Ecological Ranking of Parcels - Prioritizing Conservation Across the Landscape

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Research Team

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Minnesota Board of Water & Soil Resources

University of Minnesota
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Purpose of Webinar

Introduce a new tool for conservation planning on a local scale

Illustrate the capabilities of the tool

Help you decide whether to attend the technical training

Survey participants about technical training needs

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Goal of the Ecological Ranking Project

To more effectively target conservation programs to CRP lands and other critical lands such as

- Marginally productive croplands
- Surface water protection areas
- Important habitat areas

What Does This Tool Do?

Provides soil and landscape (terrain) analysis

Combines existing data with new data and economic information to aid resource managers

Provides a methodology to help guide allocation of conservation funds

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What Does This Tool Not Do?

Does not replace site-specific procedures

- USFWS Wildlife Habitat Evaluation Procedure (HAPET)
- soil loss equations
- water quality assessments

Does not replace local knowledge

Does not directly address forest resources or wetland restoration

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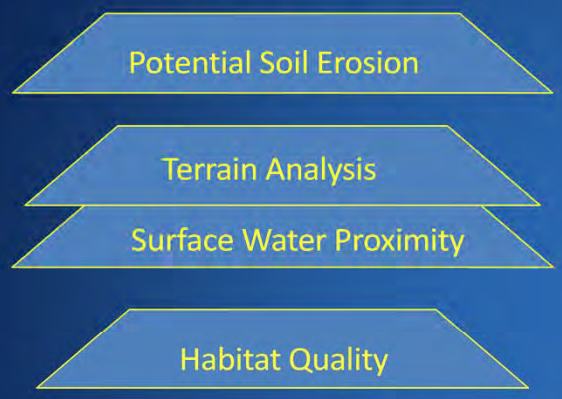
Examples of local knowledge are the location of practices or parcel boundaries

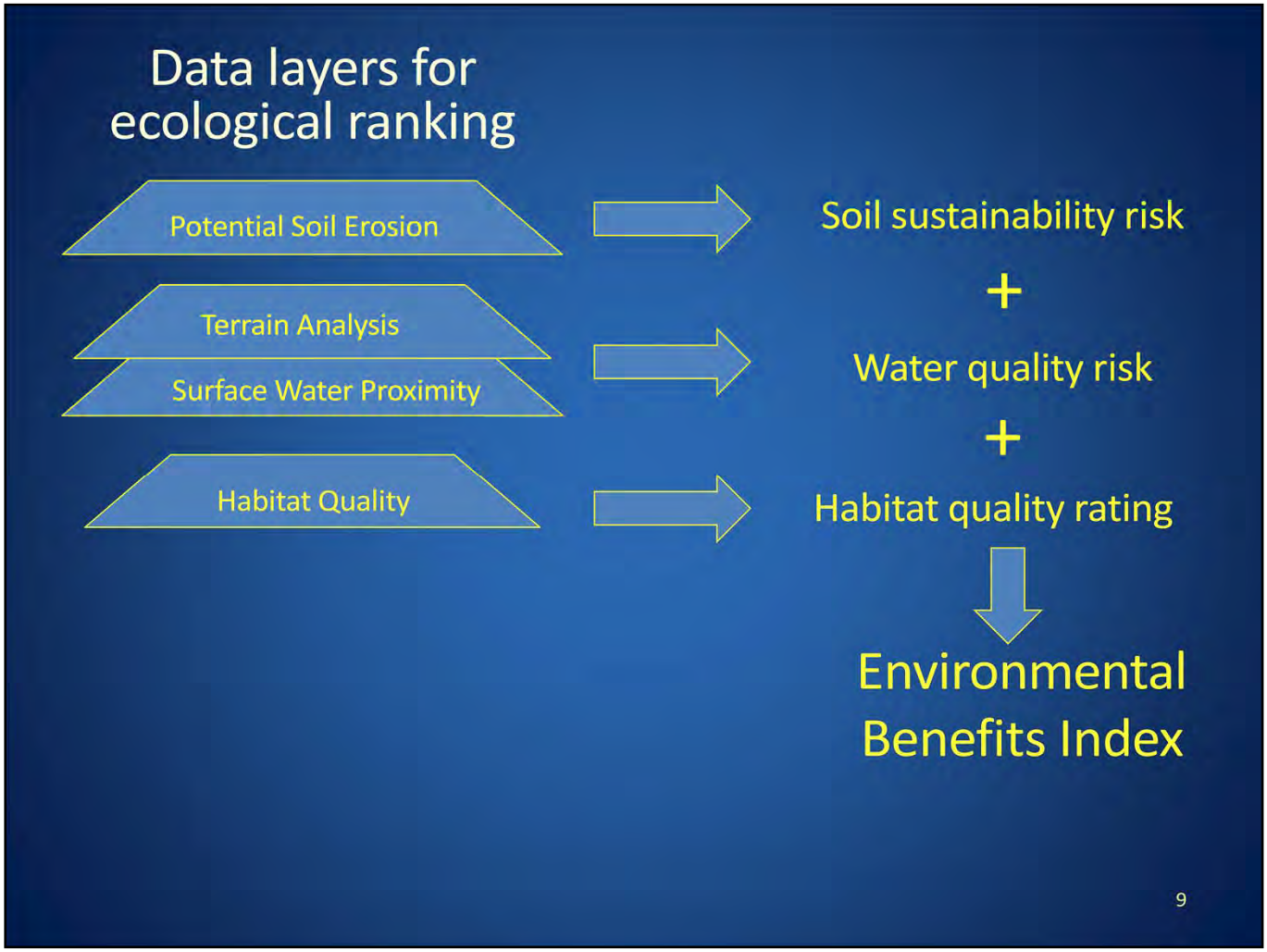
Overview of the Ecological Ranking Tool

Unique characteristics

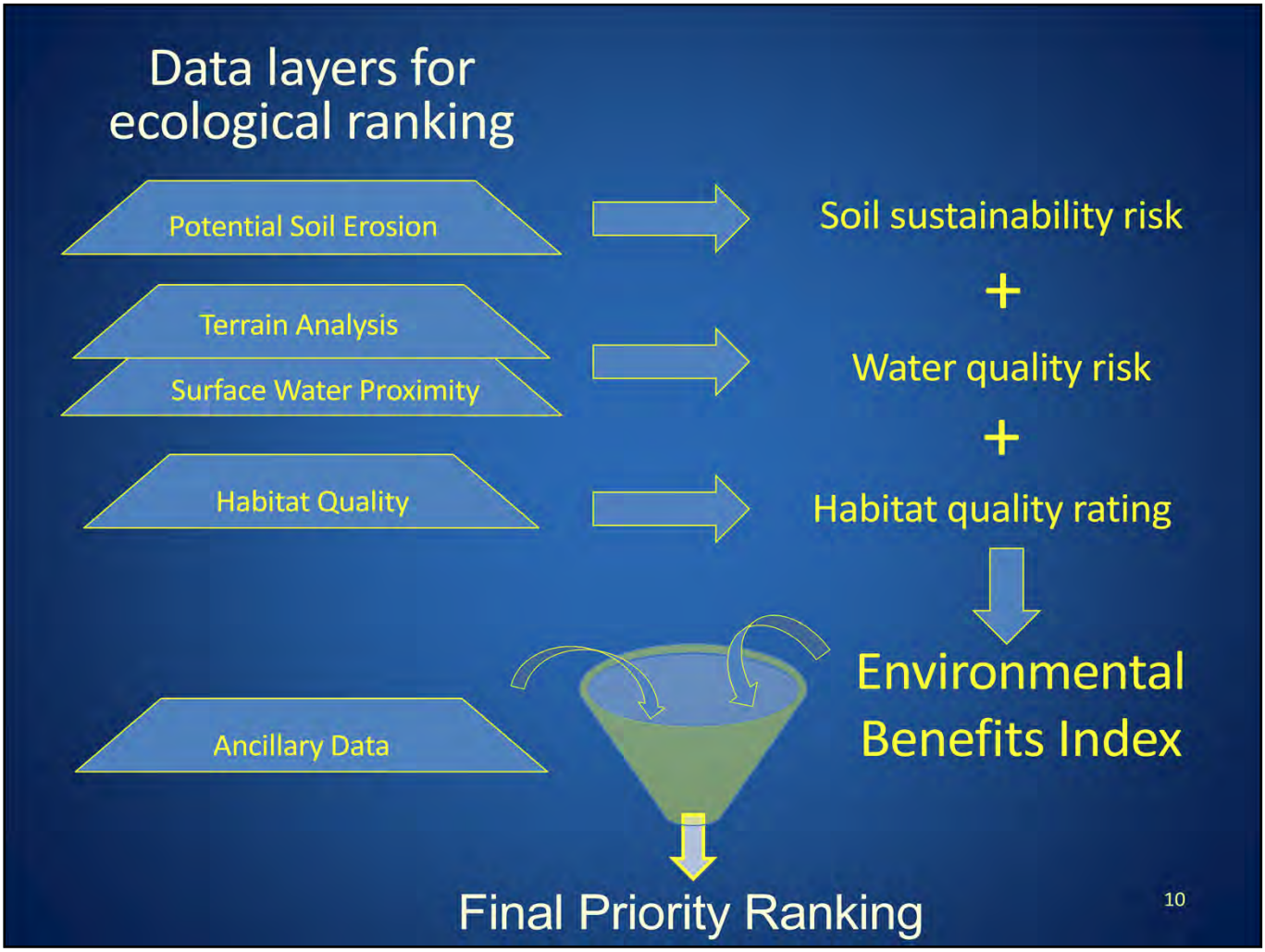
- Includes soils and landscape (terrain) analysis which are relatively new to conservation targeting efforts
  - Erosion potential
  - Soil productivity
  - Runoff potential (SPI)
- Includes economic, surface water quality, and wildlife habitat factors
- Combines these layers to address multiple conservation benefits simultaneously

Data layers for ecological ranking



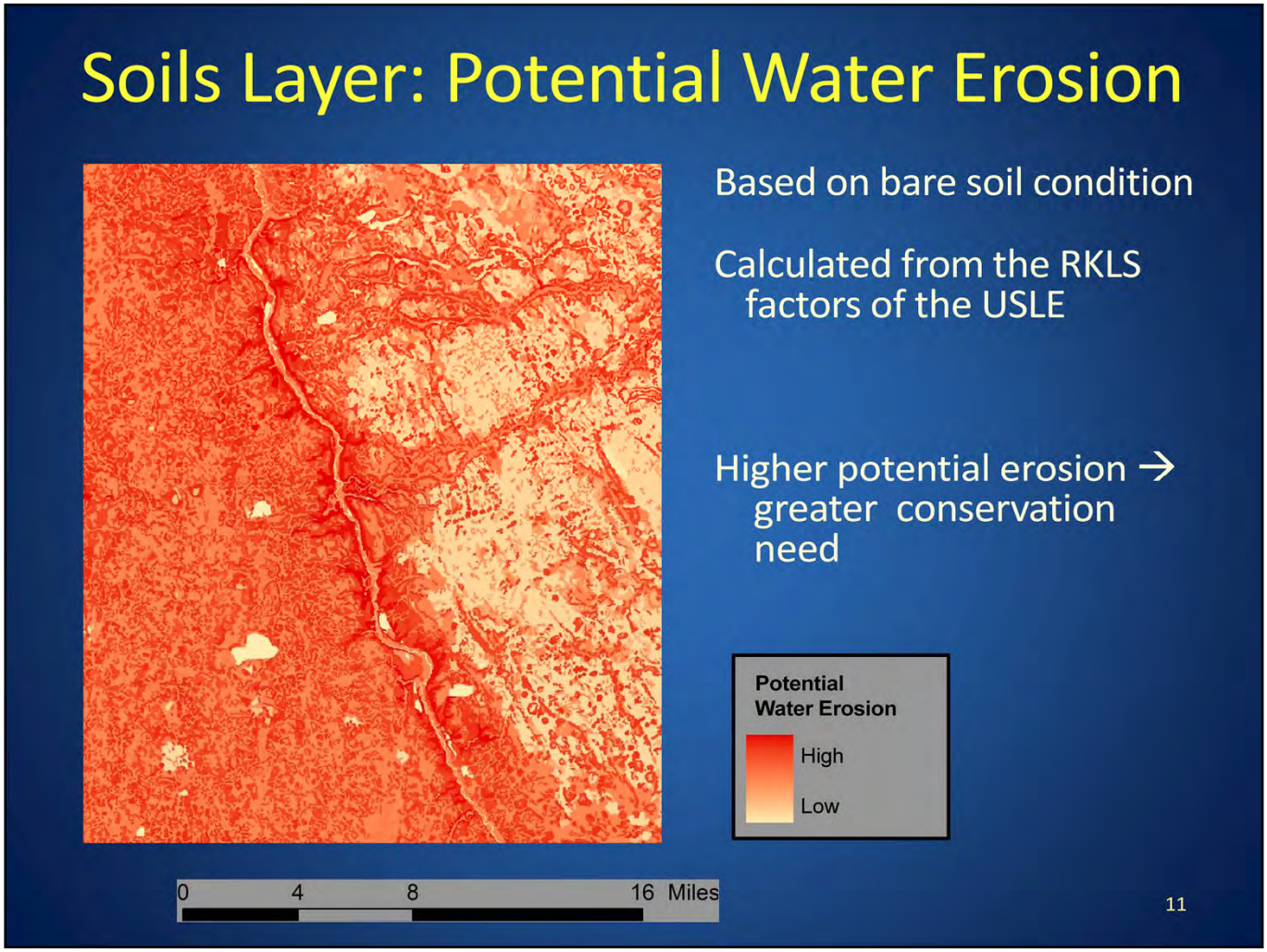


Multiple data inputs at varying scales are combined into an Environmental Benefits Index to provide a final priority ranking of land parcels.

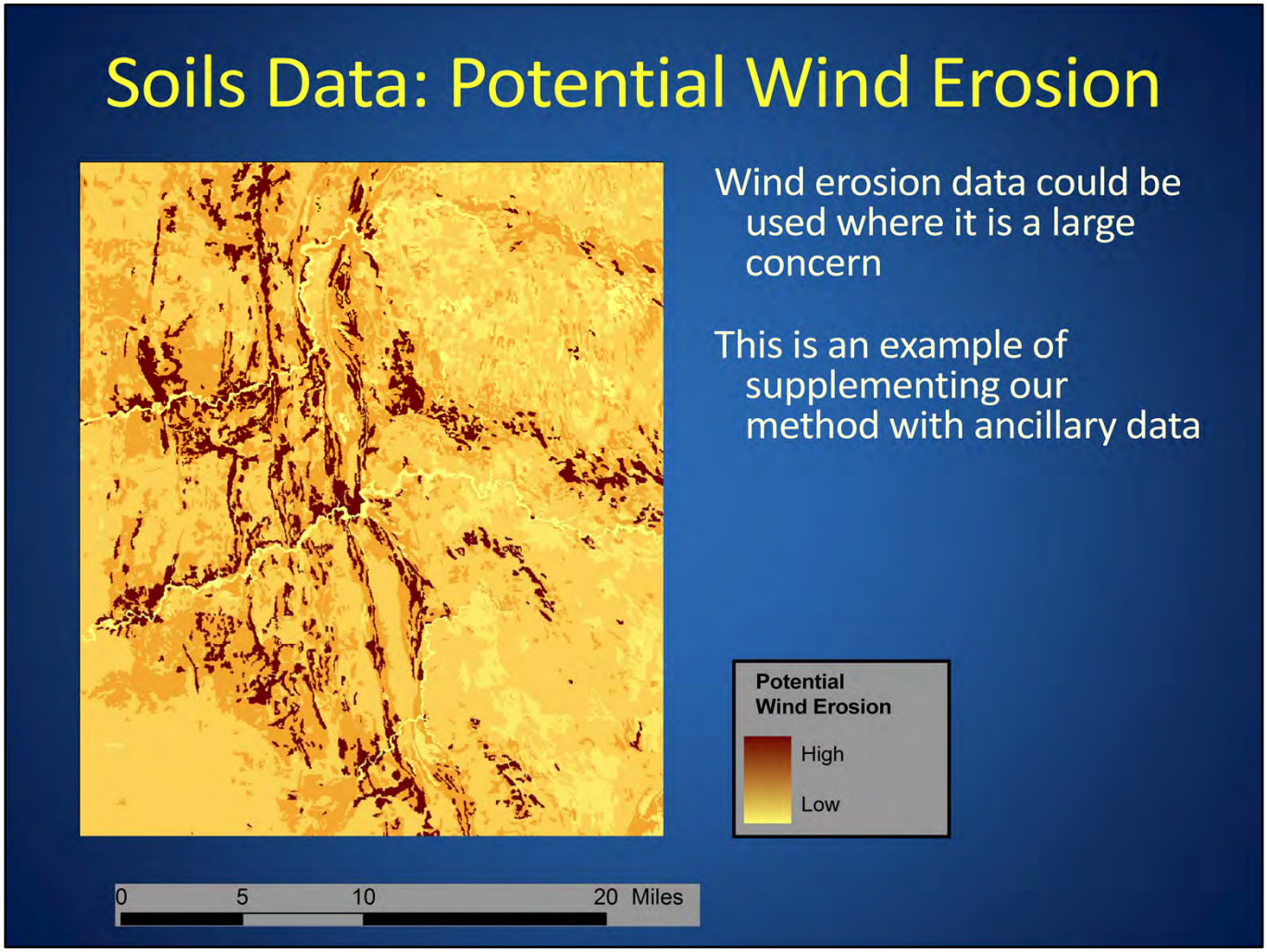


The framework provides a general guideline for ranking. Ancillary data is encouraged to be incorporated.

Examples of ancillary data are productivity, economics, other practices, and parcel boundaries.

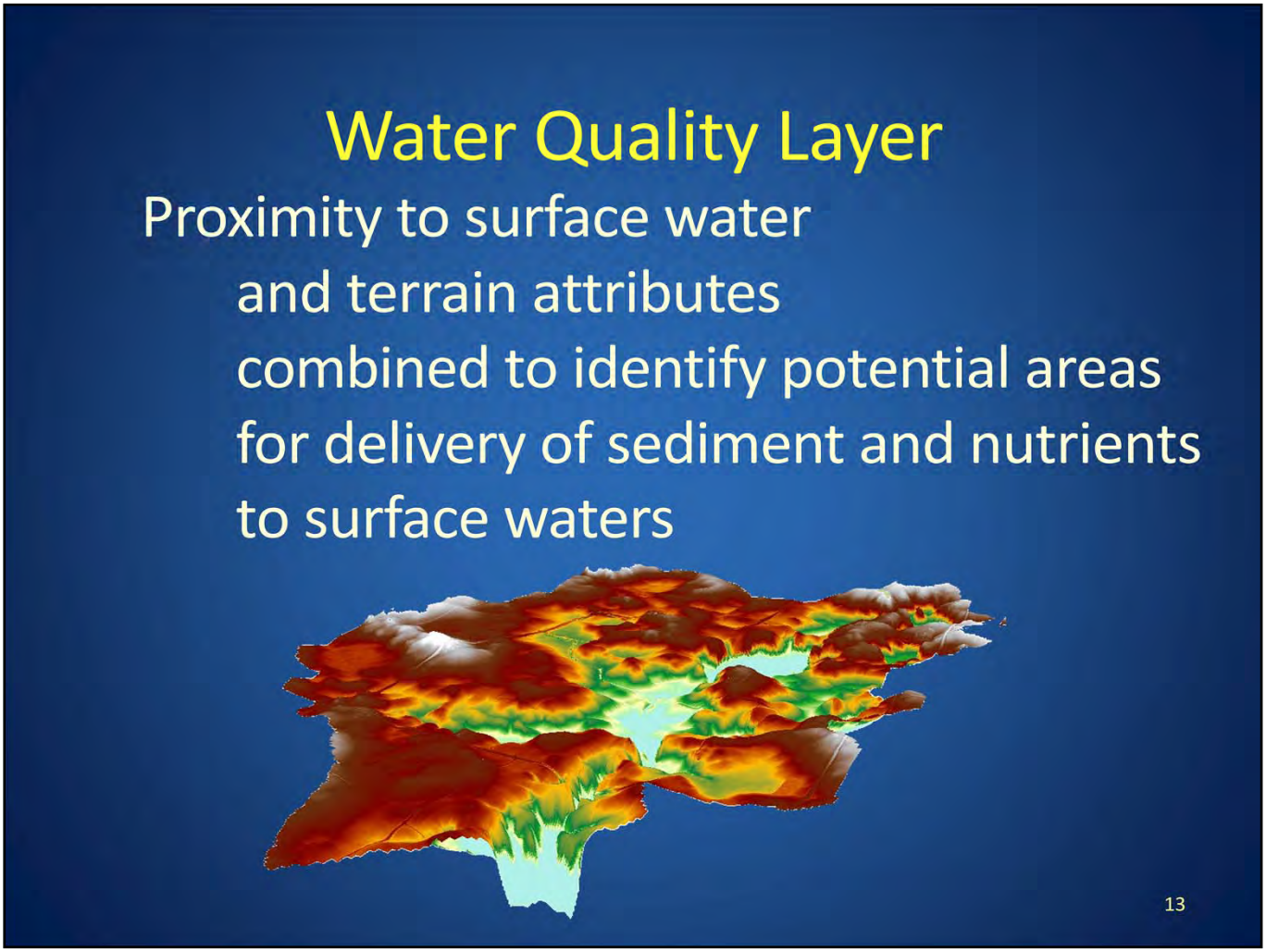


The soils layer is derived from SSURGO level soils data, and calculated with the universal soils loss equation statewide. Soils that appear darker red on the map are more susceptible to erosion.

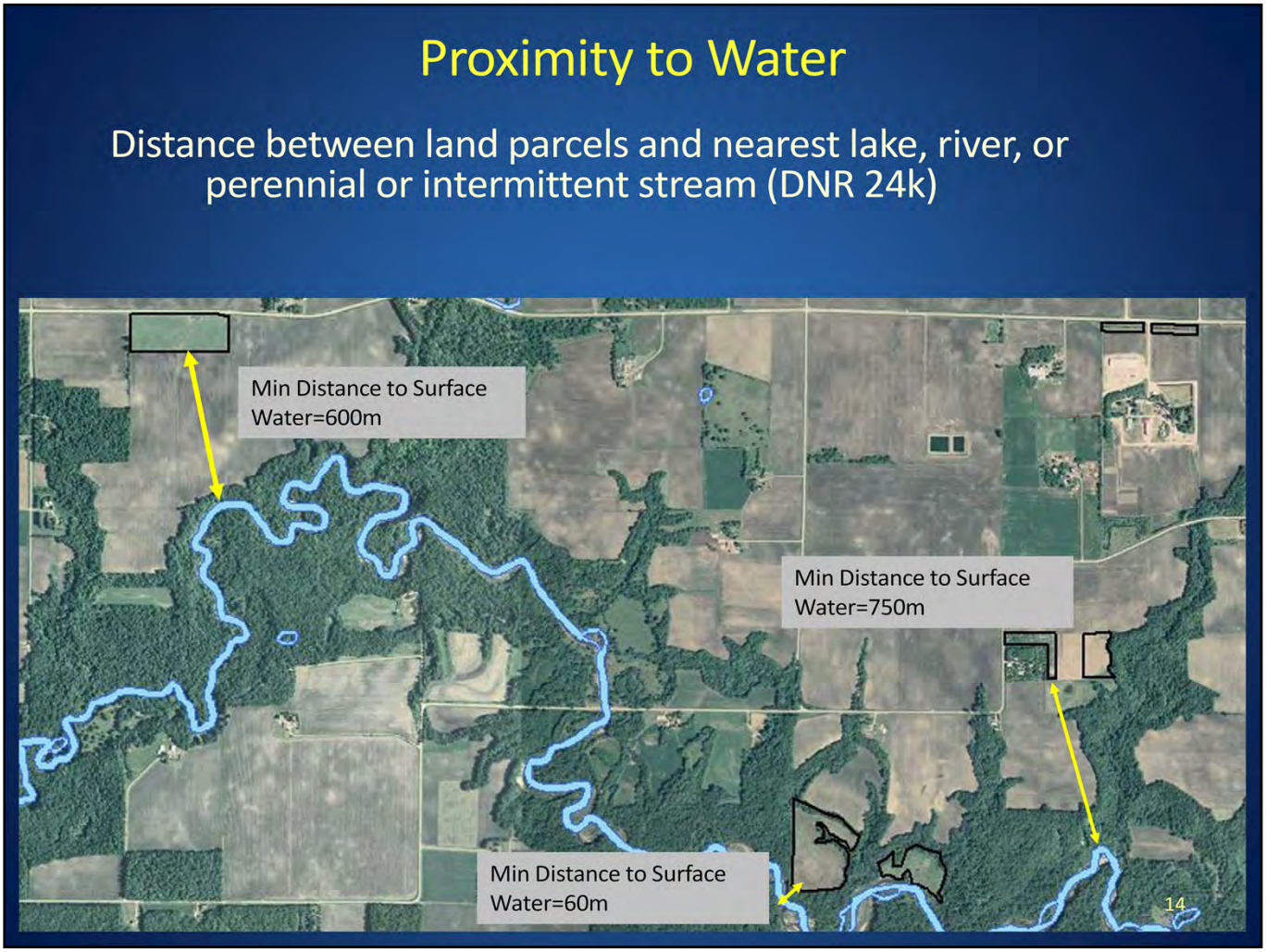


Additional wind erosion or site specific erosion data could be added where available.

Here is an example from the Red River Valley.



The Water Quality Layer helps to display where the potential for overland flow is highest, and the proximity of this flow to surface waters. Proximity to water and terrain analysis are used in calculating this layer.



Proximity to water is measured as the straightline distance from the nearest edge of the polygon of interest to the closest water feature in the DNR 24k water features layer. In this picture, the methodology is illustrated with CRP polygons.

Terrain Analysis

A quantitative, detailed, objective, repeatable process to accurately model real landscape processes

Includes the use of a DEM to analyze the landscape

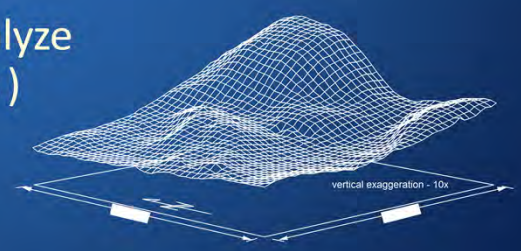
Helps to describe, analyze, and interpret topographically-related features (e.g. soils, vegetation, wildlife)

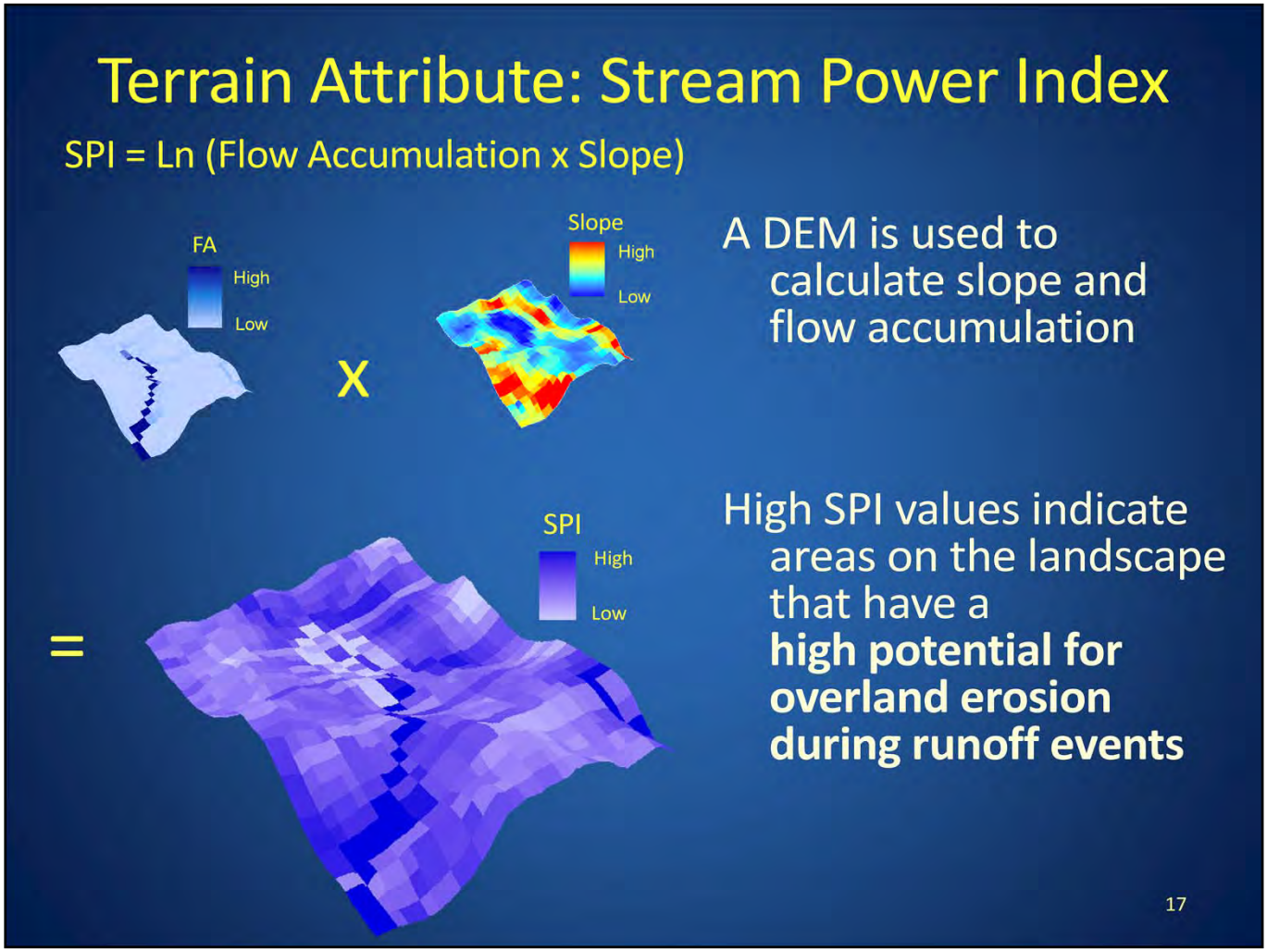
Terrain Analysis

GIS terrain analysis techniques can be used to identify points of sediment delivery from riparian areas, gullies, and side inlets using the Stream Power Index (SPI)

30m data were used in the development of this tool

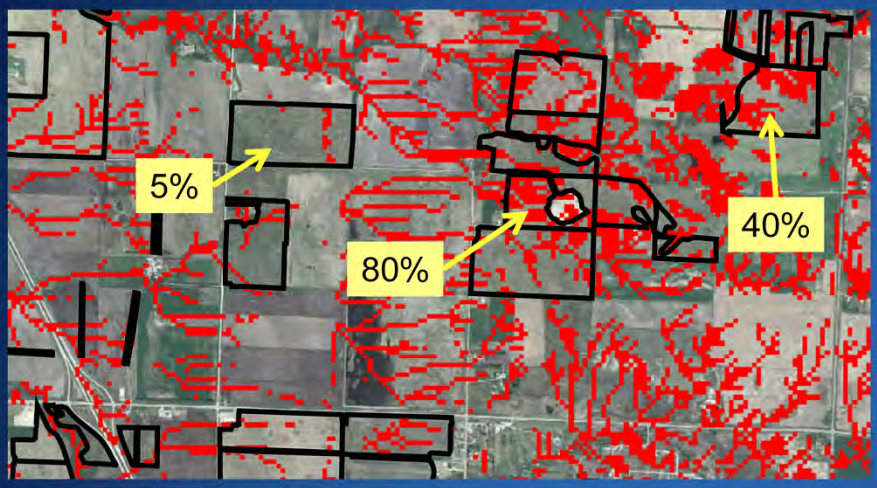
Higher resolution data could be used where available
(Upcoming research will analyze potential LiDAR applications)





Stream Power Index is a terrain attribute that measures the erosive power of flowing water. Stream Power Index is a misnomer; this index does not quantify the power of streams, but the potential for overland flow.

Stream Power Index Critical Areas



Parcel Boundary
SPI Critical Areas

High SPI areas can be identified and represent likely overland flow paths

Parcels containing a higher proportion of SPI critical areas have a higher overland erosion risk score

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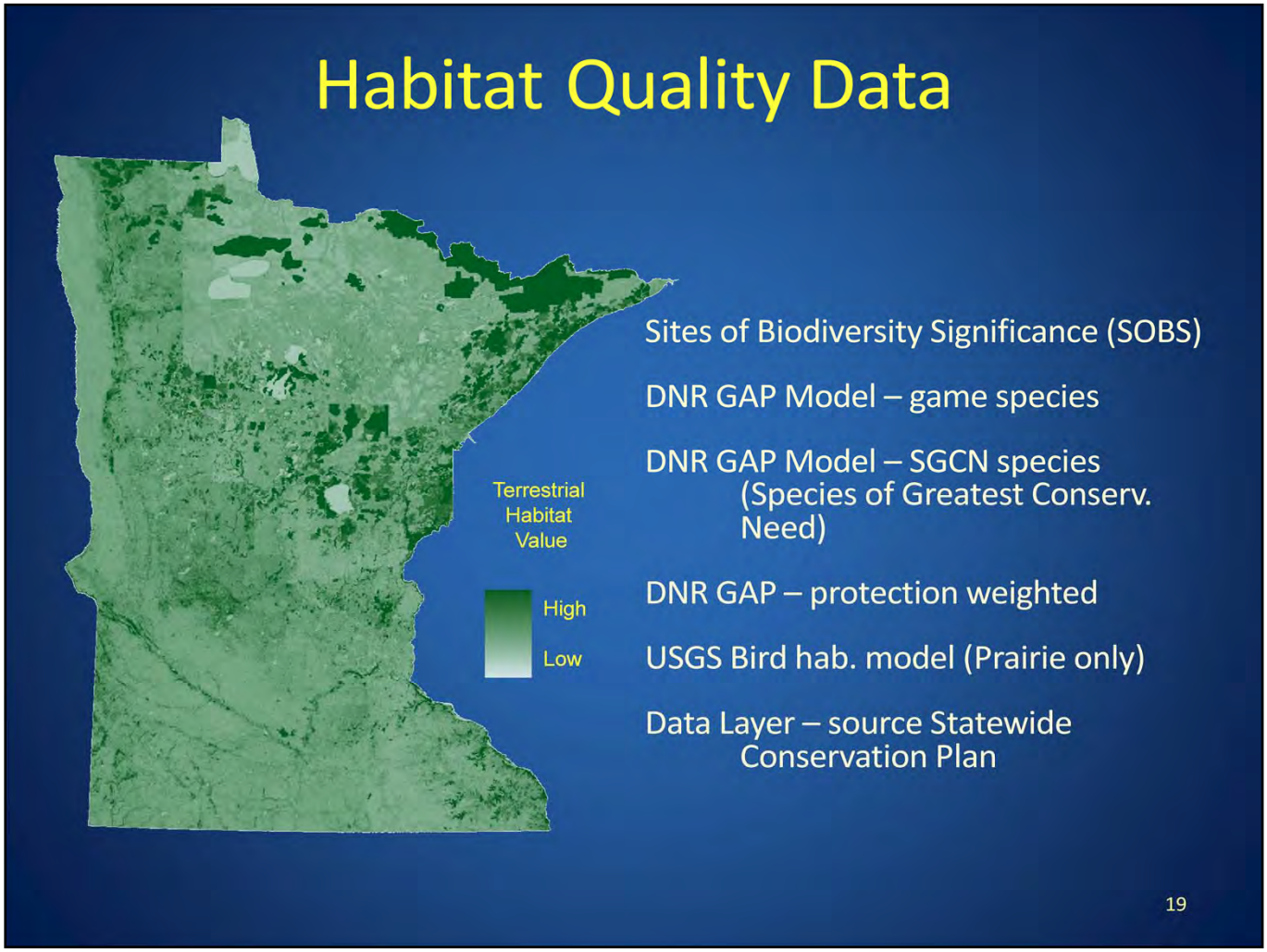
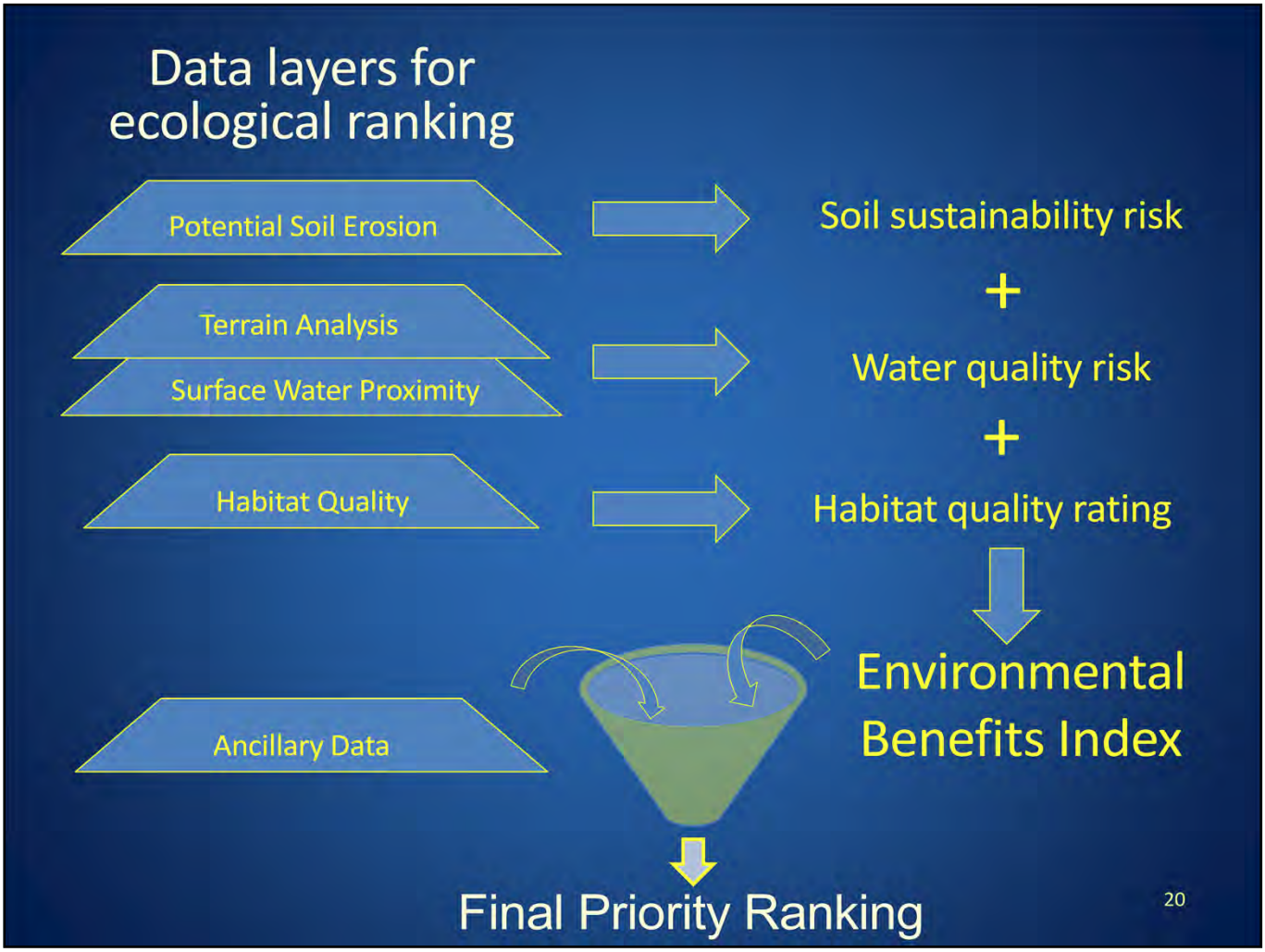


This layer identifies parcels with high value for habitat.
Habitat needs can be specie-specific. The list here is not exhaustive. The method can accommodate other habitat and specie-related data.



The previous slides introduced the data inputs that make up the priority ranking. The next set of slides show how each individual layer contributes to the final score.

Environmental Benefits Index (EBI)

Our adaptation of the EBI uses factors and weights akin to the USDA CRP EBI

Any weighting system can be accommodated depending on conservation goals

High EBI means:

- high risk (e.g. water erosion)
- high quality (e.g. habitat)
- high value for conservation

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The concept of an Environmental Benefits Index (EBI) is not a new one.
It was originally introduced to rank potential enrollment lands for CRP.

The weighting system used here is a loose guideline and other data may be used, depending on the conservation goals or specific landscape needs.

A high EBI score indicates that there is a high risk associated with this portion of the landscape OR the land is valuable for habitat.
So in other words, a high EBI score means the site is highly valued from a conservation perspective.

Environmental Benefits Index (EBI)

Calculated statewide using soil survey polygons (SSURGO) – minimum mapping unit 2-5 acres

300 potential points

- Soil Sustainability-100 pts
- Water Quality Benefits-100 pts
- Wildlife Habitat Quality/Ecosystem Value-100 pts

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This EBI ranking consists of three data layers, each scored on a scale of 0-100 points. The three main layers that contribute to the EBI score are as follows:

-Soil Sustainability
-Water Quality Benefits
-Wildlife Habitat Quality

Environmental Benefits Index (EBI)

Soil Sustainability-100 pts

- Use potential water erosion rates as an index of susceptibility to soil degradation
- Potential water erosion values are given a percentile rank to represent the 100 total points

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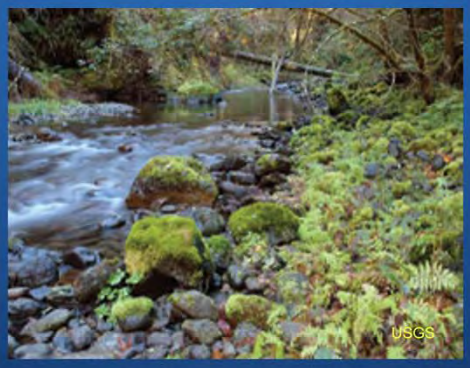
The soil sustainability layer is derived from the universal soil loss equation.
Potential erosion values were ranked statewide, the highest values receiving the highest rank, and this ranking represents the 100 possible points for this layer.

Environmental Benefits Index (EBI)

Water Quality Benefits-100 pts

- Proximity to streams and lakes based on distance rankings (50 points)
- Likelihood of sediment delivery estimated based on ranked SPI values (50 points)



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The water quality benefits layer is comprised of two data sources.
The first is the proximity to surface water.
A parcel's distance from surface waters was ranked and these rankings make up half of this layers possible 100 points.
The other half was calculated by ranking the sediment delivery estimates based on our terrain analysis that we saw earlier.
So this layer gives a high score to lands that are close to surface waters and also lands that have a high potential for sediment delivery.
The two layers combined make up for the 100 possible water quality benefits score.

Environmental Benefits Index (EBI)

Wildlife Habitat Quality/Ecosystem Value-100 pts

- Sites of Biodiversity Significance (SOBS)
- DNR GAP Model – game species
- DNR GAP Model – SGCN species (Species of Greatest Conserv. Need)
- DNR GAP – protection weighted
- USGS Bird hab. model (Prairie only)

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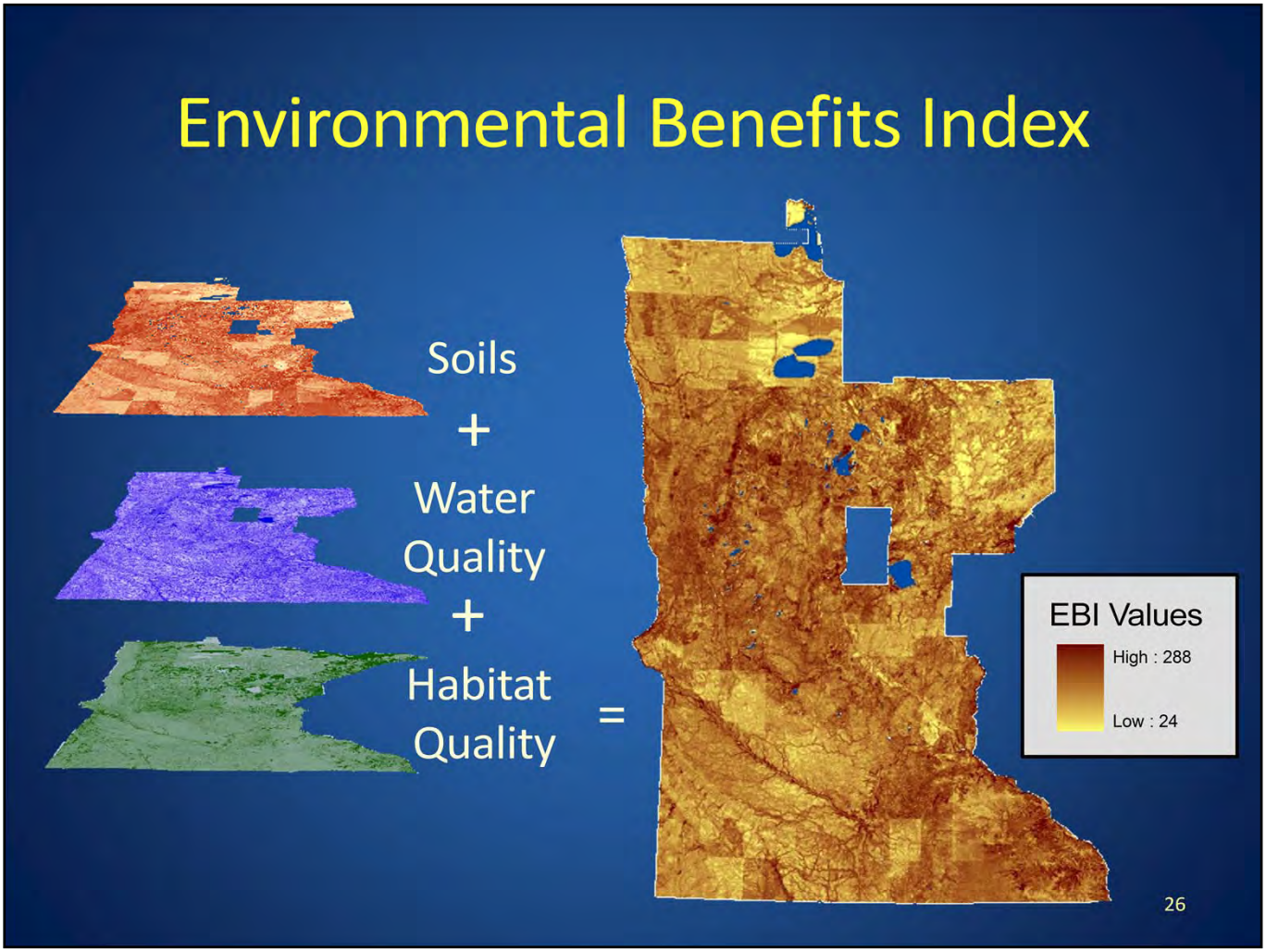
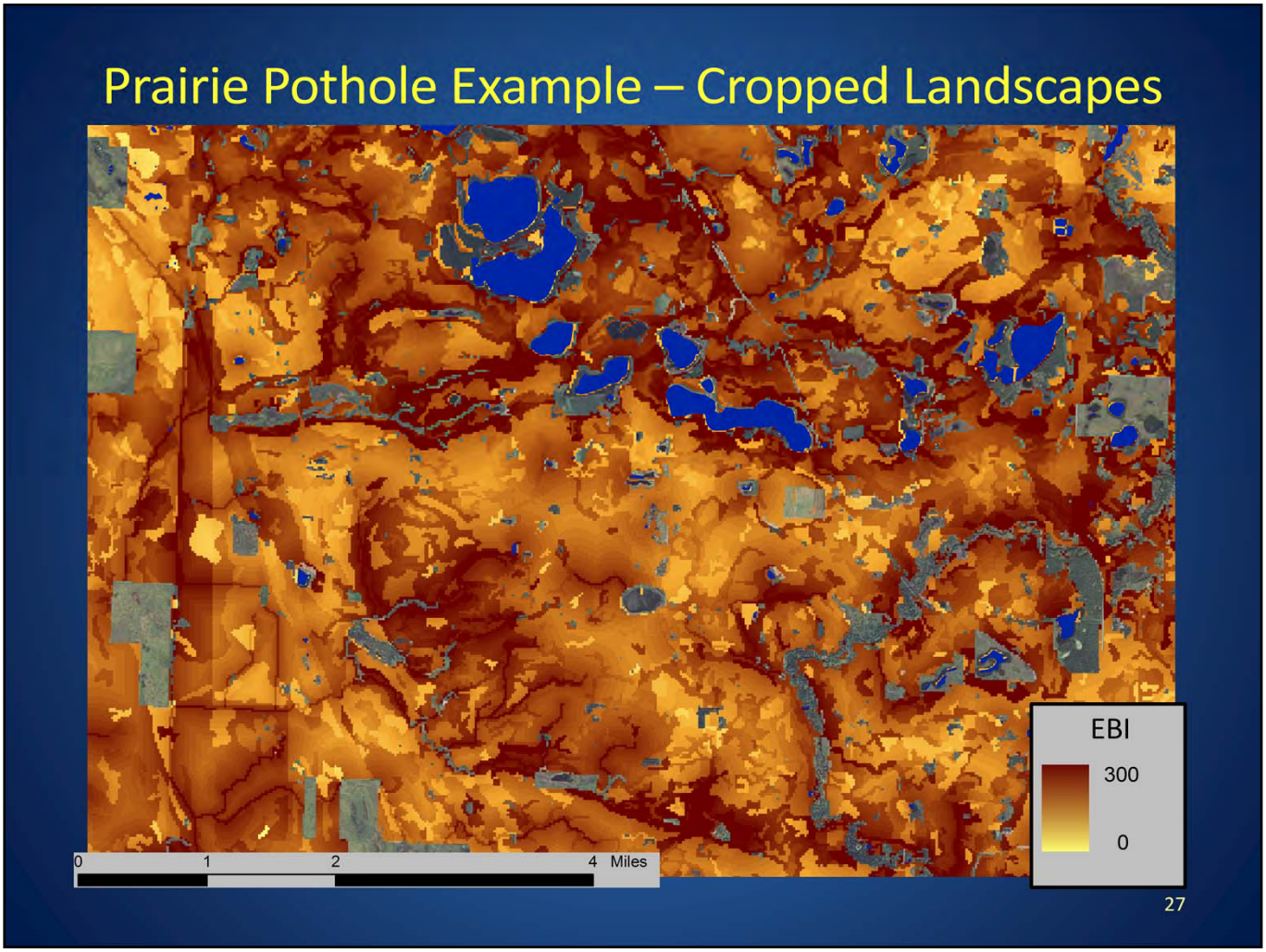
And finally the Wildlife habitat quality layer, which incorporates all the data layers listed on this slide, was created by NRRI Duluth and represents the 100 available points for this layer.

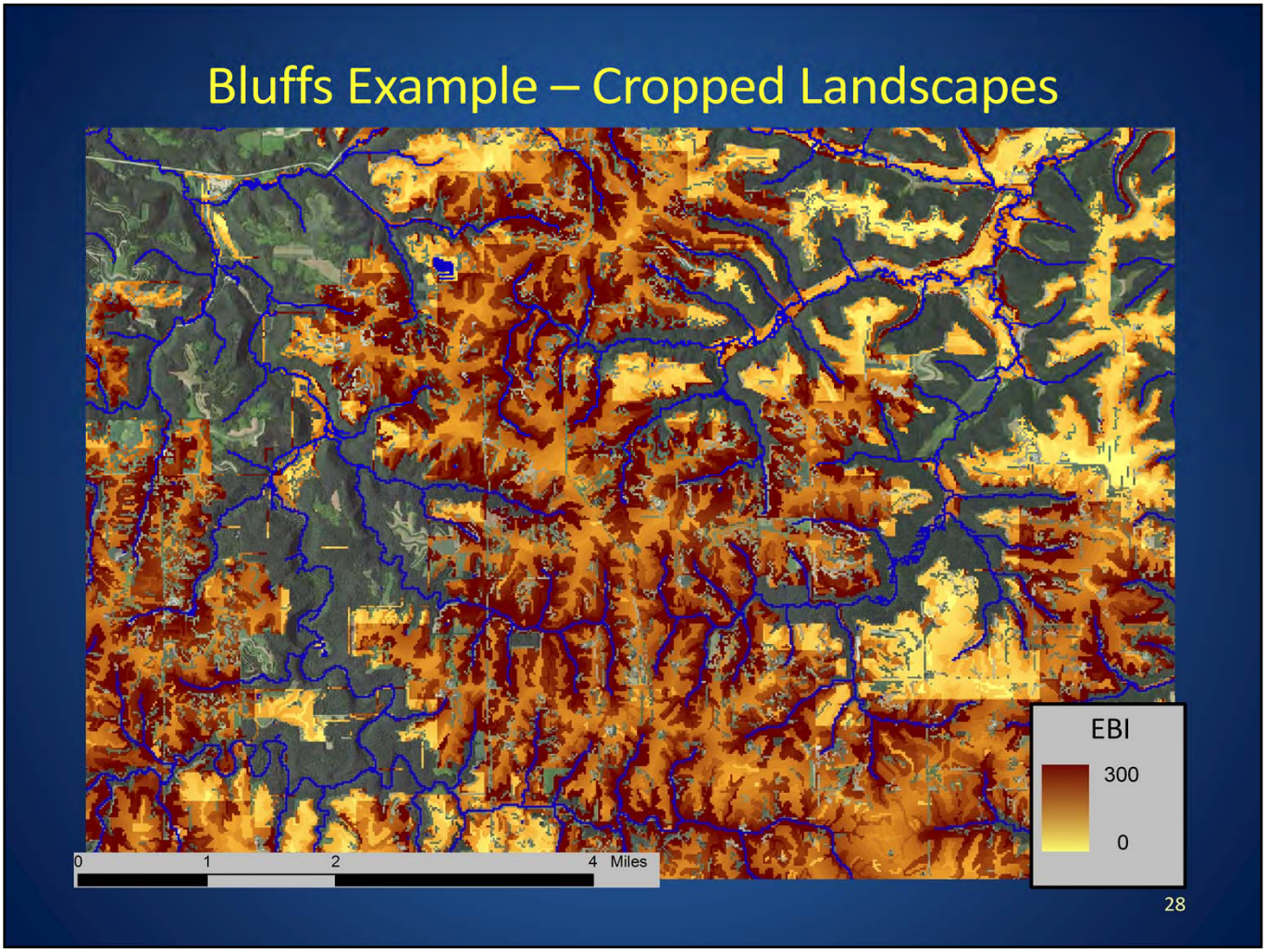


These layers are added together and combined to form a final priority ranking, or EBI score. The data shown here is incomplete across the state due to a lack of soils data in some of the arrowhead region.

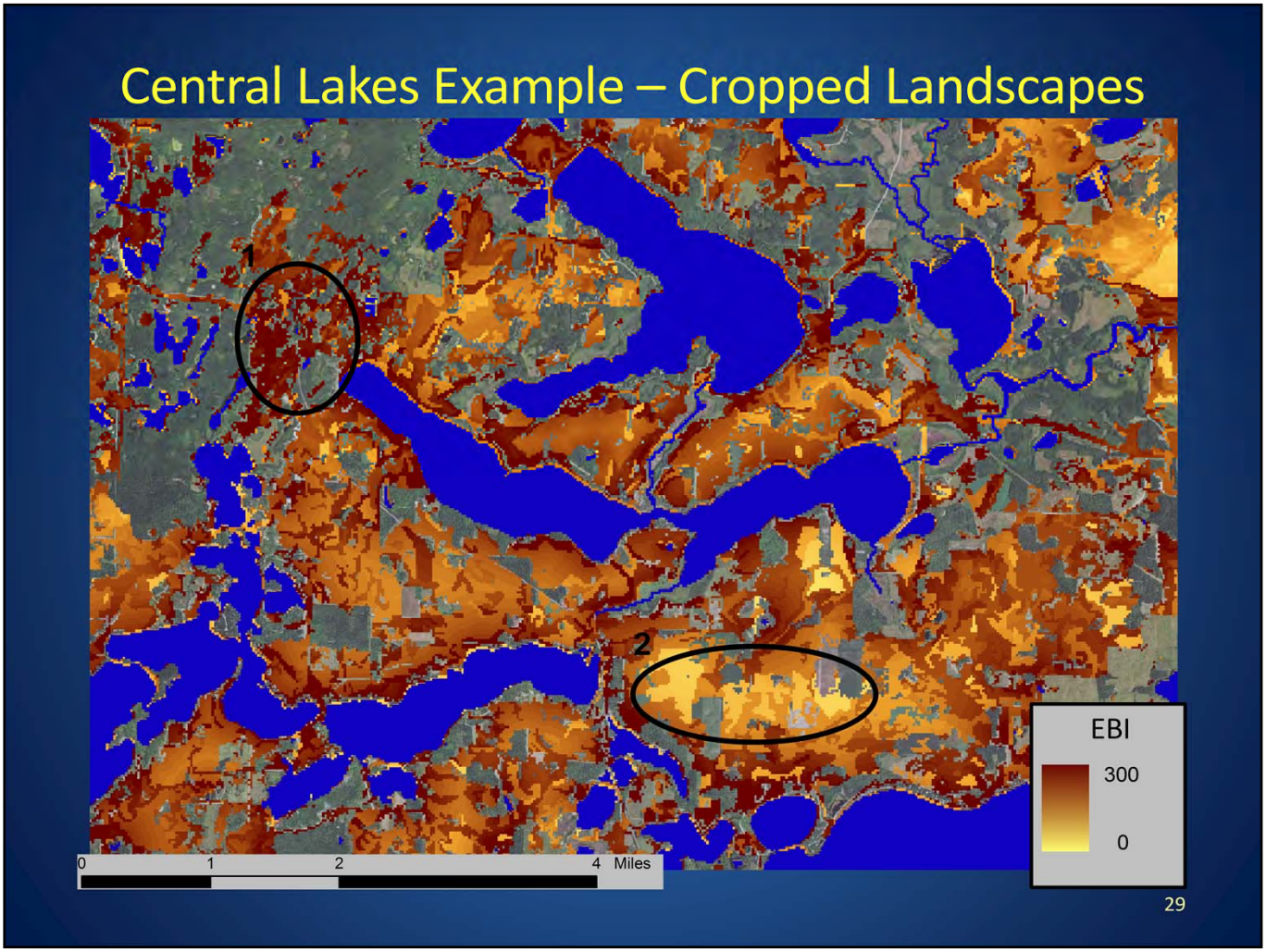


Now let's look at a few examples of using these data on different landscapes.
Here's an example from western Minnesota.
(For this example, we chose to only use the data for cropped land; so, the blocks of aerial photographs are non-agricultural areas, such as forests or wetlands.)

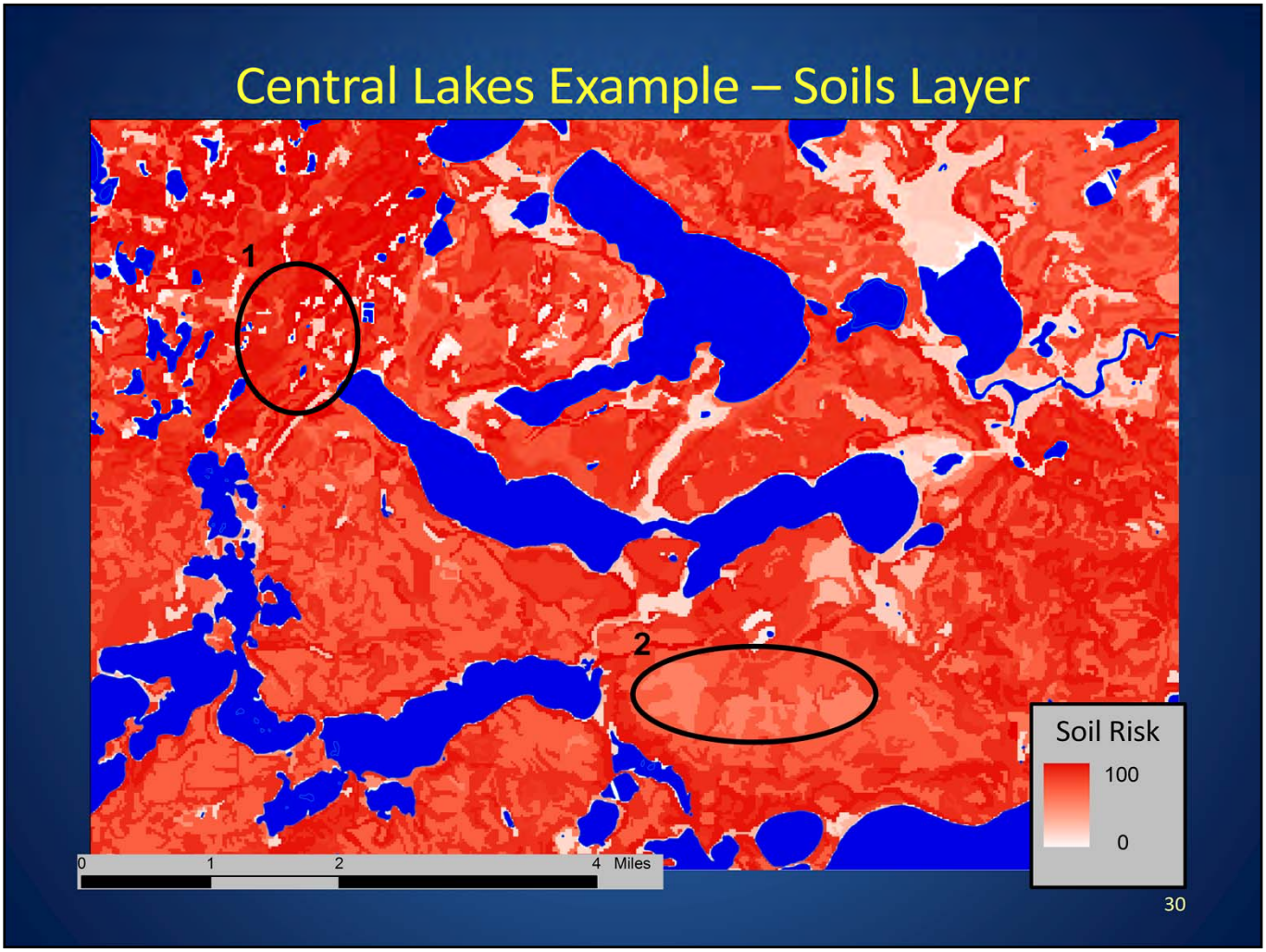
Darker areas represent higher EBI scores, implying a higher conservation value. Thinking back to the data inputs, these values likely represent a close proximity to water, and could also reflect high overland flow values, soil erosion values, and a high habitat quality.



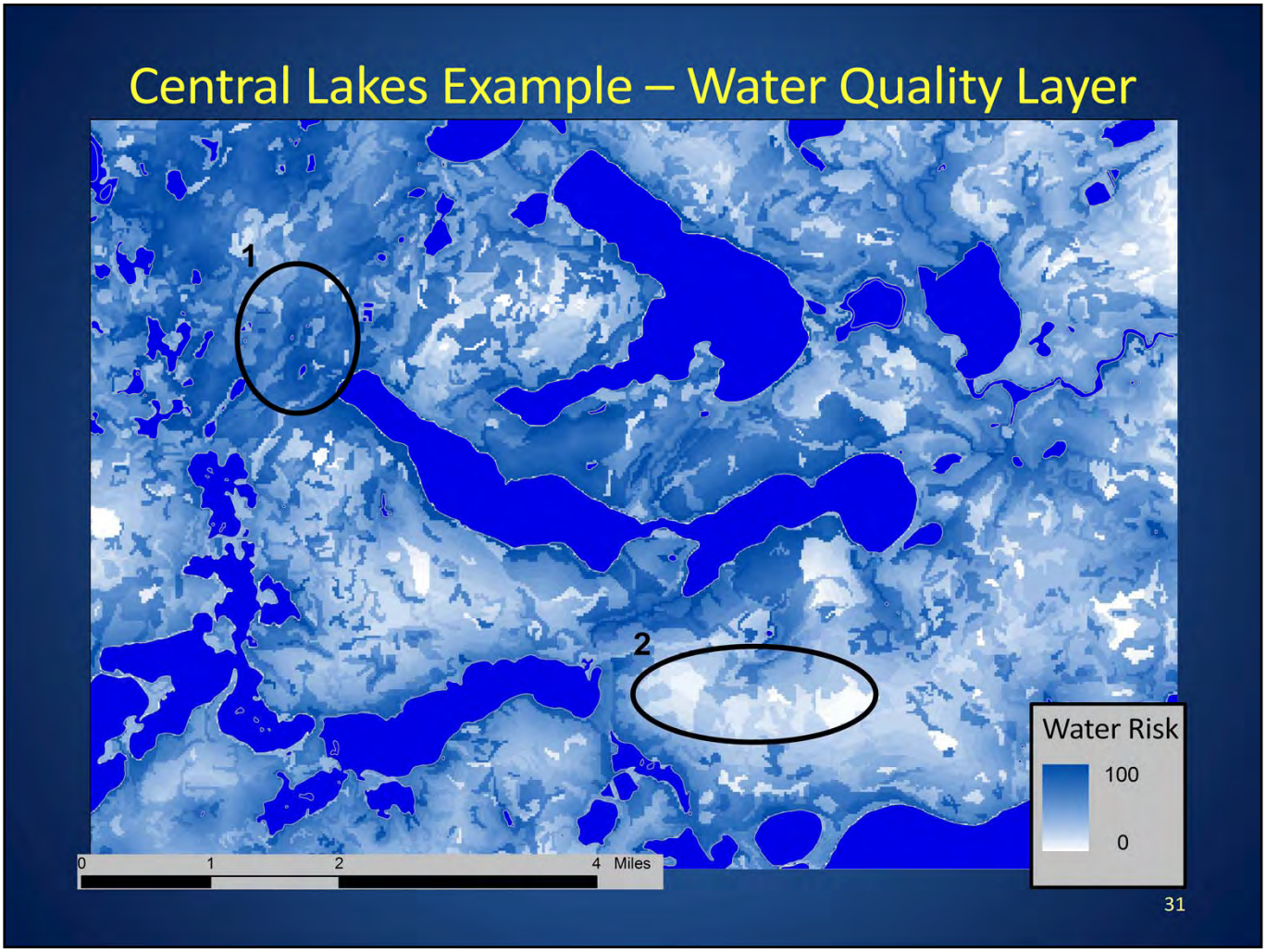
Here's an example in Minnesota's blufflands.
High EBI values seen in this map reflect a close proximity to water, but slopes are also much higher in this region, so the score would likely be influenced highly by potential erosion and overland flow values.
(Again, data on non-cropland was excluded.)



Here's an example of the central lakes portion of MN.
For this example, we'll break down the scores by the individual layers themselves.
Focus on two areas: the high values in circle #1, and the lower values in circle #2.



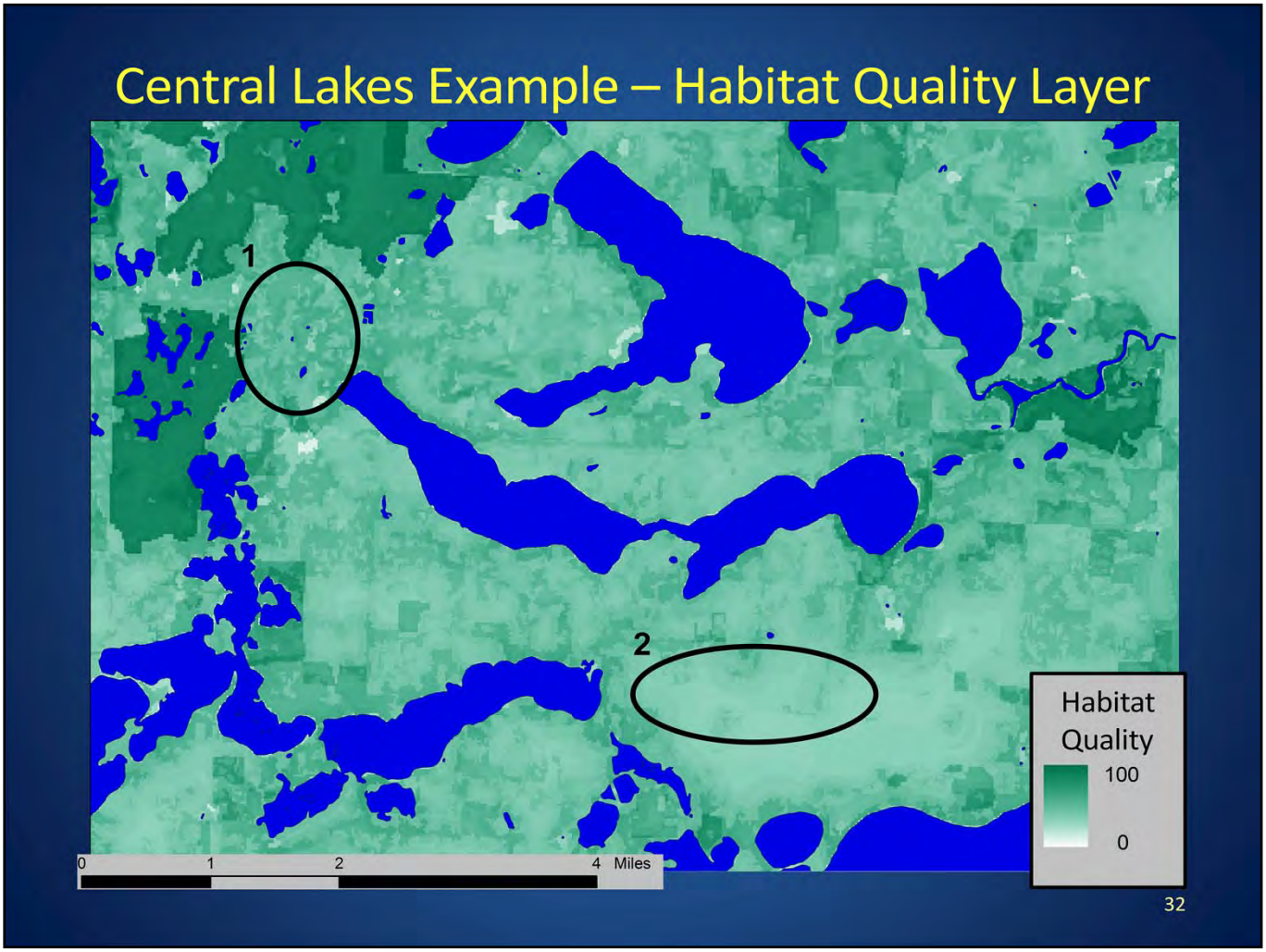
Taking a look at the soils layer, the first area has a rather high soil degradation risk. Conversely the second area displays lighter colors representing less of an erosion risk.



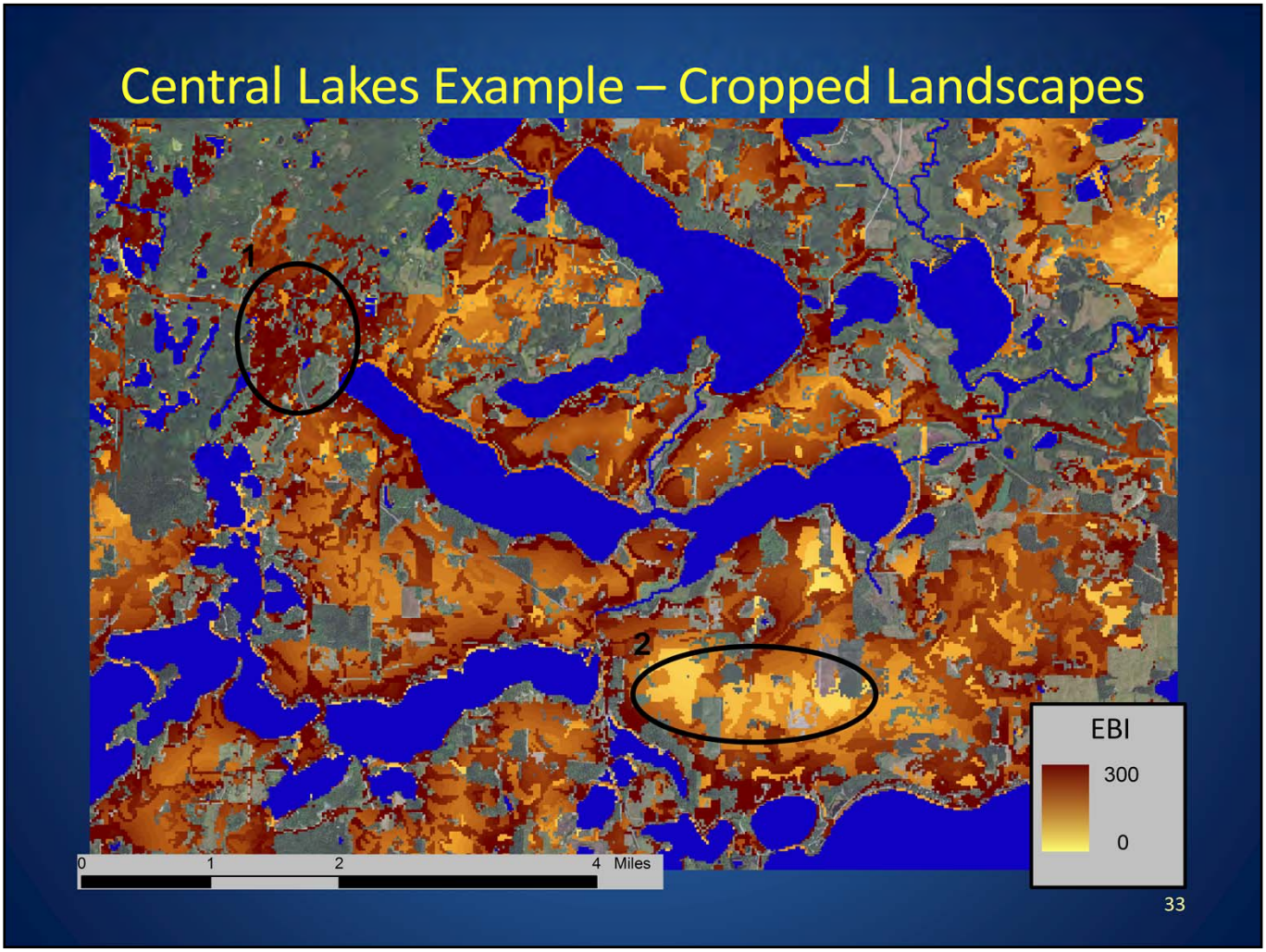
Again, the water quality layer represents both overland flow potential AND proximity to water.

The first area has a higher water quality risk likely due to its close proximity to different water bodies, but since that's only half of this layer's possible points, it likely has a high overland flow potential as well.

The second area seems to have a relatively close proximity to water, but the water risk values are much lower so their overland flow potential must be smaller.



Taking a look at habitat quality, it seems to be in the mid range for the first area and it's in the lower to mid-range for the second area.
This could be due to a number of factors that influence this habitat quality score, again remembering that there are several inputs to this layer.
This is also a good example of where this data layer could be supplemented if specie-specific habitat data is available on a local scale.
Using more local data, specific habitat concerns could then be matched to specific landscapes.



So looking back at the EBI values, each landscape shown in these examples display both high and low values.
When planning on a local level, EBI scores can help display multiple ecological benefits at once and will hopefully guide conservation planners to place a higher conservation value on the darker areas in these examples.

Example - CRP

In this example, every CRP parcel has a value calculated for each risk or benefit, as well as an overall score

Economic analysis can help predict whether or not a parcel with high conservation value is likely to exit CRP for cropping

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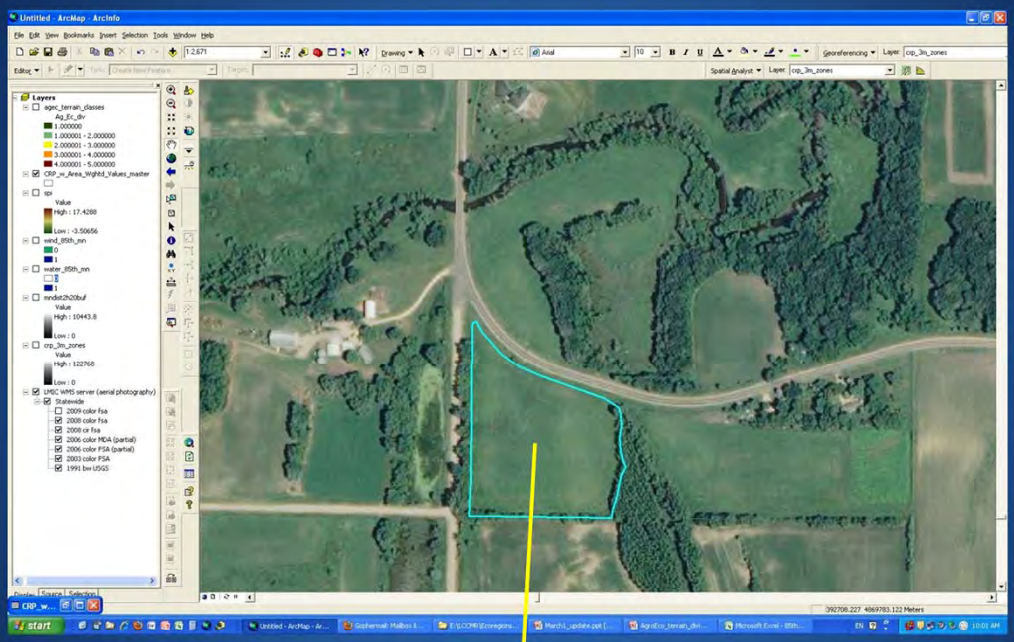
So we've seen some example maps, but what exactly can we do with these data? Here we'll demonstrate an example application that we completed using our EBI data with CRP parcels.

In this example, we used each CRP polygon to extract our EBI data.

We've coupled this example with some ancillary economic data to show how the EBI data can be supplemented with other data sources.

Example - CRP



Soil Degradation risk	Water Quality risk	Habitat Quality Score	EBI score
86	33	67	186

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Each parcel has an associated soil and water quality risk as well as a habitat score and a final EBI score.
In our database, you would be able to select any CRP parcel and see its individual score for each category.

Economic Analysis

One can predict the possibility of CRP land being converted into annual cropping systems based on prices, subsidies, and crop productivity

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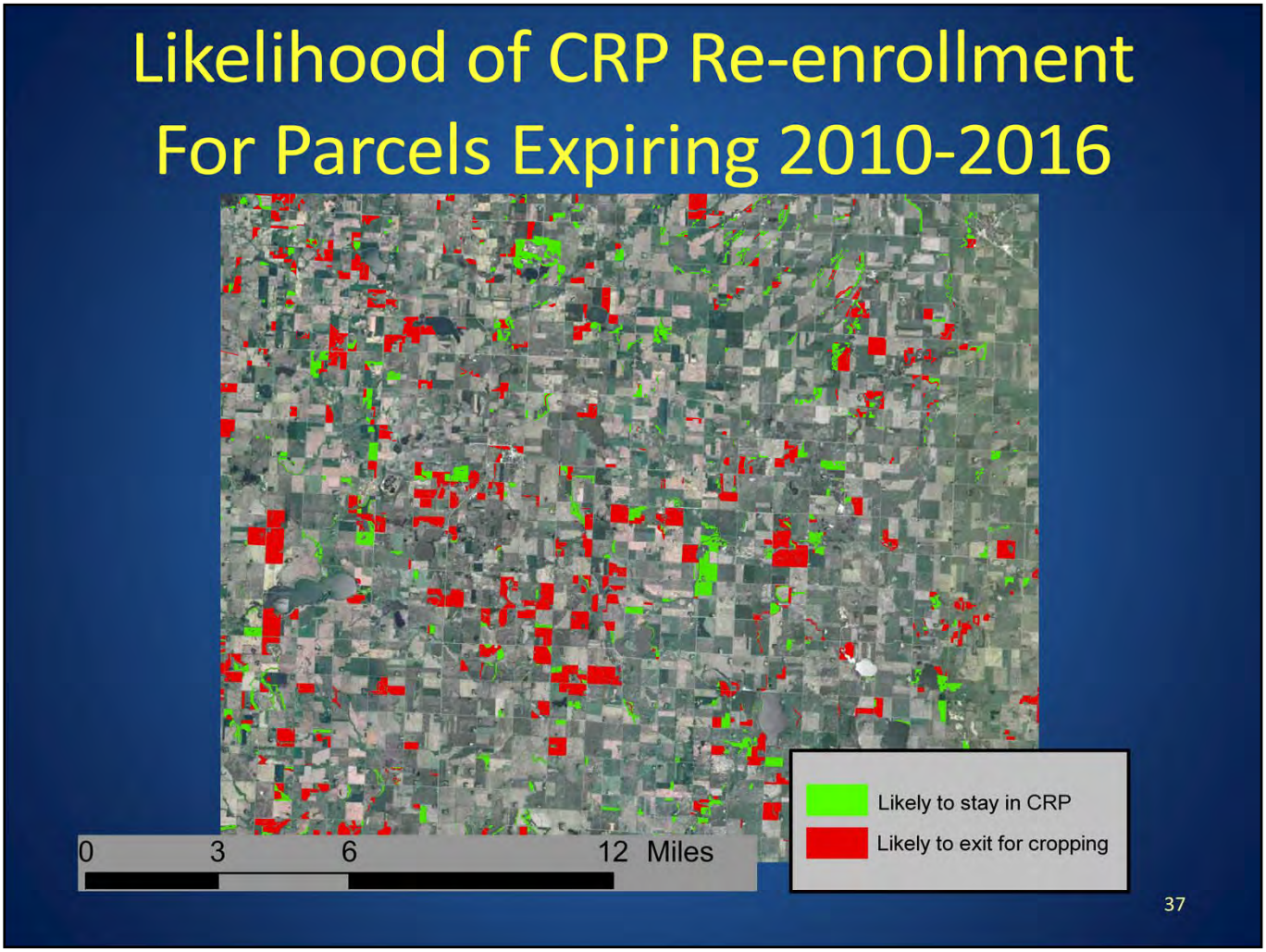
As mentioned earlier, economic data were used to supplement the EBI in this example. Based on crop prices, subsidies, and productivity data, we've used a model developed by Steve Taff (U of M Dept of Applied Economics) to determine which CRP parcels due to expire will likely exit CRP in favor of annual cropping systems



The parcels in green are likely to stay in CRP, while the red parcels are likely to exit

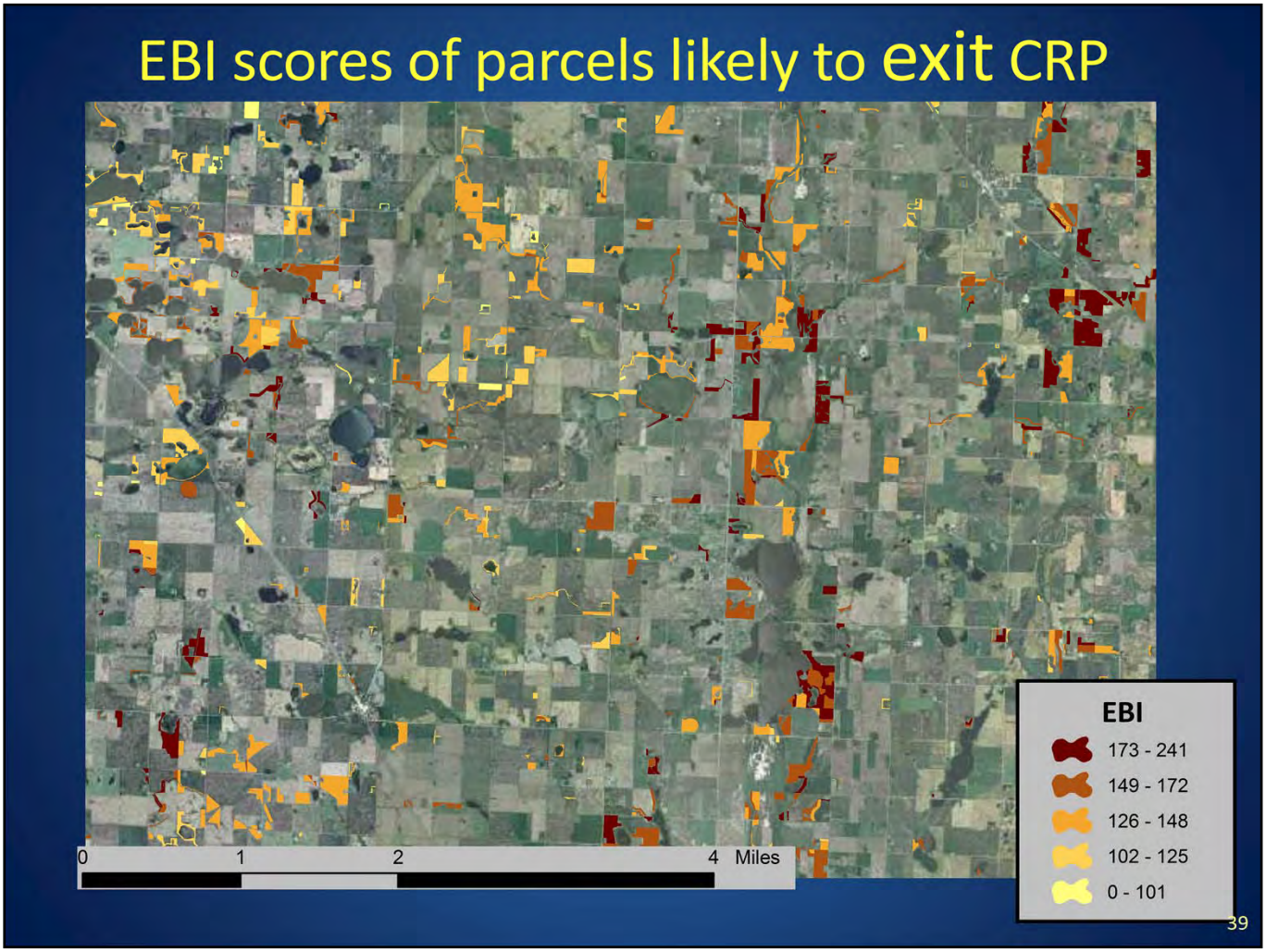
The parcels likely to exit would do so because, based on crop prices and crop productivity, it would be more attractive to farm the parcel than it would be to enroll in CRP.

The predicted shifts shown here were based on early 2010 commodity prices, but the model could be re-run to reflect more recent data.

Economic Analysis

Once parcels are identified as likely to exit CRP, they can be prioritized by EBI scores

Parcels with low EBI scores may be allowed to exit while those with higher conservation value might be targeted with available funding

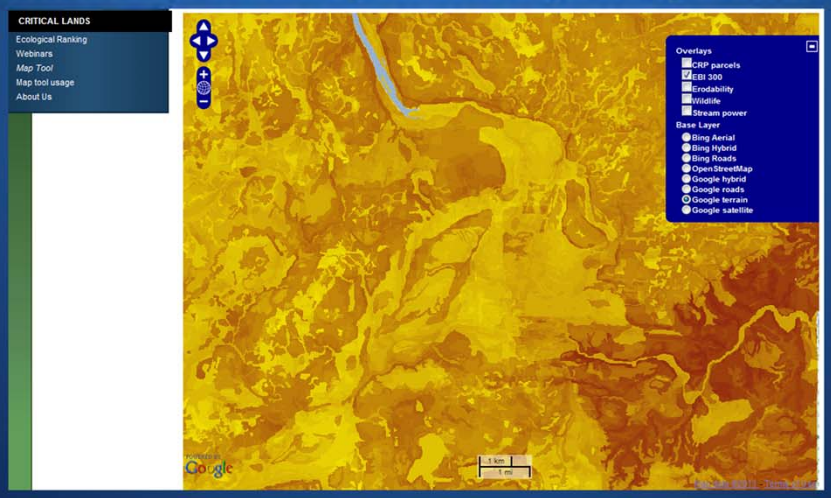


All of the colored parcels on this map are expiring parcels predicted to exit CRP based on the economic model.
Some of the parcels have lower EBI scores and therefore aren't critical losses to the CRP, based on THIS EBI. (Changing our weighting system or adding other data sources could change priorities.)
Other parcels, however, have high EBI scores and would be valuable to CRP.
These more valuable parcels from an ecological view can be prioritized and targeted with remaining conservation funds.

Training Objectives

Provide data & methodology to local governments and other conservation partners

- Hands-on training to local government and other conservation partners
- Web-based delivery of data (led by NRRI Duluth)



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This is information about the training to be provided in June for GIS specialists.

Key Points

This methodology was designed to target conservation programs to expiring CRP and other critical lands

It does not replace local knowledge or site-specific analysis

The framework presented can and should be supplemented by ancillary data where available

Local governments implement most of the conservation practices funded by the State.

Many resource issues are site-specific.

Local staff know landowners, parcel boundaries, and where conservation practices exist and where practices are needed.

Local staff—and their conservation colleagues-- can provide additional enhancements to these targeting methods.

Key Points

There are many existing data layers and methods

We have developed new data layers and ways to organize and manage data—both existing and new

This presentation was an overview; for the "inside" technical details, please join us at a technical session

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