

CHAPTER 6. FLOODS

A flood, as defined by the [National Flood Insurance Program](#), is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days. These floods, which occur when water rises and spills over the banks of a river, are also referred to as riverine floods.

Floods can also occur with little or no warning and can reach full peak in only a few minutes. Such floods are called flash floods. A flash flood usually results from intense storms dropping large amounts of rain within a brief period, but they can also occur if there is rapid snowmelt in the spring. Both events result in water flowing down from the mountains, collecting in drainages (streams and rivers), and causing a surge of rising flood waters.

According to the National Flood Insurance Program (NFIP) Community Status Book, Converse County has a current effective Digital Flood Insurance Rate Map (DFIRM) date of November 2009. The map covers the entire county and includes flood hazard areas subject to inundation by the 100-year flood event.

The North Platte River is the main source of flooding in Converse County, although many of its tributaries have the potential to flood as well. A series of upstream reservoirs exist on the North Platte beginning about 50 miles upstream of Glenrock. Most of the flood events on the North Platte occur due to snowmelt runoff and thunderstorms, or a combination of both. Ice jams in the winter months have been known to raise the river stage, but no out-of-bank flooding has been recorded. Intermittent streams may flood due to intense localized thunderstorms, and to a lesser extent, from heavy spring rains (FEMA Flood Insurance Study (FIS), 2009).

Geographical Extent

The southern section of the county is mountainous with steep slopes and stream valleys, making it more vulnerable than other parts of the county to flash flooding. All areas of the county are vulnerable to riverine flooding. Areas of lower elevation within Douglas are subject to periodic flooding due to overflow of the North Platte River, Antelope and East Antelope Creeks, Miller Draw, and the Unnamed Drainage. The North Platte River, which runs west to east through the towns of Glenrock and Douglas, has an average winter flow of 500-750 cubic feet per second (cfs) and an average spring and summer flow of 2,000-3,000 cfs.

Converse County is located downstream of several reservoirs that dam the North Platte River, notably Seminoe and Pathfinder Reservoirs. The primary cause of flooding in the North Platte River near Douglas is runoff from the drainage area below the reservoirs, particularly from drainages entering the North Platte from the south (FEMA FIS, 2009).

In times of high river flow, the upstream reservoirs can fill to capacity, which results in excess water flowing over uncontrolled spillways and increasing the volume of water in the already-swollen river. Douglas normally receives about 44 percent of its annual average 13.5 inches of precipitation in the months of April, May, and June. The lightest precipitation generally occurs in January (FEMA FIS, 2009).

Most of Converse County is situated within five watersheds: the Antelope in the northwest corner, the Dry Fork Cheyenne in the north-central region, the Lightning in the northeast, the Middle North Platte-Casper in the central/south east (including Rolling Hills and Glenrock), and the Glendo Reservoir Watershed in the central/south west (encompassing Douglas and Lost Springs) (EPA, 2011). The County has a relatively low population density (2.8 persons per square mile), which makes the danger to human health and life from flooding in the County quite low. The towns of Douglas and Glenrock, which lie along the North Platte River and its tributaries, account for most of the documented flood risk in the County.

Flood loss potential exists throughout the county, not just along the North Platte River. Tributary flooding has occurred in the past and caused recordable damages to fields, buildings, infrastructure, and other property (see “History,” next section).

History

Flooding has occurred in Converse County several times in the past. High flows occurred on the North Platte River in the years 1937, 1965, 1970, and 1973. One structure, a barn on the Wyoming State Fairgrounds, was inundated in the 1973 flood. The largest flood recorded by USGS gages in Converse County on the North Platte River occurred on May 15, 1965. Discharge volumes from this flood were 16,000 cfs at the gage approximately eight miles downstream of Glenrock, and 23,800 cfs at the gage near the community of Orin. This flood is approximately a 50-year event, or one that has a 2% chance of occurring in a given year.

Another notable flood event in Converse County was in May of 1978, when a severe thunderstorm produced up to 4.5 inches of rain overnight. Bridges and sections of roads were washed out, power lines were downed, and there was extensive damage to homes, property, crops, and livestock. Damages throughout the entire flooded area, including outside counties, were estimated at approximately \$15.5 million (information from Converse County).

In May of 1991 a flash flood occurred when a storm produced 4.5 to 11 inches of rain in 48 hours. Sections of county roads were washed out by tributary flooding, and the North Platte River came within one inch of overflowing its banks near the rural community of Orin. After the flood, there was erosion and major damage to irrigation pumps and canals, fences, and fields. Storm drains became clogged, and there were flooded basements in many areas of the County. The Water Commissioner at the time estimated the flood to be a 100-year event, at its peak.

A recent flash flood took place in July of 2008, when heavy rains caused LaPrele Creek to flood, which in turn flooded the North Platte River. The flow of water increased from

2,000 cfs to 12,000 cfs in only a few hours. Sandbagging was done for three homes in the Orin area, but no other structures were threatened. Other small streams and creeks throughout the Douglas area also flooded during this event.

In June of 2010 the North Platte reached flood stages due to rapid snowmelt and a late-season snowstorm in upstream counties, prompting sandbagging efforts in Douglas around structures in low-lying areas.

The information in Table 6.1 below is from the Wyoming Hazard Mitigation Plan (2008) and presents historic flood events for Converse County.

Table 6.1 Historic Floods in Converse County

Date	Location	Deaths or Injuries	Property Damage
7/27/1941 - 7/28/1941	Converse County		<p>Comments: A number of locally heavy rains and flash floods occurred during the month. Probably the most severe of these were the ones in southern Campbell and northern Converse Counties on the 11th and on the 27th and 28th. Considerable damage was done to growing crops and hay meadows, as well as some loss of livestock.</p>
6/26/1952	Esterbrook		<p>Comments: A hail and rain storm at Esterbrook on the 26th caused a flash flood, which did considerable damage to fences and bridges.</p>
7/24/1955	Esterbrook		<p>Comments: An observer at Esterbrook reported a cloudburst and flash flood at the Fawcett ranch nine miles to the east on the 27th that resulted in considerable damage to corrals, fences, irrigation dams, and ranch buildings. The icehouse and its contents, the springhouse, bridges, the chicken house and some thirty chickens were carried away by flood waters. The residence escaped the flood although it sustained some water damage.</p>

Date	Location	Deaths or Injuries	Property Damage
1/1/1962	Douglas, Antelope, East Antelope		
<p>Comments: A flood occurred due to inadequate bridge capacity and storm sewer overload. Mostly basements and the ground floor of structures were damaged.</p>			
5/14/1965	Glenrock, Deer Creek		\$175,000
<p>Comments: Heavy rains, especially in the central mountains, on top of heavy snow caused flooding on streams flowing out of the Laramie Mountains below Wheatland and Casper. Homes, utilities, park facilities, and athletic facilities were damaged, and many bridges and culverts were destroyed.</p> <p>Amount of damage: Glenrock- \$50,000; County- \$125,000; heavy damage from Glendo through Douglas to Glenrock.</p> <p>Discharge values: Box Elder Creek at Box Elder- 4,530 cfs; LaBonte Creek- 8,770 cfs; North Platte River near Glenrock- 16,000 cfs; North Platte River at Orin- 23,000 cfs.</p>			
6/16/1965	Bill	1 death	\$2,250
<p>Comments: Flash flood killed one coal miner on Antelope Creek.</p>			
6/12/1970	Glenrock, Deer Creek		\$1,000,000
<p>Comments: Northeast residential area flooded, municipal park severely damaged, trailer court, croplands, bridges, fences, and farm buildings damaged.</p> <p>Discharge values: Deer Creek at Glenrock- 14,200 cfs; LaPrele Creek near Douglas- 17,300 cfs</p>			

Date	Location	Deaths or Injuries	Property Damage
7/22/1983	Laramie Range drainage, eastward to southwest of Douglas near LaPrele Reservoir		
<p>Comments: Heavy thunderstorms sat almost stationary on eastern slopes of the Laramie Range for hours. Caused widespread flooding along creeks and streams. Runoff collapsed a dam, sending a 10- to 15-foot high wall of water through a nearby ranch, flooding it.</p>			
8/1/1984	Glenrock		\$2,250
<p>Comments: A thunderstorm dumped two inches of rain in 30 minutes (3.2 inches total) from a 90-minute deluge at Glenrock. Rain flooded basements of several houses, a car, and several businesses. Other minor flood damage and lightning strikes also occurred.</p>			
7/1/1998	50 NW Douglas to 30 N Douglas		\$2,000
<p>Comments: A storm produced up to 6 inches of rainfall over an area 50 miles northwest of Douglas to 30 miles north of Douglas. Water covered many rural roads in the area.</p>			

Probability of Future Events

The available flood history indicates that damaging floods occur infrequently in Converse County. Documented flood history for Converse County extends back to 1937 as described previously. This record shows about 14 floods or high-flow events in the last 73 years, which translates to one event every five years or so, or about a 19% chance any given year. Note that not all of these floods caused damage to property. Most of these floods have taken place in the summer months of June, July, and August.

National Flood Insurance Program (NFIP) Claims Analysis

Converse County, Douglas, and Glenrock all participate in the NFIP. Converse has participated since 1988, Douglas since 1978, and Glenrock since 1985. As of January 2011, there were 51 flood insurance policies in Converse County with an insured value of \$9,116,200 (source: Wyoming Office of Homeland Security, 1/2011). Forty-five of these policies are single family, one is multi-family, two are “other” residential, and three

are non-residential. Table 6.2 shows the number of insured properties in the NFIP broken out by participating communities and unincorporated areas.

Douglas has the most insurance policies (primarily single-family), but Glenrock is the only area where NFIP insurance claims have been made for flood damages. There have been no substantial damage claims (claims in excess of 50% of the structure value) in the County since 1978, the date of the initial Flood Hazard Boundary Map. There are no repetitive loss properties in Converse County as of January 2011.

Table 6.2 National Flood Insurance Program Polices and Claims

Municipality	Total Number of Policies	Insurance in Force (\$)	Insured Structure Type				Number of Paid Losses	Total Losses Paid (\$)
			Single Family	2-4 Family	All Other Residential	Non-residential		
Douglas	26	4,384,600	23	1	2	0	0	0
Glenrock	7	820,400	5	0	0	2	4	7,350.8
Unincorporated Converse County	18	3,911,200	17	0	0	1	0	0
Totals	51	9,116,200	45	1	2	3	4	7,350.8

Source: FEMA Community Information System Database for the NFIP, 2011

Impacts

Historic data indicate no injuries and one death associated with past flooding. The May 1978 flood is likely the most costly event recorded to date and may be considered the flood of record for Converse County. The flood caused about \$15.5 million worth of damage spread over 12 counties. A County-specific breakdown was not available. Assuming an even distribution of loss, Converse County had an estimated \$1.2 million in damages from that event. HAZUS-MH was used to estimate future impacts from floods and is described in the following section, and shows the potential for much higher losses.

Flood Loss Analysis

Planning level flood loss estimates were made available for every county in Wyoming with the 2010 update to the Wyoming Hazard Mitigation Plan. The results for Converse County are discussed in this section. FEMA used HAZUS-MH MR2 to model the 100-year floodplain and perform associated building and population risk assessments. HAZUS-MH is FEMA's GIS-based natural hazard loss estimation software. The HAZUS-MH flood model results include analysis for Converse County, modeling streams draining a 10-square-mile minimum drainage area, using 30 meter (1 arc

second) Digital Elevation Models (DEM). Hydrology and hydraulic processes utilize the DEMs, along with flows from USGS regional regression equations and stream gauge data, to determine reach discharges and to model the floodplain. Losses are then calculated using HAZUS-MH national baseline inventories (buildings and population) at the census block level.

HAZUS-MH produces a flood polygon and flood-depth grid that represents the 100-year floodplain. The 100-year flood is a flood magnitude that has a 1% chance of being equaled or exceeded in any single year. While not as accurate as official flood maps, these floodplain boundaries are available for use in GIS and could be valuable to communities that have not been mapped by the NFIP.

HAZUS-MH generated damage estimates are directly related to depth of flooding and are based on FEMA's depth-damage functions. For example, a two-foot flood generally results in about 20% damage to the structure (which translates to 20% of the structure's replacement value). The HAZUS-MH flood analysis results provide number of buildings impacted, estimates of the building repair costs, and the associated loss of building contents and business inventory. Building damage can cause additional losses to a community as a whole by restricting the building's ability to function properly. Income loss data accounts for losses such as business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses.

Potential losses derived from HAZUS-MH used default national databases and may contain inaccuracies; loss estimates should be used for planning level applications only. The damaged building counts generated are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis. In rural Wyoming, census blocks are large and often sparsely populated or developed; this may contribute to inaccurate loss estimates. HAZUS-MH assumes population and building inventory to be evenly distributed over a census block; flooding may occur in a small section of the census block where there are not actually any buildings or people, but the model assumes that there is damage to that block. There could also be errors and inadequacies associated with the hydrologic and hydraulic modeling of the HAZUS-MH model.

In addition, excessive flood depths may occur due to problems with a DEM or with modeling lake flooding. Errors in the extent and depth of the floodplain may also be present from the use of 30 meter digital elevation models. HAZUS Level II analyses based on local building inventory, higher resolution terrain models, and DFIRMs could be used in the future to refine and improve the accuracy of the results.

Tables 6.3 and 6.4 contain the results of the HAZUS loss estimation for four municipalities within Converse County and the unincorporated area. Building and contents value loss estimates, income-related loss estimates, and displaced population and shelter needs estimates are included in Table 6.3. These loss estimates have been grouped by municipality to demonstrate how the risk varies across the county. Per capita loss was calculated using total building loss and Census 2009 estimates to the municipal- and county-level population. Percent building loss and percent contents loss

were calculated using building and contents loss estimates, and HAZUS building and exposure data. Table 6.4 shows these estimates, also grouped by municipality.

The estimated number of displaced people for the entire county is 590, with 219 people requiring short-term shelter. Douglas, with the highest 2009 population, has the highest estimate for displaced people and people needing short term shelter (201 and 122, respectively); followed by the unincorporated areas (320 displaced, 65 needing shelter) and then Glenrock (69 displaced, 32 needing shelter). Per capita loss is estimated to be highest in the unincorporated areas (\$2,429 per person), followed by Douglas (\$716 per person) and Glenrock (\$584 per person). Potentially impacted structures in municipal areas include residential, commercial, industrial, and government buildings, to name a few examples. In sparsely-populated areas, much of the building value is concentrated in industrial structures.

Three maps were produced at the county scale and for each municipality (for a total of 12 maps). The “Flood Hazards” map shows the HAZUS floodplain boundary, the “Flood Depth” map shows the HAZUS flood depth data, and the “Building Loss” map shows total building loss, in dollars, by census block. It is important to note that the highest flood depth in the municipality maps indicates the maximum depth for the county and is not representative of the highest depth in that municipality. County-scale maps are shown on the following pages as Figures 6.1, 6.2 and 6.3. Municipality-level maps follow as Figures 6.4, 6.5, 6.6 (Douglas); 6.7, 6.8, 6.9 (Glenrock); and 6.10, 6.11 and 6.12 (Lost Springs).

According to the HAZUS model output, Converse County would suffer a total of \$16,547,000 (2009 dollars) in direct economic loss to buildings, and 590 people would be displaced in the event of a county-wide 100-year flood. There would be an estimated total of 50 damaged buildings, 12 of which would be substantially damaged (damage to greater than 50% of the structure). The North Platte River flows east across the county, through Glenrock and Douglas. Sand Creek flows south through Rolling Hills and drains into the North Platte River. The City of Douglas would suffer the most damage of the jurisdictions in the county, with a total direct economic loss for buildings of \$4,450,000 and 201 displaced people. Douglas also has the greatest percent building loss (0.7%), percent contents loss (0.8%), and per capita loss of the jurisdictions in the county. The total county, incorporated and unincorporated, would suffer 1.1% building loss, 1.4% contents loss, and \$1,219 per capita loss.

Converse County has been mapped by the NFIP and has Digital Flood Insurance Rate Maps or DFIRMs, available. All municipalities in Converse County have DFIRM coverage except the Towns of Lost Springs and Rolling Hills which are considered by FEMA to be non-flood prone communities. HAZUS did model some flood hazards that are within the boundaries of Lost Springs. Further study of the resulting map indicates there is no development in the HAZUS flood hazard area.

DFIRM is considered to be the best available data, and is therefore represented here for comparison purposes. The DFIRM 1% annual change and 2% annual chance are represented on the “Flood Hazards” map at both the county scale and for each of the municipalities. With the exception of small floodplain sections in the Douglas, Converse

County's DFIRM 1% annual chance boundary is wider and more extensive than the HAZUS 1% annual chance boundary. If the DFIRM coverage was used for analysis, loss estimates would likely be higher. The DFIRM map for Douglas indicates that a substantial area of the southeastern portion of the town is subject to inundation from the 0.2% annual chance or 500 year flood. The loss estimation does not reflect the risk to this larger, yet less likely, flood event.

Table 6.3 HAZUS Loss Estimation

Municipality	Building Loss (\$K)	Contents Loss (\$K)	Inventory Loss (\$K)	Relocation Loss (\$K)	Capital Related Loss (\$K)	Wages Loss (\$K)	Rental Income Loss (\$K)	Total Loss (\$K)	# of Displaced People	# of People Needing Short Term Shelter
Douglas	2,357	1,990	38	6	6	51	2	4,450	201	122
Glenrock	887	549	-	2	-	-	1	1,439	69	32
Lost Springs	-	-	-	-	-	-	-	-	-	-
Rolling Hills	-	-	-	-	-	-	-	-	-	-
Unincorporated	5,424	5,004	152	5	15	56	2	10,658	320	65
TOTAL	8,668	7,543	190	13	21	107	5	16,547	590	219

Table 6.4 HAZUS Loss Estimation Additional Analysis

Municipality	2009 Population*	Total Exposure (\$K)	Building Loss (\$K)	Building Exposure (\$K)	% Building Loss	Contents Loss (\$K)	Contents Exposure (\$K)	% Contents Loss	Total Loss (\$K)	Per Capita Loss (\$)
Douglas	6,212	591,798	2,357	34,7239	0.7%	1,990	244,559	0.8%	4,450	716
Glenrock	2,466	229,276	887	14,1429	0.6%	549	87,847	0.6%	1,439	584
Lost Springs	1	176	-	117	0.0%	-	59	0.0%	-	-
Rolling Hills	512	26,347	-	16,863	0.0%	-	9,484	0.0%	-	-
Unincorporated	4,387	478,673	5,424	290,031	1.9%	5,004	188,642	2.7%	10,658	2,429
TOTAL	13,578	1,326,270	8,668	795,679	1.1%	7,543	530,591	1.4%	16,547	1,219

* U.S. Census Bureau

Summary

PROPERTY AFFECTED: Medium

POPULATION AFFECTED: Medium

PROBABILITY: Medium

JURISDICTION AFFECTED: Douglas, Glenrock, unincorporated county

References

Converse County, flood history information.

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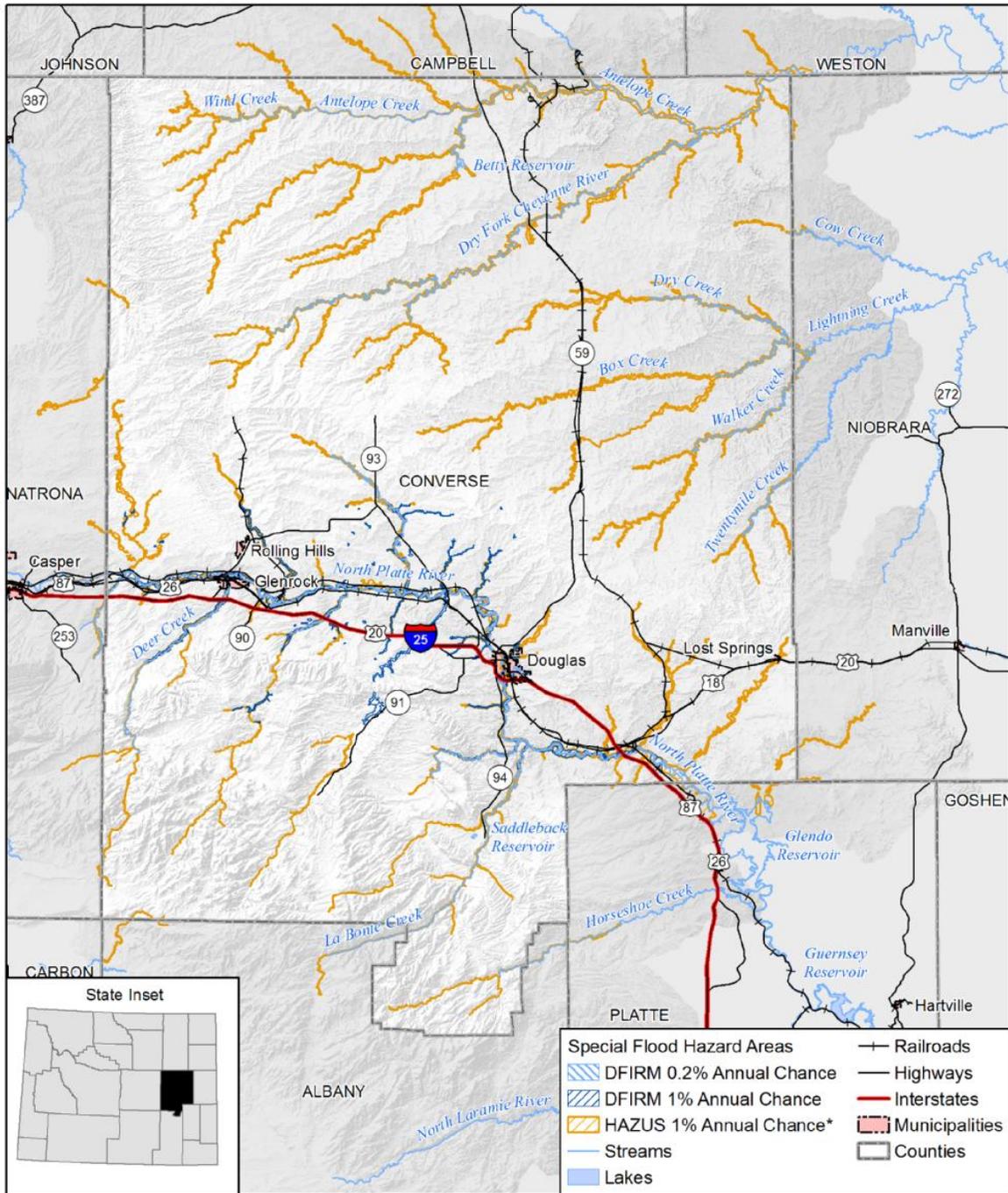
<<http://cfpub.epa.gov/surf/state.cfm?statepostal=WY>>

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Converse County DFIRM and HAZUS Flood Hazards

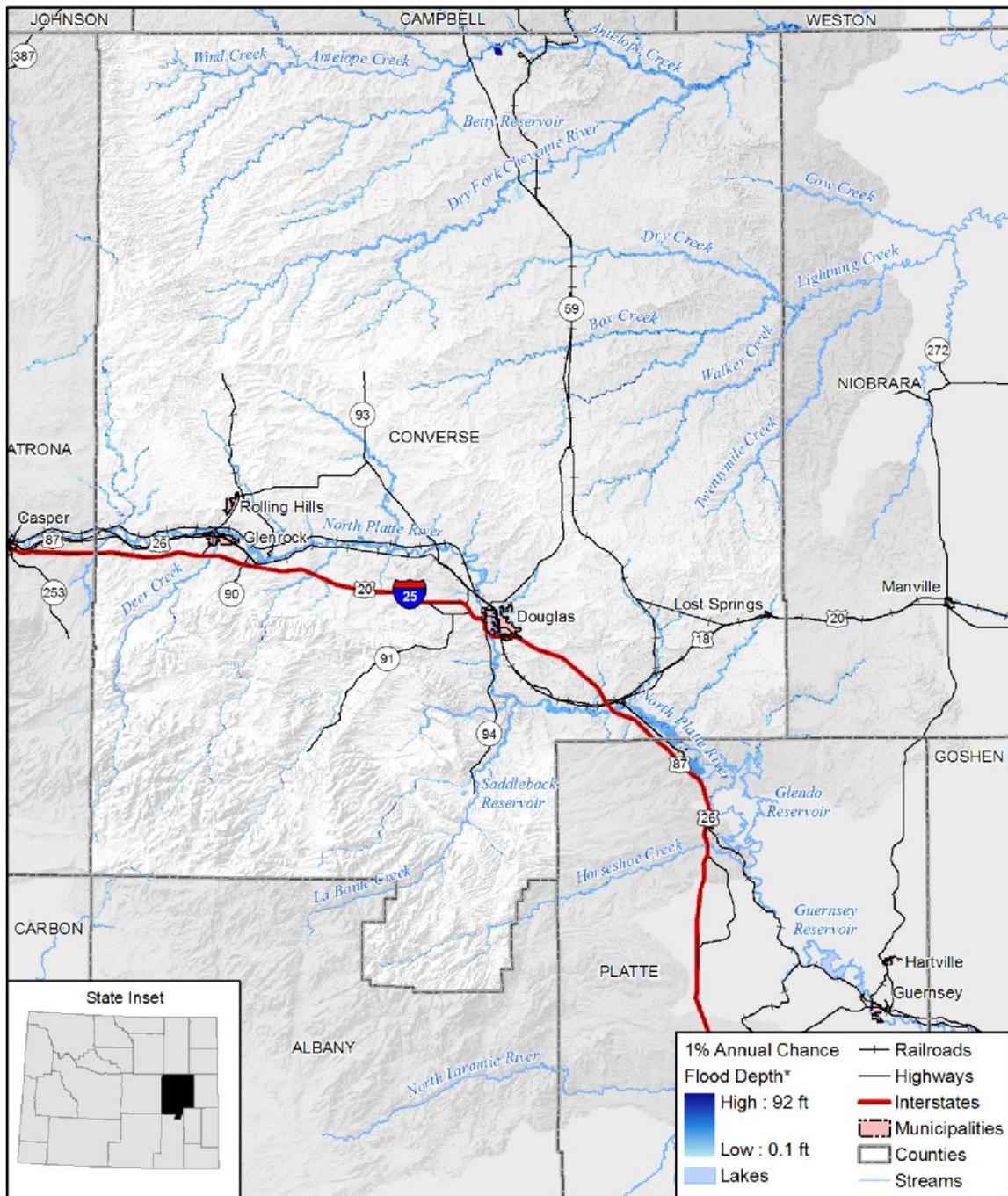


Map compiled 6/2010; intended for planning purposes only
 Data Sources: DFIRM NFHL 3/17/2010, HAZUS-MH MR2, USGS, WYGISC
 * Approximate Flood Hazard modeled by FEMA with HAZUS Level 1 utilizing 30 meter DEM



Figure 6.1 Converse County Flood Hazard Areas

Converse County HAZUS Flood Depth

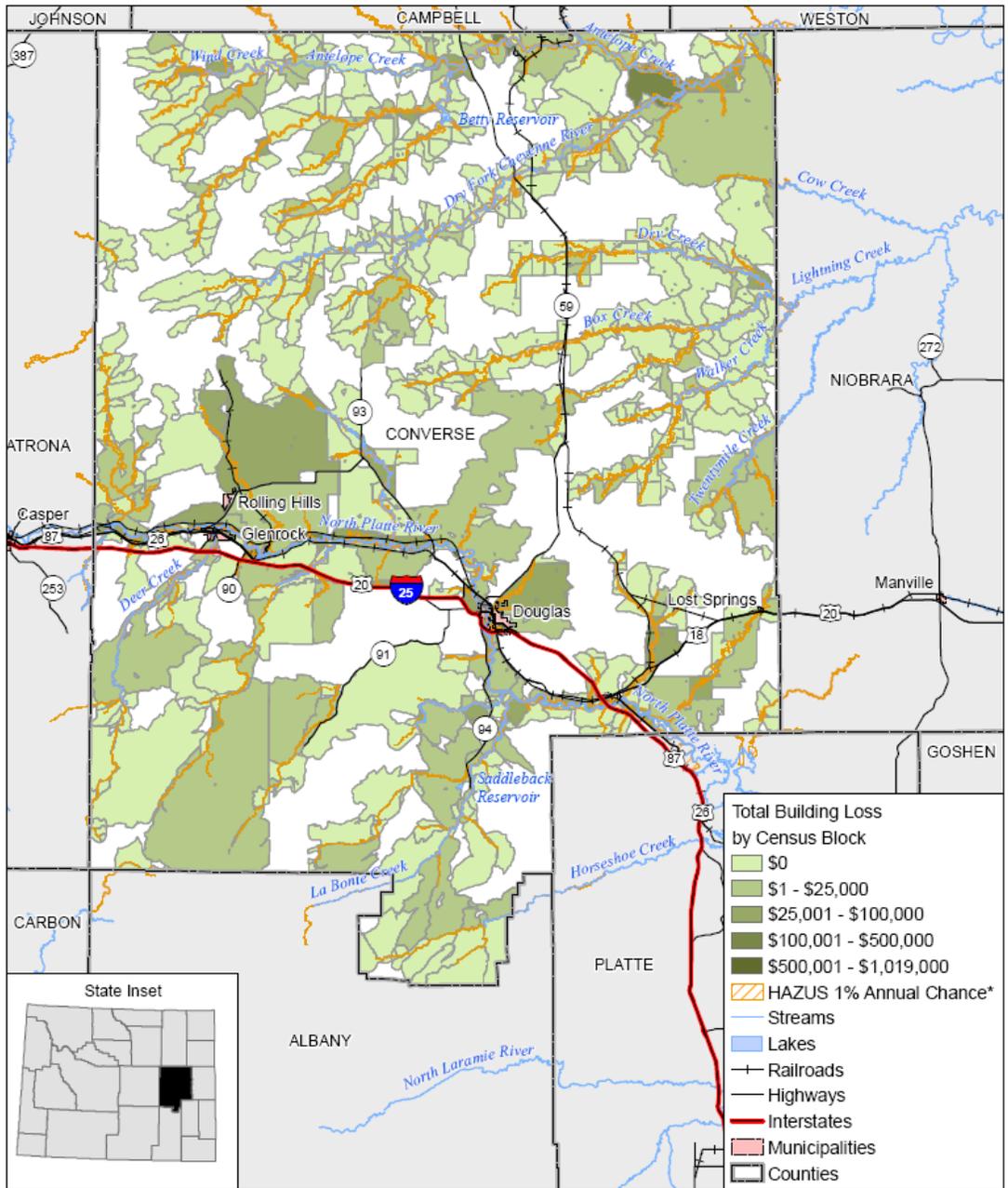


Map compiled 6/2010; intended for planning purposes only
 Data Sources: HAZUS-MH MR2, USGS, WYGIS
 * Approximate Flood Hazard modeled by FEMA with HAZUS Level 1 utilizing 30 meter DEM



Figure 6.2 Converse County HAZUS Flood Depth, 100-year Flood

Converse County HAZUS Building Loss



Map compiled 6/2010; intended for planning purposes only
 Data Sources: HAZUS-MH MR2, USGS, WYGIS
 * Approximate Flood Hazard modeled by FEMA with HAZUS Level 1 utilizing 30 meter DEM



Figure 6.3 Converse County Building Loss by Census Block

City of Douglas DFIRM Flood Hazards

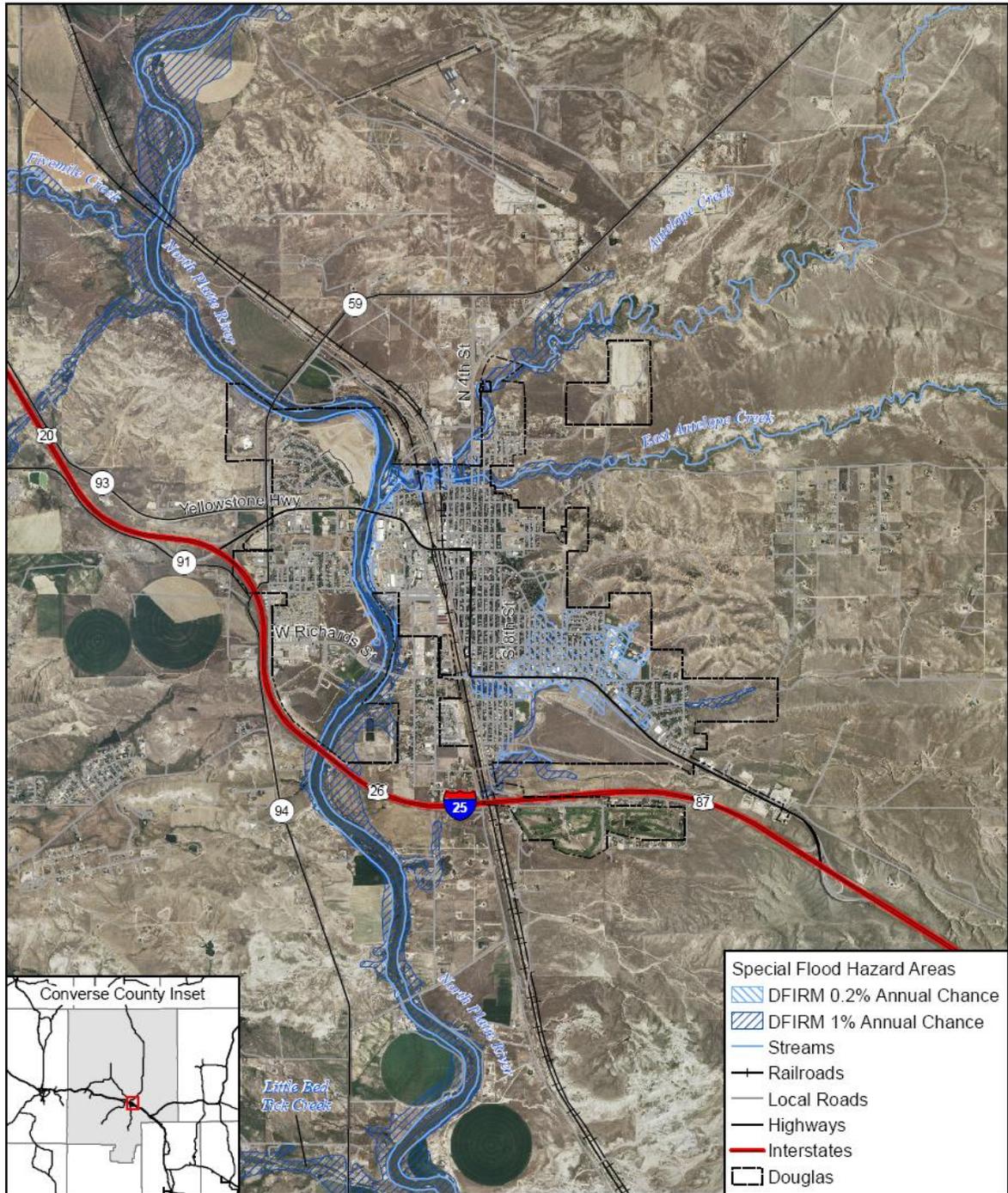


Figure 6.4 Douglas Flood Hazard Areas