AgriVia

PO Box 44
1124 Willis Ave
Perry, IA 50220

Engineer's Report
Tile Improvements
Drainage District No. 169

Wright County, Iowa
2026

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.

Jacob L. Hagan, P.E. 5/7/26 (date)
License No. 25738
My license renewal date is December 31, 2026.
Pages or sheets covered by this seal:
All

Project No. 2532-99

Executive Summary

Introduction
Following a petition by landowners in Drainage District No. 169, a comprehensive engineering study was conducted to evaluate the existing drainage infrastructure. This report summarizes the findings and presents a recommended plan to address long-standing drainage deficiencies and improve agricultural productivity across the district.

Problem Assessment
The investigation concluded that the district's main tile system, installed over 105 years ago, is inadequate for modern agricultural needs. The system is operating at only 60% of the recommended ½-inch per day drainage coefficient. This insufficient capacity, combined with the fact that over 99% of the district's soils are classified as poorly drained, results in delayed field operations, waterlogged soil, and significant crop yield limitations.

Proposed Solution
The recommended solution is a full tile improvement project involving the installation of a new main tile system and two lateral tiles. The proposed main tile route is more efficient than the original, serving all lands in the district. This new system is designed to meet the modern standard drainage capacity, providing a reliable, long-term solution for all landowners. The existing main tile will be connected to the new system to serve as a collector but will no longer be maintained by the district.

Project Cost
The total estimated cost for the proposed project is $1,257,000. The portion assessed to landowners for the tile improvements is approximately $884 per acre.

Implementation and Landowner Considerations
If approved, the project will be publicly bid, with construction potentially beginning this winter and concluding by March 2027. Costs will be allocated to landowners through a reclassification process to ensure assessments are proportional to the benefits received.

Recommendation
The existing drainage system has surpassed its functional lifespan and is a primary limiting factor for agricultural production within the district. We recommend that the Board of Trustees accept this report and schedule a public hearing to present the findings to all landowners. Should there be sufficient support, we further recommend proceeding with the preparation of final plans and specifications for construction.

Table of Contents

Introduction **3**
Overview 3
Location 3
Historical Considerations **3**
Prehistoric and Geologic Background 3
State-wide Drainage System Overview 3
County-Wide Drainage System Overview 4
Drainage District No. 169 Historical Overview 4
Historical Agricultural Demands 5
Environmental Considerations **5**
Flooding and Subsurface Drainage 5
Nutrient Loading and Subsurface Drainage 5
Climate and Weather Patterns 5
Watershed Characteristics **5**
District Landscape 5
Soils 6
Subsurface and Surface Water Flow Behavior 7
Private Drainage 7
Existing Infrastructure **7**
Field Survey 7
Existing Facilities 8
Existing Sizes and Capacities 9
Downstream Outlet 9
Proposed Project **9**
Project Design 9
Proposed Improvements 10
Preliminary Plans 11
Construction Considerations **12**
Pipe Construction Methods 12
Pipe Material Comparison 12
Related Construction Methods 13
Proposed Road Crossings 14
Existing District Tile 14
Utility Conflicts and Coordination 14
Construction Timeline 15
Estimated Costs and Analysis **15**
Cost Estimate 15
Historical Cost Comparison 15
Assessment Schedule Review 16
Installment Payment Options 16
Economic Benefit 17
Taxes 19
Permitting **19**
US Army Corps of Engineers (USACE) 19
Iowa Department of Natural Resources (DNR) 19
USDA Wetland Conservation Compliance (Swampbuster) 19
Water Quality Recommendations **19**
Conservation Practices 19
Iowa Nutrient Reduction Strategy 20
Edge-of-Field Practices 20
In-Field Practices 21
Maintenance and Long-Term Management **22**
Warranty Period 22
Work Orders 22
Landowner Considerations **22**
Public Input 22
Public Hearing on Report 22

Objections and Remonstrance 22
Landowner Construction Considerations 23
Right-of-Way and Work Areas 23
Construction Damages 23
Completion Hearing 24
Conclusion and Recommendations 24
Conclusion 24
Recommendations 24
Appendices 26
Appendix A – Petition Filed 26
Appendix B – Area of Study Map 27
Appendix C – Rainfall Chart: 1895-Present 28
Appendix D – Palmer Drought Severity Index: 1895- Present 29
Appendix E – Elevation Map 30
Appendix F – Depressional Areas 31
Appendix G – Soil Types 32
Appendix H – Soil Drainage Class 33
Appendix I – Soil Ksat 34
Appendix J – Depth to Water Table 35
Appendix K – Private Tile 36
Appendix L – Survey Photos 37
Appendix M – Itemized Cost Estimate 39
Appendix N – Current Assessment Schedule Map 41
Appendix O – Estimated Assessment Schedule 42
Appendix P – Iowa State Economic Returns from Tiling Spreadsheet 43
Appendix Q – Michigan State Drain Tool Estimated Yields 44
Appendix R – MNDWI Map 46
Appendix S – Ohio State Twenty Benefits of Improved Drainage 47
Appendix T – Nutrient Reduction Strategy Example 49
Appendix U – Landowner Engagement Letters 50
Appendix V – Right-of-Way Recommendation 53
Preliminary Plans

Introduction

Overview
Many Iowa landowners benefit from drainage infrastructure without day-to-day consideration of its operation. These systems, managed through legally established drainage districts, construct, repair, and maintain improvements such as tile lines and open ditches, allowing farmland to remain productive by controlling excess surface and subsurface water.

Drainage District No. 169 in Wright County, like many early 20th-century districts, was established to improve drainage in a wetter, less-developed landscape. The Wright County Board of Supervisors serves as trustees, overseeing maintenance and ensuring that improvements benefit all landowners within the district. Under Iowa Code Chapter 468, landowners have the right to petition for repairs or improvements. On November 5th, 2025, two landowners submitted such a petition requesting an evaluation of the existing tile system (Appendix A).

Once a valid petition is received, the Board hires a licensed engineer to conduct a preliminary study and prepare a report outlining possible improvements and associated costs. AgriVia was appointed on November 17th, 2025. This report presents the findings and recommendations resulting from that study and survey. The process is deliberate and transparent, with all landowners entitled to receive notice, review findings, attend hearings, and raise questions before any project proceeds.

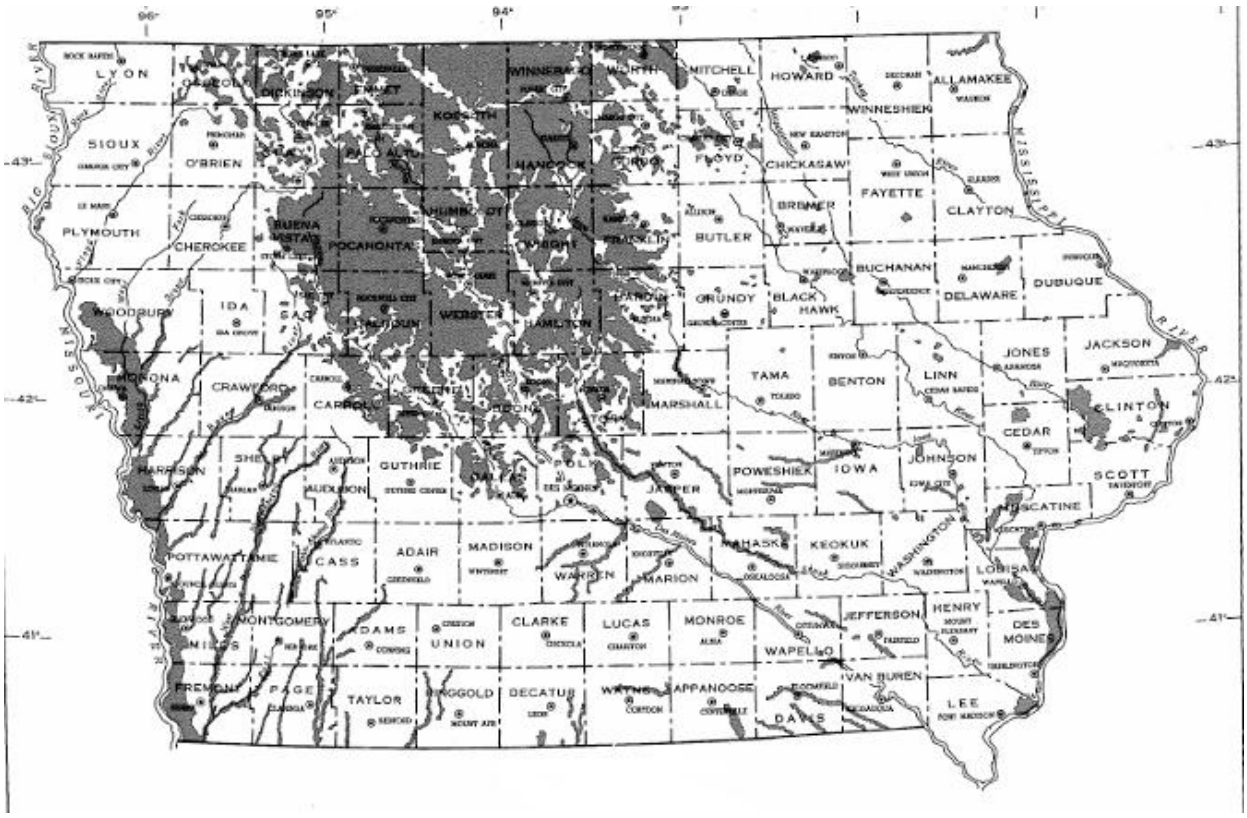
Location
Drainage District No. 169 spans lands in Sections 28-33 of Troy Township. The district lies approximately four miles west of Woolstock and five miles south of Eagle Grove. A map of the area of study is included in Appendix B.

Historical Considerations

Prehistoric and Geologic Background
Wright County, Iowa, lies within the Des Moines Lobe, shaped by the Wisconsin glaciation 12,000–15,000 years ago. Glaciers deposited clay-rich till, a dense mix of clay, silt, sand, and boulders, over older bedrock. This till forms the foundation of the region's soils and strongly affects drainage.

The glacial landscape is relatively flat, featuring end moraines, kames, eskers, and knob-and-kettle terrain with prairie potholes, shallow depressions that collect water. Combined with the low permeability of the till and limited natural drainage, these features cause frequent surface ponding.

State-wide Drainage System Overview
Artificial drainage in Iowa began in the late 1800s as settlers converted wetlands into farmland. Steam- and later gasoline-powered machinery accelerated these efforts. A 1904 constitutional amendment enabled the creation of drainage districts, allowing landowners to fund and manage large-scale drainage projects. By 1930, more than 9 million acres of wetlands had been converted to farmland.



Iowa Drainage Districts (1950 US Census of Agriculture)

The scale of Iowa's drainage efforts is striking. By 1912, investments in drainage likely exceeded U.S. spending on the Panama Canal, highlighting the significant labor and engineering required to reshape the landscape. Today, approximately 3,800 drainage districts maintain networks of ditches and tiles statewide.

County-Wide Drainage System Overview

Wright County is served by over 200 drainage districts, encompassing nearly 1,000 miles of tile and ditches and covering roughly 75% of Wright County. Most districts were established before 1930 and are undersized to meet the needs of modern farming practices.

Drainage District No. 169 Historical Overview

Drainage District No. 169 in Wright County was established to address persistent flooding and wetland conditions that limited agricultural productivity. Key events in the district's development include:

- 1917: Landowners petitioned to form the district. Engineer Charles Gross was appointed. District established and construction started.
- 1918: Classification schedule developed. The total assessment was $10,500.00.
- 1919: Construction completed.
- 1920: Levied assessments for construction.
- 1922: Levied assessment.
- 1975: Levied assessment of $639.24.
- 2012: Levied assessment of $7,483.61.

Historical Agricultural Demands

In the early 20th century, farms in Wright County were smaller and more diversified. They included a mix of row crops, small grains, hay, pasture, and livestock. Early drainage systems helped convert poorly drained land into pasture and upland areas into productive cropland.

Since then, agriculture in the county has changed dramatically. Most farms today span several hundred acres and operate in a corn–soybean rotation, which now accounts for over 90% of row-cropped land. For context, looking at the 1930s aerial photo, there were seven farmsteads within the Drainage District No. 169 boundary. Today, only one farmstead remains.

Environmental Considerations

Flooding and Subsurface Drainage

Subsurface drainage, while primarily installed to improve agronomic performance and soil workability, also plays a role in broader hydrological outcomes. A 2014 study conducted by the University of Iowa's IIHR—Hydroscience & Engineering Institute concluded that modern subsurface tile drainage systems can reduce peak flow rates during storm events. By gradually drawing down the water table and drying out soils, tile systems allow the soil to soak in more rainfall and delay the timing of runoff compared to surface flow, thereby attenuating flood peaks in receiving streams. This contradicts the common theory that tile drainage always increases flood risk.

Nutrient Loading and Subsurface Drainage

DD 169 lies in the Boone River watershed, where tile drainage supports row crops on heavy, poorly drained soils by removing excess water. However, tiles create direct paths for soluble nutrients, especially nitrate-nitrogen (NO_3^--N), to reach streams. Long-term monitoring by the Iowa DNR and USGS shows elevated nitrate levels in the Boone River during high tile flow periods. Tile drainage does not create nutrients but accelerates their movement, making nutrient management and conservation practices essential alongside drainage improvements to reduce nutrient loading and protect water quality.

Climate and Weather Patterns

Long-term weather records dating back to 1895 provide insight into shifting precipitation patterns, temperature trends, and drought cycles, all of which affect how water moves through fields and drainage systems.

Historically, Wright County has received 20 to 40 inches of rainfall per year, averaging around 31 inches (Appendix C). Since 1985, five years have exceeded 40 inches (1991, 1993, 2007, 2010, 2015), more than the four years that did so over the previous nine decades (1902, 1951, 1965, 1973). In addition to rising totals, rainfall has become more intense and unevenly distributed. Short, high-intensity storms delivering 2 to 4 inches in a single day are increasingly common, especially in spring and early summer.

The Palmer Drought Severity Index (PDSI) reflects this variability. While Wright County experienced major droughts in the 1930s, 1950s, and 2012; recent decades show more frequent wet periods and positive PDSI values (Appendix D), indicating above-normal soil moisture. At the same time, temperature records show moderate warming, especially in winter and early spring, leading to earlier snowmelt, altered freeze-thaw cycles, and longer growing seasons.

Watershed Characteristics

District Landscape

Drainage District No. 169 serves a relatively flat watershed without strongly defined drainage paths. The general flow of water in the west half of the district flows in a northeasterly and east direction. The east half of the district

flows to a more defined central drainage path that the district tile is laid in. The district tile outlets into a ditch that leads to a ravine that flows into the Boone River.

We used LiDAR (Light Detection and Ranging) to map the surface topography of the district. This technology uses laser pulses from aircraft to create highly accurate elevation maps of the ground surface. These maps help us identify where water naturally collects and how it moves across the land. An elevation map is included in Appendix E.

The surface watershed covers approximately 1,356 acres that naturally drain to the district via surface flow. However, not all tile-drained land lies within this area. Some acres are tile-drained out of the district, while others outside the surface watershed are tile-drained into it. In total, we have mapped 1,379 acres that benefit from the drainage district tile.

A detailed topographic analysis using 6-inch LiDAR contour data identified 215 depressional features within the watershed, covering approximately 120 acres. These low-lying areas collect water and lack natural surface outlets, significantly impacting drainage. They contribute to surface ponding during rain events, alter runoff patterns, and increase reliance on subsurface tile or surface inlets for effective water management. These depressions are mapped in Appendix F.

Historical aerial photos provide valuable insight into long-term drainage patterns and problem areas within the district. By examining past images, we can identify recurring issues such as drown-out spots, standing water, or poor crop growth, all of which are indicators of inadequate drainage.

Soils

Nearly all of the soils in Drainage District No. 169 are classified as clay loam, which tend to retain water and pose natural drainage challenges. The two dominant soil types, Webster clay loam and Canisteo clay loam, cover about 84% of the district. While highly fertile, these soils often lack natural drainage due to their fine texture and landscape position.

The USDA classifies Webster and Canisteo soils as poorly to very poorly drained, typically found in flat or depressional areas where water accumulates and moves slowly through the soil. Without artificial drainage, these areas are especially prone to saturation and waterlogging.

A detailed soil drainage class table is included below, and supporting soil type and soil drainage class maps are provided in Appendices G and H. Overall, over 99% of the soils in the watershed fall into the very poorly drained, poorly drained, or somewhat poorly drained categories. This highlights the critical need for artificial drainage to maintain productivity.

Soil Drainage Class		
Drain Class	**Acres**	**Percentage of Watershed**
Very Poorly Drained	38	2.8%
Poorly Drained	1,214	88.0%
Somewhat Poorly Drained	114	8.3%
Moderately Well Drained	13	0.9%
Well Drained	0	0%
Excessively Well Drained	0	0%

Subsurface and Surface Water Flow Behavior
Subsurface drainage works by collecting water through perforated pipes or the gaps between clay tiles installed below ground. As the soil becomes saturated, water moves laterally through the soil's pore spaces until it reaches the tile line, then enters through small openings and is conveyed to the district main. This process lowers the water table, improves soil aeration, and reduces surface runoff.

A key factor in drainage design is saturated hydraulic conductivity (Ksat)—a measure of how quickly water moves through saturated soil. Sandy soils have high Ksat values and drain quickly; clay soils, like those in District No. 169, have lower Ksat values and drain more slowly. Most soils in the district are clay loams with moderate to low Ksat values (Appendix I). These values are used to determine necessary drainage coefficients and guide tile spacing and depth for effective system design.

Surface water flow occurs when rainfall or snowmelt exceeds the soil's infiltration capacity, causing water to move downslope into channels or depressions. To model this, we use Curve Numbers (CN)—a standard method for estimating runoff based on land use, soil type, and moisture conditions. In District No. 169, CN values typically range from 82 to 85 for cultivated agricultural land with poorly drained soils. These values help in designing surface inlets, sizing ditches, and evaluating erosion control needs.

A map of seasonal high-water tables (Appendix J), based on USDA NRCS data, provides a general overview of how close groundwater may rise to the surface during wet periods.

Private Drainage
The primary purpose of a drainage district is to provide a legal and reliable outlet for both surface and subsurface drainage, allowing coordinated water management across multiple properties. While the district maintains shared infrastructure, such as main tile lines, individual landowners are responsible for installing and maintaining private tile systems to connect their land to the district outlet.

To better understand how private tiling interacts with the district system, we requested tile maps from landowners. Several responded with helpful documentation, which we reviewed and incorporated into our analysis (Appendix K). We also examined the original engineer's notes, which indicate that some private tile lines existed even before the district was formed. Additional information was gathered from historical and recent aerial imagery, and field surveys were conducted to locate surface tile intakes.

Through this combined effort, we identified the majority of the lands in the district are pattern tiles and approximately 440,000 feet of private tile have been installed within the district. The true extent is likely greater, as many older or undocumented tile lines are not visible or recorded.

Existing Infrastructure

Field Survey
The initial field survey of Drainage District No. 169 was completed in December of 2025. As part of this effort, we collected photographs of all major components and areas of interest throughout the district. Using high-accuracy GPS equipment, we measured the flowline elevations of the district tile at accessible points. These elevation measurements help us compare existing conditions with the original engineering plans and serve as reliable reference points moving forward.

We also documented the condition of major features including the outlet ditch, outlet tile, tile intakes, and concrete bulkhead. Many private surface intakes (where surface water enters the tile system) were also observed and recorded during the inspection. Photos taken during the field visit are included in Appendix L.

Existing Facilities

Outlet Ditch

The district tile outlets into an outlet ditch. The ditch is approximately 550 feet long extending to the Highway 17 culvert. At this culvert, the ditch turns into a ravine. This outlet ditch, though not considered a district facility at its formation, is essential to the district drainage. It was surveyed and found to be in poor condition. It is very wide bottomed, and grasses were growing on the bottom. A few small trees are growing along the sides. It was found to have a grade of approximately 0.17% from the ditch bottom on the upper end to the culvert flowline.

Main Tile

The main tile outlets into the outlet ditch in the southeast quarter of the southeast quarter of Section 28. From there, the tile runs in a westerly direction, generally following the low point for approximately 1,000 feet and then goes in a northwest direction for approximately 1,300 feet. It then crosses into the southwest quarter of Section 28 and continues in a westerly direction for approximately 1,600 feet to its terminus ending in the SW¼ SW¼ of Section 28.

The original tile was laid at a nearly consistent grade of 0.17% for the lower 3,800 feet, and then the upper end was laid at 0.60%. Because of the district's shape and natural slope, the main tile consists of the following sections:

- 30"- 1,400'
- 28"- 800'
- 24"- 1,600'
- 22"- 400'

Lateral Branches

In addition to the main tile, the district includes four smaller lateral tiles that connect into the system. Each lateral tile is listed below:

- **Lateral A**
  A 14-inch tile that connects near the upper end of the main tile and runs north for 600 feet. A 14" private tile is shown on the establishment plat that connects into the upper end of the Lateral A tile.

- **Lateral B**
  The longest branch in the district. It connects to the main tile approximately 2,000 feet upstream of the main outlet and runs northwest, ending in the SW NW of Section 28 near Calhoun Avenue. It goes from 18-inch tile down to 6-inch tile over its approximately 4,600 feet total length.

- **Lateral C**
  It connects to Lateral B and runs northerly ending at the center of Section 28. It includes 400 feet of 8" tile and 300 feet of 6" tile.

- **Lateral D**
  Connects into the main tile in the SESE of Section 28, about 300 feet upstream of the main tile outlet. It consists of a 10" tile running north for approximately 200 feet.

Upstream Private Tile

The western half of the district currently doesn't have a district tile serving those lands directly. At the time of establishment, a 15" tile served these lands and is drawn on the district plat. There is no information on the grade

or age of this tile. A private tile map of the southeast quarter of Section 29 appears to show the old 15" tile was replaced with a 24" dual wall tile from Calhoun Avenue curving south to 330th Street and a 15" dual wall tile was installed to serve the lands Section 29 north of the 24" dual wall tile. The 24" tile once crossing Calhoun Avenue at some point becomes a 16" tile and then 12" tile when it crosses Buchanan Avenue.

There was private interest in installing a new private tile to replace the district and private tile prior to the petition being filed.

Existing Sizes and Capacities

The overall condition of the tile system is defined by the hydraulic performance for each section, which includes pipe diameter, drainage coefficient, and the percentage relative to the modern standard drainage coefficient (½ in/day). These parameters are important for understanding the system's capacity to convey water flow relative to current standards. The table below provides a summary of these key attributes for each section of the tile system.

Drainage District No. 169 Existing Tile Capacity				
Section Name	**Diameter (inches)**	**Grade (%)**	**Drainage Coefficient (in/day)**	**Percentage of Modern Standard**
Main (Stations 0-14)	30	0.17	0.30	60%
Main (Stations 14-22)	28	0.17	0.30	60%
Main (Stations 22-38)	24	0.17	0.25	50%
Main (Stations 38-42)	22	0.60	0.41	82%
Lateral A (Stations 0-6)	14	0.40	1.56	312%
Lateral B (Stations 0-9)	18	0.10	0.41	82%
Lateral B (Stations 9-13)	15	0.10	0.41	82%
Lateral B (Stations 13-20)	14	0.68	0.97	194%
Lateral B (Stations 20-28)	12	0.20	0.40	80%
Lateral B (Stations 28-40)	10	0.20	0.34	68%
Lateral B (Stations 40-46)	6	0.20	0.26	52%
Lateral C (Stations 0-4)	8	0.40	0.44	88%
Lateral C (Stations 4-7)	6	1.00	0.33	66%
Lateral D (Stations 0-2)	10	0.20	0.40	80%

Downstream Outlet

Drainage District No. 169 outlet ditch outlets into a ravine that outlets into the Boone River, located in Section 34 of Troy Township. The Boone River is a significant tributary, stretching approximately 111 miles in length and draining a watershed area of about 895 square miles. It flows south, joining the Des Moines River near Stratford, Iowa. The lower 26 miles of the Boone River are designated a "Protected Water area" by the Iowa Department of Natural Resources.

Proposed Project

Project Design

As the engineer tasked with designing the drainage district tile system, we followed established standards from the American Society of Agricultural and Biological Engineers (ASABE), the Natural Resources Conservation Service (NRCS), and Iowa State University Extension and Outreach.

The drainage coefficient, the amount of water in inches per day that the system is designed to remove from the land, is the key factor in tile main design. Typical recommended values range from ⅜ to 1 inch per day, depending on soil type, topography, and crop needs. This system was designed to achieve a drainage coefficient of ½ inch

per day, which is the standard recommendation for Iowa's mineral soils under row crop production, as outlined in the Iowa Drainage Guide. A 1" drainage coefficient was considered due to the number of depressional areas with surface intakes within the watershed; however, the return on investment for such a large tile is unfavorable.

Pipe grade (or slope) is crucial in determining the correct tile size. A steeper grade allows for greater flow capacity, enabling the use of smaller diameter pipes, while flatter grades require larger pipe to maintain the same capacity. Manning's equation, using a roughness coefficient of 0.012 (consistent with NRCS and ASABE standards for smooth-walled plastic pipe and RCP), was used to size the tile based on this relationship.

Proposed Improvements
We are proposing a full tile improvement project designed to meet the district's ½" Drainage Coefficient (D.C.) requirements.

Outlet Ditch
The existing outlet ditch is in poor condition, with the flowline currently lower than the downstream culvert, major vegetation growth, and sloughed banks in places. The downstream culvert invert is at Elevation 1100.037. To establish a uniform grade over a length of approximately 560 feet, a minor cleanout is proposed. This work will consist of removing islands and meanders to restore a consistent and uniform channel profile.

Main Tile
The proposed main tile will outlet into the open ditch in the SE¼ SE¼ of Section 28 at Elevation 1102.5, which is approximately 1.2 feet above the bottom of the ditch and 0.8 feet lower than the existing district tile outlet. From the outlet, the tile runs westerly, generally parallel to the existing district tile. It continues west to northwest after its junction with Lateral No. 1. After crossing the centerline of Section 28, the alignment shifts to a due west direction. At Lateral A, the tile turns northwest and continues toward Calhoun Avenue, which it crosses into Section 29. From this point, the proposed tile replaces an existing private tile, running west and then southwest through the SE¼ of Section 29. Upon entering Section 32, the alignment continues southwest for approximately 1,500 feet, then turns due west, crossing Buchanan Avenue. Immediately west of Buchanan Avenue, the tile turns 90 degrees and runs parallel to the roadway for approximately 600 feet within Section 31, where it terminates in the SE¼ NE¼ of Section 31. The proposed route generally follows the natural surface drainage pattern of the district, paralleling the existing tile while straightening the alignment where feasible to improve grade and reduce construction costs.

Lateral No. 1
The proposed Lateral No. 1 connects to the main tile at Station 12+75 and proceeds in a southwest direction to 330th Street. At that point, the alignment turns due south and continues to its terminus in the NW¼ NE¼ of Section 33.

Lateral No. 2
The proposed Lateral No. 2 connects to the main tile on the east side of Buchanan Avenue in the SW¼ NW¼ of Section 32. From this connection, it runs due north for approximately 850 feet and terminates in the NW¼ NW¼ of Section 32.

The tile sizes, and grades of the proposed tiles are listed in the table below:

Proposed Tiles Size and Grade		
Section Name	**Diameter (inches)**	**Grade (%)**
Main (Stations 00-13)	36	0.16
Main (Stations 13-21)	30	0.30
Main (Stations 21-36)	30	0.20
Main (Stations 36-43)	30	0.19
Main (Stations 43-50)	30	0.17
Main (Stations 50-64)	30	0.16
Main (Stations 64-78)	30	0.12
Main (Stations 78-88)	24	0.20
Main (Stations 88-97)	24	0.10
Main (Stations 97-102)	24	0.08
Main (Stations 102-108)	18	0.23
Main (Stations 108-117)	18	0.12
Main (Stations 117-122)	12	0.30
Lateral No. 1 (Stations 00-01)	15	0.30
Lateral No. 1 (Stations 01-07)	12	0.60
Lateral No. 2 (Stations 00-09)	12	0.15

Existing Lateral Tiles

Lateral A is proposed to be replaced in its entirety by the new main tile and will no longer function as a separate lateral.

Laterals B and C are currently operating at an estimated drainage coefficient of 0.41 inches per day, which is approximately 80 percent of the recommended capacity. The contributing landowner has undertaken extensive private tiling improvements in this area, including installation of submains to supplement drainage performance. Based on these conditions, we do not recommend construction of a new district lateral at this time. These laterals serve a single landowner, and existing performance is considered adequate. A replacement lateral could be included as an alternate if desired; however, any associated costs should be borne entirely by the benefiting landowner.

Lateral D is in a similar condition, currently operating at approximately 80 percent of the recommended drainage coefficient. This lateral also serves a single landowner who has installed a private submain to improve drainage. In the event of failure, the existing lateral could be readily replaced with a private line. Accordingly, we do not recommend district-funded replacement of Lateral D at this time.

The proposed extension of the main tile, together with the addition of the two new lateral tiles, is expected to provide improved overall drainage and a more favorable economic return to the district's landowners compared to minor upsizing of the existing laterals.

Preliminary Plans

The proposed construction plans are enclosed with this report. These plans serve as a guide for the contractor and outline the expectations and standards for construction. Included in the plans are the proposed work limits and specific work expected to take place on each landowner's property. The plans also contain profile views showing the proposed depth of the existing and proposed tile. These plans are considered preliminary, and may be refined prior to final bidding.

Construction Considerations

Pipe Construction Methods
Drainage district pipe will be installed using open-cut excavation and follow Iowa SUDAS standards for storm sewers and culverts. Either reinforced concrete pipe (RCP) or plastic dual-wall pipe (HDPE) may be used, depending on cost, size, and conditions.

Topsoil will be stripped and set aside for final backfill. For RCP, where possible, a shaped "spoon bed" will be used for support without requiring rock. For large HDPE, crushed stone will be placed around the pipe per SUDAS standards.

RCP will be laid in sections and curved using slight joint offsets. Large HDPE will be installed in straight runs with elbows for turns, and joints fused or coupled. Grade and alignment will be controlled using laser or GPS equipment.

Trenches will be backfilled to match the original ground level, and the topsoil will be replaced and seeded with a cover crop to prevent erosion. No compaction testing is required.

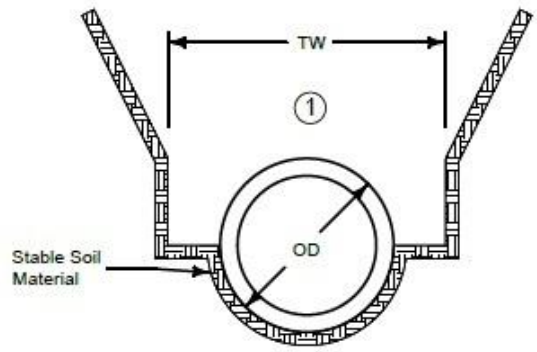
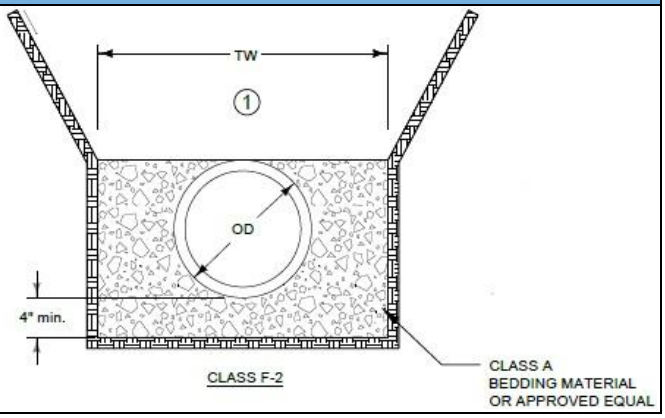
HDPE pipe will be tested after backfilling to ensure it has not deformed beyond 5%. RCP will be visually inspected for joint tightness and alignment. All work will be documented and final as-built plans provided.

Pipe Material Comparison
For the drainage district project, both reinforced concrete pipe (RCP) and plastic dual-wall pipe (HDPE) will be included in the bid package so the final selection can balance cost and performance based on site conditions, following Iowa DOT and SUDAS specifications.

- **Reinforced Concrete Pipe (RCP):**
  - Stiff and durable, supporting heavy loads in poor soils.
  - Expected design life over 100 years, resistant to corrosion and abrasion.
  - Can be installed using native soil for bedding, reducing material costs, and simplifying construction.
  - Can handle gentle curves without extra fittings.

- **HDPE Plastic Pipe:**
  - Lightweight, easier to handle, with a design life of about 50 years.
  - Requires granular (rock) bedding, increasing trucking, compaction, and quality control needs.
  - Prefabricated elbows and straight runs limit alignment flexibility.

While RCP has a higher material cost, it can reduce installation complexity and long-term maintenance. HDPE may be cheaper initially but demands more oversight and bedding materials. The final choice will depend on soil conditions, alignment requirements, and balancing initial versus long-term costs.

Typical RCP Installation	Typical HDPE Installation
	

Related Construction Methods
The following are common additional items for a tile project:

- **Tile Connections**
  Private tiles will be connected to the new district tile using Inserta-Tees for a secure fit. Disturbance will be minimized, with 3 tons of rock used for backfilling. Each connection will be documented with a photo and marked on the final plans.

- **Elbows**
  HDPE requires elbows for changes in direction, as it must be laid in straight runs. RCP can curve slightly without fittings. Elbows have a slightly reduced flow capacity by comparison.

- **Reducers**
  Reducers connect pipes of different sizes. RCP reducers will be precast; HDPE reducers will be fused or coupled. All will be bedded in rock.

- **Intakes**
  12” Hickenbottom or Bar Guard intakes will be placed in road ditches, and 12” Bar Guard intakes on property lines. These intakes let ponded surface water enter the system and allow visual inspection of the tile.

- **Bedding Rock**
  HDPE pipe requires rock bedding (crushed stone or gravel) from 4 inches below the pipe to the top. RCP will use shaped native soil ("spoon bed") and typically will not need rock. Rock is used in poor soil conditions and to bed fittings and connections.

- **Pollution Control**
  The contractor will be responsible for minimizing pollution and erosion during construction, under the engineer’s direction.

- **Seeding**
  The 100-foot-wide work area will be seeded with a cover crop after construction to reduce erosion, improve soil health, and break up compaction. Landowners may terminate the cover crop at their discretion.

- **Tile Exploration**
  Existing district tiles will be located and exposed to ensure proper alignment and connections. Each will be measured, marked, and documented.

- **Removal of Fence**
  Fences crossed during tile installation will only be replaced if used for pasture. Four pasture fences are known; others will not be replaced unless landowners submit a written request before project approval.

- **Single Wall Corrugated Plastic Tile**
  If a private tile connection is far from the main line, single-wall plastic tile will be installed to reach it. These extensions will be noted on the plans and photographed.

- **Driveway Restoration**
  If a landowner's driveway is used for access, approximately 12 tons of rock will be placed to protect it during construction. Once the project is complete, the driveway will be regraded to its original condition. Photos will be taken before and after to document the work.

- **Mobilization**
  Mobilization includes transporting equipment and materials to the site, setting up access, and preparing staging areas. After work is complete, all equipment will be removed and the site cleaned up.

Proposed Road Crossings
The proposed Main Tile will cross three gravel roads. Proposed Lateral No. 1 will cross one gravel road. Typically, gravel roads are crossed via open cutting the road and repairing the road as opposed to boring. Each county road crossing will include a 12" intake in each road ditch. Under Iowa Code §468, the cost of road crossings is the responsibility of the entity that controls the road. A table of all crossings is provided below.

Proposed Road Crossings				
Control Entity	**Road**	**Facility**	**Tile Size (inches)**	**Method**
Wright County	Calhoun Avenue	Main	30"	Open Cut
Wright County	330th Street	Main	30"	Open Cut
Wright County	Buchanan Avenue	Main	18"	Open Cut
Wright County	330th Street	Lateral No. 1	12"	Open Cut

Existing District Tile
If a new tile system is installed, the old district tile will remain in place but will no longer be maintained by the district. It will be connected to the new tile about every 1,000 feet to serve as a collector, which reduces the number of connections needed and saves the district money. Because the old tile is no longer a district responsibility, individual landowners will take over ownership and maintenance.

Utility Conflicts and Coordination
A Design One Call was completed on December 11, 2025, identifying only electrical and fiber utilities within the project area as shown on the preliminary plans. All are located within existing public road rights-of-way.

Under Iowa Code §468.186, utilities within a drainage district's right-of-way must accommodate drainage work. The district's tile system predates the utilities, so any necessary utility relocation must be done at the utility's expense.

Before construction begins, the contractor will complete a Construction One Call to ensure all utilities are properly located and marked, helping prevent conflicts and maintain a safe worksite.

Construction Timeline

If approved, we anticipate the work to bid this fall with a completion date of March 2027. While contractors must finish all work by this deadline, they are free to choose their own construction schedule.

The timeline is intentionally flexible to attract more qualified contractors and encourage competitive bidding, which can lower project costs. Some contractors prefer summer work due to better weather, while others choose winter work to avoid crop damage when fields are dormant.

Estimated Costs and Analysis

Cost Estimate

The total estimated cost for all proposed work is $1,257,000. This figure includes all anticipated construction activities, damages, engineering services, and administrative expenses. The breakdown is as follows:

Activity	Cost
Main Tile Construction	$941,000
Lateral No. 1 Construction	$20,000
Lateral No. 2 Construction	$22,000
Wright County Secondary Roads	$38,000
Engineering	$85,000
Construction Damages	$53,000
Other Expenses (Legal, Administrative, and Interest)	$98,000

This is a preliminary engineer's estimate, prepared for planning purposes. Costs are based on recent bid tab data from comparable projects and include allowances for contingency and administrative expenses. Final construction costs will depend on market conditions at the time of bidding and may vary from this estimate.

A detailed itemization of costs is provided in Appendix M.

Historical Cost Comparison

The all-inclusive estimated cost to landowners for the main tile and laterals is $1,219,000 or approximately $884 per acre. In 1917, the total cost of the tile project was $10,500 or approximately $8 per acre.

Drainage District No. 169 Historical Cost Comparison					
Year	Avg. Assessment Per Acre	Avg. Land Value Per Acre	Assessment Relative to Land Value	Avg. Revenue Per Acre for Corn Crop	Assessment Relative to Yearly Corn Revenue
1917	$8	$160	5%	$26	31%
2025	$884	$12,712	7%	$836*	105%

*2024 Corn Yield data was used for 2025; no 2025 yield data was available.

For a true apples-to-apples comparison, we evaluated the estimated landowners' construction-only costs for the proposed main tile improvements using modern materials, methods, and cost data for the 1917 design in comparison to the current proposed design. The 1917 design did not meet the recommended ½-inch drainage coefficient standard. Notably, it ended in Section 28 relying on an older private tile to serve the lands upstream,

in comparison to our proposal to extend the main tile farther. The proposed project extends the main tile to better serve the lands in the upper 2/3 of the district.

Modern Cost Figures Comparison (Estimated Main Tile Construction Only)		
Year	**Construction Costs**	**Drainage Coefficient Percent of Recommended**
1917	$400,000	60% to Lower Lands, Relying on Private Tile for Upper Lands
2025	$941,000	100% for Lower and Upper Lands

Assessment Schedule Review
Any costs to the district are shared by landowners based on the benefit their property receives. To ensure fairness, an assessment schedule is maintained so all expenses are allocated proportionally to the level of benefit each parcel gains from the drainage system.

The current assessment schedule is based on the original 1918 report and has not been updated in over 100 years. It does not reflect changes to the district since that time. If landowners choose to move forward with an improvement project, Iowa law requires the district to be reclassified so costs are shared fairly based on the benefits each parcel receives. The original schedule is included in Appendix N.

Under Iowa Code §468.38, the Board of Trustees will appoint an engineer and two neutral landowners to serve as reclassification commissioners. This team evaluates all land in the district and assigns a value based on the drainage benefit, not on market value, ownership, or acreage. For example, low-lying farmland near the tile typically receives the highest value (set at 100), while higher or more distant land receives proportionally lower values. Roads, farmsteads, and non-farm areas are also evaluated based on how much they benefit from drainage.

Today, tools like LiDAR mapping, soil surveys, aerial photos, and GIS data make this process much more accurate and fairer than when the original schedule was created. Field checks and on-site visits may also be used. Once complete, the proposed classification is shared with landowners and reviewed at a public hearing before it is finalized.

As part of reclassification, we also identify any land outside the current district boundary that benefits from the system but is not being assessed. If surface or subsurface drainage from nearby land flows through district tile, those parcels are benefiting and may be annexed into the district under Iowa Code § 468.119. Annexation ensures all landowners who benefit share in the cost. Affected landowners will be notified and have a chance to speak at a public hearing before any changes are made.

An estimated reclassification map is included in Appendix O to provide an updated view from the existing 1918 schedule. This map is for planning and estimation purposes only and is not a formal reclassification. The commission may adjust, modify, or reject this estimate, and it should not be considered a guarantee of your final assessment.

Installment Payment Options
Under Iowa drainage law, landowners who are assessed for substantial improvements may be eligible to pay their assessment over time. The Board of Trustees may authorize an installment payment plan with interest, allowing landowners to repay the assessment annually over a period of up to 20 years.

To take advantage of this option, a formal waiver request must be submitted. There is no penalty for early repayment, and landowners who wish to avoid interest may pay the full amount up front or consider private financing alternatives.

Economic Benefit

We understand every farm is different, and each landowner's financial situation is unique. This section is meant to provide a starting point, not a guarantee, so you can evaluate whether drainage improvements make sense for your operation. We have reviewed reliable university research and used available tools to estimate the potential benefits, but actual results will depend on your specific field conditions.

Most of the economic benefit from tile drainage comes from higher yields and increased land value. According to Iowa State University Extension's Understanding the Economics of Tile Drainage (2023), tile drainage can increase corn yields by 10–20 bushels per acre and soybean yields by 4–8 bushels per acre, depending on soil and weather.

Using ISU's Excel-based calculator, we estimate an annual return of roughly 16.4% for corn and 11.2% for soybeans on a $884/acre drainage investment, assuming $4.31 corn and $10.09 soybean commodity prices. This calculator, along with our example, is available in Appendix P, and you can try it yourself at: extension.iastate.edu/agdm/wholefarm/xls/c2-90tilinganalysis.xlsx. We have included a table summarizing the estimated returns below:

Drainage District No. 169 Economic Analysis (Iowa State University Calculator)		
Avg. Assessment Per Acre	**Avg. Increased Revenue per Year**	**Estimated Annual Rate of Return**
$884	$117	13.3%

The publication also notes important secondary benefits such as earlier planting and harvesting windows, reduced compaction, and more timely field operations. These factors can improve efficiency and reduce risk, especially in wetter growing seasons.

We also reviewed a 1983 ISU study (Drainage Needs and Returns in North-Central Iowa). It found that very poorly and poorly drained soils, like those covering about 91% of District No. 169, can lose up to 32% of their yield potential without proper drainage. Installing tile in these areas often showed strong economic returns, with benefit-cost ratios greater than 1. However, returns were lower in somewhat poorly drained soils, so prioritizing the worst-drained areas offers the best value. We included the estimated yield table below. Please note corn and soybean yields were much lower in the 1980s than they are today.

	Poor Drainage (Less than ¼" Drainage Coefficient)		High Drainage (½" Drainage Coefficient)		Percent Increase	
Soil Drainage Class	**Corn Yield (bu/acre)**	**Soybeans Yield (bu/acre)**	**Corn Yield (bu/acre)**	**Soybeans Yield (bu/acre)**	**Corn Yield**	**Soybeans Yield**
Very Poorly Drained	28	12	123	48	339%	300%
Poorly Drained	80	31	121	47	51%	52%
Somewhat Poorly Drained	90	34	124	48	38%	41%

The Iowa State 1983 study also points out that many existing drainage systems in the region, installed between 1900 and 1915, are outdated and inadequate by modern standards. They are often the bottleneck of the drainage system as they estimated 69% of private on-farm drainage is adequate.

To estimate the potential crop yield benefits of the proposed drainage improvement, a hydrologic analysis was performed using the Drain Tool developed by Michigan State University

(https://dsiweb.cse.msu.edu/DrainToolApp/). This tool runs DRAINMOD simulations over a 29-year climate record (1996–2024), calculating crop yield impacts from three stress factors, planting delay, excess soil water stress, and drought stress, each expressed as a percentage of maximum potential yield. The existing condition was modeled at a drainage coefficient of 0.3 inches per day, representing the current district tile capacity, and compared against a design coefficient of 0.5 inches per day. Using potential yields of 250 bushels per acre for corn and 70 bushels per acre for soybean, the model estimates an average yield increase of 11.9 bushels per acre for corn and 2.2 bushels per acre for soybean. The year-by-year results, included as a chart in Appendix Q, show that gains are concentrated in wet years when excess soil water is the dominant stress.

Drainage District No. 169 Economic Analysis (Michigan State University Calculator)		
Avg. Assessment Per Acre	**Avg. Increased Revenue per Year**	**Estimated Annual Rate of Return**
$884	$37	4.2%

A 2026 Iowa State University study looked at five drainage districts in north-central Iowa that recently upgraded their main outlets to modern standards. Using satellite images taken after major rainstorms, the researchers compared improved districts to nearby unimproved ones. Ponded acres dropped by an average of 87% after the upgrades, and the projects paid for themselves in about 18 years on average based on reduced ponding alone, before accounting for the broader district-wide yield gains the researchers also documented (up to 10% for corn and 12% for soybeans).

We used the same satellite method to look at DD 169 on five dates between 2018 and 2025, each one captured 1 to 4 days after a major rain event of at least 4 inches in the previous 10 days. Three dates showed approximately 2 acres of ponding, and two dates showed no detectable ponding. Compared to the Iowa State study, these numbers put DD 169 in the range of districts that have already been improved, rather than the unimproved districts.

An MNDWI (Modified Normalized Difference Water Index) map (Appendix R) illustrates the analysis for one of the dates analyzed. Areas with higher MNDWI values, even those still below the ponding threshold, indicate wetter surface conditions, including saturated soils and stressed crop canopies where wet ground shows through thin or struggling stands. These are the acres where outlet capacity improvements are most likely to drive yield gains. The Iowa State researchers stressed that most of the yield benefit from improvements comes from these less-visible effects spread across the entire district, not just from eliminating the few obvious ponded spots.

Long-term research from Ohio State University (1984–2009) showed the value of tile drainage. Corn yields rose by 24–39% and soybeans by 12–45% on tiled fields. Benefit-cost ratios ranged from 1.7:1 to 3.1:1, with newer models suggesting returns as high as 3:1 to 4:1. This means $3–$4 in value for every $1 spent on tile.

While results will vary depending on your soil, crops, and management, research from Iowa State and Ohio State shows that modern tile drainage can significantly boost yields and improve long-term farm value, especially in poorly drained soils like those across Drainage District No. 169. We have included “Twenty Benefits of Drainage” prepared by the Ohio State Extension highlighting yield and non-yield benefits of drainage in Appendix S.

We understand that drainage is a major investment, and the decision is personal. The data and tools in this report are meant to help you get started. We encourage you to use the Iowa State calculator or Michigan State Drain Tool with your own numbers and consider how improved drainage could benefit your farm’s productivity, value, and long-term resilience. To get a better sense of your own farm’s potential, we recommend comparing yield maps of well-drained and poorly drained areas. These maps can help estimate potential gains from new tile. If you are

interested, we can help you create overlays that combine yield data, soil types, and proposed tile layouts. These tools help guide your decision but should be viewed as estimates, not guarantees.

Taxes
While the district is not authorized to provide tax advice, landowners are encouraged to consult with their accountant or tax advisor to determine whether drainage assessments or related improvements may be deductible or eligible for depreciation under current tax laws.

Permitting

US Army Corps of Engineers (USACE)
A Section 404 permit is required only when work places dredged or fill material into a "water of the United States," which is limited to relatively permanent streams, lakes, and wetlands directly connected to them. The receiving channel here is a privately constructed agricultural drainage ditch, and the downstream ravine carries flow only in response to rainfall events; neither qualifies as a federally regulated water. The proposed outlet work therefore does not require a Section 404 permit from the Army Corps of Engineers or a related Section 401 water quality certification.

Iowa Department of Natural Resources (DNR)
The new drainage district tile is a buried linear utility, which is exempt from Iowa DNR floodplain permitting under 567 IAC 71.4(4) as long as the natural channel contours are restored after construction. The minor outlet work falls well below the regulatory thresholds for excavations and obstructions in rural areas, and the receiving channel is not a designated Protected Stream. No state floodplain permit is therefore required for the proposed work.

USDA Wetland Conservation Compliance (Swampbuster)
As part of federal conservation compliance requirements under the Food Security Act of 1985, any landowner participating in USDA programs including crop insurance, commodity payments, or CRP must obtain a valid Certified Wetland Determination from the Natural Resources Conservation Service (NRCS) before undertaking drainage improvements that may affect wetland areas. These determinations identify areas that meet federal criteria for wetland protection based on hydric soils, vegetation, and hydrology.

It is the landowner's responsibility to ensure their compliance with NRCS requirements. Affected landowners have been encouraged, via letter sent on November 25th, 2025, to request a determination as early as possible. This proactive step helps avoid future conflicts, particularly if a tile improvement project affects areas that may qualify as wetlands under federal definitions.

Water Quality Recommendations

Conservation Practices
Farmers in Wright County have made steady progress in adopting conservation practices that protect soil health and improve water quality. While most conservation measures aim to reduce in-field erosion, they also provide well-documented benefits to downstream water systems.

As of the 2024 Census of Agriculture, about 13,500 acres, roughly 4% of the county's farmland, is enrolled in the Conservation Reserve Program (CRP). These areas are planted with perennial vegetation to reduce erosion, slow runoff, and filter nutrients before they reach nearby waterways. Many include riparian buffers, filter strips, or wetland restorations, which help protect drainage outlets and reduce the movement of sediment and nutrients downstream.

In-field practices like no-till and cover crops have also expanded slowly. Between 2017 and 2022, no-till acres increased from 16,739 to 17,597 acres, while cover crop use grew from 5,395 to 7,014 acres. These practices improve water infiltration, limit erosion, and help retain nutrients in the soil, particularly during snowmelt and heavy rains.

Iowa Nutrient Reduction Strategy

Iowa's Nutrient Reduction Strategy (NRS) aims to reduce nitrogen and phosphorus runoff from farmland using a combination of in-field practices (cover crops, nutrient management, reduced tillage) and edge-of-field practices (wetlands, bioreactors, controlled drainage).

Effectively designed drainage works with the NRS by moving water efficiently while allowing nutrient-reducing practices to function effectively. For example, drainage paired with controlled outlets or bioreactors can capture and treat nutrients before they leave the field. Appendix T includes a table of potential practices that can be used alongside drainage improvements, showing options to meet nutrient reduction goals while maintaining productivity and soil health. If any landowner is interested, we can provide a copy of the spreadsheet for use on their farm.

Edge-of-Field Practices

- **Buffer Strips**
  Grass buffer strips along streambanks and ditches are one of the most effective ways to intercept runoff. These vegetated zones filter sediment, absorb nutrients like nitrogen and phosphorus, and reduce pesticide transport. They also stabilize stream banks, minimize erosion, and provide habitat for pollinators and wildlife.

- **Grassed Waterways**
  For fields with concentrated flow paths, grassed waterways help prevent gully formation and safely carry runoff away from cropland. Their dense vegetation reduces water velocity, limits soil loss, and improves downstream water quality. University of Illinois research (2018) showed that grassed waterways decreased gully erosion by up to 75%.

- **Constructed Wetlands**
  Constructed wetlands are engineered systems designed to intercept surface or subsurface drainage before it enters ditches or streams. By slowing water flow, they promote the natural removal of nitrates through microbial activity in the soil. In addition to improving downstream water quality, these systems provide valuable habitat for aquatic life, waterfowl, and other wildlife.

- **Saturated Buffers and Bioreactors**
  Saturated buffers and woodchip bioreactors are designed to treat water from subsurface tile outlets before it reaches open water. Saturated buffers route tile water through vegetated riparian areas where soil microbes and plants naturally reduce nitrate levels. Bioreactors use buried woodchips to create an anaerobic zone that encourages denitrification.

  Research from Iowa State University (2016–2020) found that saturated buffers reduced nitrate concentrations in drainage water by 40–80%, while bioreactors achieved 20–40% nitrate reduction. Both options are effective tools for addressing nitrogen loss from tile-drained fields.

In-Field Practices

- **Cover Crops**
  Cover crops, such as cereal rye, clover, or radish, are planted after harvest to protect the soil during the off-season. Their root systems reduce erosion, improve soil structure, promote microbial activity, and capture residual nutrients, particularly nitrogen, before they leach into tile systems.

  A 2017–2021 University of Minnesota study found that cover crops reduced nitrate leaching by 30–60% in tile-drained fields and increased soil organic matter by 0.5–1% over five years, supporting both environmental and agronomic benefits.

- **Conservation Tillage or No-Till**
  Reducing tillage helps maintain soil structure, increase organic matter, and reduce erosion and runoff. Better soil structure improves water infiltration, and crop residue left on the surface protects the soil during rainfall events.

  An Ohio State University study examining conventional tillage, no-till, and strip-till systems found that conservation tillage performed best when paired with subsurface drainage. No-till and strip-till fields retained higher soil structure and moisture balance, reduced erosion, and improved crop trafficability. In drained fields, corn-soybean rotations under no-till produced the highest yield benefit, while continuous corn also showed consistent improvements. The study concluded that subsurface drainage not only improved yields directly but also enhanced the effectiveness of conservation tillage systems by improving field conditions.

- **Precision Nutrient Management**
  Precision agriculture tools like soil sampling, yield mapping, and variable rate technology (VRT) allow targeted application of fertilizers and pesticides. This approach reduces the risk of nutrient runoff, improves fertilizer use efficiency, and increases profit margins by applying inputs only where they are needed.

- **Diversified Crop Rotations**
  Rotating corn and soybeans with small grains (e.g., oats or wheat) or forage crops can improve soil health, break pest and disease cycles, and reduce nitrogen imbalances. These rotations increase biological diversity in the field and may open fresh marketing opportunities or enhance farm resilience. A 2019 Kansas State University study reported that diversified rotations reduced nitrogen leaching by 20–30% and improved soil health metrics by 15–25%.

- **Split Nitrogen Applications and Stabilizers**
  Applying nitrogen in multiple smaller doses throughout the growing season, instead of a single application, reduces the chance of leaching. Using nitrogen stabilizers or inhibitors further minimizes loss by keeping nutrients in forms more available for plant uptake.

Cost-share funding is often available to help implement these practices. The Iowa Agriculture Water Alliance hosts an online tool- https://costsharecompare.com/ where landowners can search for financial assistance by ZIP code, compare multiple programs, and identify opportunities to stack funding sources for greater return on investment.

Well-maintained drainage systems improve field conditions for conservation by reducing compaction and allowing timely planting, while conservation practices help drainage systems by limiting sediment buildup and

nutrient loading. Although the Drainage District cannot require conservation measures, we strongly encourage landowners to work with their local NRCS office to explore available options. In-field and edge-of-field practices can reduce erosion, improve water quality, lower input costs, and support long-term soil health. Many are backed by research and may qualify for financial assistance through programs like EQIP, CSP, and the Iowa Water Quality Initiative.

Maintenance and Long-Term Management

Warranty Period
It is common for tile connections to be missed or for other issues to arise during or shortly after construction. To address this, the drainage district will maintain a one-year warranty with the contractor to cover construction-related errors or unforeseen problems. If a landowner observes an issue during this period, they should contact the county Drainage Admin so the district can investigate and coordinate any necessary repairs.

Work Orders
After the one-year warranty period expires, any repairs must be initiated through a formal work order. A landowner may submit a work order to the county Drainage Admin to request repairs to the district system. Common issues include tile blowouts, collapsed outlets, bank erosion, or obstructions such as beaver dams.

Once a work order is reviewed and approved, a contractor will be assigned to complete the repair. The drainage district will pay the contractor's invoice, and the cost will be shared among landowners based on the existing assessment schedule. This process ensures that maintenance is handled in a timely, fair, and consistent manner.

Landowner Considerations

Public Input
On November 25th, 2025, a letter was mailed to all landowners in the district notifying them that a petition had been filed and requesting any information relevant to drainage conditions within the district. A public informational meeting followed on February 23, 2026, at the Wright County Courthouse, where landowners had the opportunity to meet with the engineer, ask questions, and provide input. A copy of the letter for that meeting is included in Appendix U.

Public Hearing on Report
A public hearing will be scheduled to review this engineer's report and the proposed improvements. Per Iowa Code § 468.14, all landowners in the district will be notified by mail, and notice will also be published in a local newspaper. At the hearing, we will present our findings, proposed plans, and cost estimates, and will be available to answer questions and address concerns. Topics such as construction impacts and crop damages may also be discussed.

The Board of Trustees will conduct the hearing and may continue it to a later date if more discussion or information is needed. No decision can be made until the hearing is held and all landowner input is considered. This report may be amended as needed in response to feedback received during the hearing, ensuring transparency and meaningful participation.

Objections and Remonstrance
Landowners with concerns about the proposed improvements are encouraged to submit written objections before or during the hearing. Written submissions become part of the official record and help guide any revisions to the report.

Additionally, landowners may formally oppose the project through a remonstrance under Iowa Code § 468.28. A valid remonstrance requires written objections from at least 50% of landowners who collectively own more than 70% of the land subject to assessment, submitted before the hearing concludes. If a valid remonstrance is filed, the Board cannot proceed with the project. Landowners pursuing this option should include their land holdings and clearly state their opposition in writing.

Landowner Construction Considerations

If the project is approved, construction will proceed through the standard public bidding process. A bid letting will be conducted to solicit competitive proposals, with the lowest responsible bid submitted to the Board of Trustees for approval. Prior to the start of construction, all affected landowners will be notified of the anticipated timeline and project scope. Work areas will be staked in the field and marked on the plans, and landowner cooperation, including preserving survey stakes and allowing access, will be essential to support efficient project execution.

Throughout construction, we will coordinate directly with the contractor and act as the primary point of contact for all landowners. To ensure clear and consistent communication, landowners will be asked to direct any questions or concerns to us rather than contacting the contractor directly.

Right-of-Way and Work Areas

Drainage districts have the legal authority to enter private lands to construct, maintain, or improve drainage systems, including both open ditches and subsurface tile. Landowners must allow reasonable access, and the district is responsible for minimizing disturbance and compensating for any damages, such as crop loss or soil compaction.

Open ditches require a formal ROW to allow for construction, future maintenance, and spoil placement. Subsurface tile mains, however, are usually installed and maintained without a formal ROW, relying on the district's statutory access rights. Landowners retain ownership of the land, but the district can access tile routes for maintenance, inspection, or improvements. Temporary construction work area is shown on the plans covering approximately 32.8 acres across 19 parcels (see Appendix V). While work limits are shown in the engineering plans, they may shift slightly depending on final alignments. The actual area affected will be surveyed and documented after construction.

Construction Damages

In accordance with Iowa Code § 468.103, landowners are entitled to compensation for damages resulting from construction activities, including crop loss, soil disturbance, and impacts to land use.

The following recommendations are provided regarding crop damage compensation:

- **Yield and Price Calculation**
  For crops damaged during the growing season we recommend using 110% of the five-year average county yield for the affected crop, multiplied by the average price received over the past 12 months. Both the yield data and average price are to be sourced from the Iowa State University Extension and Outreach and USDA-NASS databases.

- **Field Repair Work Compensation**
  In addition to crop losses during the growing season, we recommend payment for the following field work at rates consistent with the most recent Iowa State University Custom Rate Survey (per acre):
    - One pass of rock pickup
    - Two passes of tillage: one deep tillage and one shallow tillage

- **Soil Disturbance Compensation**
  Any construction activity will result in some degree of soil compaction and mixing between topsoil and subsoil. Preventative measures will be taken to minimize long-term impacts, including separating topsoil from subsoil during excavation and seeding a diverse cover crop to promote soil recovery and health. However, we recognize that it will take time for the soil to fully heal.

  To account for potential yield reductions during this recovery period, we recommend compensating landowners for 10% of the estimated yield loss over a five-year period. This compensation should be calculated using the same method applied for determining yield and price used elsewhere in this project.

- **Other Damages**
  Landowners may submit claims for any additional damages not accounted for in this recommendation prior to the completion hearing.

Crop damages and other construction-related compensation will be paid by the drainage district and funded through the assessment schedule. As a result, all landowners within the district including those who incur damages will share in the cost of these payments through their proportionate assessments. The Board of Trustees retains the authority to amend, approve, or deny any such claims. Final decisions regarding crop damages will be made at the completion hearing.

Completion Hearing
Upon completion of construction, a Completion Hearing will be held in accordance with Iowa Code § 468.101. This hearing gives landowners the opportunity to review the finished work, raise concerns about field conditions or project compliance, and submit any remaining claims for damages not previously addressed.

At the hearing, the Board of Trustees will consider all landowner input, evaluate whether the work has been completed in substantial compliance with the approved plans and specifications, and determine final compensation for any valid damage claims. The Board also has the authority to amend, approve, or deny claims based on the evidence presented.

All landowners within the district will be notified of the hearing in advance, as required by law, and are encouraged to attend to ensure their concerns are heard and properly documented before the project is closed out.

Conclusion and Recommendations

Conclusion
The Drainage District No. 169 tile has been found to be restrictive and undersized, providing only 60% of the recommended drainage capacity, and failing to serve all the lands in the drainage district. To address this, we have developed a plan to replace and extend the Main Tile and add two laterals to better serve all lands in the district with a ½" drainage coefficient at an estimated total cost of $1,257,000. This plan is designed to meet the recommended drainage capacity and offers a long-term solution to improve drainage across the district.

Recommendations
We recommend that the Board accept the filing of this report and schedule a public hearing to formally present the findings and proposed improvements to all affected landowners. The hearing will provide an opportunity for landowners to raise objections, ask questions, and express concerns.

If there is sufficient support from the landowners at the hearing, we further recommend that the Board proceed with appointing an engineer to prepare detailed plans and specifications for the construction work.

If the Board of Trustees or landowners have any questions or concerns, please feel free to contact AgriVia at the phone numbers or emails listed.

Sincerely,

Jacob Hagan, P.E.
AgriVia
Cell: 712-250-4318
Email: jacob.agrivia@gmail.com

Tyler Buman
AgriVia
Cell: 712-579-5296
Email: tyler.agrivia@gmail.com

Appendix A – Petition Filed

IMPROVEMENT
PETITION

To the Honorable Board of Supervisors,	)	Drainage District
	)	
Wright County, Iowa	)	No. 169

We, the undersigned petitioners, respectfully state that we are owners of land within Wright County Drainage District No.169, more particularly described and defined in the permanent drainage record of said district on file in the office of the County Auditor, Wright County, Iowa.

That the lands in said District are subject to overflow and are too wet for cultivation, and the health, benefit, utility, convenience and welfare will be promoted by improving said drain and by draining, ditching, tiling, leveeing, deepening, widening and improving or strengthening the same by changing the water course thereof.

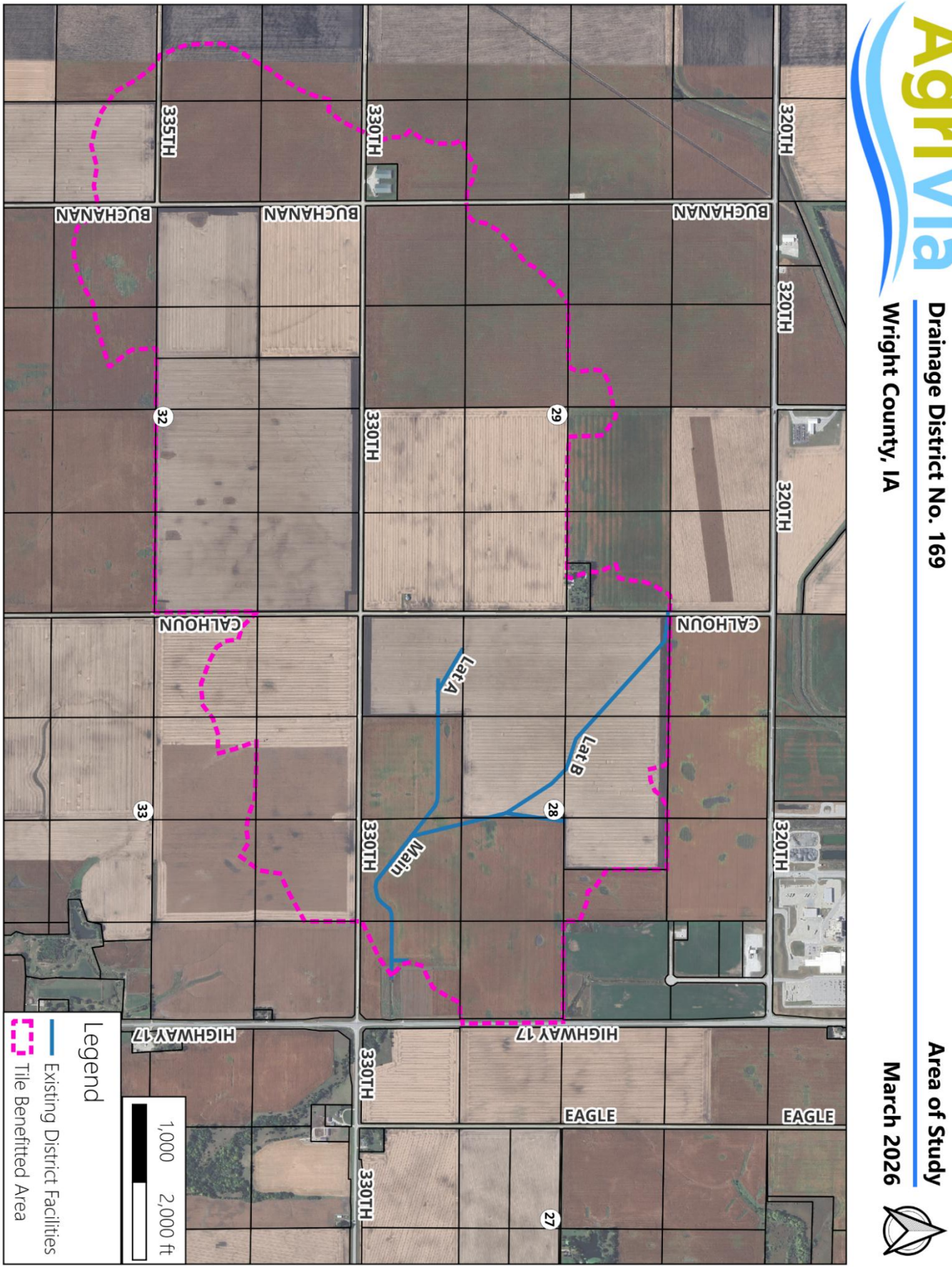
Wherefore we, your petitioners, request that the Board of Supervisors of Wright County, Iowa, to proceed according to law to establish or improve said Drain No. 169 by constructing new tile line; to make any improvements which may be necessary or desirable by enlarging, reopening, widening, deepening, straightening, or lengthening said drain, changing its location or improving or enlarging the outlet for better service; converting all or any part of said drain from an open ditch to a closed drain; installing surface pipe for open ditches; enlarging, altering, or improving pumping plants; leveling spoil banks, or constructing settling basins, and to do such acts as will be of public benefit or utility, or conductive to public health, convenience, or welfare.

Richard Stark	
Brian Pedersen	

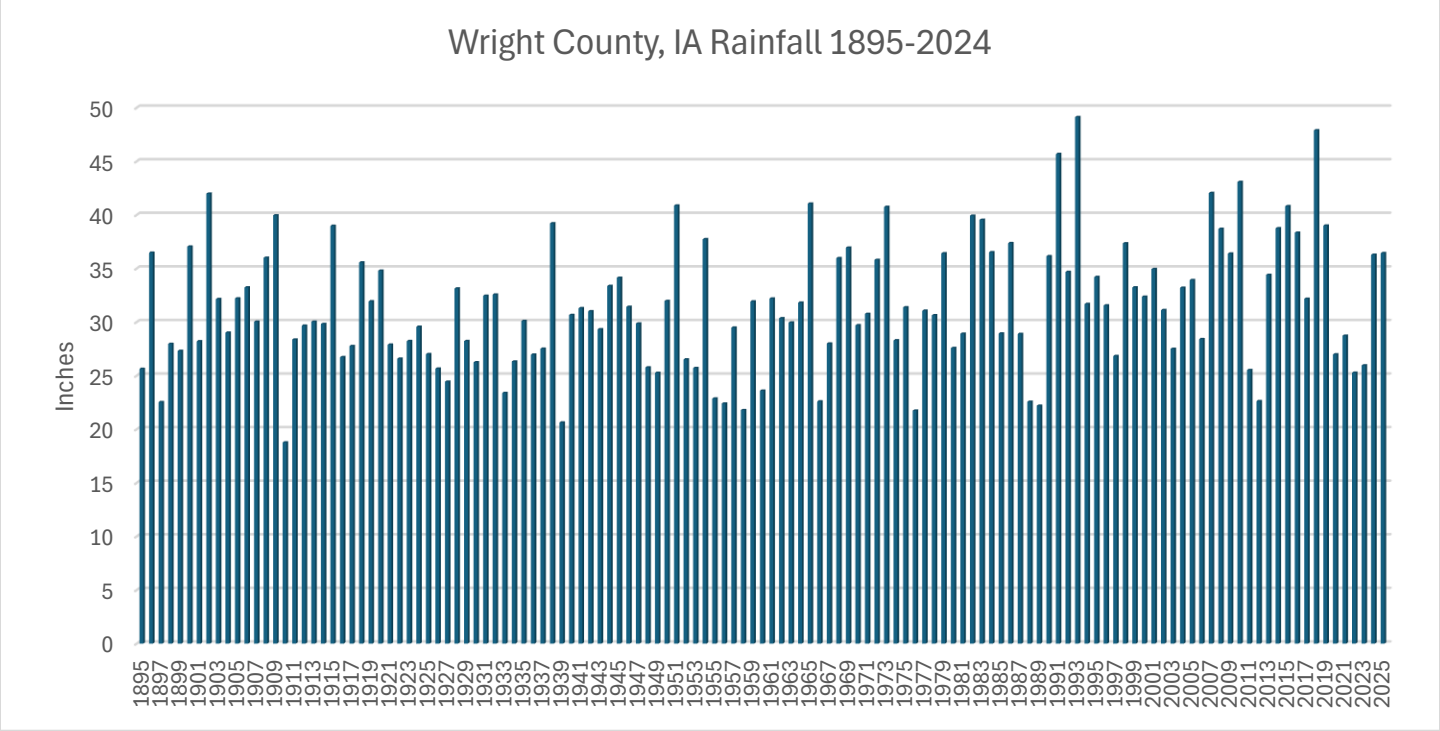
*Improve drainage by increasing tile size

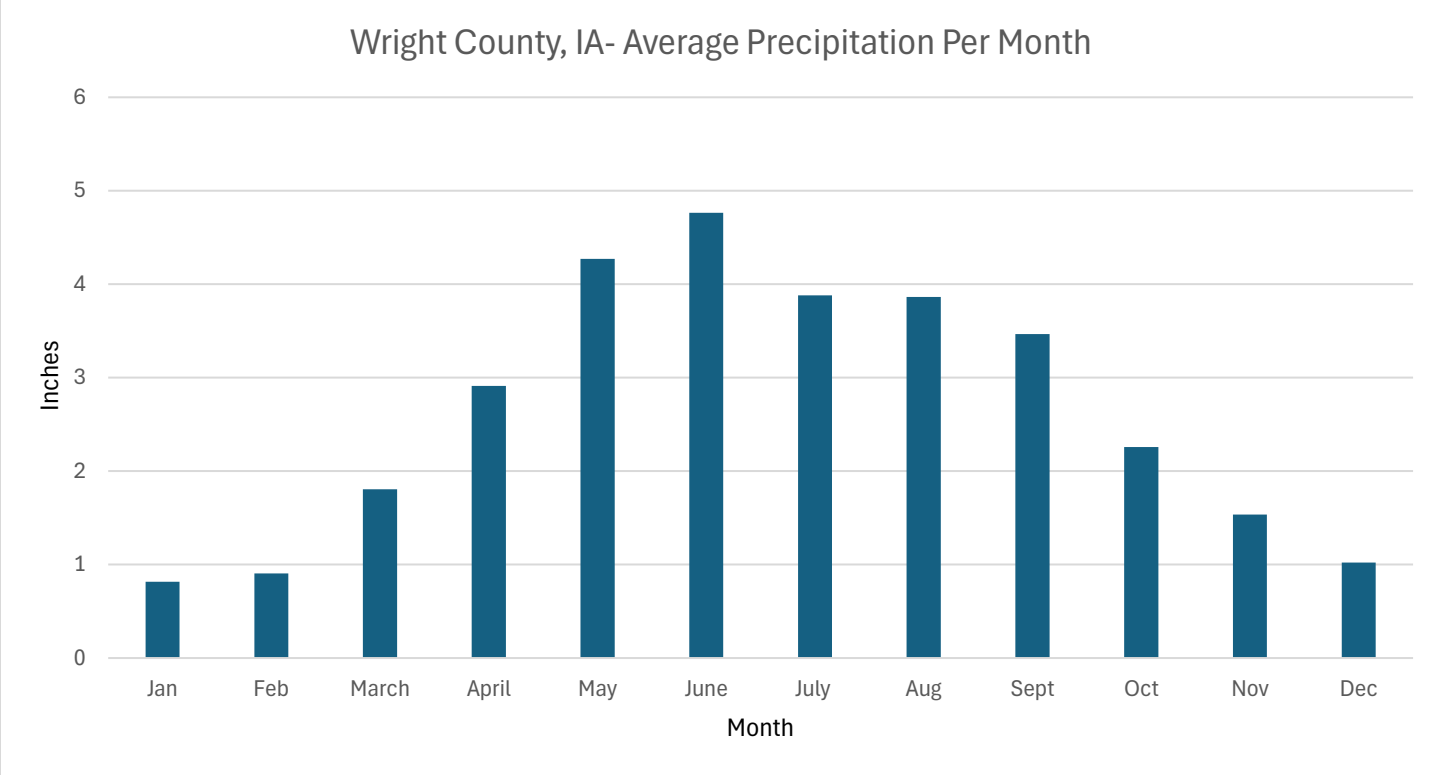
WRIGHT COUNTY AUDITOR
5 NOV 2025 AM 10:14

Appendix B – Area of Study Map



Appendix C – Rainfall Chart: 1895-Present





Charts created from data provided by:
NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series, published December 2025. Retrieved on December 11, 2025, from http://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series

Appendix D – Palmer Drought Severity Index: 1895- Present

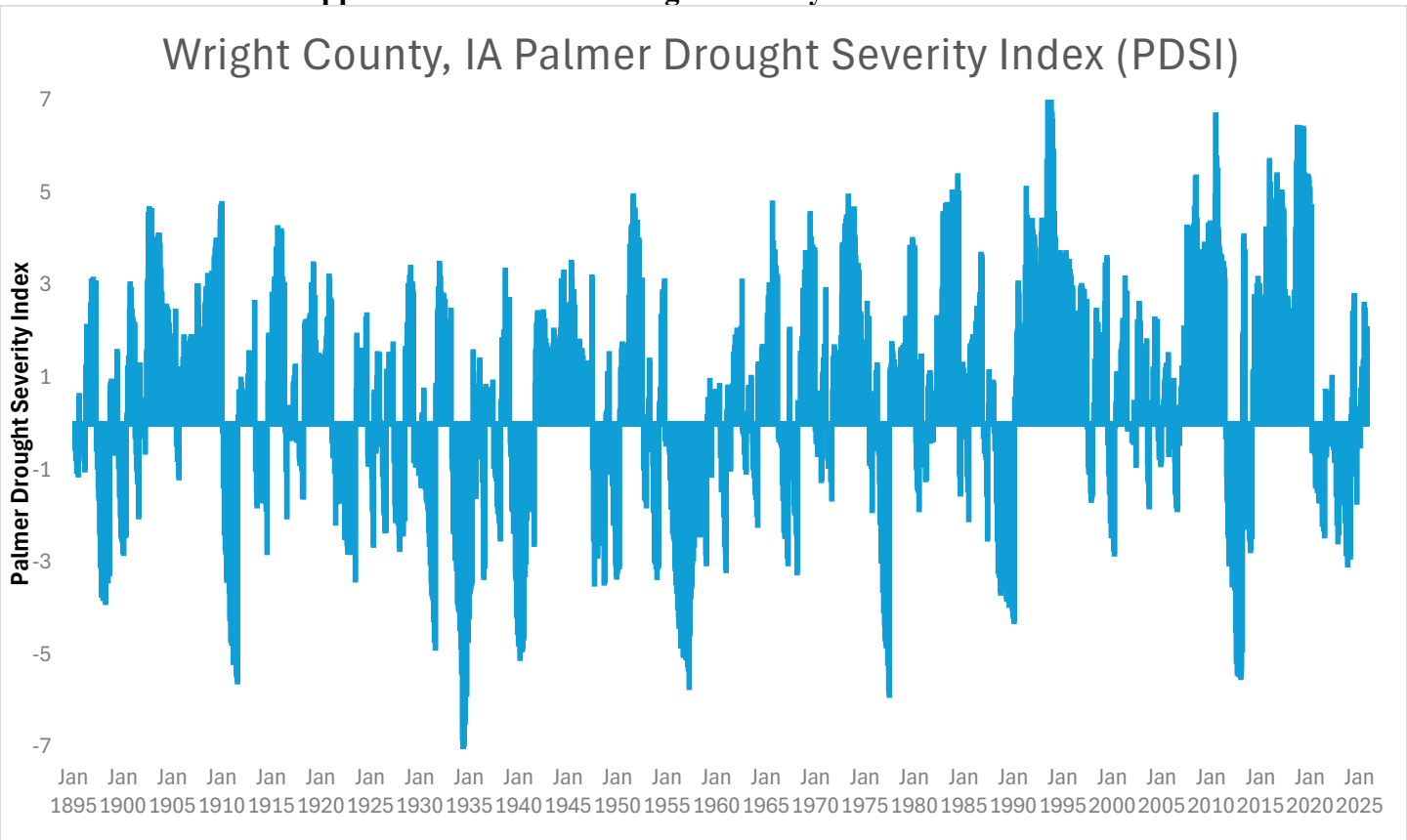
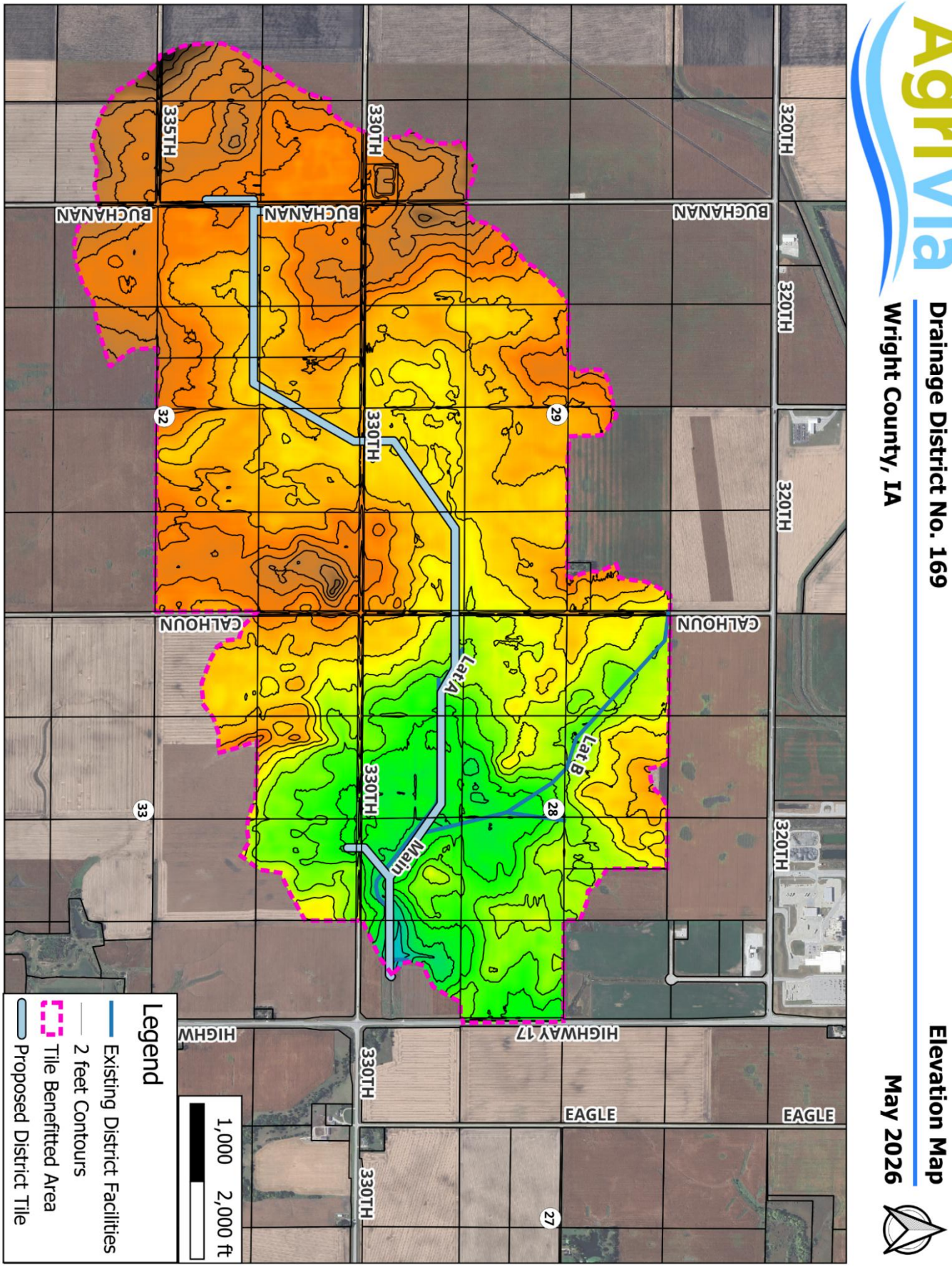
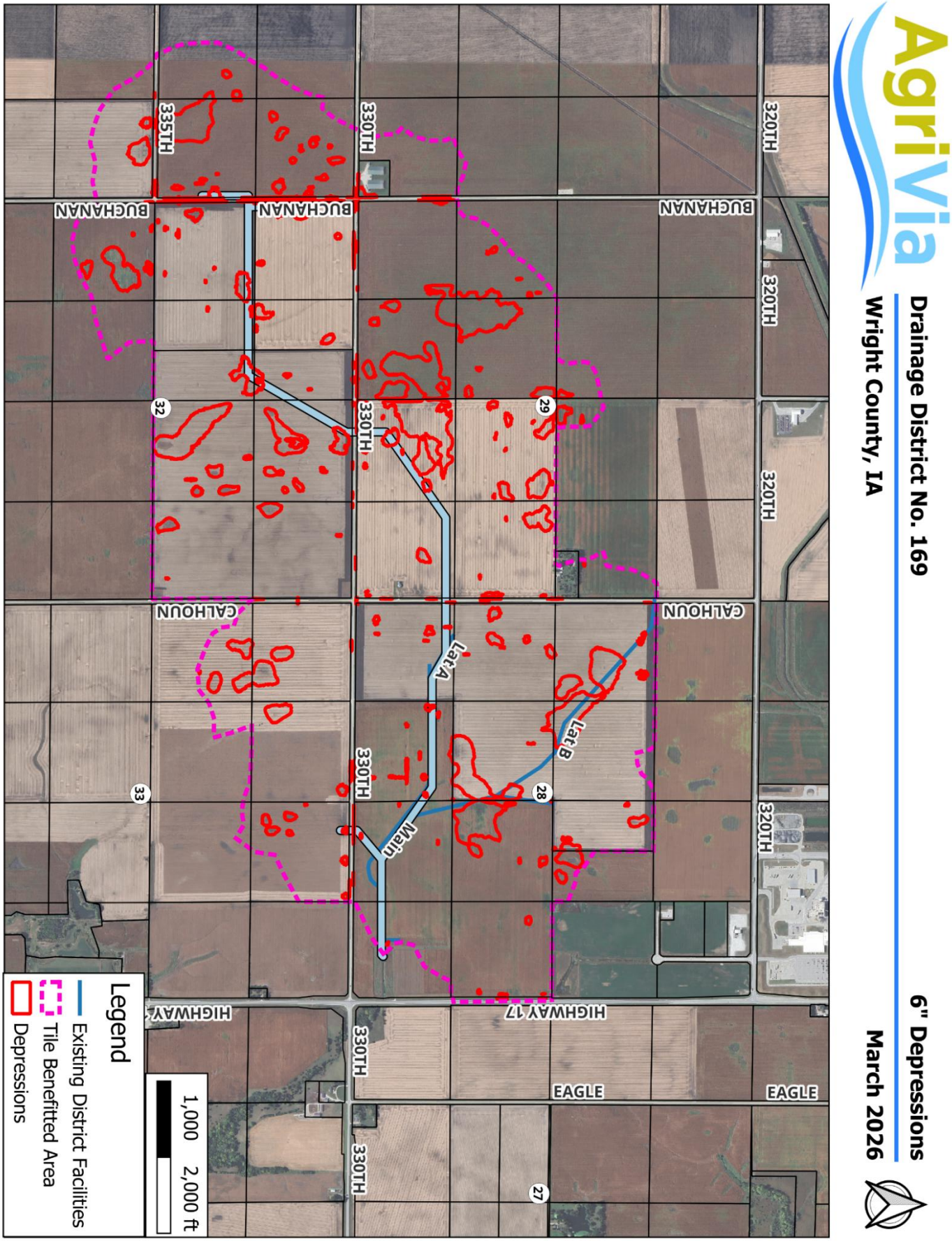


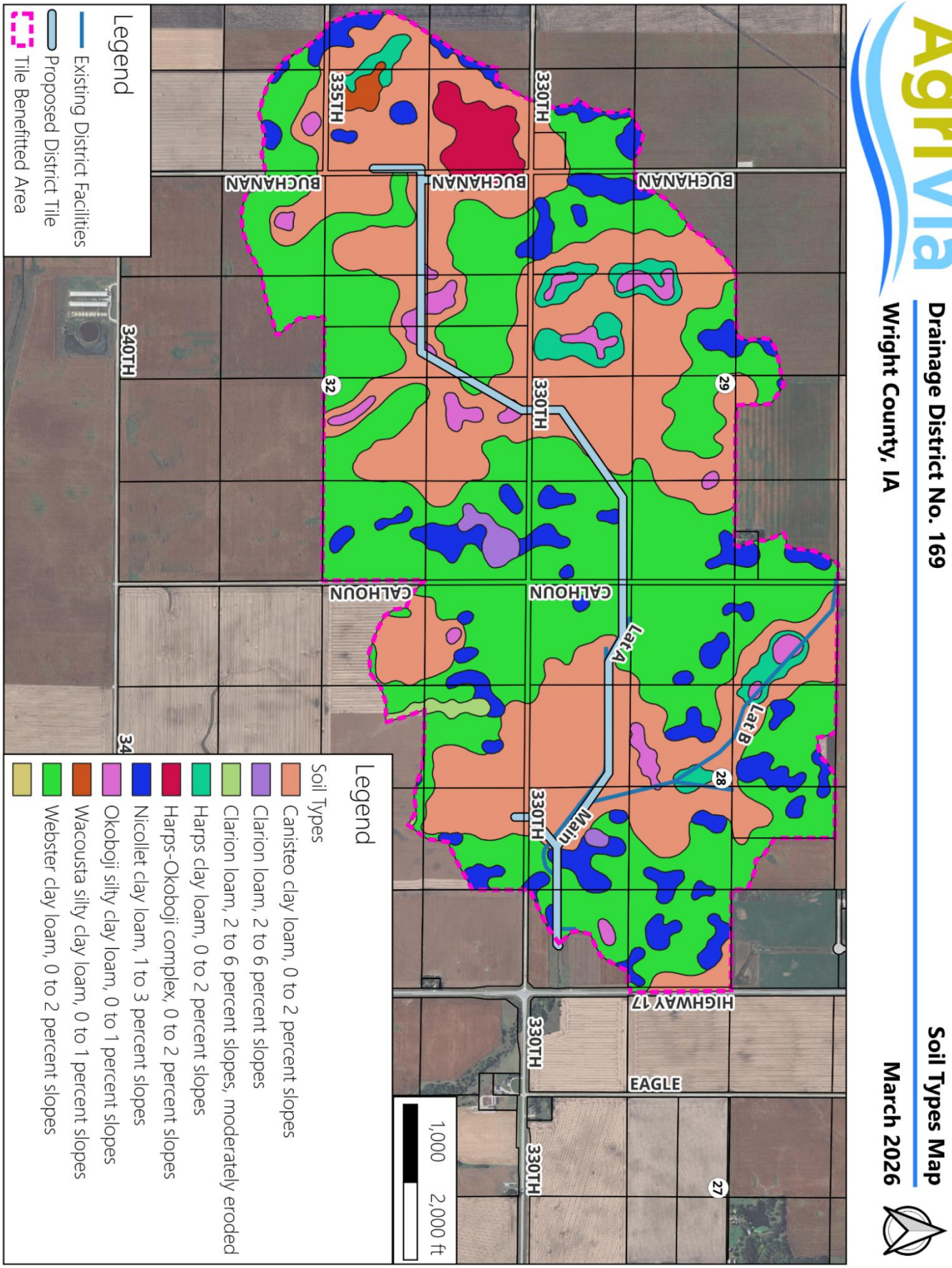
Chart created from data provided by:
NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series, published December 2025. Retrieved on December 11, 2025, from http://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series

Appendix E – Elevation Map

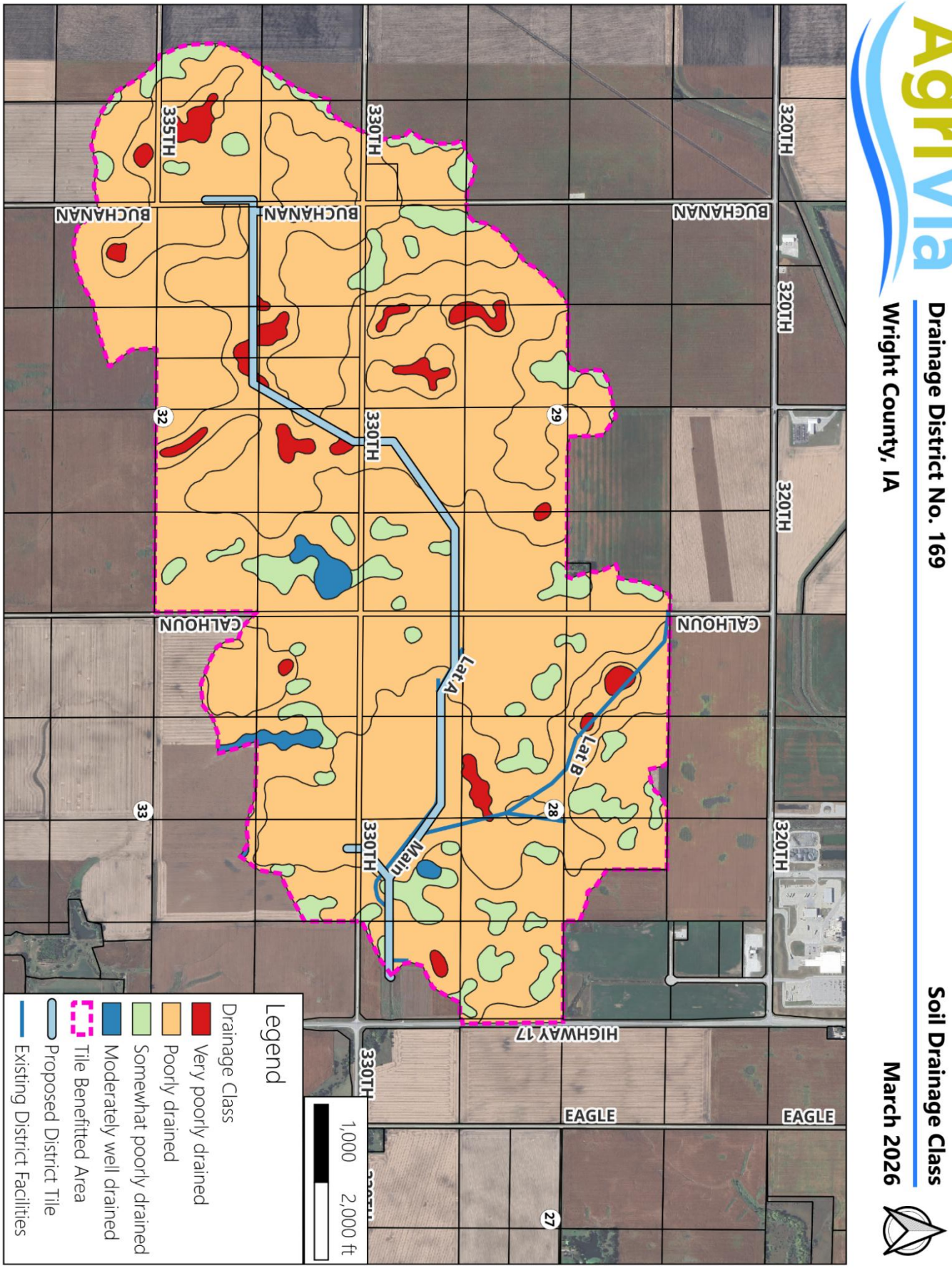



AgriVia
Drainage District No. 169
Wright County, IA
6" Depressions
March 2026
320TH
335TH
330TH
BUCHANAN
CALHOUN
HIGHWAY 17
EAGLE
Lat A
Lat B
Main
27
28
29
32
33
Legend
Existing District Facilities
Tile Benefitted Area
Depressions
1,000
2,000 ft

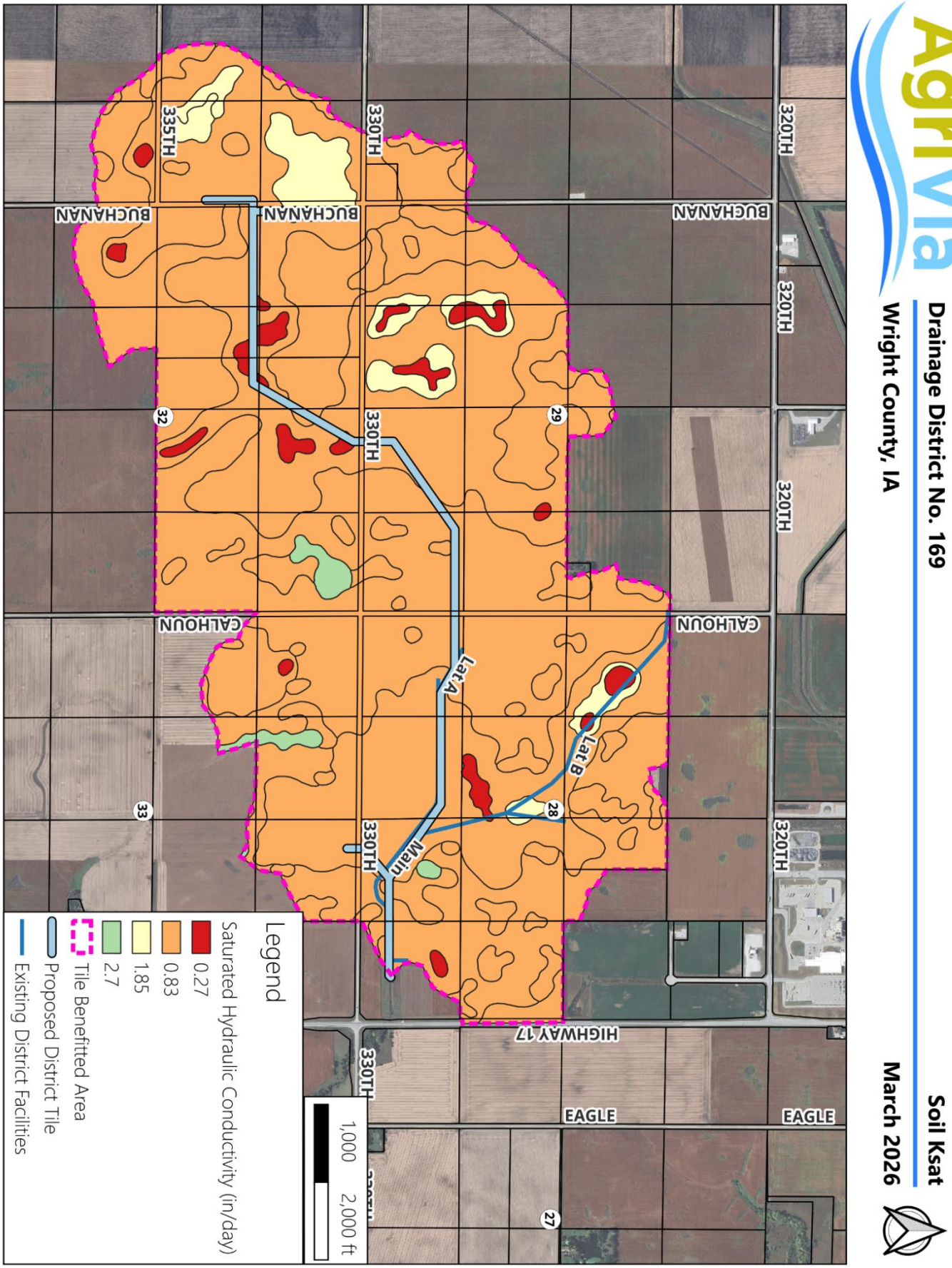
Appendix G – Soil Types



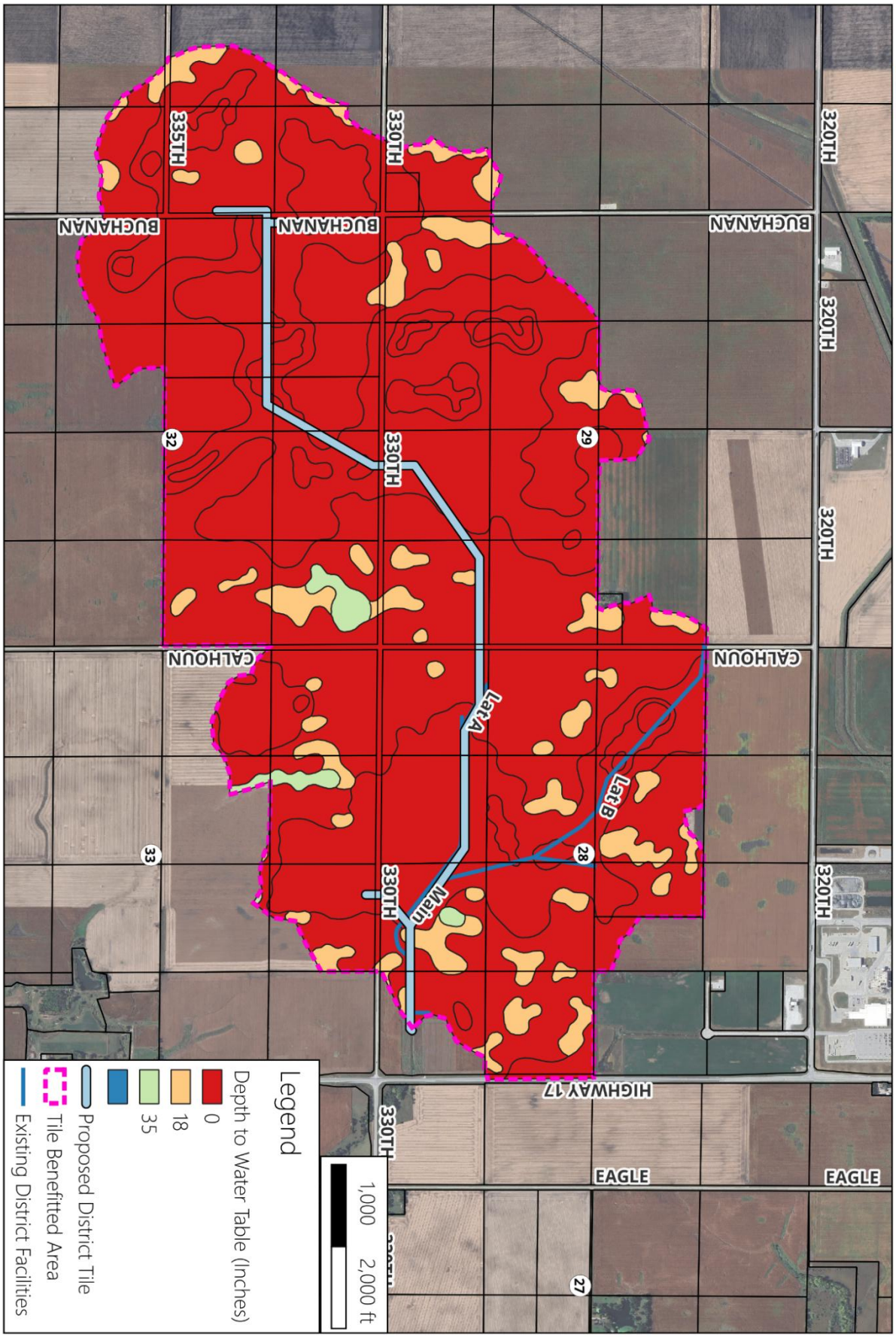
Appendix H – Soil Drainage Class



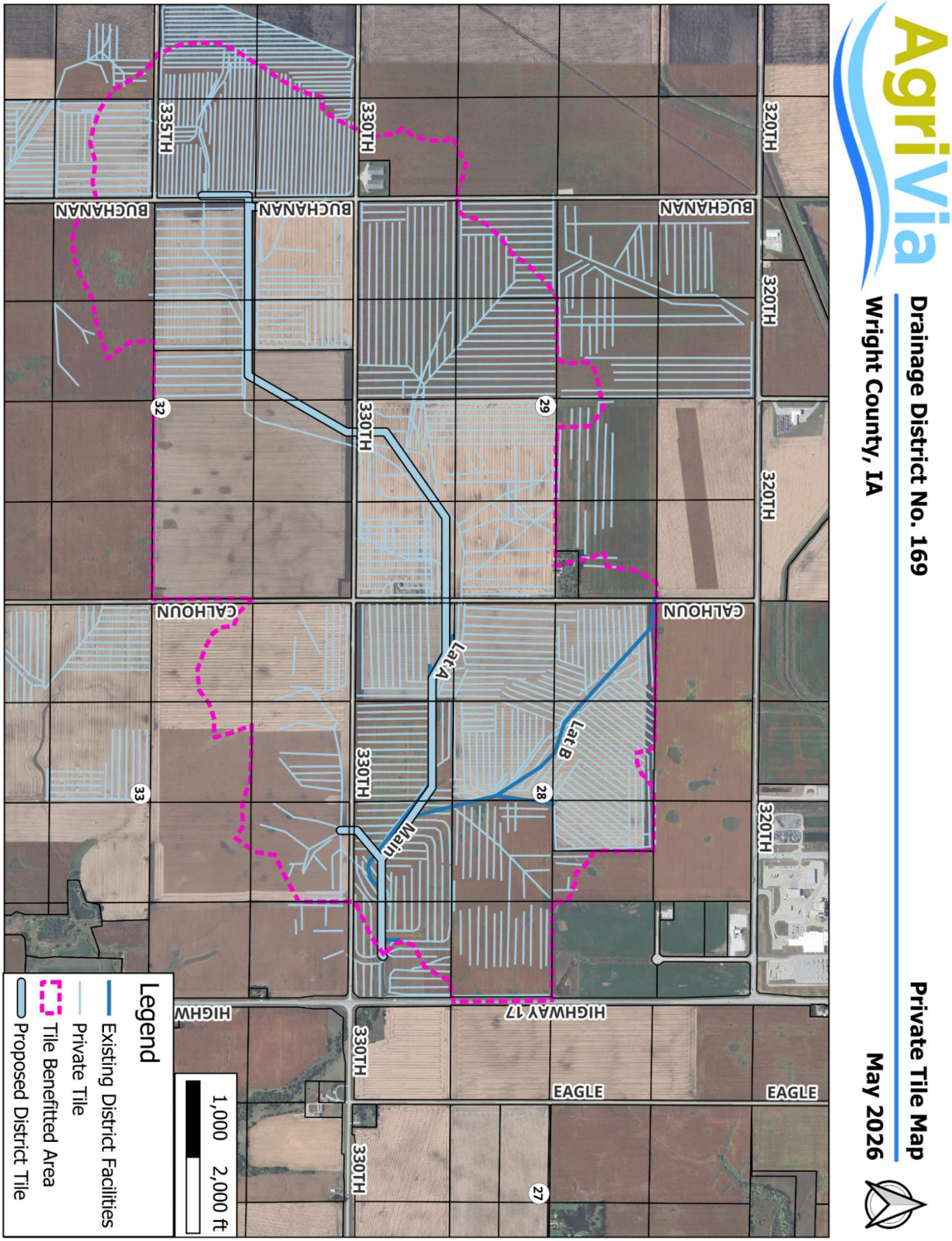
Appendix I – Soil Ksat



Appendix J – Depth to Water Table

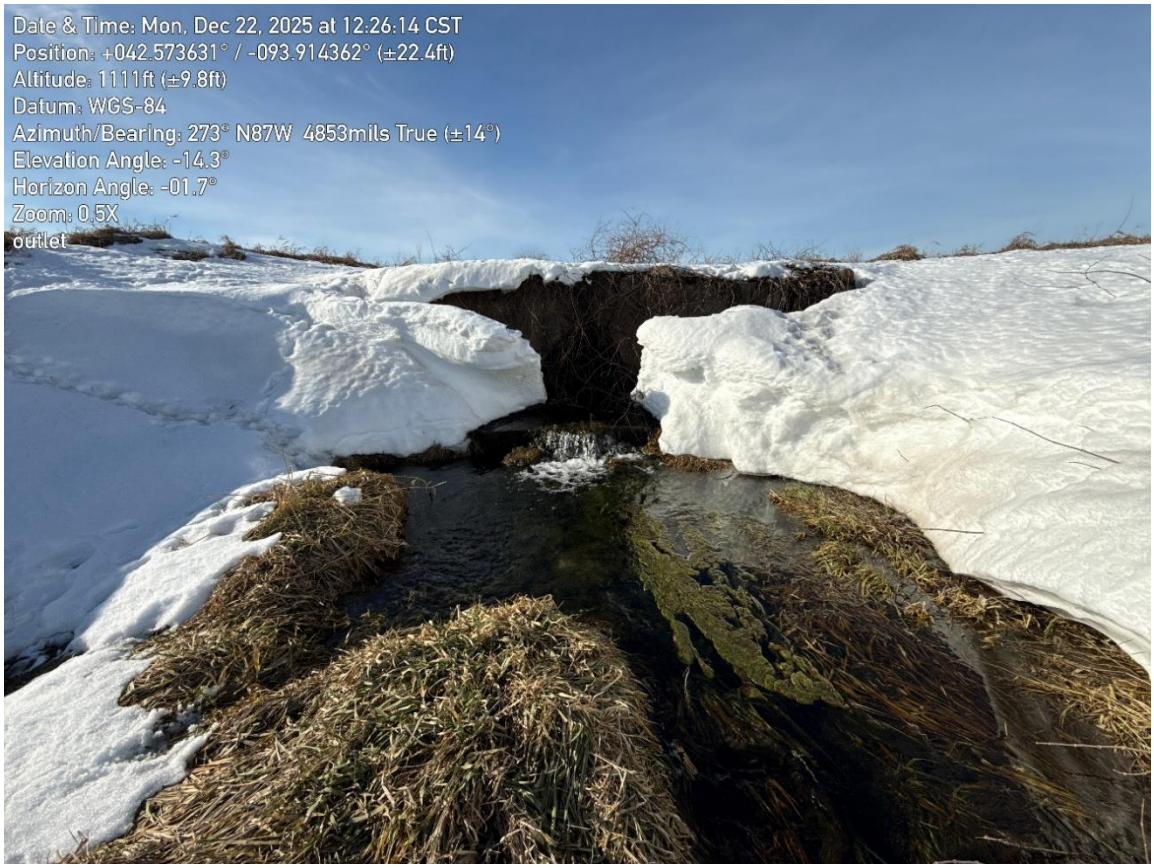


Appendix K – Private Tile



Appendix L – Survey Photos

1- Existing Tile Outlet



2- Existing Tile Bulkhead

3- Downstream Ditch- Culvert

4- Road Ditch Intake

Appendix M – Itemized Cost Estimate

Estimated Costs
Tile Improvements
Drainage District No. 169
Wright County, IA

Main Tile Construction Cost						
Item No.	Item Code	Bid Item	Est. Units	Unit	Est. Unit Price	Est. Amount
101	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 36"	1279	LF	$90	$ 115,110
102	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 30"	6414	LF	$73	$ 468,222
103	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 24"	2375	LF	$56	$ 133,000
104	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 18"	1438	LF	$42	$ 60,396
105	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	400	LF	$30	$ 12,000
106	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	165	LF	$10	$ 1,650
107	6010-CUST	REDUCER, RCP, 36" TO 30"	1	EA	$1,770	$ 1,770
108	6010-CUST	REDUCER, RCP, 30" TO 24"	1	EA	$1,560	$ 1,560
109	6010-CUST	REDUCER, RCP, 24" TO 18"	1	EA	$1,510	$ 1,510
110	6010-CUST	REDUCER, RCP, 18" TO 12"	1	EA	$1,230	$ 1,230
111	6010-CUST	ELBOW, RCP, 36"	2	EA	$1,390	$ 2,780
112	6010-CUST	TEE, RCP, 18" ON 30"	1	EA	$1,230	$ 1,230
113	6010-CUST	TEE, RCP, 15" ON 36"	1	EA	$1,390	$ 1,390
114	6010-B	INTAKE, HD BAR GUARD, 12"	1	EA	$1,140	$ 1,140
115	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	33	EA	$490	$ 16,170
116	6010-CUST	TILE CONNECTIONS, 12" AND LARGER	14	EA	$630	$ 8,820
117	2010-CUST	EXCAVATION, EXPLORATORY	17	HR	$270	$ 4,590
118	3010-C	CLASS I BEDDING STONE	120	TN	$35	$ 4,200
119	9040-J	RIPRAP, CLASS E	25	TN	$74	$ 1,850
120	9060-E	REMOVAL OF FENCE	1	EA	$220	$ 220
121	9010-A	CONVENTIONAL SEEDING, COVER CROP	31	AC	$210	$ 6,510
122	9040-CUST	DRIVEWAY RESTORATION	7	EA	$750	$ 5,250
123	11,020-A	MOBILIZATION	1	LS	$45,000	$ 45,000
					5% Construction Contingency	$ 45,000
					Subtotal Construction Cost	**$ 941,000.00**

Lateral No. 1 Tile Construction Cost						
Item No.	Item Code	Bid Item	Est. Units	Unit	Est. Unit Price	Est. Amount
201	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 15"	120	LF	$39	$ 4,680
202	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	535	LF	$20	$ 10,700
203	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	10	LF	$10	$ 100
204	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	2	EA	$490	$ 980
205	6010-CUST	TILE CONNECTIONS, 12" AND LARGER	1	EA	$630	$ 630
206	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
207	9010-A	CONVENTIONAL SEEDING, COVER CROP	1	AC	$210	$ 210
208	11,020-A	MOBILIZATION	1	LS	$1,000	$ 1,000
					5% Construction Contingency	$ 1,000
					Subtotal Construction Cost	**$ 20,000.00**

Estimated Costs
Tile Improvements
Drainage District No. 169
Wright County, IA

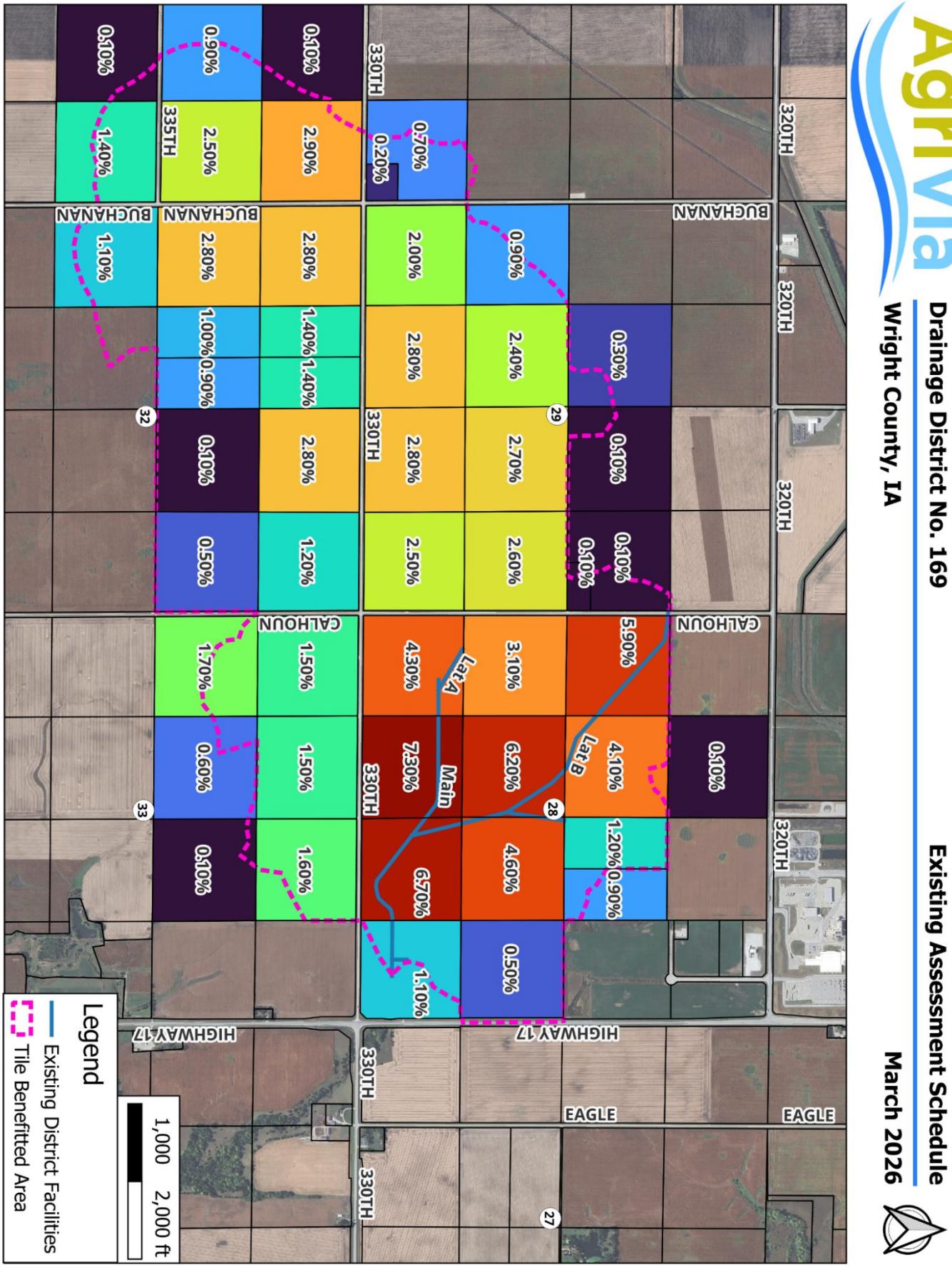
Lateral No. 2 Tile Construction Cost						
Item No.	Item Code	Bid Item	Est. Units	Unit	Est. Unit Price	Est. Amount
301	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	855	LF	$20	$ 17,100
302	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	10	LF	$10	$ 100
304	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	2	EA	$490	$ 980
305	6010-CUST	TILE CONNECTIONS, 12" AND LARGER	1	EA	$630	$ 630
306	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
307	9010-A	CONVENTIONAL SEEDING, COVER CROP	1	AC	$210	$ 210
308	11,020-A	MOBILIZATION	1	LS	$1,000	$ 1,000
					5% Construction Contingency	$ 1,000
					Subtotal Construction Cost	**$ 22,000.00**

County Secondary Roads Construction Cost						
Item No.	Item Code	Bid Item	Est. Units	Unit	Est. Unit Price	Est. Amount
401	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 30", R-2 BEDDING	132	LF	$85	$ 11,220
402	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 18", R-2 BEDDING	66	LF	$57	$ 3,762
403	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 12", R-2 BEDDING	66	LF	$37	$ 2,442
404	6010-B	INTAKE, BAR GUARD, 12"	8	EA	$1,000	$ 8,000
405	9010-A	CONVENTIONAL SEEDING, TYPE 2 SEED MIXTURE	1	AC	$2,000	$ 2,000
406	2010-CUST	EXCAVATION, EXPLORATORY	8	HR	$270	$ 2,160
407	8030-A	TRAFFIC CONTROL	4	EA	$1,000	$ 4,000
408	11,020-A	MOBILIZATION	1	LS	$2,000	$ 2,000
					5% Construction Contingency	$ 2,000
					Subtotal Construction Cost	**$ 38,000.00**

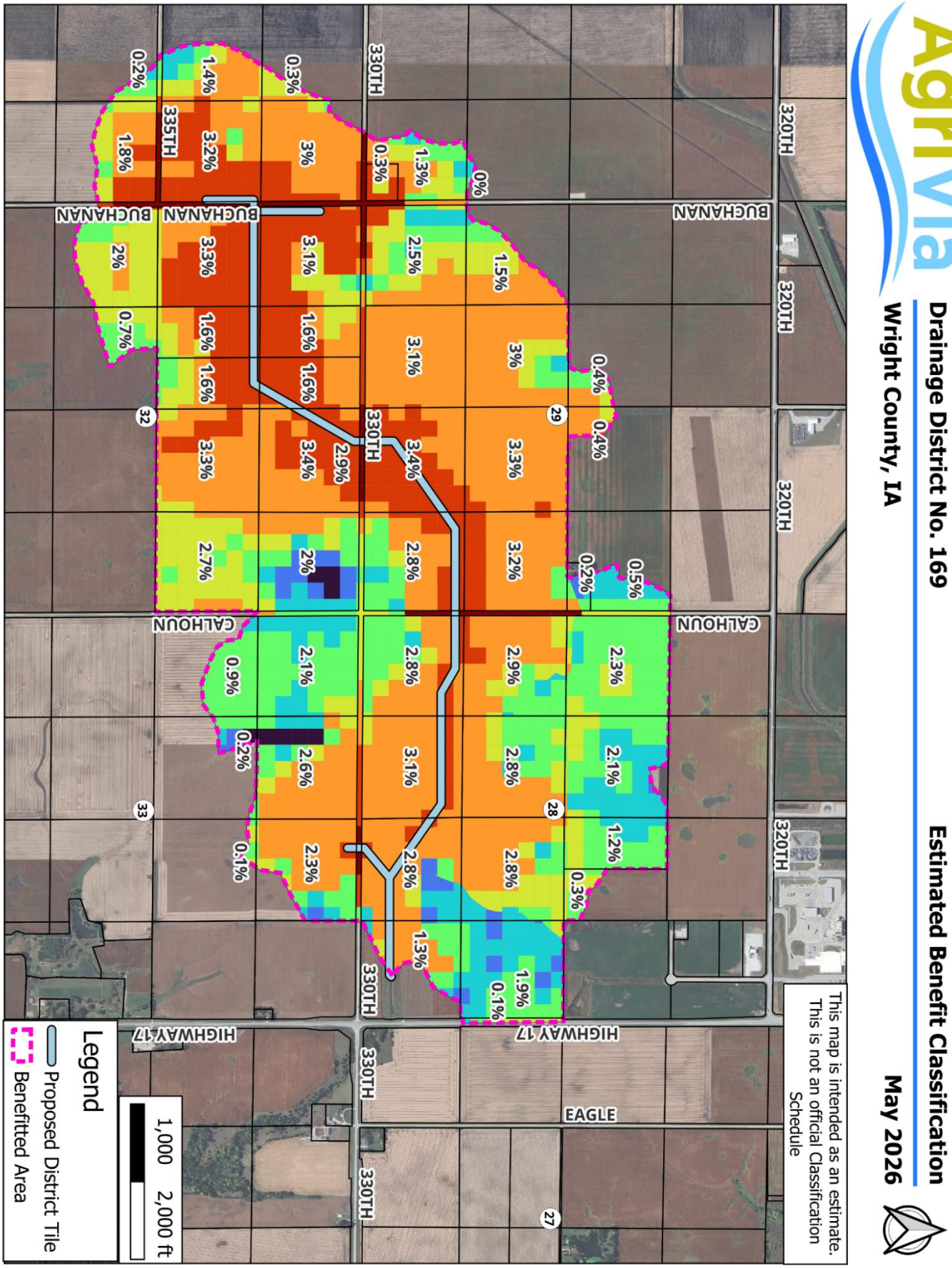
Additional Non-Construction Project Costs	
Expense	Est. Amount
Survey, Permitting, Engineer's Report, and Preliminary Plans	$ 40,000
Specifications and Construction Engineering	$ 35,000
Classification and Annexation	$ 10,000
Legal and Administrative	$ 5,000
Construction Damages	$ 53,000
Interest	$ 93,000
Subtotal Non-Construction Cost	**$ 236,000.00**

Total Project Costs	
Expense	Est. Amount
Main Tile Improvement	$ 941,000
Branch No. 1 Improvement	$ 20,000
Branch No. 2 Improvement	$ 22,000
Wright County Secondary Roads	$ 38,000
Additional Non-Construction Project Costs	$ 236,000
Total Tile Improvement Cost	**$ 1,257,000**
Total Improvement Cost to Drainage District No. 169	**$ 1,219,000**
Average Cost per Acre Benefitted (1,379 Acres)	**$ 884**

Appendix N – Current Assessment Schedule Map



Appendix O – Estimated Assessment Schedule



Appendix P – Iowa State Economic Returns from Tiling Spreadsheet

Iowa State University Extension and Outreach | Ag Decision Maker File C2-90

Farmland Tile Drainage Investment Analysis

Ag Decision Maker -- Iowa State University Extension and Outreach

Find out more on tiling in Information File C2-90, Understanding the Economics of Tile Drainage.

ISU Extension Spreadsheet modifed by AgriVia for Drainage District Improvements.

Drainage District Information

District name	**Drainage District No. 169**
Field location (general location or legal description)	**Wright County, IA**
District Size (acres to analyze for tile drainage)	1,378

Field Drainage Needs

Number of Acres by Drainage Needs	
Very poorly drained	38
Poorly drained	1,213
Somewhat poorly drained	114
Moderately well drained	13
Well drained	0
Total	1,378

Estimated Yield Response (enter impacts of tiling for both tiled and non-tiled acres)

	Very Poorly Drained	Poorly Drained	Somewhat Poorly Drained	Moderately Well Drained	Well Drained
Corn (bushels per acre)					
Pre-drainage yield (current expected yield in each category)	126.0	138.0	150.0	168.0	180.0
Post-drainage yield (expected yield after tile drainage installed)	180.0	180.0	180.0	180.0	180.0
Estimated corn yield improvement	54.0	42.0	30.0	12.0	0.0
Soybeans (bushels per acre)					
Pre-drainage yield (current expected yield in each category)	32.0	38.0	42.0	45.0	50.0
Post-drainage yield (expected yield after tile drainage installed)	50.0	50.0	50.0	50.0	50.0
Estimated soybean yield improvement	18.0	12.0	8.0	5.0	0.0

Estimated Additional Costs and Returns per Acre by Crop due to Added Tile Drainage

Enter the additional production costs expected from tiling the land and the expected value of the additional production.

	Corn (per acre)	**Soybeans** (per acre)	**Average** (per acre)
Added Cash Income			
Expected field crop rotation on acres being analyzed	48%	48%	
Acres planted to crop based on acres being analyzed and crop rotation	661.4	661.4	
Estimated yield increase (from above section)	41.1	11.8	
Long-term expected sale price	$4.31	$10.09	
Additional Cash Income due to Tile Drainage	$176.95	$118.74	
Added Cash Production Costs			
Seed	$7.00	$5.00	
Fertilizer	$15.00	$10.00	
Pesticides	$0.00	$0.00	
Hauling, drying, and handling	$10.00	$5.00	
Added Cash Costs due to Tile Drainage	$32.00	$20.00	
Net Cash Income or Loss	**$144.95**	**$98.74**	**$116.97**

Total Cost of Tile Drainage District Investment

Total	**$ 1,215,000.00**
Per Tiled Acre (1378 acres)	**$ 881.71**

Return on Investment in Tile Drainage (cash return divided by investment) (before income tax)

The added net cash return divided by the investment in tile drainage. For owner-operators, the net return is the additional crop net return from tile drainage.

Annual Rate of Return on Tile Investment	**Corn**	**Soybeans**	**Average**
Based on Additional Crop Income	**16.4%**	**11.2%**	**13.3%**
Assuming Cash Financed			
No Tax Advantages Assumed			

Version 3.0_42023
Kelvin Leibold, Extension farm management specialist
Don Hofstrand, retired agricultural business specialist
Email agdm@iastate.edu for questions regarding this Decision Tool
Date Printed:
4/30/2026

IOWA STATE UNIVERSITY
Extension and Outreach

Note: Tile drainage may result in increased land values when sold and is not factored in the results of this Decision Tool.

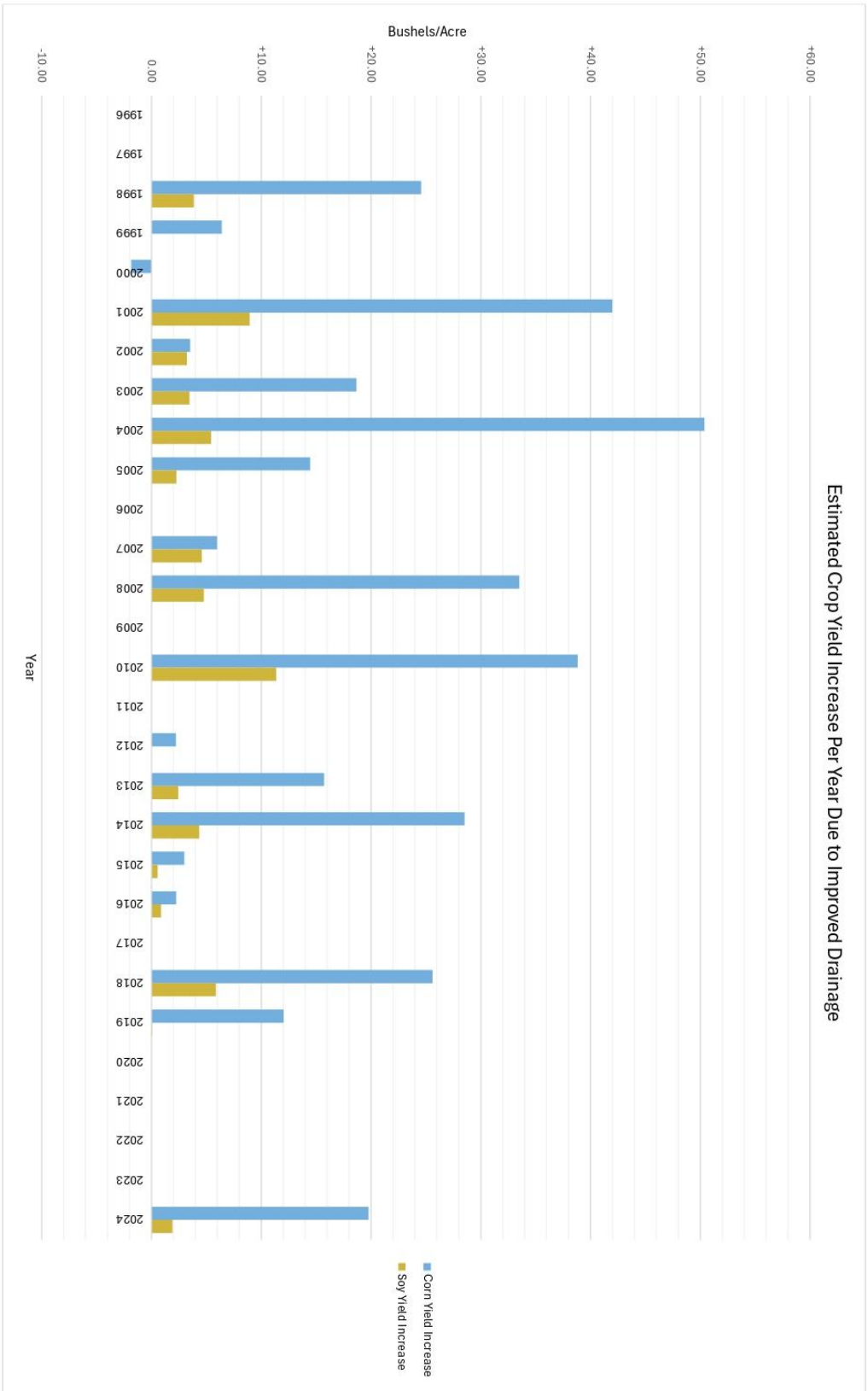
https://www.extension.iastate.edu/agdm/wholefarm/xls/c2-90tilinganalysis.xlsx

Appendix Q – Michigan State Drain Tool Estimated Yields

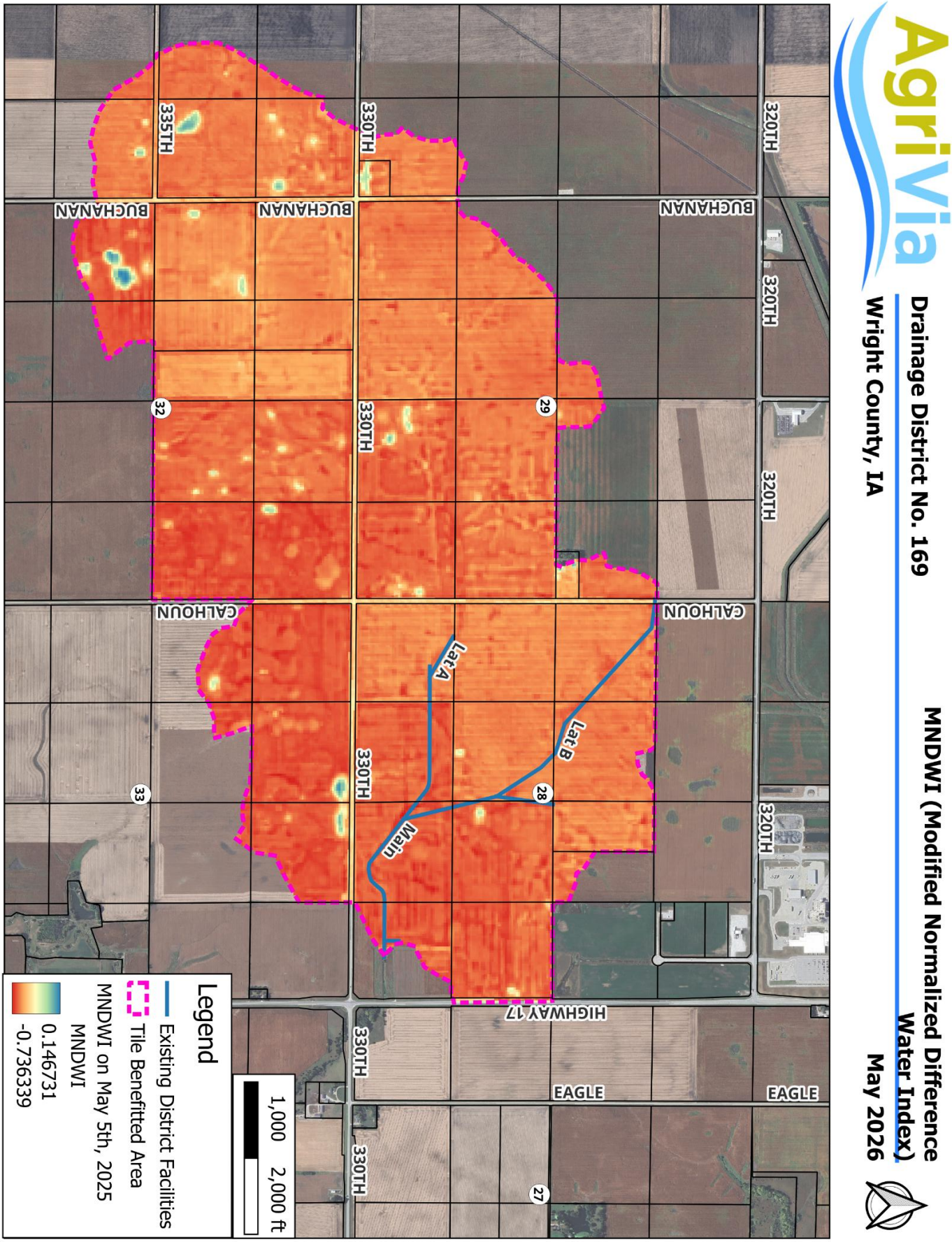
Michigan State Drain Tool Estimated Yield Increase
Tile Improvements
Drainage District No. 169
Wright County, IA

Estimated Crop Yields						
Year	Corn Yield (No Improvement	Corn Yield (Improved Drainage)	Corn Yield Increase	Soy Yield (No Improvement)	Soy Yield (Improved Drainage)	Soy Yield Increase
1996	250.00	250.00	**0.00**	70	70.00	**0.00**
1997	250.00	250.00	**0.00**	69.11	69.11	**0.00**
1998	206.29	230.85	**+24.56**	64.70	68.56	**+3.86**
1999	243.61	250.00	**+6.39**	70.00	70.00	**0.00**
2000	250.00	248.17	**-1.83**	69.82	69.82	**0.00**
2001	184.42	226.42	**+41.99**	50.98	59.93	**+8.95**
2002	246.36	249.88	**+3.52**	64.03	67.25	**+3.22**
2003	206.89	225.56	**+18.67**	60.47	63.93	**+3.46**
2004	167.35	217.71	**+50.37**	60.13	65.56	**+5.43**
2005	214.07	228.52	**+14.46**	65.60	67.87	**+2.27**
2006	220.42	220.42	**0.00**	68.14	68.14	**0.00**
2007	220.92	226.90	**+5.98**	42.26	46.84	**+4.58**
2008	147.70	181.21	**+33.51**	54.68	59.46	**+4.79**
2009	250.00	250.00	**0.00**	70.00	70.00	**0.00**
2010	107.78	146.61	**+38.83**	34.17	45.54	**+11.37**
2011	250.00	250.00	**0.00**	69.93	69.93	**0.00**
2012	140.97	143.20	**+2.23**	52.05	52.05	**0.00**
2013	187.30	203.02	**+15.73**	57.14	59.59	**+2.45**
2014	188.10	216.64	**+28.54**	60.54	64.87	**+4.34**
2015	244.77	247.77	**+3.00**	69.44	70.00	**+0.56**
2016	245.52	247.77	**+2.25**	68.44	69.31	**+0.87**
2017	231.41	231.41	**0.00**	65.44	65.44	**0.00**
2018	187.85	213.46	**+25.61**	56.30	62.17	**+5.87**
2019	224.29	236.33	**+12.04**	68.14	68.20	**+0.06**
2020	225.31	225.31	**0.00**	62.41	62.41	**0.00**
2021	237.99	237.99	**0.00**	68.14	68.14	**0.00**
2022	222.16	222.16	**0.00**	61.84	61.84	**0.00**
2023	222.32	222.32	**0.00**	65.25	65.25	**0.00**
2024	219.11	238.88	**+19.77**	67.52	69.43	**+1.91**
AVG	**213.55**	**225.47**	**+11.92**	**62.30**	**64.51**	**+2.21**

Chart and Graph created from output data from Michigan State Drain Tool
Yield Increases are estimates only based on Drain Tool.


Estimated Crop Yield Increase Per Year Due to Improved Drainage
Bushels/Acre
-10.00
0.00
+10.00
+20.00
+30.00
+40.00
+50.00
+60.00
Year
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Corn Yield Increase
Soy Yield Increase

Appendix R – MNDWI Map



Appendix S – Ohio State Twenty Benefits of Improved Drainage

AGRICULTURAL ENGINEERING
Serves Ohio
Cooperative Extension Service
The Ohio State University
Agricultural Engineering
2073 Neil Avenue
Columbus, Ohio 43210

SOIL AND WATER NO. 31

JULY 1982

TWENTY BENEFITS OF DRAINAGE

Many of the best soils in the United States and throughout the world have drainage problems that need to be solved before efficient agricultural production can be achieved. This discussion of drainage benefits is based on an earlier paper by the author entitled "Ten Benefits of Drainage" and several reports from other agricultural engineers in the United States, Canada, and England. Some of these drainage benefits are difficult to measure precisely, and many are interrelated, but their combined effect has been observed in numerous drainage studies.

1. Better soil aeration results from good drainage (surface water and free water in the root zone removed within 24 hours after heavy rainfall). This permits more extensive root development and a more favorable environment for beneficial soil microorganisms and earthworms. When soil aeration is reduced, the severity of soil-borne root diseases is increased.

2. Better soil moisture conditions with good drainage permit more efficient operation of tillage, planting, and harvesting equipment.

3. Better soil structure can be developed and maintained with good drainage, since there is less chance of destroying soil tilth due to compaction when working soil that is too wet.

4. Soils warm up more quickly in the spring when free water is removed by a drainage system. This results in better seed germination and an increased rate of plant growth.

5. An increased supply of nitrogen can be obtained from the soil when drainage lowers the water table in the root zone. Denitrification often occurs in soils with poor drainage.

6. Longer growing seasons can be achieved with good drainage due to earlier possible planting dates. This also permits the use of higher-yielding crop varities or extended grazing periods for livestock.

7. Certain toxic substances and disease organisms are removed from the soil due to better drainage and soil aeration. In wet soil, roots can be injured by toxic substances produced in the reduction of iron and manganese salts and the reduction of nitrates to nitrites.

8. Winds are less liable to uproot plants growing in soils that have been properly drained, since root systems are deeper.

9. Soil erosion and sediment loss can be reduced by subsurface drainage, since drained soils have a greater capacity to absorb rainfall and the soil filters out suspended sediment.

10. Good drainage saves fuel that would be used in working around wet areas in fields

(over)

College of Agriculture and Home Economics of The Ohio State University and The United States Department of Agriculture Cooperating

that are not properly drained. Also, since drained land is easier to work, there is less need for dual wheels or four-wheel drive tractors.

11. Good drainage reduces winter crop damage such as frost heaving of alfalfa and smothering of wheat under patches of ice.

12. Good drainage promotes earlier crop maturity and earlier fall harvests when climatic conditions are better for natural drying of grain in the field, thereby saving artificial drying costs.

13. A greater variety of crops can be grown on a farm that has good drainage. Alfalfa and sweet corn are examples of those that a farmer may choose.

14. Weed control is easier with good drainage since shallow-rooted weeds and undesirable grasses often thrive in wet soil, crowding out the planted crop.

15. Well-drained grazing land supports more livestock, with less compaction damage to vegetation and soil from animal traffic.

16. Good drainage reduces diseases that thrive on wet land. These include foot rot and liver fluke that infect livestock, and diseases carried by mosquitoes to both livestock and people.

17. Valuable livestock water supplies can be obtained by draining hillside seeps and piping the water to stock water tanks.

18. Plants are better able to withstand summer droughts with good drainage, since lower water tables in the spring permit deeper root development for extraction of soil moisture and nutrients.

19. Drainage is essential for salinity control in drier regions where irrigation is needed for permanent agricultural production.

20. Overall, good drainage results in higher crop yields, improved crop quality, and reduced risk of crop loss due to waterlogged soil. Also, fewer acres are required ro produce our needed food supplies.

Several years of drainage research in Ohio has compared corn and soybean yields from undrained, surface drained only, tile drained only, and combined tile plus surface drained plots. Annual benefit/cost ratios were also calculated for these alternative drainage systems. It was shown that the average annual return per $100 invested in drainage ranged from $120 to $210 for soybeans, and from $170 to $220 for corn. Further details on this research are reported in Soil and Water No. 23 (DRAINAGE--What is it Worth on CORN Land?" and Soil and Water No. 24 (DRAINAGE--What is it Worth for SOYBEAN Land?"). These leaflets are available from Extension Agricultural Engineers, 2073 Neil Avenue, Columbus, OH 43210.

Actual returns on a drainage investment for a particular farm will vary with factors such as soil type, weather conditions, cost of the drainage system, crops grown, and management. Drainage improvements may involve surface drainage, subsurface drainage, outlet ditches, or a combination of practices. Changes in soil and crop management techniques may also be desirable to improve soil structure and water movement in the soil. Almost 60 percent of Ohio's cropland and 25 percent of all U. S. cropland is in need of drainage.

Melville L. Palmer

Melville L. Palmer
Extension Agricultural Engineer

Appendix T – Nutrient Reduction Strategy Example

Nutrient Reduction Calculator

Practice	Nitrogen Reduction	Phosphorus Reduction	Acres	Avg. Annual Cost ($/Acre)	Total Annual Cost ($)	Practice Type	Notes
Wetlands	52%	0%		$15.00	$ -	Edge-of-Field	Highly effective for nitrate removal from tile drainage. P reduction varies.
Bioreactors	43%	0%	320	$10.00	$ 3,200.00	Edge-of-Field	Trenches with woodchips that treat tile drainage water.
Saturated Buffers	91%	58%		$231.00	$ -	Edge-of-Field	This high N reduction only applies to water that interacts with the buffer's active root zone.
Drainage Water Mgt.	33%	0%		$10.00	$ -	Edge-of-Field	Load reduction achieved by reducing flow volume, not concentration.
Terraces	0	77%			$ -	Edge-of-Field	An erosion control practice highly effective at reducing sediment and P loss.
Sediment Control	0	85%			$ -	Edge-of-Field	Includes practices like sedimentation basins or ponds.
Reduce N Rate to MRTN	10%	0%	900	-$2.00	$ (1,800.00)	In-Field	MRTN is the Maximum Return to Nitrogen rate, an economically optimal amount.
Nitrification Inhibitor	9%	0%	900	-$3.00	$ (2,700.00)	In-Field	Used with fall-applied anhydrous ammonia.
Move Fall N to Spring	6%	0%	400	-$20.00	$ (8,000.00)	In-Field	Moves fall fertilizer application to pre-plant in the spring.
Sidedress N Application	7%	0%	900	$0.00	$ -	In-Field	Compares sidedress application to a single pre-plant application.
Cover Crops	31%	29%	300	$49.00	$ 14,700.00	In-Field	One of the most effective in-field practices for reducing both N and P.
No-Till	0%	90%	250	$12.00	$ 3,000.00	In-Field	Compares no-till to a chisel plow system. Very effective for P reduction.
Conservation Tillage	0%	33%	900	-$1.00	$ (900.00)	In-Field	Compares chisel plowing to more intensive moldboard plowing.
Extended Rotations	42%	0%	300	$30.00	$ 9,000.00	Land Use	Involves a 4- or 5-year rotation with at least two years of alfalfa.
Land Retirement (CRP)	85%	75%		$192.00	$ -	Land Use	Converts cropland to perennial vegetation.
					$16,500.00		

This Example Reduction	
Nitrogen Reduction	**45%**
Phosphorus Reduction	**45%**

Spreadsheet Created by: AgriVia

"This spreadsheet is for illustrative purposes only. All acreage figures are examples and not intended to reflect actual values."

Appendix U – Landowner Engagement Letters

PO Box 44
1124 Willis Ave
Perry, IA 50220

November 25, 2025

Re: Petition for Tile Repairs and Improvements

Dear Landowner(s),

This letter is to inform you that a petition has been filed requesting a study for tile repairs and improvements in Drainage District No. 169. In response, the Board of Supervisors has appointed Jacob Hagan and Tyler Buman of AgriVia to conduct an investigation and prepare a report concerning the requested work.

As part of the preliminary investigation, we are gathering all relevant information about the existing drainage system. If you possess any tile maps, or other documentation related to the drainage within Drainage District No. 169, we respectfully ask that you share a copy with us. Additionally, if you have any concerns, observations, or questions regarding drainage in your area, we encourage you to contact us.

We will be on site next month to collect survey information including tile intake locations, the outlet, road culverts, and any other relevant tile survey work. All survey work will be conducted on foot and will be limited in scope to locating the tile. To minimize disturbance, no vehicles or UTVs will be used during this survey within any farm fields.

We encourage each landowner to visit the Wright County USDA office in Clarion to request a Wetland Determination for their farm. This determination helps identify areas where wetland regulations may apply.

We are also interested in learning whether you have any interest in water quality improvements, including the potential for constructing wetlands or other conservation practices.

An informational meeting will be held later this winter after the survey and study portion of the project has been completed. This meeting will provide an opportunity to review our findings and for landowners to make additional input. No repairs or improvements will be proposed until after this meeting and further input from landowners.

You are welcome to call, email, or text us at any time. If we are unable to answer right away, please leave a message and we will return your call as soon as possible. If you wish to stop by our office, please contact us in advance to ensure we are available, as we are in the field most days.

This letter is being sent to all landowners within the drainage district. If you have tenants who farm your land and may be interested, please share this information with them so they can stay informed.

A map of the drainage district is enclosed for your reference.

Sincerely,

Jacob Hagan, P.E.
jacob.agrivia@gmail.com
712-250-4318

Tyler Buman
tyler.agrivia@gmail.com
712-579-5296

AgriVia PLLC

cc: Courtney Morris, Wright Co. Drainage Clerk
Wright County Board of Supervisors

PO Box 44
1124 Willis Ave
Perry, IA 50220

February 9, 2026

Subject: Informational Meeting

Dear Landowners and Trustees of Drainage District No. 169,

You are invited to attend an informational meeting regarding the ongoing improvement study for Drainage District No. 169. The meeting will be held in the Board of Supervisor's Room at the Wright County Courthouse at 115 N Main St, Clarion, IA on Monday, February 23rd, 2026, at 10:00 AM.

The purpose of this meeting is to update landowners on the status of the engineer's study and to gather any pertinent information or input that you may have. No formal decisions will be made at this meeting. This is strictly an informational meeting to help guide the direction of the proposed improvements based on landowner feedback.

We encourage landowners to bring any relevant information they may have about their property, particularly private tile maps and wetland determinations. Wetland determinations can be obtained from your local NRCS office.

Much of the initial study has been completed, and we will be bringing materials and findings gathered to date to share with you.

Attendance is not required, but your participation is appreciated, especially if you have input, concerns, or historical knowledge that may be helpful in the planning process. Following the meeting, we will finalize the engineer's report and begin preparing proposed plans for the district based on the feedback received. Thank you for your time and your assistance in this shared effort.

Sincerely,

Jacob Hagan, P.E.
jacob.agrivia@gmail.com
712-250-4318
AgriVia PLLC

Tyler Buman
tyler.agrivia@gmail.com
712-579-5296

cc: Courtney Morris, Wright Co. Drainage Clerk
Wright County Board of Supervisors

Appendix V – Right-of-Way Recommendation

Work Limits (ROW) Recommendation
Tile Improvements
Drainage District No. 169
Wright County, IA

Recommended Work Limits (ROW)				
Deedholder	**S-T-R**	**Legal**	**Proposed Width (ft)**	**Acres**
Elkin 2018 Revocable Trust, Darle L., 1/2 Int	26-90-28	SE SE	100	3.9
Elkin 2018 Revocable Trust, Darle L., 1/2 Int	26-90-28	SE SW	100	3.1
Elkin 2018 Revocable Trust, Darle L., 1/2 Int	26-90-28	SW SE	100	3.4
Elkin 2018 Revocable Trust, Darle L., 1/2 Int	26-90-28	SW SE	50	0.6
Larson, Lois R.	26-90-31	SE NE	100	1.1
Radar Enterprises LLC	26-90-28	NW SW	100	0.2
Radar Enterprises LLC	26-90-28	SW SW	100	3.1
Radar Enterprises LLC	26-90-29	SE SW	100	0
Radar Enterprises LLC	26-90-32	E 1/2 NE NW	100	1.3
Radar Enterprises LLC	26-90-32	E 1/2 SE NW	100	1
Radar Enterprises LLC	26-90-32	NW NE	100	2.3
Radar Enterprises LLC	26-90-32	SW NW	50	0
Radar Enterprises LLC	26-90-32	SW NW	100	3.1
Radar Enterprises LLC	26-90-32	W 1/2 SE NW	100	1.5
Van Diest Family, L.L.C.	26-90-29	SE SE	100	3.4
Van Diest Family, L.L.C.	26-90-29	SW SE	100	3.6
Van Diest Family, L.L.C.	26-90-33	NE NW	50	0
Van Diest Family, L.L.C.	26-90-33	NW NE	50	0.3
Wagner, Brian J. & Pamela	26-90-32	NW NW	50	0.9
			Total Acres	**32.8**

PRELIMINARY PLANS FOR

DRAINAGE DISTRICT NO. 169

TILE IMPROVEMENTS

WRIGHT COUNTY, IA

2026

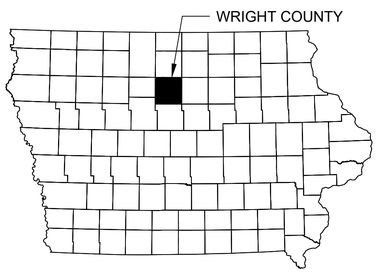
IOWA ONE CALL℠
1-800-292-8989
www.iowaonecall.com
811 Know what's below. Call before you dig.

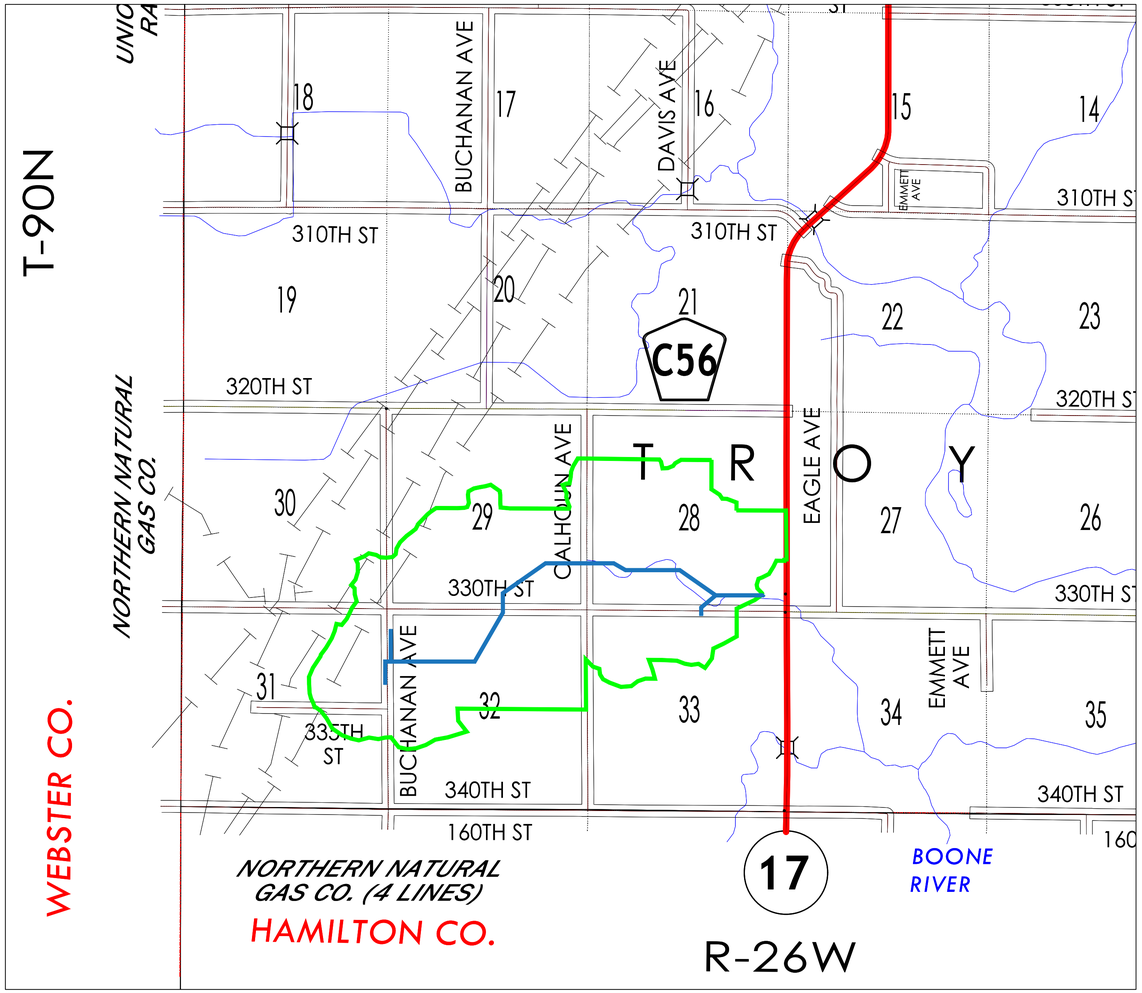
The contractor shall field verify exact locations prior to commencing construction as required by state law. Notify Iowa One Call, 811 or 1-800-292-8989.

Specifications

Unless otherwise noted, the governing standards for this project shall be the 2026 edition of the Iowa Statewide Urban Design and Specifications (SUDAS) for Public Improvements, supplemented where referenced by the Iowa Department of Transportation's Standard Specifications for Highway and Bridge Construction, Series 2023, along with all active general supplemental specifications, materials, instructional memoranda, and relevant special provisions.

Where conflicts arise, the stricter requirement shall take precedence. Complete compliance with all applicable federal, state, and local laws, ordinances, and regulations is mandatory throughout the project's execution.





Sheet Number	Sheet Title
A.01	Title Sheet
A.02	District Plat
C.01	General Construction Notes & Details
C.02	Pipe Construction Notes & Details
C.03	Pipe Structures Construction Notes & Details
M.01	Main Tile (Sta 0+00 → 29+00)
M.02	Main Tile (Sta 29+00 → 59+00)
M.03	Main Tile (Sta 59+00 → 89+00)
M.04	Main Tile (Sta 89+00 → 119+00)
M.05	Main Tile (Sta 119+00 → 122+68) & Lat. 1 & Lat. 2

PROFESSIONAL ENGINEER
JACOB L. HAGAN
25738
IOWA

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

Jacob L. Hagan, P.E. (date)
License No. 25738
My license renewal date is December 31, 2026.
Pages or sheets covered by this seal:
All

AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Notes

PLAN LEGEND
Proposed District Tile
Benefitted Area

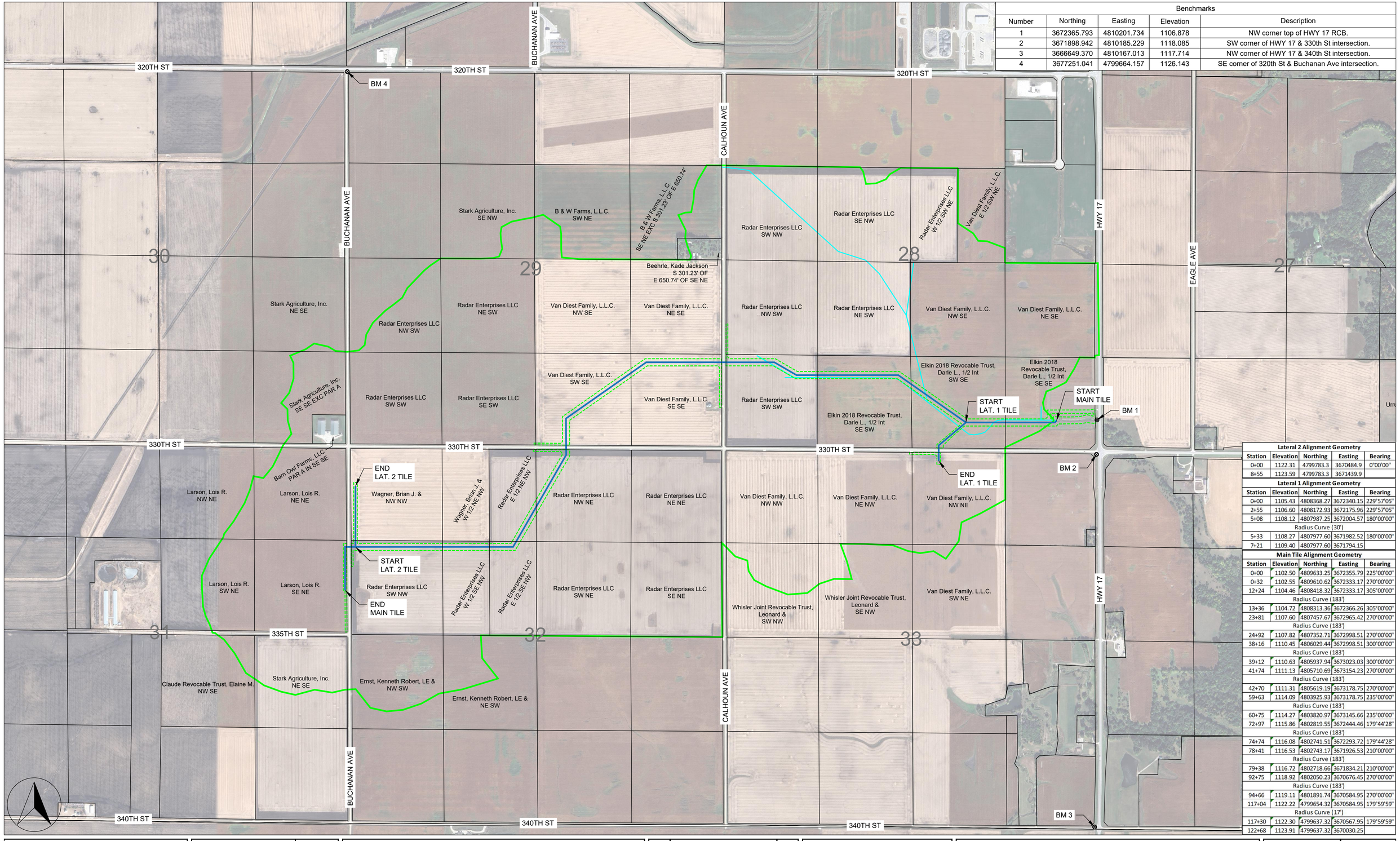
Project Datum:
State Plane, IA83-NF
NAVD 88

No.	Revision/Issue	Date

Sheet Name: Title Sheet

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project: 2532-99
Date: 2026-04-28
Plan Scale: 1" = 4000'
Sheet: A.01



Benchmarks				
Number	Northing	Easting	Elevation	Description
1	3672365.793	4810201.734	1106.878	NW corner top of HWY 17 RCB.
2	3671898.942	4810185.229	1118.085	SW corner of HWY 17 & 330th St intersection.
3	3666649.370	4810167.013	1117.714	NW corner of HWY 17 & 340th St intersection.
4	3677251.041	4799664.157	1126.143	SE corner of 320th St & Buchanan Ave intersection.

Lateral 2 Alignment Geometry				
Station	Elevation	Northing	Easting	Bearing
0+00	1122.31	4799783.3	3670484.9	0°00'00"
8+55	1123.59	4799783.3	3671439.9	

Lateral 1 Alignment Geometry				
Station	Elevation	Northing	Easting	Bearing
0+00	1105.43	4808368.27	3672340.15	229°57'05"
2+55	1106.60	4808172.93	3672175.96	229°57'05"
5+08	1108.12	4807987.25	3672004.57	180°00'00"
Radius Curve (30')				
5+33	1108.27	4807977.60	3671982.52	180°00'00"
7+21	1109.40	4807977.60	3671794.15	

Main Tile Alignment Geometry				
Station	Elevation	Northing	Easting	Bearing
0+00	1102.50	4809633.25	3672355.79	225°00'00"
0+32	1102.55	4809610.62	3672333.17	270°00'00"
12+24	1104.46	4808418.32	3672333.17	305°00'00"
Radius Curve (183')				
13+36	1104.72	4808313.36	3672366.26	305°00'00"
23+81	1107.60	4807457.67	3672965.42	270°00'00"
Radius Curve (183')				
24+92	1107.82	4807352.71	3672998.51	270°00'00"
38+16	1110.45	4806029.44	3672998.51	300°00'00"
Radius Curve (183')				
39+12	1110.63	4805937.94	3673023.03	300°00'00"
41+74	1111.13	4805710.69	3673154.23	270°00'00"
Radius Curve (183')				
42+70	1111.31	4805619.19	3673178.75	270°00'00"
59+63	1114.09	4803925.93	3673178.75	235°00'00"
Radius Curve (183')				
60+75	1114.27	4803820.97	3673145.66	235°00'00"
72+97	1115.86	4802819.55	3672444.46	179°44'28"
Radius Curve (183')				
74+74	1116.08	4802741.51	3672293.72	179°44'28"
78+41	1116.53	4802743.17	3671926.53	210°00'00"
Radius Curve (183')				
79+38	1116.72	4802718.66	3671834.21	210°00'00"
92+75	1118.92	4802050.23	3670676.45	270°00'00"
Radius Curve (183')				
94+66	1119.11	4801891.74	3670584.95	270°00'00"
117+04	1122.22	4799654.32	3670584.95	179°59'59"
Radius Curve (17')				
117+30	1122.30	4799637.32	3670567.95	179°59'59"
122+68	1123.91	4799637.32	3670030.25	

AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Notes

PLAN LEGEND
- Proposed District Tile
- Old District Tile
- Benefitted Area
- Parcel Lines
- Work Area (ROW)

No.	Revision/Issue	Date

Sheet Name: District Plat

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project: 2532-99
Date: 2026-04-28
Plan Scale: 1" = 1200'
Sheet: A.02

GENERAL PROVISIONS & PRE-CONSTRUCTION

1. **WORK AREA:** THE PLANS SHOW THE WORK AREA. STANDARD WORK AREA IS 50 FEET EACH SIDE FROM THE CENTERLINE OF THE TILE UNLESS OTHERWISE NOTED. THE CONTRACTOR MUST STAY WITHIN THIS AREA. ANY DAMAGE OUTSIDE THE WORK AREA WILL BE DEDUCTED FROM FINAL PAYMENT. ALL STAGING AND STORAGE SHALL BE WITHIN THE WORK AREA. NO STORAGE OR STAGING SHALL TAKE PLACE ON ROADWAYS.

2. **ACCESS:** ACCESS TO THE WORK AREA IS LIMITED TO PUBLIC ROAD INTERSECTIONS AND DRIVEWAYS CALLED OUT ON THE PLANS. THE CONTRACTOR IS RESPONSIBLE FOR SECURING ANY ADDITIONAL TEMPORARY ACCESS AGREEMENTS WITH LANDOWNERS OR THE COUNTY ENGINEER FOR ROAD ROW ENTRY.

3. **UTILITIES & LOCATES:** THE CONTRACTOR SHALL NOTIFY IOWA ONE CALL (811) PRIOR TO EXCAVATION. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROTECTING ALL MARKED AND UNMARKED UTILITIES.

4. **TILE EXPLORATION:** EXISTING TILE IS APPROXIMATELY LOCATED ON THE PLANS. ENGINEER MAY DIRECT CONTRACTOR TO LOCATE TILE BEFORE STARTING AND ADVANCING WORK TO DETERMINE EXISTING TILE LOCATION AND DEPTH TO AVOID POTENTIAL CONFLICTS. CONTRACTOR SHALL BE COMPENSATED ON AN HOURLY BASIS PER EXCAVATION, EXPLORATORY BID ITEM.

5. **AS-BUILT DOCUMENTATION:** THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A COMPLETE SET OF DRAWINGS SUITABLY MARKED TO SHOW ANY DEVIATIONS FROM THE ORIGINAL PLANS, INCLUDING BUT NOT LIMITED TO ACTUAL PIPE ALIGNMENTS, DEPTHS, CONNECTION LOCATIONS, AND ANY FIELD MODIFICATIONS. THIS DOCUMENTATION SHALL BE PROVIDED PRIOR TO FINAL ACCEPTANCE.

6. **THE LANDOWNERS** WHERE THE TILE IS BEING INSTALLED ARE PAYING FOR THIS PROJECT. AT COMPLETION OF THE PROJECT, THOSE LANDOWNERS ARE INVITED TO A PUBLIC HEARING AND CAN FILE CLAIMS FOR DAMAGES. THESE SPECIFICATIONS AND PLANS EXIST AS MUCH TO GUIDE AND PROTECT THE CONTRACTOR AS TO PROTECT THE LANDOWNERS. REGULAR DOCUMENTATION ALONG WITH OPEN COMMUNICATION WITH THE ENGINEER IS ESSENTIAL TO A SMOOTH PROJECT FOR ALL PARTIES.

ROADWAY CROSSINGS

1. **PERMITS & NOTIFICATIONS:** THE CONTRACTOR SHALL OBTAIN ALL NECESSARY OCCUPANCY PERMITS FROM THE COUNTY ENGINEER OR IOWA DOT. NOTIFY THE RESPECTIVE AGENCY AND THE PROJECT ENGINEER AT LEAST 48 HOURS PRIOR TO COMMENCING ANY WORK WITHIN THE ROW.

2. **TRAFFIC CONTROL:** THE CONTRACTOR IS RESPONSIBLE FOR ALL TRAFFIC CONTROL, INCLUDING SIGNAGE, BARRICADES, AND FLAGGERS. ALL SETUPS MUST STRICTLY ADHERE TO THE LATEST MUTCD (MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES) STANDARDS AND ANY SPECIFIC REQUIREMENTS SET BY THE COUNTY OR DOT PERMIT.

3. **UTILITY VERIFICATION:** ALL UTILITIES WITHIN THE ROW (FIBER OPTIC, GAS, WATER) MUST BE DAYLIGHTED VIA POTHOLING PRIOR TO THE ARRIVAL OF THE BORING OR TRENCHING EQUIPMENT.

4. **SEEDING:** DISTURBED ROAD DITCHES SHALL BE SEEDED FOLLOWING SUDAS TYPE 2 (PERMANENT COOL SEASON MIXTURE FOR SLOPES AND DITCHES) SEED MIXTURE.

5. **STORAGE AND PARKING:** NO STORAGE OR PARKING OF EQUIPMENT IN PUBLIC RIGHT-OF-WAY. NO CROSSING PAVED ROADS WITH TRACKED EQUIPMENT.

6. **OPEN CUT: COUNTY GRAVEL ROAD**

   a. PIPE SUPPORT: ALL PIPE UNDER THE ROADWAY MUST BE INSTALLED USING MODIFIED TYPE 4 TRENCHING.

   b. MATERIALS: WITHIN THE ROAD PRISM, NATIVE SOIL SHALL NOT BE USED FOR HAUNCHING. USE 1-INCH CLEAN CRUSHED STONE OR SUDAS CLASS I CRUSHED STONE TO THE SPRINGLINE OF THE PIPE. FROM THE TOP OF THE HAUNCHING TO WITHIN 12 INCHES OF THE ROAD SURFACE, THE TRENCH MAY BE FILLED WITH NATIVE SUBSOIL MATERIAL PER THE ENGINEER'S APPROVAL. THE ENGINEER MAY REQUIRE THE BACKFILL TO BE CLASS I STONE PER THEIR DIRECTION.

   c. COMPACTION LIFTS: BACKFILL SHALL BE PLACED IN MAXIMUM 8-INCH LOOSE LIFTS. EACH LIFT MUST BE MECHANICALLY COMPACTED TO 95% STANDARD PROCTOR DENSITY.

   d. SURFACE MATERIAL: THE TOP 12 INCHES OF THE TRENCH SHALL BE FILLED WITH CLASS A ROAD STONE (OR THE SPECIFIC GRAVEL GRADE USED BY THE COUNTY) AND COMPACTED THOROUGHLY.

   e. CROWNING: THE FINISHED SURFACE OF THE TRENCH SHOULD BE "CROWNED" APPROXIMATELY 1 TO 2 INCHES HIGHER THAN THE ADJACENT ROAD GRADE TO ALLOW FOR INITIAL TRAFFIC-DRIVEN COMPACTION WITHOUT CREATING A DEPRESSION.

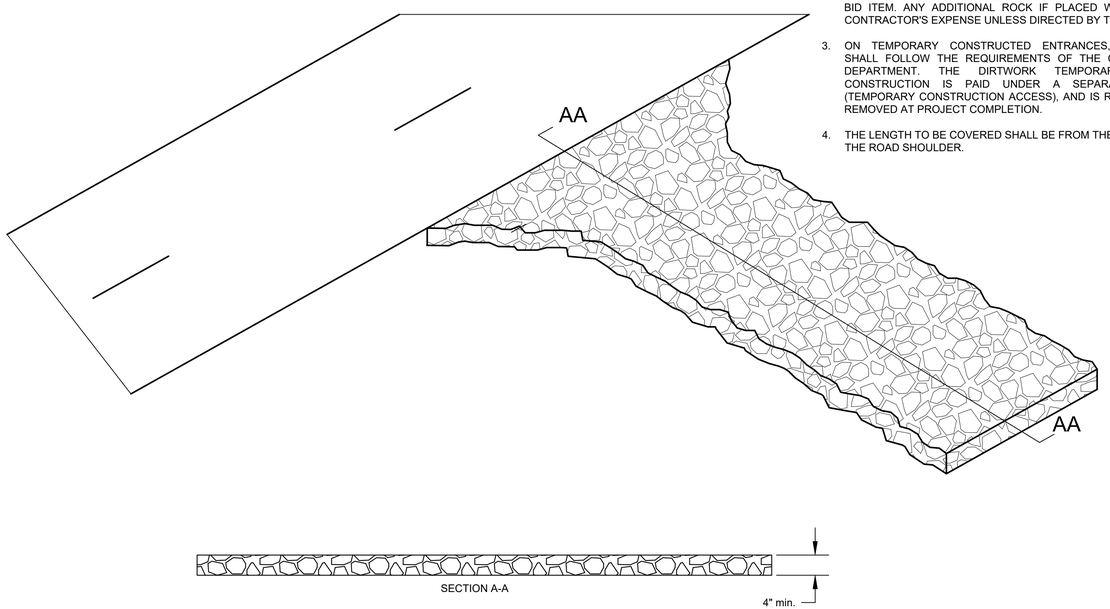
   f. SHOULDER REPAIR: ANY DAMAGE TO THE ROAD SHOULDERS OR SIDE SLOPES SHALL BE RESHAPED TO MATCH THE ORIGINAL PROFILE AND IMMEDIATELY SEEDED/MULCHED.

   g. ROAD DITCH SEEDING: SHALL FOLLOW SUDAS 9010. USE TYPE 2 (PERMANENT COOL SEASON MIXTURE FOR SLOPES AND DITCHES) SEED MIXTURE. ENGINEER MAY DIRECT DIFFERENT SEED MIXTURE DUE TO WEATHER OR SEASON CONDITIONS.

   h. ROAD CLOSURE: THE CROSSING NEEDS TO BE COMPLETED IN ONE DAY. THE ROAD SHALL ONLY BE CLOSED FROM SUN RISE TO SUN SET. BY SUN SET THE ROAD SHALL BE OPEN TO TRAFFIC.

7. **TRENCHLESS / BORED METHOD:** SHALL FOLLOW SUDAS 3020 AND IOWA DOT PERMIT REQUIREMENTS.

CONSTRUCTION ACCESS



GENERAL NOTES:

1. LOCATIONS OF CONSTRUCTION ENTRANCES ARE MARKED ON THE PLANS. OBTAIN APPROVAL FROM THE ENGINEER PRIOR TO USING ANY OTHER ENTRANCES.
2. PLACING 12 TONS OF CLASS I STONE ON EACH EXISTING AND TEMPORARY ENTRANCE WILL BE PAID UNDER THE CLASS I STONE BID ITEM. ANY ADDITIONAL ROCK IF PLACED WILL BE AT THE CONTRACTOR'S EXPENSE UNLESS DIRECTED BY THE ENGINEER.
3. ON TEMPORARY CONSTRUCTED ENTRANCES, CONTRACTOR SHALL FOLLOW THE REQUIREMENTS OF THE COUNTY ROADS DEPARTMENT. THE DIRTWORK TEMPORARY DRIVEWAY CONSTRUCTION IS PAID UNDER A SEPARATE BID ITEM (TEMPORARY CONSTRUCTION ACCESS), AND IS REQUIRED TO BE REMOVED AT PROJECT COMPLETION.
4. THE LENGTH TO BE COVERED SHALL BE FROM THE FIELD EDGE TO THE ROAD SHOULDER.

AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Notes

No.	Revision/Issue	Date

Sheet Name
General Construction Notes & Details

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale

Sheet C.01

PIPE EXCAVATION, TRENCHING & BEDDING NOTES

1. **RIGID PIPE (RCP):** SUDAS SW-102 MODIFIED R-1 BEDDING. THE TRENCH BASE MUST BE EXCAVATED WITH A SHAPED BOTTOM GROOVE CONFORMING TO AT LEAST 1/6 OF THE PIPE OUTSIDE CIRCUMFERENCE TO PROVIDE UNIFORM SUPPORT. IF A FIRM TRENCH BOTTOM IS NOT FOUND, THE CONTRACTOR SHALL OVER-EXCAVATE AND PLACE 1"–3" CLEAN CRUSHED STONE BEDDING (SUDAS CLASS 1) TO STABILIZE THE BASE PER ENGINEER'S DIRECTION. GPS LOCATED AND TIME STAMPED PHOTOS SHALL BE TAKEN EVERY 100 FEET OR ANY TIME ROCK BEDDING IS USED AND ROCK TICKETS SHALL BE SUBMITTED.

2. **FLEXIBLE PIPE (CPDT):** SUDAS SW-103 F-2 BEDDING REQUIREMENTS. TRENCH WIDTH SHALL BE THE OUTSIDE DIAMETER PLUS 12 INCHES. GPS LOCATED AND TIME STAMPED PHOTOS SHALL BE TAKEN EVERY 100 FEET SHOWING THE ROCK TO THE TOP OF THE PIPE BEFORE BACKFILLING WITH DIRT. ALL ROCK TICKETS SHALL BE SUBMITTED, AND ALL ROCK USED IS INCIDENTAL TO INSTALLATION. ROCK TICKETS SHALL BE SUBMITTED WEEKLY WITH A LOG OF LENGTH OF TILE INSTALLED CORRESPONDING TO THE ROCK USED. A SPOON BOTTOM MAY BE USED FOR PIPE 15" OR SMALLER IF LAID USING A TILE PLOW OR TRENCHER WITH GRADE CONTROL. A SPOON BOTTOM (NO ROCK BEDDING) USING AN EXCAVATOR IS NOT ACCEPTABLE FOR ANY SIZE PIPE.

   TO ENSURE LONGEVITY AND MINIMIZE SETTLEMENT FOR FLEXIBLE PIPE INSTALLATION, THE CONTRACTOR MUST PARTICIPATE IN THE FOLLOWING VERIFICATION PROCESS:

   STEP 1 (DEMONSTRATION): IN THE PRESENCE OF THE ENGINEER, THE CONTRACTOR SHALL DEMONSTRATE THEIR COMPACTION METHOD ON THE FIRST SEVERAL PIPE SECTIONS. DENSITY TESTS MAY BE TAKEN TO CONFIRM THE METHOD ACHIEVES 95% STANDARD PROCTOR DENSITY.

   STEP 2 (SPOT CHECKING): ONCE A METHOD IS APPROVED, THE CONTRACTOR MAY PROCEED, BUT MAY BE RANDOMLY TESTED BY THE ENGINEER AT THE ENGINEER'S SOLE DECISION. GPS LOCATED AND TIME STAMPED PHOTOS EVERY 100 FEET SHOWING THE TILE UNBLINDED WITH THE HAUNCHES FILLED AND COMPACTED ARE REQUIRED TO BE SUBMITTED.

   STEP 3 (VIDEO AND DEFLECTION TESTING): PER SUDAS REQUIREMENTS FOR FLEXIBLE PIPE AFTER COMPLETION OF THE PROJECT.

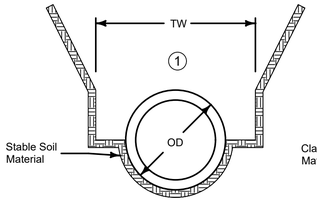
3. **BACKFILL AND TOPSOIL:** TOPSOIL (TOP 12" OR HORIZON A SOIL IF DEEPER) SHALL BE SEGREGATED DURING EXCAVATION AND PLACED ON THE OPPOSITE SIDE OF THE TRENCH AS THE SUBSOIL IS PLACED. THE SUBSOIL SHALL BE PLACED FIRST IN 6-INCH LIFTS AND THE TOPSOIL PLACED ON TOP. ROCKS SHALL BE PICKED UP AND BURIED AT LEAST 4 FEET DEEP. A SMALL MOUND IS ALLOWABLE (MAXIMUM HEIGHT OF 6 INCHES).

4. **ELBOWS AND BENDS:** THE PLANS SHOW BENDS AND ELBOWS. ADDITIONAL BENDS OR ELBOWS MAY BE REQUIRED DEPENDING ON EXISTING TILE LOCATIONS AND UNKNOWN SUBSURFACE CONDITIONS. ALL BENDS AND ELBOWS ARE INCIDENTAL UNLESS CALLED OUT IN BID DOCUMENTS. CONTRACTOR SHALL RECEIVE NO ADDITIONAL COMPENSATION FOR ADDITIONAL RCP BENDS OR HDPE ELBOWS NEEDED DUE TO ALIGNMENT CHANGES.

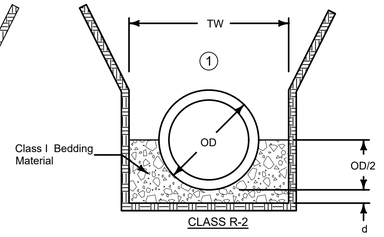
   RCP PIPE: GENTLE CURVES CAN BE ACCOMPLISHED VIA GAPPING THE PIPE. ALL RADIUSES SHALL BE WRAPPED IN FABRIC. MAXIMUM ALLOWABLE DEGREE PER PIPE SECTION IS 2.5 DEGREE.

   HDPE PIPE: ALL CHANGES IN DIRECTIONS SHALL BE DONE USING MANUFACTURED ELBOWS. THE MAXIMUM ALLOWABLE ELBOW TO BE USED IS 22.5 DEGREES. TO ACHIEVE BENDS GREATER THAN 22.5 DEGREES, MULTIPLE ELBOWS SHALL BE USED.

RCP AND VCP CIRCULAR PIPE BEDDING



STANDARD SPOON TRENCH METHOD



CLASS R-2

① Use Standard Spoon Trench Method or R-2 unless specified otherwise.

① Place remainder of bedding and backfill materials as specified in the contract documents.

Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. = OD+18 inches
Max.= 1.25xOD+12 inches OR
54 inches (whichever is greater)

d = Depth of bedding material below pipe: OD/8 or OS/8, OR 4 inches (whichever is greater)

ALLOWABLE BURY DEPTH

CLASS III RCP

Pipe Diameter (in)	Standard "Spoon-Trench" Method	Class R-2 Bedding
12	7'	10'
15	8'	10'
18	8'	11'
21	8'	11'
24	8'	12'
27	10'	15'
30	11'	15'
33	11'	15'
36	11'	15'
42	11'	15'
48	11'	15'
54	11'	15'
60	11'	15'
66	11'	15'
72	11'	15'

CLASS IV RCP

Pipe Diameter (in)	Standard "Spoon-Trench" Method	Class R-2 Bedding
12	12'	15'
15	12'	16'
18	13'	16'
21	13'	18'
24	16'	23'
27	19'	30'
30	19'	29'
33	19'	28'
36	19'	28'
42	18'	27'
48	18'	26'
54	18'	25'
60	18'	25'
66	18'	25'
72	18'	24'

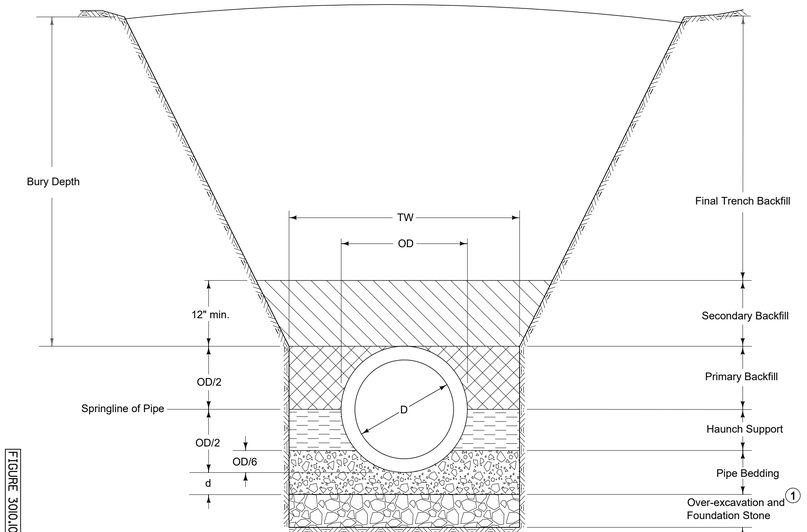
CLASS V RCP

Pipe Diameter (in)	Standard "Spoon-Trench" Method	Class R-2 Bedding
12	18'	23'
15	19'	24'
18	19'	30'
21	25'	40'
24	34'	40'
27	40'	40'
30	40'	40'
33	40'	40'
36	40'	40'
42	37'	40'
48	35'	40'
54	33'	40'
60	32'	40'
66	31'	40'
72	31'	40'

TRENCH BEDDING AND BACKFILL ZONES

Refer to the contract documents for specific material and placement requirements.

① Required only when specified in the contract documents or when directed by the Engineer.



Key

OD = Outside diameter of pipe

D = Inside diameter of pipe

TW = Trench width at top of pipe

d = Depth of bedding material below pipe

FIGURE 3010.101 | SHEET 1 OF 1

SUDAS	IOWADOT	REVISION 1 04-17-18
FIGURE 3010.101	STANDARD ROAD PLAN	SW-101
		SHEET 1 of 1

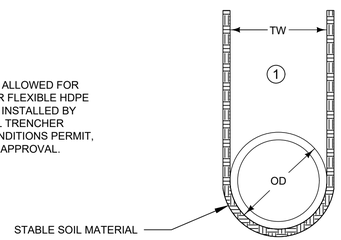
REVISIONS: Replaced Iowa DOT and SUDAS logos.

Paul D. Wigand, SUDAS DIRECTOR — Brian J. Smith, DESIGN METHODS ENGINEER

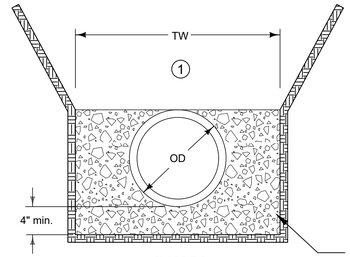
TRENCH BEDDING AND BACKFILL ZONES

HDPE & PP PIPE INSTALLATION DETAIL

NOTE
1. SPOON METHOD ALLOWED FOR 15" AND SMALLER FLEXIBLE HDPE DUAL WALL PIPE INSTALLED BY PLOW OR WHEEL TRENCHER WHERE SOIL CONDITIONS PERMIT, WITH ENGINEER APPROVAL.



SPOON TRENCH METHOD



CLASS F-2

KEY

OD = Outside diameter of pipe

TW = Trench width at top of pipe
Min. = OD+18 inches OR 1.25xOD+12 inches
(whichever is greater)

CLASS I
BEDDING MATERIAL
OR APPROVED EQUAL

ALLOWABLE BURY DEPTH

HDPE PIPE

Pipe Diameter (in)	AASHTO M 294
12	8'
15	9'
18	9'
24	9'
30	9'
36	9'
42	8'
48	8'
54	8'
60	8'

POLYPROPYLENE PIPE

Pipe Diameter (in)	ASTM F 2764
12	24'
15	25'
18	22'
24	20'
30	22'
36	21'
42	22'
48	23'
54	21'
60	21'

AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Notes

No.	Revision/Issue	Date

Sheet Name: Pipe Construction Notes & Details

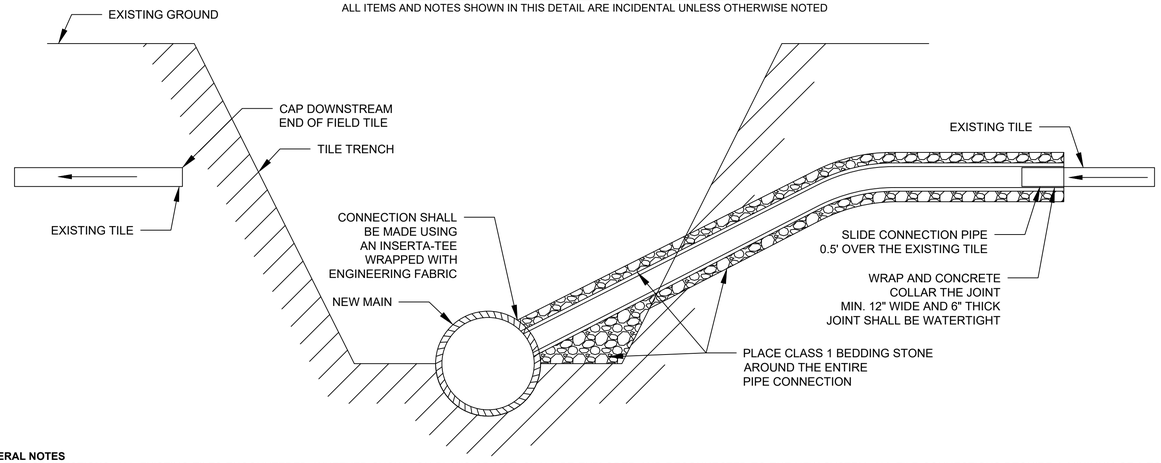
Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale

Sheet C.02

TYPICAL TILE CONNECTION DETAIL

ALL ITEMS AND NOTES SHOWN IN THIS DETAIL ARE INCIDENTAL UNLESS OTHERWISE NOTED

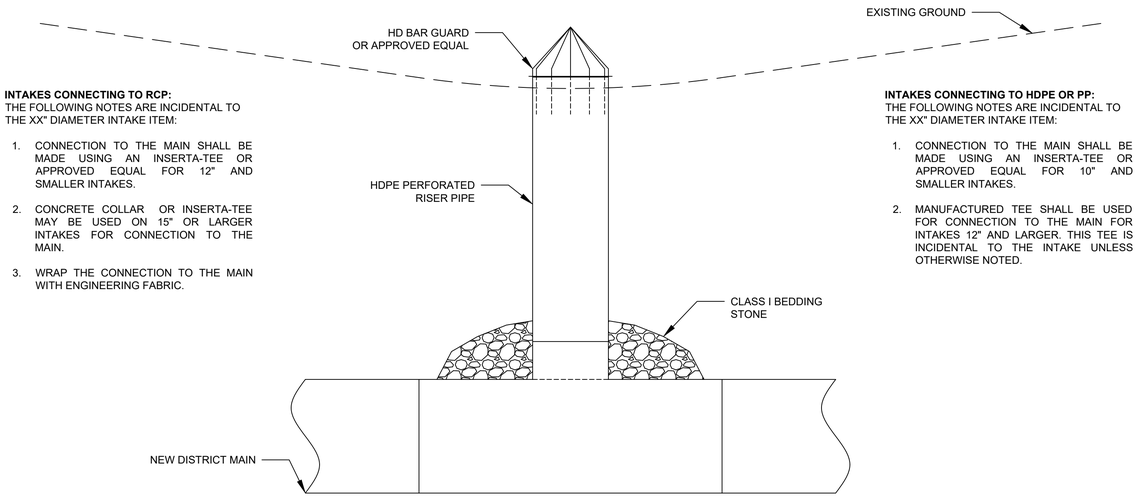


GENERAL NOTES

1. **TILE CONNECTIONS:** ALL EXISTING TILES ENCOUNTERED, WHETHER SHOWN ON PLANS OR NOT, SHALL BE EXPLORED AND RECONNECTED TO THE NEW SYSTEM. ALL TILE CONNECTIONS REQUIRE A MINIMUM OF 3 TONS OF CLASS I BEDDING STONE TO BE PLACED AROUND THE ENTIRE TILE CONNECTION. A TIME-STAMPED AND GPS-LOCATED PHOTO WILL BE REQUIRED FOR EACH CONNECTION. THE PHOTO SHALL BE TAKEN BEFORE THE ROCK HAS COMPLETELY ENCASED THE PIPE. A LOG OF ALL CONNECTIONS INCLUDING SIZE, LOCATION AND EXISTING MATERIAL SHALL BE SUBMITTED PRIOR TO PAYMENT. ROCK TICKETS MUST BE SUBMITTED. ROCK USED IS INCIDENTAL TO INSTALLATION. ANY LATERAL TILE CROSSING THE MAIN LINE TRENCH MUST BE SUPPORTED BY CRUSHED STONE BEDDING TO PREVENT SETTLEMENT AND SHEARING AT THE CONNECTION POINT.
2. TO MAKE THE CONNECTION, SINGLE WALL CORRUGATED DRAIN TILE OF THE SAME OR LARGER SIZE THAN THE EXISTING TILE MAY BE USED FOR TILES UP TO 10" IN DIAMETER. ANY TILE 12" OR LARGER WILL REQUIRE USING FLEXIBLE DUAL WALL DRAIN TILE OF THE SAME OR LARGER TILE TO MAKE THE CONNECTION. 25 LF OF DRAIN TILE IS CONSIDERED INCIDENTAL TO THE CONNECTION, IF LONGER THAN 25 FEET IS USED, IT NEEDS TO BE NOTED IN THE LOG WITH A PHOTO TO BE PAID.
3. THE UPSTREAM END CONNECTING TO THE TILE SHALL BE WRAPPED WITH FABRIC AND CONCRETE COLLARED. THE DOWNSTREAM END OF THE TILE CONNECTION SHALL BE CAPPED WITH BROKEN TILE AND CONCRETE PIECES BONDED WITH SACKRETE OR APPROVED SIMILAR AND WRAPPED WITH FABRIC OR A HDPE END CAP MAY BE USED.
4. 12" TILE INTERCONNECTIONS WITH THE EXISTING DISTRICT TILE WILL BE PAID AS LARGE TILE CONNECTIONS. TILE INTERCONNECTIONS WITH THE EXISTING FIELD TILE WILL BE PAID AS SMALL TILE CONNECTIONS.
5. **RCP DISTRICT TILE CONNECTIONS:** ALL TILE CONNECTIONS 12" OR SMALLER SHALL BE MADE WITH INSERTA-TEE OR APPROVED SIMILAR. ALL TILE CONNECTIONS 15" OR LARGER SHALL BE MADE WITH EITHER AN INSERTA-TEE OR MAY BE CONCRETE COLLARED.
6. **HDPE DISTRICT TILE CONNECTIONS:** ALL TILE CONNECTIONS 10" OR SMALLER SHALL BE MADE WITH AN INSERTA-TEE OR APPROVED SIMILAR. ALL TILE CONNECTIONS 12" OR LARGER SHALL USE A MANUFACTURED TEE CONNECTED VIA A CONCRETE COLLAR OR INTERLOCKED.

HD XX" BAR GUARD INTAKE DETAIL

ALL ITEMS AND NOTES SHOWN IN THIS DETAIL ARE INCIDENTAL UNLESS OTHERWISE NOTED



INTAKES CONNECTING TO RCP:
THE FOLLOWING NOTES ARE INCIDENTAL TO THE XX" DIAMETER INTAKE ITEM:

1. CONNECTION TO THE MAIN SHALL BE MADE USING AN INSERTA-TEE OR APPROVED EQUAL FOR 12" AND SMALLER INTAKES.
2. CONCRETE COLLAR OR INSERTA-TEE MAY BE USED ON 15" OR LARGER INTAKES FOR CONNECTION TO THE MAIN.
3. WRAP THE CONNECTION TO THE MAIN WITH ENGINEERING FABRIC.

INTAKES CONNECTING TO HDPE OR PP:
THE FOLLOWING NOTES ARE INCIDENTAL TO THE XX" DIAMETER INTAKE ITEM:

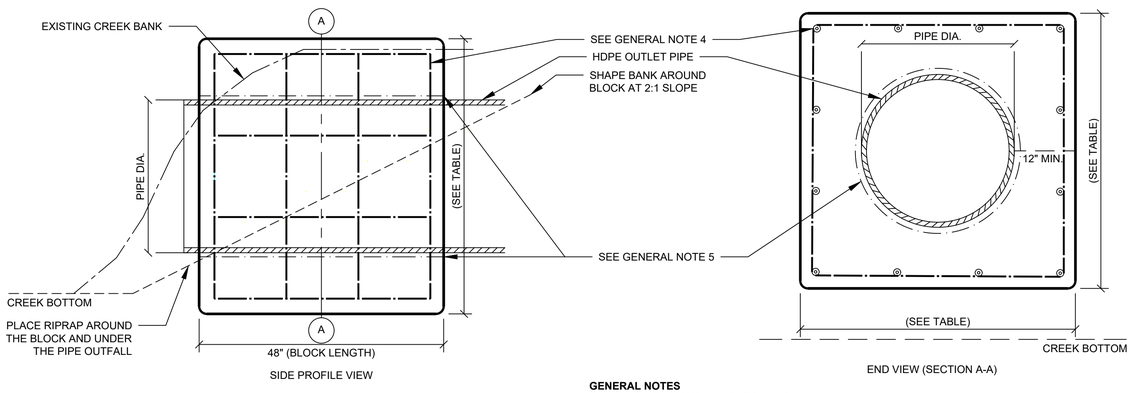
1. CONNECTION TO THE MAIN SHALL BE MADE USING AN INSERTA-TEE OR APPROVED EQUAL FOR 10" AND SMALLER INTAKES.
2. MANUFACTURED TEE SHALL BE USED FOR CONNECTION TO THE MAIN FOR INTAKES 12" AND LARGER. THIS TEE IS INCIDENTAL TO THE INTAKE UNLESS OTHERWISE NOTED.

GENERAL NOTES

1. **INTAKES (HICKENBOTTOM/BAR GUARD):** ALL INTAKES ARE CALLED OUT ON THE PLANS. ALL INTAKES REQUIRE A MINIMUM OF 3 TONS OF CLASS I BEDDING STONE TO BE PLACED AROUND THE ENTIRE CONNECTION. A TIME-STAMPED AND GPS-LOCATED PHOTO WILL BE REQUIRED FOR EACH CONNECTION. THE PHOTO SHALL BE TAKEN BEFORE THE ROCK HAS COMPLETELY ENCASED THE PIPE. A LOG OF ALL CONNECTIONS INCLUDING SIZE, LOCATION AND MATERIAL SHALL BE SUBMITTED PRIOR TO PAYMENT. ROCK TICKETS MUST BE SUBMITTED. ROCK USED IS INCIDENTAL TO INSTALLATION. THE GROUND AROUND THE INTAKE SHALL BE RESHAPED TO DRAIN TO THE INTAKE.
2. **BAR GUARD INTAKES:** ALL BAR GUARD INTAKES SHALL BE CONSIDERED HEAVY DUTY. CONSTRUCTED OF ½" STEEL ROD WITH A YELLOW POWDER COAT FINISH. AGRI-DRAIN HD YELLOW BAR GUARD OR APPROVED EQUAL.
3. **INTAKE MARKER:** ALL INTAKES PLACED IN ROAD DITCHES SHALL INCLUDE AN INLET TILE MARKER SIGN, SUCH AS PROVIDED AT AGRI-DRAIN OR APPROVED EQUAL. THE SIGN SHALL BE FIXED TO A STEEL OR WOODEN POST AT MINIMUM 6' LONG.
4. **RISER:** PERFORATED HDPE DUAL WALL PIPE SHALL BE USED AS THE RISER, THE APPROXIMATE LENGTH REQUIRED IS SHOWN ON THE PLANS. THE PIPE USED AS A RISER IS CONSIDERED INCIDENTAL TO THE INTAKE INSTALLATION. NO MEASUREMENT WILL BE MADE OF THE LENGTH NEEDED. RISER MUST BE CUT FLUSH TO GROUND LEVEL.

LARGE HDPE PIPE OUTLET DETAIL

ALL ITEMS AND NOTES SHOWN IN THIS DETAIL ARE INCIDENTAL UNLESS OTHERWISE NOTED



BLOCK SIZING TABLE

PIPE DIA.	BLOCK WIDTH	BLOCK HEIGHT	BLOCK LENGTH	CONCRETE	REBAR (#4)
(IN.)	(IN.)	(IN.)	(IN.)	(CU. YD.)	(LBS.)
18"	42"	42"	48"	1.55	65
24"	48"	48"	48"	1.90	75
30"	54"	54"	48"	2.27	100
36"	60"	60"	48"	2.66	110
42"	66"	66"	48"	3.06	135
48"	72"	72"	48"	3.47	145
54"	78"	78"	48"	3.90	175
60"	84"	84"	48"	4.35	190

GENERAL NOTES

1. ALL DIMENSIONS IN INCHES U.N.O.
2. PIPE SHALL BE CENTERED IN BLOCK.
3. CONCRETE: 4,000 PSI MIN., 28-DAY.
4. REBAR: ASTM A615, GRADE 60, #4 BARS. PLACE #4 BARS @ 12" O.C. E.W. ON EACH FACE (FRONT, BACK, AND BOTH SIDES), 3" CLR. COVER U.N.O. CUT AND BEND BARS AROUND PIPE OPENING WITH STD. HOOKS. LAP BARS 12" MIN. AT CORNERS. WIRE-TIE ALL INTERSECTIONS. 3" MIN. CONCRETE COVER OVER ALL REBAR.
5. WRAP PIPE W/ 1/4"-1/2" CLOSED-CELL FOAM BEFORE PLACING CONCRETE.
6. BACKFILL IN 6" LIFTS, COMPACT TO 95% STD. PROCTOR.
7. SMOOTH TROWEL ALL EXPOSED CONCRETE FACES.
8. ROUND ALL CONCRETE EDGES AND CORNERS.
9. REBAR QUANTITIES ARE ESTIMATED NET WEIGHTS AND DO NOT INCLUDE LAP SPLICES, HOOKS, BENDS AT PIPE OPENING, OR CUTTING WASTE.
10. PLACE 25 TONS OF RIPRAP AROUND THE CONCRETE BLOCK AND BENEATH THE PIPE OUTFALL. RIPRAP MUST BE KEYED INTO THE SLOPE AND CANNOT IMPEDE THE STREAM FLOW.
11. PLACE 6" COMPACTED CRUSHED STONE BENEATH THE BLOCK AS A BASE.

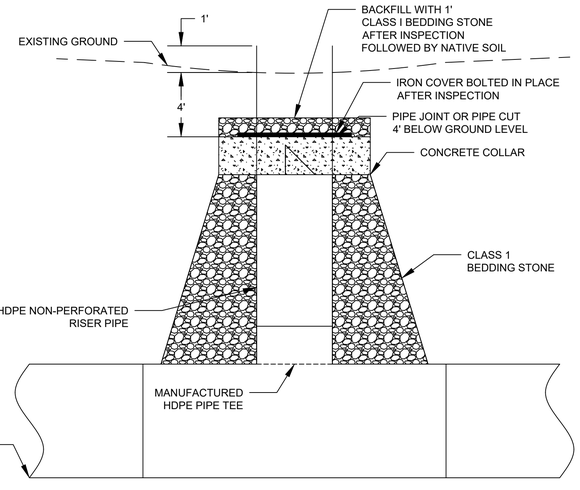
HDPE & PP INSPECTION PORT DETAIL

ALL ITEMS AND NOTES SHOWN IN THIS DETAIL ARE INCIDENTAL UNLESS OTHERWISE NOTED

MATERIALS

1. **TEE BASE:** 18" ON "MAIN TILE SIZE" FABRICATED HDPE TEE (WATERTIGHT/SOIL-TIGHT).
2. **RISER PIPE:** 18" DUAL-WALL HDPE (NON-PERFORATED) (AASHTO M294 TYPE S).
3. **COVER ASSEMBLY:** NYLOPLAST 24" DUCTILE IRON SOLID COVER (ADS PART #1801DI OR SIMILAR).

   NOTE: THE COVER MUST BE H-20 LOAD RATED (CAPABLE OF SUPPORTING 32,000 LBS PER AXLE). DO NOT USE PLASTIC SEPTIC LIDS OR FLAT END CAPS.
4. **SUPPORT STRUCTURE:** 4,000 PSI STRUCTURAL CONCRETE (FOR THE COLLAR).
5. **BEDDING/BACKFILL:** CLEAN, CRUSHED ANGULAR STONE (SUDAS CLASS I OR "1-INCH CLEAN") FOR THE BEDDING AND THE FIRST 2 FEET OF RISER BACKFILL.



INSTALLATION

1. **PHASE I: MAIN LINE CONSTRUCTION**

   INSTALL THE 18" ON MAIN TILE SIZE TEE ON A STABLE FOUNDATION OF F-2 BEDDING (PER USER SPEC).

   INSTALL THE 18" RISER PIPE VERTICALLY. FOR THE 30-DAY INSPECTION PERIOD, LEAVE THE PIPE EXTENDING 1 FOOT ABOVE THE SURFACE.
2. **PHASE II: 30-DAY INSPECTION**

   THIRTY (30) DAYS POST-CONSTRUCTION, PERFORM THE REQUIRED CAMERA INSPECTION AND MANDREL PULL THROUGH THE MAIN VIA THE 18" PORT.

   UPON APPROVAL OF THE INSPECTION, PROCEED TO FINAL BURIAL.
3. **PHASE III: FINAL BURIAL & LOAD SUPPORT**

   CUTTING: EXCAVATE AROUND THE RISER AND CUT THE HDPE PIPE TO A DEPTH OF 4 FEET BELOW FINAL GRADE.

   CONCRETE COLLAR (CRUCIAL): EXCAVATE A SHELF IN THE NATIVE SOIL AROUND THE TOP OF THE 18" PIPE. POUR AN 8-INCH-THICK CONCRETE COLLAR (SUDAS CLASS C) (APPROX. 36" IN DIAMETER) AROUND THE PIPE.

   LID PLACEMENT: SET THE NYLOPLAST DUCTILE IRON FRAME AND SOLID COVER INTO THE CONCRETE COLLAR/RISER. ENSURE THE FRAME IS LEVEL AND SUPPORTED BY THE CONCRETE, NOT JUST RESTING ON THE PLASTIC PIPE.

   BEDDING: PLACE 12 INCHES OF CRUSHED ROCK OVER THE LID TO PROVIDE A DRAINAGE/STABILITY LAYER.

   FINAL BACKFILL: BACKFILL THE REMAINING 3 FEET WITH NATIVE SOIL IN 6-INCH LIFTS, COMPACTING WITH BUCKET, LEAVE MOUND NOT TO EXCEED 6 INCHES.

GENERAL NOTES

1. ALL MATERIALS AND INSTALLATION SHALL COMPLY WITH IOWA SUDAS SECTION 4020/4040 AND MANUFACTURER SPECIFICATIONS FOR H-20 TRAFFIC LOADING.
2. INSTALL AT INTERVALS SHOWN ON PLANS (NOMINALLY EVERY 1,000 FEET) OR SHORTER AS REQUIRED BY YOUR TESTING EQUIPMENT.
3. INSPECTION PORTS ARE INCIDENTAL TO THE INSTALLATION OF HDPE AND PP DRAINAGE MAIN TILE. QUANTITY SHOWN ON PLANS IS ESTIMATED TO BE THE MINIMUM REQUIRED TO COMPLETE THE REQUIRED TESTING. IF MORE INSPECTION PORTS ARE NEEDED THAN SHOWN ON THE PLANS TO PROPERLY INSPECT THE PIPE OR IF LARGER INSPECTION PORTS ARE NEEDED FOR THE TOOLS REQUIRED, ANY ADDITIONAL COST FOR INSTALLATION IS THE RESPONSIBILITY OF THE CONTRACTOR FOR SUCH ACCOMMODATIONS. ALL ITEMS SHOWN IN THIS DETAIL ARE INCIDENTAL UNLESS OTHERWISE NOTED.
4. CONTRACTOR SHALL PROVIDE TIMESTAMPED AND GPS LOCATED PHOTOS OF EACH PORT PRIOR TO BACKFILLING. ROCK TICKETS FOR EACH PORT MUST BE SUBMITTED. ROCK USED FOR EACH PORT IS INCIDENTAL.

AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

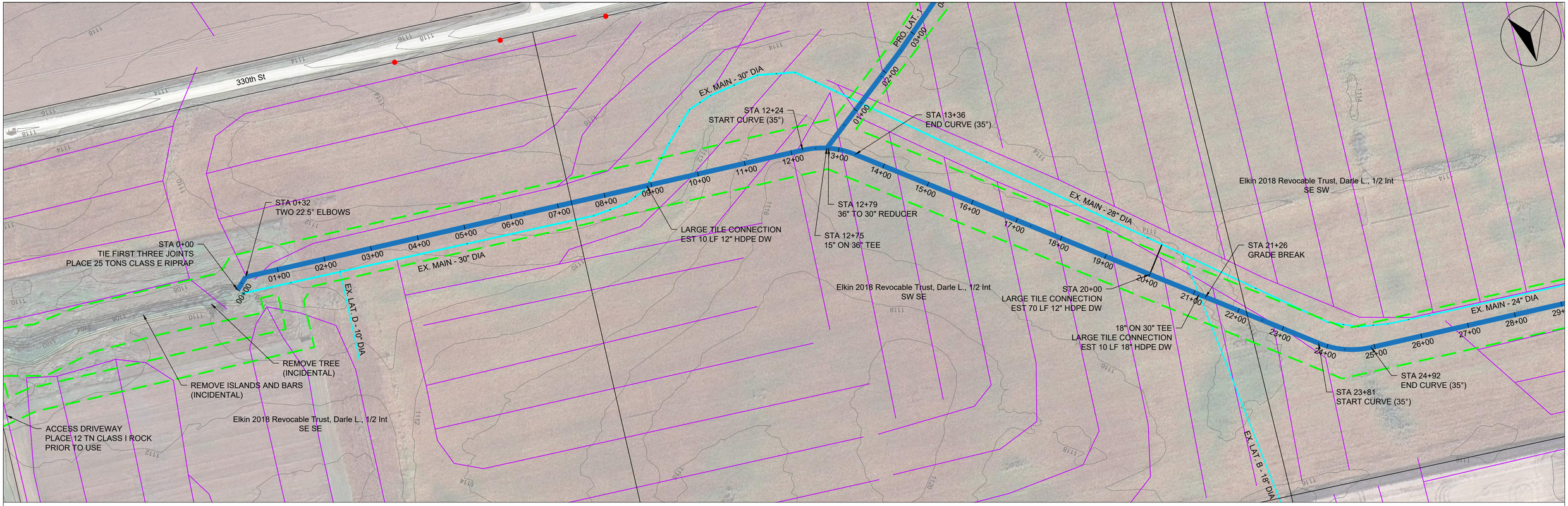
Notes

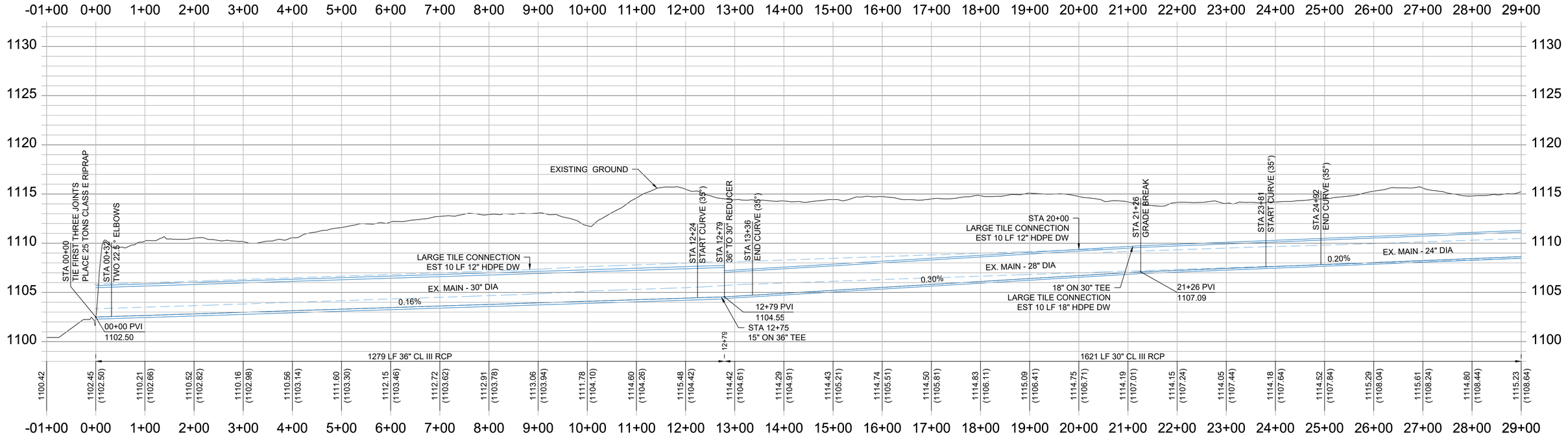
No.	Revision/Issue	Date

Sheet Name
Pipe Structures
Construction Notes
& Details

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale
Sheet C.03





AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

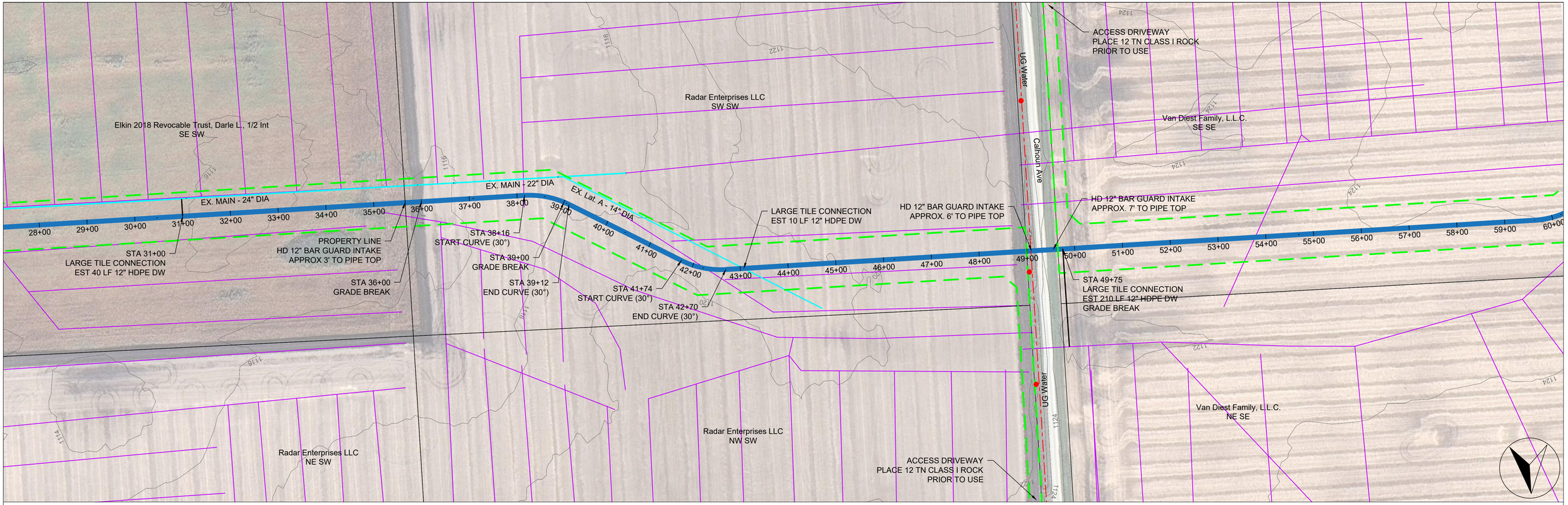
Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Area (ROW)
- Fenceline
- 2' Contours
- Utility Poles

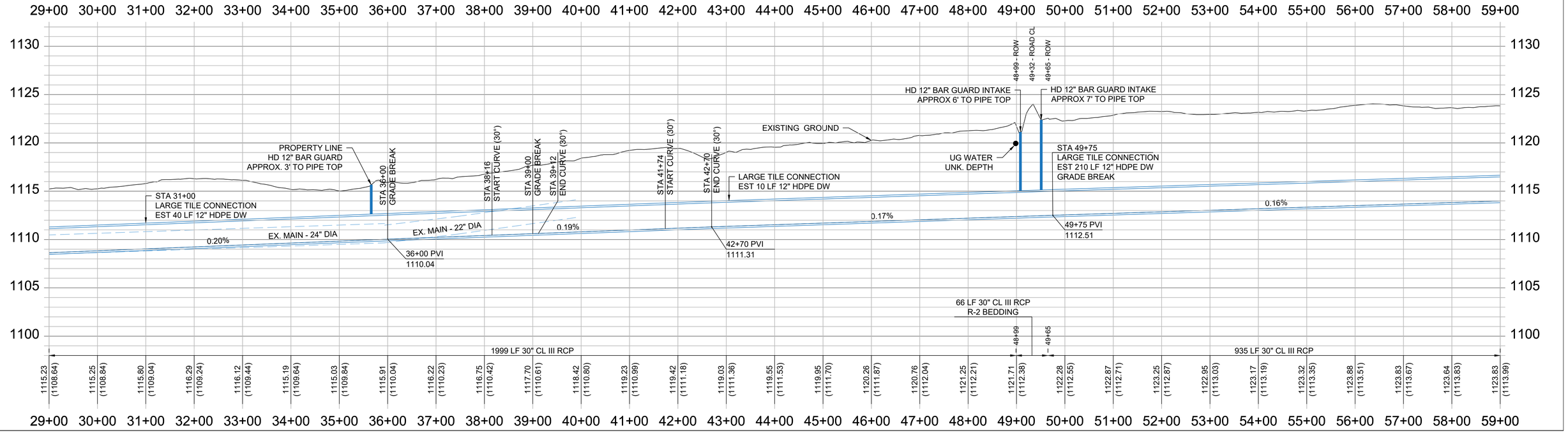
No.	Revision/Issue	Date

Sheet Name
Plan & Profile
Main Tile
Sta 0+00 → 29+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale 1" = 200'
Sheet M.01





AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Plan Legend

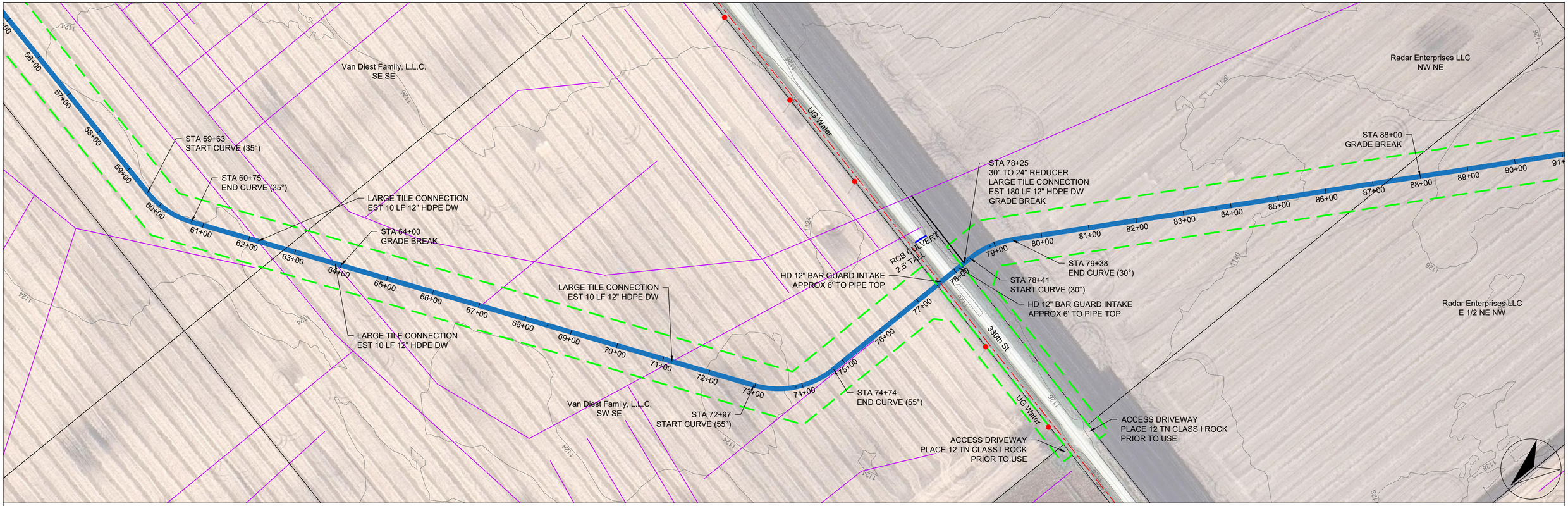
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Area (ROW)
- Fenceline
- 2' Contours
- Utility Poles

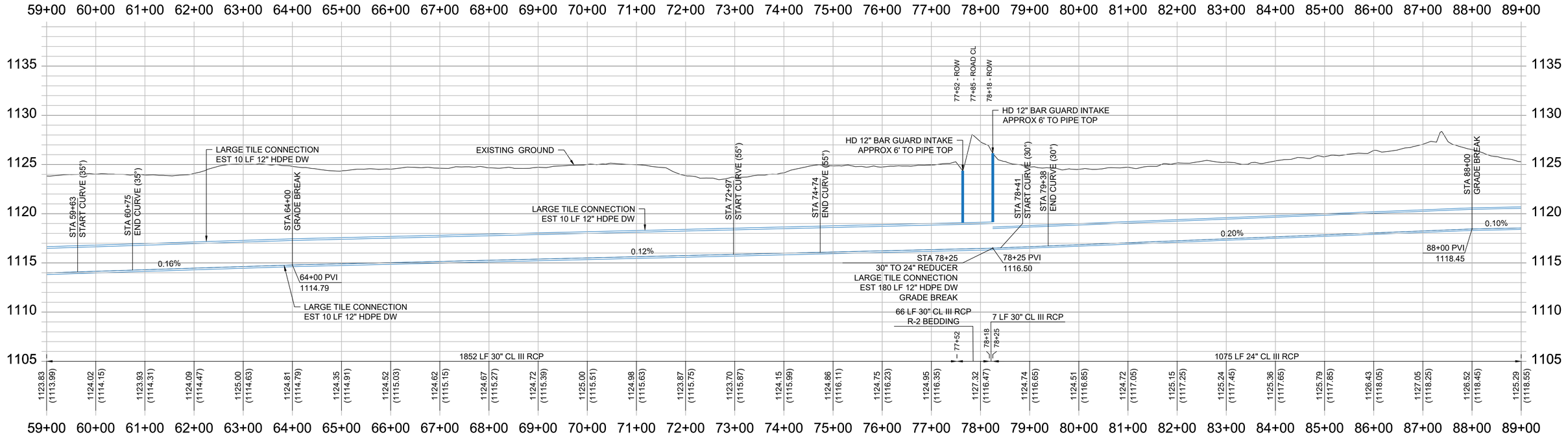
No.	Revision/Issue	Date

Sheet Name
Plan & Profile
Main Tile
Sta 29+00 → 59+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale 1" = 200'
Sheet M.02





AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Plan Legend

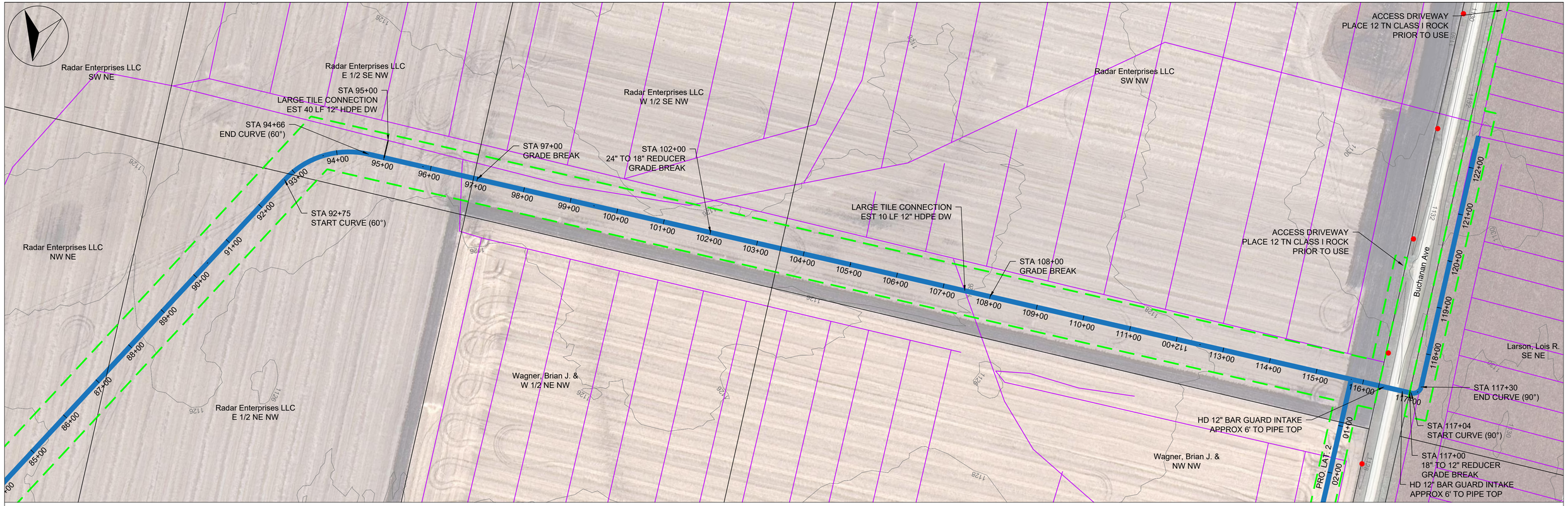
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Area (ROW)
- Fenceline
- 2' Contours
- Utility Poles

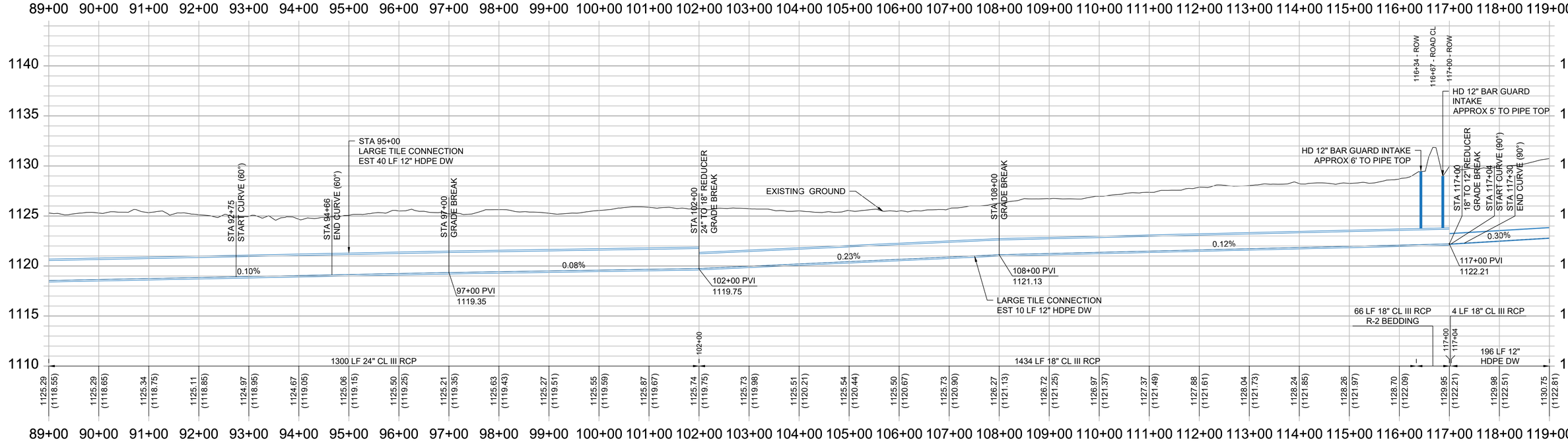
No.	Revision/Issue	Date

Sheet Name
Plan & Profile
Main Tile
Sta 59+00 → 89+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale 1" = 200'
Sheet M.03





AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Plan Legend

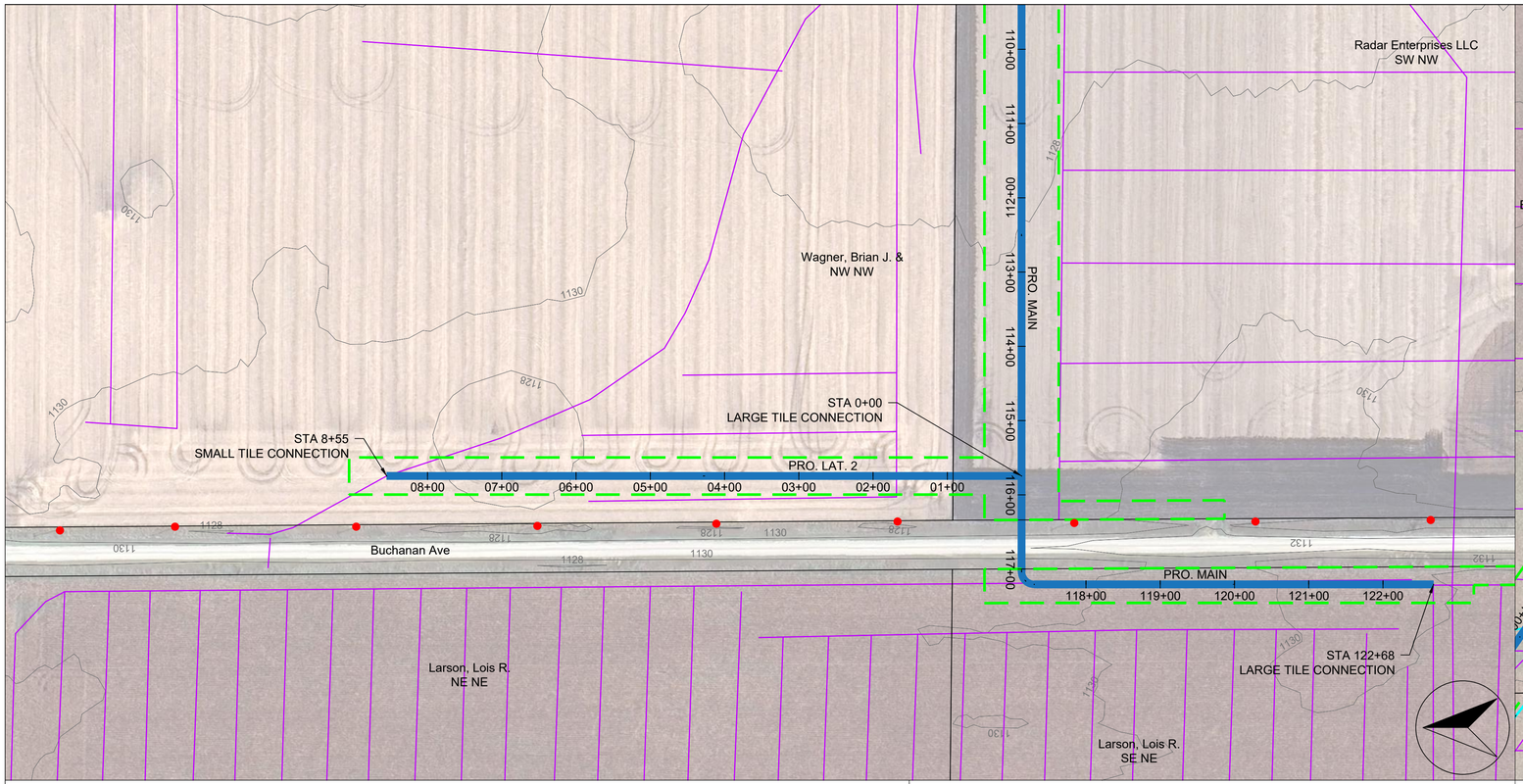
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Area (ROW)
- Fenceline
- 2' Contours
- Utility Poles

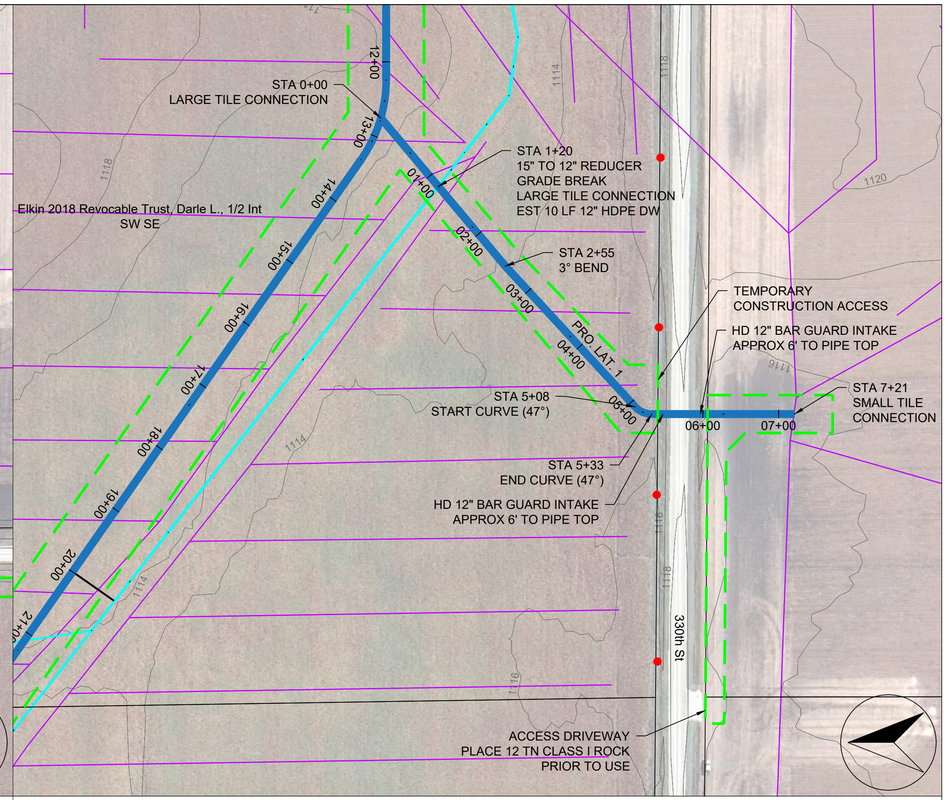
No.	Revision/Issue	Date

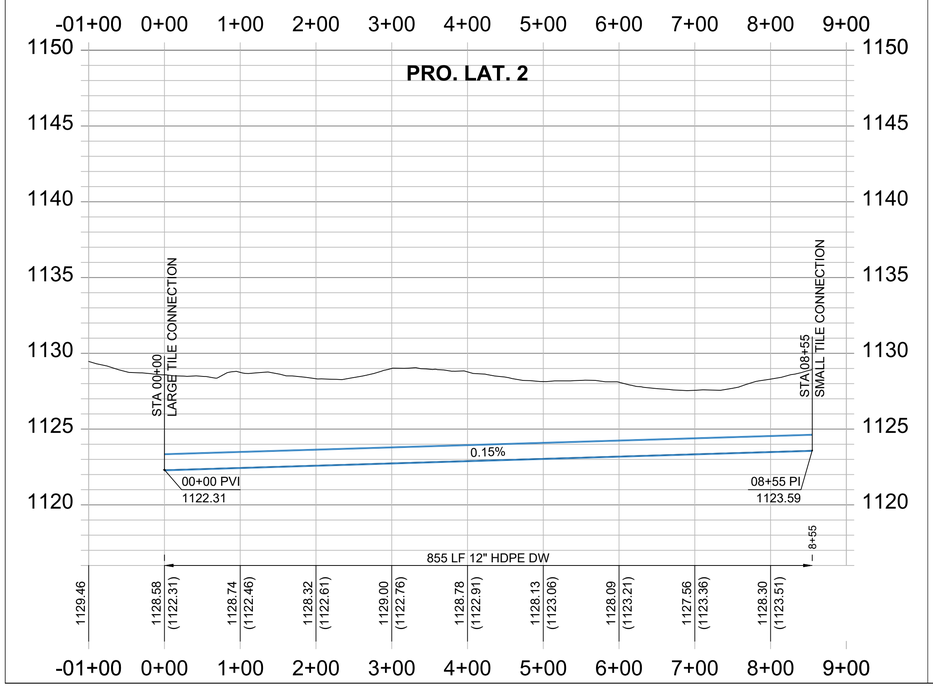
Sheet Name
Plan & Profile
Main Tile
Sta 89+00 → 119+00

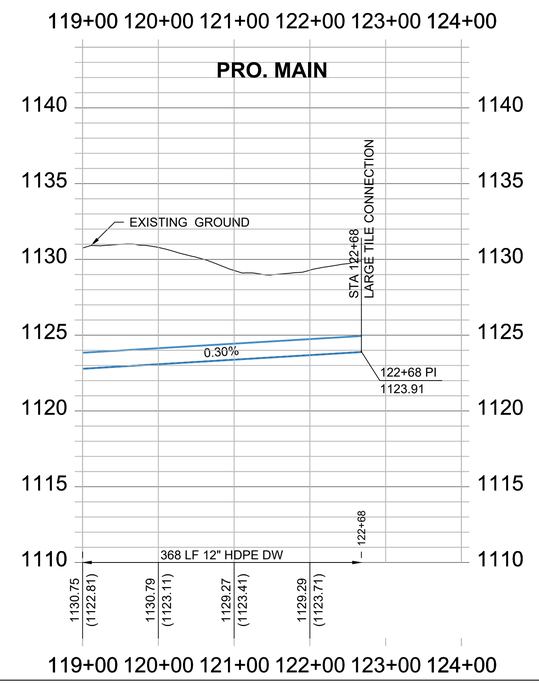
Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

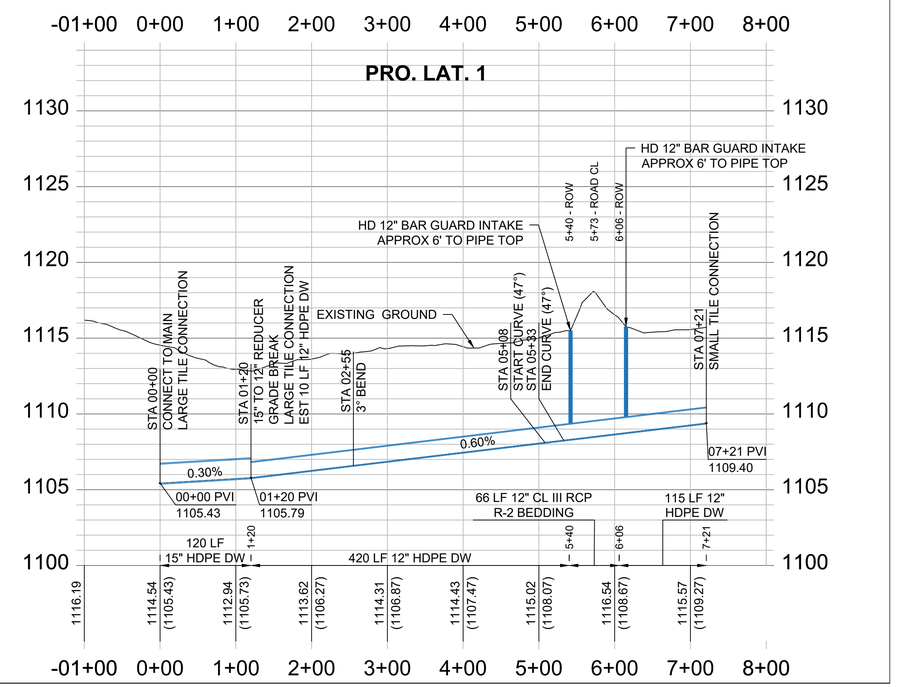
Project 2532-99
Date 2026-04-28
Plan Scale 1" = 200'
Sheet M.04











AgriVia

Company Information
AgriVia PLLC
PO Box 44
1124 Willis Ave
Perry, IA 50220

Designer JLH
Drafter TJB
Checker JLH

Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Area (ROW)
- Fenceline
- 2' Contours
- Utility Poles

No.	Revision/Issue	Date

Sheet Name
Plan & Profile
Main Tile
Sta 119+00 → 122+68
& Lat. 1 & Lat. 2

Project Name, Client, and Address
Tile Improvements
Drainage District No. 169
Wright County, IA
Hwy 17 & 330th St, Woolstock, IA 50599

Project 2532-99
Date 2026-04-28
Plan Scale 1" = 200'
Sheet M.05