AgriVia

PO Box 44
1124 Willis Ave
Perry, IA 50220

Engineer's Report

Drainage District No. 20
Tile Improvements

Greene County, Iowa
2025

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 9/24/25

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

Project No. 2517-74

Executive Summary

Introduction
Following a petition by landowners in Drainage District No. 20, 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 115 years ago, is severely inadequate for modern agricultural needs. The system is operating at only 22% of the recommended ½-inch per day drainage coefficient. This insufficient capacity, combined with the fact that over 80% 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 branch tiles. The proposed main tile route is more efficient than the original, shortening the tile length and increasing the grade to improve flow. 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 and Economic Benefits
The total estimated cost for the proposed project is $2,107,000. The portion assessed to landowners for the main tile improvement is approximately $1,574,632, or about $1,011 per acre. The cost of the branch tiles will only be assessed to the landowners who benefit from those tiles.

Improved drainage is projected to increase corn yields by 10–20 bushels per acre and soybean yields by 4–8 bushels per acre. This translates to an estimated annual rate of return of 12.2% and a payback period of approximately 8.3 years.

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. The district has also entered an agreement with the Iowa Department of Agriculture and Land Stewardship (IDALS) to facilitate the construction of voluntary water quality improvement practices in conjunction with the project.

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

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. 20 in Greene County, like many early 20th-century districts, was established to improve drainage in a wetter, less-developed landscape. The Greene 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 January 31, 2025, three 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. 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.

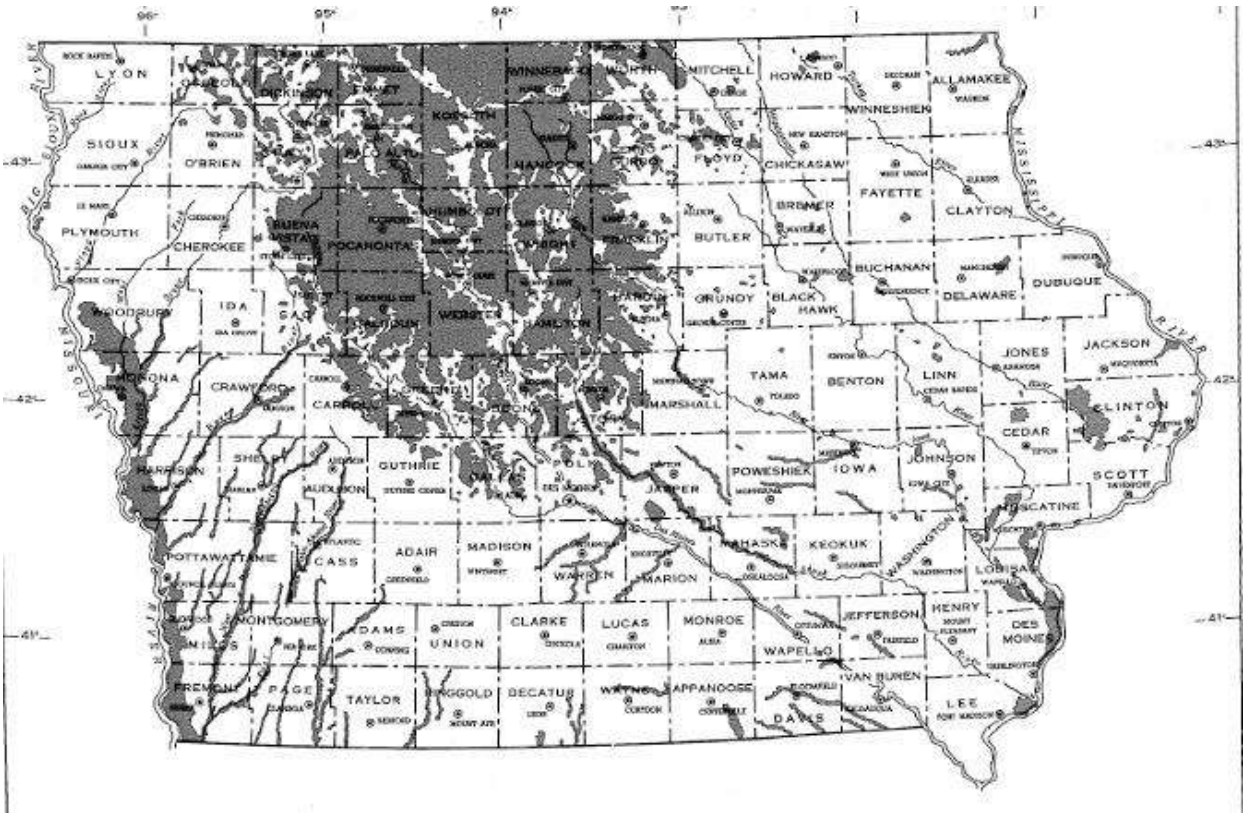
Location
Drainage District No. 20 spans lands in Sections 5, 8, 9, 16, 17, 21, and 22 of Highland Township. The district lies north and east of Churdan and east of Adaza. A map of the area of study is included in Appendix B.

Historical Considerations

Prehistoric and Geologic Background
Greene County, Iowa, lies within the Des Moines Lobe, shaped by the Wisconsinan 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

Greene County is served by 136 drainage districts, encompassing nearly 3,000 miles of tile and ditches and covering roughly 175,000 acres of farmland. Most districts were established before 1930 and are undersized to meet the needs of modern farming practices.

A clay drainage tile from 1885, inscribed "We the men who started the tile work did so with a motive to benefit the town and country" by T.P. LaRue of Scranton, Iowa, is displayed at the Greene County Historical Society, reflecting the long legacy of tiling in Greene County.

Drainage District No. 20 Historical Overview

Drainage District No. 20 in Greene County was established to address persistent flooding and wetland conditions that limited agricultural productivity. Key events in the district's development include:

- 1907–1908: Landowners petitioned to form the district. Engineer Geo. M. Thomson proposed a tile drainage system, and construction of the main tile and lateral branches

was completed by summer 1908. Initial assessments totaling approximately $14,000 were levied on district lands.

- 1909–1911: Modifications were made to improve tile depth and extend lines, including an agreement with D.S. Lightner for construction contributions. Additional assessments were levied to cover cost shortfalls.
- 1917–1935: Petitions and engineering recommendations led to new outlets, incorporation of preexisting private tiles, and periodic assessments to fund repairs and maintenance.
- 1943–1961: The Board continued levying small assessments to cover ongoing district debts.
- 1952: An engineering study proposed major improvements due to ineffective upper-watershed tiles. Landowners raised concerns over cost and scope, and the proposed project did not move forward.
- 1969–1993: Control of DD 20 was transferred to the City of Churdan in 1969, then returned to Greene County in 1993, with maintenance responsibilities reverting to county-managed assessments.
- 2008-2017: The bulkhead at the outlet was repaired and in 2017, the Open Ditch was cleaned out.

Historical Agricultural Demands

In the early 20th century, farms in Greene 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.

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 20 lies in the North Racoon 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 North Raccoon 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 affects how water moves through fields and drainage systems.

Historically, Greene County has received 30 to 40 inches of rainfall per year, averaging around 36 inches (Appendix C). Since the mid-1980s, however, annual precipitation has increased, with more years exceeding 40 inches and several such as 1993, 2008, 2010, and 2018 surpassing 45 inches. 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 Greene 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. 20 serves a watershed defined by a central valley, where the main tile line is installed. The lower third of the district has greater slope, producing more defined surface flow and direct drainage. In contrast, the flatter upper two-thirds contain numerous depressions, leading to poorly defined drainage patterns and localized ponding. Prior to the district's formation, the original engineer estimated that over 20% of the land was untillable wet grassland or swamp. Today, nearly all land within the district is considered tillable due to the effectiveness of drainage improvements.

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 in included in Appendix E.

The surface watershed covers approximately 1,514 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.

A detailed topographic analysis using 6-inch LiDAR contour data identified 157 depressional features within the watershed, covering approximately 158 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

Most of the soils in Drainage District No. 20 are classified as clay loam, which tend to retain water and pose natural drainage challenges. The three dominant soil types, Webster clay loam, Canisteo clay loam, and Nicollet clay loam, cover about two-thirds 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. Nicollet clay loam is somewhat poorly drained and occurs on slightly higher or gently sloping ground. Although it has better internal drainage than Webster or Canisteo, it still benefits significantly from subsurface tile systems.

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 80% 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	160	10.5%
Poorly Drained	774	51.1%
Somewhat Poorly Drained	300	19.9%
Moderately Well Drained	209	13.8%
Well Drained	72	4.7%
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. 20, 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. 20, CN values typically range from 75 to 82 for cultivated agricultural land with moderately 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 and open ditches, 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 approximately 317,000 feet of private tile within the district. The true extent is likely greater, as many older or undocumented tile lines are not visible or recorded.

Existing Infrastructure and Conditions

Field Survey

The initial field survey of Drainage District No. 20 was completed in May 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

Open Ditch

The district's open ditch outlets into Hardin Creek. The lower 700 feet of the ditch are in poor condition, with noticeable meanders, sharp curves, and significant bank erosion. Trees have been planted about 25 feet back from the top of the bank on both sides. A small bridge was observed about 400 feet upstream of the outlet into the creek.

The upper 300 feet of the ditch are in better condition, though we noted a few small islands and signs of minor sloughing. Only one private tile outlet was found near the upstream end. The ditch is mostly well vegetated with grass on both sides along its entire length. According to district records, the upper end of the ditch was last cleaned out in 2017. The current condition matches that. The ditch bottom has widened beyond its original 4-foot design, and the side slopes appear flatter than originally planned.

Main Tile

The main district tile outlets into the open ditch in the northeast quarter of the southwest quarter of Section 22, through a concrete bulkhead. The outlet pipe is currently a 24-inch dual-wall plastic tile, which is a repair of the original line. The concrete bulkhead is in poor condition, and a large cottonwood tree is growing within 50 feet of the outlet.

From there, the tile runs in a northwesterly direction, generally following the low point of the surrounding valley. At J Avenue, we found a tile intake on each side of the road ditch directly over the tile. The tile continues northwest and crosses 130th Street, where we again found intakes in both ditches. As the valley becomes less defined, the tile route shifts northerly through Section 16. At 120th Street, we found an intake on the north side of the road, but none on the south. The tile then angles northwest and crosses Highway 4, where the intakes are offset from the main on each side of the road. Further north, we located an intake in the road ditch just north of 110th Street in Section 8.

Because of the district's shape and natural slope, the tile sizes do not change as frequently as in some other systems. The lower portions of the district contribute relatively few additional acres, and the steeper grade in that area allows a consistent tile size to carry the flow while maintaining the same drainage coefficient as upstream areas. The main tile consists of the following sections:

- 22"- 4,700'
- 20"- 6,900'
- 14"- 5,100'
- 12"- 3,600'

The original tile was laid at varying grades throughout, changing the grade 38 times in the main tile, often rising or flattening with the landscape. In places, the grade is as steep as 25%, in others, as flat as 0.06%.

As part of our survey, we recorded seven flowline elevations along the main tile and compared them to the original tile design. These points matched the original design documents closely, which indicates the tile was likely installed according to the original engineering plans.

Lateral Branches
In addition to the main tile, the district includes seven smaller branch tiles that connect into the system. We surveyed intakes on two of these laterals. While both were repairs rather than original tile, their elevations also aligned closely with the original design, further indicating the system was installed as designed. Each lateral tile is listed below:

- **1st Road Branch**
  An 8-inch tile that connects to the main tile in the Highway 4 road ditch (Section 8) and runs north for 400 feet.

- **F.A. Moran Branch**
  Connects to the main tile in Section 16 and runs northeast, crossing 120th Street. It includes 7-inch and 6-inch tile. While the original plans showed road ditch intakes, we did not locate them during our survey. We did find a plastic intake about 160 feet south of the road that aligns with the tile.

- **J.H. Schroeder Branch**
  The longest branch in the district. It connects to the main tile in Section 16 and runs west, then northwest, crossing Highway 4 and continuing through Section 17. The lower 1,900 feet are 14-inch tile, and the upper 700 feet are 8-inch. The Iowa DOT recently replaced the portion under Highway 4 with an 18-inch steel casing and installed new manhole-style intakes on both sides of the road. We included those intakes in our survey.

- **2nd Road Branch**
  Connects into the Schroeder Branch on the west side of Highway 4 and runs north for 900 feet. It was also replaced during the DOT project with a 12-inch tile, matching the existing size.

- **Conner Branch**
  A 700-foot-long, 6-inch tile located in the southeast quarter of Section 16. It runs north across the half-section line.

- **1st Timmons Branch**
  A 12-inch tile in Section 21 that connects the main tile to an older 12-inch tile system that predates the district. The 12-inch tile was later assumed by the district in 1929 and extends to the ¼ ¼ line of the NW SW of Section 16.

- **2nd Timmons Branch**
  A 6-inch tile in Section 22 that runs north for 700 feet and connects to the main tile.

Existing Sizes and Capacities
The existing conditions of the tile system are defined by the hydraulic performance for each section, which include pipe diameter, drainage coefficient, and the percentage relative to the modern standard drainage coefficient (0.5 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. 20 Existing Tile Capacity				
Section Name	**Diameter (inches)**	**Grade (%)**	**Drainage Coefficient (in/day)**	**Percentage of Modern Standard**
Main (Stations 0-47)	22	0.15	0.11	22%
Main (Stations 47-60)	20	0.20	0.12	24%
Main (Stations 60-116)	20	0.06	0.07	14%
Main (Stations 116-167)	14	0.20	0.11	22%
Main (Stations 167-203)	12	0.06	0.07	14%
1st Road Branch	8	0.10	0.14	28%
F.A. Moran Branch (Stations 0-5)	7	0.10	0.08	16%
F.A. Moran Branch (Stations 5-18)	6	0.06	0.05	10%
J.H. Schroeder Branch (Stations 0-19)	14	0.08	0.13	26%
J.H. Schroeder Branch (Stations 19-26)	8	0.10	0.10	20%
2nd Road Branch	12	0.30	0.89	178%
Conner Branch	6	0.06	0.16	32%
1st Timmons Branch	12	0.60	0.36	72%
2nd Timmons Branch	6	1.5	0.47	94%

Downstream Outlet

Drainage District No. 20 outlets into Hardin Creek, located in Section 22 of Highland Township. Hardin Creek is a significant tributary, stretching approximately 140 miles in length and draining a watershed area of about 171 square miles. It flows southeast, joining the North Raccoon River near Jefferson, Iowa.

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 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.

As part of our design process, we evaluated four alternative layouts to reduce costs. Four options were considered:

- Option 1 – Follow the existing alignment: This would be the simplest approach but resulted in high costs due to the long pipe length and the need for permits to lower the open ditch.
- Option 2 – 1952 Proposal (to Happy Run at Hwy 4): This would partially relieve the Main Tile downstream, but it would not provide a full ½" drainage coefficient (D.C.) for all landowners, requiring additional tile installation at higher cost than Option 1.
- Option 3 – Main Tile over the ridge to 1st Timmons Branch, discharging to Happy Run: This layout reduced costs compared to Options 1 and 2, but still failed to provide a full ½" D.C. downstream.
- Option 4 – Main Tile to Happy Run, cutting off the lower end upstream of J Avenue: This option was the most cost-effective and achieved a full ½" D.C. to all landowners in the district, providing the best balance of performance and cost.

Proposed Improvements

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

The main tile will outlet into Happy Run in the NE¼ SE¼ of Section 21 and run north, crossing the watershed divide into Drainage District No. 20. From there, it runs northwest through Section 21, crossing 130th Street about 1,650 feet west of J Avenue. The tile continues north-northwest through Section 16, crossing 120th Street approximately 1,680 feet east of Highway 4. In Section 9, the main tile proceeds northwest, crossing Highway 4 about 2,330 feet north of 120th Street. It then continues through Section 8, crossing County Road E13, where it ends.

The proposed route generally follows the central valley near the low point of the district, paralleling the existing tile while straightening the route where possible to increase grade and reduce costs. A notable change occurs near the center of Section 16, where the new tile remains on the east side of the section instead of following the existing tile on the west side. This adjustment shortens the route, avoids cutting several pattern tile systems, and reduces connection costs. The existing 20" tile in this area is deep and, according to landowners, in good condition. It provides more than the recommended ½" D.C. for these pattern systems once the upstream acres are removed.

The 1st Timmons Branch will connect to the proposed main tile in the NE¼ NE¼ of Section 21, running west through the NW¼ NE¼, then turning sharply north across 130th Street and continuing north to the south line of the NE¼ SW¼ of Section 16.

The FA Moran Branch will connect to the proposed main tile in the NE ¼ NW ¼ of Section 16, running northeast crossing 120th Street, where it ends.

The lower portion of the existing main tile downstream of the intersection point with the new main will continue to operate as a drainage district facility. The existing 22" tile will provide greater than a ½" D.C. when the upstream lands are removed.

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 00-25)	36	0.16
Main (Stations 25-35)	30	0.30
Main (Stations 35-48)	30	0.28
Main (Stations 48-57)	30	0.26
Main (Stations 57-65)	30	0.24
Main (Stations 65-82)	30	0.20
Main (Stations 82-87)	30	0.15
Main (Stations 87-104)	24	0.21
Main (Stations 104-127)	24	0.17
Main (Stations 127-136)	18	0.37
Main (Stations 136-151)	18	0.33
Main (Stations 151-163)	18	0.20
Main (Stations 163-172)	18	0.10
1st Timmons Branch (Stations 00-18)	15	0.21
1st Timmons Branch (Stations 18-38)	15	0.10
F.A. Moran Branch (Stations 00-10)	12	0.47
F.A. Moran Branch (Stations 10-18)	12	0.23

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 (2023) 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 HDPE, crushed stone will be placed around the pipe per SUDAS standards.

RCP will be laid in sections and curved using slight joint offsets. 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.

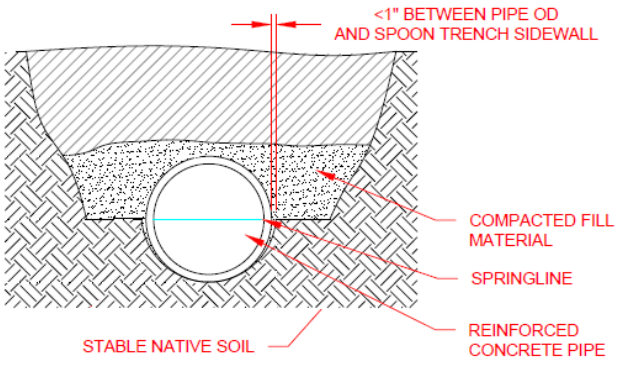
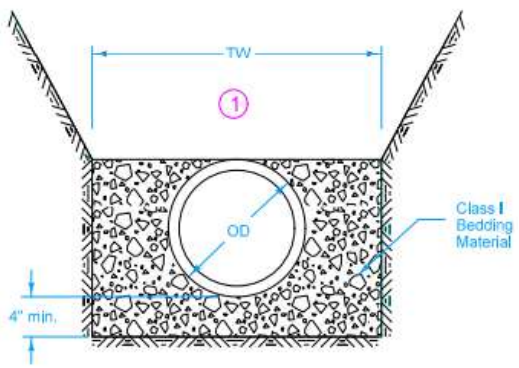
Pipe Material Comparison

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**
  24" Hickenbottom intakes will be placed in road ditches, and 18" 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 Class A rock will be placed to protect it during construction. Once the project is complete, the driveway will be restored 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 two gravel roads and two paved roads. The 1st Timmons Branch will cross one gravel road, and the FA Moran Branch will cross one gravel road. Gravel roads will be opened and repaired, while paved roads will be bored under to avoid disruption.

Each county road crossing will include a 24" Hickenbottom intake in the 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**
Greene County	120th Street	Main	30"	Open Cut
Greene County	130th Street	Main	24"	Open Cut
Iowa DOT	Highway 4	Main	24"	Bore
Greene County	E13	Main	18"	Bore
Greene County	120th Street	1st Timmons Br.	15"	Open Cut
Greene County	130th Street	FA Moran Br.	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 May 22, 2025, identifying only electrical and city water utilities within the project area. 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 winter 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 $2,107,000. This figure includes all anticipated construction activities, damages, engineering services, and administrative expenses. The breakdown is as follows:

Activity	Cost
Main Tile Construction	$1,274,000
1st Timmons Br. Construction	$124,000
FA Moran Br. Construction	$43,000
Greene County Secondary Roads	$159,000
Iowa Department of Transportation	$161,000
Engineering	$95,000
Construction Damages	$91,000
Other Expenses (Legal, Administrative, and Interest)	$161,000

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.

Only landowners who benefit from the 1st Timmons Branch and the F.A. Moran Branch will be assessed for the costs of those branches if approved. All landowners within the district will share in the cost of improvements to the Main Tile.

A detailed itemization of costs is provided in Appendix N.

Historical Cost Comparison

The all-inclusive estimated cost to landowners for the main tile is $1,574,632 or approximately $1,011 per acre. In 1909, the total cost of the tile project was $14,060 or approximately $10 per acre. The total estimated cost in 1952 to complete a parallel tile improvement to the existing tile was $77,696 or approximately $54 per acre.

Drainage District No. 20 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
1909	$10	$94	11%	$19	53%
1952	$54	$301	18%	$77	142%
2025	$1,011	$12,650	8%	$970	104%

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 1909 and 1952 designs in comparison to the current proposed design. Neither the 1909 nor the 1952 designs meet the recommended ½-inch drainage coefficient standard. Notably, the 1952 plan relied on the continued use of the 1909 tile system to achieve the ½" drainage coefficient. In contrast, we are not recommending a parallel system, as was done in 1952, because the existing tile, now over 115 years old, is well past the end of its intended service life.

Modern Cost Figures Comparison		
Year	Construction Costs	Drainage Coefficient Percent of Recommended
1909	$1,118,000	22%
1952	$1,692,000	82%
2025	$1,274,000	100%

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 1908 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 O.

Under Iowa Code §468.38, the Board of Supervisors 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 P to provide an updated view from the existing 1908 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. At current crop prices, that is a gross return of about $100–$145 per acre.

Using ISU’s Excel-based calculator, we estimate an annual return of roughly 14.8% for corn and 10.6% for soybeans on a $1,011/acre drainage investment, assuming stable prices and yields. This calculator, along with our example, is available in Appendix Q, 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. 20 Economic Analysis			
Avg. Assessment Per Acre	**Avg. Increased Revenue per Year**	**Estimated Annual Rate of Return**	**Estimated Payback Period**
$1,011	$123.53	12.2%	8.3 Years

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.

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.

We also reviewed a 1983 ISU study (Drainage Needs and Returns in North-Central Iowa). It found that poorly drained soils, like those covering about 62% of District No. 20, 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 soybeans yields were much lower in the 1980's than they are today.

	Poor Drainage (Less than ¼" Drainage Coefficient)		**High Drainage (1/2" 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.

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. 20. We have included "Twenty Benefits of Drainage" prepared by the Ohio State Extension highlighting yield and non-yield benefits of drainage in Appendix R.

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 with your own numbers and consider how improved drainage could benefit your farm's productivity, value, and long-term resilience.

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)
Because the proposed tile outlets into Happy Run, which is considered a jurisdictional water under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, the proposed work including excavation and bank stabilization falls under the regulatory authority of the U.S. Army Corps of Engineers. To avoid delays due to permitting timelines, a Section 404 and Section 10 permit application has been proactively submitted.

Iowa Department of Natural Resources (DNR)
The proposed tile outlets into Happy Run, thus work will be done within the 100-year floodplain, meaning there is a 1% chance of a major flood each year. The Iowa DNR Draft 1% Flood Extent Map is shown in Appendix G. All work on the creek and outlet, including bank stabilization, must follow Iowa DNR floodplain regulations. The DNR Floodplain permit application has been submitted in advance to avoid delays.

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 May 16th, 2025, to request a determination

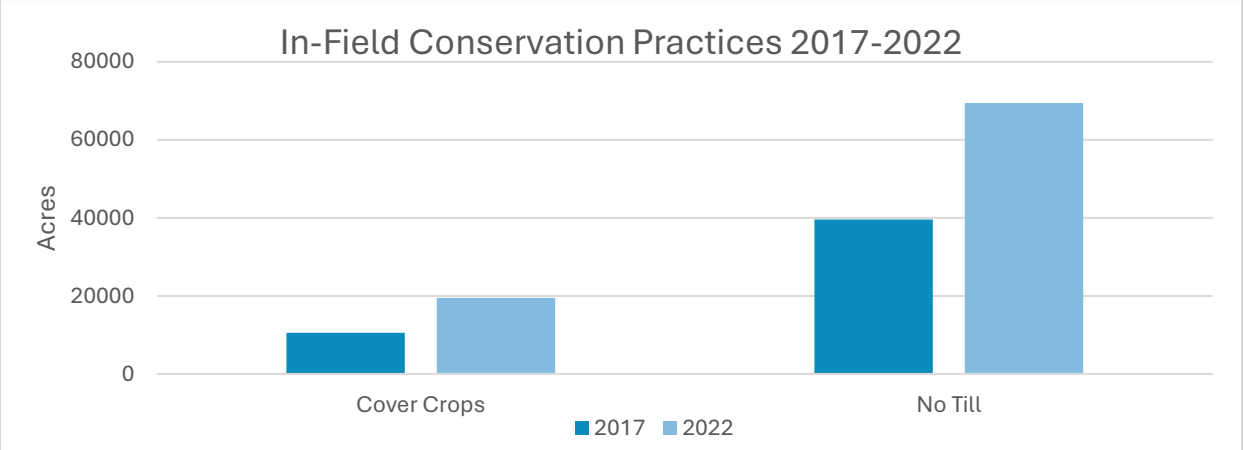
as early as possible. This proactive step helps avoid future conflicts, particularly if a tile improvement project affects areas that may qualify as wetlands under federal definitions.

Water Quality Recommendations

Conservation Practices
Farmers in Greene 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 significantly. Between 2017 and 2022, no-till acres increased from 40,000 to 69,000, while cover crop use grew from 11,000 to 19,000 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 S 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.

28E Agreement with Iowa Department of Agriculture
Drainage District No. 20 has entered into a 28E Agreement with the Iowa Department of Agriculture and Land Stewardship (IDALS) to enable a collaborative approach to constructing water quality projects within the district as part of a larger improvement effort.

Several landowners have already expressed interest in hosting such projects on their land. Under this agreement, IDALS will cover all costs related to water quality construction including engineering, easement acquisition, and financial compensation to participating landowners, while the drainage district will fund the drainage improvement portions of the project. This partnership is mutually beneficial, as it allows both IDALS and Drainage District No. 20 to reduce costs by leveraging overlapping work. It also enables the district to play a more proactive role in supporting water quality initiatives, demonstrating how drainage improvements and environmental stewardship can go together.

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 Clerk 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 Clerk 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 May 18, 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 June 25, 2025, at the Churdan Public Library, where landowners had the opportunity to meet with the engineer, ask questions, and provide input. Copies of the letter, invitation, and the sign-in sheet from that meeting are included in Appendix T.

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 Limits
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 limits are shown on the plans covering approximately 57.2 acres across 26 parcels (see Appendix U). 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 during or 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. 20 tile has been found to be restrictive and significantly undersized, providing only 22% of the recommended drainage capacity, and is approximately 115 years old. To address this, we have developed a plan to replace the Main Tile and two branch tiles at an estimated total cost of $2,107,000. 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, E.I.T.
AgriVia
Cell: 712-579-5296
Email: tyler.agrivia@gmail.com

Iowa Code Section 468.8

DRAINAGE PETITION

TO THE BOARD OF SUPERVISORS OF GREENE COUNTY, IOWA:

The undersigned ask that a drainage district and tile commencing at Drainage district 20

and terminating at Highland 22

be Studied for possible repairs and improvements

Your petitioners further state that lands situated in Highland 5, 8, 9, 16, 17, 21 & 22

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

Landowner	Date	Landowner	Date
[signature]	1-31-25		
[signature]	1-31-25		
[signature]	1-31-25		

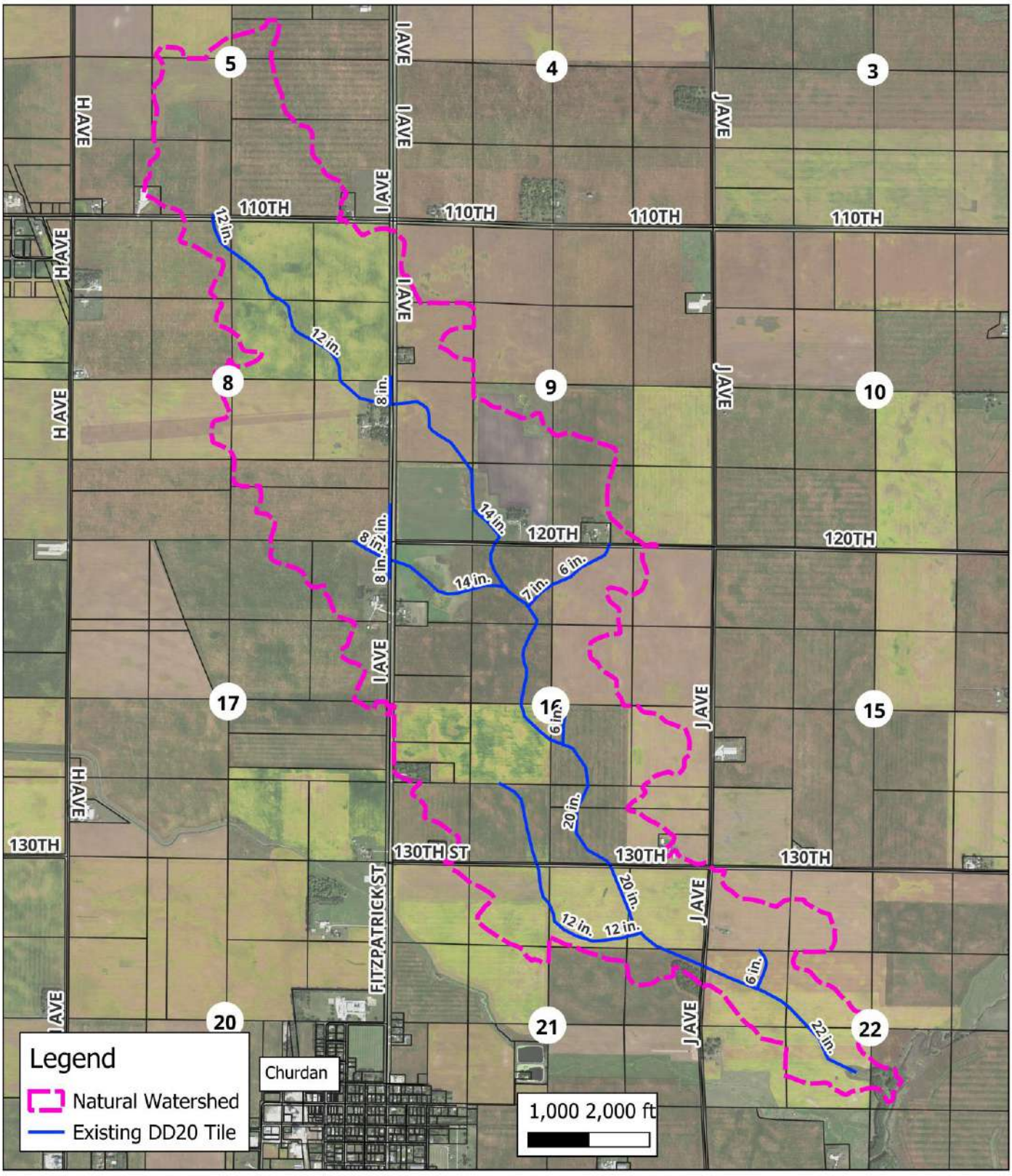
GREENE COUNTY AUDITOR
'25 FEB 3 AM 10:05

Appendix B- Area of Study Map

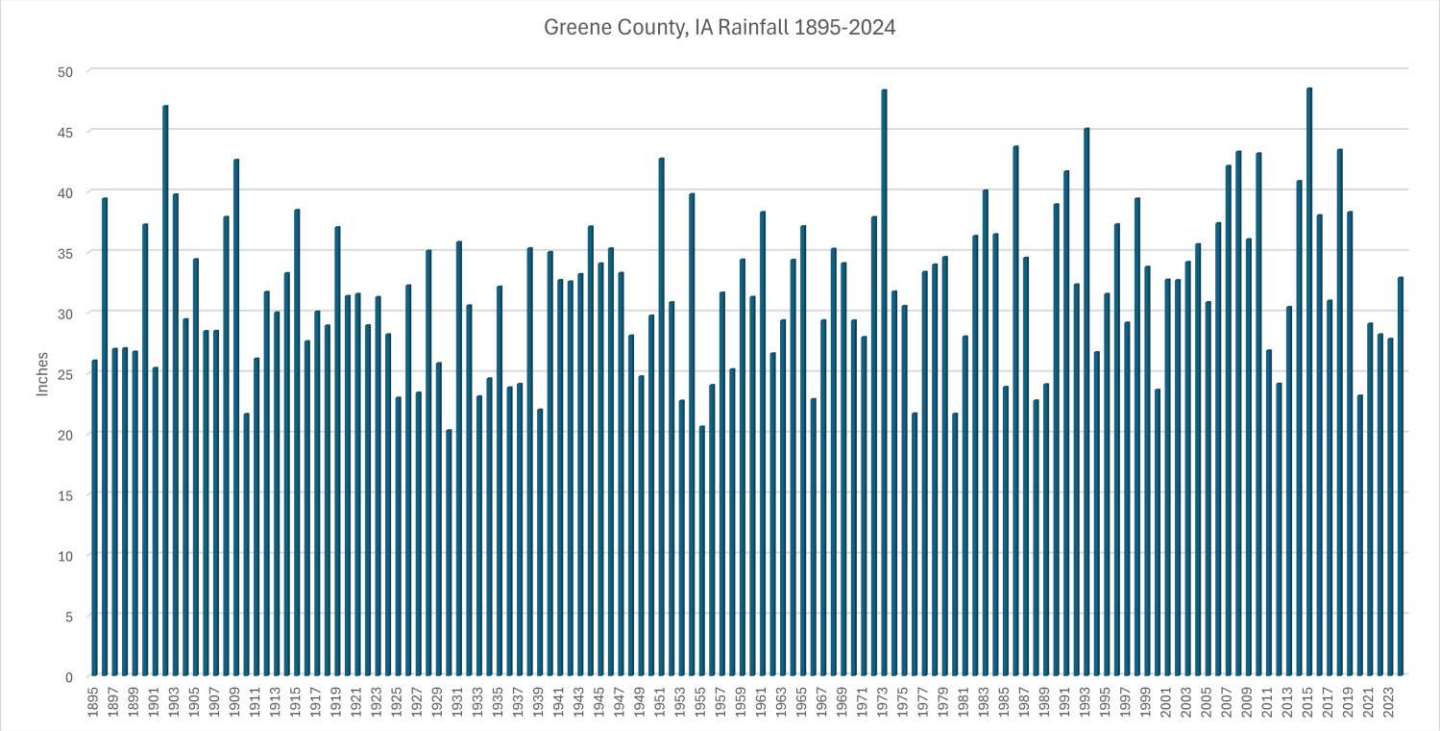
AgriVia

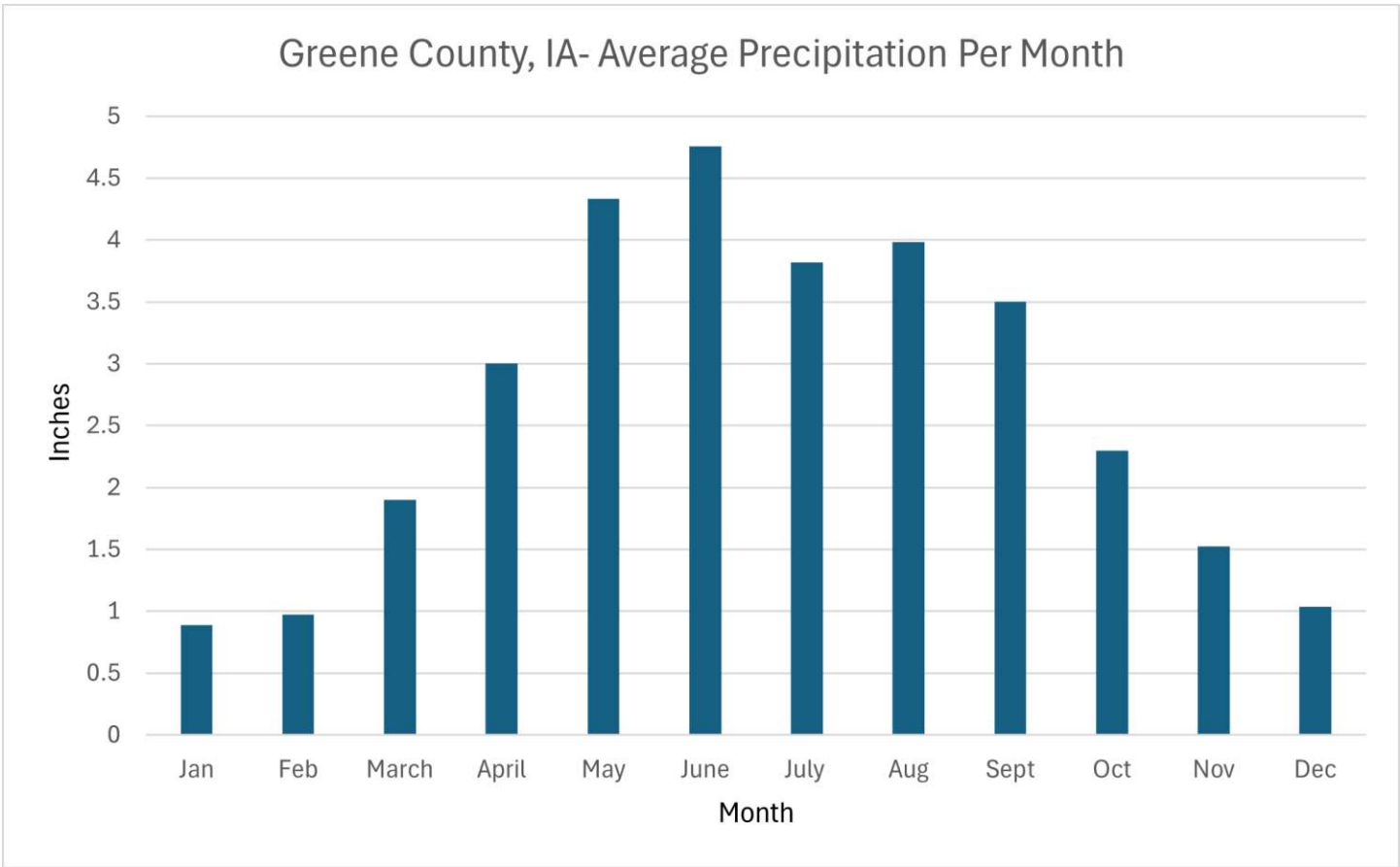
Drainage District No. 20 — **Area of Study**

Greene County, IA — **September 2025**



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, publish May 2025. Retrieved on May 30, 2025, from http://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series

Appendix D- Palmer Drought Severity Index: 1895- Present

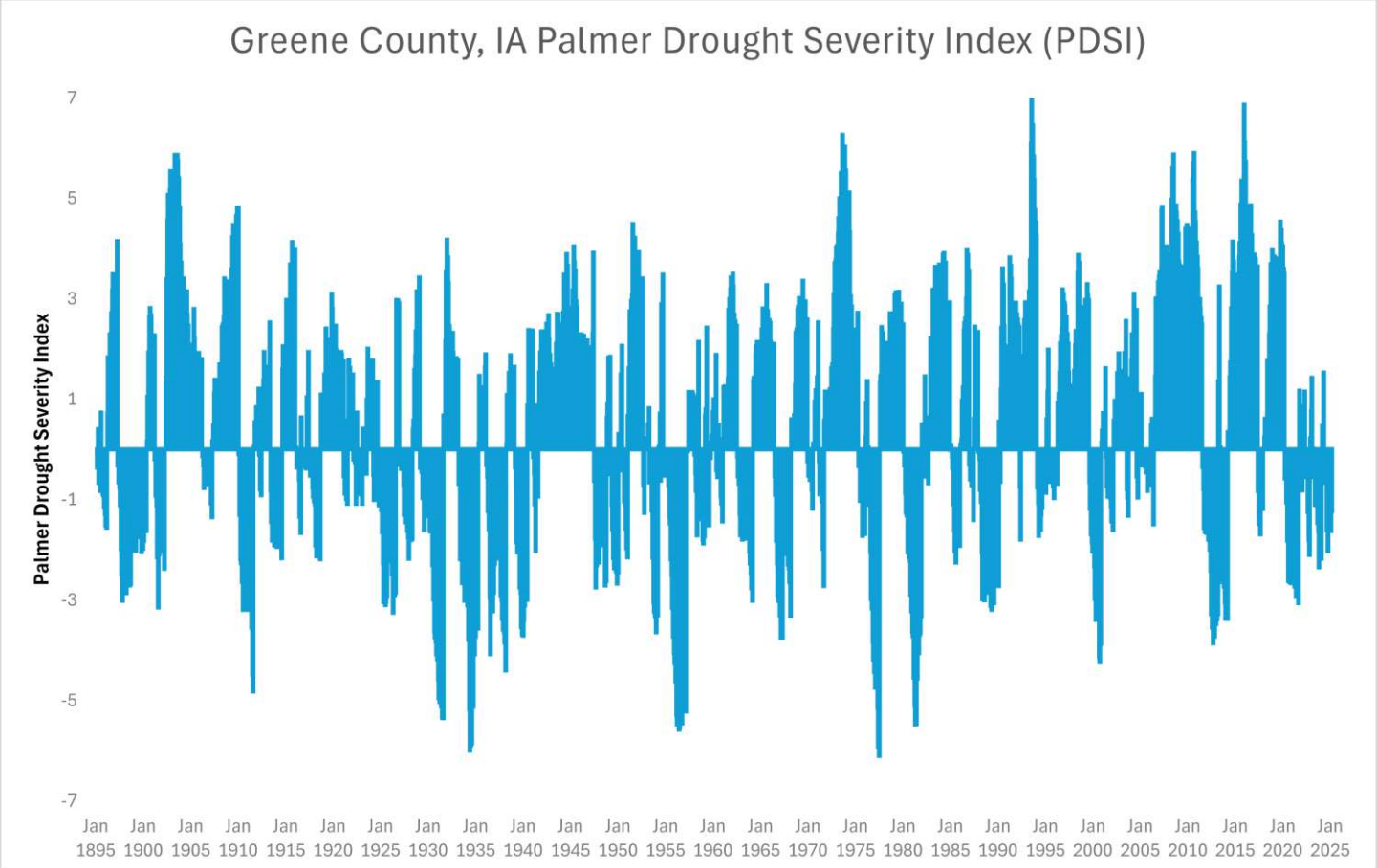
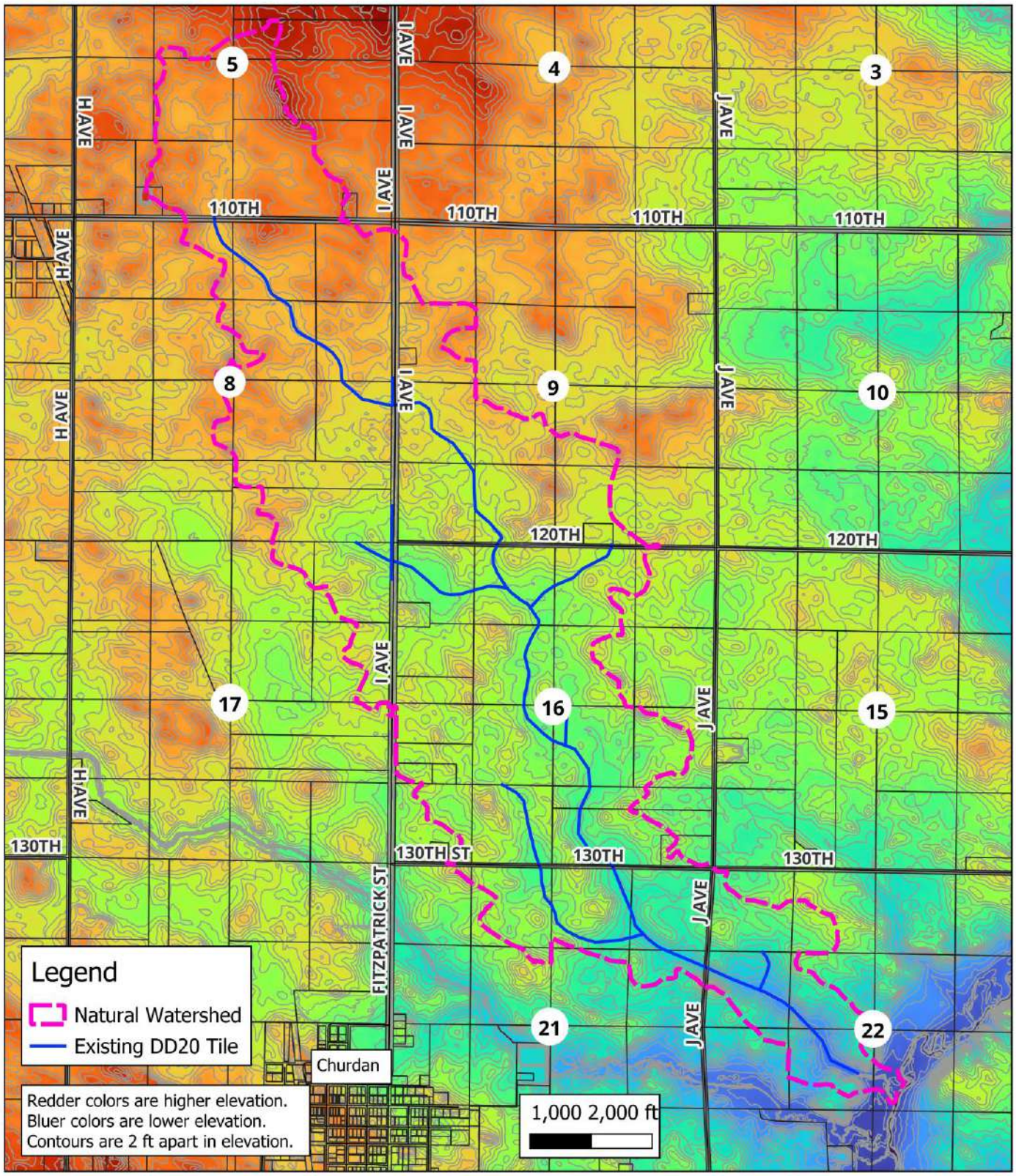


Chart created from data provided by:
NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series, publish May 2025. Retrieved on May 30, 2025, from http://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series

Appendix E – Elevation Map

Drainage District No. 20 | **Elevation Map**

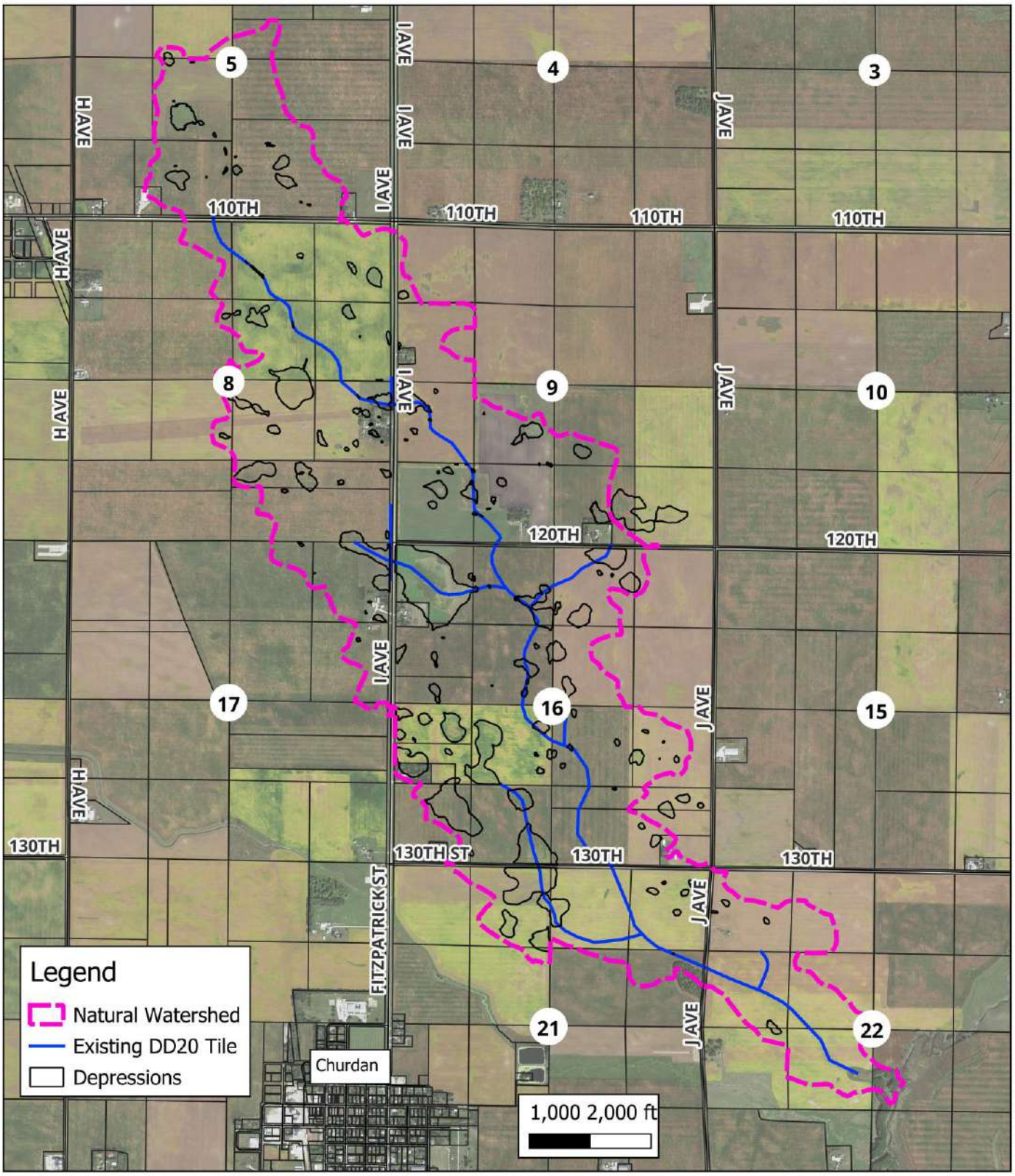
Greene County, IA | **September 2025**



AgriVia

Drainage District No. 20 — **Depressions Map**

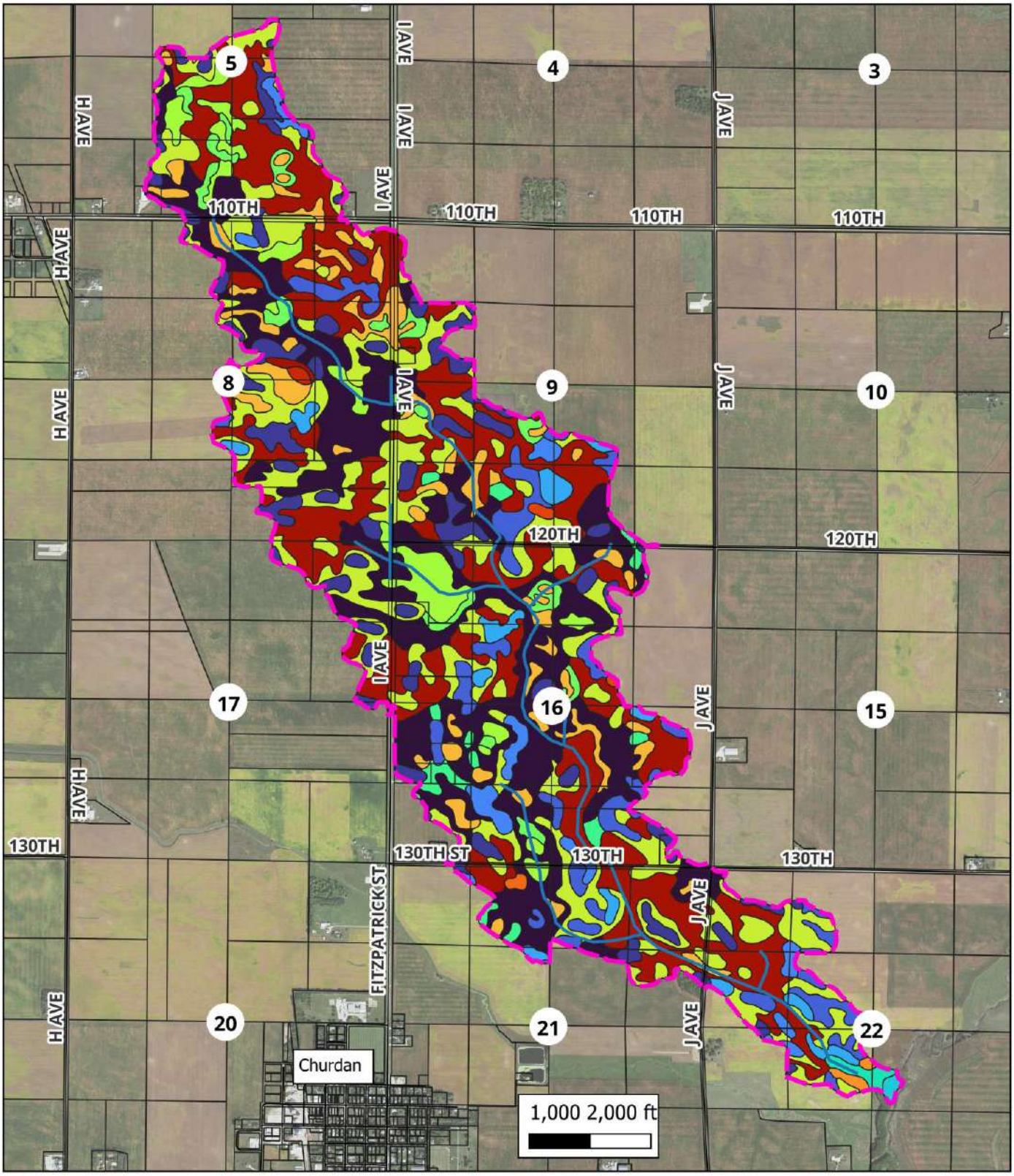
Greene County, IA — **September 2025**



AgriVia

Drainage District No. 20 — **Soil Type Map**

Greene County, IA — **September 2025**

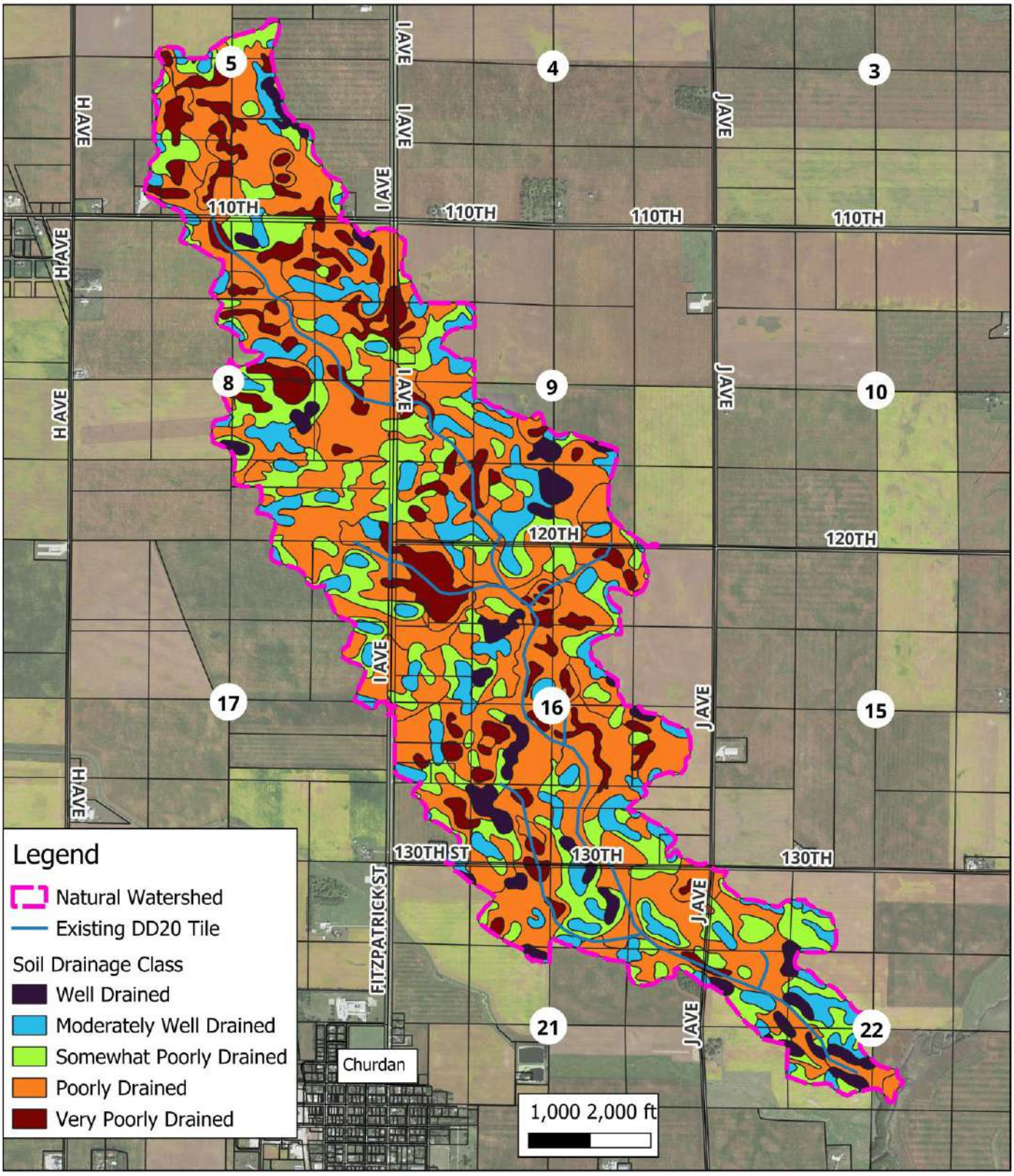



Legend
Natural Watershed
Existing DD20 Tile
Soil Types
Canisteo clay loam, 0 to 2 percent slopes
Clarion loam, 2 to 6 percent slopes
Clarion loam, 2 to 6 percent slopes, moderately eroded
Clarion loam, 6 to 10 percent slopes, moderately eroded
Clarion-Storden complex, 6 to 10 percent slopes, moderately eroded
Coland clay loam, 0 to 2 percent slopes, frequently flooded
Coland clay loam, 0 to 2 percent slopes, occasionally flooded
Crippin loam, 1 to 3 percent slopes
Harps clay loam, 0 to 2 percent slopes
Knoke silty clay loam, 0 to 1 percent slopes
Nicollet clay loam, 1 to 3 percent slopes
Ocheyedan loam, 2 to 5 percent slopes
Okoboji silty clay loam, 0 to 1 percent slopes
Omsrud-Storden complex, 10 to 16 percent slopes, moderately eroded
Salida-Storden complex, 5 to 9 percent slopes, moderately erode
Storden loam, 6 to 10 percent slopes, moderately eroded
Wacousta silty clay loam, 0 to 1 percent slopes
Webster clay loam, 0 to 2 percent slopes

AgriVia

Drainage District No. 20 — **Soil Drainclass Map**

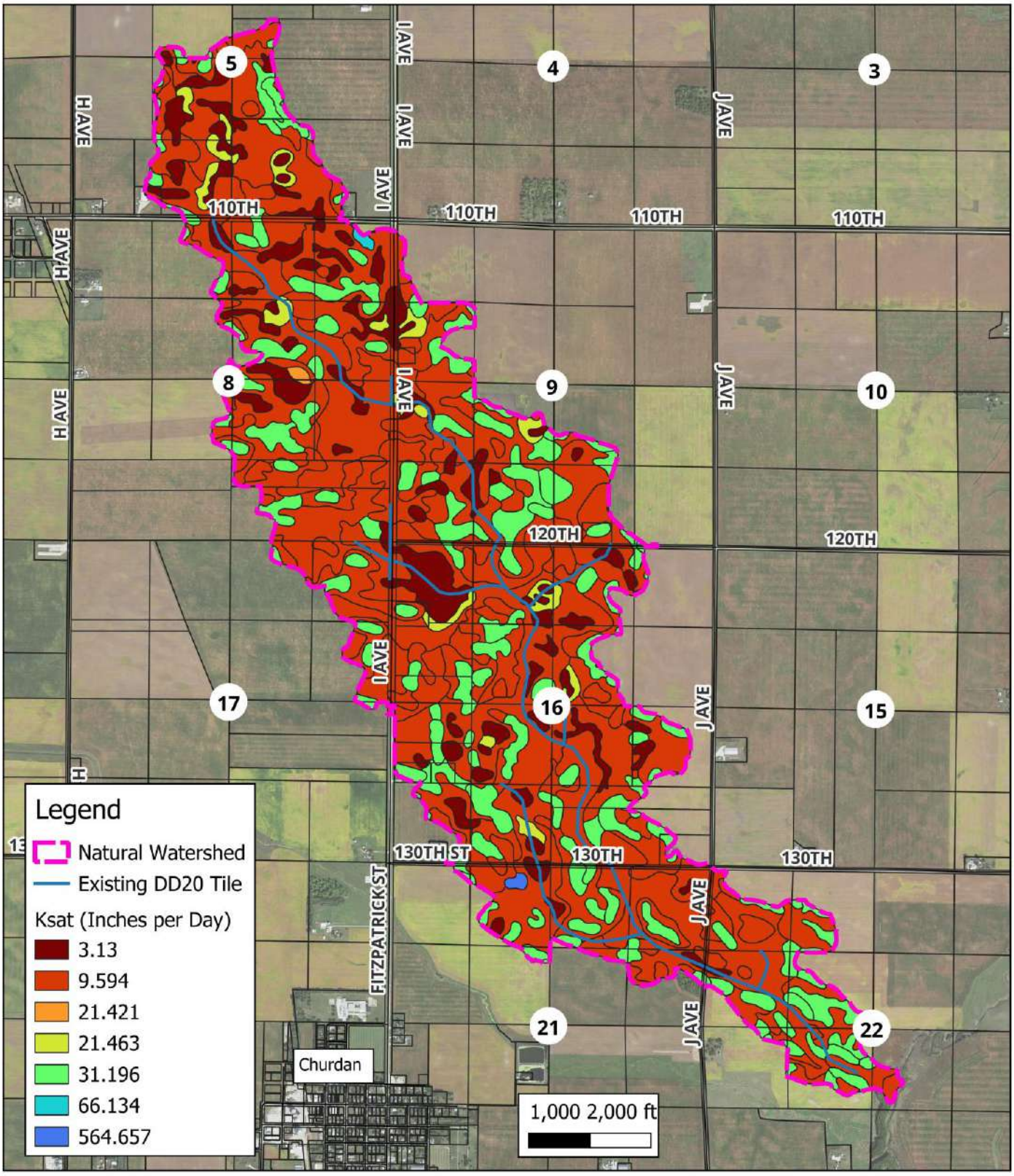
Greene County, IA — **September 2025**



AgriVia

Drainage District No. 20 — **Ksat Map**

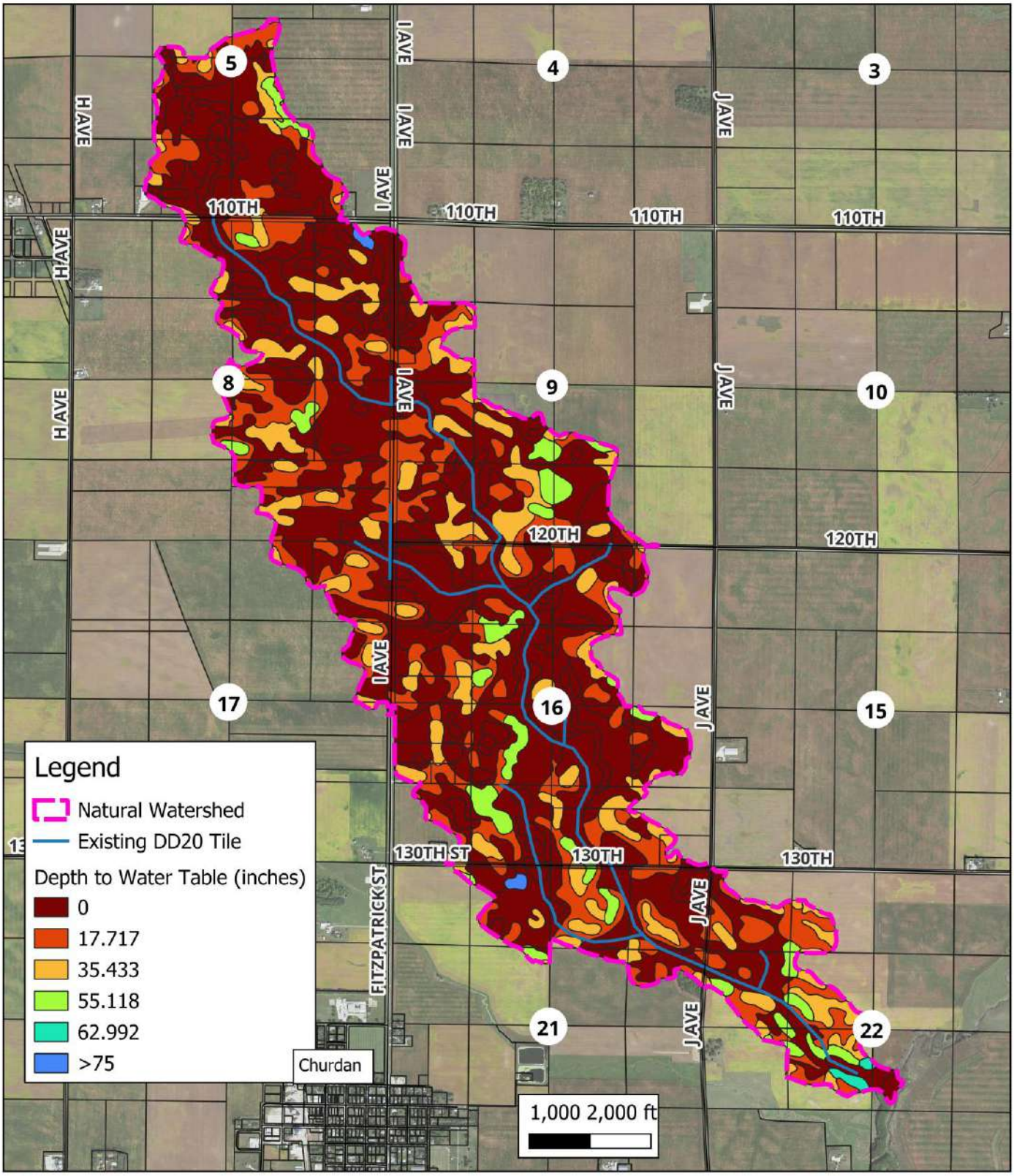
Greene County, IA — **September 2025**



AgriVia

Drainage District No. 20 **Water Table Depth Map**

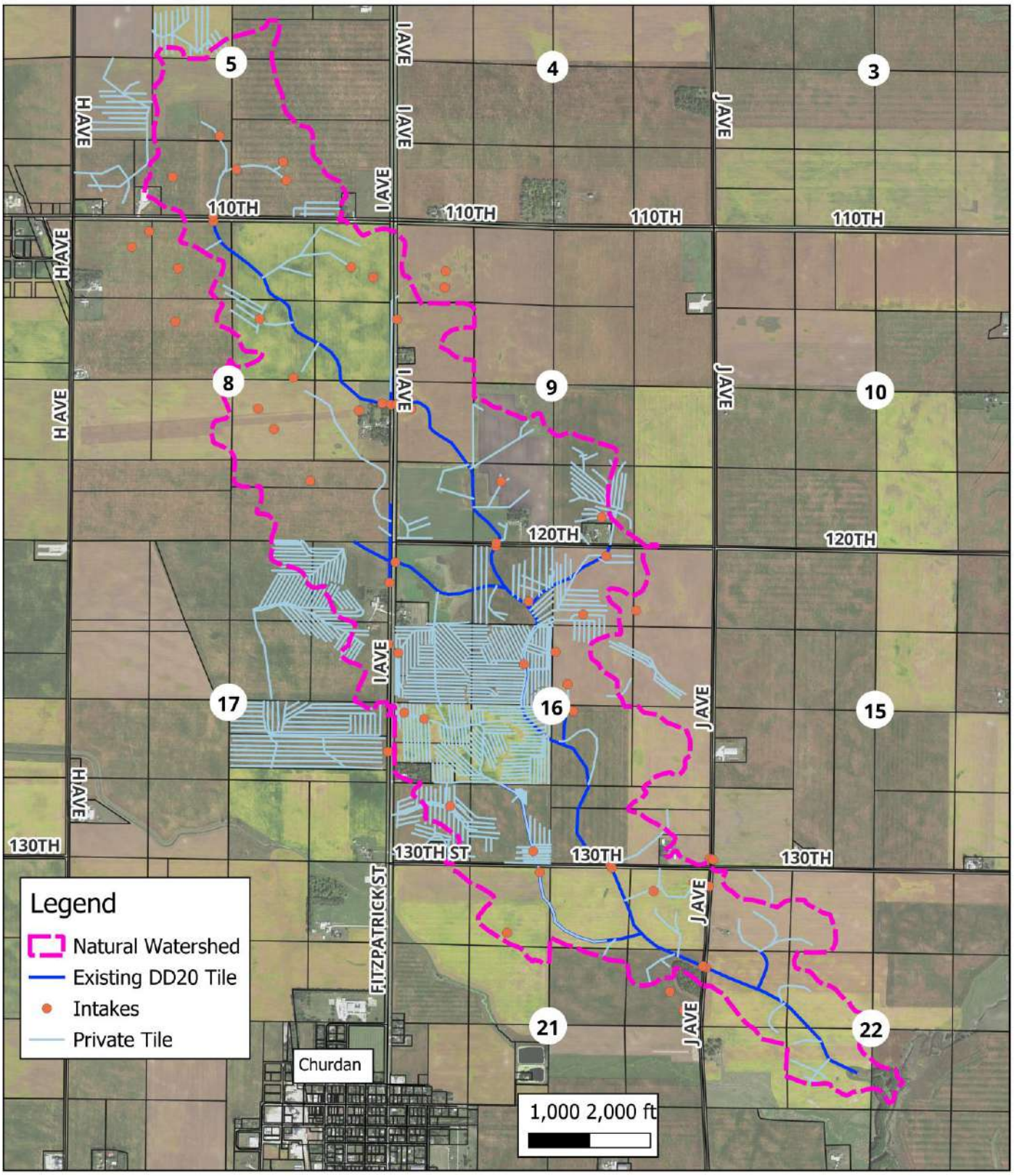
Greene County, IA **September 2025**



AgriVia

Drainage District No. 20 **Private Tile Map**

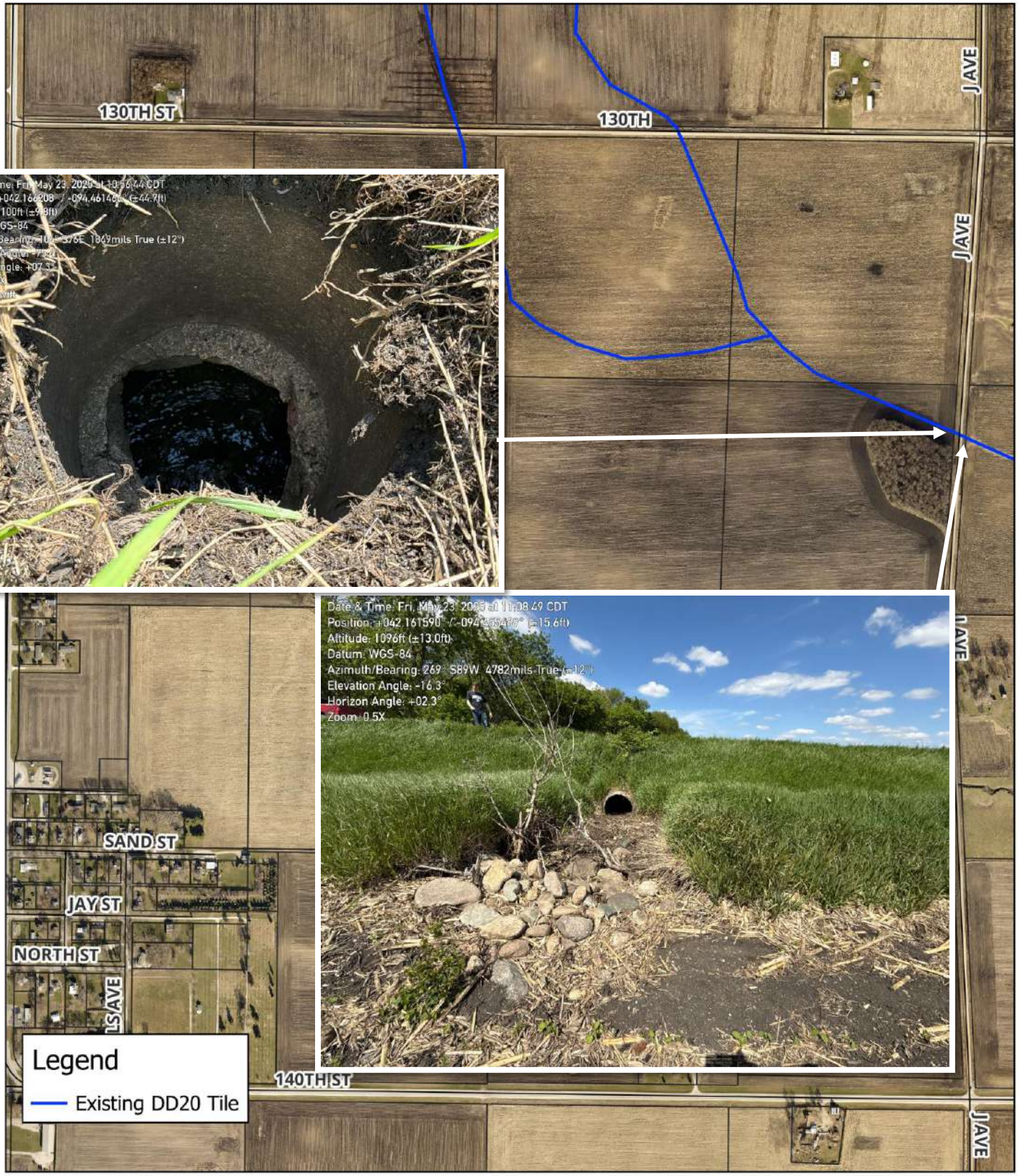
Greene County, IA **September 2025**

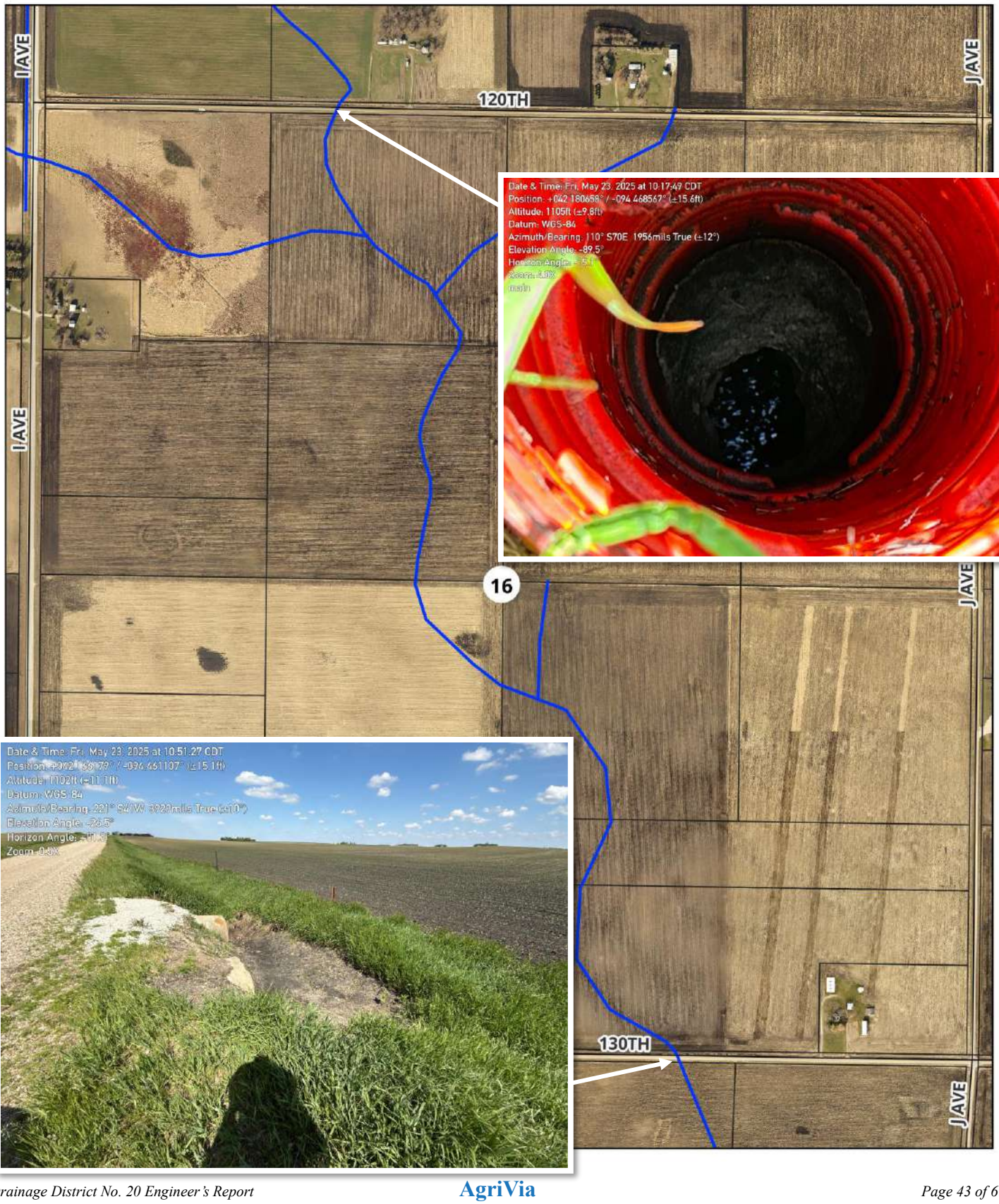


AgriVia

Drainage District No. 20 — **Survey Photos**

Greene County, IA — **September 2025**


130TH ST
130TH
J AVE
J AVE
Date & Time: Fri, May 23, 2025 at 10:56:44 CDT
Position: +042.166208° / -094.461462° (±44.7ft)
Altitude: 1100ft (±9.8ft)
Datum: WGS-84
Azimuth/Bearing: 102° S78E 1849mils True (±12°)
Elevation Angle: +7.2°
Horizon Angle: +07.3°
Zoom: 2.0X
flowing swift
Date & Time: Fri, May 23, 2025 at 11:08:49 CDT
Position: +042.161590° / -094.463548° (±15.6ft)
Altitude: 1096ft (±13.0ft)
Datum: WGS-84
Azimuth/Bearing: 269° S89W 4782mils True (±12°)
Elevation Angle: -16.3°
Horizon Angle: +02.3°
Zoom: 0.5X
SAND ST
JAY ST
NORTH ST
S AVE
Legend
Existing DD20 Tile
140TH ST
J AVE


I AVE
120TH
J AVE
16
130TH

Date & Time: Fri, May 23, 2025 at 10:17:49 CDT
Position: +042.180658° / -094.468567° (±15.6ft)
Altitude: 1105ft (±9.8ft)
Datum: WGS-84
Azimuth/Bearing: 110° S70E 1956mils True (±12°)
Elevation Angle: -89.5°

Date & Time: Fri, May 23, 2025 at 10:51:27 CDT
Zoom: 0.9X


Date & Time: Fri, May 23, 2025 at 09:39:10 CDT
Position: +042.186521° / -094.474611° (±10.2ft)
Altitude: 1116ft (±9.8ft)
Datum: WGS-84
Azimuth/Bearing: 272° N88W 4836mils True (±12°)
Elevation Angle: -12.1°
Horizon Angle: -03.0°
Zoom: 0.5X
culvert
I AVE
120TH
Legend
Existing DD20 Tile


110TH
I AVE
110TH
I AVE
120TH
I AVE
Legend
Existing D

Appendix N- Itemized Cost Estimate

Estimated Costs - Main Tile
Tile Improvements
Drainage District No. 20
Greene 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"	1800	LF	$88	$ 158,400
102	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 36", R-2 BEDDING	700	LF	$102	$ 71,400
103	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 30"	6134	LF	$72	$ 441,648
104	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 24"	3814	LF	$56	$ 213,584
105	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP OR HDPE DUAL WALL, 18"	4400	LF	$42	$ 184,800
106	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	440	LF	$20	$ 8,800
107	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	210	LF	$10	$ 2,100
108	6010-CUST	REDUCER, RCP, 36" TO 30"	1	EA	$2,050	$ 2,050
109	6010-CUST	REDUCER, RCP, 30" TO 24"	1	EA	$2,020	$ 2,020
110	6010-CUST	REDUCER, RCP, 24" TO 18"	1	EA	$1,660	$ 1,660
111	6010-B	INTAKE, HD BAR GUARD, 18"	9	EA	$1,000	$ 9,000
112	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	42	EA	$450	$ 18,900
113	6010-CUST	TILE CONNECTIONS, 12" AND LARGER	19	EA	$650	$ 12,350
114	2010-CUST	EXCAVATION, EXPLORATORY	17	HR	$270	$ 4,590
115	3010-C	TRENCH FOUNDATION	175	TN	$32	$ 5,600
116	9040-J	RIPRAP, CLASS E	50	TN	$75	$ 3,750
117	9060-E	REMOVAL OF FENCE	7	EA	$140	$ 980
118	9040-CUST	EROSION CONTROL PLAN	1	LS	$500	$ 500
119	9010-A	CONVENTIONAL SEEDING, COVER CROP	45	AC	$100	$ 4,500
120	9040-CUST	DRIVEWAY RESTORATION	7	EA	$500	$ 3,500
121	9040-CUST	STABILIZED CONSTRUCTION ENTRANCE	2	EA	$1,000	$ 2,000
122	11,020-A	MOBILIZATION	1	LS	$60,500	$ 60,500
					5% Construction Contingency	$ 61,000
					Subtotal Construction Cost	**$ 1,273,632.00**

County Secondary Roads Construction Cost						
Item No.	**Item Code**	**Bid Item**	**Est. Units**	**Unit**	**Est. Unit Price**	**Est. Amount**
201	4020-A-2	DRAIN TILE, TRENCHLESS, STEEL CASING, BORED/JACKED, 18"	84	LF	$1,100	$ 92,400
202	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 30", R-2 BEDDING	66	LF	$85	$ 5,610
203	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 24", R-2 BEDDING	66	LF	$66	$ 4,356
204	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 18", R-2 BEDDING	16	LF	$50	$ 800
205	6010-CUST	TEE, RCP, 24" ON 30"	2	EA	$1,130	$ 2,260
206	6010-CUST	TEE, RCP, 24" ON 24"	2	EA	$910	$ 1,820
207	6010-CUST	TEE, RCP, 18" ON 18"	2	EA	$820	$ 1,640
208	6010-CUST	REDUCER, HDPE, 24" TO 18"	2	EA	$800	$ 1,600
209	6010-B	INTAKE, HICKENBOTTOM, 24"	6	EA	$2,000	$ 12,000
210	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
211	9010-A	CONVENTIONAL SEEDING, TYPE 2 SEED MIXTURE	0.3	AC	$2,000	$ 600
212	2010-CUST	EXCAVATION, EXPLORATORY	6	HR	$270	$ 1,620
213	8030-A	TRAFFIC CONTROL	1	LS	$1,000	$ 1,000
214	11,020-A	MOBILIZATION	1	LS	$6,500	$ 6,500
					5% Construction Contingency	$ 6,500
					Subtotal Construction Cost	**$ 138,956.00**

Iowa Department of Transportation Construction Cost						
Item No.	Item Code	Bid Item	Est. Units	Unit	Est. Unit Price	Est. Amount
301	4020-A-2	DRAIN TILE, TRENCHLESS, STEEL CASING, BORED/JACKED, 24"	120	LF	$1,200	$ 144,000
302	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
303	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
304	8030-A	TRAFFIC CONTROL	1	LS	$1,000	$ 1,000
305	11,020-A	MOBILIZATION	1	LS	$7,500	$ 7,500
					5% Construction Contingency	$ 7,500
					Subtotal Construction Cost	**$ 160,790.00**

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	$ 72,000
Interest	$ 139,000
Subtotal Non-Construction Cost	**$ 301,000.00**

Total Project Costs	
Expense	Est. Amount
Main Tile Improvement	$ 1,273,632
Greene County Secondary Roads	$ 138,956
Iowa Department of Transportation	$ 160,790
Additional Non-Construction Project Costs	$ 301,000
Total Main Tile Improvement Cost	**$ 1,874,378**
Total Main Tile Improvement Cost to Drainage District No. 20	**$ 1,574,632**
Average Cost per Acre Benefitted (1,558 Acres)	**$ 1,011**

Estimated Costs - 1st Timmons Branch
Tile Improvements
Drainage District No. 20
Greene County, IA

1st Timmons Branch Tile Construction Cost						
Item No.	**Item Code**	**Bid Item**	**Est. Units**	**Unit**	**Est. Unit Price**	**Est. Amount**
401	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 15"	3734	LF	$25	$ 93,350
402	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	225	LF	$20	$ 4,500
403	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	70	LF	$10	$ 700
404	6010-B	INTAKE, HD BAR GUARD, 15"	2	EA	$450	$ 900
405	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	9	EA	$450	$ 4,050
406	6010-CUST	TILE CONNECTIONS, 12" AND LARGER	5	EA	$650	$ 3,250
407	2010-CUST	EXCAVATION, EXPLORATORY	4	HR	$270	$ 1,080
408	3010-C	TRENCH FOUNDATION	40	TN	$32	$ 1,280
409	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
410	9010-A	CONVENTIONAL SEEDING, TYPE 5 SEED MIXTURE	8	AC	$100	$ 800
411	9040-CUST	DRIVEWAY RESTORATION	1	EA	$500	$ 500
412	9040-CUST	STABILIZED CONSTRUCTION ENTRANCE	1	EA	$1,000	$ 1,000
413	11,020-A	MOBILIZATION	1	LS	$6,000	$ 6,000
					5% Construction Contingency	$ 6,000
					Subtotal Construction Cost	**$ 123,660.00**

County Secondary Roads Construction Cost						
Item No.	**Item Code**	**Bid Item**	**Est. Units**	**Unit**	**Est. Unit Price**	**Est. Amount**
501	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 15", R-2 BEDDING	66	LF	$42	$ 2,772
502	6010-CUST	TEE, RCP, 15" ON 15"	2	EA	$760	$ 1,520
503	6010-CUST	REDUCER, HDPE, 24" TO 15"	2	EA	$750	$ 1,500
504	6010-B	INTAKE, HICKENBOTTOM, 24"	2	EA	$2,000	$ 4,000
505	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
506	9010-A	CONVENTIONAL SEEDING, TYPE 2 SEED MIXTURE	0.1	AC	$2,000	$ 200
507	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
508	8030-A	TRAFFIC CONTROL	1	LS	$350	$ 350
509	11,020-A	MOBILIZATION	1	LS	$600	$ 600
					5% Construction Contingency	$ 1,000
					Subtotal Construction Cost	**$ 11,732.00**

Additional Non-Construction Project Costs	
Expense	**Est. Amount**
Specifications and Construction Engineering	$ 5,000
Construction Damages	$ 12,800
Interest	$ 12,000
Subtotal Non-Construction Cost	**$ 29,800.00**

Total Project Costs	
Expense	**Est. Amount**
1st Timmons Branch Improvement	$ 123,660
Greene County Secondary Roads	$ 11,732
Additional Non-Construction Project Costs	$ 29,800
Total 1st Branch Tile Improvement Cost	**$ 165,192**
Total 1st Branch Tile Improvement Cost to 1st Timmons Branch	**$ 153,460**
Average Cost per Acre Benefitted (153 Acres)	**$ 1,003**

Estimated Costs - FA Moran Branch
Tile Improvements
Drainage District No. 20
Greene County, IA

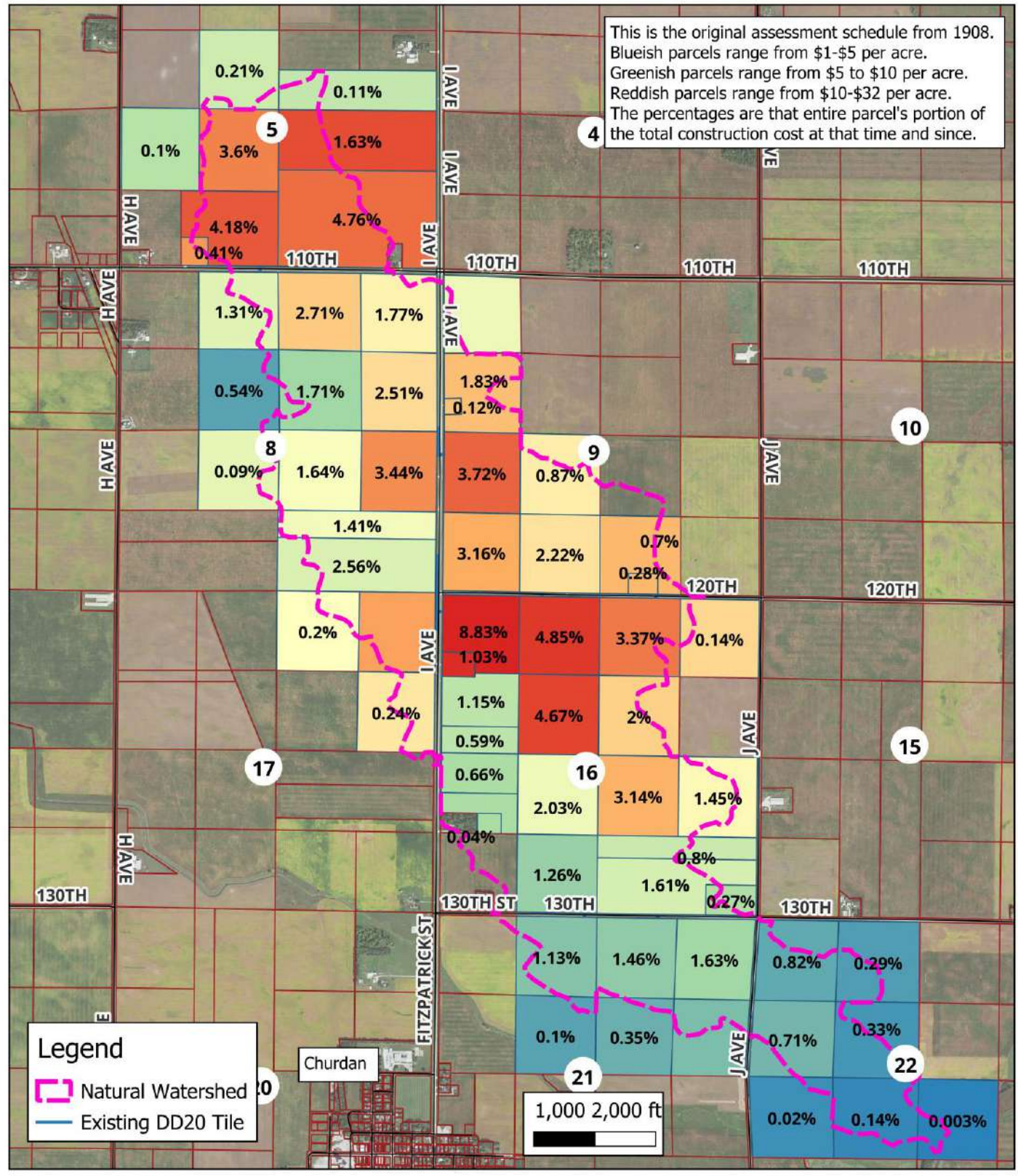
FA Moran Branch Tile Construction Cost						
Item No.	**Item Code**	**Bid Item**	**Est. Units**	**Unit**	**Est. Unit Price**	**Est. Amount**
601	4020-A-1	DRAIN TILE, HDPE DUAL WALL, 12"	1684	LF	$20	$ 33,680
602	4020-A-1	DRAIN TILE, HDPE SINGLE WALL, 4" - 10"	35	LF	$10	$ 350
603	6010-B	INTAKE, HD BAR GUARD, 12"	1	EA	$450	$ 450
604	6010-CUST	TILE CONNECTIONS, 10" AND SMALLER	5	EA	$450	$ 2,250
605	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
606	3010-C	TRENCH FOUNDATION	17	TN	$32	$ 544
607	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
608	9010-A	CONVENTIONAL SEEDING, TYPE 5 SEED MIXTURE	4	AC	$100	$ 400
609	9040-CUST	DRIVEWAY RESTORATION	2	EA	$500	$ 1,000
610	11,020-A	MOBILIZATION	1	LS	$2,000	$ 2,000
					5% Construction Contingency	$ 2,000
					Subtotal Construction Cost	**$ 43,464.00**

County Secondary Roads Construction Cost						
Item No.	**Item Code**	**Bid Item**	**Est. Units**	**Unit**	**Est. Unit Price**	**Est. Amount**
701	4020-A-1	DRAIN TILE, TRENCHED, CLASS III RCP, 12", R-2 BEDDING	66	LF	$38	$ 2,508
702	6010-CUST	TEE, RCP, 12" ON 12"	2	EA	$690	$ 1,380
703	6010-B	INTAKE, HICKENBOTTOM, 12"	2	EA	$1,000	$ 2,000
704	9040-CUST	EROSION CONTROL PLAN	1	LS	$250	$ 250
705	9010-A	CONVENTIONAL SEEDING, TYPE 2 SEED MIXTURE	0.1	AC	$2,000	$ 200
706	2010-CUST	EXCAVATION, EXPLORATORY	2	HR	$270	$ 540
708	8030-A	TRAFFIC CONTROL	1	LS	$350	$ 350
709	11,020-A	MOBILIZATION	1	LS	$400	$ 400
					5% Construction Contingency	$ 400
					Subtotal Construction Cost	**$ 8,028.00**

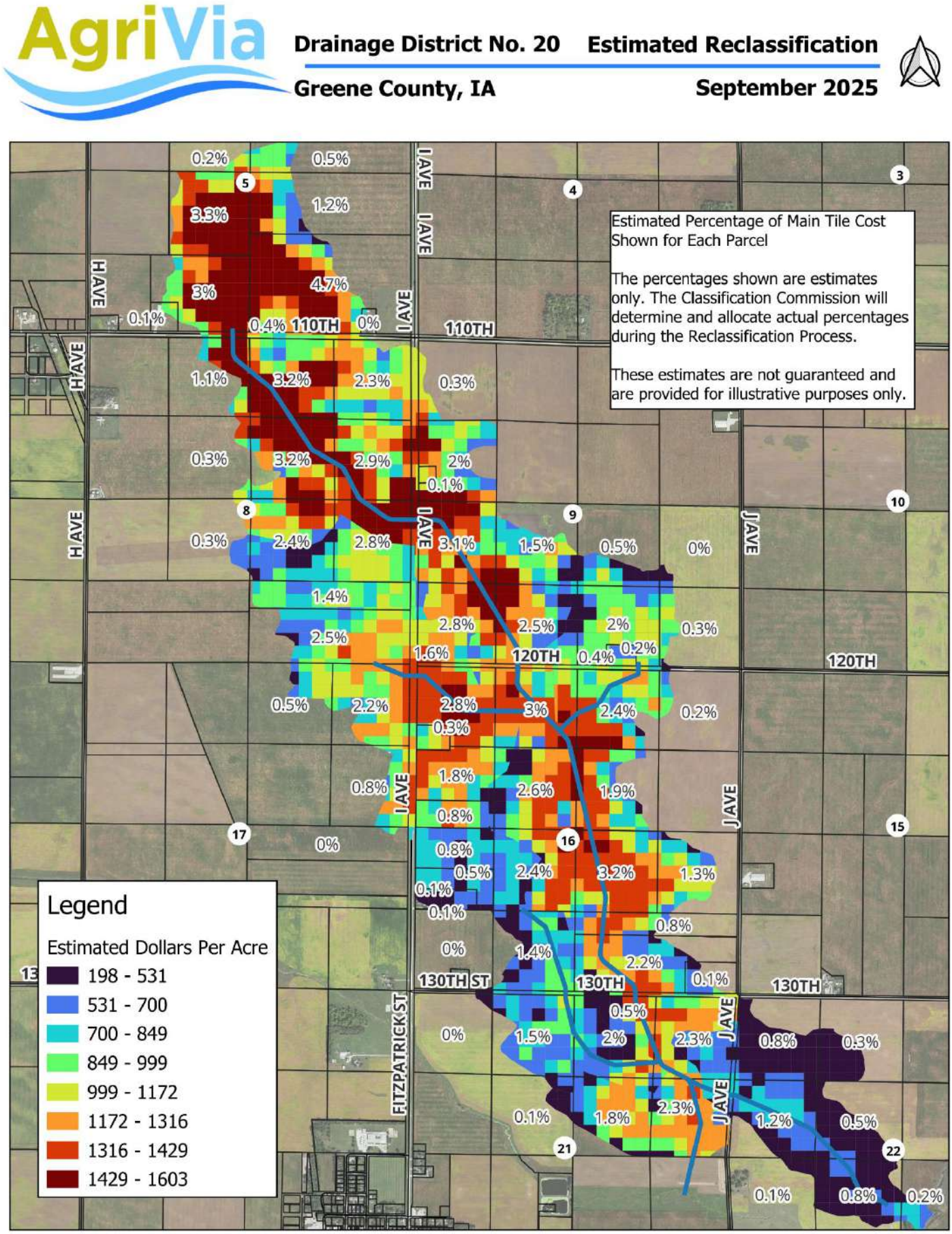
Additional Non-Construction Project Costs	
Expense Catergory	**Est. Amount**
Specifications and Construction Engineering	$ 5,000
Construction Damages	$ 6,400
Interest	$ 5,000
Subtotal Non-Construction Cost	**$ 16,400.00**

Total Project Costs	
Expense	**Est. Amount**
FA Moran Branch Improvement	$ 43,464
Greene County Secondary Roads	$ 8,028
Additional Non-Construction Project Costs	$ 16,400
Total FA Moran Branch Tile Improvement Cost	**$ 67,892**
Total FA Moran Branch Tile Improvement Cost to Drainage District No. 20	**$ 59,864**
Average Cost per Acre Benefitted (102 Acres)	**$ 587**

Appendix O– Current Assessment Schedule Map



Appendix P- Estimated Reclassification Map



Appendix Q- Iowa State Economic Returns from Tiling Spreadsheet

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. 20**
Field location (general location or legal description)	**North and east of Churdan**
District Size (acres to analyze for tile drainage)	1,558

Field Drainage Needs

Number of Acres by Drainage Needs	
Very poorly drained	161
Poorly drained	801
Somewhat poorly drained	306
Moderately well drained	214
Well drained	76
Total	1,558.0

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

Corn (bushels per acre)	Very Poorly Drained	Poorly Drained	Somewhat Poorly Drained	Moderately Well Drained	Well Drained
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.

Added Cash Income	**Corn** (per acre)	**Soybeans** (per acre)	**Average** (per acre)
Expected field crop rotation on acres being analyzed	48%	48%	
Acres planted to crop based on acres being analyzed and crop rotation	747.8	747.8	
Estimated yield increase (from above section)	34.7	10.3	
Long-term expected sale price	$5.24	$12.39	
Additional Cash Income due to Tile Drainage	$181.90	$127.46	
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	**$149.90**	**$107.46**	**$123.53**

Total Cost of Tile Drainage District Investment

Total	**$ 1,574,632.00**
Per Tiled Acre (1558 acres)	**$ 1,010.68**

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	**14.8%**	**10.6%**	**12.2%**
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:
9/22/2025

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.

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)

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 to 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 S – Nutrient Reduction Strategy Examples

Nutrient Reduction Calculator						
Practice	Nitrogen Reduction	Phosphorus Reduction	Acres	Avg. Annual Cost ($/Acre)	Total Annual Cost ($)	Practice Type
Wetlands	52%	0%	660	$15.00	$ 9,900.00	Edge-of-Field
Bioreactors	43%	0%	160	$10.00	$ 1,600.00	Edge-of-Field
Saturated Buffers	91%	58%		$231.00	$ -	Edge-of-Field
Drainage Water Mgt.	33%	0%		$10.00	$ -	Edge-of-Field
Terraces	0	77%			$ -	Edge-of-Field
Sediment Control	0	85%			$ -	Edge-of-Field
Reduce N Rate to MRTN	10%	0%	1000	-$2.00	$ (2,000.00)	In-Field
Nitrification Inhibitor	9%	0%	1000	-$3.00	$ (3,000.00)	In-Field
Move Fall N to Spring	6%	0%	500	-$20.00	$ (10,000.00)	In-Field
Sidedress N Application	7%	0%	1000	$0.00	$ -	In-Field
Cover Crops	31%	29%		$49.00	$ -	In-Field
No-Till	0%	90%	650	$12.00	$ 7,800.00	In-Field
Conservation Tillage	0%	33%	350	-$1.00	$ (350.00)	In-Field
Extended Rotations	42%	0%		$30.00	$ -	Land Use
Land Retirement (CRP)	85%	75%		$192.00	$ -	Land Use
					$ 3,950.00	

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."

Nutrient Reduction Calculator						
Practice	Nitrogen Reduction	Phosphorus Reduction	Acres	Avg. Annual Cost ($/Acre)	Total Annual Cost ($)	Practice Type
Wetlands	52%	0%	900	$15.00	$ 13,500.00	Edge-of-Field
Bioreactors	43%	0%		$10.00	$ -	Edge-of-Field
Saturated Buffers	91%	58%	160	$231.00	$ 36,960.00	Edge-of-Field
Drainage Water Mgt.	33%	0%		$10.00	$ -	Edge-of-Field
Terraces	0	77%			$ -	Edge-of-Field
Sediment Control	0	85%			$ -	Edge-of-Field
Reduce N Rate to MRTN	10%	0%		-$2.00	$ -	In-Field
Nitrification Inhibitor	9%	0%		-$3.00	$ -	In-Field
Move Fall N to Spring	6%	0%		-$20.00	$ -	In-Field
Sidedress N Application	7%	0%		$0.00	$ -	In-Field
Cover Crops	31%	29%		$49.00	$ -	In-Field
No-Till	0%	90%	500	$12.00	$ 6,000.00	In-Field
Conservation Tillage	0%	33%	500	-$1.00	$ (500.00)	In-Field
Extended Rotations	42%	0%	100	$30.00	$ 3,000.00	Land Use
Land Retirement (CRP)	85%	75%	60	$192.00	$ 11,520.00	Land Use
					$70,480.00	

This Example Reduction	
Nitrogen Reduction	**45%**
Phosphorus Reduction	**48%**

Spreadsheet Created by: AgriVia

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

Appendix T- Landowner Engagement Letters

AgriVia
1124 Willis Ave.
P.O. Box 44
Perry, IA 50220

May 15, 2025

Landowners of Drainage District No. 20
Greene County, IA

Subject: Petition for Tile Repairs and Improvements

Dear Landowner,

This letter is to inform you that a petition has been filed requesting a study for tile repairs and improvements in Drainage District No. 20. 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. 20, 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 week 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 appreciate your cooperation and understanding as we work to complete this important step in the study.

We encourage each landowner to visit the Greene County USDA office in Jefferson 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 summer 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.

Please direct all communication to:

AgriVia
1124 Willis Ave
P.O. Box 44
Perry, IA 50220

Jacob Hagan
Email: jacob.agrivia@gmail.com
Cell: 712-250-4318

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

Your input is essential to ensuring a successful and responsible project. We appreciate your cooperation and look forward to working with you throughout this process.

Sincerely,

Jacob Hagan & Tyler Buman
AgriVia
Ag Engineering Services

cc: Michelle Fields, Greene Co. Drainage Clerk
Greene County Board of Supervisors
Jefferson USDA Office

AgriVia

1124 Willis Ave
Perry, IA 50220
PO Box 44

June 6, 2025

Subject: Informational Meeting

Dear Landowners and Trustees of Drainage District No. 20,

You are invited to attend an informational meeting regarding the ongoing improvement study for Drainage District No. 20. The meeting will be held at the Churdan Public Library on Wednesday, June 26, 2025, at 6:00 PM.

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. A download link will be provided at the meeting containing additional information and documentation for your review.

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 (712-250-4318) jacob.agrivia@gmail.com
Tyler Buman (712-579-5296) tyler.agrivia@gmail.com
AgriVia PLLC

cc: Michelle Fields, Greene Co. Drainage Clerk
Greene County Board of Supervisors

AgriVia

1124 Willis Ave
Perry, IA 50220
PO Box 44

June 9, 2025

Subject: Informational Meeting

Dear Landowners and Trustees of Drainage District No. 20,

This letter is a correction to the previous letter dated June 6th inviting all landowners to the Churdan Public Library for an informational meeting. The previous letter had the meeting scheduled on "Wednesday, June 26th, 2025". The correct date is **Wednesday, June 25th, 2025 at 6:00 P.M**.

Our apologies for any confusion. We hope to see you there.

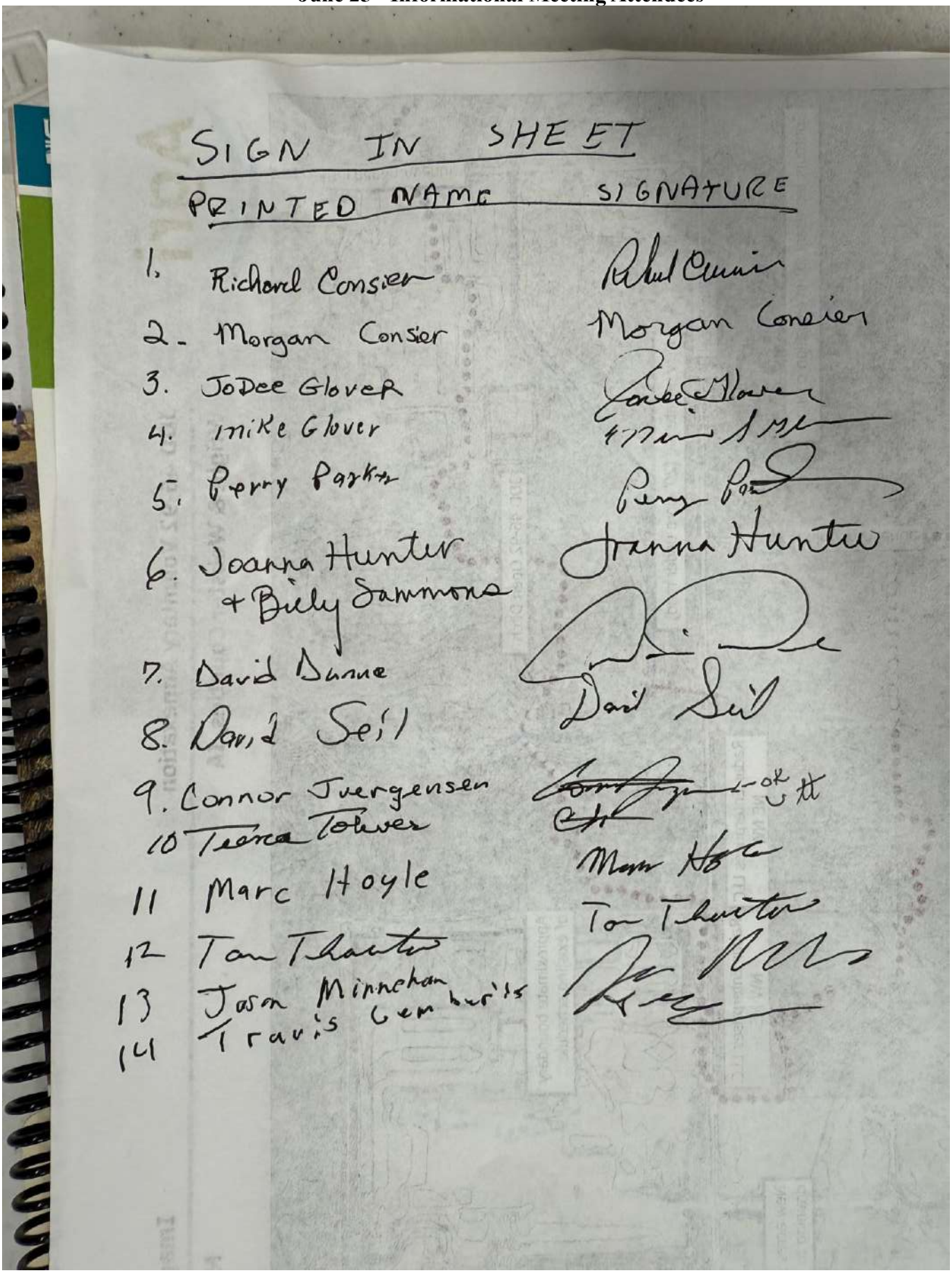
The library address is:
414 Sand St, Churdan, IA 50050

Sincerely,

Jacob Hagan (712-250-4318) jacob.agrivia@gmail.com
Tyler Buman (712-579-5296) tyler.agrivia@gmail.com
AgriVia PLLC

cc: Michelle Fields, Greene Co. Drainage Clerk
Greene County Board of Supervisors

June 25th Informational Meeting Attendees



SIGN IN SHEET

	PRINTED NAME	SIGNATURE
1.	Richard Consier	Richard Consier
2.	Morgan Consier	Morgan Consier
3.	JoDee Glover	JoDee Glover
4.	Mike Glover	
5.	Perry Parker	Perry Parker
6.	Joanna Hunter + Billy Simmons	Joanna Hunter
7.	David Dunne	
8.	David Seil	David Seil
9.	Connor Juergensen	
10	Teresa Tolver	Mark Hoyle
11	Marc Hoyle	Tom Thornton
12	Tom Thornton	
13	Jason Minnehan	
14	Travis Cemburis	

Appendix U- Right-of-Way Recommendation

Work Limits (ROW) Recommendation
Tile Improvements
Drainage District No. 20
Greene County, IA

Recommended Work Limits (ROW)				
Deedholder	S-T-R	Legal	Proposed Width (ft)	Acres
ADAMS REAL ESTATE, LLC	9-85-31	SW1/4 SE1/4 (EX LOT 1)	100	0.2
ADAMS REAL ESTATE, LLC	9-85-31	LOT 1 SW1/4 SE1/4	100	0.2
BLANCHFIELD, ROGER L	8-85-31	NE1/4 NW1/4	100	1.8
BLANCHFIELD, ROGER L	8-85-31	SE1/4 NE1/4	100	1.8
BLANCHFIELD, ROGER L	8-85-31	NW1/4 NE1/4	100	2.4
BLANCHFIELD, ROGER L	8-85-31	SW1/4 NE1/4	100	2.4
CONSIER, RUTH	8-85-31	NE1/4 SE1/4	100	2.4
D & M TASLER CO	16-85-31	NE1/4 NE1/4	100	0.2
D & M TASLER CO	16-85-31	SW1/4 NE1/4	100	2.1
D & M TASLER CO	16-85-31	NW1/4 NE1/4	100	3.4
FERGUSON, DONALD CHARLES & CHERYL LEE	16-85-31	S1/2 SE1/4 (EX LOTS 1 & 2)	100	3.7
GUESS FAMILY TRUST	5-85-31	SE1/4 SW1/4 (EX LOT 1) BUT INCL THAT PART SW1/4 SW1/4 LYING E OF LINE EXTENDING N FROM NW COR LOT 1	100	0.9
HOYLE, MARC P	16-85-31	SE1/4 NW1/4	100	1
HUNTER, JOANNA E	9-85-31	SW1/4 SW1/4	100	1.2
HUNTER, JOANNA E	9-85-31	SE1/4 SW1/4	100	2.3
JUERGENSEN LAND & LIVESTOCK, INC	21-85-31	NE1/4 NE1/4	100	2
JUERGENSEN LAND & LIVESTOCK, INC	21-85-31	SE1/4 NE1/4	100	3.6
JUERGENSEN LAND & LIVESTOCK, INC	21-85-31	NW1/4 NE1/4	100	5.8
KUCK REVOC TRUST, DOROTHY M	9-85-31	NW1/4 SW1/4	100	4.1
MACKE FARMS, INC	16-85-31	LOT 2 S1/2 SE1/4	100	0.9
MACKE FARMS, INC	6-85-31	NW1/4 SE1/4	100	3.1
MINNEHAN, JASON	16-85-31	NE1/4 SW1/4	100	0.2
SEIL, DAVID & BARBARA	16-85-31	SE1/4 SW1/4	100	3.7
SEIL, DAVID D & BARBARA A	16-85-31	NE1/4 NW1/4	100	4.8
STREAM, MEREDITH & MARDEL	21-85-31	NE1/4 SE1/4	100	1.5
VOGEL, LOUISE D	21-85-31	NE1/4 NW1/4	100	1.5
			Total Acres	**57.2**

PROPOSED PLANS FOR

DRAINAGE DISTRICT NO. 20
TILE IMPROVEMENTS

GREENE COUNTY, IA

2025

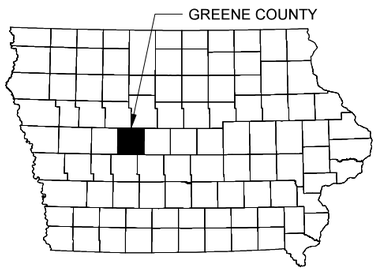
IOWA ONE CALL SM
1-800-292-8989
www.iowaonecall.com
811 Know what's below. Call before you dig.

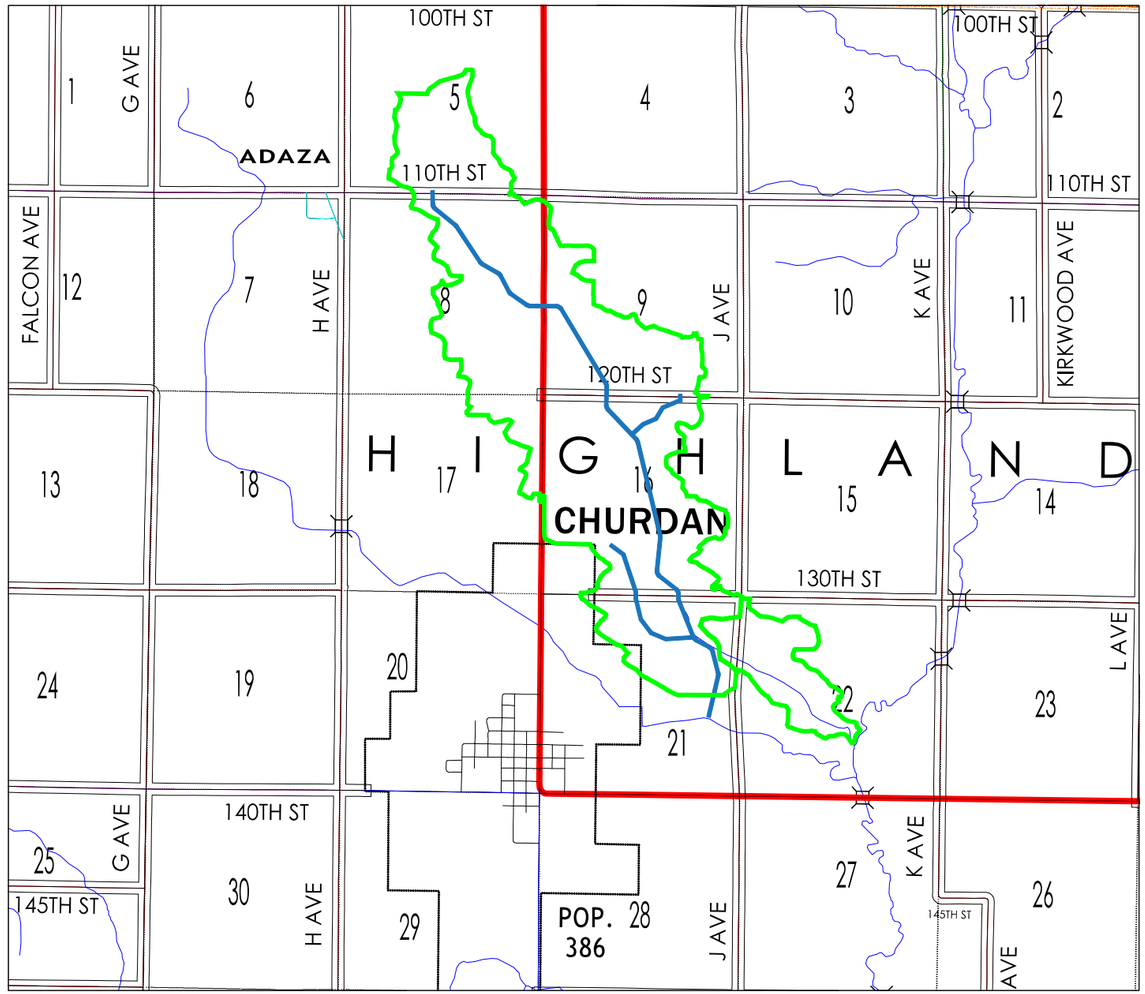
The contractor shall field verify exact locations prior to commencing construction as required by state law. Notify Iowa One Call, 811 or 1-800-292-8989.

Specifications

Unless otherwise noted, the governing standards for this project shall be the 2025 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
M.01	Main Tile (Sta 0 -> 28+00)
M.02	Main Tile (Sta 28+00 -> 58+00)
M.03	Main Tile (Sta 58+00 -> 88+00)
M.04	Main Tile (Sta 88+00 -> 118+00)
M.05	Main Tile (Sta 118+00 -> 148+00)
M.06	Main Tile (Sta 148+00 -> 172+00)
M.07	1st Timmons Branch Tile (Sta 0+00 -> 29+00)
M.08	1st Timmons Branch Tile (Sta 29+00 -> 38+00)
M.09	FA Moran Branch Tile (Sta 0+00 -> 17+50
V.01	Boring Sheet (State Hwy 4)
V.02	Boring Sheet (110th St / Co Rd E13)

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 TJB
Drafter TJB
Checker JLH

Notes

PLAN LEGEND
Proposed District Tile
Old 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. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 4000'
Sheet A.01

Benchmarks

Number	Northing	Easting	Elevation	Description
1	3524288.579	4656956.647	1095.986	Top of road box culvert.
2	3535662.655	4654090.560	1119.259	Top of road culvert.
3	3530124.256	4657066.046	1103.247	Top of road culvert.
4	3525085.189	4660686.407	1094.907	Top of road culvert.
5	3519724.109	4665555.435	1083.368	Highway bridge railing.
6	3521509.235	4662124.977	1079.682	Center of bolt on bridge railing bottom.

FA Moran Branch Tile Alignment Geometry

Station	Elevation	Northing	Easting	Bearing
0	1093.55	3529300.61	4659405.29	42°46'43"
375	1095.31	3529575.7	4659660.11	42°46'43"
Radius Curve (183')				
462	1095.74	3529622.21	4659733.2	67°08'34"
716	1096.93	3529720.84	4659967.19	67°08'34"
Radius Curve (183')				
831	1097.48	3529794.54	4660052.56	31°14'43"
1057	1098.41	3529987.50	4660169.63	31°14'43"
Radius Curve (183')				
1173	1098.67	3530061.88	4660256.60	67°41'12"
1544	1099.53	3530202.55	4660599.36	67°41'12"
Radius Curve (183')				
1660	1099.80	3530293.48	4660661.39	0°05'30"
1750	1100.00	3530383.39	4660661.54	0°05'30"

1st Timmons Branch Tile Alignment Geometry

Station	Elevation	Northing	Easting	Bearing
0	1079.38	3523977.44	4661014.89	265°57'37"
694	1089.23	3523928.57	4660322.87	265°57'37"
Radius Curve (183')				
780	1089.41	3523942.48	4660238.90	292°51'17"
1108	1090.10	3524069.94	4659936.49	292°51'17"
Radius Curve (183')				
1205	1090.30	3524128.95	4659861.03	323°11'55"
1566	1091.06	3524418.05	4659644.75	323°11'55"
Radius Curve (183')				
1640	1091.21	3524484.91	4659613.35	346°29'05"
2149	1092.00	3524979.38	4659494.50	346°29'05"
Radius Curve (183')				
2190	1092.06	3525020.73	4659489.43	359°33'26"
2314	1092.21	3525144.32	4659488.48	359°33'26"
Radius Curve (183')				
2371	1092.27	3525199.97	4659479.36	341°49'51"
3322	1094.60	3526104.68	4659182.45	341°49'51"
Radius Curve (183')				
3436	1094.92	3526194.72	4659117.43	306°30'13"
3800	1097.49	3526411.43	4658824.60	306°30'13"

Main Tile Alignment Geometry

Station	Elevation	Northing	Easting	Bearing
0	1074.50	3521867.98	4661410.33	13°07'17"
1113	1076.28	3522952.38	4661663.12	13°07'21"
Radius Curve (183')				
1201	1076.42	3523039.49	4661660.27	345°37'21"
1787	1077.36	3523606.69	4661514.87	345°37'21"
Radius Curve (183')				
1939	1077.60	3523720.84	4661421.16	298°02'38"
2314	1078.20	3523897.05	4661090.38	298°02'38"
Radius Curve (183')				
2442	1078.41	3523992.14	4661008.59	338°03'05"
3463	1081.39	3524939.28	4660626.53	338°01'54"
Radius Curve (183')				
3535	1081.60	3525009.85	4660614.78	0°33'05"
3635	1081.88	3525110.07	4660615.75	0°33'05"
Radius Curve (183')				
3803	1082.35	3525254.66	4660542.24	308°03'05"
4345	1083.87	3525588.40	4660115.86	308°03'05"
Radius Curve (183')				
4529	1084.38	3525752.00	4660049.93	5°33'05"
5391	1086.68	3526609.86	4660133.31	5°33'05"
Radius Curve (183')				
5455	1086.84	3526673.26	4660127.12	346°33'05"
7975	1092.35	3529124.61	4659540.93	346°33'05"
Radius Curve (183')				
8071	1092.54	3529207.06	4659493.90	316°33'05"
9140	1094.43	3529983.14	4658758.75	316°33'05"
Radius Curve (183')				
9284	1094.72	3530115.26	4658711.45	1°33'05"

Main Tile Alignment Geometry

Station	Elevation	Northing	Easting	Bearing
9750	1095.67	3530580.94	4658724.06	1°33'05"
Radius Curve (183')				
9854	1095.89	3530679.61	4658695.86	329°03'05"
12128	1099.94	3532630.04	4657526.30	329°03'05"
Radius Curve (183')				
12312	1100.26	3532715.69	4657372.11	271°33'05"
12987	1101.98	3532721.54	4656697.67	270°29'49"
Radius Curve (183')				
13091	1102.36	3532753.25	4656600.07	302°59'50"
13588	1104.20	3533038.95	4656192.40	305°01'23"
Radius Curve (183')				
13676	1104.50	3533105.77	4656136.43	332°33'05"
14137	1106.02	3533514.34	4655924.21	332°33'05"
Radius Curve (183')				
14241	1106.36	3533586.97	4655851.71	300°03'05"
14724	1107.95	3533828.87	4655433.59	300°03'05"
Radius Curve (183')				
14812	1108.24	3533890.48	4655371.89	326°33'05"
15920	1110.83	3534815.02	4654761.15	326°33'05"
Radius Curve (183')				
15976	1110.95	3534855.52	4654722.79	309°03'05"
16660	1111.95	3535286.25	4654191.85	309°03'05"
Radius Curve (183')				
16820	1112.11	3535427.06	4654127.09	359°03'05"
17200	1112.50	3535807.35	4654120.79	359°03'05"

AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

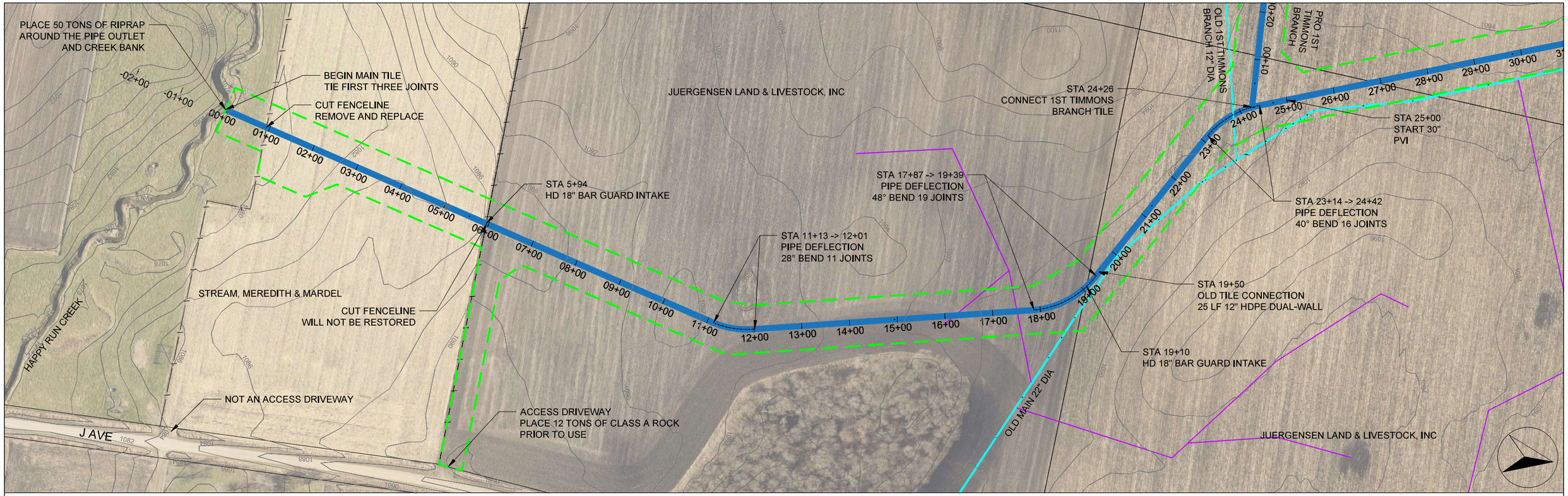
PLAN LEGEND
- Proposed District Tile
- Old District Tile
- Benefitted Lands
- Parcel Lines
- Work Limits (ROW)

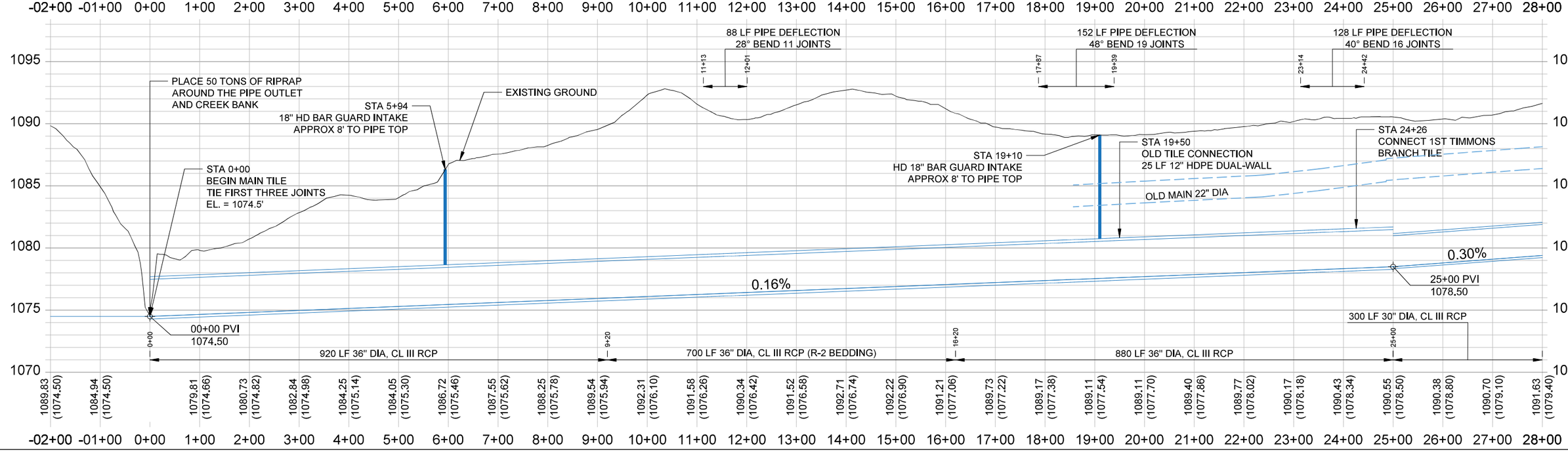
No.	Revision/Issue	Date

Sheet Name: District Plat

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project: 2502-37
Date: 2025-09-17
Plan Scale: 1" = 650'
Sheet: A.02





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

Designer TJB
Drafter TJB
Checker JLH

Notes

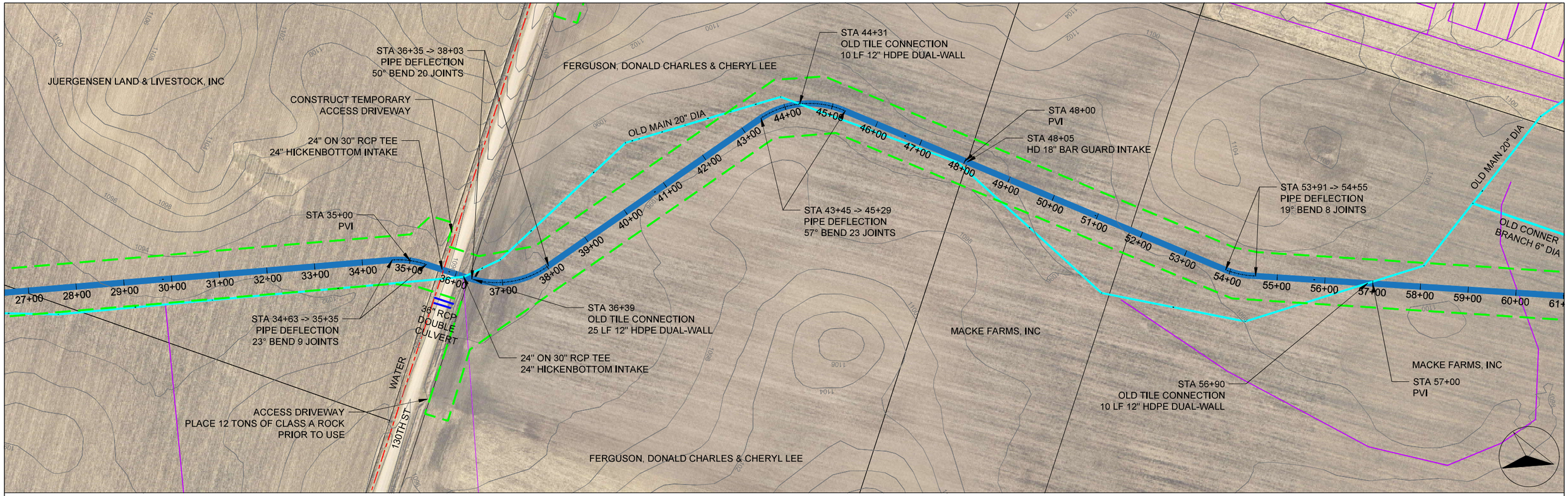
Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Limits (ROW)
- Fenceline
- 2' Contours

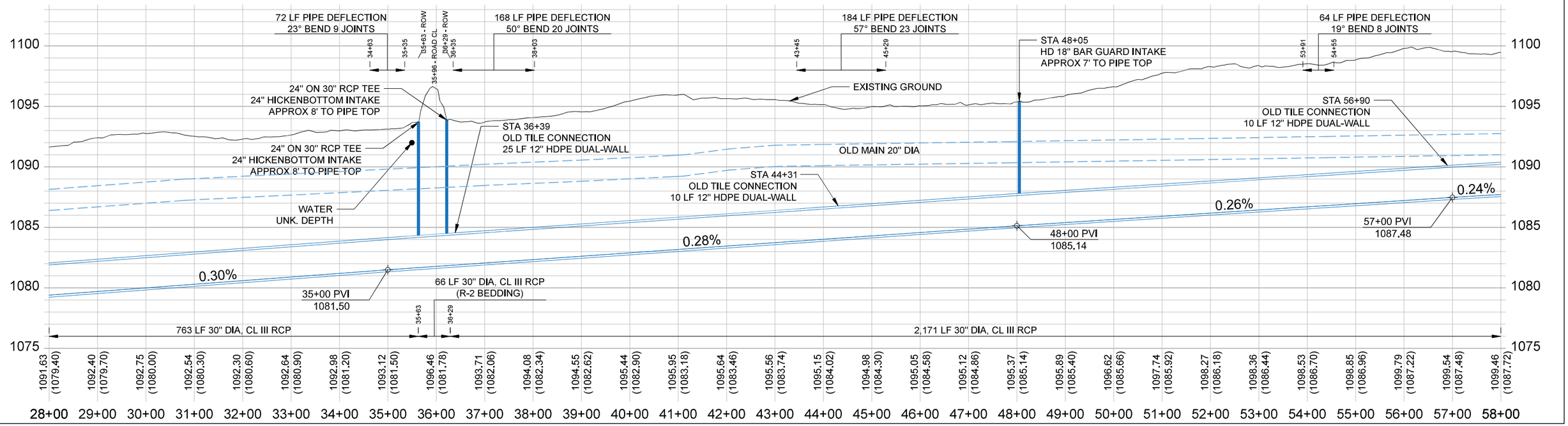
No.	Revision/Issue	Date

Sheet Name
Main Tile
Sta 0+00 -> 28+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'
Sheet M.01





AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

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

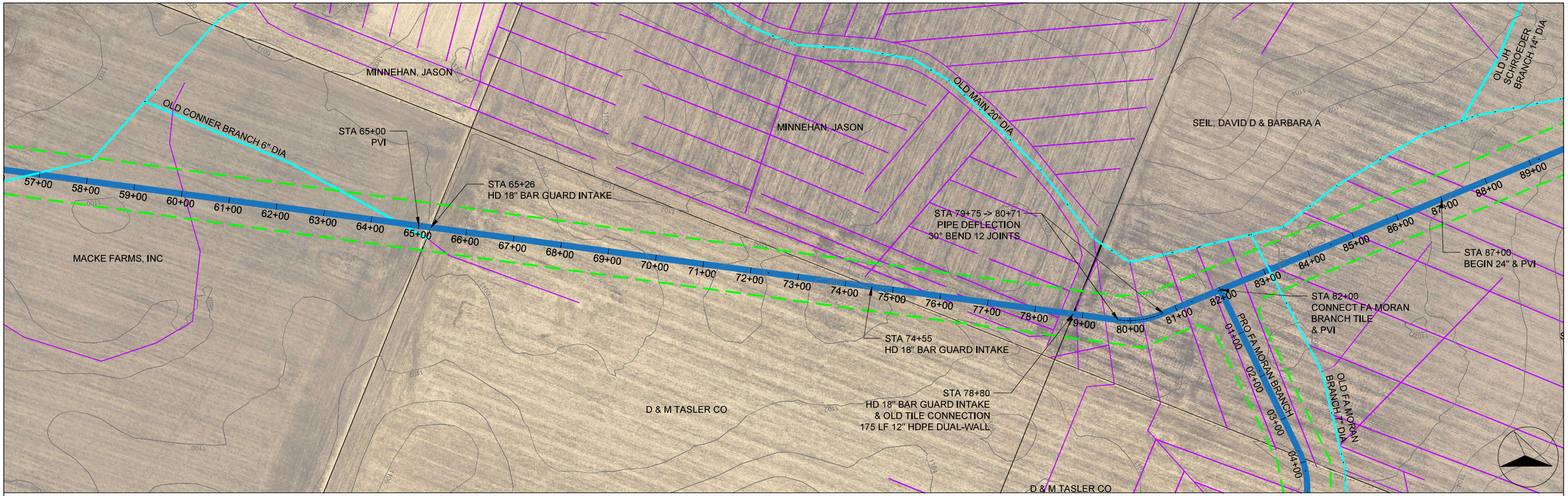
No.	Revision/Issue	Date

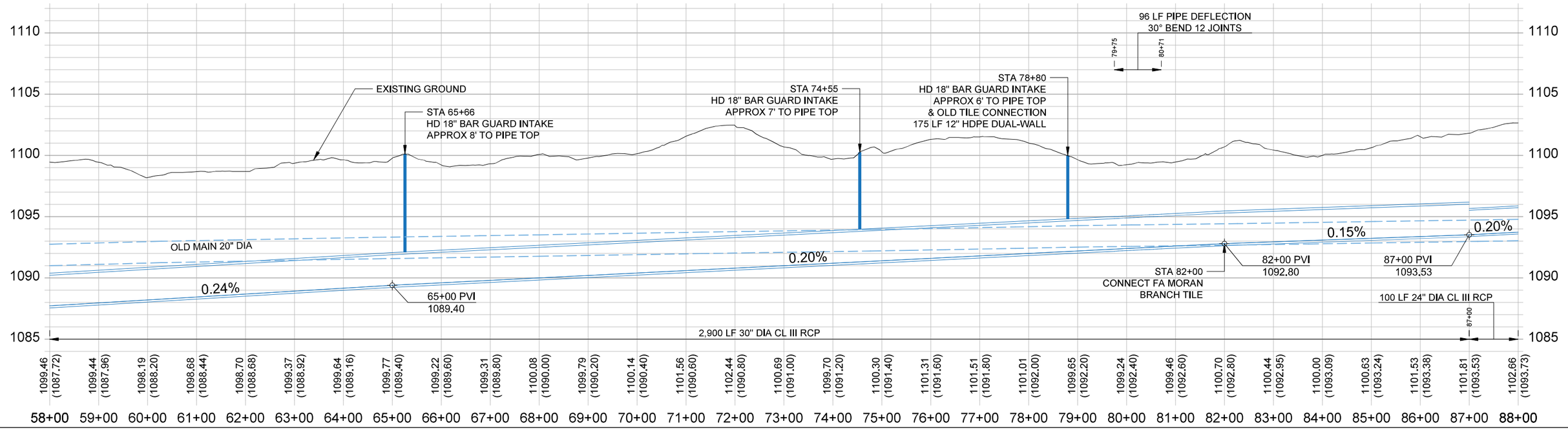
Sheet Name
Main Tile
Sta 28+00 -> 58+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'

Sheet M.02





AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

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

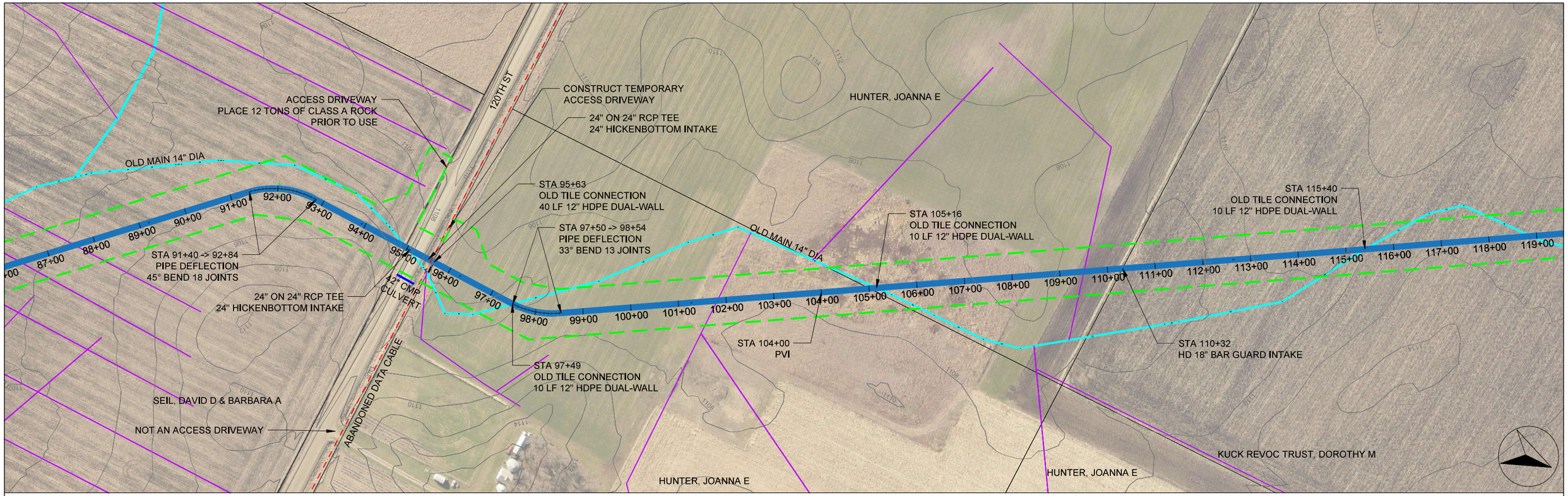
No.	Revision/Issue	Date

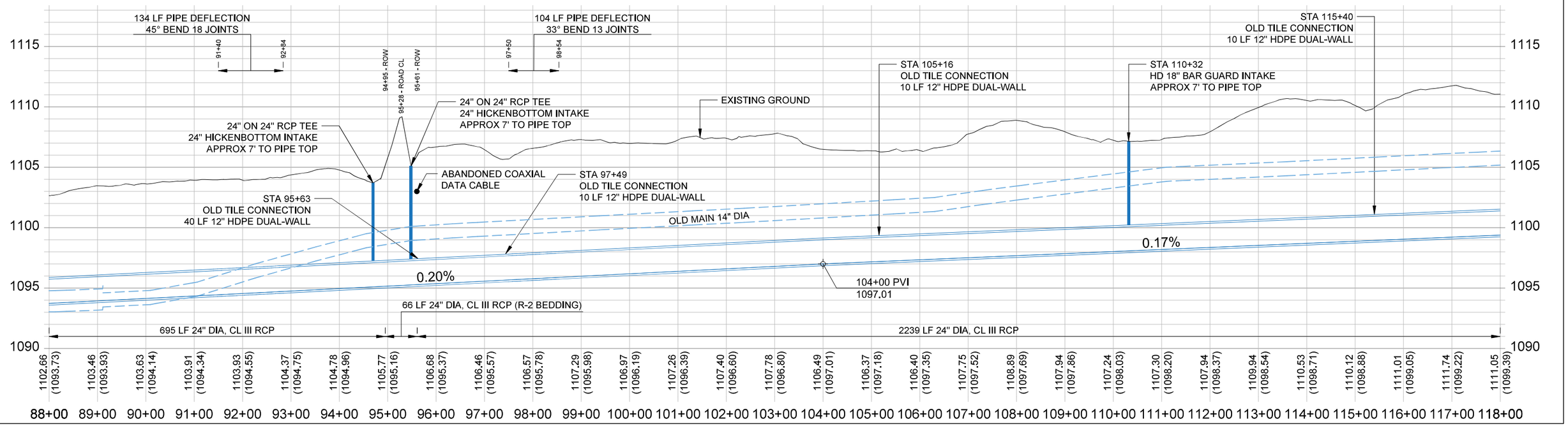
Sheet Name
Main Tile
Sta 58+00 -> 88+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'

Sheet M.03





AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

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

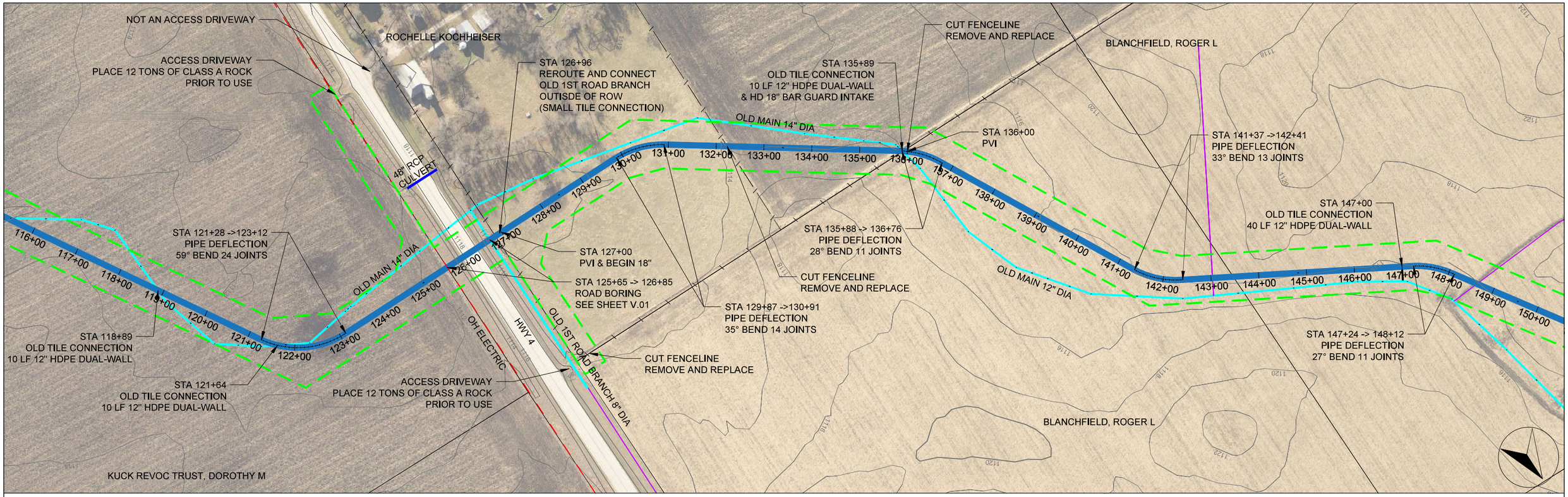
No.	Revision/Issue	Date

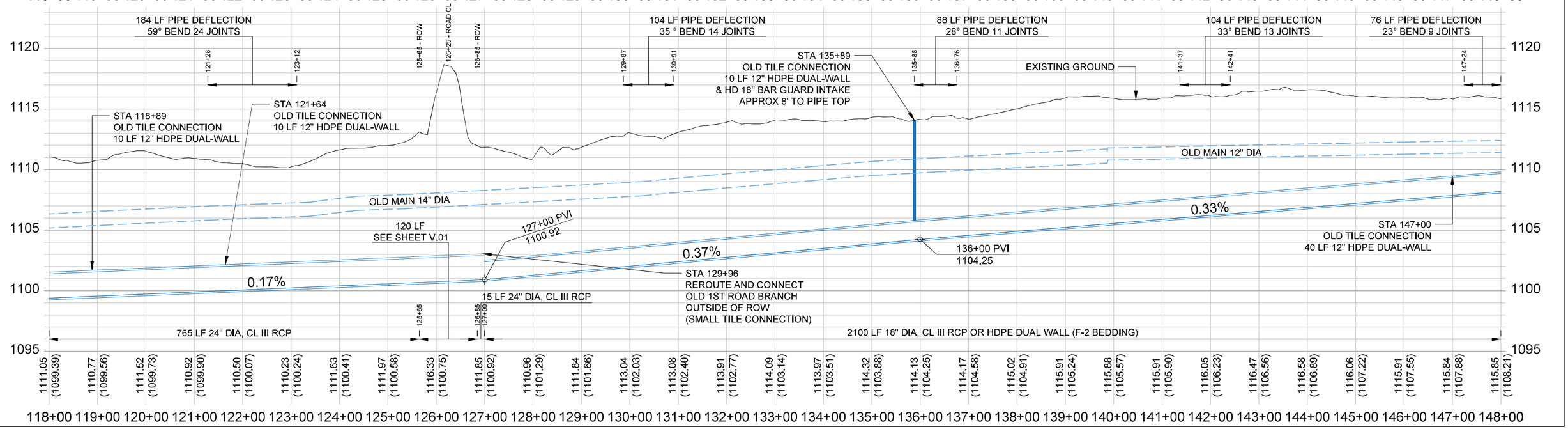
Sheet Name
Main Tile
Sta 88+00 -> 118+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'

Sheet M.04





Company Information	Designer
AgriVia PLLC PO Box 44 1124 Willis Ave Perry, IA 50220	TJB Drafter TJB Checker JLH

Notes

Plan Legend

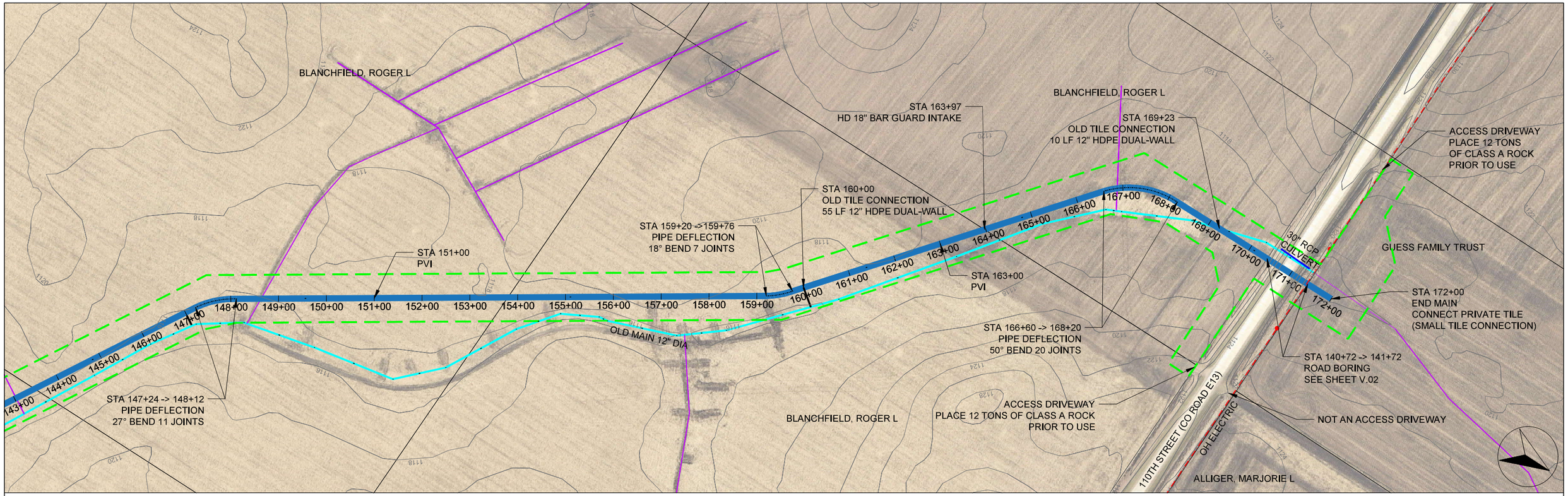
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Limits (ROW)
- Fenceline
- 2' Contours

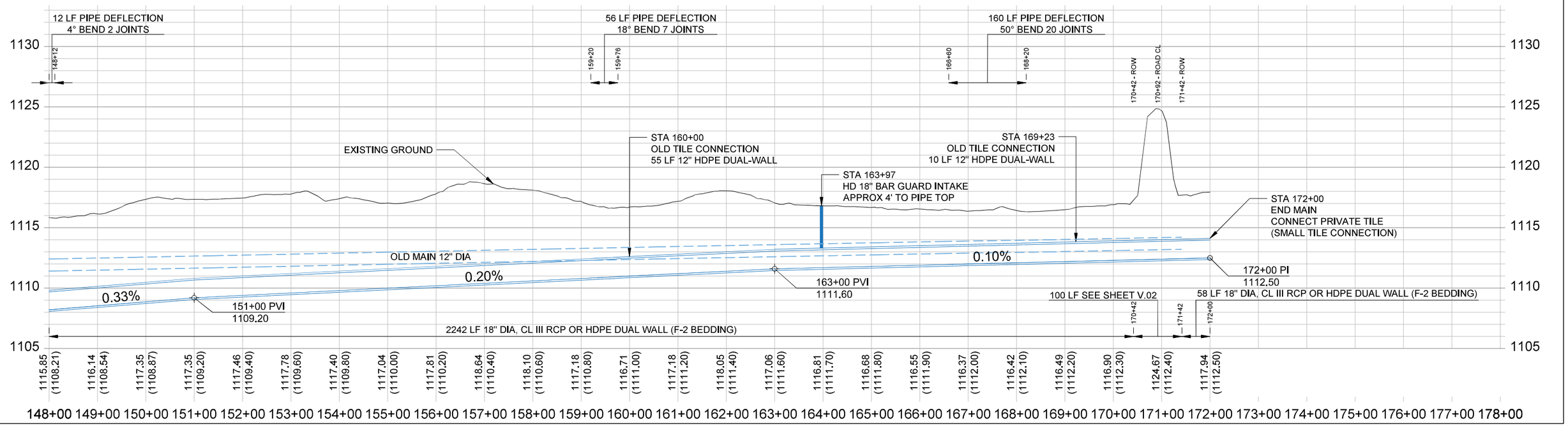
No.	Revision/Issue	Date

Sheet Name: Main Tile
Sta 118+00 -> 148+00

Project Name, Client, and Address:
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project: 2502-37
Date: 2025-09-17
Plan Scale: 1" = 200'
Sheet: M.05





AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

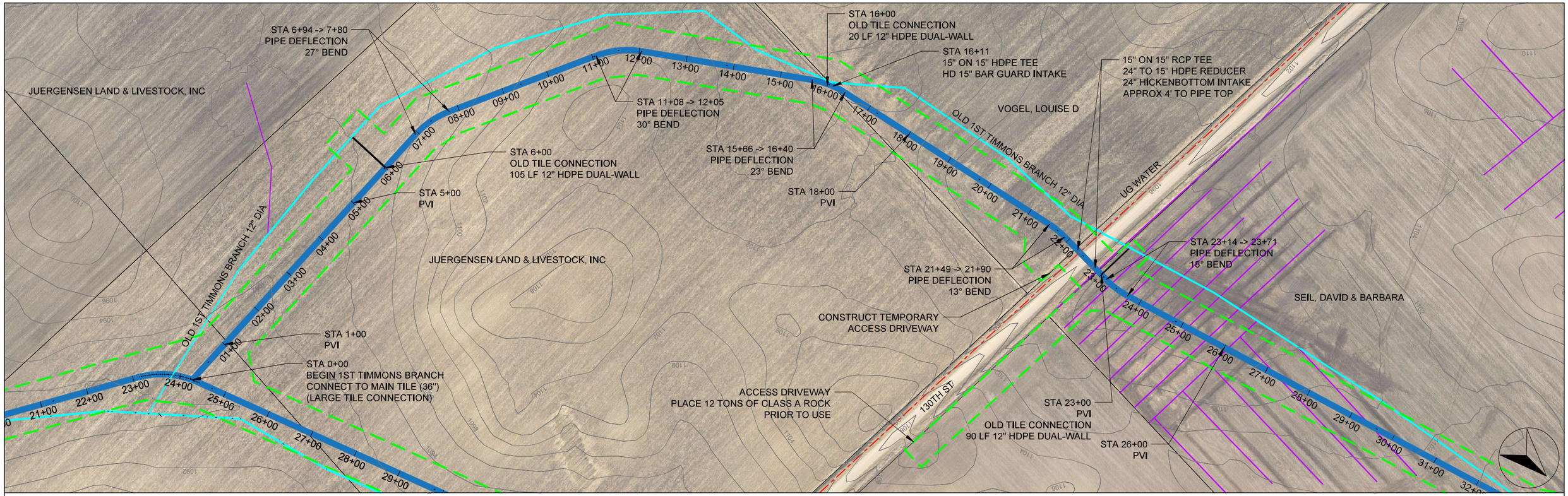
Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Limits (ROW)
- Fenceline
- 2' Contours

No.	Revision/Issue	Date

Sheet Name
Main Tile
Sta 148+00 -> 172+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'
Sheet M.06



AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

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

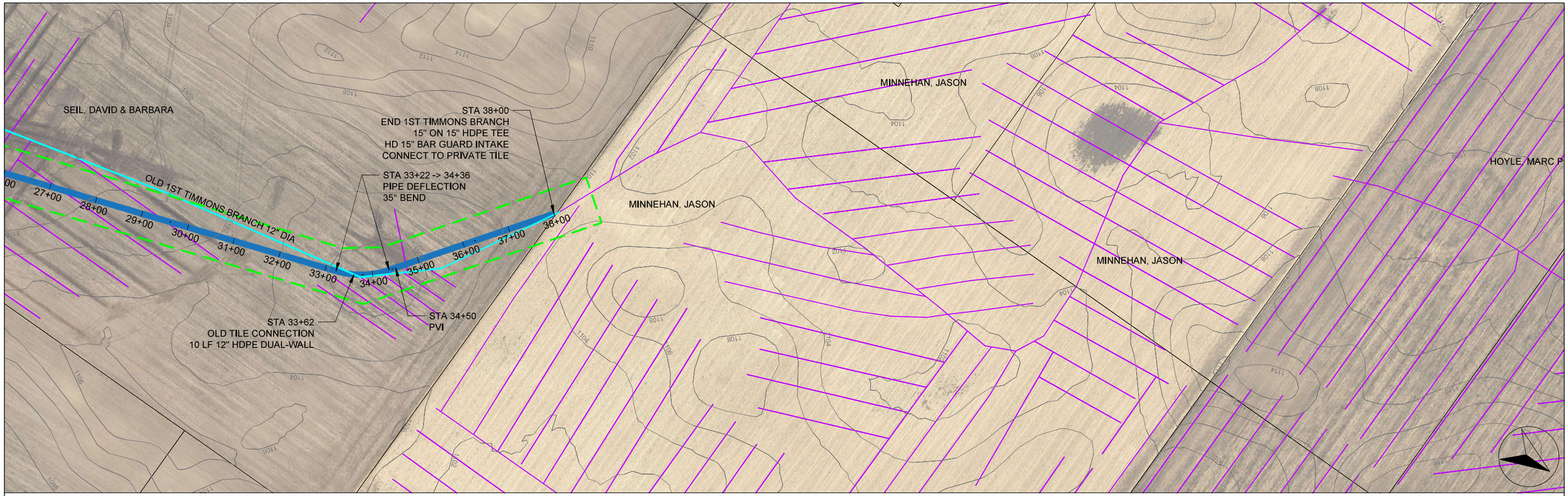
No.	Revision/Issue	Date

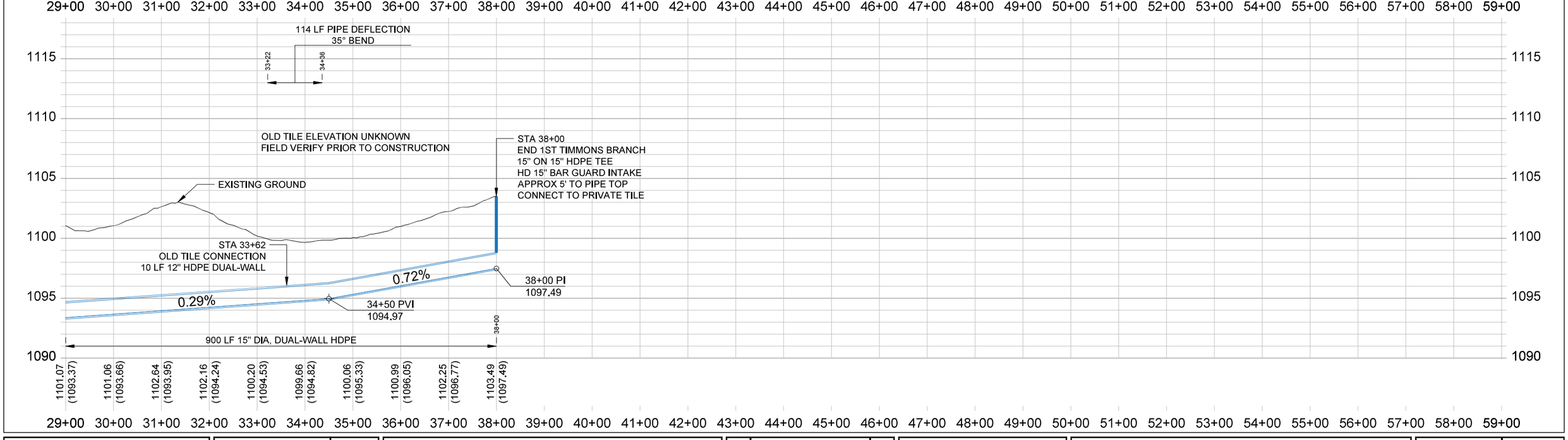
Sheet Name
1st Timmons
Branch Tile
Sta 0+00 -> 29+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'

Sheet M.07





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

Designer TJB
Drafter TJB
Checker JLH

Notes

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

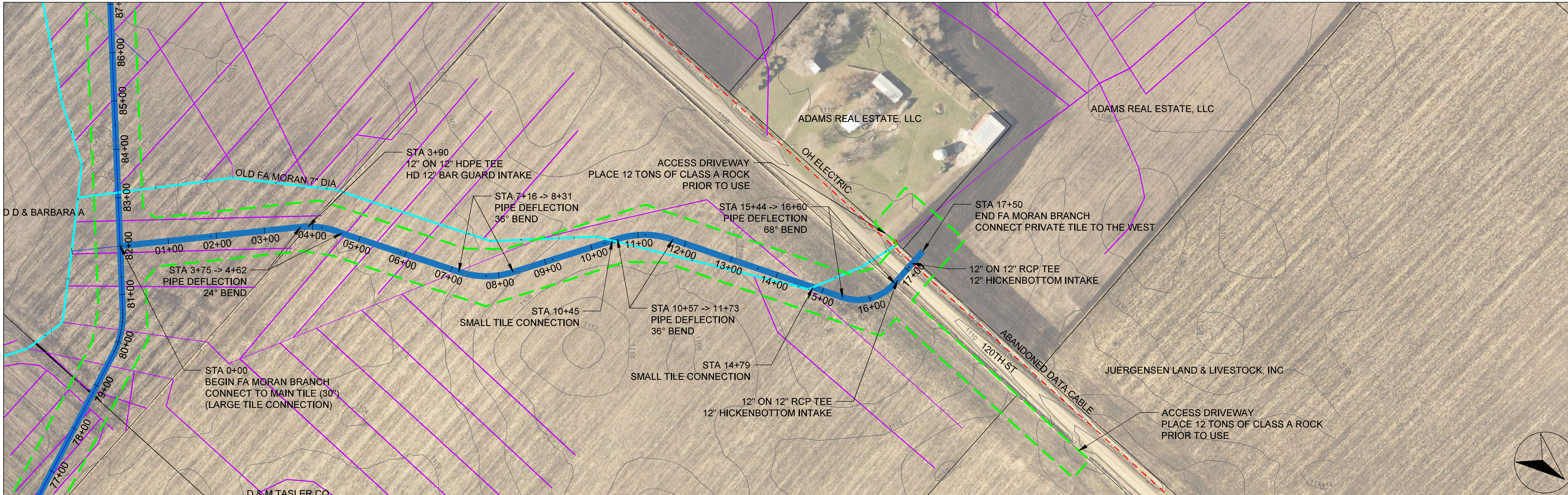
No.	Revision/Issue	Date

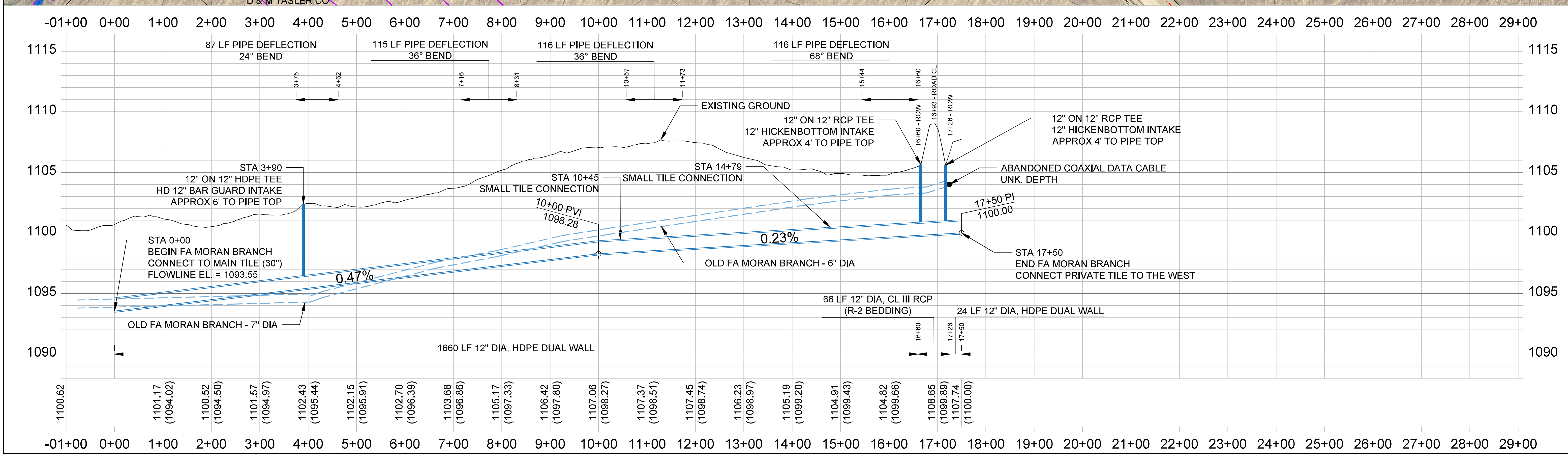
Sheet Name
1st Timmons
Branch Tile
Sta 29+00 -> 38+00

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 200'

Sheet M.08



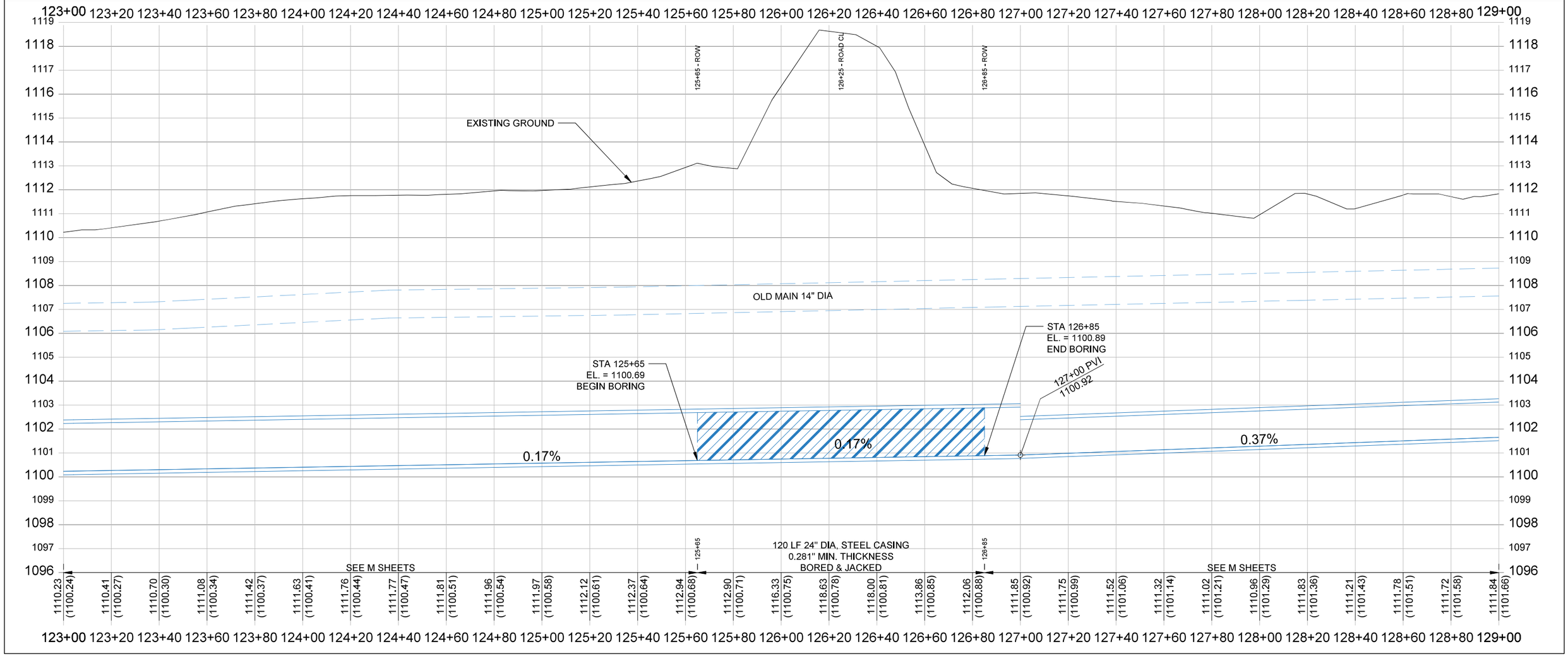


Company Information AgriVia PLLC PO Box 44 1124 Willis Ave Perry, IA 50220	Designer TJB Drafter TJB Checker JLH	Sheet Name FA Moran Branch Tile Sta 0+00 -> 17+50	Project Name, Client, and Address Tile Improvements Drainage District No. 20 Greene County, IA J Ave & 130th St, Churdan, IA 50050	Project 2502-37 Date 2025-09-17 Plan Scale 1" = 200'	Sheet M.09

Notes

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

No.	Revision/Issue	Date



AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

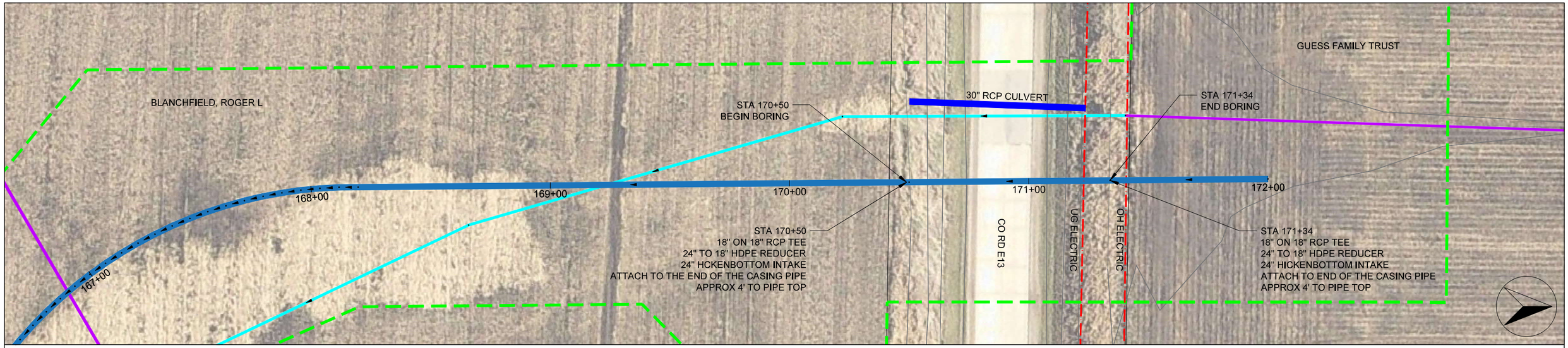
Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Limits
- Fenceline
- 2' Contours

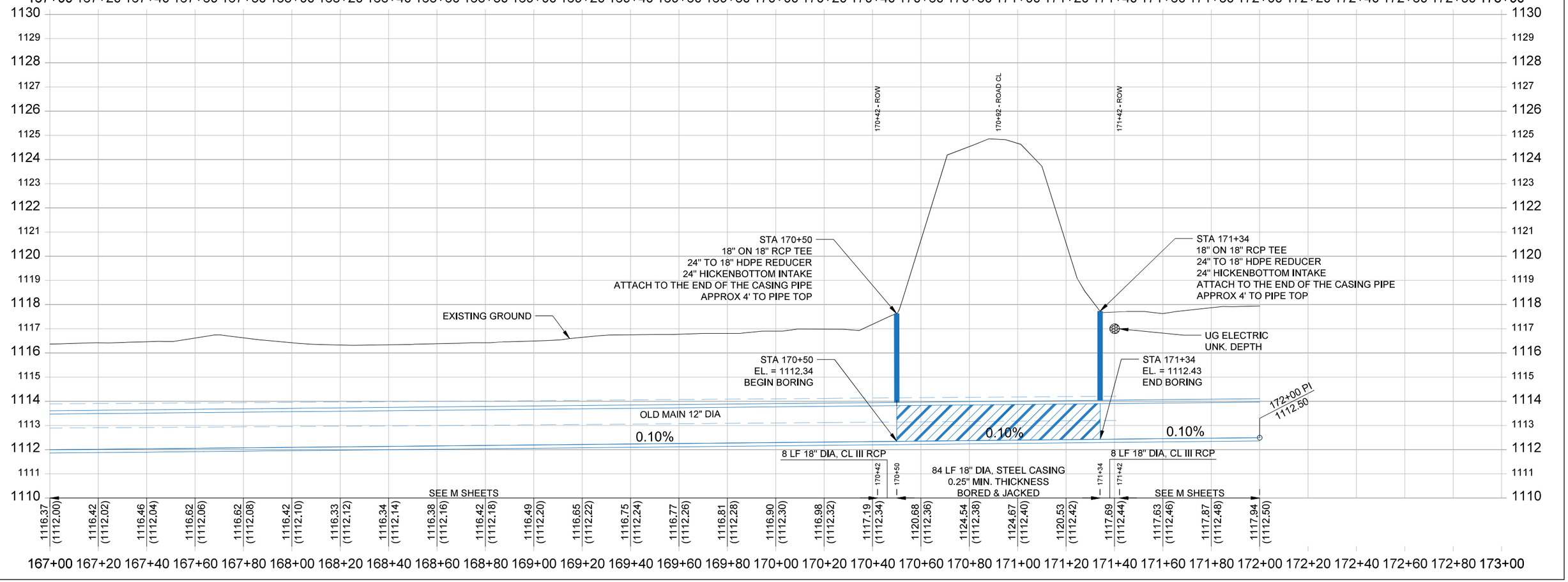
No.	Revision/Issue	Date

Sheet Name
Boring Sheet
(State Hwy 4)

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 40'
Sheet V.01





AgriVia

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

Designer TJB
Drafter TJB
Checker JLH

Notes

Plan Legend
- Proposed District Tile
- Old District Tile
- Private Tile
- Work Limits
- Fenceline
- 2' Contours

No.	Revision/Issue	Date

Sheet Name
Boring Sheet
(110th St / Co Rd E13)

Project Name, Client, and Address
Tile Improvements
Drainage District No. 20
Greene County, IA
J Ave & 130th St, Churdan, IA 50050

Project 2502-37
Date 2025-09-17
Plan Scale 1" = 40'

Sheet V.02