2. Watershed Characterization

2.1. Hydrology

Squaw Creek is part of the larger South Skunk River Watershed (HUC 8) which, after combining with the North Skunk River, becomes the Skunk River. Figure 2-1 shows the hydrologic map for the State of Iowa and where the Squaw Creek watershed lies. The Skunk River flows into the Mississippi River which ultimately drains into the Gulf of Mexico. It is important to understand the hydrologic setting of the Squaw Creek watershed and the challenges facing downstream areas. Many communities draw their drinking water from downstream rivers and countless people are dependent on the rivers and the Gulf of Mexico for their livelihoods. While having clean water within the small streams of the Squaw Creek watershed may not seem important, dependable flows of clean water are essential to the economies of downstream populations. Hypoxia/dead zone issues in the Gulf of Mexico are well documented but closer to home; reaches of the South Skunk River are impaired due to elevated bacteria levels.

Figure 2-1. Squaw Creek Watershed Hydrologic Setting

2.1.1. **Subwatersheds**

Table 2-1 summarizes the 7 main subwatersheds (HUC 12) within the watershed. We have developed an alternate naming convention for the subwatersheds that is hopefully more intuitive than the HUC12 names. In the case where a large reach (and associated direct drainage area) of Squaw Creek is within the subwatershed the name is appended with "Squaw Creek". In other cases where the subwatershed is the drainage area to a unique resource that named creek stands alone. This is the case for Montgomery and Onion Creek Subwatershed.

Table 2-1. Subwatersheds of the Squaw Creek Watershed

Subwatershed	HUC 12	HUC 12 Name	Area (acres)	Percent of Total
Crooked Creek	070801050301	Crooked Creek 2	11,618	7.90%
Drainage Ditch192 - Squaw Creek	070801050302	Drainage Ditch 192	24,355	16.60%
Montgomery Creek	070801050303	Montgomery Creek	21,643	14.70%
Crooked Creek -Squaw Creek	070801050304	Crooked Creek 3	26,164	17.80%
Onion Creek	070801050305	Onion Creek	12,733	8.70%
Lundys Creek -Squaw Creek	070801050306	Lundys Creek	27,167	18.50%
Worle Creek -Squaw Creek	070801050307	Worrell Creek	23,273	15.80%

Crooked Creek Subwatershed

The Crooked Creek subwatershed is located in the northeastern end of the watershed and, along with the Drainage Ditch 192- Squaw Creek subwatershed, can be partially considered the headwaters of Squaw Creek (some maps alternatively refer to Crooked Creek as a branch of Squaw Creek). The subwatershed is approximately 12,000 acres. The City of Stanhope is located in the subwatershed which is entirely within Hamilton County. Other resources in the subwatershed include an un-named tributary that flows from southeast of Stanhope and meets up with Crooked Creek near where it drains into Squaw Creek. The subwatershed is also heavily ditched and tiled.

Drainage Ditch 192 – Squaw Creek Subwatershed

This subwatershed is located in the northwestern end of the watershed and can be considered the headwaters of Squaw Creek. The subwatershed is roughly 24,000 acres. The eastern half of the City of Stratford is within the subwatershed. Portions of Webster, Boone and Hamilton County are within the subwatershed. It is the only subwatershed that extends in to Webster County. Hydrologically, the subwatershed is heavily ditched and tiled. Other than Upper Squaw Creek, the subwatershed has

Drainage Ditch 192, Stratford Creek and Drainage Ditch 245. The subwatershed outlet is defined as the confluence with Crooked Creek.

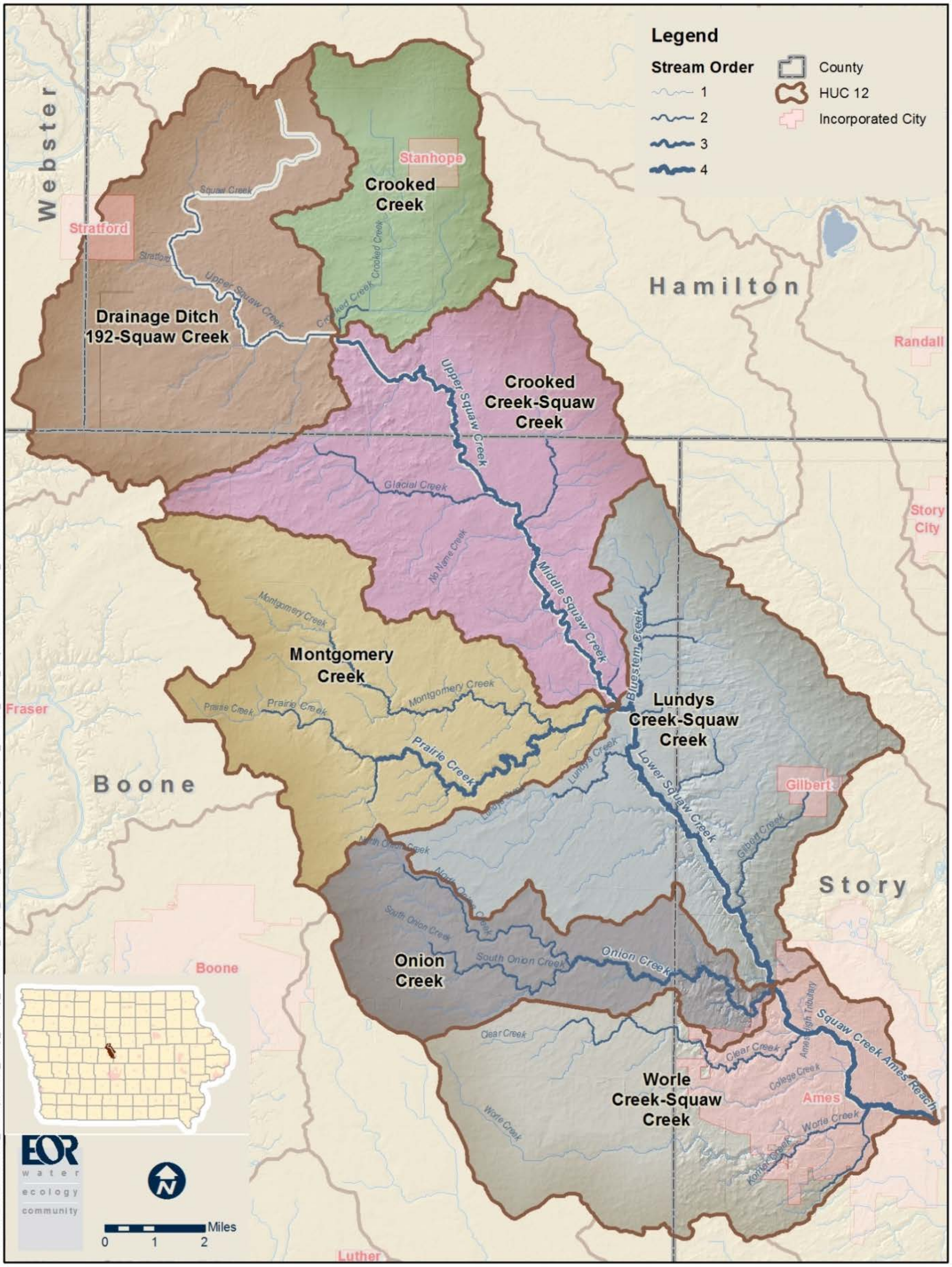

Figure 2-2. Squaw Creek Subwatersheds

Montgomery Creek Subwatershed

The Montgomery Creek subwatershed is located in the west central portion of the watershed and lies entirely within Boone County. The subwatershed is roughly 22,000 acres. Drainage within the subwatershed runs mainly eastward through Montgomery and Prairie Creeks and their numerous tributaries. The subwatershed drains into Squaw Creek approximately at its midpoint.

Crooked Creek – Squaw Creek Subwatershed

This subwatershed is in the north central part of the watershed along the northern boundary of Booke County. It also extends slightly into southern Hamilton County. The subwatershed is approximately 26,000 acres. Squaw Creek becomes well defined within the subwatershed. It runs from below the point at which Crooked Creek joins Squaw Creek down to the point at which Montgomery Creek drains into Squaw Creek. Squaw Creek becomes a recreational use stream within the subwatershed. Specifically, at the confluence with Glacial Creek it transitions to a Class 2A stream. Further information on the classification can be found in the watershed assessment section. In addition to Squaw and Glacial Creeks the subwatershed contain Scott Drainage Ditch 292 and several small un-named tributaries.

Onion Creek Subwatershed

The Onion Creek subwatershed is located in the southern portion of the watershed and drains approximately 13,000 acres of Boone County and a portion of Story County, including a very small portion of the City of Ames. Onion Creek branches into North and South Onion Creek midway up the subwatershed. Onion Creek drains into Squaw Creek near the northern border of the City of Ames.

Lundy's Creek – Squaw Creek Subwatershed

This subwatershed is located in the eastern portion of the watershed and straddles the boundary between Boone and Story Counties. The City of Gilbert is within the subwatershed. It is approximately 27,000 acres. Besides the mainstem of Squaw Creek, the subwatershed includes Lundy's Creek, Little Bluestem Creek and Gilbert Creek/Drainage Ditch 70 as well as several small un-named tributaries. The outlet of the subwatershed is defined as the confluence with Onion Creek.

Worle Creek – Squaw Creek

This subwatershed is at the lower end of the watershed and contains its outlet into the South Skunk River. Boone and Story Counties are located within the subwatershed as is a large portion of the City of Ames. The subwatershed contains several tributaries; Clear, College and Worle Creeks in addition to the mainstem of Squaw Creek itself. There are approximately 23,000 acres of land in the subwatershed nearly half of which is developed to various degrees.

2.1.2. **Hydrologic Model Drainage Areas**

In addition to the 7 major HUC12 subwatersheds we have delineated drainage areas that are on the order of ~500 acres each. This further refinement was needed for the watershed modeling and will be used to report the results of that analysis (Figure 2-3). Also shown in the figure are the modeled reaches.

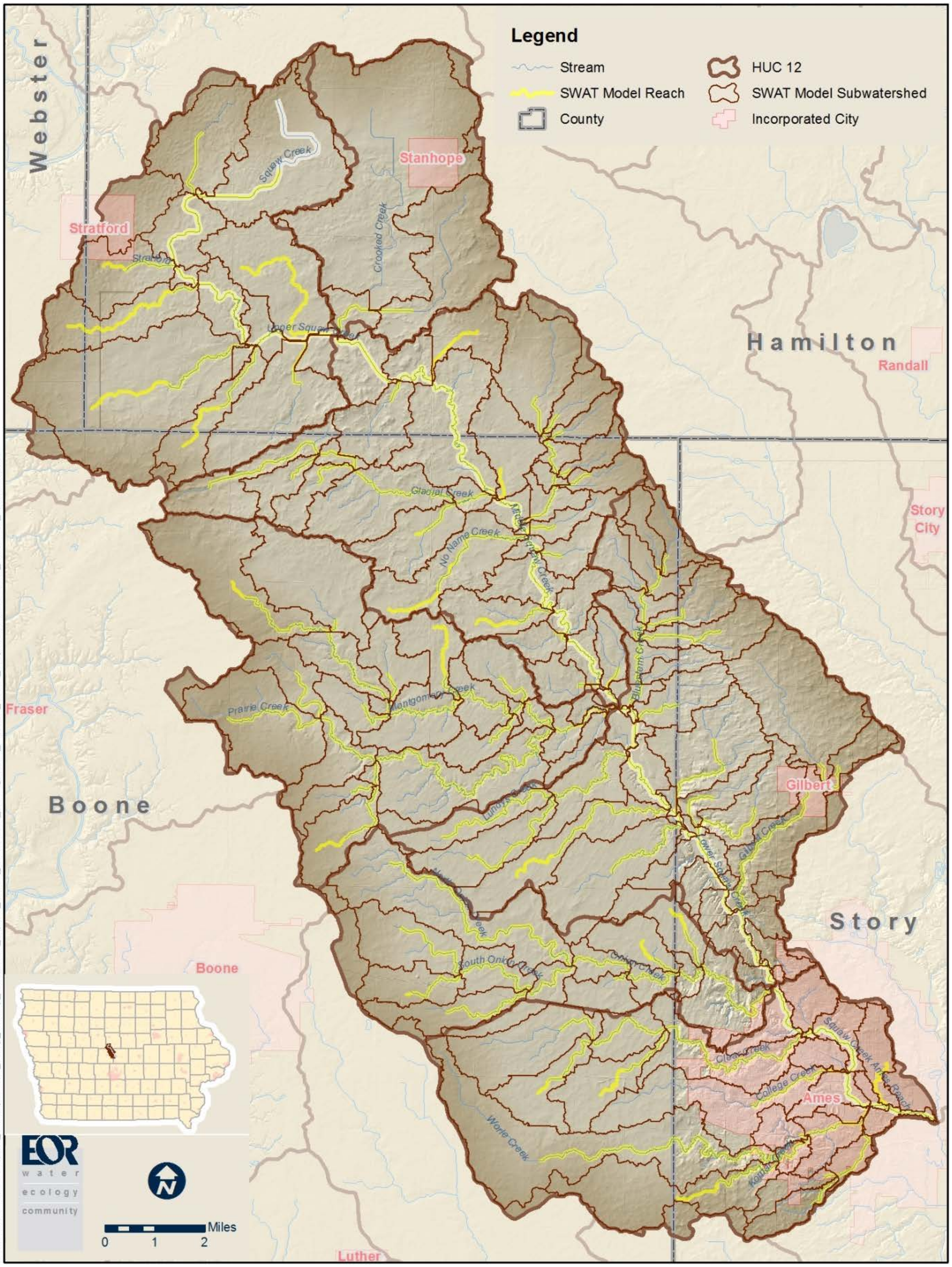

Figure 2-3. Watershed Model Drainage Areas and Stream Reaches

2.1.3. **Stream Reaches**

For the purpose of describing discreet units of the mainstem Squaw Creek we have developed a stream reach naming convention. The reaches were defined by changes in stream use, tributary inputs and common land use. The reaches are shown in Figure 2-2. The water quality analysis is based on these reaches

Upper Squaw Creek

This is the upsteam-most reach of Squaw Creek. It extends from above the confluence of Glacial Creek to the headwaters of Squaw Creek. The rationale behind breaking the reach at Glacial Creek is that is the point along the stream where the Class A1 Primary Contact Recreational Use designation ends (see Appendix 3: Recreational Use Assessment and Attainability Analysis). Upper Squaw Creek is designated as a Class B(WW2) water.

Upper Squaw Creek runs through the Crooked Creek – Squaw Creek and Drainage Ditch 192 – Squaw Creek Subwatersheds.

Middle Squaw Creek

This reach of Squaw Creek runs, looking downstream, from the confluence with Glacial Creek to the confluence with Montgomery Creek. It is the upper-most portion of the Class A1 Primary Contact Recreational Use designation.

Middle Squaw Creek runs within the southern half of the Crooked Creek – Squaw Creek Subwatershed.

Lower Squaw Creek

This reach of Squaw Creek runs, looking downstream, from the confluence of Montgomery Creek to the confluence of Onion Creek and is designated as a A1 Primary Contact Recreational Use water.

Lower Squaw Creek runs entirely within the Lundy's Creek Subwatershed.

Squaw Creek Ames Reach

This is the reach of Squaw Creek that lies below Onion Creek to the outlet of Squaw Creek into South Skunk River. The reach is designated as a A1 Primary Contact Recreational Use water

Squaw Creek Ames Reach runs entirely within the Worle Creek – Squaw Creek Subwatershed.

Further description of each reach of Squaw Creek and its tributaries can be found in the stream health section.

2.2. Watershed Topography

The figure on the following page (Figure 2-4) depicts the topographical relief and varying slopes found within the watershed. It was derived using LIDAR data. The slope and topographical data was used in developing watershed model input parameters and to determine the most appropriate sites for conservation practices.

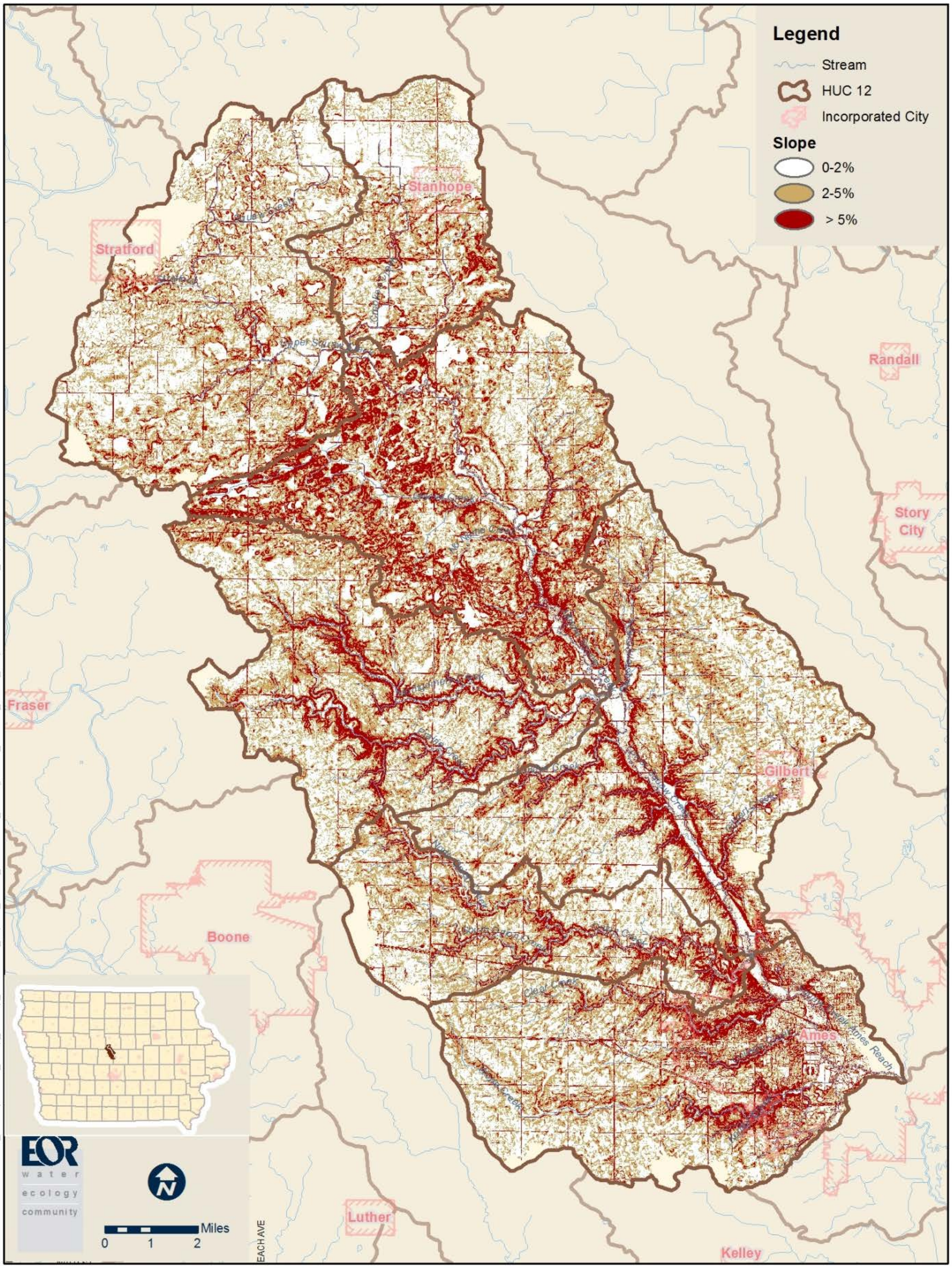

Figure 2-4. Slopes within the Squaw Creek Watershed

2.3. Land Cover/Land Use

The land uses and land cover, both natural and human influenced, within a watershed are the main factors in determining the quality and character of its water resources. Land use within the Squaw Creek watershed is heavily agricultural with some urban land use found primarily in the lower subwatersheds (Table 2-2).

We have provided two land use maps for the watershed. The first, (Figure 2-5) is a high resolution land cover map produced from aerial imagery in 2009. This figure does an excellent job of depicting the various land covers within the watershed, particularly the forested riparian areas along the major stream reaches and the varied land cover within the developed portions of the watershed. Of note, however, is the observation that this mapping may be over predicting the presence of ponds and wetlands, particularly in the northern portions of the watershed. It is possible that the mapping was developed during a wet period. The second land use map (Figure 2-6) was built for the watershed modeling and integrates cropping rotational information from the past 6 years. This land use mapping was provided by David James of the USDA-ARS. The crop rotations have been combined for display purposes. Within the model there are 16 distinct land uses when all of the various crop rotations are taken into consideration. Additionally, the model also discretizes the various crop rotations as to whether they occur on surface inlet draintile or subsurface draintile. Refer to the SWAT Modeling section for further information. The land use summary of Table 2-2 uses the second land use classification.

Table 2-2. Land Use of the Squaw Creek Watershed

Land Use	Acres	% of Watershed
Corn Soybean	105,225	71.6%
Continuous Corn	12,561	8.5%
Conservation Corn Rotation	3,694	2.5%
Forest	3,953	2.7%
Grass	11,331	7.7%
Urban	10,107	6.9%
Ponds/Wetlands	129	0.1%

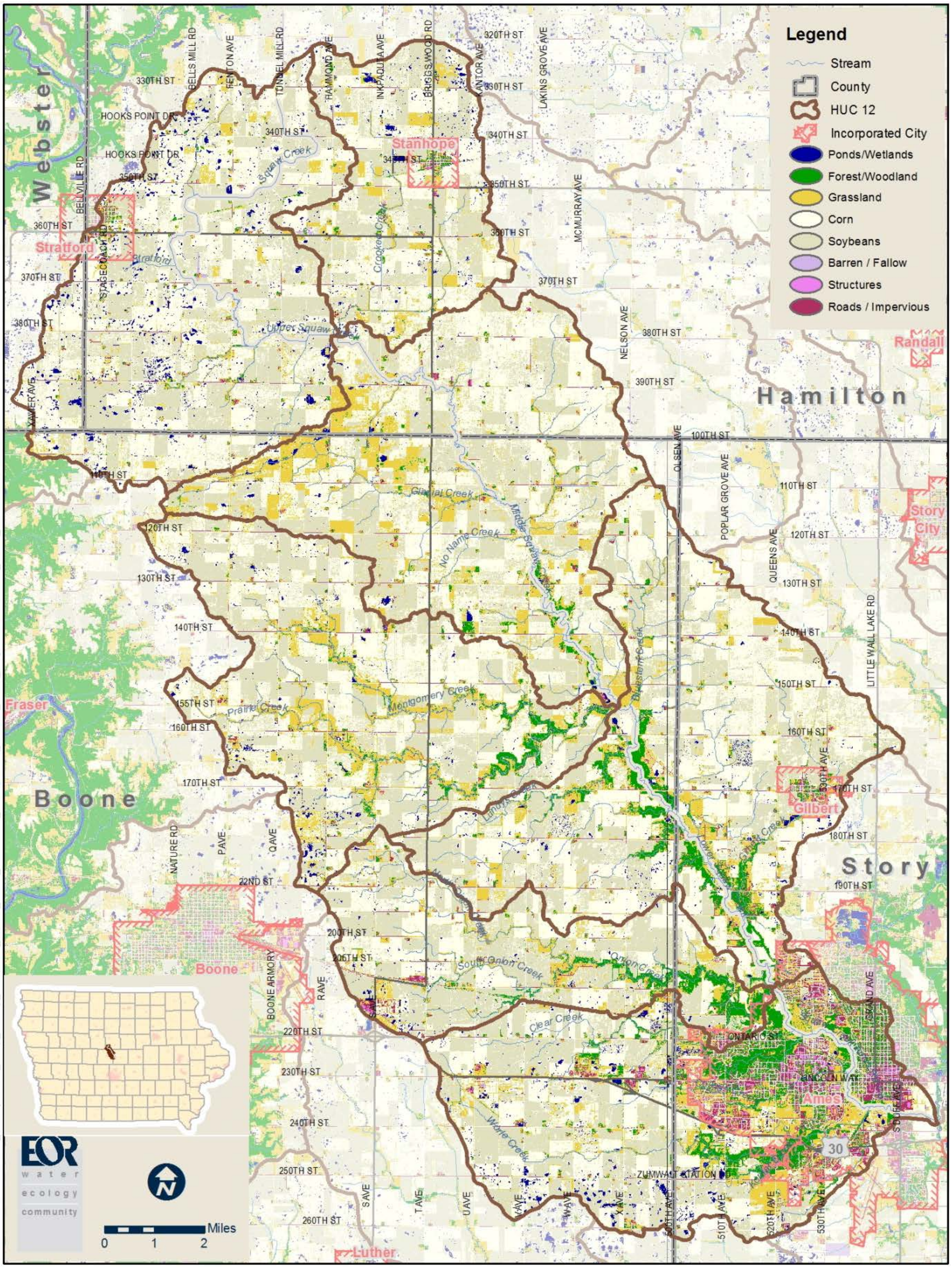

Figure 2-5. High Resolution Land Cover Squaw Creek Watershed 2009

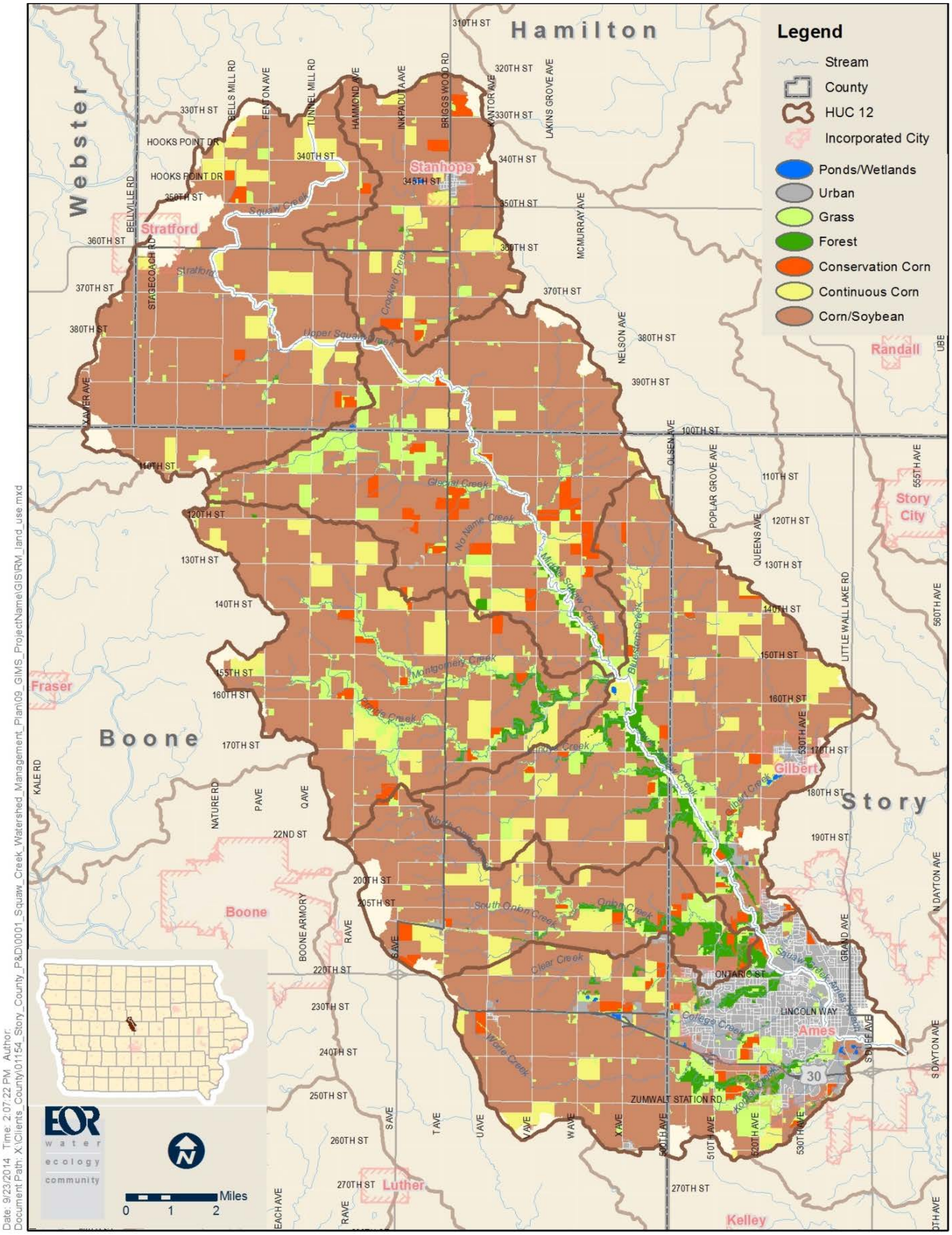

Figure 2-6. Land Use Squaw Creek Watershed

2.4. Climate

Climate information is one of the first aspects examined in watershed studies. Stream runoff is largely determined by rainfall patterns as moderated by temperature, evaporation, vegetation, ponds/storage, slopes and land uses such as agricultural fields and impervious surfaces in the urban setting. The Squaw Creek area has what is referred to as a humid continental climate with extremes of both cold and heat.

2.4.1. **Temperature**

National Oceanic and Atmospheric Administration (NOAA) climate data from Ames, IA were summarized with corresponding average, maximum and minimum monthly temperatures plotted by month (Figure 2-7). The average annual temperature is about 50° F with hot and humid summers often near or exceeding 90° F. Peak average daily summer temperatures (about 85° F) are typically observed in July with slightly lower averages noted for June and August. Winters can be harsh dropping well below freezing in December, January and February. The remaining 'cold' months of November, March and April typically have average daily maximum temperatures above freezing (32°F). Broadly speaking, daily average minimum and maximum temperatures vary about 15- 25° F.

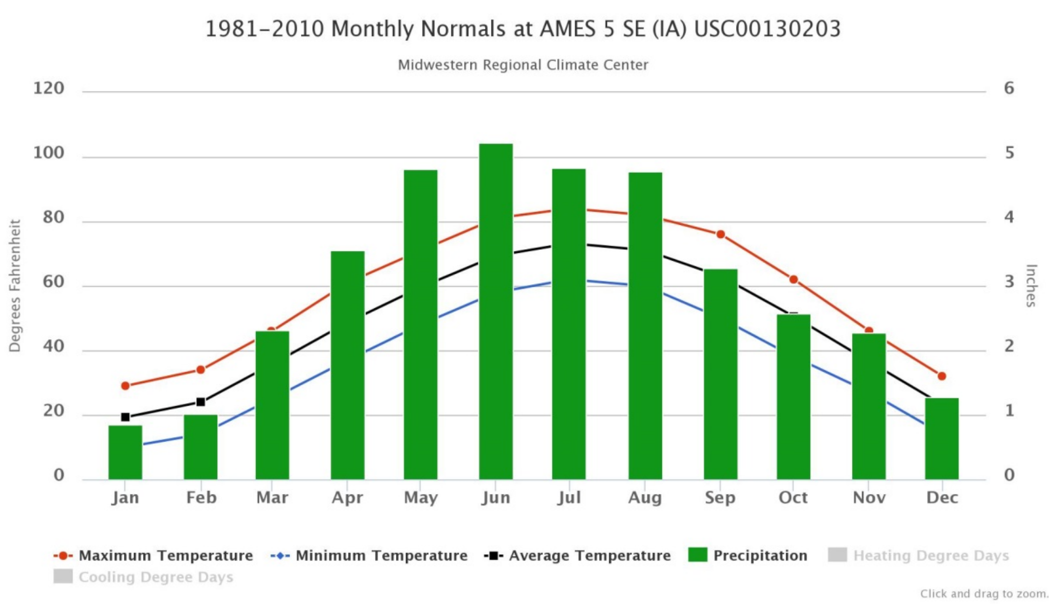

Figure 2-7. Average monthly climate data for Ames, IA. NOAA's Midwestern Regional Climate Center

It has been noted that the regional temperatures have increased. To evaluate this, average annual minimum and maximum temperatures for Ames, IA (Station 8 WSW) were plotted in Figure 2-8 and Figure 2-9. While there can be seen a slight increase in average annual maximum temperatures, the increasing pattern is much more pronounced for the average annual minimum temperatures. Annual minimum temperature values have increased about 2-3 degrees F from 1970 to 2013. Other studies have also noted that since 1970: (1) the nighttime temperatures have increased more than the daytime temperatures; (2) daily minimum temperatures have increased in the summer and winter; (3) daily maximum temperatures have risen in winter but declined substantially in the summer (Report to the Governor and Iowa General Assembly, 2011.)

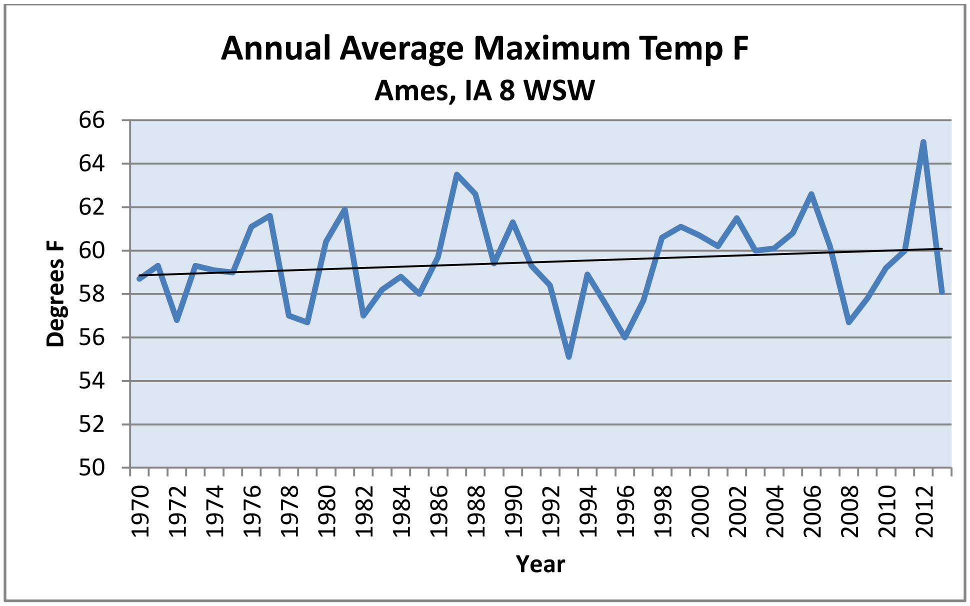

Figure 2-8. Annual Average Maximum Temperature 1970-2013, Ames IA

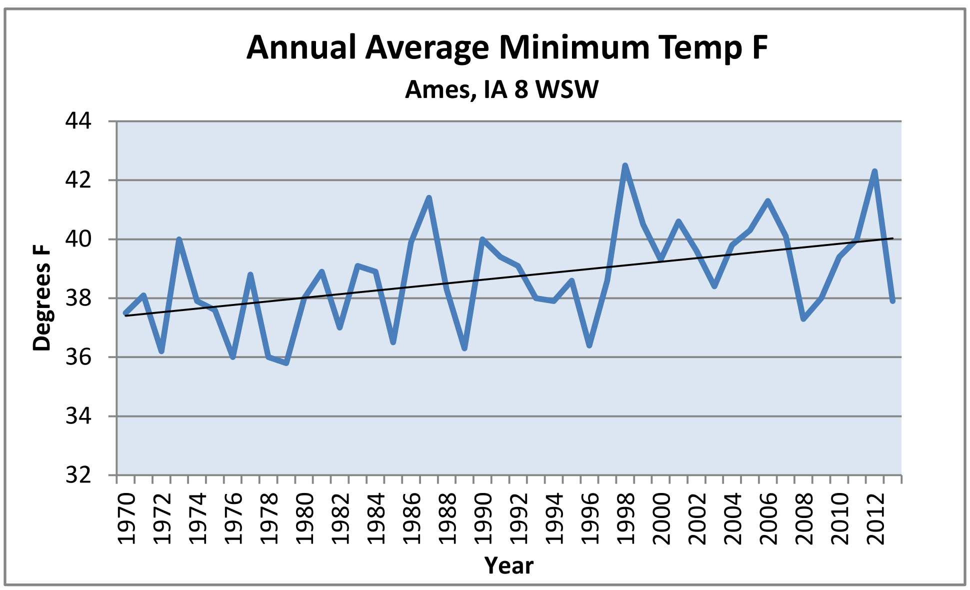

Figure 2-9. Annual Average Minumum Temperature 1970-2013, Ames IA

2.4.2. **Rainfall**

Annual average precipitation totals about 35.8 inches +/- 8.0 inches with the growing season typically having the highest rainfall totals of about 3.5 inches to 5 inches per month. Annual rainfall measured at the Ames, IA site during the 1970 – 2013 time period has varied from about 21 inches (1981) to 56.4 inches (1993 flood) (Figure 2-10). For the same time period, growing season (May-October) rainfall averaged about 21.5 +/- 6.9 inches with values that ranged from about 10.4 inches (1976) to 45.72 inches (1993) (Figure 2-11). Most recently drier growing season conditions were noted in 2012-2013 with about

11.7 and 14.8 inches recorded, respectively. In contrast, 2010's growing season was noted to be 39.3 inches. Hence, considerable variability has been noted over the past 10 years.

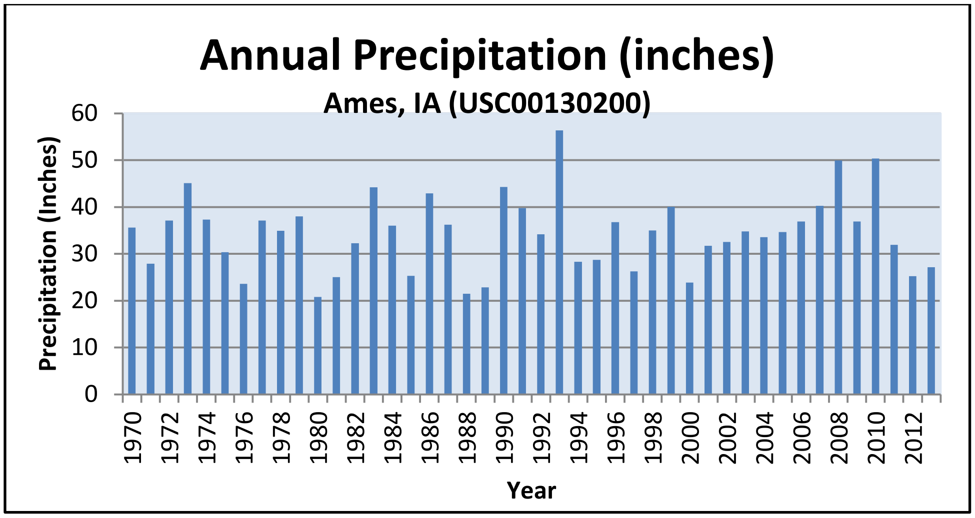

Figure 2-10. Annual Precipitation 1970-2013, Ames IA

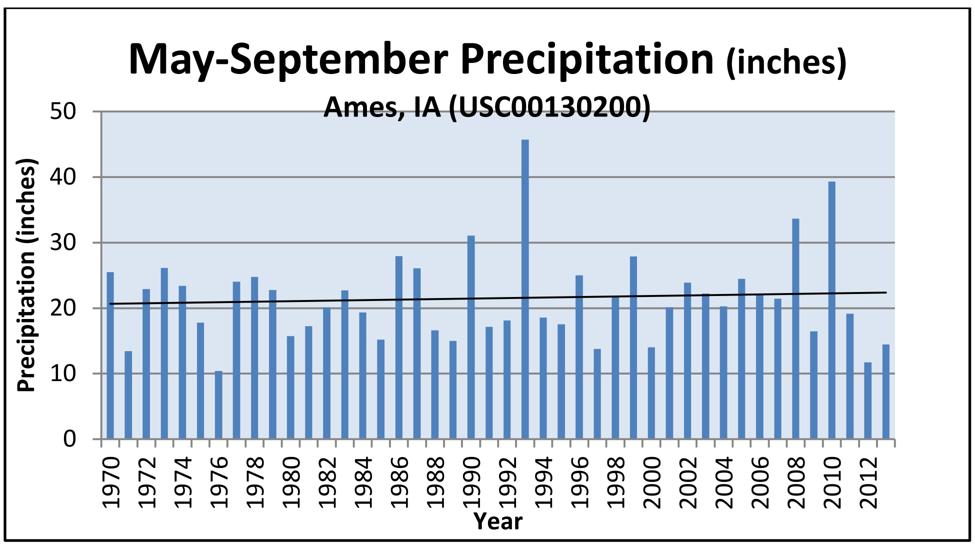

Figure 2-11. Growing Season (May-Sept) Precipitation 1970-2013, Ames IA

2.4.3. **Storm Intensities and Rainfall Amounts**

Of increasing interest is the intensity of storms and the amounts of rainfall that occur over longer periods. This was examined by looking at rainfall intensity (or inches of rain per 2 hours, 24 hours etc.) and the duration of storm events (very short time periods such as 5 minutes to much longer periods up to 60 days). Annually, two hour storms of 1.63 inches up to 24 hour storms of 2.74 inches are to be expected. These totals increase to 2.38 inches (over two hours) to 3.88 inches (24 hour storms) inches when looking at storms that occur every five years. Hence, cloud bursts of this intensity and amounts should be typically expected.

Wet periods can be evaluated based on the occurrences of back-to-back events over 2 or more days, for example. The State of Iowa recently sponsored an update of the rainfall records by NOAA in what is called Atlas 14 (NOAA, 2013) that characterizes storms for all areas of the State. From this report, data from Ames, IA was summarized and expressed in terms of common occurrences (annually expected) versus the much less common storms (such as the one per 100 year storm). These storm terms are confusing as the later means that there is a 1/100 or 1 percent chance of a storm at a specific location. Values are now included for the 1 per 1000 year events or 0.1 percent chance of occurring over an area on any one day.

From the updated NOAA records (through 2009), a 2.74 inch storm over 24 hours can be expected each year in the Ames area. In a similar fashion, a 4.5 inch storm over 24 hours can be expected every 10 years, 6.99 inch storm per 24 hours can be expected every 100 years and 9.96 inch storm per 24 hours can be expected every 1000 years. Also noted has been the increase in summer storms (those exceeding 1.25 inches per 24 hours) and depending upon storm speed and tracks, are capable of producing summer flooding events. In general, the more common storms have not increased appreciably, however larger storms have increased particularly in the eastern half of Iowa

From a stormwater management perspective, water quality designs (such as stormwater ponds) typically focuses on 1-2 year frequency events (about 2.74 – 3.15 inches/day), roadway drainage on the 10 year events (about 4.5 inches/day) and flood prevention designs based on the 100 year events (about 6.99 inches/day).

2.4.4. **Wet Periods**

Back-to-back storms extending over several days may be a better yard stick for evaluation of impacts to fields, cities and stream runoff. For a perspective, longer events occurring over **2-4 days** were defined using the same NOAA Atlas 14 data with precipitation totals noted as follows:

- Annual recurrence: 3.13 to 3.63 inches
- 5 year recurrence: 4.34 to 5.09 inches;
- 10 year recurrence: 5.01-5.93 inches and
- 100 year recurrence: 7.65 to 9.05 inches. (Similar to the August 9-11, 2010 back-to-back event.)

Wet periods, or back-to-back rain events occurring within four days with rainfall totals ranging from 3 to 5 inches, can be expected to generate substantial runoff volumes. Hence, stormwater runoff from both agricultural and urban settings should consider a variety of innovative practices to encourage retaining and slowing runoff for rainfalls of this magnitude as possible. This same range of rainfall was noted to generate peak Squaw Creek instantaneous and daily average flows.

2.4.5. **Growing Season Length**

The growing season, defined as the period between spring and fall dates with 32 degree or lower temperatures, has averaged about 168 days (plus or minus a standard deviation of 16 days) from 1970 to 2013 with a range of 140 to 204 days. Using this definition, the growing season length by year was plotted with a general increasing pattern noted since 1970 (Figure 2-12). In general longer growing seasons are also linked to earlier snowmelts, longer ice-free periods on lakes and streams and longer aquatic growing seasons in lakes, streams and wetlands. The latter aspect means that algae and bacteria also have more days to grow and assume nuisance levels given excessive nutrient supplies.

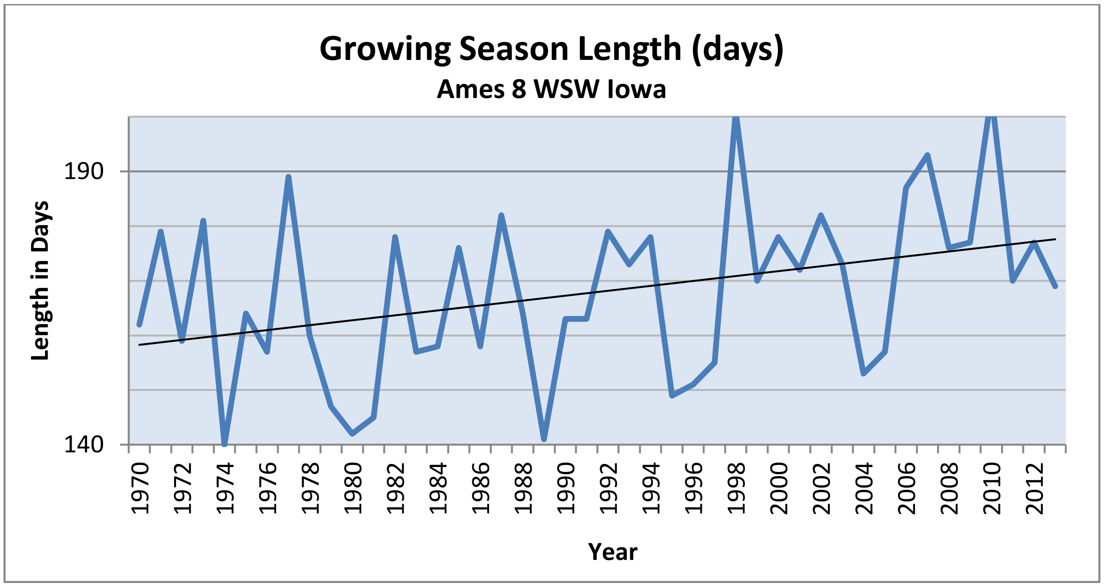

Figure 2-12. Growing Season Length 1970-2013

2.4.6. **Evaporation**

The amount of water that is vaporized and lost into the atmosphere is called evaporation. For estimating losses from the surface of a shallow lake or ponds, changes in daily water levels are measured by use of a standardized pan open to the atmosphere (or Class A Pan Evaporation). Over an average year, evaporation amounts to about 38-40 inches (NOAA, 1983) for this portion of Iowa with the highest evaporation rates encountered during the peak temperatures of the growing season. Losses from crops and vegetated areas are referred to as evapotranspiration (ET) or crop water use, are similarly affected by temperatures and vary by crop.

2.4.7. **Severe Weather**

Squaw Creek is at the center of America's Heartland which is one of the most active weather areas of the country (and world) resulting from the mixing of Canadian and Western weather fronts with the typically warm and moist frontal systems from the Gulf of Mexico. Accordingly, Iowa's summer humidity and dew-points have been noted to increase by about 13% over the past 35 years providing greater fuel for development of thunderstorms. The severe weather period begins in the spring with the largest number of Iowa related tornadoes occurring in May and June. Iowa averages about 45-50 tornados a year with the majority having the weakest rating. However, there has been a substantial rebound of tornado activity in 2014 (53 tornadoes) after two quiet years (2012-2013). Considerable variability of weather is common to the area including 'catastrophic' incidents with losses from straight-line winds, hail (most common) and tornadoes.

2.4.8. **Variable and Changing Climate**

Of the climate data summarized above and from leading Iowa researchers, there have been several key changes noted over the past 40 years that affect farms, cities, landscapes and waters. These measured changes include:

- Precipitation amounts, the frequency and intensity of large storms and back-to-back storms have been defined by recent NOAA updates of precipitation data. In general, the large (and less frequent) storms have increased by 4% to 20+% depending upon location and storm size. The more common storms (occurring less than every ~25 years) have changed small percentages. More precipitation occurs in the first half of the year and less in the second half. Precipitation increases are typically greater on the eastern half of Iowa than the west, with Squaw Creek being smack in the middle. These trends are expected to continue well into the future.
- The amount of moisture in the atmosphere has increased as measured by humidity and dew point temperatures by about 13% (Report to the Governor and Iowa General Assembly, 2011). Atmospheric moisture fuels thunderstorms and severe weather. Squaw Creek is in the center of America's Heartland that is one of the most active weather areas of the world as evidenced by the number of tornadoes and severe weather events. 2014 has been an active severe weather year following two relatively quiet years (2012-2013).
- Growing seasons, or the length of time between spring and fall freezing dates, have increased by about 5 to 15 days as defined from the Ames, IA weather record (1970-2013).
- Warmer winter and spring temperatures may translate into earlier and slower snow melts reducing springtime flooding incidence at the critical time when vegetation and cover crops are typically at low levels.

Climatologists have continued to refine changing climate assessment techniques and projections. In short, there is widespread agreement that many of the above patterns are going to continue but with considerable wet and dry year-to-year variability likely. In general, factors affecting increased stream flows and flooding are to become more frequent. Hence, watershed management should incorporate innovations that retain water on the land as much as possible.

Report to the Governor and the Iowa General Assembly, 2011. Climate Change Impacts on Iowa. Climate Change Impacts Committee. **http://www.iowadnr.gov/Environment/ClimateChange/ClimateChangeAdvisoryCo.aspx**

2.5. Soils

The soils within the Squaw Creek Watershed are primarily Nicollet, Clarion, Canisteo, Lester and Webster. They are loams, silty loams and clay loams. For modeling purposes we have defined the hydrologic soil groups which are depicted in (Figure 2-13). The primary soil hydrologic groups and B ad B/D which are moderately well drained and moderately well drained with a high water tables, respectively. In the northern part of the watershed there are heavier, C/D soils associated with prairie pothole nature of that area.

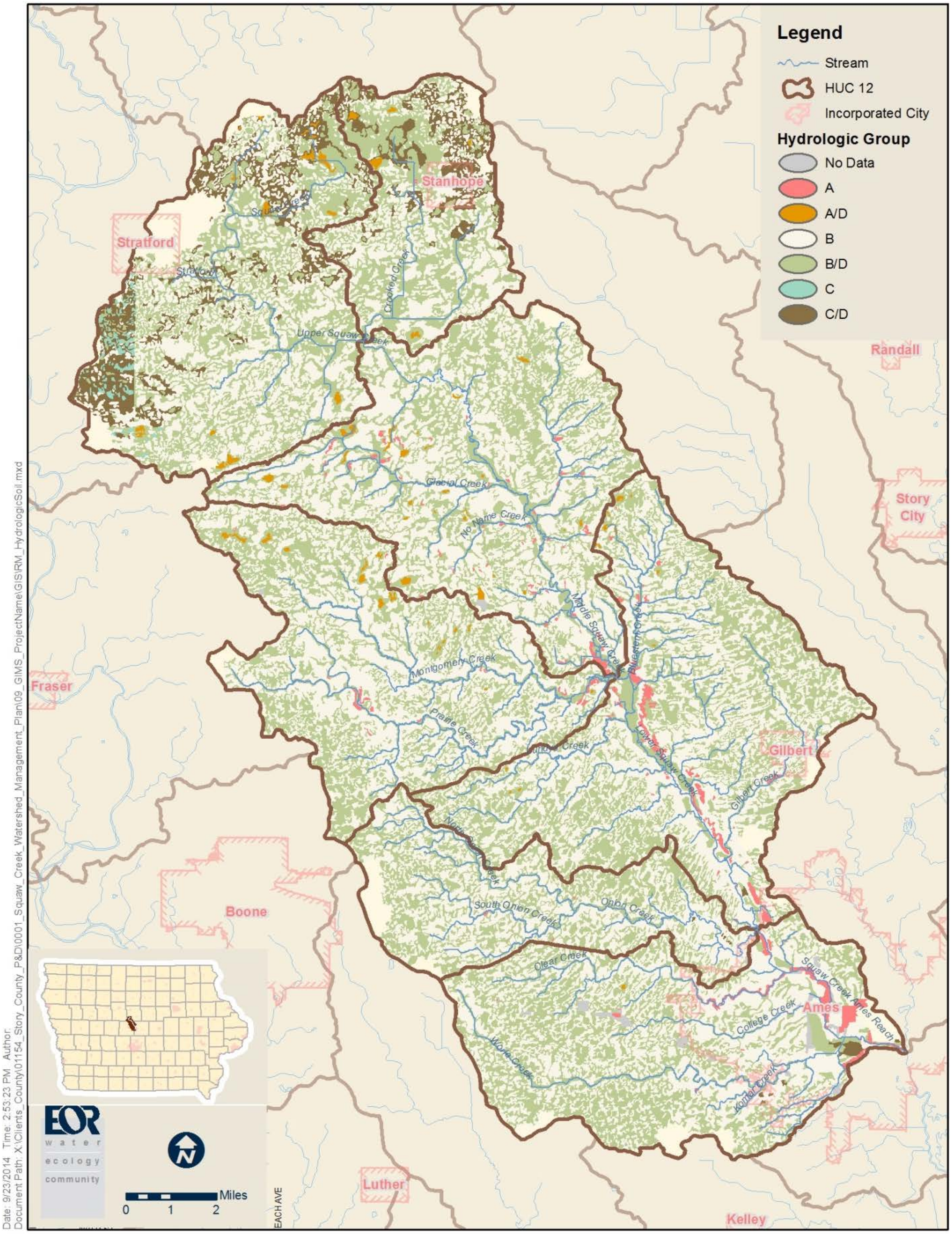

Figure 2-13. Soils by Hydrologic Soil Class

2.6. Groundwater

The following is a cursory examination of the groundwater system of the watershed based on review of available data. Additional analysis of the groundwater system is currently being developed by researchers at Iowa State.

2.6.1. **Surficial Hydrogeology**

The watershed is covered by glacial drift commonly associated with two periods of glaciation, the Late Wisconsin Episode (Des Moines Lobe) and the earlier Hudson Episode. Since the glacial period, the surface has been worked and re-worked by rivers and streams, eroding valleys leaving significant alluvial deposits.

Figure 2-14 shows the locations of surficial aquifers. The alluvial aquifers consist mainly of sand and gravel transported and deposited by modern streams and make up the floodplains and terraces in major valleys. Alluvial deposits are shallow, generally less than 50-60 feet.

The drift aquifer is the thick layer of clay- to boulder-size material (till) deposited over the bedrock by glacial ice. The composition of the glacial drift varies considerably, and in many places does not yield much water. There are however, lenses or beds of sand and gravel in the drift, which are thick and widespread enough to serve as dependable water sources. Usually one or two sand layers can be found in most places that will yield minimum water supplies for domestic wells.

The buried channel aquifers consist of stream alluvium of partially filled valleys that existed before the glacial period. The valleys were overridden by the glaciers, and are now buried under the glacial drift. They may or may not coincide with present day alluvial valleys (Thompson, 1982).

Figure 2-15 shows the depth to groundwater throughout the watershed. The alluvial and drift aquifers are visible as the areas with the least depth to groundwater.

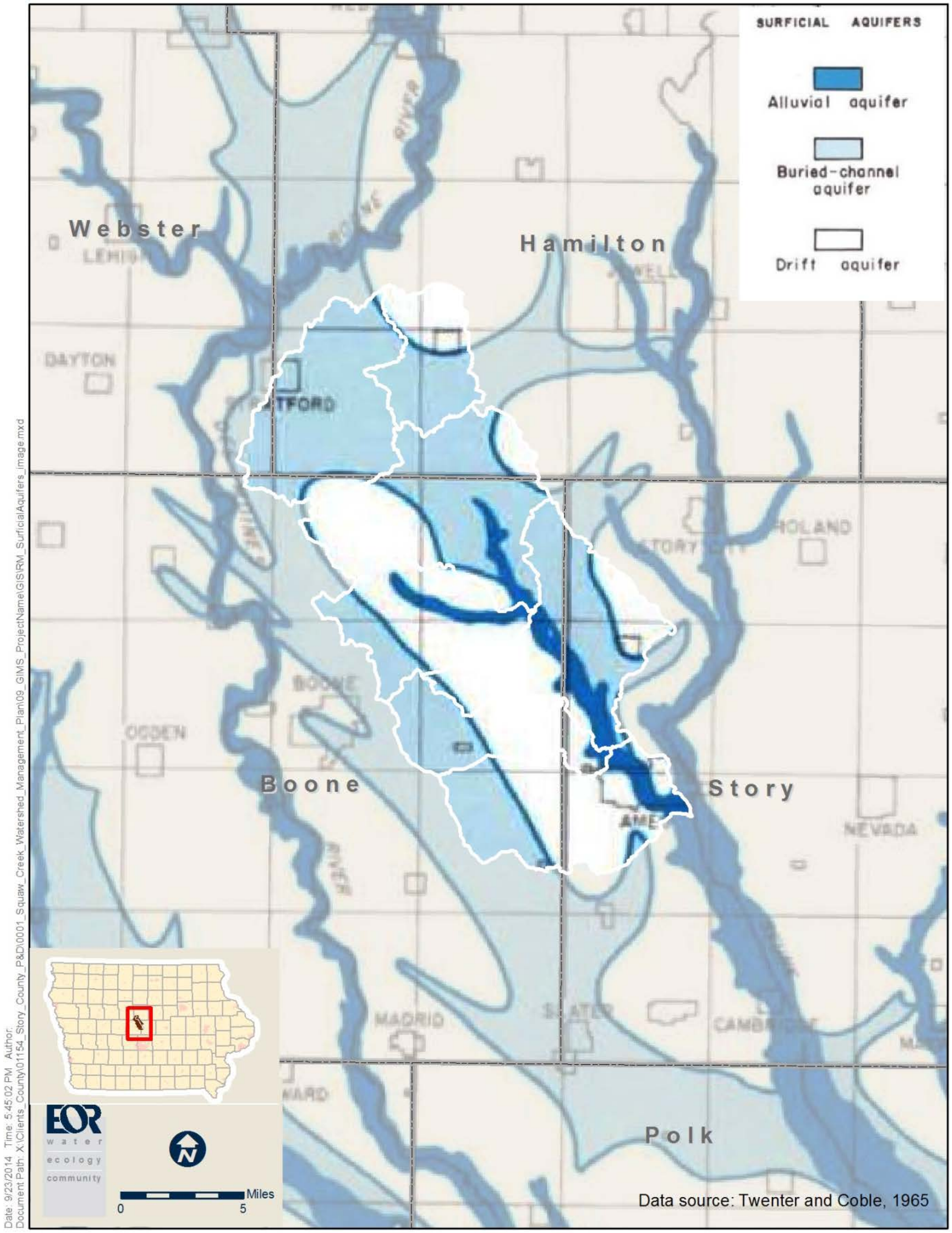

Figure 2-14. Surficial Aquifers

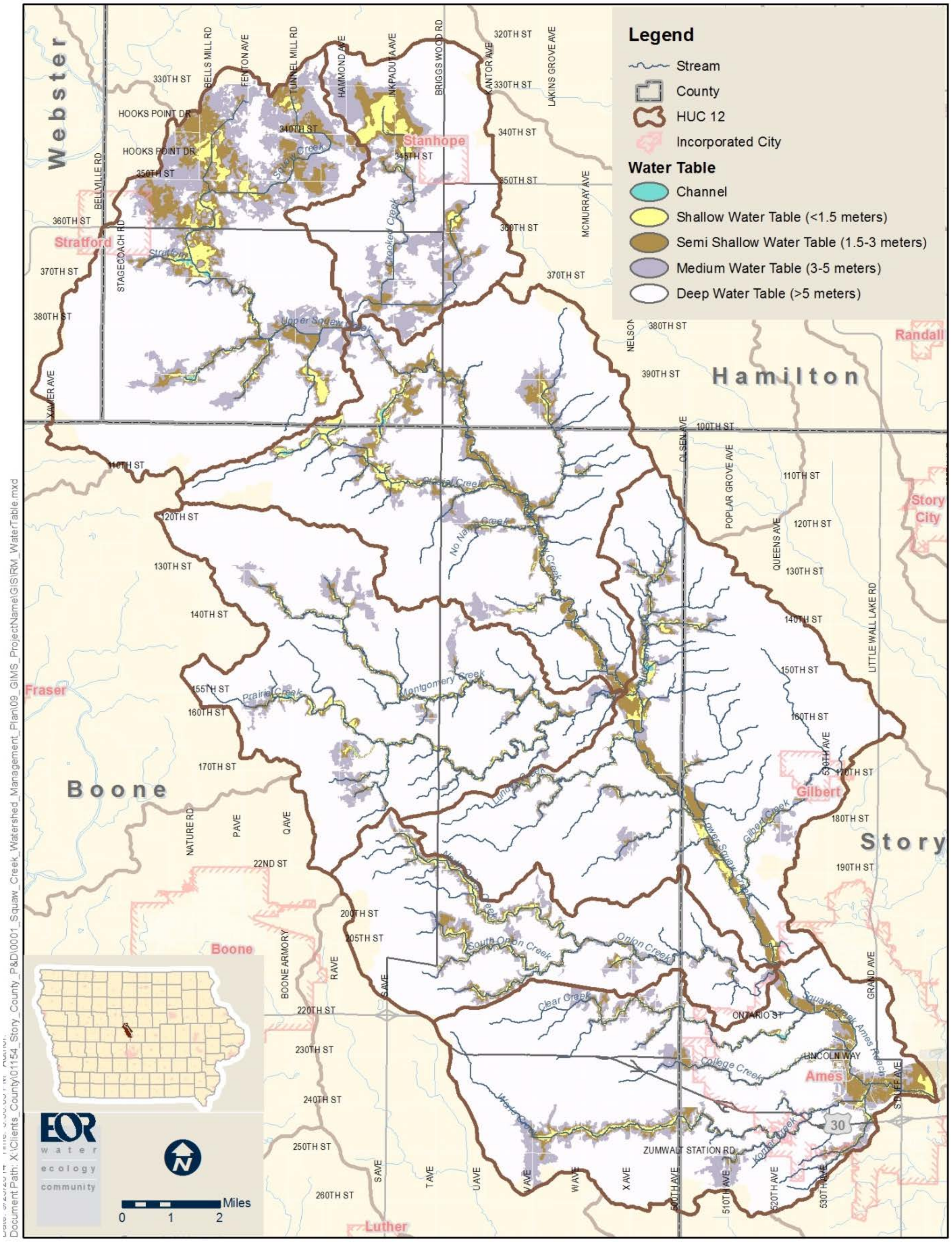

Figure 2-15. Depth to Groundwater

2.6.2. Bedrock Hydrogeology

Below the drift and other surficial materials is a thick sequence of layered rocks, formed from deposits of rivers and shallow seas that alternately covered the state during the last 600 million years. Table XX lists the geologic and hydrogeologic characteristics of the rock units underlying the watershed. These rocks are primarily shales, siltstones, sandstones, thin coal beds and minor limestone beds. Because shales predominate, the Pennsylvanian sequence acts as an aquiclude and only locally can water be produced. Most of the water from the Pennsylvanian is found in the sandstone layers within the Cherokee Group. In general, the water is highly mineralized, with high concentrations of dissolved solids, sulfate, and sodium (Thompson, 1982).

Table 2-3. The Aquifers and Rocks of Central Iowa (Twenter and Coble, 1965)

Aquifers	General thickness (feet)	Age of rocks	Name of rock units	General description of rock units
Surficial Alluvial Buried-channel Drift	0-380	Quaternary (0-1 million years old)	Undifferentiated	Primarily alluvium and drift composed of gravel, sand, silt, and clay
	0-900	Cretaceous (63-135 million years old)	Undifferentiated	Shale, limestone, and sandstone; in Webster County only
	0-550	Permian (230-280 million years old)	Fort Dodge beds	Gypsum and shales; in Webster County only
		Pennsylvanian (280-310 million years old)	Undifferentiated	Shale, sandstone, thin limestones, and coal
Upper Bedrock	0-475	Mississippian (310-345 million years old)	Ste. Genevieve St. Louis Warsaw Keokuk Burlington Gilmore City Hampton	Shale and limestone Limestone, sandy Shale and dolomite Dolomite and limestone Dolomite and limestone Limestone Limestone and dolomite
	5-200		McCraney English River Maple Mill Aplington Sheffield	Limestone Siltstone Shale Dolomite Shale
Middle Bedrock	400-750	Devonian (345-405 million yrs	Lime Creek Cedar Valley Wapsipinicon	Dolomite and shale Limestone and dolomite Limestone, dolomite, and shale

Aquifers	General thickness (feet)	Age of rocks	Name of rock units	General description of rock units
		old)		
	330-700	Silurian (405-425 million years old)	Undifferentiated	Dolomite and sandy dolomite
		Ordovician (425-500 million years old)	Maquoketa Galena Decorah Platteville	Dolomite and shale Dolomite and chert Limestone and shale Limestone, shale, and sandstone
Lower Bedrock	375-560		St. Peter Prairie du Chien	Sandstone Dolomite and sandstone
		Cambrian (500-600 million years old)	Jordan St. Lawrence	Sandstone Dolomite
	350-550		Franconia Galesville Eau Claire Mt. Simon	Sandstone, siltstone, and shale Sandstone Sandstone, shale, and dolomite Sandstone
	- - - - - - - -	Precambrian (600 million to 2 billion years old)		Igneous and metamorphic rocks, locally overlain by sedimentary rocks that are chiefly sandstone

The Mississippian Aquifer (Upper Bedrock Aquifer) is heavily used, and consists of a series of limestones and dolostones. The Devonian-Silurian Aquifer (Middle Bedrock Aquifer) is used by several communities and rural residents. The main water-producing units in the Devonian-Silurian are a series of limestones and dolostones. The Cambro-Ordovician aquifer is the major deep aquifer in the county, and includes the St. Peter Sandstone, the Prairie du Chien dolomite, and the Jordan Sandstone, the latter being the major water producer (Thompson, 1982).

Figure 2-16 shows the uppermost bedrock present throughout the watershed.

References

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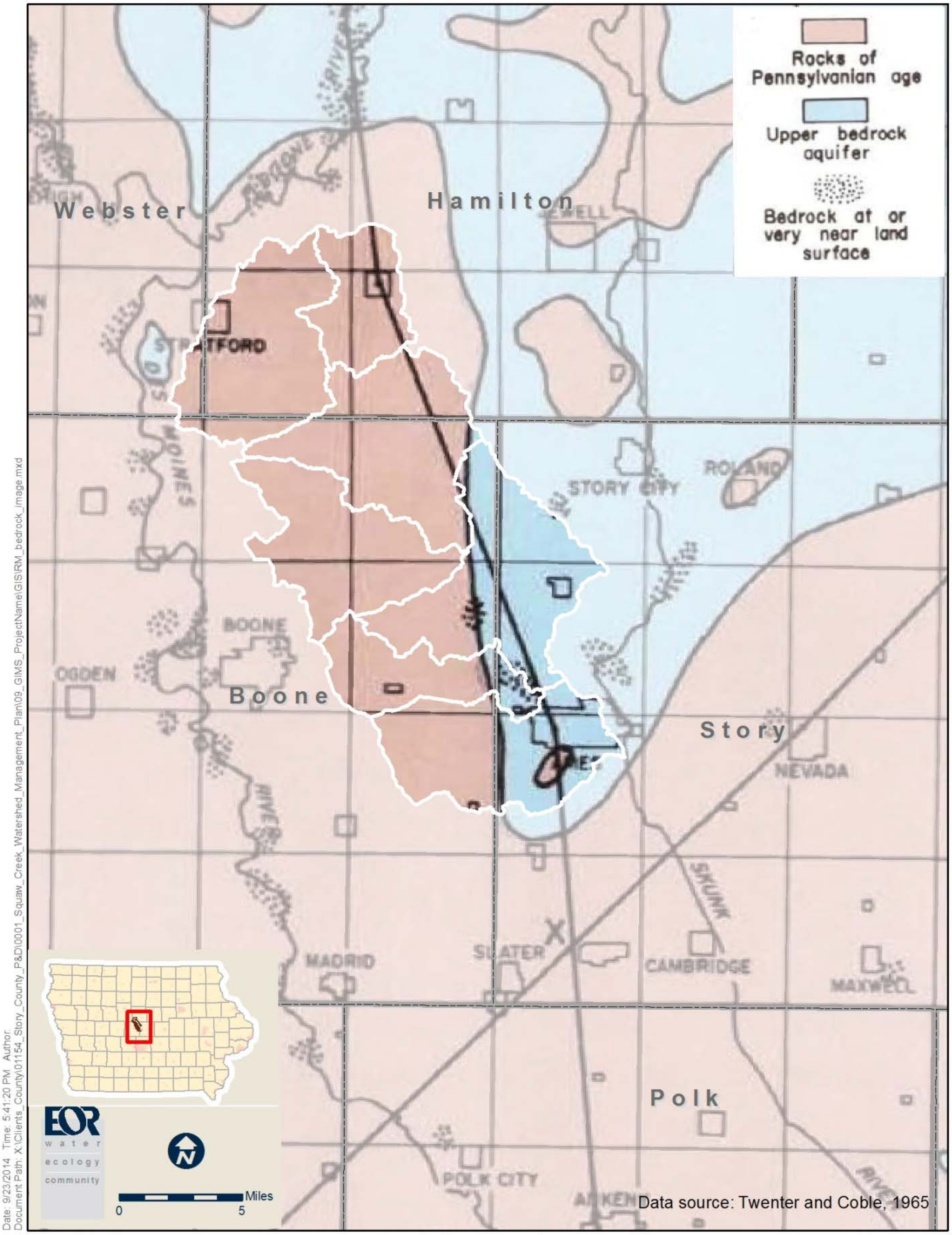

Figure 2-16. Uppermost Bedrock