Engaging Individuals to Make Big Changes **in the Upper Tippecanoe R. Watershed**

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Meet Lake Tippecanoe

Lake Tippecanoe is one of Indiana's largest and deepest lakes covering 768 acres with a maximum depth of 123 feet. The lake forms the headwaters of the Tippecanoe River draining 113 square miles (Figure 1). Water enters Lake Tippecanoe from four small tributaries, Kuhn Ditch (1,600 acres), Hannah B. Walker Drain (600 acres), Long Ditch (340 acres), and Indian Creek (300 acres), as well as two larger tributaries: Grassy Creek (52 square miles) and the Tippecanoe River (51 square miles).

Grassy Creek receives drainage from a series of streams and lakes, including Ridinger, Robinson, Troy Cedar, and the Barbee Lakes Chain, while the Tippecanoe River drains Crooked, Big, Loon, Goose, Old, New, Smalley, and Webster Lakes before entering Lake Tippecanoe. Agricultural row crops cover nearly 60 percent of the lake's watershed with an additional 13 percent in pastureland, 11 percent in forestland and nearly 6 percent in open water in the more than 50 lakes measuring greater than one acre located throughout the watershed. The lake's shoreline measure 20.9 miles and nearly 90 percent of shoreline is developed with nearly 1300 dwellings identified (Richardson and Jones 1997). This relatively large watershed area to lake area ratio (93:1) suggests that maintaining or improving in-lake conditions will require shoreline and watershed-based efforts.

In 1994, Lake Tippecanoe residents and the Lake Tippecanoe Property Owners (LTPO) identified a trend in decreasing water quality. Mean total phosphorus concentrations rose from 0.020 mg/L in 1973 to 0.050 mg/L in 1989 to 0.069 mg/L in 1994 (Richardson and Jones 1997). Concurrently, summer Secchi disk transparencies decreased from 23 feet in 1992 to 17.6 feet in 1994. Given Lake Tippecanoe's relatively large drainage area (113 square miles) and large lake volume (28,491 acre-feet or 35,143,000 cubic meters), Lake Tippecanoe can absorb a high volume of phosphorus before deleterious effects occur. However, a reduction in total phosphorus loading by 20 percent was estimated to lower the in-lake total phosphorus concentration to 0.030 mg/L (Richardson and Jones 1997). In response to increasing eutrophication, the LTPO and The Watershed Foundation (TWF) initiated a series of watershed diagnostic studies, education and outreach programming, and watershed-wide on-the-ground conservation project implementations targeting lake and watershed residents and agricultural producers throughout the Upper Tippecanoe River Watershed.

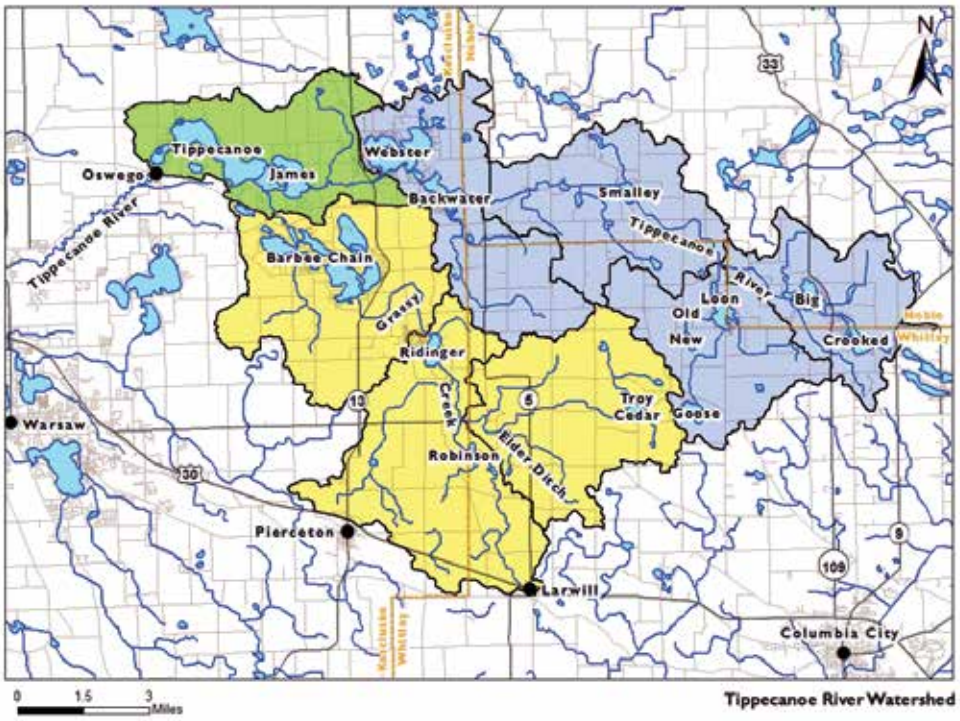

Figure 1. The 113-square-mile Upper Tippecanoe River Watershed.

Making Big Changes

The 1997 Lake Tippecanoe Diagnostic Study identified and designed three projects located on small tributaries draining directly to Lake Tippecanoe (Richardson and Jones 1997). LTPO and TWF recognized that Lake Tippecanoe residents needed to expand their focus from in-lake plant and shoreline management efforts to encompass the entire Lake Tippecanoe watershed. With this in mind, initial water quality implementation projects started with implementing projects along these local, small tributaries immediately adjacent

to Lake Tippecanoe. Following their successful implementation from 1999 through 2001, additional subwatershed based diagnostic and feasibility studies identified numerous localized projects throughout the Upper Tippecanoe River Watershed. Each subsequent project engaged local lake and watershed residents in their portion of the watershed allowing each individual lake association to focus on their local watershed and providing a watershed-wide, cohesive working group to share resources, focus energies, and build a watershed organization. Through LTPO and TWF's targeted efforts to draw lake residents from solely lake-focused to working throughout the entire watershed, they launched long-term success in water quality improvement project implementation.

Since 1998, more than 300 individual water quality improvement projects have been identified throughout the 113 square mile Upper Tippecanoe River Watershed (TELWF 2006; TWF 2015). Nearly one-third of these water quality projects have been implemented with donations, as well as local, state, regional, and national funding totaling more than $2,958,000. Implemented projects included wetland restoration, conservation farming practices, filter strip and grassed waterway installation and repair, livestock restriction, sediment trap construction, ravine stabilization, stormwater detention and retrofits, shoreline rain garden and rain barrel installation, and shoreline stabilization (Figure 2). These combined efforts address runoff from 35 percent of the watershed and resulted reductions of more than 56,658 pounds of phosphorus, 198,365 pounds of nitrogen, and 22,433 tons of sediment loading annually to Lake Tippecanoe watershed streams from 2013 through 2015 using the USEPA Region 5 Pollutant Load Reduction Model customized for Indiana (Region 5 Model). Watershed implementation of water quality improvement projects resulted in 557 million pounds algae and aquatic plants prevented from growing in Lake Tippecanoe.

Let's take a closer look at some of these projects:

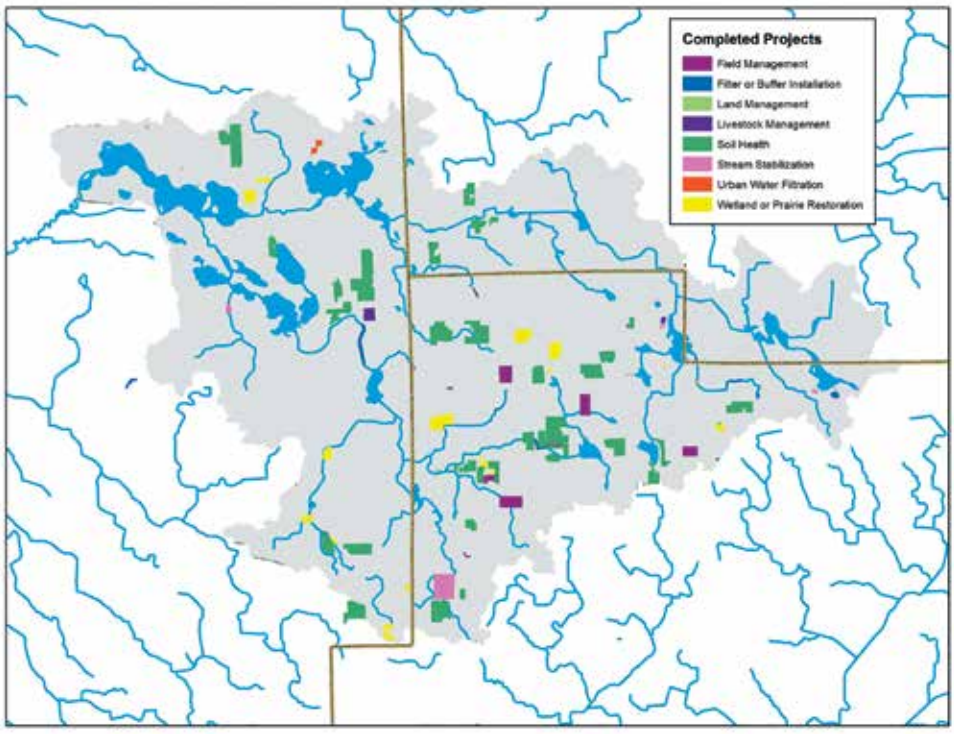

Figure 2. Water quality improvement projects implemented in the Upper Tippecanoe River Watershed.

Putney Ditch Streambank and Bed Stabilization

The Watershed Foundation identified nearly 1,100 lineal feet of Putney Ditch, a tributary to Little Barbee Lake, a lake within the Barbee Lakes Chain, in need of stabilization. This incised creek meanders through second-growth forested floodplain draining nearly 2,400 acres of predominantly agricultural lands. The flashy nature of this small stream was exacerbated by field tiling, ditching, and draining. Project engineers determined that stabilization of this portion of the stream by raising the stream channel created the best mechanism to interrupt the feedback loop of stream down-cutting, enabling reconnection of the stream with its adjacent floodplain. Engineers accomplished this through the installation of a series of seven grade control structures to raise the bed of the stream to allow the stream to access the floodplain during two year or larger storm events and concurrent streambank stabilization using soil-encapsulated lifts along nearly 325 feet of eroding streambank. This project resulted in 400 tons less sediment, 340 pounds less phosphorus and 675 pounds less nitrogen entering Little Barbee Lake annually since 2003 as modeled using the Region 5 Model (Figure 3A and B).

Shanton Ditch Two-Stage Ditch and Livestock Restriction

Shanton Ditch, a tributary to Ridinger Lake, is a flashy stream located within a predominantly row crop agriculture watershed that routinely scours its banks resulting in stream down-cutting and streambank erosion. TWF worked with a local landowner to design and implement livestock restriction and streambank stabilization efforts along 300 lineal feet of Shanton Ditch. Streambank erosion and down-cutting resulted in eroding banks along this reach of Shanton Ditch. Areas of erosion were exacerbated by livestock accessing the ditch at this location. Project engineers designed a two-stage ditch and installed livestock fencing and an alternate watering facility at this site. The two-stage ditch provides a stable, low flow channel through which Shanton Ditch flows during typical conditions. A constructed bench located approximately three feet above the low channel and planted it with native plants is accessed by flood waters during high flow conditions, reducing the velocity of water flowing across its surface and allowing suspended sediments and nutrients to settle out of the water. The bench provides additional

Figure 3. Putney Ditch streambank stabilization project during (A) and 8 years after implementation (B).

instream stability, reduces stream down-cutting, and improves instream habitat. Since its construction in 2008, the Shanton Ditch two-stage ditch and livestock restriction resulted in more than 550 tons less sediment, 425 pounds less phosphorus, and 790 pounds less nitrogen entering Ridinger Lake (Figure 4A, B and C).

Troy Cedar Branch of Elder Ditch Streambank Stabilization and Livestock Restriction

Like Putney Ditch and Shanton Ditch, the Troy Cedar Branch of Elder Ditch is a flashy stream located within predominantly row crop agriculture, tile drained fields. Erosion measuring greater than ten feet in height occurred along nearly 200 feet of the Troy Cedar Branch. Stabilization including the installation of soil-encapsulated lifts, bank reshaping, and seeding resulted in vegetated and stable streambanks. The installation of livestock fence and provision of an alternate water source further improved stability at this location resulting in nearly 260 tons less sediment, 135 pounds less phosphorus, and 350 pounds less nitrogen entering Ridinger Lake annually (Figure 5A and B).

Soil Health Initiative

TWF initiated their Healthy Soils, Clean Water program in 2013. This program supports three part-time watershed conservationists (including a retired NRCS soil conservationist) who target the installation of soil health practices throughout the Upper Tippecanoe River Watershed. Soil health focuses on four key ideas: (1) keep soil covered, (2) use plant diversity to increase microbe diversity within soils, (3) maintain living roots throughout the year to feed the soil, and (4) reduce soil disturbance. Ultimately, implementing soil health practices like no till farming and planting cover crops allows agricultural row crop fields to mimic nature. TWF initiated the Healthy Soils, Clean Water program in 2013 and has worked with more than 29 producers to implement more than 2,500 acres of cover crop planting and nearly 900 acres of no-till farming. These efforts saved nearly 4,000 tons of sediment, more than 20,000 pounds of phosphorus, and nearly 82,000 pounds of nitrogen from entering Upper Tippecanoe River Watershed streams annually (Figure 6).

Healthy Shorelines Initiative

In 2011, TWF created the Healthy Shoreline Initiative to improve shoreline habitat and stabilize soils along their watershed's more than 50 lakes. These cost-share efforts provided up to $3,000 to individual lakeshore residents to improve shoreline habitat and reduce erosion and runoff. In five years, TWF worked with 100 shoreline residents on 14 lakes to implement over a mile of bioengineering, install new glacial stone seawalls, and reface existing seawalls with glacial stone (Figure 7).

Engaging Individuals

Making big changes requires connecting lake and watershed residents with their local waterbodies, providing key knowledge that will empower individuals to implement sound water quality improvement projects in key locations and creating cohesion and connection between and within lake residents, watershed residents, and agricultural producers throughout the Upper Tippecanoe River Watershed. Since

Figure 4. Shanton Ditch two-stage ditch and livestock restriction project before (A), during (B), and 18 months after implementation (C).

2005, The Watershed Foundation (TWF) engaged more than 200 individuals with agricultural field days and lake and watershed tours highlighting soil health projects, ongoing and previously implemented water quality improvement projects, and discussing lake history and water quality concerns on a subwatershed basis. Since 2008, TWF, in partnership with the Kosciusko County SWCD, hosted more than 3,500 high school students in a Grassy Creek to Lake Tippecanoe educational float. Watershed residents engage in Lake Tippecanoe's volunteer water monitoring program, participate in citizen clean-up events hosted by TWF and LTPO, engage in cottage tours of Lake Tippecanoe residences, and attend education and outreach events on a variety of topics. In total, more than 13,600 individuals engaged with Lake Tippecanoe and its watershed from 2010 through 2014 (Crighton 2015).

Stakeholder social indicator surveys indicate that these targeted efforts yield quality results (Busse et al. 2015). Survey data collected in 2014 indicate that both lake residents and agricultural producers were more likely to identify their personal responsibility in improving water quality conditions within the Upper Tippecanoe River Watershed than they were in 2010. Agricultural producers also became more aware of specific conservations practices, their use and implementation as well as the equipment required to implement specific practices between 2010 and 2014.

Measuring Impact

In 1994, Lake Tippecanoe residents and the Lake Tippecanoe Property Owners (LTPO) identified a trend in decreasing water quality. As detailed above, mean total phosphorus concentrations tripled from 1973 to 1994, while Secchi disk transparencies decreased by one third (Richardson and Jones 1997). Data collected by the Indiana Clean Lakes Program indicate that mid-summer conditions within Lake Tippecanoe continued to decline through 2003, when mean total phosphorus concentrations reached 0.115 mg/L – more than five times the concentrations measured in the early 1970s. Mean total phosphorus concentrations measured in Lake Tippecanoe in 2012 and again in

Figure 5. Troy Cedar Branch of Elder Ditch streambank stabilization and livestock restriction before (A) and one year after implementation (B).

Figure 6. Soil health educational billboard.

2014 were 0.037 mg/L suggesting that in-lake conditions are improving as a result of watershed-wide, targeted water quality improvement project implementation.

In-stream conditions further indicate improving conditions within the Upper Tippecanoe River Watershed. Total Kjeldahl nitrogen and total phosphorus concentrations measured in the Tippecanoe River up and downstream of the lake in 2015 are less than one-quarter those measured in-stream in 1996 (Richardson and Jones 1997; Peel 2016). In addition, seven of ten streams within the Upper Tippecanoe River Watershed showed an improvement in fish community with Index of Biotic Integrity scores increasing by an average of more than ten points from 2005 through 2014 (Bright 2005; 2014) (Figure 8).

These data suggest that the collaborative efforts to restore streambanks, improve wetland function, install filter strips, fence livestock from streams, create rain gardens, reduce stormwater impacts, and educate and engage landowners and residents throughout the watershed resulted in improved stream and lake health.

Citations

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Figure 7. Healthy shoreline initiative project on Loon Lake.

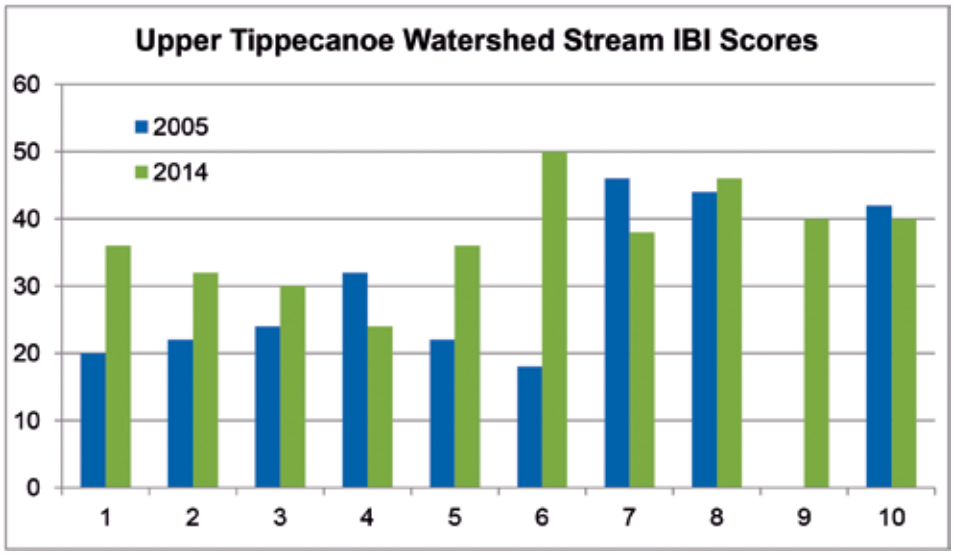

Figure 8. Biological integrity improvements measured in Upper Tippecanoe River Watershed streams.

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Tippecanoe Watershed Foundation. 2015. Project list, unpublished.

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