July 25, 2016

Board of Managers
Buffalo-Red River Watershed District
PO Box 341
Barnesville, MN 56514

Subject: Wilkin County Ditch 7 Repair
T133N, R45W (Andrea Township), Wilkin County
HEI Project No. 1915_231

Dear Board of Managers:

Wilkin County Ditch 7 begins in the northwest corner of Section 22, T133N, R45W (Andrea Township) and runs south along the east side of 310th Avenue for 1 ¾ miles before crossing to the west side of 310th Avenue in Section 27. From there the ditch continues to run south along the west side of 310th Avenue for ¼ mile, then turns westerly and runs along the north side of 330th Street for 3 miles before outletting into Wilkin County Ditch 3, Lateral 2 at the section line separating Andrea Township from Nilsen Township. We recently collected and reviewed survey data for this ditch system. This letter report summarizes our review and repair recommendations for the ditch system.

Background
The establishment of Wilkin County Ditch 7 was originally petitioned for in June of 1906. The initial viewers report, dated December 6th, 1906, found that the expenses of the ditch exceeded the benefits, and the ditch was not constructed. In January of 1907 the viewer's report was amended to show increased benefits and the ditch was established and constructed in 1907. A petition for repair in 1953 led to some excavating/clearing work in the mid-1950's. Another petition for improvement was filed in February of 1972 and plans were created for grubbing/cleaning the ditch in 1973, as well as updating the drainage structures. This improvement was completed in 1973.

Drainage Area
The drainage area to the ditch was delineated using light detection and ranging (LiDAR) data and found to be approximately 9,300 acres (14.5 square miles). The general drainage pattern of the contributing area is to the south and west. A map showing the delineated drainage area is shown as Exhibit 1.
**Existing Ditch Condition**

The surveyed channel gradeline and cross sectional geometry was compared to the as-built channel information from the last ditch improvement in 1973. The 1973 improvement included reshaping the channel geometry to 3:1 horizontal to vertical side slopes and either a 10 or 12-foot bottom width. The condition of the ditch as it is today is described on a section by section basis from upstream to downstream as follows:

- **Section 22, Andrea Township**: Survey of the farthest upstream ditch mile shows an existing gradeline very close to the as-built gradeline from the 1973 project, which is approximately at a slope of 0.08%. However, the cross sections indicate that the field side slope of the ditch is steeper than 3:1 and the ditch bottom is less than the designed 10 feet. There are currently no inlet pipes in this mile as field swales drain straight to the ditch. Survey also indicates no vegetated buffer strip along this mile of the legal ditch.

- **Section 27, Andrea Township**: Survey of the ditch section between County Road 166 and where the ditch crosses 310th Avenue shows an existing gradeline very close to the as-built gradeline from the 1973 project, which is approximately at a slope of 0.09%. However, the cross sections indicate that the field side slope of the ditch is steeper than 3:1 and the ditch bottom is less than the designed bottom width. The 1973 as-builds show the design ditch bottom changes at the ¼ line from 10 to 12 feet wide. There are currently no inlet pipes in this reach as field swales drain straight to the ditch. A large field ditch with a drainage area of 2.5 square miles also enters WCD 7 approximately 430 feet upstream of where the ditch crosses 310th Avenue. A small headcut appears to be forming at the mouth of the swale outlet to Wilkin County Ditch 7. Survey also indicates no vegetated buffer strip along this stretch of ditch.

- **Section 28, Andrea Township**: After crossing 310th Avenue, WCD 7 runs south along the west side of 310th Avenue before turning westward and running along the north side of 330th Street. Survey in this stretch of the ditch indicates a gradeline consistently 1-3 feet below the as-built gradeline from the 1973 project. The as-built gradeline shows a slope between 0.14% and 0.16%, which is steeper than the design ditch slope upstream where the ditch grade has remained unchanged from the 1973 project. Cross sections throughout this stretch show field side slopes slightly steeper than the design 3:1, though less so than farther upstream reaches of the ditch. Existing inlet pipes convey runoff from field swales through the spoil bank on the north side of the channel. However, no vegetated buffer strip currently exists along the ditch in this stretch.

- **Section 29, Andrea Township**: The surveyed gradeline for this ditch mile is consistently 1 foot lower than the 1973 as-built ditch grade. The as-built ditch grade slope varies between 0.12% and 0.13%. The cross sections show field side slopes steeper than 3:1 and a ditch bottom less than the design 12 foot width. There are no field inlet pipes in this stretch of ditch since field drainage runs parallel with the ditch from east to west before outletting to
the County Road 15 road ditch, which runs south through a field approach culvert before outletting to WCD 7. Survey also shows no vegetated buffer strip for this reach of the legal ditch.

- **Section 30, Andrea Township:** Survey of the farthest downstream ditch mile shows an existing gradeline very close to the as-built gradeline from the 1973 project, which varies between 0.07% and 0.12%. However, the cross sections indicate that the field side slope of the ditch is steeper than 3:1 and the ditch bottom is less than the designed 12 feet. There are currently no inlet pipes in this mile since field drainage runs parallel to the ditch east to west before outletting to the 280th Avenue road ditch. An existing field approach and culvert are located at the outlet of the road ditch to WCD 7. Survey also indicates no vegetated buffer strip along this mile of ditch.

**Proposed Repair Features**

Multiple repairs are recommended for Wilkin County Ditch 7. The survey data shows that for the majority of the ditch the field side slopes are steeper than the design 3:1. Therefore, it is recommended that the ditch side slopes be excavated and pulled back to the design level on the field side of the ditch. Excavated material should be spoiled along the ditch in spoil banks. The spoil bank height will be at least 6 inches below the road shoulder elevation so as to protect from roadway overtopping during extreme events.

It also appears that the ditch has downcut 0-3 feet between where it crosses 310th Avenue and County Road 15. This stretch of ditch was constructed back in 1973 at a greater longitudinal slope (0.12% - 0.16%), potentially resulting in the downcutting. It is recommended that a series of four rock drop structures be installed through this reach in order to stabilize the ditch grade. The top of the rock drops will be approximately at the historic elevation and the maximum height will be 2.5 feet. Additionally, it is recommended that a one-foot tall rock drop structure be installed at the outlet of the large field drain in Section 27 so as to protect this waterway from future headcutting.

Field inlet pipes should be installed along the north-south stretch of the legal ditch in Sections 22 and 27, Andrea Township. The field inlet pipe sizes are based on their delineated drainage area to the ditch. Spoil from the side slope excavation should be used to create the embankment through which the inlet pipes extend. The ditch side of the field inlet pipes should be within 2 feet of the ditch bottom and flapgates should be installed so as to prevent backflow from the ditch up into the fields.

After the ditch side slopes are pulled back to the design 3:1 horizontal to vertical side slope, a 1-rood vegetated buffer (16.5 feet) is recommended to be installed from the field side daylight line of the ditch slope throughout the length of the legal ditch. This buffer is required to be installed by state law by November, 2018. Plans showing the proposed repair features have been included in this letter report as **Exhibit 2**.
Opinion of Probable Cost

Each of the repair features have been quantified and can be found in the Opinion of Probable Cost, which has been included in this letter report as Exhibit 3. The opinion of probable project construction cost is estimated to be $252,000. Approximately 13.0 acres of permanent easements will need to be obtained in order to establish the required 1-rod buffer strips along the ditch system. The Buffalo-Red River Watershed District Board of Managers will need to determine what, if anything, should be paid for this permanent as well as the temporary easement required for the repair construction.

Let me know if you have any questions or concerns.

Thank you.

Sincerely,

HOUSTON ENGINEERING, INC.

Erik S. Jones, PE

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Enclosure
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