BOLTON & MENK

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Engineer's Report

Proposed Tile Improvements

Drainage District No. 46 Lateral No. 9

Worth County, Iowa 2020

Submitted by:
Bolton & Menk, Inc.
218 11th Street SW Plaza
Spencer, IA 51301
P: 712-580-5075
F: 515-233-4430

Certification

Engineer's Report

For

Proposed Tile Improvements

Drainage District No. 46 Lateral No. 9
Worth County, Iowa
A14.119355

2020

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

By: Jonathan P. Rosengren

Jonathan P. Rosengren, P.E.
License No. 21661

Date: April 17, 2020

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Appendix

I. Introduction

A. Scope of Work

On July 15th, 2019 a petition signed by a landowner in the district was filed with the Board of Supervisors requesting investigation of necessary improvements needed to bring drainage relief to lands of the petitioners. The Board appointed Bolton & Menk, Inc. to complete the necessary survey, study, plan and report. This report addresses the petitioners' request for improvement within Drainage District No. 46 Lateral No. 9. A copy of the petition is contained in Appendix A of this report.

B. Location

The watershed of Drainage District No. 46 Lateral No. 9 encompasses approximately 369 acres within Sections 17-20 of Hartland Township in Worth County. The tile outlets to the Drainage District No. 46 Main Open Ditch.

C. History

1920- Drainage District No. 46 established and constructed.

1980- Relief Tile proposed- no record of its construction could be found.

2015- An Engineer's Report and plans filed. The improvement project was completed in October of 2015 as a mutual drain agreement.

II. Investigation

Survey of the existing tile system was completed in fall of 2019. Studying the original plans and profiles, we have estimated the drainage coefficient (Dc) for the existing tile system. The drainage coefficient represents the depth of excess water removed from the surface of the watershed in a 24-hour period. The modern standard of ½" of water removed from the surface area of the watershed in 24 hours (½" Dc) has been in use since the mid-1950's.

The tile is restricted by the 14" tile draining at only 0.23 Dc, since this the outlet for the 10" and 8" tile upsteam, it effectively limits the Dc to 0.23 for the entire upper watershed of DD 46 Lat 9. The petitioners requested a 1" Dc to better drain the lands more quickly, using a 1" Dc, the existing system is only operating at approximately 25% of the requested capacity. The 2015 mutual drain was constructed at a minimum of a 2" Dc.

The coefficients and percent of modern capacity, as shown below, assume the tile is clean, straight and unrestricted. However, due to the age of this system, it is likely that the actual capacity of the existing system is roughly 80-90% of that shown on the table above. Paralleling the existing system is not recommended because the function of the system would rely upon a century old tile.

Existing DD 46 Lat 9 Tile Capacities			
Facility	**Size & Grade (Diameter @ %)**	**D_c* (Inches/Acre/Day)**	**% of ½" D_c (Modern Standard)**
2015 Mutual Drain Tile	36" @ 0.25%	2.00	400%
1920 District Tile	14" @ 0.10%	0.23	46%
1920 District Tile	10" @ 0.10%	0.49	98%
1920 District Tile	8" @ 0.10%	0.55	110%

A. Utilities

Overhead power lines and other utility lines will parallel or cross the tile at various locations; extra care will need to be taken when working under or near these utility lines. There are three liquid pipelines along the east side of the proposed tile, care will need to be taken to avoid these. The contractor will be responsible to determine and notify utility companies and to cooperate in locating, marking and protecting their facilities.

III. Farm Program Compliance

We assume any regulations concerning wetlands and CRP lands were addressed in 2015. If there are any farmed wetland issues which arise, please notifiy us and we can provide assistance in appealing and mitigation.

A. Farm Program Wetland Conservation Rules

The farm program wetland conservation rules are regulated by the USDA Farm Service Agency. The USDA Natural Resources Conservation Service provides technical assistance. This technical assistance includes policing for program violations and making certified wetland determinations. We have made requests of landowners receiving benefits from the proposed improvements to secure certified wetland determinations from the USDA/NRCS and to provide them to the district. Only landowners or their authorized agents may request the determinations. Some have not yet provided this information.

The USDA has recently adopted a few new interpretations of the farm program wetland conservation rules which are applicable here.

- For any improvements constructed by a drainage district, the NRCS will make a rebuttable assumption that every farmed wetland in the drainage district will be converted. (This assumption can be appealed by the impacted landowners, but not by the drainage district.)
- Mitigation of converted farmed wetland must compensate for all lost wetland functions and must also be made at a minimum acre for acre basis.
- A plan for the mitigation of all converted farmed wetland in the drainage district must be approved by the NRCS prior to the beginning of the construction of the improvements. After all opportunities for appeals are exhausted, the farmed wetland not covered by that mitigation plan would be found converted and the landowner and tenant would be in technical violation of the farm program. Penalties can be avoided when a drainage district causes the conversion, but only at the price of abandoning farming of the converted farmed wetlands or ceasing to participate in the farm program.
- The planned mitigation must be in place and functioning no later than the completion of the project which converts the farmed wetlands.

If a landowner does not request a certified wetland determination and he happens to end up with a converted farmed wetland, he will find himself in technical violation of the farm program rules and be subject to a USDA claim for the forfeiture and possibly refund of farm program payments when the work commences.

The Board of Supervisors may approve and authorize construction of the proposed improvements without accruing risk to the district from farm program wetland conservation rules violations. Obviously, the board will want to know the wetlands status of all landowners and to help to keep them all in farm program compliance, but the board cannot allow the failure of an individual landowner to share wetland information to influence the very important decisions it is charged to make for all of the benefitted landowners. However, by the rules, the program penalties will fall solely to the owners of the converted farmed wetlands for which compensatory mitigation is not secured. It is fully up to the landowner to cooperate with the district

toward keeping himself/herself in farm program compliance.

B. Converted Wetland Mitigation Alternatives

Since 1987, the USDA has assumed jurisdiction over the conversion (or improved drainage) of what has become commonly termed "farmed wetland". It being the rebuttable assumption of the current USDA policies that all farmed wetlands will be converted and that acre-for-acre mitigation will be necessary to put the converted farmed wetlands back into production, the decision process is made a little easier—although mitigation is much costlier.

Mitigation options include the purchase of wetland credits in a mitigation bank. Mitigation banks are not common and their credits are expensive. We understand that the Iowa Agriculture Mitigation Bank, Inc. has available credits for farmed wetlands in this area of the state. Another alternative is for the district to self-mitigate, wherein a mitigation plan to use a suitable site inside or outside the district on which to create wetlands for mitigation of impacted wetlands is developed for review and approval by the NRCS.

Farm program rules clearly provide that when a farmed wetland is converted by a drainage district the conversion act is attributed to the owner of the farmed wetland. However, the farm program rules also clearly provide that the owner of the converted farmed wetland may remain eligible for farm program benefits by opting to not farm the converted farmed wetland. If for some reason mitigation is delayed, this can be a temporary solution for the farmed wetland owners in a drainage district. It is also an option for those who choose not to report certified farmed wetland determinations and for which mitigation will not be provided.

C. Conservation Reserve Program Complications

We note that there may be areas of CRP along the proposed new drains alignments. There are some manageable drawbacks that must be addressed by the owners of affected CRP tracts.

The CRP includes an option to enroll farmed wetland and prior converted cropland where the underlying tile drains are disabled and a wetland cover is created. It has been our experience that if the disabled tile is not restored, the USDA may allow the land to stay in the CRP until the contract expires. However, only the landowner can seek and secure this waiver.

But, if a CRP site includes a certified farmed wetland and the USDA determines that it will be converted by the tile improvement project, the alternative of leaving the farmed wetland sit idle does not exist and mitigation will need to be secured immediately. The drainage district could make some reasonable accommodations, such as sealed pipe joints or an altered alignment, to help the owner, but it will be up to the owner to work with the USDA in securing immediate mitigation. Perhaps taking additional steps to make the CRP site wetter will be possible for the landowner.

D. CRP Damage Waivers

The destruction of CRP vegetation by construction activities places the landowner in technical violation of farm program conservation rules. The penalties can include loss of the CRP contract, forfeiture of back CRP payments and financial penalties. To avoid these penalties, landowners are advised to request a waiver from the USDA Farm Service Agency County Committee. The county committee will grant waivers for ditch or tile work if CRP vegetation restoration, in compliance with NRCS requirements, is timely done after the work is complete. If the project is authorized, all CRP owners in the path of construction must independently seek the FSA County Committee waivers. This process should be initiated immediately if the project is authorized.

E. Nesting Season Restrictions

The CRP rules also restrict disturbances during the primary nesting season, which covers the period of May 15 to August 1 in Worth County. Recent relaxations of this rule, although specific to drainage district maintenance of open ditches having CRP buffers, likely would now

favor allowing tile installation work without penalty on CRP during the primary nesting season. It makes no sense for a drainage district to wait for up to 3 months during ideal work weather. This is another situation where only the landowner can seek and secure the needed waiver.

IV. CLEAN WATER ACT COMPLIANCE

Dredging and filling of water of the United States (WOTUS) is regulated under Section 404 of the Clean Water Act. In the 1990's the USEPA & USACE adopted rules to extend Section 404 jurisdiction to isolated wetlands, including farmed wetlands. For a few years it became necessary to get CWA Section 404 permits for drainage district improvements where farmed wetland conversions were expected. Drainage districts were helped at the time with the issuance of a memorandum of understanding entered into by 4 regulatory agencies. This agreement gave the NRCS primacy in mapping and regulating wetlands on agricultural land. Great relief came in 2001 when the U.S. Supreme Court ruled that isolated wetlands were not subject to CWA Section 404 jurisdiction.

However, in 2012, the USEPA launched an aggressive rulemaking procedure to reestablish jurisdiction of isolated wetlands by revising the definition of "Waters of the United States" (WOTUS) to include isolated wetlands. This massive rule change became effective on August 28, 2015. However, a temporary stay was imposed by the Sixth Circuit Court of Appeals in October 2015 and that remains in effect for an unknown period.

The WOTUS rule: 1) expands CWA Section 404 jurisdiction to include all isolated farmed wetlands and even drained prairie potholes; 2) identifies more jurisdictional wetland than has the USDA has identified under the farm program; and 3) demands more stringent and costly mitigation for the conversion of farmed wetland. That is assuming drainage improvements will be allowed at all – a scary thought, but one that is applicable from a plain reading of the CWA Section 404(b)(1) guidelines.

Regardless of political leanings, the change of the administrations gives hope that the WOTUS rule will be abandoned. We are reasonably confident that there will be no CWA Section 404 jurisdictional wetlands found in the benefited area. But, this is a reminder that environmental regulations tend to get tougher over time and that consideration should be made in light when the opportunity for improvements are presented.

V. WATER QUALITY

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

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

We encourage the landowners of this District to consider multi-purpose drainage management, which incorporates Best Management Practices (BMPs) which utilize effective measures aimed at reducing sediment and nutrient loading, and improving water quality. These BMPs are divided into three (3) areas: preventative measures, control measures, and treatment measures.

Preventative measures that can be applied throughout the watershed including crop rotation, cover crops, residue management, and nutrient management. These measures are aimed at controlling sediment, minimizing erosion and nutrient loss, and sustaining the soils health, all without dramatically changing the current land use of the landscape.

Control measures are practices aimed at improving water quality directly associated with the flow of water by reducing peak flows, providing in stream storage, sedimentation, and nutrient uptake. Examples of control measures include alternative tile intakes, grassed waterways, two (2) stage ditches, water control structures, and controlled subsurface drainage. These practices are directly linked to the conveyance of subsurface tile water or open channel ditch flow.

The function of **treatment measures** is to improve water quality by directly removing sediment and nutrients from the subsurface or surface water flow throughout a watershed. Examples of treatment measures include surge basins (storage ponds), filter/buffer strips, wetland restorations, woodchip bioreactors, and water and sediment control basins (WASCOBs).

These practices may be incorporated to either the public or private drainage systems. Funding options are available to land owners through the Environmental Quality Incentives Program (EQIP) and the Iowa Water Quality Initiative. EQIP is a voluntary program that provides financial assistance to individual land owners for various conservative practices as identified above. Also, the State of Iowa through the Iowa Water Quality Initiative provides cost share funds to participating landowners to voluntarily install nutrient reduction practices.

A unique opportunity may exist when a wetland is created within the district for the treatment of the tile and/or surface waters of the watershed. A properly sized and created wetland may be able to be utilized as a mitigation site for any farmed wetlands that are found within the drainage district. With the possibility of a large share of the created wetland being funded by the Iowa Water Quality Initiative program, any potential farmed wetlands could be mitigated at a much-reduced cost.

If there is landowner interest in any of these water quality features and funding options, further study and review would be required to select, site and fund the water quality measures appropriate for the area.

VI. Proposed Work

A. Improvement- Recommended

The investigation has confirmed the need for drainage relief within the district. Modern farming practices rely upon well drained soils to achieve maximum productivity. This standard applies to land with surface relief and little ponding. We recommend replacement of the existing Drainage District No. 46 Lateral No. 9 tile with a system designed according to modern standards.

The standard design for drainage tile in northern Iowa is the ½" Dc. This standard is adequate for the majority of drainage districts in Worth County and is a cost-effective design to maximize the productivity of today's farming practices. The tile installed in 2015 was designed to a 2" Dc, and the petitioners have requested we design this improvement to a minimum 1" Dc.

The proposed tile will generally follow the route of the existing tile in the valleys of the district. The proposed tile route is described below.

- The proposed 24" tile will connect to the existing 36" tile and head southeast to cross county road S28. From there, it will turn back northeast for 250' before turning back southeast. At station 78+00, the tile will downsize to 12" and will head north for about 1,700' and ending north of Marks Hill Road.

The total estimated cost of the proposed project is $222,000. A detailed opinion of probable cost for the recommended work is included in Appendix B of this report.

The proposed tile will cross existing tile at several locations. Where an existing tile is crossed, the upstream end will be connected to the proposed main and the downstream end will be capped to allow the tile to continue functioning to bring smaller private tile to the new main.

It is recommended that this new tile be constructed using tongue and groove reinforced concrete pipe (RCP). RCP is recommended over dual wall HDPE pipe for several reasons including, less demanding installation requirements, assured smooth walls, and proven longevity of the material.

To comply with the manufacturers recommended installation methods, the dual wall HDPE pipe would need to be completely encased in crushed rock. The inclusion of this bedding envelope raises the cost of the dual wall HDPE installation above the typical installation cost of RCP. RCP also does not deform under the weight of the soil. In cases where dual wall HDPE has been used, such deformation stresses the liner, causing rippling and detachment. Finally, the existing rigid wall tile mains found throughout north central Iowa were constructed of clay or concrete and these materials have shown their durability over the past 100 years. We expect a much longer service life from today's RCP products.

1. Work Area

   The district will need an area to install the tile. The extent of the work limits on the tile will be finalized when the final construction plans are developed, but it will typically be out to 50 feet from the tile centerline. Landowners will also be entitled to compensation for damages in the work area. It is recommended that in cropped areas whenever possible, a landowner not crop the work area and instead accept fair rent for the land. Compensation for use of and damages within the temporary work area is normally determined at the project completion hearing.

2. Road Crossing

   One paved county secondary road crossings and one gravel county secondary road crossing is required as part of the recommended improvement. It is assumed that the paved crossing will be bored and the gravel crossing will be open cut. The table below summarizes the road crossing which is part of the proposed tile improvement.

Tile Road Crossings				
Road	**Control Agency**	**Type**	**Station**	**Diameter**
S28	Worth County	Bored	66+22	24"
A15	Worth County	Open Cut	16+08	12"

   Iowa Code Section 468 requires that all costs of primary and secondary road crossings are to be paid from funds available to the entity that controls the road. The total estimated cost to the Worth County Secondary Roads is $48,000.

VII. Assessment Schedule Review

A. Benefited Lands Not Now Assessed

There are approximately 445 acres within the Drainage District No. 46 Lateral No. 9 existing assessment schedule. We are not recommending annexation to the Lateral No. 9 assessment area at this time. The watershed is shown on Benefitted Lands Map in Appendix B of this report.

B. Existing Assessment Schedule Review

Appendix B contains a map showing the existing benefited units assessed per acre and classification for each parcel in the currently assessed area of DD 46 Lat 9.

Since this project is an extension of an existing tile and only serving the upper lands of the district watershed, a one-time assessment schedule could be created for this project. This schedule will include the 189 acres draining directly to the proposed tile. All lands downstream of the proposed tile will not be included and will not be assessed for this improvement.

After this project, the entirety of Lateral No. 9 would be assessable upon a single maintenance schedule.

Before a decision is made, an estimate for the cost of a proposed project for each benefitted parcel can be made available. The Board may direct the engineer to develop a pre-classification similar to what the benefit commission would consider at the end of the project. A pre-classification of this type could be developed for approximately $5,000. Please be reminded that a pre-classification is an estimate only. The final approved distribution would still be subject to review by the commission appointed by the Board, and the final changes be made by the Board at the reclassification hearing at the end of the project.

C. General Classification Methodology

The process of reclassification uses several factors to equitably spread project costs based upon benefits received. The three common factors are: Use; Proximity; and Wetness.

The Use Factor considers how much of the facility is required to bring an outlet to a particular location. The more a facility is used by any given property, the higher the Use Factor on that property. A parcel using one mile of a facility should pay less than a parcel using 5 miles of the facility.

The Proximity Factor considers the portion of the outlet provided. Lands nearer to the facility receive a higher assessment because they have easy access to district facilities. Lands farther from the facility must invest in additional private drainage to access the facility. A 40 acre tract which is crossed by a facility should pay more than a 40-acre tract a mile away which must build a private system to reach thedisitrct facility.

The Wetness Factor accounts for the soil types' varying natural wetness and need for drainage. Wet soils in a pothole are high because the soils have more need for drainage than drier soils on the hill tops.

Other considerations may be necessary to achieve equitable assessments.

VIII. Discussions & Recommendations

This report confirms the need to improve the drainage efficiency and capacity of the Drainage District No. 46 Lateral No. 9 drainage system. The work described herein can accomplish that improvement.

Improvement Recommended. The improvements proposed will provide the drainage capacity needed for modern farming practices. The estimated assessable cost of the requested 1" Dc improvement is $222,000. We find that the proposed improvements will be practicable, feasible, and beneficial to the public.

Reclassification Recommended. The existing assessment schedule is inequitable and should be reclassified. Reclassification is expected to cost approximately $10 per acre for each schedule developed.

Installment Payments. Iowa drainage district law provides that large repair assessments may be paid in not less than ten nor more than twenty annual installments at the discretion of the Board of Supervisors. Typically, the board would spread assessments of the magnitude contemplated in this report over twenty years. If we assume that the board will allow twenty annual installments at 5% interest, improvement costs for lands now in the district would be about $38 per acre per year for the DD 46 Lat 9 watershed. If a one-time assessment schedule is used for only the upper lands benefiting from the proposed tile the assessment per acre for those acres would increase to $90 per acre per year. Be reminded that assessments are based upon benefits and that some parcels will likely bear two to three times the average assessments.

Tiling is a long term investment; the upfront costs are high, but the cost of operation tends to be low during its useful life. Included in Appendix C is a financial analysis of the probable costs and the likely payback period for different assessment thresholds at different yield increases resulting from this project. The financial analysis uses current commodity prices and average yields from the Agricultural Decision Maker website. Varying yield increases have been used to estimate pay back periods for a range of possible assessments. Iowa State University and University of Minnesota research indicates a likely average yield increase between 10% and 25% for an improvement of this type.

Assuming corn averages $3.30/bushel over the next 20 years and using only the increase in revenue from an assumed 10% yield increase, an average assessment for the recommended 1" Dc could be repaid in approximately 19 years. These improvements would likely continue to function well for another century bringing continued benefit to future generations and owners.

It is recommended that the Board of Supervisors of Worth County, acting as trustees for Drainage District No. 46 Lateral No. 9 take appropriate action, with legal guidance, to accomplish the following:

- Tentatively approve this engineer's report.
- Conduct a public hearing on the proposed improvements.
- Adopt the proposed improvement plan, modified as deemed appropriate to satisfy the needs of the district.
- Direct the engineer to prepare the necessary plans and specifications and to proceed toward a bid letting.
- Initiate reclassification procedures.

Respectfully submitted,

Bolton & Menk, Inc.

Jonathan P Rosengren, P.E

Appendix A: Petition

PETITION FOR REPAIRS

To The Board of Supervisors,

Worth County, Iowa

I wish to call your attention to the necessity for repairs to:

Drainage District No. 46, Lateral No. L-9, which is located in

Section 18 & 19, Hartland Township, and ask that the said matter

be investigated and repairs made as soon as possible.

Thank you.

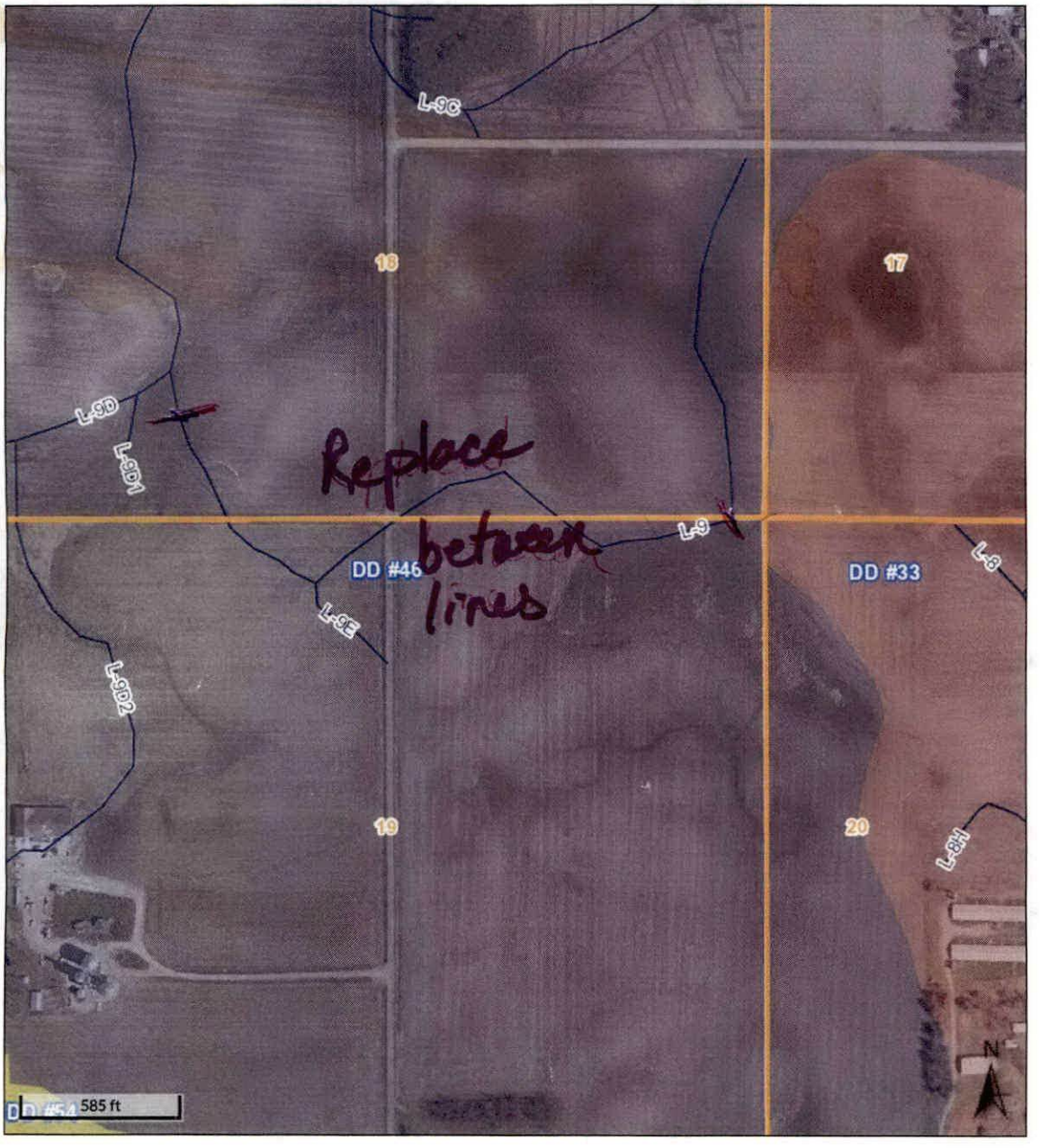
Name: Kris Ryland Date: 7-15-19

Phone Number: 641-390-0220

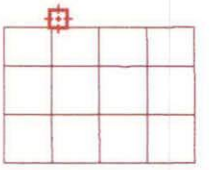
Other information/comments:

Main is in disrepair. Needs to be replaced. Should be replaced with larger main. 30"-36".

Beacon™ Worth County, IA



Overview



Legend

- Sections
- Drainage District Tiles

Drainage Districts

- <all other values>
- DD #10
- DD #11
- DD #12
- DD #13
- DD #14
- DD #15
- DD #16
- DD #18
- DD #19
- DD #2
- DD #21
- DD #23
- DD #24
- DD #25
- DD #26
- DD #27
- DD #28
- DD #29
- DD #30
- DD #32
- DD #33
- DD #34
- DD #37
- DD #38
- DD #39
- DD #4
- DD #40
- DD #41
- DD #44
- DD #45
- DD #46
- DD #48
- DD #49

Appendix B: Existing Assessment Schedule Review

Drainage District No. 46 Lateral No. 9

Worth County, IA

Existing Assessment Schedule Review

April, 2020

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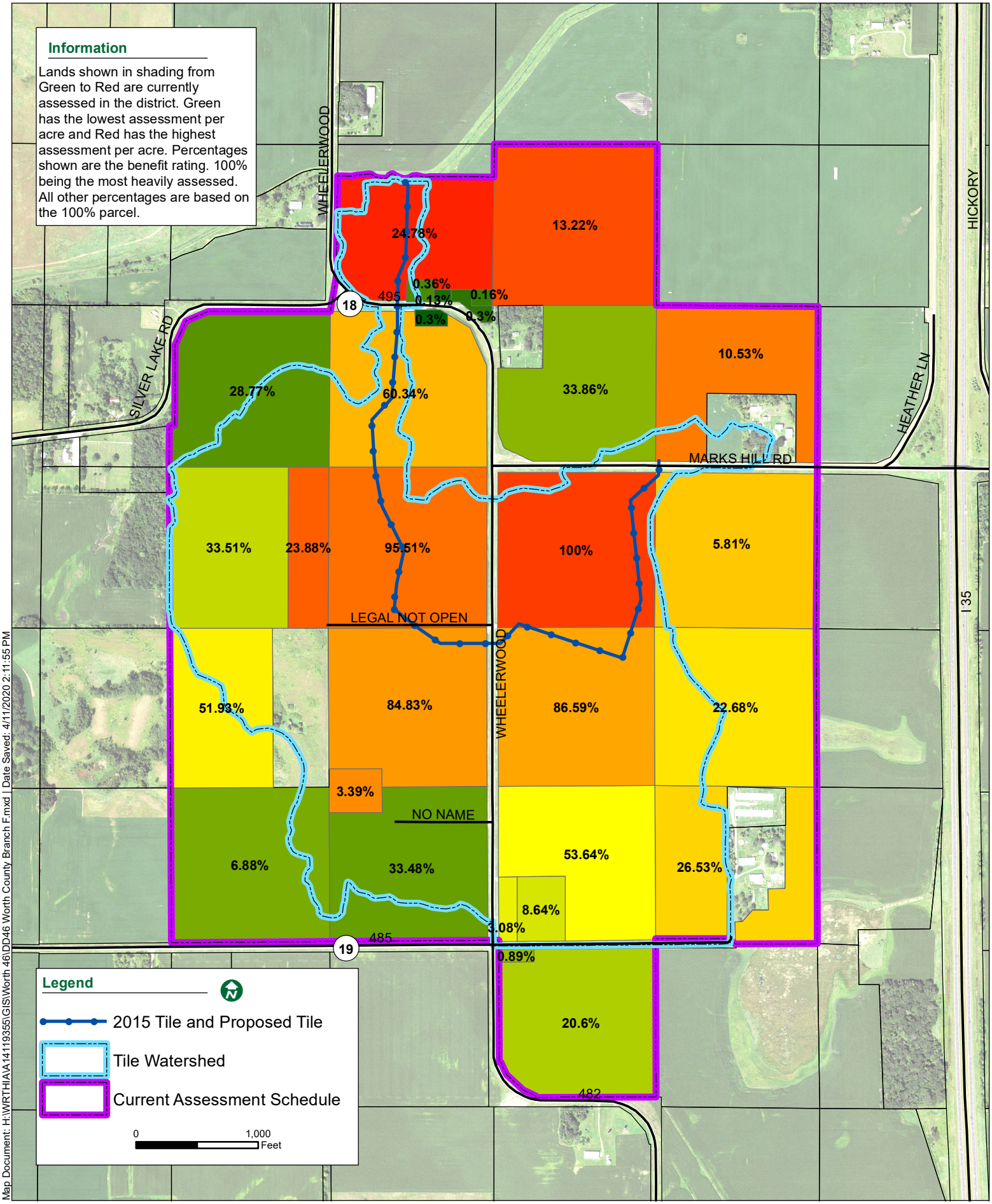

Map Document: H:\WRTH\A\A14119355\GIS\Worth 46\DD46 Worth County Branch F.mxd | Date Saved: 4/11/2020 2:11:55 PM

Appendix C: Engineer's Opinion of Probable Cost

Drainage District 46 Lateral 9

Proposed Tile Improvements
Worth County, Iowa
OPINION OF PROBABLE COSTS

Friday, April 17, 2020

BOLTON & MENK

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Construction Division 1--Private Lands

Item	Description	Unit	Quantity	Unit Price	Total
100	CL II R.C.P., 24'' Dia.	LF	774	$44	$34,056
101	CL III R.C.P., 24'' Dia.	LF	635	$44	$27,940
102	CL II R.C.P., 12'' Dia.	LF	1,579	$29	$45,791
103	24'' Dia., R.C.P. Elbow Section, Fabrication Only	EA	8	$500	$4,000
104	12'' Dia., R.C.P. Elbow Section, Fabrication Only	EA	3	$350	$1,050
105	36'' Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	$1,500	$1,500
106	24'' Dia., R.C.P. Tee Section, Fabrication Only	EA	1	$600	$600
107	Lateral Tile Connections, 10" Dia. or Smaller	EA	13	$300	$3,900
108	Lateral Tile Connections, 12" Dia. or Larger	EA	2	$400	$800
109	Tile Trench Stabilization and Cradling Rock	TN	92	$40	$3,680
110	Administration of Erosion Management Plan	LS			$1,000
111	Seeding of Temporary Stabilization	AC	10	$500	$5,000
112	Silt Fence Install and Review	LF	460	$3	$1,150
113	Spot Tile Exploration	HR	8	$200	$1,600
114	Fence Cuts	EA	4	$100	$400
115	Mobilization	LS			$14,500
				Estimated Division 1 Subtotal	**$147,000**

Construction Division 2--County Secondary Roads

Item	Description	Unit	Quantity	Unit Price	Total
200	CL III R.C.P., 24'' Dia.	LF	15	$44	$660
201	Steel Casing, 0.312'' Wall, Jacked and Bored, 24'' Diameter	LF	76	$500	$38,000
202	CL II R.C.P., 12'' Dia.	LF	90	$29	$2,610
203	Tile Trench Stabilization and Cradling Rock	TN	50	$40	$2,000
204	Seeding and Fertilizing (Rural)	LS			$500
205	Traffic Control	LS			$1,000
206	Silt Fence-Install and Remove	LF	100	$6	$600
207	Mobilization	LS			$2,500
				Estimated Division 2 Subtotal	**$48,000**
				Construction Contingency	**$9,800**
				Total Estimated Construction Cost	**$204,800**
				Total Estimated Assessable Construction Cost	**$156,800**

Drainage District 46 Lateral 9

Proposed Tile Improvements
Worth County, Iowa
OPINION OF PROBABLE COSTS

Friday, April 17, 2020

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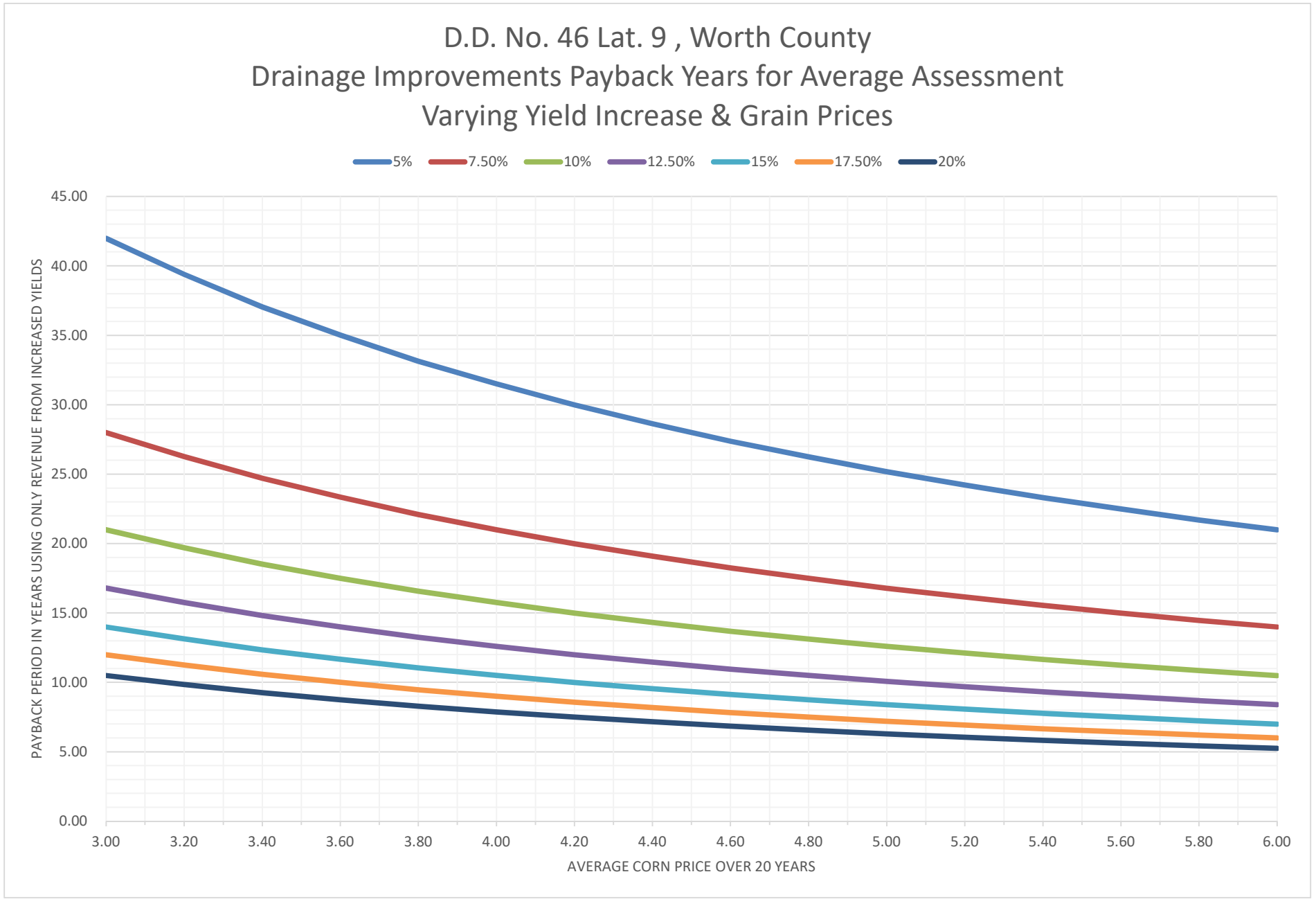
Construction Related Damages	
Other Damages	$5,000
Basic Engineering Services	
Survey, Study & Report. Meetings & Hearing	$20,000
Wetland & Other Regulations Administration	$1,000
Construction Plans, Specifications, & Bid Letting	$5,000
Construction Engineering Services	$20,000
Legal Services, Publications, Mailings, Etc..	$4,000
Finance, Interest & Contingency	$10,600
Associated Assessable Project Costs of District	**$65,600**
Total Estimated Assessable Project Cost	**$222,000**
Estimated Average Cost Per Currently Assessed Acre (445 ac)	$499
Estimated Average Cost Per Acre Per Year (10 years)	$64
Estimated Average Cost Per Acre Per Year (20 years)	$38
Estimated Average Cost Per Benefited Acre (New Drains System Only) (189 ac)	$1,175
Estimated Average Cost Per Acre Per Year (10 years)	$150
Estimated Average Cost Per Acre Per Year (20 years)	$90

Appendix C - Payback Analysis of Drainage District System Replacement Costs



Assumed Rotation CCB: Soybean Price: 260% of Corn.

Appendix C

This worksheet is based upon one prepared by Dr. Stewart Melvin, ISU Extension Agricultural Engineer, Retired

Appendix C - Payback Analysis of Drainage District System Replacement Costs

Drainage District: DD 46 Lat 9

ACRES IN DD	Enter>	189	ac
% Corn Acreage	Enter>	63	%
% Soybeans Acreage	Enter>	33	%
% Other (Roads, Etc)		4	%
Base Corn Yield	Enter>	183	bu/a
Base Soybeans Yield	Enter>	51	bu/a

Average Yield Improvement Due to Better Drainage Outlet, %	2.5	5	7.5	10	12.5	15	17.5	20
Total Increase in Yield, Corn (bu)	545	1,089	1,634	2,179	2,724	3,268	3,813	4,358
Total Increase in Yield, Soybeans (bu)	80	159	239	318	398	477	557	636

Enter Estimated Average Annual Yield Increase Over the Next 20 Years, % (See Footnote)	1.5%
Avg Price of Corn Next 20 Years	$ 3.87
Avg Price of Soybeans Next 20 Years	$ 10.13

<< The historic annual yield increase for corn in Iowa has been 2.1% since the 1930's, using less is a conservative assumption

Annual Increase in Revenue	2.5	5	7.5	10	12.5	15	17.5	20
From Corn	$ 2,108	$ 4,216	$ 6,324	$ 8,433	$ 10,541	$ 12,649	$ 14,757	$ 16,865
From Soybean	$ 806	$ 1,611	$ 2,417	$ 3,222	$ 4,028	$ 4,833	$ 5,639	$ 6,444
Total	$ 2,914	$ 5,827	$ 8,741	$11,655	$ 14,569	$ 17,482	$ 20,396	$ 23,310
Increased Revenue/acre	$ 15	$ 31	$ 46	$ 62	$ 77	$ 92	$ 108	$ 123
Increased Revenue/acre over the anticipated life of the facility (100 years)	$ 1,542	$ 3,083	$ 4,625	$ 6,167	$ 7,708	$ 9,250	$ 10,792	$ 12,333

Payback Period For Revenues From Only Yield Increase (Years)			2.5	5	7.5	10	12.5	15	17.5	20
Very High Assessment										
$2,938	per ac	250% of Avg	190.5	95.3	63.5	47.6	38.1	31.8	27.2	23.8
High Assessment										
$2,350	per ac	200% of Avg	152.4	76.2	50.8	38.1	30.5	25.4	21.8	19.1
Above Average Assessment										
$1,763	per ac	150% of Avg	114.3	57.2	38.1	28.6	22.9	19.1	16.3	14.3
Average Assessment										
$1,175	per ac	100% of Avg	76.2	38.1	25.4	19.1	15.2	12.7	10.9	9.5
Low Assessment										
$588	per ac	50% of Avg	38.1	19.1	12.7	9.5	7.6	6.4	5.4	4.8
Very Low Assessment										
$294	per ac	25% of Avg	19.1	9.5	6.4	4.8	3.8	3.2	2.7	2.4
			2.5	5	7.5	10	12.5	15	17.5	20
			Average Yield Improvement Due to Better Drainage Outlet, %							

Appendix C

This worksheet is based upon one prepared by Dr. Stewart Melvin, ISU Extension Agricultural Engineer, Retired

Appendix C - Payback Analysis of Drainage District System Replacement Costs

Drainage District Law Allows For Payment of Assessments in 20 Annual Installments

Assuming a 1.5% annual yield improvement over 20 years for corn currently priced at $3.3 and soybeans at $8.63

A **very high** cost assessment (250% of average) would be be paid off in	31.8	years on a 15% average yield increase.
A **high cost** assessment (200% of average) would be paid off in	30.5	years on a 12.5% average yield increase.
An **above avg** cost assessment (150% of average) would be paid off in	28.6	years on a 10% average yield increase.
An **average** cost assessment (100% of average) would be paid off in	25.4	years on a 7.5% average yield increase.
A **low** cost assessment (50% of average) would be paid off in	19.1	years on a 5% average yield increase.
A **very low** cost assessment (25% of average) would be paid off in	19.1	years on a 2.5% average yield increase.

Future Prices to Reflect Annual Yield Change Trend

Corn Today	$3.30	Date
Beans Today	$8.63	4/13/2020

Average Annual Yield Change	Price Adj. for Yield Change CORN 20-Year Avg. Price	SOYBEANS 20-Year Avg Price
0.0%	$3.30	$8.63
0.5%	$3.47	$9.08
1.0%	$3.66	$9.58
1.5%	$3.87	$10.13
2.0%	$4.10	$10.73
2.5%	$4.35	$11.39
3.0%	$4.63	$12.11
3.5%	$4.93	$12.90

Yield Improvements on 40 acres if Drowned Areas

Percent Increase over Current Conditions

Drowned Area ac	Percent of Average Yield Achieved by Improvements 50%	60%	70%	80%	90%	100%
1	1.3%	1.5%	1.8%	2.1%	2.3%	2.6%
2.5	3.3%	4.0%	4.7%	5.3%	6.0%	6.7%
5	7.1%	8.6%	10.0%	11.4%	12.9%	14.3%
7.5	11.5%	13.8%	16.2%	18.5%	20.8%	23.1%
10	16.7%	20.0%	23.3%	26.7%	30.0%	33.3%
15	30.0%	36.0%	42.0%	48.0%	54.0%	60.0%

Assumes Avg. Co. Yield on Non-Drowned Area

Existing Farm Yield vs. Potential Farm Yield

Average Field Yield with Improvement bu/ac	Current Average Corn Yield over Entire Field bu/ac 90	110	130	150	170	190
90	0.0%					
100	11.1%					
110	22.2%	0.0%				
120	33.3%	9.1%				
130	44.4%	18.2%	0.0%			
140	55.6%	27.3%	7.7%			
150	66.7%	36.4%	15.4%	0.0%		
160	77.8%	45.5%	23.1%	6.7%		
170	88.9%	54.5%	30.8%	13.3%	0.0%	
180	100.0%	63.6%	38.5%	20.0%	5.9%	
190	111.1%	72.7%	46.2%	26.7%	11.8%	0.0%
200	122.2%	81.8%	53.8%	33.3%	17.6%	5.3%

Appendix C - Payback Analysis of Drainage District System Replacement Costs

Payback Years for Average Yield Improvements for Range of Average Grain Prices

Assumptions

Long-term Soybean/Corn price ratio is 2.6

Average assessment of $1,175/acre

1.5% average annual yield improvement due to causes other than better drainage.

A flat grain price is assumed in this analysis.

Average Current Grain Price Used Over Payback Period		Average Yield Response Due to Drainage Improvements						
Corn	Soybeans	5%	7.50%	10%	12.50%	15%	17.50%	20%
3.00	7.80	41.98	27.99	20.99	16.79	13.99	11.99	10.49
3.20	8.32	39.39	26.26	19.69	15.76	13.13	11.25	9.85
3.40	8.84	37.04	24.69	18.52	14.81	12.35	10.58	9.26
3.60	9.36	35.01	23.34	17.50	14.00	11.67	10.00	8.75
3.80	9.88	33.13	22.09	16.57	13.25	11.04	9.47	8.28
4.00	10.40	31.50	21.00	15.75	12.60	10.50	9.00	7.87
4.20	10.92	29.98	19.98	14.99	11.99	9.99	8.56	7.49
4.40	11.44	28.63	19.09	14.32	11.45	9.54	8.18	7.16
4.60	11.96	27.37	18.24	13.68	10.95	9.12	7.82	6.84
4.80	12.48	26.24	17.50	13.12	10.50	8.75	7.50	6.56
5.00	13.00	25.18	16.78	12.59	10.07	8.39	7.19	6.29
5.20	13.52	24.22	16.15	12.11	9.69	8.07	6.92	6.06
5.40	14.04	23.31	15.54	11.66	9.32	7.77	6.66	5.83
5.60	14.56	22.49	14.99	11.24	8.99	7.50	6.42	5.62
5.80	15.08	21.70	14.47	10.85	8.68	7.23	6.20	5.42
6.00	15.60	20.99	13.99	10.49	8.39	7.00	6.00	5.25

Footnotes:

It is important to note that after it is paid for, the drainage system will continue to foster improved crop yields for more than a century

No credit is given in the above calculations for an immediate increase in land value resulting from the improved productivity

The average annual yield increase is intended to reflect through price adjustment the long term historic yield increase trend rather than to predict future grain price changes. In effect this analysis uses a stagnant current grain price tied to a reliable yield improvement trend. An entry of 0% assumes no average yield improvement or price increase over the next twenty years.

Appendix C

This worksheet is based upon one prepared by Dr. Stewart Melvin, ISU Extension Agricultural Engineer, Retired

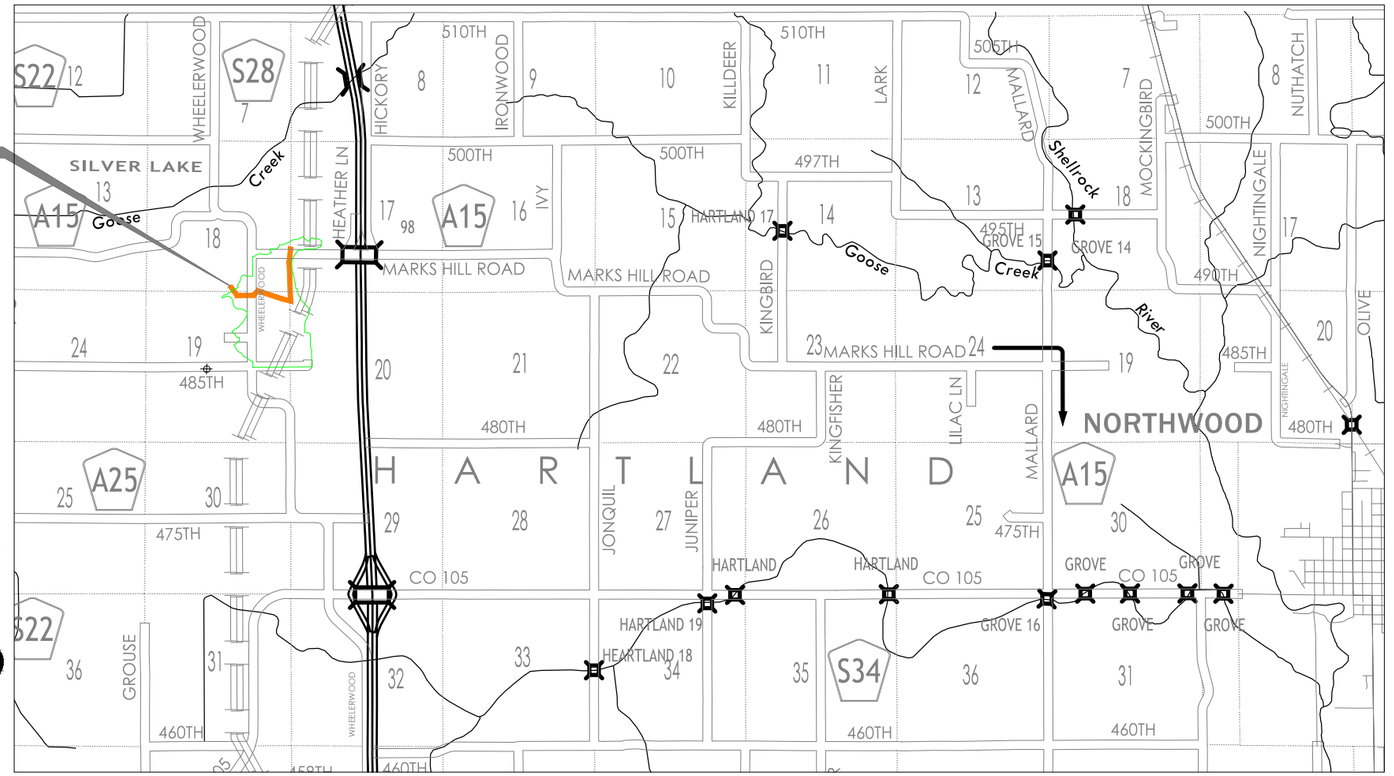
Preliminary Plans

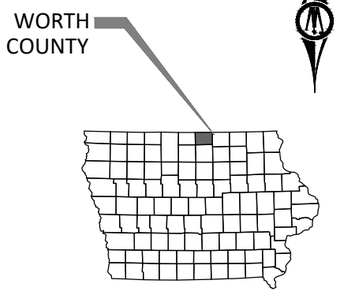
PRELIMINARY PLANS FOR

DRAINAGE DISTRICT No. 46 LAT No. 9
PROPOSED TILE IMPROVEMENTS
WORTH COUNTY, IOWA
2020

SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
A.01	TITLE SHEET
A.03	LANDOWNER PLAT & ALIGNMENT GEOMETRY
M.01 - M.02	PLAN & PROFILE - MAIN TILE
V.01	BORING DETAIL - WHEELERWOOD RD. (S28)

PROJECT LOCATION





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THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."

GOVERNING SPECIFICATIONS

THE 2020 EDITION OF THE "IOWA STATEWIDE URBAN STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS" SHALL GOVERN.

IOWA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION", SERIES 2020 AND ALL CURRENT GENERAL SUPPLEMENTAL SPECIFICATIONS AND MATERIALS INSTRUCTIONAL MEMORANDUM SHALL GOVERN AS REFERENCED.

ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND ORDINANCES WILL BE COMPLIED WITH IN THE CONSTRUCTION OF THIS PROJECT.

DATUM EQUATIONS
DRAINAGE DISTRICT NO. 46 LAT 9
1920 DATUM + 1120 = 2019 DATUM

PROJECT DATUM: STATE PLANE
HORIZONTAL: IOWA NORTH
VERTICAL: NAD 1983

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Email: Jefferson@bolton-menk.com
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NO.	ISSUED FOR	DATE

HAMILTON COUNTY, IOWA
DRAINAGE DISTRICT No. 246 LATERAL IMPROVEMENTS
TITLE SHEET

SHEET A.01

LEGEND

- PROPOSED OPEN DITCH ALIGNMENT
- PROPOSED TILE ALIGNMENTS
- PARCEL LINES
- CORPORATE LIMITS
- WATERSHED BOUNDARY
- ASSESSMENT BOUNDARY

WORTH Co. DD 46, LAT 9 TILE ALIGNMENT GEOMETRY						
No.	Type	Length	Start Station	End Station	Start E-N	End E-N
1	Line	412.55'	57+00'	61+12.55'	E4956258.16',N4000224.56'	E4956502.03',N3999891.81'
2	Line	572.52'	61+12.55'	66+85.08'	E4956502.03',N3999891.81'	E4957074.55',N3999893.43'
3	Line	220.14'	66+85.08'	69+05.21'	E4957074.55',N3999893.43'	E4957226.06',N4000053.13'
4	Line	893.40'	69+05.21'	77+98.61'	E4957226.06',N4000053.13'	E4958074.34',N3999772.79'
5	Line	1243.73'	77+98.61'	90+42.35'	E4958074.34',N3999772.79'	E4959035.15',N3998983.03'
6	Line	1257.65'	90+42.35'	103+00'	E4959035.15',N3998983.03'	E4960292.73',N3998995.77'

SILVER LAKE RD.

SHUPE, RONALD
NW SE EX PAR.
18-100-21

SHUPE, RONALD
SE SW EXC E ½
18-100-21

SHUPE, RONALD
E ½ SE SW
18-100-21

SHUPE, RONALD
SW SE
18-100-21

RUGLAND, ARLOW
& JULIE TR
NW SW
A/K/A PARCEL "B"
EXC PARCEL "A"
17-100-21

RUGLAND, ARLOW
& JULIE TR
NE SE EX PAR
18-100-21

THOMPSON, JASON
& LAURA
PARCEL "A"
IN NW SW
17-100-21

MARKS HILL RD. (A15)

RUGLAND, ARLOW
& JULIE TR
SE SE
18-100-21

RUGLAND, KRISTOFFER
SW SW
A/K/A PARCEL "C"
17-100-21

RUGLAND, KRISTOFFER
SE SW
A/K/A PARCEL "C"
EXC PAR
17-100-21

BEGIN CONSTRUCTION

END CONSTRUCTION

56+00
60+00
65+00
70+00
75+00
77+00
80+00
85+00
90+00

APPROXIMATE LOCATION OF
LIQUID PIPELINES
2 - MAGELLAN PIPELINES
1 - KOCH PIPELINE

TROE, CHARLES
NE NW EX PAR
19-100-21

TROE, CHARLES
PAR IN NE NW
19-100-21

RUGLAND, ARLOW
& JULIE TR
NW NE EX PAR
19-100-21

WHEELERWOOD RD. (S28)

DRESS FAMILY
INVESTMENTS LLC
NE NE
19-100-21

DRESS FAMILY
INVESTMENTS LLC
NW NW
20-100-21

DRESS FAMILY
INVESTMENTS LLC
NE NW EXC PAR
20-100-21

RUGLAND, KRISTOFFER
& ADDIE
PARCEL IN
SW NE & NW NE
19-100-21

E & F PORK LLC
PAR "A" IN SW NW
20-100-21

RUGLAND, ARLOW
& JULIE TR
SE NW
19-100-21

RUGLAND, ARLOW
& JULIE TR
SW NE EX PAR
19-100-21

DRESS FAMILY
INVESTMENTS LLC
SE NE EXC PAR
19-100-21

DRESS FAMILY
INVESTMENTS LLC
SW NW EXC PAR
20-100-21

KELSO, JOHN
PAR IN SW NW
20-100-21

DRESS FAMILY
INVESTMENTS LLC
SE NW EXC PAR
20-100-21

RUGLAND, KRISTOFFER
W 196' OF
W 595' OF
S 560' OF SE NE
19-100-21

JULSETH, PETER
PAR IN SE NE EXC PAR
19-100-21

I 35 NORTH BOUND LANES
I 35 SOUTH BOUND LANES

568120
DOT BENCHMARK
N:3997363.86
E:4952971.08
ELEV:1290.34

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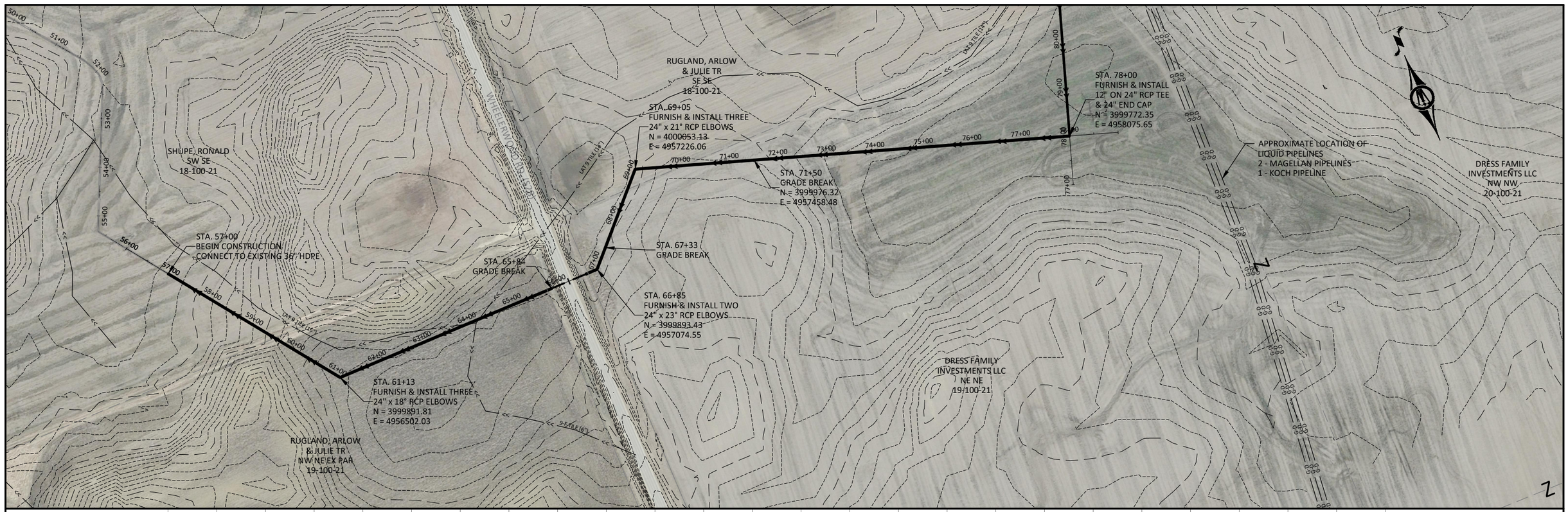
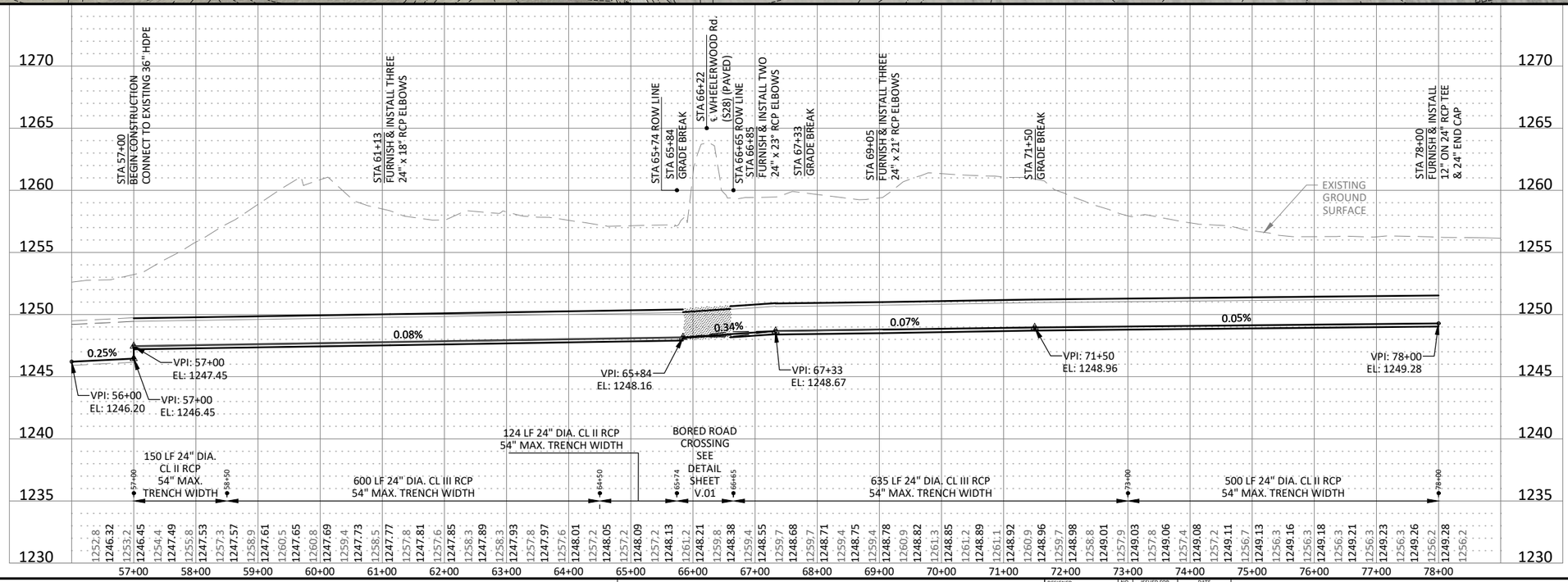
NO.	ISSUED FOR	DATE

WORTH COUNTY, IOWA
DRAINAGE DISTRICT No. 46 LATERAL 9 IMPROVEMENTS
LANDOWNER PLAT & ALIGNMENT GEOMETRY

SHEET
A.02





HORZ. SCALE 0 100 200 FEET

VERT. SCALE 0 5 10 FEET

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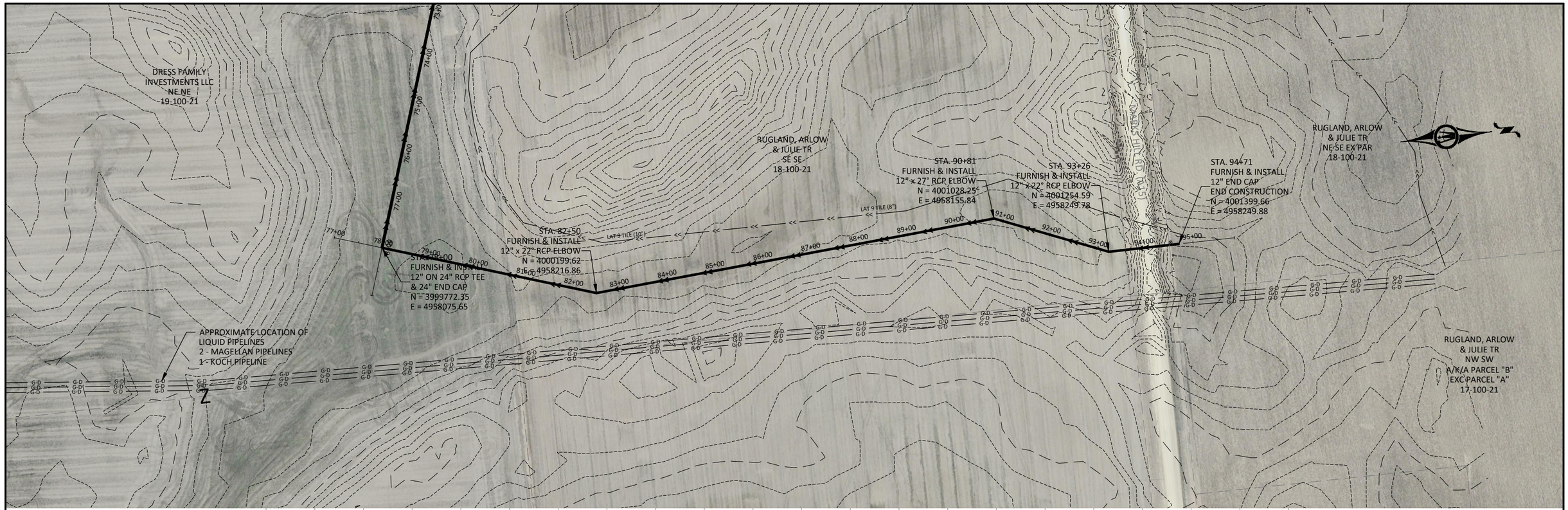
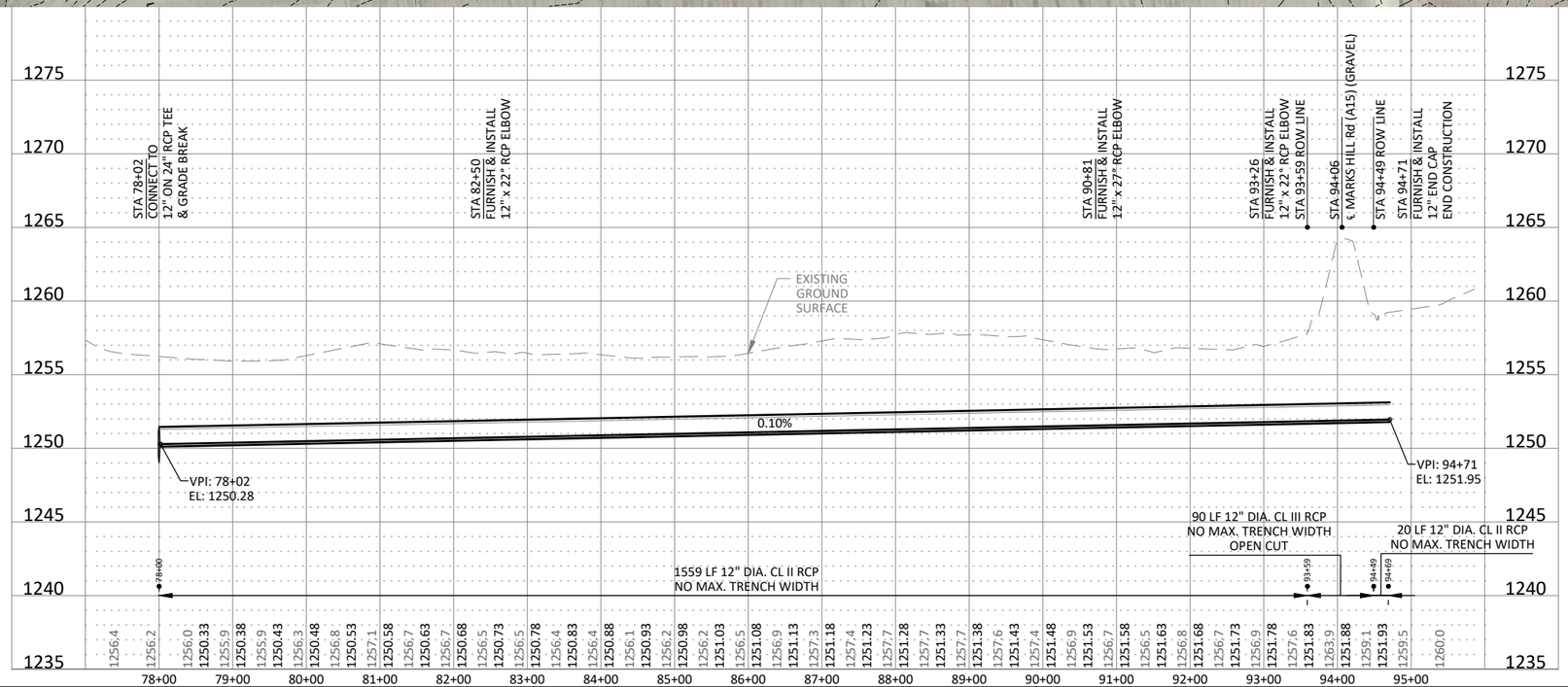
WORTH COUNTY, IOWA

DRAINAGE DISTRICT No. 46 LATERAL 9 IMPROVEMENTS

PLAN & PROFILE - MAIN TILE

SHEET M.01





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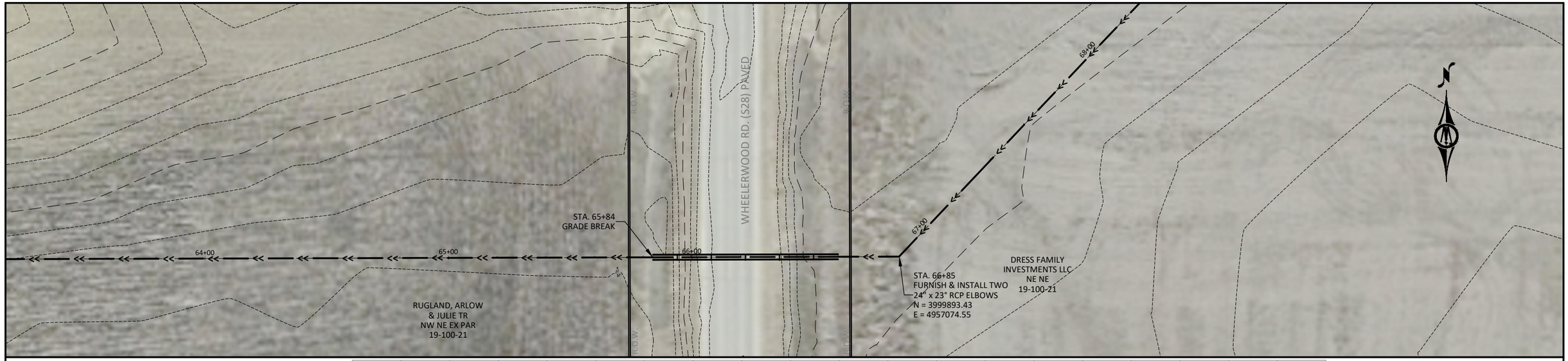
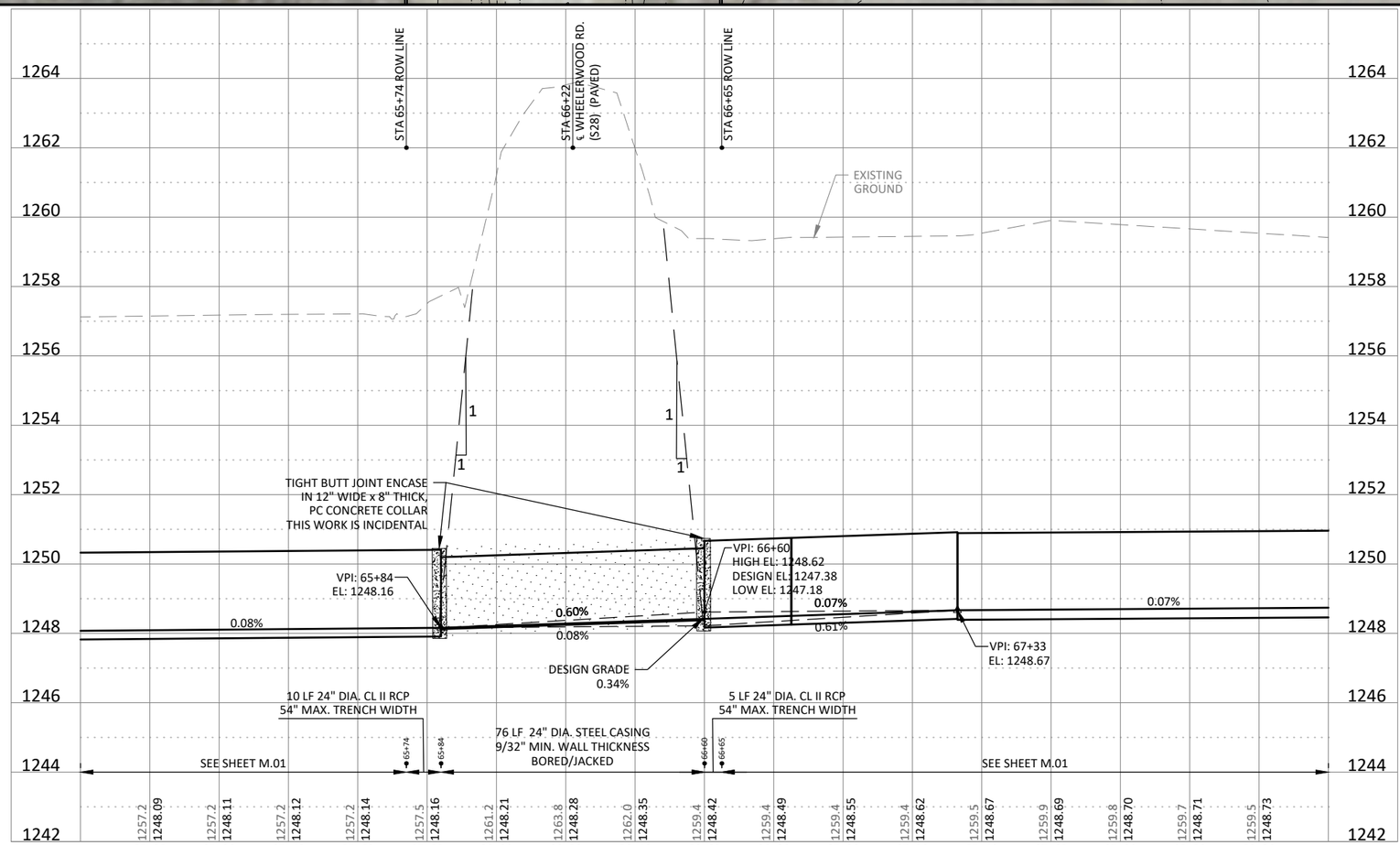
WORTH COUNTY, IOWA
DRAINAGE DISTRICT No. 46 LATERAL 9 IMPROVEMENTS
PLAN & PROFILE - MAIN TILE

SHEET
M.02





HORZ. SCALE 0 20 40 FEET

VERT. SCALE 0 4 8 FEET

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BORING DETAIL - WHEELERWOOD RD. (S28)

SHEET V.01