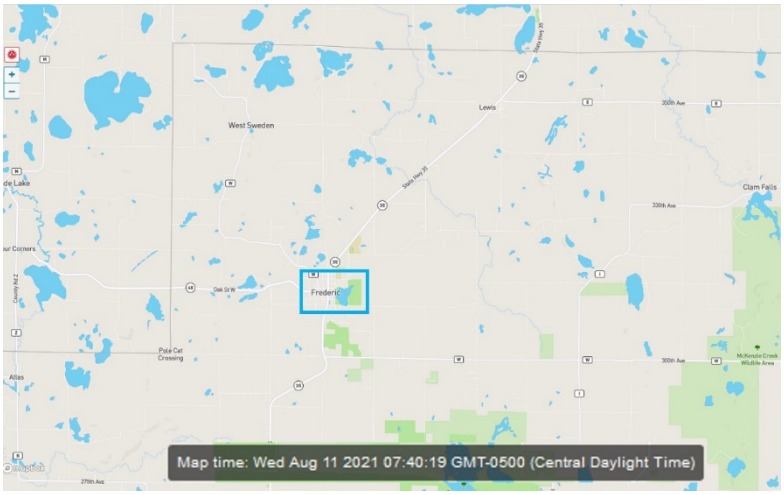
Exploring Change over Time - Alexandria, MN

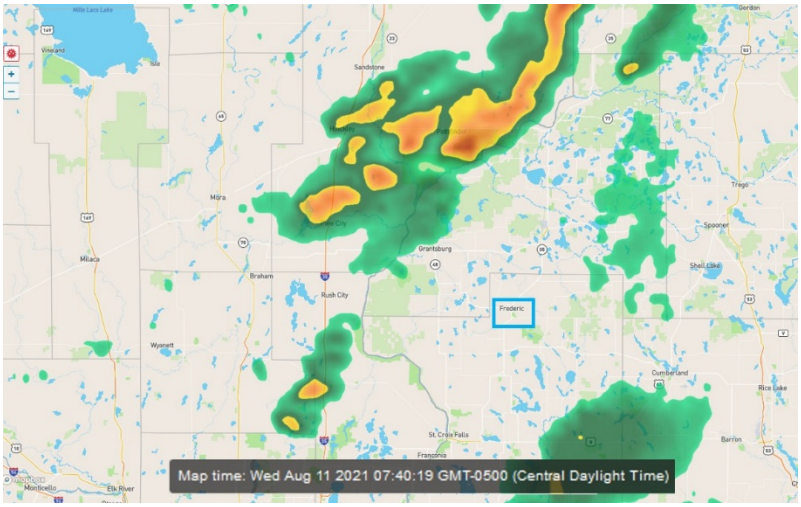
Changing the scale

Both time and scale are important for viewing and discerning change. Although we might not realize it, we apply this concept almost every day as we review the weather for our hometown. By way of illustration, let's view a series of images showing a weather radar over space and time.

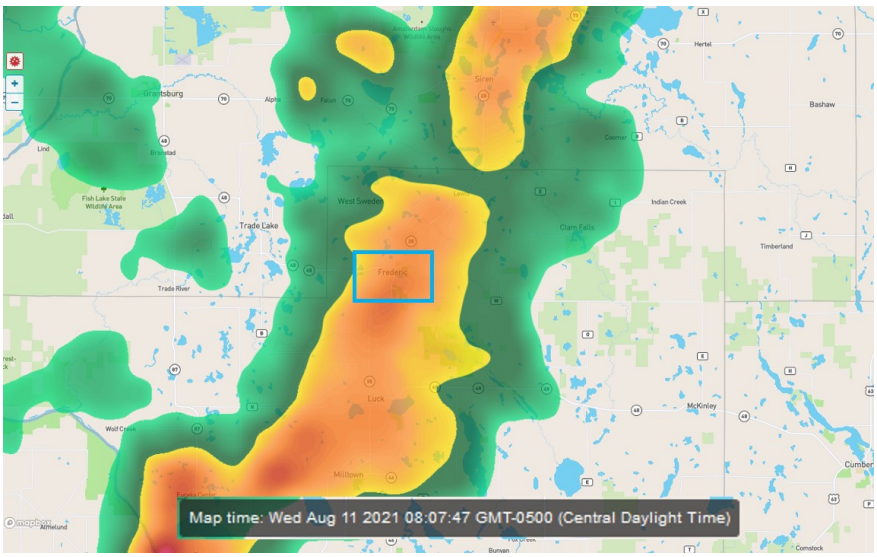
Frederick, Wisconsin and immediate area; 7:40 am, August 11th, 2021. Immediate area shows no threats on a clear morning, no worries for the drive to work.



Expanded view; also 7:40 am, August 11th, 2021. Just beyond the immediate horizon, a storm is traveling toward Fredrick. By changing the scale, now you might ask; how severe, how fast and how large is this system?



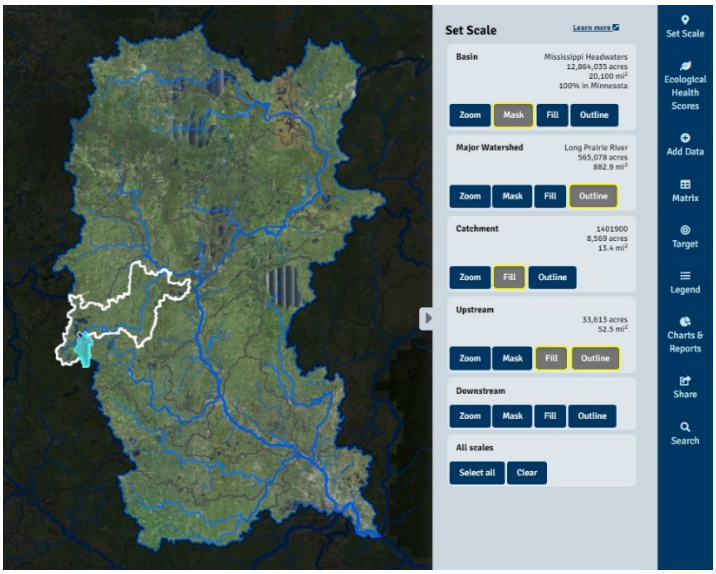
Advance time by 27 minutes to complete the story; 8:07am, Frederick is now in the middle of the orange and red swath, engulfed in a summer storm.



We are accustomed to thinking about weather this way, but how do we get better at seeing the risks to our landscapes that are brewing beyond our usual time and space horizons? What changes have already occurred? What future changes can we anticipate? What tools can help us to look, learn and prepare?

Where in the watershed are we?

Before we explore connections between land use history and watershed health, we need to know where in the watershed we are located. For this exploration, we want to know what is upstream and what is downstream of Alexandria.



Open [this map] to see the upstream area for the Alexandria area. The upstream watershed (blue fill) is within the Long Prairie Major Watershed (white outline). The major watershed is nested within the

Mississippi Headwaters basin (boundary mask) as the Long Prairie River joins the Mississippi River near Motley, Minnesota. It is important to note that this major watershed is a headwater area, a place where rivers, lakes and stream originate and flow downstream. Alexandria's 'top of the watershed' location is important for providing ecological refuge, hydrologic stability and quality water downstream.

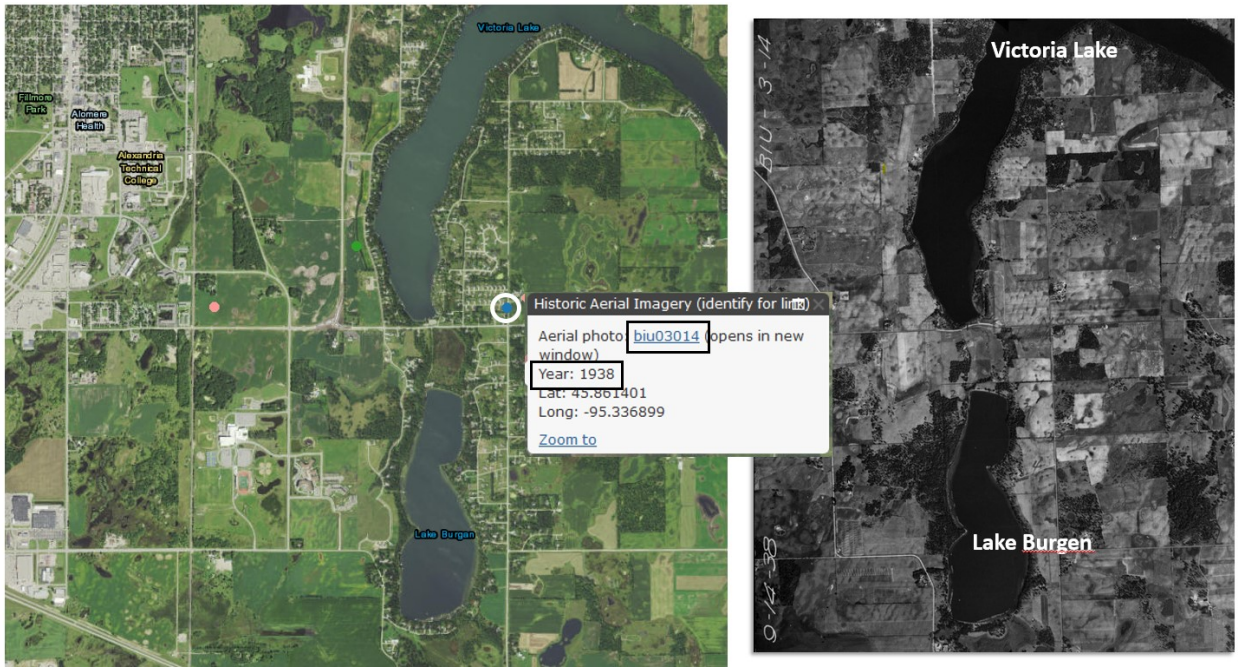
Learning from the Landscape – Looking Back

To understand changing conditions, it is important to look back and lay the foundation. It can be a challenge to envision how your landscape looked in the past. Here are some ways the WHAF can help.

- Historic Aerial Photos
- Map of Pre-settlement Vegetation
- Change in Health Scores
- Climate Summary

Historic Aerial Photos

Let's start by looking at the City of Alexandria and its surrounding area, comparing current and historic aerial photos.



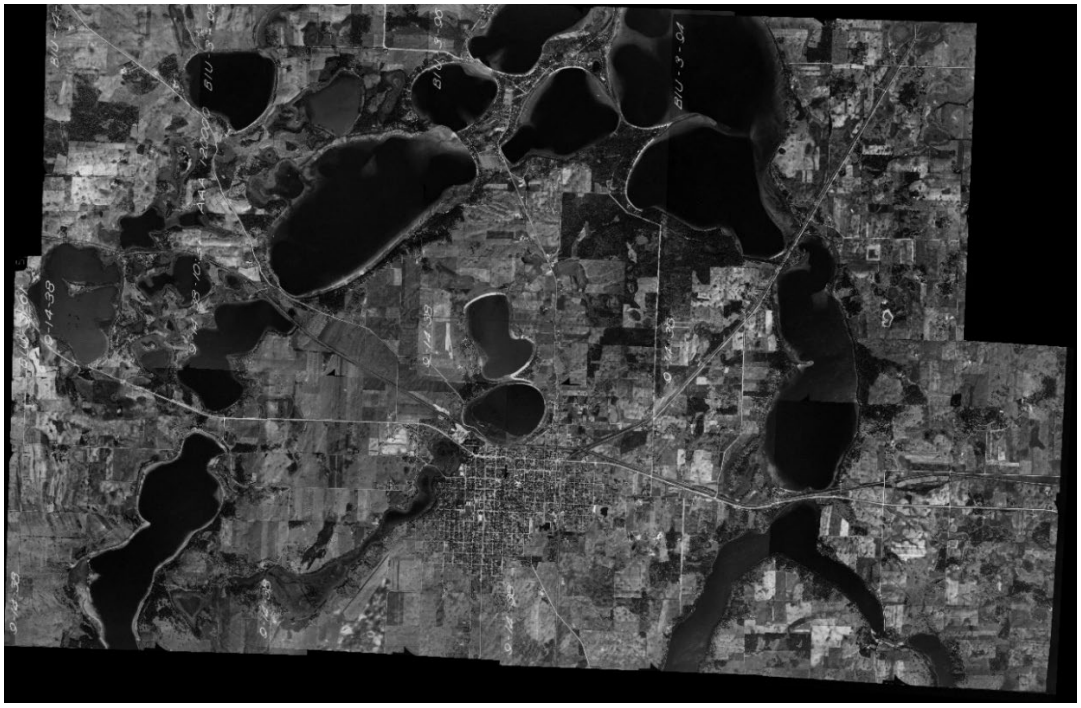
Click to open the map on the left.

1. In the Add Data Panel, click on 'Historic Aerial Images' layer name.
2. The Legend Panel provides the date range for each dot color of the aerial images.
3. Click on a 'dot' in the map to open the information box.
4. Click the link in the box to view historic aerial image.

These aerial photos cover Victoria Lake and Lake Burgen in 2017 and 1938. The images show how residential development has grown around these lakes that lie just east of the City of Alexandria.

Expand your view

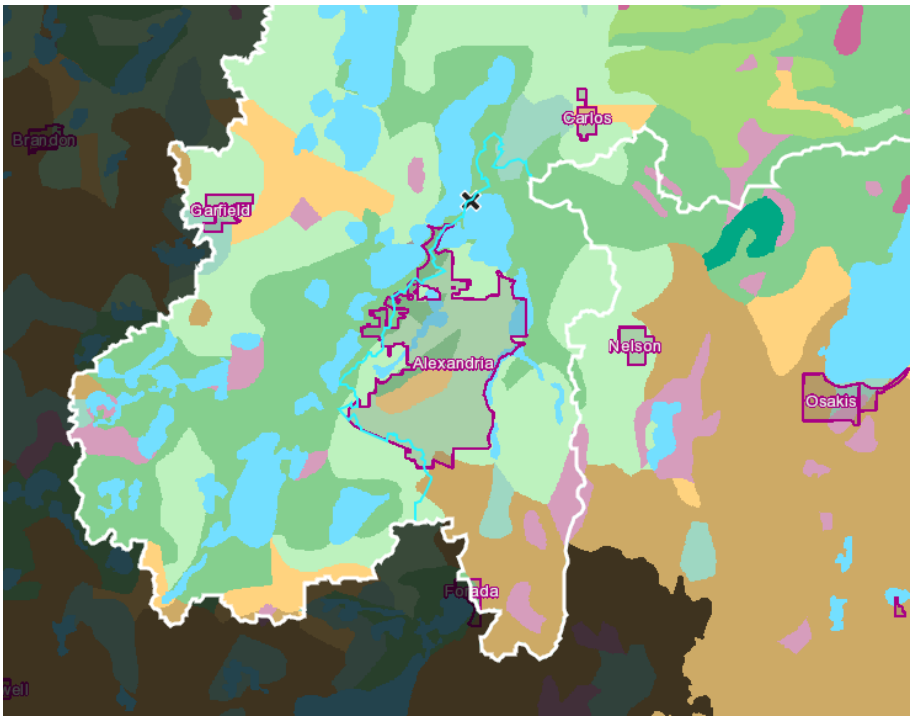
Like zooming out on the weather map, we created a composite of the 1938 images for the Alexandria area to expand our view. Compare the historic image below to the current (2017) aerial photo. Examine the change that occurred throughout this larger area over the past 80 years. City streets, housing developments, lake homes, docks, interstate highways and airports have all been added within this timeframe.



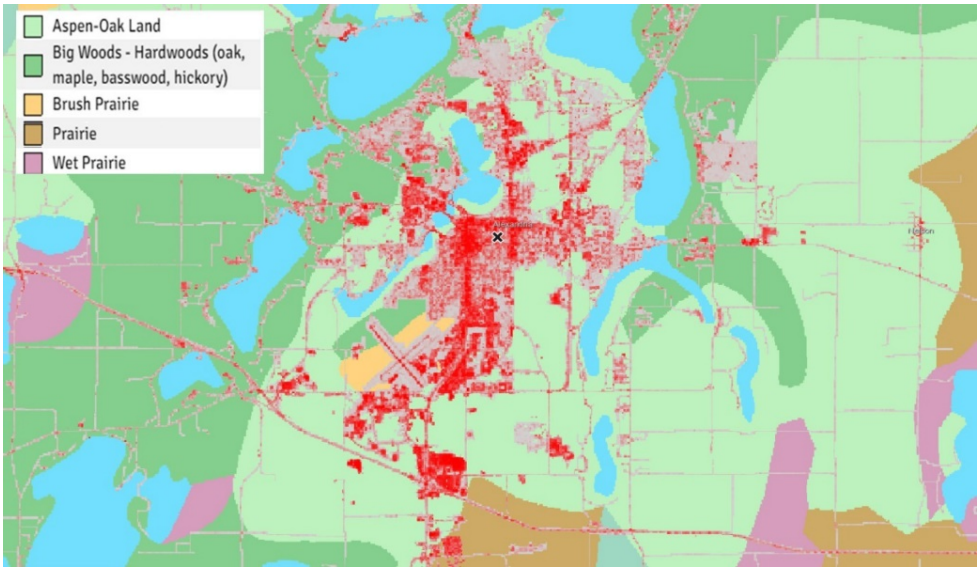
Historic Land Cover

To understand what the landscape was like before any of these changes occurred, we can travel back to the 1890's. By adding the Presettlement Vegetation data layer in the WHAF, we can look back at what the vegetation looked like prior to European settlement of this area.

Alexandria lies at the headwaters to the Long Prairie watershed. The lakes and streams here flow downstream to form the Long Prairie River and eventually join the Mississippi River. In the 1890's, land surveyors noted that this area was comprised mostly of Big Woods – Hardwoods, Aspen-Oak Land, some Conifer Bogs and Swamps, Brush Prairie, and Prairie; with a high density of lakes. In fact, settlement in Alexandria was primarily on the Aspen-Oak lands found nestled between lakes.

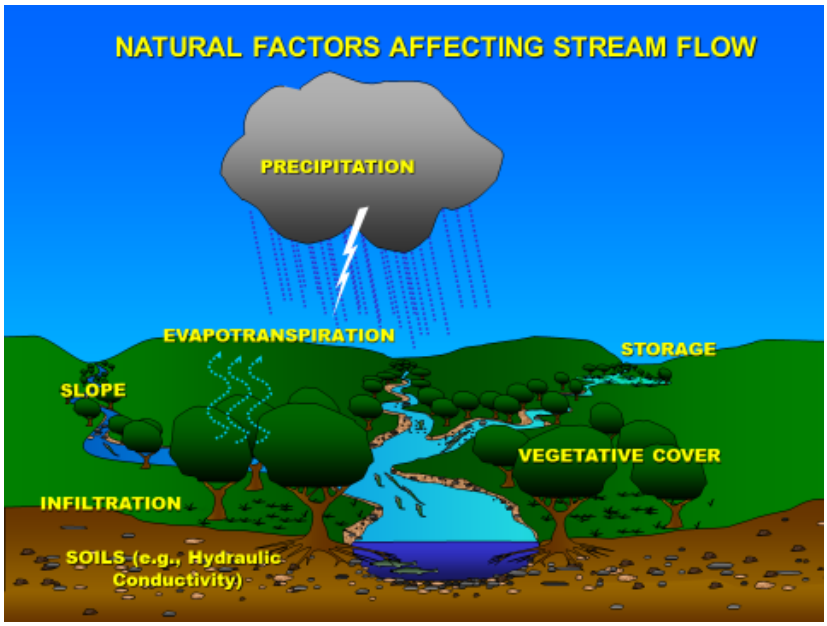


WHAF map shows the Alexandria area city boundaries displayed over presettlement vegetation. This important perspective signals how modern land use relates to the complex of historic ecological systems. Forests, bogs and prairie are now city streets, houses and cropland. These new surfaces change the way water replenishes to lakes, streams and groundwater, moving more quickly and often carrying contaminants.



By adding today's roads and impervious surfaces on top of the pre-settlement vegetative cover, we can confirm that most modern development converted Aspen-Oak lands into the community of Alexandria. Also much of the land adjacent to area lakes was Big Woods; a unique cover type combining several of hardwood tree species.

Keep in Mind...



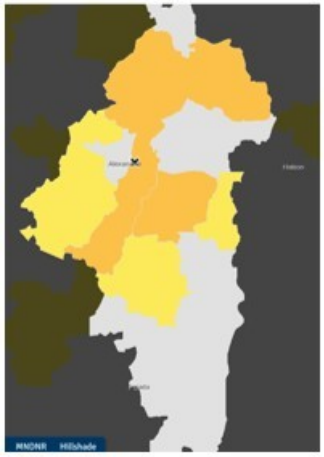
While precipitation is the ultimate determinant of the amount of water that enters a stream, a number of geologic, climatic, and biological characteristics determine the rate and path of runoff. These factors are generally thought of as intrinsic watershed characteristics, but they are all factors which are affected by human intervention. The shift in the Alexandria area away from native vegetation created a responding shift in stream flow by altering the components of the hydrologic cycle.

Change in Health Scores

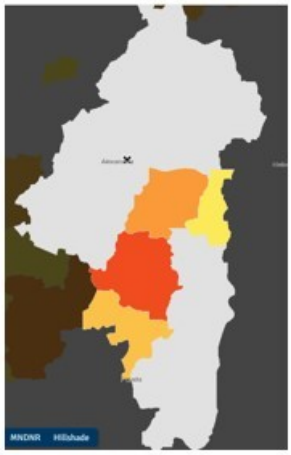
Another way to view recent changes to the landscape is to look at how health scores have changed over time. By using a consistent index calculation, we can quantify an objective view of some aspects of change over time.

- Change in Perennial Cover (2001-2016) - presence/absence of vegetation
  - Loss of Perennial Cover will change rates of evapotranspiration, reduce storage and increase runoff.
- Change in Impervious Cover (2001-2016) - intensity of the built environment
  - Expanding Impervious Cover will create flashier stream levels, reduce infiltration and deliver more contaminants to our streams and rivers.
- Change in Water Withdrawal (1990-2019) - areas stressed by water use
  - Increasing rates of Water Withdrawal can create water stress by extracting more water than is replenished. This may reduce groundwater reserves, stream flow and lake levels.

It is important to understand that changes occurring on the surface of the land trickle throughout the watershed in many different ways and on different time scales. Here are some examples of changing health scores for the area upstream of Alexandria:



Change in Perennial Cover
(From 2001 to 2016)



Change in Impervious Index
(From 2001 to 2016)

Change in Water Withdrawal
(2015-2019; compared to 1990-2019)

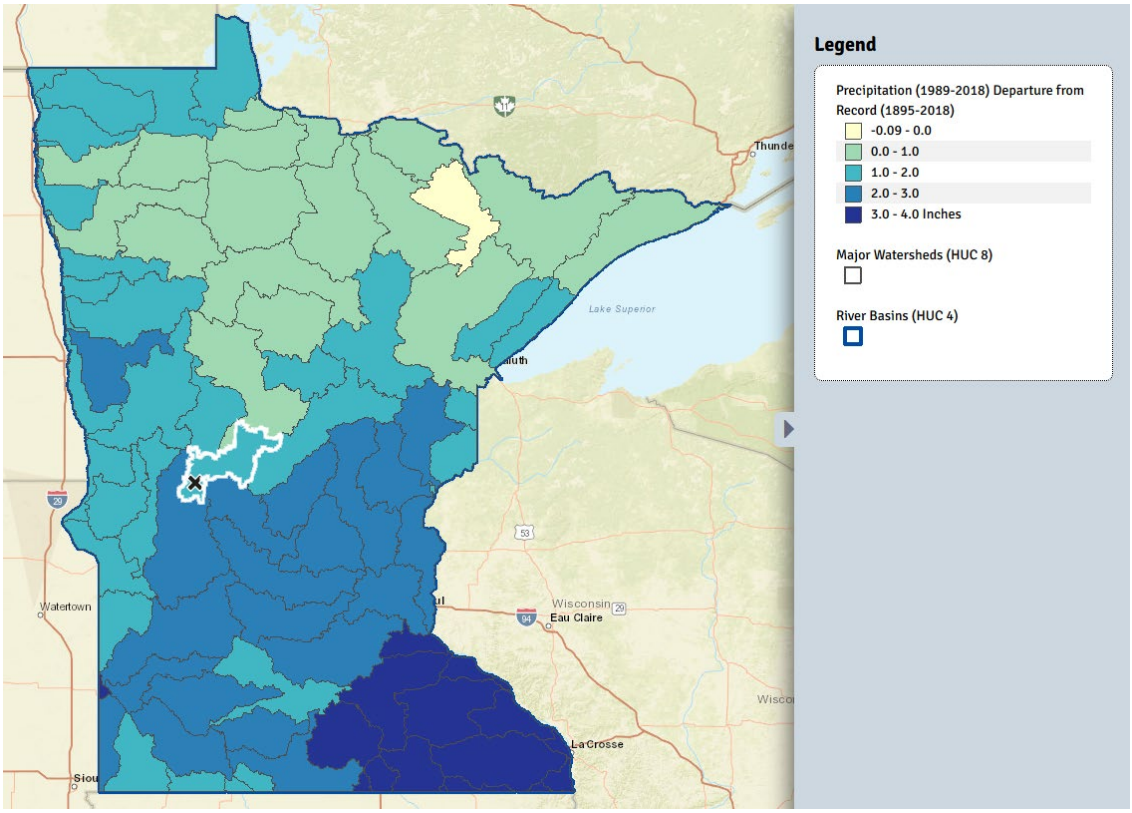
Trends influencing land cover near Alexandria

These changes in health scores indicate areas that are likely to experience some level of ecological stress and diminished function. Tracking these changes can help us decide when and where it might be necessary to change the way we use our land and water.

Changing climate

Climate must also be included as we consider the factors that are changing over time and space. With greater uncertainty in the future patterns of precipitation, temperature and extreme events, it is even more important to build systems that are resilient to fluctuating conditions. Our food, water, transportation, housing and business networks are all vulnerable to disruption from climate change. The WHAF Climate Summary: Long Prairie Major Watershed summarizes climate data (1895-2018) into a

series of maps and graphs that compare the most recent 30 years to the entire climate record. The WHAF Map also displays data layers of recent climate and climate departure from the historic record.



Conclusions

In today's world, the pace of change seems to accelerate along with the mountains of data keeping us 'informed'. All that information helps us better understand watershed health when delivered together with interpretation and historical context. In this example, our exploration followed several steps:

- Changed the spatial scale to look across watershed boundaries and place Alexandria at the headwaters of its watershed, an influential position for downstream watershed health.
- Changed the time scale to look at the pre-settlement mosaic of vegetation and water. We found that Aspen-Oak and Big Woods were converted to housing, industry and cropland. Aerial photos showed that development (from 1930's to recent) expanded on these early patterns.
- Examined recent trends with WHAF Health Scores. Changing health scores confirmed that impervious surface expanded, perennial vegetation decreased, and more water was used.
- Reviewed the historic climate record and noted that Long Prairie major watershed has shifted toward more annual precipitation and warmer temperatures, particularly in the winter.

Like many places in Minnesota, the Alexandria area has experienced intense change in the way land and water resources are used. These changes can create watersheds that are out-of-sync with the balance and rhythm of the historic system. Knowing how the landscape looked and functioned in the past is important information as we seek to implement innovative actions that rebuild a balanced, healthy system with the resilience to withstand the inevitable changes of the future.