DRAINAGE REPORT

DANE COUNTY
DRAINAGE DISTRICT #4

May 2019

PREPARED FOR:

Dane County Drainage Board

PREPARED BY:

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1. Project Contacts

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2. Purpose

The purpose of providing this report is to provide an engineering study proposing modifications to the District 4 tile system. The Board requested that an engineering study be conducted to determine the an opinion of costs to make these modifications as well as determining the watershed area contributing to the system. To perform this study, we propose the following tasks:

1. Using County Lidar information determine watershed boundary.
2. Calculate current capacity of main and propose main using an appropriate removal rate.
3. Discuss options for surface inlets to prevent sediment into the system.
4. Estimate of costs for a new main system.

3. Background

Dane County Drainage District 4 is located in the town of Bristol (T9N R11E) in Dane County Wisconsin. The District consists of a subsurface tile main and eight laterals. District Specifications and Plans were prepared by Ayres Associates in 2005. In discussions with the Board and landowners at a 11/8/18 meeting, drainage is inadequate and improvements need to be made. The tile consists of concrete and clay tile with some repairs having been made with P.E. tile or pipe. Several tile inlets exist in the system and comments have been made that these may be contributing sediment to the tile system which may be contributing to reduced flow. The tile system outlets to a ditch in the SWSW of Section 9. This ditch is not a District Drain.

4. Engineering Design

NRCS Conservation Practice Standards explain the requirements of a conservation practice and where it applies. For purpose of this report Wisconsin NRCS Conservation Practice Standard 606- Subsurface Drain (March 2014) was referenced for criteria in evaluating the District 4 tile drainage system. Wisconsin NRCS Conservation Practice Standard 608- Subsurface Drain, Main or Lateral (April 2016) as well as DATCP Chapter 48 Drainage Districts was referenced for criteria for design of an open ditch. A copy of the Standards and State Code is presented in Appendix A.

Topographic information

2ft County contours from Dane County were used to delineate the watershed draining to the tiled lands. The delineated watershed is approximately 1,803 acres. The drainage district boundary encompasses 1,264 acres. The topography is generally sloping to flat with depressions scattered in the landscape and limited surface drainage. A map of the watershed with the district boundary is presented is Appendix B.

Soils information

The primary soils in the area of the main are as follows:
RaA-Radford silt loam-0 to 3%
The Radford soil consists of a silt loam to a silty clay loam from 0 to 79"
Hydric with depth to water rating of (50 cm) 19 in.

RnB-Ringwood silt loam-2 to 6%
The Ringwood soil consists of a silt loam to a silty clay loam from 0 to 22", from 22 to 36" a sandy clay loam, and from 36-79" a sandy loam to a gravelly sandy loam.

Depth to water rating of (200+ cm) 6.5+ ft.

SaA-Sable silty clay loam-0 to 2%
The Sable soil consists of a silty clay loam to a silt loam from 0 to 60"
Hydric with depth to water rating of (15 cm) 6 in.

ScB- St Charles silt loam-2 to 6%
The St Charles soil consists of a silt loam from 0 to 48", a sandy loam from 48 to 54" and a sandy loam to a gravelly sandy loam from 54 to79".
Hydric with depth to water rating of (122 cm) 48 in.

VrB- Virgil silt loam-1 to 4%
The Virgil soil consists of a silt loam from 0-15", a silty clay loam from 15 to 51" and a sandy loam from 51 to 79"
Hydric with depth to water rating of (38 cm) 15 in.

Soil types and soils information were determined by outlining the district in the NRCS Web Soil Survey and generating soils reports. Others soil types are present but the soils described above generally exists along the main. The Soil Survey reports are presented in Appendix C.

Outlet information

The outlet was observed and is 20 inch concrete tile and at elevation 919.20.

As previously noted, the tile system drains to a ditch that drains under Wilburn Rd. The culvert at Wilburn Rd is a concrete bridge with an 8 foot wide by 5 foot high opening at elevation 911.70.

Drainage coefficient

The drainage coefficient was determined from the NRCS Standard 606- Subsurface Drain Table 2 shown below. The capacity is based the entire area being drained. Table 1 (No Open Inlets) and Table 2 (Surface Inlets in Subsurface Drains) provides the range of inches of water removed per the drainage area. Since the drainage system has surface inlets, Table 2 was used for capacity. For field crops in mineral soils the drainage coefficient would range from ½ to ¾" for Blind Inlets and ½ to 1" for Open Inlets. The existing and proposed system has open inlets so a ¾" drainage coefficient was used for capacity calculations.

Table 2
Drainage Coefficients
(Surface Inlets in Subsurface Drains)

Soil	Field Crops		Truck Crops	
	Blind Inlets (inches)	Open Inlets (inches)	Blind Inlets (inches	Open Inlets (inches)
Mineral	½ to ¾	½ to 1	¾ to 1	1 to 1½
Organic	½ to 1	½ to 1½	¾ to 2	2 to 4

Drainage capacity and velocity

The existing main was evaluated for capacity based on the watershed draining to each section of the main. Using a drainage calculator and inputs of existing tile size, tile slope and the watershed for each reach of tile it was determined that the tile main was providing a drainage coefficient of less than an 1/8”. Velocities in the existing tile were primarily above the recommended minimum of 0.5 ft/s except in two portions of the 10” and 12” main where the velocities were calculated at 0.35 and 0.4 ft/s.

Surface Inlets

Many surface inlets exist within the tile system. The suggestion that surface inlets may be allowing sedimentation of the tile system and reducing flow maybe a legitimate concern especially in areas where the velocity is below the minimum velocity of 0.5ft/sec. The NRCS standard suggests that blind inlets should only be used in areas where surface drainage will handle most of the flow. Since there is little to no surface drainage in the district the standard would not recommend blind inlets. The district may want to experiment with a water quality inlet which is intended to filter water before entering the drainage system. An example of a product is presented in Appendix E.

5. Alternatives

Split the Main into a North Main and a South Main

Splitting the main into a north and south main would provide use of some of the existing tile system. The concept was by reducing the drainage area for a north main much of the existing tile would be utilized for this main and get an increased drainage coefficient based on the drainage area reduction. The north main and south main concept would have drainage areas of 607 and 973 acres respectively. The existing 20” pipe at the outlet would only have a capacity to drain 282 acres at a ¾” drainage coefficient. The existing tile would only be providing a drainage coefficient of between ¼” and 3/8”. Therefore, this alternative was determined as not acceptable based on providing a ¾ inch drainage coefficient.

Replace the Main

A new main was sized based on a ¾” drainage coefficient. The proposed new main primarily follows the same route as the existing main and tile sizes ranged from 30” to 48” pipe. LiDAR data was used to estimate cover. The tile system was proposed with a 2 to 2.5 feet of cover minimum as the NRCS standard recommends 2 feet minimum cover. The tile was extended about 1000 feet downstream to provide a more effective outlet. Alternatively, the existing ditch could be dug deeper to provide an outlet but may require further waterway wetland permitting. The new main would require seven road crossings. Preliminary drawings for the Replace the Main alternative accompany this report.

Proposed sizing of the Laterals was estimated using the existing grades from the existing plans. Tile sizes ranged from 10” to 30”.

Add a Second Main with Inter Connections to Existing Main

Since the existing tile system is providing less than an 1/8” drainage coefficient adding a second main to achieve the ¾” drainage coefficient would require placing a parallel tile of the same size as the Replace the Main option. So this maybe considered a viable option but then the District would be accepting that the existing tile may be plugged or have lower than optimal velocities in the areas pointed out above which would limit drainage in these areas unless multiple interconnections are made. In concept this option may be considered an add on to the Replace the Main option as it would need to be determined if this would be a cheaper way of connecting the lateral and private tiles.

Replace the Main as an Open Ditch

Another option considered for comparison is installing an open ditch. While the Board suggested this would not be a popular option since the District farmers were used to farming with a tile system that did not affect farming operations or removed land from production, it seemed worth adding to the discussion as an alternative. An open ditch was laid out from the existing ditch starting at the next fence line beyond the District Boundary to Mueller Rd, then along the North side of Mueller Rd before crossing to the south side of Mueller Rd. Following Mueller Rd and crossing back to the north side of Mueller Rd and crossing Mueller at Norway Road and following Norway Road on the east side for a quarter of a mile. The ditch is conceptually proposed to be a 4ft bottom with 2:1 side slope with a minimum depth of 5 feet to allow depth for out letting drain tiles. Ditch capacity was calculated using the USGS Flood Frequency for the 10 year and 25 year storm event and a baseflow condition following criteria in ATCP 48. These calculations and depths are presented in the Appendix D. The depth of flow for the Q10 ranged from 2.3 to 3.4 feet while the Q25 ranged in depth from 2.5 to 3.7 feet.

The open ditch alternative would require three road crossings. Following the roadways does create deep cuts as the ditch is not necessarily in the lowest point in the landscape. The deepest cuts were 12-17 feet in depth. In these areas the it maybe economical to replace the ditch with sections of pipe to limit excavation.

Discussions could be made with the town on about placing the ditch partially in the Right of Way or what setback would be required from Mueller and Norway Rd. Discussions with affected landowners and the district on acquiring easements or land for the ditch. This was not factored into the cost at this time. The preliminary drawings for the Open Ditch concept accompany this report.

6. Costs

Replace the Main

The estimated cost for replacing the main is estimated to be $1,530,500. Replacing the laterals is estimated to be $344,250. This includes the piping and roadway repairs. It does not include connections to private tile or connections to the existing main.

Open Ditch

The open ditch concept involves excavation and spreading of 65,500 cubic yards of soil. This includes excavation and spreading the soil adjacent to the ditch and includes three road crossings with culverts. The estimated costs for construction of the Open Ditch is $701,000.

In the open ditch option, the cost for replacing the laterals should be included when comparing the option to replace the main option. As discussed previously the cost of acquiring land or adding piping for deeper cut sections is not included, but may be significant costs to the project. These costs will need to be evaluated if the District landowners determining that this option is viable.