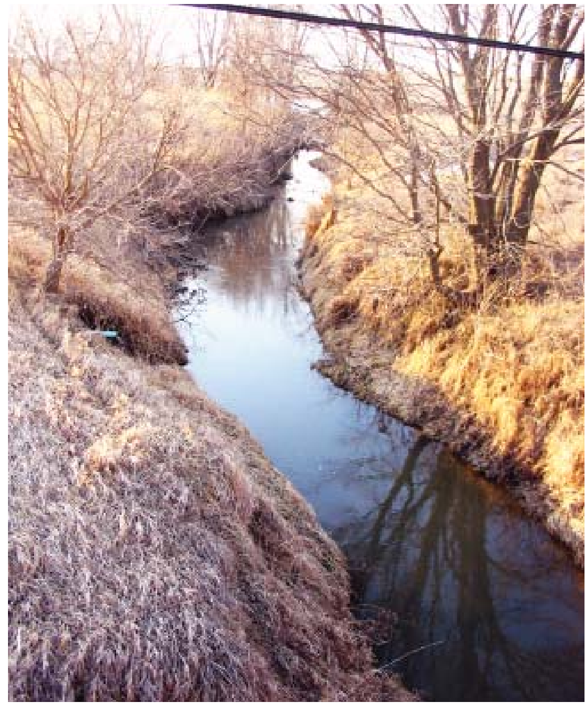
3 watershed inventory and analysis

3.01 INTRODUCTION

The Duck Creek watershed, located in eastern Scott County, Iowa and the Rock River Ravine Study Area located in northern Rock Island County, Illinois comprise two subwatersheds of the Quad Cities area that contribute surface water that ultimately flows to the Mississippi River. Conservation Design Forum (CDF) is assisting with watershed planning for these two areas under the direction of River Action, Inc. As part of this planning effort, CDF is responsible for conducting an assessment of the existing conditions of the waterways (rivers, creeks, and contributing influences) within each watershed. This information forms the base from which the recommendations for improvement will be derived.

A solid understanding of the unique features and natural **hydrologic** (water-based) processes that form the underlying framework of the watershed -- as well as a clear comprehension of the current and predicted future conditions of these processes if no action is taken -- is critical to developing an effective watershed plan. The watershed inventory and analysis section of this report organizes, summarizes, and presents data and observations gathered about the current conditions of the watershed in a manner that clearly communicates the current issues and processes so that those that live and work in the watershed (stakeholders) can make informed decisions about the watershed's future. This inventory and analysis helps to identify causes and sources of watershed impairment, and provides the basis for recommending actions intended to improve conditions within the watershed, which are found in Chapter Five. Factors that have influence on the degree of watershed impairment that may be observed include water quality, surface water quantity, erosion, type of land cover, etc.

To conduct the inventory and assessment, CDF and other members of the project team collected and reviewed available watershed data and reports, investigated and photographed stream reaches in the field, and gathered input from watershed stakeholders. Examples of information that was investigated for the Duck Creek watershed include historic water quality data; field observation of streambank and channel conditions and erosion; soil characteristics;



Duck Creek in winter.

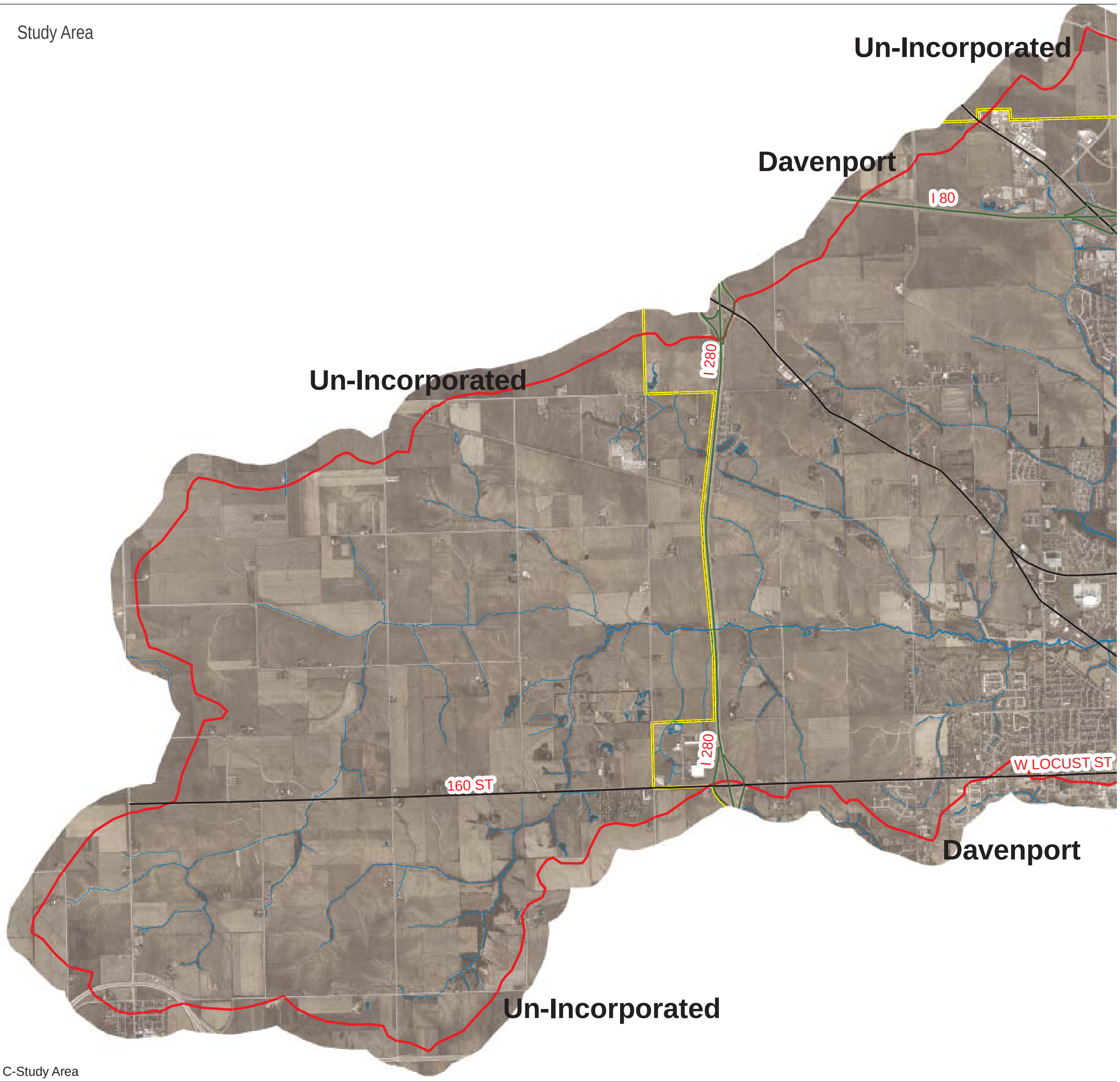
Duck Creek in spring.

and maps of existing wetlands, floodplains, the stormwater drainage system, and land use.

Geographic Information System (GIS) software was used to compile and display this complex geographic information in graphic and map format to help stakeholders and other readers of this report more easily understand the condition and location of watershed resources and problems. The project team also investigated water quality by computer modeling the amount of different pollutants that are expected from various land uses.

This chapter presents the results of the inventory and analysis in a narrative form accompanied by an illustrative series of maps, tables, and photographs. A 'State of the Watershed' assessment completes the chapter.

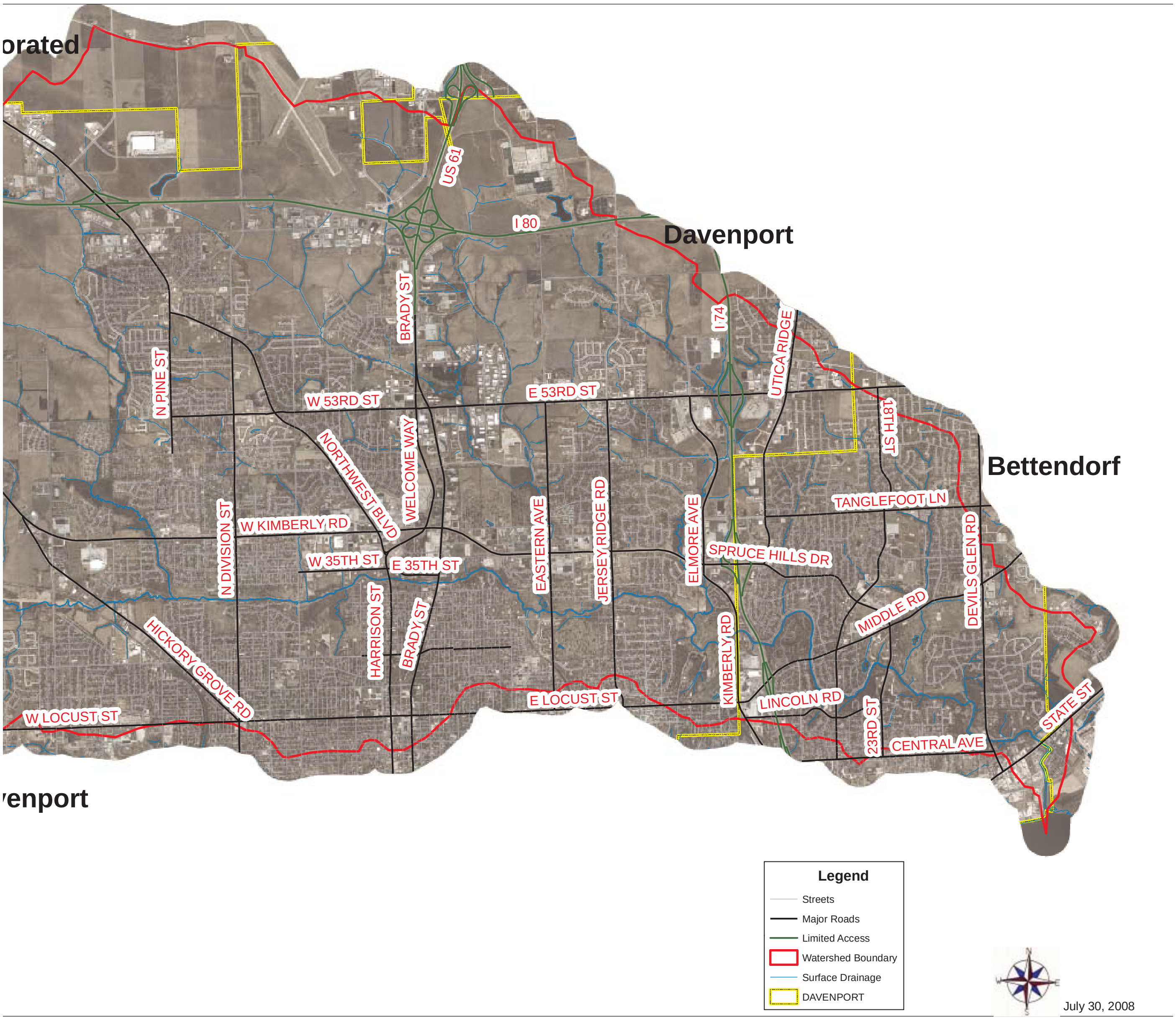
Figure 3.02.1 Study Area



Subtask C-Study Area

3.02 WATERSHED SETTING

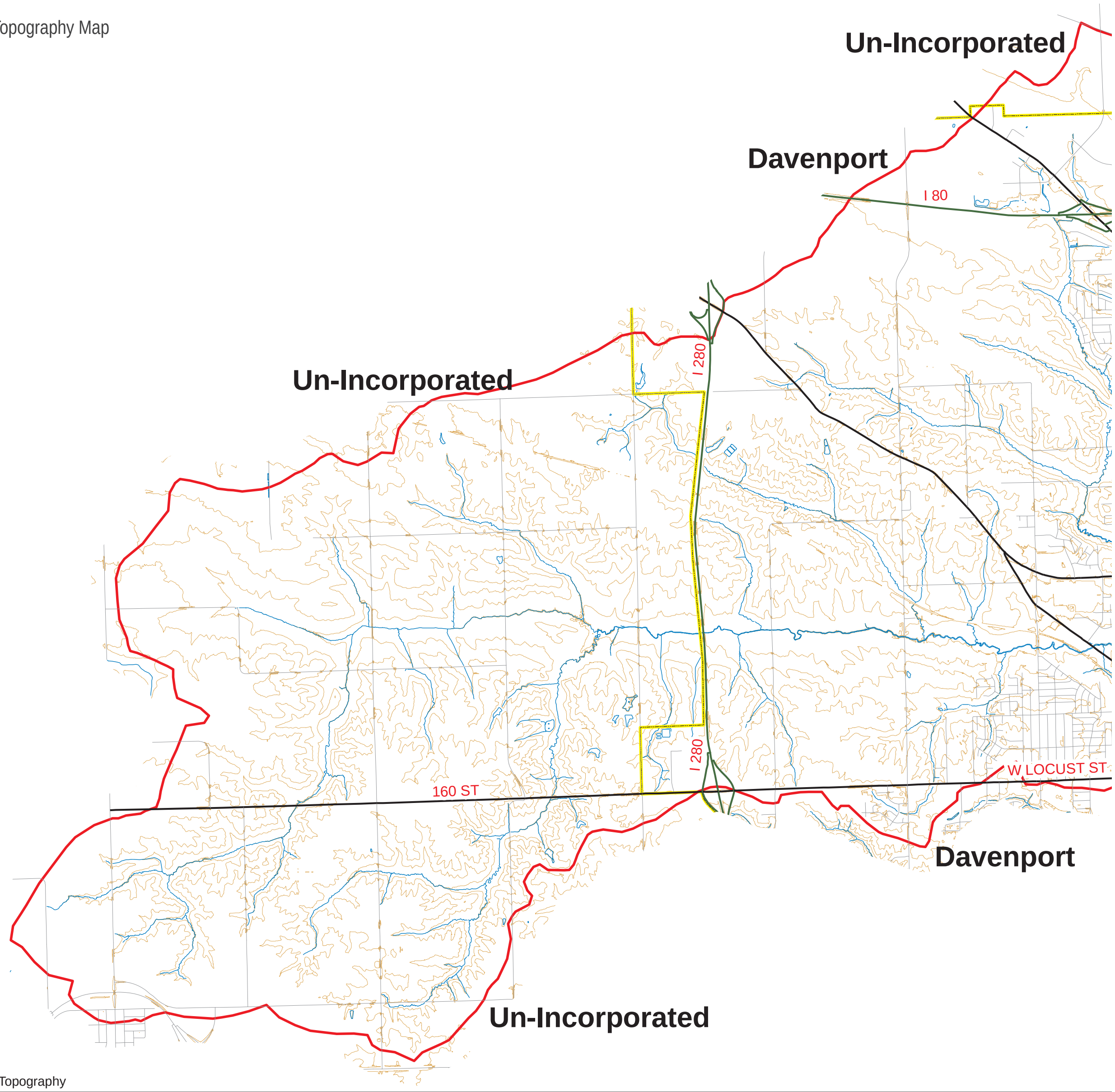
The 64 square miles (40,772 acres) that encompasses the Duck Creek watershed shown in Figure 3.02.1 drains west to east from the gently rolling headwater reaches in the farmland west of I-280 and south of 160th Street, through Davenport generally north of Locust Street. To the north, the watershed boundary extends to include a portion of the Davenport Municipal Airport north of I-80. East of this point, its boundary turns generally southeast to include Bettendorf, and a very small western section of Riverdale. Turning south here, Duck Creek flows through steeper terrain before discharging into the Mississippi east of the Devils Glen Road and State Street intersection. A large portion of the western half of the Duck Creek watershed is agricultural land, while the eastern 50-60% drains the significantly urbanized cities of Davenport and Bettendorf.



Water resources within the Duck Creek watershed primarily include approximately 81.6 miles of stream corridor and 88 acres of wetlands. From west to east, the major named Duck Creek tributaries are: Silver Creek, Goose Creek, and Pheasant Creek. Additional minor creeks that contribute flow include Greenway Creek, Stafford Creek, Halcyon Creek, and 44th Street Creek, all in Bettendorf.

The overall quality and connection of the Duck Creek and Rock River systems relative to the overall quality of the Mississippi River and, ultimately, the Gulf of Mexico, is critical. An appreciation and understanding of this connection should influence the proper management and stewardship of our valuable and degraded aquatic resources.

Figure 3.04.1 Topography Map



Subtask C-2 Topography

3.03 CLIMATE AND PRECIPITATION

The climate of the Duck Creek Study Area watershed and of the Quad Cities region in general exhibits a wide range of temperatures over the calendar year. Mean high summer temperatures are in the low eighties; mean low winter temperatures are in the low teens. Precipitation and snowfall in the watershed average 38.04 and 35.3 inches per year, respectively. Precipitation is greatest during the late spring and summer and is typically associated with low-pressure weather systems. These systems result in the thunderstorms that are commonplace across the Midwest during the summer months. Table 3.03.1 presents the 1971–2000 temperature and normal precipitation for the watershed.

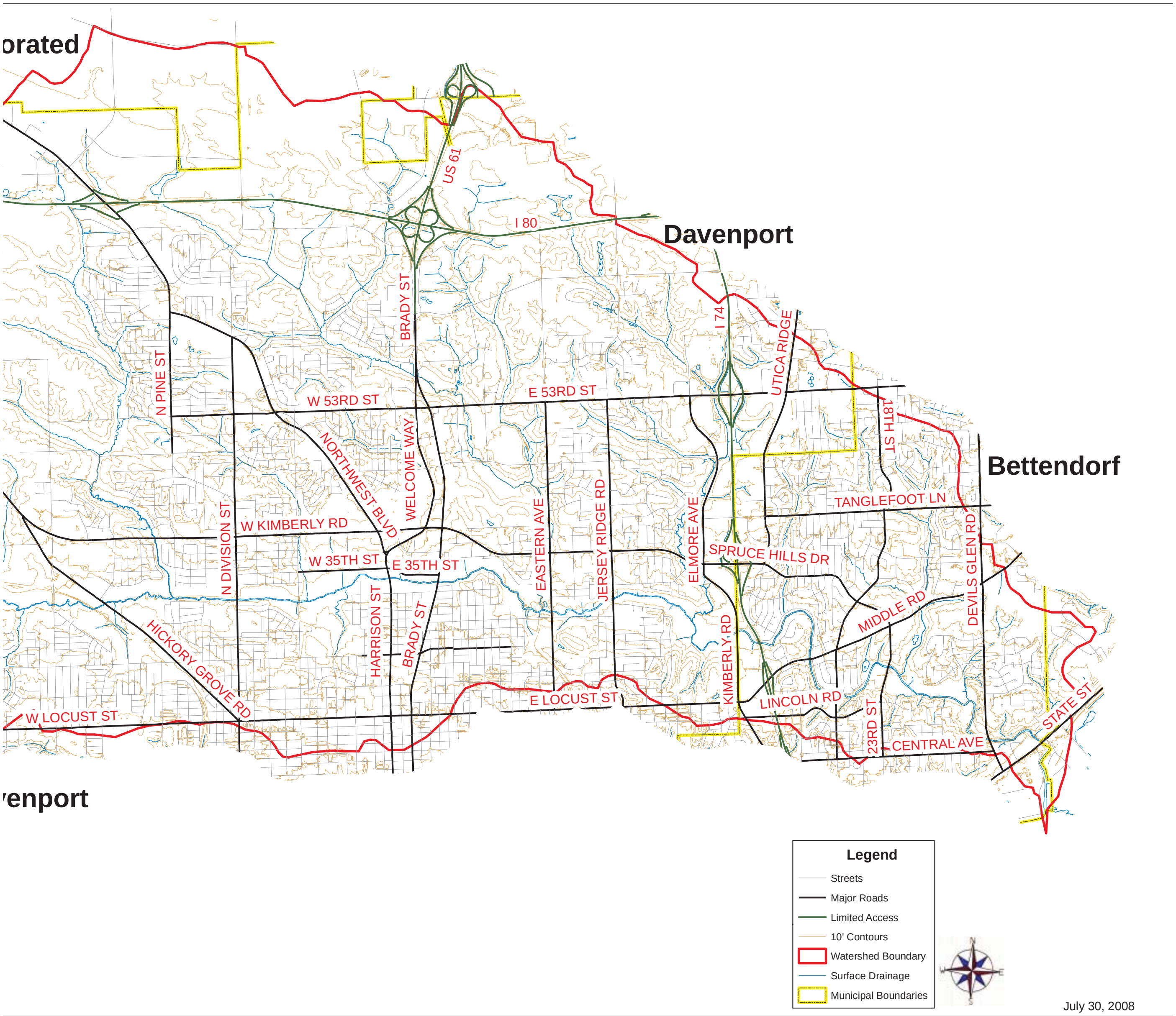


Table 3.03.1 1971-2000 Precipitation and Temperature data for Moline climate station

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Totals
Precipitation (in)	1.58	1.51	2.92	3.82	4.25	4.63	4.03	4.41	3.16	2.80	2.73	2.20	38.04
Snow (in)	10.2	7.2	4.9	1.3	0.0	0.0	0.0	0.0	0.0	0.2	3.0	8.5	35.30
High Temp (F)	29.8	35.6	48.3	61.7	73.3	82.7	86.1	83.9	76.5	64.4	48.0	34.5	60.4
Low Temp (F)	12.3	18.2	29.0	39.3	50.0	59.7	64.5	62.4	53.4	41.6	30.1	18.3	39.9
Mean Temp (F)	21.1	26.9	38.7	50.5	61.7	71.2	75.3	73.2	65.0	53.0	39.1	26.4	50.2

Source: Data from Illinois State Water Survey Climate Office, 1971-2000 averages, Moline Station, IL

3.04 GEOLOGY AND TOPOGRAPHY

Glacial action has significantly shaped the landscape character of the Quad Cities region. The first glaciers to reach this area advanced from the northwest about 300,000 years ago and crossed the present-day upper Mississippi River valley into eastern Iowa, scouring the bedrock and depositing sediments as they advanced and retreated. Within the last 25,000 years, the region was covered by a glacial lake that deposited massive quantities of sediment as it drained. Subsequently, as the glaciers made their final retreat, fine-grained sediments were transported by wind from the front of the ice sheet to be deposited as a thick blanket of loess, a buff to gray deposit of fine-grained, calcareous silt or clay. These multiple glacial deposits range in thickness from less than 25 feet to nearly 100 feet over the bedrock of the region. Soils along the lower reaches of the Rock River in Illinois and Duck Creek in Iowa clearly show this history by being composed almost entirely of well-drained, silty loam with very little clay content, typical of glacial outwash. Some areas have a high percentage of sand.

As with soil composition, the regional topography is influenced by both bedrock geology and the surficial processes that have occurred over time. Receding glaciers deposited broad, irregular mounds of sediment known as moraines, creating local variations in the topography and landform that resulted in steep slopes of up to 60 degrees such as are seen along the Rock River ravine drainage system. These variations become more pronounced as you move from the flat or rolling uplands along the northern border of the watershed boundary down into the Mississippi and Rock River floodplains. Streams have carved these ravines and valleys into the surface deposits as surface water has been drained thorough the system rather than infiltrated. Eroding surface soils by water action has exposed dolomite, shale, and limestone bedrock at the land surface in some locations. River dynamics have deposited sediment (alluvium) within the broad, flat floodplains in the lower reaches of the system that have first been favored by agriculture and, second, followed by industry seeking large flat areas and access to water for use in industrial processes and to transport raw materials and products into and out of the area.

The variable topography of the Duck Creek watershed falls generally to the east where it flows into the Mississippi River from a western high point approximately 5 miles west of I-280. Land within the majority of the watershed is generally gently sloping or rolling with some areas of steep cliffs and ridges in the lower reaches, primarily within Bettendorf (see Figure 3.04.1. Duck Creek topography) The creek's headwaters begin at approximately 780 feet above sea level and enter the Mississippi River at around 550 feet. The elevation data for the watershed, depicted in Figure 3.04.1 was used to define smaller drainage areas within the watershed that are referred to as Subwatershed Management Units (SMU's), which are discussed below.

3.05 SOILS

Three aspects of the soils in the region were investigated and mapped for this inventory: hydric soils, hydrologic soil group, and soil erodibility. The hydrologic soil group and hydric soil classifications provide valuable information for determining the appropriate management practices for different applications throughout the watershed. For example, understanding the extent and location of hydric soils helps to identify possible locations for restoring former wetlands. Erodible soils indicate areas where development or improper management may cause erosion, and where maintaining vegetative cover can help hold soils in place. Accurate soil mapping in developed areas is not possible as defining soil characteristics are lost as part of the construction process.

HYDRIC SOILS

The hydric soils data was obtained from the County Soil Survey that is developed and published by the Natural Resources Conservation Service. Hydric soils are formed when soils have been saturated, flooded, or ponded long enough during the growing season to develop anaerobic (oxygen-lacking) conditions in the upper part of the soil layer. These conditions favor the growth and regeneration of wetland, or hydrophytic, vegetation; that is plants that grow either partly or totally submerged in water or in waterlogged soil. Hydric soils have unique physical and chemical properties that can be detected and identified in the field even if the soils are dry, therefore hydric soils that are drained will retain those chemical and physical properties.

Knowledge of the location of hydric soils is important for a number of reasons. Hydric soils provide an indication of historic wetlands and locations for potential wetland restoration. Hydric soils are also areas that may be prone to flooding or otherwise wet conditions if the infrastructure that drains the soil (tiles and ditches) is not maintained. Hydric soils occur along natural drainageways and therefore can be useful in identifying natural connections between isolated wetlands where no apparent connection exists, and where restoration can improve the surrounding hydrology.

Hydric soils occur throughout the Duck Creek watershed as shown in **Figure 3.05.1** (Duck Creek Watershed Hydrologic

Table 3.05.1 Hydrologic Soil Groups and Hydric Soils

Hydrologic Soil Group	Acres	Percentage
HSG A	15	0
HSG B	25,075	62
HSG C	730	2
HSG D	12	0
HSG B/D	2,485	5
Urban Soils	12,459	31
Hydric Soils	10,853	27

Soil groups). Approximately 10,853 acres (27%) of the total acreage within the watershed are classified as hydric with the greatest concentration found within the Duck Creek floodplain or stream channels, where many wetlands remain. Within the watershed large pockets of hydric soils are also clearly delineated on the map that extend in a southeasterly direction from the northern and western borders of the watershed and do not appear to be associated with an obvious stream channel. In these areas, it is likely that these are remnant hydric soils that remain after tiling to drain them for agricultural purposes. These likely demonstrate current or former large wetland complexes associated with the headwater areas of Duck Creek. These hydric soils in their natural state may be either poorly drained soils, or well-drained soils that are saturated due to a high water table such as those typically associated with wet prairies, wetlands, and streams. If currently tiled for farming, these areas may present opportunities for wetland restoration.

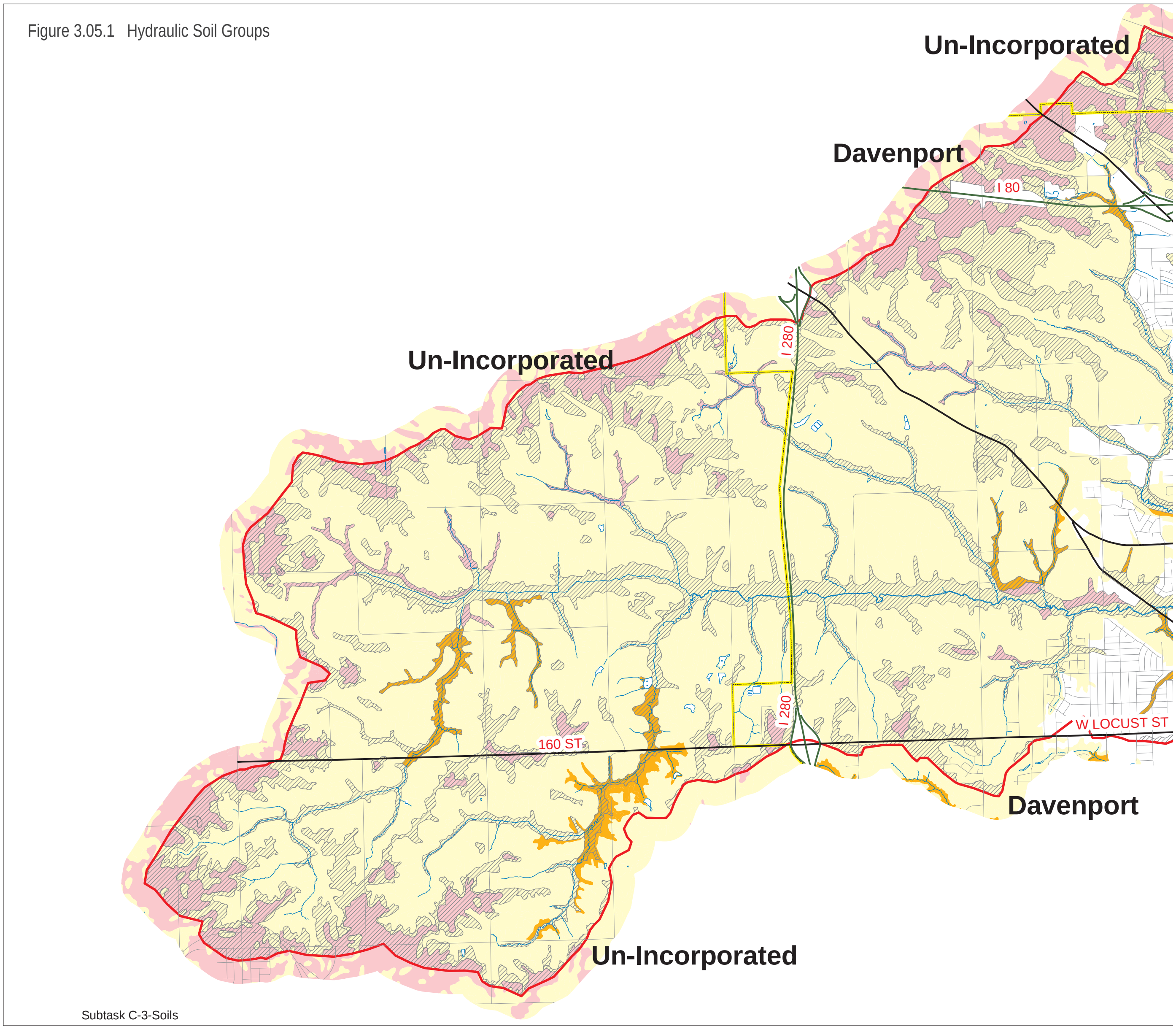
HYDROLOGIC SOIL GROUP (HSG)

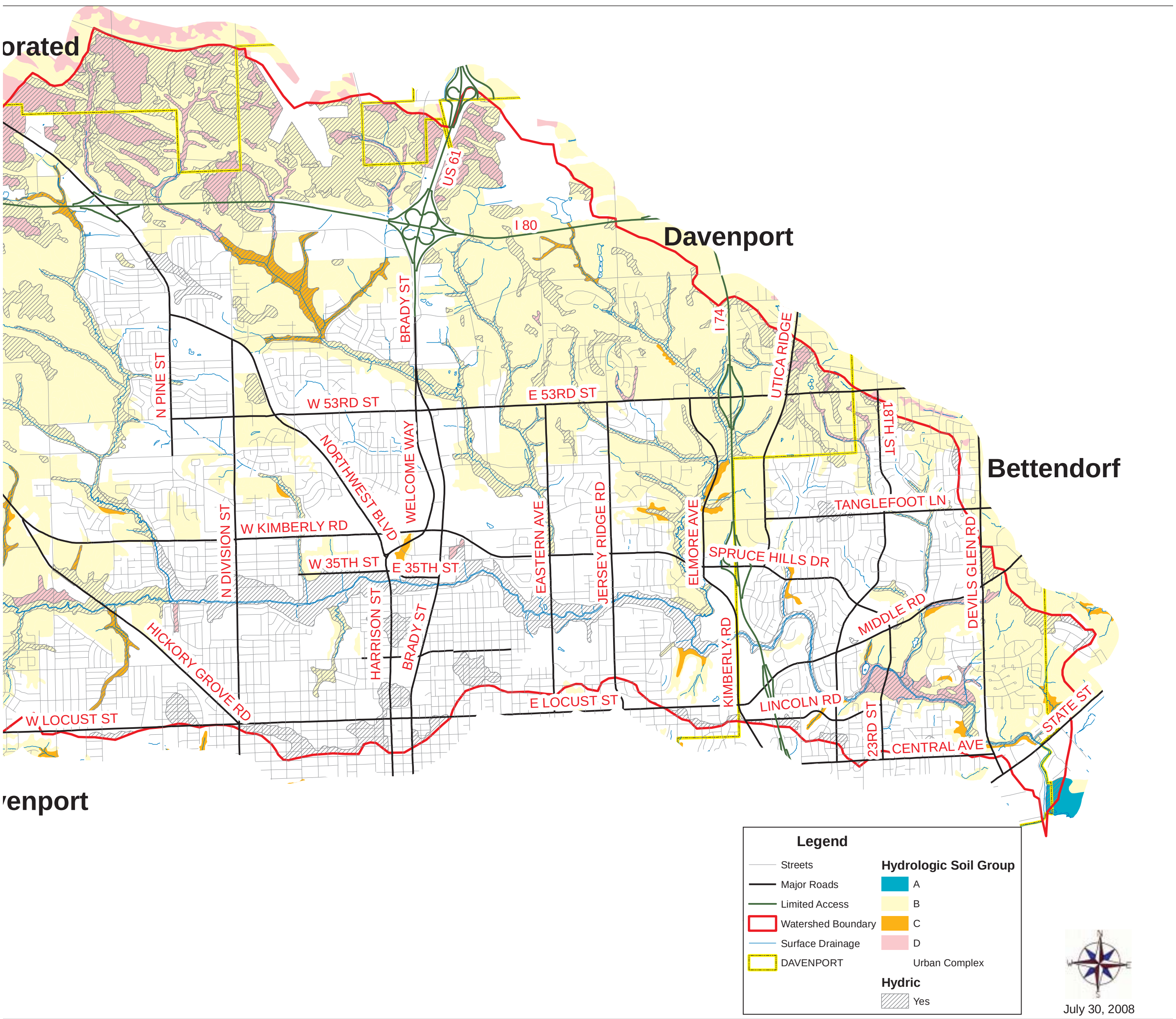
Under a system devised by the U.S. Department of Agriculture, soils are classified into one of four hydrologic soil groups -- A, B, C, or D -- based on the degree to which the soil continues to absorb water during a long rain event. Precipitation that is not absorbed or infiltrated becomes runoff. Therefore, the hydrologic soil group classifications within a watershed are one determinant of how much rainfall will run off as surface flow to streams. In general, Group A (sandy soils) has the highest permeability and least runoff potential whereas Group D (predominantly clay soils) has the lowest permeability and highest runoff potential. **Figure 3.05.1** (Duck Creek Hydrologic Soil Groups) shows the location of Hydrologic Soil Groups in the Duck Creek Study

Area watershed. For mapping purposes, hydric soils labeled as B/D were mapped as D soils. The percentages of each HSG classification in the watershed are shown in Table 3.05.1.

In general, outside of the developed areas of Davenport and Bettendorf, soils fall into the HSG B class. These are moderately deep or deep soils that are fairly well-drained that typically absorb water at a moderate rate. HSG C soils are found infrequently along water courses. These finer textured soils absorb water more slowly and therefore have a higher potential for runoff in larger rain events. In general these soils are also identified as hydric. Pockets of HSG D soils, also hydric, are found along the far west/northwest border of the watershed. Typically HSG D soils are primarily composed of clay or have a high water table or other condition that impedes the absorption of water. HSG D soils have the highest risk of runoff.

Figure 3.05.1 Hydraulic Soil Groups





orated
Davenport
Bettendorf
venport
I 80
US 61
I 74
N PINE ST
W 53RD ST
E 53RD ST
BRADY ST
NORTHWEST BLVD
WELCOME WAY
W KIMBERLY RD
N DIVISION ST
W 35TH ST
E 35TH ST
HARRISON ST
EASTERN AVE
JERSEY RIDGE RD
ELMORE AVE
SPRUCE HILLS DR
KIMBERLY RD
UTICA RIDGE
18TH ST
TANGLEFOOT LN
MIDDLE RD
DEVILS GLEN RD
LINCOLN RD
23RD ST
CENTRAL AVE
STATE ST
E LOCUST ST
W LOCUST ST
HICKORY GROVE RD
Legend
Streets
Major Roads
Limited Access
Watershed Boundary
Surface Drainage
DAVENPORT
Hydrologic Soil Group
A
B
C
D
Urban Complex
Hydric
Yes
July 30, 2008

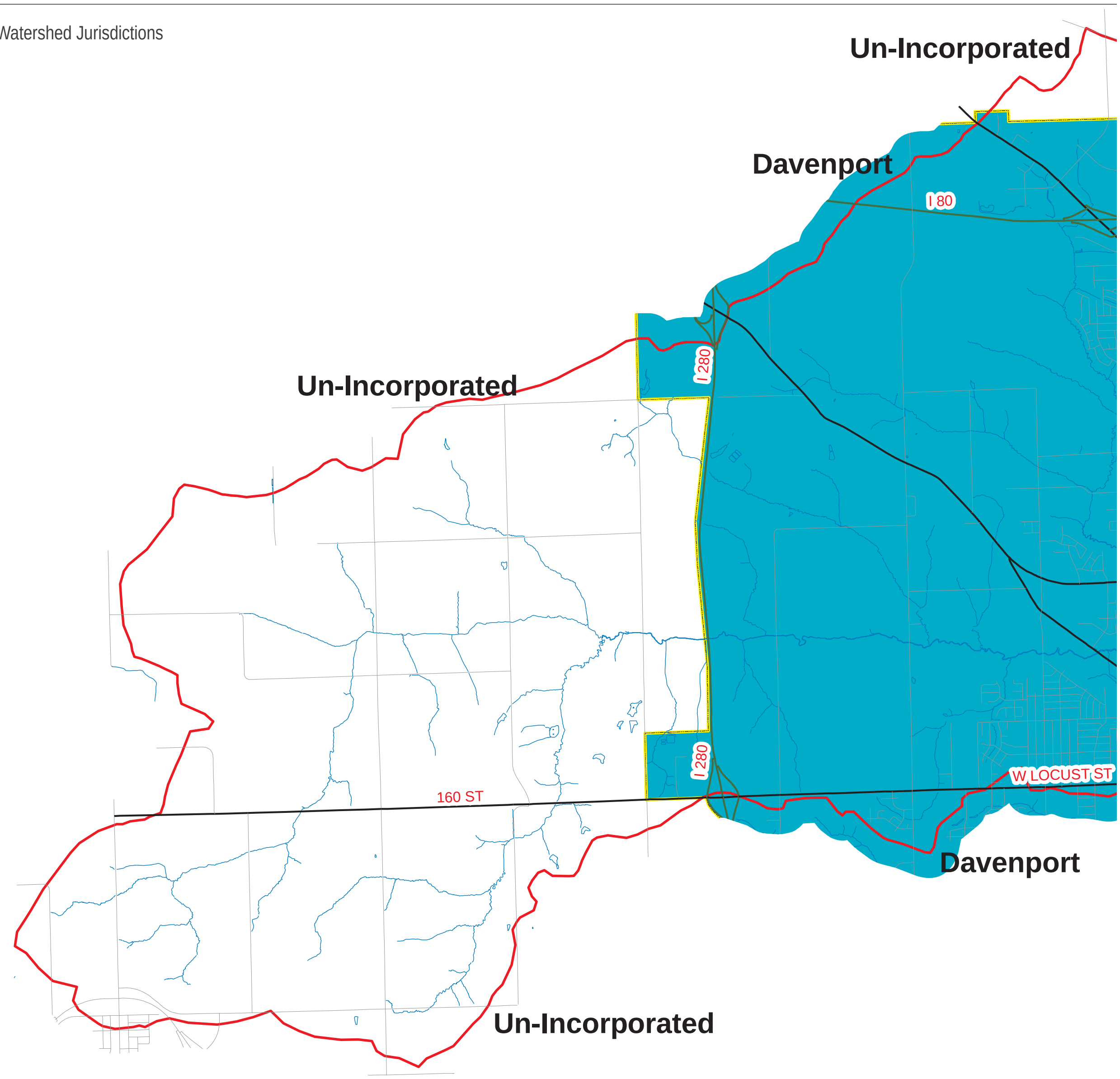
3.06 WATERSHED JURISDICTIONS

The Quad Cities area encompassed by Davenport, Moline, and Rock Island Metropolitan Statistical Area has a population of 377,291 and 150,409 households. The 2010 and 2025 project populations are 381,580 and 400,320 respectively. The Duck Creek watershed municipalities include Riverdale, Bettendorf, and Davenport (Refer to **Figure 3.06.1**).

3.07 LAND USE

Land use and land cover refer to the type of use assigned to a section of land (parcel), such as residential or agricultural, and the type of surface coverage found on that parcel, such as forest or grassland, respectively. This information, as well as an understanding of the landscape characteristics prior to European settlement, provide a foundation for

Figure 3.06.1 Watershed Jurisdictions

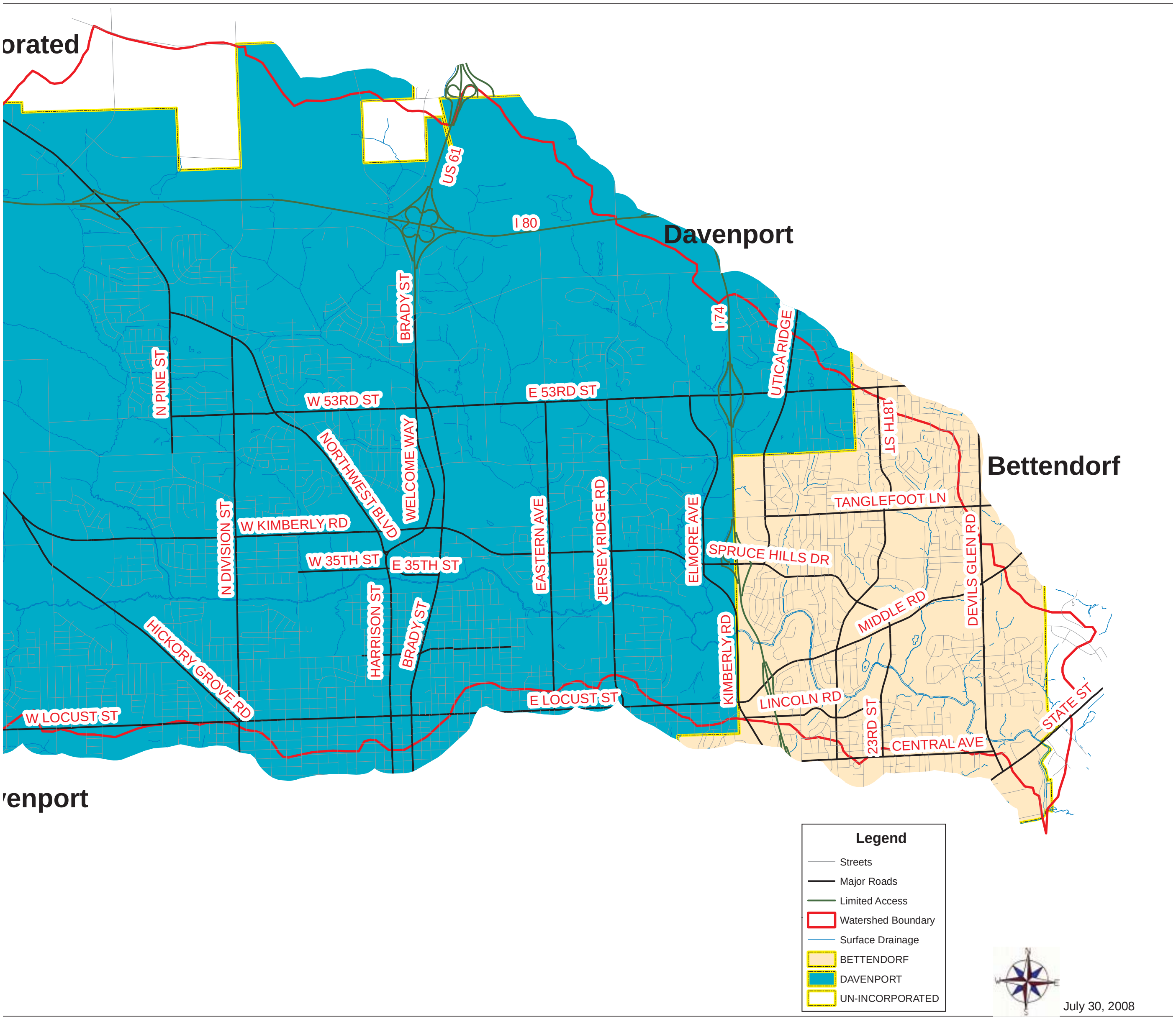


Subtask C-4 Watershed Jurisdictions

understanding the impact of current and future land use decisions on watershed resources and the restoration potential of a particular parcel within the watershed. For example, a parcel that is being farmed will have a much higher restoration potential than one where a large big box commercial complex has covered the landscape in large impermeable areas of roof and parking lot.

PRESETTLEMENT VEGETATION

Prior to European settlement, much of the Quad Cities region consisted of a mix of wet to dry prairie and open woods, with some Mississippi River bottomland near the mouth of the Rock River and Duck Creek a mix of forest, prairie and wetland systems that included river bluffs, limestone cliffs, and rugged terrain bordering the Mississippi River floodplain.



According to a number of sources (Braun, 1950; Kuchler, 1964; Schwegman, 1973), the dominant presettlement condition for much of the study area included wet and mesic prairie, wet (sedge) meadow, and marsh. Of these types of systems mesic prairie is the driest and marsh the wettest. With the exception of the mesic prairie, all are considered a type of wetland. Wet prairie species found historically included prairie cordgrass, various wetland sedges, and blue-joint grass. Associated plants in the mesic prairie were ironweed, boneset, swamp milkweed, and water hemlock.

Non-forested wetlands included duckweed, various grasses, tickseed, jewelweeds, soft rush, rice cutgrass, smartweeds, broadleaf cattail, prairie cordgrass, river bulrush, sedges, clearweed, and arrowhead, bur cucumber, swamp iris, blue vervain, sweetflag, spikerush, moneywort, scouring rush, swamp milkweed, and horsetail. Shrubs include buttonbush, red osier dogwood, alternate-leaved dogwood, elderberry, willows, swamp rose, halberd-leaved rosemallow, and ironweed.

Forests in the lowest floodplain areas were subject to seasonal and prolonged flooding. Floodplain forest species include silver maple, American elm, green ash, some oak and hickory species, black cherry, black walnut, basswood, sycamore, cottonwood, hackberry, and honey locust. Shrub species included dogwood, blackberry, brier, Virginia creeper, and gooseberry. The herbaceous ground layer included white snakeroot, great lobelia, bur cucumber, smartweeds, knotweeds, stinging nettle, Solomon's seal, moneywort, moonseed, violets, and jewelweed.

There may have been areas of savanna (a drier area with a mix of oaks scattered within a prairie grassland) and oak woodlands (wooded areas dominated by oak species but also including other tree and shrub species) along the ridges and ravines. The savannah ecosystem type, which is now globally rare, occurred along the intersection of the great Eastern forests and the Midwestern open prairies. Its open, pleasant character and fertile soils resulted in mass conversion of these lands for agriculture and settlement. Oak woodland landscapes were more densely wooded than savanna, but would have been considered open by today's standards, with an understory of grasses and forbs.

Except for the oak woodlands along the ravines, most of the presettlement vegetation cover types have been converted to agriculture and urban land uses to provide living, working, learning, recreation, and other uses for people.

The 1837 General Land Survey notes for the area traversed by Duck Creek provide some insight into the pre-settlement character of the Quad Cities landscape. These notes indicate a condition somewhat different from that found today. In a number of locations where the survey line crossed Duck Creek, the channel was found to be 10 feet wide with a muddy bottom and a gentle current, and ranging up to 26 feet in width in downstream reaches. The land is described variously as level to rolling 2nd rate (marginal for agricultural production) prairie with scattered trees, one or two locations of uneven and thinly timbered land, and a few locations of 1st rate bottom land. Noted tree species primarily include white, bur and black oak, hickory, and birch found at the confluence with the Mississippi River. Along one surveyed line where there currently exists a stream channel, no stream channel existed in 1837, indicating either a modification of the landscape for drainage or the evolution of a stream channel due to rain water runoff. In one location, in the left bank of Duck Creek, a four foot thick bed of bituminous stone coal was observed overlaid with sandstone rock, which is consistent with coal and shale found south of the Mississippi River in Carbon Cliff.

EXISTING LAND USE

The composition of existing land use and land cover for the Duck Creek watershed are shown in Table 3.07.1 and Figure 3.07.1. The watershed consists of a fairly even mix between the highly developed areas of Davenport and Bettendorf in the eastern half and rolling agricultural land in the western headwaters. In aggregate, natural and open lands (agricultural land, forest and grassland, open space (including recreational areas and some nature preserves), water, and wetlands) make up approximately 63% of the land use in the watershed (63.08%). Developed areas – a mix of residential, commercial, office business park, industrial and institutional land uses – occupy the remaining 36.92%. Approximately 58 percent of the developed area is committed to residential land use with the significant majority of this (88.95%) considered Low Density Residential.

Table 3.07.2 Land Use Categories

Land Use & Cover Category	Definition
Agricultural	Cropland, pastureland, orchards, nurseries and greenhouse operations, and horse farms and stables.
Commercial / Office Business Park	Shopping malls and parking, office and research parks, office buildings and hotels, and retail (such as department stores, grocery stores, hardware stores).
Parks / Recreation / Conservation / Preservation	Parks, golf courses, nature preserves, playgrounds and athletic fields, forested land or grassland that is under public or private ownership for the purposes of preservation of natural resources and/or recreation.
Institutional	Medical and health, educational, correctional, and religious facilities.
Industrial	Mining, mineral extraction, manufacturing and processing, warehousing and distribution centers, wholesale facilities, and industrial parks.
Medium / High Density Residential	Apartment and retirement complexes.
Open Space	Vacant or underutilized land in private ownership.
Low Density Residential	Single homes, duplex homes, townhomes, and farmhouses.
Unclassified	Roads and transportation rights-of-way and land that is unclassified within another land use listed above.

Table 3.07.1 Existing Land Use

Land Use	Acres	Percentage
Low Density Residential	7822	19%
Medium/High Density Residential	971	2%
General Commercial	2271	6%
Office Business Park	348	1%
Industrial	2241	5%
Institutional	1402	3%
Parks/Rec/Conservation/Preservation	1987	5%
Agriculture	18616	46%
Not Classified	5204	13%

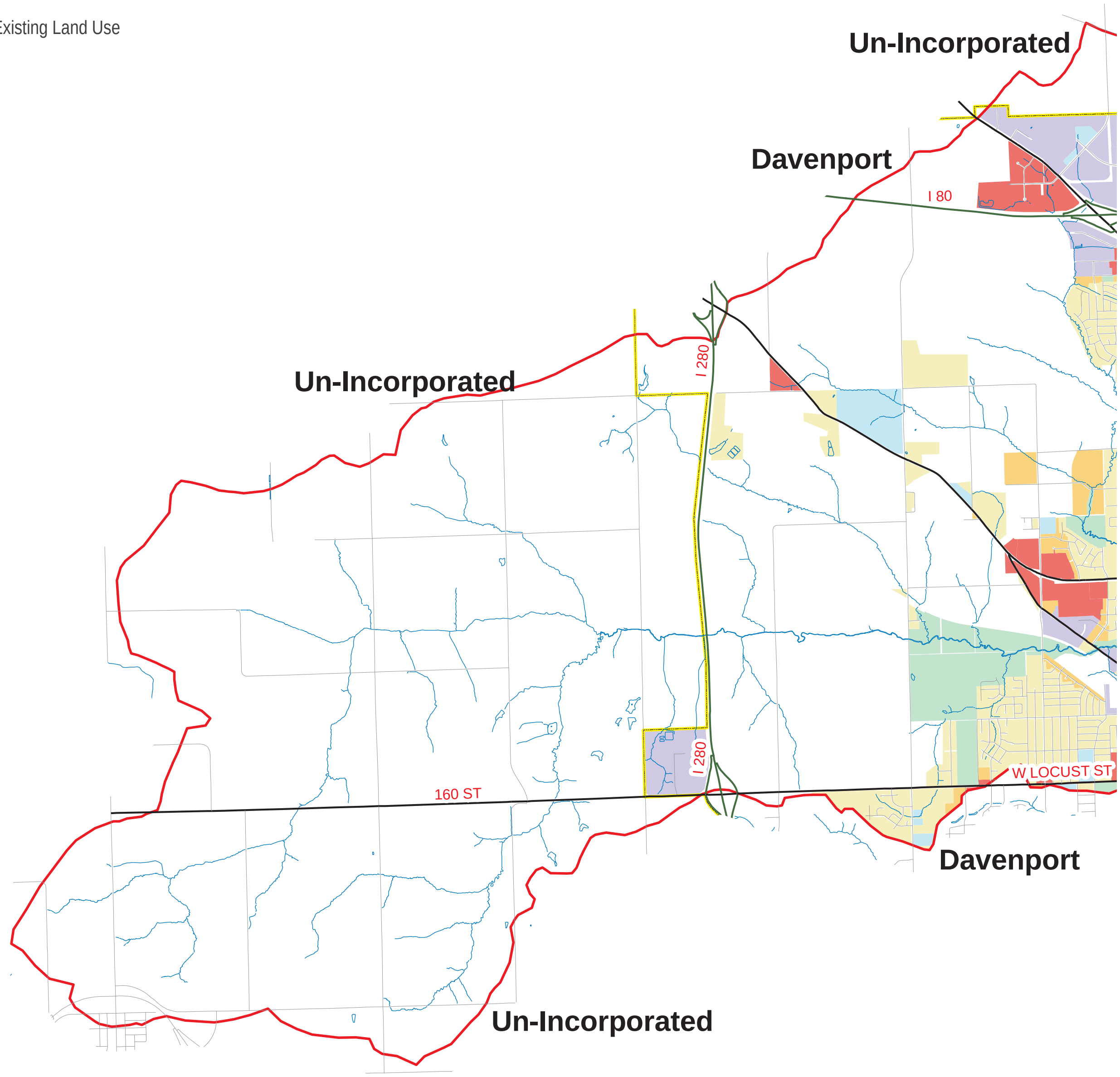
Table 3.07.3 Future Land Use

Land Use	Acres	Percentage
Low Density Residential	11,318	27.8%
Medium/High Density Residential	1,047	2.6%
General Commercial	2,825	6.9%
Office Business Park	430	1.1%
Industrial	3,369	8.3%
Institutional	1,470	3.6%
Parks/Recreation/Conservation/Preservation	2,702	6.6%
Agriculture/Open Space/Not Classified	17,611	43.1%

Commercial corridors generally follow I-74, Brady Street and Kimberly Road between Northwest Boulevard and Jersey Ridge Road with other isolated nodes scattered throughout the eastern 2/3rds of the watershed. Industrial land uses follow the I-80 corridor and are also found north and south of E. 53rd Street east of US-61 (Brady Street). Another pocket has developed in the northwest quadrant of the I-280/160th Street interchange

In the main, the headwaters of each branch of Duck Creek originate in largely undeveloped areas west and north within the watershed, however the downstream half of the main channel of Duck Creek traverses the more intensely developed southeast quadrant of the watershed. The percentage of open space in the watershed that is non-agriculture today, e.g. wetlands or publically owned parks or preserves, is just a little less than 5%. Most of this is

Figure 3.07.1 Existing Land Use

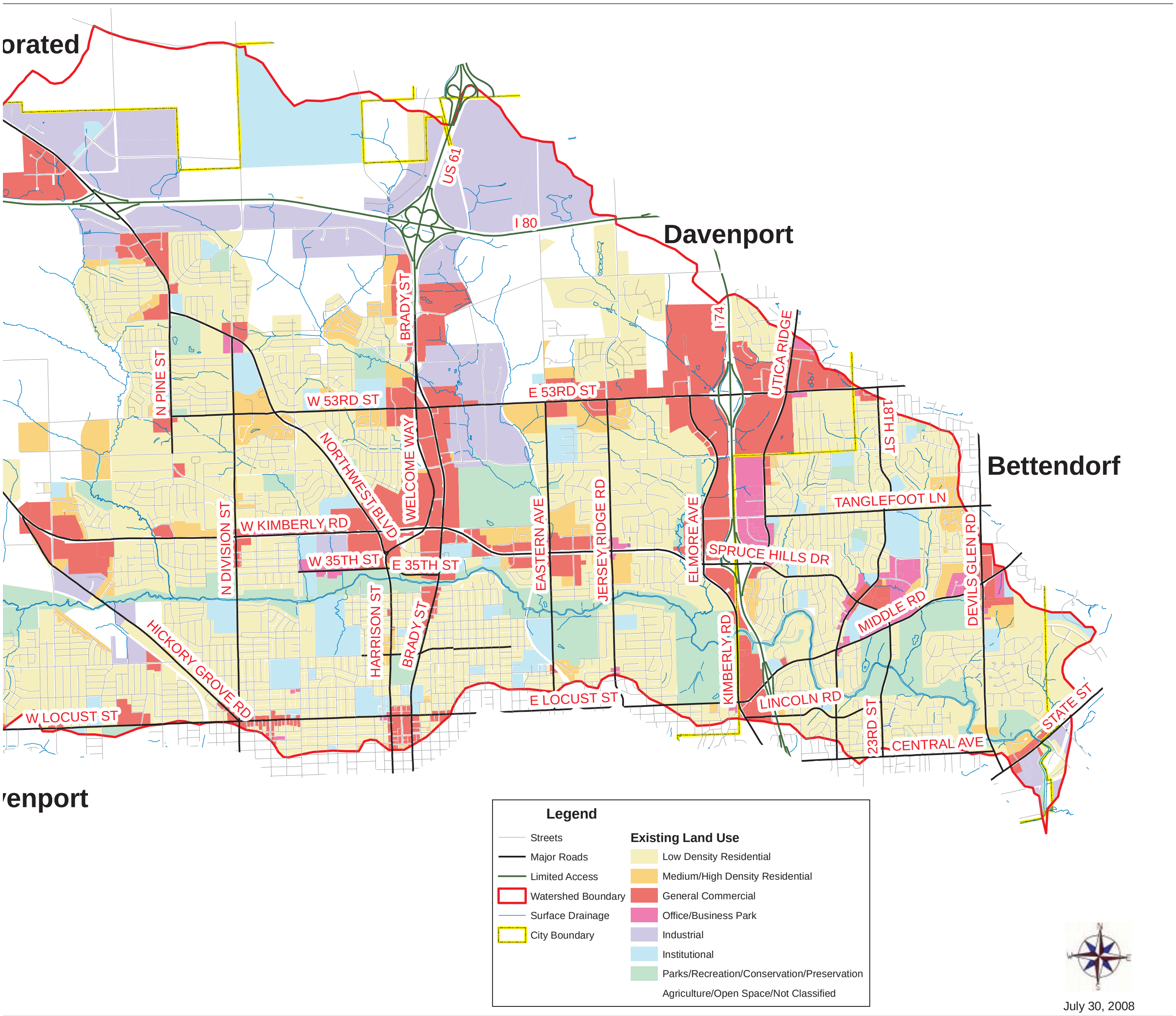


Subtask C-5-A-Existing Land Use

publically owned land in the bottomlands of Duck Creek (Figure 3.08.3 Green Infrastructure). Existing land use information is used to understand the impacts of development on watershed resources and water quality, and will be used as part of the non-point source pollution loading modeling in Section 3.14.4. Refer to Table 3.07.2 for a description of the land use categories.

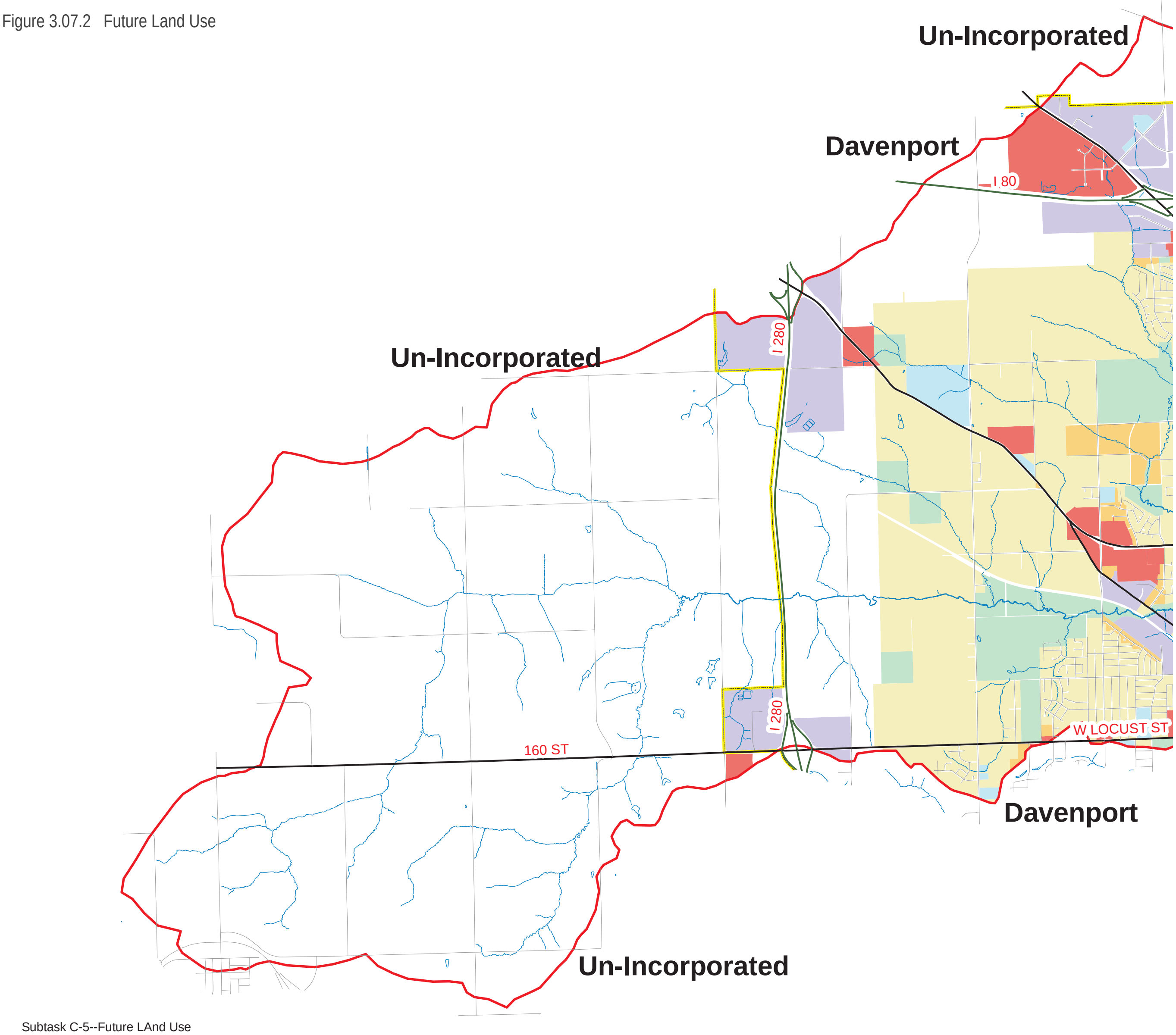
FUTURE LAND USE

Based on future land use projections (Figure 3.07.2 and Table 3.07.3), the amount of land held in agriculture will decrease by 6119 acres or 25.79%. This land use loss is distributed over various land use types. The largest projected increase, 50.33% or 1,128 acres, is projected for the industrial land use category with low density residential a close second with a 44.69% increase (3,496 acres). New



industrial development will fill in the north side of I-80, the west side of US-61, and extend further west beyond the I-80/ Pine Street interchange. In addition, new industrial areas will surround the south side of the I-280/Hickory Grove Road interchange and expand to the NE quadrant of the I-280/160th Street interchange. Residential expansion extends west more closely approaching I-280 on its western border and fills in the unincorporated area south of I-80 and west of Brady Street (US-61). Some new park/conservation land is added in the large land area projected for new low density residential development, and a large section is added east of Brady Street and north of E. 53rd. The fact that medium/ High Density Residential Use is projected to increase by only 76 acres (7.83%), is clear evidence of continued urban sprawl development patterns within the watershed. Overall, residential uses are projected to increase by 40.62%, and other development types by 12.17%.

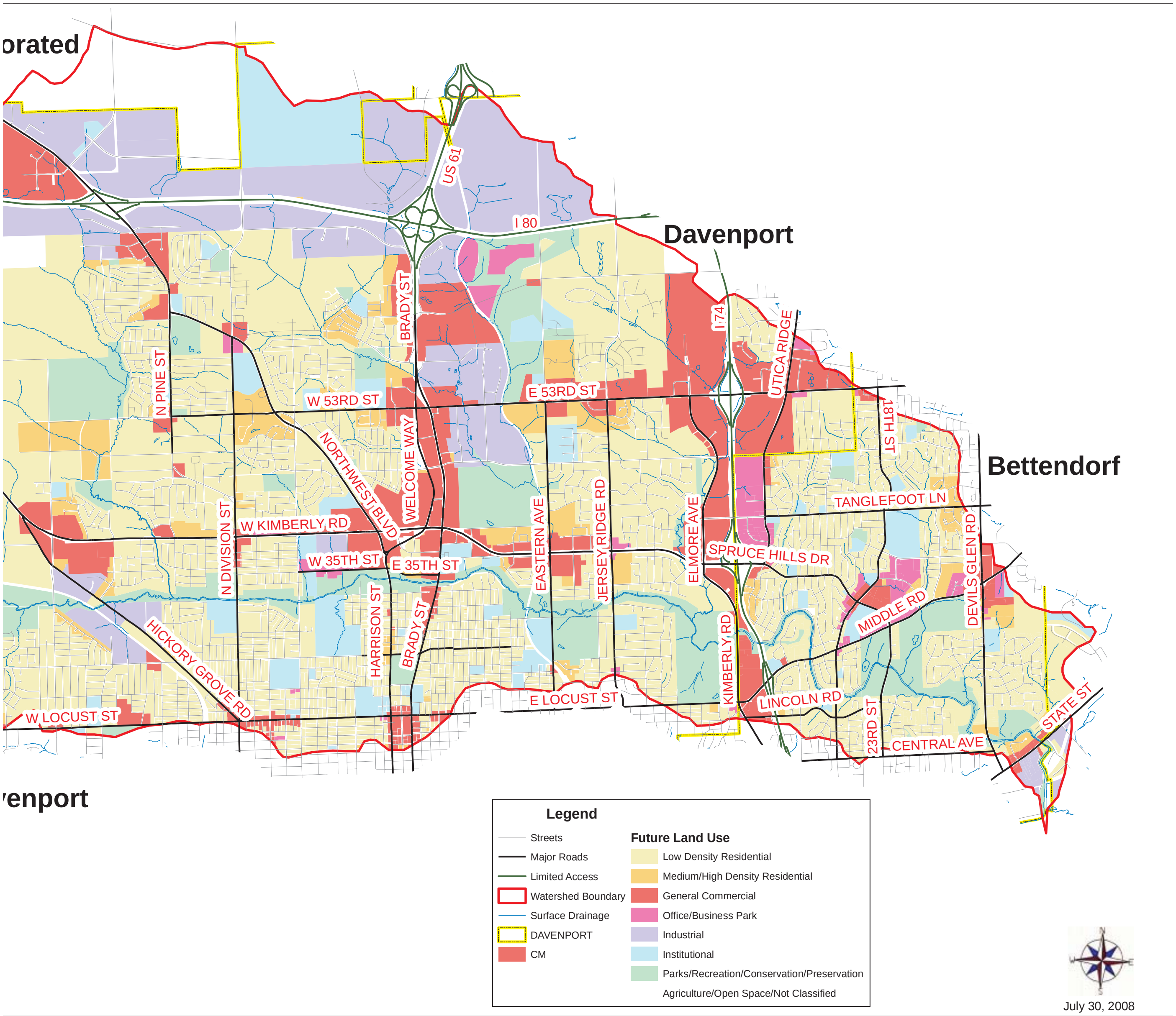
Figure 3.07.2 Future Land Use



Subtask C-5--Future LAnd Use

Conversion of agricultural/open space lands to industrial, residential and commercial land uses around I-80 will adversely affect the condition of the subwatershed served by these creeks by worsening the water quality and runoff impacts caused by increased imperviousness within the watershed. In addition, while it may be thought that low density residential development is more protective of water quality in the watershed, this type of development brings its own problems, largely through the increased runoff from turf lawns and the increased concentrations of salt, and phosphates and nitrogen seen with fertilizer use. These nutrient additions increase algal blooms in downstream locations, reducing the dissolved oxygen content in the water and, in turn causing die-off of fish and other organisms.

Through land use decisions and development standards and controls, Muscatine County and the municipalities and of the Duck Creek watershed have the discretion to significantly



influence the quality of the watershed in the future. To help reduce the negative impact of additional impervious surfaces, best management practices should be integrated into development designs wherever possible. Conservation development, a practice that attempts to preserve the drainage and infiltration capactiy of the developed landscape, is another very effective way to ameliorate the negative effects of land use conversion. Without proper attention to development location and more innovative designs for managing stormwater, future impacts to the watershed will exacerbate increased flooding and streambank erosion and the associated degradation of water quality, aquatic habitat, and floristic diversity that occurs with these changes.

3.08 GREEN INFRASTRUCTURE AND NATURAL AREAS

One of the goals of the watershed planning process is to identify green infrastructure that is important and should be preserved as a functional part of the natural drainage system. The intent is to plan a possible watershed green infrastructure system of open space, greenways, streams, wetlands, and natural areas that form an interconnected support system for natural functions and processes, particularly natural hydrologic functions and the aquatic environment. Some definitions of green infrastructure, such as that of the US Environmental Protection Agency, include storm water management as a component or benefit:

Green infrastructure represents a new approach to storm water management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure techniques utilize natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse and reduce storm water runoff using plants, soils and microbes.

On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities and wildlife habitat.

On the local scale, green infrastructure consists of site-specific management practices (such as rain gardens, porous pavements, and green roofs) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls. (See Figure 3.08.1)

Appropriate preservation and management of a green infrastructure system can help allow movement of runoff through the watershed in a manner that enhances the aquatic ecology of the watershed, and at the same time provides natural conveyance, floodwater storage, water quality benefits, stream bank stabilization and restoration, natural resource preservation, wetlands, and habitat. Green infrastructure network elements typically include hubs (large, intact blocks of natural areas that support a diversity of habitats and wildlife and provide space for recreation and storm water management) and links (natural corridors and greenways that link larger natural areas). Figure 3.08.2 illustrates the relationship between these features. Hubs and links may be composed of:

- Lakes, ponds, and wetlands.
- Stream corridors and waterways.
- Parks, recreational areas, greenways, and trails.
- Public and private conservation lands.
- Nature preserves, natural areas, and wildlife habitat (woodlands, savannas, and prairies).
- Open space and vacant lands.
- “Working lands” such as forests, farms, and ranches.

As part of the effort to connect and expand existing green infrastructure elements, such as creek corridors, the green infrastructure inventory identified publicly owned parcels of land with the potential to contribute to the watershed green infrastructure system. Table 3.08.1 shows the location of these parcels. Some of the publicly-owned green infrastructure parcels are protected status, such as parks and golf courses, meaning that there is very low risk that they could be converted to other land uses.

NATURAL AREAS AND DIVISIONS

The boundaries that define the edges around and divisions within the Rock River Ravine and Duck Creek Study Areas are formed by natural geologic landforms left by the last ice age. They include major rivers, floodplain bottomlands and

Table 3.08.1 Duck Creek Area: Parks and Open Space

Significant parklands and open space land holdings include, from west to east:

Park	Location	Primary Use	Potential for Restoration
Duck Creek Corridor	Along Duck Creek	Recreation / natural	Good
Emeis Park & Golf Course	Davenport along Duck Creek	Recreation / golf	Good
Whalen Park	Davenport	Unknown	Unknown
Silver Creek Park	Davenport along Silver Creek	Unknown	Unknown
Red Hawk Golf Course	Davenport	Recreation / golf	Possible
Davenport Soccer Complex	Davenport	Recreation / golf	Poor
Ridgeview Park	Davenport along Goose Creek	Recreation / ball fields	Poor
Northwest Park	Davenport along Duck Creek	Recreation / ball fields	Possible
Marquette Park	Davenport along Duck Creek	Walking paths / natural	Good
Goose Creek Park	Davenport along Goose Creek	Natural?	Good?
Slattery park	Davenport	Recreation / walking paths	Possible
Junge Park	Davenport along Duck Creek	Recreation / ball fields	Good
Vander Veer Park	Davenport	Recreation / walking paths	Possible
Garfield Park	Davenport along Duck Creek	Recreation / ball fields	Possible
Eastern Park	Davenport along Duck Creek	Recreation / walking paths	Good
Duck Creek Park & Golf Course	Davenport along Duck Creek	Recreation / golf	Good
Kiwanis Park	Bettendorf	Recreation / ball fields	Poor
Hoover Park	Bettendorf	Recreation / ball fields	Poor
Middle Park	Bettendorf along Duck Creek	Recreation / ball fields / walking paths / natural	Good
Edgewood Park	Bettendorf	Recreation / ball fields	Poor
Palmer Hills Municipal Golf Course	Bettendorf along Duck Creek	Recreation / golf	Possible
Hollowview Park	Bettendorf along Duck Creek	Recreation / walking paths / natural	Good
Devil's Glen Park	Bettendorf along Duck Creek	Natural / walking paths	Good

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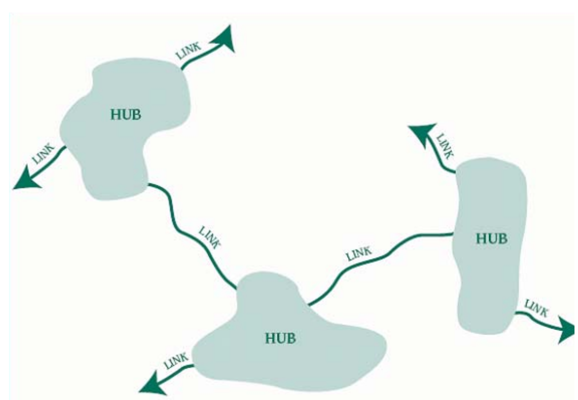
FIGURE 3.08.1 LOCAL GREEN INFRASTRUCTURE AT THE SITE SCALE



© Growing With Green Infrastructure, Karen Williamson, 2003

FIGURE 3.08.2 CONCEPTUAL GREEN INFRASTRUCTURE HUBS AND CONNECTING LINKS wetlands, uplands, wooded ravines, and river bluffs.

Because of the extensive development within the watershed, there are very few, if any true natural areas or remnants in the Duck Creek watershed although much of the land along the creek proper is identified as Parks/Recreations/ Conservation or Preservation as a land use.

The Environmental Resources Inventory identified a number of animal species that are found within the area. Reptiles and amphibian species known to occur in the area include cricket frog, upland chorus frog, northern leopard frog, green frog, bullfrog, garter snake, milk snake, watersnake, painted turtle, and soft shell turtle. Mammal species include muskrat, beaver, bats, squirrels, fox, opossum, raccoon, mink, rabbit, skunk, deer, woodchuck, mice, mole, and shrew.

Because of its location in the Mississippi flyway, many bird species can be seen as visitors in the Quad Cities region during the spring and/or fall migration. Bald eagles once commonly nested along the larger rivers, and important wintering sites for them are still found along the Mississippi. Eagles which nest further north migrate to this area to feed on the fish below the dams where the turbulent water remains open even in the coldest winters. One important winter roost is just upstream from the Quad Cities at the Elton E. Fawks Bald Eagle Refuge Nature Preserve. Heron and osprey use the area as well.

GREENWAYS AND TRAILS

The greenway and trail systems of the Duck Creek watershed include:

1. The Iowa segment of the Mississippi River Trail follows the Mississippi River shoreline on the Iowa side of the river. The trail stretches 2000 contiguous miles between the river's headwaters in Minnesota and the Gulf of Mexico.
2. Duck Creek Parkway, Davenport / Bettendorf / Riverdale. This greenway includes a separated, multi-purpose trail that passes through and connects several community parks along its route and ultimately connects to the Mississippi River greenway trails.
3. Main Street Corridor, Davenport. Active greenway uses urban design techniques, such as landscaping, outdoor furnishings, public art, and /or signage to connect the Mississippi riverfront through downtown Davenport to Vander Veer Park and the Duck Creek Parkway.
4. Wisconsin Avenue Corridor, Davenport. Provides a connection between the Duck Creek Parkway at Emeis Park south the Mississippi River Trail at Credit Island Park and north to the Silver Creek passive greenway.
5. Marquette Street Corridor, Davenport. Parallels Robin Creek as it flows along Marquette Street and into Duck Creek.
6. Middle Road Corridor, Bettendorf. Provides and active greenway from the Crow Creek passive greenway to Middle Park in Bettendorf.
7. Devil's Glen Road Corridor, Bettendorf. Provides a transportation connection from State Street on the south to Crow Creek corridor. A proposed multi-purpose connection, utilizing urban design techniques along this route, would interconnect the Mississippi River and Trail with the Crow Creek greenway.
8. The Silver Creek system, Davenport, is identified as a passive greenway, part of which is planned for utilization as an active greenway containing a multi-purpose trail. It connects Silver Creek park to the Duck Creek Parkway.
9. The Goose Creek system, Davenport, is identified as a passive greenway, part of which is planned for utilization as an active greenway containing a multi-purpose trail. It connects Goose Creek Park to the I.C. & E. Railroad Corridor and the Duck Creek Parkway.
10. The I.C. & E. Railroad Corridor follows the railroad right-of-way from Eldridge in the north through Davenport to the Mississippi River greenway trails.
11. Pheasant Creek, Davenport, is identified as a passive greenway.

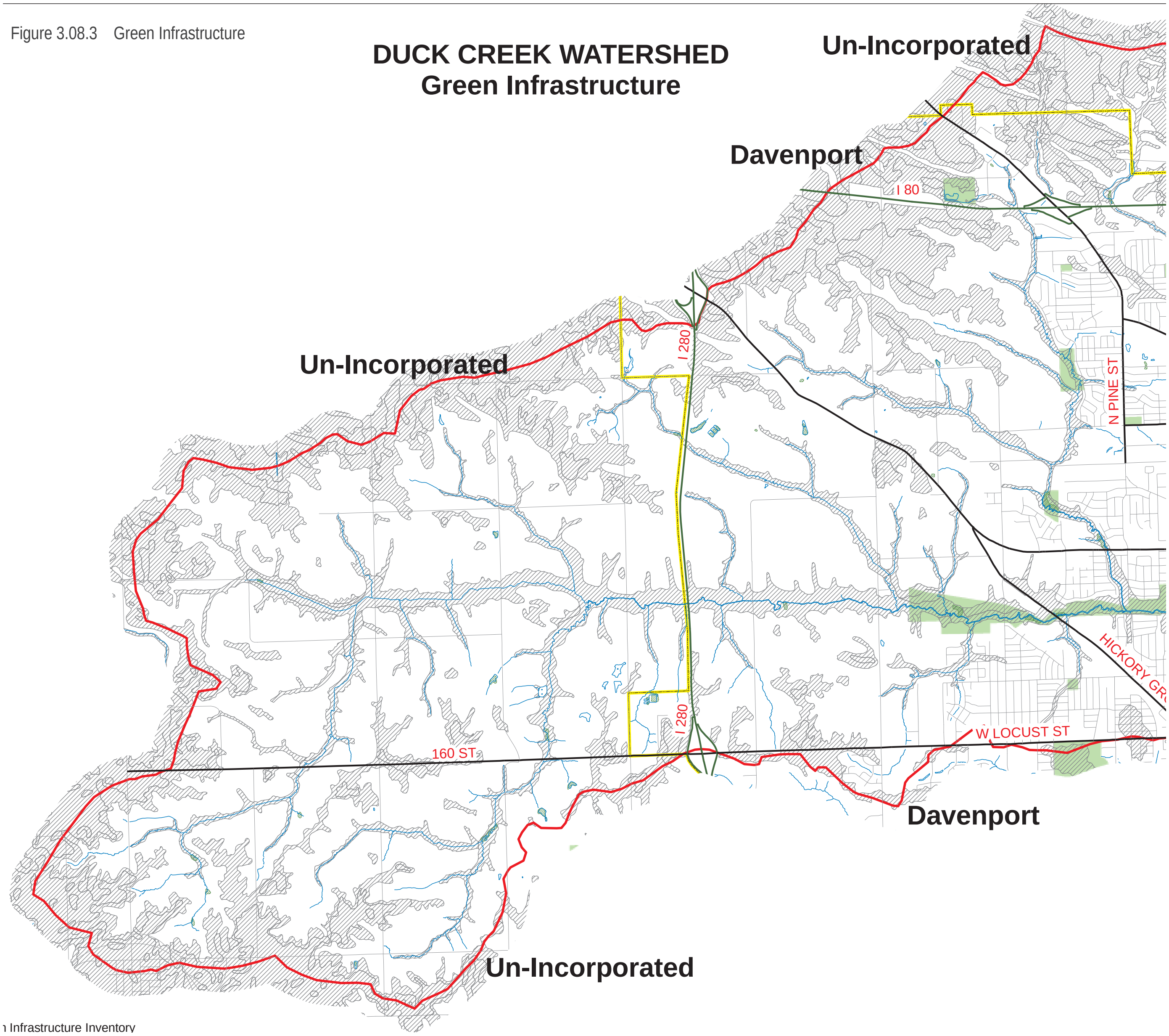
Table 3.08.2 Scott County IA: State and Federally listed Threatened and Endangered species

Common Name	Scientific Name	Class	State Status	Federal Status
Bald Eagle	Haliaeetus leucocephalus	Birds	Endangered	
Lake Sturgeon	Acipenser fulvescens	Fish	Endangered	
Butterfly	Ellipsaria lineolata	Freshwater Mussels	Threatened	
Creeper	Strophitus undulatus	Freshwater Mussels	Threatened	
Higgin's-eye Pearly Mussel	Lampsilis higginsii	Freshwater Mussels	Endangered	Endangered
Pistolgrip	Tritogonia verrucosa	Freshwater Mussels	Endangered	
Round Pigtoe	Pleurobema sintoxia	Freshwater Mussels	Endangered	
Sheepnose	Plethobasus cyphyus	Freshwater Mussels	Endangered	Special Concern
Zebra Swallowtail Butterfly*	Eurytides marcellus	Insects	Special Concern	
Southern Bog Lemming *	Synaptomys cooperi	Mammals	Threatened	
Earleaf Foxglove	Tomanthera auriculata	Plants	Special Concern	
Lake Cress	Armoracia aquatica	Plants	Special Concern	
Mead's Milkweed *	Asclepias meadii	Plants	Endangered	Threatened
Rose Turtlehead	Chelone obliqua	Plants	Special Concern	
Schreber's Aster *	Aster schreberi	Plants	Endangered	
Valerian	Valeriana edulis	Plants	Special Concern	
Field Sedge	Carex conoidea	Plants	Special Concern	
Glomerate Sedge	Carex aggregata	Plants	Special Concern	
Green's Rush	Juncus greenei	Plants	Special Concern	
Slender Sedge *	Carex tenera	Plants	Special Concern	
Ledge Spikemoss	Selaginella rupestris	Plants	Special Concern	
Northern Adder's-tongue	Ophioglossum pusillum	Plants	Special Concern	
Blanding's Turtle	Emydoidea blandingii	Reptiles	Threatened	
Copperbelly Water Snake	Nerodia erythrogaster neglecta	Reptiles	Endangered	
Massasauga Rattlesnake	Sistrurus catenatus	Reptiles	Endangered	
Ornate Box Turtle *	Terrapene ornata	Reptiles	Threatened	
Total # of Species 26				
Federally Endangered Species: Any species which is in danger of extinction throughout all or a significant portion of its range.				
Federally Threatened Species: Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.				
State Endangered Species: Any species which is in danger of extinction as a breeding species in the state.				
State Threatened Species: Any breeding species which is likely to become a state endangered species within the foreseeable future in the state.				

3.09 STREAM INVENTORY

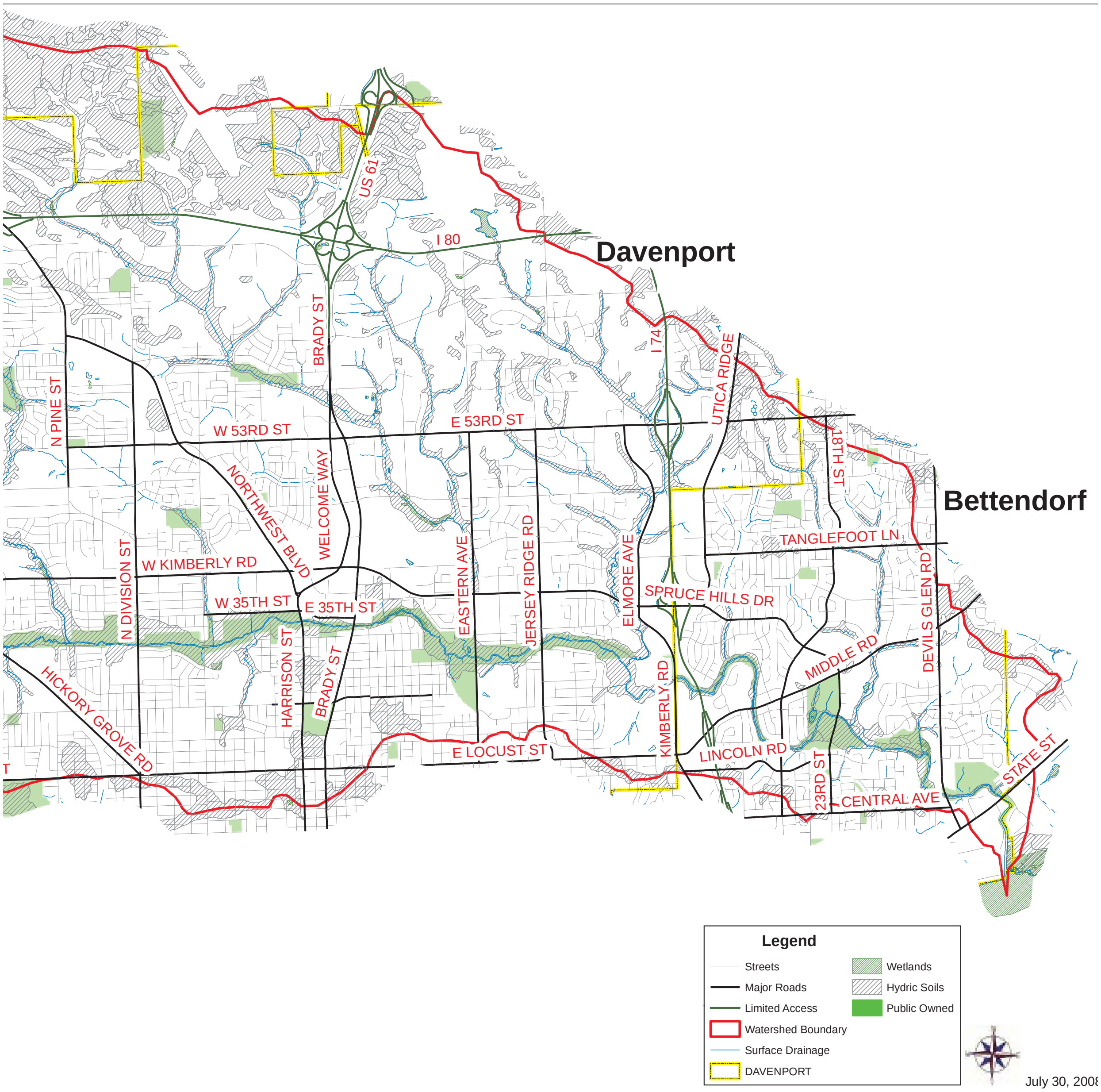
Duck Creek flows from its headwaters in Scott County, Iowa near Blue Grass, through the municipalities of Davenport and Bettendorf, to its confluence with the Mississippi River. Duck Creek is fed by eight primary tributaries (from west to east): Cardinal Creek, Silver Creek, Goose Creek, Candlelight Creek, Deere Creek, Hanlin Creek, Pheasant Creek and Stafford Creek. Duck Creek drains a watershed area of approximately 64 square miles through a network of 82 total stream miles, 19.5 miles of which are considered the main stem. Agricultural land uses dominate the western third and northern edge of the watershed, while the eastern two thirds is built up in older and newer residential, commercial, industrial, and institutional uses. Industrial uses along the Mississippi River impact the lowest reaches and the confluence of Duck Creek with the Mississippi.

Figure 3.08.3 Green Infrastructure



Duck Creek has been studied and examined by a number of agencies and individuals over the years. This section of the assessment attempts to summarize information gathered by the project team to generate an overall understanding of stream quality and to identify issues and impairments not identified through other means. Refer to Figures 3.09.2 and Table 3.09.1 for references to typical stream morphology.

In June of 2008, the project planning team conducted a stream inventory of the Duck Creek main stem to assess its condition and characteristics. Left and right bank are oriented as one looks downstream. Duck Creek exhibits a condition fairly typical of a Midwestern stream impacted by land use changing from natural to agricultural to urban and suburban. Many of the creeks problems can be attributed to the impact of this land use change on the flow and

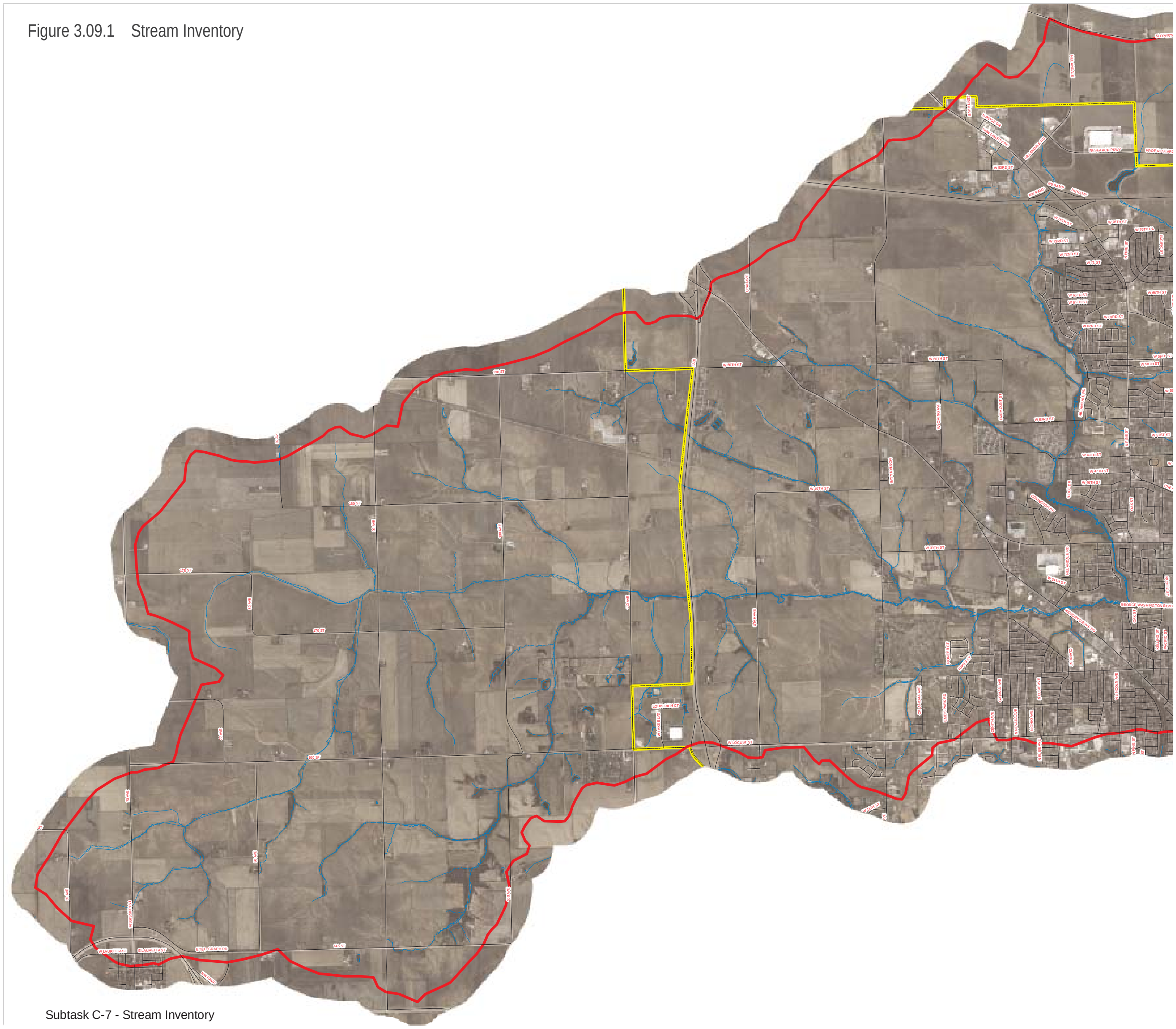


quality of water as it flows across the landscape and into the creek. The symptoms of this condition are evident along the entire length of the Duck Creek mainstem and most of its tributaries: steep, high, eroding and unstable streambanks; lack of quality habitat conditions including silt / muck bottom substrate and few pools and riffles; and an unnatural, narrow riparian corridor impacted by sediment and lack of appropriate management. Inventory points are found on Figure 3.14.2 .

DUCK CREEK AT 42ND STREET / DEPOT ST. RAILROAD BRIDGE (DW1)

At the railroad crossing near 42nd Street and Depot Street, Duck Creek flows very gradually through a wide (approximately 80') and flat channel to its confluence with the Mississippi River. This confluence is a mixing zone for Mississippi River and Duck Creek water, providing an environment where wildlife from both river systems can be

Figure 3.09.1 Stream Inventory

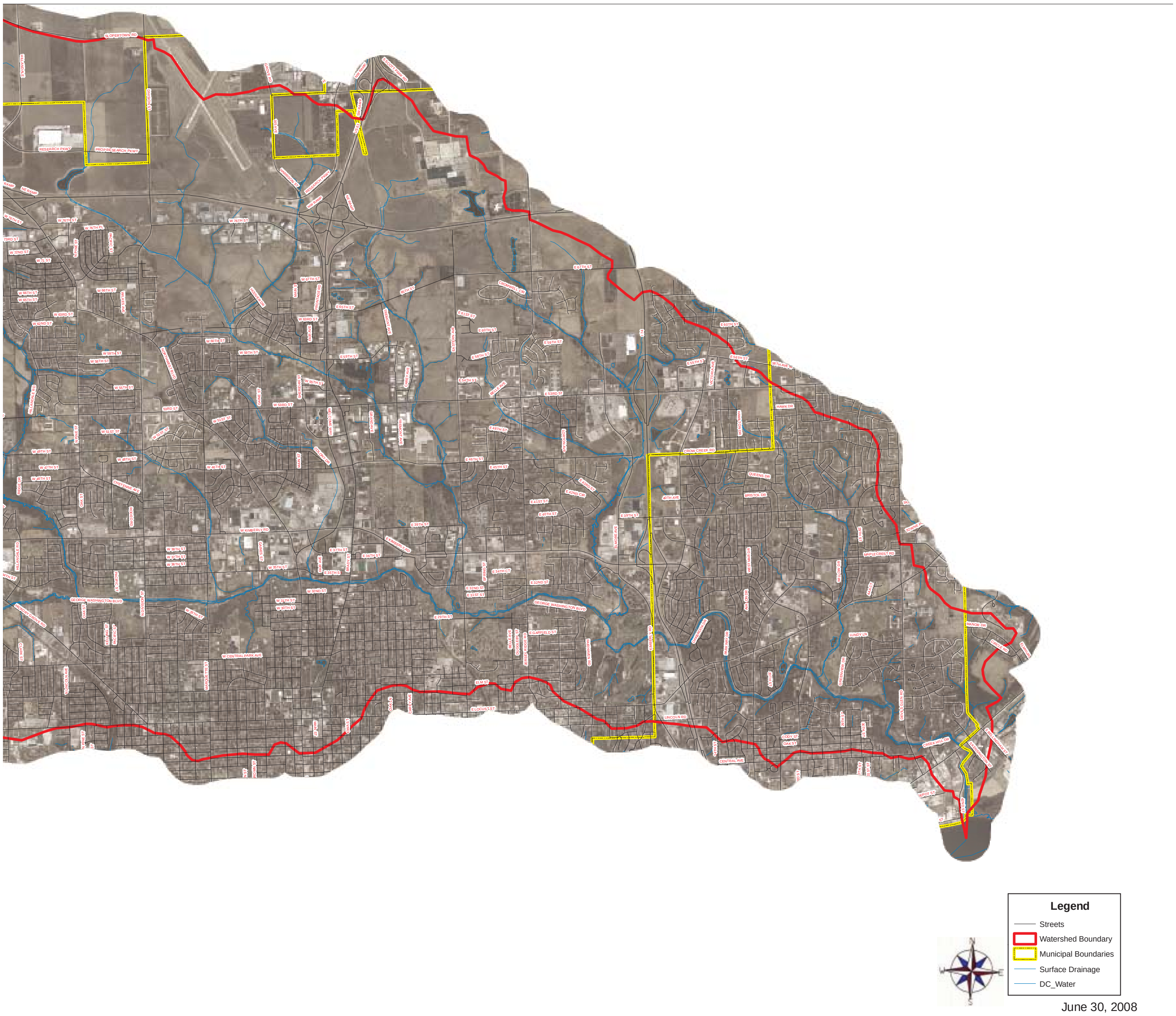


Subtask C-7 - Stream Inventory

found. The channel bottom here is believed to be primarily a black muck substrate with poor habitat conditions.

Throughout this reach, Duck Creek exhibits contrasting bank conditions. The left bank is low (2-4' high) and well vegetated floodplain forest (60' in width) with minor levels of erosion. The right bank is steep (20' or more) and exhibits little vegetation and rock stabilization at the railroad crossing, with a greater amount of bank vegetation (10' in width) found downstream. Both of these banks are moderately stable.

The differences in the condition of the left and right banks are largely attributable to differences in surrounding land uses. On the left, low density residential uses and remaining natural areas have allowed an effective riparian buffer to remain in place to stabilize and protect the bank. On the



right, conversion of natural floodplain areas to industrial uses, the stabilization of the railroad crossing, and the construction of a levee to protect these uses, has created an unnatural condition where the bank is vulnerable to erosion.

DUCK CREEK AT DEVILS GLEN ROAD / DEVILS GLEN PARK (DW2)

Underlying geology strongly influences the character of this beautiful reach of Duck Creek in Devils Glen Park. This geology is exhibited by dolomite outcrops on the banks and exposed bedrock and cobble along the channel bottom. These dolomite outcrops create steep cliffs on the right bank, protecting it from erosion. The left bank is lower and exhibiting mild erosion, as demonstrated by exposed fine plant roots that were new growth in the spring of 2008. Erosion appears to be exposing more of the bedrock layer over time, but the banks appear to be moderately stable. There is also evidence of sediment deposition on the left bank.

The bedrock and cobble channel substrate, interspersed with areas where sand and gravel have accumulated on the bottom, produces stream pools, riffles, and runs, an indicator of a healthier stream substrate condition and aquatic habitat than in upstream reaches. It is likely that the volume and rate of flow of Duck Creek within this reach helps carry suspended and heavier sediment downstream.

Land uses along the left bank include a Frisbee golf course, the Duck Creek Parkway, and the Riverfront Trail that runs along the creek. A narrow (10-30') riparian buffer remains on the left bank, and a small floodplain terrace helps stabilize the river bank between the trail and Duck Creek. However, this terrace is planted with turf grass and mown to create one of the Frisbee golf holes. This turf grass riparian zone does not help stabilize the bank, nor does it filter stormwater runoff from the park, road, parking areas, or paved trail. Residential uses top the cliffs on the right bank.

DUCK CREEK AT HOLLOWVIEW PARK (DW3)

The reach of Duck Creek near Hollowview Park is protected from nearby land uses by a relatively wide forested floodplain buffer (60' or more) that is thick and overgrown with trees and a dense forest canopy. Sand and gravel substrate dominate the creek bottom, and some minor riffles were observed, with more prominent riffles downstream of the survey point where more rocky substrates are presumed to be present. Overall, this reach exhibits average habitat conditions.

Surrounding land uses include Palmer Hills Golf Course upstream and the Duck Creek Parkway and Riverfront Trail, which parallels the creek here. Because floodwater and associated disturbances such as inundation rarely flood the forested buffer on the left bank, the area has developed a stable, predominately native plant composition. This area has the highest mean conservation value (3.0) and the highest Floristic Quality Index (16) found along the mainstem of Duck Creek, indicating a somewhat diverse plant community with the potential for restoration to a higher quality system.

Although floodwater rarely disturbs the established vegetation, the banks of the creek are showing the effects of increased runoff and higher peak flows from the upstream watershed. Erosion and active bank slumping are damaging the 6-10' high banks, and a nearby open channel discharging storm flow from adjacent residential neighborhoods also exhibits a high level of erosion.

STAFFORD CREEK AT MIDDLE ROAD AND TANGLEFOOT LANE (DW3.1 AND DW3.2)

Stafford Creek joins Duck Creek just downstream of 23rd Street in Bettendorf. Between its confluence with Duck Creek and intersection with Middle Road, Stafford Creek bisects Palmer Hills Golf Course, where turf dominates bank conditions. At the intersection of Middle Road and Happy Joe Drive, Stafford Creek displays a silt and sand substrate. Along this reach the stream banks are in a condition of fairly active erosion, with bare soil exposed in some areas.

Upstream of Middle Road, Stafford Creek runs through a narrow channel lined by residential neighborhoods where a narrow vegetated buffer provides minimal stream protection. Further upstream, this buffer enlarges after the creek crosses Tanglefoot Lane, and a fence encloses the creek and riparian vegetation. This fence limits disturbance and contributes to the formation of heavily overgrown vegetation

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DW 1: Duck Creek at its mouth, flowing into the Mississippi River.

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DW 2: the lower reaches of Duck Creek exhibited moderate habitat quality and healthy substrates.

Table 3.09.1 Useful Definitions

Term	Definition
channelization	straightening or ditching of a stream channel
sinuosity	degree of stream channel turns and bends
pool and riffle	alternating series of deep pools and shallow rapids
bank erosion	the loss of streambanks due to scouring by water flow
sediment accumulation	build-up of soil, sand, and gravel in the streambed
debris load	natural and man-made debris including leaves, sticks, logs, lumber, and trash

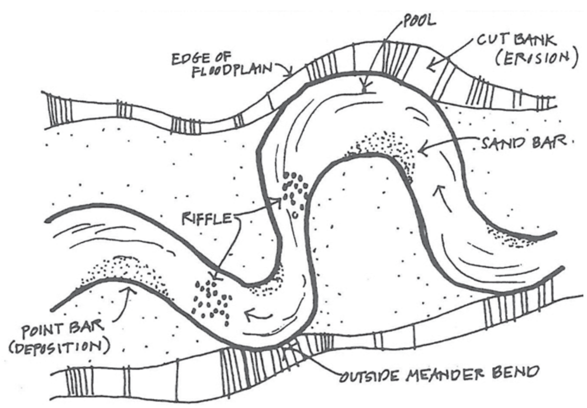

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Figure 3.09.2 natural stream morphology

along the creek banks and a dense shade canopy. Stafford Creek disappears from view upstream of Crow Creek Road, where it is likely contained within a storm sewer.

DUCK CREEK AT MIDDLE PARK (DW4)

Just upstream from Middle Park in Bettendorf, residential neighborhoods and public open spaces abut and buffer Duck Creek. Looking downstream, the Riverfront Trail and Parkway Drive parallel the left bank with a predominantly turf grass buffer to the bank edge. The right bank has a wide, heavily forested cover that helps to buffer the creek from residential land uses nearby.

The creek is shallow and fast here, likely the result of more prominent downward slope in the area and the hard bedrock that prevents further channel downcutting. The good substrates, moderate meandering, and a few riffles and pools found here contribute to the average habitat condition. However, fast and high water movement is causing erosion along the outside bends, including an exposed dolomite outcrop in one location. Both banks are moderately unstable with overbank sand and sediment deposition due to recent flooding. Upstream of this location, Duck Creek runs slower and deeper with a sand bottom.

DUCK CREEK AT FAIRLANE DRIVE AND SKYLINE DRIVE (DW5)

West of 18th Street along Parkway Drive, Duck Creek is buffered by forest on the right bank and a turf grass buffer and a few trees on the left bank, where the Riverfront Trail parallels the creek. Similar to conditions near Middle Park, Duck Creek here has a sandy substrate and lacks pools and riffles. The lack of riparian vegetation on the left bank as well as high creek flows have left the bank vulnerable to erosion, which could eventually threaten the Riverfront Trail. In a number of locations, concrete and rock retaining walls have been installed to help stabilize the bank from erosion.

DUCK CREEK AT GREENWAY DRIVE (DW6)

This reach of Duck Creek east of Interstate 74 is surrounded by residential uses, the Riverfront Trail, and a turf grass buffer on the left bank. An open, grassy buffer area mixed with groups of trees line the right bank. This reach appears to be a long run with a gravel bottom along the toe of the bank. Gravel substrate and riffles are suspected to persist throughout the channel bottom. A stream bank stabilization and prairie restoration project along the left bank appears to have stabilized the bank, while the 6-10’ right bank shows active erosion. The prairie restoration site has been covered with sediment from creek flooding and little high quality prairie vegetation remains from the initial restoration efforts. It is likely that the sediment deposited here during flooding causes the soil condition to be unsupportive of a true prairie restoration. Upstream of the restoration site the left bank is actively eroding and slumping into the creek, indicating that the bank stabilization project has been successful.

DUCK CREEK AT DUCK CREEK PARK / DUCK CREEK GOLF COURSE (DW7)

West of Kimberly Road in Davenport, Duck Creek runs through the groups of trees and open turf grass areas of Duck Creek Park and Duck Creek Golf Course. The left bank has a narrow (10’ or less) buffer of trees separating the golf course turf from the creek. The Riverfront Trail here runs parallel to Duck Creek along the right bank, where a narrow (10’ or less) mix of turf and trees define the buffer vegetative character.

The diversity of vegetation here contributes to a slightly better biological quality than is typically found along the creek, with a small wetland present between the park access road and parking area and the creek. Before settlement, the area was most likely degraded timber woodland. At that time Duck Creek likely ran through this area 6-8’ higher than its current bank elevation, indicating that the creek has downcut into the underlying substrate over the years following settlement. The current banks are steep, moderately unstable, and exhibit erosion and slumping problems. Toe and bank stabilization efforts such as rock armoring have helped curb these erosion problems and stabilize the banks. Some riffles remain within the channel, which has a cobble substrate.

DW 4: Duck Creek along Parkway Drive is a beautiful community amenity.

DW 5: Duck Creek is paralleled by a heavily used recreational trail.

DW 4: Duck Creek along Parkway Drive exhibits pools, riffles, and runs.

PHEASANT CREEK AT 53RD STREET / INTERSTATE 74 (DW7.1)

At 53rd Street, Pheasant Creek is nestled in a wide vegetated valley and stream buffer running along Interstate 74, presumably a part of the right-of-way for the interstate that has reverted to an open grown state. Interstate 74 runs along its left bank looking downstream, and big box commercial stores such as Best Buy and Super Target are high above its right bank. Vast impervious surface parking lots service the retail centers, posing potential runoff problems for Pheasant Creek. The protection of the wide stream buffer has allowed for the establishment of dense grass vegetation along the banks and scattered trees further away from the channel. The creek passes through a culvert at East 53rd Street and receives overflow runoff from another culvert running under the East 53rd Street onramp. That culvert connects to a detention basin for I-74.

HANLIN'S CREEK AT 53RD STREET / BELLE COURT RD. (DW7.2)

Hanlin's Creek is a small tributary that converges with Pheasant Creek near East 46th Street and Elmore Road. It passes through a mix of residential uses, including large single family homes and multi-family apartment buildings, commercial uses, and open space. Its riparian buffer varies in width accordingly, with generally narrow buffer strips through residential uses and wider buffers in the open spaces surrounding nearby commercial land uses. In some places the buffer is mostly grass, but more often it is a forested edge. The stream disappears just west of Jersey Ridge Road at East 53rd Street near Belle Court Road. Near this point, reed canary grass and willow marsh were found along the stream corridor.

DUCK CREEK AT RIVERFRONT TRAIL PEDESTRIAN BRIDGE NEAR FERNWOOD AVENUE (DW8)

This reach of Duck Creek, upstream of Duck Creek Park at the pedestrian bridge east of Jersey Ridge Road, is influenced by the residential neighborhoods along both banks of the creek. The Riverfront Trail runs along both banks downstream of the pedestrian bridge to Duck Creek Golf Course and Park. The character of the creek here is defined by high instability. Lateral migration of the stream channel is actively occurring and both sand deposits and point bars have formed along a primarily silty muck bottom that exhibits poor habitat conditions. Overbank deposition of silt and sediment is frequent and pronounced. A sedimentation line exists in the grass area away from the stream banks and an 8-12" deep sediment layer was found in the surrounding forest. The 6-10' banks here slump and erode, causing trees in the buffer to fall into the creek. The forested stream buffer varies from 10' to 60' in width.

DUCK CREEK AT EASTERN AVENUE PARK / GOOSE CREEK CONFLUENCE (DW9)

Goose Creek flows into Duck Creek just to the west of Eastern Avenue within Eastern Avenue Park. The park is mostly an open expanse of turf grass with a narrow buffer of trees lining both Goose Creek and Duck Creek banks. A nearby backwater pond that was once used as an ice skating rink and appears to be filling with sediment, possibly due to backflow from a flooding Duck Creek. Surrounding land uses include residential neighborhoods and a community center south of the creek.

At this point, both Duck Creek and Goose Creek suffer from changes in hydrology due to current and recent development upstream along Goose Creek. The result is an unnatural waterway out of step with its surrounding geology and landforms. According to one stakeholder, upstream development and increased runoff from impervious surfaces causes Goose Creek to flood more frequently now than prior to development. Duck Creek is moving laterally here, though whether the channel is widening is unclear. The unstable 6-10' banks exhibit severe erosion and slumping from changing stream conditions, and overbanking flooding deposits sand and other sediment into the riparian buffer, which is primarily turf grass. Minor meanders exist in the area and a gravel bar has formed under the Eastern Avenue Bridge.

DW 7: Duck Creek within the Duck Creek Golf Course exhibited signs of erosion as well as some pools and riffles.

DW 9: heavy sediment deposition in the riparian corridor significantly impairs habitat and vegetative quality.

DW 7.2: Hanlin Creek in a well-vegetated riparian corridor near I-74.

DW 9: significant bank erosion and slumping, and a very narrow native riparian corridor on the left bank of Duck Creek.

DW 8: Duck Creek showing typical erosion on the outer bank of the meander and deposition of sediment on the inside bank.

DEERE CREEK AT 53RD STREET AND RAILROAD CROSSING (DW9.1)

Deere Creek joins Goose Creek south of 46th Street. Along its pathway, Deere Creek is bordered primarily by agricultural fields with a narrow riparian buffer composed primarily of trees. At the 53rd Street railroad crossing, light industrial / retail uses are on both banks looking downstream, and recreational fields lay adjacent to the left bank of the creek looking upstream. The light industrial uses typically have large impervious surface parking lots that appear to drain into the creek. A very narrow buffer of trees and overgrown grass and understory plants separates a parking lot from the creek at the railroad crossing. The creek passes through a culvert at 53rd Street and takes an S-turn immediately downstream of the outfall. Deere Creek is noticeably impacted by recent upstream development and the railroad crossing at East 53rd Street. Softstem bulrush observed at the crossing indicates that the creek may be recovering from a previous worse condition.

GOOSE CREEK AT 53RD STREET / HAMILTON TECHNICAL COLLEGE (DW9.2)

Goose Creek intersects East 53rd Street in Davenport just west of Hamilton Technical College, flowing underneath a vehicular bridge. Light industrial and commercial uses abut the right bank of Goose Creek, and the left bank is bordered by Hamilton Technical College south of 53rd Street and by agricultural uses north of 53rd Street. Parking lots from Hamilton Technical College and the commercial and industrial uses appear to drain towards the creek. There is a narrow forested buffer that provides some protection to the creek. Upstream of East 53rd Street, the creek exhibits eroding banks and fallen trees. Both a point bar and a broken storm outfall were observed, with a moderately overgrown vegetated buffer. Downstream, Goose Creek exhibits more siltation as an effect of upstream erosion.

DUCK CREEK AT EAST GEORGE WASHINGTON BOULEVARD (DW10)

At East George Washington Boulevard, Duck Creek is bordered by a variety of land uses, including single family homes, light industrial, and the Riverfront Trail and associated park and recreational uses. Duck Creek experiences significant erosion and sand and sediment deposition along this reach. Although there is a rock bank present in one area, the majority of the 6-10’ banks are very unstable with severe erosion and overbank sand and sediment deposition occurring during flood events. A narrow forested buffer lines the Riverfront Trail on the right bank, while the left bank buffer is wide and forested with a dense tree canopy that prevents the penetration of sunlight to the forest floor. Side gullies have formed where flood water that left the creek channel returned to the creek after the floodwater receded. Street runoff from the residential neighborhood directly adjacent to the creek is also contributing stormwater flow, which intensifies the gully formation. Further evidence of flow-related damage is the presence of a big bank blowout downstream near the Riverfront Trail pedestrian bridge.

DUCK CREEK AT NORTH BRADY STREET (DW11)

At the Brady Street Bridge, Duck Creek is surrounded primarily by commercial land uses and parking lots. The Riverfront Trail follows Duck Creek on the right bank and water from a storm sewer discharges from the left bank just east of North Brady Street. At this location, Duck Creek is characterized by a narrower channel with faster flow. A few minor meanders are present, and a floodplain terrace lines both sides of the creek, where it appears that structures may have been removed. The moderately unstable 6-10’ banks exhibit some active erosion and slumping, while a number of spots along the bank appear to be relatively stable. Upstream and downstream of the bridge, a grass buffer of 10’ (right bank) to 60’ (left bank) exists. Downstream of the bridge, the right bank has been reinforced by approximately 100’ of poured concrete. This intervention was likely completed to protect the Riverfront Trail from the erosive forces of the creek. A gully has formed upstream of the bridge where overbank flood water returned to the creek channel. Flooding has also deposited a mix of sand, silt, and muck along the banks, and a point bar has also formed on the path side. A vegetation restoration project was attempted here just downstream of Brady Street on the left bank. Though the seeds from the project may still be present in the soil, this attempt at restoration will likely fail due to frequent flooding

DW 10: Severe and recent erosion of the Duck Creek stream banks.

DW 10: gully erosion forms when flood waters flow back into Duck Creek.

DW 10: heavy sediment deposition indicates movement of significant volumes of sediment from upstream to downstream.

DW 11: severe bank erosion and slumping near Brady Street.

DW 11: thick riparian vegetation helps hold soil in place.

and sediment deposition. The silt and muck bottom substrate here indicates a fairly poor habitat condition.

CANDLELIGHT CREEK AT 53RD STREET / GAINES STREET (DW11.1)

Candlelight Creek is a small tributary that joins Duck Creek at 32nd Street and Main Street. Its path runs through a highly developed area with residential neighborhoods and large commercial uses such as car dealerships and the Northpark Mall. Riparian buffers are narrow, with properties encroaching on the creek edge. As a result, Candlelight Creek is moderately channelized and in some locations has been put in an underground storm sewer. The creek is contained in an underground pipe at Lujack Hyundai above 35th Street and daylights near 46th Street, north of Northpark Mall. After intersecting 53rd Street near Gaines Street, the creek again disappears into a culvert. Candlelight Creek was observed at the intersection of 53rd Street and Gaines Street, and seems mostly affected by large debris loads upstream of East 53rd Street.

DUCK CREEK AT JUNGE PARK (DW12)

At Junge Park, Duck Creek is surrounded by turf grass, baseball fields and a narrow riparian buffer of grass and trees. To the north of Junge Park are a number of commercial and light industrial operations that drain to Duck Creek. To the south of the park are primarily residential neighborhoods. The Riverfront Trail also runs to the south of the creek along the right bank.

The creek here has highly unstable banks that display recent, active erosion and bank slumping, evident in the presence of exposed fine roots and freshly exposed dirt. While some vegetation was found on the banks, they are primarily bare and exposed except where banks that have previously fallen into the creek support vegetative growth. The inner bend of the creek shows sand, sedimentation, and the formation of point bars. These point bars force the stream to the other side, exacerbating bank erosion on the outside bend. Deposition on the inside and erosion of the outside bends indicate that lateral movement of the creek is occurring here. Floodwaters have deposited a layer of sand and silt within the riparian buffer area, and as floodwater flows back into Duck Creek it causes gully erosion. Turf grass extends to the edge of the creek throughout Junge Park and appears to be mowed to the edge on a regular basis. A very narrow band of longer grass and some trees line the creek banks in a few locations. Interestingly, the tree trunks show evidence of beaver activity in the area, though no beaver evidence was found elsewhere along Duck Creek.

DUCK CREEK AT MARQUETTE CREEK PARK PEDESTRIAN BRIDGE (DW13)

West of North Marquette Street in Marquette Creek Park, sand deposits within the exposed banks indicate that this area of Duck Creek may be an old lake plain and/or sandy outwash plain. Currently, the creek is in a neighborhood park surrounded by residential land uses and crossed by the Riverfront Trail. The riparian buffer is fairly narrow along both sides of this reach, approximately 10’ of turf grass and scattered trees. Some areas of the buffer are mowed turf grass all the way to the edge. The creek runs mostly straight here with minor meandering and a silt muck substrate, yielding a poor habitat condition.

Banks along this reach are generally 6-10’ high, up to 15’ in some places. They are relatively unstable with both bank slumping and erosion. Slumps are creating ephemeral point bars, and heavy sediment deposits of sand and silt were found along the overbank terraces. A low head dam installed just upstream of the pedestrian bridge, possibly to mitigate the effects of a storm discharge point farther upstream or to protect a crossing sanitary sewer. Its presence appears to affect bank composition downstream, as vertical banks found upstream become more terraced downstream of the dam. A broken storm sewer outfall is the result of the eroding streambank removing what was once a supporting streambank.

DUCK CREEK AT DUCK CREEK PARK PEDESTRIAN BRIDGE (DW14)

Duck Creek flows through Duck Creek Park in Davenport west of Division Street. Recreational facilities border the left bank, including baseball and softball diamonds, soccer fields, and tennis courts. Large recreation fields of Williams Middle School and Adams Elementary School border the


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DW 12: severe erosion within Junge Park.


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DW 12: severe erosion within Junge Park threatens the recreational trail.


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DW 12: turf grass does little to stabilize stream banks.


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DW 13: one of the low head dams / sewer crossings on Duck Creek.


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DW 13: stream bank erosion can cause the failure of stormwater infrastructure, requiring expensive repairs.


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DW 13: a mildly meandering reach of Duck Creek.

right bank. The pedestrian bridge links a nearby residential area on the right bank with the Riverfront Trail on the left.

The creek is predominantly straight here with some minor meandering. The unstable 6-10' banks are showing areas of severe erosion and active fresh slumping that may eventually change the stream morphology. Flood water leaving the channel and entering the floodplain deposits sediment along the banks and creates new erosion paths as it returns to the channel. An exposed sand layer in the stream bank is unstable and easily dislodged. The buffer ranges from approximately 10' wide on the left bank to 40' wide on the right bank and is composed of grass and scattered trees.

SILVER CREEK AT WEST KIMBERLY ROAD (DW14.1)

Silver Creek is a branched tributary that joins Duck Creek just west of Duck Creek Park. Because of its location on the outskirts of Davenport, Silver Creek is bordered in some locations by residential development and in others by more rural, agricultural land uses. Growth and development is beginning to put pressure on the creek, but so far the creek in general has maintained forested riparian buffers. A particularly dense and wide patch remains between West Kimberly Road and 49th Street, although residential development south of West Kimberly Road has constrained the creek to a narrow channel. One location of concern along Silver Creek is found at its intersection with West Kimberly Road where a utility pipe currently traverses the stream. Particularly severe flood events, or even continued typical erosion, could potentially damage or dislodge the pipe, causing utility service interruption and possibly hazardous conditions.

DUCK CREEK AT HICKORY GROVE ROAD (DW15)

At Hickory Grove Road, Duck Creek passes under a vehicular bridge and is paralleled by the Riverfront Trail on the left bank. Industrial and agricultural land uses are nearby. The buffer width along this reach varies, but generally the right buffer is wide (60' or more) with a mix of grasses and trees, whereas the narrow left bank buffer has turf extending to the edge with grasses covering the banks. At this location, the presence of slumping on the right bank and severe erosion on both banks indicates a relatively unstable bank condition. The downstream edge of the Hickory Grove Road bridge footing is aerating water flowing over 2' drop, which may have been caused by downcutting of the channel bottom. Minor meandering is present and some braiding is apparent downstream. Nonetheless, the habitat condition in this reach is poor.

DUCK CREEK AT FAIRMOUNT STREET (DW16)

At Fairmount Street Duck Creek flows fast within a fairly wide (60' or more) vegetated buffer and utility easement. The wider flatter, more connected floodplain here allows the stream enough space to exhibit a more natural morphology and habitat condition than in more constricted areas downstream and agricultural areas upstream. Some stream riffles and braiding are occurring at the bridge, though the silt muck bottom contributes to the poor habitat condition. Sedimentation is occurring outside of the banks of the creek, and the banks are moderately unstable. Adjacent land uses include residential and agricultural row crops, though these occur outside of the generous buffer.

DUCK CREEK AT WISCONSIN AVENUE (DW17)

Duck Creek here is heavily influenced by adjacent and upstream agricultural land uses. The 6-10' banks are fairly well vegetated but are moderately unstable with some evidence of erosion, particularly where drain tiles discharge to the stream bank and under trees, which shade out ground vegetation. The substrate is a deep, silty muck, largely the result of erosion from adjacent agricultural fields. The stream habitat condition in this location is poor. The riparian buffer here is narrow (10' or less) and consists primarily of long grass and some groups of trees.

CARDINAL CREEK AT WISCONSIN AVENUE / WEST 39TH STREET (DW17.1)

The majority of Cardinal Creek is within Davenport, although one of its tributaries does begin in Scott County. It flows into Duck Creek near Emeis Municipal Golf Course on Wisconsin

DW 14: a decent stream buffer near Division Street.

DW 16: some moderate stream braiding was observed along Duck Creek.

DW 15: moderate stream meandering and braiding were observed in upstream reaches.

Avenue. Unlike many of the other tributaries to Duck Creek, Cardinal Creek's adjacent land uses are almost exclusively rural and agricultural. Typically the creek has a very narrow riparian buffer composed of grasses and trees. Just upstream of this tributary's confluence, a deeply incised ditch was found upstream of the road crossing and a stormwater management structure or connection downstream of the crossing, where the Cardinal Creek appears to have been located underground until it intersects with Duck Creek.

CARDINAL CREEK AT WEST 46TH STREET (DW17.2)

Cardinal Creek upstream of West 46th Street is narrow and fairly choked with buffer vegetation. Downstream of the road crossing the creek flows through a residential property which has been cleared of tall vegetation to the creek edge, where a line of trees shade the creek and the riparian buffer.

DUCK CREEK AT NORTH UTAH AVENUE (DW18)

Duck Creek here is heavily influenced by adjacent and upstream agricultural land uses. The 6-10' banks are fairly well vegetated but are moderately unstable with some evidence of erosion, particularly where drain tiles discharge to the stream bank and under trees, which shade out ground vegetation. The substrate is a deep, silty muck, largely the result of erosion from adjacent agricultural fields. Stream habitat here is in poor condition. The riparian buffer here is moderate (30-60' or more) and consists primarily of long grass and some groups of trees.

DUCK CREEK TRIBUTARIES

The Storm Water Management Plan (SWMP) prepared for the City of Bettendorf (October 2000) presents findings of a field reconnaissance of the major Duck Creek Tributaries within the Bettendorf jurisdiction. The SWMP evaluates existing conditions (erosion, drainage patterns, topography, hydraulic structures, possible detention areas, land use, access constraints, and whether previous recommendations had been implemented) and identifies potential future problems within four Duck Creek tributary subwatersheds: Greenway Creek, Stafford Creek, Halcyon Creek, and 44th Street Creek. Because this Duck Creek watershed plan is focused on the main stem of Duck Creek, this tributary information is presented here to give watershed stakeholders an idea of watershed issues within the Duck subwatersheds. Some of the recommendations contained in the SWMP report have been incorporated into the action plan contained in Chapter 5 of this plan.

GREENWAY CREEK

Greenway Creek originates in Davenport north of Crow Creek road and drains south through Bettendorf to Duck Creek. The creek drains approximately 570 acres, most of which is developed as medium density residential land use with some commercial development near Spruce Hills Drive and Utica Ridge Road. The large percentage of impervious area in the watershed causes a relatively quick stream response to rain events, which may worsen due to development of agricultural land upstream. Current channel conditions indicate problems caused by increasing runoff. Moderate to heavy erosion is present, and has exposed a sanitary sewer crossing the bottom of the creek channel west of Medina Court. Moderate debris buildup is also present through the stream channel.

STAFFORD CREEK

Stafford Creek originates in Davenport north of Crow Creek road and drains south through Bettendorf to Duck Creek. The creek drains approximately 1300 acres, most of which is developed with medium density residential land use with some commercial development near the intersections of 18th Street and Spruce Hills Drive and Middle Road and Devil's Glen Road. Moderate to heavy erosion and debris buildup exist along a number of reaches of the creek.

HALCYON CREEK

Halcyon Creek, located in the southern portion of Bettendorf, drains northeast to southwest into Duck Creek from its origin southeast of the intersection of Middle Road and Devil's Glen Road. The creek drains approximately 265 acres, 70% of which is developed with medium density residential land use, with commercial development along Devil's Glen Road. Undeveloped areas to the northeast part of the watershed

DW 17: Duck Creek within agricultural areas of Scott County.

DW 18: Duck Creek within agricultural areas of Scott County.

are slated for commercial / office land use. The watershed's impervious areas cause a relatively quick stream response to rain events. Erosion is low to moderate and debris buildup is primarily moderate with higher occurrences of debris buildup in upper reaches.

44TH STREET CREEK

The 44th Street Creek, located in the southern portion of Bettendorf, drains from northeast to southwest into Duck Creek. The creek drains about 300 acres of primarily residential use property. As in the other tributary watersheds, the creek exhibits a relatively quick response to precipitation events. Light to moderate erosion is found along the majority of the stream length, with primarily moderate buildup of debris, more excessive in the upper reaches south of Deer Springs Drive.

DUCK CREEK BIOLOGICAL ASSESSMENT

In September 2002 the Iowa Department of Natural Resources conducted a bioassessment of a 413 foot headwaters reach of Duck Creek as part of the 2002-2006 statewide random stream survey project. This single sample taken from the most upstream area of the watershed is not sufficient to draw conclusions about stream quality or the aquatic community. Additional sampling at two or more locations downstream from the assessment site would be helpful to better define the stream's biological condition.

The bioassessment found one hundred fish of four different native species, a low abundance and diversity of fish resulting in a poor FIBI (Fish Index of Biotic Integrity) score of 24. The FIBI is a ranking of the quality of a stream based on the living things present, from 0 (minimum) to 100 (maximum). Sites that score between 0 - 25 are considered poor. In poor communities, fish abundance is usually lower than normal or, if fish are abundant, the collection is dominated by a few species that are tolerant of wide-ranging water quality and habitat conditions, the number of native fish species present is low, and sensitive species and habitat specialists are absent or extremely rare. Table 3.08.2 provides a listing of state and federally listed animal species in Scott County.

During this bioassessment, no Benthic Macroinvertebrate Index of Biotic Integrity (MIBI) score could be calculated due to the lack of a sufficient sample of benthic macroinvertebrates (i.e., insects and other small aquatic life that live in the stream substrate), also an indicator of adverse stream conditions.

As displayed in Table 3.09.2, this headwaters reach exhibited few favorable habitat features and characteristics. The high percentage of silt and detritus / muck (71% combined) do not provide conditions supportive of high quality fish or other aquatic species. Riffles, which increase the diversity of the habitat and help oxygenate the water, are completely lacking from the reach. The stream banks are mostly bare and somewhat steep, indicating a condition of active erosion.

The monitoring results of the September 2002 bioassessment were used by the Iowa DNR to make an "evaluated" (less confident) type of use support assessment for Duck Creek. The Designated Use for Duck Creek is listed as General Use and the Overall Use Support is listed as Not Supporting, indicating that the stream condition is impaired due to significant levels of silt substrate, a lack of instream cover for fish and other aquatic wildlife, and eroding stream banks. Natural fluctuations in stream flow and aquatic habitat conditions that would be expected in a stream with a small watershed area may also be contributing to the aquatic life impairment. Based on the bioassessment, the Iowa DNR determined the causes and sources of impairment as shown in Table 3.09.3.

In addition to the Bioassessment site discussed above, the Iowa Rivers Information System contains fish survey records from four additional locations on Duck Creek sampled in the 1980's and a fish kill investigation site in 1994. These data (Table 3.09.4) provide additional insight as to what fish might occur in Duck Creek, but are not suitable for calculating an accurate Index of Biotic Integrity score nor for making conclusions regarding historical trends.

During the watershed planning team's stream inventory, data was collected on the floristic quality of the Duck Creek main stem corridor. As noted in the pre-settlement vegetation discussion above, at the time of settlement, the plant communities along Duck Creek varied from wet to dry prairie and open woods, with some Mississippi River

Table 3.09.2

Stream Parameter	Measurement	Value
Reach	Length (ft)	472
	Average Stream Width (ft)	4.7
	Average Depth (ft)	0.5
	Maximum Depth (ft)	1.3
Substrate	Clay (%)	2.0
	Silt (%)	63.0
	Sand (%)	15.0
	Gravel (%)	12.0
	Detritus/Muck (%)	8.0
Macrohabitat	Riffles (%)	0.0
	Runs (%)	42.9
	Pools (%)	57.1
Streambank	Bare - Left (%)	73.5
	Bare - Right (%)	74.5
	0-15 degree slope - Left Bank	30.0
	0-15 degree slope -Right Bank	0.0
	20-50 degree slope - Left Bank	60.0
	20-50 degree slope - Right Bank	70.0
	55-110 degree slope - Left Bank	10.0
	55-110 degree slope - Right Bank	30.0
	115-180 degree slope - Left Bank	0
	115-180 degree slope - Right Bank	0
Canopy	Shaded Channel (%)	67 (13-99 range)
Buffer Width	Minimum Width - Left Bank	20
	Minimum Width - Right Bank	30
In-Stream Cover		0

Table 3.09.3 Causes and Sources of Impariment

Causes (magnitude)	Sources (magnitude)
Siltation (Moderate)	Bank or Shoreline Modification / Destabilization (moderate)
Other Habitat Alterations (moderate)	Hydromodification (moderate)
	Natural Sources (moderate)

Table 3.09.4 IRIS Fish Survey Records

Scientific Name	Common Name
Carpiodes carpio	River Carpsucker
Catostomus commersoni	White Sucker
Etheostoma flabellare	Fantail Darter
Ictalurus punctatus	Channnel Catfish
Lepomis cyanellus	Green Sunfish
Semotilus atromaculatus	Creek Chub
Cyprinella lutrnsis	Red Shiner
Pimephales notatus	Bluntnose Minnow
Cyprinus carpio	Common Carp
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Luxilus cornutus	Common Shiner
Phenacobius mirabilis	Suckermouth Minnow
Nocomis biguttatus	Horneyhead Chub
Notropis dorsalis	Bigmouth Shiner
Pimephales promelas	Fathead Minnow

Table 3.09.5 Floristic Quality Assessment of Duck Creek

Area	Native Species	Mean C	FQI
Original Duck Creek	100	5.0	50
Blackhawk State Park	116	3.8	41
DW1	17	2.0	8
DW2	20	1.8	8
DW3	30	3.0	16
DW4	18	0.7	3
DW5			
DW6	9	0.3	1
DW7	27	2.3	12
DW8	17	2.5	10
DW9	27	1.5	8
DW10	42	2.1	14
DW11 (restoration site)	10	1.8	6
DW11	16	1.5	6
DW12	23	1.6	8
DW13	26	1.8	9
DW14	18	0.8	4
DW15	30	1.2	6
DW16	18	1.1	5
DW17	6	1.3	3
DW18	6	0.7	2
Current Duck Creek Average	20	1.5	7

bottomland near the mouth. In each acre of any of the plant communities there resided no fewer than 100 native species of plants. The plants ranged in character from native "camp followers" to highly specialized species growing in unique, site-specific assemblages.

These plant species are designated with Coefficients of Conservatism, ranging from 0 to 10, which are an indicator of the quality of the habitat in which the plants grow. The Mean C (an average of the Coefficients of Conservatism for the Duck Creek area) at the time of settlement was approximately 5.0. Each 1 point of incremental increase of Mean C value can be regarded as about 10 times more complex and higher in quality. Thus an area with a Mean C value of 3.0 is 10 times less complex and of lower quality than an area with a Mean C value of 4.0. The floristic quality of the area is a product of the species richness and Mean C and is expressed as the Floristic Quality Index (FQI), which was about 50 for each acre within the Duck Creek corridor.

In Table 3.09.5, the extent to which the Mean C differs from 5.0 or the FQI differs from 50, is the extent to which system degradation has occurred in the plant communities bordering the creek. As a comparison, Blackhawk State Park, arguably the highest quality natural area in the Quad Cities region, has a Mean C value of 3.8 and an FQI of 41, approximately 10 times less complex and of lesser quality than the original pre-settlement landscape condition. Generally, the low values for Duck Creek inventory points reflect the fact that the habitats in the watershed have changed dramatically, so the native biodiversity of the corridor has diminished in quality dramatically.

DUCK CREEK OBSERVATION SUMMARY POINTS

1. *Stormwater runoff is creating flashy conditions* within the Duck Creek channel, causing significant and rapid fluctuation in water levels ("flashy hydrology") that is destabilizing and eroding the banks of the creek. In some locations, steep eroding banks up to 15' high (average approximately 6-10') are exposed and slumping into the creek. Bank erosion is found more frequently on outside bends of meanders, with deposition occurring on inside bends, though erosion is certainly not confined to outside bends and is found throughout the system. In sum, the altered hydrology is causing the stream system to disassemble and fall apart, with restoration becoming increasingly difficult the more degraded it becomes. Erosion is causing the loss of property, trees and vegetation, and sediment loading, which may settle in the stream bottom impairing habitat, or be carried to the Mississippi and ultimately the Gulf of Mexico. Lower reaches seem to be more protected from erosion for unknown reasons, possibly related to soil structure and geology rather than a less destructive hydrology than in upper reaches. Upper reaches are more incised with steeper, eroding banks.
2. *Stormwater management infrastructure* is damaged and failing in some places, and causing bank erosion in other places due to high flow rate and volume.
3. In some locations, *streambank armoring and stabilization* measures appear to be holding well, in other locations it is failing, and in other locations the armoring is merely causing erosion problems to occur elsewhere, i.e., move downstream. In others, armoring will be needed to slow erosion.
4. *Overbank flooding* is damaging property and infrastructure, and depositing sediment (primarily sand and silt) within the overbank / floodplain area, degrading the ability to support native vegetation. Sediment deposition is very heavy in some areas, up to 12" of accumulated sediment. As floodwater that have left the channel seek to return to the channel, it seeks a low spot and creates a small gully that, with repeated flooding, can widen and deepen into an erosion problem. Development appears to be causing increasing flooding and runoff problems, such as is reported along Goose Creek.
5. *Water clarity* following storm events is very turbid, indicating a heavy load of suspended sediment. Sources are suspected as agricultural land, urban sediment and runoff from impervious surfaces, and streambank and streambed erosion.
6. Well *vegetated streambanks* are more stable, though even the densest deep-rooted vegetation can not hold against the erosive forces of a very flashy hydrology.
7. Downstream reaches tend to have *better habitat structure* (meanders, pools, riffles and runs) and more

natural stream morphology, largely due to the presence of exposed bedrock and cobble / sand substrate. In these reaches, the faster, shallower flow may be carrying suspended sediment beyond and into the Mississippi River. These reaches also tend to be more aesthetically pleasing with a more naturalistic appearance.

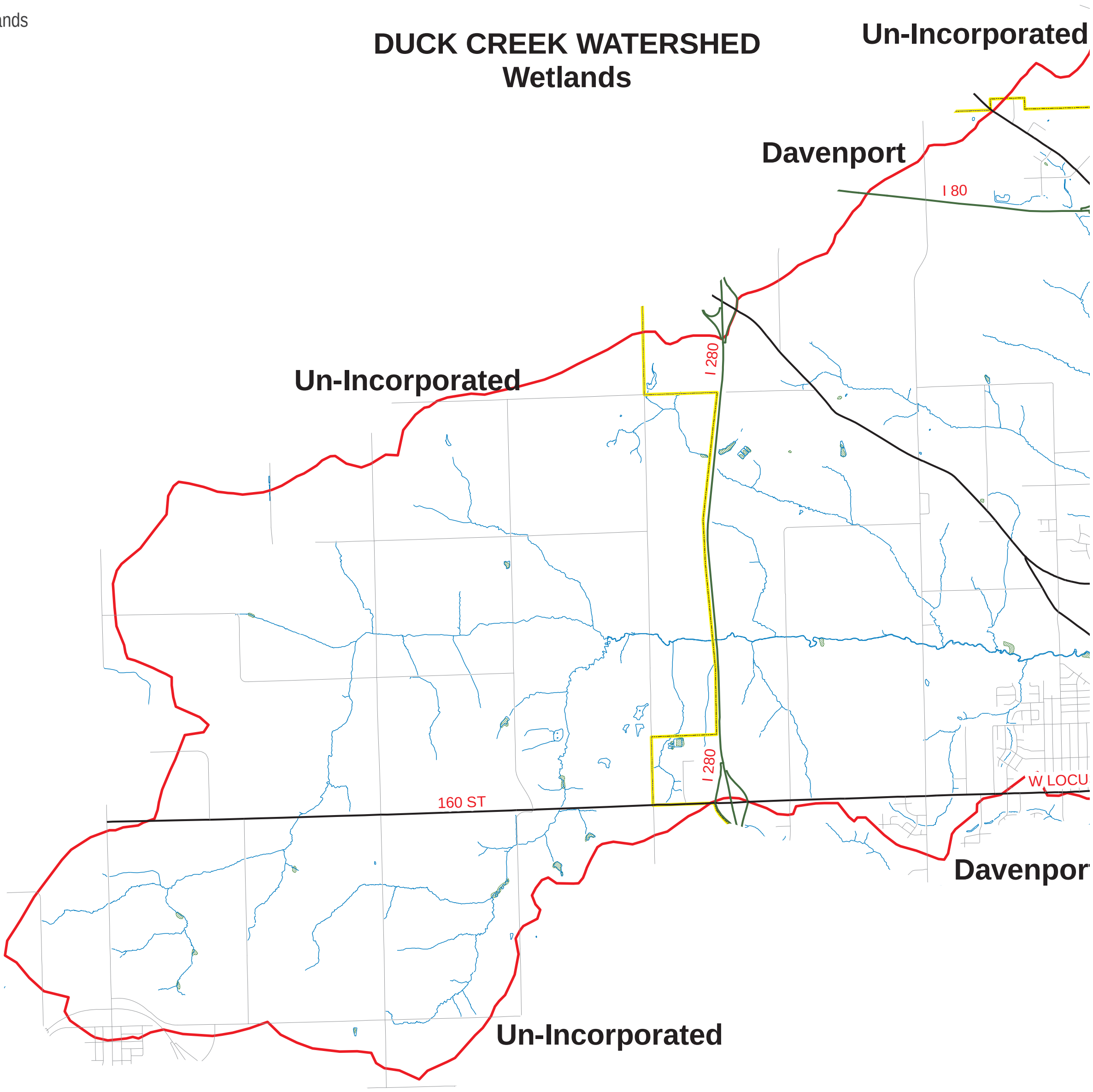
8. The *riparian buffer* is of varying widths along the main stem, in some cases a very narrow strip of tall turf grass serves as the buffer, which does not provide the functions a riparian buffer should serve. In some locations turf grass is mown right to the edge of the stream bank. In other locations, the buffer is densely forested (i.e., thick and overgrown) with little ground vegetation to help hold soil in place. Exposed fine roots of trees and other vegetation indicate that these roots do not adequately anchor the soil in place. Other reaches have wide buffers of tall grass (primarily reed canary grass, an invasive species) with a few individual or groups of trees. None of these conditions is adequate to protect the streambanks from the erosive forces of a flashy hydrology, though a tall grass buffer with a few trees may be the best of the three conditions observed. Need to find a balance between access, recreation, and a healthy riparian habitat and stream protection.
9. *Erosion and deposition is a natural process*, which ultimately returns a straightened stream channel to a more natural meandering pattern and can help return some habitat structure to a channel. However, unless the hydrology can be corrected, the early evidence of channel recovery will be destroyed by high flow events. Point bars forming on inside bends are forcing water to the outside bend and causing further erosion. Some braiding is observed, primarily downstream of bridges where sediment can accumulate. Sand is present along many of the reaches, both as overbank sediment, within the exposed banks, and / or along the channel bottom, which may indicate that the area was an old lake plain.
10. *Channel widening and/or lateral movement* is occurring, as well as downcutting in middle and upper reaches. The creek was not always 6-10' below the level of the land! In most locations there is adequate room to allow the stream to find its path, in others there are a few constraints such as the pedestrian / bike path, bridges and culverts, and roadways. There were only a few occurrences of built structures or paved areas encroaching on the stream corridor, primarily in the dense commercial area such as along Brady Street. Low head dams or other grade control structures (whether installed intentionally or unintentional (i.e., sewer lines) appear to have a beneficial downstream impact on streambank stability, and likely help to aerate the water adding oxygen. However, these structures may need additional protection or other management measures, such as dredging behind them, to maintain their benefits.
11. *Biologically*, the riparian stream corridor is significantly impacted by land use change and the changing hydrology of the system. Little of the original native system remains, though there are a few spots where some native plants have held ground. Sedimentation from frequent overbank flooding events degrades the riparian corridor such that natural vegetation systems would have a very difficult time surviving within the flood zone.
12. *Debris loading* from trees or other natural or man made debris in the stream channel did not appear to be a large problem, with only a few occurrences of buildup, and trash or other dumping was seldom observed. However, it is possible that any built up debris was flushed downstream during the recent flood event.
13. Within the *agricultural areas* the stream is much incised and banks, though well vegetated, are moderately unstable, and showing significant bare soil and erosion under trees. Riparian buffers vary from 10 to 50 feet. Field tile discharges are showing early signs of creating erosion channels.
14. There is *significant space and opportunity for making improvements* along the mainstem of Duck Creek. However, some efforts at restoration may be futile without addressing the larger problem of watershed hydrology.

3.10 WETLANDS

Wetlands are of interest to watershed studies of this sort due to the benefits they provide. These benefits include absorbing and moderating the flow of runoff from the landscape, reducing the risk and damage of flooding by providing space for excess water to go, filtration and cleansing pollutants from runoff, and as important habitat for watershed wildlife. They are extremely important for fish species that use wetlands as nursery areas for spawning and the raising of young. Ducks and geese, deer, raccoon, mink, muskrats, frogs, salamanders, turtles, snakes, non-game birds such as herons and egrets, eagles and others use the wetlands as well. Many bald eagles over winter in the Quad Cities due to the hunting and fishing areas created by the locks and dams on the Mississippi River. Eagles use the large trees along the river and in the wetlands for resting and nesting.

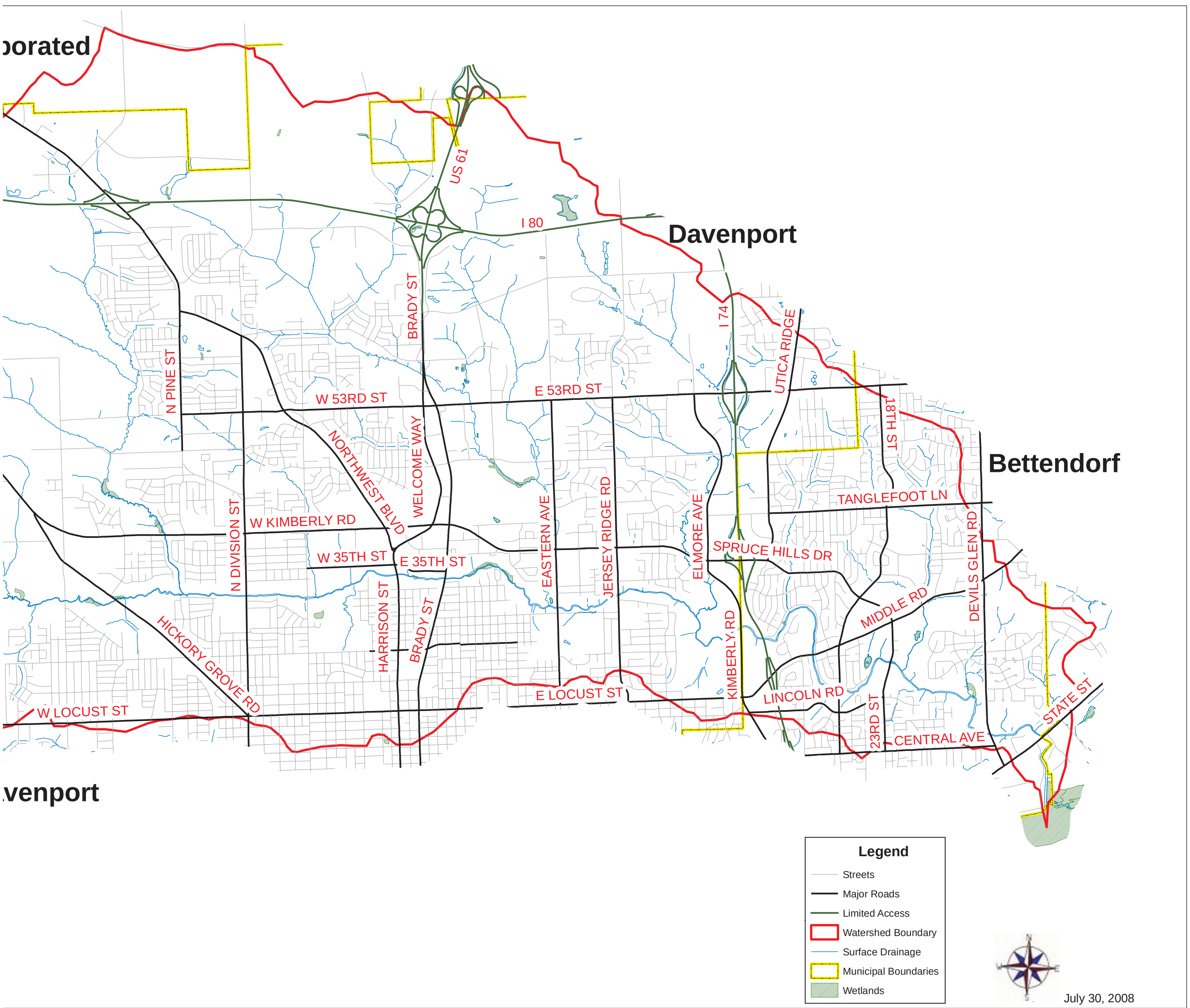
Currently, approximately 88 acres of wetlands (0.2% of the entire watershed area) exist within the Duck Creek watershed,

Figure 3.10.1 Wetlands



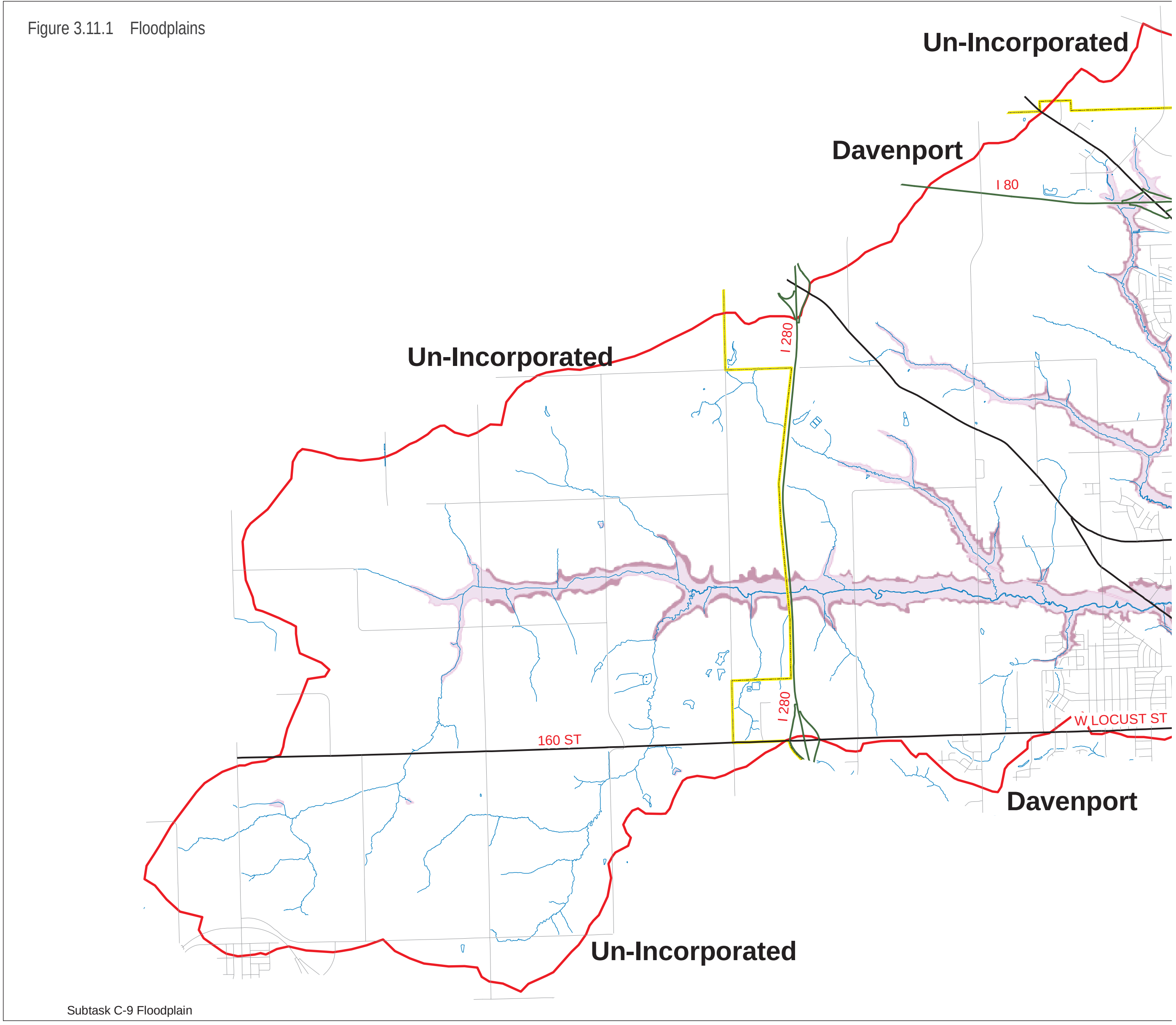
10,765 acres (99%) less than an estimated original 10,853 acres. The number of acres of wetland lost was estimated by calculating the area of hydric soil not classified as wetland, assuming that these areas were once wetlands and have since been drained and/ or developed. These losses have occurred across the entire watershed. Wetlands and hydric soils are shown in Figure 3.10.1.

The US Army Corps of Engineers Duck Creek / Fairmount Park Wetland Restoration project is planned for a 42-acre, Davenport-owned park site bordered on the east by Fairmount Avenue, on the north by the Iowa Interstate Railroad embankment, on the south by Duck Creek, and on the west by an unnamed tributary. The proposed project includes a wetland, prairie, and stream restoration component. The proposed wetland restoration project is intended to expand and improve existing wetland areas within the Duck Creek floodplain and provide improved conditions for submergent and emergent vegetation re-establishment and diversity. The wetlands would also improve water quality through increased nutrient and sediment removal



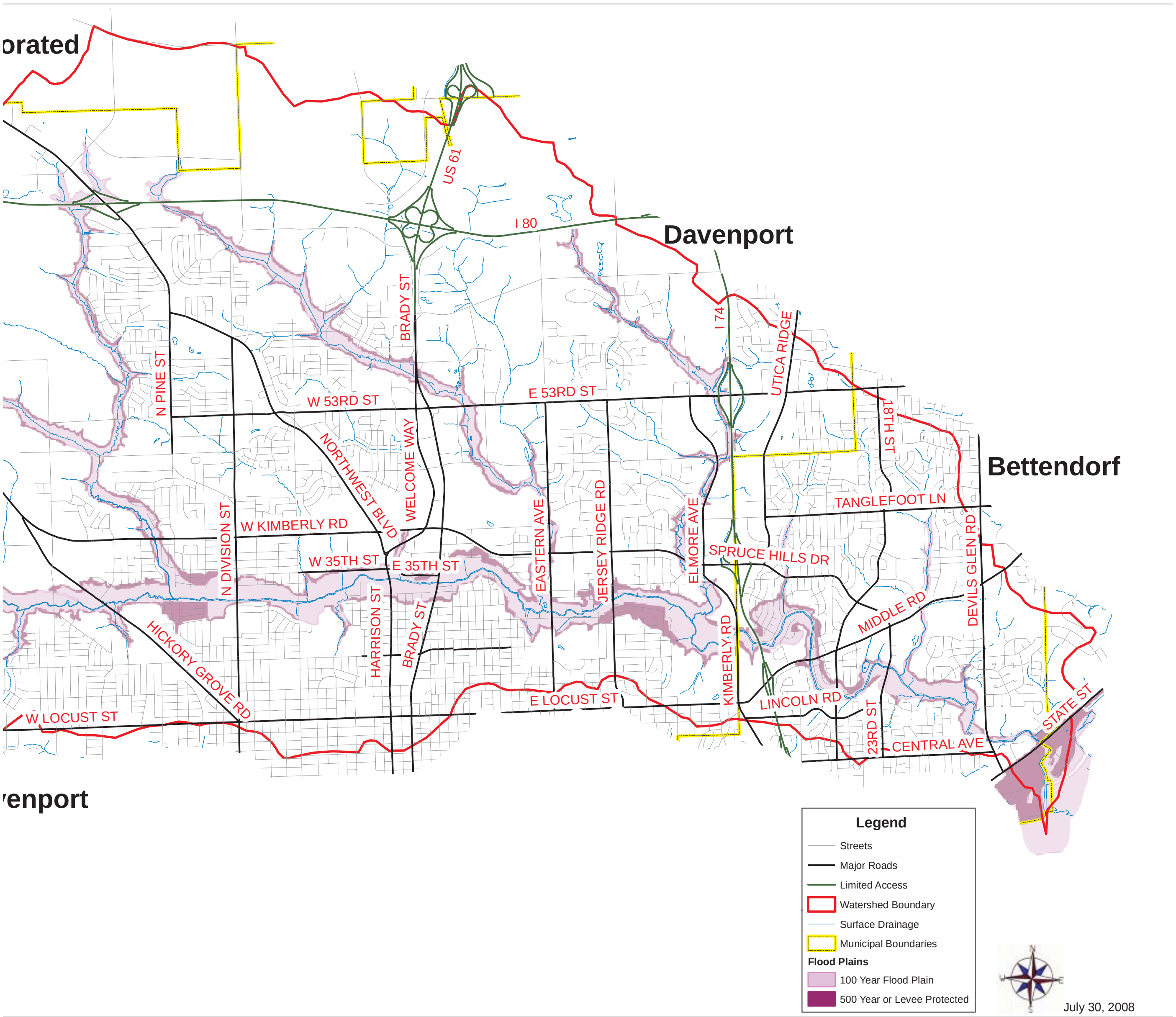
and restore wildlife habitat. The prairie component would restore native prairie plants to the site and provide a prairie buffer habitat that has been largely removed from the Duck Creek corridor. The stream restoration component includes pool and riffle complexes created by weir placement in Duck Creek, which would slow water flows, provide streambank erosion control, improve fish habitat, reduce turbidity, and increase oxygenation of the water. Recreational improvements are being considered as well, such as a bike path around the proposed wetland complex and a bridge connecting the spur to the bike path on the south side of Duck Creek. This project has been approved for a feasibility study and is waiting for additional funding through the Corps' Section 206 Continuing Authorities program. The lack of wetlands within the Duck Creek watershed suggests that an assessment be conducted to determine the feasibility and location of wetland restoration potential throughout the watershed. The goal of the study, and of restoration and management efforts, would be to recover the flood water storage and water quality benefits that tend to mitigate the impacts of urban and agricultural development.

Figure 3.11.1 Floodplains



3.11 FLOODPLAIN

Floodplains are shown on **Figure 3.11.1** Floodplains are an important component of stream ecology and also serve to moderate flow rates and stream energy during high flow runoff conditions. When floodplain areas and volumes are reduced, additional flood potential as well as increased streambank erosion can occur. The floodplain is important for identifying potential flooding issues and developing Plan recommendations. The 100-year floodplain is the area of land that is expected to be flooded, or has a 1% chance of being flooded, at least once in a 100-year period. Likewise, 10-year floods have a 10% chance of occurring in any given year. Similarly, the 500-year floodplain is the area of land that is expected to be flooded, or has a 1% chance of being flooded, at least once in a 500-year period.



Within the Duck Creek watershed, 2558 acres are within the 100-year floodplain, and an additional 647 acres are within the 500-year floodplain, as illustrated in **Figure 3.11.1**.

3.12 TRANSPORTATION NETWORK

According to state and local transportation documents, a few significant roadway construction projects are planned in the watershed, as listed in **Table 3.12.1**. The impact of streets and highways on the watershed, particularly water quality, is significant. **Table 3.12.2** lists a number of water quality pollutants and their sources, all of which are associated with the transportation system. Rain water flowing over the surface of streets carries these pollutants into wetlands, streams and ultimately the Mississippi River and the Gulf of Mexico, where they can accumulate and impair the quality of these resources for aquatic life.

3.13 SUBWATERSHED MANAGEMENT UNITS

The Duck Creek watershed has been subdivided into eight Subwatershed Management Units (SMUs) based on major ravine systems, as shown in **Table 3.13.1 and Figure 3.13.1.** This organizational structure allows the planning effort to examine the watershed at a scale smaller than the entire watershed. SMUs are drainage systems that drain to the most downstream point in the SMU. These eight SMUs form the management units within which the action recommendations are organized, which simplifies the management structure of the plan.

Table 3. 12.1

Highway	Planning Studies and Construction Projects
US 6	Widening of Kimberly Road from Brady Street to Elmore Avenue
	Replace the westbound Kimberly Road bridge over Goose Creek
	Realignment of Kimberly Road from I-280 to Fairmount
IA 130	Modiy I-80 eastbound off-ramp at NW Boulevard
	Modify I-80 westbound off-ramp at NW Boulevard
I-74	Entire corridor being studied for replacement of the pavement and bridges

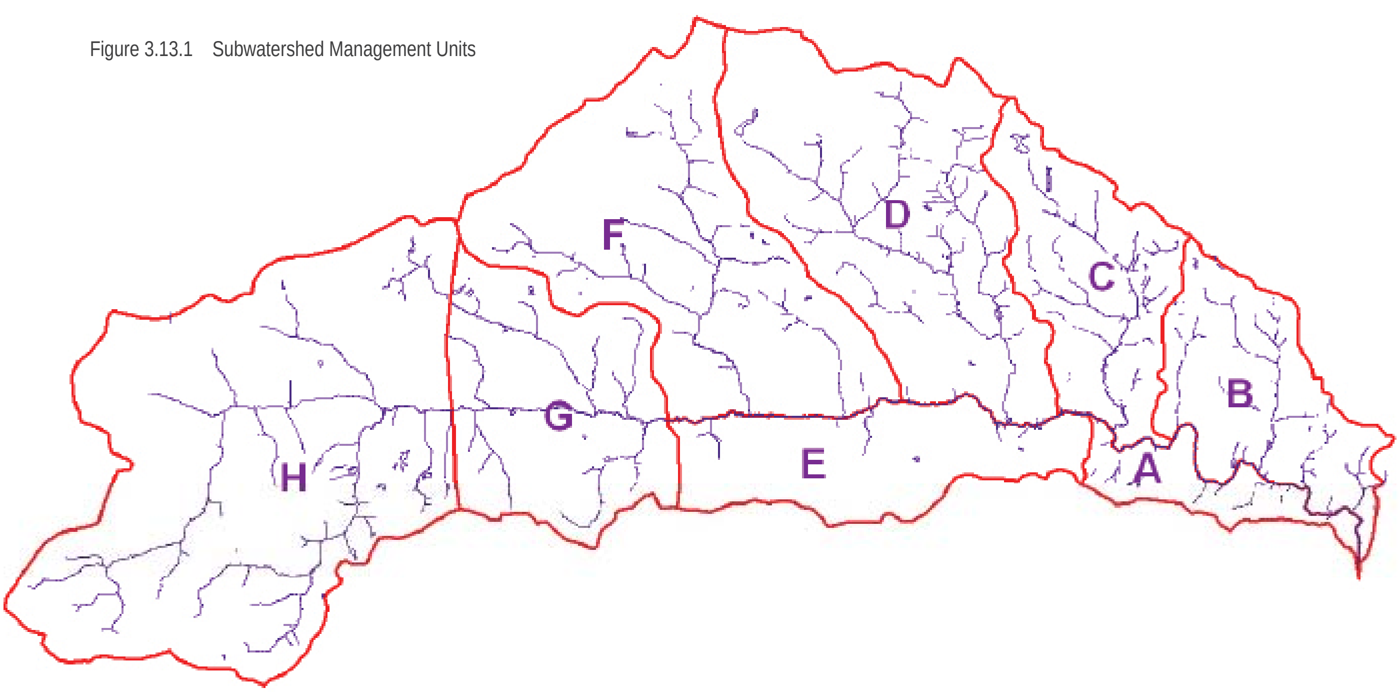
Table 3.12.2 Common Transporation-related Pollutants

Constituent	Primary Sources (USEPA, 1993)
Particulates	Pavement wear, vehicles, atmoshper
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Tire wear, automobile exhaust
Zinc	Tire wear, motor oil, grease
Iron	Auto body rust, steel highwway structures, moving engine parts
Copper	Metal plating, brake lining wear, moving engine parts, bearing and bushing wear, fungicides and insecticides
Cadmium	Tire wear, roadside insecticide application
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, brake lining wearr, asphalt paving
Manganese	Moving engine parts
Cyanide	Anticake coumpound used to keep deicing salt granular
Sodium, Calcium, Chloride	Deicing salts
Sulphate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks, or blow-by of motor lubricants, antifreeze and hydraulic fluids, asphalt surface leachate

Table 3.13.1 Duck Creek Subwatershed Management Units

SMU	Area (acres)
A	1134
B	3095
C	3291
D	6960
E	3114
F	7160
G	4353
H	11668

Figure 3.13.1 Subwatershed Management Units



3.14 WATER QUALITY

When rain flows across the landscape, pollutants such as oil and grease, road salt, eroding soil and sediment, metals, bacteria from pet wastes, and excess nutrients (nitrogen and phosphorus) from fertilizers are washed from streets, buildings, parking lots, construction sites, lawns and golf courses into the streams and the Mississippi River. Table 3.12.2 displays common transportation-related pollutants. This kind of pollution is called nonpoint source pollution, because it comes from the entire watershed rather than a single point, plant, or facility. These pollutants accumulate as the water flows downstream and eventually begin to degrade the quality of our streams and the Mississippi River for aquatic life, as well as for human uses such as fishing, swimming, and bird watching. In this way, every small bit of pollution adds up to a very large problem.

In addition to chemicals and other substances picked up from the landscape, non point source pollution includes other measures such as temperature, acidity, and the amount of oxygen in the water. Aquatic organism, including fish and insects that are critical links in the food chain, need oxygen that is dissolved in the water to breathe. Low flows and non-point source pollution can cause the dissolved oxygen levels in the water to fall below healthy levels. When this happens, some plants and animals will die, in some cases causing large fishkills, and others will leave that location to try to find more habitable waters.

Water temperature can also cause problems. Many fish and other aquatic animals require cool or cold flowing water to survive. As rainwater flows across urban surfaces and through the sewer system, these surfaces warm the water causing the overall temperature of the receiving stream to be too warm for many aquatic plants and animals. This water can also be either more acidic or more alkaline than is healthy for these organisms to survive.

Wastewater infrastructure, whether in the form of septic systems or sanitary sewer lines, are another potential source of pollution. Non-point source pollution can be traceable to issues (cross connections with the stormsewer system, leakage into or out of the sanitary sewer system, overflows of the sanitary sewer system due to stormwater infiltration or combined sewers) with the sanitary or sewer system.

Water quality data for Duck Creek has been collected by the Iowa DNR and volunteers over a number of years. This data has led to Duck Creek being listed on the 2006 Iowa 303d list of the state's Impaired Waters due to the presence of pathogens, detected through elevated E. coli indicator bacteria collected during the Midwest Bacteria Project discussed below. High bacteria levels can present health risks for those swimming, wading and playing in Duck

Lakes and stretches of streams and rivers in Iowa each have specific designations, based on what they are used for—like recreation, such as swimming or fishing; drinking water; or maintaining a healthy population of fish and other aquatic life.

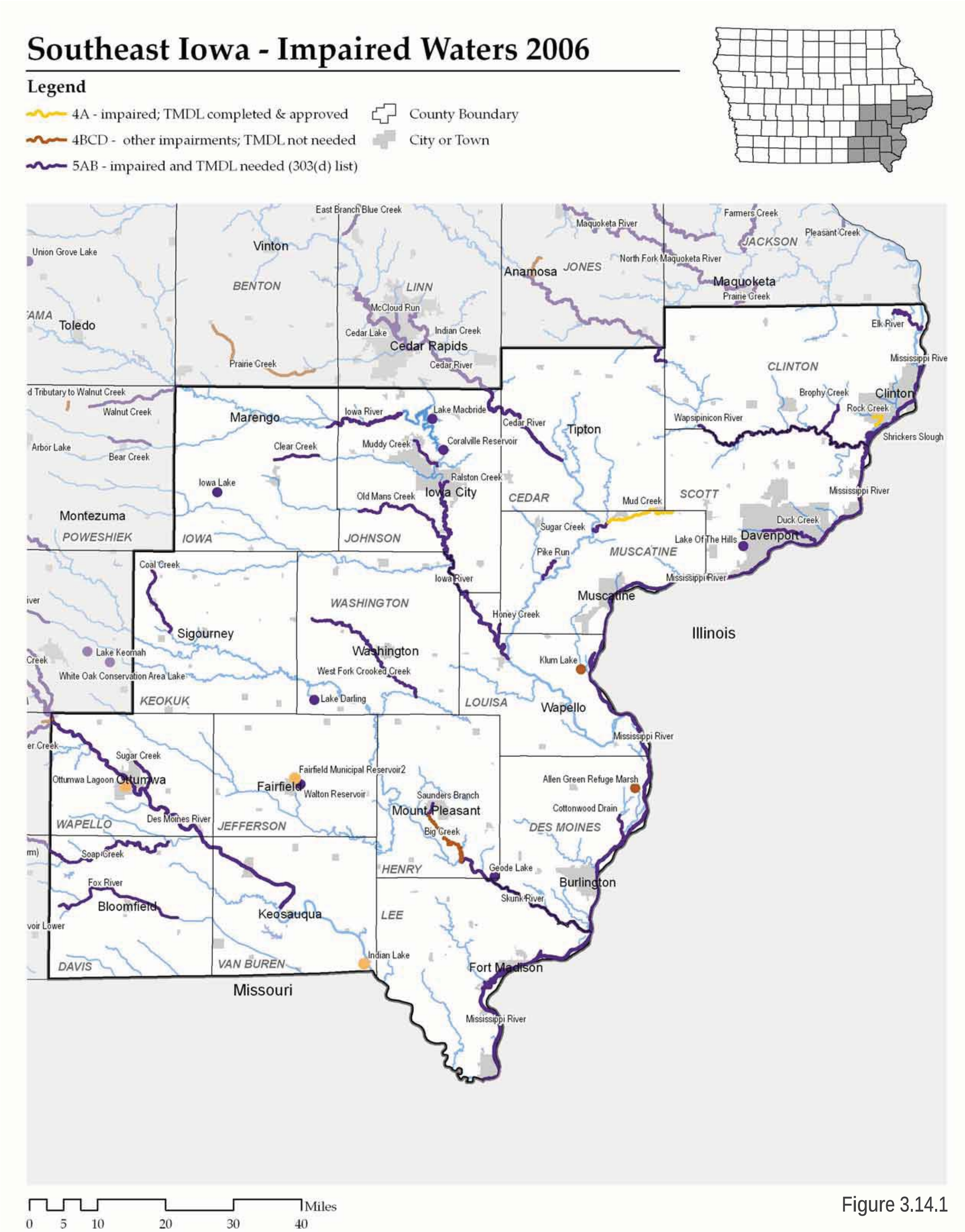
Every two years, Iowa must report on its progress in meeting water quality goals to the U.S. Environmental Protection Agency. The state prepares a report, called the 305(b) report that shows how well Iowa waters are meeting those goals. The report includes waters that meet the designated uses, waters that we need more information about and waters that are impaired.

If the water quality in the stream or lake prevents it from meeting its designated use, it does not meet Iowa's water quality standards and is considered "impaired." The waterbody is then placed on the "303(d)" list, commonly referred to as the "impaired waters list." This is named after section 303(d) of the federal Clean Water Act and means that the stream or lake needs a water quality improvement plan written (also known by a technical name, "Total Maximum Daily Load," or "TMDL").

The water quality improvement plan outlines water quality problems, identifies sources of the problem, identifies needed reductions in pollutants and offers possible solutions. Water quality improvement plans are approved by the U.S. Environmental Protection Agency and then the waters are moved off the 303(d) list. Even though a waterbody moves off the 303(d) list, the waterbody is still considered impaired until water quality improves.

While the water quality improvement plan can offer ideas for solutions, and the DNR can provide technical or financial assistance for Iowans looking to organize a watershed improvement project, local groups need to take action and work with the DNR to actually improve their stream or lake.

Local action can lead to improved water quality, which can help the stream or lake meet state water quality standards again. When the waterbody meets those standards, it may be able to come off the impaired waters list.
-from the Iowa DNR's Understanding Iowa's Impaired Waters brochure



Southeast Iowa - Impaired Waters 2006
Legend
4A - impaired; TMDL completed & approved
4BCD - other impairments; TMDL not needed
5AB - impaired and TMDL needed (303(d) list)
County Boundary
City or Town
Vinton
BENTON
LINN
Cedar Rapids
Toledo
Anamosa
JONES
Maquoketa
JACKSON
CLINTON
Clinton
Marengo
Tipton
CEDAR
SCOTT
Davenport
Iowa City
JOHNSON
IOWA
Montezuma
POWESHIEK
MUSCATINE
Muscatine
Illinois
Sigourney
KEOKUK
WASHINGTON
Washington
LOUISA
Wapello
Ottumwa
WAPELLO
Fairfield
JEFFERSON
Mount Pleasant
HENRY
DES MOINES
Burlington
Bloomfield
DAVIS
Keosauqua
VAN BUREN
LEE
Fort Madison
Missouri
Mississippi River
Iowa River
Cedar River
Wapsipinicon River
Des Moines River
Skunk River
Miles
0 5 10 20 30 40

Figure 3.14.1

Creek, which as been designated by the state for these uses. (Duck Creek's formal designated use is "Primary Contact and Recreation," a Class A stream.) A listing as impaired does not necessarily indicate severely or grossly polluted conditions or that the water is unsafe for human contact. In fact, reports of waterborne illness related to this use have historically been, and continue to be, extremely rare. In most cases, impairment indicates that there is a minor potential human health risk problem and that we need to address it before it becomes severe.

Due to this impairment and the potential for human health problems, Duck Creek is on schedule for a Total Maximum Daily Load (TMDL) study, which is essentially a water quality improvement plan, that will identify contributing sources of the pathogens causing the impairment listing and recommend actions for reducing the impairment. As part of this study, the Iowa DNR will be sampling Duck Creek weekly at 3 sampling sites on the main stem and 6 sites on Duck Creek tributaries.

Figure 3.14.1 shows the state's impaired waters for Region 6. Duck Creek is listed as impaired from its mouth (at the Mississippi River) to County Road (Fairmount Street) in Davenport.

MIDWEST BACTERIA PROJECT

The Midwest Bacteria Project water quality study monitored E. coli bacteria levels at five Duck Creek mainstem sites for 14 consecutive weeks from July 18 through October 23, 2004. From upstream to downsteam, these sampling locations, as displayed on Figure 3.14.2, include: DC16 (110th Ave), DC3 (Hickory Grove), DC8 (Eastern Road), DC11 (Middle Road), and DC12 (Devils Glen). Sample results show that points DC16, DC8, and DC11 exhibited maximum values greater than the Iowa state standard of 235 CFU/100ml for 98% of the samples collected. DC12 exceeded the state standard 57% of the samples, and DC3 exceeded 50% of the time. When all of the sample dates are aggregated for each sample site, median E. coli bacteria counts were equal to or greater than the state standard nearly 100% of the time.

There does not appear to be a spatial, or upstream to downstream, trend in the data except for a notable dip in the values at DC3. Most of the very high concentration events were associated with high daily mean discharges, indicating that very high concentrations are associated with high flows. This does not, however, explain the consistently high counts during times of normal flows.

IOWA DNR BIOASSESSMENT

The Iowa DNR Bioassessment information for Duck Creek collected water quality chemistry data on three dates in 2002, as shown in Table 3.14.1. This data indicates that the chemical parameters studied fall within acceptable state water quality standards. Total phosphorous concentrations, which varied between 0.18 and 0.49 mg/L, indicate possible elevated levels of phosphorous when compared to the rule-of-thumb concentration of 0.05 mg/L generally used to identify a potential problem. Phosphorous levels above 0.05 mg/L can result in excessive algae growth in the water. When this algae dies, the decomposition process consumes oxygen in the water. If too much of the dissolved oxygen is consumed, the water becomes uninhabitable to some sensitive aquatic wildlife species. That said, dissolved oxygen levels within Duck Creek that are above the state standard for the sampled dates indicate that low dissolved oxygen levels are not an issue.

IOWA DNR IOWATER PROGRAM

The Iowater program of the Iowa DNR provided water quality sampling data for Duck Creek and its tributaries based on six years (2002 – 2007) of data collected in May and October from 18 sampling sites on the Duck Creek mainstem, Silver Creek, Robin Creek, Goose Creek, Pheasant Creek, and Stafford Creek. The parameters sampled include those listed in Table 3.14.2. For Duck Creek, which should support human contact and recreational uses, E. coli bacteria is the parameter of highest concern due to the potential for human health impacts of pathogens in the water column. However, chloride, phosphorous, dissolved oxygen, and transparency are also of interest due to their impact on habitat quality in both Duck Creek and also downstream in the Mississippi River.

The water quality threshold for E. coli is a count of 235 organisms (CFU) per 100ml of water sample. E. coli bacteria indicate a relatively fresh source of human or animal waste. The bacteria, by themselves, do not cause human diseases, but their presence indicates the likelihood that disease

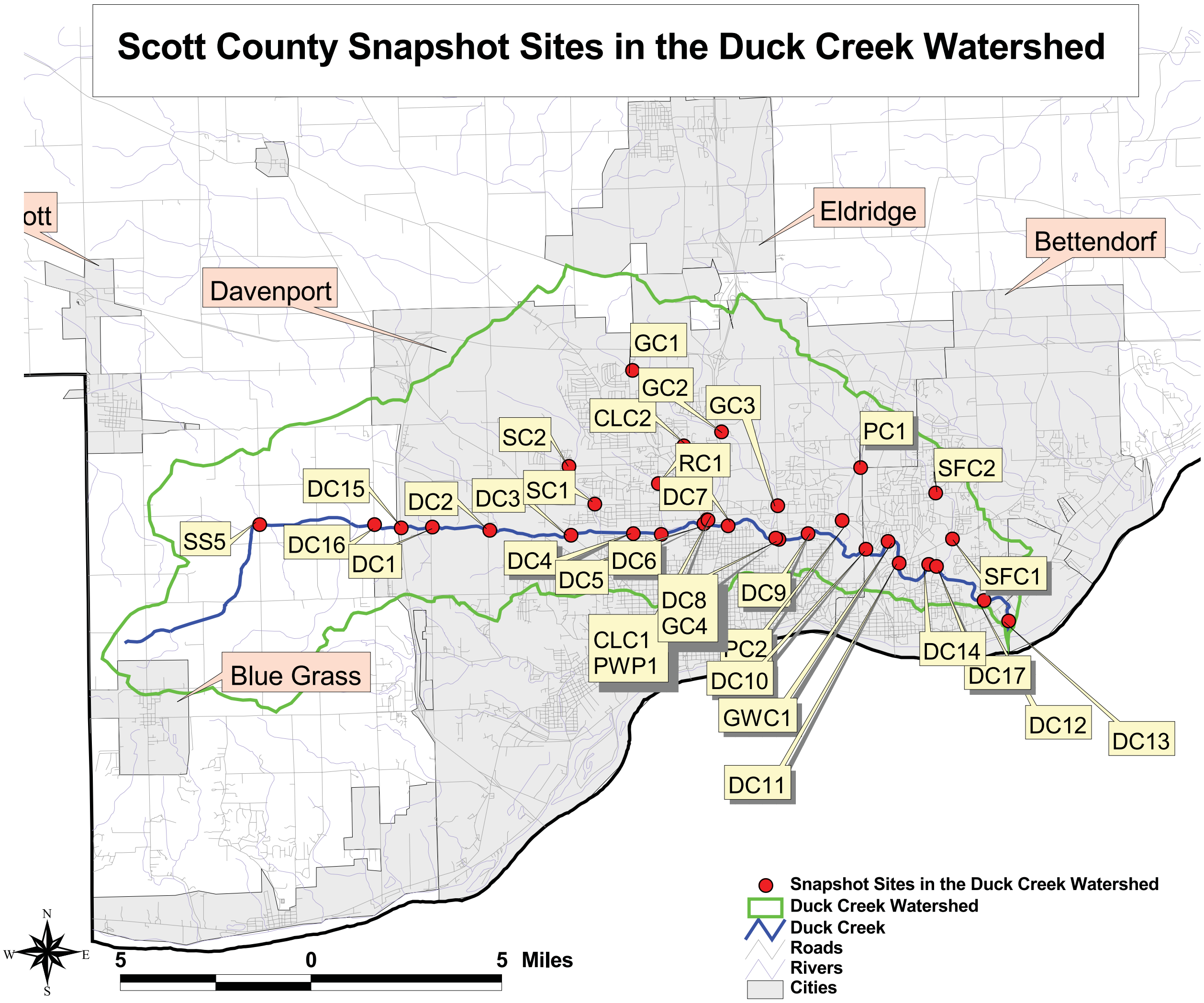

Scott County Snapshot Sites in the Duck Creek Watershed
ott
Eldridge
Bettendorf
Davenport
Blue Grass
GC1
GC2
GC3
CLC2
SC2
RC1
PC1
SFC2
DC15
DC2
DC3
SC1
DC7
SS5
DC16
DC1
DC4
DC5
DC6
DC8
GC4
DC9
SFC1
CLC1
PWP1
PC2
DC10
DC14
DC17
GWC1
DC12
DC13
DC11
Snapshot Sites in the Duck Creek Watershed
Duck Creek Watershed
Duck Creek
Roads
Rivers
Cities
N
W
E
S
5
0
5 Miles

Figure 3.14.2

causing organisms may be present. As shown in Figure 3.14.2, elevated E. coli levels were present throughout Scott County, which may suggest a link to the agricultural land uses found there.

In the Duck Creek watershed, E. coli levels above 235 CFU/100ml are found throughout the course of the stream with no strong upstream or downstream trend and no apparent link to high flow or low flow conditions. This suggests there may be multiple, point and non-point sources of contamination being driven by both continuous flow and rainfall conditions. However, preliminary and unconfirmed data collected as part of the TMDL study for Duck Creek, which is intended to help identify the locations of the sources of E. coli, have initially located high bacteria concentrations in Candlelight Creek and Stafford Creek. Further investigation and data analysis is needed to confirm this preliminary assessment.

When found in elevated concentrations in the stream, chloride, a chemical found in salts, can indicate inputs of human or animal waste, inputs from fertilizers applied to agricultural fields in the spring of fall, or road salt runoff following application for snow and ice control. Road salt can occur at toxic levels in the water column at intermittent times when the weather conditions demand its use. Sodium chloride is not removed by BMPs and is conservative (does not decompose or readily change form), and can cause spikes in the water column, typically detected as increased conductivity. Normal stream concentrations are generally 20-30 mg/L. The Iowater data indicates elevated chloride levels within Duck Creek for the majority of sampling sites in both May and October. Due to the time of year that these samples were taken, it is highly unlikely that these are the result of road salt application. An assessment of the data from upstream to downstream show that elevated chloride concentrations begin around DC2 at Wisconsin Avenue, where the land use begins to change from agricultural to more urbanized (see Figure 3.14.2). Significantly elevated chloride levels are found beginning near DC6 at Harrison / Brady Street. This trend of increasing chloride concentrations from upstream (agricultural land uses) to downstream (urban land uses) suggest that the source is not fertilizer application on agricultural fields but an urban source, possibly a source of human or other animal waste entering the stream. This conclusion is consistent with data showing elevated E. coli levels.

Dissolved oxygen is necessary in streams for aquatic life to survive, and low oxygen levels can inhibit fish reproduction and reduce food organism populations. The State of Iowa has designated a water quality standard of 5 mg/L for Iowa warm water streams. Dissolved oxygen concentrations are affected by water temperature, time of day, time of year, stream flow, aquatic plants, and human impacts. As the Iowater data indicate, dissolved oxygen levels for Duck Creek meet or exceed the water quality standard for the vast majority of points sampled. Thus, low dissolved oxygen levels do not appear to be an issue in Duck Creek.

Phosphorous concentrations in Duck Creek are mildly elevated above the 0.05 mg/L rule-of-thumb level in upstream reaches. Algae blooms due to phosphorous impair the habitat quality of water resources and block light from reaching desirable aquatic plants. When the algae dies, the decomposition process can deplete dissolved oxygen levels in the water, impairing the habitat quality for aquatic wildlife. Because dissolved oxygen levels are healthy in Duck Creek, phosphorous does not appear to be a problem. However, it should be noted that phosphorous is likely flowing into the Mississippi River from across an enormous agricultural and urban watershed and causing water quality impairment within the Mississippi or the Gulf of Mexico, where a dead zone forms every year due to nutrient and fertilizer inputs.

Transparency, the clarity of the water column, is an indicator of how much sediment (also known as Total Suspended Solids, or TSS) is being carried within the stream. Water clarity is not only important for aesthetics and public perception of the health and cleanliness of the stream, but for aquatic organisms as well. The primary impact of high suspended solids concentrations in streams occurs when these solids settle in depositional areas of the stream system and cover the more desirable gravel substrates. Excessive levels of particulate material also create difficult conditions for gill breathing fish and some of their food sources, including macroinvertebrate organisms. During the stream inventory conducted in June 2008, water clarity was found to be very low, particularly in upstream reaches. Iowater data

Table 3.14.1 Duck Creek Sampling Data

Parameter	July 11, 2002	July 25, 2002	Sept 18, 2002	State Standard
Ammonia Nitrogen as N (mg/L)	<0.05	<0.05	<0.05	Varies by pH
Chloride (mg/L)	14	22	17	-
Dissolved Oxygen (mg/L)	8.7	7.6	7.8	5.0
pH (pH units)	7.7	7.8	8.2	6.5 – 9.0
Temperature (c)	18	17.5	16.9	30 (July) / 29 (Sept) maximum
Flow Rate (cfs)	4.7	1.2	0.1	-
Nitrate + Nitrite Nitrogen (mg/L)	6.5	9.5	5.1	-
Ortho Phosphate as P (mg/L)	0.2	0.13	0.11	-
TKN (mg/L)	1.3	<0.05	0.46	-
Total Dissolved Solids (mg/L)	360	370	420	-
Total Phosphate as P (mg/L)	0.49	0.18	0.21	-
Total Suspended Solids (mg/L)	270	15	9.0	-
Total Volatile Suspended (mg/L)	34	2	1	-
Turbidity (NTU)	110	14	8.8	-

Table 3.14.2

Iowater Sampling Parameters
pH
Dissolved Oxygen
Nitrate-Nitrogen
Fecal Coliform Bacteria
E. Coli Bacteria
Nitrate+Nitrite-Nitrogen
Ammonia-Nitrogen
Total Dissolved Solids
Total Kjelahl Nitrogen
Total Phosphorous
Transparency
Chloride

supports this finding, with lower transparency readings found in upstream reaches and water clarity increasing moving downstream, presumably due to the increasing volume of water and the dilution of sediment concentrations, as well as the deposition of sediment in slower reaches of the stream.

The sources of TSS appear to be streambank erosion (due to hydrologic instability) with contributions from agricultural land uses and urban runoff over impervious surfaces. Suspended solids can be transported to the streams and lakes, even from remote areas of the watershed, via tile drainage, storm sewers, and roadside ditches. Another significant source of TSS in some reaches is runoff through overgrown woodlands along the stream corridor that have little or no ground cover vegetation to prevent surface erosion. Increases in impervious cover combined with introduction of stormwater drainage systems and loss of wetlands has lead to significant changes in watershed hydrology (flow alterations). This has in turn lead to increased streambank and streambed erosion and degradation of instream habitat in many reaches.

Potential sources of petroleum based hydrocarbons (oil and grease), metals, and synthetic organic compounds (SOCs) to the stream include stormwater runoff from urban land uses such as transportation, commercial, industrial, and residential. These toxic substances impair the quality of aquatic habitat and can bioaccumulate (concentrate within animal flesh and fat) through the food chain. Oil and grease and other organic compounds also use oxygen as they decompose and therefore can deplete dissolved oxygen. Because these pollutants exist in stormwater runoff, “dumping” or “spills” are not necessary for these to be present. Normal wear and tear on vehicles, machinery, and other equipment can contribute metals and other toxic materials to the water column.

Data collected on habitat quality of the Duck Creek and riparian corridor indicate a significantly impaired system due to the lack of habitat features, sedimentation, and significant erosion of stream banks. The limited data on aquatic biology indicate an impaired system, though this data should not be used as an indicator of the habitat quality for the entire length of Duck Creek and its tributaries. The riparian corridor suffers from significant flooding and sediment deposition over bank, which severely reduces the ability of the corridor to support healthy native habitats. The riparian buffer and corridor is very narrow in some locations and of poor habitat quality. See the Stream Inventory section above for details on the vegetative quality of the riparian corridor.

Watershed stakeholders also have raised the issue of Combined Sewer Overflows occurring within the watershed and the potential for discharge of pollutants during high rainfall events. Although the duration and impact of these events are unknown, the potential for significant impact is included here and in the list of impairments, causes, and sources.

NON-POINT SOURCE POLLUTANT LOAD MODELING ASSESSMENT

For each of the eight subbasins in the Duck Creek watershed, twelve non-point source pollutant loads were calculated. Loading was determined using unit area loading rates in lbs/acre/year for each land use category and for each pollutant. The land use specific unit area loading rates were multiplied by the area of each of the land uses in the particular subbasin and summed to obtain the total load for the subbasin (in units of lbs/year). The twelve pollutants assessed are displayed in Table 3.14.3.

The unit area loading rates were determined using the U.S. EPA Simple Method popularized by the Center for Watershed Protection. This method uses an event mean concentration (EMC, the average storm pollutant concentration) along with average annual rainfall and a runoff coefficient to determine an average annual pollutant load for each land use and constituent. Typical EMC values for urban areas were based on work during the National Urban Runoff Program, from the Northeastern Illinois Areawide Water Quality Management Plan, and from the Wisconsin DNR.

It should be noted that this analysis is based strictly on loading rates that are typical for the given land uses and not on any watershed-specific data. The analysis also does not reflect the influence that watershed landscape features such as depressional storage and wetlands have on delivery of pollutants to the watershed outlet. Thus, the watershed totals in are likely higher than what is actually leaving the watershed. Instead the values should be viewed as the total load to various water resource areas both inside and outside the watershed.

Table 3.14 .3

Non-point Source Pollutants
Total Phosphorous (TP)
Total Suspended Solids (TSS)
Chemical Oxygen Demand (COD)
Biological Oxygen Demand (BOD)
Total Dissolved Solids (TDS)
Total Nitrogen (TN)
Total Kjedahl Nitrogen (TKN)
Dissolved Phosphorous
Cadmium (Cad)
Lead (Lead)
Copper (Cop)
Zinc (Zn)

Table 3.14.4 Pollutant Ratings

SMU	Pollutant Contribution Rank
DWA	Moderate
DWB	Moderate
DWC	High
DWD	High
DWE	High
DWF	Moderate
DWG	Moderate
DWH	Low

For this modeling assessment, four pollutants in particular are considered as pollution indicators for this watershed: total suspended solids / sedimentation (TSS), total phosphorous (TP), chemical oxygen demand (COD), and biological oxygen demand (BOD). TSS and TP are typical indicators of high urban pollutant loadings. TSS can lead to excessive sedimentation in stream reaches and ultimately cover and impair instream habitat. TP can lead to excessive productivity levels of aquatic plants in slow moving reaches and in lakes and wetlands. This can then lead to low DO levels as the plant material decays, which can make the stream uninhabitable for some species of aquatic life. Since COD and BOD represent oxygen demanding substances they were included in the list of indicator pollutants for this watershed.

For each pollutant, subbasins were classified as High, Medium, or Low based on the subbasin average loading rate (lbs/acre/year) relative to the watershed average loading rate, as described below:

- If a subbasin average loading rate was greater than 1.5 times the watershed average loading rate, that subbasin was classified as a High contributor of the particular pollutant and given a rating of 3.
- If a subbasin average loading rate was between 1.5 times and 0.5 times the watershed average, that subbasin was classified as a Medium contributor of the particular pollutant and given a rating of 2.
- If a subbasin average loading rate was less than 0.5 times the watershed average, that subbasin was classified as a Low contributor of the particular pollutant and given a rating of 1.

After each subbasin was rated according to its loading contribution for each pollutant, a composite rating for the subbasin was determined based on the average of the rating of the four indicator pollutants (TSS, TP, BOD, and COD). The results of this assessment indicate that Subwatershed Management Units DWC, DWD, and DWE rank as a potential high contributors, and DWH a low contributor of non-point source pollutants relative to the other SMUs. The results are displayed in Table 3.14.4.

3.15 SUMMARY AND CONCLUSIONS

This watershed inventory and assessment provides important insight into the issues and problems in the watershed and the opportunities available for preserving and improving watershed resources. The vast majority of the impacts and impairments to watershed resources identified above are the result of years of modification of the stream and from a landscape changing from natural to agricultural to urban. The impacts of this changing landscape on watershed resources are summarized here and actions for addressing these impacts are included in the Action Plan in Chapter 5.

It is important to identify potential causes and sources of impairment in the watershed so that preventive and remedial measures can be planned and implemented. The impairments, issues, causes and sources identified below and in Table 3.15.1 are based on available data and the best estimate and professional judgment of the planning team and the watershed planning committee based on the watershed inventory assessment and input from watershed stakeholders. The impairments have not been identified nor confirmed by the state agency that determines water quality impairment designations by the state. Thus, they should be considered as potential rather than confirmed until additional sampling and surveying can be done.

The causes and sources of impairment displayed in Table 3.15.1 are selected primarily from a more complete list included in the Illinois Environmental Protection Agency and Iowa Department of Natural Resources 305(b) and 303(d) water quality reports and supplemented to a limited extent by professional opinion. Table 3.15.1 includes those impairments, causes, and sources that are most relevant to the Watershed-Based Plan nine element requirements of the United States Environmental Protection Agency. Because this table is intended to satisfy one of these nine requirements, it does not include all of the issues and problems identified below. However, they all have been addressed within the Action Plan included in Chapter 5.

WATER QUALITY

The most important water quality issues that need to be addressed include the following.

- bacterial contamination due to an unknown source
- elevated chloride levels, possibly resulting from sources linked to bacterial contamination, application of salt for snow and ice control on roads, or fertilizer application on agricultural fields;
- sedimentation and poor water clarity within the stream channel that is the result of streambank erosion, agricultural land erosion, and runoff from the urban landscape including roads and highways;
- toxic substances in the water column from urban runoff form impervious surfaces including roads and highways;
- nutrients that contribute to the potential for other water quality problems in Duck Creek and downstream resulting from urban and agricultural runoff;
- impacts from Combined Sewer Overflow events;
- potentially high non-point source pollution loading from Subwatershed Management Units DWC, DWD, and DWE.

STREAM CHANNELS

The most important issues related to stream channels that need to be addressed include the following.

- streambank erosion resulting from flashy hydrology (higher high flows, flooding conditions, and lower low flows), unstable streambanks, and stormwater discharges;
- stormwater discharges from residential and municipal stormwater management systems that cause erosion of the streambanks and stream channel;
- streambank and stream channel armoring that is intended to control erosion but is not designed, installed, or maintained adequately, resulting in erosion problems;
- sedimentation buildup within the stream channel;
- channelized and incised stream channels and channel widening / lateral movement;
- loss / lack of habitat characteristics such as pools and riffles and healthy channel substrates, though downstream reaches tend to be of higher quality;
- stormwater or other infrastructure within or along the

Table 3.15.1 Duck Creek Impairments Causes and Sources

Impairment	Cause	Source
Water Quality	Total suspended solids / sedimentation and siltation	Urban runoff / storm sewers
		Streambank modification and destabilization
		Runoff from forest / grassland / parkland
		Highway / road / bridge runoff
Water Quality	Bacterial contamination	Unknown sources
		Sanitary sewer problem / failure
		Animal feeding / grazing operations
		On-site treatment systems (septic)
		Combined sewer overflows
Water Quality	Nutrients (primarily phosphorous)	Urban runoff / storm sewers
		Agricultural activity / golf courses
		Runoff from forest / grassland / parkland
Water Quality	Aquatic life toxicity (chlorides / total dissolved solids)	Urban runoff / storm sewers
		Road salt and storage / highway maintenance and runoff
		Highway / road / bridge runoff
		Agricultural runoff
		Unknown sources
		On-site treatment systems (septic) (DC)
		Combined sewer overflows
Habitat degradation and alteration	Lack of habitat characteristics (pools, riffles, substrate, meandering, cover, streambanks)	Channelization / incision
		Streambank modification and destabilization
		Habitat modifications
		Impacts from hydrostructure flow regulation / modification
Habitat degradation and alteration	Hydrologic disturbance / flow alterations (increase or decrease of streamflow	Urban runoff / storm sewers
		Site clearance / development / land use conversion
		Loss / drainage of depressional / wetland storage
		Impacts from hydrostructure flow regulation / modification
Habitat degradation and alteration	Draining, filling, and degradation of wetlands	Draining, filling, loss of wetlands
Habitat degradation and alteration	Exotic and invasive species (natural areas and riparian zone)	Spread from existing infestations
		Habitat modification
		Impacts from hydrostructure flow regulation / modification
Habitat degradation and alteration	Loss / reduction / degradation of natural buffer; streamside alterations	Site clearing / development / land use conversion
		Inappropriate land management
		Streambank modification / destabilization
		Habitat modification / loss of riparian habitat
		Loss of riparian habitat and vegetation
		Agricultural activity / golf courses

stream channel that are either damaged or in danger of becoming damaged due to flashy hydrology.

RIPARIAN CORRIDORS

The most important riparian corridor issues that need to be addressed include the following.

- inappropriate management of riparian land uses, such as turf grass to the water or stream bank edge, which destabilizes streambanks and provides no water quality or riparian habitat benefits;
- narrow riparian buffers in a few locations;
- a dense tree and shrub canopy along the streambanks and riparian corridor of some reaches that shades ground cover, exposing soils to erosion;
- invasive species, such as reed canary grass, that degrade the natural quality of the riparian zone;
- deposition of sediment within the riparian corridor that degrades habitat and restoration potential;

GREEN INFRASTRUCTURE

The most important issues related to green infrastructure that need to be addressed include the following:

- lack of substantial green infrastructure hubs along the Duck Creek tributaries and upstream reaches of the main stem;

NATURAL AREAS

The most important issues related to watershed natural areas include the following:

- few areas of moderate or higher biological / vegetative quality within the watershed;
- poor habitat quality along the Duck Creek mainstem;
- lack of management and restoration plans and action to preserve and restore native habitat;
- invasive species infestations that degrade natural habitat;
- modified hydrologic / streamflow patterns that degrade natural habitat;
- impacts from upstream influences, such as erosion and sedimentation.

WETLANDS

The most important issues related to watershed wetlands include the following:

- lost wetland acreage and services due to drainage, filling, or other cause: water quality improvement, water retention and storage, and habitat;
- impairment of natural hydrologic patterns that support healthy wetlands resulting from stormwater discharge;
- lack of restoration and management plans and action for existing and former wetlands.

LAND USE

The most important land use issues that need to be addressed include the following:

- conversion of vacant, agricultural, or open land to urban uses, which increases impervious surface area and impacts water quality and runoff volume;
- lack of appropriate development best management practices, particularly with regard to stormwater management, incorporated into existing or new development;
- agricultural land uses and practices that may be contributing pollutants, particularly sediment, to the stream.

As noted above, these issues are addressed in the Action Plan in Chapter 5. With dedication and determination, these issues can be addressed and the watershed can be restored to health and well-being.