

NORTHWEST DRAIN (1996-2000)
Tuscola County, Michigan
Drain Commissioner, Sarah M. Pistro

The Northwest Drain is a complex system of county drains that serves a watershed of approximately 65 square miles of mostly agricultural land in the northwest corner of Tuscola County. Several hundred miles of drainage channels convey excess runoff from as far away as 2 miles south of M-81 to the Quanicassee River and Saginaw Bay.

This system was badly damaged in the storm of June, 1996. A combination of the heavy rains and previous deterioration in the condition of the outlets caused damage to the channel and to recently planted cropland that cost millions of dollars in losses to the landowners in the watershed. Flooding persisted for over a week, covering crops at an important time in their growth cycle, damaging equipment, homes, and roads. Early after the flooding occurred in 1996, FEMA inspected the damage and eventually contributed several hundred thousand dollars of aid to be used on the project

During the flood, large sections of the channel slopes were saturated and carried downstream. Some of these sediments were deposited at bends in the channel and large amounts of topsoil were carried to the outlets and deposited. The sediments created new areas of erosion and further blocked the outlets.

An aging infrastructure also plagued the outlets. In the vicinity of Saginaw Bay, the Northwest Drain opens up into channels 12 to 17 feet in depth and as much as 90 feet wide at the top. Bridges had been constructed to farms and homes over the years that, though adequate for their time, could no longer support the equipment used on today's commercial farms. Additionally, these bridges were aging and had suffered damage and stopgap fixes in the past. One landowner, Jeffery Shian, used a Ford Crossing 17 feet deep to access farmland. He was often blocked from planting this field by high, long-lasting spring flows.

Landowners circulated three petitions for separate parts of the system through 1996. Separate petitions were filed for Outlets No. 1 and No. 2 of the Northwest Drain, Outlet No. 3 and the Main Channel of the Northwest Drain, and for Branch No. 1 of the Northwest Drain. A Board of Determination was convened in each case. In each board, a project was deemed necessary. Eventually, a fourth meeting was held to consolidate the three petitions. A final, fifth meeting was held on September 1, 1998 to review bridge designs for the Outlets.

BMJ Engineers and Surveyors, Inc. was appointed to design improvements to the system in the fall of 1996 by Tuscola County Drain Commissioner, Sarah Pistro. A representative of BMJ was in attendance at the Board of Determination Meetings. Maps, information and criteria were gathered and surveys began early in the summer of 1997.

Surveys of the system found that large sediment dams had built up at each of the outlets. Bridges were also surveyed and eventually it was found that 13 of the bridges in the Outlets would require replacement. Erosion damage was noted throughout the petitioned areas and detailed measurement and profiles of the system were compiled for use in design. In all, the survey of approximately 32 miles of channel was conducted between June and October of 1997.

Design of the reconstruction of the Northwest Drain commenced in November, 1997. The criteria identified at the meetings attended by BMJ were: (1) Repair and Control Erosion Damage (2) Eliminate Sediment Deposits at Outlets, (3) Replace Obsolete Bridges on Outlets, Main and Branch. (4) Integrate Function of Outlet System, (5) Increase Capacity of Outlet System Where Necessary.

The goals of the project were to meet the criteria above, recommend a maintenance strategy to sustain the design, protect the environmentally sensitive outlets, and provide an infrastructure that will serve farming needs far into the future. The criteria and project goals, combined with the survey information resulted in a project that incorporated a diversity of measures, construction techniques and materials to accomplish the desired ends.

Starting with Outlet No. 1 and continuing through the outlets numerically, then on to the Main channel and Branch No. 1 the following is a description of the Northwest Drain Project, the survey, the design and reasoning behind it. Bridge work accomplished by the project will be discussed separately because of the scope of the effort undertaken on them.

Outlet No. 1 passes through a 1,000 foot long channel called Outlet B on its way to the Quanicasse Dredge Cut. This northwest running channel replaced the original configuration of Outlet No. 1 around 1949 when the last large scale project on the Northwest Drain commenced. The channel was redirected into the Quanicassee at its present location to avoid conflict with the construction of a new bridge for M-25 over the Quanicassee.

This outlet channel is a relief drain for the Main channel of the Northwest and splits runoff flows from the Main approximately 7 miles upstream of Saginaw Bay. Outlet No. 1 directs these flows 5 miles west and 3 miles north to its outlet. Along the way several watercourses add subsurface and storm runoff to the already substantial flow. Near the Quanicasse River outfall, at the intersection of Akron and Van Buren Roads, the V.C.C.M. & S. Drain enters and Outlet A splits from Outlet No. 1.

Outlet No. 2 is a 4 mile long channel that connects Outlet No. 3 and Outlet No. 1 while providing an outlet to several farms with extensive tile networks. Outlet No. 2 parallels Akron Road on the south side along its entire length from Garner Road to Van Buren Road, where it joins Outlet No.1.

From the divergence between the Main channel and Outlet No. 1 the primary channel is designated Outlet No. 3. A predominant portion of base flow and storm runoff makes its way to Saginaw Bay through this outlet, which runs northward along Garner Road for most of its length.

The Main Channel of the Northwest mentioned earlier stretches from the outlets to nearly 2 miles south of M-81, a direct distance of approximately 14 miles from the Bay. This is accomplished through a meandering channel of much greater length. The project portion of this channel encompassed only about three miles downstream of M-138/Fairgrove Road. Finally, Branch No. 1 of the Northwest Drain is a 10.2 mile long tributary to the system that was in need of repair. This Branch enters the Main channel 2 miles northwest of the village of Fairgrove and extends through that village to its point of ending approximately 3 miles west of the City of Caro.

Survey of Outlet No. 1 had shown that it had not been functioning effectively as a relief drain. At its connection with the Main channel, slopes had failed and filled the channel to nearly 4 feet above the level of the Main. Near the Point of Beginning, surveys indicated that sedimentation had occurred to the point of laying down a 4 feet high obstruction made of some of the finest topsoil in the watershed.

Outlet B was treated as an extension of Outlet No. 1 for the sake of design. The two outlets are continually in Bay water level influence. Additionally, considerable wetland and marsh area provides more than adequate flood storage. The channel, marshland and farmland provide significant habitat for fisheries and birds. It was important in the design of this area that dredging be isolated from the undisturbed areas. In response to this, the channel was dammed off from the Quanicassee and dredged in dry conditions. A submerged outlet was proposed in the Quanicassee and a floating curtain barrier was installed at the mouth of Outlet B while construction commenced.



Permit restrictions at the lower end of Outlet No. 1 and Outlet B included a window of time in which no work could proceed. A Bald Eagle nest was located near the project site in this location. Since eaglets do not thermo-regulate until late spring, work could not proceed in the area until June 15. As the schedule for contractors worked out construction began in October of 1999 and proceeded out of the area prior to the end of the construction season. Workers and survey crews have observed the eagles constructing a new nest with stray branches left over from clearing operations. A new nest was seen in a tree approximately 1,000 south of the nest mentioned in the permit. The eagles have been spotted several times by construction personnel during the project.

The connection of Outlet No. 1 to the Main channel was lowered to within a foot of the Main. A sediment trap was constructed to trap construction sediment and provide storage of later deposits which tend to accumulate at divergent channels. Along the entire length of Outlet No. 1 side slopes were drawn back to a 2.0 ft. H: 1.0 ft. V ratio and stabilized at locations where erodible soils were identified and at channel bends. Additionally, the greater relief capacity of Outlet No. 1 required some increase in capacity at strategic locations. Daily seeding of side slopes provided a quick vegetative cover to minimize erosion of the excavated channel.

Outlet No. 2 exhibited a similar condition to Outlet No. 1 in that it was much higher than Outlet No. 3 and it had a sediment dam at its point of beginning. Again, the inlet was lowered and stabilized and the outlet was cleared with a sediment sump installed. Outlet No. 2 paralleled a road where no excavation was allowed to stabilize the roadside. Consequently, fill areas and rock riprap slope protection were incorporated on that portion of the drain. Large numbers of tile outlets along the length of Outlet No. 2 required the installation of rock splash pads beneath a majority of the structures.

Outlet No. 3, at 7 miles in length and averaging 17 feet in depth was the largest channel construction undertaking of the project. With its size came the most problems. The Point of Beginning of the Drain reached nearly ½ mile into Saginaw Bay. Through years of neglect, the channel had filled completely with approximately 10,000 cubic yards of sandy sediment mixed with clay. This channel fill had made its way into Outlet No. 3 from wave action and shoreline transport common to the Bay. Though this five feet high obstruction offered no problem in warm weather storms, iced conditions virtually cut off flows in the early spring. A design depth of 7 feet was chosen for the submerged outlet to be constructed in the Bay. An additional added benefit obtained from this cleared channel was renewed access to the Northwest by both fisheries and navigation. They had been cut off from the channel for some years by the sand bar. Eroded Banks, damaged tiles and a threatened roadway also required attention along the length of Outlet No. 3.

Discharging into the middle of the Fish Point Wildlife Area, work on the lower end of Outlet No. 3 required a sensitive approach to construction. Hydraulic Dredging allowed the preservation of habitat on the west side of the outlet and an access road on the east side. Spoils were pumped in slurry form to a staging pond as much as 5,000 feet from the work area. There the spoils were allowed to settle before the water content was pumped away. A two stage detention area was designed and a floating barrier was installed to catch remaining suspended particles. Further, the dredging proceeded from the upstream end of the sand bar to isolate the work for as long as possible from Saginaw Bay.

The rest of the channel in Bay level water influence was dammed off and excavated in dry conditions. Rock stabilization was conducted along the road side of the channel and seeding was conducted wherever soil was exposed on the sided slopes of the drain.

Two miles upstream from the Bay, M-25 crosses Outlet No. 3. At this point roadway geometries created an erosion problem. The channel is paralleled on both sides by county roads at a place where the M-25 bridge directs erosive flows at the west bank of the drain. During survey the banks were seen to have failed, threatening Dickerson Road. The close proximity of roads on either side of the drain ruled out a conventional flattening of slopes. A sheet pile bulkhead was installed in this area to achieve the required slope stabilization.

Additional problems showed up at this crossing. Survey and previous plans indicated that the footings that the M-25 bridge sat on were constructed too high to allow a return to the original grade. The exposed footings had been damaged in previous years and MDOT protected the footings with large riprap that caused erosive turbulent flows downstream and blocked flows for 3,000 feet upstream of the bridge. Negotiations over the measures to solve this problem resulted in an agreement to pave the channel and thereby protect the footings from scour and undercutting while providing a constant grade through the structure.

Only approximately 3 miles of the Main channel of the Northwest Drain were included in the project. In this portion of the project, two channel relocations were undertaken along with the requisite stabilization of the new channel geometries. One relocation on the horse farm of Ernest Richardson helped to eliminate a severe erosion problem and restored a long cut off piece of the property to use without the construction of an expensive bridge.

Branch No. 1 of the Northwest Drain is a 10.2 mile long tributary to the system that suffered heavy damage in the storm of 1996. Its character is different from the Outlets and Main channel which are relatively flat in grade slope. The grade slope of this branch is approximately twice as steep as that of the outlet system. As a consequence flood flows often race down this branch until they intersect with those of the outlet system. The faster flows have caused erosion in the branch and deposited the sediments where the branch enters the Main.

The Branch was redesigned to pull slopes back to a 2.0 ft. H: 1.0 ft. V ratio. The lighter soils found in this area were stabilized with rock riprap at strategic locations. Established vegetation was left in areas where there was little damage and flood capacity was adequate. As with the rest of the project, daily seeding was conducted to establish a vegetative cover on excavated slopes. Additionally, Branch B, a 1.5 mile tributary to Branch No. 1 was improved to provide drainage to farmland in need of a drainage outlet.

The improvement of bridge infrastructure along the length of the project eventually required the replacement of twenty-seven crossings. Fourteen of those were bridges of 44 feet of clear span or larger. Thirteen of those fourteen bridges were built using concrete abutments over a deep piling foundation with a deck comprised of pre-stressed concrete box beams. Eleven of these thirteen were private bridge crossings that provide access to farmland directly from a county road. The remaining two were county road crossings over Outlets 1 and 3.



The requirements for farm bridges along the roads eventually led to designs which incorporated the need to protect traffic from leaving the roadway near the abutments and a wide enough turning radius for farm equipment and trucks to enter the crossings from the narrow, elevated roadways which exist along the Northwest Drain. Guardrail on the approaches to the bridges was used along with a 24 foot bridge roadway width and low rails on the deck to achieve the clear area required for the large custom equipment common to the district. The road bridges were constructed to Tuscola County Road Commission requirements using 1990 MDOT Specifications.



The fourteenth bridge of long span was installed at the earlier mentioned Shian property crossing. This bridge replaced a frequently submerged ford crossing in the Main channel. At this point, the channel is approximately 90 feet in width across the top. Until recently no feasible alternative existed to provide a bridge to this area. The hydraulic requirements of the channel at

his point upstream of the relief drains required that no obstructions to flow be allowed. Building a conventional clear span bridge at his location was not feasible for a farm crossing.

The landowner, Jeffery Shian, had inquired with the drain office if it was possible to construct an access bridge at this site because he was frequently cut off from his property by deep flows in the main channel. The water remained deep for long enough some years to significantly delay planting. A solution was found in a new structure offered by Premarc. This pre-cast structure known as a CON/SPAN offered the dual advantage of a pre-engineered, pre-cast culvert that could be installed with relative ease at a lower cost than conventionally constructed bridges. The largest span available, a 48 foot span culvert, when modeled, was found to fit the requirements at the Shian property.



Massive concrete footings were laid out by a BMJ survey crew and installed by the contractor several weeks prior to delivery of the precast structure. A diversion channel was constructed to maintain the flow of water around the construction area. Several precast arch sections were delivered from Grand Rapids, Michigan late on August 21, 2000 and were set in place as they were unloaded. On Tuesday August 22, 2000, the rest of the structure was delivered as crews maneuvered the sections into place.



Five 35 ton arches were placed while four sections completing the head walls and weighing 8 tons per piece were attached. Finally four massive wingwalls weighing 16 tons each were installed on the structure. The entire operation of constructing the bridge from the time delivery began to the last wingwall in place took approximately one day. In all, 271 tons of precast concrete

bridge were delivered and installed. Another few days were required to install drainage, backfill the structure, reshape the channel to plan and construct a gravel roadway.

Comparable sized conventional sized bridges on the project took approximately 2 ½ months to construct and cost approximately twice as much as this structure. It should be stated that though it seems obvious that if this crossing was so cost effective and that it could have saved money if installed on the outlets, there were reservations expressed by landowners and the Tuscola County Road Commission about the installation of massive footings under the roadway. Additionally the size of this structure was not suited to many of the installations where spans reached 55 feet and more. The CON/SPAN structure was an excellent solution to the problem that existed in this unique situation.

The Northwest Drain Project was an ambitious and costly undertaking that most would not like to have to repeat. The involvement of federal and state government participation marked the utilization of a large amount of resources of the Army Corps of Engineers, FEMA, and MDEQ. To that end, a maintenance plan has been recommended that includes periodic inspection of the outlets. Control of damaging vegetation in the channel must be controlled and will be undertaken by the Tuscola County Drain Commissioner's office. Sarah Pistro has promoted a program under the control of the Michigan Department of Environmental Quality to compensate farmers that establish filter strips along the drainage network to protect the channel from further sedimentation and erosion damage. These filter strips should extend beyond the length of the many existing and newly installed drainage structures along the drain. Education in the district continues from USDA, USRCS, and MDEQ aiding farmers to practice beneficial farming techniques that will preserve this valuable infrastructure.

Some of the statistics of this project are interesting and indicate the investment that has been made in this watershed by the landowners of the Drainage District. In all, there were six construction contracts entered into by the District. Proposal No. 1 for channel excavation and appurtenances was contracted to Nicol and Sons, Inc. of Cass City, Michigan. The total contract was \$2,116,340.55. Proposal No. 2 for the construction of Garner Road Bridge over Outlet No. 1 was contracted to C.R. Hunt Inc. of Cass City, Michigan. The contract total was \$271,286.50. Proposal No. 3 for the construction of three private bridges over Outlet No. 2 was contracted to S.L.& H. Contractors, Inc. of Corunna, Michigan. The contract total was \$578,385.24. Proposal No. 4 for the construction of three more bridges over Outlet No. 2 was contracted to C.R. Hunt, Inc. That contract was for \$544,607.35. Proposal No. 5 for the construction of two private bridges over Outlet No. 2 and one private bridge over Outlet No. 3 was contracted to S.L.& H Contractors, Inc. for \$664,905.80. Finally, Proposal No. 6 for the construction of two private bridges over Outlet No. 3 and the Elmwood Road bridge over Outlet No. 3 was contracted to Heystek Contracting, Inc. of Montrose, Michigan for \$932,850.10.

The total contracted cost of construction and material for the Northwest Drain Project is \$5,108,375.54. Over the course of the project more than 500,000 cubic yards of soil was excavated. 39,202 square yards of drain slopes were armored with rock rip rap. Over 90 acres of construction disturbance was seeded, 27 crossings were constructed, and 32 miles of channel were excavated, cleared, repaired and stabilized, and/or reseeded. On the bridge work, approximately 14,000 feet of steel piling bridge foundation was driven, ¾ of a mile of deck beams were placed and nearly 50 tons of steel reinforcement was used. 1,748 parcels of land were assessed. Over 44,000 acres of land benefited from this drainage improvement project.

A project of this scope was not without problems or disputes. Disagreements between contractors and the owner and between landowners about construction, design, or scheduling were quickly dealt with, often at meetings held on site. Focus on problem solving instead on blame salvaged more than one potentially litigious situation.

Project participation included all of the following entities either as governmental review agencies, consultants, contractors, subcontractors or suppliers:

Government Agencies

Federal Emergency Management Agency
United States Army Corps of Engineers
Michigan Department of Environmental Quality
Michigan Department of Transportation
Tuscola County Road Commission

Consultants

BMJ Engineers and Surveyors, Inc.
Dortmann Engineering Associates, P.C.
Professional Services, Inc.
Non-Destructive Testing Group

Contractors

Nicol and Sons, Inc.
C.R. Hunt, Inc.
S.L.& H. Contractors, Inc.
Heystek Contracting, Inc.

SubContractors

Monchilov Excavating
J&J Fabrications
Work Safe Supply
Cardinal Fabrications
McNally-Nimergood Equipment

Suppliers

Jensen Bridge and Supply Company
Stress-Con Industries
Premarc
Northern Concrete Pipe, Inc.
Price and Company

This very large project was supervised, coordinated and administered by the Office of the Tuscola County Drain Commissioner, Sarah M. Pistro, which includes Sue Orłowski, Deputy Drain Commissioner and Patty Witkovsky, accounting clerk with contract administration and inspection conducted by BMJ Engineers and Surveyors, Inc. and Dortmann Engineering Associates, P.C.

The achievements that make this unique project stand out are that it was first and foremost a conventional project that incorporated forward looking goals into its framework. Though flooding control was the first criteria, sustainability, erosion control, habitat protection, landowner education, and infrastructure improvement were major objectives. These goals were achieved by negotiation, communication with landowners, design innovation to solve problems unique to the watershed, and consultation and cooperation with other regulating agencies of the State of Michigan.