

Drainage District No. 19 Main Tile

Preliminary Engineer's Report
Dickinson County, Iowa

August 13, 2024

Project No. 23-29501



Architecture
Engineering
Environmental
Planning
ISGinc.com

REPORT FOR:
Dickinson County
Board of Supervisors acting as
Trustees of Drainage District No. 19
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INTRODUCTION

Scope of Work

On June 20, 2023, a petition was filed with the Dickinson County Board of Supervisors requesting that the Drainage District No. 19 (DD19) Main Tile (MT) be investigated for improvement. The Board of Supervisors accepted the petition on June 27, 2023 and appointed ISG to perform an investigation and to report findings. As part of the preliminary investigation, a desktop and field review of District records, facilities and previous projects was completed, a watershed for the DD19 Main Tile was developed and existing drainage capacity was evaluated. Additionally, a multipurpose drainage management plan (MDM Plan) was developed. On December 19, 2023, an informational landowner meeting was held and the Board of Supervisors directed ISG to complete a preliminary engineer's report, including design options, preliminary cost estimates, and results of hydraulic & hydrologic modeling. After this meeting, the trustees directed ISG to proceed with the evaluation and prepare a preliminary engineer's report with improvement options for the DD19 Main Tile.

Location + District Facilities

WATERSHED

The DD19 MT drains approximately 3,836 acres. Its watershed is characterized by lightly rolling hills, and multiple low areas with an elevation difference of approximately 132 feet across the entire watershed. The predominant land use within the watershed is agricultural row crops. There are several wetlands within the DD19 MT watershed that have been identified by the National Wetland Inventory. The outlet of the Main Tile into the DD19 Main Open Ditch is in the NE ¼ of Section 25 of Excelsior Township.

The predominant hydrologic soil type in the system's watershed is type "C/D," which is considered a dual hydrologic soil group, a wet soil that has the potential to be adequately drained. The "D" in this group corresponds to the soil having over 40 percent clay and restricted water movement. The "C" signifies the soil in its drained condition. C/D soils such as those found in DD19 are typical of drainage districts throughout Iowa as they require intensive artificial drainage to be productive for agricultural use.

MAIN TILE

The Main Tile of Drainage District No. 19 outlets into the DD19 Main Open Ditch in the SW ¼ of the NE ¼ of Section 25 of Excelsior Township. The Main Tile is approximately 25,800 feet long, traversing Sections 25, 24, 23, 26, 27, 34, and 33 of Excelsior Township, ending in the NE ¼ of the NE ¼ of Section 33, just after crossing 130th Avenue. The diameter of the tile ranges from 38 inches to 14 inches, with approximate burial depths ranging from 5 to 12 feet laid at a grade of 0.08% to 0.5%.

SURFACE WATERWAY

As mentioned previously, DD19 has incorporated a surface waterway to help relieve some capacity for subsurface drainage in the Main Tile watershed. This surface waterway generally follows the alignment of the Main Tile as described in the previous subsection. Documents from 1995 show the District waterway extending through Section 25, ending at 190th Street. According to historical records, the surface waterway was constructed privately through Sections 24 & 23 and is not a district facility.

INVESTIGATION

History Summary

Based on county records, Drainage District No. 19 was established in 1914. A Main Open Ditch cleanout was completed for the District in 1975, and again in the mid 1980's. In 1984, a full reclassification of the District was completed. A proposed surface channel improvement for the District was proposed in 1985, but was not completed. 10 years later, in 1995, a petition was filed

for investigation of drainage in Section 25 of Excelsior Township, also within the Main Tile watershed. This petition resulted in a waterway improvement project in 1996 for portions of Sections 24 and 25. The reclassification and annexation of additional lands for the Main Tile followed in 1997. Between 1997 and 2012, miscellaneous repairs and preventative maintenance were performed. In 2017 a partial reclassification of benefits for some branches of DD19 was completed.

Extensive records exist for Drainage District No. 19. These records range from one-sentence correspondences between the contractor and engineer in 1914 during original construction, to plan and profile sheets from 1995, and contain many iterations of reports, addendums, etc. Many of these documents were determined to be inconsequential to the scope of ISG's preliminary investigation. Although ISG made every effort to review documentation and gather all relevant information effectively and efficiently, some information on District Facilities was unable to be procured or was found to be incomplete. However, ISG is confident that all information necessary for preliminary investigation has been obtained or supplemented by investigation methods described in the investigation summary.

Survey + Field Review

A field review of the DD19 Main Tile watershed was completed in July of 2023. The field review included visual review of the watershed topography, land use, current drainage conditions, and a visual review of existing drainage facilities where applicable. Additionally, a drone flight of the district facilities was completed in October of 2023, and May of 2024.

During site visits and drone flights in the spring and summer of 2024, multiple areas of significant drown out and flooding were identified. Specifically, the petitioned area, the West 1/2 of the Southeast 1/4 of Section 23 is subject to consistent and significant drown outs. Multiple additional areas along the DD19 Main Tile alignment were also identified as subject to drown

out and crop loss. Drone photos displayed below provide a visual of the extents of drown out on May 9th of 2024. Additionally, a LiDAR drone topographic survey, completed in early 2024, gathered ground elevation data of the existing surface channel. This information was utilized in calculating the capacity of the existing channel and the amount of excavation need to improve the channel.



Figure 2: West 1/2 of the Southeast 1/4 of Section 23



Figure 1: Southeast 1/4 of the Northwest 1/4 of Section 24



Figure 3: Southwest 1/4 of the Northwest 1/4 of Section 24

Tile Condition & Capacity Evaluation

DD19 MAIN TILE CONDITION

The DD19 Main Tile (MT) was observed on a limited basis through surface intakes and generally appeared to be functional. There were no obvious locations of concentrated wetness or blowouts indicative of tile blockages or collapses found. However, the tile is over 100 years old, so some failures within the system should be expected. To better document and understand the existing condition of the DD19 Main Tile, televising with a pipe crawler would be necessary.

DD19 MAIN TILE CAPACITY

Standards for agricultural drainage recommend a tile facility to be sized to drain a minimum of 1/2" of runoff from the lands in the watershed in a 24-hour period, when the lands have insufficient natural surface relief (1/2" Drainage Coefficient). DD19 has a history of incorporating surface drainage to supplement subsurface drainage. Improvement projects have taken place to provide drainage relief to the DD19 MT watershed via surface flow through grassed waterways and surface channels, primarily in the lower portion of the DD19 MT watershed. However, based on our preliminary evaluation, we have found the lands within the watershed of DD19's Main Tile to currently have insufficient surface drainage and require a 1/2" coefficient, unless surface drainage is improved. If adequate surface drainage was provided to the petitioned lands via an improved surface waterway, a 3/8" drainage coefficient may be adequate. The existing tile capacities of the DD 19 Main Tile are consistently below standard. The average of the existing tile capacities is approximately 1/5" per day or 40 percent of the recommended coefficient. The most restrictive sections are as low as 1/6" per day or 33 percent of the recommended coefficient. A detailed summary of the existing capacity of the DD19 Main Tile is included within Appendix B.

Surface Channel Condition & Capacity Evaluation

SURFACE CHANNEL CONDITION

The existing DD19 Surface Waterway was observed at multiple road crossings along its alignment as well as via drone video and photos. The grade and cross section of the channel were also defined through the topographic LiDAR Drone Survey. In Section 25, between 190th street and the bulkhead of the DD19 MOD, the waterway is well defined and appears to generally be functioning and in good condition with limited sedimentation. The private portion of the surface channel, upstream of 190th street (County Road A22) in Section 24, is still defined and in fair condition until Branch 294. Upstream of Branch 294, the channel becomes less defined and is obviously silted in. The condition of the surface waterway generally continues to degrade further upstream in the watershed. For a short stretch in Section 23, the waterway is no longer visible and is actively cultivated and farmed. It is apparent from field review that at least some portions of surface channel are in a state of disrepair and not functioning as originally designed.

SURFACE CHANNEL CAPACITY

The DD19 surface waterway, improved in the late 1990's, existing from DD19's MOD north to 190th street (County Road A-22), appears to be in acceptable condition and provides sufficient capacity with limited sedimentation based on our survey and review.

The remaining portion of the surface waterway, privately constructed in the late 1980's, from 190th street (County Road A-22) just south of Branch 277 to 140th Ave just south of Branch 403, appears to be in disrepair along much of its length due lack of a defined channel. From our survey and review, it is obvious that the private channel has silted in significantly and is no longer providing sufficient surface relief.

Outlet Analysis

The Drainage District 19 Main Tile (MT) outlets into the Drainage District 19 Main Open Ditch (MOD) in the NW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 25 of Excelsior Township. Under existing conditions, the DD 19 MOD has the required capacity to carry flow from the DD19 MT watershed. The proposed improvements would increase the flows from the DD19 MT watershed. Review of the existing condition, grade and cross section of the DD 19 MOD, found its current “bank full” capacity is approximately 1200 CFS (cubic feet per second). This capacity is capable of accommodating flows from Improvement Options 1 and 2 up to 100-year storm event without erosive velocities. Improvement Option 3 peak flows are nearly double the other options. These flows may not be contained in shallower sections of the existing DD 19 Main Open Ditch. If Improvement Option 3 is pursued, further analysis and consideration of the existing DD19 MOD capacity and outlet adequacy is needed. Some accommodations for peak flow, such as alternative side intakes or constructed storage ponds should be considered to limit the downstream impacts of the proposed improvements. Refer to the Storage section of this report for specifics. For further specifics on system hydraulics and capacities, refer to appendices A & B.

HYDROLOGIC ANALYSIS + MODELING

Modeling Summary

A detailed 2-dimensional hydrologic and hydraulic model utilizing Infoworks ICM was completed for the existing DD19 Main Tile watershed and the proposed drainage improvement options. The 5-, 10-, 50-, and 100-year storm events were modeled with a 24-hour duration. The respective rainfall depths for these storm events are shown in Table 1 below.

Table 1. Rainfall Depths

Return Period	Rainfall Depth (in)
5-Year	3.67
10-Year	4.39
50-Year	6.45
100-Year	7.48

The model showed that peak flows increase between the existing system and the proposed improvements. Iowa Drainage law does not prohibit peak flow increases, but additional analysis was completed to determine that the DD19 Main Open Ditch will continue to serve as a stable outlet for the Tile improvement options even with increased peak flows. Shown in Table 2 below is a comparison of peak flows for the existing versus the proposed peak flowrates at the DD19 Main Tile outlet. For peak flow specifics for Improvement Option 3, refer to the detailed hydraulic analysis in Appendix C.

Table 2. Peak Flow Comparison

Event	Existing (cfs)	Proposed Option 1 (cfs)	Proposed Option 2 (cfs)
5-Year	144.02	195.89	278.12
10-Year	217.48	258.66	342.08
50-Year	405.11	450.47	523.95
100-Year	451.93	532.04	596.24

Figure #4 is an example of the flooding results of Infoworks ICM for the DD19 Main Tile. Detailed modeling results and discussions related to the Hydrologic and Hydraulic (H&H) analysis of the DD19 MT system can be found in Appendix C. It was found that the proposed improvement options generally reduce the area and time of flooding within the District.

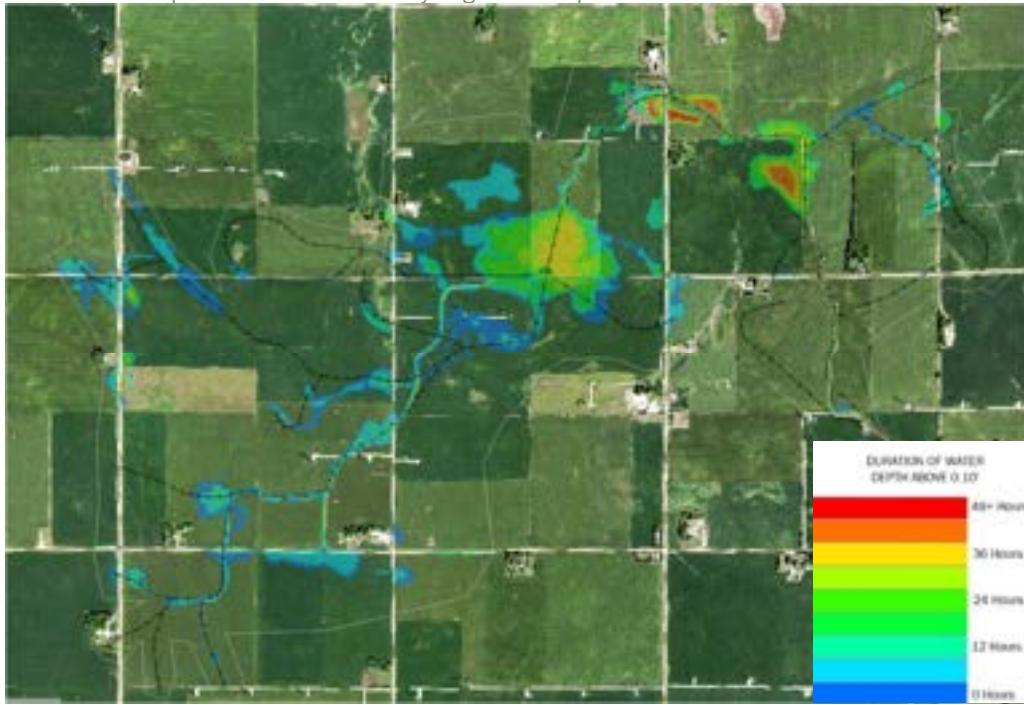


Figure 3. Existing 10-Year Innundation Map

PROPOSED IMPROVEMENTS

Based on current standards for agricultural drainage, the capacity of the existing DD19 facilities are inadequate. Much of DD19 currently has a drainage coefficient of 0.2 inches per day or less. With improved surface relief, such as a surface waterway or open ditch, a drainage coefficient such as a 3/8" coefficient may be adequate. Without surface drainage improvement, a minimum of a ½-inch drainage coefficient is recommended for agricultural drainage. To meet these standards, the capacity of the system must be increased by modifying the tile alignment, grade, and size; cleaning out the existing surface channel; or by extending the DD19 Main Open Ditch. A variety of improvement options were considered, including standalone tile improvements, partial tile improvements, surface channel cleanouts & improvements, open ditch cleanouts and improvements, and wetlands or storage ponds. Standalone tile improvements were found to provide little benefit for their high costs. Ultimately, to address the drainage issues within the petitioned areas, surface drainage must be improved. Any potential tile improvements should be paired with surface drainage improvements to make a significant impact on flooding and drown out within the DD19 MT watershed. Summarized below are three different potential improvement options that would provide the petitioned drainage relief. Although Right-of-Way exists for the existing district surface channel, additional Right-of-Way will need to be acquired for all options.

Option 1: Surface Channel Cleaning + Extension with Partial Tile Improvement

Option 1 includes limited cleaning of the existing district surface channel in Section 25 and more extensive improvement of the existing private surface channel to a 24-foot bottom, 2 to 1 side slopes, at a grade of 0.1 percent. The headwall drop structure at the surface channel outlet into the DD19 MOD would also be removed and replaced. The proposed improvement extends the surface channel through petitioned lands in the SW ¼ of the SE ¼ of Section 23 of Excelsior Township. The cleaning and deepening of the surface channel would result in the existing DD19 Main Tile becoming exposed or very shallow in locations that it crosses the surface channel within Section 23. If exposed or shallowed, it is likely that the 100-year-old tile would fail and collapse. Therefore, to complete the surface drainage improvements and still maintain subsurface drainage, the existing Main Tile would also be replaced and improved from Branch 371 to the road crossing at 150th Avenue. The proposed tile improvement

would follow a similar alignment with minor changes compared to the existing to maintain minimum cover. The improved DD19 Tile through this section would be 42-inches, sized for a 3/8" drainage coefficient in consideration for improvement of the remainder of the system in the future. The tile and surface channel alignments often cross each other resulting in limited cover. To address the limited cover areas, a more durable pipe material, such as polypropylene or reinforced concrete, would be utilized with granular backfill ensure long term stability of the DD19 Main Tile. A plat displaying the location of these improvements is included within Appendix E.

Option 2: Surface Channel Cleaning + Extension with Full Tile Improvement

This option purposes the same surface channel cleaning and extension as described above in Option 1. Option 2 includes a more complete improvement of the Main Tile from Branch 371 to the outlet at the DD19 Main Open Ditch. The proposed tile improvement sizing would follow a 3/8" drainage coefficient with the tile from Branch 371 to Branch 325 being improved to a 42-inch pipe, and from Branch 325 to the outlet improved to a 48-inch pipe. The drainage calculations included in Appendix B provide a detailed summary of proposed capacity. The headwall drop structure at the surface channel outlet into the DD19 MOD would also be removed and replaced. This option includes the similar considerations as Option 1 regarding minimum cover above the improved tile. A plat displaying the location of these improvements is included within Appendix E.

Option 3: 2-Stage Ditch Extension

Option 3 includes replacing the existing DD19 Main Tile with an open ditch. The proposed 2-stage ditch improvement would generally follow the alignment of the existing surface channel and provide both surface and subsurface drainage, essentially extending the existing DD19 Main Open Ditch. The ditch extension would extend to the petitioned lands in the SW ¼ of the SE ¼ of Section 23 of Excelsior Township. The new 2-stage ditch has a proposed cross-section with a 4-foot bottom, a 6-foot deep first stage at 1.5: 1 side slopes, an 8-foot bench on each side, and 2:1 side slopes to surface. This option requires a wider right of way and easement than Options 1 and Option 2. It is proposed that the existing DD19 Main Tile will either outlet into the proposed channel, be removed or abandoned. DD19 Branch Tiles would be outlet into the new Open Ditch. Alternative side inlets (ASI) and saturated buffers would be considered in lieu of traditional tile outlets and surface pipes for water quality benefits and external project funding.

Storage Consideration

During evaluation of the proposed improvement options, consideration was given to the incorporation of storage within the DD19 Main Tile watershed. The incorporation of storage into drainage systems has many benefits including reducing peak flows during rain events, nutrient reduction, providing wildlife habitat. Proposed storage locations are typically in existing surface depressions where crop production is generally marginal. Oftentimes, cost share is available for the construction of storage facilities due to their benefits, and downstream District facilities can be downsized. Sometimes this can create financial benefits for Drainage Districts.

Preliminary evaluation showed that financial drainage benefit resulting from the incorporation of storage into the above proposed options would be minimal on a District-wide scale. This is mostly due to storage potential for a large wetland or pond being limited by the depth of the Main Tile. The petitioned area is one of the largest areas of potential wetland or storage development, and could be pursued in drainage improvement is not pursued. However, we encourage the landowners of this District to consider multi-purpose drainage management, which incorporates Best Management Practices (BMPs) to utilize effective measures aimed at reducing sediment and nutrient loading and improving water quality. Many BMP's such as wetlands, ponds, and alternative side inlets, as described above, incorporate storage and provide benefit to the District by slowing down water and reducing peak

flows during rain events. A Multipurpose Drainage Management (MDM) Plat Map showing potential BMP locations can be found in Appendix E. If there is interest in pursuing a wetland development or storage pond, external funding could be secured to offset additional costs.

Funding options are available to landowners for BMPs through the Environmental Quality Incentives Program (EQIP) and the Iowa Water Quality Initiative. EQIP is a voluntary program that provides financial assistance to individual landowners for various conservative practices as identified above. Also, the State of Iowa, through the Iowa Water Quality Initiative, provides cost share funds to participating landowners to voluntarily install nutrient reduction practices.

Dickinson County Secondary Roads

The DD 19 Main Tile & Surface Channel facilities cross 2 secondary roads, 150th Avenue in the Southeast ¼ of Northeast ¼ of Section 23, and 190th Street in the Southwest ¼ of the Southeast ¼ of Section 24. Each of the proposed improvement options would also cross these roadways, therefore the existing road culverts and/or tile within road Right-of-way (ROW) would be considered for improvement or replacement. Option 1 would require that the culvert at 150th Avenue be lowered to the improved grade of the surface channel. Option 2 would also require the 150th Avenue culvert be lowered and the DD19 MT replaced across the road ROW at both 150th Avenue and 190th Street. Option 3 would require culvert improvements at both 150th Avenue and 190th Street. Iowa Law (code section 468.108) requires that the cost of crossing a secondary road or public highways be paid for from the appropriate road funds. It will be the County Engineers' decision as to the method of installation for these crossings. The Dickinson County Engineer may choose to separately contract the crossing work. If the work is to be included in the District project under one construction contract, the District shall be reimbursed for the cost of construction by the appropriate road fund. Once a preferred improvement option is identified, ISG will coordinate with the Dickinson County engineer regarding the proposed work at each road crossing.

Opinion of Probable Cost

As part of the evaluation, a preliminary opinion of probable costs was developed for each of the options discussed above. The preliminary cost estimates are based on the improvements described above and associated work. These estimates, which are summarized in the table below, represent our best judgement of the probable cost based upon our experience with similar projects. The quantities and unit costs for construction are believed to be reasonably accurate for use in this report. Actual costs are subject to the market for the respective components and to other economic forces. These estimates carry no actual or implied guarantees. Preliminary itemized cost estimates for the improvement options are included within Appendix D. Additional cost estimates for alternative improvement options can be developed at the request of the landowners of the district.

Table 3. Preliminary Opinion of Probable Cost

Improvement Option	Estimated Construction Cost	Average Cost Per Ace
Option 1: Surface Channel Cleaning + Extension with Partial Tile Improvement	\$1,403,139	\$366
Option 2: Surface Channel Cleaning + Extension with Full Tile Improvement	\$3,306,643	\$862
Option 3: 2-Stage Ditch Extension	\$1,302,526	\$340

ANNEXATION + RECLASSIFICATION

Annexation

As part of the investigation, ISG mapped the watershed boundary of the DD19 Main Tile using LiDAR data, aerial photography, and District plat maps to determine the lands which drain by surface and/or subsurface to the District. This information was compared to historical data and the current assessment schedule. From this, it was concluded that the current assessment schedule includes all lands the benefit from the DD19 Main Tile and no annexation is necessary.

Reclassification

If an improvement option is selected, reclassification of the district should be considered to better determine each landowners' portion of the cost for the proposed improvement project. Since reclassification of a District determines each parcels' benefit, the reclassification will vary depending on the selection of improvement option. Landowners may benefit differently from a surface channel and Main Tile Improvement than they would with an Open Ditch extension. ISG has developed a methodology for reclassification that incorporates model results from the ICM model developed and discussed above. Since the model is mostly developed, and just needs refining based on the selected improvement option, this may result in some cost savings for the District in comparison to more traditional reclassification methodologies. If desired, ISG can open a discussion on the proposed methodology, and would also be able to complete a preconstruction reclassification for the District as well.

PERMITTING

Conservation Reserve Program (CRP) and Farm Service Agency (FSA).

The proposed tile options cross one parcel of land within the watershed out of crop production and potentially in a Conservation Reserve Program (CRP). If the land within the watershed is in CRP, construction may disturb portions of this reserve land and it will be the landowner's responsibility to notify the Farm Service Agency (FSA) about the project and temporary soil spoil being placed on their ground. In April 2023, the Iowa FSA issued a memo stating any disturbance to existing CRP during the primary nesting season must be permitted through the State FSA office. This permit must be applied for by the individual landowner, therefore coordination between the landowner, ISG, and the Drainage District will be crucial to ensure no delays in construction. The FSA will need to permit the work and approve a continuation of their contracts. Each landowner will be responsible for reseeding their grounds according to their contracts after the completion of the District's improvement project. The landowners will be eligible to claim damages for reseeding any portion of their ground affected by the proposed tile improvement project.

Jurisdictional Wetlands

The USDA Farm Program includes wetland conservation compliance "swampbuster" provisions administrated by the Natural Resources Conservation Service (NRCS). These rules and policies require that the lost functions, values, and area of each converted (better drained) farmed wetland be replaced (mitigated). Under Part 12 of Title 7 of the Federal Regulations, "activities of a water resource district, drainage district, or similar entity will be attributed to all persons within the jurisdiction of the district or other entity who are assessed for the activities of the district or entity. Accordingly, where a person's wetland is converted due to the actions of the district or entity, the person shall be considered to have caused or permitted the drainage."

The United States Army Corps of Engineers (USACE) in conjunction with the United States Environmental Protection Agency (USEPA) also have jurisdiction of wetlands under the Federal Clean Water Act, Section 404. However, for the wetlands to be

jurisdictional, they must be connected to waters of the United States and not isolated wetlands. A review of the USFWS Wetland Mapper shows any potential wetlands that could be impacted by the proposed improvement options would be isolated wetlands. Therefore, we do not expect there to be wetlands under the USACE jurisdiction.

If one of these improvement options is approved, impacts to the wetlands need to be considered under the swampbuster rules of the USDA. To verify no farmed wetlands would be impacted, the NRCS requires all lands in the watershed must have a wetland determination completed prior to any construction of an improvement by the District. The landowners or their tenants are the only individuals able to request these determinations. If any of the options proposed are approved, all landowners will be asked to provide a certified wetland determination for their land. If landowners do not have wetland determinations, certified wetland determinations can be requested by signing a 1026 form at the Dickinson County FSA office. If these determinations cannot be completed in a timely manner, the District may choose to complete 3rd party wetland determinations to expedite permitting. Based on a preliminary review, there is at least one potential wetland under swampbuster jurisdiction that would be traversed by the proposed improvements.

Other Permitting Considerations

As part of the project evaluation and preliminary design, ISG has completed a due diligence evaluation of potential project permitting requirements. If any of the proposed options are approved and the project proceeds, additional consideration and research will need to be given to US Fish & Wildlife Service (USFWS) Endangered Species, State Historical Preservation Office (SHPO) and Iowa Department of Natural Resources (DNR) regarding the permitting requirements, if any, related to this project.

Water Quality

The hydrologic impacts to tile drainage entail a complex interaction of processes dependent upon landscape, climatic and human influences, watershed scale, soil permeability and rainfall event size. There is a popular and often accepted idea an increase in subsurface drainage facilities adds to an increase in both peak and total rainfall values thereby increasing flooding. Recently published research from the University of Iowa's IIHR – Hydroscience and Engineering Center refutes that perception. This University of Iowa report was the result of a water model study of the Clear Creek Watershed in Iowa and Johnson Counties and found an increase in field tile and subsurface drainage decreases peak flows for most storm events. The field scale DRAINMOD model was used in the research in conjunction with a simplified routing equation to analyze the impact of tile drains in the Clear Creek Watershed.

However, additional steps are required to slow, impound, or infiltrate water to receive benefits in water quality. Water quality is a growing topic throughout the nation and more recently throughout Iowa. The particle loads and nutrient levels within drainage water is a concern receiving increased scrutiny. Processes and reduction practices are being developed and incorporated on farms and into projects throughout Iowa which reduce nitrogen loss and improve water quality. Enhancement of water quality is possible through many different drainage applications, seeing both immediate and long-term benefits.

We encourage the landowners of this District to consider multi-purpose drainage management, which incorporates Best Management Practices (BMPs) to utilize effective measures aimed at reducing sediment and nutrient loading and improving water quality. Funding options are available to landowners through the Environmental Quality Incentives Program (EQIP) and the Iowa Water Quality Initiative. EQIP is a voluntary program that provides financial assistance to individual landowners for various conservative practices as identified above. Also, the State of Iowa, through the Iowa Water Quality Initiative, provides cost share funds to participating landowners to voluntarily install nutrient reduction practices.

DISCUSSION + RECOMMENDATIONS

Our investigation confirms the need for drainage relief in the DD19 Main Tile Watershed. Therefore, we recommend that one of the proposed improvement options be completed to provide surface and subsurface drainage relief. The improvement options included within the report were intended to provide “levels” of investment into the DD19 infrastructure, based on the landowner’s support. Additional improvement options or ideas can be studied at the request of the district. Additionally, even though storage was not determined to provide any significant economic benefit to the district, ISG recommends that the District research funding opportunities for water quality Best Management Practices “BMPs” and dependent on funding and interest, implement said BMPs into the selected improvement option. As a next step, ISG recommends that the Dickinson County Supervisors, as trustees of DD19, tentatively accept this report as filed, and schedule and hold an informational meeting with landowners to discuss the improvement options and water quality opportunities. Based on input received at the informational meeting, ISG would modify and finalize this report, with preliminary plans for the improvement option(s) of interest and file a final engineer’s report.

Appendix A: Petition

DRAINAGE PETITION

TO THE BOARD OF SUPERVISORS OF Dickinson COUNTY, IOWA:
The undersigned ask that a drainage study of improvement of the Drainage District 19 Main Tile
commencing at the NW-SE Section 25 of Excelsior TWP

and running thence North approximately 1 mile to the middle of Section 24, then West 3/4 mile into
the SW - NE of Section 23 and then South approximately 1/2 mile

and terminating at the junction of Branch 371 in the SW-SE of Section 23 of Excelsior TWP

be Improved for Drainage Relief

Your petitioners further state that the lands situated in Sections 23 and 24 of Excelsior TWP

are subject to overflow (or are too wet for cultivation or subject to erosion or flood danger), and the public benefit, utility, health, convenience and welfare will be promoted by the above mentioned project.

NAMES

NAMES

____ We further request that ISG be appointed as civil engineer to ____
____ complete this study of improvement. We have worked with ISG ____
____ previously and they have completed multiple improvement ____
____ studies and projects involving my land in Osceola County ____

Goodwin Sonstegard

Goodwin Sonstegard (Jan 22, 2023 09:45 CDT)

Goodwin Sonstegard, Landowner
and managing partner for
Sonstegard Family Farms

Appendix B: Drainage Calculations

Drainage District 19 Main Tile

Area	STA	Existing Size (in)	Existing Slope (%)	Drainage Area (Acres)	Existing Tile Drainage Coefficient (in/day)	% of 0.5" Drainage Coefficient	Surface Waterway Capacity (cfs)
MOD (STA 234) to Br 238	0+00	38	0.12%	3835.4	0.18	36.0%	10.30
Br 238 to STA 248	4+00	38	0.12%	3705.3	0.19	37.2%	10.30
STA 248 to STA 249	14+00	38	0.10%	3686.6	0.17	34.2%	406.00
STA 249 to STA 250	15+00	38	0.14%	3686.3	0.20	40.4%	287.15
STA 250 to Br 259	16+00	38	0.12%	3686.0	0.19	37.4%	266.22
Br 259 to Br 277	25+00	38	0.12%	3624.0	0.19	38.1%	491.84
Br 277 to Br 294	43+00	38	0.12%	3579.7	0.19	38.6%	18.13
Br 294 to STA 299	60+00	36	0.12%	3114.7	0.19	38.4%	12.32
STA 299 to STA 300	65+00	36	0.08%	3082.0	0.16	31.7%	12.32
STA 300 to STA 301	66+00	36	0.16%	3081.7	0.22	44.8%	12.32
STA 301 to Br 325	67+00	36	0.12%	3081.4	0.19	38.8%	12.32
Br 325 to STA 370	91+00	34	0.12%	2901.3	0.18	35.4%	6.12
STA 370 to Br 371	136+00	34	0.11%	2343.9	0.21	41.9%	6.12
Br 371 to STA 390	137+00	30	0.20%	1962.3	0.24	48.3%	43.54
STA 390 to Br 398	156+00	28	0.40%	1896.1	0.29	58.9%	43.54
Br 398 to Br 403	164+00	26	0.40%	1717.6	0.27	53.3%	74.51
Br 403 to STA 419	169+00	20	0.40%	998.9	0.23	45.5%	61.17
STA 419 to STA 420	185+00	20	0.30%	944.4	0.21	41.7%	-
STA 420 to STA 421	186+00	20	0.40%	943.8	0.24	48.2%	-
STA 421to STA 422	187+00	20	0.50%	943.1	0.27	53.9%	-
STA 422 to STA 438	188+00	20	0.40%	942.6	0.24	48.3%	-
STA 438+00 to Br 457	204+00	18	0.30%	873.1	0.17	34.1%	-
BR 457 to STA 467	223+00	16	0.30%	435.2	0.25	49.9%	-
STA 467 to Br 479	233+00	16	0.50%	412.9	0.34	67.9%	-
Br 479 to Br 485	245+00	15	0.50%	254.8	0.46	92.7%	-
Br 485 to STA 499	251+00	14	0.50%	158.6	0.62	123.9%	-

**Dickinson County
Drainage District No. 19**



PROPOSED OPTION #1 TILE SUMMARY

Area	Existing Size (in)	Proposed Size (in)	Existing Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	Existing Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
150th Ave to STA 370	34	42	0.12%	0.15%	2901.3	0.18	0.35
STA 370 to Br 371	34	42	0.11%	0.15%	2343.9	0.21	0.43



PROPOSED OPTION #2 TILE SUMMARY

Area	Existing Size (in)	Proposed Size (in)	Existing Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	Existing Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
MOD (STA 234) to Br 238	38	48	0.12%	0.12%	3835.4	0.18	0.34
Br 238 to STA 248	38	48	0.12%	0.12%	3705.3	0.19	0.35
STA 248 to STA 249	38	48	0.10%	0.12%	3686.6	0.17	0.35
STA 249 to STA 250	38	48	0.14%	0.12%	3686.3	0.20	0.35
STA 250 to Br 259	38	48	0.12%	0.12%	3686.0	0.19	0.35
Br 259 to Br 277	38	48	0.12%	0.12%	3624.0	0.19	0.35
Br 277 to Br 294	38	48	0.12%	0.12%	3579.7	0.19	0.36
Br 294 to STA 299	36	48	0.12%	0.10%	3114.7	0.19	0.38
STA 299 to STA 300	36	48	0.08%	0.10%	3082.0	0.16	0.38
STA 300 to STA 301	36	48	0.16%	0.10%	3081.7	0.22	0.38
STA 301 to Br 325	36	48	0.12%	0.10%	3081.4	0.19	0.38
Br 325 to STA 370	34	42	0.12%	0.15%	2901.3	0.18	0.35
STA 370 to Br 371	34	42	0.11%	0.15%	2343.9	0.21	0.43

Channel Report

DD19 Existing Main Open Ditch

Trapezoidal

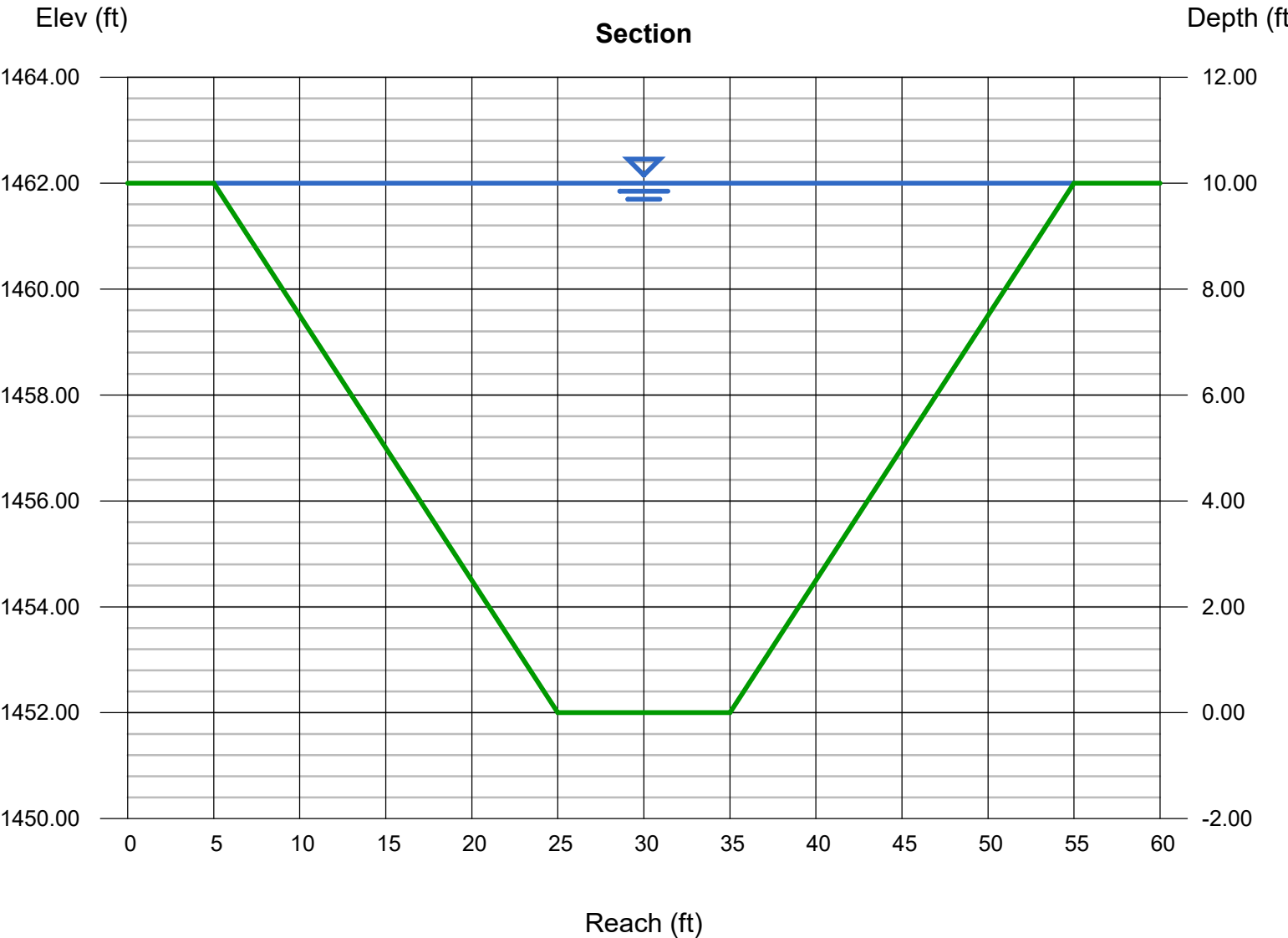
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 10.00
Invert Elev (ft)	= 1452.00
Slope (%)	= 0.10
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 10.00
Q (cfs)	= 1,253
Area (sqft)	= 300.00
Velocity (ft/s)	= 4.18
Wetted Perim (ft)	= 54.72
Crit Depth, Yc (ft)	= 5.52
Top Width (ft)	= 50.00
EGL (ft)	= 10.27



Channel Report

Proposed DD19 2-Stage Ditch Cross Section

User-defined

Invert Elev (ft) = 1448.00
Slope (%) = 0.10
N-Value = Composite

Calculations

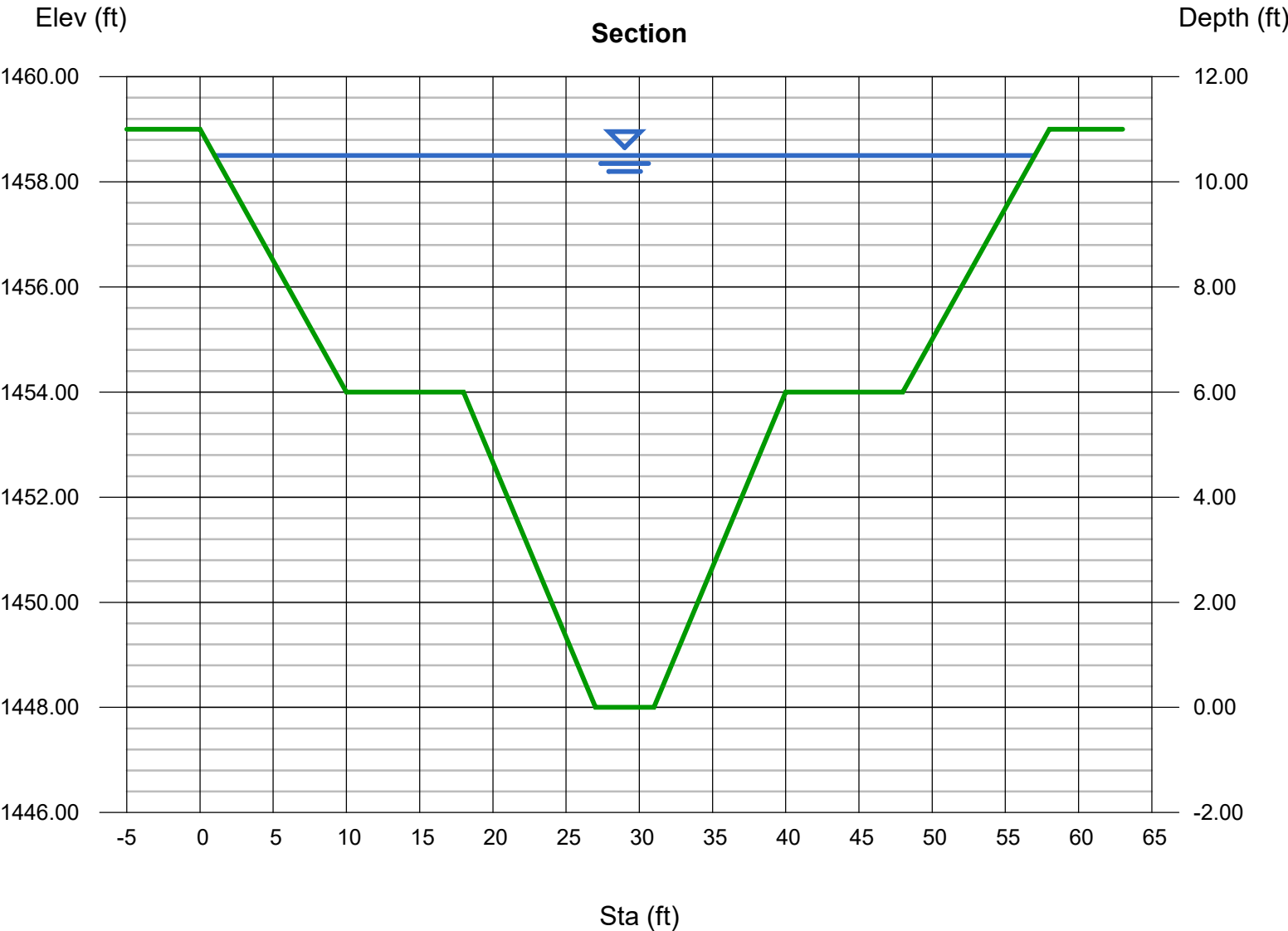
Compute by: Q vs Depth
No. Increments = 22

Highlighted

Depth (ft) = 10.50
Q (cfs) = 1,091
Area (sqft) = 289.50
Velocity (ft/s) = 3.77
Wetted Perim (ft) = 61.76
Crit Depth, Yc (ft) = 6.95
Top Width (ft) = 56.00
EGL (ft) = 10.72

(Sta, El, n)-(Sta, El, n)...

(0.00, 1459.00)-(10.00, 1454.00, 0.035)-(18.00, 1454.00, 0.035)-(27.00, 1448.00, 0.035)-(31.00, 1448.00, 0.035)-(40.00, 1454.00, 0.035)-(48.00, 1454.00, 0.035)-(58.00, 1459.00, 0.035)



Appendix C: Hydraulics + Hydrology Report

Dickinson County Drainage District No. 19 Hydrology Report

The logo for ISG (Infrastructure Systems Group) is located in the top right corner. It consists of the letters "ISG" in a white, sans-serif font, centered within a dark gray square.

PROJECT OVERVIEW

The Drainage District No. 19 (DD19) Main Tile improvement proposes to increase the tile capacity and/or surface drainage capacity of the Main Tile watershed. For more information on the existing system or proposed improvements please refer to the DD19 Preliminary Engineer's Report. The capacity of the system must be increased by modifying the tile alignment, grade, and size and cleaning out the existing surface channel, or by extending the DD19 Main Open Ditch. Four different potential options have been analyzed and are listed below:

- Option 1: Surface Channel Cleaning + Partial Tile Improvement
- Option 2: Surface Channel Cleaning + Full Tile Improvement
- Option 3: Two-Stage Ditch Extension
- Option 4: Wetland Development or Storage

Preliminary analysis of Option 4 indicated that there would be minimal benefit to the District with the incorporation of a wetland or storage, therefore no ICM model was completed. If landowners are interested in incorporating storage or water quality components into the Drainage District No. 19, improvements an ICM model can be completed by ISG at the District's request. A fifth option of a full tile Improvement (no surface channel cleanout) was modeled in ICM, but benefit to the District was minimal. Photos of results are shown in this report, but analysis is not included due to the high cost and low benefit of this option. Since the project is still in the preliminary planning stage, the ICM model results discussed within the report are not final but are rather to inform landowners in the decision-making process as to which design option(s) they would like to pursue. The analysis and modeling in this report was completed within the Infoworks ICM software (ICM). Model calibration was done through site visits, drone flights, and landowner testimony.

MODEL PARAMETERS

HYDROLOGIC PARAMETERS

The runoff routing method for the models used the SCS Hydrology method. Two parameters were calculated in GIS (Geographic Information System): the runoff sub-catchment area and the time of concentration. This information was calculated for points located strategically along the DD19 Main Tile and branch tiles. Utilizing the area draining to each node, surface cover, and land use, the SCS method was used to calculate the time of concentration for each subcatchment. The values used for this tool conservatively assumes that the entire watershed is tile drained. The curve number was determined to be 78 through review of the land use and soil parameters within the watershed.

The SCS depth, or storage depth, used the runoff curve number and was calculated as 0.235 ft (2.82"). The initial abstraction factor is the proportion of the storage depth that is retained on the surface before runoff occurs (i.e. through infiltration, evaporation, and surface depression storage). The initial abstraction factor used for the DD19 model is 0.20.

HYDRAULIC PARAMETERS

One assumption made to model the existing drainage system is that it is functioning as it was originally constructed. It does not take into consideration the blockages, restrictions, or failures that may be found within the existing tiles and culverts. Both the existing and proposed tile systems are modeled using a Manning's n value of 0.013.

Another factor for consideration when reviewing the results of the model is that the flow is routed directly into the pipes, which assumes 100% privately tiled ground. Some landowners may not have their land completely privately tiled at this time, but the Engineer believes this is a necessary conservative factor. The Engineer understands that additional flooding may occur on the landscape that is not representative in the model and is taking a conservative approach to the model.

INFILTRATION

2D hydraulic infiltration was used in the model to allow surface water to infiltrate into the soil. Soil data was imported from the USDA NRCS Web Soil Survey to apply infiltration parameters based on the USDA Hydrologic Soil Types and soil texture. Infiltration is calculated within the model using the Green-Ampt methodology.

STORM EVENTS

The design storm events were chosen to ensure that sufficient drainage is provided for frequently occurring storm events. It was determined that the system improvements needed to provide enough capacity to drain surface ponding from a 5-year, 24-hour storm in fewer than 48 hours, with the exception of surface channels and tile branches that are not part of the proposed improvements. Additionally, the Main Tile Improvements needed to significantly decrease areas of long-term (48+ hours) ponding for a 10-year storm. Storm events used for modeling were the 5-, 10-, 50-, and 100-year storms.

Modeled rainfall depths were determined using NOAA Atlas 14 Point Precipitation Frequency Estimates: IA as provided for Milford, IA (43.3666, -95.2851) and the obtained values can be seen in Table 1 below. The 24-hour duration was used as it is the standard design storm duration and is the necessary duration to use the NRCS MSE3 rainfall distribution, which was the selected rainfall distribution for the model.

Table 1. Modeled 24-hr precipitation values

Return Period	Rainfall Depth (inches)
5-Year	3.67
10-Year	4.39
50-Year	6.45
100-Year	7.48

MODEL REVIEW

A 2-dimensional hydraulic/hydrologic (H/H) model was created for both the existing and proposed conditions to model the 5-, 10-, 50-, and 100-year storm events in ICM. Tables 2-4 show a comparison of the peak flow and velocity Main Open Ditch just downstream of the DD19 Main Tile outlet.

Table 2. Tile System Outlet Flow Comparison, 5-yr 24-hr Storm

	Volumetric Flow (cfs)	% Change from Existing
Existing	144.02	-
Option 1	195.89	36.0%
Option 2	278.12	93.1%
Option 3	348.34	141.9%

Table 3. Tile System Outlet Velocity Comparison, 5-yr 24-hr Storm

	Velocity (ft/s)	% Change from Existing
Existing	2.04	-
Option 1	1.33	-34.8%
Option 2	1.62	-20.6%
Option 3	2.45	19.6%

Table 4. Total Peak Flow Comparison at Main Tile Outlet

Event	Existing (cfs)	Proposed Option 1 (cfs)	Proposed Option 2 (cfs)	Proposed Option 3 (cfs)
5-Year	144.02	195.89	278.12	348.34
10-Year	217.48	258.66	342.08	536.62
50-Year	405.11	450.47	523.95	920.91
100-Year	451.93	532.04	596.24	1067.92

Modeling of the Drainage District No. 19 proposed Main Tile and surface channel improvements shows that the modifications made to the system can significantly enhance the drainage and provide relief to problem areas that have been subject to frequent crop stress and drown-outs in the past.

Figures 1 – 4 show the hydrographs at the outlet of the Project drainage system. The inundation maps shown in Figures 5-14 show the time that water deeper than 0.1-foot sits on the landscape, with Figures 9 and 14 showing inundation maps of a tile only improvement. Generally, crop stress from excess water occurs when water sits on the landscape for more than 24 hours, and crops generally die if they remain flooded for longer than 48 hours. These maps illustrate the improved drainage across the system and where the project will most impact the landscape.

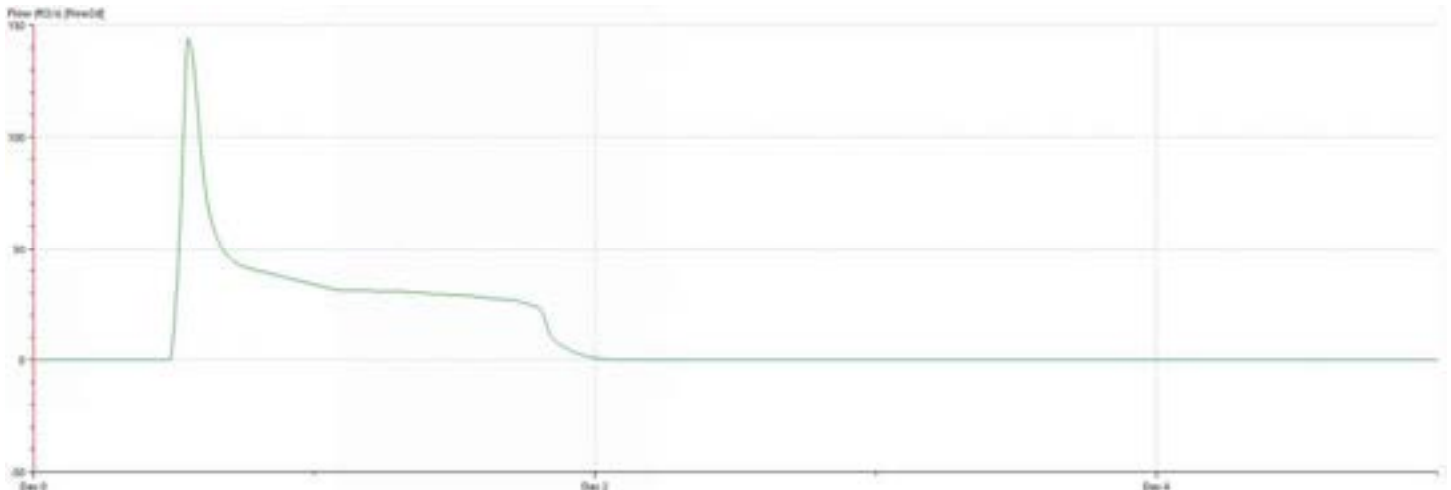


Figure 1. Existing Outlet Peak Flow Hydrograph (5-Year, 24-Hour Storm)

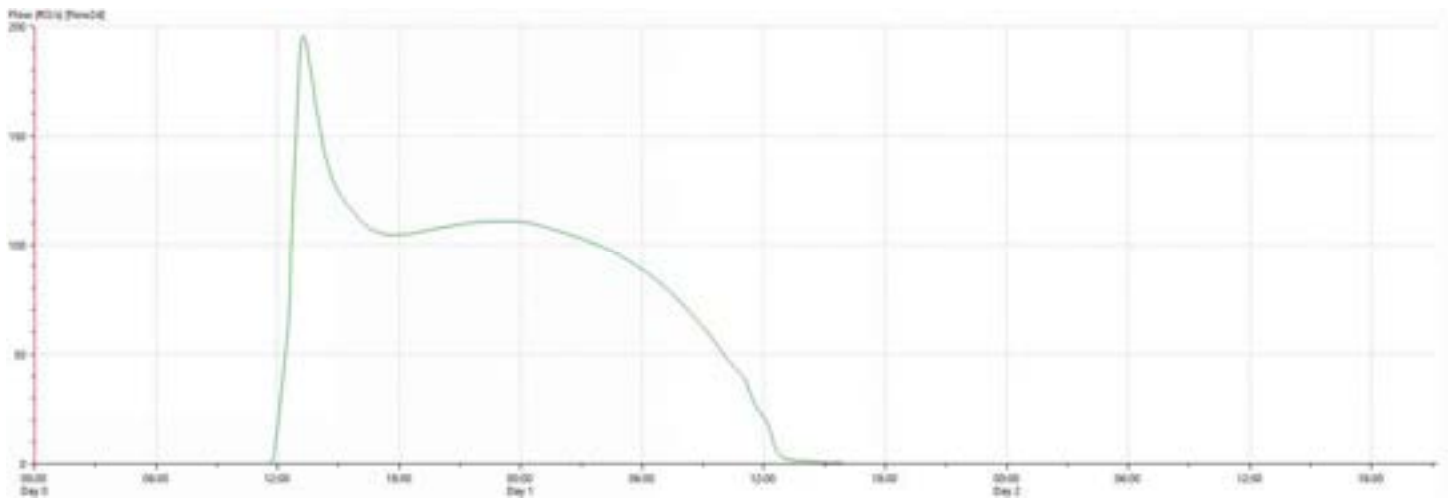


Figure 2. Proposed Option 1 Outlet Peak Flow Hydrograph (5-Year, 24-Hour Storm)

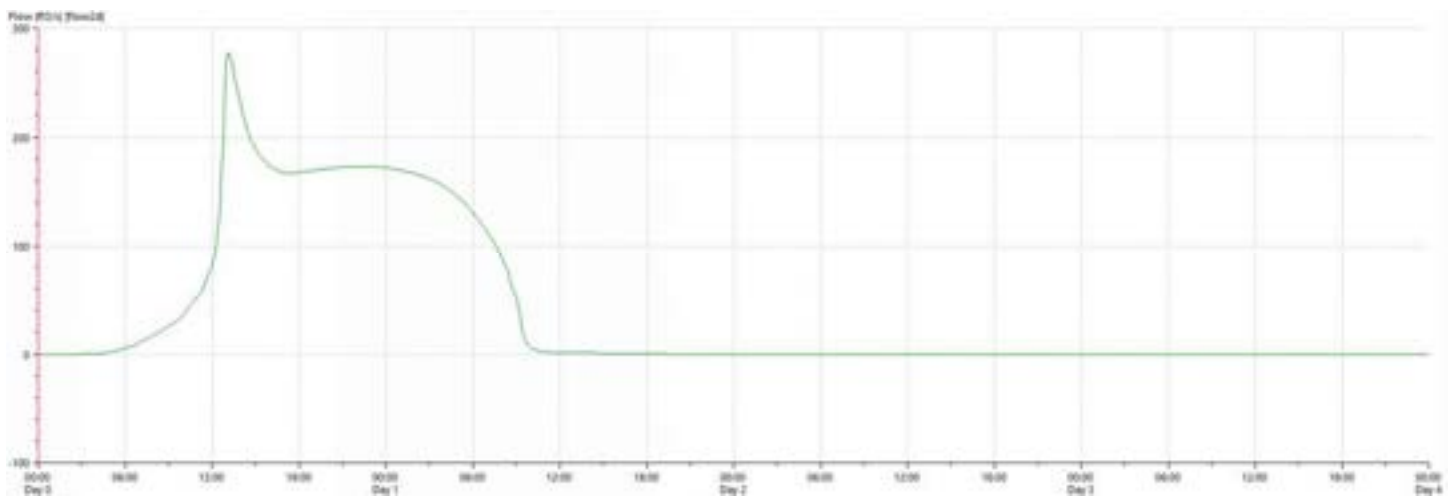


Figure 3. Proposed Option 2 Outlet Peak Flow Hydrograph (5-Year, 24-Hour Storm)

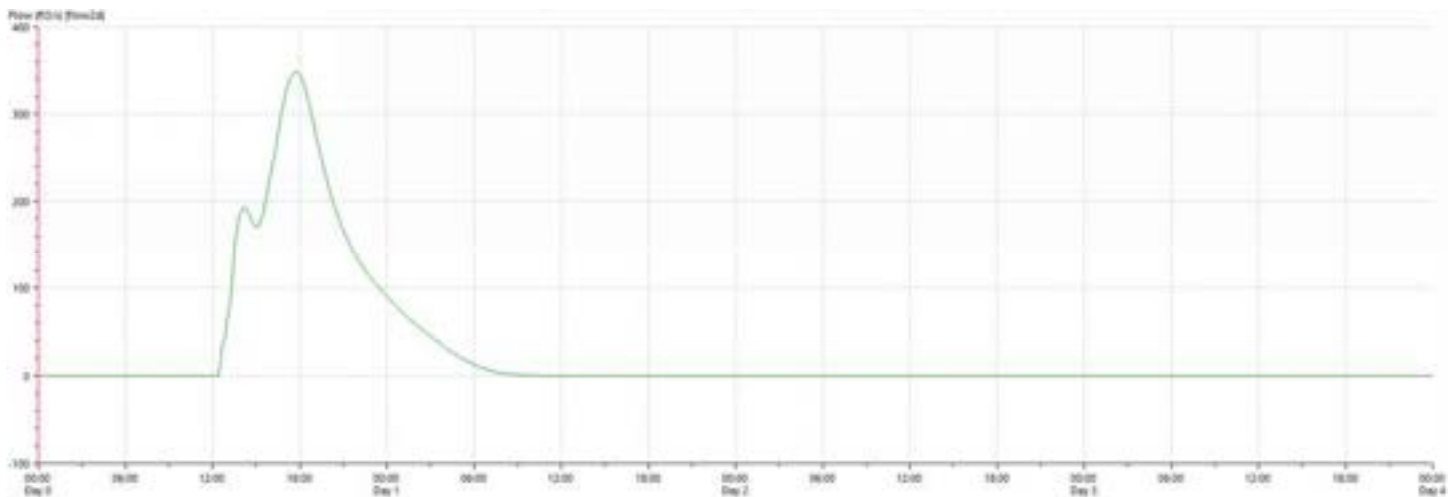


Figure 4. Proposed Option 3 Outlet Peak Flow Hydrograph (5-Year, 24-Hour Storm)

SYSTEM OUTLET

The outlet of DD19 Main Tile is the DD19 Main Open Ditch (MOD), which is not classified as a public water. The DD19 Main Open Ditch was found to generally be in good condition during ISG's review of the system. It was also determined that the outlet provides sufficient capacity for the existing system. The model results showed that there was a general increase in total peak flows (sum of 1D and 2D flows) between the existing and proposed models. Therefore, it is necessary to complete a more in-depth outlet analysis during final design to ensure that there will be no adverse effects on the system by increasing peak flows. Preliminary analysis of the proposed MOD extension cross sections found that velocities within the ditch were non-erosive.

ERRORS

The volume balance error is calculated by comparing the initial water volume in the 2D model and conduits to infiltration, system outflows, and final water volume in the 2D system and conduits. Table 5 shows the volume balance error for each modeled storm event. The maximum absolute volume balance error was 0.4302%, which was for the 5-year event Option 1 model. This is well within ICM's allowable percent error of 5%.

Table 5. Volume Balance Errors

Event	Existing (% Error)	Proposed Option 1 (% Error)	Proposed Option 2 (% Error)	Proposed Option 3 (% Error)
5-Year	-0.0902	-0.1831	-0.4302	-0.0153
10-Year	-0.1012	-0.1278	-0.1523	0.0281
50-Year	0.0247	-0.1010	-0.0433	0.0446
100-Year	0.0097	0.0169	-0.1187	0.0091

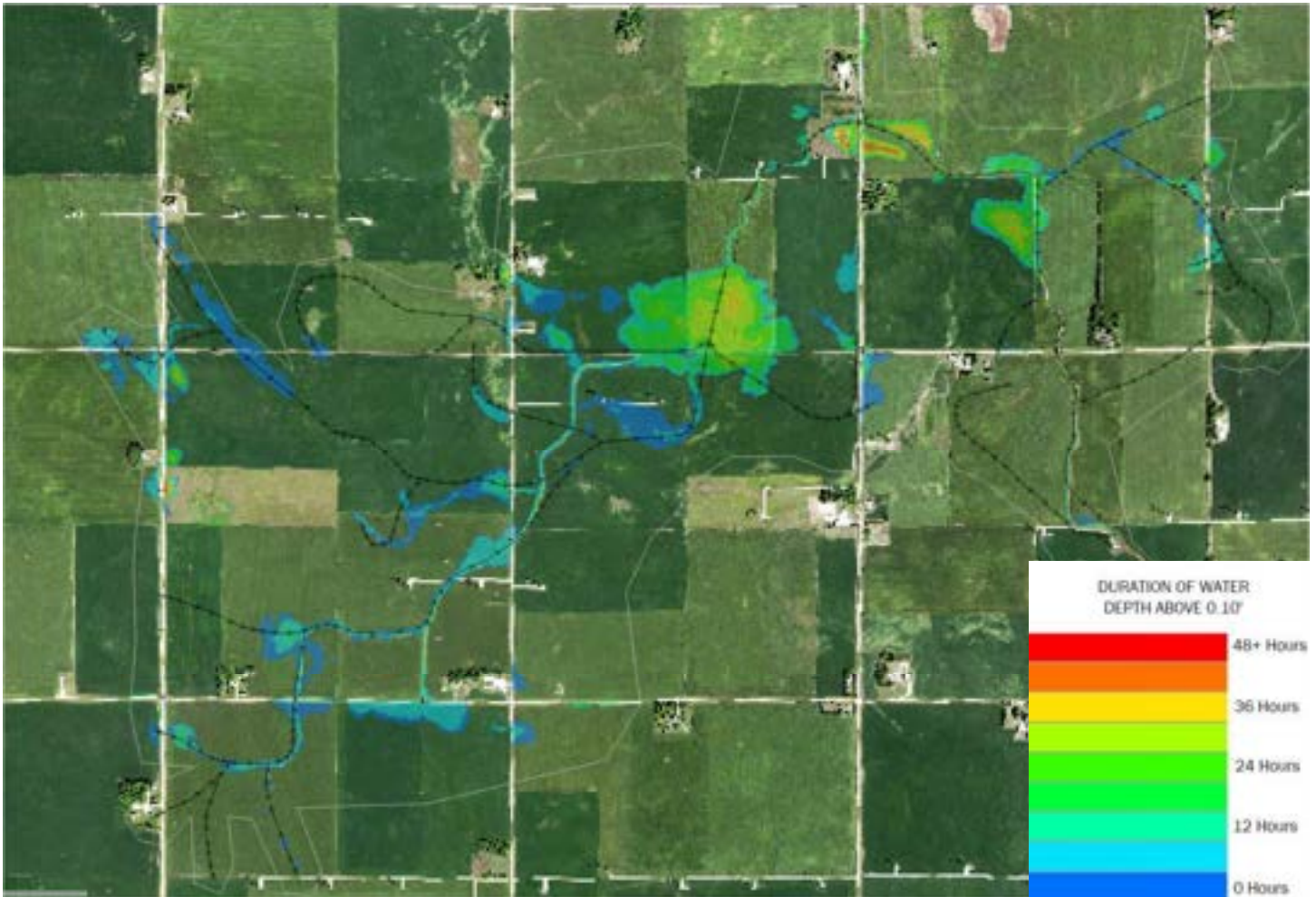


Figure 5. Existing 5-Year Inundation Map

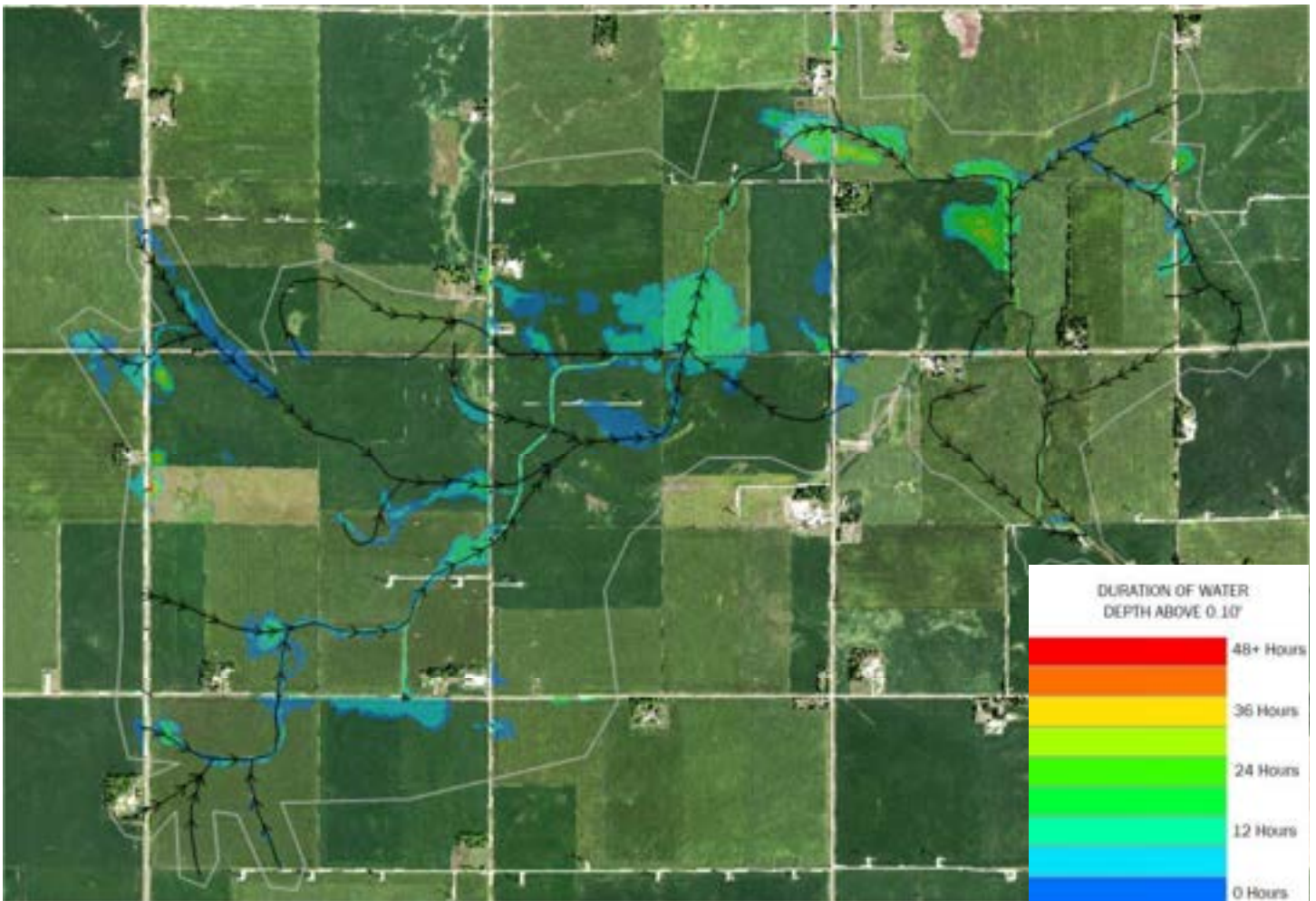


Figure 6. Proposed Option 1 5-Year Inundation Map

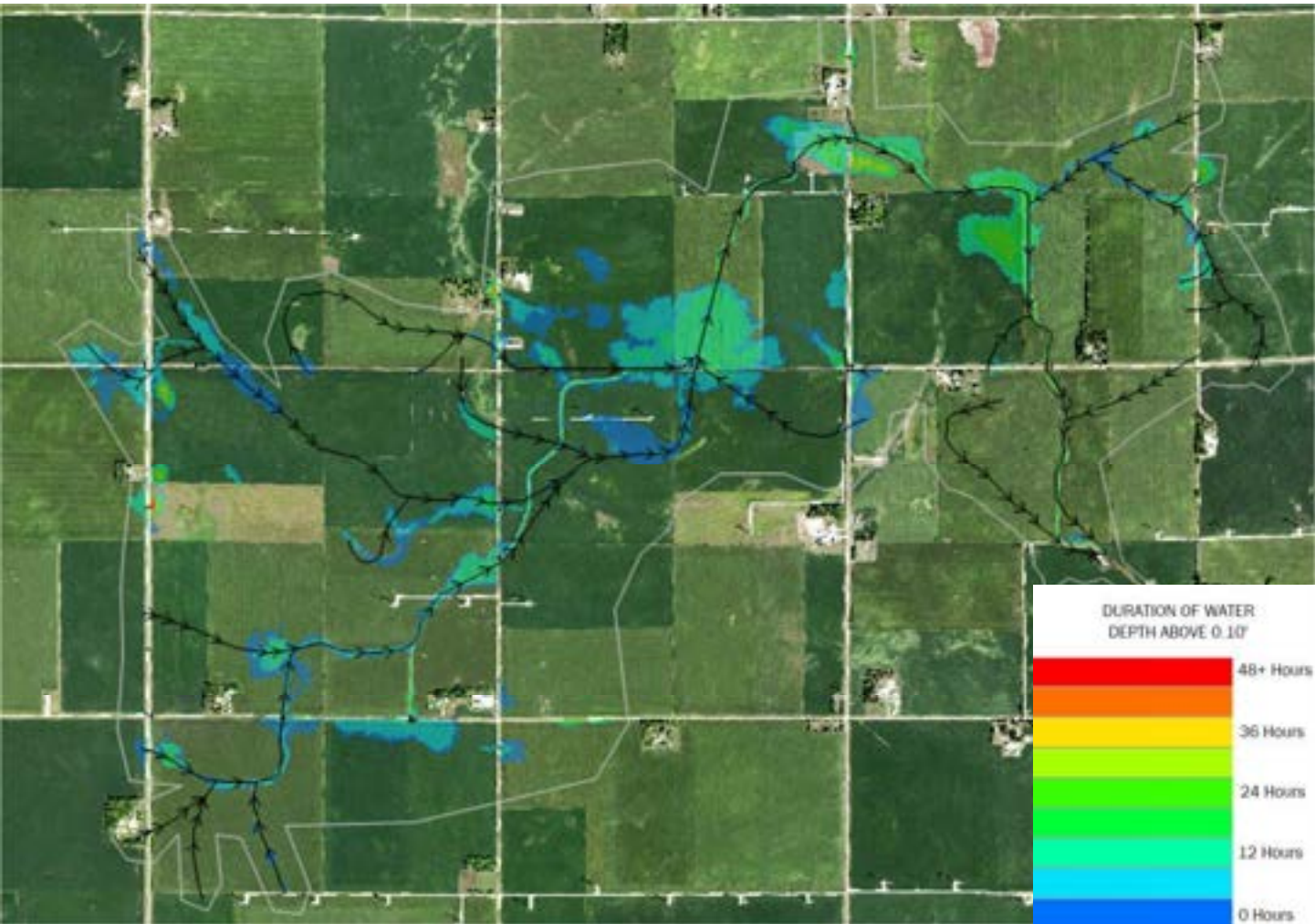


Figure 7. Proposed Option 2 5-Year Inundation Map

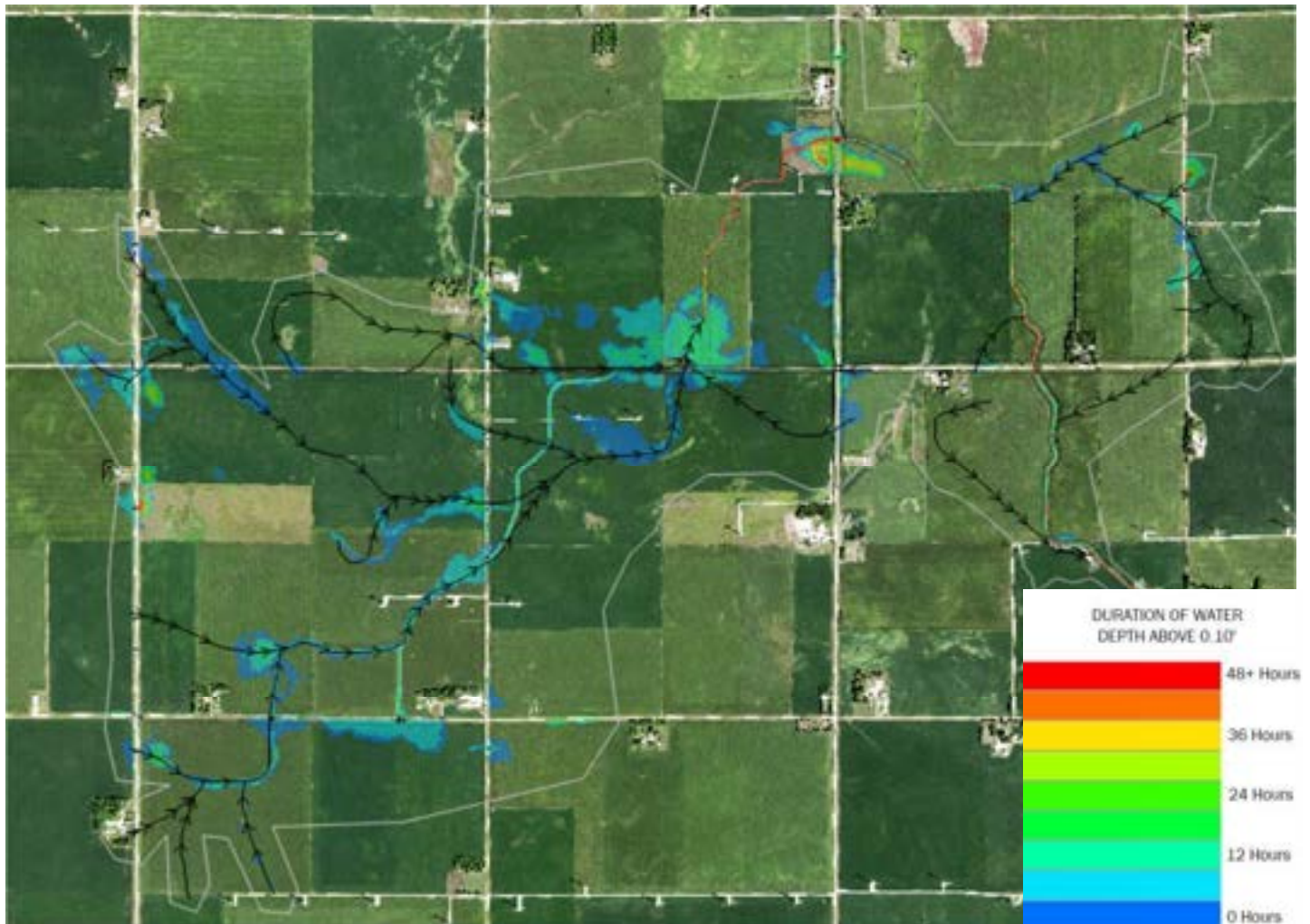


Figure 8. Proposed Option 3 5-Year Inundation Map

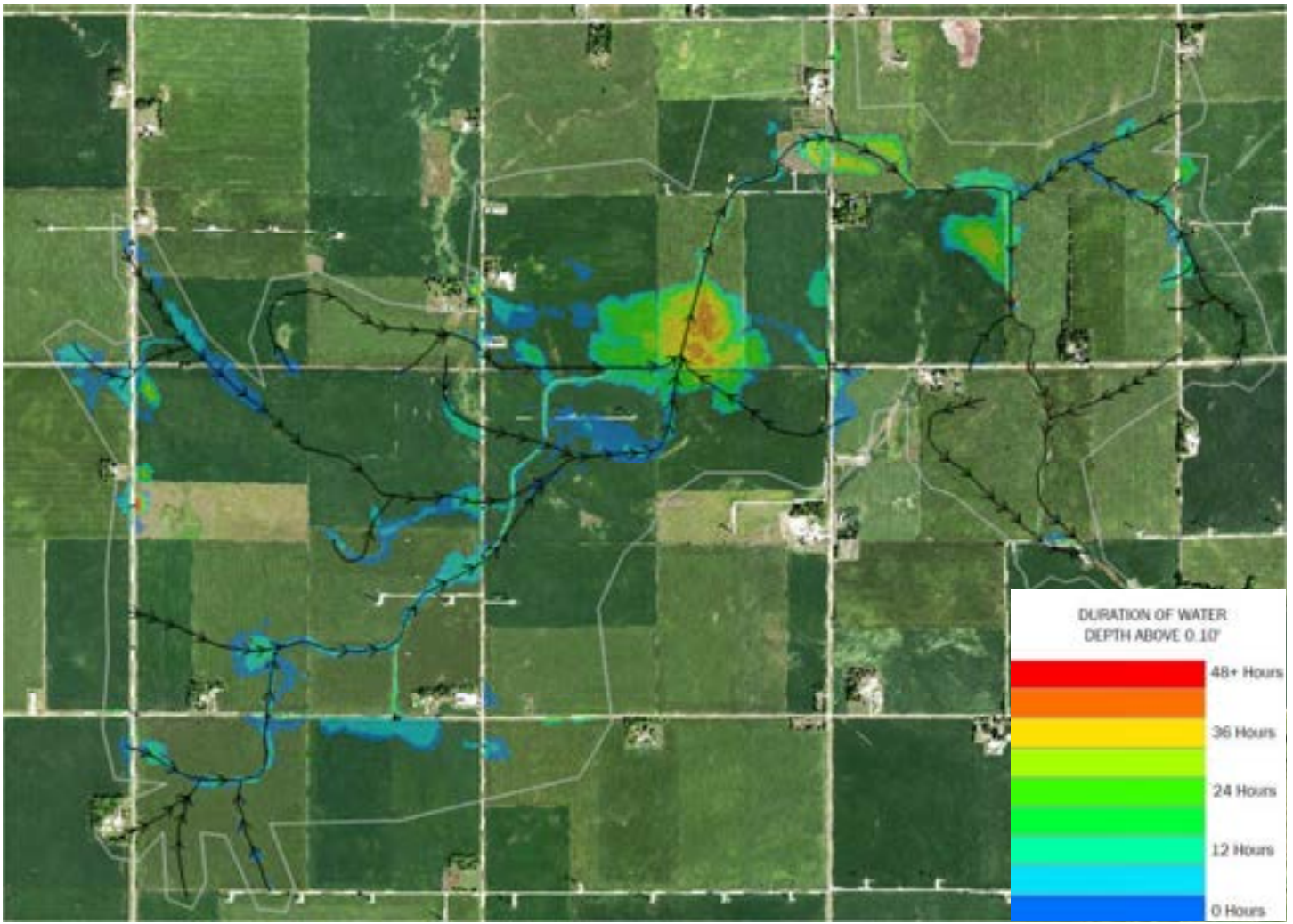


Figure 9. Tile Improvement Only 5-Year Inundation Map

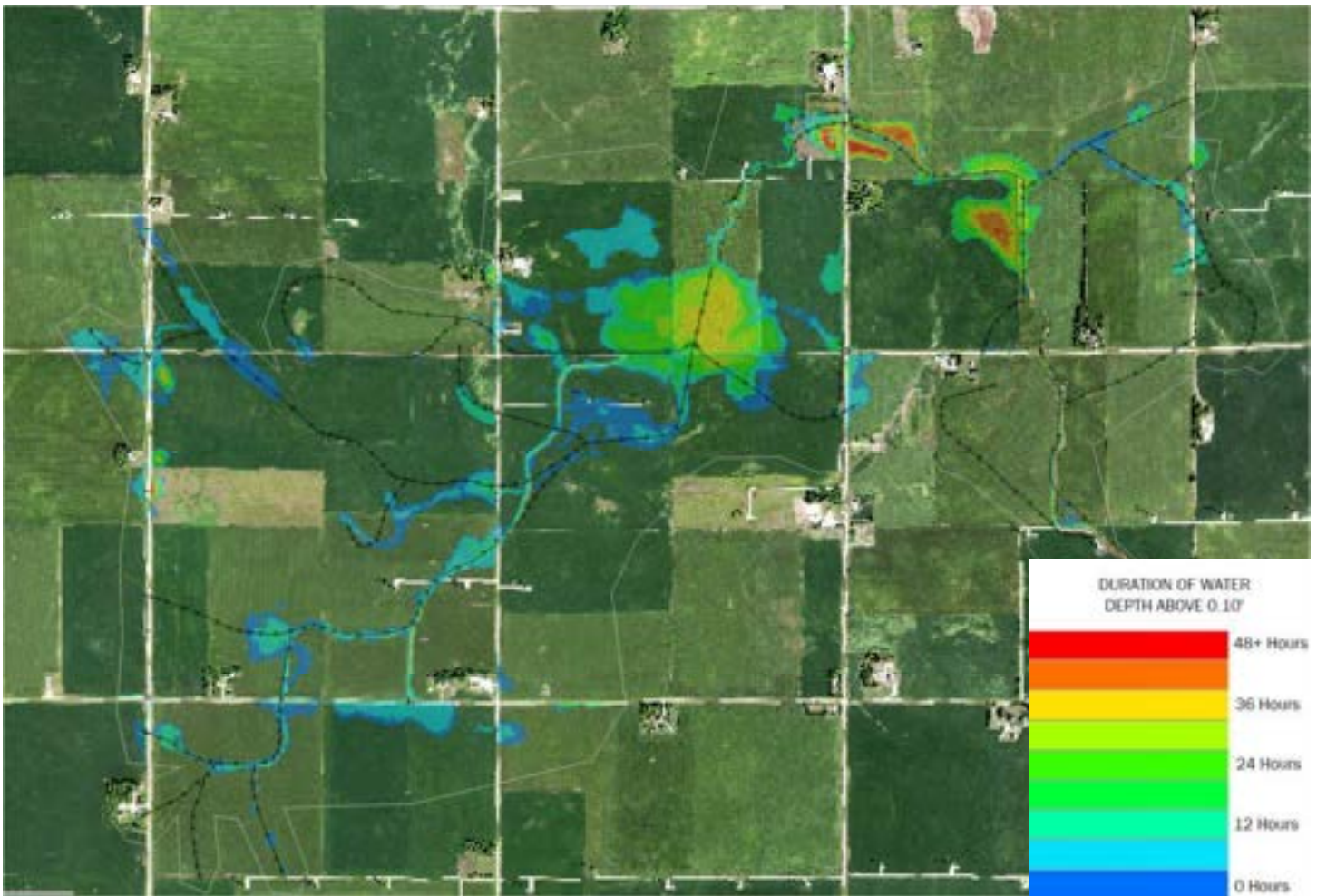


Figure 10. Existing 10-Year Inundation Map

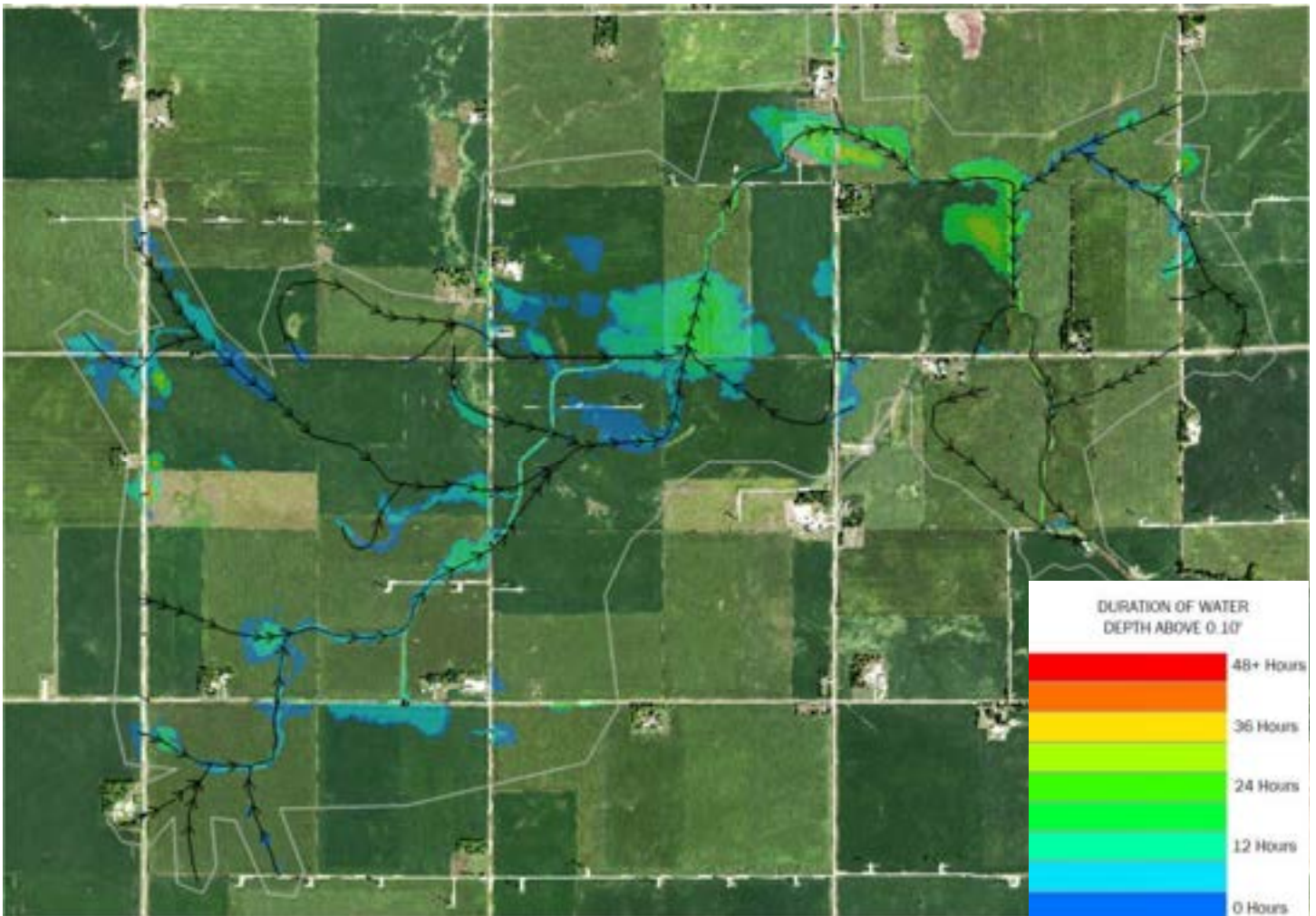


Figure 11. Proposed Option 1 10-Year Inundation Map

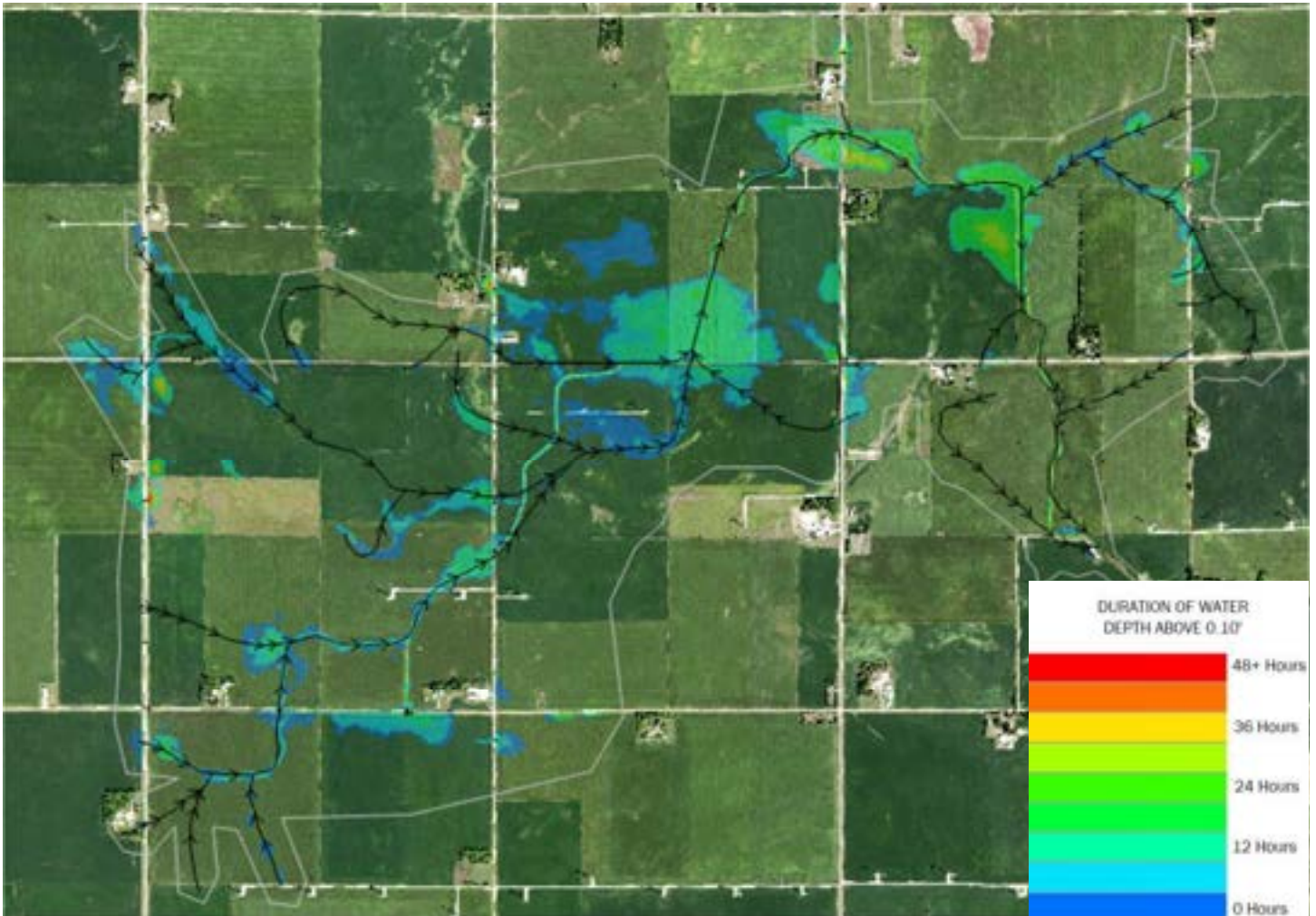


Figure 12. Proposed Option 2 10-Year Inundation Map

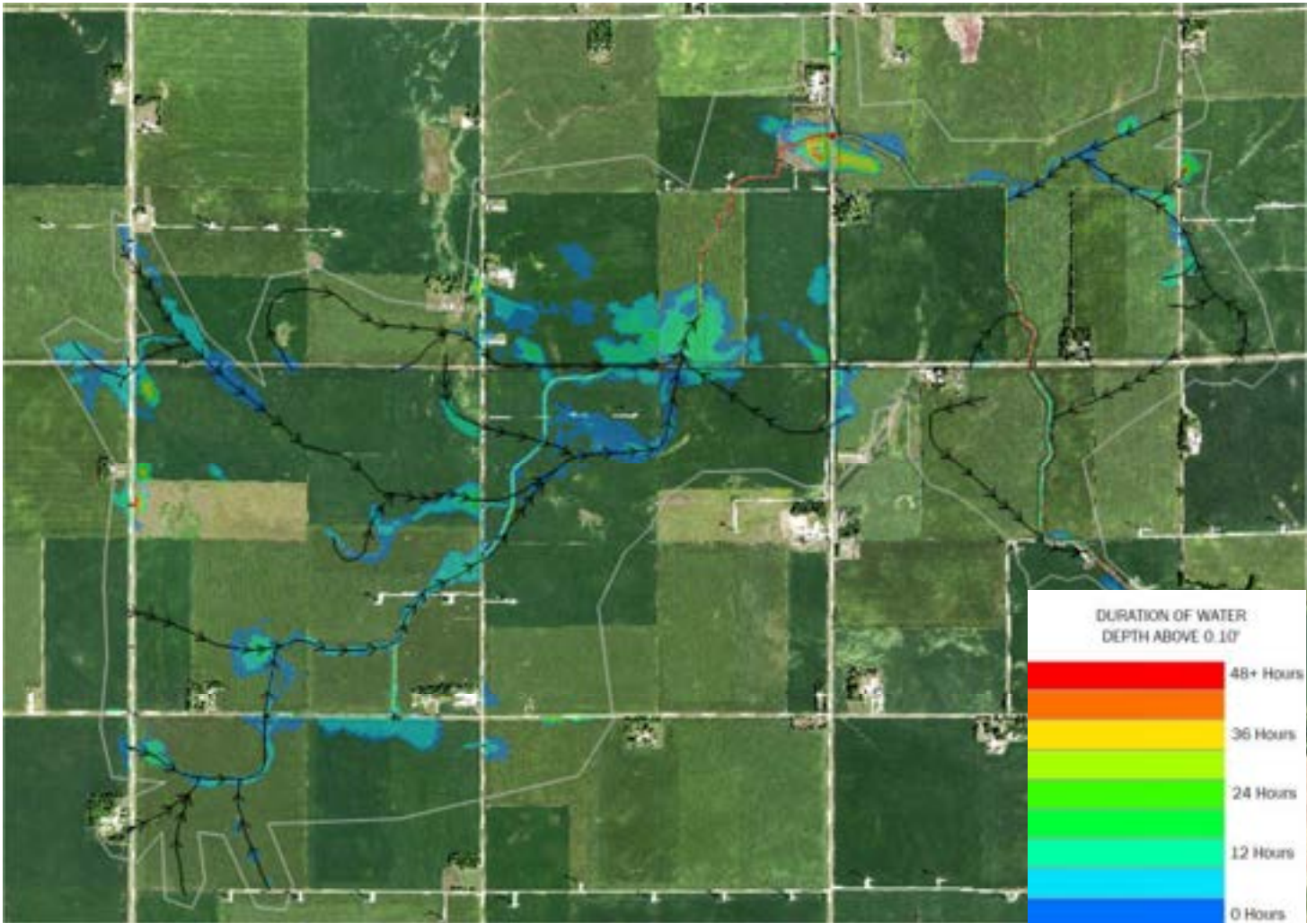


Figure 13. Proposed Option 3 10-Year Inundation Map

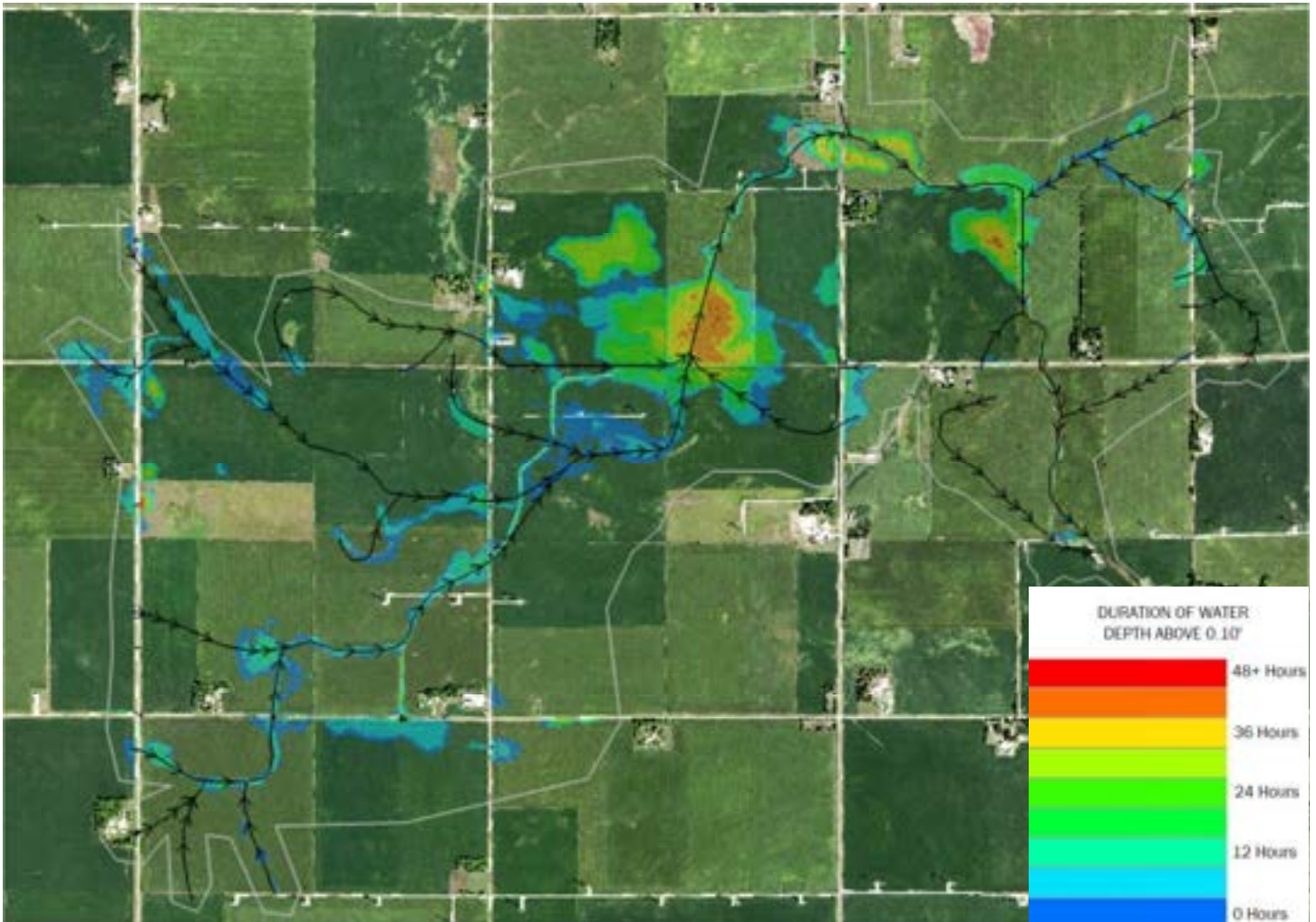


Figure 14. Tile Improvement Only 10-Year Inundation Map

Appendix D: Cost Estimates

Option 1 - Surface Channel Cleaning + Extension with Partial Tile Improvement

Main Tile Improvements

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	MOBILIZATION	LS	1	\$ 36,200.00	\$ 36,200
102	TILE INVESTIGATION	HR	5	\$ 200.00	\$ 1,000
103	TOPSOIL STRIP, STOCKPILE, RESPREAD (50')	LF	4500	\$ 3.00	\$ 13,500
104	42-INCH AGRICULTURAL TILE	LF	4500	\$ 125.00	\$ 562,500
105	42-INCH DIA. ELBOW SECTION, FABRICATION ONLY	EA	9	\$ 1,600.00	\$ 14,400
106	CONNECT EXISTING TILE (SIZE & MATERIAL MAY VARY)	EA	23	\$ 500.00	\$ 11,500
107	DISTRICT TILE CONNECTIONS (SIZE & MATERIAL MAY VARY)	EA	1	\$ 1,000.00	\$ 1,000
108	24-INCH CROSS-CONNECT W/40 LF OF SPECIFIED PIPE	EA	2	\$ 2,500.00	\$ 5,000
109	GRANULAR FOUNDATION MATERIAL	CY	125	\$ 60.00	\$ 7,500
110	INSTALL DROP INTAKE (18-INCH)	EA	2	\$ 2,500.00	\$ 5,000
111	INSTALL DROP INTAKE (24-INCH)	EA	3	\$ 3,000.00	\$ 9,000
112	CRUSH & BURY TILE (SIZE & MATERIAL MAY VARY)	LF	4500	\$ 3.00	\$ 13,500
113	REPLACE HEADWALL DROP STRUCTURE	EA	1	\$ 80,000.00	\$ 80,000
SUBTOTAL CONSTRUCTION COST					\$ 760,100
20% UNFORSEEN					\$ 152,020
TOTAL CONSTRUCTION COST					\$ 912,120
TEMPORARY DAMAGES		AC	10.33	\$ 650.00	\$ 6,715
TELEVISIONING (POST CONSTRUCTION)		LF	4500	\$ 1.25	\$ 5,625
SURVEY					\$ 5,000
TOTAL MAIN TILE IMPROVEMENTS COST					\$ 929,460

Surface Waterway Improvements

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	MOBILIZATION	LS	1	\$ 13,000.00	\$ 13,000
102	OPEN DITCH EXCAVATION	CY	41873	\$ 3.00	\$ 125,619
103	SPOIL BANK LEVELING (TWO SIDES)	STA	138	\$ 200.00	\$ 27,600
104	TOP SOIL STRIP, STOCKPILE, RESPREAD (100')	LF	13800	\$ 5.00	\$ 69,000
105	FURNISH & INSTALL RIPRAP	TN	200	\$ 85.00	\$ 17,000
106	OPEN DITCH FERTILIZING & SEEDING	STA	138	\$ 150.00	\$ 20,700
SUBTOTAL CONSTRUCTION COST					\$ 272,919
20% UNFORSEEN					\$ 54,584
TOTAL CONSTRUCTION COST					\$ 327,503
DRAINAGE DISTRICT ROW (TAKEN)		AC	4.86	\$ 14,000.00	\$ 68,084
DRAINAGE DISTRICT ROW (EASEMENT)		AC	15.84	\$ 1,300.00	\$ 20,592
SEVERANCE DAMAGE PAYMENT					\$ 50,000
SURVEY					\$ 7,500
TOTAL SURFACE WATERWAY IMPROVEMENTS IMPROVEMENT COST					\$ 473,679

Option 1 - Surface Channel Cleaning + Extension with Partial Tile Improvement

Other District Costs

Type	Amount
DISTRICT ADMINISTRATION COSTS (Legal, Staff, Advertisement)	\$ 5,000
REPORTS, PLANS AND SPECIFICATIONS	\$ 175,000
CONSTRUCTION STAKING & ADMINISTRATION	\$ 99,171
PERMITTING: WETLANDS, FSA & OTHER	\$ 15,000
RIGHT-OF-WAY ENGINEERING	\$ 7,000
RECLASSIFICATION	\$ 17,500
WARRANT INTEREST	\$ 225,737
TOTAL OTHER DISTRICT COSTS	\$ 544,408

Dickinson County Road Crossings

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	TRAFFIC CONTROL	JOB	1	\$ 7,500.00	\$ 7,500
102	INSTALL 72" RCP CULVERT	JOB	1	\$ 100,000.00	\$ 100,000
SUBTOTAL CONSTRUCTION COST					\$ 107,500
10% UNFORSEEN					\$ 10,750
TOTAL DICKINSON COUNTY ROAD CROSSINGS COST					\$ 118,250

TOTAL IMPROVEMENT COST

Main Tile Improvements	\$ 929,460
Surface Waterway Improvements	\$ 473,679
Other District Costs	\$ 544,408
Dickinson County Road Crossings	\$ 118,250
COMPLETE IMPROVEMENT COST	\$ 2,065,797
DRAINAGE DISTRICT CONSTRUCTION COST	\$ 1,403,139
TOTAL DRAINAGE DISTRICT COST	\$ 1,947,547

Option 2 - Surface Channel Cleaning + Extension with Full Tile Improvement

Main Tile Improvements

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	MOBILIZATION	LS	1	\$ 110,730.00	\$ 110,730
102	TILE INVESTIGATION	HR	14	\$ 200.00	\$ 2,800
103	TOPSOIL STRIP, STOCKPILE, RESPREAD (50')	LF	13700	\$ 3.00	\$ 41,100
104	48-INCH AGRICULTURAL TILE	LF	9100	\$ 145.00	\$ 1,319,500
105	42-INCH AGRICULTURAL TILE	LF	4600	\$ 125.00	\$ 575,000
106	48-INCH DIA. ELBOW SECTION, FABRICATION ONLY	EA	16	\$ 2,000.00	\$ 32,000
107	42-INCH DIA. ELBOW SECTION, FABRICATION ONLY	EA	6	\$ 1,600.00	\$ 9,600
108	CONNECT EXISTING TILE (SIZE & MATERIAL MAY VARY)	EA	69	\$ 500.00	\$ 34,500
109	DISTRICT TILE CONNECTIONS (SIZE & MATERIAL MAY VARY)	EA	6	\$ 1,000.00	\$ 6,000
110	24-INCH CROSS-CONNECT W/40 LF OF SPECIFIED PIPE	EA	2	\$ 2,500.00	\$ 5,000
111	GRANULAR FOUNDATION MATERIAL	CY	425	\$ 60.00	\$ 25,500
112	INSTALL DROP INTAKE (18-INCH)	EA	5	\$ 2,500.00	\$ 12,500
113	INSTALL DROP INTAKE (24-INCH)	EA	10	\$ 3,000.00	\$ 30,000
114	CRUSH & BURY TILE (SIZE & MATERIAL MAY VARY)	LF	13700	\$ 3.00	\$ 41,100
115	REPLACE HEADWALL DROP STRUCTURE	EA	1	\$ 80,000.00	\$ 80,000
SUBTOTAL CONSTRUCTION COST					\$ 2,325,330
20% UNFORSEEN					\$ 465,066
TOTAL CONSTRUCTION COST					\$ 2,790,396
TEMPORARY DAMAGES		AC	31.45	\$ 650.00	\$ 20,443
TELEVISIONING (POST CONSTRUCTION)		LF	13700	\$ 1.25	\$ 17,125
SURVEY					\$ 5,000
TOTAL MAIN TILE IMPROVEMENTS COST					\$ 2,832,964

Surface Waterway Improvements

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	MOBILIZATION	LS	1	\$ 13,000.00	\$ 13,000
102	OPEN DITCH EXCAVATION	CY	41873	\$ 3.00	\$ 125,619
103	SPOIL BANK LEVELING (TWO SIDES)	STA	138	\$ 200.00	\$ 27,600
104	TOP SOIL STRIP, STOCKPILE, RESPREAD (100')	LF	13800	\$ 5.00	\$ 69,000
105	FURNISH & INSTALL RIPRAP	TN	200	\$ 85.00	\$ 17,000
SUBTOTAL CONSTRUCTION COST					\$ 272,919
20% UNFORSEEN					\$ 54,584
TOTAL CONSTRUCTION COST					\$ 327,503
DRAINAGE DISTRICT ROW (TAKEN)		AC	4.86	\$ 14,000.00	\$ 68,084
DRAINAGE DISTRICT ROW (EASEMENT)		AC	15.84	\$ 1,300.00	\$ 20,592
SEVERANCE DAMAGE PAYMENT					\$ 50,000
SURVEY					\$ 7,500
TOTAL SURFACE WATERWAY IMPROVEMENTS IMPROVEMENT COST					\$ 473,679

Option 2 - Surface Channel Cleaning + Extension with Full Tile Improvement

Other District Costs

Type	Amount
DISTRICT ADMINISTRATION COSTS (Legal, Staff, Advertisement)	\$ 5,000
REPORTS, PLANS AND SPECIFICATIONS	\$ 175,000
CONSTRUCTION STAKING & ADMINISTRATION	\$ 249,433
PERMITTING: WETLANDS, FSA & OTHER	\$ 15,000
RIGHT-OF-WAY ENGINEERING	\$ 7,000
RECLASSIFICATION	\$ 17,500
WARRANT INTEREST	\$ 481,205
TOTAL OTHER DISTRICT COSTS	\$ 950,138

Dickinson County Road Crossings

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	OPEN CUT, CLASS 4, 42-INCH RCP	LF	100	\$ 250.00	\$ 25,000
102	JACK + BORE 48-INCH STEEL CASING PIPE	LF	100	\$ 1,200.00	\$ 120,000
103	TRAFFIC CONTROL	JOB	2	\$ 7,500.00	\$ 15,000
104	INSTALL 72" RCP CULVERT	JOB	1	\$ 100,000.00	\$ 100,000
SUBTOTAL CONSTRUCTION COST					\$ 260,000
10% UNFORSEEN					\$ 26,000
TOTAL DICKINSON COUNTY ROAD CROSSINGS COST					\$ 286,000

TOTAL IMPROVEMENT COST

Main Tile Improvements	\$ 2,832,964
Surface Waterway Improvements	\$ 473,679
Other District Costs	\$ 950,138
Dickinson County Road Crossings	\$ 286,000
COMPLETE IMPROVEMENT COST	\$ 4,542,781
DRAINAGE DISTRICT CONSTRUCTION COST	\$ 3,306,643
TOTAL DRAINAGE DISTRICT COST	\$ 4,256,781

Option 3 - 2-Stage Open Ditch Extension

Open Ditch Improvements

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	MOBILIZATION	LS	1	\$ 36,800.00	\$ 36,800
102	OPEN DITCH EXCAVATION	CY	147227.3	\$ 3.25	\$ 478,489
103	SPOIL BANK LEVELING (TWO SIDES)	STA	138	\$ 225.00	\$ 31,050
104	TOP SOIL STRIP, STOCKPILE, RESPREAD (200')	LF	13800	\$ 7.00	\$ 96,600
105	FURNISH & INSTALL RIPRAP	TN	400	\$ 85.00	\$ 34,000
106	OPEN DITCH FERTILIZING & SEEDING	STA	138	\$ 150.00	\$ 20,700
107	FURNISH & INSTALL CORRUGATED METAL SURFACE PIPE, 36" DIA.	LF	200	\$ 85.00	\$ 17,000
108	FURNISH & INSTALL CORRUGATED METAL SURFACE PIPE, 24" DIA.	LF	200	\$ 60.00	\$ 12,000
109	FURNISH & INSTALL CORRUGATED METAL SURFACE PIPE, 18" DIA.	LF	800	\$ 45.00	\$ 36,000
110	FURNISH & INSTALL CORRUGATED METAL TILE EXT PIPE, 48" DIA.	LF	20	\$ 130.00	\$ 2,600
111	FURNISH & INSTALL CORRUGATED METAL TILE EXT. PIPE, 36" DIA.	LF	20	\$ 100.00	\$ 2,000
112	FURNISH & INSTALL CORRUGATED METAL TILE EXT. PIPE, 24" DIA.	LF	20	\$ 70.00	\$ 1,400
113	FURNISH & INSTALL CORRUGATED METAL TILE EXT. PIPE, 15" DIA.	LF	80	\$ 50.00	\$ 4,000
114	FURNISH & INSTALL CORRUGATED METAL TILE EXT. PIPE, 12" DIA.	LF	1100	\$ 40.00	\$ 44,000
115	REMOVE HEADWALL DROP STRUCTURE	EA	1	\$ 2,500.00	\$ 2,500
116	CRUSH & BURY TILE (SIZE & MATERIAL MAY VARY)	LF	12200	\$ 3.00	\$ 36,600
SUBTOTAL CONSTRUCTION COST					\$ 855,739
20% UNFORSEEN					\$ 171,148
TOTAL CONSTRUCTION COST					\$ 1,026,887
DRAINAGE DISTRICT ROW (TAKEN)		AC	13.82	\$ 14,000.00	\$ 193,428
DRAINAGE DISTRICT ROW (EASEMENT)		AC	19.01	\$ 1,300.00	\$ 24,711
SEVERANCE DAMAGE PAYMENT					\$ 50,000
SURVEY					\$ 7,500
TOTAL OPEN DITCH IMPROVEMENTS IMPROVEMENT COST					\$ 1,302,526

Other District Costs

Type	Amount
DISTRICT ADMINISTRATION COSTS (Legal, Staff, Advertisement)	\$ 5,000
REPORTS, PLANS AND SPECIFICATIONS	\$ 175,000
CONSTRUCTION STAKING & ADMINISTRATION	\$ 82,239
PERMITTING: WETLANDS, FSA & OTHER	\$ 15,000
RIGHT-OF-WAY ENGINEERING	\$ 7,000
RECLASSIFICATION	\$ 17,500
WARRANT INTEREST	\$ 174,407
TOTAL OTHER DISTRICT COSTS	\$ 476,146

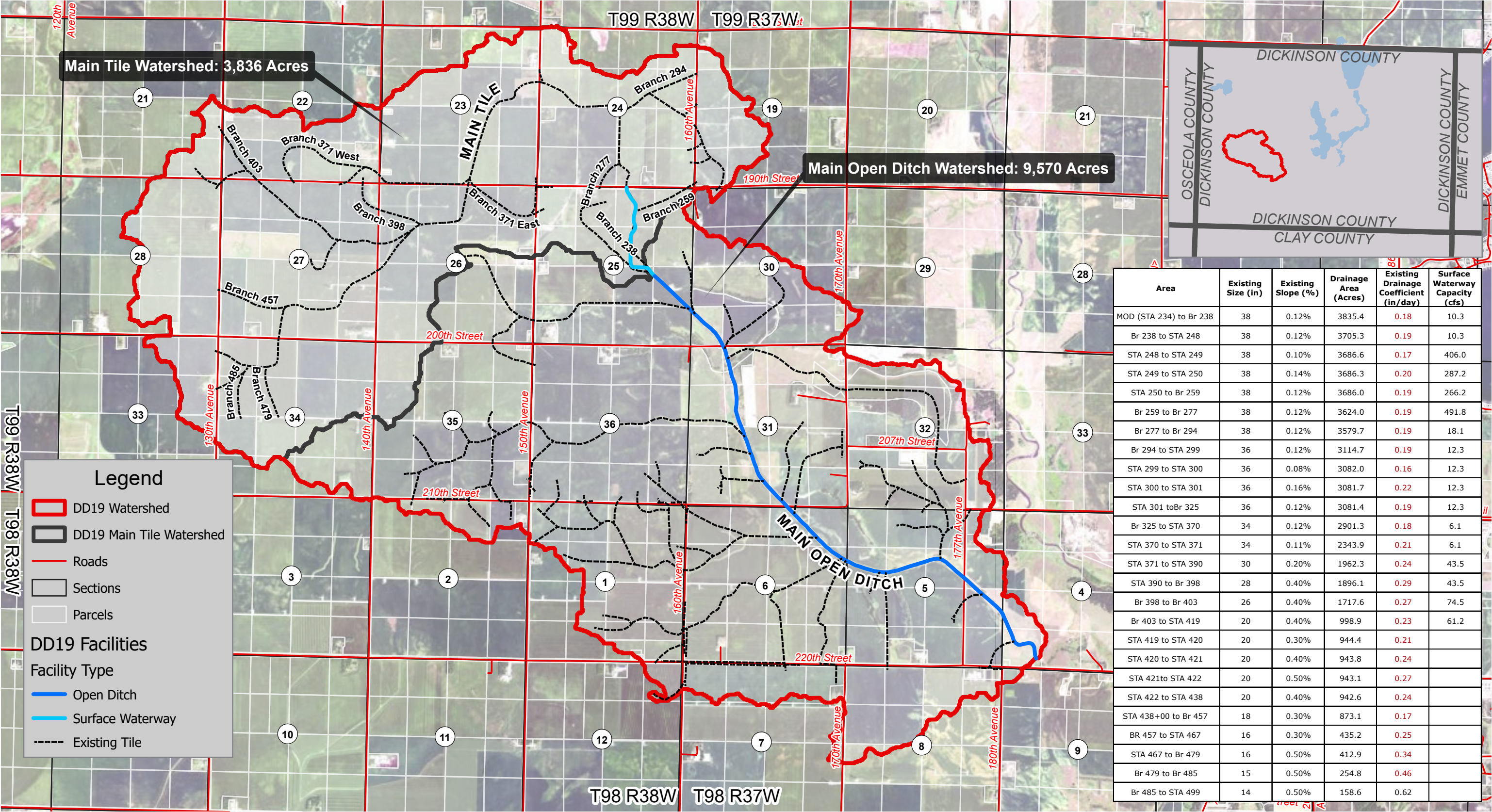
Dickinson County Road Crossings

Item No.	Item	Unit	Quantity	Unit Price	Amount
101	TRAFFIC CONTROL	JOB	2	\$ 7,500.00	\$ 15,000
102	INSTALL PRECAST BOX CULVERT	JOB	2	\$200,000.00	\$ 400,000
SUBTOTAL CONSTRUCTION COST					\$ 415,000
10% UNFORSEEN					\$ 41,500
TOTAL DICKINSON COUNTY ROAD CROSSINGS COST					\$ 456,500

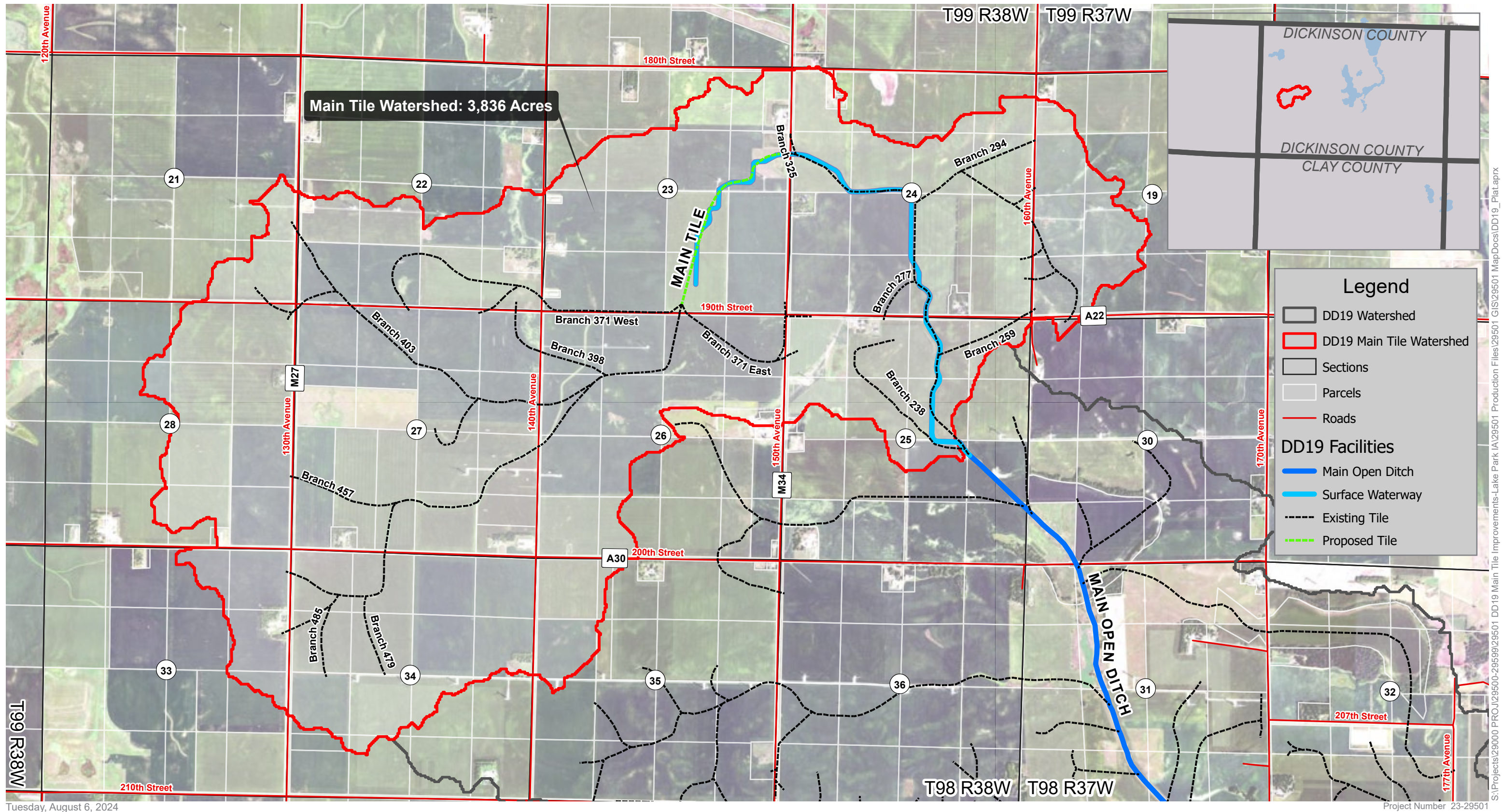
TOTAL IMPROVEMENT COST

Open Ditch Improvements	\$ 1,302,526
Other District Costs	\$ 476,146
Dickinson County Road Crossings	\$ 456,500
COMPLETE IMPROVEMENT COST	\$ 2,241,272
DRAINAGE DISTRICT CONSTRUCTION COST	\$ 1,302,526
TOTAL DRAINAGE DISTRICT COST	\$ 1,784,772

Appendix E: District Plats



Tuesday, August 6, 2024 Project Number 23-29501



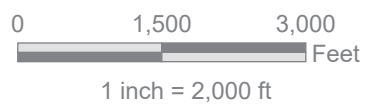
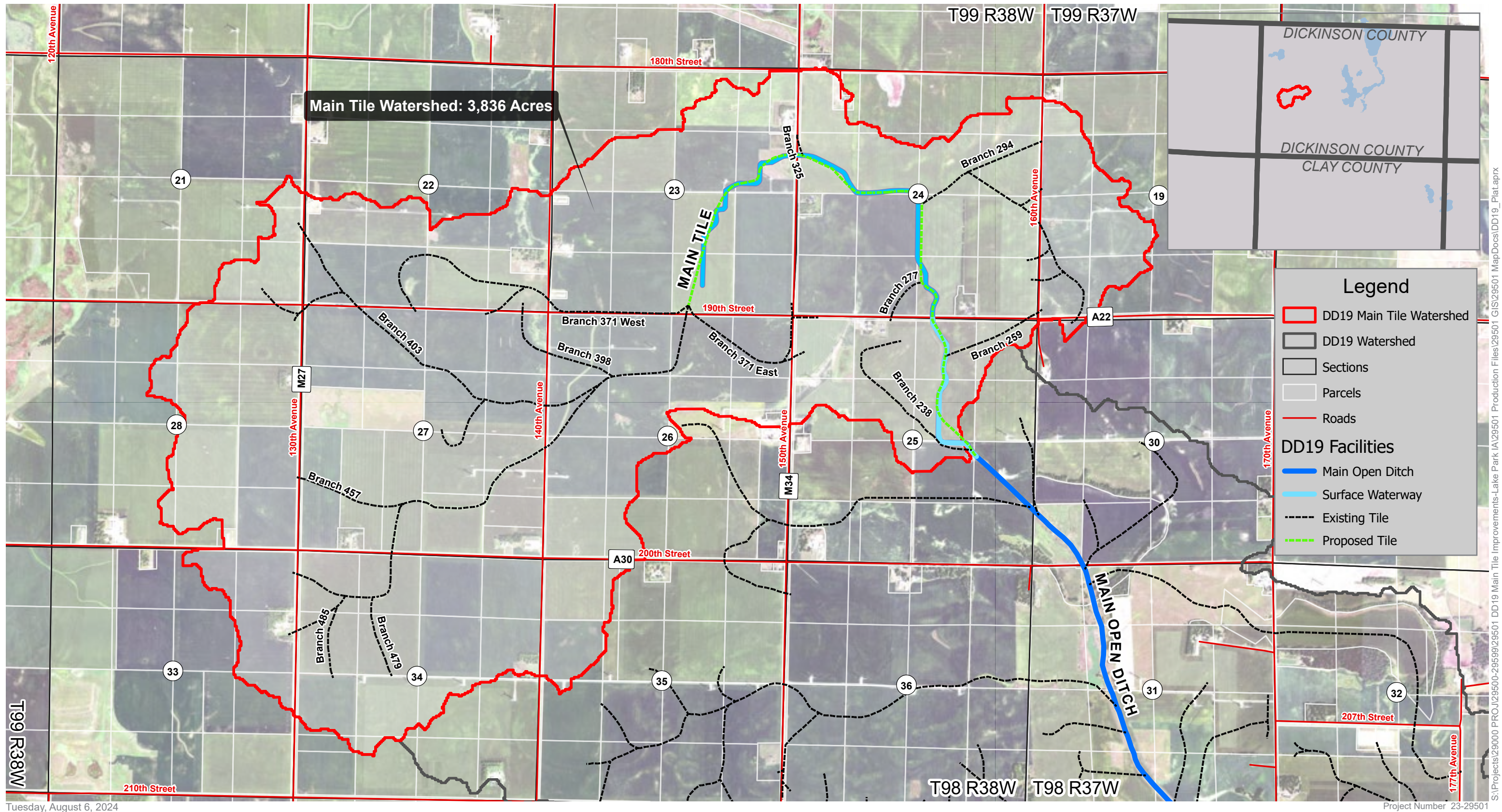
0 1,500 3,000 Feet
1 inch = 2,000 ft



Improvement Option 1 Plat Drainage District No. 19 Dickinson County, Iowa

Source(s):
Orthophoto (USDA, 2021)
Parcels (Dickinson County, 2024)
Roads (OpenStreetMap, 2015)

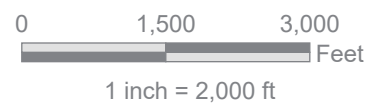
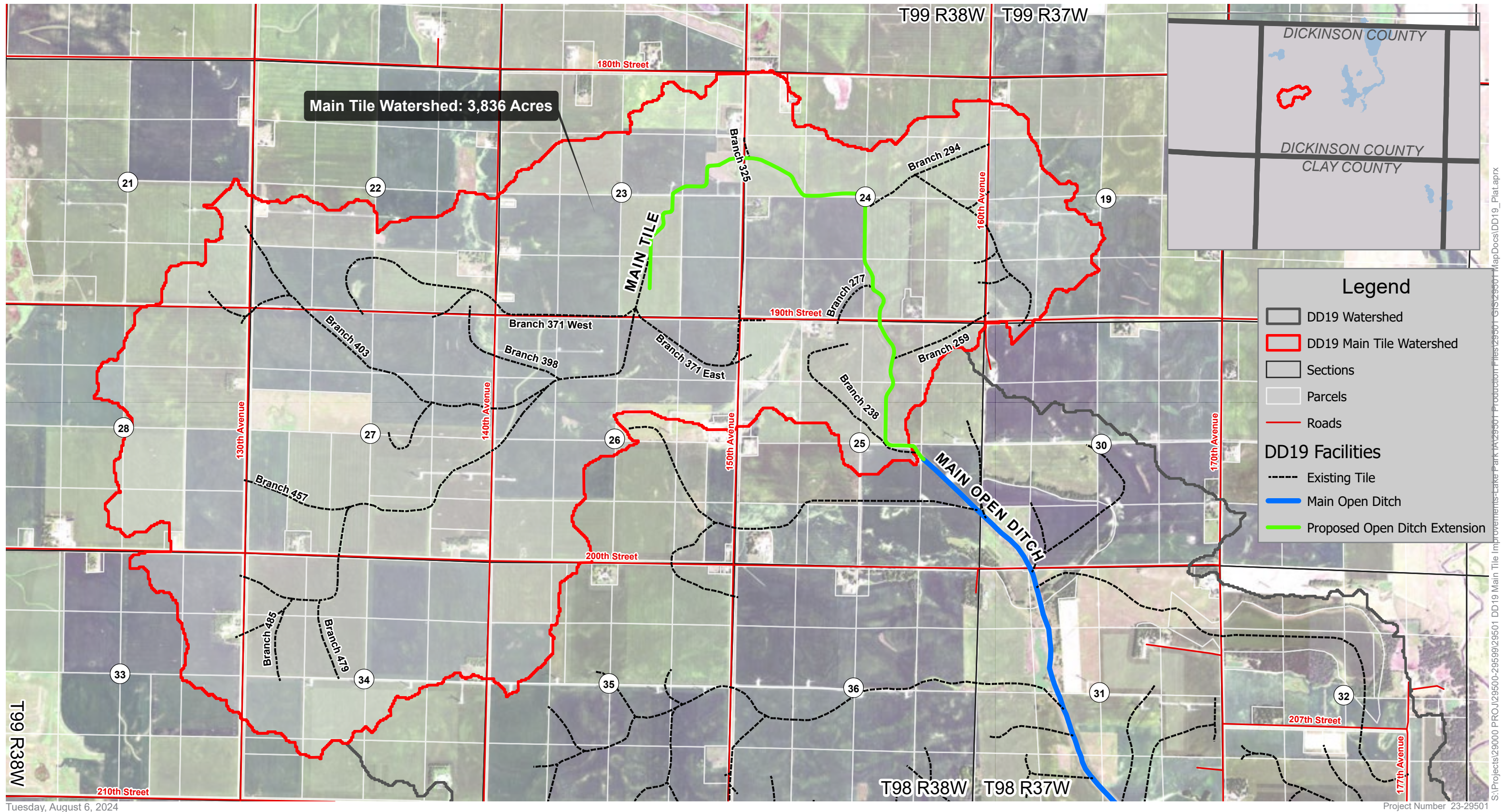
ISG



Improvement Option 2 Plat Drainage District No. 19 Dickinson County, Iowa

Source(s):
Orthophoto (USDA, 2021)
Parcels (Dickinson County, 2024)
Roads (OpenStreetMap, 2015)

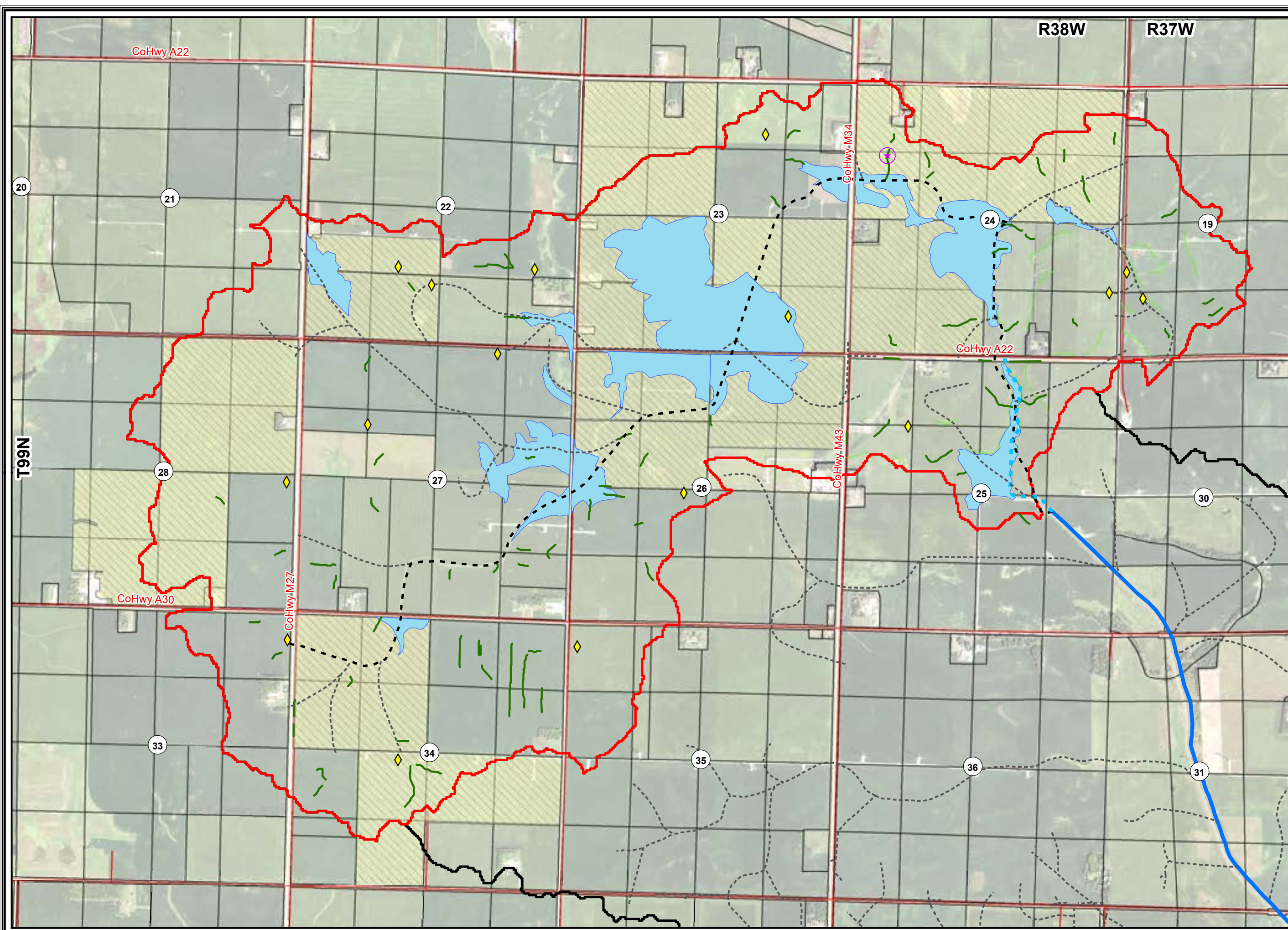
ISG



Improvement Option 3 Plat Drainage District No. 19 Dickinson County, Iowa

Source(s):
Orthophoto (USDA, 2021)
Parcels (Dickinson County, 2024)
Roads (OpenStreetMap, 2015)

ISG



DD19 Main Tile
Multipurpose
Drainage Map
Dickinson County, Iowa
August 06, 2024

Legend

- In-Field Wascob
- Bioreactor
- DD19 Tile Facilities
- DD19 Open Ditch
- DD19 Main Tile
- DD19 Waterway
- Grassed Waterways
- Wetland
- MT Watershed
- DD19 Watershed
- Controlled Drainage
- Contour Buffer Strips
- County Parcels

PN: 23-29501
Orthophoto (2021)

0 425 850 1,700 Feet
1 inch = 1,700 feet