GIS Analysis of Climate Change Impacts in the Lower Wabash River Basin

Prepared by Brielle Cummings, Michael Santel, Michael Caldie

Professors Gwen White and Vicky Meretsky

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School of Public and Environmental Affairs, Indiana University

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Acknowledgements

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Executive Summary

Climate change presents a challenge in planning for conservation in the future. Our team, working in conjunction with the LCD team, has performed geographic information system(GIS) analysis of the impacts of climate change within the Lower Wabash River basin. Future climate change scenario models indicate that the area is likely to become warmer and receive greater amounts of precipitation in the future. Because of this, we have examined where these changes will have the greatest impact in order to identify lands at greatest risk to these changing climate conditions and lands suitable for habitat restoration or conservation.

We developed a database to analyze the most severe carbon emissions trend (RCP 8.5) based on the Intergovernmental Panel on Climate Change's most recent assessment report. We have included a number of environmental variables to help describe the Lower Wabash River basin and assess the area for conservation potential.

We set out to create a GIS framework and map enabling land managers to:

- Determine where adaptation actions and best management practices (BMPs) can be best implemented.
- Identify lands at high risk to future extreme weather events and lands with high habitat suitability to promote enrollment in conservation programs or increase conservation acquisitions by project partners.

We found that the floodplains presented the greatest opportunity for conservation actions. The area of highest potential in Illinois is the Little Wabash River watershed. Areas located around the Patoka River National Wildlife Refuge present the greatest conservation potential for Indiana.

Introduction

The Eastern Tallgrass Prairie and Big Rivers Landscape Conservation Cooperative (LCC) consists of eleven states in the Midwest, working to provide a functional working landscape by restoring the natural communities in the region. Within the LCC, a smaller group known as the Lower Wabash River Landscape Conservation Design (LCD) team is working within the Lower Wabash watershed to improve soil health, water quality, and wildlife habitat in the area.

Climate change presents a challenge in planning for conservation in the future. Our team, working in conjunction with the LCD team, has performed geographic information system(GIS) analysis of the impacts of climate change within the Lower Wabash River basin. Future climate change scenario models indicate that the area is likely to become warmer and receive greater amounts of precipitation in the future. Because of this, we have examined where these changes will have the greatest impact in order to identify lands at greatest risk to these changing climate conditions and lands suitable for habitat restoration or conservation.

Our objectives were to make a GIS framework and map that enables land managers to:

- Determine where adaptation actions and best management practices (BMPs) can be best implemented.
- Identify lands at high risk to future extreme weather events and lands with high habitat suitability to promote enrollment in conservation programs or increase conservation acquisitions by project partners.

Analysis

We have included two different models in our analysis, a high temperature and high precipitation model, and a high temperature and low precipitation model. For an in depth technical discussion on the creation of our models, refer to the Technical Appendix.

Our study area consists of the counties that lie within the Lower Wabash River Basin (Table 1). In Illinois, cropland dominates the area, however 18% of the area consists of upland and bottomland forests (Illinois Natural History Survey n.d.). Much of the study area in Indiana is unsuitable for farming and consists of bottomland hardwood forests (Jackson 2006).

Table 1. Counties included in the GIS analysis.

Indiana	**Illinois**
Clay	Clark
Daviess	Clay
Dubois	Crawford
Gibson	Edgar
Greene	Edwards
Knox	Gallatin
Martin	Hamilton
Orange	Jasper
Pike	Lawrence
Posey	Richland
Sullivan	Wabash
Vanderburgh	Wayne
Vigo	White
Warrick	

Data Layers

We have included images for all layers in the Technical Appendix.

Both models include climate projections based on the Intergovernmental Panel on Climate Change's (IPCC) most recent model of the highest carbon dioxide emission scenario, RCP 8.5 (Figure 1). The Representative Concentration Pathways (RCP) scenarios represent a broad range of outcomes based on global development and can be interpreted as greater atmospheric CO_2 concentrations and warmer temperatures with an increasing RCP label value. We chose to project to 2086 because much of the conservation activity in the Lower Wabash River Basin focuses on reforestation and we decided to model the risk scenarios on the period when these communities will be mature.

In our first model, we have mapped the highest monthly temperatures (Figure 12) and highest monthly levels of precipitation (Figure 11) for the 2086 growing season of April-October. This initial model portrays a scenario in which the likelihood of flooding in the study area is observed. The second model uses the highest monthly temperatures and lowest monthly levels of precipitation (Figure 11) for the same period, which models a drought scenario.

The lowlands layer (Figure 5) represents areas that lie below the mean elevation based on local topographic positioning. These areas are likely to collect and retain water, indicating risk of flooding, but also are potential locations for wetland restoration. For our analysis, we considered any lowland area as being highly suitable for conservation.

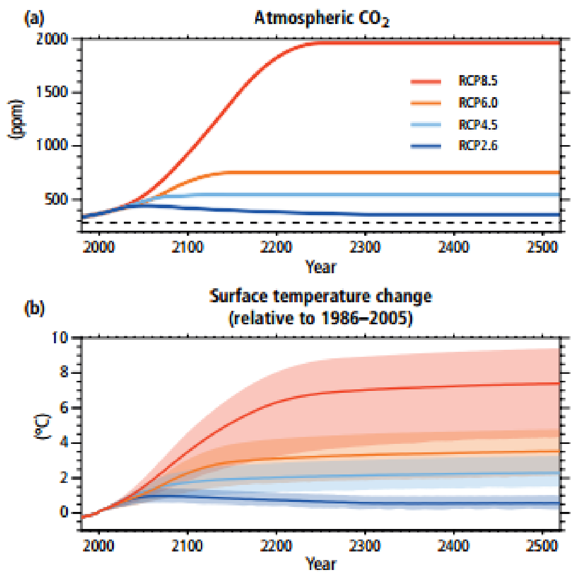

Figure 1. Projected CO_2 concentrations (a) and surface temperature change (b) from 1986-2300. Concentrations and temperatures in year periods following 2300 are constant (Pachauri et al. 2014).

The floodplains layer (Figure 6) shows the location of Federal Emergency Management Agency (FEMA) 100-year and 500-year floodplains. The majority of floodplains in the study area are 100-year floodplains, however there are 500-year floodplains in the southern most portion. Lands that lay within the 100-year floodplains were considered to be at greatest risk of flooding due to the potential for increased precipitation. These areas may therefore be more well suited for conservation.

Wetlands can mitigate flood risk and capture sediments from upstream sources as a means of protecting downstream water quality (US EPA 2002). Wetlands are also critical habitat for many species of birds, reptiles, and amphibians. Because wetlands serve as a means of water and sediment retention, they have the potential to reduce downstream flooding. Our wetlands layer (Figure 7) displays the presence of wetlands, as defined by the US Fish and Wildlife Service, and deep water currently in the study area. We have classified wetlands as having higher suitability and need for conservation than open water areas due to the focus of land management in our analysis. Though the danger of climactic changes posed to water bodies in the Lower Wabash River Basin will require conservation, it is not within the scope of the model.

The poorly drained soils layer (Figure 8) represents soils in the study area that are characterized by the Natural Resources Conservation Service (NRCS) as being of poor or very poor drainage class. This layer does not indicate if fields are tiled, and as such, may be well drained at this point in time. We included it in our analysis because these soils offer the potential for a higher risk of flooding than soils of a higher valued drainage class, provided they are not currently tiled.

The environmental site potential layer (Figure 9) presents the current projected natural vegetative communities that could be supported in the absence of human activity, given various factors such as climate, soil type, and competitive ability of plants within these communities. Some communities in the study area such as interior beech-maple forests are highly vulnerable of conversion to another habitat given future environmental stressors, whereas communities such as glades and barrens are much less vulnerable to change (Brandt et al. 2014). Much of the western portion of the study area consists of dry-mesic oak communities, while the eastern portion is dominated by interior mesophytic forest. Directly west of the Wabash River, maple-basswood and beech-maple forests line the extent of the river in our study area with the greatest concentration of these communities in the northern and southern extents.

Our marginal soils layer (Figure 10) represents the National Commodity Cropland Productivity Index (NCCPI) as defined by the NRCS. The NCCPI is calculatation based on the response of crops on non-irrigated cropland to factors such as soil, landscape, and climatic conditions. Lower NCCPI values indicate lower soil productivity. For the purpose of our analysis, we classified the lowest NCCPI values as indicating a greater opportunity for conservation. If the capacity for growing crops is low, farmers may be more willing to enroll the land in conservation programs.

The protected areas database layer (Figure 13) is compiled by the US Geological Survey (USGS) and represents public protected lands as well as reported conservation easements created and owned by private citizens. For our analysis, we considered lands closer to protected areas as higher priority for conservation in order to prioritize increasing the size of current protected areas.

The National Land Cover Database 2011 (NLCD 2011) was created by the Multi-Resolution Land Characteristics (MRLC) Consortium in an effort to map land use change over time. It is based on a 16-class land cover classification system. Our land cover layer (Figure 14) displays the NLCD 2011 data in our study area, however, we have removed urban and suburban developed areas from the analysis in order to prevent these areas from indicating a suitability for conservation.

Recommendations for Improvements to the Analysis

Higher resolution data would give our model much more detail in areas with steep topography such as thin valleys where creeks are present. Public data availability of high resolution data and available computer processing capabilities were limits in the analysis but can be overcome by professional staff who use our data as a start to their own work.

The CARL layer from Ducks Unlimited will be helpful for identifying more conservation easements that are not in the Protected Areas Database and will likely lead to a greater number of areas eligible for conservation. Additionally, the inclusion of parcel data for Illinois would allow for a full analysis of properties eligible for conservation to be carried out in the entire study area.

Our models assumed that all variables were weighted equally. We recognize that in the real world, some drivers have a greater impact than others. With input from experts, the weight of variables can be altered to better reflect real world environmental interactions in order to produce a more accurate model.

The low precipitation model used the same variables as the high precipitation model. Much of the risk from the high precipitation model was due to factors relating to flooding. Because lower precipitation would likely lead to less flooding, this model is likely not as accurate as it could be. Inclusion of new variables pertaining to drought and removal of inappropriate variables will improve the accuracy of this model.

Results

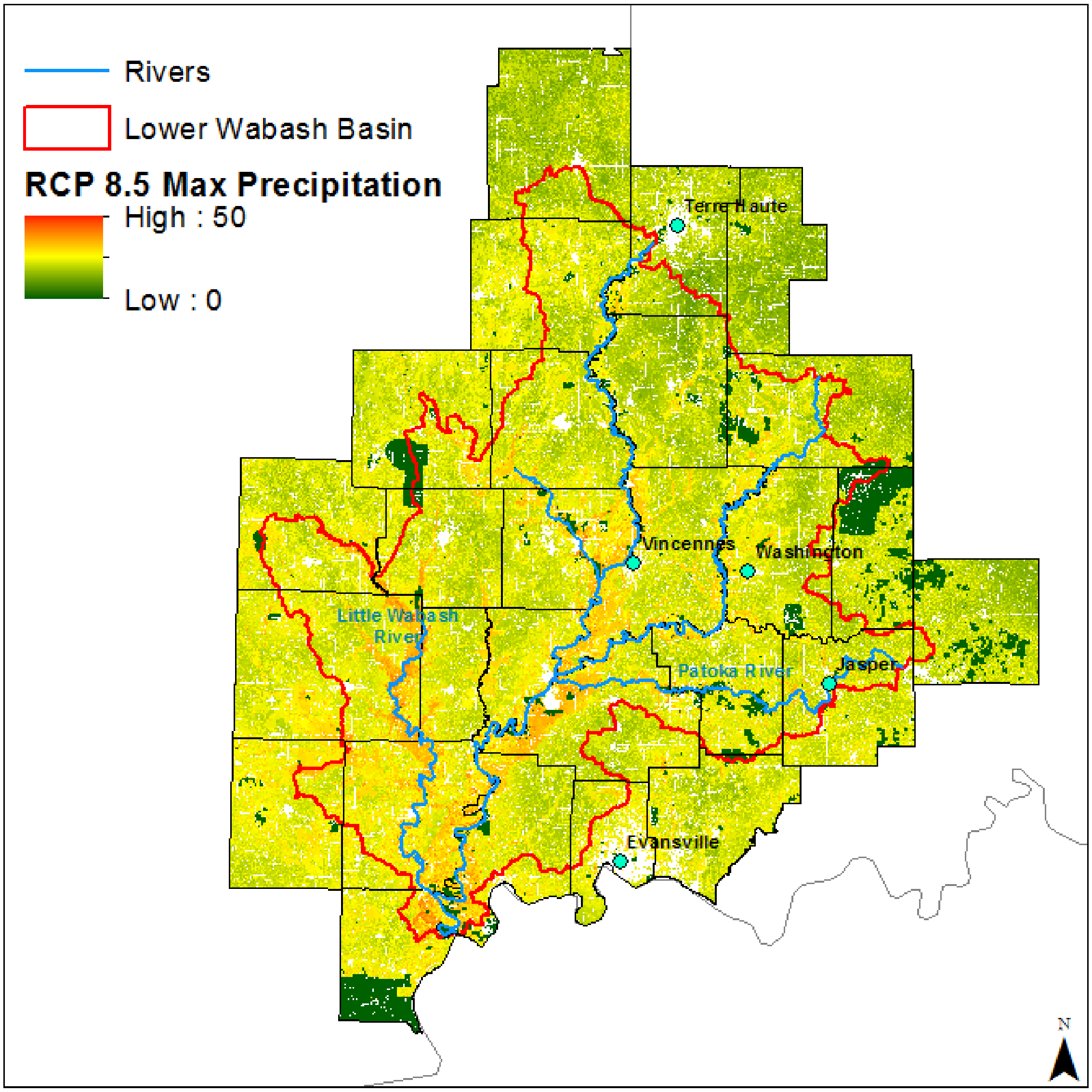

Figure 2. RCP 8.5 results of high temperature and high precipitation scenario.

Both scenario maps (Figures 2 & 3) present lands by greatest need or suitability for conservation. Higher values indicate greater need for enrollment or acquisition. High priority areas mostly lie along the floodplains of rivers. We expected this as many of the model inputs reflect the characteristics of floodplains such as low lying areas, wetlands, and poorly draining soils. This intuitiveness supports the accuracy of our models, indicating they worked as expected.

The highest total output values lie along the Little Wabash River as well as the Patoka River adjacent to the Patoka National Wildlife Refuge. The greatest density of highest valued areas lies along the Little Wabash River. These areas are the most suitable for conservation actions and we recommend that these be the initial primary focus of decision makers. Because our analysis classifies all of the areas, these can be used to set the priority of less critical areas. We recommend that this focus be placed on the floodplains.

Differences between the two models are due solely to using different precipitation inputs. Both maps indicate the same general areas as having the highest priority, however the minimum precipitation model has a higher number of high priority areas. This variation could be due to the difference in range of values between the maximum precipitation and minimum precipitation models. The minimum precipitation value range is smaller, and because of our classification scheme, there is less variation in values. As a result, the minimum values appear more frequently in the analysis.

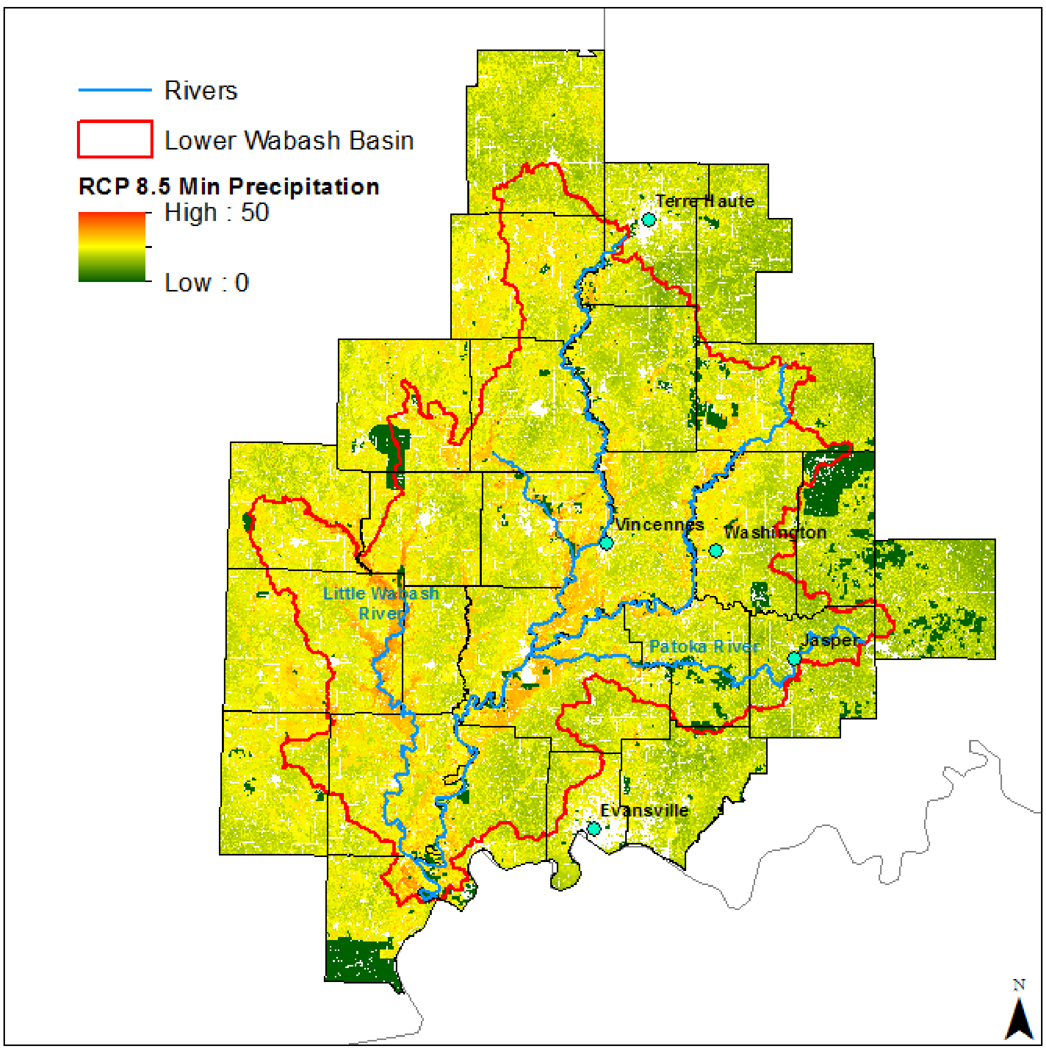

Figure 3: RCP 8.5 results of high temperature and low precipitation scenario.

Effects on Decision Making

Our analysis can empower decision makers to identify specific areas for enrollment in conservation programs or pursue for acquisition. As an example we have overlaid land parcels on the highest risk areas near Patoka River National Wildlife Refuge in order to highlight the accuracy of this tool (Figure 4). Our tool identified individual parcels adjacent to the refuge and if enrolled in conservation programs, these lands could enhance the resilience of the area.

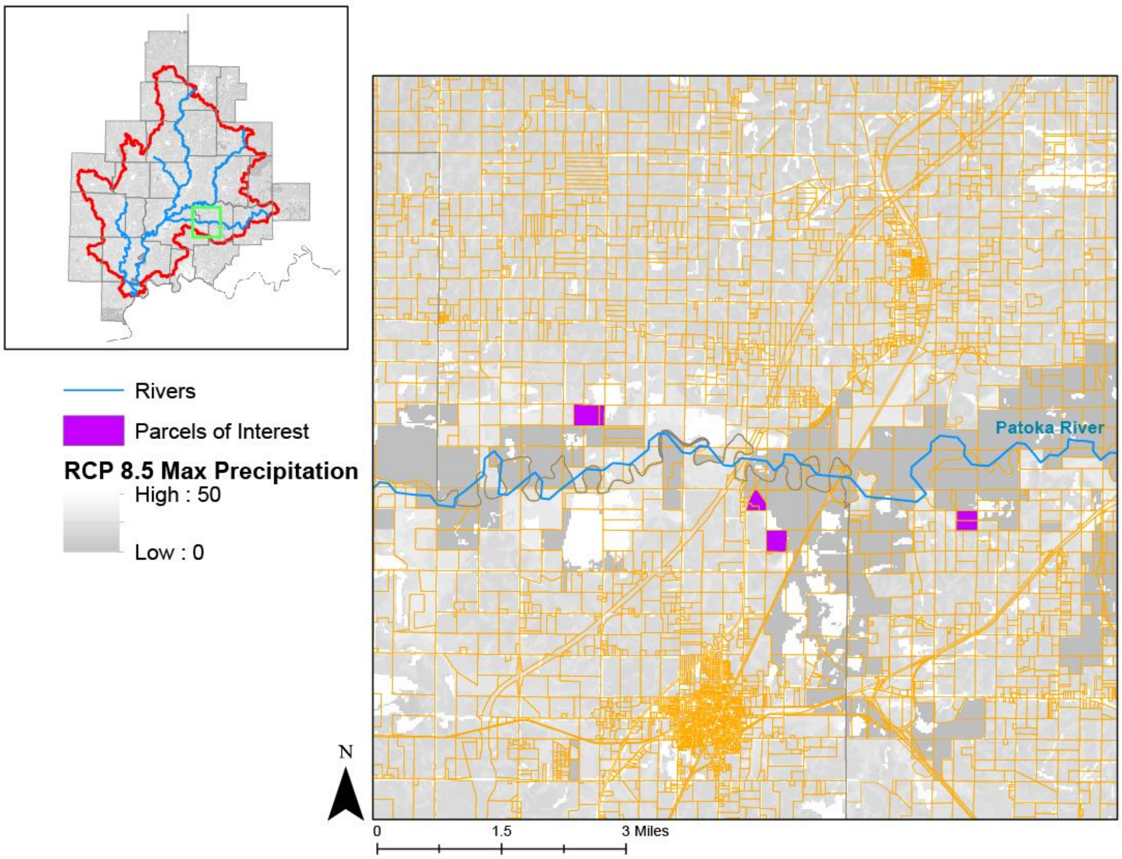

Figure 4. RCP 8.5 model with maximum temperature and maximum precipitation top 10% conservation priority areas near Patoka River National Wildlife Refuge.

Conclusion

The model our team constructed provides a powerful framework for members of the LCC to utilize as part of their existing conservation practices. As presented, it provides useful insight and results for using resources strategically in the Lower Wabash River Basin, but the data provided could be improved. Increased technical expertise and inclusion of relevant datasets will be useful for improving the analysis. Given these improvements, this tool has the potential to become an essential guide for area land managers.

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Technical Appendix

Assumptions and Limitations

- Temperature forecasts were based on maximum monthly temperatures The precipitation forecasts were based on maximum and minimum monthly precipitation levels over the growing season (April-October).
- The risk model was run at 30-meter resolution reflecting the finest scale available from all included data layers.
- Each dataset was weighted equally in our analysis. Reclassified values are equal across datasets but represent different ranges of original values for each individual layer (Table 2).
- Many of our variables are focused on the impacts of flooding. Because of this, the results of our drought model analysis may not be accurate as the model retains the same reclassification values for all variables except for precipitation.

GIS Data Acquisition

Existing resources of the Gulf Hypoxia Initiative were integral in the creation of several layers, but our team has collected a substantial quantity of data from outside sources to add value and build on the current initiative. We have compiled a list of our files, sources, and metadata in the Data Dictionary.

Data Manipulation

Basemap and Initial Processing – The blue lines indicate major rivers and the red line indicates the extent of the lower Wabash River Basin on the basemap. We expanded the area of interest (AOI) to counties that contain portions of the basin (Table 1). All of the layers collected were projected to North American Datum Universal Transverse Mercator (UTM) 1983 Zone 16N and clipped to the identical county AOI. This is the most accurate projection we could use because the entire AOI lies within this zone, and the shape and area of the AOI were preserved with minimal distortion. This was important because it offered the truest shape and size of conservation areas in the AOI.

Climate Data Processing—Climate data for all scenarios were downloaded for all months for year 2086. Data represented average monthly temperature and were reported in tables using latitudinal and longitudinal position. Data then were imported into STATA for processing to discard all months not in the growing season (April-October) and to calculate growing season maximum and minimum temperatures (Celsius) and precipitation (mm). Next, data were imported into ArcMap to create working point feature classes for inverse distance weighted (IDW) interpolation.

Resolution - All of our datasets were resampled to 30-meter resolution in ArcGIS. This was the finest resolution from available datasets. The 30-meter resolution is also consistent with the finer scale for local planning in the larger Gulf Hypoxia Initiative – Precision Conservation Blueprint (The Conservation Fund 2016).

Reclassification - Every dataset was reclassified to values between 1-5 to fit in the analysis model. Reclassification categorizations are listed Table 2. The reclassified values represent increasing severity of risk to extreme weather events, with a 1 indicating lowest risk and a 5 representing highest risk. Layers representing habitat suitability for conservation were classified with 1 indicating lowest and 5 as highest priorities. Binary layers (Figures 5 & 8) were reclassified from 0 and 1 to 0 and 5. Pixels that contained no data were reclassified to a value of 0 so data would still be included in the total output values but not impact analysis values of the final model. If pixels lacking data were not reclassified to 0, those pixels would have been omitted from the final analysis. The areas with the highest total value from the output analysis were those marked with greatest conservation need.

In the floodplains layer (Figure 5), 100-year floodplains were classified of highest value because parcels in these areas are at the greatest risk of inundation. The 500-year floodplains were assigned a lower value of 3 as the likelihood for flooding in these areas is lower but still possible with more frequent weather events.

The five types of wetlands present in the study area (Figure 6) were characterized into two different values based on their sensitivity. We reasoned that wetlands were more sensitive to environmental stressors than open water. Additionally, because waterfowl habitat is of primary interest, wetlands are very critical for this cause.

The environmental site potential layer (Figure 9) was reclassified by community type based on vulnerability evaluations from the Central Hardwoods Ecosystem Vulnerability Assessment (Brandt 2014).

The Protected Areas Database layer (Figure 12) was reclassified using distance from existing conserved properties in miles. A value of 5 corresponds with locations within 1 mile of a protected area, a value of 4 within two miles of a protected area, continuing until values of 0, which have no conserved properties within 5 miles of them.

The soil productivity index or marginal soils layer (Figure 10) was reclassified using even breaks of 10 resulting in indices from 0-19 being valued at 5, 20-39 at 4, and so on until 80-99 valued at 1. Areas missing data were assigned a value of 0.

The RCP 8.5 climate scenarios of maximum growing season temperature in Celsius, maximum growing season precipitation in millimeters, and minimum growing season precipitation in millimeters were all reclassified into 5 classes using Jenks natural breaks. The ranges in values can be found in Table 2. Areas with no data were assigned a value of 0.

The land cover dataset was reclassified according to habitat suitability for waterfowl. Developed and open water areas were removed, allowing these areas to be omitted from the output analysis. We assigned cropland a value of 5 due to the abundance in the AOI and conservation potential.

Table 2. Reclassification values for data sets used in analysis.

Dataset	Original Values	Reclass Values
Lowlands	0	0
	1	5
Floodplains	100-year	5
	500-year	3
Wetlands	Freshwater Lake/Pond	1
	Riverine, Freshwater Emergent Wetland, Freshwater Forested / Shrub Wetland	5
Poorly drained soils	0	0
	1	5
Environmental site potential	Barren Rock / Sand / Clay, Central Interior Highlands Calcareous Glade and Barrens, Central Interior Highlands Dry Acidic Glade and Barrens	1
	North - Central Interior Dry Oak Forest and Woodland, North - Central Interior Dry - Mesic Oak Forest and Woodlands, North - Central Interior Wet Flatwoods, Ozark - Ouachita Dry Mesic Oak Forest, South - Central Interior Mesophytic Forest, Southern Interior Low Plateau Dry - Mesic Oak Forest	2
	Mesic bottomland forest, Mississippi River Alluvial Plain Dry - Mesic Loess Slope Forest	3
	Central Interior and Appalachian Floodplain Systems, Central Interior and Appalachian Riparian Systems, Central Interior and Appalachian Swamp Systems, Eastern Great Plains Floodplain Systems	4
	North - Central Interior Beech - Maple Forest, North Central Interior Maple - Basswood Forest	5
Marginal Soils	0-19	5
	20-39	4
	40-59	3
	60-79	2
	80-99	1
RCP 8.5 Temperature	25.41-26.23	1
	26.24-26.81	2
	26.85-27.32	3
	27.33-27.74	4
	27.75-28.16	5

Table 2 Continued.

RCP 8.5 Precipitation Max	138.9-149.66	1
	149.67-158.62	2
	158.63-165.61	3
	165.62-171.53	4
	171.54-184.62	5
RCP 8.5 Precipitation Min	76.2-84.3	1
	72-76.19	2
	69.13-71.99	3
	67.03-69.12	4
	59.66-67.02	5
Protected Areas Database	1 mi	5
	2 mi	4
	3 mi	3
	4 mi	2
	5 mi	1
National Land cover	Barrens	1
	Evergreen	2
	Deciduous / Mixed Forest/ Shrubland	3
	Wetlands	4
	Cropland/Grassland	5

Model Development

All reclassified layers were summed using the Raster Calculator tool in ArcMap (Figure 16). The addition of a Protected Areas Database(PAD) easement raster was necessary to discard those areas already enrolled or being managed via conservation plans from the output analysis. This intermediate raster was created from the original PAD easement polygon feature, then reclassified to –999 for easement areas and 0 for all other areas within the raster extent. Including this layer with the other 10 layers previously discussed highlighted the conservation easements by assigning a negative value in the resulting output raster but did not influence the other pixel values of interest.

Identifying Parcels of Conservation Interest

The top 10% of pixels, those totaling 45-50, were extracted from the output raster for each analysis. Those pixels were then converted to a polygon feature and used as a source layer to select intersecting Indiana parcels. This process was performed via "select by location" using the pixel polygon as the source feature and the parcels as the target feature. Illinois areas of interest were found using Public Land Survey System (PLSS) sections in the absence of parcel data. Selected parcels or sections were then exported to their own feature class.

Figures

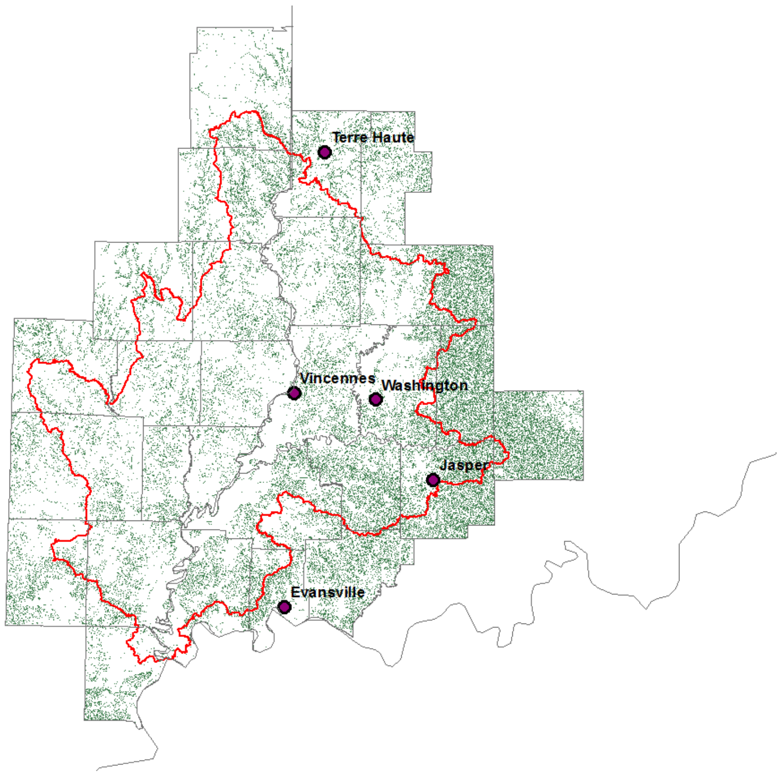

Figure 5. Lowlands of the AOI.

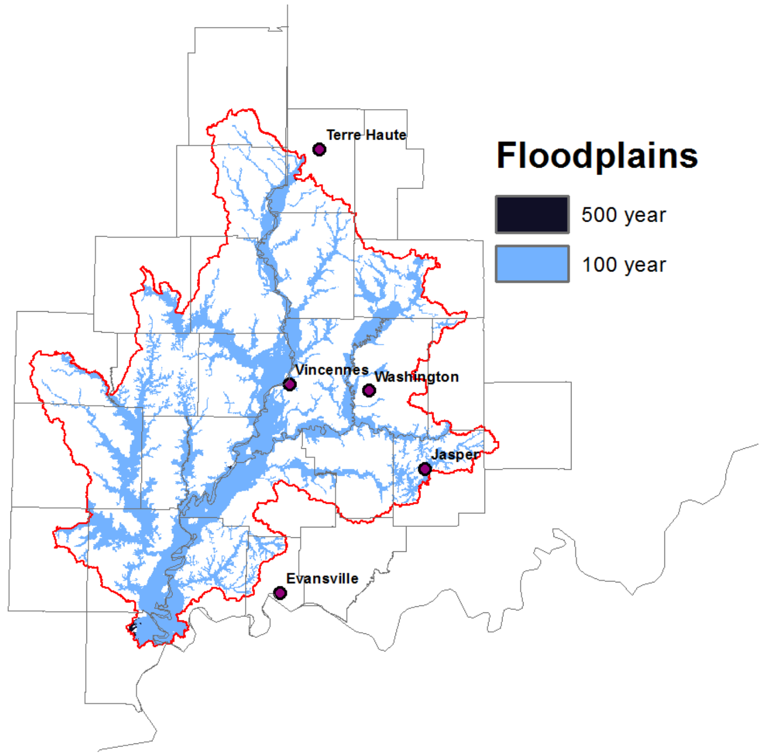

Figure 6. Floodplains in the AOI.

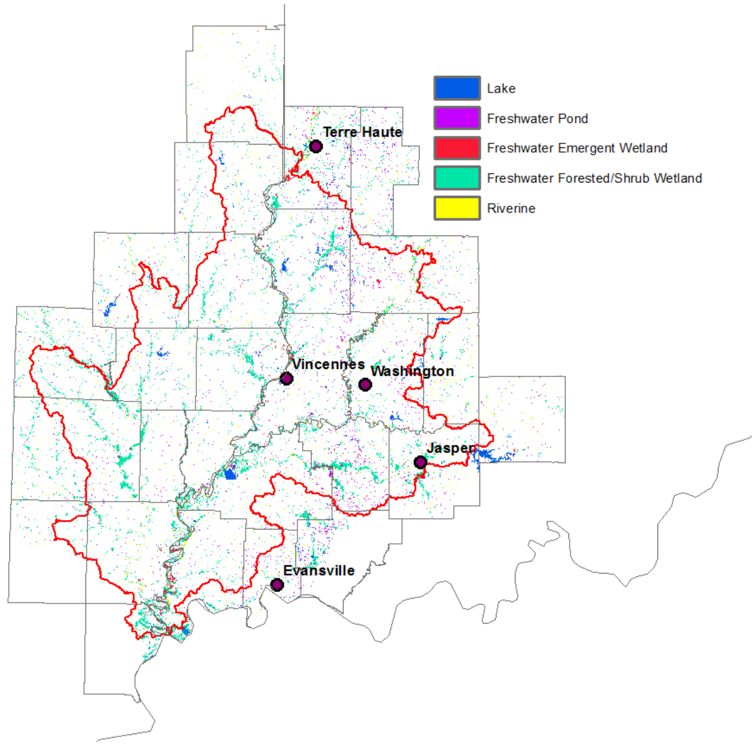

Figure 7. Wetlands located in the AOI.

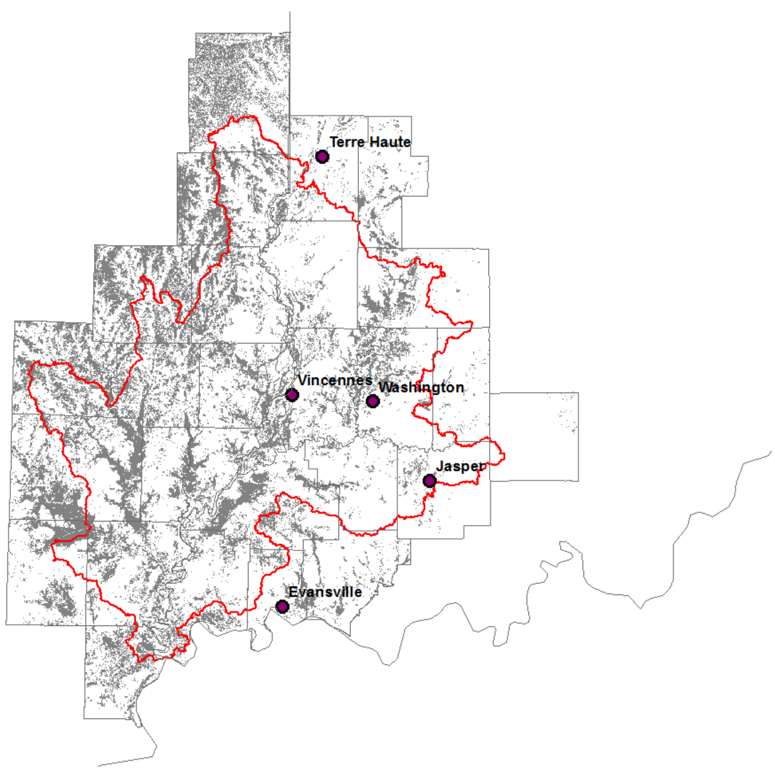

Figure 8. Poorly drained soils in the AOI.

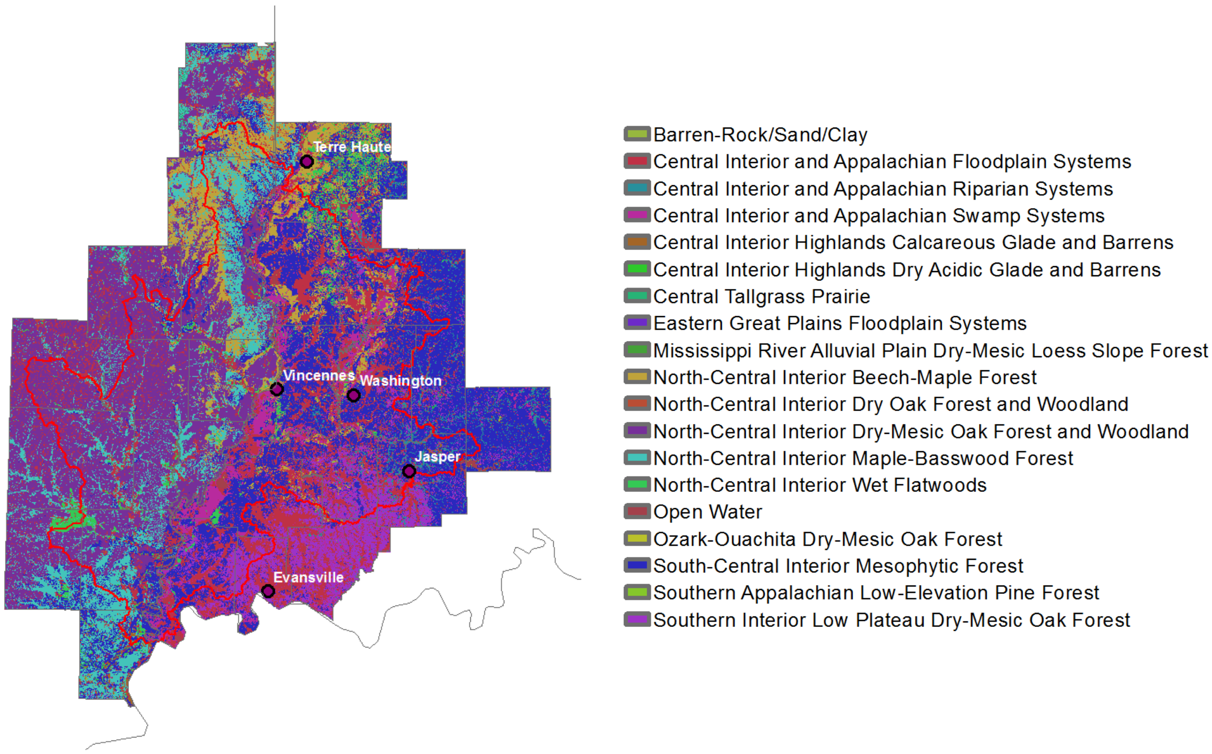

Figure 9. Environmental site potential featuring projected vegetation communities in the AOI.

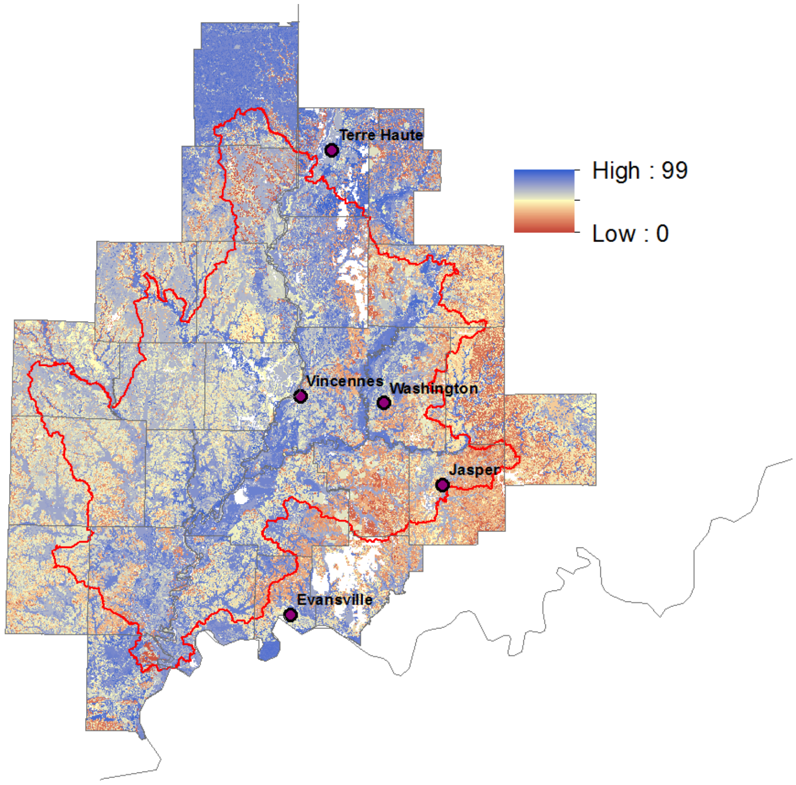

Figure 10. Marginal soils of the AOI.

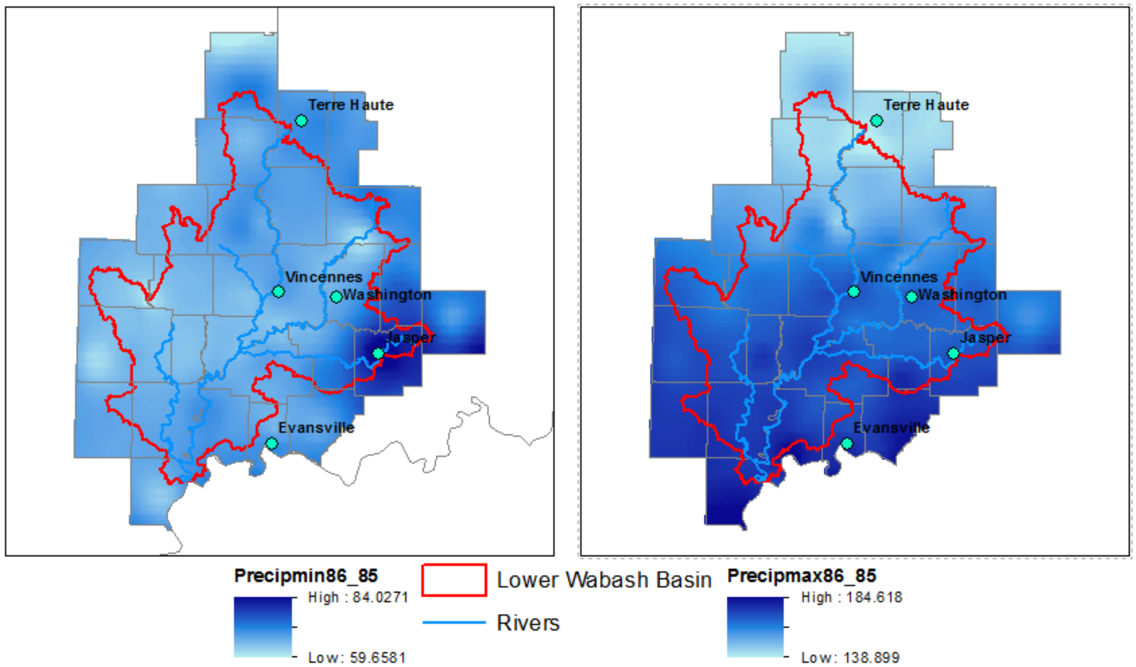

Figure 11. RCP 8.5 projected monthly minimum precipitation (left) and maximum precipitation (right) for the year 2086 (mm).

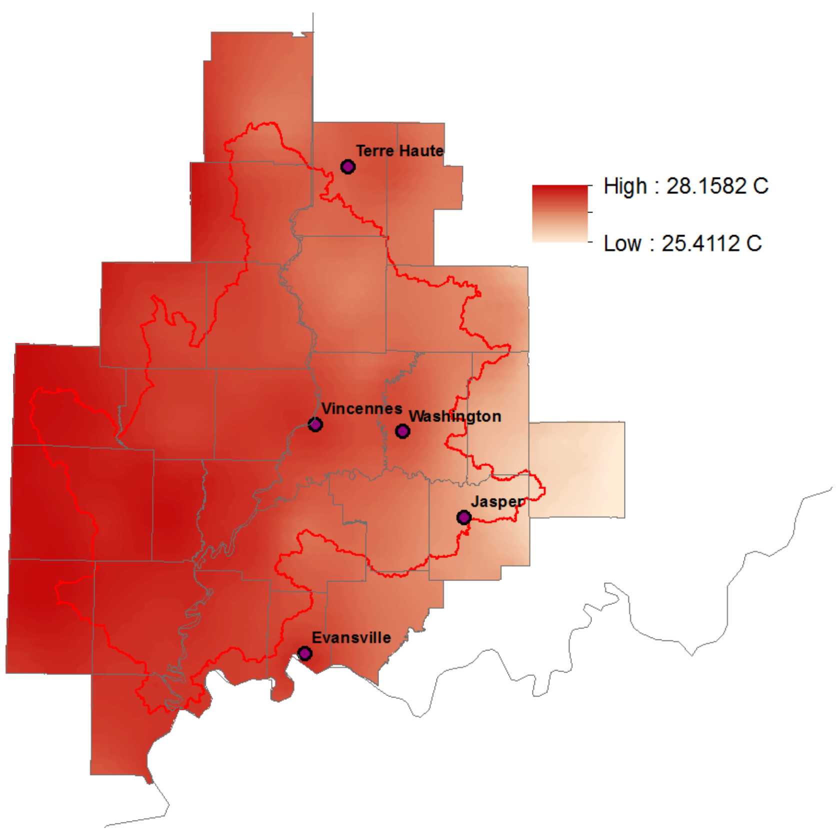

Figure 12. RCP 8.5 projected monthly maximum temperatures for the year of 2086 (°C).

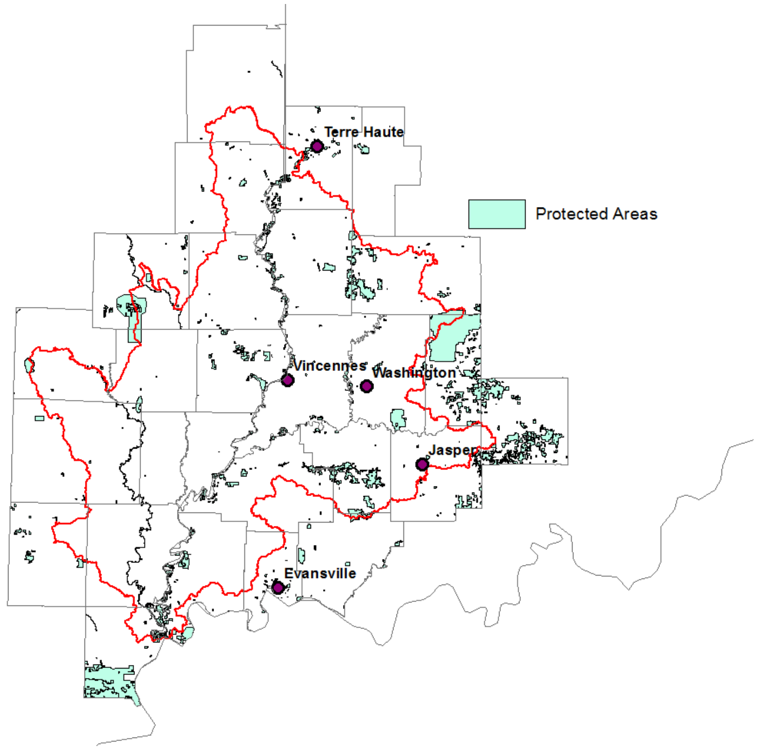

Figure 13. Protected Areas Database (PAD-US) easements in the AOI.

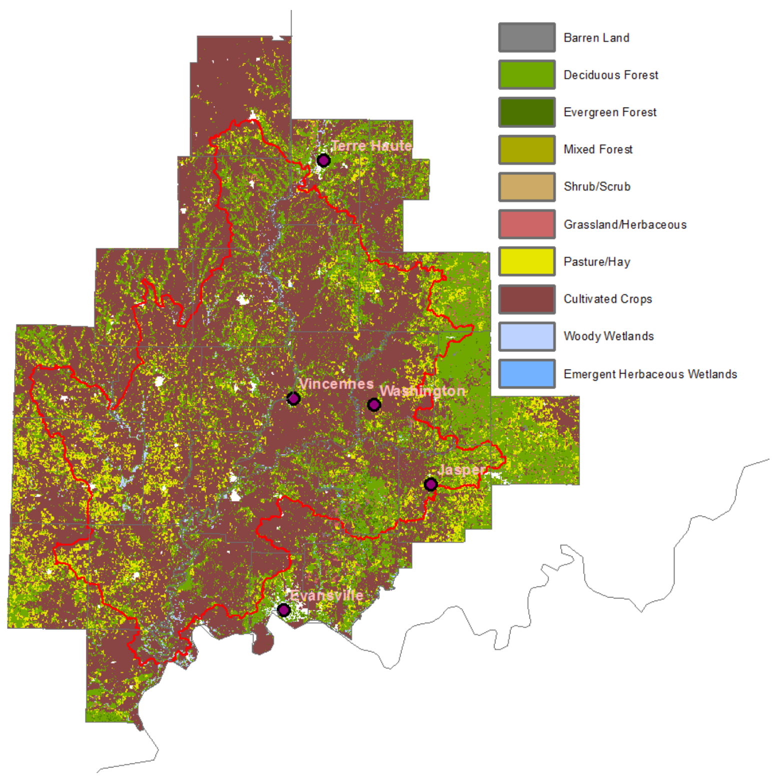

Figure 14. National land cover classifications in the AOI.

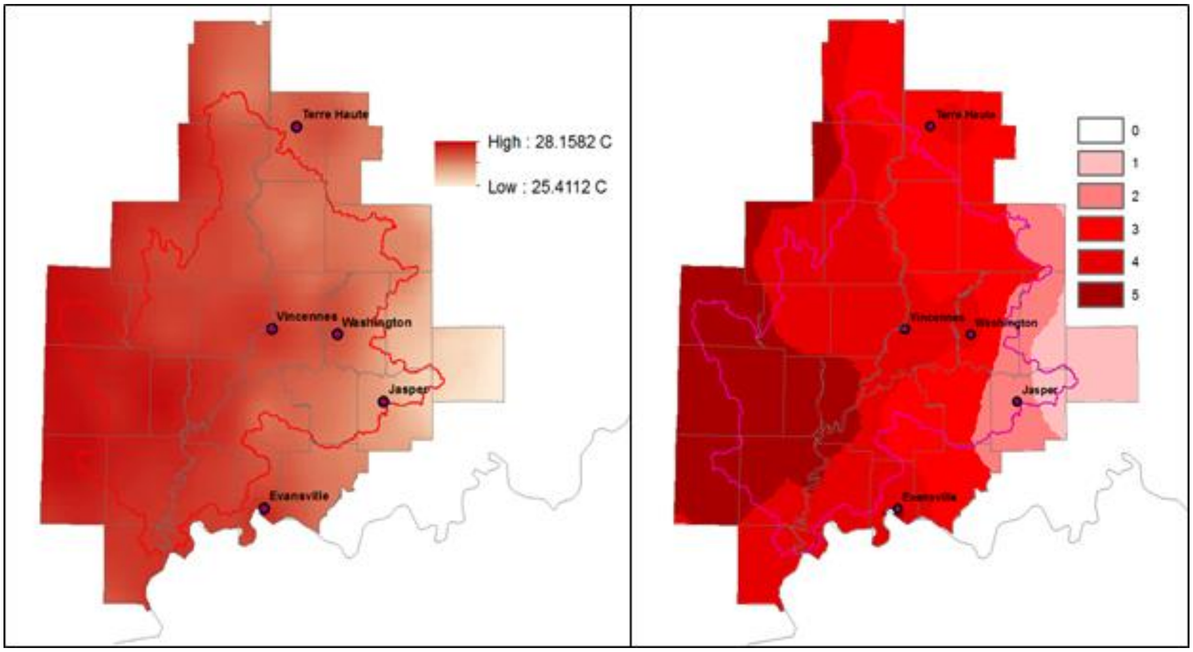

Figure 15. Reclassification of RCP 8.5 temperature projection.

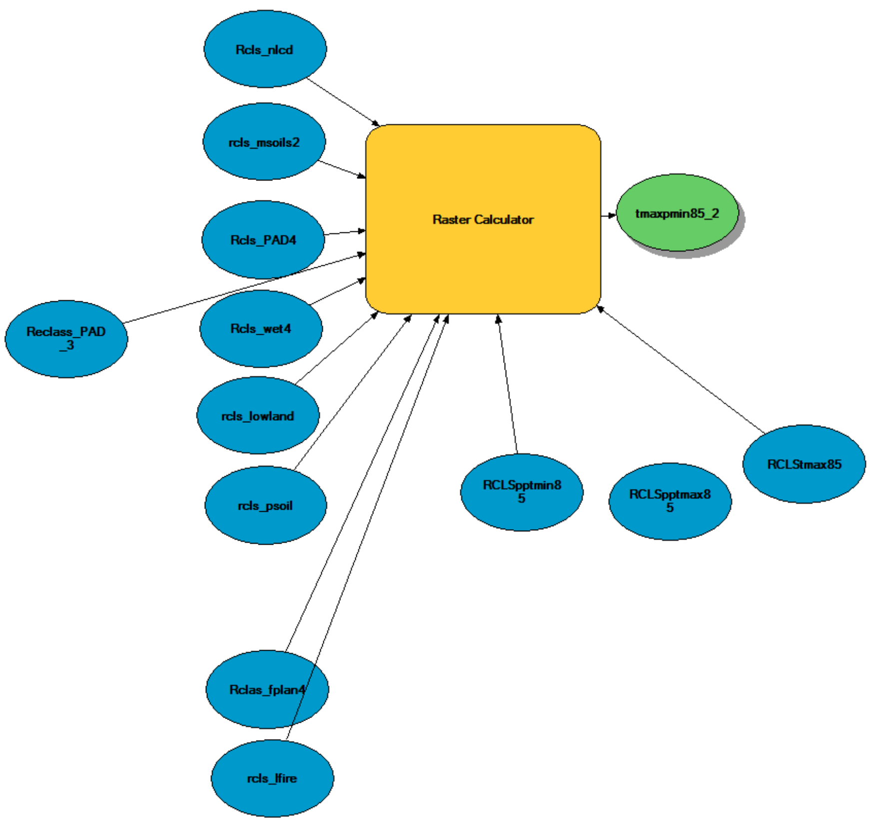

Figure 16. Model builder representation of raster calculator tool for output analysis

Data Dictionary

Dataset Title	Filename	Type	Metadata Description	Source	Theme	Date Created
Lower Wabash Basin	Wabash_Basin	polygon	Lower Wabash Basin (Landscape conservation Design project extent) derived from WBD HUC-10 boundaries.	USGS	Basemap	2012
U.S. Counties	Counties	polygon	U.S. Counties represents the counties of the United States in the 50 states, the District of Columbia, and Puerto Rico.	US Census Bureau	Basemap	2015
River Segments of Interest - Lower Wabash LCD	LowWash_ERF1_v2_1k_Abrdgd_1	line	River segments of interest to the Lower Wabash Landcape Conservation Design (LCD) team.	USGS	Basemap	2003
HUC-10 Watersheds - Lower Wabash	LoWash_HU10	polygon	Lower Wabash HUC-10 boundaries.	USGS	Basemap	2012
Indiana and Illinois State Boundaries	IN_IL	polygon	Illinois and Indiana borders derived from USA States	US Census Bureau	Basemap	2015

Cities	Cities	point	Locations of cities within United States with populations of 10,000 or greater (based on Census 2010 figures), all state capitals, and the national capital. Its layers symbolize the cities by population class (based on 2014 population) using manual classification method	ESRI	Basemap	2016
Gridded SSURGO - Poorly Drained Soils	Poorly_Drained_Soils	raster	Mississippi River Basin Gridded SSURGO mapunits where "drclassdcd" (Drainage Class - Dominant Condition) is poorly or very poorly drained.	USDA	Soil	2014
Reclassified Poorly Drained Soils	rcls_psoil	raster	This dataset is the poorly drained soil in the AOI, derived from the Gridded SSURGO - Poorly Drained Soils dataset; Reclassed to 5 Classes ranging in value from 1-5; no data set to 0	USDA	Soil	2014

Gridded SSURGO - Cropland Productivity Index (Overall) X 100	Soil_Productivity	raster	The Gridded SSURGO National Commodity Crop Productivity Index (NCCPI), version 2.0, arrays soils according to their inherent capacity to produce dryland (nonirrigated) commodity crops.	USDA	Soil	2014
Reclassified Crop Productivity Index	rcls_msoil4	raster	This dataset is the marginal soils in the AOI, derived from the Gridded SSURGO - Cropland Productivity Index (Overall) X 100; Reclassed to 5 Classes ranging in value from 1-5; no data set to 0	USDA	Soil	2014
Landfire - Environmental Site Potential (v1.2.0)	Wbash_Landfire	raster	The Environmental Site Potential (ESP) layer represents the vegetation that could be supported at a given site based on the biophysical environment within the Mississippi River Basin.	USGS	Habitat	2010

Reclassified Landfire Potential	rsmp_lfire_30.tif	raster	Environmental site potential for the AOI, derived from Landfire - Environmental Site Potential (v1.2.0);Reclassed to 5 Classes ranging in value from 1-5; no data set to 0	USGS	Habitat	2010
Land cover	landcover	raster	National Land Cover Dataset; most recent national land cover product created by the Multi-Resolution Land Characteristics (MRLC) Consortium; 30m spatial resolution	USGS MRLC	Habitat	2011
Reclassified Land cover	rcls_nlcd	raster	National Land Cover Dataset; most recent national land cover product created by the Multi-Resolution Land Characteristics (MRLC) Consortium; 30m spatial resolution; Reclassed to 5 Classes ranging in value from 1-5; no data set to 0	USGS MRLC	Habitat	2011

Lowlands	lowlands	raster	Low-lying areas (1-acre minimum) within the MRB/GHI Water Quality Priority Zone derived from 30-m NED DEM Topographic Position Index (180-m radius) values less than 1/4 standard deviation below the mean.	Michael Schwartz (served through USGS)	Elevation	2015
Reclassified Lowlands	rcls_lowlands	raster	Low-lying areas (1-acre minimum) within the MRB/GHI Water Quality Priority Zone derived from 30-m NED DEM Topographic Position Index (180-m radius) values less than 1/4 standard deviation below the mean; Values reclassified from 0,1 to 0,5 respectively	Michael Schwartz (served through USGS)	Elevation	2015
PAD_Easements	PAD_easement	polygon	Protected Areas Database of the United States; Edition 1.4; Inventory of protected areas, including public open space and voluntarily provided, private protected areas, identified as an A-16 National Geospatial Data Asset in the Cadastral Theme; Most areas are public lands owned in fee; however, long-term easements, leases, and agreements or administrative designations documented in agency management plans may be included	USGS GAP	Habitat	2016

PAD Easement Buffer	PAD_buffer	polygon	PAD Easement layer with multi-ring buffer in 1-mile increments out to 5 miles	USGS GAP	Habitat	2016
Reclassified PAD Buffer	rcls_Pbuffer	raster	PAD Easement layer with multi-ring buffer in 1-mile increments out to 5 miles; Reclassed to 5 classes ranging from 5 (1-mile from easement) to 1 (5-miles from easement); no data set to 0	USGS GAP	Habitat	2016
Reclassified PAD Easement Raster	Reclass_PAD	raster	PAD Easement raster generated from the original PAD polygon reclassified to binary values of -999 for easements and 0 for all other area; Protected Areas Database Edition 1.4	USGS GAP	Habitat	2016
RCP 2.6 Temperature Data	tminmax86_26	point	Imported XY data points for average monthly temperatures (Celsius) for months April through October from the RCP 2.6 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 4.5 Temperature Data	t89maxmin_45	point	Imported XY data points for average monthly temperatures (Celsius) for months April through October from the RCP 4.5 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 6.0 Temperature Data	t89maxmin_6	point	Imported XY data points for average monthly temperatures (Celsius) for months April through October from the RCP 6.0 scenario for year 2086	National Center for Atmospheric Research	Climate	2012

RCP 8.5 Temperature Data	t89maxmin_85	point	Imported XY data points for average monthly temperatures (Celsius) for months April through October from the RCP 8.5 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 2.6 Precipitation Data	pminmax86_26	point	Imported XY data points for average monthly precipitation (mm) for months April through October from the RCP 2.6 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 4.5 Precipitation Data	pminmax86_45	point	Imported XY data points for average monthly precipitation (mm) for months April through October from the RCP 4.5 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 6.0 Precipitation Data	pminmax86_6	point	Imported XY data points for average monthly precipitation (mm) for months April through October from the RCP 6.0 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 8.5 Precipitation Data	pminmax86_85	point	Imported XY data points for average monthly precipitation (mm) for months April through October from the RCP 8.5 scenario for year 2086	National Center for Atmospheric Research	Climate	2012
RCP 8.5 Temperature Max	tmax86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Maximum average monthly temperature (Celsius) for months April through October for year 2086	National Center for Atmospheric Research	Climate	2016

Reclassified RCP 8.5 Temperature Max	rcls_tx86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Maximum average monthly temperature (Celsius) for months April through October for year 2087; Reclassified into 5 classes using Jenks Natural Breaks; No data was assigned 0	National Center for Atmospheric Research	Climate	2016
RCP 8.5 Precipitation Min	pmin86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Minimum average monthly precipitation (mm) for months April through October for year 2086	National Center for Atmospheric Research	Climate	2016
Reclassified RCP 8.5 Precipitation Min	rcls_pn86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Minimum average monthly precipitation (mm) for months April through October for year 2087; Reclassified into 5 classes using Jenks Natural Breaks; No data was assigned 0	National Center for Atmospheric Research	Climate	2016
RCP 8.5 Precipitation Max	pmax86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Maximum average monthly precipitation (mm) for months April through October for year 2086	National Center for Atmospheric Research	Climate	2016

Reclassified RCP 8.5 Precipitation Max	rcls_px86_85	raster	Inverse Distance Weighted (IDW) interpolation for RCP 8.5 Maximum average monthly precipitation (mm) for months April through October for year 2087; Reclassified into 5 classes using Jenks Natural Breaks; No data was assigned 0	National Center for Atmospheric Research	Climate	2016
Temp Max Precip Max 8.5 Scenario	tmaxpmax85_2 (main)	raster	Output raster representing total reclass values for maximum growing season monthly temperature RCP 8.5, maximum growing season monthly precipitation RCP 8.5, Landfire, land cover, wetlands, floodplains, poorly drained soils, soil productivity, PAD easements, easement buffer, and lowlands; values range from 0(low) to 50(high); negative values indicate area already enrolled/managed for conservation; 30m spatial resolution	Capstone	Analysis	2016
Temp Max Precip Min 8.5 Scenario	tmaxpmin85_2 (main)	raster	Output raster representing total reclass values for maximum growing season monthly temperature RCP 8.5, minimum growing season monthly precipitation RCP 8.5, Landfire, land cover, wetlands, floodplains, poorly drained soils, soil productivity, PAD easements, easement buffer, and lowlands; values range from 0(low) to 50(high); negative values indicate area already enrolled/managed for conservation; 30m spatial resolution	Capstone	Analysis	2016

Parcels within Indiana Scoring in top 10% of analysis: Temp Max Precip Max 8.5	txpx85_10par_3	polygon	Parcels within Indiana Scoring in top 10% of analysis: Temp Max Precip Max 8.5; values 45-50	Capstone	Analysis	2016
Parcels within Indiana Scoring in top 10% of analysis: Temp Max Precip Min 8.5	txpn85_10par_3	polygon	Parcels within Indiana Scoring in top 10% of analysis: Temp Max Precip Min 8.5; values 45-51	Capstone	Analysis	2016
Indiana Parcels	In_parcels (parcel ID)	polygon	Indiana county land parcels	IDHS	Reference	2015
Illinois Public Land Survey System Sections	IN_PLSS_clip (main)	polygon	Illinois Public Land Survey System (PLSS) boundaries and designations in line and polygon feature classes; attribute data include meridian, township, range, section and county number (FIPS) designations	ISGS	Reference	1985
Wetlands	allmergeproject	polygon	Extent, status, and location of National Wetland Inventory wetland mapping projects for NWI Version 2, Surface Waters and Wetlands; includes type and date of imagery used to map the wetlands and a link to a document about specific mapping techniques and habitat information	USFWS NWI	Habitat	2016

Wetlands Raster	allmergeraster	raster	Extent, status, and location of National Wetland Inventory wetland mapping projects for NWI Version 2, Surface Waters and Wetlands; includes type and date of imagery used to map the wetlands and a link to a document about specific mapping techniques and habitat information; 30m spatial resolution	USFWS NWI	Habitat	2016
Reclassified Wetlands Raster	Reclass_wetlands	raster	Extent, status, and location of National Wetland Inventory wetland mapping projects for NWI Version 2, Surface Waters and Wetlands; includes type and date of imagery used to map the wetlands and a link to a document about specific mapping techniques and habitat information; 30m spatial resolution: See Table X for Reclass	USFWS NWI	Habitat	2016
Floodplains	fplain_prjt	polygon	Merged polygon of Indiana and Illinois 100 year and 500 year flood zones; Federal Emergency Management Agency (FEMA) National Flood Insurance Program (FIRM) maps and Flood Hazard Boundary maps	ISGS; FEMA FIRM	Habitat	2005
Reclassified Floodplains	Reclass_floodplains	raster	100 year and 500 year flood zones; Federal Emergency Management Agency (FEMA) National Flood Insurance Program (FIRM) maps and Flood Hazard Boundary maps	ISGS; FEMA FIRM	Habitat	2005