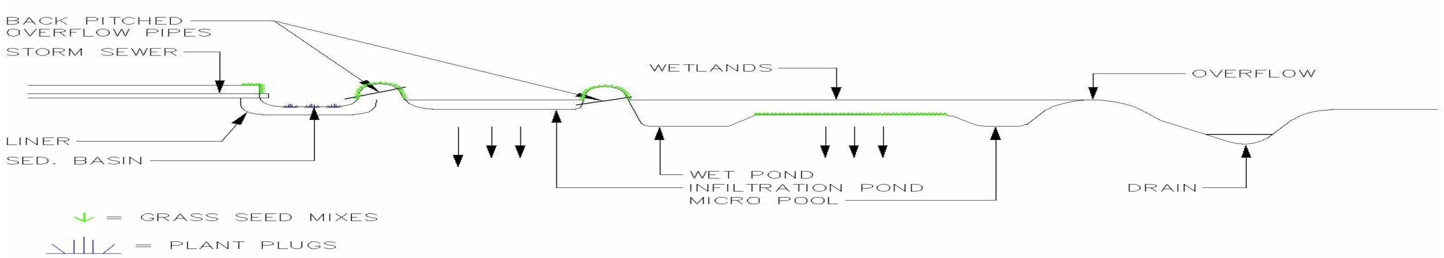

stem Bulrush (*Scirpus acutus*), River Bulrush (*Scirpus fluviatilis*), and Common Bur-reed (*Isparganium eurycarpum*). These plants are shallow-rooted, grow aggressively in shallow water and, when colonized, help to remove contaminants and slow water flow (allowing for greater sediment fall-out.)

In addition, 0.25 acres of both Detention Basin Seed Mix (a combination of 22 grasses, sedges and flowers for saturated and wetland environments) and 0.25 acres of Economy Prairie Seed Mix (a combination of more than 20 varieties of grasses and flowers) were also installed in the sediment cells. Following seeding, 800 square yards of straw/coconut erosion blanket (North American Green SC-150BN) were laid to minimize erosion and enhance the establishment of plant colonies. The choice of blankets was based on time needed for plant colonization, flow (shear stress analysis) and slope. The blankets are designed to stay in place for one-to-three years, after which they degrade naturally.

Wet to Mesic Prairie Seed Mix (a broad-spectrum application with more then 40 varieties of permanent and temporary grasses and flowers) was applied to the 1.5-acre infiltration basin areas. Plant plugs were not installed in these basins. After seeding, 5,700 square yards of the straw/coconut erosion blanket were laid, again to assist plant propagation and limit bank erosion.

The bottom of the wetland area was then seeded with the same Detention Basin Mix used in the sediment basins, while the slopes of the wetland basin and the waterfowl island were seeded with the Wet to Mesic Prairie Seed Mix used in the infiltration basins. Due to the water depth, no seeding or plants were installed in the wet pond and micro pool areas.

The system has been in place for 18 months and has performed beyond expectations. To date, the system has not used the rip rap overflow to the Peavine Drain and stormwater has left the treatment train only via groundwater infiltration and evaporation. System maintenance consists of monitoring sediment buildup in the sediment cells and subsequent removal when levels reach an unacceptable depth.

This system was designed to accommodate unusual environmental concerns with limited land and fiscal resources. Similar systems can be engineered for almost any scenario with sufficient space. Moreover, as more and more land is developed, management of storm water through natural means is cost-effective, retains and in some cases creates habitat, and is aesthetically pleasing. As one resident of the Dowagiac industrial park recently noted in retrospect, he now wishes he had designed the building with his offices overlooking the flourishing wetland. It is a naturally beautiful addition to the neighborhood.

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A Stormwater Treatment Tale

BRINGING ECONOMICS, INDUSTRY AND NATURE TOGETHER

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In 1991, the City of Dowagiac, Michigan began a four-phase development of a 191-acre industrial park. A decade later, in 2001, Wightman & Associates, Inc. became involved providing design and construction engineering services for Phases II, III, and IV. The engineering goals of the project were simple: extend the City's roadway, water main, and sanitary sewer, and create a stormwater system to provide for continued growth of the park.

At the beginning of Phase II, however, reexamination of the original drawings revealed a "lineal wetland" that had gone unnoticed 10 years earlier. This lineal wetland, a shallow, narrow ditch under heavy canopy, was determined to have been dug by the previous property owner, a farmer, with the intent of draining upstream wetlands. After many years, it had become a part of the wetland and now prompted considerable plan revisions to both comply with Michigan's wetland regulations and accomplish the storm water retention needs of the overall project.

Another important storm water issue also soon came to light: the downstream end of the industrial park property flowed into the Peavine Drain, a tributary of Peavine Creek. In 1996, the Michigan Department of Natural Resources (MDNR) conducted a field survey of Peavine Creek and found a wild population (sustained without stocking) of 268 brown trout per surface acre of creek. This is considered a very good wild population of the species and is essentially due to the creek's cold water flows from groundwater contributions. The average July water temperature of 58 degrees makes Peavine Creek an excellent trout habitat and a unique resource to the entire area, and especially to the Dowagiac River watershed. To maintain the health of the creek habitat, storm water release became a critical part of the planning process.


Infiltration cell leading to wetland area

Working closely with the Michigan Department of Environmental Quality (MDEQ), Surface Water Quality Division, two primary possibilities were examined. The City could choose to create several small, private storm water retention basins throughout the industrial park, or one large system that could provide retention, treatment, infiltration and groundwater recharge. Since management of private basins would be the responsibility of the individual property owners, the City decided to retain control of the system to ensure system viability through ongoing maintenance. This decision also provided added value to prospective purchasers of industrial park property, who would be relieved of some of the aspects of managing storm water runoff.

A key element to any project and primary to the storm water treatment train design was the issue of volume. As the industrial park was developed, studies were performed to determine runoff volume from two primary roads and various proposed industrial sites. Although the plan was constrained by land availability, the final design included 850,000 cubic feet of required volume - the capacity necessary to handle a 50-year storm. This capacity would be served by 7,000 linear feet of storm sewer varying in size between 12 and 30 inches in diameter. Using MDEQ Wetland Best Management Practices (BMPs) and drawing on knowledge gained from similar projects, the storm sewer system design included a treatment train consisting of two parallel systems. This provided two separate entry points for storm water runoff with a final connection point at the wetland. The entire system consists of five cells: two sediment cells, two infiltration cells, and 3.5 acres of newly created wetland. The wetland area contains a wet pond, micro pool, and a waterfowl island. The wet pond and micro pool are approximately 9.5 feet deep and serve to protect aquatic life during prolonged droughts. The micro pool is located at the Peavine Drain outfall point where it can facilitate additional water cooling prior to overflow during periods of high precipitation.


Sediment cell and infiltration pond


Back-pitched pipes from sedimentation cell to infiltration cell


Infiltration cell outfall from sedimentation cell

Near the end of the decision and design phases, the City realized that additional funds would be required to construct the treatment train as part of Phase II. Emphasizing the economic benefits of the development, the City submitted the new plan to the Michigan Economic Development Corporation (MEDC) with a request for additional funding. The MEDC approved the proposed system as an indirect way to help increase employment in the area and provided the City with a total of $650,000 for Phase II. With the blessing of the MDEQ and MEDC, a change order was issued and the treatment train became part of the new overall site plan.

Construction of the new treatment train began in early summer of 2001. The general contractor, G. J. Selge, Inc., began with the recycling of chippings from seven acres of trees and shrubs, followed by implementation of erosion control measures. Five acres were required for the footprint of the treatment train and maintenance paths; the remaining two acres were for the spoils pile.

The treatment cells were excavated using backhoes and haul trucks; scrapers were used for pond excavation. Due to the high groundwater table in the area, dewatering was necessary during the excavation of the wet pond, micro pool and the final grading of the bottom of the treatment train system. When excavations were complete, the spoils pile was seeded with grass seed mix and the remainder of the site was prepared for the special seeding requirements.

With construction underway, Wightman & Associates, Inc. prepared a Request for Proposals for ecological services. These would include plantings and erosion control measures to maximize the system's treatment capabilities. JFNew was awarded the contract and submitted several proposals to meet the project's treatment requirements within the available funding.

JFNew evaluated the site and gathered information on area hydrology and hydraulics, native plant requirements, proposed treatment capacity, possible pollution constituents, and system maintenance requirements. Despite funding limitations, treatment goals were met with a conservative but capable combination of seeding mixes and plug plantings. Various mixes of native seeds and plant plugs were chosen to meet the specific goals of each basin and to survive the expected intermittent hydrology. To ensure that the planted species possessed local genotype characteristics, all seed and plant materials were produced at JFNew's native plant nursery in Walkerton, Indiana.

In the two sediment cells (north and south), the primary goal is the removal of sediments via natural settlement. These cells are approximately 2,500 square feet each and are connected to the infiltration basin cells (north and south) by a series of eight back-pitched pipes that prevent downstream flow of floating objects, oils or grease. The sediment cells were lined with a 20 mil polyvinylchloride (PVC) liner to protect the groundwater from contamination,.

In addition to sediment capture, the sediment cells also serve as phytoremediation (the use of plants to remove contaminants from soil and water) treatment cells via the planting of appropriate vegetation. This included a total of 200 hand-planted plugs of Common Arrowhead (*Sagittaria latifolia*), Hard-