4 ENVIRONMENT

INTRODUCTION

In a fast-developing community, understanding the existing environmental conditions will help guide sustainable growth and development. Care should be taken to ensure environmentally sensitive land is being left undeveloped. This can include land in the floodplain, on or near wetlands, some areas of prime agricultural land, tree cover, areas with steep slopes, streams, or areas within stream buffers. The presence of these natural features should merit special consideration when planning for future land use. In the following chapter, areas worthy of special environmental consideration in Ankeny and the planning boundary will be identified and described. Using best practice approaches, a series of standards and recommendations will be outlined to help protect Ankeny's environmental resources.

ENVIRONMENTAL CONDITIONS

Several environmental conditions in Ankeny will be reviewed in detail. The environmental features to be considered are:

- Floodplains + Floodways
- Wetlands
- Prime Agricultural Land
- Tree Cover
- Steep Slopes
- Streams + Stream Buffers
- Stormwater Management
- Watersheds

FLOODPLAINS + FLOODWAYS

There are several areas in Ankeny within a designated floodplain as outlined by the Federal Emergency Management Agency (FEMA). FEMA's Risk, Mapping, Assessment, and Planning (Risk MAP) Program oversees the creation of official flood hazard information used in the National Flood Insurance Program (NFIP). The Flood Insurance Rate Maps (FIRMs) created by FEMA are updated based on changes in the environment such as weather patterns, erosion, and new development.[1] The Flood Map Service Center (MSC) makes these maps publicly available so communities can better understand their risk.

Areas with a known flood risk are referred to as Special Flood Hazard Areas (SFHA). Flood hazard areas can be further divided into zones based on the areas likely to flood each year. There are many different zones identified by FEMA and these zones can be grouped by the level of hazard per year. The common categories of flood hazard areas are: 100-Year Floodplain, 500-Year Floodplain, and the Regulatory Floodway.

100-Year Floodplain

100-Year Floodplain covers areas with a 1% annual chance of flooding every year. These are areas where the likelihood of a flood event over a 30-year mortgage is 26%.[2] These areas are generally viewed as High Risk.

500-year Floodplain

500-year Floodplain covers areas with a 0.2% annual chance of flooding every year. This can include areas such as a location with a 100-year flood risk that is also protected by levees.[3] These areas are viewed as lower risk.

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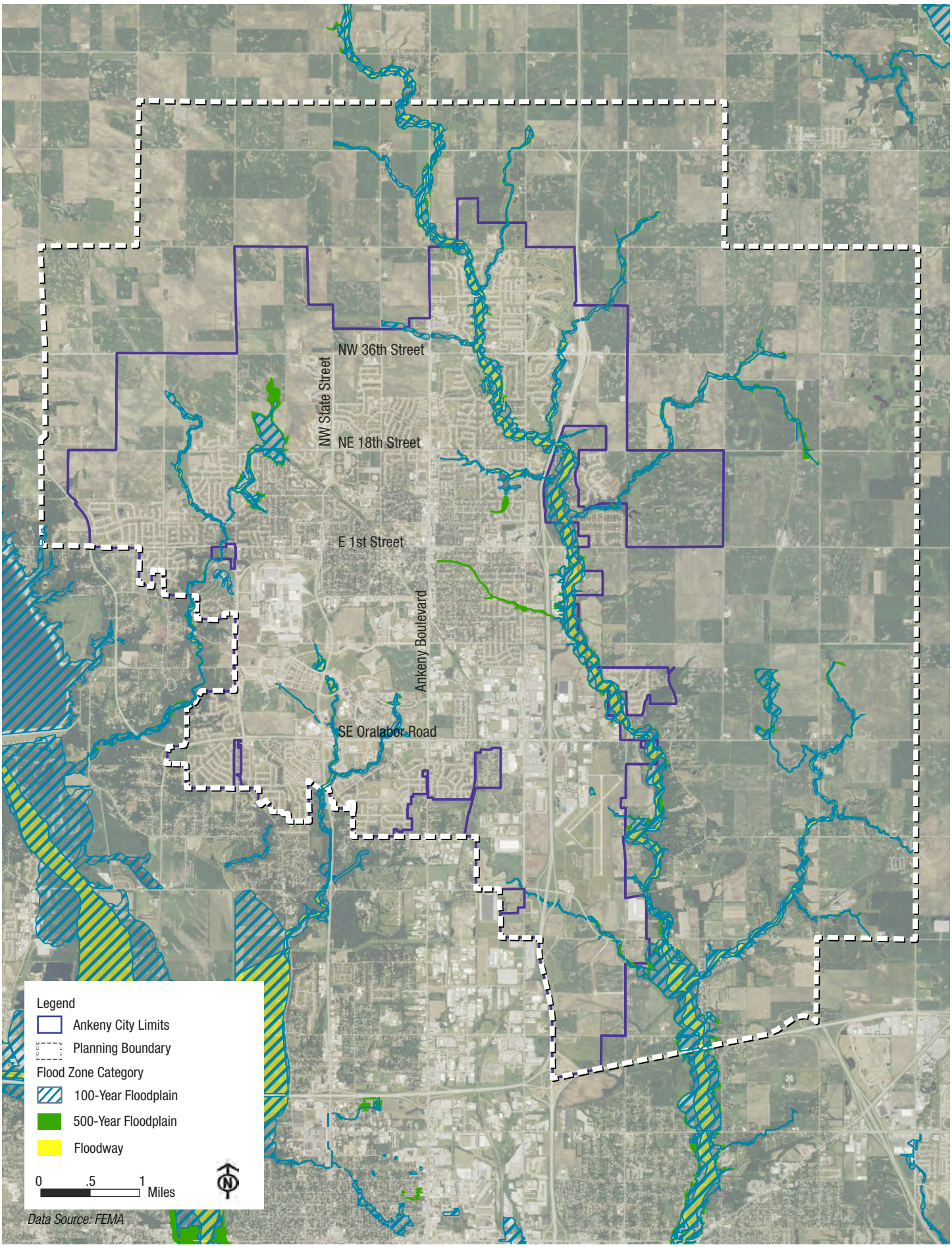
[1] FEMA, Flood Hazard Mapping Updates

[2] FEMA, "How to Read a Flood Insurance Map Tutorial," (June 2003).

[3] Ibid., "How to Read a Flood Insurance Rate Map Tutorial," (June 2003).

FIGURE 4.1 **Floodplains + Floodways - Ankeny, Iowa**



Data Source: FEMA


representative photo


representative photo


representative photo

WETLANDS

Wetlands come in many shapes and sizes. They can be more natural as shown in the top right image. They can also be more manicured and landscaped as shown in the top left image. The picture to the immediate left shows a wetland in-between the more natural and more engineered.

Regulatory Floodways

Regulatory Floodways are the channel of a river or waterbody and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.[4] Many communities, including Ankeny, apply restrictions on development and uses in the floodway.

The MSC makes a variety of flood hazard products available for public use. The FIRM panels showing the outlined flood hazard for a community or area are available to view online by section. Another useful product created by FEMA are downloadable shapefile datasets that can be viewed in ArcGIS or other mapping programs. This allows the floodplain data to be overlaid with existing land use and existing streets, structures, and development.

Ankeny has some areas of 100-year floodplain, 500-year floodplain, and regulatory floodways. They are mainly, though not exclusively, clustered in the area around Four Mile Creek and its tributary streams. Figure 4.1 shows the location of the floodplains and floodway.

Development in the floodplain is generally discouraged because of the environmental and financial impacts. From an environmental perspective, the floodplain serves an important role in the water cycle by providing adequate areas of inundation during high water events. If the floodplain has permeable surfaces and vegetation, it can better handle occasional flooding events. These areas are often viewed as important environmental buffer areas housing a more diverse number of species of flora and fauna.

From an economic perspective, building in the floodplain is often expensive due to the increased likelihood of a flooding event and the potential for property damage or loss of property/life. The FIRM panels created by FEMA serve many purposes, but an important function is to identify areas requiring flood insurance, a coverage not generally provided on basic property insurance policies. These expanded policies can be costly because of the increased hazard risk associated with the property. Development in the floodway itself is generally limited to agriculture or recreation provided the development does not place any structure or fill in the floodway. Development near the floodway often requires certification by a professional engineer to show the development does not impact the base flood elevation.[5]

WETLANDS

Wetlands are valuable environmental areas generally occurring near other streams or water sources. The Environmental Protection Agency (EPA) defines wetlands as, “areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season.[6]” The regulatory definition for wetlands in Iowa is, “an area of two or more acres in a natural condition that is mostly under water or waterlogged during the spring growing season and is characterized by

[4] FEMA, “Floodway,” https://www.fema.gov floodway (March 7, 2017).
[5] Iowa State University “Flooding in Iowa - Frequently Asked Questions,” (2017).
[6] EPA, “Wetlands,” (February 27, 2017).

PAUL ERRINGTON MARSH

The Paul Errington Marsh Wildlife is a protected marshland east of Ankeny's city limits. The area is a popular location for waterfowl hunting.

the vegetation of hydric soils.[7]" Wetlands are environmentally significant areas for a healthy ecosystem and water supply. For many years in the past, wetlands were often drained to make way for development until their environmental, economic, and social importance were widely recognized. According to the Iowa Department of Natural Resource's Wetland Program Plan, Iowa has lost between 90-95% of the original wetlands present in the state.[8] Of the many benefits of wetlands, some important ones to highlight are:[9]

- Recharge groundwater
- Reduce flooding
- Improve water quality
- Regulate our climate
- Offer food and fiber
- Support recreation and cultural activities
- Wildlife Habitat
- Filter Stormwater

Due to the importance of wetlands, the U.S. Fish and Wildlife Service (FWS) has created a National Wetland Inventory (NWI) for public use. The NWI provides information about the location and type of some identified wetland environments present throughout the United States and is available to view online or download. A map showing wetlands identified by the NWI in Ankeny's planning boundary is shown in Figure 4.2. Additional wetlands may be present and should be identified by a wetland professional.

There are many types of wetlands, varying based on the type of vegetation present, depth, and permanency, among other variables. There are two common systems for classifying wetlands: the Circular 39 System and the Cowardin classification. The Circular 39 System was created by the U.S. Fish and Wildlife Service in 1956 and categorizes wetlands into eight different types. The Cowardin Classification is a tier system that provides more detailed, specific descriptions of the wetland by features such as landscape position, vegetation cover, and hydrologic regime. Iowa law defers to wetland classification from the more general Circular 39 System.[10] The Circular 39 System places wetlands into one of the following eight types:[11]

Type 1 – Seasonally Flooded Basins or Floodplains

Vegetation varies according to season and the amount of flooding

Type 2 – Wet Meadows

Soil is without standing water during most of the growing season, but is saturated below the surface

Type 3 – Shallow Marshes

Soil is usually waterlogged early in the spring and often covered with six or more inches of water

Type 4 – Deep Marshes

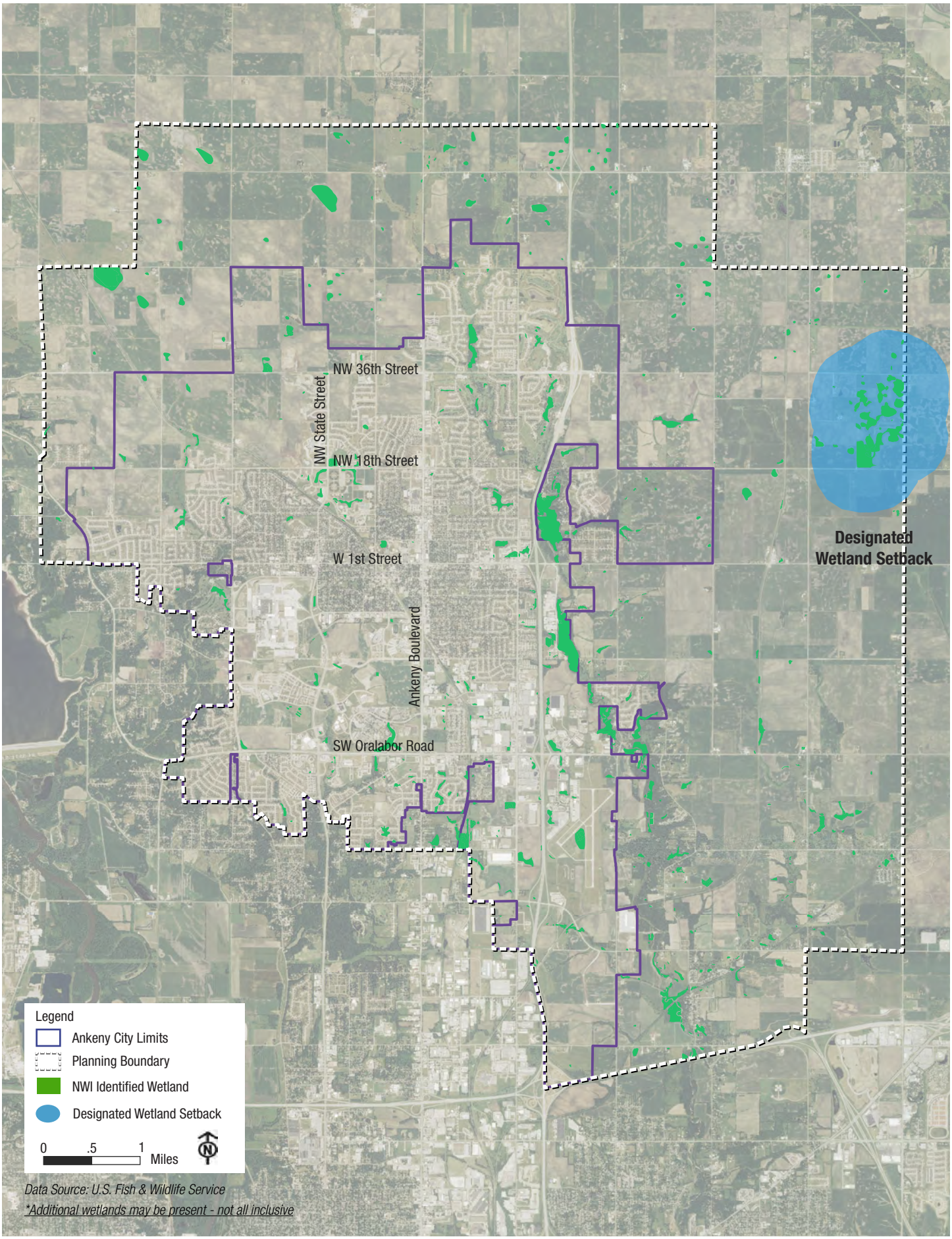
Soil is usually covered during spring and summer—anywhere from three to six feet

Type 5 – Open Water Wetlands

Shallow ponds and reservoirs, water is usually

[7] Association of State Wetland Managers, "Iowa State Wetland Program Summary," (August 2015).
[8] Iowa DNR, "Wetland Program Plan for Iowa," (2016).
[9] U.S Fish & Wildlife "National Wetlands Inventory," http://107.20.228.18/decoders wetlands.aspx, (2017).
[10] Blue Earth County, "Circular 39 - Wetlands of the United States," (2017).
[11] Ibid. "Circular 39 - Wetlands of the United States," (2017).

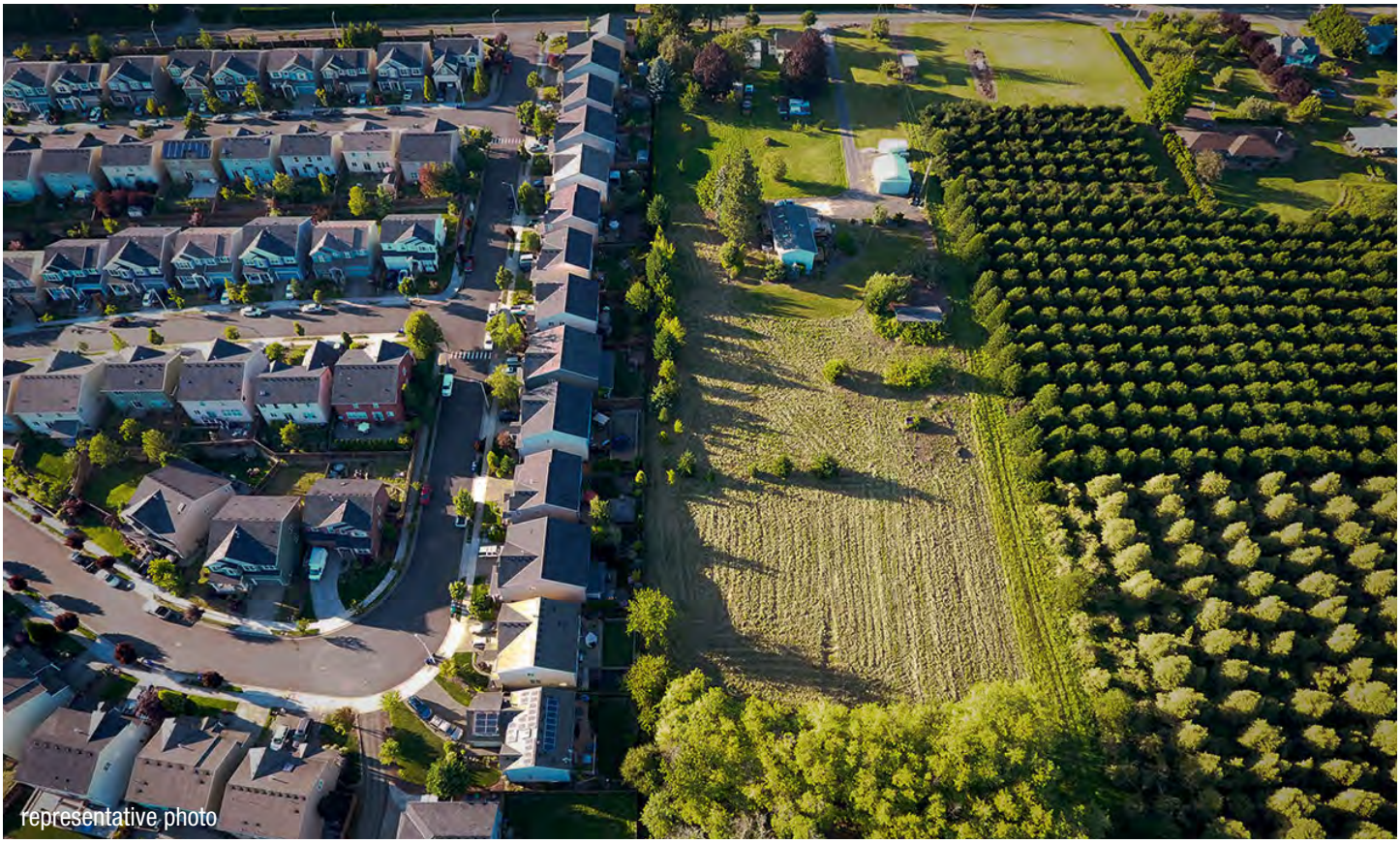
FIGURE 4.2 **National Wetland Inventory Wetlands - Ankeny Planning Boundary**



Data Source: U.S. Fish & Wildlife Service
**Additional wetlands may be present - not all inclusive*

AGRICULTURAL LAND

Due to its location at the edge of the Des Moines metropolitan area, Ankeny is located at the urban and rural land use divide. Much of the Ankeny planning boundary includes land currently used for agriculture.



less than six feet deep and fringed by a border of emergent vegetation

Type 6 – Shrub Swamps

Soil is usually waterlogged during much of the growing season and is often covered with as much as six inches of water

Type 7- Wooded Swamps

Soil is waterlogged to within a few inches of the surface during the growing season and can be covered with as much as a foot of water

Type 8 – Bogs

Soil is usually waterlogged and has a spongy covering of moss

The State of Iowa provides protection for certain 'designated wetlands' in Iowa. Designated Wetland is defined in Iowa Code subsection 459.102 (21) as, "land designated as a protected wetland by the United States Department of Interior or the Department of Natural Resources, but does not include land where agricultural drainage has caused a temporary wetland.[12]" Protected Wetlands are defined by the state as wetlands that are Type 3, 4, or 5 and as with designated wetlands, does not include land where agricultural drainage has caused a temporary wetland.[13]

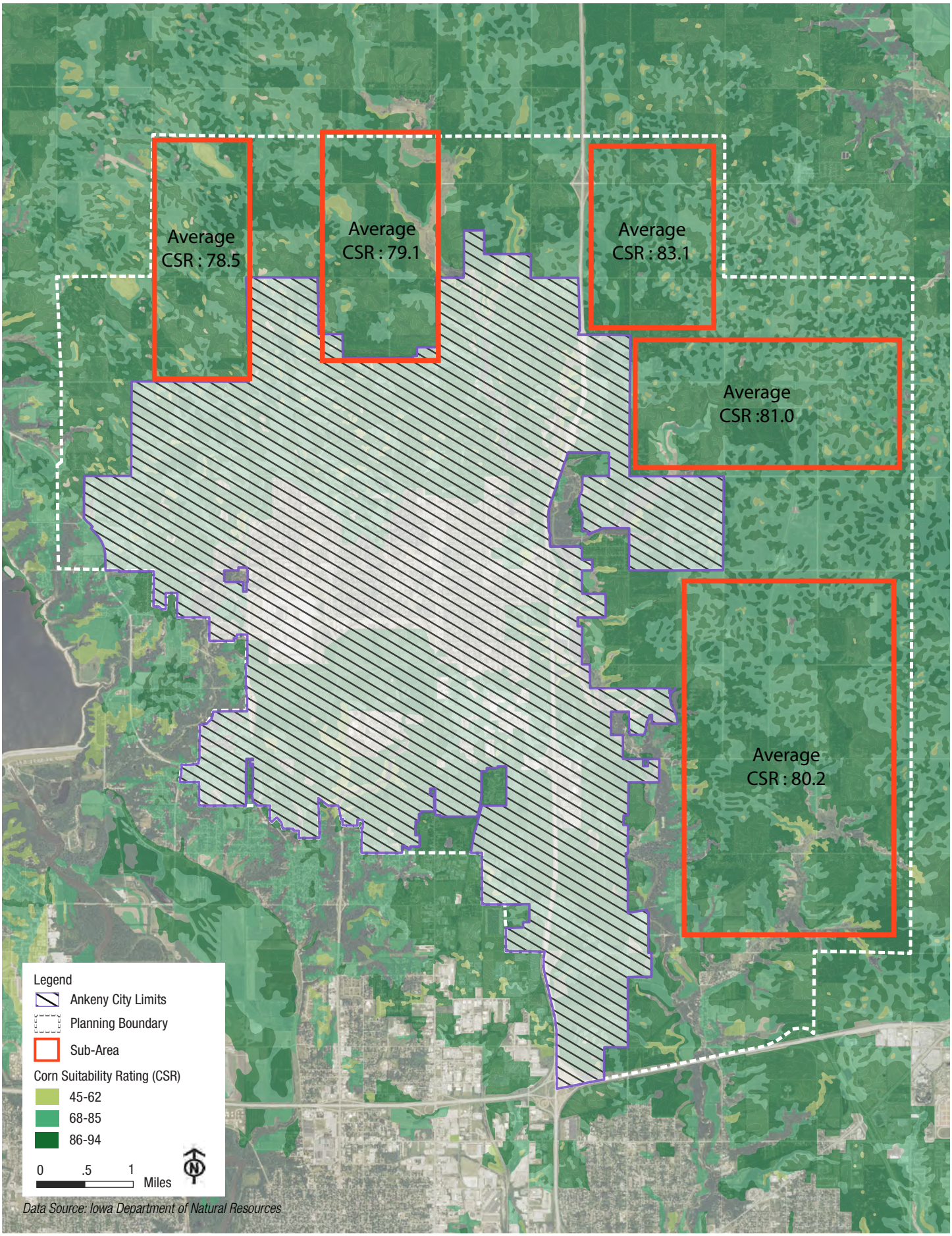
In Ankeny's planning boundary, there is only one location that is a state and nationally recognized, designated wetland in Iowa, the Paul Errington Marsh Wildlife Management Area, a 305-acre marshland four miles east of Ankeny.[14] Under state law, no animal feedlot can be built within 2,500 feet of this designated wetland.[15] State law also requires the Iowa Department of Natural Resources to inventory the wetlands and marshes of each county and designate those wetlands that constitute "protected wetlands.[16]" All other wetland environments are evaluated under the U.S. Army Corps of Engineer's Manual, which outlines wetland delineation policy for the U.S. Clean Water Act.

PRIME AGRICULTURAL LAND

At its core, Iowa is an agriculture-based state. Centuries of prairie growth and flood events enriched the soils in Iowa with the minerals and composition perfect for farming. The Iowa Department of Natural Resources has dutifully categorized the soils of Iowa for a wide variety of factors. There are many factors that go into determining prime agricultural land including location, soil, and productivity potential.[17] One worthy proxy for prime agriculture land is the corn suitability rating (CSR). This category measures the potential for row-crop productivity in area.[18] Generally, the rating range is 0-100 with the best corn suitable soil

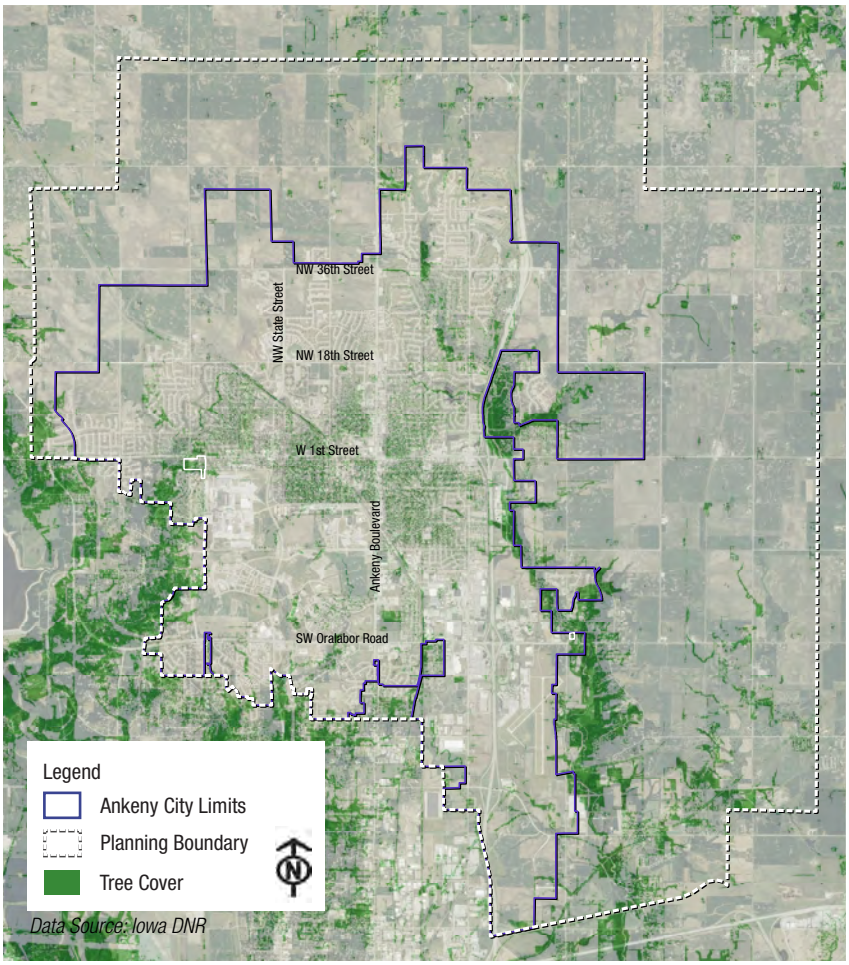
[12] Data.Gov, "Designated Wetlands and Setback Distances in Iowa," (July 2013).
[13] Ibid. "Designated Wetlands and Setback Distances in Iowa," (July 2013).
[14] Iowa DNR, "Paul Errington Marsh Wildlife Management Area," (August 2014).
[15] Iowa DNR, "Designated Wetlands and Setback Distances in Iowa," (August 2006).
[16] Ibid. "Iowa State Wetland Program Summary," (August 2015).
[17] A.D. Carver and J.E. Yahner, "Defining Prime Agricultural Land and Methods of Protection," (2017).
[18] Iowa Agriculture and Home Economics Experiment Station, "Corn Suitability Rating (CSR) Background and Update," (May 2013).

FIGURE 4.3 **Corn Suitability Rating (CSR) - Ankeny, IA Area**



Data Source: Iowa Department of Natural Resources

FIGURE 4.4 Tree Cover - Ankeny, Iowa



TREE COVER

The map to the left shows the location of trees in the Ankeny area based on analysis performed by the Iowa Department of Natural Resources. Outside of trees planted in town, the majority of the natural tree stands in Ankeny exist along the natural stream channels in the area. These trees represent a precious resource for the community and are a strong environmental asset. Efforts should be made to preserve existing tree stands in developing areas.


representative photo

having a rating in the mid-80s to 90s.[19] Given Iowa's prominence in the agricultural world, it is likely many areas of undeveloped land in the state will have a high suitability rating for corn. Given Ankeny's likely population growth, land will inevitably be developed and therefore high corn suitability rating cannot be the sole limiting factor to growth. However, the distribution of soil quality should be considered when identifying areas most environmentally sensitive or precious.

Figure 4.3 shows a breakdown of the corn suitability rating for Ankeny and the planning boundary for this Comprehensive Planning process. The average corn suitability for the planning boundary ranges from 78 to 83. These are strong suitability ratings; however, there are significant pressures for growth and development in the area as the Des Moines metropolitan area continues to grow. Ankeny will be at the forefront of determining the extent to which growth and development of land continues into farmland.

TREE COVER

Trees are important for a healthy ecosystem and local economy and provide a pleasant aesthetic quality for an area. The Environmental Protection Agency (EPA) has identified multiple benefits associated with tree cover and vegetation including:[20]

- *Reduced Energy Use* – tree cover provides shade and can decrease the need for electricity and air conditioning

- *Improved Air Quality and Lower Greenhouse Gas Emissions* – reduced energy demand leads to decreased greenhouse gas emissions from electricity plants. Trees also are able to help remove air pollutants

- *Enhanced Stormwater Management and Water Quality* – vegetation and trees slow the effects of runoff and help filter water entering the stream system

- *Reduced Pavement Maintenance*– pavement with tree cover deteriorates slower, reducing maintenance / replacement costs

- *Improved Quality of Life* – many flora and fauna species surround trees and noise reduction can occur around tree cover

Another strong economic benefit of tree cover is the added value to residential and commercial properties located around trees. Developments with trees can add value to property sales.[21]

Historically, Ankeny has largely been treeless or tree-deficient. Given the location of Ankeny on the edge of the Des Moines metropolitan area, much of the planning boundary growth area will develop on prairie land turned agricultural land. Apart from tree sources around stream beds or near farm houses, much of the planning boundary growth area will have sparse tree cover. This makes the

[19] Marc Schober "Understanding CSR2," (July 31, 2013).
[20] EPA, "Using Trees and Vegetation to Reduce Heat Islands," (August 12, 2016).
[21] Tree Pittsburgh "Economic Benefits of Trees," http://treepittsburgh.org/resources economic-benefits-trees, (2017).

CHANNEL EROSION

Most of the areas with a higher slope in the Ankeny planning boundary are around stream channels. The picture below shows the type of channel bank erosion that occurs on the sloped areas around streams.

remaining tree cover a precious resource in Ankeny.

The Iowa Department of Natural Resources compiled land cover data for Iowa including Ankeny's land cover in 2009. The tree cover was extracted from the data set and is shown Figure 4.4. While there have likely been some changes since 2009, this map provides good insight into the currently available tree cover in Ankeny and the planning growth boundary. Much of the tree cover remains along Four Mile Creek and other streams / tributaries present in the planning boundary growth area. The residential tree growth also appears on this map. However, large swaths of land in the planning boundary remain relatively treeless.

Given the scarcity of trees in Ankeny, measures should be considered to protect the remaining tree cover when possible. The areas of plentiful tree cover are attractive places for parks and trail system development. The tree cover also correlates well with the existing streams in Ankeny.

STEEP SLOPES

Steep slopes are important environmental features sensitive to development and erosion. Some sloped areas are associated with beauty, others with harsh, unattractive terrain, especially if vegetation has been removed. If improperly maintained, slopes can become a hazard. If slopes begin to erode, they can degrade water quality if too much soil or dissolved solids enter a stream on the flood bank.

Slopes are often discussed in terms of the percent slope occurring in an area. Generally, slopes are categorized into the following ranges:[22]

- 0 to 3%
- 3% to 8%
- 8% to 15%
- 15% to 25%
- 25% to 50%

When communities begin to regulate slope varies, but many begin to regulate slope at 15 or 25%.[23] The type of soil present will also impact the regulation of the area.

Ankeny has a generally flat terrain for most of the planning boundary. Figure 4.5 shows the percent slope for the planning boundary. The only areas with a percent slope above 5% are the areas surrounding the streams in Ankeny. Only a few areas along the streams have a slope percent higher than 15%. These areas are in the lower segments of Four Mile Creek in the planning boundary and in Muchikinock Creek and some small sections along the northern stretches of Four Mile Creek and its tributaries.

Overall, slope will likely not be a major concern for development in Ankeny apart from areas around the stream system. These select areas may require special attention in drawing stream buffers to be discussed in the next section and the recommendation section.

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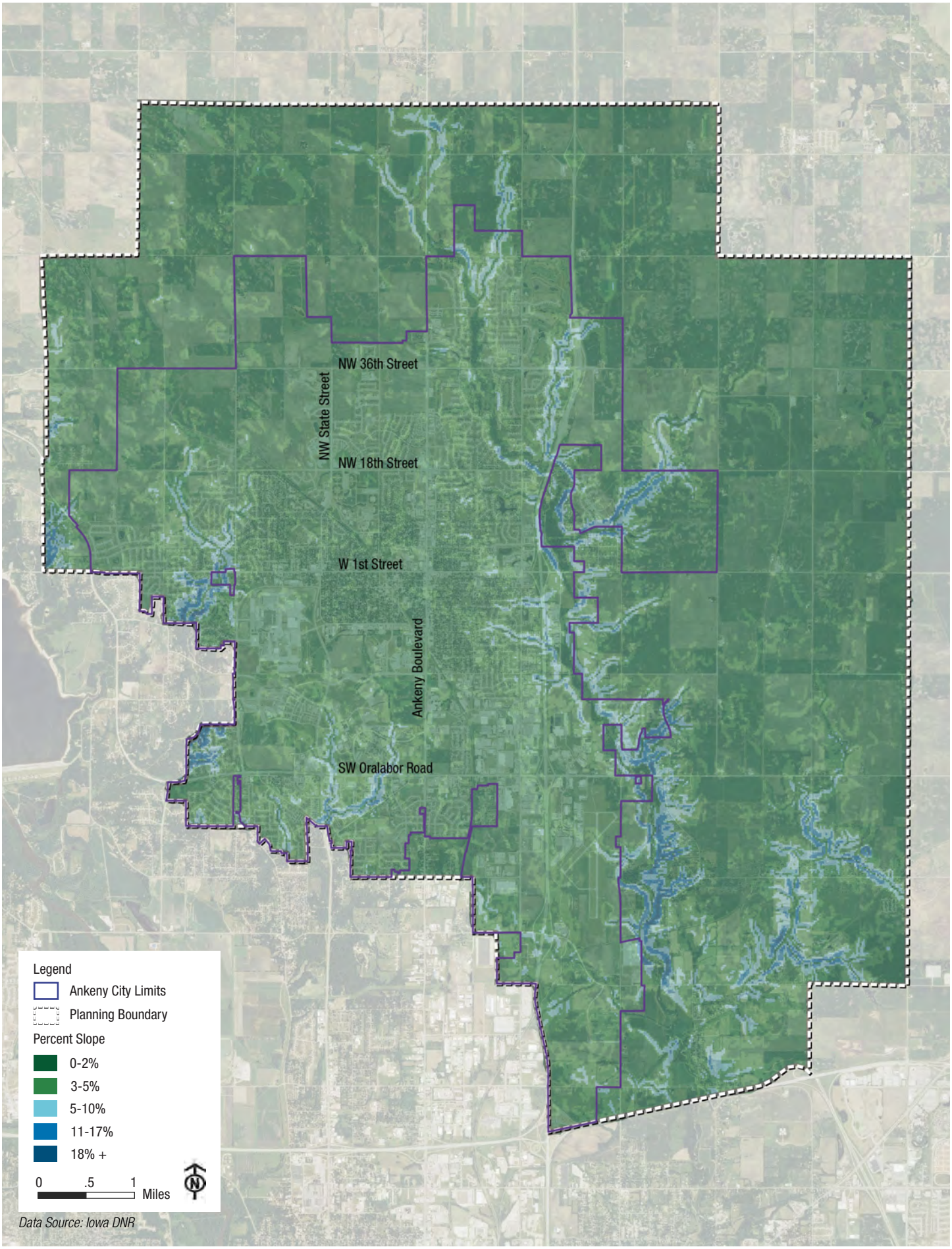
[22] Kevin Anderson and John Thellacker, "Steep Slope Ordinance," http://conservationtools org/guides/59-steep-slope-ordinance, (2017).

[23] Ibid., "Steep Slope Ordinance"

FIGURE 4.5 **Percent Slope - Ankeny, Iowa Area**



Data Source: Iowa DNR

STREAMS + STREAM BUFFERS

Streams and rivers have an important role in supplying drinking water, irrigating crops, mitigating damage from floods, filtering pollutants, providing power via hydroelectricity, supporting fish and wildlife populations, providing space for recreational activities, and assisting various commercial activities.[24] Stream health is vital to the ability of a stream to perform the above mentioned tasks. In addition to the environmental significance of streams, there is a strong economic benefit. Fishing is a popular activity with large sums of money being spent on gear, trips, and licenses. Similarly, hunting is a major activity in the U.S. and animals such as waterfowl live near wetland areas. Many manufacturing processes require a fresh water source nearby as part of their operations. Important to Iowa especially, agriculture often relies on streams and wetlands to irrigate crops.[25]

Ankeny has several stream systems running throughout the community and the planning boundary. While there are many smaller tributary streams present throughout Ankeny, the major streams are Four Mile Creek, Rock Creek, Otter Creek, and the Muchikinock Creek. Four Mile Creek is particularly important to the City and region. The City of Ankeny is a member of the Fourmile Creek Watershed Management Authority (FMCWMA). The role of the WMA in identifying stream health and priorities in Ankeny will be discussed further in the chapter.

Stream Classification

Streams can be classified in several ways: stream order, permanency, size, width, velocity, or use, just to name a few. From an environmental perspective, Ankeny's streams will be classified based on stream order, per Strahler's stream order hierarchy, and permanency, as determined by the National Hydrography Dataset functional code.

Stream Order

Stream order is a concept conceived first by scientists in the mid-twentieth century. Stream orders range from 1-12 with 12 being the largest. For perspective, parts of the Amazon River are a 12th Order Stream and the Mississippi River is considered a 10th Order Stream.[26]

First Order Streams are tributaries with no contributing streams. Generally, streams of the first, second, and third order are referred to as headwaters. Headwater streams feed into higher order streams. Middle reaches are 4th, 5th, and 6th order streams. These streams are usually wider and can support different wildlife such as small bass or sunfish. Streams with an order of 7th or higher are referred to as Lower Reaches. These are the largest streams that can be used for transportation or more intense recreational activities.[27] Streams increase in order when two merge provided the two streams are the same or one is a higher order. For instance, two first order streams combine to create a second order stream.[28] If a third order stream and a first order stream merge, it remains a third order stream. Figure 4.7 shows stream order in the Ankeny planning boundary can help exemplify this relationship.

The highest order stream in Ankeny is Four Mile Creek. Four Mile Creek enters the planning boundary as a second order stream until it merges with another second order stream just south of Otter Creek. The remaining planning boundary segment of Four Mile Creek is a third order stream. The other second order stream present in the planning boundary is Muchikinock Creek in the southern portion. A small part of Saylor Creek penetrates the southern border of the planning boundary. Many of the first order streams within the planning boundary flow into Four Mile Creek. Some others in the southeastern section flow into either Rock Creek or Saylor Creek.

USGS Stream Types

Another way to classify streams is to look at the permanency of the water flow. The USGS classifies streams into several categories in preparing their geological survey maps. These feature class definitions are used in the creation of the National Hydrography Dataset, a publicly available data source of water flow lines in the United States. Ankeny and the planning boundary contain stream features from the following categories:[29]

- **Type 1 Streams**

Perennial Streams are stream beds that contain water throughout the year, except for infrequent periods of severe drought.

- **Type 2 Streams**

Intermittent Streams are stream beds that contain water for only part of the year, but more than just after rainstorms and snowmelt.

- **Connectors**

Connectors are a known, but non-specific connection between two nonadjacent stream network segments

- **Canal / Ditch**

Canal / Ditch is artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterbody for watercraft

Streams by stream type are shown in Figure 4.8. Stream Type categories are often used when drafting stream buffer ordinances.

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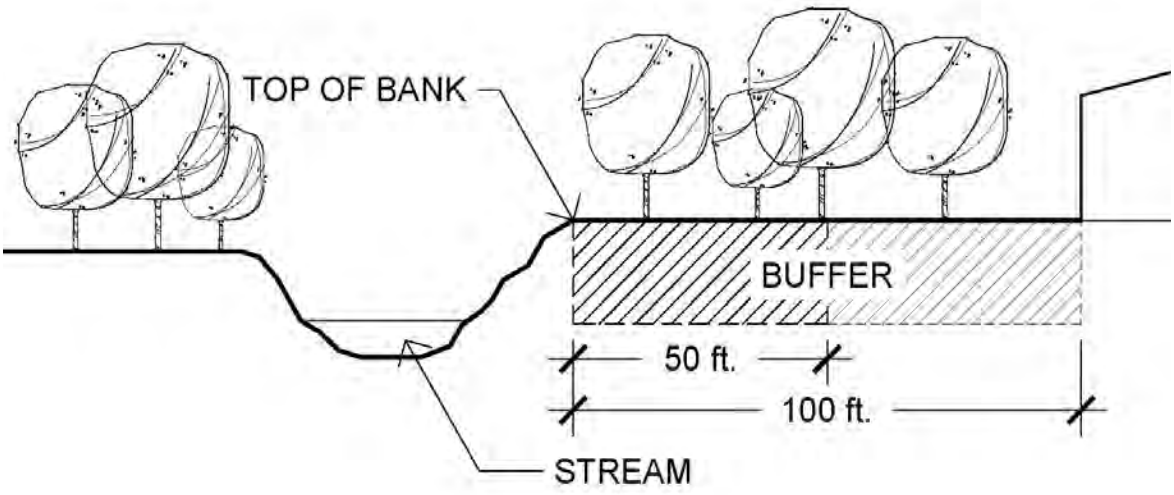
[24] EPA, "Rivers & Streams," (March 13, 2013). [25] Ibid. "Rivers & Streams," (March 13, 2013).
[26] USGS "Strahler Stream Order," (2017).
[27] Bedford County Conservation District, "Stream Order and the River Continuum Concept," (2017).
[28] Ibid, "Stream Order and the River Continuum Concept," (2017).
[29] USGS National Hydrography Dataset, "Feature Directory," https://nhd.usgs.gov FeatureDirectory.pdf, (2017).

FIGURE 4.6 **Stream Buffer Diagram**



STREAM BUFFER

Figure 4.6 shows a stream buffer diagram. The Ankeny Plan 2040 recommends 50 and 100 ft. buffers among Type 1 and Type 2 streams in the Ankeny area. The diagram to the left outlines both a 50 ft. and 100 ft. buffer option.

Stream Buffers

In assessing streams, the area around the stream, or buffer, is an equally important environmental feature. Per the Environmental Protection Agency, stream buffers are vegetated areas, including trees, shrubs, and herbaceous vegetation, that exists or is established to protect a stream system, lake, reservoir, or coastal estuarine area.[30]" Stream buffers accomplish the following tasks:[31]

- Restore and maintain the chemical, physical, and biological integrity of the water resources
- Remove pollutants delivered from urban stormwater
- Reduce erosion and sediment entering the stream
- Stabilize stream banks
- Provide infiltration of stormwater runoff
- Maintain base flow of streams
- Contribute the organic matter as a source of food and energy for the aquatic ecosystem
- Provide tree canopy to shade streams and promote aquatic organisms
- Provide riparian wildlife habitat
- Furnish scenic value and recreational opportunity

Some municipalities have undergone steps recommended by the Environmental Protection Agency to create a stream buffer ordinance. These ordinances require all new city development with streams on site to create a stream buffer. A sample stream buffer ordinance for Ankeny is provided in Chapter 14: Appendix. While the need for a stream buffer has near unanimous support among scientists, the exact width of the stream buffers will vary based on several factors including stream order, the surrounding slope, the amount of vegetation nearby, use of the stream, and the need for access points.[32] The EPA recommends a minimum 100-foot buffer on both sides of the stream bank with optional modification criteria based on stream order, percent slope, 100-year floodplain, or wetlands. Potential modifications include:[33]

- If a stream is a third order stream or higher, the EPA recommends adding 25 feet to the buffer width.
- If a steep slope is close to the stream, they have a sliding scale of buffer width after 15% slope.
- If a stream is used for recreation a scale of buffer width increases.
- If the buffer is near part of the 100 year floodplain, the buffer should extend a minimum 25 feet beyond the floodplain edge.
- If a wetland or other critical area is near the stream buffer, the buffer should extend 25 ft. beyond the wetland edge.

The recommendations by the EPA are just sample buffer widths. Communities will adapt the ordinance to meet the needs of the community being served.

[30] EPA, "Aquatic Buffer Model Ordinance," (2017).
[31] Ibid. "Aquatic Buffer Model Ordinance"
[32] North Carolina State University, "Riparian Buffers: What are they and how do they work?", (2017).
[33] Ibid. "Aquatic Buffer Model Ordinance."

FIGURE 4.7 **Stream Orders - Ankeny, Iowa**

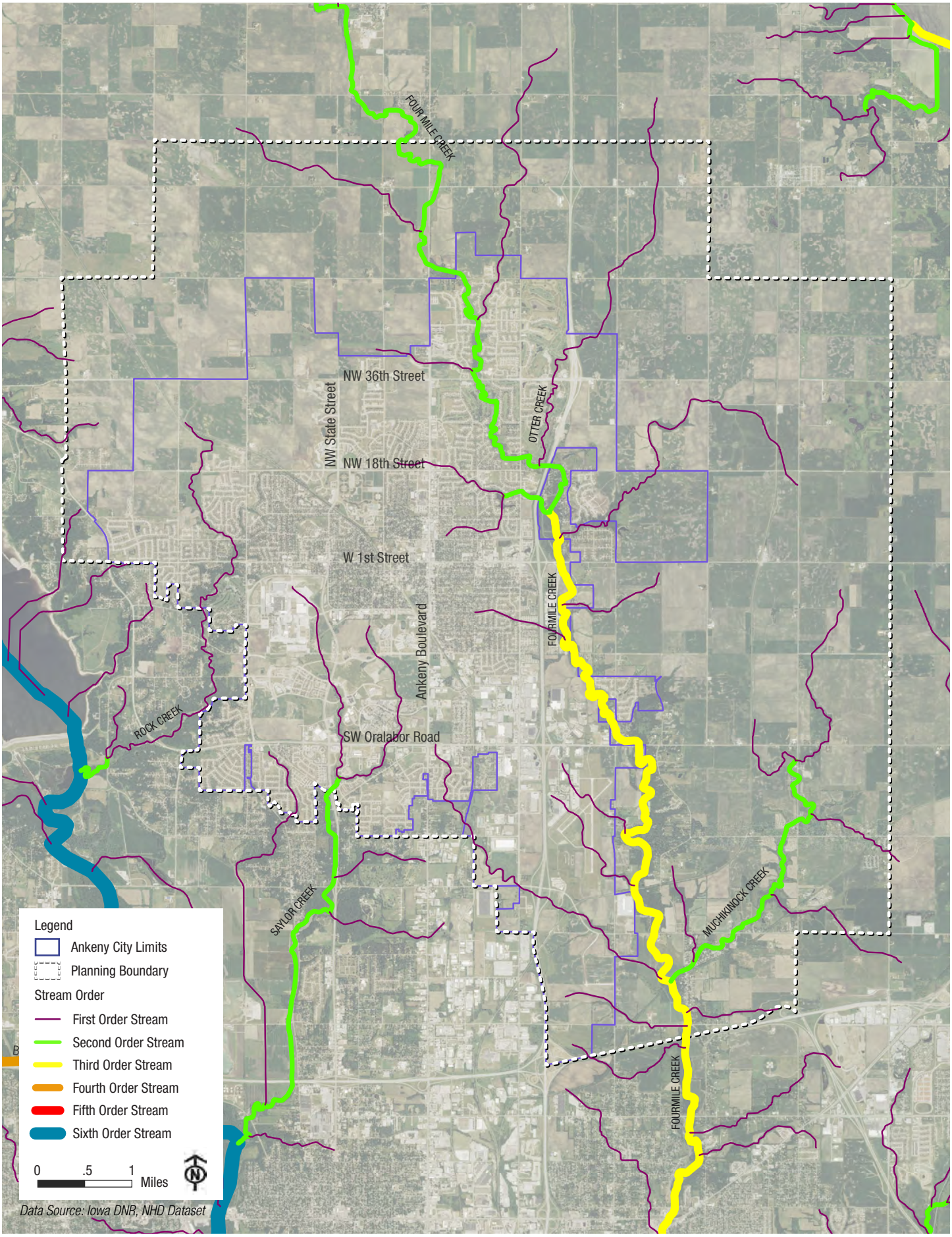
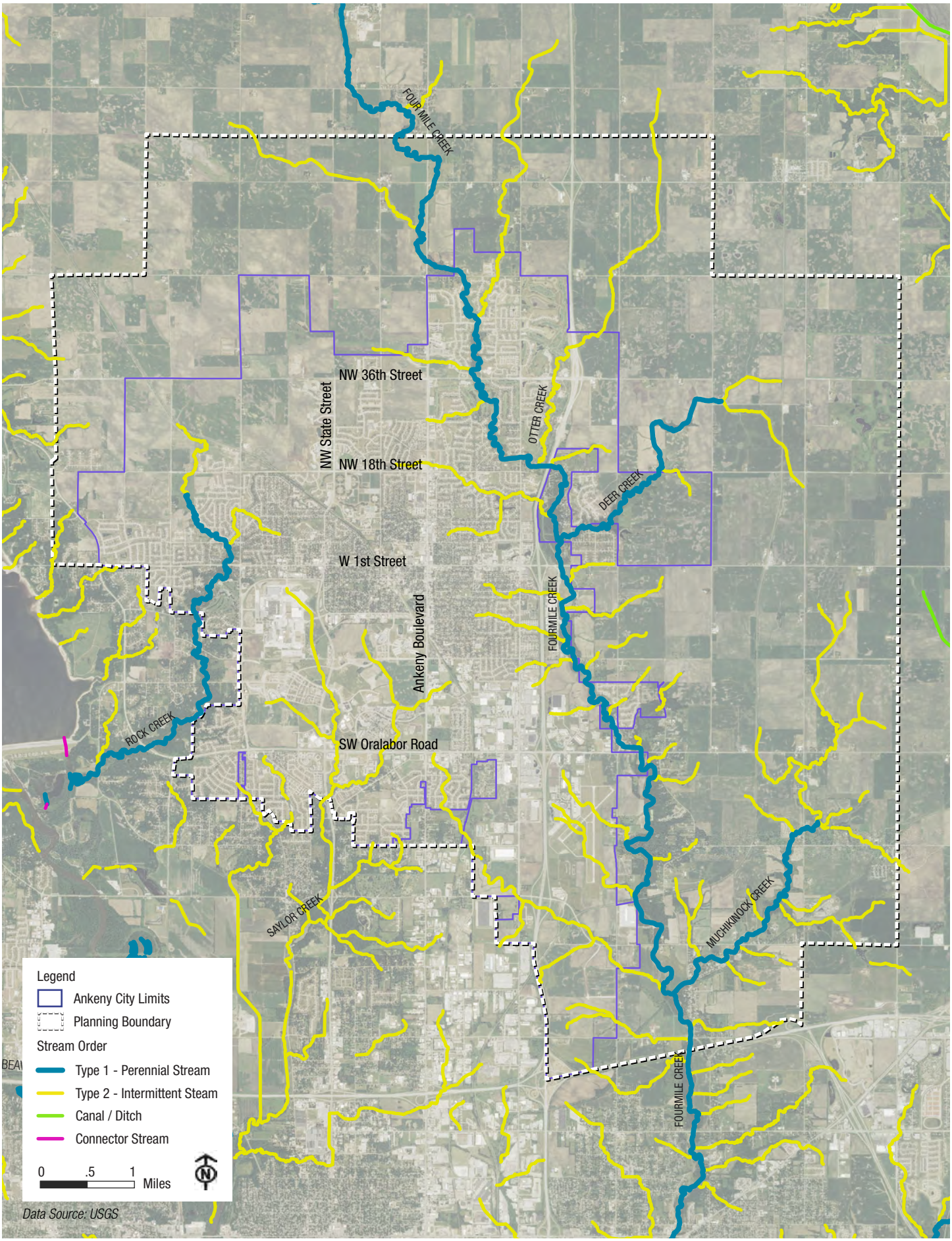


FIGURE 4.8 **USGS Stream Types - Ankeny, Iowa**



WATERSHEDS

Watersheds, sometimes referred to as drainage basins, are defined by the USGS as an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. Watersheds are identified by their hydrologic unit code (HUC). There are six levels of hydrologic unit codes ranging from 2 to 12 digits long. The most general hierarchy group is a two-digit region code followed by subregions, basins, subbasins, watersheds, and subwatersheds with a twelve-digit code. There are approximately 21 regions in the United States and approximately 160,000 subwatersheds. The State of Iowa is part of two regions: the Missouri and the Upper Mississippi. Ankeny falls under the Upper Mississippi region. This places Ankeny among cities such as the Twin Cities in Minnesota, Chicago, Illinois, and St Louis, Missouri, all of whose water flows to a common outlet, the Mississippi River.

Watersheds are most commonly referred to by their eight-digit subbasin code, ten-digit watershed code, or twelve-digit subwatershed code. Ankeny and the planning boundary intersect five watersheds: Sugar Creek-South Skunk River, Big Creek, Saylor-Creek-Des Moines River, Four Mile Creek, and the Calhoun Creek-Des Moines River. More specifically, there are ten subwatersheds in the Ankeny planning boundary: Saylor Creek-Des Moines River, Mud Creek, Lower Four Mile Creek, Coon Creek-South Skunk River, Chichaqua Wildlife Habitat-South Skunk River, Middle Four Mile Creek, Rock Creek-Des Moines River, Big Creek, Upper Four Mile Creek, and Murphy Branch-Des Moines River. Most of the planning boundary is served by the Saylor Creek-Des Moines River, Middle Four Mile Creek, Rock-Creek-Des Moines River, and Upper Four Mile Creek subwatersheds, with the Upper and Middle Four Mile Creek subwatersheds being the most dominant. Figure 4.9 shows the subwatersheds in the Ankeny planning boundary.

Watersheds significantly contribute to the water quality and health not only in the immediate stream area, but far downstream as well. What may enter a drainage system in the Ankeny area may be transported through the stormwater system and end up in the Mississippi River and ultimately the Gulf of Mexico at the Mississippi Delta. There are many indicators of stream health including water velocity, water pH, water temperature, water conductivity, water clarity, composition of the stream bed, water plants, deposits, and bank vegetation, to name a few.

The Four Mile Creek watershed is a highly studied watershed in the Ankeny area. As the largest subwatershed in the Ankeny area, its management has big impacts on the water quality and stream health of Ankeny. Ankeny joined the Fourmile Creek Watershed Management Authority (FCWMA) in 2012 to address flooding and water quality issues in the area. In 2015, the FCWMA hired consultants to complete a management study.

FOURMILE CREEK WATERSHED STUDY

The City of Ankeny is a member of the Fourmile Creek Watershed Management Authority (FCWMA). The FCWMA was created in 2012 to address flooding and water quality concerns in communities located within the Fourmile Creek Watershed. Responsibilities of the WMA include:

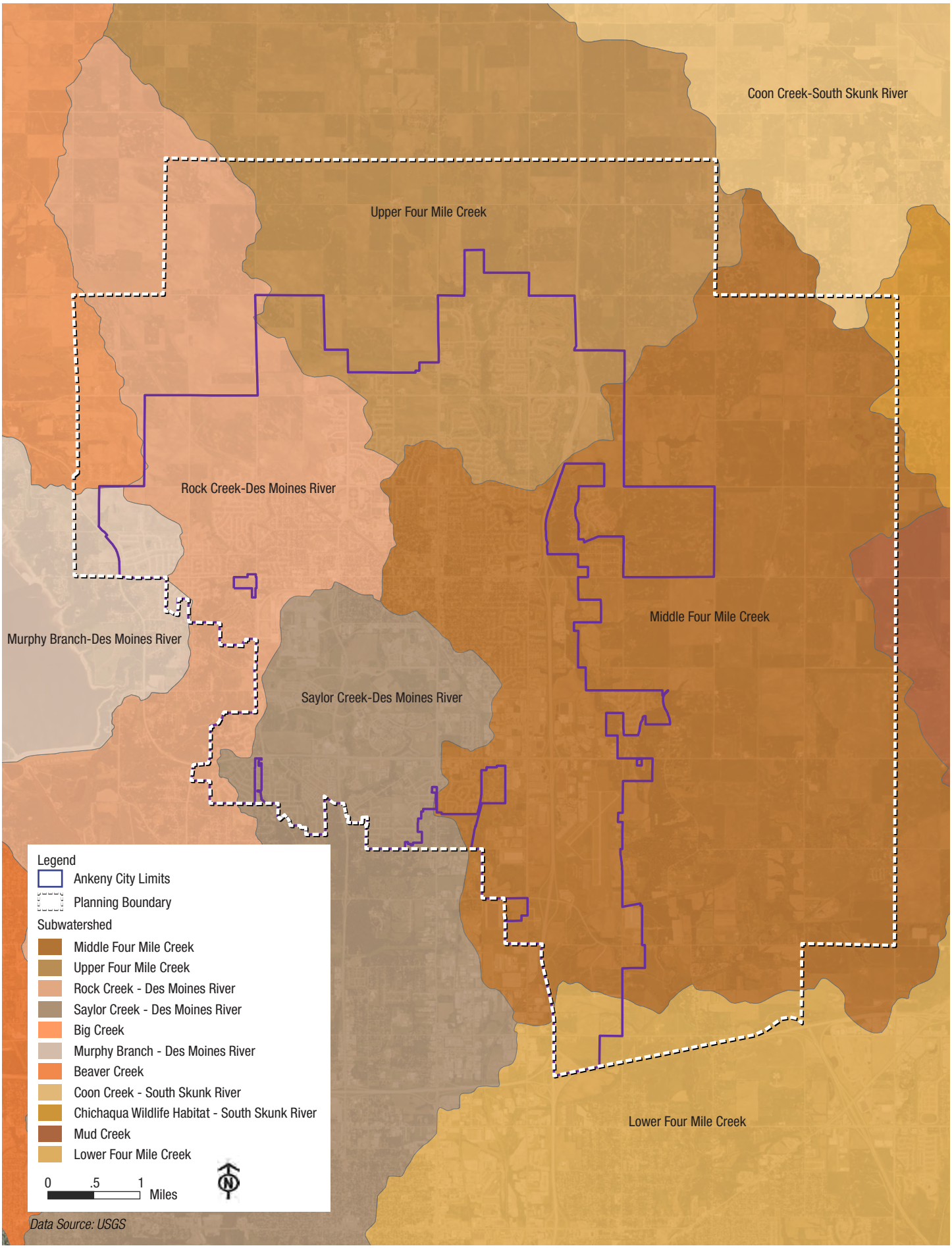
- Assess the flood risk of the watershed
- Assess the water quality of the watershed
- Assess options for reducing flood risk and improving water quality in the watershed
- Monitor federal flood risk planning and activities
- Educate residents of the watershed area regarding water quality and flood risk
- Seek and allocate moneys made available to the Authority for purposes of water quality and flood risks
- Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the Authority.

In April 2015, a Fourmile Watershed Management Plan was completed for the Fourmile Creek Watershed Management Authority (FCWMA). This management plan was meant to address and describe Watershed Characteristics, Pollutants, Stream Assessment, Stakeholder Involvement, and to create an Implementation Plan including a Prioritization list and budget/funding options.

Included in the Implementation Plan were eight goals over 5 phases and an estimated total cost of $26,034,000:
Goal 1: Monitor for Success
Goal 2: Engage Rural + Urban Partners
Goal 3: Adopt a Greenway System
Goal 4: Promote Consistent Implementation
Goal 5: Work to Establish Consistent Regional Guidelines + Standards
Goal 6: Employ Performance Based Measures
Goal 7: Identify and Implement Funding Alternatives
Goal 8: Establish Effective Means of Education + Communication

The Management Plan included a series of informative environmental assessments to gauge stream health including stream order, slope/erosion risk, and major pollutants. A Rapid Assessment of Stream Conditions Along Length (RASCAL) tool was used to perform a stream analysis, finding that there are significant areas of erosion along Four Mile Creek. Water quality testing was also performed revealing Four Mile Creek has several pollutants typical of an urban stream. The pollutant assessment found Four Mile Creek has high phosphorous, high E. coli bacteria, normal dissolved oxygen, normal to high nitrogen, and high water clarity. Adhering to the goals and implementation strategies of the report will be key for achieving Ankeny's environmental goals.

FIGURE 4.9 **Subwatersheds - Ankeny, Iowa Area**

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STORMWATER RUNOFF

Another issue of environmental concern to Ankeny is the negative effects of stormwater runoff pollution and its impact on water quality. There are two main sources of water pollution: point source and nonpoint source pollution. Point source pollution is pollution that is emitted by a specific, traceable source such as a factory or a combined sewer overflow (CSO) event. A CSO event occurs when stormwater and sanitary sewer use a combined system and overflow during a period of high rain or snow melt, releasing untreated sewage into a waterbody. Point source pollution presents a serious problem. However, the source of the problem is often easier to determine and address. This is not the case with nonpoint source pollution.

Nonpoint source pollution is pollution caused by contaminated runoff entering a water body. A main example of this is stormwater runoff, which is created during rain events, generally those exceeding 0.01 inches, or snow melt. In a more natural environment, native vegetations and other permeable surfaces such as grass or prairie would help absorb and slow stormwater runoff and the permeable surfaces would allow for the infiltration of water by absorbing water into the ground. However, in urban and suburban environments, the natural environment has been altered by the removal of native vegetation and foliage and the installation of large swaths of impermeable concrete, asphalt, and rooftops. During storm events, water that would naturally reabsorb or infiltrate begins to flow across the surface of streets, parking lots, and driveways picking up pollutants along the way.

Stormwater issues can be defined as two separate but connected issues: one of quantity and one of quality. The quantity issue deals with the amount of stormwater produced by rainfall and is concerned with the conveyance of the stormwater from one point to another to prevent flooding or system overflow. This has traditionally been the role of stormwater engineering, ensuring the water goes to one place instead of another using extensive and expensive grey infrastructure.

Additionally, recent approaches to stormwater are equally concerned with creating a stormwater system that more closely mimics the natural environment. This approach addresses water quality by using vegetation, soil, and natural processes to capture and clean the runoff resulting from storms producing less than 1.25 inches of rainfall. A vast majority of the rainfall events are below this threshold and the first flush of runoff from these smaller events have been shown to contain the greatest amount of pollutants, nutrients, oils, chlorides and other toxins that can degrade water quality in Ankeny's lakes, streams, and wetlands. Targeting these smaller storms with water quality strategies can provide an excellent cost-benefit in protecting the areas water resources. These new, environmentally sensitive approaches are collectively referred to as green infrastructure and have been shown to provide a number of other environmental and economic benefits to communities such as:

- Improving air quality
- Enhanced aesthetics
- Capturing carbon
- Lowering urban heat island effects
- Protecting biodiversity
- Increased property values
- Many other positive impacts

Water quality issues relating to stormwater deal with the negative impact on water quality resulting from polluted runoff. When stormwater runoff is polluted or contaminated, the water quality of nearby streams or lakes can be negatively impacted. This issue is familiar to the Ankeny area as the water quality health of Four Mile Creek is well documented. Runoff can pick up garbage, oil, heavy metals, and other pollutants, all of which can harm environmental and human health. In agricultural states like Iowa, runoff from farmland carrying various fertilizers and pesticides used on crops is also of concern. Given Ankeny's location on the edge of the Des Moines metro, the City faces the potential impacts of both an urban and more rural environment.

LEGAL REQUIREMENTS

Stormwater management is primarily addressed through the Clean Water Act (CWA). After years of increasing water pollution issues, the Clean Water Act was passed in 1972 with the goal of restoring water quality by regulating the discharge of pollutants into the waters of the United States. Years of unbridled pollution had left a system of streams, rivers, and lakes that were highly polluted. Under the CWA, large (250K+), medium (100K-249K), and small (all other cities in urban areas) cities were forced to apply for a permit to discharge storm and sanitary sewer water into waters of the United States.

The Environmental Protection Agency (EPA) oversees municipal stormwater systems through two different phases. The Phase I Stormwater Rule covers large and medium-sized municipalities with a minimum population of 100,000. The Phase II Stormwater Rule regulates all municipalities not categorized as either medium or large municipalities and are within an urbanized area. Regardless of phase, all municipalities with stormwater systems are identified by the EPA as a municipal separate stormwater system (MS4). At its current size, Ankeny falls under the Phase II Stormwater Rule and has obtained a National Pollutant Discharge Elimination System (NPDES) permit. These permits are distributed by an NPDES permitting authority. Once a permit is received, Stormwater Phase II Final Rule oversees the issuing of National Pollutant Discharge Elimination System (NPDES) permits for small-municipalities and their stormwater sewer and each community must maintain and implement a stormwater management program.

As a Phase II regulated MS4 the City must design a Stormwater Management Program that:
1. Reduces the discharge of pollutants to the maximum extent practicable
2. Protects water quality
3. Satisfies the appropriate water quality requirements of the Clean Water Act

The Maximum Extent Practical (MEP) is the standard that establishes the level of pollutant reduction the MS4 should be working toward in their program. The MEP will vary depending on the hydrology and types of pollutants within the community. The MEP may vary over time and progress in water quality will be measured against this set level.

The six required components of a Stormwater Management Plan are:
1. Public Education and Outreach on Stormwater Impacts
2. Public Involvement / Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Stormwater Management in New Development and Redevelopment
6. Pollution Prevention / Good Housekeeping for Municipal Operations

For each component, a series of best management practices and measurable goals will be outlined to comprehensively address the element. The municipality must complete annual reviews of their progress and the measurable goals and MEP should be reevaluated at least every five years.

Best Management Practices (BMP) are defined in stormwater context as structural, vegetative, or managerial practices used to treat prevent or reduce water pollution.

Measurable Goals are BMP design objectives that quantify the progress of program implementation and the performance of your BMP. All measurable goals should include descriptions of the action to be taken, the anticipated results of the goal, and the frequencies and dates for the actions.

As a MS4, Ankeny has a Stormwater Management Program that addresses the six required components. Information on their stormwater efforts is on the City website. A brief description of the efforts for each component is below:

1. Public Education and Outreach on Stormwater Impacts

The website lists a variety of helpful homeowner habits residents should follow including information on litter and pet waste, lawn fertilizer and chemicals, chemical disposal, soil erosion, and others. There is information on the benefits of native planting, soil quality restoration, rain barrels, and rain gardens. The City also has a Stormwater Best Management Practices Reimbursement Program. This cost-share reimbursement program allocates $12,000 annually to reimburse landowners and businesses that utilize innovative approaches to controlling water quality impacts caused by stormwater runoff. The program provides up to a 50% match on the best management practices (BMP) constructed with a maximum amount of $1,800 per land owner or business.

2. Public Involvement / Participation

The Ankeny Water Quality Improvement Stormwater Education (WISE) Group was established in 2005 to work with volunteer citizens concerned with stormwater to provide a community perspective to Ankeny's stormwater management. A stream/watershed clean-up event is held each spring in conjunction with Earth Day.

3. Illicit Discharge Detection and Elimination

The City of Ankeny manages an illicit discharge detection and elimination (IDDE) program. Under this program, inspection of outfalls is completed once every five years or whenever necessary. If illicit discharge is identified, samples are taken and reconnaissance is performed. Once the source is determined, the party is notified and the discharge source is eliminated.

4. Construction Site Runoff Control

Ankeny requires all construction activity over one-acre to develop a stormwater pollution prevention plan (SWPPP) to minimize the amount of erosion coming off each site. Construction sites must have perimeter erosion control, stabilized construction entrance, and good construction site housekeeping.

5. Post-Construction Stormwater Management in New Development and Redevelopment

Ankeny enforces a post-construction site runoff control policy ordinance which addresses the control of runoff from building activities after construction is complete. Examples of practices promoted by the ordinance include stormwater detention and retention, grass swales, bioretention swales, riparian buffers, and proper operation of these facilities. The City performs site plan review of post-construction runoff controls, inspects runoff control devices, and implements a watershed assessment program.

6. Pollution Prevention / Good Housekeeping for Municipal Operations

Ankeny performs a variety of pollution prevention methods including operation and maintenance of stormwater sewers including street sweeping and inspection of infrastructure, a pesticide and fertilizer management program, a training program for employees to reduce pollutants, and a series of best management practices at City facilities to reduce stormwater on site. Ankeny has created a training program for all grounds maintenance and landscaping crews for the City that teaches the workers how to reduce the spread of pesticide and fertilizer drift in their work.

Each fiscal year, the City of Ankeny submits an annual report highlighting the efforts completed over the previous year regarding the stormwater management plan. The FY 2017 report is available for public view on the City of Ankeny website.


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STORMWATER MANAGEMENT BEST PRACTICES

Stormwater management best practices can be aesthetically pleasing in addition to improving the environmental conditions of the community. The pictures below and to the left show how retention ponds with native planting and non-turfgrass buffer areas can be attractive features for a community.


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RECENT STORMWATER PLANS AND STUDIES

2015 PUBLIC STORMWATER DETENTION BASIN STUDY

In 2015, the City of Ankeny hired HR Green and Applied Ecological Services to complete a Public Stormwater Detention Basin Study. The report provided a detailed inventory and assessment of the City's existing stormwater detention basins. As part of this review, a preliminary assessment of Ankeny's watersheds was performed and a condition rating and basin classification system was developed. Goals were created for each basin type and a series of specific recommendations were established. The probable cost opinions for the listed capital improvement project needs were gathered and the effectiveness of the fountains and diffusers in the stormwater basins were analyzed.

Overall, the consultants found most of the City's stormwater detention basins were working as designed. However, they noted that the detention basins were not significantly improving the water quality of the area. Several improvement projects were identified in a few basins. The Tradition Basin was singled out as a basin in need of a more detailed study to assess and plan for improving the functionality and resiliency of the basin. There were a couple of safety issues identified by the consultants though they were mostly minor. Overall, the consultant team stressed the importance of introducing more natural solutions for stormwater issues into the stormwater management strategy. From an environmental perspective, there are many stormwater management program best practices that can fulfill a dual role of providing stormwater management and providing additional environmental benefits. The consultants argue that the "greatest return-on-investment (ROI) for capital improvement projects will be gained when projects are designed with equal attention to ecology, engineering, and landscape architecture. This will lead to improved user experience, better runoff management, enhanced aesthetics, and better wildlife habitat. Installing or widening natural buffers and expanding native plantings around stormwater basins are easy and affordable ways to increase these benefits and have less cost than maintaining weed-free, mowed turf." The consultants outlined a set of general and specific recommendations for the City.

GENERAL RECOMMENDATIONS

Natural Buffers

Natural buffers consist of perennial vegetation, preferably a diversity of native species. The wider the buffer, the greater the benefit received. Natural buffers among Ankeny's stormwater detention sites would lead to:

- Reduced maintenance (no need to mow regularly, controlled burns occasionally needed)
- Improved water quality (filter/infiltrate runoff, capture sediments and chemical pollutants, less geese)
- Improved wildlife habitat (habitat for diverse wildlife, small mammals, birds, insects, turtles, frogs, fish)

The consultants advised that all of Ankeny's stormwater basins would benefit from wider natural buffers. They also highlighted the problems associated with detention basins with a geese population. By maintaining and mowing turf grasses up to the stream edge, the bare area is inviting a geese population that has a negative impact on the water quality.

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Native Landscaping

The consultants advocated for the conversion of turf to native landscaping citing many of the same benefits as natural buffers. They admitted that while lawns are considered more attractive to some people, they also require a larger investment and more maintenance, all while providing little benefit to the environment. They also addressed the relative cost of installing and maintaining native vegetation as compared to the installation and maintenance of turfgrass concluding that by the third or fourth year of native vegetation the year-to-year costs should be less. Finally, they mention that properly installed and maintained native vegetation can achieve a similarly polished look as those achieved through turfgrass.


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Vegetation Management

The consultants also promoted strong control of invasive species as important to the ecological health of Ankeny's open space. The targeting of invasive species along detention basin banks and parkland should be prioritized, along with the reintroduction of native species. In particular, the consultants highlighted cattails as a common invasive species found along Ankeny public detention basins. Cattails are an aggressive invasive species that competes with native wetland plants among drainage basins in the Ankeny area. Over time, invasive species like cattails reduce the overall cover and diversity of an environment. Ankeny should aim for a goal of limiting cattails to cover less than 10% at any one basin. There were several basins identified as having 10% or more of the basin covered with cattails and several basins dominated by cattails.


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CATTAILS

Cattails were cited as a prevalent invasive species around Ankeny's detention basins. These plants are non-native and aggressive plants are the dominant plant in many Ankeny area detention basins. Cattails are direct competitors with more native species in Iowa.

Stormwater Design Management
The Consultants provided several design management policies and guidelines the City should consider:

- Areas that generate concentrated or untreated runoff can be rerouted to a raingarden or infiltration system.
- Filter strip of dense vegetation to remove sediment
- Construct with gentle side slopes and a flat bottom to minimize opportunity for erosion and to maximize infiltration surface
- Curb cuts can be installed in parking lots to divert stormwater to level turf areas or swales
- Turfed depression (like in Prairie Ridge Sports Complex) can be retrofitted into rain gardens or infiltration basins


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STORMWATER MANAGEMENT APPROACHES

Ankeny is comprised of urbanized/ developed areas, and undeveloped agricultural land. Stormwater management approaches in these environments have different approaches and goals. Highly urbanized built areas typically have limited opportunity for introducing comprehensive site design strategies to reduce the negative impacts of stormwater. However, there are typically opportunities to integrate targeted BMPs in select locations of a site being mindful of flooding issues and maintaining appropriate conveyance. This approach can be effective due to the large quantity of impervious surfaces in urbanized areas, but it can also be expensive and should be completed strategically such as periods of property ownership change, changing land uses, and during redevelopment and/or repair projects to street, walks, and parking areas. Regional facilities can also be effective in these systems if land becomes available. All retrofit facilities should be installed off-line, meaning that they are able to accept stormwater runoff in smaller storms, but the existing conveyance system is preserved and utilized during larger events.

There are opportunities in newly developing areas to control runoff closer to the point that it is generated, instead of managing further downstream where there are greater conveyance, flooding, and structural concerns. Regardless of the site, the following management approaches and techniques should be utilized to reduce, capture, and cleanse runoff on a particular site.

- **Site Design Features**
  Providing features to capture and treat runoff. This includes numerous BMPs and Green Infrastructure components to address water quality.
- **Street Construction Features**
  Reducing road widths, reducing frontage requirements, and impervious surface reduction in general
- **Construction Practices**
  Pollution prevention practices that minimize soil disturbance, soil compaction, and soil migration.

There are several guides that contain useful information regarding development practices that can limit the impacts associated with stormwater runoff. A general list of additional sources of BMP and Green Infrastructure design information can be found at http://www.iowasudas.org/. The use of Green Infrastructure to treat stormwater runoff is growing throughout the nation, has been studied by the EPA, and is showing promise as a cost-effective suite of tools to help cities manage stormwater while improving the fabric of their communities.

GREEN INFRASTRUCTURE

More traditional approaches to stormwater management such as storm sewers and other means of conveyance will be discussed further in Chapter 8: Infrastructure.

The USEPA defines green infrastructure as "a cost-effective, resilient approach to managing wet weather impacts that provide many community benefits. While single-purpose grey stormwater infrastructure – conventional piped drainage and water treatment systems – is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits." Rather than seeing stormwater as a nuisance that needs to be conveyed off site, green infrastructure recognizes the aesthetic, environmental, and economic quality of rainwater. Green infrastructure and its principles can be applied to small-scale areas such as a single-family home or building or at a larger city-wide level using permeable pavement, green road design, or other methods.

Many cities across the United States are recognizing the environmental and economic benefit of green infrastructure. Ankeny already has experience with this dual benefit using detention basins, permeable pavers, and bio-swales in various locations in town. The detention basins provide a location for stormwater to pool while also providing an attractive aesthetic feature for the park or neighborhood. If home values are increased due to the proximity to a park or water feature, this translates into additional revenue for the City.

Some cities cite concerns over the initial cost of green infrastructure solutions compared to the more historically common methods using grey infrastructure. Typically, construction costs of grey vs. green infrastructure are the only methods for assessing the economic implications and impacts of green infrastructure. This approach ignores the differences in performance between green infrastructure and grey infrastructure, as well as the benefits of each approach. A more comprehensive approach to evaluating the cost, performance, and investment of green infrastructure is to consider a cost-benefit analysis. This analysis would provide decision makers with a comprehensive inventory on the benefits associated with different stormwater control options. The EPA has assisted communities in undergoing this type of comprehensive cost-benefit analysis and have published the studies here, http://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources, as well as multiple resources for municipalities to evaluate the use of green infrastructure in their development and operations strategies.

The benefits of green infrastructure that have been measured through research and various studies include:

- Improved water quality
- Reduced water treatment input
- Reduced grey infrastructure needs
- Reduced flooding
- Increase in available water supply
- Increased groundwater recharge
- Reduced urban heat island effect
- Reduced energy use
- Improved air quality
- Reduced atmospheric CO_2
- Improved aesthetics
- Increased recreational opportunities
- Reduced noise pollution
- Improves community identity and cohesion
- Improves habitat
- Cultivates public education opportunities
- Others

There are opportunities to implement green infrastructure across all of Ankeny's land uses and at multiple scales. Green infrastructure is easiest and most effectively implemented during the initial planning and design stages, where it can fit into a comprehensive approach. However, green infrastructure can be retrofitted into the existing infrastructure network and should be explored as the city redevelops and renovates areas with aging infrastructure. Green infrastructure can also be part of a comprehensive approach to addressing the effects of climate change, making Ankeny more resilient to the elements of increased frequency and strength of severe storms, drought periods, and heat waves.

GREEN INFRASTRUCTURE BEST MANAGEMENT PRACTICES

DOWNSPOUT DISCONNECTION

Downspout disconnection separates roof downspouts from the storm sewer system and redirects roof runoff onto pervious surfaces, most commonly a lawn. This reduces the amount of directly connected impervious area in a drainage area.

RAINWATER HARVESTING

Collect and store rainfall for later use. Slow and reduce runoff and provide source of water during dry periods for irrigation or other uses. Reducing the cost and need for city water.

RAIN GARDENS

Shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets. Runoff can be infiltrated into the ground or cleansed and conveyed to the existing stormwater system, depending on localized factors such as soils and groundwater.

PLANTER BOXES

Urban rain gardens with vertical walls and either open or closed bottoms. They collect and absorb runoff from sidewalks, parking lots, and streets and are ideal for space-limited sites in dense urban areas and as a streetscaping element.

BIOSWALES

Vegetated, mulched, and xeriscape channels that provide treatment and retention as they move stormwater from one place to another.

PERMEABLE PAVEMENTS

Infiltrate, treat, and/or store rainwater where it falls. Pervious concrete, porous asphalt, or permeable interlocking pavers.

GREEN STREETS AND ALLEYS

Created by integrating green infrastructure elements into their design to store, infiltrate, and evapotranspire stormwater. Includes use of permeable pavement, bio-swales, planter boxes, and trees.

GREEN PARKING

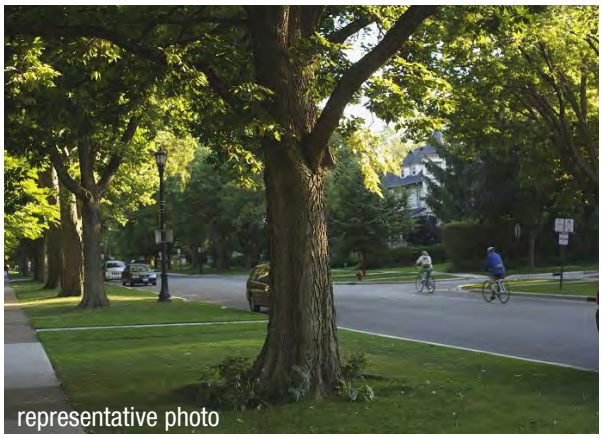
Green infrastructure elements worked into parking lot design such as permeable pavements, rain gardens, or bio-swales. Shared parking between compatible businesses and institutions can minimize the amount of impervious surface requiring stormwater development.

GREEN ROOFS

Roofs covered with growing media and vegetation that enable rainfall infiltration and evapotranspiration of store water. Green roofs can also be a building amenity, providing a tranquil open space for residents or employees.

TREE CANOPY

Trees reduce and slow stormwater by intercepting precipitation in their leaves and branches. A tree with a 25-inch diameter canopy and associated soil can manage the 1-inch of rainfall from 2,400 square feet of impervious surface.



DETENTION BASINS

Help absorb water during flash flood events, by creating a location for rainwater to collect and be absorbed. During dry times, a detention basins remains dry while a retention basins has some water present permanently.

NATURAL RESOURCE CONSERVATION

Land conservation efforts such as the preservation of riparian areas, wetlands, and steep hillsides can help provide a more natural landscape to absorb and slow rainwater and snow melt. The permeable surfaces infiltrate water back underground.

STRUCTURAL TREE TRENCHES

Rooting space is created below impervious surfaces–promoting healthier trees and larger canopies, while allowing heavy pedestrian and vehicular traffic. Structural soils and rocks are typically comprised of larger void spaces for air and water storage.

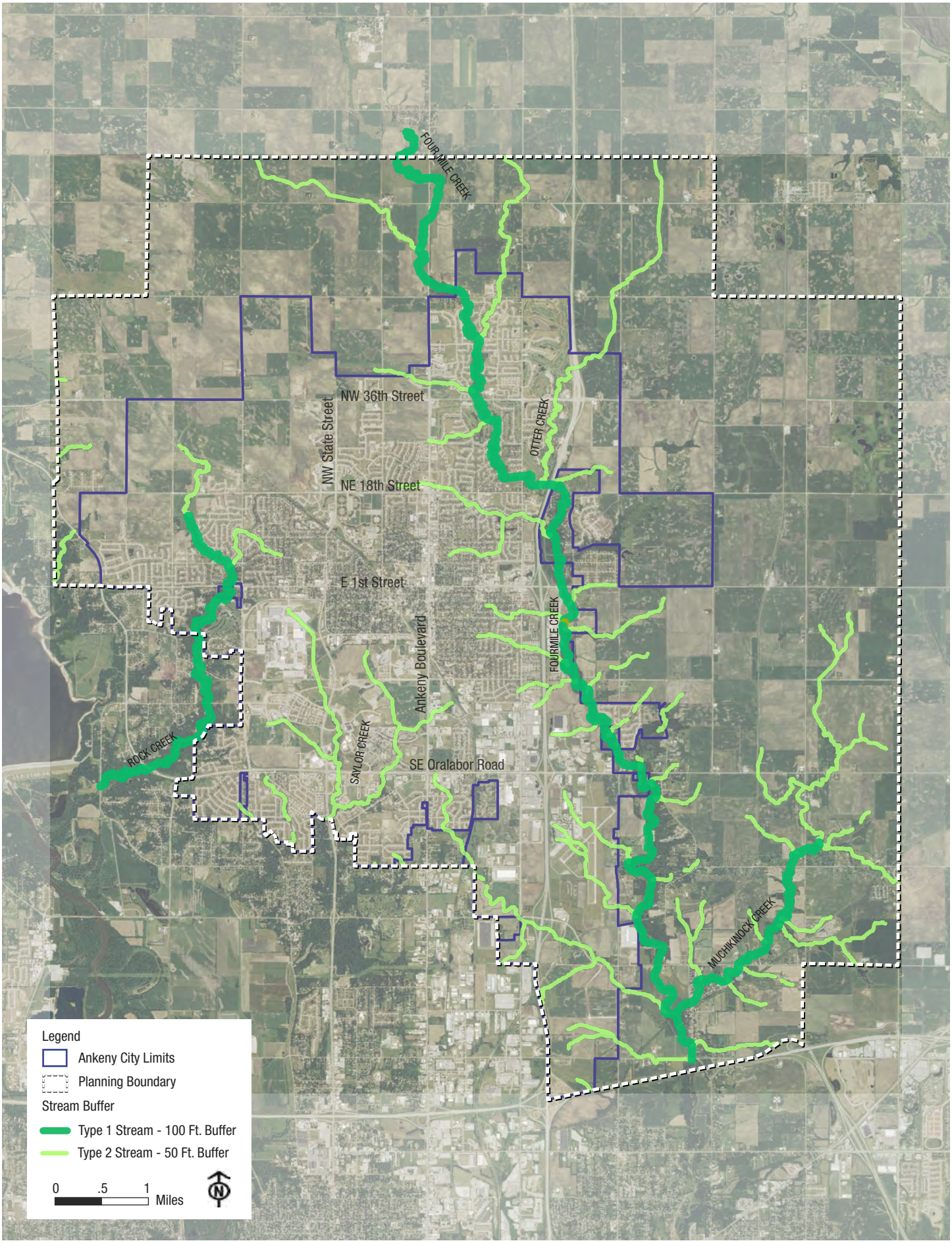
CONSERVATION DESIGN

Preserving the natural environment by clustering homes and infrastructure together and preserving larger tracts of open space. Narrower street design, shared driveways, and the use of vegetated swales for runoff conveyance, reduce the amount of impervious and runoff that is generated.

GREENBELT MAP

In assessing the environmental features of Ankeny, it became clear that one of the more pressing environmental issues in Ankeny is stream health. Based upon the evaluation of streams in the Ankeny planning boundary, a buffer stream corridor, or greenbelt, has been identified. The greenbelt will be used to guide the implementation of stream buffer purchases and easements along most type 1 and type 2 streams in Ankeny. The greenbelt will subsequently be used to identify proposed trail expansions in Ankeny as discussed in Chapter 6: Parks and Recreation. The greenbelt map can be seen in Figure 4.10. The greenbelt proposes a series of 100 and 50 feet buffers along major stream channels in the Ankeny area. A model stream buffer ordinance for implementation is provided in the Appendix of this report.

FIGURE 4.10 **Greenbelt Buffer System - Ankeny, Iowa**



ENVIRONMENT GOALS AND POLICIES

Goal 1: Reduce impact of flooding and soil erosion

Policy 1.1 - Discourage development within the 100-year floodplain or within the floodway as determined by FEMA

Action 1.2 - Adopt a stream buffer ordinance requiring stream buffers as follows:
Type 1 - Perennial Stream : 100 Feet
Type 2 - Intermittent Stream : 50 Feet

Policy 1.3 - Follow the Fourmile Creek Management Plan and maintain membership in the Fourmile Creek Watershed Management Authority

Action 1.4 - Adopt an ordinance requiring new development to analyze and construct necessary stream stabilization measures

Goal 2: Protect, preserve, and increase tree cover

Policy 2.1 - Require new development to preserve significant tree stands

Policy 2.2 - Promote the planting of a variety of trees with new development

Goal 3: Preserve areas for open space

Goal 4: Enhance water quality

Policy 4.1 - Promote and require stormwater best management practices

Goal 5: Support renewable energy where appropriate

Action 5.1 - Draft a code on solar energy systems installation

Goal 6: Preserve high value wetlands

Action 6.1 - Adopt ordinance requiring new development to incorporate existing high quality wetlands as an amenity where appropriate

Goal 7: Continue to promote and implement alternative infrastructure solutions to reduce the impact of stormwater runoff and improve water quality

Policy 7.1 - Encourage stormwater best management practices be incorporated with all new development and redevelopment and public improvement projects