

How the scientific laws of nature are helping to save it.



Physics and the Wildlife Action Plan

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Physics. The mere sound of the word fills some people with anxiety. So why would this word even appear in *OutdoorIllinois* amid photographs of deer and frogs and articles about fishing? Physics, after all, is the intimidating science that deals with materials, energy, movement and forces. Think Einstein and inscrutable equations.

Yet the seemingly impenetrable world of physics can help identify and solve problems in our physical world, including the world of nature. In fact, physics is helping implement the Illinois Wildlife Action Plan and saving some of Illinois' precious lands, waters and wildlife while simultaneously aiding national security and preventing potential power outages.

Example: South Kickapoo Creek runs through the Marseilles State Fish and

Wildlife Area in LaSalle County. This site protects natural lands and provides opportunities for hunting, and also hosts the Illinois Army National Guard and serves as a training site for many branches of the military, including soldiers preparing to go to war. In addition, Com-Ed power lines run through the site carrying electricity to surrounding communities.

Before acquisition by the DNR, the site housed a gravel-mining operation, and a portion of South Kickapoo Creek was detoured to improve conditions for mining. The stream was moved from its



natural channel and rerouted using constructed levees to keep it in place.

Physics helps to explain how energy and forces, over time, affect matter; in this case the speed and strength of water in the creek was affected by gravity and, over time, destroyed a portion of the man-made levee.

South Kickapoo Creek is not a slow-moving, flat-land Illinois creek, but closer to a mountain stream because its change of elevation through this area is much steeper, so water moves faster in response to gravity.

A significant attempt was made to fortify the streambed where the stream enters the gravel pit, but a severe rainstorm completely washed away the concrete blocks and beams. Erosion proceeded rapidly in this area creating steep, unstable banks and washing tons of soil and sediment into the creek and then directly to the Illinois River.

South Kickapoo Creek flows under a major Com-Ed transmission line. The eroding force of the water was cutting into the base of one of these towers, but bank armoring along with pool and riffle construction now protects it.

Other changes in the watershed, such as upland channelization and the loss of forest or grass buffers along the stream, speed up the water entering the system during rain events, increasing the amount of water at those times. Together, the increased amount and speed are a much stronger eroding force, and in 2005, when the Marseilles area received a record rain event, the physical force of the water broke out of the man-made channel and resumed flowing along its historic path, now a mined gravel pit. The mining had changed the elevation difference in the stream even more, throwing the system drastically out of balance.

In physics we are taught that a system out of balance seeks to regain balance in whatever way it can.

In seeking to regain equilibrium, South Kickapoo Creek began aggressively excavating into the stream bed against the flow of water, to reduce the difference in elevation and create a flatter slope (a process called headcutting). But another problem added to the dire situation: the geology and soil types were no



(Illinois Department of Military Affairs.)



(Photos courtesy Illinois Department of Military Affairs.)



(Photo courtesy Diane Tescic.)



match for the energy and forces of the water. Layer by layer they began to give way—some faster than others—and all of that soil and rock material was being washed into the creek and transported downstream to the Illinois River. The stream channel became deeper (channel incision) and wider as the banks began to collapse in, taking with it trees and other creek-corridor habitat. The land was literally getting washed downstream and into the Illinois River.

South Kickapoo Creek is considered an intermittent stream, but it becomes a raging torrent after a rainstorm. The force of this water can move small boulders.





The erosion process has sped up so much that it turned this small tributary to South Kickapoo creek into a small canyon in the span of only a few years.

In the Illinois Wildlife Action Plan, the Stream Campaign was developed specifically to identify and address some of the widespread problems of Illinois streams and the wildlife they support. Gullies, streambank erosion, channel incision and sedimentation can be problems in streams and rivers throughout Illinois, but the situation at South Kickapoo Creek encompassed all those problems and was happening more rapidly because of the site conditions and several years of extreme rainfall.

In addition to the severe problems of this stream system itself, the process affecting the stream was damaging internal roads at the site, threatening a Com-Ed transmission tower, and had already decimated the fishery of the gravel-pit lake. Something had to be done to stop the aggressive process.

Staff from DNR Land Management, Fisheries, Natural Heritage and Forestry met with Illinois State Water Survey personnel to discuss possible fixes, and physics led to the solution. The ISWS has dealt with other situations like this and they suggested installing a series of small rock dams (weirs) that create pools and riffles that mimic natural stream features and restore a more natural grade (change in elevation) to this stream section. These

rock weirs would bring the stream closer to equilibrium and also would provide resistance to the water, slowing it down and reducing some of the damaging high energy. The group concurred that weirs were the only long-term solution that would better control the erosion process and help maintain the stream grade during the intense flow of major rain events. In addition, this would fulfill aspects of the IWAP Streams Campaign by reducing sedimentation and headcutting; it also would create better in-stream habitat for aquatic species and save and restore bank and near-stream habitat.

Clearly, this was the right solution for the problem, but this project would not be cheap. This major design and construction project would require, literally, tons and tons of rock to complete. The reality of budget shortfalls became the major obstacle.

In physics, we learn that a lever allows us to move something large with a smaller effort because the lever is a force multiplier.

DNR could not implement this project on its own, but the power of partnerships and working together acted as leverage to do the heavy lifting this project required.

The Illinois Environmental Protection Agency, along with the U.S. EPA, recognized the need for this project and funded a contract with Illinois State Water Survey specialists to analyze the situation, plan and design the overall project and obtain necessary permits. Their work included extensive surveying of the stream bed and banks, determination of locations and dimension details of the structures, and providing on-the-ground construction oversight. The IEPA is funding an additional contract with ISWS to assess stream channel conditions throughout the South Kickapoo watershed to locate problem areas with the potential to produce excessive sediment. ISWS will submit a grant proposal to IEPA to address these additional needs after the emergency work is completed.

Recognizing the importance of this project to both their energy transmission system and the health of the environment near their facilities, Com-Ed

Riffle construction starts by creating a solid base within the bank to stabilize the bank and provide a platform for the heavy equipment.



Goals of partner organizations involved with the South Kickapoo Creek project are:

- Improve water quality in the Illinois River—IEPA, USEPA and DNR
- Stabilize transmission lines with an economical fix and improve access to their transmission towers and lines—Com-Ed
- Stabilize and improve the site and its infrastructure for better training capabilities, while providing good environmental stewardship—Illinois Army National Guard
- Enhance training, including use of a transport helicopter to place large concrete beams—Illinois Army National Guard
- Provide good environmental stewardship through implementation of the Wildlife Action Plan Streams Campaign—DNR

provided for the purchase of a portion of the materials to complete the necessary work. In addition, their transmission engineers and crew assisted planning and construction preparation in the vicinity of the transmission lines.

The Illinois Army National Guard, DNR's partner at Marseilles SFWA, recognized the importance of this project from the beginning. They offered funding to assist with project design and provided a significant contribution for the purchase of construction materials, as well as free construction material

A completed riffle structure appears natural soon after construction and provides quality in-stream habitat in addition to dissipating stream energy and slowing creek flow.



The force of the water at this bend in the creek had already destroyed part of the adjacent roadway and was continuing to erode areas near where it had been repaired.

that lowered the overall cost. The National Guard provided heavy equipment and engineers for surveying and construction and cooperated with the scheduling of their training to maximize access to the project area.

DNR's role in this partnership was to provide overall coordination of the project and the heavy equipment (excavator, bulldozer and loader) and operators to complete the construction of all the structures. DNR also purchased a portion of the rock and geotextile fabric needed in some areas for added stability. DNR staff also pursued potential

opportunities to obtain free concrete—used primarily as a foundation for the weirs due to the size and shape of the material—as a substitute for some of the rock to reduce overall cost. The company, Prestress Engineering, provided truckloads of clean concrete at no cost to the state to be used as fill in the structures. This significantly reduced the overall project cost.

As it nears completion, it is clear that this project is achieving different goals for each partner organization, yet achieving the one shared goal of stream restoration.

A partnership is most successful when it brings the needed resources together to achieve both individual and shared goals. This project could not have been successfully completed without any one of the partners. In these times of limited staffs, budgets and resources, this type of cooperation is needed to implement the Illinois Wildlife Action Plan, solve critical problems and improve our natural resources.

Can physics help explain the power of partnerships? Yes.

Partners add leverage to endeavors. Partners are a force multiplier. 

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