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Two-stage Channel Restoration of Mary E. Smith Ditch, Wood County, Ohio

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Abstract. *Drainage ditches in NW Ohio have been straightened or otherwise modified to increase the safe removal of excess water from agricultural lands to help enhance crop management capacity and food production, and help decrease flooding impacts. However, ditch modifications have created negative impacts on habitat and are a leading cause of aquatic life use impairments. In addition, ditch maintenance costs are high and their improved water removal benefits may last only a few years. This ditch reconstruction project in the Bull Creek Subwatershed and is Joint County Ditch No. 2458. Materials presented herein summarize the progress on the development of this alternative drainage channel restoration construction project.*

Keywords. Drainage ditch, channel modification, two-stage channel, agricultural drainage

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Introduction

Drainage ditches in much of NW Ohio have been straightened or otherwise modified to increase the safe removal of excess water from agricultural lands to help enhance crop management capacity and food production, and help decrease flooding impacts. However, ditch modifications have created a negative impact on habitat and are a leading cause of aquatic life use impairments. In addition, ditch maintenance costs are high and their improved water removal benefits are often only temporary.

Dramatic advancements have been made in understanding how natural streams work. The science of fluvial geomorphology is leading a revolution in river engineering and stream restoration. Stream management efforts now focus more clearly on the restoration of ecological integrity and using natural stream characteristics to manage for channel stability and flood control. One application of fluvial geomorphology that remains relatively unexplored is the management of low gradient, artificially drained streams (i.e., drainage ditches) on agricultural landscapes.

The overall goal of this project is to evaluate and demonstrate an alternative drainage channel form that incorporates naturalized fluvial features to enhance stream integrity and maintain or improve drainage capacity. The materials presented herein summarize the progress on the development of an alternative drainage channel restoration construction project. The purpose of this project is to increase our understanding of how we may address multiple environmental objectives while meeting drainage needs by restoration and monitoring of drainage channels in an agricultural watershed in Northern Ohio. Specifically, we believe that retaining and incorporating vegetated benches, and small main channels that are created by natural fluvial (flow) processes, will result in lower nutrient and sediment discharges and will reduce maintenance costs on the long-term.

Approach

The flow of water in a ditch naturally creates a small main channel and low benches that are quickly covered in vegetation. These benches help stabilize the sides of the ditch and will reform if removed by maintenance. Considering this phenomenon, Ward et al. (2001) A Two-Stage Design Method for ditches is being developed by Dan Mecklenburg, ODNR-DSWC and Andy Ward, Department of Food, Agricultural, and Biological Engineering, at The Ohio State University. The cross-sectional area of the small main channel can be estimated based on the drainage area to the ditch. The width and depth of the small main channel can also be estimated from the drainage area. These procedures are based on data obtained in the Portage River Watershed. A study of other watersheds in Ohio will be conducted in the next two years. As part of a new, multi-state project funded by the USDA and EPA, research will be conducted on ditches in Minnesota and Illinois.

The new design method was developed by Dan Mecklenburg, ecological engineer, ODNR-Division of Soil and Water Conservation, and Andy Ward, professor, Department of Food, Agricultural, and Biological Engineering, The Ohio State University. The method incorporated (1) knowledge of bench and channel features in the ditch; (2) drainage area (watershed) size information; and (3) equations based on a study of ditches in the upper reaches of the Portage River Basin.

Not all existing ditches have stable benches. Relatively narrow ditches tend to form unstable benches. However, other factors such as the amount of maintenance, the depth of the ditch, bed material, and the depth to bed rock, and other factors also influence ditch stability.

The study area is located in Northwest Ohio (Fig. 1 above) in the upper reaches of the Portage River Basin (Fig. 2 above). A ditch reconstruction project is located in the Bull Creek Sub-watershed (Fig. 3 below) on the Mary E. Smith farm on Fast Road, just off of S.R. 18 and east of Bairdstown, Ohio (Fig. 4 below).

Rosengarten Construction, Inc. was employed for the work of reconstructing Joint County Ditch number 2458, petitioned by Mary E. Smith in Wood County, Ohio. The overseer of construction was D.J. Mears, Office of the Wood County Engineer.

The Wood County Engineer staff developed the project design by applying the new design method. Figure 1 shows typical cross sections of sites along the Fast Road ditch. Thirty cross-section stations were surveyed (Fig. 2 below) along the waterway and the data used to develop the final engineering design of the reconstructed ditch. The sequence of photos in Fig. 3 (bottom) depict stages of development of the new channel at cross-section station 69+00.

Chapters 6131, 6133, 6135, 6137 of the Ohio Revised Code provide for the petition, review, feasibility, design, construction, assessments, and maintenance of county drainage ditches. ORC Chapter 6133 specifically addresses Joint County Ditches, which applied to this particular project.

Results

Project construction began on May 6, 2002 and ended June 6, 2002, with several days of downtime because of wet weather. Bench formation and earth removal took approximately 6 days; 3 days for approximately 6,000 linear feet of bench construction, and 2.5 days to excavate and remove approximately 4,400 linear feet of earth. Bench work progressed by approximately 1,475 feet per day, more than double the expected daily amount. Outlet installation and rock removal each were completed in 2 days.

The ORC process and engineering costs totaled \$24,865, and this amount included advertisement, mailings, surveying materials and construction staking, inspection, engineering design, contingencies, and an initial maintenance fund. The

actual construction costs totaled \$13,606, and this amount included excavation, tree and debris removal, rock work, subsurface drain outlet replacement and splash apron, seeding, fertilizer, etc. The total project cost was projected to be \$38,471, with approximately 65% of the costs associated with the ORC process and engineering, and approximately 35% associated with the actual construction.

The total number of acres benefiting from the drainage improvement was determined by the County Engineer's staff to be 2323 ac. The total of the estimated appraised benefits was \$299,473, producing a benefits-to-cost ratio, B/C, of approximately 7.78. All Ditch Petition Projects performed in accordance with the Ohio Revised Code must have the appraised benefits exceed the total costs.

Summary and Conclusion

Study of other Ohio watersheds being conducted (engineering, hydrology, ecology, economics, etc.)

Design process being refined by Ward and Mecklenburg, others

Other demonstration sites being developed

New, multi-state project funded by USDA and EPA initiated in 2003 (Ohio, Minnesota and Illinois)

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To obtain a copy of the MS Powerpoint Presentation titled "Drainage Channel Restoration Construction Project," contact the corresponding author, L.C. Brown.

References