



The influence of  
**LANDSCAPE  
FACTORS**  
on transportation systems

prepared by Iowa State University

# Overview



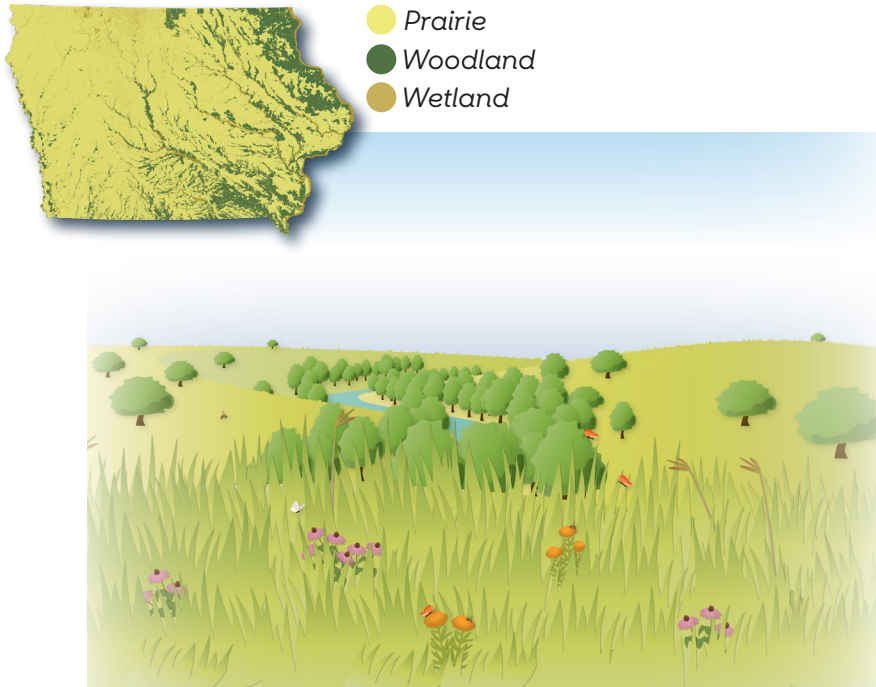
image credit: wikipedia

This presentation explores the relationship between the landscape and built systems in your community. Specifically, we will examine:

- The development of transportation systems and community land use over time
- How surface water and topography affect where communities and transportation systems develop
- The impact of groundwater (when present) on transportation and land use
- Benefits of trees and other vegetation and how trees in towns fit with transportation networks, main streets, and neighborhoods

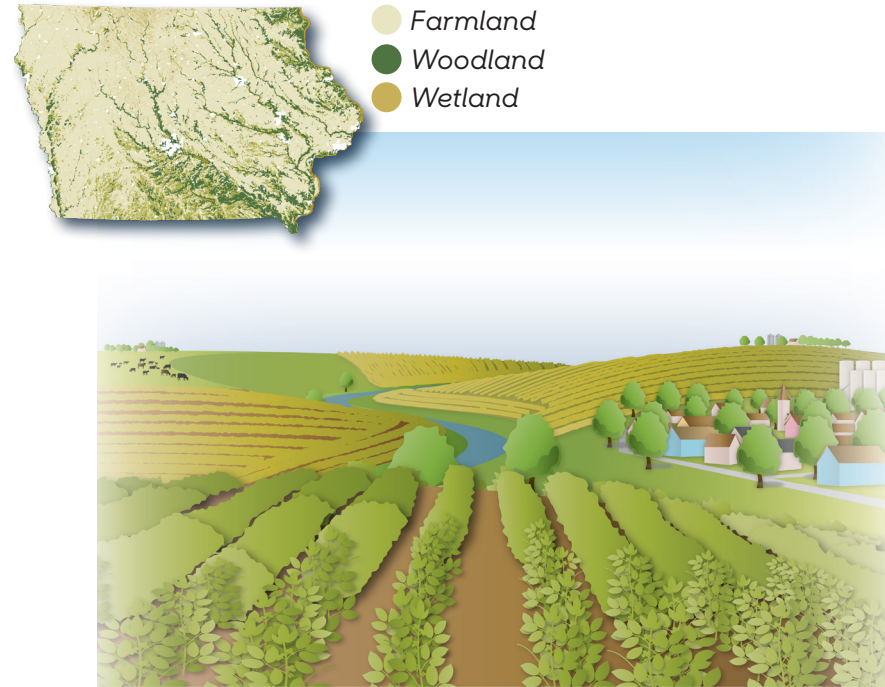
Donnellsen is located in the heart of Lee County, at the southeast end of the Historic Hills Scenic Byway. Nearly 900 people call Donnellsen home. The city was incorporated in 1892 by a surveyor, Eston A. Donnell, and later named after the Donnell family. Eston's son, W.R. Donnell, was the first railroad agent, express agent, merchant, and postmaster. Donnellsen became the fastest growing town in Lee County during the early 1900s, beginning when the Burlington Railroad expanded from Fort Madison through town and on to Farmington. The rail line is no longer in use, but the historic depot is still intact and used as a community space and museum at Railroad Park. Today, Donnellsen is home to "Iowa's Oldest Fair" (the Lee County Fair), hosted north of downtown at the Lee County Fairgrounds and Speedway.

# Land Cover Changes Over Time



**Historical Landscape**

The historical landscape of Iowa was dominated by prairie and savannas. Tree canopy was typically found in valleys along river corridors adjacent to scattered savannas, because the fires that maintained the prairies could not spread as easily in those places. Native plants such as switchgrass, little bluestem, coneflower, and milkweed are some of the more recognizable plants found in the diverse prairie landscape.



**19th Century Landscape**

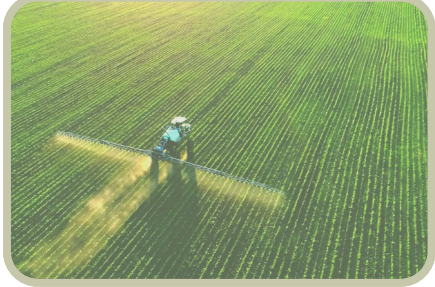
The once-dominant prairie has been replaced by agricultural fields, pasture lands, and small towns in the post-settlement Iowa landscape. Fire suppression and development have allowed for greater growth of wooded areas among the rural landscape and in town. At the same time, many wooded river corridors have narrowed to make more room for cropland.

# Current Land Cover

## Impervious Surfaces



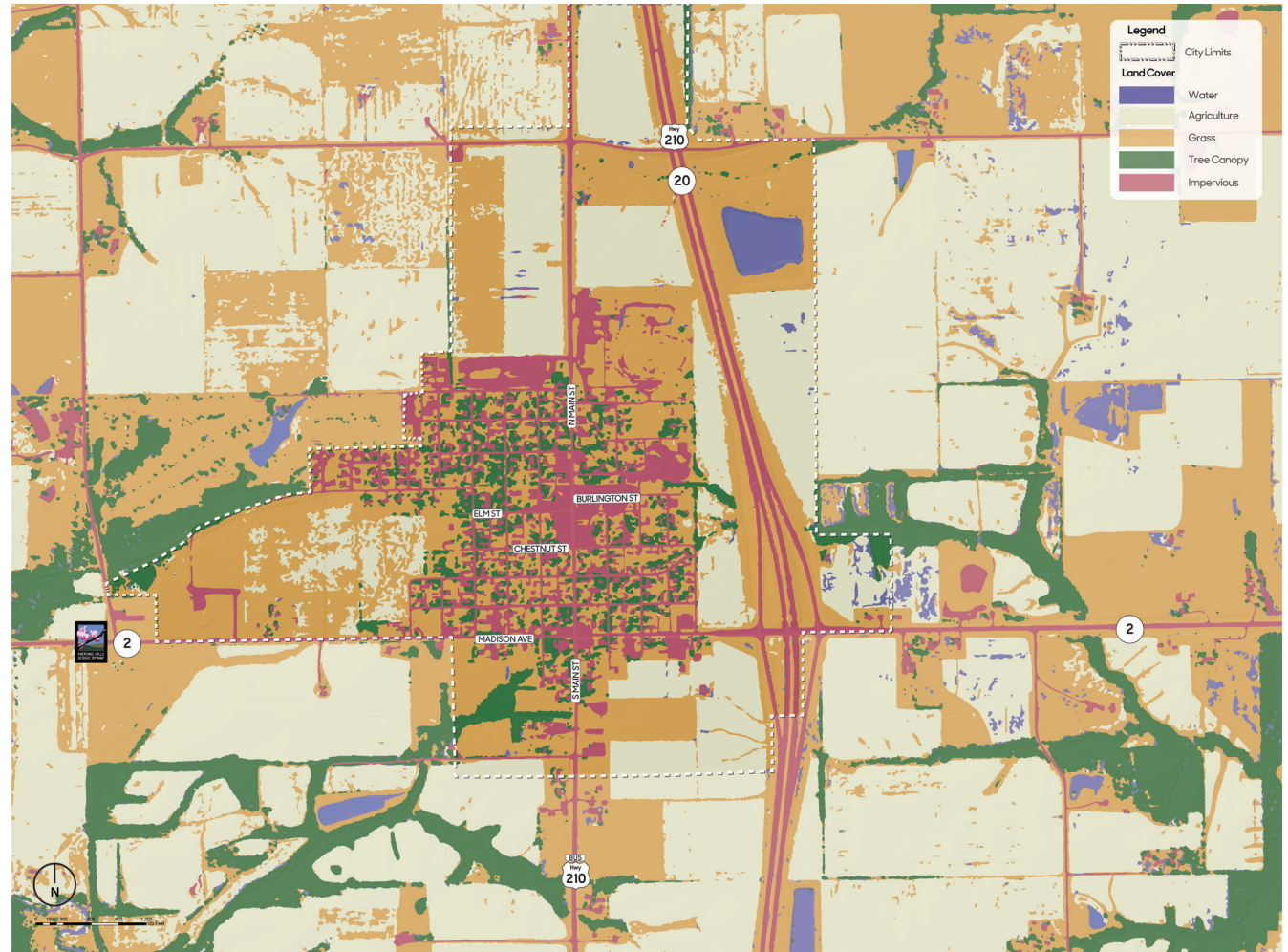
## Agricultural Land



## Grassland/Lawn

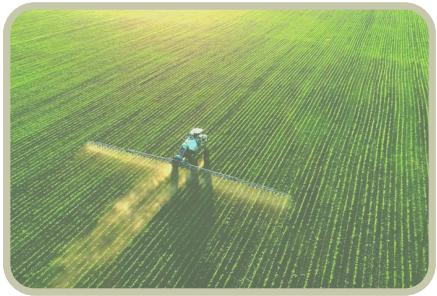


## Tree Canopy



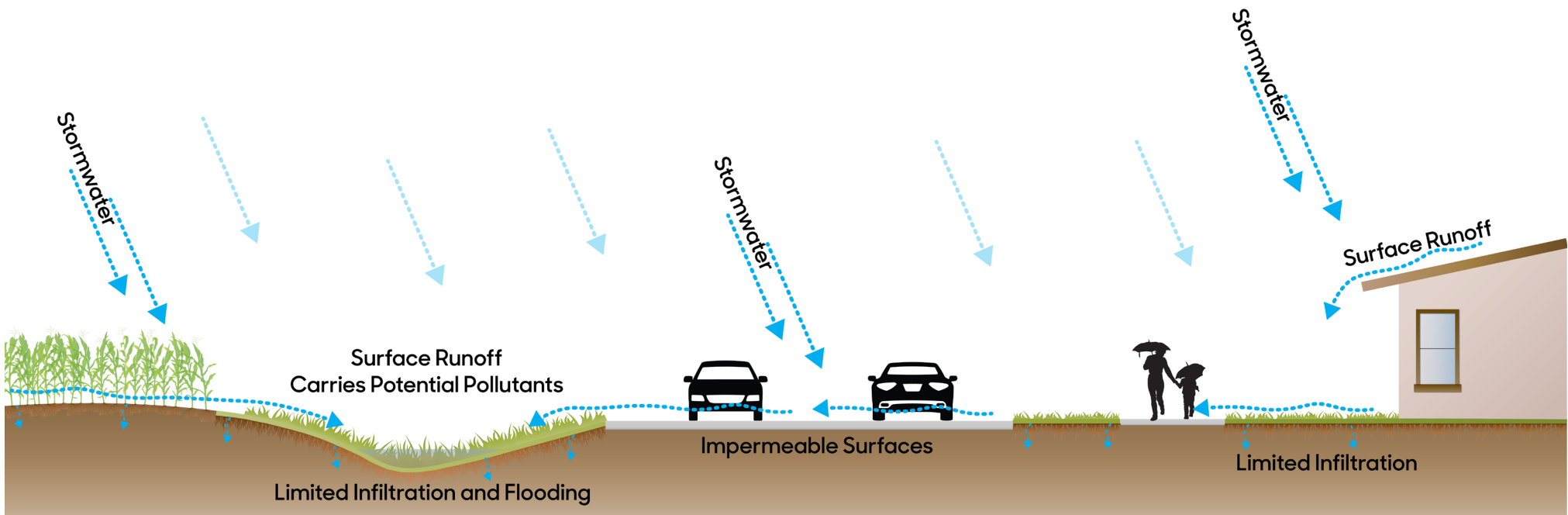
The land cover in most of Iowa's small towns today is a mix of residential lawns or neighborhood spaces dotted by trees. Streets and parking are paved and are sometimes flanked by sidewalks. Commercial and industrial zones are typically dominated by impervious surfaces.

Donnellson has a balanced mix of impervious and vegetated spaces. The residential landscape quickly gives over to grasslands and agricultural fields, which have replaced the early prairie landscape that once covered the gently rolling hills of this area.



## Impervious Surfaces, Agricultural Land, & Lawns

Impervious surfaces limit or prevent stormwater from infiltrating the ground and, in expansive areas, can create heat-island effects through stored and reflected heat. Agricultural land that is in annual crops and tilled provides limited infiltration, which can contribute to local flooding. Lawns can also limit infiltration, especially over compacted soil. All of these factors contribute to stormwater runoff and localized flooding, especially during intense rainfall.



# Groundwater Concerns

The depth to the water table refers to the distance from the surface that groundwater fully saturates soil. In places with a high water table (zero or only a few feet below the surface), groundwater can well up and cause localized flooding. Rivers and natural lakes are generally areas where the water table is above the ground. These rivers and lakes receive most of their water from groundwater with some surface-water runoff from rain or snowmelt. This is why rivers can still be seen even if it hasn't rained in a while.

High water tables can have effects beyond just surface pooling, such as in the case of "frost boils." Frost boils result from groundwater freezing during winter and forming bubbles of ice called "ice lenses" that expand and push up from the ground. When the ice thaws, the frost boils collapse, leaving a divot in the surface. With certain kinds of flexible pavement, such as asphalt or gravel, these frost boils form potholes.

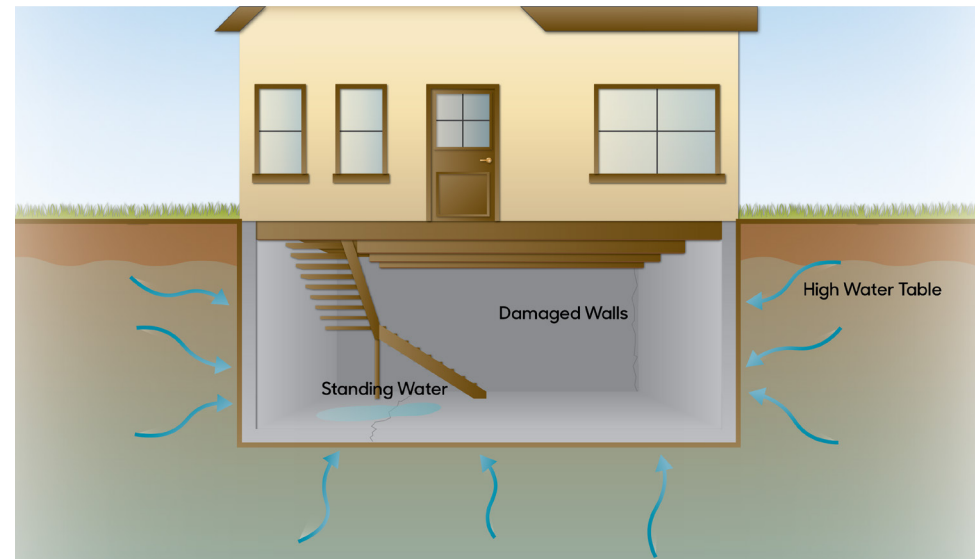
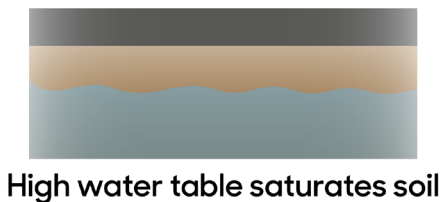
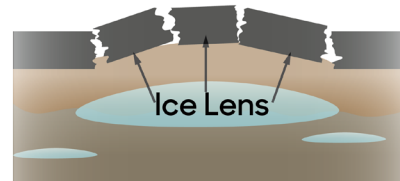


Diagram of the effects of a high water table on foundations and basements.

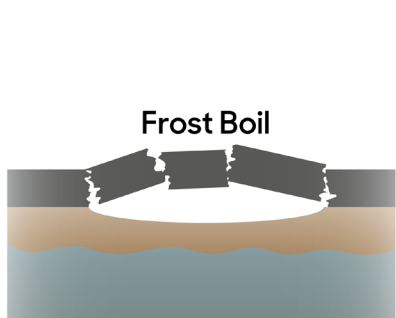
High groundwater tables can also have detrimental effects on one's home. Houses with basements surrounded by a high water table develop cracks or damaged walls due to water pressure. Typically a tile drain mitigates some of these effects, but wet foundations can require "dewatering," which can be expensive. Developing landscapes with high water tables requires more expensive maintenance, construction, and paving. Creating public spaces or parks in these areas makes good sense.



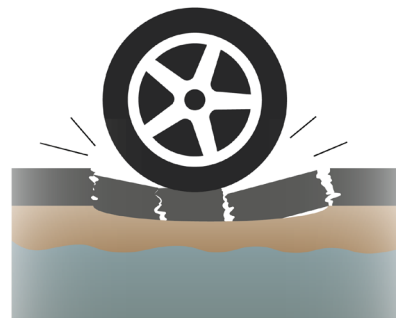
High water table saturates soil



Water freezes and expands



Ice thaws and saturated soil collapses



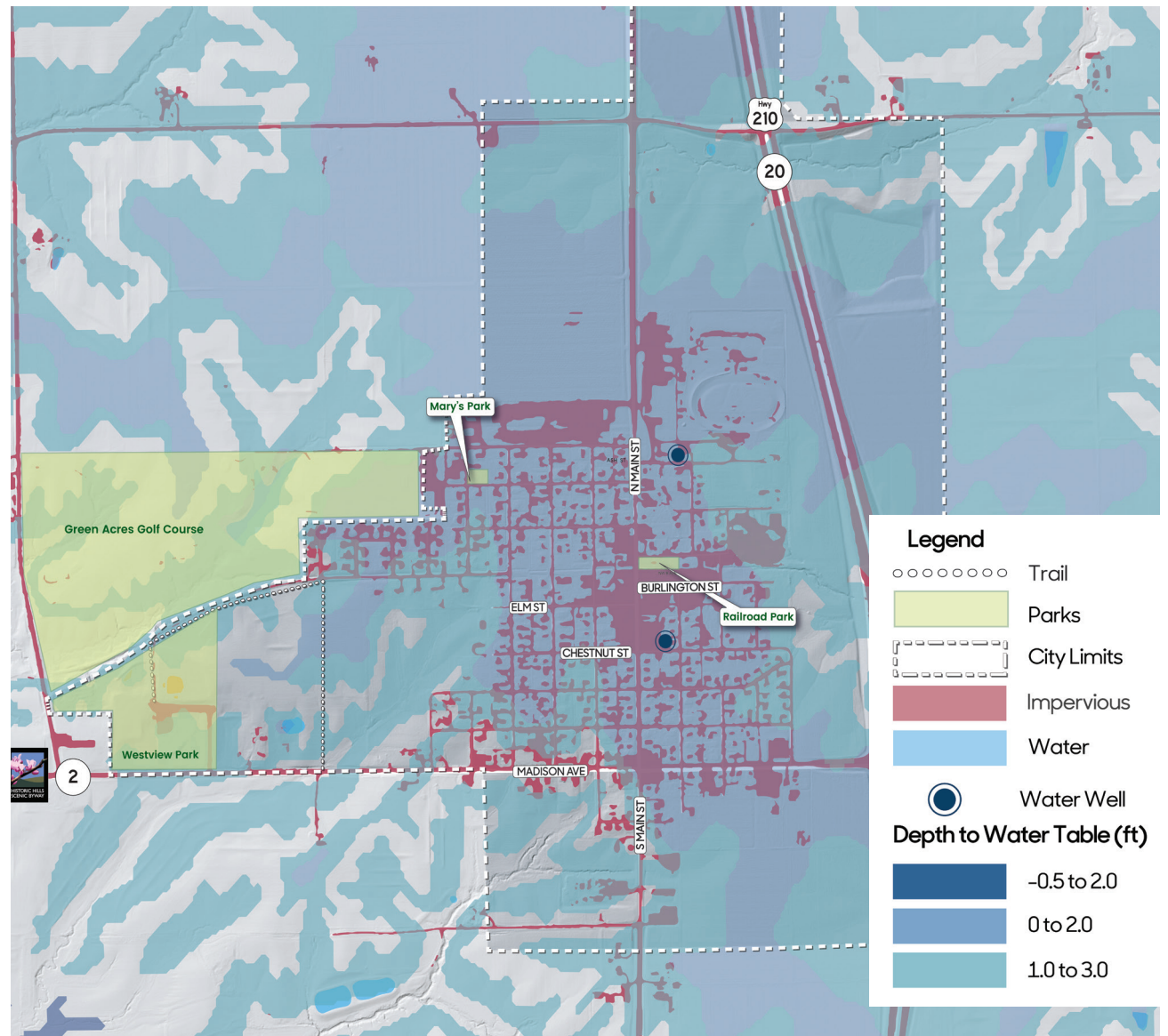
Traffic breaks bubble and wears surface

Diagram of the process by which frost boils affect roadways.

## Example Community



Emmetsburg's high water table has caused repeated damage on streets and even parking lots. The highway shows signs of continual repairs.



Groundwater and impervious surface map of Donnellson, IA

Looking at your town map, are there areas where the high water table and impervious surfaces overlap? Next time you are in this part of town, note local pavement conditions. Do you see signs of cracks or buckling? Has the surface been patched multiple times?

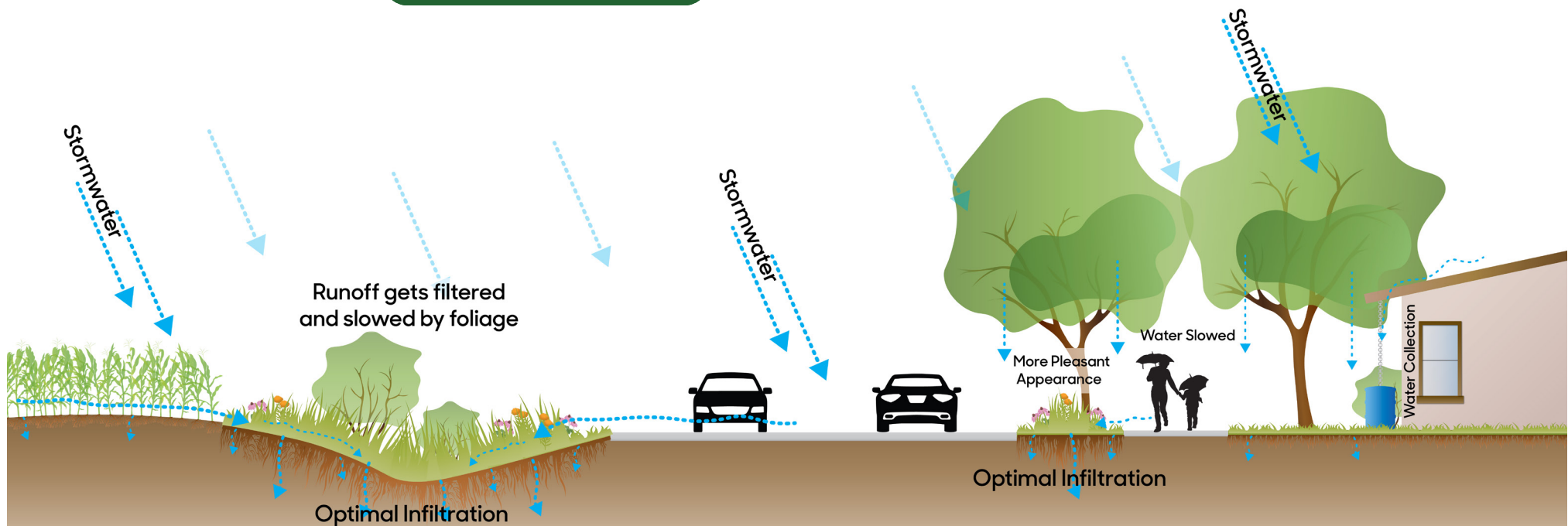
# Vegetation Benefits



## Grasslands & Tree Canopy

Native grasslands with deep-rooted plants aid in infiltrating stormwater, while dense foliage slows and filters stormwater from other areas. Practices such as bioswales and natural roadsides capitalize on these benefits to improve water quality.

Trees offer many advantages. They clean the air, create shade, and cool the atmosphere. They intercept rainfall, which helps mitigate stormwater runoff and flooding. They consume groundwater, which lowers the water table and makes space for water storage below ground. Carefully chosen and placed trees create community identity and make spaces comfortable for residents. Grasslands and trees provide habitat for pollinators and birds, which provides enjoyment for residents.





## Example Streetscapes with Minimal Vegetation



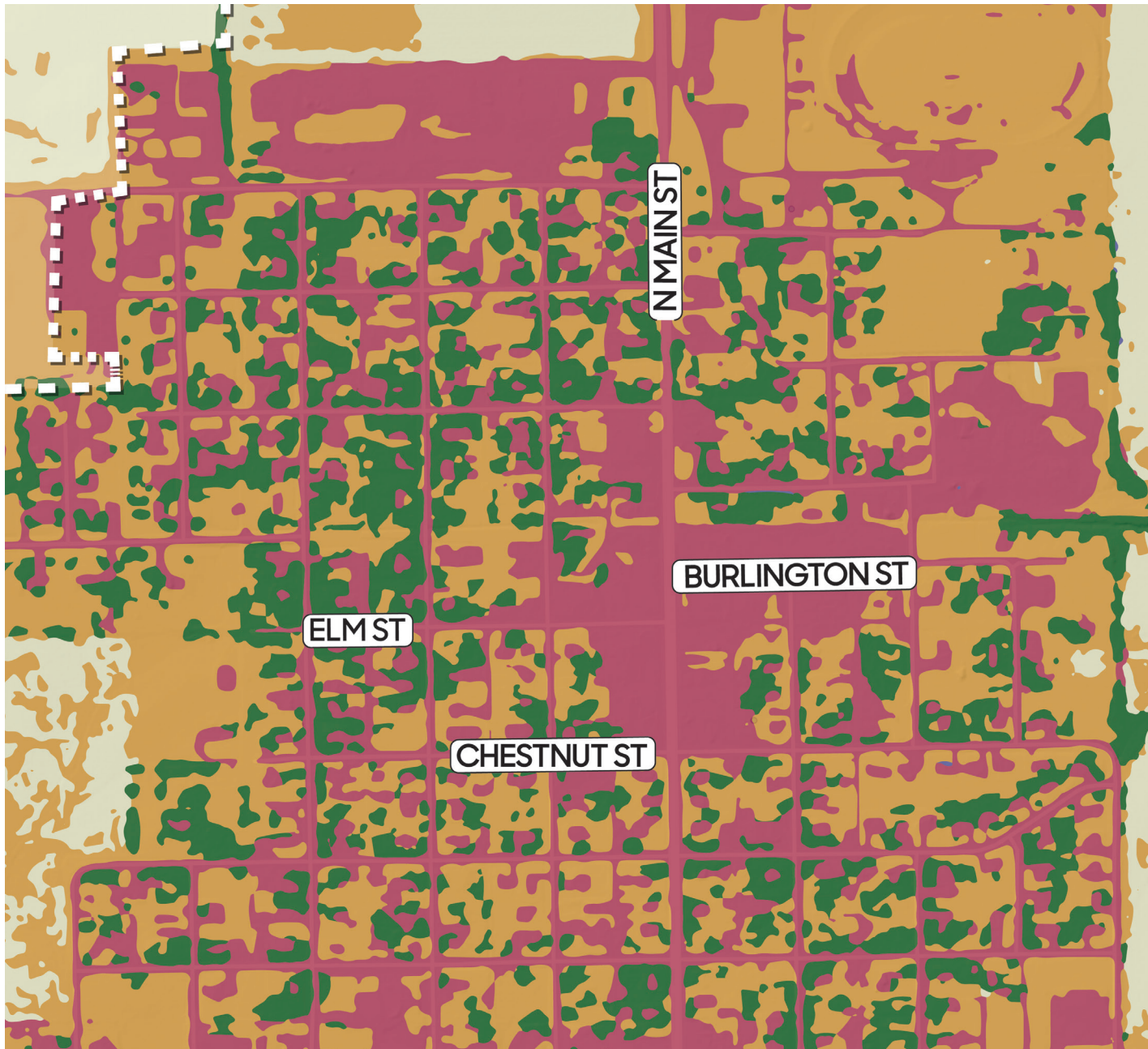
Lack of street trees creates uncomfortable spaces that feel unwelcoming and exposed to the elements.

## Example of Vegetated Streetscapes



Street trees, shrubs, and planters along a roadway offer shade and protection from the elements, while also enhancing the experience of the street.

# Vegetation Benefits



Land Use Map of Donnellson, IA

Downtown Donnellson is dominated by impervious surfaces and lacks tree canopy. Moving into the residential areas, the impervious surfaces decline, but tree cover is still fairly sparse.

Looking at the heart of your community, does your downtown core have trees?

How does this change as you move from the downtown into residential areas of town?

Reflecting on your own experiences, where do you feel most comfortable on a hot summer day?

How do you think visitors see this space?

## Legend

 City Limits

## Land Cover

-  Water
-  Agriculture
-  Grass
-  Tree Canopy
-  Impervious



*Aerial photograph of Donnellson, IA  
Downtown is exposed, with no tree cover and wide open streets, because Main Street used to be the main highway. Tree cover does increase away from the downtown core, but it still limited in many residential blocks, especially to the southwest.*

Next time you are out in town, note what it feels like to be in areas where there are more trees and vegetated areas.

How does it feel to be in areas mostly dominated by impervious surfaces with minimal vegetation?

Do you notice a difference in how many people pause or gather in those spaces?

# Surface Water Conditions

A watershed is an area defined by elevated boundaries that separate water flowing toward different rivers and creeks. These basins show the extent of a drainage area flowing to a single outlet point.

Where a community is located within its watershed(s) determines how much water flows into or through it. Location also influences the town's capacity to manage flooding issues. For example, a community located near the end of a watershed (close to the outlet point) will have little capacity for reducing the amount of water draining toward it from upland areas, and will receive greater volumes of water during flooding seasons than other communities located higher in the same watershed.

Development of channelized waterways, drainage tiles, and impervious surfaces also leads to increased quantities and speed of the water headed downstream; while a community located near the top of its watershed may not experience flooding, managing water will have a greater effect on neighboring communities downstream.

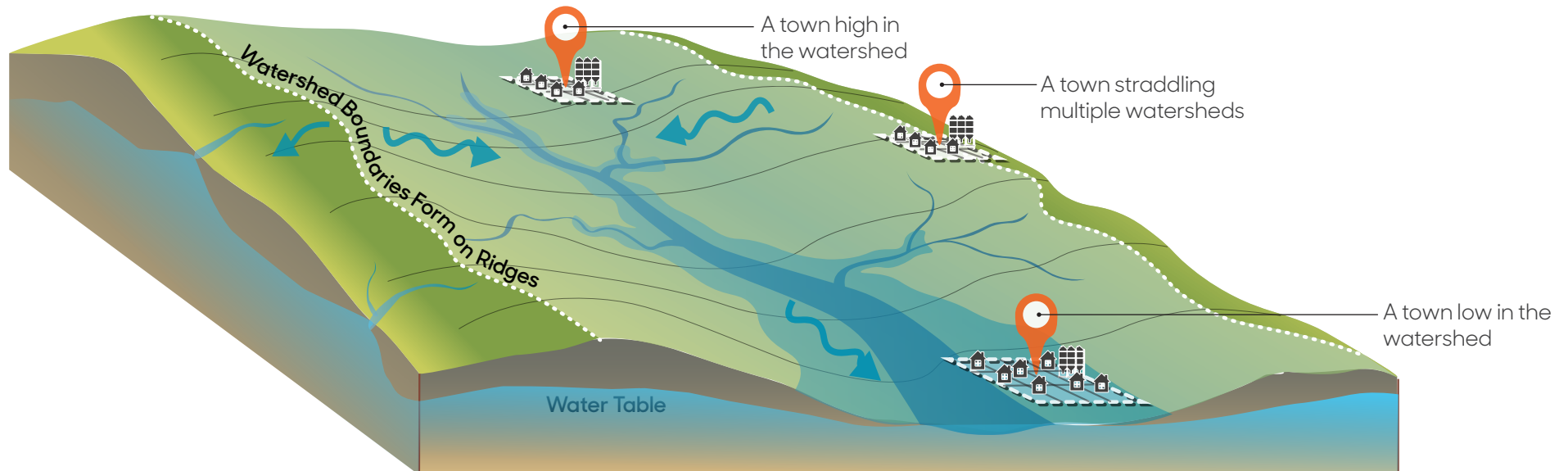
The map on the following page highlights your community within its surrounding watershed(s).

Where is your community located within the watershed(s)? Is water flowing to your community or away from it?

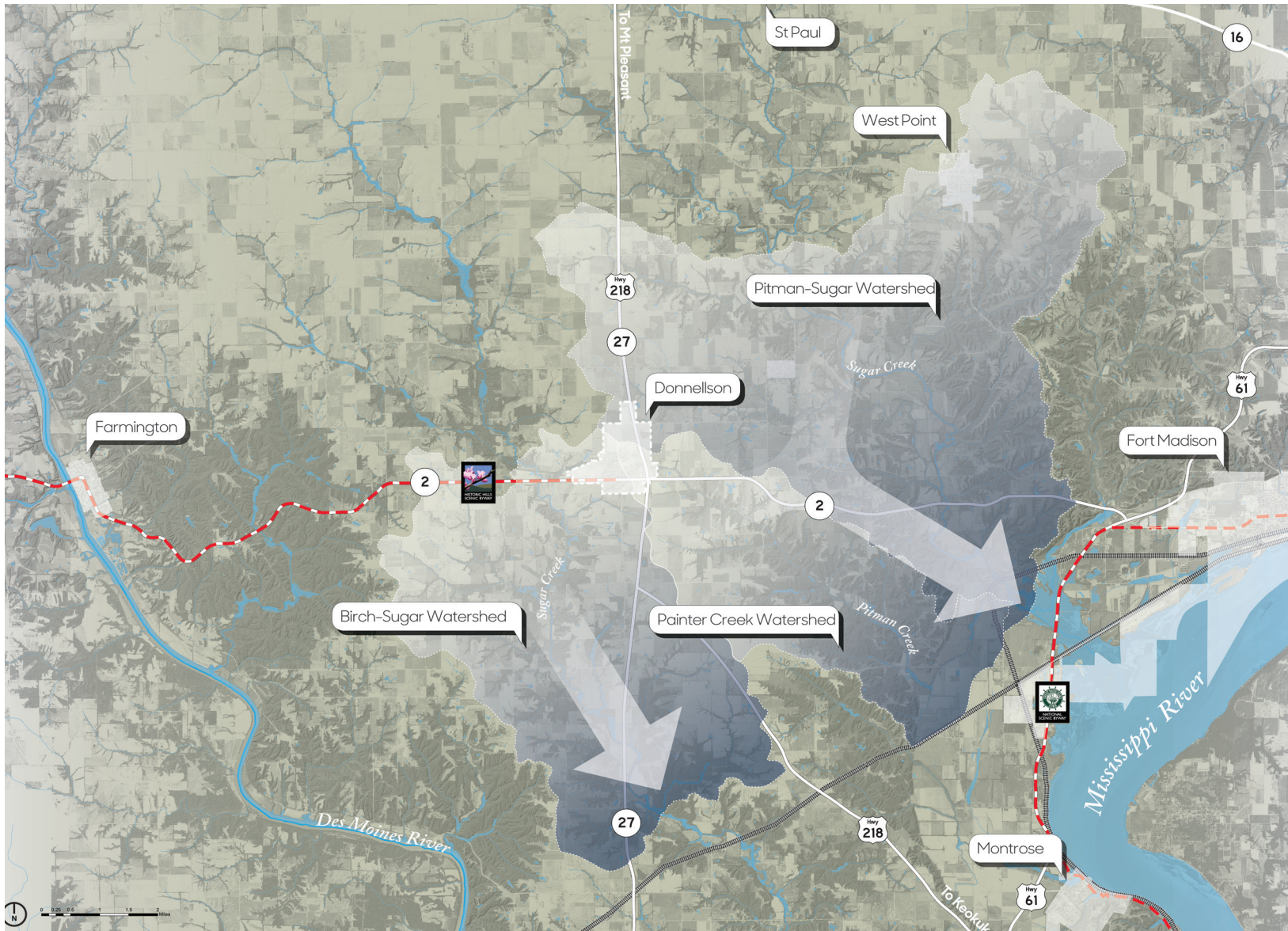
Is flooding an issue in your community?









How big is the watershed above your town? What conditions might increase or reduce flooding?

Are there conditions or practices happening in your community that could be creating risk for communities downstream from you?



*Axonometric diagram of the physical characteristics of a watershed.*



- ### Legend
-  River
  -  Railroad
  -  Scenic Byway
  -  Highway
  -  City Limits
  -  Water
  -  Watershed
  -  Watershed Flow

Watershed map of Donnellson, IA  
 Donnellson is situated near the top of three watersheds: Birch-Sugar, Pitman-Sugar, and Painter Creek. This location poses a low risk for flooding, because no water routes flow into town.

# Surface Water Conditions

The elevation and flow map displays differences in elevation. A combination of contour lines and the color gradient depicted in the legend show which areas are highest and which are lowest in the landscape.

If your community lies within or near a floodplain or floodway, the map on the following page reflects these features. Not all communities will have all of these elements; if they are absent on this map, none are present.

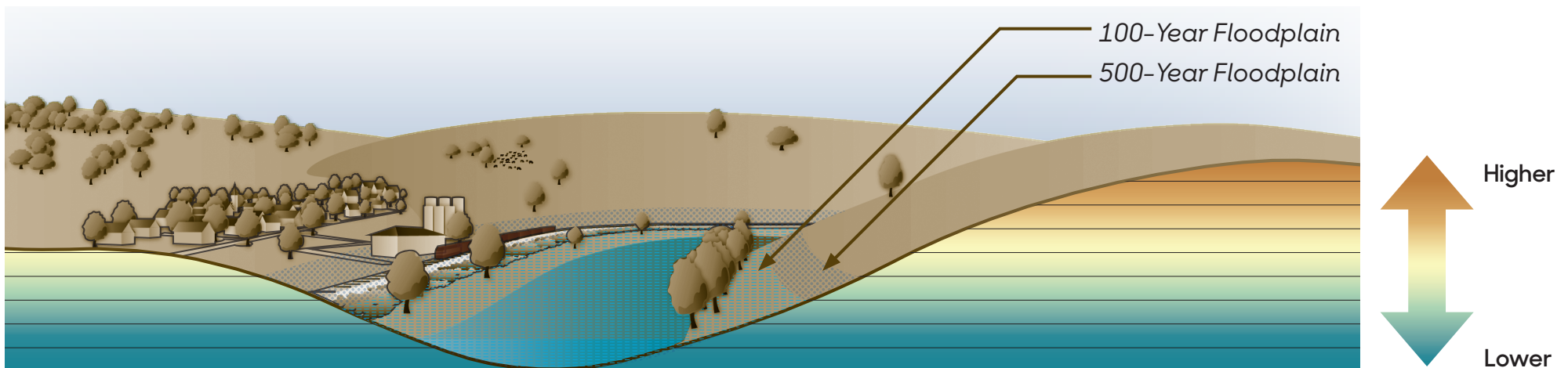
Flood risk is correlated to low-lying land. The map on the following page shows your community's 100- and 500-year flood risk as defined by the Federal Emergency Management Agency (FEMA) Flood Map Service Center. A floodway may also be shown, which signifies the greatest flow during a flood and is a zone that cannot be developed.

Note the position of your community in this landscape: is it located in a valley, on high ground, or between the two?

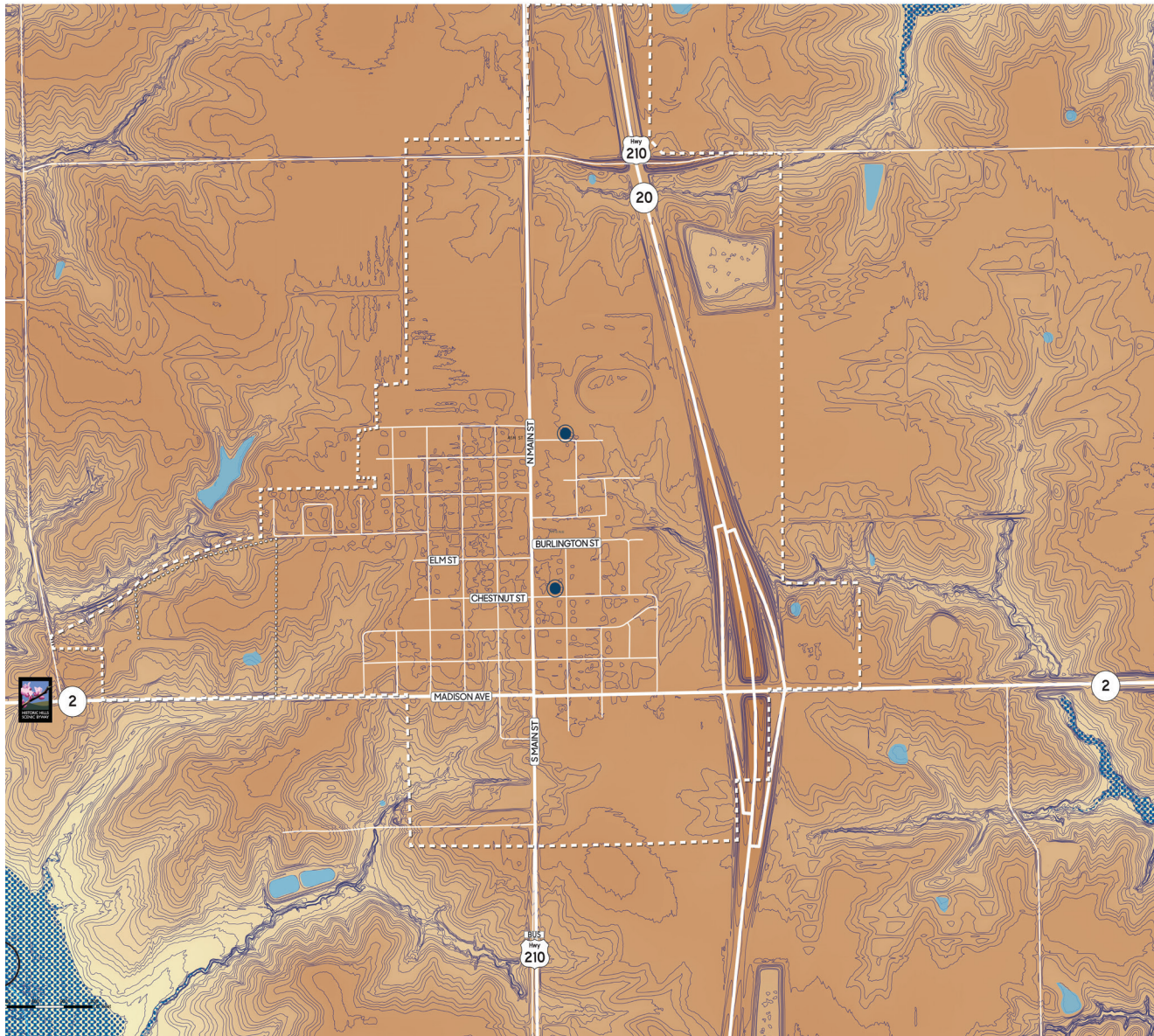
What parts of the community are in the floodplain or are at risk of flooding?

Why do you think these areas have developed in this location?

As the town grew historically, at what elevation did development happen? Has this changed over time?



Sectional diagram depicting the scale of elevation in relation to topographic features and development patterns.



### Legend

- ○ ○ ○ ○ Trail
- River
- City Limits
- Road
- Water
- 2ft Contours
- 100 -Year Flood
- 500 -Year Flood
- Flood Way
- Water Well
- Higher Elevation  
↓  
Lower Elevation

#### *Elevation and flow map of Donnellson, IA*

*Because Donnellson is located on a higher elevation, away from surrounding rivers and streams, there is no flood risk to the community. The topography in and around Donnellson changes little, especially to the east. These flat landscapes would have made it easy for the railroad and highways to develop through this region.*

# Settlement Patterns



1930s Aerial map of Donnellson, IA

In 1930, the core of the town was already well developed. The yellow building footprints show the current structures that have developed since the 1930s.

In the late 19th and early the 20th centuries, transportation corridors through the area spurred Donnellson's growth. The Burlington and Southwestern Railroad and Highway 218 brought people and goods and services into town. By the 1930s, the community was well established. In its early history, Donnellson was serviced by Highways 2 and 218. However, in the early 2000s Highway 218 was rerouted to bypass east of town, removing some of the high-trafficked routes through the community.

Although bypasses decrease traffic congestion and speeds in town, they also reduce the number of people who visit and contribute to the economies of our rural towns. Over the last century, most of Donnellson's residential growth happened to the northwest and east of town. Some commercial offerings have popped up near the Highway 218 exit ramp that both serve the community and bring business into town from the highway.



