

INDIAN PINE PILOT WATERSHED PROJECT

OFFICE
OF
WATER MANAGEMENT
11 22 1999

**US-EPA 319
Final Report**



prepared by

**George R. Parker
Department of Forestry and Natural Resources**

submitted to

Indiana Department of Environmental Management

December 23, 1999

Introduction

This is the second project funded by the EPA 319 program to examine processes within the Indian and Little Pine creek watersheds (Figure 1). The first project examined water quality in relation to land use practices throughout both watersheds (Final Report submitted July 31, 1998). Non-point source pollution was shown to be important within the agricultural ditches of Little Pine creek in the first study. In general, concentrations of nitrates, phosphorus, and total suspended solids found in stream water within the two watersheds were typical of the region and are among the highest in the nation. The largest input of chemicals to streams occurs from March through June corresponding to agricultural cultivation, chemical application to crop fields, and storm events.

The first study indicated a need to develop BMPs that would remove non-point pollutants from agricultural ditches before reaching the more natural parts of Little Pine Creek and the Wabash River. Since these pollutants reach the ditch via overland flow and tile drain systems, the BMP used needed to reduce pollutant levels without significantly interrupting drainage of cropland or converting cropland to other uses. Placing a BMP structure on every tile outlet or grass waterway would not satisfy either condition and probably would not be acceptable to landowners. Therefore, constructed wetlands were proposed as a BMP to solve the problem. Agricultural ditch water could be pumped through a series of constructed wetlands to remove pollutants and then returned to the ditch. These wetlands needed to be large enough to treat a large area of the upper watershed instead of treating each tile or waterway individually.

Unfortunately the scale of this project and limited funding delayed the completion of the wetlands so that no data is yet available on their effectiveness in removing pollutants from the ditch water. Funding is available from other sources to fully operate these wetlands during the year 2000 growing season. These data will be provided in a supplementary report in November 2000, at no additional cost to IDEM.

This report will summarize the procedure and costs associated with construction of these wetlands.

Project Site

The site selected for construction of the wetlands is in the upper reach of Little Pine Creek along Marshall Ditch (Figure 2 and 3). This site is approximately one half mile down stream from the gauging station on Marshall Ditch where water flow and quality have been monitored for several years as part of the Indian Pine program (Figure 4). The site is fairly level and low in elevation compared to adjacent areas. Soils of the site are poorly drained and dark in color indicating it had been wet prior to installation of tile drainage and Marshall Ditch (Figure 5). The land is managed by the Animal Sciences Department, Purdue University as part of the research farm complex. The Purdue University Aquaculture Center is located to the east of the site and produces approximately 30,000 gallons per day of relatively clean water (Figure 6). This water outlets to Marshall Ditch immediately upstream from the wetland site. This is an important source of water for operation of the wetlands during dry periods when the ditch is dry as was the case this fall, 1999.

Design of Wetlands

Design of the wetland cells was initiated in February of 1998. Initial plans were to construct three cells, each 40 x 1600 feet in size. Ron Wukasch of the School of Civil Engineering suggested we contact J. F. New and Associates located in Walkerton, Indiana. They agreed to provide plans for the wetlands at no cost. These plans were completed in July of 1998 and submitted to local contractors for estimates. The lowest estimate received was around \$40,000 for excavation only. Since this exceeded our available funds, we had to downsize the wetland cells and request a new estimate from the low bidder. The final project design was two sediment basin (40x40 feet) and 4 cells (each 40x400 feet) (Figure 7). The contractor began excavation in November 1998 (Figure 5).

EPICS

A proposal was submitted to the EPICS (Engineering Projects in Community Service) program to form a team of students to work on the wetlands project in January 1998. This program allows undergraduate students to become involved in local community projects to gain experience in design. The wetlands project was approved and a team of Civil Engineering students began assisting with design and construction of the wetlands in March, 1998 under the direction of Dr. Ronald Wukasch. These students were very helpful in various aspects of the project and will continue to assist in water quality monitoring during the spring of 2000. For example these students designed and constructed the wier box (Figure 8) and assisted in the planting of 8000 wetland plants (Figure 9). The EPICS program has also provided limited funding for miscellaneous supplies.

Construction

Merkel Excavating was awarded the contract for excavation the sediment traps and wetland cells for \$18,000 in October 1998. Excavation began in November, 1998 and nearly completed in late April, 1999 (Figure 10). Additional work such as installing inlet and outlet piping, piping between cells, and concrete boxes to house pumps added another \$6000 to the cost. A local gravel company delivered 1000+ cubic yards of 1.5inch rock and 300 cubic yards of pea gravel to the subsurface wetland at a cost of \$10,000 (Figure 11). Another 100 tons of limestone rock was placed on the parking area and entry road to the wetland for \$1000.

Two 1900-gallon concrete boxes were custom ordered from Irvin's Concrete Products for \$1130 each. These were delivered and set in place on the edge of Marshall Ditch in May, 1999 (Figure 12). A 1/3 hp pump has been placed in one box to pump the water from the Aquaculture Center into Cells 1 and 2. This water is free of sediment and will not pass through the sediment traps. A 1hp pump is operating in the other box to pump water from Marshall Ditch into the sediment traps and then gravity flow into Cells 1 and 2. We

believe this pump has the capacity to move approximately 90% of the ditch flow through the Cells. The Cells will be by-passed during extremely high flow events.

Electrical service was finally delivered to the site in September, 1999 (Figure 13).

TIPMONT REMC installed 1000feet of underground line and a transformer to provide 100 amp service to the site for \$7900.

All piping was completed and weir boxes were installed in November, 1999, so that the system is now operational (Figures 14, 1, 16 and 17). Two-inch pvc pipe is used to pump Aquaculture water to cells 1 and 2. Six-inch pvc pipe is used to pump Marshall Ditch water into sediment basins, gravity feed through the cells, and outlet to Marshall Ditch. One hundred gallon fiberglass tanks were installed at the outlet of Cells 3 and 4 to serve as water reservoirs before flowing to Marshall Ditch. The water level in each cell can be controlled independently using pvc risers out the outlet of each cell.

Establishment of Plants

J. F. New & Associates provided 8900 plants and 27 pounds of seed at cost (\$6500). A \$10,500 grant was received from the Division of Fish and Wildlife (Non-Game Program), IDNR for the purchase of plants and for monitoring colonization of the wetlands by animal species. Seed was dispersed through the surface Cells (Cells 1, 2 & 4) in late April and plants were planted on May 1 and early June. EPICS students and students from Forestry and Natural Resources assisted in planting (Figure 9). Seven different plant species were planted and another five species were seeded to the Cells (Table 1). Survival of plants and germination of seed was very good, but required the use of a gasoline pump to keep water in the Cells during the fall drought (Figures 18 and 19). Native prairie grass seed was purchased from the Coal Creek Chapter of Pheasants Forever and spread over the berms of all wetland cells in April, 1999. Many plants also established in the cells and on the berms from seed stored in the soil of the site (Figure 20). Muskrats moved into Cells 1 and 3 during the fall, 1999 and are interrupting water flow by plugging outlets (Figure 21 and 22). These animals will be removed during this winter.

Summary

The first US-EPA 319 project within the Indian and Little Pine creek watersheds found they were typical of other agricultural streams of the region with excessive levels of nitrate, phosphorus and total suspended solids. The current project is an attempt to develop an effective BMP to remove these chemicals from stream water in order to reduce chemical loading on streams such as the Wabash River.

The objective of this project was to determine the effectiveness of constructed wetlands in the removal of agricultural chemicals from stream water. A constructed wetland was placed along Marshall Ditch at the outlet of a small agricultural watershed (~2000 acres) on the headwaters of Little Pine Creek in Tippecanoe County Indiana. Water from the ditch will be pumped through the four wetland cells and then returned to the ditch. Water flow and quality will be monitored entering and leaving the cells to determine their effectiveness in removal of non-point source pollutants.

Completion of the Constructed Wetlands BMP took longer and was more costly than envisioned when the proposal was written. Time delays were primarily due to coordination with various contractor services and weather. Overall construction costs for the wetlands was around \$60,000. Around \$31,000 of this cost was paid through the 319 Grant with the remainder coming from Purdue University and other outside grants. This does not include funds from the 319 Grant, which paid for labor.

Delay in completion of construction of the wetlands coupled with the extreme drought during the fall prevented collection of any data from the wetlands to determine their effectiveness in improving water quality of Marshall Ditch. However the wetlands are now operational, which will allow data collection this coming spring and summer. These data will be provided in a supplementary report to IDEM during the fall, 2000 at no additional cost.

Table 1. Plant species planted or seeded to constructed wetland cells in spring, 1999.

1. Wetland Plants and Installation Instruction. The services to be provided by New under this agreement ("Services") pertain to the wastewater treatment wetland in West Lafayette, Indiana (the "Site"). New will provide bare-root wetland plants and deliver to the Site. New will also provide one day of plant installation instruction at the Site.

New will provide 3,630 plants to be installed on 3.0' spacing in 0.75 acre Surface Flow wetland. Species and quantities are as follows:

<u>Common Name</u>	<u>Botanical Name</u>	<u>Quantity</u>
River Bulrush	Scirpus fluviatilis	908
Hard-stem Bulrush	Scirpus acutus	907
Soft-stem Bulrush	Scirpus validus	908
Cattails	Typha species	907

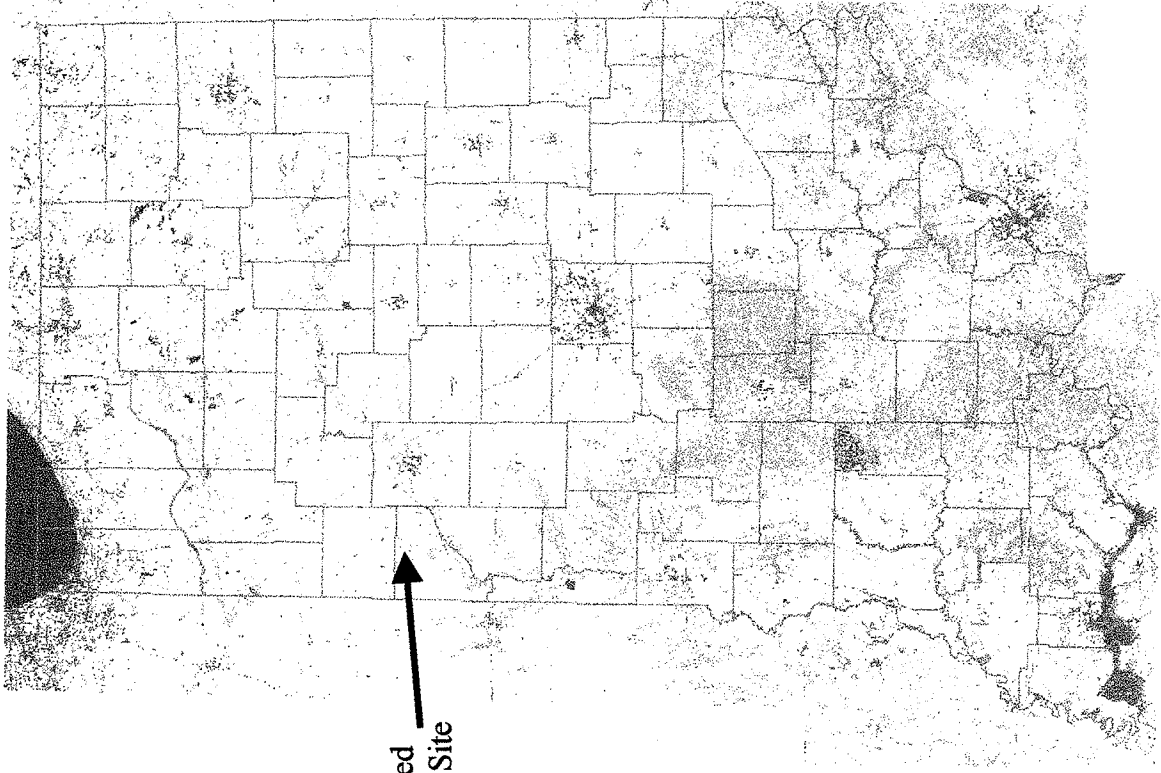
New will also provide a seed mix for the 0.75 acre Surface Flow wetland. Species and quantities are as follows:

<u>Common Name</u>	<u>Botanical Name</u>	<u>Quantity</u>
Bulrush species	Scirpus sp.	6.0 ounces
Broad-leaf arrowhead	Sagittaria latifolia	8.0 ounces
Soft rush	Juncus effusus	8.0 ounces
Broad-leaf water plantain	Alisma subcordatum	8.0 ounces
Rice cut grass	Leersia oryzoides	6.0 ounces
Seed oats	Avena sativa	24.0 pounds

New will provide 5,140 plants to be installed in the 0.75 acre Subsurface Flow wetland. Species, quantities and plant spacing:

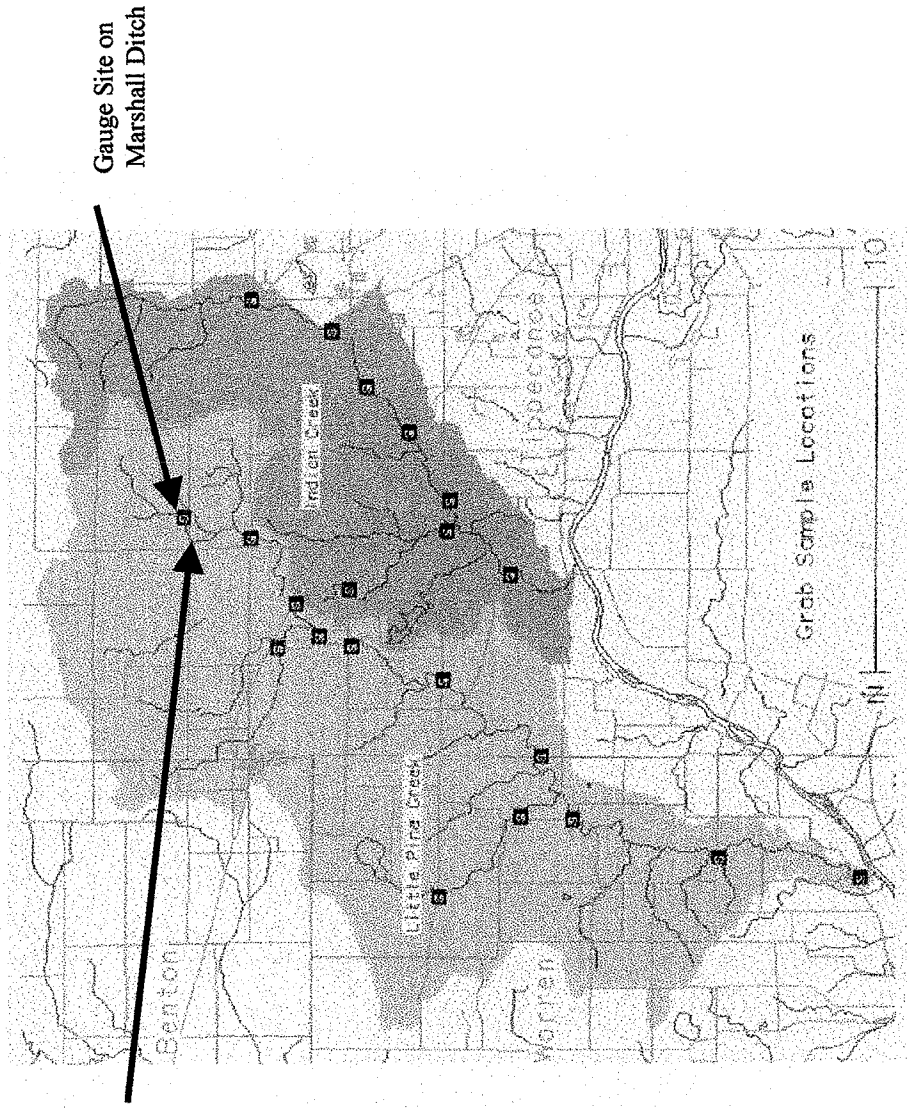
<u>Common Name</u>	<u>Botanical Name</u>	<u>Quantity</u>	<u>Spacing</u>
River Bulrush	Scirpus fluviatilis	605	3.0'
Hard-stem Bulrush	Scirpus acutus	605	3.0'
Soft-stem Bulrush	Scirpus validus	605	3.0'
Cattails	Typha species	605	3.0'
Bebb's Oval Sedge	Carex bebbi	907	2.0'
Brown Fox Sedge	Carex vulpinoidea	907	2.0'
Bearded Sedge	Carex comosa	906	2.0'

Plant and seed Total	\$ 5,900.00
Training	600.00
Total:	\$ 6,500.00



Constructed
Wetlands Site

Figure 1. Constructed wetlands site on Little Pine Creek in northern Tippecanoe County, Indiana



Constructed Wetland Site

Gauge Site on Marshall Ditch

Figure 2. Constructed Wetland Site within the Indian and Little Pine Creek Watersheds

