

white RIVER PLAN

HAMILTON CO.  INDIANAPOLIS

Task Three: Hydrology, Water Quality & Ecology

In this task, the team developed an understanding for existing conditions of the ecology and hydrology the White River. The team evaluated water quality, hydrology, and the native ecology of the White River, and made recommendations to improve these aspects.

The following pages detail our understanding of the current conditions and plans for the river.

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RECONNECTING TO OUR WATERWAYS

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**TASK THREE: HYDROLOGY, WATER QUALITY
& ECOLOGY**

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Hydrology Capacity, Flows, and Flooding

Historic Flooding – White River

Flooding is the most commonly encountered natural process that people can experience as a natural disaster. Almost every community has experienced some kind of flooding. Flooding and associated flood damages are prevalent in the springtime because heavy rains combine with melting snow. If soils are already saturated, however, intense, brief rainfalls during summer thunderstorms can produce damaging flash floods. Floods can rise slowly or quickly, but generally develop over a period of days.

The flood of March 1913 stands as the “flood of record” for central Indiana – it was larger than any known flood, before or since. It devastated much of the region and left thousands homeless. While a flood of that scale has not happened since, more intense

storm events are becoming more common as the climate changes. Historical flood data recorded at the White River streamgage at Nora in Indianapolis shows an increase in the frequency of moderate to major flood events since 2000. A moderate flood typically occurs every ten years. In comparison, the 1913 flood established the 100-year flood event. The most recent large floods, estimated as between 10- and 25-five-year events, occurred in July 2003, January 2005, and April 2013. These floods resulted in multiple road closures and flood damage to property and infrastructure in low-lying areas.

Researchers at the Indiana Climate Change Impact Assessment (IN CCIA) predict that, by 2050, total annual rainfall will increase eight percent statewide, compared to the historical average. Rainfall is not expected to be evenly distributed; instead, twenty-five percent of the increase will happen in winter and twenty percent in the spring. Both minor and moderate flood-stage events are also

becoming more frequent. In the thirty flood impact areas along the White River, it is not uncommon in any year for some streets to flood and water to surround buildings. Areas in the floodplain will experience more flood events each decade as this trend continues.

Future Hydrology

VIEW OF THE NEXT 30 YEARS (2050)

Who?

Indiana Climate Change Impact Assessment (IN CCIA)

What?

The hydrologic or water cycle describes the continuous movement of water on, above, and below the earth's surface through the process of evaporation, condensation, precipitation, and runoff/collection. Climate change is likely to cause this cycle to speed up as air temperatures increase and more water evaporates into the air. Warmer air can hold more water vapor, which can lead to more intense rainfall and cause flooding.

Current and Projected Rainfall Trends:

- **Total Annual Precipitation:** Over the past 120 years, the annual depth of rainfall has increased fifteen percent, or about 5.6 inches. Over the next thirty years, the pace of this increase will quicken; annual precipitation is expected to increase an additional six to eight percent. From 1895 to 1959, the state gained 0.32 inches of rain per decade. Since then, the rate has increased to 1.33 inches per decade, a four-fold increase.
- **Seasonal Precipitation:** According to IN CCIA, it is predicted that Indiana will experience a twenty-five percent increase in winter precipitation and twenty percent in the spring, with a five percent decrease in summer and fall precipitation. The extent of dryer periods during summer and fall is more of a challenge to examine, though notably less rainfall is anticipated during these seasons.
- **Storm Intensity/Extreme Events:** The most extreme rainfall events, defined as the top one percent daily total rainfall occurrences on record, are occurring more frequently and trending to continue doing so. IN CCIA has initially estimated that a one- to two-day increase in the average number of days per year with extreme precipitation is likely. Regional observations have also indicated more intense storms, with a forty-two percent increase in the amount of rain falling during these extreme events.

In short:

- Annual rainfall totals are increasing each year on average.
- Rainfall is likely to be more abundant in the winter and spring seasons, with drier conditions in the summer and fall.
- Extreme events are likely more intense with greater water falling within a particular storm.

LAND USE CHANGES IN THE WHITE RIVER WATERSHED:

Impervious land cover prevents natural soil infiltration, and increases stormwater runoff volume, velocity, and pollutant loadings. Paving and building over natural ground reduces what can be absorbed into the soil, and quickens runoff flowing to the White River and its tributary streams. The sub-watersheds in both Hamilton and Marion County are expected to increase in impervious cover up to five percent by 2050. This would increase impervious cover in urban areas up to thirty-five percent on average, while rural areas would likely increase more slowly as they maintain a low level of impervious cover.

IMPACTS OF CHANGES IN RAINFALL AND LAND USE IN THE WHITE RIVER:

- Water surface elevations during major flood events are estimated to increase by 0.5 feet, to 4.0 feet (2.3 feet on average). Increases to flood elevation will likely prompt expansion of the regulatory 100-year floodplain boundaries. (Note: Elevation impacts are very difficult to determine with current hydraulic models

of the White River. The noted elevations are reflective of likely trend in impact, but specific numbers should be used with caution.)

- Water discharges during floods are expected to increase by twenty to forty percent.
- Increased rainfall in the winter and spring is a particular concern for both flooding and water quality conditions, since the ground may be frozen and there is limited vegetation to intercept and absorb pollutants.
- Decreased precipitation in the summer and fall will impact aquatic and wildlife populations, as well as pollutant loads in streams.
- More severe drought conditions in the summer and fall seasons are likely.
- Water quality is impacted by impervious surface increases. Based on research by The Center for Watershed Protection, watersheds with ten to twenty-five percent of connected impervious surfaces show signs of degraded or impacted streams and cannot support high-quality stream ecosystem.

Why?

Potential specific future impacts include infrastructure (dams, levees, bridges, and roads, as well as water supply for industry, power plants, and drinking could be impacted), ecosystems (aquatic and terrestrial habitats could be degraded), flood impact areas (low-lying areas prone to flooding and additional

areas may require flood insurance coverage), and water quality (increased runoff, including contaminated runoff, may impact previous efforts to improve water quality). It may also be challenging to administer/comply with regulatory programs (i.e. NPDES permits and TMDLs) in low-flow conditions.

So What?

There are many challenges for the future of the river, including greater and more severe flooding, changes for aquatic life, and overall water quality. More extreme storm events will occur, and it is not a matter of whether the White River will be impacted, but rather when. New challenges will result from the more intense rains. While we continue to expand our built environment, we need to take measures to alleviate the effects of the changing climate. By understanding current trends, and employing sustainable and reasonable solutions, we can minimize the adverse impacts of increased precipitation.

Flood Impacts

Flood Hazard Areas - Floodplains

Who?

FEMA 2014 (Hamilton County) and 2016 (Marion County)

What?

The floodplain is defined as the channel and the area adjoining any wetland, lake, or watercourse which may be covered by the regulatory flood (one percent annual exceedance probability or 100-year floodplain). The regulatory flood (roughly six inches of rain in twenty-four hours) is the basis for FEMA's Flood Insurance Rate Maps (FIRMs) which identifies the floodway, 100-year, 500-year, and approximate stream studies or Unnumbered Zone A. In Indianapolis, the FIRM includes an additional category for areas with reduced flood risk due to levees. For flood insurance purposes, each of these areas has a flood risk premium associated with it.

Why?

Floodplains are subject to periodic inundation that may result in loss of life and property, health and safety hazards, disruption of

business and government services, and public expenditures for flood protection, response and recovery. All of these factors adversely affect the public health, safety, and general welfare of Noblesville, Carmel, Fishers, Hamilton County, Indianapolis, and the state of Indiana. There are approximately 6,500 buildings at risk of flooding, flood damage, and flood-related losses in the study area. Of these at-risk structures, 1,400 are in Hamilton County and 5,100 in Indianapolis.

So What?

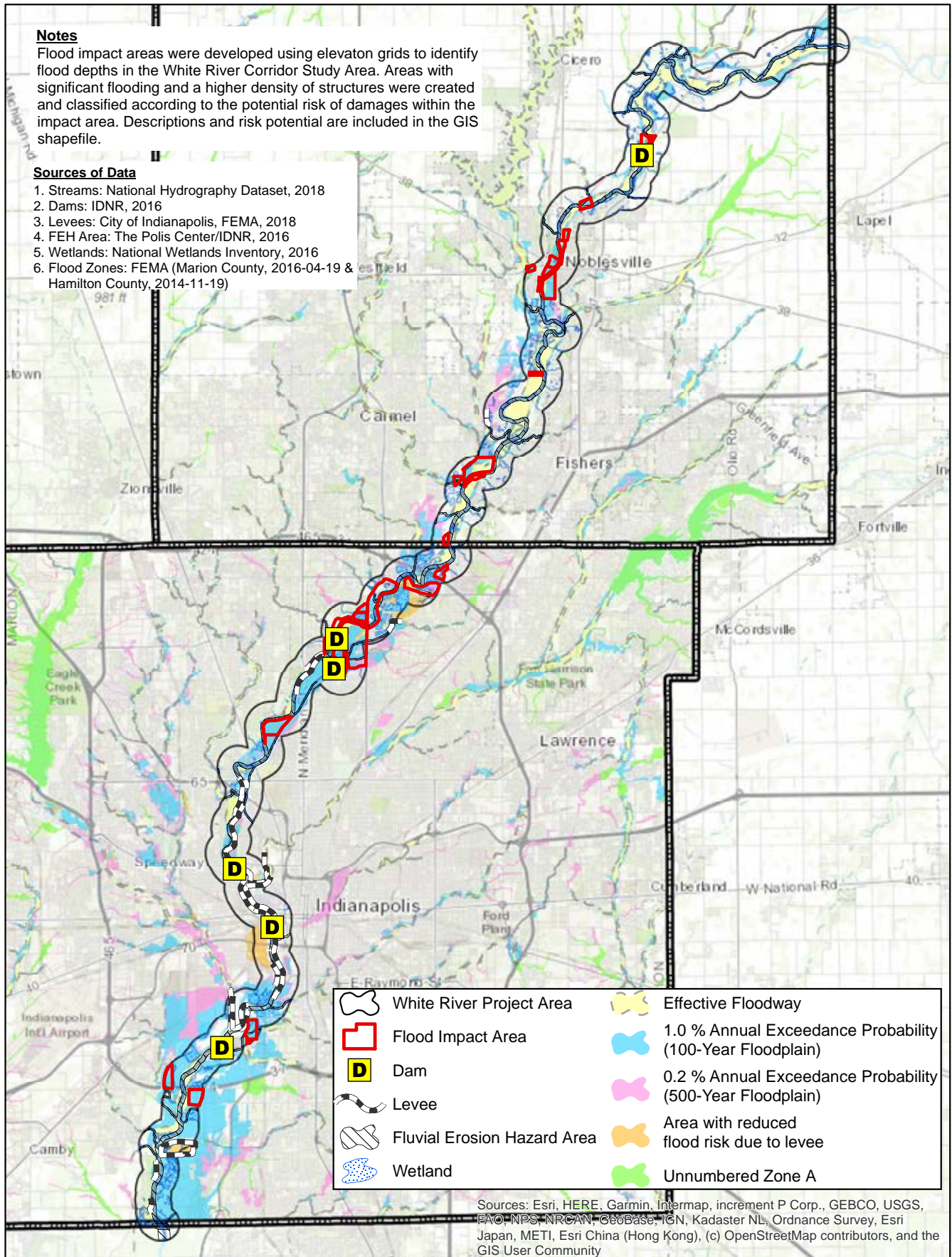
Flood losses are caused by the cumulative effect of obstructions in floodplains, which increase flood heights and velocities. Within flood hazard areas, there are many land uses which create vulnerabilities, such as hazardous materials within lands which are inadequately elevated, inadequately flood-proofed lands, or lands otherwise unprotected from flood damages. Development and land alteration in the floodplain contributes to additional flood heights and velocities, and should be discouraged. Each of the communities in the study area have adopted compensatory storage requirements in their flood ordinances to maintain the natural and beneficial functions of the floodplain.

Notes

Flood impact areas were developed using elevation grids to identify flood depths in the White River Corridor Study Area. Areas with significant flooding and a higher density of structures were created and classified according to the potential risk of damages within the impact area. Descriptions and risk potential are included in the GIS shapefile.

Sources of Data

1. Streams: National Hydrography Dataset, 2018
2. Dams: IDNR, 2016
3. Levees: City of Indianapolis, FEMA, 2018
4. FEH Area: The Polis Center/IDNR, 2016
5. Wetlands: National Wetlands Inventory, 2016
6. Flood Zones: FEMA (Marion County, 2016-04-19 & Hamilton County, 2014-11-19)



Flood Impact Areas (FIA)

Who?

Noblesville Flood Response Plan 2016, Indianapolis Flood Response Plan 2018, and CBBEL analysis of flood depths on the White River both north and south of Noblesville in Hamilton County.

What?

Flood Impact Areas (FIA) were developed to show roads and buildings impacted by flooding during the 10-, 50-, 100-, and 500-year flood frequencies.

Why?

Emergency managers use these maps to identify road closures, flood-safe routes, areas for evacuations, and shelter locations.

So What?

In the White River corridor, there are two FIAs in Hamilton County (north of Noblesville), eleven FIAs in Noblesville, three FIAs in Carmel, one FIA in Fishers, and 13 FIAs in Indianapolis. In total there are approximately seventy-five commercial/industrial buildings and 2500 residential buildings in high potential flood risk areas. These areas will likely be inundated by flood waters to the extent that structures will be flooded, and human life and safety will be at risk. Most of these buildings impacted are in Indianapolis. Any enhancements to these areas to improve access or connection with the river should take flood risk into account.

Fluvial Erosion Hazard (FEH) or Stream Meander Zone

Who?

The Polis Center/IDNR 2016

What?

Fluvial Erosion Hazard (FEH) is the area within which the river needs to move to maintain physical and geomorphic equilibrium. Rivers that are not in equilibrium experience a faster rate of erosion than rivers that are in equilibrium. How quickly the river moves within the FEH is determined by local geology, sediment load, slope, vegetation, and land use. The Polis Center and IDNR have defined the FEH boundary for many of the rivers in Indiana. The intent of this work is for communities to adopt FEH avoidance strategies to avoid risk, with measures including setbacks and no-disturbance policies.

Why?

The FEH area is especially important during a flood event, since this is where the stream is most powerful and the greatest damage will occur to property, utilities, and infrastructure.

So What?

As it flows through Hamilton and Marion Counties, The White River is considered to be relatively stationary. The FEH corridor width was calculated using three times the river's bankfull width or 100 feet – whichever is greater – on either side. Within this defined FEH there are buildings, utilities, and critical infrastructure. It should be noted that this area has only recently been defined as a result of advancements in stream morphology and flood risk reduction strategies. Moving forward, the FEH and floodway should be protected by setbacks and no-disturbance policies including fill, excavation, buildings, utilities, and infrastructure.

Wetlands

Who?

National Wetland Inventory (NWI) 2016

What?

The NWI, assembled by the US Fish and Wildlife Service (FWS), provides information on the types and distribution of wetlands nationwide. The intent is to promote the understanding, conservation, and restoration of wetlands. There are roughly 20,000 acres of wetlands within a half mile of the White River in Hamilton and Marion Counties including one percent freshwater emergent wetland; six percent freshwater forested/shrub wetland; three percent freshwater pond; eight percent lake; and eighty-two percent riverine.

Why?

Wetlands have social, economic, and ecological benefits. They provide valuable habitat for fish, wildlife, and plants; clean drinking water; recharge groundwater; reduce flooding; and support recreational activities. While nearly eighty-five percent of Indiana's natural wetlands have been lost to development and agricultural practices, IDEM, DNR, and NRCS all administer programs to protect and restore this valuable resource.

So What?

Freshwater forested/shrub wetland and emergent wetlands can be found along the

lower reaches of rivers and around freshwater lakes that are inundated permanently or seasonally with freshwater. These areas provide value as a food source for wildlife, storage during flood events, and recreational opportunities. In the project study area, these types of wetlands can be found throughout most of Hamilton County, as well as the northern and southern reach of the White River in Marion County.



Water Quality Analysis and Mapping

Historic Water Quality – White River

According to the Long-Term Control Plan for the City of Indianapolis, from 1900 through the mid-1970s, published reports document extremely poor water quality conditions in the White River due to inadequate wastewater treatment, industrial pollution, sewage overflows, and upstream land use in urban and rural areas.

Urbanization played a role as hard surfaces such as concrete and asphalt replaced forests and fields. This allowed more pollutants to be washed into streams during rainstorms. Pollutants such as petroleum products from automobiles, litter, and pet wastes are flushed off the urban landscape and into storm sewers, which directly deposit these materials into sewers and streams and eventually into the White River.

Agricultural activities have also impacted water quality in many of the outer reaches of the watershed. Tillage and manure application practices can be large contributors of pollutants. As landowners become more aware of their impacts and as programs become available, these practices are changing. Conservation tillage reduces the sediment and phosphorus loads to waterways. Manure application practices have evolved to reduce the potential for bacteria and polluting nitrogen to leave the fields.

In recent years, the communities near the WRVP study area have been leaders in stormwater management ordinances that protect channels and floodplains during storms. Many groups have also implemented projects such as tree plantings, green infrastructure practices, and conservation agricultural practices in an effort to protect the stream and habitat along the River. Efforts such as these are designed to increase water purity; increase the stream's habitat and overall ability to support fish and macroinvertebrates; and provide a cleaner and more beautiful environment for residents and visitors.

Summary of Pollutants of Concern:		
POLLUTANT	SOURCE	CONCERN
MERCURY	Natural, household or industrial wastes, atmospheric deposition	Effects on brain and kidney tissue; concerns for fetal development
POLYCHLORINATED BIPHENYLS (PCBS)	Cooling fluids, transformers, accumulations in sediment	Effects such as various cancers and damages to human health systems such as immune, reproductive, nervous, and endocrine
BACTERIA	Wastewater treatment plants, failing septic systems, wildlife, pets	Indicates potential presence of other pathogens or diseases that may sicken people
SEDIMENT	Construction sites, cropped fields	Destruction of fish and macroinvertebrate habitat and food sources; carries other pollutants, such as phosphorus
NUTRIENTS (NITROGEN/ PHOSPHORUS)	Fertilized lawns, cropped fields, wastewater treatment plants, failing septic systems, industrial discharges	Increases algal growth, which may then lead to dramatic swings in oxygen levels in the water system; nitrogen over 10 ppm causes “blue baby syndrome”, a dangerous condition for infants

Many efforts have focused on improving water quality, through planning efforts and implementation of projects, on individual lots and throughout watersheds.

Water quality pollutant loadings for Hamilton and Marion counties were estimated using the Long-Term Hydrologic Impact Analysis (LTHIA) tool. LTHIA is a GIS-based desktop analysis developed by Purdue University that estimates change in recharge, runoff, and nonpoint source pollution including nitrogen, phosphorus, total suspended solids (TSS), and biological oxygen demand (BOD) based on land use, soil, and climate data. LTHIA's results are somewhat generalized since it considers the entire watershed however, it is one of the better desktop tools for estimating pollutant loadings and runoff volume for current and future land use. For ease of understanding, pollutant loadings are categorized into broad categories of good, acceptable, fair and poor. These rankings are used by IDEM, IUPUI Center for Earth and Environmental Sciences (CEES), and/or Ohio EPA.

In addition to the LTHIA analysis, current and future land use was used to estimate impervious cover. Percent impervious is a common indicator of stream health and, according to the Center for Watershed Protection findings, is classified into the following:

- Sensitive Stream (watershed is 1-10% impervious) – water may be warmer and slightly polluted, erosion may be evident, most rare and endangered species absent, few insect species
- Impaired Stream (watershed is 11-25% impervious) – warmer water, erosion usually obvious, rare species absent, pollution tolerant insects only
- Non-supporting Stream (watershed is 26-100% impervious) - warm water and pollution evident, unstable habitat, non-native species dominate, only pollutant tolerant fish and insects

The watersheds contributing to the White River in Hamilton and Marion counties include Dixon Branch-Eagle Creek, Elm Run-Indiana Creek, Lick Creek, Prairie Creek, Vestal Ditch-White River, Williams Creek Upstream

and Williams Creek Downstream (see map). The following tables summarize the current and future conditions for each of these watersheds.

DIXON BRANCH-EAGLE CREEK WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	296,735 lbs/yr	299,252 lbs/yr
Ranking	Good	Fair
Phosphorus	87,472 lbs/yr	88,231 lbs/yr
Ranking	Good	Fair
TSS	7,410,229 lbs/yr	7,598,953 lbs/yr
Ranking	Fair	Fair
BOD	8.32 mg/L	10.32 mg/L
Ranking	Fair	Fair
Impervious Cover	18%	25%
Stream Health	Impacted	Impacted
Runoff Volume	65,564 ac-ft	73,210 ac-ft

ELM RUN-INDIAN CREEK WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	621,615 lbs/yr	658,190 lbs/yr
Ranking	Poor	Poor
Phosphorus	182,910 lbs/yr	193,752 lbs/yr
Ranking	Poor	Poor
TSS	15,049,385 lbs/yr	15,995,976 lbs/yr
Ranking	Fair	Fair
BOD	3.39 mg/L	3.25 mg/L
Ranking	Acceptable	Acceptable
Impervious Cover	6%	6%
Stream Health	Sensitive	Sensitive
Runoff Volume	85,859 ac-ft	88,349 ac-ft

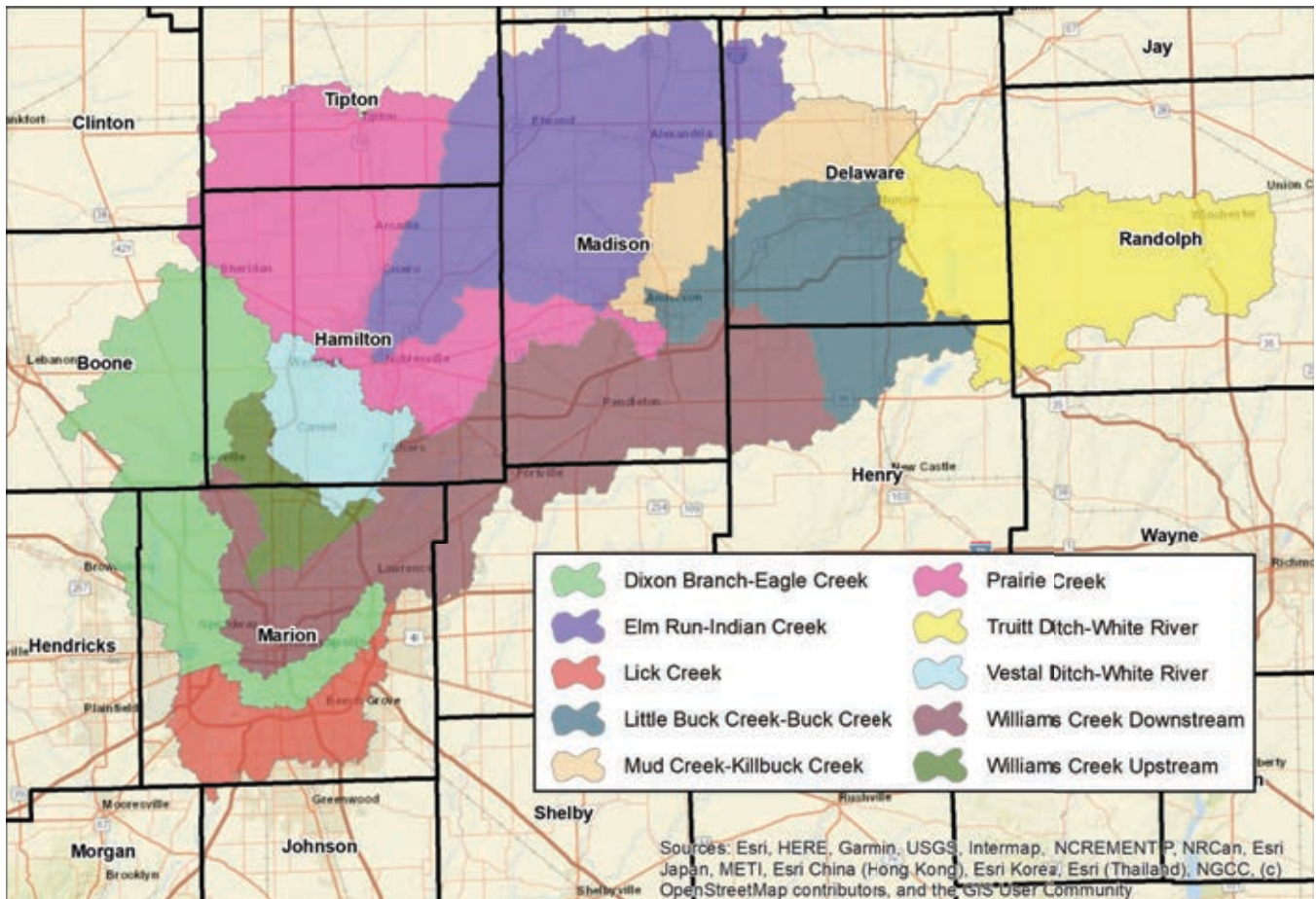
LICK CREEK WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	96,998 lbs/yr	138,001 lbs/yr
Ranking	Fair	Fair
Phosphorus	28,512 lbs/yr	40,548 lbs/yr
Ranking	Fair	Fair
TSS	2,509,160 lbs/yr	3,635,841 lbs/yr
Ranking	Fair	Fair
BOD	17.09 mg/L	20.98 mg/L
Ranking	Poor	Poor
Impervious Cover	30%	40%
Stream Health	Non-supporting	Non-supporting
Runoff Volume	23,942 ac-ft	30,014 ac-ft

PRAIRIE CREEK WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	988,527 lbs/yr	1,022,909 lbs/yr
Ranking	Poor	Poor
Phosphorus	291,833 lbs/yr	302,238 lbs/yr
Ranking	Poor	Poor
TSS	23,978,693 lbs/yr	24,977,572 lbs/yr
Ranking	Fair	Fair
BOD	7.92 mg/L	9.80 mg/L
Ranking	Fair	Fair
Impervious Cover	8%	11%
Stream Health	Sensitive	Impacted
Runoff Volume	78,272 ac-ft	84,705 ac-ft

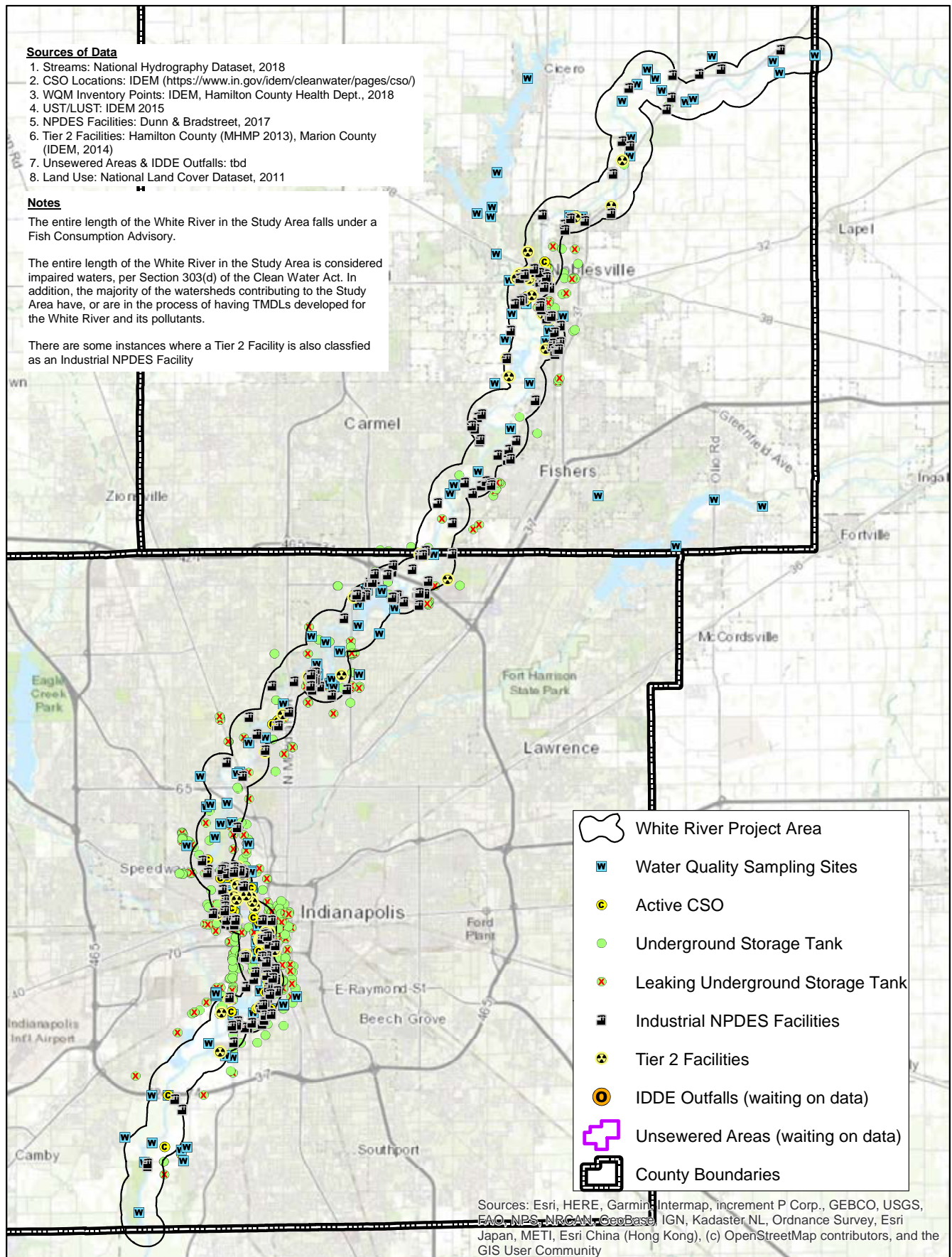
VESTAL DITCH-WHITE RIVER WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	124,512 lbs/yr	144,277 lbs/yr
Ranking	Poor	Poor
Phosphorus	37,251 lbs/yr	43,019 lbs/yr
Ranking	Poor	Poor
TSS	3,042,003 lbs/yr	3,638,843 lbs/yr
Ranking	Fair	Fair
BOD	20.53 mg/L	22.28 mg/L
Ranking	Poor	Poor
Impervious Cover	26%	39%
Stream Health	Non-supporting	Non-supporting
Runoff Volume	20,355 ac-ft	26,295 ac-ft

WILLIAMS CREEK DOWNSTREAM WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	806,812 lbs/yr	821,070 lbs/yr
Ranking	Poor	Poor
Phosphorus	238,519 lbs/yr	243,617 lbs/yr
Ranking	Poor	Poor
TSS	19,661,485 lbs/yr	20,101,805 lbs/yr
Ranking	Fair	Fair
BOD	14.80 mg/L	15.35 mg/L
Ranking	Poor	Poor
Impervious Cover	17%	21%
Stream Health	Impacted	Impacted
Runoff Volume	95,577 ac-ft	104,114 ac-ft

WILLIAMS CREEK UPSTREAM WATERSHED		
NON-POINT SOURCE POLLUTANT	CURRENT CONDITION	FUTURE CONDITION
Nitrogen	74,479 lbs/yr	77,589 lbs/yr
Ranking	Poor	Poor
Phosphorus	22,494 lbs/yr	23,684 lbs/yr
Ranking	Poor	Poor
TSS	1,797,022 lbs/yr	1,865,445 lbs/yr
Ranking	Poor	Poor
BOD	83.35 mg/L	79.47 mg/L
Ranking	Poor	Poor
Impervious Cover	28%	30%
Stream Health	Non-supporting	Non-supporting
Runoff Volume	3,627 ac-ft	5,040 ac-ft



WATERSHEDS DRAINING TO THE WHITE RIVER IN HAMILTON AND MARION COUNTIES. BOUNDARIES CONSOLIDATED BY CBEL



Water Quality Sampling Sites

Who?

Indiana Water Monitoring Inventory (eighty-six sites); Hamilton County Health Department; and Marion County Health Department (forty-eight sites).

What?

Ambient water quality sampling completed for various parameters (metals, sediments, nutrients, *E. coli*, and others) by various groups; as well as monitoring of fish, macro-invertebrates, and habitat (using the Qualitative Habitat Evaluation Index or QHEI).

Why?

The Indiana Water Monitoring Inventory is a clearinghouse for water quality data. Many groups who provide their data to this platform collect ongoing sampling to establish trend data and provide a long-term view of the quality of the water. Groups such as the Health Department collect *E. coli* samples at contact-recreation sites to determine if it is safe for people to be in contact with the water.

So What?

Many samples appear to be below detection limits for metals sampling. *E. coli* levels are exceeding the Indiana State Standard more than half of the time in Hamilton County and routinely in Marion County. Nutrient

levels sampled by the Marion County Health Department, the most consistent effort, appear to be below state benchmarks for phosphorus and nitrogen.

303(d) List of Impaired Streams:

Who?

IDEM Office of Water Quality

What?

Indiana's 303(d) List of Impaired Waters is part of the Integrated Water Monitoring and Assessment Report (IR), which is submitted to the US EPA every two years in accordance with Sections 305(b) and 303(d) of the Clean Water Act (CWA). CWA Section 305(b) requires states to make water quality assessments and provide water quality reports to the US EPA. CWA Section 303(d) requires states to identify waters through their water quality assessments that do not or are not expected to meet applicable state water quality standards with federal technology-based standards alone. Under CWA Section 303(d), states are also required to develop a priority ranking for these waters, taking into account the severity of the pollution and the designated uses of the waters.

Why?

Once this listing and ranking of impaired waters is completed, states are required

to develop Total Maximum Daily Loads (TMDLs) for these waters in order to achieve compliance with the water quality standards.

So What?

The entire mainstem of White River and numerous tributaries are listed on the 303(d)-list due to *E. coli* and PCBs (in fish tissue), with smaller segments listed for nutrients and Impaired Biotic Communities (IBCs). This information assists watershed groups and municipalities in developing efficient actions regarding water quality. With a TMDL and the majority of waterbodies on the 303(d) list, the abundance of *E. coli* present in the White River and its tributary stream is further highlighted.

Total Maximum Daily Load (TMDL)

Who?

IDEM Office of Water Quality

What?

A Today Daily Maximum Load (TMDL) report is an assessment of water quality in rivers, lakes, and streams in a given watershed where impairments exist. The report contains an overview of the waterbodies, the sources of pollutants, and the methods used to analyze data. Two TMDLs, both for *E. coli*, have been prepared: West Fork White River-Muncie to Hamilton/Marion County Line and the West Fork White River. These two reports cover

nearly the entire White River within the study area and site sources such as agricultural lands and application of manure and urban and rural run-off; point sources from straight pipe discharge and home sewage treatment system disposal; as well as combined sewer overflow outlets.

Why?

The reports also outline reductions in levels of pollutants needed to restore water quality, such as a need for ninety-eight percent reduction at the Hamilton-Marion County line and actions that need to be taken to reduce pollutant levels, such as septic system maintenance and excluding livestock from streams and waterbodies.

So What?

TMDLs outline the potential sources of *E. coli* along with an estimation of to what degree each source is loading the pollutant into the waterbody. Both TMDLs cite non-point source stormwater or “Other” as a high contributor, along with failing septic systems in Hamilton County and Combined Sewer Overflows (CSOs) in Marion County. This provides frameworks for local watershed groups and municipalities when considering water quality and potential actions to efficiently reduce pollutant loading.

WEST FORK WHITE RIVER (MUNCIE TO HAMILTON/MARION COUNTY LINE):

- To develop this TMDL, point sources were considered to be meeting their permitted discharge limits and loads from CSOs were set to zero, presumably to indicate levels achieved if/when facilities are meeting permitted standards.
- Two of the four TMDL assessment points are within or very near to, the Hamilton County area, the Perkinsville point and the Hamilton-Marion County Line point.
- At the Hamilton-Marion County Line, primary source of *E. coli* is “other” nonpoint sources (approximately sixty-seven percent) and septic systems (approximately twenty-two percent).
- At the Perkinsville point, essentially the Madison-Hamilton county line, the primary sources of *E. coli* are “other” at seventy-six percent and septic systems at twenty-one percent.
- At the Perkinsville point the needed *E. coli* reduction is eight-eight percent to meet the TMDL.
- At the Hamilton-Marion county line, the needed *E. coli* reduction is ninety-eight percent to meet the TMDL.
- BMPs suggested are septic system outreach program and maintenance; livestock exclusion; and structural urban BMPs.

WEST FORK WHITE RIVER (MARION COUNTY TO WAVERLY):

- Overall, CSOs and stormwater runoff contribute the largest loads to the White River.
- In upper reaches (Marion County line to Lake Indy), primary sources of *E. coli* are non-point source stormwater (seventy-five percent) and upstream (Hamilton County) sources (fifteen percent) such as agriculture and septic systems; permitted stormwater discharges (seven percent) are the largest point source contributor.
- In middle (CSO segment) and lower (Tibbs/Banta Landfill to Waverly) reaches, primary source of *E. coli* is CSO outputs at approximately ninety-eight percent for both reaches, an additional 1.5% from permitted stormwater discharges and less than one percent from all other considered sources.
- Overall sources: septic systems, illicit connections, Advanced Wastewater treatment plants, wildlife, stormwater runoff, CSO, and upstream sources.

Underground Storage Tanks (UST)/Leaking UST (LUST)

Who?

IDEM Office of Land Quality

What?

All Underground Storage Tanks (UST) that store petroleum or certain hazardous substances must register with IDEM. Any UST found to be leaking, therefore a “LUST,” must undergo investigative actions such as sampling of soils and groundwater and reporting to IDEM throughout the process.

Why?

IDEM maintains the listing to track responsible parties in case of leaks or pollutant migration. Training is required for someone at each site.

So What?

Concentrations may indicate areas of higher potential for pollutants (petroleum or hazardous substances) to enter into the river system over time or areas where legacy pollutants may already exist. USTs located near a large river system may also be located within the floodplain, near to the water table, or other areas making them more susceptible to

decay or breakdown of protective structures, creating a more direct route for pollutants to enter the waterbody.

Illicit Discharge Detection and Elimination (IDDE) Outfalls

Who?

Carmel, Fishers, Noblesville, Hamilton County, and Indianapolis

What?

MS4 entities are required to map and sample effluent from their MS4 outfalls through the IDDE requirement within the stormwater permit.

Why?

This allows MS4 entities to locate and then work to eliminate polluted effluent, such as illegal connections to the storm sewers. They also drive education and outreach efforts within the community to change behavior of residents, therefore reducing pollutant loading from the storm sewers. Pollutants from these outfalls may include *E. coli*, nutrients, sediment, metals, and petroleum products.

So What?

Concentrations of MS4 outfalls may indicate areas of higher potential for pollutants to enter into the river system over time. Further, MS4 Coordinators may have insight regarding areas of concern over time, illegal dump sites, and other potential problems within their jurisdiction. This information may lead to recognition of unhealthy areas (polluted water/*E. coli*), as well as aesthetically unpleasing areas (dump sites).

Fish Consumption Advisory (FCA):

Who?

Indiana State Department of Health

What?

Fish consumption recommendations are based on species of fish, location, size, and age and gender of the person consuming the fish caught in a local waterbody. Populations are divided into two categories; the general population: males over eighteen and females over fifty; and the sensitive population: females under fifty and males below eighteen.

Where?

Throughout the study area, the entire West Fork of the White River is under a FCA for sensitive populations, and should be limited to one meal of caught fish per month for the general population.

Why?

Toxins such as Mercury and Polychlorinated Biphenyls (PCBs) accumulate in fish tissue and may then cause harmful effects to humans or other animals that eat those fish.

So What?

FCA provides insight into the legacy water quality of the area, and helps to guide the type of recreation that may or may not be suggested for the area. While the White River in entirety is under an FCA, it would not be wise to suggest many other fishing options outside of the catch-and-release scenario.

Industrial Facilities Listing

Who?

Indiana Chamber of Commerce 2017

What?

Listing and location of facilities classified into categories indicating a potential need for an industrial stormwater permit through IDEM.

Why?

This indicates a higher potential for stormwater pollution based on the type of activities performed at that location or within that business such as metal work, milling, automotive work, or textiles. MS4 entities are encouraged to utilize this data to develop potential “hot spots” within their systems and develop their outreach and education programs including these facilities.

So What?

Concentrations of such facilities may indicate areas of higher potential for pollutants to enter into the river system over time. Pollutants may range from petroleum products to other industrial chemicals produced or utilized at facilities.

Tier 2 Facilities:

Who?

Hamilton County Emergency Management Agency (EMA) and Indianapolis Department of Homeland Security (DHS)

What?

Facilities with hazardous chemicals of a certain nature or quantity must comply with federal regulations and provide information related to the chemicals and quantities on site, along with facility maps to local emergency response agencies.

Why?

These chemicals may be especially harmful, if not deadly, to aquatic and human life if released into the environment.

So What?

It is important to know and understand the location of these facilities in relation to existing and proposed recreation sites such that if an event were to occur then evacuations may need to be completed, or areas may need to be shut down until the event has passed.

Watershed Management Plans:

Who?

Various

What?

A watershed plan is a strategy and a work plan for achieving water resource goals, and it provides assessment and management information for a geographically defined watershed. It includes the analyses, actions, participants, and resources related to development and implementation of the plan. The watershed planning process uses a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, and develop and implement protection or remediation strategies as necessary.

HAMILTON COUNTY:

- Cool Creek: Critical areas are based on streambank erosion, sedimentation, bacterial problems, and flooding problems.
- Duck Creek: Critical areas are based on total suspended solids, *E. coli*, total nitrogen, and total phosphorus.
- Morse Reservoir-Cicero Creek: Critical areas are based on *E. coli*, Nitrate+Nitrite, Phosphorus, and total suspended solids.
- Stony Creek: Critical areas based on unbuffered stream reaches, agricultural tillage practices, flooding and streambank erosion, failing septic systems, and livestock operations.

MARION COUNTY:

- Eagle Creek: Critical areas are based on level of water quality degradation, vulnerable land uses, and feasibility of remediation.
- Fall Creek (Lower): Critical areas are based on sedimentation, agricultural tillage practices, potential nutrient loading, and unsewered areas.
- Pleasant Run: Critical areas are based on poorly buffered streams and tributaries, residential areas/schools/parks and golf courses/churches, stormwater ponds, greenspace overlapping with hydric soils, and areas upstream of CSOs.

Why?

A watershed management plan is a guide for watershed coordinators, resource managers, policy makers, and community organizations to restore and protect the quality of lakes, rivers, streams, and wetlands in a given watershed. It is intended to be a practical tool with specific recommendations on practices to improve and sustain water quality. The plan must be re-examined and revised to reflect goals that have been achieved or not met.

So What?

While only small portions of these areas are within the study area, the watershed contributes to the overall water quality of the White River. Several studies have determined that the same issues are problematic throughout the watersheds (sediment, *E. coli*, and nutrients), indicating regional impact. As work is completed within these watersheds, it is assumed overall water quality will improve within the larger White River watershed and within the White River mainstem.

Combined Sewer Overflows (CSOs)

Who?

Noblesville (six active CSOs) and Indianapolis (twenty-seven active CSOs).

What?

A CSOs is the direct discharge of untreated stormwater and wastewater from a combined sewer system (CSS) into a receiving body of water. A CSS is a single pipe designed to collect rainfall, domestic sewage and industrial wastewater. Under normal conditions, the CSS is able to transport its contents to the sewage treatment plant, however, heavy rainfall events (or snowmelt) can cause the CSS to exceed its capacity, resulting in a CSO event. Both Noblesville and Indianapolis have signage posted at CSO outfalls and notify the public when an event has occurred, and that they should avoid contact with waterways in the CSO area for forty-eight hours.

Why?

Reducing CSO events is a priority water pollution concern nationwide, and the US EPA enforces compliance through the CSO Control Policy. Both Noblesville and Indianapolis (via Citizens Energy Group) have prepared Long-Term Control Plans (LTCPs) and are actively implementing major capital improvement projects to reduce CSO events according to their individual consent decrees with US EPA by 2022 (Noblesville) and 2025 (Indianapolis).

So What?

Eliminating CSOs will improve the water quality and recreational opportunities in and along the White River. Noblesville plans to reduce CSO events to four times per year through a series of wastewater treatment plant improvements, partial separation of CSS, and increased sewer conveyance and storage. Indianapolis (via Citizens Energy Group) anticipates a ninety-five percent reduction (four times per year) of CSOs in the White River through primarily a network of deep tunnel storage facilities and wastewater treatment plant enhancements.

It's important to note that even with the number of CSO events significantly reduced, the White River will continue to violate water quality standards due to untreated stormwater runoff, leaching septic systems, illicit connections to storm sewers, and wildlife and domestic animal waste throughout the watershed.

Unsewered Areas

Who?

Hamilton County, Carmel, Fishers, Noblesville, and Indianapolis

What?

Septic systems provide wastewater treatment for homes in remote areas that are not in proximity to city sanitary sewers. When not properly maintained, septic systems can be a

major source of pollution discharging human waste into nearby streams and groundwater.

Why?

Within the White River corridor study area, there are several pockets of unsewered areas. In Indianapolis, CEG is working to extend sewer infrastructure through their Septic Tank Elimination Program (STEP). Areas are prioritized based on septic system failure rates, housing density, and proximity to a floodplain. In Hamilton County, pockets of unsewered areas can be found along the White River in Fishers, Noblesville, and most of the unincorporated county. The Hamilton County Health Department has identified priority areas with historical septic problems and illegal discharges. Upstream of Hamilton County, a significant portion of the watershed is unsewered.

So What?

Lack of maintenance of septic systems and poor soil absorption properties contribute to *E. coli* pollutant loads. Work toward remediating septic systems will improve water quality in the White River.

Bacteria

Who?

Marion and Hamilton County Public Health Departments

What?

Marion County Public Health Department collects monthly samples for *E. coli* from major waterways from April through October, when many people recreate on the river. The Departments uses the sample to warn people when high *E. coli* levels exist in recreational hotspots such as parks, greenways, canoe launches, schools, and fishing areas to determine if it is safe for people to be in contact with the water. Warning signs are posted where *E. coli* levels exceed the 235 cfu/100ml State Water Quality Standard.

Sampling results indicate that levels are highest in the month of May, and most sites have lower *E. coli* levels in July and August. *E. coli* levels are exceeding the Indiana State Standard more than half of the time in Hamilton County and routinely in Marion County.

Where?

About sixty sites are sampled across Marion County in the recreational season, often as part of other projects, and an average of eighty signs are posted each season. The Hamilton County Health Department samples four sites in the study area between the Madison and Marion County lines.

Ambient water quality samples are collected regularly for various parameters (metals, sediments, nutrients, *E. coli*, and others) as well as monitoring of fish, macro-invertebrates, and habitat using the Qualitative Habitat Evaluation Index (QHEI).

The Indiana Water Monitoring Inventory (<https://www.inwmc.net/>) is a clearinghouse for water quality data. Many groups (including the Public Health Department) who provide their data to this platform collect on-going sampling to establish trend data and provide a long-term view of the quality of the water. The water monitoring inventory includes as many as 138 water quality sampling sites in the study area and many more located throughout the Upper White River Watershed.

Why?

Bacterial pollution obscures the present and future use of the White River. It truly is a public health issue, with as many as eight in 1000 people predicted to become ill from swimming in the river at the water quality threshold. Even when bacteria levels are low, the public still perceived it was a polluted river. The story here is of human health and enjoyment.

Sediment

Who?

Marion County Soil and Water Conservation District (SWCD) and Hamilton County SWCD

What?

The Marion County SWCD has a soil health program that improves soil capacity to take in water quickly, with measures such as reducing the amount running overland to the river. As an example, farmer Mark Starkey of Brownsburg has helped to significantly reduce sediment entering the Eagle Creek Reservoir by using no-till farming techniques.

The Hamilton County SWCD is contacting private landowners next to the river, inviting them to participate in a cost-sharing program

for no-till agriculture and planting cover crops to reduce sediment. Much more could be done with “edge-of-field” practices that store water and remove sediment. The program will soon be replicated by Marion County SWCD.

Why?

Reducing sediment inputs to the river would improve the river in many ways. Stream banks and beds erode from too much water, and sediment loads increase, burying fish spawning grounds and mussel beds. Mercury and PCBs (polychlorinated biphenyls) are chemically bound in river sediment, which has led to a fish consumption advisory. A lot of the phosphorus is bound to particles of sediment. If phosphorus-laden sediment is prevented from reaching the river, this would stop most of the algal blooms in the White River.



CONFLUENCE OF FALL CREEK AND SEDIMENT-LADEN WHITE RIVER. (SOURCE: GOOGLE MAPS, 2018)

Flood Control Infrastructure Review

Levees

Who?

City of Indianapolis

What?

A levee is a man-made structure, usually an earthen embankment, designed to prevent areas adjacent to the river from flooding during high water. Indianapolis maintains an extensive network of twenty-seven segments or twenty-four miles of levees. Two levee segments are accredited and recognized by FEMA for reduced flood risk, five levee segments are in the process of accreditation and one has a letter of map revision filed to change its flood protection status. The remaining nineteen segments are not accredited. Modification to any of these levees requires the approval of the USACE.

Types of Levee Failure:

- Overtopping: This occurs when floodwaters exceed the height of a levee and flow over its crown. To mitigate disaster, sandbags may be placed on top of levees to increase their height.
- Breach: This occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning.
- Other common indicators of problems: This includes unwanted vegetation and debris, unauthorized encroachments, slides, slump, and cracks that can indicate slope instability, signs of erosion, levee settlement, floodwall damages (cracks, tilting, bending in a floodwall), damaged riprap, and seepage of water on the landward side.

LEVEE SEGMENTS AND ASSOCIATED LAND USES (SEE MAP ON NEXT PAGE)

LAND USE	WR-01	WR-10	WR-12	WR-16A	WR-17	WR-18	WR-20A	WR-20B	WR-21	WR-22	WR-26/29	WR-27	WR-C1	TOTALS
APARTMENT						3	1	1			14			19
COMMERCIAL			5	30		1	6	3			177		13	235
RESIDENTIAL			2	429			1	102			1413	3	447	2397
CONDOMINIUM											30	5		35
INDUSTRY		1	24	27			3	15						70
OTHER	1	1		8				3	5	1	8			27
WORSHIP			1	3							6			10
SCHOOL				1	1	3	2	2			3		1	13
TOTALS	1	2	32	498	1	7	13	126	5	1	1651	8	461	2806

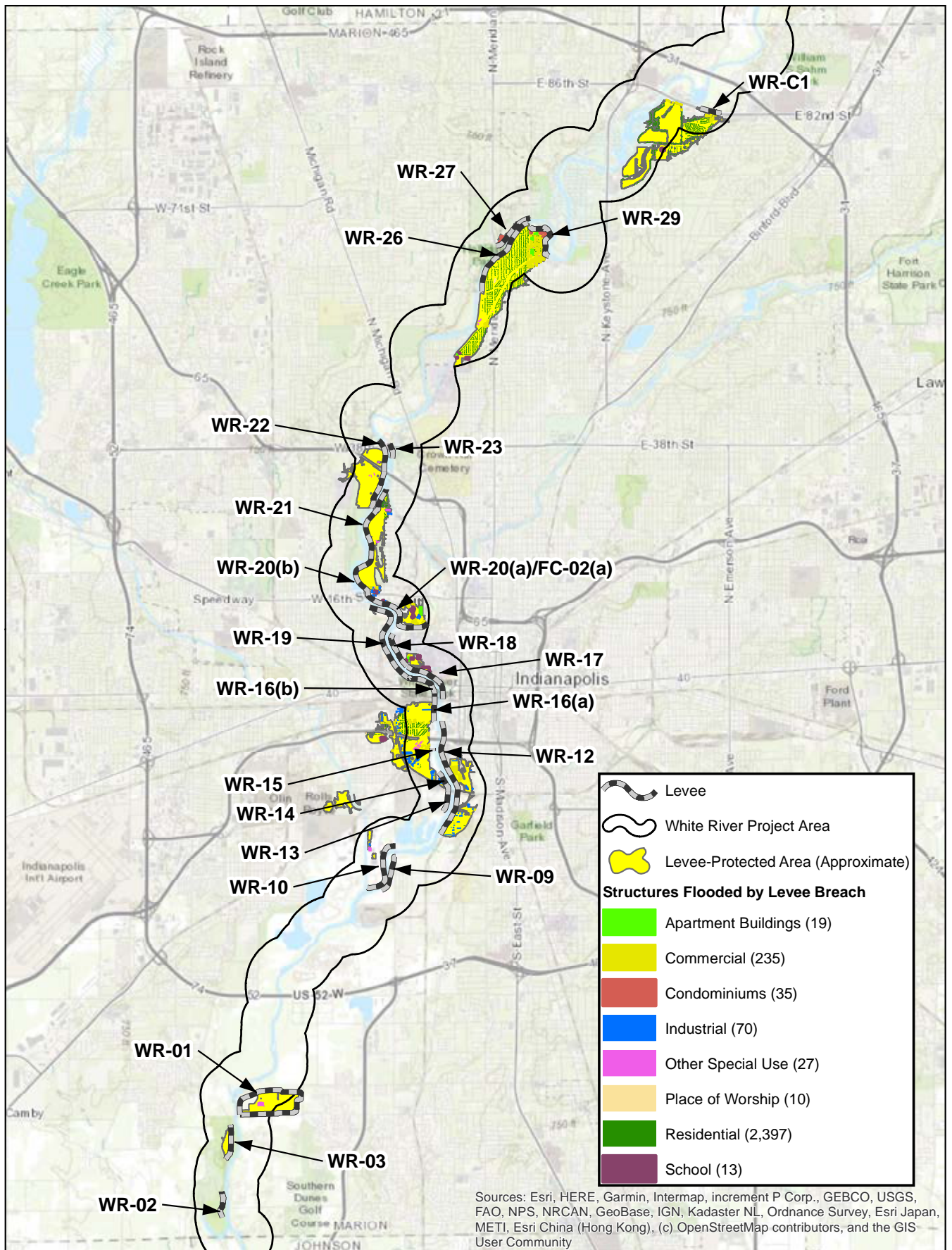
(SOURCE: CBBEL GIS ANALYSIS)

Why?

The levees in place reduces the flood risk for 2,806 residents and businesses, predominantly in the Broad Ripple area, and along either side of the White River from 38th Street south through the downtown area. The following table shows the number and type of structures, based on land use, that would be impacted if the corresponding levee segment were to fail during a flood event.

So What?

The levee network is a critical piece of the city's flood control infrastructure and is heavily regulated and adjacent uses restricted. These restrictions may impact access points and desired elements to engage people along the river.



Dams and Impacts on Water Quality & Ecology

Low-Head Dams

Who?

IPL (Harding Street Dam), CEG (Chevy Dam, Broad Ripple Dam, Williams Creek Cutoff), Duke (Riverwood Power Dam), and Indianapolis (Emerichsville Dam)

What?

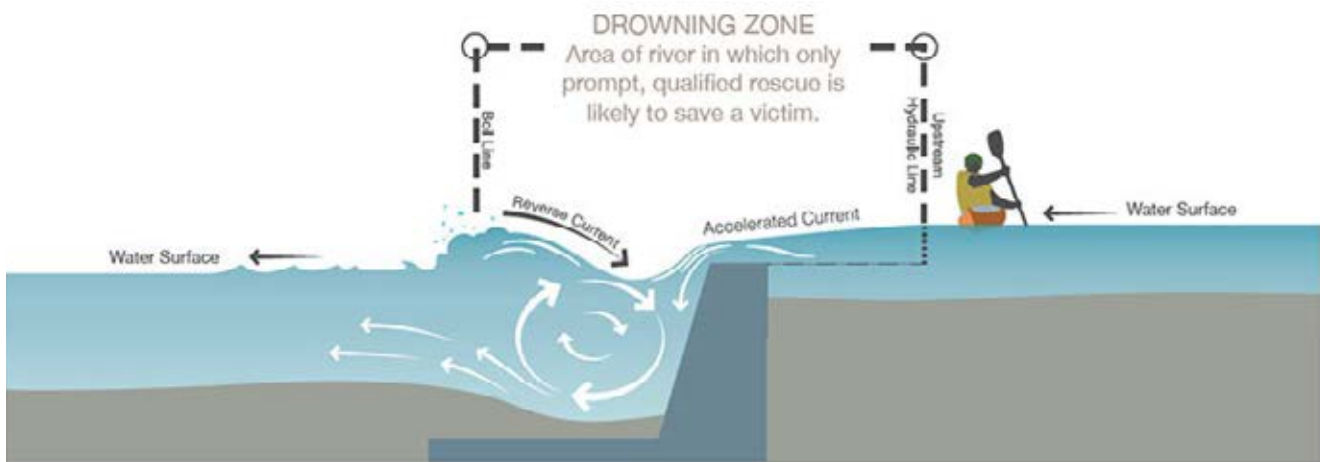
A low-head dam is a man-made obstruction, typically concrete, built in the river channel that spans the entire width of the waterway. Low-head dams are designed to impound water upstream, and similar to a spillway, they allow water to flow uniformly over the entire surface of the dam. IDNR classifies these low-head dams as “low hazard risk” based on their volume, height, and watershed area. Low-head dams are regulated by IDNR, and any modifications and improvements need to be permitted and approved through a floodway permit.

Why?

While low-head dams pond water upstream for water supply and/or recreation, their design creates a major barrier for fish and other aquatic species trying to migrate upstream. On the downstream side, low-head dams create an extremely dangerous recirculating hydraulic force that traps anyone or anything that gets too close.

So What?

There is a desire to balance the function of the low-head dams in the study area with the river ecology and public safety. Following several recent fatalities and river rescues at low-head dams in Indianapolis and elsewhere in the state, the Indiana Silver Jackets (ISJ) and IDNR have been promoting an educational campaign to raise awareness of the dangers of low-head dams. There are several examples of successful low-head dam retrofits nationwide, including in Indiana and Ohio, that successfully balance the function, ecology, and public safety desired.



Source: Iowa DNR

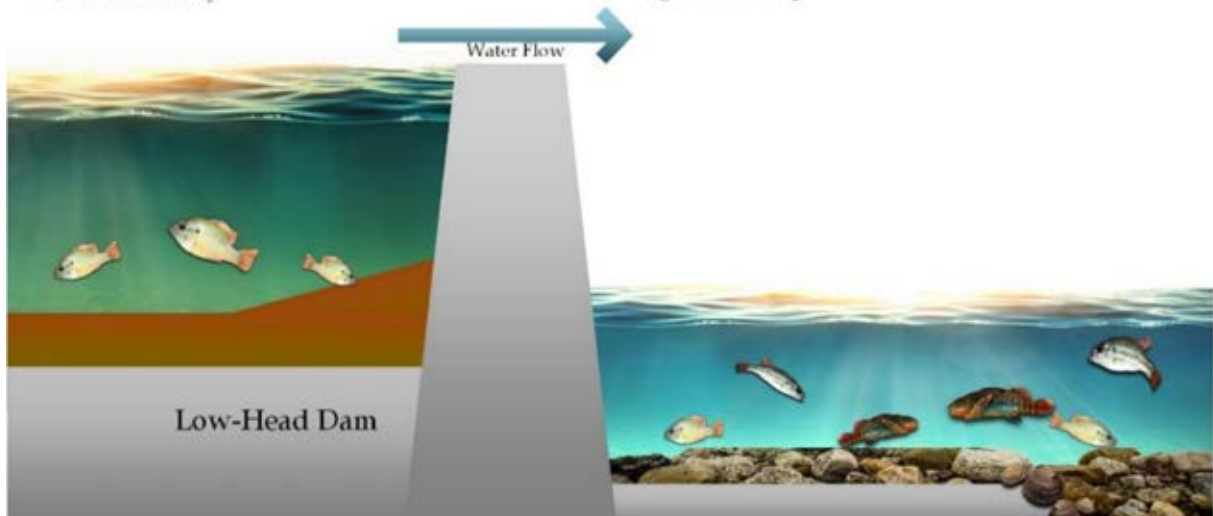
Impact of Low Head Dams on Water Quality

Impounded Water

- Lower water velocity
- Higher water temperature
- Lower dissolved oxygen concentrations
- Excessive algal growth can be present
- Higher nutrient concentrations and riverbed sedimentation
- Lower Biodiversity

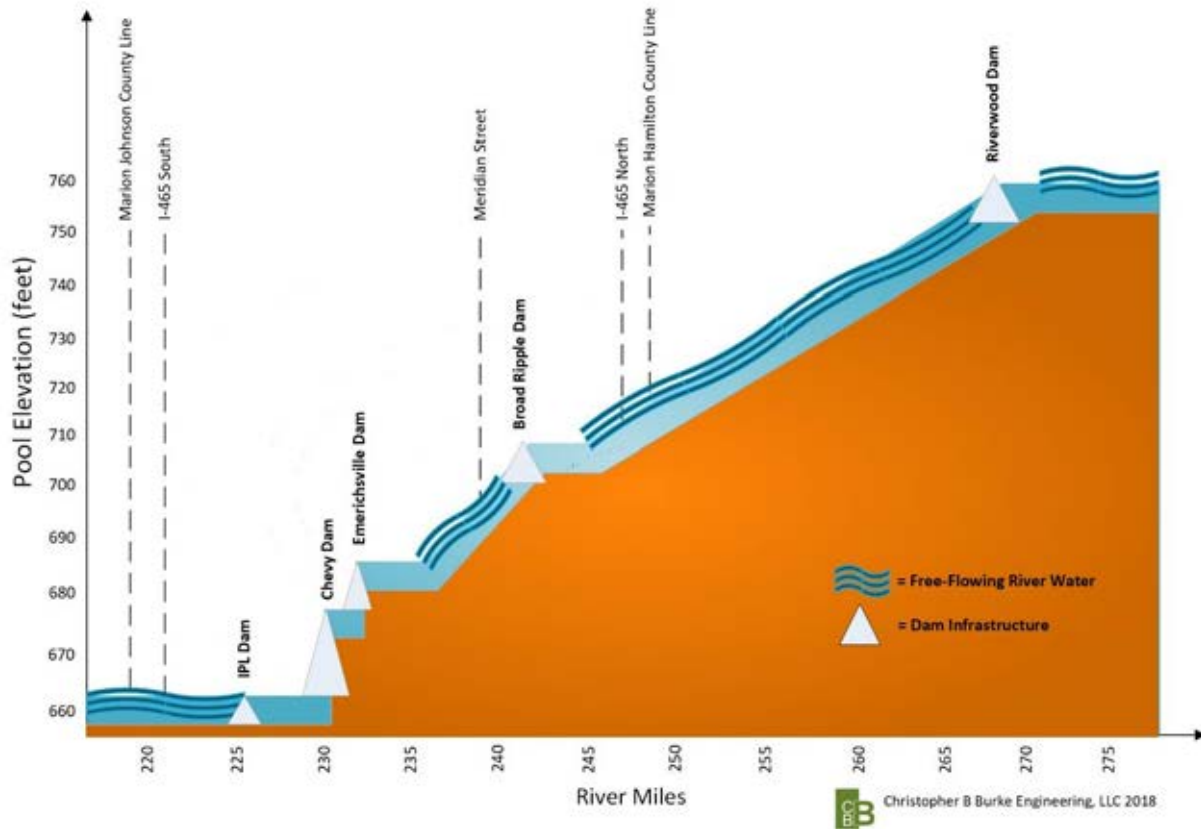
Free-flowing Waters

- Higher water velocity
- Cooler water temperatures
- Adequate dissolved oxygen concentrations
- Higher sediment transport
- Nutrients distributed efficiently
- Larger mussel and macroinvertebrate populations
- Higher biodiversity



White River Low-Head Dam Pool Impact Areas

Estimated from FIS Profiles and Topographic Data



Riverwood Power Dam

State ID: 29-2

OWNER

Duke Energy

PURPOSE

Originally for electricity, now for cooling natural gas power plant

STATS

- Height: 10'
- Length: 240'
- Pool Length: 3.3 miles
- Dam Elevation: 760.60'
- West Bank Elevation: 770.61'
- Source: Google Maps, 2018
- East Bank Elevation: 765.77'

GENERAL DESIGN

The structure is a concrete in-channel dam with a sloping downstream face located across the White River. Two cable-operated tainter gates at left end of structure are still in place.

CONDITION

Conditionally poor (1/18/18 inspection); recommendations – clear debris from structure, tainter gates, and out of roller area



SOURCE: GOOGLE MAPS, 2018

HISTORY

Built in 1922, the Riverwood power dam generated electricity until 1957. The power plant has since been converted to a natural gas fueled generator and the dam now collects water for cooling and generator start-up at the present power plant.

SUGGESTED MODIFICATION

Retrofit with rock ramp, such as in the Grand Forks Dam, MN.

Broad Ripple Dam

State ID: 49-4

OWNER

Citizens Energy Group (CEG)

PURPOSE

Intake for Central Canal water supply and recreation upstream

STATS

- Height: 10'
- Length: 300'
- Pool Length: 3.9 miles
- Dam Elevation: 708.49'
- West Bank Elevation: 725.52'
- East Bank Elevation: 710.29'

GENERAL DESIGN

Concrete end walls, concrete curved head structure, abutments made of timbercrib and glacial deposits.

CONDITION

Conditionally poor (2/14/17 inspection) due to condition of abutments. Monitoring of the entire area for seepage and boils is recommended. All debris should be cleared off the structure and out of rollers.

HISTORY

The Dam is a segment of the Central Canal that was significant in the development of Indianapolis. Its construction drew in



SOURCE: GOOGLE MAPS, 2018

laborers causing a population increase and new industries emerged along its path. Based on 11/7/1925 profile cross-section page in its inspection file, the dam appears to be 300 feet across. The dam was worked on in 1921-1922, 1924, 1925, and more recently between the 3-20-2012 and 2-14-2017 inspections. The dam looks totally different and no plans or permits are on file in the Dam and Levee Safety Section.

SUGGESTED MODIFICATION

Retrofit with rock ramp with notches, such as in the Manchester Whitewater Park in Iowa.

Williams Creek Cutoff Dam

State ID: 49-6

OWNER

Citizens Energy Group (CEG)

PURPOSE

Maintain water level for Central Canal water supply intake, recreation upstream

STATS

- Height: 5'
- Length: 180'
- Pool Length: N/A
- Dam Elevation: 711.00'
- West Bank Elevation: 721.89'
- East Bank Elevation: 719.06'

GENERAL DESIGN

Concrete concave crest formed in an arch, concrete abutments reinforced by large stone riprap.

CONDITION

Good condition (11/19/14 inspection). It is recommended that debris be cleared as needed.

HISTORY

Structure was built for stabilization purposes, to stabilize the grade in Williams Creek and to maintain the White River Elevation for the



SOURCE: GOOGLE MAPS, 2018

Broad Ripple Dam and the canal.

SUGGESTED MODIFICATION

Retrofit with rock ramp such as at the Story City Dam in Iowa.

Emerichsville Dam

State ID: 49-7

OWNER

City of Indianapolis

PURPOSE

Recreation upstream and water intake for CEG

STATS

- Height: 10'
- Length: ~364'
- Pool Length: 4.3 miles
- Dam Elevation: 681.75'
- West Bank Elevation: 691.50'
- East Bank Elevation: 690.84'

GENERAL DESIGN

The dam has reinforced concrete auxiliary spillways located at the north and south abutments on the land side of the towers. The auxiliary spillways have a bottom width of about 80 feet with a crest elevation approximately 4 feet above the primary spillway across White River.

CONDITION

Seriously deficient (12/5/17 inspection). Recommendations: Emerichsville Dam failed in September 2018 and has since been stabilized. At this time the city has yet to decide the long-term use and function of this structure. CEG is in the process of determining the location and design of a



SOURCE: GOOGLE MAPS, 2018. NOTE: DAM FAILED SEPT 2018 AND HAS SINCE BEEN STABILIZED. THE CITY WILL NEED TO DECIDE HOW TO MOVE FORWARD WITH RESTORATION/RETROFIT. (PHOTO NOV 2018)

replacement dam upstream to support their water intake. Recommendations include to construct structural modifications to the dam to significantly reduce or eliminate the opportunity for a submerged hydraulic jump to form. Install signage and buoys to improve the safety at the dam. Coordinate with DNR Law Enforcement regarding potential designation of a safe portage around the dam.

HISTORY

The dam was originally constructed in 1899 by the City of Indianapolis, which is the current owner, through its Board of Park Commissioners to increase the depth of water upstream for recreation. Significant repairs were made to the dam in 1908 to address scour at the downstream toe. In the 1960s, several improvements were made in conjunction with levee and channel improvements along White River. In September 2018, the levee failed.

SUGGESTED MODIFICATION

Restoration with rock ramp, such as at Crookston Dam in Minnesota.

Chevy/White River Dam

State ID: 49-10

OWNER

Citizens Thermal Energy

PURPOSE

Cooling water supply for generating plant, pools water through downtown Emerichsville Dam

STATS

- Height: 18'
- Length: 695'
- Pool Length: 2.5 miles
- Dam Elevation: 674.67'
- West Bank Elevation: 676.54'
- East Bank Elevation: 678.95'

GENERAL DESIGN

Wood cribbing filled with bags of concrete. Upstream and Downstream slopes are stone filled. Structure is topped with used bricks and concrete.

CONDITION

Fair condition (1/21/18 inspection); recommendations – clear debris out of roller area, remove local camper near dam shore



SOURCE: GOOGLE MAPS, 2018.

HISTORY

Dam constructed in 1918 for cooling water supply for the Perry K. Generating station. In 1972, dam was restored and increased in height by 6' and in width by 4'.

SUGGESTED MODIFICATION

Restoration with rock ramp and pedestrian bridge, such as at Morehouse Dam in Minnesota.

IPL/Harding Street Dam

State ID: 49-3

OWNER

Indianapolis Power and Light Co.

PURPOSE

Originally for electricity, now cooling natural gas power plant

STATS

- Height: 10'
- Length: 200'
- Pool Length: 4.8 miles
- Dam Elevation: 662.56'
- West Bank Elevation: 663.47'
- East Bank Elevation: 663.52'

GENERAL DESIGN

Rock and sheet piling on the main portion. Left end consists of many concrete bays with concrete abutments

HISTORY

Built as a wood crib dam originally for a grist mill in the 1920s. Rock and sheet piling have since been added. Dam received repairs in 1938.



SOURCE: IDNR [HTTPS://WWW.IN.GOV/DNR/OUTDOOR/9419.HTM](https://www.in.gov/dnr/outdoor/9419.htm)

SUGGESTED MODIFICATION

Retrofit with rock ramp, as in the Vernon Springs Dam in Iowa.

Indiana Low-Head Dam Removal and Retrofits

Removals:

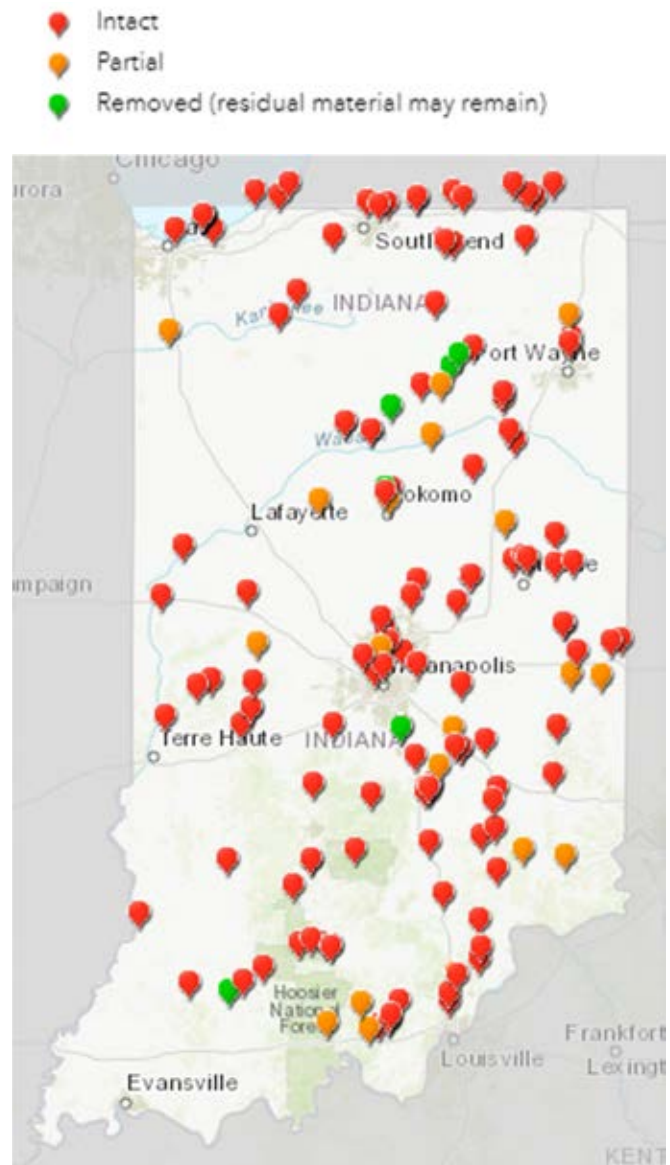
While dams can benefit society, they also cause considerable harm to rivers. Dams have depleted fisheries, degraded river ecosystems, and altered recreational opportunities on nearly all our nation's rivers. Today, many dams no longer serve their intended purposes.

- North Manchester Dam, Eel River, 2012
- Liberty Mills Dam, Eel River, 2012
- Mexico Dam, Eel River, 2016
- Huntington Mill Dam, Little River, 2016
- Fawn River Hatchery Dam, Fawn River, 2017
- Patoka River Dam, Patoka River
- Hurricane Creek Dam, Hurricane Creek

Proposed Removals:

The following dams and communities have proposals or plans to remove dam infrastructure soon.

- In May 2018, Indiana DNR gave public notice about plans to remove the defunct George R. Dale low-head Dam located on the White River in Muncie
- In 2018, Morgan County revealed plans to remove the Eagle Valley low-head dam,



SOURCE: IDNR

located at the Three Rivers Fishing Area in Martinsville

- The Army Corps of Engineers announced plans to remove the Elkhart River low-head dam, located in Elkhart, Indiana. Construction is scheduled to begin in 2019. The restoration project would enable the passage of aquatic species, improve

the riverine habitat for endangered and threatened fish and mussel species, stabilize the stream bank, and naturalize sediment transport

- West Fork Dam, Muncie, Indiana
- McCulloch Dam, Muncie, Indiana

Retrofits:

- South Marshall Dam, Newton County, Partial Removal
- Cedar Creek Dam, Allen County, Partial Removal
- Big Raccoon Creek Dam, Montgomery County, Partial Removal
- Eel River Dam South of Laketon, Wabash County, Partial Removal
- Mill Creek Dam, Wabash County, Partial Removal
- Kokomo Waterworks Dam #3, Howard County, Partial Removal
- Adams Mill Dam, Carroll County, Partial Removal
- White River Dam at Kessler Ave, Marion County, Partial Removal
- Matthews In-Channel Dam, Grant County, Partial Removal
- Marlott Mill Dam, Grant County, Partial Removal
- Kennedy Park Dam, Shelby County Partial Removal
- Willow Fork Dam, Shelby County Partial Removal
- Old Timbers Lodge Dam, Ripley County, Breached Partial Removal
- Friendship Mill Dam, Ripley County, Partial Removal
- Milltown Dam, Crawford County, Partial Removal
- Blue River Dam, Crawford County, Partial Removal
- White Cloud Dam, Harrison County, Partial Removal

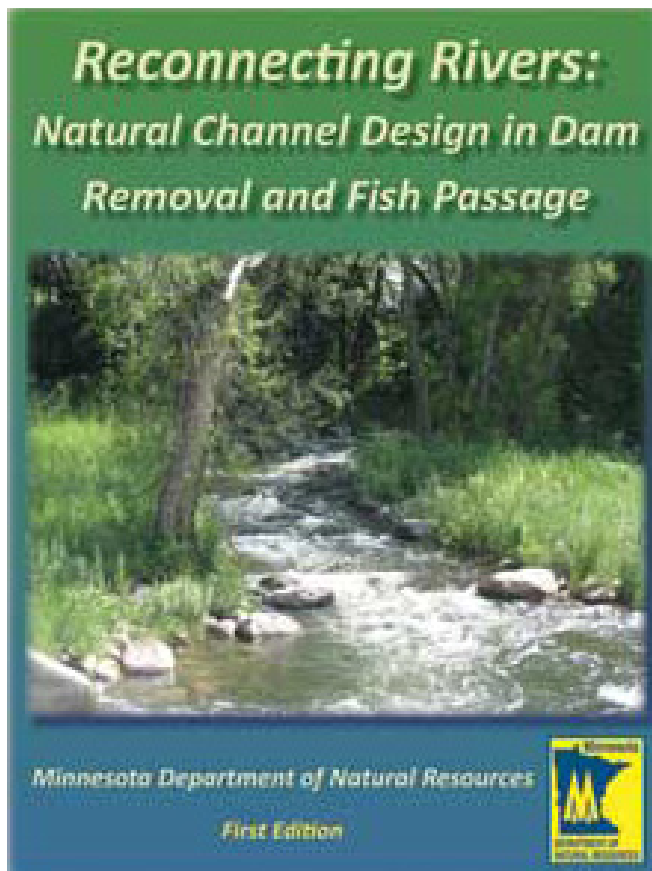
Other Low-Head Dam Removals and Retrofits:



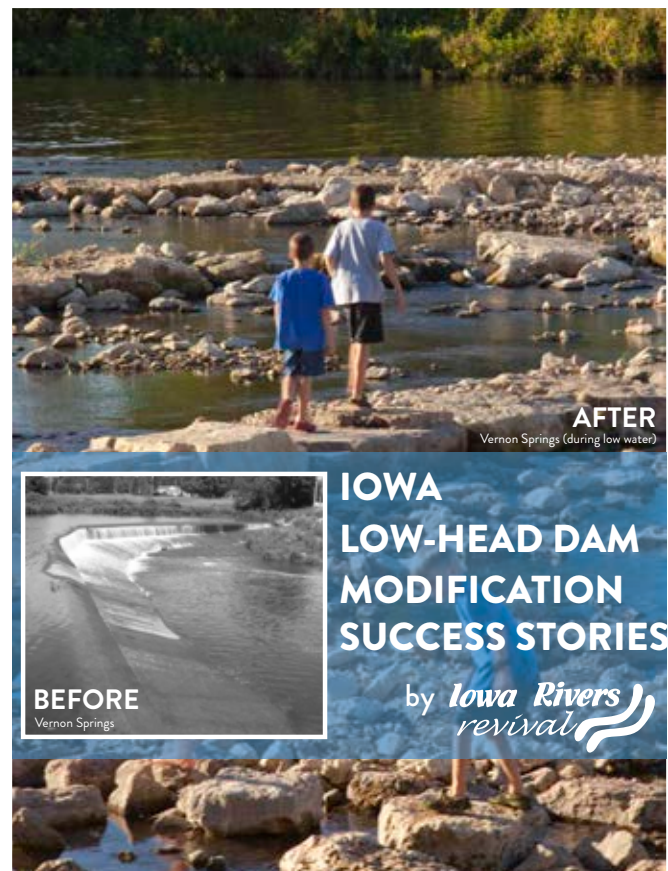
BEFORE / SOURCE: MN DNR



AFTER / SOURCE: MN DNR



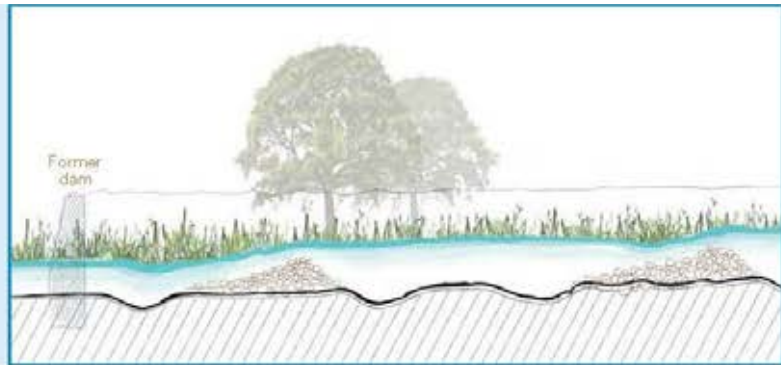
SOURCE: MN DNR / [HTTPS://WWW.DNR.STATE.MN.US/ECO/STREAMHAB/RECONNECTING_RIVERS.HTML](https://www.dnr.state.mn.us/eco/streamhab/reconnecting_rivers.html)



SOURCE: MN DNR / [HTTP://IOWARIVERS.ORG/WP-CONTENT/UPLOADS/2016/04/IOWA-LOW-HEAD-DAM-MODIFICATION-SUCCESS-STOREIS.PDF](http://iowarivers.org/wp-content/uploads/2016/04/iowa-low-head-dam-modification-success-storeis.pdf)

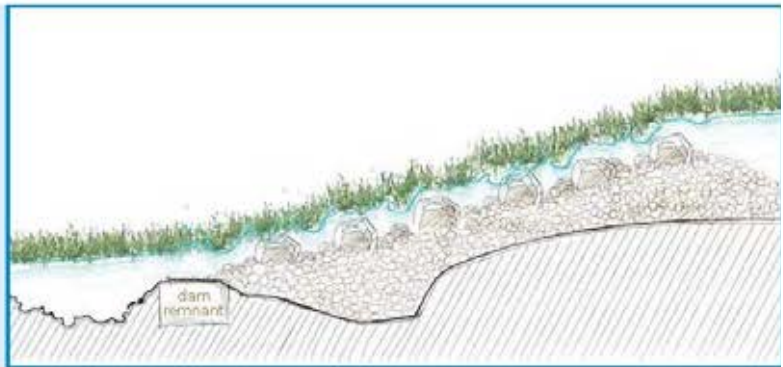
Complete dam removal with river restoration

Maintenance costs for aging and deteriorating dams can be eliminated through complete dam removal. Floodplains restored with native vegetation in the former impoundment stabilize banks and improve water quality. Rock riffles help stabilize channel beds.



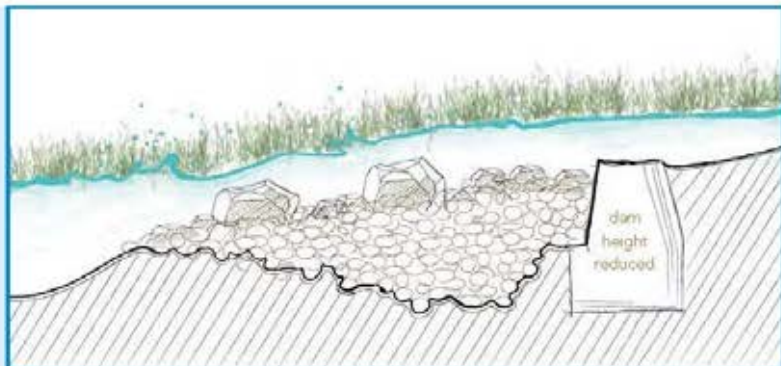
Rock arch rapids

Some deteriorating and dangerous dams that still serve a purpose, such as maintaining depth for water supply, can be replaced with a backsloped rock arch rapids. The rock ramp maintains the water height of the former dam but improves safety and allows fish passage.



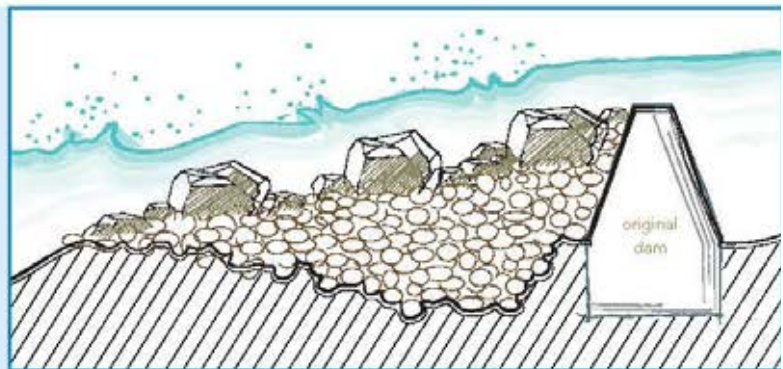
Height reduction

Partial removal of a dam is preferred when complete removal would cause the excessive release of sediment. The rock ramp eliminates the dangerous recirculating current, allows fish passage, and transports sediment more slowly downstream.



Rock ramps

Dangerous recirculating currents can be eliminated without removing a dam by strategically placing rocks and boulders downstream of the dam. The sloped rock formations also allow fish to reconnect with the river upstream.



Source: Iowa River Revival

Natural Areas Assessment

Mussel Inventory

Who?

Survey of the Freshwater Mussels of the Wabash River Drainage, by Cummings et al. 1992. Illinois Natural History Survey, Champaign, IL.

What?

This 1989-1991 study documents the decline of freshwater mussels from the 1820s to 1990 in the West Fork of the White River.

Freshwater mussels were a dominant feature of the White River in the early 1800s, with more than seventy species of mussels cataloged. The Midwest formerly was a global hotspot for mussel diversity. Dense mussel beds covered hundreds of square feet in many reaches of rivers. Mussels were a keystone species. They strongly influenced the river ecosystem and other species by regulating water quality and changing the morphology of the river bed.

Mussels were heavily harvested from the White River from the 1890s through the 1960s for the button and cultured pearl

industries. This harvest depleted many species and dramatically reduced the abundance and effect of mussels on the ecosystem. Harvesting mussels was made illegal in 1991, but their recovery has been slow. The seventeen dams from Martinsville to the headwaters of the West Fork prevent mussel recolonization; dredging and channelizing the river and its tributaries eliminates good habitat; runoff from urban areas (especially Marion and Hamilton County) overwhelms the capacity of mussels to filter water effectively; and an invasive Asian clam competes with native species for habitat and resources. Today, the Asian clam is throughout much of the White River.

A 1989-1991 mussel surveys of the West Fork of the White River detected sixty-five species from the 1820s on, but only thirty-eight were found alive—a loss of forty-six percent. Several of those were threatened or endangered species. Once-dense mussel beds were rare, with most species represented by a few individuals. At the time, no species were alive in the river in Indianapolis, whereas formerly eighteen to twenty-two species lived there. A 2016 survey, however, found nine living species and weathered shells of two others.

Clearly conditions for mussels have improved since the 1980s.

Kim Chapman, Principal Ecologist at AES, interviewed Cummings (now retired) in the summer of 2018. Cummings recommended four actions to improve the White River ecosystem for mussels, fish, and people:

- Don't dredge the channels that form naturally after twenty years in tributaries of the White River. It costs farmers money and doesn't drain fields faster. Many remnant mussel populations are in the tributaries, from which they colonize the river.
- Remove or retrofit the dams to allow free passage of fish, which would help mussels recolonize reaches where they have disappeared. Removing dams eliminates the risk of people dying at the dams and eliminates maintenance and reauthorization costs. Turning them into long rapids greatly reduces the risk of death and creates interesting places on the river. It will take some years for dam retrofitting and removal to have a noticeable effect on mussels. Steve Pescatelli, Fisheries Biologist at the Illinois DNR has experience with this.
- Protect a wide riparian zone on the White River and install vegetated buffers between the river's tributaries and cropland, streets or parking lots. This prevents bank erosion and filters dirty runoff before the water reaches the river and its tributaries.
- Reintroduce mussels from reaches where they are missing. Scott Gritter with the

Iowa DNR has successfully colonized fish gills with glochidia (baby mussels), then released the fish to restore mussels in a reach from which they had disappeared. The Freshwater Mussel Conservation Society has a lot of expertise in different ways to reintroduce mussels to rivers where they used to be.

Why?

Freshwater mussels act as natural filters by removing large amounts of sediment and organic matter from the river. As they move along the river bottom, using their "foot," they mix riverbed sediment with a material produced by their feet, "cementing" the sediment in place and keeping it out of the water column. Mussel populations usually are in rivers with good water quality. They are important food for heron, egret, duck, goose, otter, raccoon, fish, and other creatures.

Fish Inventory

Who?

Fishes of the White River Basin, Indiana, by Crawford et al. 1996.

What?

A review of fish species that once existed and currently exist in the White River and its tributaries.

Since 1895, 158 fish species have been found in the White River watershed. In 1987, 134 fish species called the White River watershed home. These include familiar game fish, big river fish, and other notable smaller fish.

Past insults to the river ecosystem and its fish began in the early 1800s with forest clearing and wetland drainage. This fed sediment to the river, disrupting both mussel beds and fish spawning habitat. Over-fishing and declining fish stocks led to government-sponsored introduction of carp, which is native to China and Russia. Carp disturbed the river bottom by rooting and eating vegetation, and competed with native fish for resources. In the 1890s, Indianapolis damaged the river ecosystem in the city by excavating fifteen feet into the bed of the White River (though some of this sediment may have been soil from upstream field erosion).

Runoff from expanding urban areas and direct discharge of chemicals and waste harmed water quality by reducing oxygen

levels or through outright poisoning. This regularly resulted in large fish kills; 160 were recorded from 1960 to 1992. Despite best efforts, they occasionally still occur. In 1994, a CSO overflow event killed 510,000 fish in the Indianapolis reach of the river, and a chemical release killed a large number of fish in December 1999. Despite periodic fish kills, a focus on cleaning up wastewater and increasing oxygen levels since 1980 led to a significant rebound in Indianapolis—over a twenty-year span, the number of fish species went from nine to sixty-three.

Due to pollution by mercury and PCBs (polychlorinated biphenyls), the entire White River carries a fish consumption advisory for females under fifty and males under eighteen; everyone else is limited to eight ounces of White River fish per month.

People tried to improve the fishery in the past, beginning in the early 1900s when harvest regulations and fish hatcheries helped bolster fish populations. Although small changes in water management were begun in the early 1900s, the 1972 Clean Water Act significantly improved water quality. Wastewater handling improved, runoff from pavement and fields improved, including changes in crop tillage practices, and wetlands were restored. For example, Muncie, Indiana improved the river bed. Loose, bacteria-laden streambeds in 1972 were converted to sand, gravel, and bedrock by 2000; the fish responded, increasing from thirty to sixty-nine species.

Mussels rely on fish to transport their larvae to upstream areas of the river and connecting creeks. Many species of mussel attract fish with special lures (that look like a worm or small prey fish) and release fertilized eggs when a fish approaches the lure. Mussel larvae, called glochidia, attach to the gills of fish and mature. When old enough, glochidia drop from the gills in hopes of landing in the correct habitat. Dams, however, limit fish movement and prevent mussels from recolonizing reaches from which they have disappeared.

Why?

The variety, number and health of the fish in the river are obvious sign of a healthy river ecosystem. Past pollution affected fish, but changes in laws and behavior starting in the 1970s have dramatically improved the fish community. Over time, perhaps the recovery of a fully functioning river ecosystem will reduce the other contaminants in the river, which people in the community who fish in the river are interested in seeing happen.

Mussel and Fish Monitoring

Who

Indiana Department of Natural Resources

What

Since 2000, the Indiana Department of Natural Resources has periodically sampled the mussel and fish communities of the White River in the study area. Data are available from Brant Fisher, Nongame Aquatic Biologist, Science Unit. Brant is the non-game aquatic biologist for the Indiana DNR. He helped to sample the mussels and fish in the White River after the 2000 fish kill. Periodically, he's sampled the river for mussels in Marion County, the latest in 2016. In general, mussel and fish diversity is higher than it was in the 1980s.

Kim Chapman interviewed Brant Fisher in the summer of 2018. His observations on mussels in the river follow:

- As far as mussels are concerned, the West Fork of the White River is really two different rivers: a larger river from Marion County and downstream, and smaller river from Hamilton County and upstream. Upstream before 1850 there were thirty-five species of mussels, and downstream fifty species. Today there are ten to twelve species on average living in the river. The only way to get back the former diversity is to reintroduce the mussels artificially

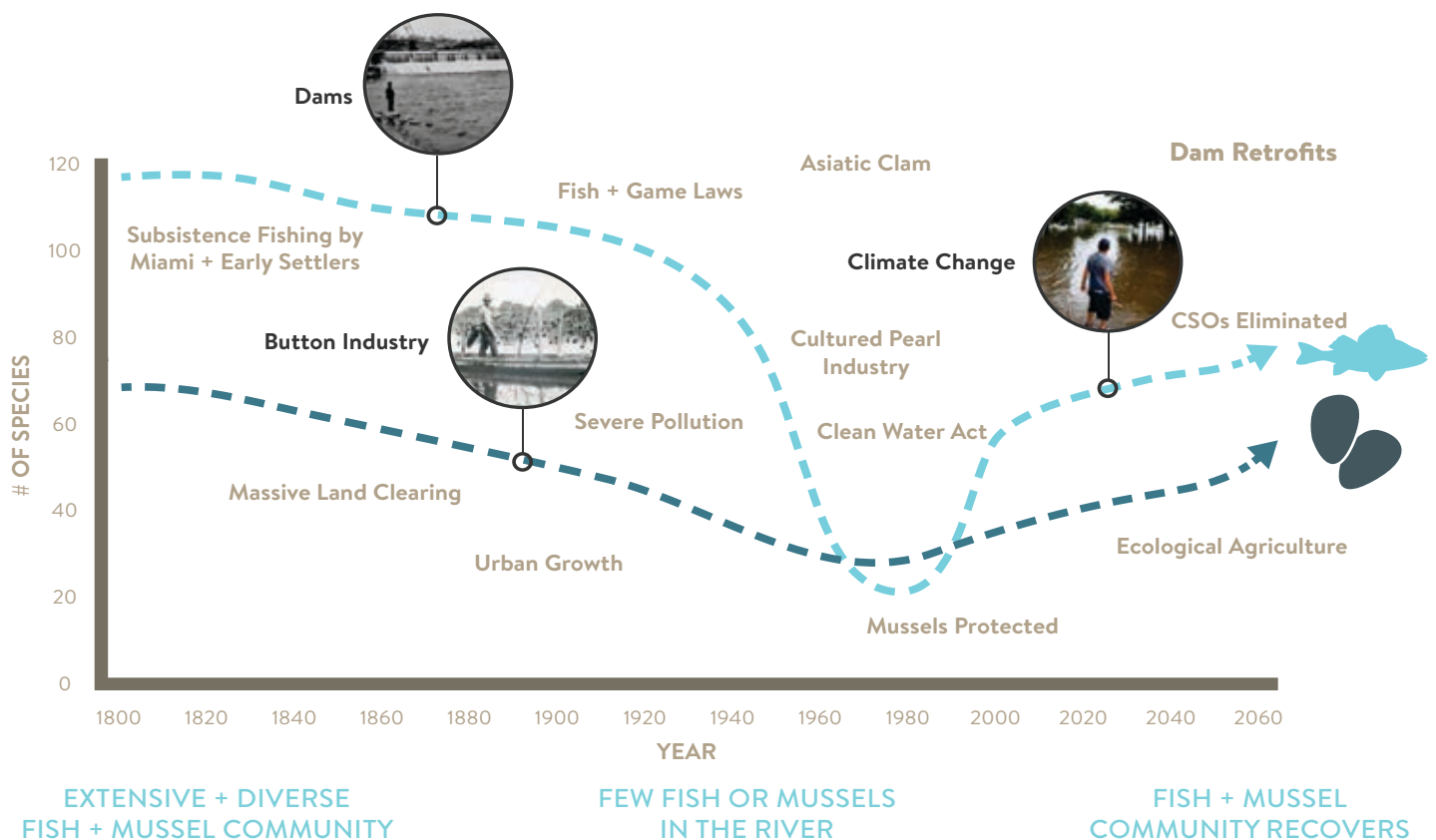
(because dams prevent recolonization and, even with dams gone, some species have been extirpated and will not return).

- The West Fork has improved dramatically since 1980. Below Chevy Dam there were no mussels in 1980; in 2016 Brant and his colleagues found nine living mussel species and weathered shells of two others.
- The freshwater drum is a formerly plentiful fish that is a common host of mussel glochidia. Catfish is another common host. The drum was reintroduced above Chevy Dam after the fish kill in hopes that it would help move the mussels into waters from which they were missing.
- Brant laid out in priority order how to restore the former abundance of mussels, so they again act as important filters of the water, improving water clarity below their extensive beds:
 - Increase the density of mussels in their beds—this raises the chance of egg fertilization and glochidia production, which is lower when mussels are spread out.
 - Greatly reduce the sediment in the river, which affects mussel beds and the ability of mussels to feed. Sediment also reduces mussel reproduction rates.
 - Increase the abundance of the fish that host glochidia. Fish movement is constrained by dams, and sediment covers areas of the river bottom that could be used for fish spawning and reproduction.

- Improve the quality of river habitat: more vegetation, less ditching (especially of tributaries), more gravel and sand (less fine sediment that provides poor habitat), less flood scouring through better runoff control from impervious cover and cropland.

Why?

Water pollution, dams, and over-harvesting have all devastated fish and mussel populations in the White River. As water clean-up, dam retrofits, reintroductions, and limits or bans on harvesting continue, ongoing inventory and monitoring of the response of fish and mussel populations is critical in tracking the success of these efforts.



RISE AND FALL OF THE FISH AND MUSSEL POPULATION.

Land Cover Base Map

Who?

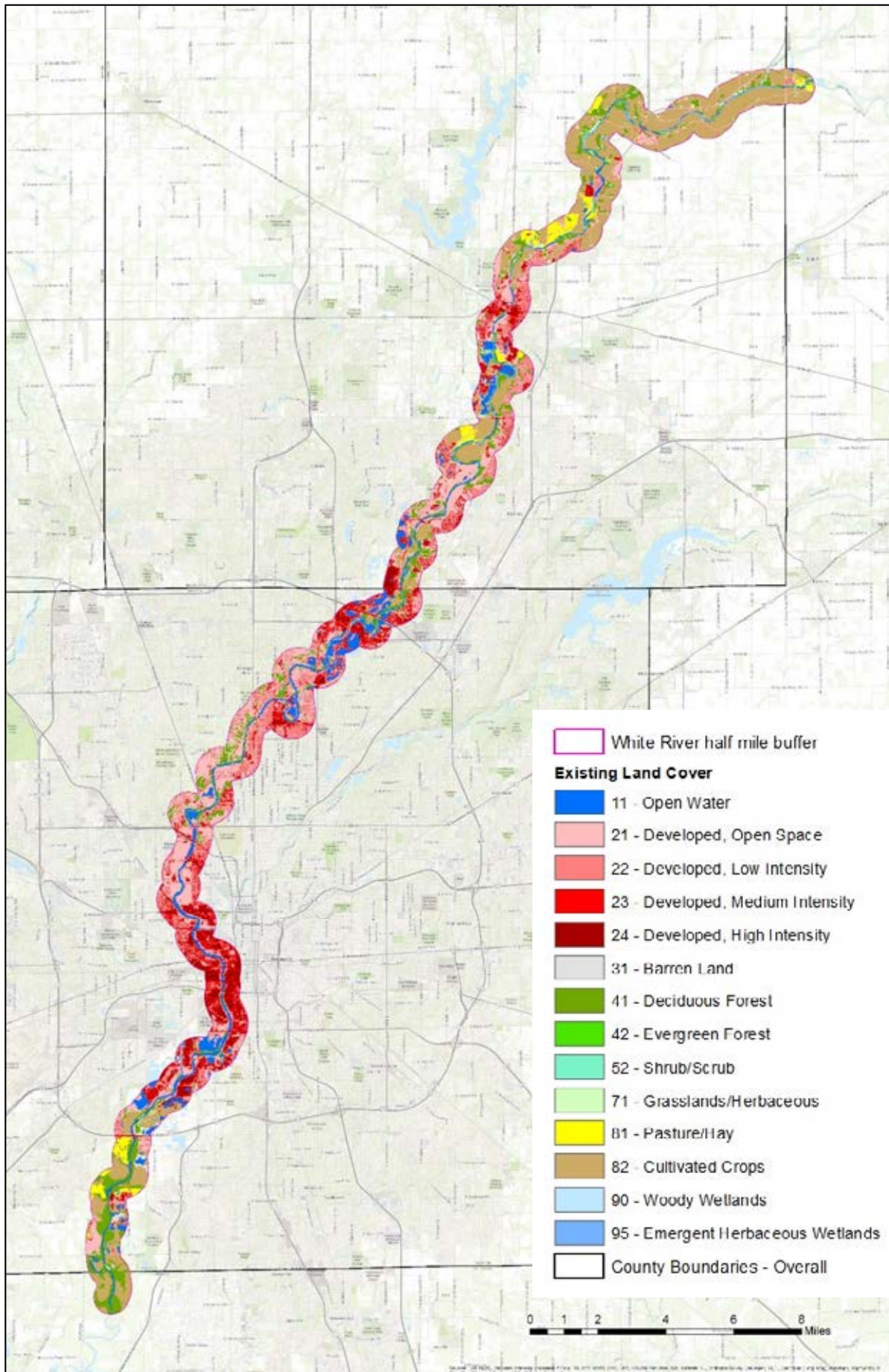
USGS National Land Cover Database

What?

Basemaps for field investigations and starting point for habitat classifications.

Why?

The opposite page shows mapping of land cover from the USGS National Land Cover Database. Land cover is the foundation for planning and carrying out conservation and vegetation management. In 2011, more than seventy-five percent of the White River corridor consisted of “cultural lands,” including agriculture and urban areas. Corn-soybean-wheat cropping and livestock production occupied twenty-three percent of the land, while cities and towns covered fifty-two percent. The rest of the land cover was “natural and semi-natural land,” which consists of forest, shrubland, grassland, wetland, and open water. Natural plant life covered seventeen percent of the White River corridor, with upland deciduous forest being the most common land cover type.



Existing Land Cover from NLCD (Source: USGS)

Historical Vegetation

Who?

Presettlement Vegetation in the White River Corridor

What?

This report reviews generalized presettlement vegetation types of Indiana, circa 1816. The mapping is based on original land survey records and modern soil maps of counties. Before heavy European influence, the entirety of the study area and in fact, the vast majority of Central Indiana was considered to be “Beech-Maple” (*Fagus grandifolia*-*Acer saccharum*) Forest. Small areas of oak-hickory (*Quercus*-*Carya*) forest were also present.

Why?

Pre-settlement vegetation data is a framework to understand the current ecological conditions and what the land potentially may become, if managed for natural vegetation. It also provides a template for which species to plant in areas that are being restored.

Rare Features

Who?

Indiana Natural Heritage Data Center

Disclaimer notice:

This report includes data provided by the Indiana Natural Heritage Data Center. These data are not based on a comprehensive inventory of the State. The lack of data for any geographic area shall not be construed to mean that no significant natural features are present. The State of Indiana is not responsible for any inaccuracies in the data and does not necessarily endorse any interpretations or products derived from the data.

What?

AES received a dataset from the Indiana Natural Heritage Data Center from June 11, 2018 for rare plants, animals, and unique ecological features within the White River Study Area. There were eighty-five rare feature occurrences in the dataset.

The Indiana Natural Heritage Information System database reported thirty-one rare species (state endangered or species of special concern) and five types of rare natural communities within a half-mile of the White River. All were documented at least once since 1980. Of these, nineteen are rare mussel species only known from empty shells, with no live records of mussels. Two species of rare birds, five rare bats, two rare amphibians,

GROUP	NUMBER OF PROTECTED SPECIES ¹	NUMBER OF SPECIAL CONCERN SPECIES ²	NUMBER OF HIGH VALUE NATURAL COMMUNITIES ³
ANIMALS & PLANTS			
BIRDS		2 GREAT EGRET, BALD EAGLE	
MAMMALS	2 LITTLE BROWN BAT, INDIANA BAT	2 EASTERN RED BAT, AMERICAN BADGER	
AMPHIBIANS		1 COMMON MUD PUPPY	
PLANTS		2 WOLF BLUEGRASS, TUFTED HAIRGRASS	
NATURAL COMMUNITIES			
UPLAND NATURAL COMMUNITIES			2
LOWLAND NATURAL COMMUNITIES			5

¹ STATE-LISTED THREATENED OR ENDANGERED

² STATE-LISTED SPECIES OF SPECIAL CONCERN, STATE RARE, AND WATCH LIST SPECIES

³ CLIPPED TO ONE-HALF MILE OF WHITE RIVER.

and two species of rare plants were also documented.

Rare features within the one-half mile White River Study Area. Mussels and species with records only older than 1980 are excluded.

Where?

All rare wildlife, plants, natural communities, and geologic features listed are within the 58-mile study area.

Why?

Results of this query were used to rank natural areas in importance. Large areas with

occurrences of rare features were ranked as more important for conservation than small natural areas with no rare features. Results of this ranking fed into the selection of the six major focus areas.

The highest concentrations of rare species tended to occur in the largest, most intact, and least disturbed natural areas. Within the White River project corridor, there are three locations that have three to five rare features, and one location with six rare features. Most of the fifteen smaller areas of good habitat support one to two rare features.

LIST OF NATIVE OR MIGRATORY SPECIES WITHIN THE CENTRAL INDIANA WHITE RIVER STUDY AREA

COMMON NAME	TYPICAL HABITAT	NATIVE	COMMON NAME	TYPICAL HABITAT	NATIVE
MAMMALS			Northern Leopard Frog	River Shorelines	Native
Beaver	River Shorelines/River Aquatic	Native	Painted Turtle	River Shorelines/River Aquatic	Native
Long-tailed Weasel	River Shorelines/River Aquatic	Native	Snapping turtle	River Shorelines/River Aquatic	Native
Mink	River Shorelines/River Aquatic	Native	Wood Frog	River Shorelines	Native
Muskrat	River Shorelines/River Aquatic	Native	Black Crappie (Calico Bass)	River Aquatic	
River Otter	River Shorelines/River Aquatic	Native	Bluegill	River Aquatic	
BIRDS			Bluntnose Minnow	River Aquatic	
Bald Eagle	River Shorelines/River Aquatic	Native	Channel Catfish	River Aquatic	
Canada Goose	River Aquatic	Native	Creek Chub	River Aquatic	
Double-crested Cormorant	River Aquatic	Native	Emerald Shiner	River Aquatic	
Great Blue Heron	River Shorelines	Native	Flathead Catfish	River Aquatic	
Great Egret	River Shorelines	Native	Freshwater Drum	River Aquatic	
Green Heron	River Shorelines	Native	Largemouth Bass	River Aquatic	
Killdeer	River Shorelines	Native	Redear Sunfish	River Aquatic	
Mallard	River Aquatic	Native	Golden Redhorse	River Aquatic	
Lesser Yellowlegs	River Shorelines	Native	Sauger	River Aquatic	
Osprey	River Shorelines/River Aquatic	Native	Smallmouth Bass	River Aquatic	
Spotted Sandpiper	River Shorelines	Native	Striped Shiner	River Aquatic	
Wood Duck	River Aquatic	Native	MUSSELS		
REPTILES AND AMPHIBIANS			Threeridge	River Aquatic	
Blanding's Turtle	River Shorelines/River Aquatic	Native	Giant Floater	River Aquatic	
Common Watersnake	River Shorelines	Native	Wabash Pigtoe	River Aquatic	
Eastern Gray Treefrog	River Shorelines	Native	Plain Pocketbook	River Aquatic	
Northern Cricket Frog	River Shorelines	Native	White Heelsplitter	River Aquatic	
			Fragile Papershell	River Aquatic	
			Mapleleaf	River Aquatic	

Important Natural Areas

Who?

Applied Ecological Services (AES)

What?

AES analyzed data and identified the kinds and concentrations of rare natural features and locations of large and moderately-sized natural areas. Important natural areas were ranked as having moderate, high, and exception value using the below criteria:

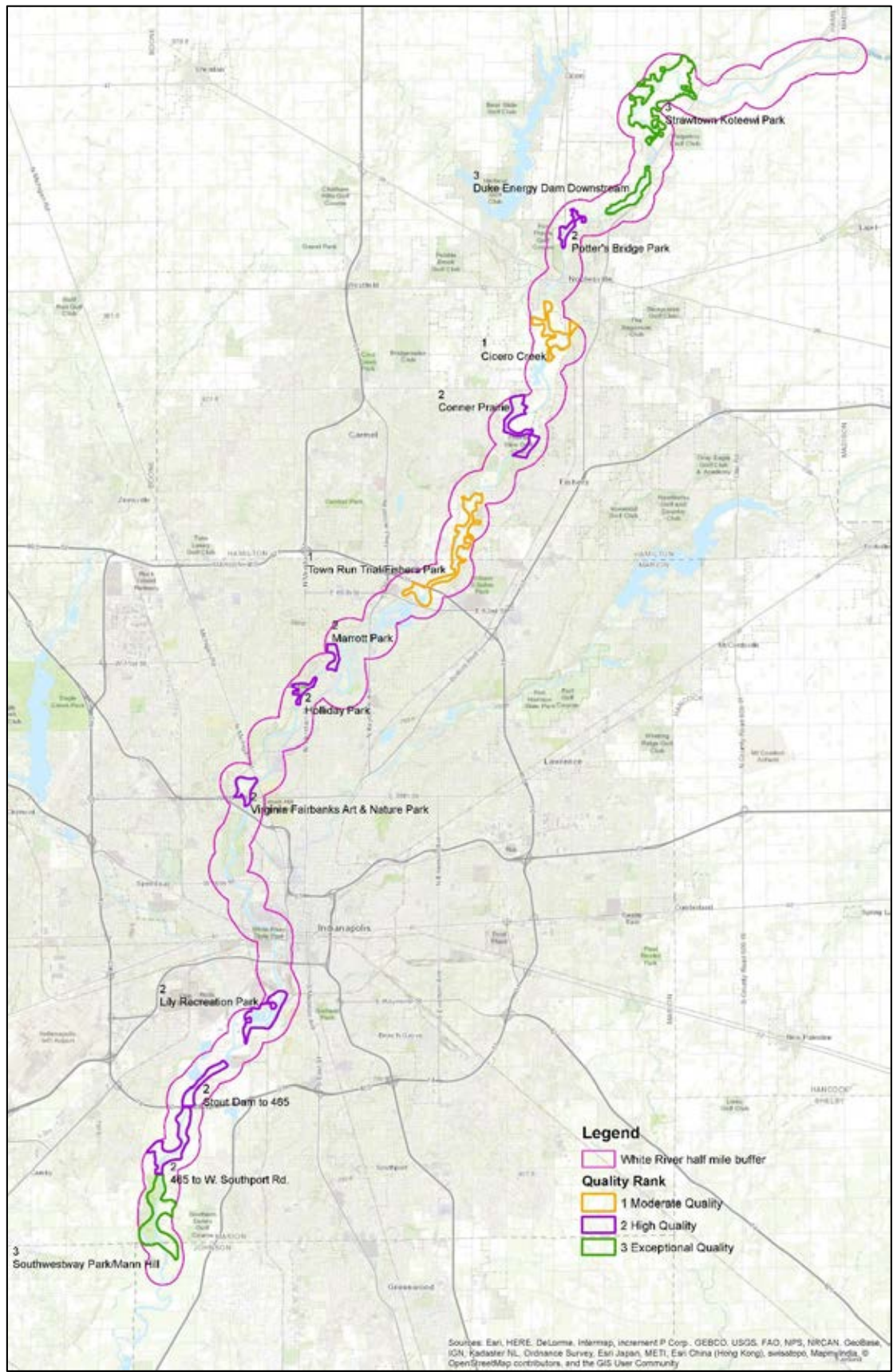
The following Important Natural Areas were identified and ranked:

IMPORTANT NATURAL AREA

QUALITY RANK

Strawtown Koteewi Park	Exceptional
Duke Energy Dam Downstream	Exceptional
Southwestway Park/Mann Hill	Exceptional
Potter's Bridge Park	High
Conner Prairie	High
Marrott Park	High
Holliday Park	High
Virginia Fairbanks Art & Nature Park	High
Lily Recreation Park	High
Stout Dam to 465	High
465 to W. Southport Rd.	High
Cicero Creek	Moderate
Town Run Trail/Fishers Park	Moderate

QUALIFIER	MODERATE VALUE	HIGH VALUE	EXCEPTIONAL VALUE
SIZE	1-10 ACRES	11-100 ACRES	101+ ACRES
SURROUNDING LAND USE	DEVELOPED	AGRICULTURAL	NATURAL
HABITAT CONNECTIVITY	UNCONNECTED	SOMEWHAT CONNECTED	CONNECTED
HABITAT COMPLEXITY	FEW PLANT COMMUNITIES AND HABITATS	SOME PLANT COMMUNITIES AND HABITATS	SEVERAL PLANT COMMUNITIES AND HABITATS
RARE FEATURES	1-2 RARE FEATURES	3-4 RARE FEATURES	5-7 RARE FEATURES



Important Natural Areas Quality Ranking

Ecological Community Classification

Who?

NatureServe Explorer

What?

This information is from Ecological Associates Comprehensive Reports. Their website states: *“NatureServe Explorer provides conservation status, taxonomy, distribution, and life history information for more than 70,000 plants, animals, and ecological communities and systems in the United States and Canada.”*

Before 1830, the region was blanketed by several forest types: Oak-Hickory forest on dry ground, Oak-Maple-Tulip and Beech-Maple forest on rich sites, Maple-Elm-Cottonwood forest on floodplains, and Sycamore-Cottonwood forests on riverbanks. That situation has changed, with forest now covering about eleven percent of the White River study area, developed lands about fifty-two percent, and cropland about twenty-three percent.

- Oak-Hickory Forest: This once-extensive dry forest occurs on hilltops, slopes, and some terraces that slope towards floodplains. Logging and expansion of

maple and invasive understory plants has reduced the amount of oak and hickory. The non-native trees may colonize in more urban areas. The herbaceous groundcover can be quite diverse where not overtaken by invasive species.

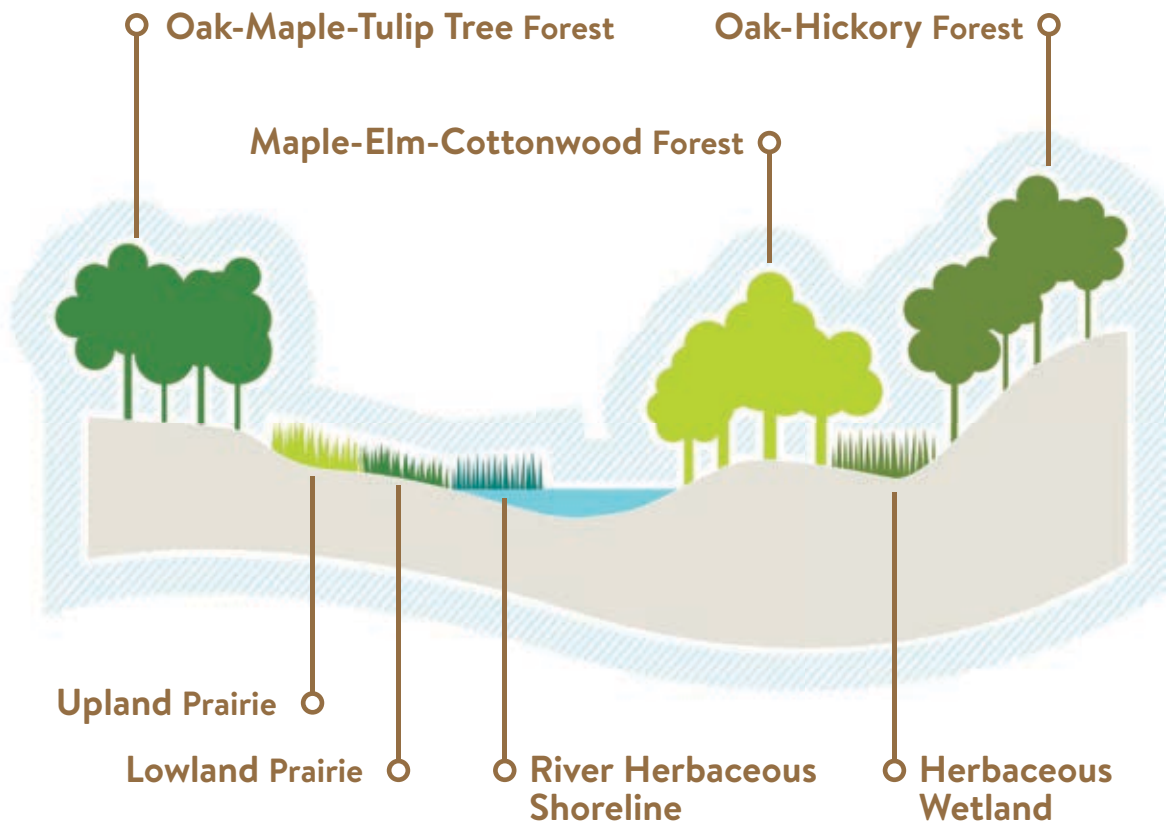
- Oak-Maple-Tulip Forest: This forest (and the related beech-maple forest) were once extensive, with a large diversity of species growing on moist, level areas. Today, it exists primarily in public parks and private residential neighborhoods. These forests often were selectively harvested for wood products until protected. In parks, the ground layer is usually mowed.
- Maple-Elm-Cottonwood Floodplain Forest: Often occurs along the White River or in bottomland sloughs inland. This forest may flood to a depth of six feet or more after spring snowmelt and late spring rains. Quite often, extremely large old-growth canopy trees are found here. Understories are relatively clear of dense brush due to flooding. Shrubs occur where there is more light. On White River banks, massive cottonwoods often grow out of the banks and overhang the water.
- Upland Prairie: Upland prairie is a mostly treeless herbaceous plant community that once covered large expanses of Indiana but was virtually eliminated in the 1800s by agriculture and development. Remnants of the original prairies, together with restored prairies, make up a tiny fraction of the land surface in the White River corridor. From dry hills and southerly slopes, to wet sites in lowlands, all prairies are dominated by grasses, with a large proportion of wildflowers in the aster, pea,

and mint families. A large, plant-rich prairie is in flower from May into October and supports hundreds of species of insects – including many pollinators – and dozens of species of birds, small mammals, and reptiles.

- **Wet Meadow:** Wet meadows of sedges, grasses, rushes, and wildflowers can be found in any low, wet place that is regularly disturbed by flooding, grazing, or burning. Most wet meadows are often colonized and overtaken by introduced plants.
- **River Shore:** The littoral, or shallow water zone of the White River, supports beds of herbaceous plants and some shrubs. In many urban stretches of river, non-native species become more common.

Why?

During ecological community inventorying, it is important to understand the ecosystems encountered in the field which can be incorporated in conservation and management plans. Resources such as NatureServe's Ecological Associates Comprehensive Reports provide full and detailed information on the location, elevation, slopes, geology, hydrology, historical condition and plant species likely to be encountered in an ecological community.



Native and Invasive Species

Who?

Indiana Native Plant Society

City of Indianapolis Office of Land Stewardship

Keep Indianapolis Beautiful

What?

Invasive plants cover a large proportion of the White River watershed to the exclusion of many native species. Common invasive plants include honeysuckle, white mulberry, tree-of-heaven, reed canary grass, narrow-leaved cattail, and purple loosestrife. Controlling invasive plants requires considerable investment and long-term attention to prevent their return.

Controlling invasive plants like bush honeysuckle is an urgent need to prevent continued degradation of forested ecosystems in the region. Efforts to control invasives are sporadic and scattered (e.g., Fishers at Ritchie Woods), but more coordination, technical assistance, and funding are needed. People do not realize honeysuckle control is a long-term commitment, like maintaining streets and sewers. After the first treatment – such as cutting honeysuckle and painting stumps with herbicide – the seedlings and resprouting stumps must be treated for

another year or two. Ongoing maintenance must occur thereafter, with a return visit and spot-treatment of invasive plants or a prescribed burn to make the native plants more competitive.

Once invasive woody and herbaceous plants are removed, the next step is to plant native trees and shrubs, install native seed, and then manage and monitor native plant success.

Where?

Large, intact natural habitats are a good target for invasive species removal because the potential for recovery is higher than small, disrupted habitats. Other particularly good areas to target for invasive species removal are along sections of the White River where people have noted that the vegetation blocks their view of the water. In places where this vegetation consists of invasive species, clearing and replacing those with suitable native shrubs and trees will both improve the shoreline habitat and improve visibility and public perception.

Why?

To restore habitats within the White River, it is first important to inventory and know what is present and what challenges each natural area face – including invasive species. Restoring these areas often includes seeding and planting native species; hence, developing a good planting list is the first step. Appropriate native species must be selected for the target area. Lists of native plants from the Indiana Native Plant Society and other resources will help with future implementation in this effort.

LIST OF PLANT SPECIES WITHIN THE CENTRAL INDIANA WHITE RIVER STUDY AREA

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Ailanthus altissima</i>	Tree-of-heaven	Tree	Invasive
<i>Bromus inermis</i>	Smooth brome	Herbaceous	Invasive
<i>Cirsium arvense</i>	Canada thistle	Herbaceous	Invasive
<i>Festuca elatior</i>	Tall fescue	Herbaceous	Invasive
<i>Hesperis matronalis</i>	Dame's rocket	Herbaceous	Invasive
<i>Lespedeza bicolor</i>	Bicolor lespedeza	Shrub	Invasive
<i>Lespedeza cuneata</i>	Sericea lespedeza	Herbaceous	Invasive
<i>Lythrum salicaria</i> *	Purple loosestrife	Herbaceous	Invasive
<i>Melilotus alba</i> , <i>M. officinalis</i>	Sweet clover	Herbaceous	Invasive
<i>Miscanthus sinensis</i>	Maiden grass	Herbaceous	Invasive
<i>Morus alba</i>	White mulberry	Tree	Invasive
<i>Phalaris arundinacea</i> *	Reed canary grass	Herbaceous	Invasive
<i>Robinia pseudoacacia</i>	Black locust	Tree	Invasive
<i>Rosa multiflora</i>	Multiflora rose	Shrub	Invasive
<i>Typha angustifolia</i> *	Narrow-leaved cattail	Herbaceous	Invasive
<i>Viburnum opulus</i> v. <i>opulus</i>	Highbush cranberry	Shrub	Invasive
<i>Acer platanoides</i>	Norway maple	Tree	Invasive
<i>Ailanthus altissima</i>	Tree of heaven	Tree	Invasive
<i>Alnus glutinosa</i>	Black alder	Shrub	Invasive
<i>Bromus inermis</i>	Smooth brome	Herbaceous	Invasive
<i>Euonymus alatus</i>	Winged burning bush	Shrub	Invasive
<i>Euonymus fortunei</i>	Purple winter creeper	Vine	Invasive
<i>Glechoma hederacea</i>	Creeping Charlie	Vine	Invasive
<i>Hesperis matronalis</i>	Dame's rocket	Herbaceous	Invasive
<i>Lespedeza bicolor</i>	Bicolor lespedeza	Shrub	Invasive
<i>Ligustrum vulgare</i>	Common privet	Shrub	Invasive

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Lonicera japonica</i>	Japanese honeysuckle	Herbaceous	Invasive
<i>Lonicera maackii</i>	Asian bush honeysuckle	Shrub	Invasive
<i>Lysimachia nummularia</i>	Creeping Jenny	Vine	Invasive
<i>Lysimachia</i> spp.	Loosestrife	Herbaceous	Invasive
<i>Microstegium vimineum</i>	Japanese stiltgrass	Herbaceous	Invasive
<i>Ornithogalum umbellatum</i>	Star of Bethlehem	Herbaceous	Invasive
<i>Polygonum cuspidatum</i>	Japanese knotweed	Herbaceous	Invasive
<i>Rosa multiflora</i>	Multiflora rose	Herbaceous	Invasive
<i>Ulmus pumila</i>	Siberian elm	Tree	Invasive
<i>Viburnum opulus</i> v. <i>opulus</i>	Highbush cranberry	Shrub	Invasive
<i>Vinca minor</i>	Periwinkle	Vine	Invasive
<i>Asclepias incarnata</i>	Marsh milkweed	Herbaceous	Native
<i>Bidens aristosa</i>	Bur marigold	Herbaceous	Native
<i>Caltha palustris</i>	Marsh marigold	Herbaceous	Native
<i>Carex</i> spp.	Sedges	Herbaceous	Native
<i>Carex stricta</i>	Tussock sedge	Herbaceous	Native
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub	Native
<i>Chelone glabra</i>	Turtlehead	Herbaceous	Native
<i>Eleocharis</i> spp.	Spike-rushes	Herbaceous	Native
<i>Eupatorium purpureum</i>	Sweet joe-pye weed	Herbaceous	Native
<i>Filipendula rubra</i>	Queen-of-the-prairie	Herbaceous	Native
<i>Hibiscus moscheutos</i>	Swamp rose mallow	Herbaceous	Native
<i>Ilex verticillata</i>	Winterberry holly	Shrub	Native
<i>Iris cristata</i>	Dwarf crested iris	Herbaceous	Native
<i>Iris virginica</i>	Blue flag	Herbaceous	Native
<i>Juncus effusus</i>	Soft rush	Herbaceous	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Lobelia cardinalis</i>	Cardinal flower	Herbaceous	Native
<i>Lobelia siphilitica</i>	Blue lobelia	Herbaceous	Native
<i>Panicum virgatum</i>	Switch grass	Herbaceous	Native
<i>Populus deltoides</i>	Eastern Cottonwood	Tree	Native
<i>Salix interior</i>	Sandbar willow	Shrub	Native
<i>Sambucus canadensis</i>	Elderberry	Shrub	Native
<i>Saururus cernua</i>	Lizard tail	Herbaceous	Native
<i>Schoenoplectus americanus</i>	American bulrush	Herbaceous	Native
<i>Sedum ternatum</i>	Wild stonecrop	Herbaceous	Native
<i>Sorghastrum nutans</i>	Indian grass	Herbaceous	Native
<i>Vernonia gigantea</i>	Ironweed	Herbaceous	Native
<i>Acer rubrum</i>	Red maple	Tree	Native
<i>Amphicarpaea bracteata</i>	American hog-peanut	Herbaceous	Native
<i>Anemone virginiana</i>	Tall thimbleweed	Herbaceous	Native
<i>Botrychium virginianum</i>	Rattlesnake fern	Herbaceous	Native
<i>Brachyelytrum erectum</i>	Long-awned wood grass	Herbaceous	Native
<i>Carya alba</i>	Mockernut hickory	Tree	Native
<i>Carya glabra</i>	Pignut hickory	Tree	Native
<i>Carya ovata</i>	Shagbark hickory	Tree	Native
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	Broadleaf enchanter's nightshade	Herbaceous	Native
<i>Cornus florida</i>	Flowering dogwood	Shrub	Native
<i>Cornus foemina</i>	Stiff dogwood	Shrub	Native
<i>Corylus americana</i>	American hazelnut	Shrub	Native
<i>Desmodium glutinosum</i>	Pointed- leaved tick trefoil	Herbaceous	Native
<i>Galium concinnum</i>	Shining bedstraw	Herbaceous	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Geranium maculatum</i>	Wild geranium	Herbaceous	Native
<i>Juglans nigra</i>	Eastern black walnut	Tree	Native
<i>Maianthemum racemosum</i>	False solomon's-seal	Herbaceous	Native
<i>Osmorhiza claytonii</i>	Sweet cicely	Herbaceous	Native
<i>Ostrya virginiana</i>	American hophornbeam	Tree	Native
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Shrub	Native
<i>Prunus serotina</i>	Black cherry	Tree	Native
<i>Quercus alba</i>	White oak	Tree	Native
<i>Quercus ellipsoidalis</i>	Northern pin oak	Tree	Native
<i>Quercus macrocarpa</i>	Bur oak	Tree	Native
<i>Quercus rubra</i>	Northern red oak	Tree	Native
<i>Quercus velutina</i>	Black oak	Tree	Native
<i>Ribes cynosbati</i>	Prickly gooseberry	Shrub	Native
<i>Sanicula odorata</i>	Clustered black snakeroot	Herbaceous	Native
<i>Sassafras albidum</i>	Sassafras	Tree	Native
<i>Symphotrichum cordifolium</i>	Blue wood-aster	Herbaceous	Native
<i>Tilia americana</i>	American basswood	Tree	Native
<i>Zanthoxylum americanum</i>	Common prickly-ash	Shrub	Native
<i>Acer saccharum</i>	Sugar maple	Tree	Native
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	Herbaceous	Native
<i>Aesculus glabra</i>	Ohio buckeye	Tree	Native
<i>Carpinus caroliniana</i>	American hornbeam	Tree	Native
<i>Carya cordiformis</i>	Bitternut hickory	Tree	Native
<i>Celtis occidentalis</i>	Hackberry	Tree	Native
<i>Cercis canadensis</i>	Redbud	Tree	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Erythronium americanum</i>	Yellow trout lily	Herbaceous	Native
<i>Fagus grandifolia</i>	American beech	Tree	Native
<i>Fraxinus americana</i>	White ash	Tree	Native
<i>Juglans cinerea</i>	Butternut	Tree	Native
<i>Juglans nigra</i>	Black walnut	Tree	Native
<i>Liriodendron tulipifera</i>	Tulip tree	Tree	Native
<i>Osmorhiza claytonii</i>	Sweet cicely	Herbaceous	Native
<i>Ostrya virginiana</i>	American hophornbeam	Tree	Native
<i>Polygonatum biflorum</i>	Smooth solomon's-seal	Herbaceous	Native
<i>Prunus serotina</i>	Black cherry	Tree	Native
<i>Quercus coccinea</i>	Scarlet oak	Tree	Native
<i>Quercus alba</i>	White oak	Tree	Native
<i>Quercus macrocarpa</i>	Bur oak	Tree	Native
<i>Quercus muehlenbergii</i>	Chinquapin oak	Tree	Native
<i>Quercus rubra</i>	Northern red oak	Tree	Native
<i>Quercus velutina</i>	Black oak	Tree	Native
<i>Tilia americana</i>	Basswood	Tree	Native
<i>Trillium grandiflorum</i>	Great white trillium	Herbaceous	Native
<i>Acer negundo</i>	Box elder	Tree	Native
<i>Acer saccharinum</i>	Silver maple	Tree	Native
<i>Acer saccharum</i>	Sugar maple	Tree	Native
<i>Amphicarpaea bracteata</i>	American hog-peanut	Herbaceous	Native
<i>Apios americana</i>	Potato bean	Herbaceous	Native
<i>Betula nigra</i>	River birch	Tree	Native
<i>Boehmeria cylindrica</i>	False nettle	Herbaceous	Native
<i>Celtis occidentalis</i>	Hackberry	Tree	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Cercis canadensis</i>	Redbud	Tree	Native
<i>Cinna arundinacea</i>	Sweet wood reed	Herbaceous	Native
<i>Cornus spp.</i>	Dogwoods	Shrub	Native
<i>Echinocystis lobata</i>	Wild cucumber	Herbaceous	Native
<i>Elymus virginicus</i>	Virginia wild-rye	Herbaceous	Native
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	Native
<i>Gleditsia triacanthos</i>	Honey locust	Tree	Native
<i>Impatiens pallida</i>	Yellow jewelweed	Herbaceous	Native
<i>Laportea canadensis</i>	Canadian wood nettle	Herbaceous	Native
<i>Leersia virginica</i>	Whitegrass	Herbaceous	Native
<i>Lindera benzoin</i>	Northern spicebush	Shrub	Native
<i>Matteuccia struthiopteris</i>	Ostrich Fern	Herbaceous	Native
<i>Morus rubra</i>	Red mulberry	Tree	Native
<i>Onoclea sensibilis</i>	Sensitive fern	Herbaceous	Native
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Herbaceous	Native
<i>Pilea pumila</i>	Canadian clearweed	Herbaceous	Native
<i>Platanus occidentalis</i>	American sycamore	Tree	Native
<i>Populus deltoides</i>	Eastern cottonwood	Tree	Native
<i>Rubus occidentalis</i>	Black raspberry	Shrub	Native
<i>Salix nigra</i>	Black willow	Tree	Native
<i>Sambucus canadensis</i>	Common elderberry	Shrub	Native
<i>Solidago gigantea</i>	Giant goldenrod	Herbaceous	Native
<i>Symphytotrichum lateriflorum</i>	Calico aster	Herbaceous	Native
<i>Toxicodendron radicans</i>	Poison ivy	Herbaceous	Native
<i>Ulmus americana</i>	American elm	Tree	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Ulmus rubra</i>	Slippery elm	Tree	Native
<i>Urtica dioica</i>	Common nettle	Herbaceous	Native
<i>Vitis riparia</i>	Riverbank grape	Herbaceous	Native
<i>Allium cernuum</i>	Nodding onion	Herbaceous	Native
<i>Andropogon gerardii</i>	Big bluestem	Herbaceous	Native
<i>Asclepias tuberosa</i>	Butterfly weed	Herbaceous	Native
<i>Baptisia lactea</i>	White false indigo	Herbaceous	Native
<i>Bouteloua curtipendula</i>	Sideoats grama grass	Herbaceous	Native
<i>Ceanothus americanus</i>	New Jersey tea	Shrub	Native
<i>Coreopsis tripteris</i>	Tall coreopsis	Herbaceous	Native
<i>Dodecatheon meadia</i>	Shooting star	Herbaceous	Native
<i>Echinacea pallida</i>	Pale-purple coneflower	Herbaceous	Native
<i>Eryngium yuccifolium</i>	Rattlesnake master	Herbaceous	Native
<i>Helianthis occidentalis</i>	Western sunflower	Herbaceous	Native
<i>Helianthus grosseserratus</i>	Saw-tooth sunflower	Herbaceous	Native
<i>Heliopsis helianthoides</i>	False sunflower	Herbaceous	Native
<i>Liatris pycnostachya</i>	Prairie blazing star	Herbaceous	Native
<i>Monarda fistulosa</i>	Wild bergamot	Herbaceous	Native
<i>Oligoneuron rigidum</i>	Stiff goldenrod	Herbaceous	Native
<i>Panicum spp.</i>	Panic grasses	Herbaceous	Native
<i>Panicum virgatum</i>	Switch grass	Herbaceous	Native
<i>Penstemon grandiflorus</i>	Large-flowered foxglove	Herbaceous	Native
<i>Penstemon hirsutus</i>	Hairy foxglove	Herbaceous	Native
<i>Physostegia virginiana</i>	Obedient plant	Herbaceous	Native
<i>Pycnanthemum virginianum</i>	Mountain mint	Herbaceous	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Ratibida pinnata</i>	Yellow coneflower	Herbaceous	Native
<i>Rhus copallinum</i>	Winged sumac	Shrub	Native
<i>Rudbeckia hirta</i>	Black-eyed susan	Herbaceous	Native
<i>Rudbeckia subtomentosa</i>	Sweet black-eyed susan	Herbaceous	Native
<i>Rudbeckia triloba</i>	Brown-eyed susan	Herbaceous	Native
<i>Schizachyrium scoparium</i>	Little bluestem	Herbaceous	Native
<i>Silphium integrifolium</i>	Rosinweed	Herbaceous	Native
<i>Silphium laciniatum</i>	Compass plant	Herbaceous	Native
<i>Silphium terebinthinaceum</i>	Prairie dock	Herbaceous	Native
<i>Solidago sphacelata</i>	Autumn goldenrod	Herbaceous	Native
<i>Sorghastrum nutans</i>	Indian grass	Herbaceous	Native
<i>Sporobolus heterolepis</i>	Prairie dropseed	Herbaceous	Native
<i>Symphiotrichum laeve</i>	Sky-blue aster	Herbaceous	Native
<i>Symphiotrichum novae-angliae</i>	New England aster	Herbaceous	Native
<i>Vernonia gigantea ssp. gigantea</i>	Ironweed	Herbaceous	Native
<i>Veronicastrum virginicum</i>	Culver's root	Herbaceous	Native
<i>Andropogon gerardii</i>	Big bluestem	Herbaceous	Native
<i>Bromus ciliatus</i>	Fringed brome grass	Herbaceous	Native
<i>Carex bebbii</i>	Bebb's sedge	Herbaceous	Native
<i>Chelone glabra</i>	Turtlehead	Herbaceous	Native
<i>Elymus riparia</i>	Virginia wild rye	Herbaceous	Native
<i>Eupatoriadelphus fistulosus</i>	Hollow joe-pye weed	Herbaceous	Native
<i>Eupatorium maculatum</i>	Spotted Joe-pye weed	Herbaceous	Native
<i>Eupatorium perfoliatum</i>	Common boneset	Herbaceous	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Eupatorium purpureum</i>	Sweet joe-pye weed	Herbaceous	Native
<i>Filipendula rubra</i>	Queen-of-the-prairie	Herbaceous	Native
<i>Helenium autumnale</i>	Sneezeweed	Herbaceous	Native
<i>Helianthus giganteus</i>	Tall sunflower	Herbaceous	Native
<i>Iris virginica</i>	Blue flag	Herbaceous	Native
<i>Liatris spicata</i>	Dense blazing star	Herbaceous	Native
<i>Lobelia cardinalis</i>	Cardinal flower	Herbaceous	Native
<i>Lobelia siphilitica</i>	Blue lobelia	Herbaceous	Native
<i>Lysimachia ciliata</i>	Fringed loosestrife	Herbaceous	Native
<i>Panicum virgatum</i>	Switch grass	Herbaceous	Native
<i>Physostegia virginiana</i>	Obedient plant	Herbaceous	Native
<i>Pycnanthemum virginianum</i>	Mountain mint	Herbaceous	Native
<i>Ratibida pinnata</i>	Yellow coneflower	Herbaceous	Native
<i>Rudbeckia fulgida</i> var. <i>sullivantii</i>	Showy black-eyed Susan	Herbaceous	Native
<i>Silene regia</i>	Royal catchfly	Herbaceous	Native
<i>Silphium terebinthinaceum</i>	Prairie dock	Herbaceous	Native
<i>Solidago gigantea</i>	Giant goldenrod	Herbaceous	Native
<i>Sorghastrum nutans</i>	Indian grass	Herbaceous	Native
<i>Sorghastrum nutans</i>	Indian grass	Herbaceous	Native
<i>Symphyotrichum lanceolatum</i>	Panicled aster	Herbaceous	Native
<i>Symphyotrichum novae-angliae</i>	New England aster	Herbaceous	Native
<i>Symphyotrichum puniceum</i>	Purple-stemmed aster	Herbaceous	Native
<i>Thalictrum dasycarpum</i>	Tall meadow-rue	Herbaceous	Native
<i>Vernonia gigantea</i>	Ironweed	Herbaceous	Native
<i>Veronicastrum virginicum</i>	Culver's root	Herbaceous	Native

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	NATIVE
<i>Acorus calamus</i>	Sweet flag	Herbaceous	Native
<i>Alisma subcordata</i>	Water plantain	Herbaceous	Native
<i>Asclepias incarnata</i>	Marsh milkweed	Herbaceous	Native
<i>Caltha palustris</i>	Marsh marigold	Herbaceous	Native
<i>Carex stricta</i>	Tussock sedge	Herbaceous	Native
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub	Native
<i>Chelone glabra</i>	Turtlehead	Herbaceous	Native
<i>Eleocharis</i> spp.	Spikerush	Herbaceous	Native
<i>Elymus riparia</i>	Virginia wild rye	Herbaceous	Native
<i>Eupatorium perfoliatum</i>	Common boneset	Herbaceous	Native
<i>Eupatorium purpureum</i>	Sweet joe-pye weed	Herbaceous	Native
<i>Filipendula rubra</i>	Queen-of-the-prairie	Herbaceous	Native
<i>Glyceria striata</i>	Fowl mannagrass	Herbaceous	Native
<i>Hibiscus moscheutos</i>	Swamp rose mallow	Herbaceous	Native
<i>Ilex verticillata</i>	Winterberry holly	Shrub	Native
<i>Iris cristata</i>	Dwarf crested iris	Herbaceous	Native
<i>Iris virginica</i>	Blue flag	Herbaceous	Native
<i>Juncus effusus</i>	Soft rush	Herbaceous	Native
<i>Lobelia cardinalis</i>	Cardinal flower	Herbaceous	Native
<i>Lobelia siphilitica</i>	Blue lobelia	Herbaceous	Native
<i>Panicum virgatum</i>	Switch grass	Herbaceous	Native
<i>Sagittaria latifolia</i>	Arrowhead	Herbaceous	Native
<i>Sedum ternatum</i>	Wild stonecrop	Herbaceous	Native
<i>Silene regia</i>	Royal catchfly	Herbaceous	Native
<i>Sorghastrum nutans</i>	Indian grass	Herbaceous	Native
<i>Vernonia gigantea</i>	Ironweed	Herbaceous	Native

Geology and Soils

Who?

Climate, geology and soils data from NOAA, the USGS, and USDA

What?

The ancient bedrock of limestone, dolomite, shale, and sandstone of the White River area was glaciated 13,000 years ago, forming a gently rolling landscape. The soils that developed were very fertile, enriched with calcium carbonate. The climate, geology, soils, and historical and existing vegetation of the White River constitute an ecoregion – a land area where these factors are similar. The White River is in what is called the “Loamy, High Lime Till Plains Ecoregion” of central Indiana.

The loamy, slightly alkaline soil makes excellent farmland with high natural drainage and fertility. This benefit to farmland was what led to a region-wide clearing of the forest (ninety percent) and drainage of wetlands (also ninety percent) by the year 1900.

Waterways and Natural Areas Connectivity Assessment

Habitat Connectivity and Conservation

Who

Saving Nature's Legacy, by Reed F. Noss and Allen Cooperrider, 1994. Defenders of Wildlife. 443 pp.

What?

This research urges preservation of the wildlife already present while attract new species through designating a core habitat and adjacent transition areas. No infrastructure should intrude on the core habitat zone, and human use should be limited to education, research, and walking. Some

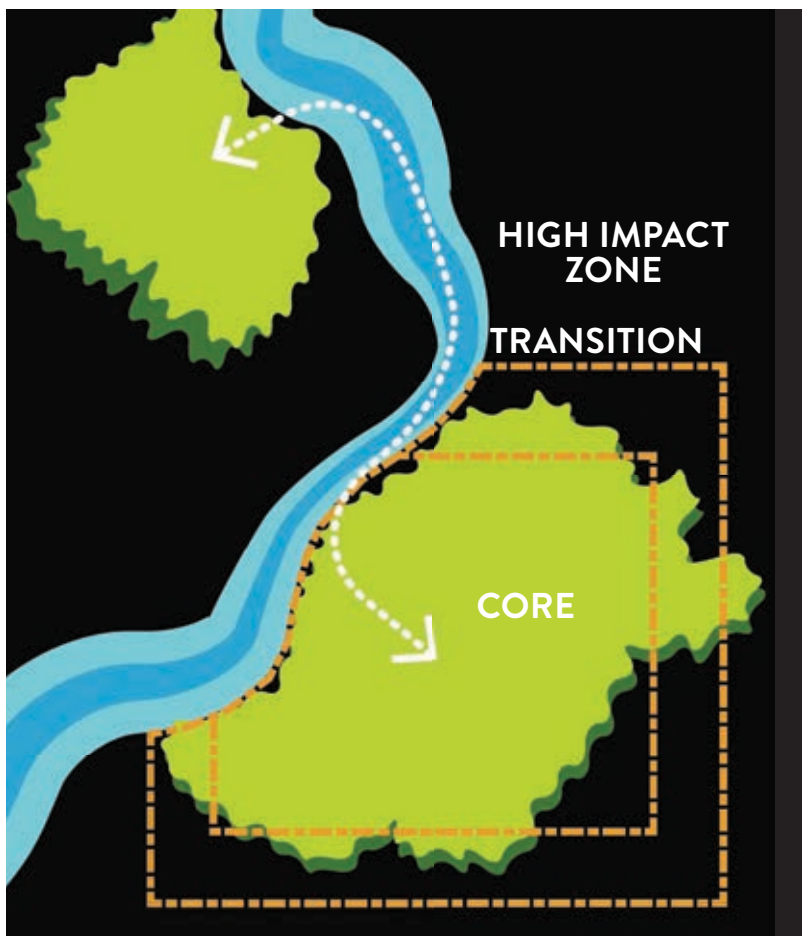
light infrastructure, such as paved trails and tent campgrounds, are suited to the transition zone, but human use should not damage the core habitat by creating edge effects. Edge effects are damaging influences on core habitat due to incompatible uses on adjacent lands that penetrate the core habitat, reducing the habitat's suitability for many plant and animal species.

Why

Written by two leading conservation biologists, *Saving Nature's Legacy* is a thorough and readable introduction to issues of land management and conservation biology. It presents a broad, land-based approach to biodiversity conservation in the United States, with the authors succinctly translating principles, techniques, and findings of the ecological sciences into an accessible and practical plan for action.

After laying the groundwork for biodiversity conservation – what biodiversity is, why it is important, and its status in North America – Noss and Cooperrider consider the strengths and limitations of past and current approaches to land management. They then present the framework for a bold new strategy, with explicit guidelines on:

- Inventorying biodiversity
- Selecting areas for protection
- Designing regional and continental reserve networks
- Establishing monitoring programs
- Setting priorities for getting the job done



Restoration and Enhancement

Who?

Applied Ecological Services

What?

Using all data gathered, AES developed high-level restoration and enhancement concepts in mapped ecological communities within the seven final focus areas, as well as associated implementation costs.

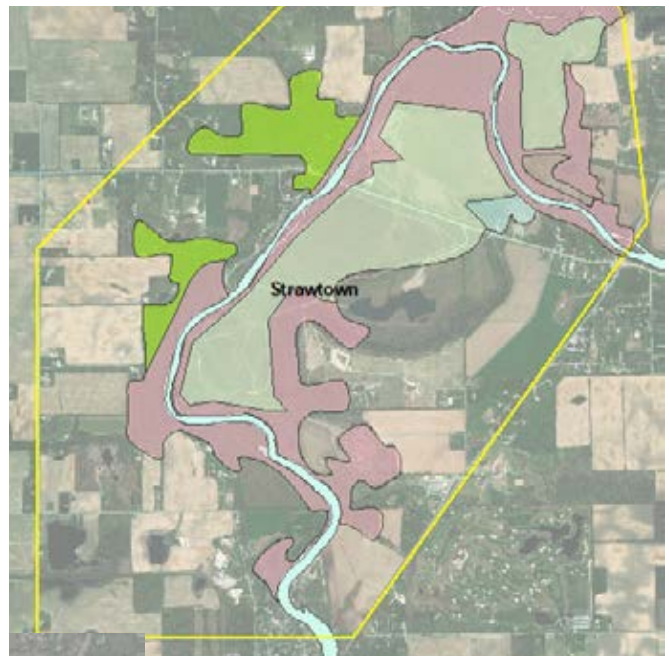
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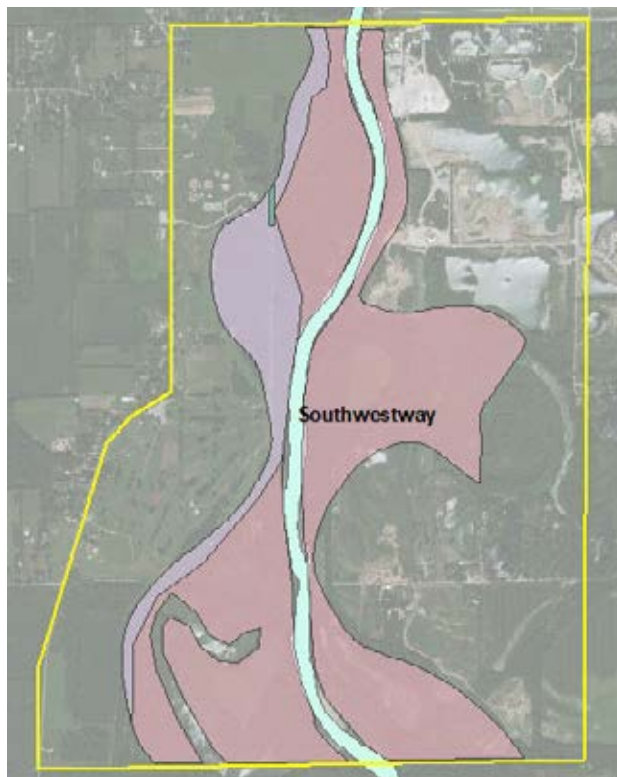
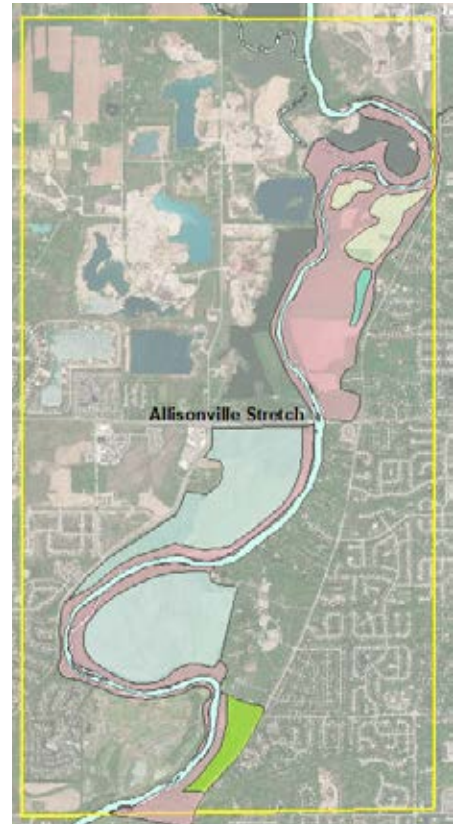
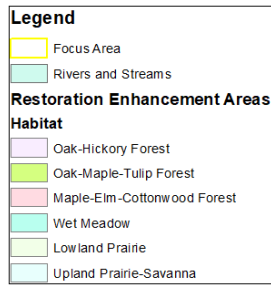
Strawtown-Kowteewii, Noblesville, Allisonville Stretch, Oliver's Crossing, Broad Ripple, Downtown Indianapolis, and Southwestway.

Why?

Restoration efforts in these seven focus areas provide ecological benefit to many identified "Important Natural Areas," as well as providing public recreational and aesthetic value. They also serve as a model for future restoration and enhancement efforts in other reaches of the White River. Over time, if practiced in with this recommended methodology, the White River will consist of a connected, diverse biological corridor in an urban and rural landscape.

These diagrams illustrate the restoration and enhancement strategies within the White River Master Plan's seven focus areas.





OPINION OF PROBABLE COST FOR ECOLOGICAL RESTORATION WITHIN SEVEN TARGET FOCUS AREAS

Focus Area	Natural Communities	Remove Invasive Trees/Shrubs (acres)	Control Invasive Herbaceous Vegetation (acres)	Plant Trees/Shrubs (acres)	Plant Herbaceous Vegetation (acres)	Prescribed Burning (acres)	Other Perpetual Management (acres)	Ecological Monitoring (acres)	Focus Area Total
Strawtown Koteewi	Oak Hickory Forest								total acres 1064.6
	Oak Maple Tulip Forest	122.3		122.3			122.3	122.3	
	Maple Elm Cottonwood Forest	536.5		536.5			536.5	536.5	
	Wet Meadow								
	Lowland Prairie		390.5		390.5	390.5	390.5	390.5	
	Upland Prairie and Savanna		15.3		15.3	15.3	15.3	15.3	
		\$1,449,360	\$395,655	\$658,800	\$344,930	\$142,030	\$266,150	\$85,168	\$ 3,342,093.00
Downtown Noblesville	Oak Hickory Forest								total acres 31.9
	Oak Maple Tulip Forest								
	Maple Elm Cottonwood Forest	31.9		31.9			31.9	31.9	
	Wet Meadow								
	Lowland Prairie								
	Upland Prairie and Savanna								
		\$70,180	\$0	\$31,900	\$0	\$0	\$7,975	\$2,552	\$ 112,607.00
Allisonville	Oak Hickory Forest								total acres 1001.9
	Oak Maple Tulip Forest	39.6		39.6			39.6	39.6	
	Maple Elm Cottonwood Forest	499.8		499.8			499.8	499.8	
	Wet Meadow		9.2		9.2	9.2	9.2	9.2	
	Lowland Prairie		52.3		52.3	52.3	52.3	52.3	
	Upland Prairie and Savanna		196.8		196.8	401	401	401	
		\$1,186,680	\$251,843	\$539,400	\$219,555	\$161,875	\$250,475	\$80,152	\$ 2,689,979.50
Oliver's Crossing	Oak Hickory Forest								total acres 218.7
	Oak Maple Tulip Forest								
	Maple Elm Cottonwood Forest	195.7		195.7		195.7	195.7	195.7	
	Wet Meadow								
	Lowland Prairie								
	Upland Prairie and Savanna					23	23	23	
		\$430,540	\$0	\$195,700	\$0	\$76,545	\$54,675	\$17,496	\$ 774,956.00
Broad Ripple	Oak Hickory Forest								total acres 238
	Oak Maple Tulip Forest	79.5		79.5			79.5	79.5	
	Maple Elm Cottonwood Forest	158.5		158.5			158.5	158.5	
	Wet Meadow								
	Lowland Prairie								
	Upland Prairie and Savanna								
		\$523,600	\$0	\$238,000	\$0	\$0	\$59,500	\$19,040	\$ 840,140.00
Downtown	Oak Hickory Forest								total acres 58.8
	Oak Maple Tulip Forest								
	Maple Elm Cottonwood Forest	42		42			42	42	
	Wet Meadow								
	Lowland Prairie								
	Upland Prairie and Savanna		16.8		16.8	16.8	16.8	16.8	
		\$92,400	\$16,380	\$42,000	\$14,280	\$5,880	\$14,700	\$4,704	\$ 190,344.00
Southwestway Park	Oak Hickory Forest	92.4		92.4			92.4	92.4	total acres 560
	Oak Maple Tulip Forest								
	Maple Elm Cottonwood Forest	466.7		466.7			466.7	466.7	
	Upland Prairie and Savanna								
	Lowland Prairie								
	Wet Meadow		0.9		0.9	0.9	0.9	0.9	
		\$1,230,020	\$878	\$559,100	\$765	\$315	\$140,000	\$44,800	\$ 1,975,877.50
	Total Acres	2,264.90	681.80	2,264.90	681.80	1,104.70	3,173.90	3,173.90	Grand Total Acres
	Unit Cost (per acre)	\$2,200	\$975	\$1,000	\$850	\$350	\$250	\$80	3173.9
	Opinion of Probable Cost	\$4,982,780	\$664,755	\$2,264,900	\$579,530	\$386,645	\$793,475	\$253,912	
								TOTAL	\$9,925,997.00

References and Endnotes

1. Cummings, Kevin S., Christine A. Mayer, and Lawrence M. Page. Survey of the Freshwater Mussels (Mollusca: Unionidae) of the Wabash River Drainage. Champaign: Illinois Natural History Survey, 1992.
2. Crawford, Charles G., Michael J. Lydy, and Jeffrey W. Frey. Fishes of the White River Basin, Indiana. Indianapolis: United States Geological Survey, 1996.
3. Hamilton County Indiana Health Department. Recreational Water Sample Reports. <https://secure2.hamiltoncounty.in.gov/HealthOnline/Default.aspx?PossesPresentation=RecWaterList>
4. Indiana Natural Heritage Data Center. 2018. State of Indiana, Department of Natural Resources, Division of Nature Preserves.
5. Indiana Native Plant Society. Invasive plants in Indiana. <https://www.in.gov/dnr/naturepreserve/files/np-InvasivePlantsBrochure111009.pdf>
6. Indiana Native Plant Society. Landscaping with Plants Native to Indiana. <https://indiananativeplants.org/wp-content/uploads/LandscapingPlants022218.pdf>
7. Marion County Indiana Health Department Water Quality Data. Environmental Health Department, Surface Water Program. <http://marionhealth.org/surface-water-program/>
8. Natural Resources Conservation Service (NRCS), United States Department of Agriculture. Web Soil Survey. <https://websoilsurvey.sc.egov.usda.gov/>
9. Noss, Reed F. and Allen Cooperrider. 1994. *Saving Nature's Legacy*. Defenders of Wildlife. 443 pp.
10. Lindsey, Alton, Ed. 1966. *Presettlement Vegetation Types of Indiana from Natural Features of Indiana*. Indiana Academy of Science, Indianapolis, IN. 280 pp. Digitized by the Indiana Department of Natural Resources. https://maps.indiana.edu/previewMaps/Environment/Land_Cover_Presettlement_IDNR.html
11. NatureServe. 2018. Arlington, VA. <http://explorer.natureserve.org/index.htm>
12. USGS The National Map Download (V1.0). <https://viewer.nationalmap.gov/basic/>