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PRELIMINARY ENGINEERING REPORT

JOINT DRAINAGE DISTRICT NO. 1
OPEN DITCH CLEANOUT
DICKINSON & OSCEOLA COUNTY, IOWA

JWA PROJECT NO: E13191

LICENSED PROFESSIONAL ENGINEER
RICHARD A. HOPPER
8106
IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Richard A. Hopper Date 1/27/15

Richard A. Hopper, P.E., License number 8106
My license renewal date is December 31, 2015
Pages or sheets covered by this seal: All

I. INTRODUCTION/HISTORY

Joint Osceola and Dickinson County Drainage District No. 1 (Joint DD #1) was originally established on November 20, 1911. The district contains 10,745 acres in Iowa. Some land in Minnesota appears to fall within the watershed of Joint DD#1. A portion of this land is north of Section 11, Fairview Township, Osceola County. The area in Minnesota is approximately 83 acres. There is a low area near the center of this ground. It appears the only way to get this water into Joint DD#1 is to tile it to Branch No. 13, Lateral No. 1 of Joint DD#1.

The other area in Minnesota to consider is north of Section 7 and 8 of Silver Lake Township in Dickinson County, Iowa and Section 12 of Fairview Township in Osceola County, Iowa. The west 154 acres of this area appears to drain into a permanent pond in Minnesota, so this water would stay in Minnesota. The east 130 acres of this area could possibly drain into a low area that would be drained by Branch No. 3 of Joint DD#1.

The total Minnesota area that could be drained into Joint DD#1 is the sum of the two areas mentioned, or 213 acres. With 10,745 acres in Iowa in Joint DD#1, the addition of 213 acres would represent less than a two percent increase in the area (1.98%). The extra cost involved in making the district an interstate district would never be recovered from the Minnesota lands. The Minnesota ground could also have a lot to say about what is done in Joint DD#1 in Iowa even though they would have less than two percent of the area. The only time we would recommend including Minnesota ground would be if Branch No. 13, Lateral No. 1, or Branch No. 3 are improved. At that time, investigation could be done to see if private tile from Minnesota connect to them. Annexation could become more practical at that time.

The work on the original construction was completed November 11, 1914.

The district was originally started as Drainage District No. 13 in Osceola County. Later Dickinson County lands were added and it was named Joint Drainage District No. 1, Osceola and Dickinson County.

A cleanout of the open ditch portion of the main was cleaned out in 1982 and 1983. The plans for this project were dated September 7, 1982 and were signed by the Chairman of the Board of Supervisors by each county. It appears that these plans were prepared by the engineering department of one, or both of the counties.

A letter dated February 27, 1984, by Wallace Holland Kastler Schmitz & Co. to address the areas drained by Branch 3, Lateral 3 of Branch 3, and Branch 20 of Joint DD#1 also evaluated the feasibility of improving the channel between the present lower end of DD#1 open ditch at STA 88+00 and the outlet for the two existing mutual tile serving as an outlet for Branch 20. A check of elevations indicated that channel improvements would only provide "marginal" improvements to the tile outlets in Branch 20 and drainage of the swamplands in Section 21.

Plans dated February 9, 2009 show a proposed cleanout of silt from the upper 12,140 lineal feet of the main open ditch beginning at a point approximately 150 feet east and 100 feet north of the west quarter-point of Section 20-100-38 (Silver Lake Township in Dickinson County) and continuing to follow the route of the existing ditch until it ended at a point approximately 750 feet west and 300 feet south of the east quarter-point of Section 23-100-39 (Fareview Township in Osceola County). The project was awarded on March 12, 2009, with the final pay estimate for work completed through July 31, 2009 in the amount of $79,191.48.

II. EXISTING IMPROVEMENTS

The existing improvements in the district include 15,000 lineal feet (2.84 miles) of main open ditch. The main also includes 14,700 lineal feet of tile ranging in size from 32-inch to 8-inch. The original report on the district includes an open ditch with bottom widths of 16, 14, 12, 10 and 8 feet. The cleanout plans from 1982 show only 10 feet and 8 feet widths. It appears that at some time, before the original construction, the bottom widths were reduced to 10 feet and 8 feet. The side slopes on the original main open ditch were 1:1. The cleanout done in 2009 started 2860 feet upstream from the original outlet for the main open ditch. This point is approximately 150 feet east and 100 feet north of the west quarter of Section 20-100-38. It stayed with the bottom widths of 10 feet and 8 feet. The sideslopes were 1½:1 for the upper 6,129 lineal feet of the ditch and 1:1 for the balance of the proposed cleanout in 2009 (6000 L.F.). This basically means the ditch slopes west of 100th Avenue were 1½:1 and east of 100th Avenue were 1:1. The end of the main open ditch discharges into a meandering private natural waterway which, then discharges into Trappers Bay. The length of the private natural waterway is 2.52 miles.

This district includes many branches and laterals. Tile connecting to the main open ditch or tile were labeled branches. Tile connected to the branches were labeled laterals. There are 20 branches in this district and 50 laterals.

III. STARTING POINT, ROUTE AND TERMINUS

The proposed cleanout of the main open ditch begins where the ditch joins Trapper's Bay at a location 850 feet north and 1100 feet east of the center of Section 28-100-38. From there it runs slightly south before turning west and traveling to a point 750 feet north and 250 feet east of the center of Section 28-100-38. The ditch then meanders in a northwesterly direction until it reaches a point located 1800 feet east and 400 feet north of the center of Section 20-100-38. The ditch turns southwest to a point located 950 feet south and 1000 feet west of the center of Section 20-100-38. It then curves around to a point approximately 150 feet east and 100 feet north of the west quarter-point of Section 20-100-38 (Silver Lake Township in Dickinson County).

The cleanout would continue generally northwest approximately 1140 feet to a point approximately 1150 feet north and 560 feet west of the west quarter point of Section 20-100-38.

The cleanout proceeds generally west approximately 2345 feet to a point approximately 1600 feet north of the center of Section 19-100-38.

The cleanout would continue generally west, southwest approximately 8655 feet to a point approximately 750 feet west and 300 feet south of the east quarter point of Section 23-100-39 (Fareview Township in Osceola County). This would be the upper end of the cleanout of the main open ditch.

IV. PROPOSED IMPROVEMENTS

There have been several reports and studies done on the Silver Lake Watershed and how to improve the water quality of Silver Lake. One such study was the Silver Lake Watershed Management Plan done in 2011, which suggested the primary threats to water quality in Silver Lake were sedimentation, excess nutrients, human and livestock waste, stormwater contaminants and loss of natural wetlands.

This report states 1089 tons of sediment is delivered to Silver Lake from sheet and rill erosion. This does not include sediment delivered from gully erosion. The Flovial Geomorphology and Channel Erosion Assessment West Branch of the Little Sioux River conducted by Catherine Sereg and Joe Thompson suggests 762 tons of sediment /year is eroding from the banks of Joint DD#1 and the meandering waterway leading to Trappers Bay. Charles Ikenberry estimated that the streambank erosion is actually contributing 832 tons of sediment per year.

IV. PROPOSED IMPROVEMENTS (cont.)

In order to stop the streambank erosion in Joint DD#1 an improvement of the ditch is necessary. Several alternatives were looked at to determine the best solution.

A two-stage ditch was mentioned at several previous meetings and has many benefits that improve water quality; however, there are also some challenges to two-stage ditches including increased costs and additional land requirements. A two-stage ditch consists of a main channel designed to carry a one-year 24-hour storm with grassed benches on both sides of the main channel designed to carry a ten-year 24-hour storm in agricultural areas. According to information from the Great Lakes Regional Water Program, "a two-stage system is best suited for drainage areas of 1 to 10 square miles and in channels with bed slopes that are less than 0.5%." Analysis of a two-stage ditch in the upper portion of the ditch to where less than 10 square miles drains into the ditch was done to determine the estimated size of the ditch and compared to the existing ditch and proposed trapezoidal ditch that was sized based on the appropriate curve for grain crops in Iowa. The two-stage ditch would have a main channel width ranging from 9 feet to 22 feet wide, with the overall bench width ranging from 19 feet to 46 feet wide. This compares to the proposed trapezoidal ditch that would ranges from 8 feet to 12 feet wide.

From the report prepared by Catherine Sereg and Joe Thompson, dated October 10, 2012, it states that "sheet and rill erosion upslope from the main channel would constitute a relatively minor portion of the sediment and phosphorus being delivered to Silver Lake." There were no observed tributary channels or gullies along the main channel except at the point where the main channel begins. It is our opinion that landowners are not going to be willing to give up the necessary land required for a two-stage ditch plus be willing to pay the increased costs of construction for the two-stage ditch. The Nature Conservancy website estimates that a two-stage ditch requires an extra one acre of land for every 0.5 miles of ditch.

The remaining options looked at to improve the ditch were a typical trapezoidal ditch and one that includes some channel re-alignment. As shown in the topographic survey obtained, and also referenced in the report by Sereg and Thompson, the major problem in the drainage ditch is channel erosion, mainly due to sloughing of the channel banks. Flattening the side slopes and establishing good vegetation will greatly reduce the sloughing problem. Some tiling behind the ditch spoils will be considered also to help relieve pressure on the ditch banks.

The Iowa Drainage Guide provides a table for side slopes based on soils. The soils at the site are mainly classified as MH (silt with high plasticity) and CL (clay with low plasticity). Side slopes in silt should be no steeper than 2:1 and in clay no steeper than 1½:1. Currently side slopes are 1½:1 and 1:1 in the ditch.

Permissible velocity of flow was also studied within the proposed channel. For open channels a minimum velocity of 2 to 3 feet/second is recommended. Velocities less than 1.5 feet/second will allow siltation to take place and allow the growth of moss and weeds. High velocities will result in erosion and should also be avoided. Velocities in the designed channel were calculated to be between 2 and 4 feet/second. 4 feet/second in the channel for a soil type of clay with low plasticity may be a little high considering Chapter 14 of the National Engineering Handbook suggests the maximum velocity of sandy clay loam is 3.5 feet/second. To slow down the velocity in the channel, we would suggest that centerline slopes and ditch widths be reviewed during design stages if it appears improvements will move forward.

We are proposing a trapezoidal ditch with a base width ranging from 8 feet at the upper end to 30 feet at the lower end and 2:1 side slopes. The ditch in the previously unimproved areas currently occupies approximately 15 acres from top of bank to top of bank. With the proposed changes and no re-alignment, the new ditch will occupy 21 acres. If the ditch is re-aligned it would occupy 17.6 acres. By flattening out the side slope to the recommended minimums and hydroseeding to establish a good vegetative base, the estimated 832 tons of sediment eroding from the ditch will be reduced greatly. The channel itself is in stable condition as determined from the topographic survey which showed very

IV. PROPOSED IMPROVEMENTS (cont.)

little sediment build-up or down-cutting. This was also noted in the report done by Sereg and Thompson. While sediment and phosphorous are closely related, streambank erosion does not carry nearly the same amount of phosphorous attached to sediment from sheet and rill erosion in the surrounding farm land. Stabilizing the banks of the ditch will result in a minimum removal of 483 tons of sediment and close to 870 pounds of phosphorus. This is based on achieving a 58 percent reduction in phosphorous, which is the reduction shown for buffers in the Iowa Nutrient Reduction Strategy. There are also at least 7 intakes close to the ditch that we would recommend putting a buffer around or changing to a rock intake. This would result in a reduction of 3 pounds phosphorous/intake. There are other measures to be taken on an individual basis to reduce the amount of phosphorous getting to the drainage ditch and transported to the lake. A vegetative filter strip of a minimum width of 15 feet on each side of the top of ditch banks would slow down runoff and allow the sediment to settle out before reaching the ditch. Rock intakes and/or 50' x 50' buffer areas around tile inlets would do the same for in field runoff. A change in farming practices for ground within the watershed area to reduce the transport of sediment would need some incentives through programs offered by NRCS, such as cover crops, buffers, and no-till. Some area farmers within the watershed are already doing no-till and a few are doing strip till. Bioreactors on tile lines reduces the amount of nitrogen leaving the field from the tile line which in turn improves water quality. The Iowa Soybean Association estimates the average installation costs for a bioreactor is around $8,000.00, with EQIP funding available depending on location. The bioreactors are expected to remove 35-50% of nitrate from tile water and the life expectancy is 10-15 years before the wood chips need to be replaced.

Mathew Helmers of the Department of Agriculture and Biosystems Engineering at Iowa State University was part of a group which published an article titled "Buffers and Vegetative Filter Strips". They discovered several interesting findings.

They discovered that buffers reduced sediment loads by 60-90 percent, runoff loads by 50-80 percent and total phosphorous loads by 50 percent. They found that narrow buffers can be very effective. The most important factors for buffers are the integrity, density and continuity of the buffers.

Another factor with buffers is to minimize concentrated loads. One method to do this is to ensure that the buffer edges have dense vegetation, which tends to distribute flow.

The last option investigated was also the trapezoidal ditch with some channel realignment in the natural waterway portion of the ditch. This would increase the drainage capability of the ditch and not increase the velocity. Trying to smooth out the bends in the natural waterway and create a gentle curve would help stabilize the banks. In rural streams draining 10 to 100 square miles, no more than a 25 percent reduction in the original length of the existing channel through any contiguous parcel(s) of the applicant's (s') property would be allowed. We would be proposing to reduce the overall length from 28,646 lineal feet to 26,416 lineal feet, a reduction of 7.8 percent.

The same 2:1 side slopes would be used with this option. Hydroseeding of the slopes would also be critical. The realignment, or smoothing of the sharp bends would help significantly in reduction of erosion of the channel.

With this option, we would still recommend filter strips, intakes with buffer areas, cover crops, no-till, strip till and bioreactors.

More detailed drawings of the realignment are also at the back of this report.

V. RIGHT-OF-WAY

Additional right-of-way will be required for any improvements being considered.

VI. COST ESTIMATES *(without realignment)*

The estimated cost for the improvements without realignment are found below:

1) Excavation	119,530 C.Y.	@	$	2.50/C.Y.	= $	298,825.00
2) Rock Field Crossing	3 Each	@	$	3,500.00/Each	= $	10,500.00
3) Outlet Repair	25 Each	@	$	900.00/Each	= $	22,500.00
4) Surface Drain	10 Each	@	$	3,000.00/Each	= $	30,000.00
3) Seeding & Fertilizing	23.7 Acre	@	$	2,000.00/Acre	= $	47,400.00

ESTIMATED TOTAL CONSTRUCTION COST	= $	409,225.00
CONTINGENCIES (10%)	= $	40,923.00
ENGINEERING, LEGAL, ADMINISTRATION	= $	85,000.00
RECLASSIFICATION	= $	30,000.00
EXISTING DITCH/CREEK (14.7 acres @ $1500/acre)	= $	22,050.00
PERMANENT RIGHT-OF-WAY FOR DITCH (20.7 acres @ $6000/acre	= $	124,200.00
PERMANENT RIGHT-OF-WAY FOR ACCESS (15' each side - 11.2 acres @ $6000/acre)	= $	67,200.00
INTEREST	= $	25,000.00
ESTIMATED TOTAL PROJECT COST	= $	803,598.00

(Average cost per acre, based on 10,745 acres = $74.79 acre)

VI. COST ESTIMATES *(with realignment)* (cont.)

The estimated cost for the improvements with realignment are found below:

1) Excavation	114,510 C.Y.	@	$	2.50/C.Y.	= $	286,275.00
2) Rock Field Crossing	3 Each	@	$	3,500.00/Each	= $	10,500.00
3) Outlet Repair	25 Each	@	$	900.00/Each	= $	22,500.00
4) Surface Drain	10 Each	@	$	3,000.00/Each	= $	30,000.00
3) Seeding & Fertilizing	21.8 Acre	@	$	2,000.00/Acre	= $	43,600.00

ESTIMATED TOTAL CONSTRUCTION COST	= $	392,875.00
CONTINGENCIES (10%)	= $	39,288.00
ENGINEERING, LEGAL, ADMINISTRATION	= $	95,000.00
RECLASSIFICATION	= $	30,000.00
EXISTING DITCH/CREEK (14.7 acres @ $1500/acre)	= $	22,050.00
PERMANENT RIGHT-OF-WAY FOR DITCH (17.6 acres @ $6000/acre	= $	105,600.00
PERMANENT RIGHT-OF-WAY FOR ACCESS (15' each side - 9.8 acres @ $6000/acre)	= $	58,800.00
INTEREST	= $	24,000.00
ESTIMATED TOTAL PROJECT COST	= $	767,613.00

(Average cost per acre, based on 10,745 acres = $71.44 acre)

VI. CONCLUSIONS/RECOMMENDATIONS

The open ditches of this district have significant erosion and many sharp bends which are adding to the problems in the ditch. For this reason, we are recommending proceeding with the improvement that includes realignment.

The Board of Supervisors for Osceola and Dickinson County should accept this report and set a date for a hearing on the report.

There is a significant amount of information to consider in this report. We are strongly recommending that the trustees have at least one informal hearing prior to the formal hearing. This will allow landowners to have a better understanding of the proposed improvements before they have to decide if they object to the work.

Reclassification of the district will be required since the project is an improvement.