



**JACOBSON-WESTERGARD & ASSOCIATES, INC.**  
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## ***ENGINEER'S REPORT***

# **DRAINAGE DISTRICT NO. 5 TILE REPAIR BREMER COUNTY, IOWA**

**PROJECT NO: E22159**

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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.

\_\_\_\_\_  
Date

Collin J. Klingbeil, P.E.

License number 24741

My license renewal date is December 31, 2023

Pages or sheets covered by this seal: \_\_\_\_\_

## **I. INTRODUCTION/HISTORY**

### **A. Scope**

A work order request for repairs to the Main Tile of Drainage District No. 5 (DD5) of Bremer County, Iowa was filed with the Board of Supervisors on November 21, 2022 and is enclosed. The request for repair describes “several sinkholes” over the 36” diameter Main Tile in Section 16 of Maxfield Township (T-91-N, R-12-W). The Bremer County Board of Supervisors, acting as trustees for DD5, appointed Jacobson-Westergard & Associates, Inc. on December 12, 2022 to develop an engineer’s report regarding the most feasible means of repairing the tile, and to evaluate the adequacy of the design of the existing tile system. This report addresses the request.

Drainage District No. 5 is located in Sections’ 2, 10, 11, 14, 15, 16, & 23 of Maxfield Township (T-91-N, R-12-W) of Bremer County, Iowa. A little less than ½ of the town of Readlyn (western portion) is included in the district.

### **B. History**

We note that the records available for this district are unfortunately somewhat sparse, the history includes only records available at the courthouse.

- 1919 – Presumably a petition was filed for establishment of a drainage district but is not part of the drainage district records.
- December 31, 1919 – Engineer’s Report Filed by Bremer County Engineer C.A. Cool recommending construction of a major tile system with tile ranging in size from 36” to 8” in diameter and including a Main Tile as well as Sub-Mains 1, 2, 3, 4, & 5, and Laterals to the Main Tile, Sub-Main #3, and Sub-Main #5.
- March 25, 1920 – Entered into contract with Paul Berg for construction of the district facilities for \$47,262.35. Contract completion date was set at September 1, 1921.
- May 3, 1920 – Appraisers appointed to classify the district.
- July 27, 1920 – Classification hearing held.
- October 1, 1966 – Agreement executed with the City of Readlyn which allowed the City to run an 8” diameter line from the sanitary wastewater treatment plant to Sub-Main 5 for payment of \$210 annually over twenty years. Maximum flow was set at 310 gallons/minute (0.69 cfs) or about ¼ of the tile’s total capacity.
- November 14, 2016 – Agreement executed with the City of Readlyn which allowed the City to replace the existing 8” diameter line from the sanitary wastewater treatment plant to Sub-Main 5 with a new 12” diameter PVC line. No maximum flow was set. Design capacity of the PVC line is equal to 100% of the Sub-Main 5 design capacity, although the design maximum wet weather (MWW) flow from the plant (1.10 MGD) still only would take up about 2/3rd of the pipe capacity.

## **II. EXISTING TILE STARTING POINT, ROUTE AND TERMINUS**

See enclosed map showing the existing tile systems of DD5, as well as a portion of the original 1919 Engineer’s Report giving a narrative description of the tile systems.

## **III. INVESTIGATION**

Survey data was collected on the Main Tile in Section 16 of Maxfield Township (T-91-N, R-12-W). In addition, Engineer’s reports and plats, plans, and profiles of district facilities were reviewed. Due to flood conditions in Crane Creek, we were not able to get all the survey we would have liked in advance of the March 13<sup>th</sup>, 2023 informational meeting. We hope to gather additional survey information as soon as conditions allow.

### **A. Tile Blowouts:**

At the locations of the Main Tile blowouts in Section 16, we note that the tile has less than 1 foot of cover (depth of soil over the top of the pipe). The distance between the lowermost and uppermost tile blowouts observed is 86 feet.

On the day of site visit (Feb. 28, 2023) we observed water standing in the field where the tile blowouts are located. Crane Creek was in flood condition. Backpressure on the tile was causing water to “push”

out of the tile at the blowout locations. This is a side-effect of the lack of cover over the tile, as the water can easily push through the shallow layer of soil above the tile to get to the surface. This action can also cause the tile joints to push apart, as can freeze/thaw action near the outlet. The picture below shows a tile blowout, underwater.



Cover issues are not isolated to the portion of the Main Tile experiencing blowouts. In looking at the original Main Tile profiles, the first approximately 6,000 feet of tile (36" – 26" diameter) was installed with an average of about 1.5 feet of cover (from about 8" to 30"). For a district tile we typically recommend no less than 2.5 feet of cover under normal conditions, and at least 3 feet of cover where the ground is likely to subside (peat ground) or erode (surface waterway). At these shallow depths of cover we would expect that approximately 20-30% of the wheel load of passing equipment would be transmitted to the tile. The tile was installed over 100 years ago, and has held up quite well. But we do expect this to continue to be a problem into the future. Tile installed in the early 1900's was only expected to last for 50 years and has already long outlasted its life expectancy.

**B. Main Tile Outlet Channel:**

It appears that the Main Tile outlets to a side-channel of Crane Creek. It is about 400 feet in length from the tile outlet to Crane Creek. On the February 28, 2023 site visit we noted that there is a potential restriction of flow in the outlet channel. More survey is needed to check elevations, but a thick growth of tree saplings was present in the bottom of the channel. The channel may need to be cleaned out as part of this repair work.



### C. Readlyn Stormwater Wetland:

As part of our investigation of the capacity of the existing tile system of Drainage District No. 5, we investigated a stormwater wetland that was constructed in 2018 in the area of the Sub-Main 5 tile. See enclosed plan sheets. Sub-Main 5 Lateral 1 tile was removed. At the upper end of the original lateral, a 10" dual-wall HDPE pipe was installed to route the flow to the downstream side of a rock letdown structure upstream of the wetland. The lower portion of the Sub-Main 5 Lateral 1 tile was replaced with a 6" single-wall HDPE pipe that connects into the Sub-Main 5 tile. As a result of the project, we consider Sub-Main 5 Lateral 1 tile to be abandoned.

There is a water control structure at the downstream side of the wetland, which is the outlet for the wetland. From the control structure the water flows through a 10" diameter dual-wall HDPE pipe to the 12" diameter Sub-Main 5 tile. It was noted that site topography limited the ability to provide significant detention for large flood events. As such, the design flows into and out of the wetland are orders of magnitude greater than the design capacity of the existing tile. If the tile is overloaded, the wetland will overflow, and water will go down a rock chute and continue westward via a series of surface waterways to Crane Creek along a similar path as the Main Tile.

### D. Design Capacity of Existing Tile System:

The adequacy of the existing tile system has been analyzed, and is shown in the tables below and in the enclosed maps. Note that the capacities shown assume the tile is in good condition. The design parameter commonly used for drainage tile is known as the *drainage coefficient (DC)*. According to the Iowa Drainage Guide, the drainage coefficient is the rate at which water can be removed from the land, and is expressed as the equivalent depth of water covering the surface of the drained area that can be removed in 24 hours. For field crops with good surface drainage, a drainage coefficient of 3/8" to 1/2" per day is recommended. However, in the early 1900's tile systems were commonly designed with a drainage coefficient of 1/4" to 1/8" per day or less.

Most drainage districts include only agricultural land. This district is somewhat unique in that it includes the western portion of the City of Readlyn. The impervious paved streets, sidewalks, driveways, roofs, etc. generate more storm runoff than agricultural lands, necessitating either a larger tile to carry the extra water away during and following rainfall events, or surface drainage of some sort (waterway, ditch, etc.).

Main Tile & Main Lateral 1							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Main	0+00	36	0.096%	24.42	2,500	1,937.4	0.30
Main	25+00	36	0.240%	38.62	2,000	1,879.5	0.49
Main	45+00	32	0.145%	21.93	650	1,633.4	0.32
Main	51+50	32	0.145%	21.93	450	1485	0.35
Main	56+00	26	0.364%	19.97	1,300	902.7	0.53
Main	69+00	20	0.364%	9.92	800	696.3	0.34
Main	77+00	18	0.364%	7.49	1,300	390.9	0.46
Main	90+00	18	0.666%	10.13	600	278.9	0.86
Main	96+00	12	0.500%	2.98	1,200	127.2	0.56
Main	108+00	12	0.857%	3.90	400	113.4	0.82
Main	112+00	8	0.857%	1.32	650	89.7	0.35
Main	118+50	8	0.333%	0.82	300	49.5	0.40
Main Lat 1	0+00	8	0.900%*	1.35	740	57.7	0.56

\*: No profile for this reach. Estimated based on ground elevations.



Sub-Main 1							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Sub-Main 1	0+00	12	0.200%	1.88	100	142.7	0.31
Sub-Main 1	1+00	12	0.600%	3.26	900	142.7	0.54
Sub-Main 1	10+00	10	0.658%	2.10	1,000	124.5	0.40
Sub-Main 1	20+00	8	0.658%	1.16	700	62.9	0.44
Sub-Main 1	27+00	8	1.309%	1.63	1,100	34.5	1.13

Sub-Main 2							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Sub-Main 2	0+00	12	0.200%	1.88	200	136.4	0.33
Sub-Main 2	2+00	12	0.750%	3.65	1,200	136.4	0.64
Sub-Main 2	14+00	10	1.050%	2.65	1,000	90.2	0.70
Sub-Main 2	24+00	8	1.050%	1.46	600	52.4	0.66
Sub-Main 2	30+00	8	1.600%	1.81	500	43.5	0.99
Sub-Main 2	35+00	8	0.750%	1.24	400	25.8	1.14

Sub-Main 3 and Sub-Main 3 Lateral 1							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Sub-Main 3	0+00	18	0.600%	9.62	500	555.7	0.41
Sub-Main 3	5+00	18	0.300%	6.80	2,000	551.3	0.29
Sub-Main 3	25+00	18	0.500%	8.78	400	472.3	0.44
Sub-Main 3	29+00	18	0.700%	10.39	300	407.7	0.61
Sub-Main 3	32+00	15	0.540%	5.61	1,300	354	0.38
Sub-Main 3	45+00	15	0.566%	5.74	600	328.7	0.42
Sub-Main 3	51+00	15	0.450%	5.12	900	253.3	0.48
Sub-Main 3	60+00	12	0.450%	2.82	1,000	211.4	0.32
Sub-Main 3	70+00	10	0.450%	1.74	100	69.1	0.60
Sub-Main 3	71+00	10	0.700%	2.17	1,000	69.1	0.75
Sub 3 Lat 1	0+00	8	0.800%	1.28	500	33.3	0.91
Sub 3 Lat 1	5+00	8	0.500%	1.01	1,000	33.3	0.72
Sub 3 Lat 1	15+00	8	0.330%	0.82	300	17.9	1.09

Sub-Main 4							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Sub-Main 4	0+00	12	0.300%	2.31	900	171.4	0.32
Sub-Main 4	9+00	10	0.300%	1.42	1,100	155.8	0.22
Sub-Main 4	20+00	10	0.830%	2.36	100	118.9	0.47
Sub-Main 4	21+00	8	0.830%	1.30	500	118.9	0.26
Sub-Main 4	26+00	8	1.600%	1.81	720	23.1	1.86

Sub-Main 5 and Sub-Main 5 Lateral 1							
<u>Lateral</u>	<u>Starting Station</u>	<u>Dia. (in)</u>	<u>Grade (%)</u>	<u>Ex Capac. (cfs)</u>	<u>Approx. Length</u>	<u>Acres Drained</u>	<u>DC (in/day)</u>
Sub-Main 5	0+00	12	0.413%	2.71	1,500	294.3	0.22
Sub-Main 5	15+00	12	0.583%	3.21	1,100	255.7	0.30
Sub-Main 5	26+00	8	0.583%	1.09	100	70.8	0.37
Sub-Main 5	27+00	8	0.846%	1.31	1,300	70.8	0.44
Sub-Main 5	40+00	8	0.400%	0.90	500	39.4	0.55
Sub 5 Lat 1	0+00	10	0.633%	2.06	1,197	115.8	0.42

The original tile system appears to have generally been designed for a minimum drainage coefficient between 1/4" and 1/3" per day. The grades generally follow the ground, which at times has quite a bit of slope resulting in higher drainage coefficients for the tile system.

Overall, for the agricultural lands in the district we would recommend a minimum of a 3/8" per day drainage coefficient. For the tile system to carry all the stormwater runoff from the town of Readlyn a very large drainage coefficient would be needed, however because surface waterways are available to carry whatever the tile system cannot, the tile does not need to be designed to carry the entire flow. With that being said, most of the tile systems have either above or very close to 3/8" per day drainage coefficient and improvements are not advised.

#### **E. Repair vs. Improvement:**

Based on the Iowa Drainage Code, repairs are required whereas improvements are permissive. A repair is whatever is necessary to restore or maintain a district tile to its original capacity or efficiency. An improvement is anything that is intended to expand, enlarge or otherwise increase the capacity of the tile. For this project, simply patching the tile blowouts would be considered a repair. However, if we lower the tile to gain cover, it would actually be considered an improvement.

### **IV. OPTIONS**

At this point in time, we see two options for addressing the tile blowouts at the lower end of the Main Tile.

#### **A. Option #1: Patch Tile and Add Fill**

The area with blowouts would be repaired using new 36" diameter reinforced concrete pipe (RCP) with rubber gaskets at the joints, and fill (1-2 feet) would be hauled in to increase the amount of cover over the tile in the area of repair. This would be the least costly option. If the remainder of the Main Tile in the area is in good condition this would be the best option. However, if the tile is in poor condition, if the tile joints have separated, or if there is very little cover in other areas additional repairs could be necessary in the future. We would not recommend the use of dual-wall HDPE for this option because of the limited amount of cover, as it is much more susceptible to deflection and failure than RCP.

#### **B. Option #2: Re-route and Potentially Lower Tile**

The Main Tile in Section 16 would be re-routed out of the low ground and into a side-hill in order to gain additional cover over the tile. With this option, tile blowouts and other problems caused by lack of cover over the pipe would be permanently fixed. There is also a possibility of lowering the tile at the outlet, depending on elevations (to be determined), which would then be an improvement. A portion of the existing Main Tile would be abandoned.

### **V. COST ESTIMATES**

#### **OPTION 1: PATCH TILE AND ADD FILL**

<u>ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>TOTAL PRICE</u>
1	36" DIA. RCP, 2000D	100	LF	\$100.00	\$10,000.00
2	Topsoil Fill, and Grading	400	CY	\$20.00	\$8,000.00
3	Exploratory Excavation	1	HR	\$250.00	\$250.00

4	Trench Stabilization and Bedding Stone	10	TN	\$35.00	\$350.00
5	Outlet Channel Cleanout	1	LS	\$3,000.00	\$3,000.00
6	Mobilization	1	LS	\$1,000.00	\$1,000.00
ESTIMATED OPTION 1 CONSTRUCTION COST:					\$23,000
ESTIMATED SUBTOTAL CONSTRUCTION COST:					\$23,000
CONSTRUCTION CONTINGENCIES					\$2,000
ESTIMATED TOTAL CONSTRUCTION COST					\$25,000
<b>NON-CONSTRUCTION COSTS</b>					
ENGINEERING - (REPORT, HEARINGS, PLANS & SPECS, BID LETTING, CONSTRUCTION, COMPLETION)					\$10,000
LEGAL, PUBLICATIONS, MAILINGS, ETC.					\$1,000
RE-CLASSIFICATION					\$6,000
INTEREST					\$2,000
ESTIMATED TOTAL DISTRICT COST					\$44,000
AVG COST PER ACRE FOR (BASED ON 1,934.7 ACRES):					\$23
AVERAGE COST PER ACRE PER YEAR AT 6% INTEREST FOR 10 YEARS:					\$3
AVERAGE COST PER ACRE PER YEAR AT 6% INTEREST FOR 20 YEARS:					\$2
<b>OPTION 2: RE-ROUTE AND POTENTIALLY LOWER TILE</b>					
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
1	36" DIA. RCP APRON W/ANIMAL	1	EA	\$4,500.00	\$4,500.00
2	36" DIA. RCP, 2000D	2300	LF	\$100.00	\$230,000.00
3	Topsoil Fill, and Grading	400	CY	\$20.00	\$8,000.00
4	Exploratory Excavation	2	HR	\$250.00	\$500.00
5	Trench Stabilization and Bedding Stone	40	EA	\$35.00	\$1,400.00
6	Mobilization	1	LS	\$12,000.00	\$12,000.00
ESTIMATED OPTION 2 CONSTRUCTION COST:					\$256,000
ESTIMATED SUBTOTAL CONSTRUCTION COST:					\$256,000
CONSTRUCTION CONTINGENCIES					\$26,000
ESTIMATED TOTAL CONSTRUCTION COST					\$282,000
<b>NON-CONSTRUCTION COSTS</b>					
ENGINEERING - (REPORT, HEARINGS, PLANS & SPECS, BID LETTING, CONSTRUCTION, COMPLETION)					\$50,000
LEGAL, PUBLICATIONS, MAILINGS, ETC.					\$1,000
RE-CLASSIFICATION					\$6,000
TEMPORARY EASEMENT (3 Acres @ \$1,000/AC)					\$3,000
OTHER DAMAGES					\$1,000
INTEREST					\$21,000
ESTIMATED TOTAL DISTRICT COST					\$364,000
AVG COST PER ACRE FOR NORTH WATERSHED (BASED ON 1,937.4 ACRES):					\$188
AVERAGE COST PER ACRE PER YEAR AT 6% INTEREST FOR 10 YEARS:					\$26
AVERAGE COST PER ACRE PER YEAR AT 6% INTEREST FOR 20 YEARS:					\$16

## **VI. PROPOSAL**

In our opinion, the cost of relocating and/or lowering the first approximately 2,300 feet of the Main Tile is cost prohibitive. Therefore, we recommend that Option 1 be pursued. Repairs can be completed in the area of the recent blowouts, and fill hauled in for a reasonable price, presuming the tile outside the area of the recent blowouts is in good condition. At the writing of this draft report the extent of the outlet channel cleaning that is necessary is unclear, but we believe at a minimum the tree saplings should be removed, as they are creating an obstruction.

## **VII. RIGHT-OF-WAY**

Iowa Code grants drainage district a permanent right of egress and ingress, and right of access for maintenance, repair, improvement, and inspection of drainage district facilities. Unless right-of-way is acquired, which we are not recommending, landowners will be reimbursed for any damages caused in the process of maintenance, repair, improvement, or inspection.

The district will need an area to perform the proposed work. Compensation for damages within the work limits is normally determined at a completion hearing and is subject to approval by the Board of Supervisors.

## **VIII. ASSESSMENT SCHEDULE REVIEW**

This district is currently under its original assessment schedule from when it was established in 1920. All district tile facilities are included in this single assessment schedule. Under this schedule all lands are assessed for work done on any tile in the district, regardless of whether the lands benefit from it. For example, parcels that drain into Sub-Main 3 tile would help pay for repairs to Sub-Main 5 Tile, which they do not use nor benefit from. The remedy for this is to develop separate assessment schedules for each district facility, to make the cost of improvements and future repairs more equitable. This process is called re-classification. Re-classification is done by a classification commission which includes an engineer and two Bremer County landowners who neither own nor have any interest in the lands being re-classified.

On December 12, 2022 the Bremer County Board of Supervisors, acting as trustees for Drainage District No. 5 directed us to proceed with reclassification. The reclassification will soon be filed as a separate report and will be available both on the county website and at the auditor's office. Once approved, the new assessment schedules will be used as the basis for future levies to pay for maintenance, improvements, engineering, etc. We have enclosed dollars maps for the Lower Main Tile schedule, which shows assessment amounts for a theoretical levy of \$44,000. Actual assessments are proportionately adjusted based on the total amount levied.

## **IX. FARM PROGRAM WETLAND COMPLIANCE**

Because a repair is being recommended rather than an improvement, farm program wetland compliance is not an issue for this project.

## **X. CONCLUSION/RECOMMENDATIONS**

This report confirms the need for drainage repairs within Drainage District No. 5. We recommend replacing the existing concrete 36" diameter tile in the area of blowouts (approximately 100 feet) with 36" diameter reinforced concrete pipe (2000D). We also recommend placing topsoil fill over the tile in the area of the repair (plus a couple hundred feet in each direction) to increase the cover over the tile, which is now approximately 1 foot or less. Because the existing Main Tile has nearly adequate capacity, repairing and replacing tile as needed is a worthwhile investment. The estimated project cost for the repairs is \$44,000 or an average of \$23/acre in the district. By Iowa Code repairs are required.

We note that although the engineering costs, including investigation and reclassification, are a large portion of this repair project cost if repairs to the tile in the future are needed minimal engineering involvement will be necessary.



The Board of Supervisors, as trustees for Drainage District No. 5, should tentatively approve this report and set a date for a public hearing. At the hearing, the trustees should seek input from landowners. Once modifications to the report are made, if any, the project should be approved, and a contractor employed to complete the repairs. We are willing to assist the county in any way necessary, including soliciting competitive quotes for the work.

Sincerely,

**JACOBSON-WESTERGARD & ASSOCIATES INC.**

Collin J. Klingbeil, P.E.

Encl.    Work Order  
          Map of Existing DD5 Tile Systems  
          Clip of 1919 Engineer's Report  
          Readlyn Stormwater Wetland Plan Sheets C101 & C203  
          Dollars Maps for Estimated \$44,000 Repair

Mail to: Bremer Co. Auditor  
415 E Bremer Ave  
Waverly, IA 50677

## REQUEST FOR REPAIR BREMER COUNTY, IOWA

To the Board of Supervisors, Bremer County, Iowa:

I, the undersigned, hereby state that repairs are necessary to tile lines and/or open ditches of the organized Drainage District No: 5, Lateral No. Main and I hereby request that the matter be investigated and repairs be made at the earliest possible date.

Signed: \_\_\_\_\_

Date: 11/21/2022

### DRAINAGE WORK ORDER

Repair requested by: Landon Moore

☐ Owner

☐ Tenant

☒ Other

Telephone: 319-352-4302

Address: Piedmont/240th

Site available for repair now? ☒ Yes ☐ No

Landowner name, phone & address (if not provided above): Dawn Lau

Does this also involve private tile? Yes ☒ No ☐

Preference for Contractor to do the repair? \_\_\_\_\_

Please give description of the problem: Several sinkholes over 36" main

On the grid below, please indicate where the damage is located. Draw in the tile to the best of your ability. The box in the center represents the middle of the section.

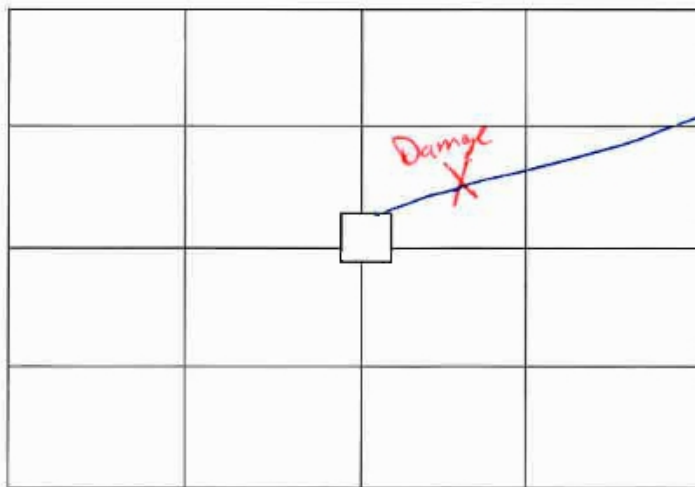
NW ¼

NE ¼

Section: 16  
Township: 9N  
Range: 12W

SW ¼

SE ¼



\*\*\*\*\*

### REPAIRS (for County use ONLY):

☐ Approved for Work

☐ Investigation Necessary

☐ Not Approved for Work

Supervisor's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Work Order #: \_\_\_\_\_

Contractor Assigned: \_\_\_\_\_

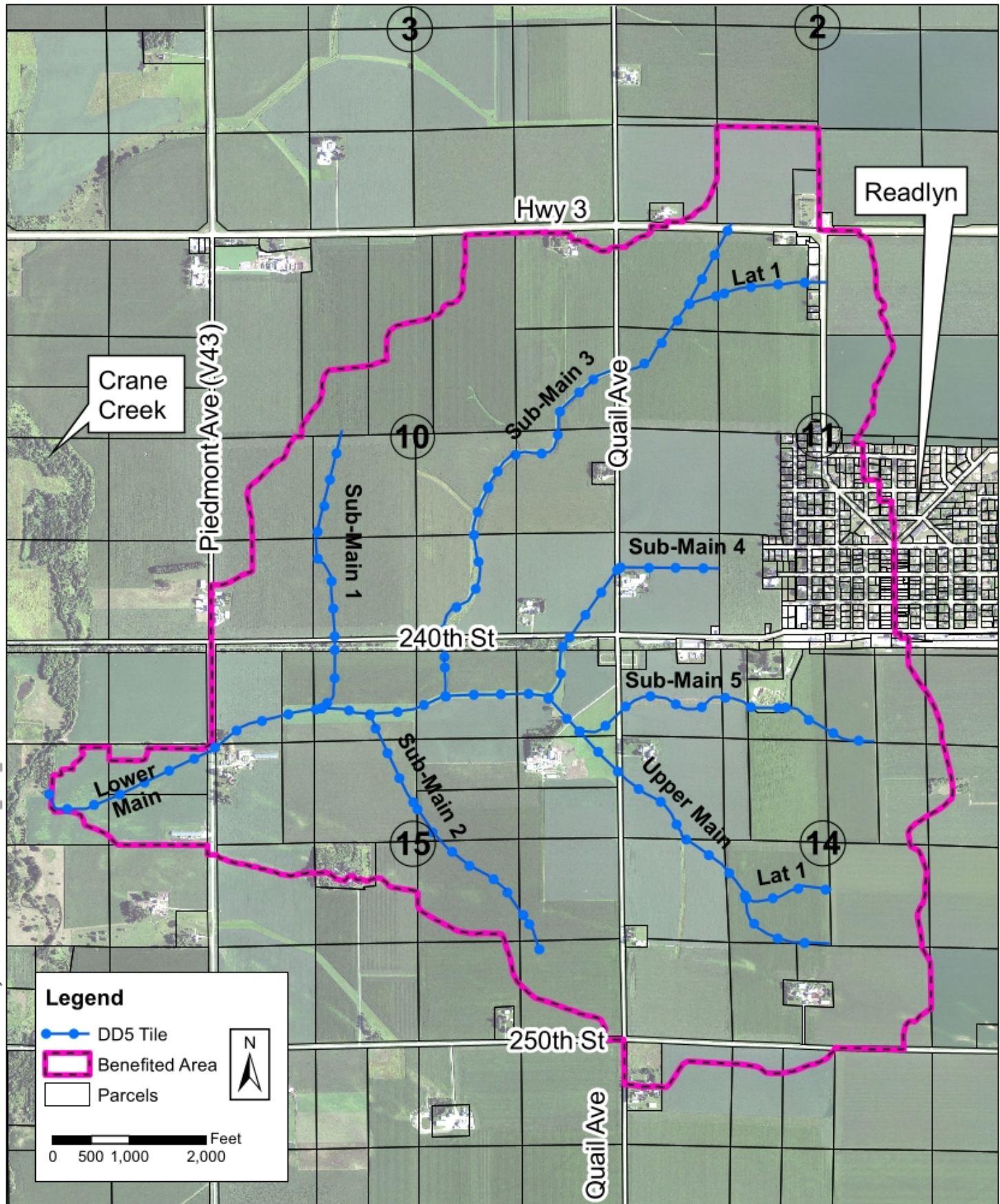
White: return to Auditor's Office for payment  
(Invoices submitted without a work order will not be paid)

Yellow: retain for your records



# Drainage District No. 5 Tile Map

Bremer County, Iowa





REPORT ON DRAINAGE DISTRICT (Highway) # 5.

To the Honorable Board of Supervisors of Bremer County.

Gentlemen:

Your Engineer, in accordance with the resolution passed by you, has surveyed and planned a drainage system for the lands mentioned in your resolution and begs to make the following report.

I went over the watershed covered by your resolution and find that the most practical way of draining the watershed is as shown by the attached map.

The outlet for this watershed is in a small gully that discharges into Crane Creek, on the land of August Wittenberg in Sec. 16-91-12, and the outlet is about 200' south of the point where the gully empties into Crane Creek at a point 700' north of the center line of the section and 2280' west of the east line. The Main line runs in a general north-westerly direction across the lands of August Wittenberg, Herman Oltrogge and August Wittenberg and thence in a south-easterly direction across the lands of Louis Meyerhoff and Ed Huebner and terminates on the land of Herman Thies.

The size of tile in the main is as follows - from sta. 0-00 at the outlet to sta. 43-00, a point in Herman Oltrogge's field where sub-main #1 commences, will be 36"; from sta. 43-00 to sta. 56-00 where sub-main #3 commences, will be 32"; from sta. 56-00 to sta. 69-00, the point where sub-main #4 commences, will be 26"; from sta. 69-00 to sta. 77-00, the point where sub-main #5 commences will be 20"; from sta. 77-00 to sta. 96-00 will be 18"; from sta. 96-00 to sta. 112-00 will be 12" and from sta. 112-00 to sta. 121-90 will be 8".

Sub-main #1 consists of 1000' of 12" tile, 1000' of 10" tile and 1770' of 8" tile.

Sub-main #2 consists of 1400' of 12" tile, 1000' of 10" tile and 1510' of 8" tile.

Sub-main #3 consists of 3200' of 18" tile: 2800' of 15" tile; 1000' of 12" tile and 1400' of 10" tile.

Sub-main #4 consists of 900' of 12" tile; 1200' of 10" and 1220' of 8" tile.

Sub-main #5 consists of 2600' of 12" tile and 1818' of 8" Tile.

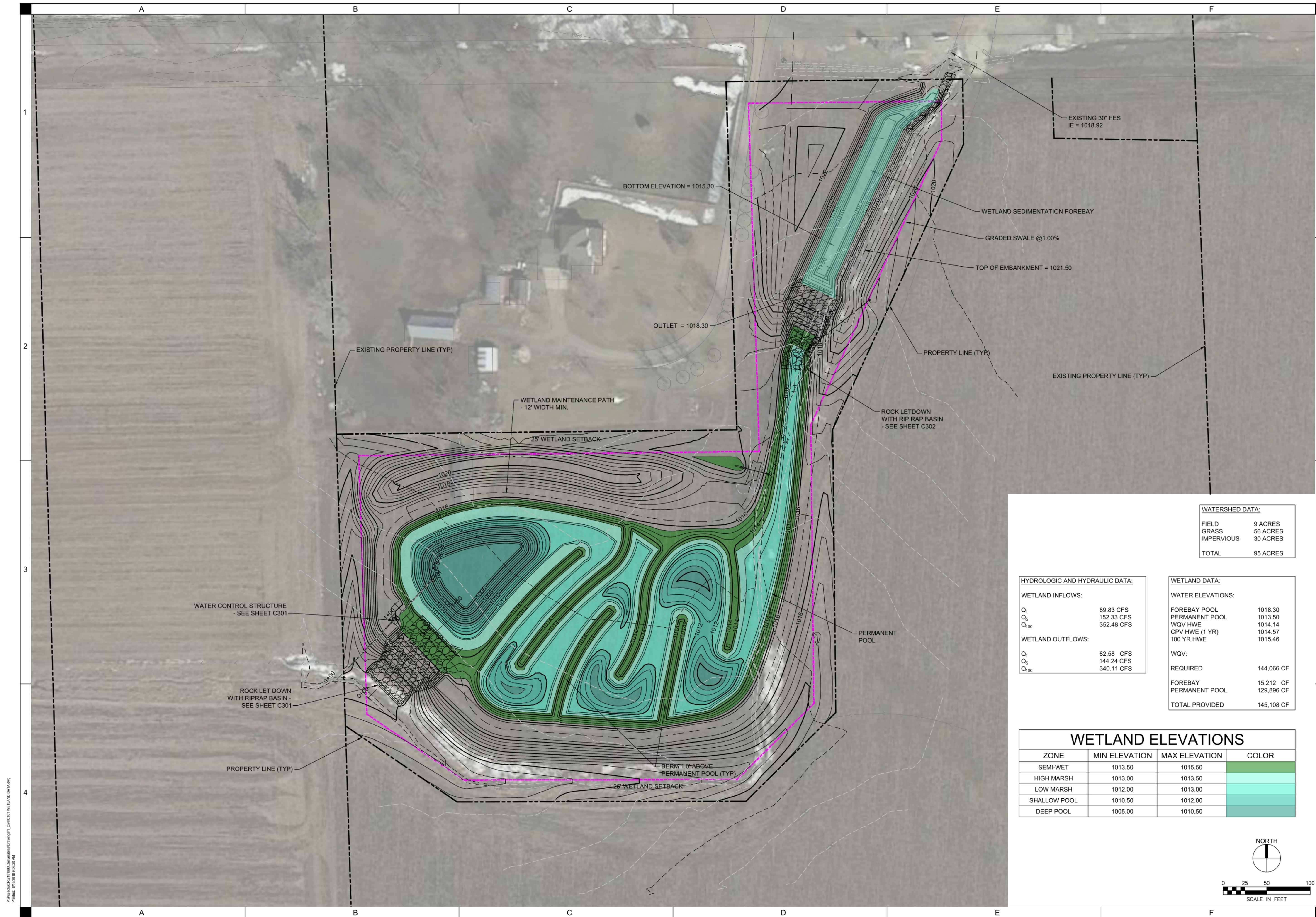
Lateral #1, Sub-main #5 consists of 1197' of 10" tile.

Lateral #1, Main line, consists of 740' of 8" tile.

Lateral #1, Sub-Main #3 consists of 1760' of 8" tile.

The total area of this watershed is 1900 acres and about 60% of the area requires drainage in order that the land can be placed under plow.



[illegible]

DRAWN:	AJH
APPROVED:	LTM
ISSUED FOR:	BIDDING
DATE:	08/16/2018
PROJECT NO:	2181090
FIELD BOOK:	---
CLIENT NO:	---

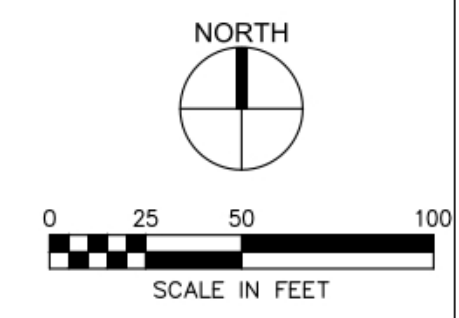
4  
WETLAND DATA  
C101

WATERSHED DATA:	
FIELD	9 ACRES
GRASS	56 ACRES
IMPERVIOUS	30 ACRES
<b>TOTAL</b>	<b>95 ACRES</b>

HYDROLOGIC AND HYDRAULIC DATA:	
WETLAND INFLOWS:	
Q <sub>1</sub>	89.83 CFS
Q <sub>5</sub>	152.33 CFS
Q <sub>100</sub>	352.48 CFS
WETLAND OUTFLOWS:	
Q <sub>1</sub>	82.58 CFS
Q <sub>5</sub>	144.24 CFS
Q <sub>100</sub>	340.11 CFS

<u>WETLAND DATA:</u>	
WATER ELEVATIONS:	
FOREBAY POOL	1018.30
PERMANENT POOL	1013.50
WQV HWE	1014.14
CPV HWE (1 YR)	1014.57
100 YR HWE	1015.46
WQV:	
REQUIRED	144,066 CF
FOREBAY	15,212 CF
PERMANENT POOL	129,896 CF
TOTAL PROVIDED	145,108 CF

WETLAND ELEVATIONS			
ZONE	MIN ELEVATION	MAX ELEVATION	COLOR
SEMI-WET	1013.50	1015.50	
HIGH MARSH	1013.00	1013.50	
LOW MARSH	1012.00	1013.00	
SHALLOW POOL	1010.50	1012.00	
DEEP POOL	1005.00	1010.50	



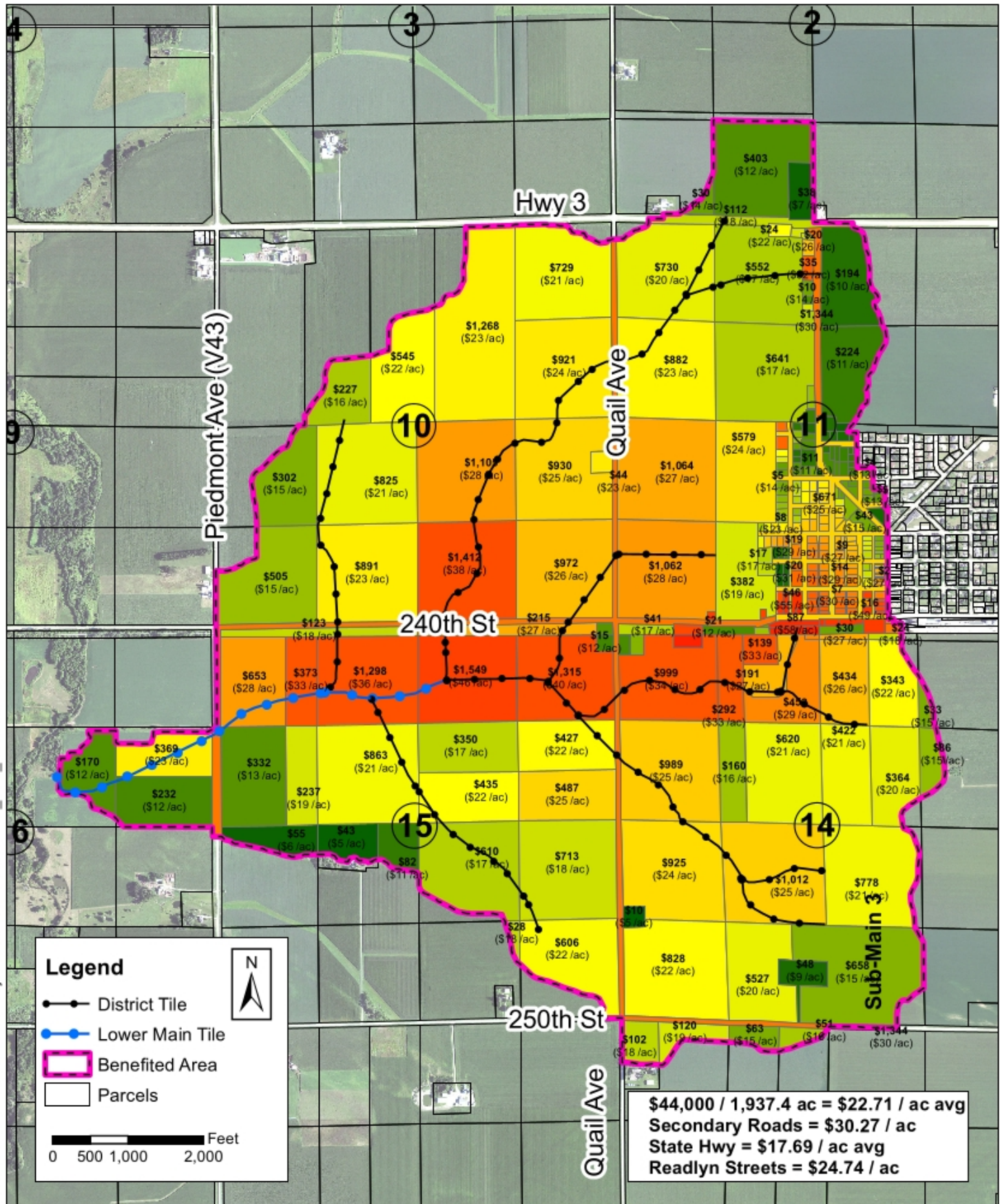






# Drainage District No. 5 Lower Main Tile Dollars Map Based on \$44,000 Levy

Bremer County, Iowa





Bremer County, Iowa



**JACOBSON-WESTERGARD**  
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Consulting Engineers &amp; Land Surveyors

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