Crow Creek, Fred Creek, Fry Ditch No. 2, Hager Creek, Haikey Creek, Harlow Creek, Joe Creek, Mooser Creek, Nickel Creek, Red Fork Creek and South Fork Joe Creek all have significant channel scour, based on the City of Tulsa's Channel Maintenance System (CMS) program. For these streams, Critical Factor C7 will fail. The Validation and Status Type for these streams should be changed to Unverified and TO BE STUDIED, respectively.

Little Haikey Creek, Harlow Creek, Harlow Creek Overflow, Lower Fred Creek, East Branch Joe Creek, Split Flow, Little Joe Creek, South Fork Little Joe Creek, South Fork Joe Creek all have centerlines that are outside of the SFHA for portions of their lengths. The Validation and Status Type for these streams should be changed to Unverified and TO BE STUDIED, respectively.

Recommended CNMS Status modifications from Valid to Unknown:
Duck Creek has Critical Factor 3 listed as Unknown, indicating that whether or not the model methodology used to produce the effective analysis still meets current guidelines and specifications is not known. Its validation status should be changed to "Unknown" and its status type to "To Be Assessed".

Little Joe Creek, South Fork Little Joe Creek, Broken Arrow Creek, Harlow Creek Overflow, South Fork Joe Creek, West Branch Joe Creek, North Fork Little Joe Creek, Broken Arrow Creek, Joe Creek, West Branch Broken Arrow Creek, Mooser Creek Tributary, Red Fork Creek, East Branch Joe Creek, Mooser Creek, Little Haikey Creek Tributary, Hager Creek and Little Haikey Creek should have a Critical Factor 3 status of Unknown. The hydrology method is shown as SNYDER METHOD, rather than HEC1. The models are not available and so cannot be updated without a new study. For the most part, the effective models are from 1979 (over thirty years old) and are in urban areas. They are not adequate.

Recommended CNMS general modification:
Euchee Creek Tributaries 1 and 2, Prattville Creek Tributaries 1, 2, 3 and 4, Redfork Creek Tributaries 1 and 2, and West Bigheart Creek also have Critical Factor 3 listed as Unknown, indicating that whether or not the model methodology used to produce the effective analysis still meets current guidelines and specifications is not known. These streams were studied by Meshek & Associates, under contract with the City of Sand Springs, and were included in MapMod. The methods used were HEC-HMS and HEC-RAS, and all models run. The Unknown designations should be removed.

Euchee Creek Tributaries 1 and 2, Prattville Creek Tributaries 1, 2, 3 and 4, Redfork Creek Tributaries 1 and 2, and West Bigheart Creek have Secondary Factors S1, S3 and S10 listed as Unknown, indicating that it is unknown whether or not rural regression equations were used in urbanized areas, an increase in impervious area in the subbasin of more than 50 percent has taken place, and new regression equations available. These same streams also have Secondary Factor 3 listed as Unknown, indicating that whether or not there has been an increase in impervious area in the sub-basin of more than 50 percent is not known. However, all of these streams were prepared using HEC-HMS, not

regression equations and the current level of impervious area was used to develop the models. The Unknown designations should be changed.

The Arkansas River, Crow Creek, East Branch Joe Creek Split Flow, Little Joe Creek, North Fork Little Joe Creek, and Red Fork Creek all failed Secondary Element S2 indicating that repetitive losses have been noted outside the SFHA.

Anderson Creek Tributary, Fisher Creek Overflow, Hager Creek, Joe Creek, Little Joe Creek, Mooser Creek, North Fork Little Joe Creek, Red Fork Creek and Wilmott Creek all failed Secondary Element S4 indicating that an addition or removal of more than one, but less than five hydraulic structures, along the studied streams since the date of the Effective Study has occurred.

The following streams list Secondary Element S3 as Unknown, indicating that it is not known whether an increase in impervious area in the subbasin of more than 50 percent has occurred. These are all streams that were studied by the Tulsa District Corps of Engineers in 2002, prepared under a Tulsa County CTP grant.

- Anderson Creek
- Anderson Creek Tributary
- Anderson Creek Tributary A-1
- Arkansas River
- Berryhill Creek
- Berryhill Creek Tributary
- Bigheart Creek
- Cherry Creek (West Tulsa)
- Duck Creek
- Duck Creek
- Duck Creek Tributary
- Euchee Creek Tributary 1
- Euchee Creek Tributary 2
- Fisher Creek
- Fisher Creek Overflow
- Fisher Creek Tributary
- Franklin Creek
- Harlow Creek
- Little Sand Creek
- Posey Creek
- Posey Creek North Tributary 1
- Posey Creek South Tributary 1
- Posey Creek South Tributary 2
- Prattville Creek Tributary 1
- Prattville Creek Tributary 2
- Prattville Creek Tributary 3
- Prattville Creek Tributary 4
- Redfork Creek
- Redfork Creek Tributary 1
- Redfork Creek Tributary 2
- Sand Springs Lake Tributary
- Shady Grove Creek
- Snake Creek
- Snake Creek Tributary
- West Bigheart Creek
- White Church Creek

Anderson Creek

Tributary, Anderson Creek Tributary A-1, Aspen Creek, Berryhill Creek, Berryhill Creek Tributary, Bixby Creek, Coal Creek (West Tulsa), Coal Creek Tributary A, Coal Creek Tributary B, East Branch Haikey Creek, Elm Creek, Euchee Creek, Floral Haven Creek, Fred Creek, Fry Creek, Fry Ditch No. 1, Fry Ditch No. 1 Tributary, Fry Ditch No. 2, Fry Ditch No. 2 Tributary, Haikey Creek, Harlow Creek Overflow, Little Haikey

Creek, Lower Fred Creek, Middle Branch Haikey Creek, Mud Creek, Nichol Creek, Old Fry Ditch No. 1, Old Fry Ditch No. 2, Old Joe Tributary to Fred Creek, Olive Creek, Park Grove Creek, Polecat Creek, Prattville Creek, Rolling Meadows Creek, Sand Creek, Sand Springs Lake Tributary, Shell Creek, Turtle Creek, Unnamed Tributary to Coal Creek (West Tulsa), West Branch Haikey Creek, and West Branch Haikey Creek Tributary all had null values for all Critical and Secondary Elements.

Wagoner County, OK

Wagoner County contains 128 total stream miles. The Zone A streams include 84.6 stream miles with the study type listed as New Approximate. They all have a validation status of Valid.

of the 43.4 stream miles of Zone AE, Broken Arrow Creek Tributary (3.1 miles) and Coweta Creek Tributary B (0.7 miles) have a validation status of Unverified.

Broken Arrow Creek Tributary failed Critical Element C5, indicating that the streamline is shown outside the SFHA. It also failed Secondary Elements S3, S4, S5, S6, and S7, indicating that there has been an increase in impervious area in the subbasin of more than 50 percent, the addition or removal of more than one, but less than five hydraulic structures, along the studied streams since the date of the effective study has occurred, there have been improvements to the channel since the study date, better topographic data exists, and there have been changes to the vegetation or land use of the area.

Coweta Creek Tributary B failed Secondary Elements S3, S4, S6, and S7, indicating that there has been an increase in impervious area in the subbasin of more than 50 percent, the addition or removal of more than one but less than five hydraulic structures along the studied streams since the date of the effective study has occurred, better topographic data exists, and there have been changes to the vegetation or land use of the area.

Middle Branch failed Secondary Elements S2 and S6 indicating that there are repetitive losses outside the SFHA and better topographic data exists.

Coweta Creek Tributary A and South Branch both failed Secondary Element S6, indicating that better topographic data exists.

<u>Recommended CNMS Status modifications from Valid to Unknown:</u>
Broken Arrow Creek Tributary, Coweta Creek Tributary B, Middle Branch, South Branch, Broken Arrow Creek, Coweta Creek, and Coweta Creek Tributary A have Critical Element C7 listed as Unknown, indicating that the existence of significant channel fill or scour is unknown. All except Broken Arrow Creek Tributary and Coweta Creek Tributary B have a validation status of Valid. Their validation status should be changed to Unknown and status type to “To Be Assessed”.

Recommended CNMS general corrections:
Thirty-four percent of the stream miles in Wagoner County are listed as NP (No Point Annotation) in the CNMS database. These should be given names in the CNMS database.

Table 17 shows the study methodologies for Zone AE streams studied by enhanced methods and their validation status.

Table 17: Hydrologic and Hydraulic Information for Enhanced Streams

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Biven Creek	Creek	Valid	8/1/1998	OTHER	HEC-2
Childres Creek	Creek	Unverified	5/1/1980	OTHER	HEC-2
Childres Creek	Creek	Valid	9/1/2007	UNKNOWN	OTHER
Middle Duck Creek	Creek	Valid	9/1/1980	REGRESSION EQUATIONS	HEC-2
Nickel Creek	Creek	Unverified	8/1/1998	HEC-HMS	HEC-2
Nickel Creek	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS 3.1.1
North Duck Creek	Creek	Valid	9/1/1980	REGRESSION EQUATIONS	HEC-2
Polecat Creek	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS
Polecat Creek Tributary 2	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS
Polecat Creek Tributary 4	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS
Polecat Creek Tributary 4-1	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS
Rock Creek	Creek	Valid	9/1/2007	HEC-HMS	HEC-RAS
Stream A	Creek	Valid	9/1/1980	REGRESSION EQUATIONS	HEC-2
Arkansas River	Muskogee	Unverified	7/1/1988	OTHER	HEC-2
Arkansas River (Upper Reach)	Muskogee	Valid	7/1/1988	REGRESSION EQUATIONS	HEC-2
Haskell Creek	Muskogee	Unverified	7/1/1988	REGRESSION EQUATIONS	WSP-2
Mosquito Creek	Muskogee	Valid	7/1/1988	REGRESSION EQUATIONS	HEC-2
Pecan Creek	Muskogee	Valid	7/1/1988	REGRESSION EQUATIONS	HEC-2
Virgle Creek	Muskogee	Unverified	7/1/1988	REGRESSION EQUATIONS	HEC-2
Duck Creek	Okmulgee	Valid	11/1/2005	2040	1011
Snake Creek	Okmulgee	Valid	11/1/2005	2040	1011
Big Heart Creek	Osage	Valid	2/1/1991	HEC-1	HEC-2
Euchee Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
Euchee Creek Tributary	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
Harlow Creek	Osage	Valid	9/1/1979	HEC-1	HEC-2

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Harlow Creek Tributary	Osage	Valid	9/1/1979	HEC-1	HEC-2
Sand Springs Lake Tributary	Osage	Valid	1/1/2005	UNKNOWN	Unknown
Shell Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
UT 1 To Euchee Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
UT 1 To Shell Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
UT 2 To Euchee Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
UT 3 To Euchee Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
UT 4 To Shell Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
West Big Heart Creek	Osage	Valid	1/1/2003	HEC-HMS	HEC-RAS
Anderson Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Anderson Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Anderson Creek Tributary A-1	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Arkansas River	Tulsa	Valid	1/1/2002	GAGE ANALYSIS	HEC-RAS
Berryhill Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Berryhill Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Bigheart Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Bixby Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Broken Arrow Creek	Tulsa	Valid	7/1/1983	SNYDER METHOD	HEC-2
Broken Arrow Creek	Tulsa	Valid	7/1/1983	SNYDER METHOD	HEC-2
Cherry Creek (West Tulsa)	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Coal Creek (West Tulsa)	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Coal Creek Tributary A	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Coal Creek Tributary B	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Crow Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Duck Creek	Tulsa	Valid	1/1/2002	OTHER	HEC-RAS 2.2 (SEPTEMBER 1998)
Duck Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
East Branch Haikey Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
East Branch Haikey Creek	Tulsa	Valid	3/18/2010	HEC-HMS	HEC-RAS
East Branch Joe Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
East Branch Joe Creek Split Flow	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Euchee Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Euchee Creek Tributary 1	Tulsa	Valid	1/1/2002	OTHER	Unknown
Euchee Creek Tributary 2	Tulsa	Valid	1/1/2002	OTHER	Unknown
Fisher Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Fisher Creek Overflow	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Fisher Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-2
Floral Haven Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Franklin Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Fred Creek	Tulsa	Valid	12/30/2003	HEC-1	HEC-2
Fry Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Fry Ditch No. 1	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Fry Ditch No. 1 Tributary	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Fry Ditch No. 2	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Fry Ditch No. 2 Tributary	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Hager Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Haikey Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Haikey Creek	Tulsa	Valid	3/1/1980	HEC-HMS	HEC-2
Harlow Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Harlow Creek Overflow	Tulsa	Unverified	9/1/1979	SNYDER METHOD	HEC-2
Joe Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Little Haikey Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Little Haikey Creek Tributary	Tulsa	Valid	5/1/1983	SNYDER METHOD	HEC-2
Little Haikey Creek Tributary	Tulsa	Valid	11/16/2006	HEC-1	HEC-RAS
Little Haikey Creek Tributary	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Little Joe Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Little Sand Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Lower Fred Creek	Tulsa	Valid	12/30/2003	HEC-1	HEC-2
Middle Branch Haikey Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Middle Branch Haikey Creek	Tulsa	Valid	1/27/2007	HEC-HMS	HEC-RAS
Mooser Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Mooser Creek Tributary	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Nichols Creek	Tulsa	Valid	5/1/1990	HEC-HMS	HEC-2
Nickel Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
North Fork Little Joe Creek	Tulsa	Valid	12/1/1989	SNYDER METHOD	HEC-2
Old Joe Tributary To Fred Creek	Tulsa	Valid	12/30/2003	HEC-1	HEC-2
Olive Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Park Grove Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Polecat Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Posey Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Posey Creek North Tributary 1	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Posey Creek South Tributary 1	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Posey Creek South Tributary 2	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Prattville Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Prattville Creek Tributary 1	Tulsa	Valid	1/1/2002	OTHER	Unknown
Prattville Creek Tributary 2	Tulsa	Valid	1/1/2002	OTHER	Unknown
Prattville Creek Tributary 3	Tulsa	Valid	1/1/2002	OTHER	Unknown
Prattville Creek Tributary 4	Tulsa	Valid	1/1/2002	OTHER	Unknown
Red Fork Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
Red Fork Creek	Tulsa	Valid	1/1/2002	HEC-1	Unknown
Red Fork Creek Tributary 1	Tulsa	Valid	1/1/2002	OTHER	Unknown
Red Fork Creek Tributary 2	Tulsa	Valid	1/1/2002	OTHER	Unknown
Rolling Meadows Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Sand Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Sand Springs Lake Tributary	Tulsa	Valid	3/31/2010	UNKNOWN	HEC-RAS
Sand Springs Lake Tributary	Tulsa	Valid	1/1/2002	HEC-1	Unknown
Shady Grove Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Shell Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Snake Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
Snake Creek Tributary	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS 2.2 (SEPTEMBER 1998)
South Fork Joe Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
South Fork Little Joe Creek	Tulsa	Valid	9/1/1979	SNYDER	HEC-2

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
				METHOD	
Turtle Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
Unnamed Tributary To Coal Creek (West Tulsa)	Tulsa	Valid	12/30/2009	HEC-HMS	HEC-RAS 3.1.3
Unnamed Tributary To West Branch Broken Arrow Creek	Tulsa	Valid	12/24/2008	UNKNOWN	HEC-RAS
Vensel Creek	Tulsa	Valid	9/27/1999	HEC-1	HEC-RAS
Vensel Creek South	Tulsa	Valid	9/27/1999	HEC-1	HEC-RAS
Vensel Creek Tributary D	Tulsa	Valid	9/27/1999	HEC-1	HEC-RAS
Vensel Creek Tributary H	Tulsa	Valid	9/27/1999	HEC-1	HEC-RAS
West Bigheart Creek	Tulsa	Valid	1/1/2002	OTHER	Unknown
West Branch Broken Arrow Creek	Tulsa	Valid	7/1/1983	SNYDER METHOD	HEC-2
West Branch Haikey Creek	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
West Branch Haikey Creek Tributary	Tulsa	Valid	11/1/2005	HEC-HMS	HEC-RAS
West Branch Joe Creek	Tulsa	Valid	9/1/1979	SNYDER METHOD	HEC-2
White Church Creek	Tulsa	Valid	1/1/2002	HEC-HMS	HEC-RAS
Wilmott Creek	Tulsa	Valid	8/17/1981	HEC-1	HEC-2
Arkansas River	Wagoner	Valid	12/1/2007	2040	1033
Arkansas River	Wagoner	Valid	12/1/2007	2040	1033
Broken Arrow Creek	Wagoner	Valid	5/1/1986	2037	1032
Broken Arrow Creek Tributary	Wagoner	Unverified	5/1/1986	2037	1032
Cowetta Creek	Wagoner	Valid	5/1/1986	2037	1032
Cowetta Creek Tributary A	Wagoner	Valid	5/1/1986	2037	1032
Cowetta Creek Tributary B	Wagoner	Unverified	5/1/1986	2037	1032
Middle Branch	Wagoner	Valid	1/1/1985	OTHER	1032
South Branch	Wagoner	Valid	1/1/1985	OTHER	1032

v. 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 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 30 percent of streams miles. For the remaining 70 percent, the CNMS database does not indicate whether or not the streams are model-backed.

Based on limited hydraulic analysis and engineering judgment, several disconnects were identified at the county boundaries. Table 18 lists these disconnects for the PS Watershed.

Table 18: Hydraulic Issues with Floodplain Boundaries

Stream Name	Issue	Location
None		

Table 19 identifies any recent LOMRs in the watershed that have had impacts on the hydraulics and may be the source of disconnects that were located within the floodplains.

Table 19: LOMRs that Revise Hydraulics within the Watershed

Stream Name	Case Number	Basis of Request	Notes
Fry Ditch No. 2	03-06-831P	Base Map Changes, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on new infrastructure, channelization and fill.
Fred Creek, Lower Fred Creek, Old Joe Tributary to Fred Creek, and Unnamed Shallow Flooding Area	03-06-1939P	Base Map Changes, Hydrologic Analysis, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on new infrastructure, channel relocation, and channelization. Project also diverted Fred Creek and created Lower Fred Creek, and an unnamed shallow flooding area.
West Branch Broken Arrow Creek, White Church Creek, Aspen Creek, Elm Creek	04-06-1461P	Hydrologic and Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs and hydraulic analyses were performed due to new topographic data, channelization, new infrastructure, and fill.
Broken Arrow Creek	04-06-1611P	Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on new topographic data, channelization, new infrastructure and fill.
Little Haikey Creek	05-06-A125P	Floodway, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Middle Branch of Haikey Creek	06-06-BE22P	Hydraulic Analysis, Hydrologic Analysis, New Topographic Data Floodway	LOMR that revised BFEs based on updated topographic data, hydrologic and hydraulic analysis.
Middle Branch of Haikey Creek	06-06-BJ56P	Floodway Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Mooser Creek and Mooser Creek Tributary	07-06-2371P	Floodway Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.

Stream Name	Case Number	Basis of Request	Notes
Aspen Creek	08-06-1898P	Hydraulic Analysis, Hydrologic Analysis, Updated Topographic Data	LOMR that revised BFEs based on updated topographic data, hydrologic and hydraulic analysis.
Unnamed Tributary to West Branch Broken Arrow Creek	08-06-2075P	Floodway Hydraulic Analysis, Hydrologic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data, hydrologic and hydraulic analysis.
Unnamed Tributary to Coal Creek (West Tulsa)	09-06-0482P	Hydraulic Analysis, Hydrologic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data, hydrologic and hydraulic analysis.
Unnamed Tributary to Coal Creek (West Tulsa)	09-06-0482P	Hydraulic Analysis, Hydrologic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Arkansas River	09-06-2072P	Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Arkansas River	09-06-2568P	Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Arkansas River	09-06-2568P	Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Arkansas River	10-06-0428P	Floodway, Hydraulic Analysis, Hydrologic Analysis, New Topographic Data, Base Map Changes	LOMR that revised BFEs based on updated topographic data, hydrologic and hydraulic analysis.
East Branch Haikey Creek	10-06-0568P	Floodway, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Hager Creek, Tributary 1 to Hager Creek, Tributary 2 to Hager Creek	10-06-0594P	Update	Re-issuance of a LOMR based on new effective information and vertical datum information. This LOMR does not revise the BFEs or SFHA/floodway boundaries along the revised reaches.
Sand Springs Lake Tributary	10-06-0758P	Hydrologic Analysis, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydrologic and hydraulic analysis.
Posey Creek	10-06-1294P	Floodway, Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on updated topographic data and hydraulic analysis.
Sand Springs Lake Tributary	10-06-1294P	Floodway, Hydraulic Analysis,	LOMR that revised BFEs based on updated topographic

Stream Name	Case Number	Basis of Request	Notes
		New Topographic Data	data and hydraulic analysis.
Posey Creek	10-06-2150P	Update	LOMR that revised BFEs based on an update.
Unnamed Tributary to West Branch Broken Arrow Creek	11-06-0589P	Base Map Changes, Update	Re-issuance of a LOMR based on the the new effective information and vertical datum information.
Fry Creek	99-06-1888P	Hydrologic and Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs based on hydrologic and hydraulic analysis, more detailed topographic information, new infrastructure, fill channelization, and channel realignment.

vi. Summary of Findings

MISSING

IV. Watershed Options

In conjunction with the assessment of risk, need, and the availability of topographic data, as well as the input of community officials and stakeholders in the watershed, flood hazard delineation projects should be initiated in the Polecat Snake Watershed. Table 20 lists some potential needs in the watershed and actions that could be taken under each of the four areas discussed during the Discovery Meeting, which are:

- Risk identification and communication, including traditional flood studies and data updates
- NFIP community actions, including insurance-related mitigation or information
- Mitigation planning and mitigation actions, including items related to planning updates
- Community benefits and grant opportunities, which relate to outreach and disaster preparedness as well as non-flooding hazards like safe room information

Table 20: Potential Watershed Needs and Actions

Risk Identification and Communication
• Update FISs and FIRMs for flooding sources identified by the communities as needing updates due to updated topographic information, infrastructure improvement projects not incorporated into the effective FIS and FIRMs, and inaccuracies in effective information. • City of Jenks noted errors in new floodplain mapping which were resolved by the 2009 FIRM. Errors reappeared on revised 2011 FIRMs. • City of Bixby noted errors in new floodplain mapping for Bixby Creek (downtown area). Revised detailed hydrologic and hydraulic studies for approximate 1 mile are available. • City of Keifer noted errors in floodplain mapping of Childres Creek due to changes to stream. Segments of stream are outside of SFHA. • City of Sapulpa requested a study on Rock Creek to assess risk of significant, recent development in western portion of City. • Tulsa County noted errors along Bird Creek, 56th Street North, east of HWY 169. Area outside Polecat-Snake Watershed. Note in future Bird Creek and/or Lower Verdigris Discovery. • Wagoner County requested study for Redbird Creek and Zone A or AE. • Update FISs and FIRMs and convert Zone As to Zone AEs in urbanized areas where communities noted availability of updated hydrologic and hydraulics detailed studies and floodplain mapping. • City of Broken Arrow noted availability of detailed hydrologic and hydraulic studies and Zone AE floodplain mapping for Elm, Aspen, and Adams[3] creeks. City of Broken Arrow provided matching funding for detailed study of Broken Arrow Creek in 2011. • City of Tulsa, Sapulpa, Sand Springs noted availability of citywide master drainage documents, updated detailed hydrologic and hydraulic studies and revised floodplain mapping. Document already in use as non-regulatory products. • City of Broken Arrow, in collaboration with the City of Tulsa, requested completion of master

[3] Adams Creek is located in the Lower Verdigris HUC-8 Watershed.

Risk Identification and Communication
drainage plan and detailed studies for Haikey Creek. • Perform and/or update FISs on streams identified as having excessive streambed and bank erosion. Evaluate Fry Ditch No. 2, Big Heart Creek, North Fork Little Joe Creek, Mooser Creek, Nickel Creek, and Vensel Creek. • Deliver presentations on the benefits of Risk MAP to interested communities. Include insurance issues in discussions with City of Glenpool.
NFIP Community Action
• Deliver presentations on the benefits of joining the NFIP to non-participating, interested communities. • Deliver presentations on the CRS program to interested communities. • Train communities on the electronic Letter of Map Amendment (eLOMA) process to facilitate LOMC submissions. • Work with Tribes to increase communication.
Mitigation Planning and Mitigation Actions
• Facilitate prompt adoption of plan updates. Mitigation Plans for cities of Sapulpa, Broken Arrow and Glenpool expired in 2009. Updates are being prepared. • Assist communities with preparation of Emergency Action Plan for small communities / private dam owners. • Review availability of grants for small communities / private dam owners for repair and breach inundation mapping. • Assist City of Broken Arrow in continuing the acquisition of floodplain areas. City requested funding assistance. • Foster and support continued communication with communities. Osage county requested to communicate with FEMA regarding bridges in the county. • Train communities on grants for repetitive loss properties. • Support and leverage communities master drainage planning efforts.
Community Benefits and Grant Opportunities
• Additional communities in NFIP. • Community outreach improved. • Increased facilitation for HMP Grants applications. • Expedite the Grant approval process. • Local drainage and flooding issue addressed. • Updated and current flood hazard information for communities. • Increased credibility of NFIP information. • Identification of local drainage issues and possible solutions.

To further detail the list of needs captured during the Discovery meeting and in any follow-up correspondence, Table 21 provides a specific evaluation of streams or areas that could benefit from additional study. FEMA-based metrics are noted that would be met if the need or issue was addressed and if any current FEMA map actions would impact the activity. A comment or concern raised by a stakeholder during the Discovery process that could be correlated to one of the Needs or Actions for the watershed is also noted. Some needs and actions listed were not noted by any particular community but were improvements that could be made in the Polecat Snake Watershed to meet general FEMA Regional goals.

Needs are identified as being on the critical path as high, medium or low priority or as something that a State or local community could be tasked with completing. These definitions are also included in Table 21.

High – Local community would immediately benefit from the action, and FEMA's metrics would also be met.

Medium – Local community would benefit over the longer term from the action, and a portion of FEMA's metrics may be met.

Low – Local community activities can continue without this revision, and FEMA's metrics are not impacted.

Community Action – Activity would be more appropriate as a community-led action rather than a FEMA-led action.

Table 21: Metrics and Rankings of Needs

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	Details				

A	Mitigation / Prepare New HMP	• Completion of new HMP for recommended.
		• The following communities are included Creek County Hazard Mitigation Plan in process but not yet completed:
		• Town of Kellyville
		  o Town of Kiefer
		  o Town of Liberty
		  o Town of Mannford
		  o Town of Mounds
		  o Town of Winchester
		• The Town of Liberty does not currently have a HMP.
			• None	• Facilitate the application for HMP Grants
				• Expedite the Grant approval process
					Community Action	No specific comment

B	Mitigation / HMP Updates	• The following plans are undergoing update, review and/or approval.
		  o City of Broken Arrow
		  o City of Glenpool
		  o City of Sapulpa
		• 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.
			• None	• Impacts all communities
				• Facilitate the application for HMP Grants
				• Expedite the Grant approval process
					Community Action	C2, C3

C	Mitigation / HMP Approval	• City of Sapulpa inquired about FEMA's approval status of completed HMP.	• None	• Impacts community • Facilitate the application for HMP Grants • Expedite the Grant approval process	High	M12

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	Location of Need/Project	Details				
D	Outreach / Coordination for Dam Emergency Action Plan	• City of Broken Arrow expressed concern over program due to lack of hydrologic and hydraulic modeling on dams. • OWRB has begun to request Emergency Action Plans for dams. • OWRB to coordinate and assists communities with compliance.	• None	• Community outreach improved	Community Action	C11
E	Outreach / Coordination for Discovery	• OWRB to provide Discovery Reports.	• None	• Community outreach improved	Community Action	C1, C7
F	Outreach / Coordination for FPM	• OWRB to extend outreach to support protection and beneficial use of floodplain areas.	• None	• Community outreach improved	Community Action	C6
G	Outreach / Coordination for Grant Opportunities	• OWRB to provide information on grants for small communities / private owners for dam repair and breach inundation mapping.	• None	• Community outreach improved	Community Action	C6, M22
H	Outreach / Coordination for Repetitive Loss Grant Opportunities	• City of Sapulpa noted interest in grants opportunities for repetitive loss properties. • City of Sand Springs discussed $3,000,000 grant application for purchase of Anderson Basin Meadow Valley RLPs.	• None	• Community outreach improved	High	C4, C5, C9
I	Outreach / Coordination to enter CRS program	• OWRB to extend outreach for CRS program.	• None	• Potential decrease in flood insurance premiums • Community outreach improved	Community Action	No specific comment
J	Outreach / Coordination to join NFIP program	• Central North Canadian River Conservation District, Dewey County, and Dewey County Conservation District expressed interest in joining the NFIP.	• None	• Additional communities in NFIP • Community outreach improved	Medium	No specific comment

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	Location of Need/Project	**Details**				
K	Outreach / Master Drainage Planning	• City of Broken Arrow requested assistance from FEMA for the completion of a Master Drainage Plan (MDP) for Haikey Creek in cooperation with City of Tulsa. • City of Broken Arrow is currently completing MDP for Adams Creek (Lower Verdigris Watershed). • City of Sapulpa completed MDP in 2011. City requested that studies and new mapping be included in DFIRMs. • Future Sapulpa project underway to change a dam in western portion of City.	• None	• Identification of local drainage issues and possible solutions • Grant application for assistance in mitigation • Community outreach improved	High	C10
L	HAZUS Outreach / Coordination	• Provide information from the Average Annualized Loss Study. • Introduction to HAZUS.	• 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	No specific comment

M	Updating the FIRM and FIS for Arkansas River, Muskogee County.
	• Community noted changes in mapping due to levee decertification.
	• Effective model dated:
	  o 1988 for Upper and Middle Reach, Muskogee County.
	  o 2002 for segment of Arkansas River, Tulsa County.
	  o 2007-2008 for segment of Arkansas River, Wagoner County.
	• Request for study due to significant, recent urbanization changes and replacement of structures.
	• Updated hydrology available since the study effective date.
		• 4.62 miles of detailed hydrologic and hydraulic analysis.
		• 4.62 miles of floodplain mapping.
			• None	• 4.6 miles of new NVUE.
				• Community outreach improved.
				• FIRMs updated to reflect existing conditions.
					High	M3, M4, M5, M24, N17

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	Location of Need/Project	Details				
N	Updating the FIRM and FIS for Aspen Creek, Tulsa County. • Community noted SFHAs mapping changes. • Updated hydrology and hydraulics available to convert from Zone A to Zone AE. • Effective model (for valid segment) dated 2008.	• 7.1 miles of detailed hydrologic and hydraulic study. Updated, detailed hydrology and hydraulics already completed by City of Broken Arrow. • 7.1 miles of floodplain mapping.	• None	• 6.4 miles of new NVUE. • No NVUE for 0.7 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M40, M44, and N1
O	Updating the FIRM and FIS for Bixby Creek, Tulsa County. • Community noted SFHAs mapping changes. • Updated hydrology and hydraulics available. • Effective model dated 2005.	• 1.0 miles of detailed hydrologic and hydraulic study (limit of downtown, City of Bixby). Updated, detailed hydrology and hydraulics already completed by City of Bixby. • 1.0 miles of floodplain mapping.	• None	• No NVUE for 1 mile (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M25

P	Updating the FIRM and FIS for Broken Arrow Creek, Tulsa and Wagoner County.
	• Effective model for Broken Arrow Creek dates to 1983.
	• Request for detailed study due to significant, recent urbanization changes.
		• 24.9 miles of detailed hydrologic and hydraulic analysis for:
		  o 10.7 miles Broken Arrow Creek
		  o 3.1 miles Broken Arrow Creek Tributary
		  o 7.3 miles West Branch Broken Arrow Creek
		• 21.4 miles of floodplain mapping.
		• Updated topo (FY2012) exists for study reaches.
			• None	• 5.2 miles of new NVUE
				• No NVUE for 19.7 miles (study already valid in CNMS).
				• Community outreach improved.
				• FIRMs updated to reflect existing conditions.
					High	C10

Q	Updating the FIRM and FIS for Childres Creek, Town of Keifer.
	• Community noted SFHAs mapping errors.
	  o Creek segments mapped outside SHFA.
	  o New bridge structure (2004) not included in effective study.
	  o Channel modifications performed in 1980s not shown.
	• Effective model dated:
	  o 1980 for Unverified segment
	  o 2007 for Valid segments
		• 11.2 miles of detailed hydrologic and hydraulic study for:
		  o 6.2 miles Childres Creek
		  o 5.0 miles Childres Creek (creek name not populated in CNMS)
		• 11.2 miles of floodplain mapping.
			• None	• 1.1 miles of new NVUE
				• No NVUE for 10.2 miles (study already valid in CNMS).
				• Revision of 5.0 miles of CNMS stream miles (not populated with correct stream name).
				• Community outreach improved.
				• FIRMs updated to reflect existing conditions.
					High	M19, M20, M21, M34

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	Location of Need/Project	Details				
R	Updating the FIRM and FIS for Coal Creek, Tulsa County. • Community requested outreach support to inform residents concerning possible changes in insurance requirements. • Detailed study requested for Zone A in urbanized areas. • Effective study date unknown.	• 20.3 miles of detailed hydrologic and hydraulic study for: o 8.0 miles Coal Creek o 1.1 miles Rolling Meadows o 1.6 miles Nichols Creek o 2.0 miles Unnamed Tributary o 2.15 miles Coal Creek Tributary A o 3.0 Coal Creek Tributary B • 20.3 miles of floodplain mapping.	• None	• 5.9 miles of new NVUE • No NVUE for 14.4 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	N12
S	Updating the FIRM and FIS for Crow Creek, Tulsa County. • Significant channel scour for main stem and tributary.	• 1.8 miles of detailed hydrologic and hydraulic study. • 1.8 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Corrects NVUE to Valid from Unknown • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M51, M52 and M53
T	Updating the FIRM and FIS for Coweta Creek, Wagoner County. • Community requested new studies to assess changes in flood risk due to significant, recent urbanization changes. • Flash flooding reported along Highway 51b caused by Tributary. • Effective model dated 1981.	• 15.8 miles of detailed hydrologic and hydraulic study for: o 9.0 miles Coweta Creek • 1.4 miles Cowetta Creek Tributary A and B o 3.2 miles Middle and South Branch o 2.3 miles Unknown (stream name not populated in CNMS) • 15.8 miles of floodplain mapping.	• None	• 0.7 miles of new NVUE • No NVUE for 5.4 miles (study already valid in CNMS). • Revision of 2.3 miles of CNMS stream miles (not populated with correct stream name). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M6, M31, M32, M33, M37
U	Updating the FIRM and FIS for Elm Creek, Tulsa County. • Community noted SFHAs mapping changes. • Updated hydrology and hydraulics available to convert from Zone A to Zone AE. • Effective model (for valid segment) dated 2008.	• 4.0 miles of detailed hydrologic and hydraulic study for: o 3.75 miles Elm Creek o 0.25 miles Unnamed Stream • 4.0 miles of floodplain mapping. • Updated, detailed hydrology and hydraulics already completed by City of Broken Arrow.	• None	• 4.0 miles of new NVUE. • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M41, M42, M43 and N1

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	Location of Need/Project	**Details**				
V	Updating the FIRM and FIS for Fry Ditch, Tulsa County. • Community noted significant changes to geometry and capacity of channel. • Project currently in construction in the City of Bixby. • Significant channel scour reported for Fry Ditch No. 2. • Effective model dated 2005 for Fry Ditch No. 2.	• 5.6 miles of detailed hydrologic and hydraulic study for: o 0.9 miles Fry Creek o 2.1 miles Old Fry Ditch No. 1 o 2.6 miles Old Fry Ditch No. 1 • 5.6 miles of floodplain mapping.	• None	• 4.7 miles of new NVUE. • No NVUE for 0.9 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M30
W	Updating the FIRM and FIS for Hager Creek, Tulsa County. • Significant channel scour. • Effective model dated 1979.	• 4.0 miles of detailed hydrologic and hydraulic study. • 4.0 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M54
X	Updating the FIRM and FIRM and FIS for Little Haikey Creek, Tulsa County. • Community of Bixby noted: o CLOMR in progress for structural improvements. o New dike/levee constructed for removal of a portion of the land southwest of 126th and Haikey Creek. • City of Broken Arrow noted: o New LOMRs: 144 Lot LOMR (East Branch) and Haikey Creek (West Branch). o Updated 2009 to 2012 topographic data in effect for the East Branch model. o Requested completion of Master DrainaHaige Plan for Haikey Creek in cooperation with the City of Tulsa.	• 8.2 miles of detailed hydrologic and hydraulic study for: o 7.8 miles Little Haikey Creek o 0.5 Little Haikey Creek Tributary • 8.2 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M23, M50, M52

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	Location of Need/Project	**Details**				
Y	Updating the FIRM and FIS for Harlow Creek, Bigheart Creek and West Bigheart Creek, Osage and Tulsa County. • Significant channel scour. • Effective model dated 1979 for Harlow Creek.	• 20.6 miles of detailed hydrologic and hydraulic study for: o 5.1 Harlow Creek o 3.1 Bigheart Creek o 2.7 miles West Big Heart Creek o 1.7 Harlow Creek Overflow o 1.7 Harlow Creek Tributary o 3.0 miles Parkview Ditch and Oak Creek o 2.1 Sand Springs Lake Tributary o 0.7 miles Shady Grove Creek • 20.6 miles of floodplain mapping.	• None	• 7.2 miles of new NVUE. • No NVUE for 13.4 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M50, M51
Z	Updating the FIRM and FIS for Haskell Creek, Town of Haskell, Muskogee County. • Effective model dated 1988 for segments of main stem. • Noted as unverified in CNMS. Channel intersects Town of Haskell.	• 3.8 miles of approximate (model-backed) hydrologic and hydraulic study for: o 0.7 miles Haskell Creek Tributary 1 o 3.1 miles Unnamed Stream • 0.6 miles of detailed hydrologic and hydraulic study for Haskell Creek. • 4.4 miles of floodplain mapping.	• None	• 0.63 miles of new NVUE. • No NVUE for 6.8 miles (study already valid in CNMS). • Revision of 6.1 miles of CNMS stream miles (not populated with correct stream name). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	No specific comment.
AA	Updating the FIRM and FIS for Joe Creek, Tulsa County. • Effective model dated 1979. • Significant channel scour at Joe Creek and North Fork Little Joe Creek.	• 12.9 miles of detailed hydrologic and hydraulic study. • Updated, detailed hydrology and hydraulics available for 2.2 miles of Old Joe Tributary to Fred Creek and South Fork Joe Creek (LOMR submitted by City of Tulsa). • 15.1 miles of floodplain mapping. • Updated topographic information available.	• None	• 0.23 miles of new NVUE. • No NVUE for 12.7 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M50, M51, M52
AB	Updating the FIRM and FIS for Mooser Creek, Tulsa County. • Effective model dated 1979. • Significant channel scour.	• 4.7 miles of detailed hydrologic and hydraulic study for: o 3.6 miles Mooser Creek o 1.1 miles Mooser Creek Tributary • 4.7 miles of floodplain mapping. • Updated topographic information available.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M51, M52

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	Location of Need/Project	**Details**				
AC	Updating the FIRM and FIS for Nickel Creek, Creek County. • Effective model dated 1998 for 4.6 miles of Nickel Creek. • Significant channel scour.	• 6.65 miles of detailed hydrologic and hydraulic study for: o 4.6 miles Nickel Creek o 2.05 miles Tributaries (not populated with correct stream name in CNMS). • 6.65 miles of floodplain mapping. • Updated topographic information available.	• None	• 4.6 miles of new NVUE. • No NVUE for 2.1 miles (study already valid in CNMS). • Revision of 2.1 miles of CNMS stream miles (not populated with correct stream name). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	No specific comment.
AD	Updating the FIRM and FIS for Polecat Creek, Tulsa County. • Community noted SFHAs mapping changes. • New studies requested to assess changes in flood risk. (Current study prepared for grant application to be updated to include floodways) • Effective model dated 2007.	• 8.7 miles of detailed hydrologic and hydraulic study for Polecat Creek Tributary 2, 4, 4-1 and 4-2, Creek County. • 8.4 miles of detailed hydrologic and hydraulic study for Polecat Creek, Tulsa County. Perform in conjunction with Wilmott Creek. • 17.1 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M11, M15
AE	Updating the FIRM and FIS for Red Fork Creek, Tulsa County. • Significant channel modifications made since date of effective model. • Effective model dated 1979.	• 0.7 miles of detailed hydrologic and hydraulic study. • 0.7 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M52
AF	Updating the FIRM and FIS for Rock Creek, Creek and Tulsa County. • Community noted: o New development in floodplain near Wickam and 117th Street, Creek County. o New subdivision and school, has occurred in the western portion of the City. • Request for study due to significant, recent urbanization changes and replacement of structures.	• 10.5 miles of detailed hydrologic and hydraulic study for: o 7.3 miles Rock Creek o 3.2 miles Unnamed Stream • 10.5 miles of floodplain mapping.	• None	• 9.0 miles of new NVUE • No NVUE for 1.5 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M7, M10

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	Location of Need/Project	**Details**				
AG	Updating the FIRM and FIS for Snake Creek, Tulsa County. • Community noted SFHA mapping changes for: o Channelization project (Ina Beck's property). o Railroad bridge removal in 1980s or 1990s. Model not yet updated to reflect the removal of the road bed which acts as a levee. o New bridge constructed on East 203rd Street west of 145th. o Knight Industrial Park CLOMR issued in 2009. Work under construction. • Effective model dated 2002.	• 15.7 miles of detailed hydrologic and hydraulic study: o 12.1 miles Snake Creek o 3.6 miles Snake Creek Tributary • 15.7 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M26, M27
AH	Updating the FIRM and FIS for Vensel Creek, Tulsa County. • Significant channel scour. • Effective model dated 1999.	• 4.6 miles of detailed hydrologic and hydraulic study for: o 2.3 miles Vensel Creek o 1.5 miles Vensel Creek South o 0.7 miles Vensel Creek Tributary D & H • 4.6 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M51, M58
AI	Updating the FIRM and FIS for White Church Creek, Tulsa County. • Community requested new studies to assess changes in flood risk due to significant, recent urbanization. • Effective model dated 2002.	• 4.1 miles of detailed hydrologic and hydraulic study. • 4.1 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	N5
AJ	Updating the FIRM and FIS for Wilmott Creek, Tulsa County. • Community noted SFHAs mapping changes. • New studies requested to assess changes in flood risk since 2009 DFIRM. • Effective model dated 1981.	• 1.3 miles of detailed hydrologic and hydraulic study. • 1.3 miles of floodplain mapping.	• None	• No NVUE for 1.3 miles (study already valid in CNMS). • FIRMs updated to reflect existing conditions.	High	M16, M17 and M18

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