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Engineer's Report

# Proposed Open Ditch Repairs Drainage District No. 2 Worth County, Iowa 2022

**Submitted by:**

Bolton & Menk, Inc.  
300 W. McKinley Street  
Jefferson, IA 50129  
Phone: 515-386-4101

# Certification

Engineer's Report

For

Proposed Open Ditch Repairs

Drainage District No. 2  
Worth County, Iowa

2022

BMI Project No. 0A.1124364



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.

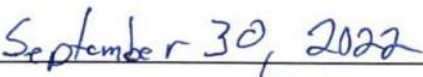
By:



Jonathan P. Rosengren, P.E.

License No. 21661

Date:



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## I. Introduction

### A. Scope of Work

The Board of Supervisors requested the investigation of necessary repairs needed to bring drainage relief to lands of Drainage District No. 2 and appointed Bolton & Menk, Inc. to complete the necessary survey, study, plan, and report on April 5<sup>th</sup>, 2021. This report addresses the request for repairs to the open ditch within Drainage District No. 2. A copy of the Board minutes recommending repairs is contained in Appendix A of this report.

### B. Location

The watershed of Drainage District No. 2 encompasses approximately 10,980 acres. This watershed includes land in Sections 19-20, & 23-36 of Hartland Township, 24-25, & 36 of Silver Lake Township, 2-10, & 15 of Brookfield Township and Section 1 of Bristol Township in Worth County.

The outlet of the Drainage District No. 2 Main Open Ditch lays in the SW SW of Section 30 in Hartland Township (T-100-N, R-21-W), one mile west of Northwood. The watershed of Drainage District No. 2 fully encompasses Drainage District Nos. 15, 16, 44, 54, and 64.

### C. History

Drainage District No. 2 is a large and active district, being the second district to be formed in Worth County in 1905. Since its formation, there has been three major repairs, once in the 1950's, 1970's and early 2000's.

July 22, 1905 – Petition for improvements filed.

Nov 17, 1905 – Engineer's Report for improvements filed. Recommends construction of an open ditch and assessing only those swamp grounds near the channel. Outlet of channel located at the east line of the NW NE of Section 36-100-21.

Nov 20-22, 1905 – Hearing on Engineer's Report for Establishment.

Dec 7, 1905 – District Established.

June 7, 1906 – Hearing on Classification Commission Report.

Oct 25, 1948 – Petition for Repairs and Improvements.

March 14, 1950 – Engineer's Report filed, recommending the following:

Merge all existing internal districts into DD 2;

Improvements to Open Ditch;

Improvements to several existing district outlets; and

Construction of several new laterals.

June 8, 1950 – Hearing on Engineer's Report. Hearing continued to allow Board to inspect the ditch.

June 19, 1950 – Continued hearing on Engineer's Report.

July 25, 1950 – 2<sup>nd</sup> Continued Hearing on Engineer's Report. Four remonstrances filed. Board determined to stop project, no repairs or improvements approved. No annexation made. No facilities built.

Oct 9, 1953 – Petition for Writ of Mandamus filed in Worth County District Court by 10 landowners.

Dec 21, 1953 – Decree by District Court for Mandamus action compelling repair of the ditch.

Apr 24, 1954 – Engineer’s Report for Repairs filed. Recommends extension of the outlet approximately ¼ mile to the east line of the NE NE of Section 36-100-21.

Aug 12, 1954 – Hearing on Engineer’s Report. All repairs and improvements approved.

July 2, 1962 – Order by Board to ban all pigs, in any number, and all other farm animals, in large numbers, from all district improvements under the authority of the board.

July 27, 1964 – Hearing on Engineer’s Report for annexation of lands to the district.

Sept 21, 1966 – Agreement for additional annexation.

Apr 10, 1967 – Hearing on Reclassification.

Oct 25, 1967 – Engineer’s Report for improvements to Lateral 1 Open Ditch (Lateral H), Open Ditch, and Tile Laterals. Includes construction of Lateral 1-A and parallel of existing tile with Lateral 1-B.

Dec 5, 1967 – Hearing on Engineer’s Report for Lateral 1 Improvements. Remonstrance successfully stopped the project from proceeding.

Oct 31, 1969 – Hearing on Engineer’s Report for Repairs and Improvements to the Open Ditch. Recommended widening and extension of lower end to north line of the NW NW Section 31-100-20.

Dec 17, 1969 – Continued Hearing on Engineer’s Report.

Feb 27, 1970 – 2<sup>nd</sup> Continued Hearing on Engineer’s Report. Mandamus suit threatened to force repair.

March 2, 1970 – 3<sup>rd</sup> Continued Hearing on Engineer’s Report. Repairs and Improvements approved. No changes to the Report of Appraisers.

Nov 27, 1972 – Hearing on Chapter 465 of 1971 Code of Iowa (468.600). Relief of SW NW Section 8-99-22. Lateral approved, \$2,250 damages awarded.

Dec 11, 1972 – Completion Hearing on project.

Sept 27, 1976 – Hearing on Repairs to the Open Ditch, project not to exceed \$11,750.00 (25% of original construction cost of \$83,040.35).

Mar 1, 2000 – Hearing on repairs to Open Ditch. Approved cleaning starting at Highway 105 and proceeding west and north. Paid \$90 per acre for areas disturbed by work.

March 13, 2000 – Corrections to Classifications.

Dec 3, 2001 – Petition for repairs to Lateral A & A1 (Not Built as DD 2 Facilities).

2003 – Repairs to Upper and Lower Main Open Ditch.

June 1, 2004 – Petition to repair Lateral H (Not Built as DD 2 Facility).

Feb 21, 2006 – Assessment for Diamond Jo Casino raised 1.5%.

Oct 29, 2007 – Hearing on Code 468.600 relief of SW NW of Section 8-99-22. Lateral approved, no damages awarded.

Dec 12, 2019 - Classification Report filed.

#### D. Investigation

Full survey of the 13 miles of the Main Open Ditch, Branch 1 Ditch, Lateral A & A-1 Open Ditch, and Lateral H Open Ditch was completed in the summer of 2021. Using the survey and profiles, several cross sections were made and all points of water entry, both surface and subsurface, were analyzed. All trees, interfering fences, rock piles, and large debris located near or in the open ditch were measured. The survey data was compared to historical plans and profiles, culvert elevations, cross section review and the surveyed hardpan showing how deep the ditch has been dug in the past. Using this information, we were able to determine a repair grade of best fit that appears to most closely resemble the best possible historical drainage provided by the ditch.

##### Main Open Ditch

The investigation found the Main Open Ditch flowline to be at or near the design flowline for nearly its entire length. However, the appearance of the Main Open Ditch could be described as fair to poor. There are areas of dense tree and shrub growth along the banks, bank erosion, meanders, and sloughs.

##### Lateral A

Lateral A is a 2,500-foot-long ditch adjoining the Main in Section 26 of Hartland Township. The investigation found an average of one foot of sediment in the lower portion, with the ditch at or below grade from Station 16+00 onward. The overall condition is fair.

##### Lateral D

Lateral D is an 800-foot-long ditch adjoining the Main in Section 34 of Hartland Township. The facility is in very poor condition, in need of repair. We are recommending a complete reconstruction. This ditch has too steep of grade, we are recommending constructing rock drop structure at the beginning and end of the ditch to slow the water down and decrease stream erosion.

##### Lateral H

Lateral H is the longest lateral and was constructed privately. The upper end was designed to be higher than the lower end creating a step. The investigation found the Lateral H Ditch to be near its design flowline in the lower end, but after crossing 460<sup>th</sup> Street, to have approximately 2' of silt on its bottom. There are places with bank erosion and dense tree growth. The upper end has better side slopes with grass growing along the side slopes but needs cleaned out.

##### Lateral M

Lateral M is a 2,800-foot-long ditch located in Section 30 of Hartland Township. The investigation found Lateral M to have approximately 1 foot of silt. The bottom had grass growing on it, but the side slopes appeared in good condition.

#### E. Ditch Crossings

There is two state, nine county, and seven private crossings on the DD 2 Open Ditches. Four of the crossings are significantly above the design grade of the ditch. Some will need cleaned out as part of the proposed repairs. We analyzed the seven private crossing and found six to be sized appropriately. A 36" CMP crossing that is on the Lateral H open ditch at Station 149+75 is undersized. If the landowner would prefer not to purchase a larger pipe, the private crossing to be lowered to the design elevation, and high flows will be able to go over the top of the crossing creating a vented ford crossing. A table showing all ditch crossings is included on the following page. The highlighted crossings are above design grade and will need to be lowered as part of the project. The cost to lower any ditch crossing is the responsibility of the owner of the crossing, be that a private landowner, county secondary roads or state DOT. There is one crossing on Juniper Ave. at 241+26 of the Main open ditch that is 0.4' higher than the

design grade, we are recommending a modified grade upstream to account for this instead of lowering the culvert. We estimate the costs to lower the Worth County Secondary Roads culverts to be \$81,500. We will discuss with the county engineer if there are other options he would prefer.

Crossings – DD 2 Open Ditches							
Ditch	Road	Station	Existing Structure Flowline Elevation	Ditch Design Flowline Elevation	Road Type	Owner	Culvert
Main	Mallard Ave	75+25	-	1206.87'	Gravel	County	Bridge
Main	Highway 105	156+24	-	1213.86'	Paved	County	Bridge
Main	Highway 105	230+65	-	1217.56'	Paved	County	Bridge
Main	Juniper Ave	241+26	1218.47'	1218.08'	Gravel	County	3- 72" x 108" CMP
Main	Jonquil Ave	289+86	1221.11'	1221.33'	Gravel	County	2- 108" CMP, & 1- 96" CMP
Main	Private Crossing	370+75	1237.58'	1238.36'	Private	Private	2- 36" Conc., 1-48" Conc, & 1-42" Conc.
Main	Interstate 35 & Wheelwood Rd.	382+25	1240.45'	1240.79'	Paved	State & County	8' x 10' Box Culvert
Main	Highway 105	432+26	1249.35'	1247.62'	Paved	County	10' x 10' Box Culvert
Main	Private Crossing	467+00	1249.41'	1249.44'	Dirt	Private	42" CMP
Main	460 <sup>th</sup> St.	504+83	1254.14'	1251.40'	Gravel	County	4' x 4' Box Culvert
Lateral A	Private Crossing	10+60	1218.51'	1216.36'	Private	Private	36" CMP
Lateral H	460 <sup>th</sup> St.	23+40	1236.17	1236.32'	Gravel	County	48" CMP & 42" CMP
Lateral H	Private Crossing	60+76	1238.59	1240.29'	Private	Private	102" CMP
Lateral H	450 <sup>th</sup> St.	97+56	1242.74'	1244.06'	Gravel	County	72" CMP
Lateral H	Private Crossing	113+95	1244.51'	1245.74'	Private	Private	54" CMP
Lateral H	Private Crossing	136+12	1248.33'	1249.10'	Private	Private	42" CMP
Lateral H	Private Crossing	149+75	1254.71'	1252.35'	Private	Private	36" CMP
Lateral H	Interstate 35	155+62	1252.53'	1252.75'	Paved	State	8' x 10' Box Culvert
Lateral H	450 <sup>th</sup> St.	163+83	1260.15'	1257.25'	Gravel	County	2- 54" CMP
Lateral H	Wheelwood Dr.	168+92	1261.97'	1260.02'	Paved	County	8' x 5' Box Culvert

#### F. Utilities

Overhead power lines and other utility lines will parallel or cross the ditch at various locations. Extra care will need to be taken when working under or near these utility lines. The contractor will be responsible to determine and notify utility companies and to cooperate in locating, marking, and protecting their facilities.

#### G. District Right-of-Way

Claims for damages were paid when the district was originally established, hence establishing right-of-way along the ditch. In 2019, right-of-way was purchased to make a uniform 100' wide right-of-way along the entire length of the open ditches within Drainage District No. 2. Land within the right-of-way may be farmed or used by the landowner, however, the district maintains the right to use the right-of-way for maintenance of the open ditch. No crop damages are paid within the right-of-way.

## II. Farm Program Compliance

#### A. CRP Riparian Vegetative Filter Strips

It appears most of the lands along the ditches in DD 2 have some form of grass filter strips along the ditch slopes. According to the NRCS, these strips as can be effective in reducing excess sediment, organic material, nutrients, and pesticides in surface runoff by reducing the rate of run off, decreasing suspended solids, reducing edge of field sheet erosion, and increasing infiltration, microbial activity, evapotranspiration, and overall water storage capacity.

We encourage landowners of this district to ask the local NRCS/FSA office about the benefits of this program and what financial assistance could be available.

#### B. CRP Damage Waivers

The destruction of CRP buffer strip 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.

#### C. Nesting Season Restrictions

The CRP rules also restrict disturbances during the primary nesting season, which covers the period of May 15<sup>th</sup> to August 1<sup>st</sup> 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.

## III. 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 – Hydrosience 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 in order 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.

## IV. Proposed Work

### A. Proposed Repair

The investigation has confirmed the need for drainage relief within the district. To restore the original drainage efficiency, it is necessary to remove accumulated sediment from the Drainage District No. 2 Main, Branch 1, Lateral A & A-1, and Lateral H Open Ditches. In areas where little sediment is to be removed, the banks will be reshaped to remove any sloughing and meanders. This work will necessitate the removal of much of the bank vegetation, however, this will be limited to only as necessary for the work. We have included an estimated cost of this work in our Engineer's Opinion of Probable Cost.

We found several surface drain pipes and tile outlet extensions during the survey in varying condition. There are undoubtedly some drain tile outlets that were missed during the survey. We anticipate several modifications to the pipe work plans during the course of the work. We recommend replacing pipes in poor condition throughout the open ditches.

To protect the functional life of the restored open ditch, it is recommended that the entire set of drain tile extension pipes and surface drainpipes be individually evaluated and be placed or replaced as found necessary during the ditch restoration work.

If any fences are cut or removed during construction, the district is not obligated to pay damages associated with fences within the existing right-of-way. Damages can be claimed for fence damages occurring outside the ditch right-of-way within the work limits. Fence owners are encouraged to remove their own fences where it is necessary to do so, especially where they wish to salvage part of the materials.

It is recommended that the newly exposed open ditch banks be fertilized and seeded. NRCS research indicates that broadcasting the seed and fertilizer at the end of each day's work is the best way to secure good growth, and because additional seedbed work isn't needed, the cost is more reasonable than for other methods. Economically successful seeding remains a difficult goal for drainage ditches, it being so dependent upon favorable weather. Typically, the best that is achieved is a sparse growth that supplements and aids the progress of natural re-vegetation.

There are some locations along the open ditch where we recommend erosion stone be placed to prevent bank scour during and after construction. The actual location and length of riprap placed will be determined in the field at the time of the repair.

The spoil material is recommended to be uniformly leveled and shaped to a typical cross section with a fairly flat top (2% slope) about 16 feet wide, adjacent to the ditch with a 10 to 1 back slope pushed out onto the adjacent land. The leveled spoil will then be deep tilled by the contractor and exposed rocks and debris are to be gathered and disposed of.

### B. Work Area

The work limits on the open ditch will typically be out to 100 feet from the open ditch centerline on the side or sides in which work will be done. Damages within the work area but outside the right-of-way are eligible for compensation.

### C. Engineer's Opinion of Probable Cost

The estimated total cost of the proposed repairs is \$1,564,000. A detailed Opinion of Probable Cost for the recommended work is included in Appendix B of this report. The individual lateral open ditches and the Main Open Ditch would each be expensed to their corresponding assessment schedule. The estimated construction cost for each of the assessment schedules is shown on the following page:

DD 2 Open Ditches Construction Cost			
Ditch	Estimated Construction Cost	Acres Assessed	Avg. Construction Cost/ Acre
Main, Branch 1, Lateral D & Lateral M	\$892,000	10,980	\$81
Lateral A	\$29,700	340	\$87
Lateral H	\$217,000	2,097	\$103
<b>Total</b>	<b>\$1,138,700</b>		

## V. Assessment Schedule Review

### A. Existing Assessment Schedule Review

Drainage District No. 2 and all its laterals and drainage districts within its benefitted areas were reclassified in 2019. We are not recommending reclassification at this time.

### B. General Classification Methodology

The process of reclassification used several factors to equitably spread project costs based upon benefits received. The four factors used were: Use; Proximity; Runoff, and Wetness.

- The Use Factor considered 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 considered the portion of the outlet provided. Lands nearer to the ditch 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 ditch should pay more than a 40-acre tract a mile away which must build a private system to reach the open ditch.
- The Runoff Factor considered the amount of hard surface a property that is designed to shed the water quicker than a farm field. On those properties, the district facility is being used as a storm sewer outlet and pays more for that use.
- The Wetness Factor accounted 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.

## VI. Discussions & Recommendations

Typically, in Worth County, repairs to an open ditch occur every 30-40 years. This ditch was last repaired about 20 years ago, however, that was spot repairs not addressing the entire ditch system as one unit. This report confirms the need to repair the drainage efficiency and capacity of the Drainage District No. 2 Ditches. The work described herein can accomplish that repair.

**Repair Recommended.** The repairs proposed will restore the original design capacity of the open ditch. The estimated assessable cost of the recommended repair is \$1,564,000. We find that the proposed repairs will be practicable, feasible, and beneficial to the public.

**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 ten years. If we assume that the board will allow ten annual installments at 6% interest, repair costs for lands now in the district would be about \$19 per acre per year. If a one-time use schedule is used to assess only these lands benefited, the cost would increase to \$142 per acre. Be reminded that assessments are based upon benefits received and that some parcels will likely bear two to three times the average assessments.

It is recommended that the Board of Supervisors of Worth County, acting as trustees for Drainage District No. 2, take appropriate action, with legal guidance, to accomplish the following:

- Tentatively approve this Engineer's Report.
- Conduct a public hearing on the proposed repairs.
- Adopt the proposed repair 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.

Respectfully submitted,

Bolton & Menk, Inc.

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Jonathan P. Rosengren, P.E

## Appendix A: Petition

April 5, 2021

Fourteenth Day

The Worth County Board of Supervisors met pursuant to adjournment with A.J. Stone, Mark Smeby and Enos Loberg present.

Stone led the meeting in the Pledge of Allegiance.

Unless otherwise indicated, all of the following motions offered at this meeting were carried with the following vote: Ayes: Stone, Smeby and Loberg. Nays: none. Abstentions: none. Absent: None.

Motion by Smeby, second by Loberg, carried to approve the April 5, 2021 board agenda.

Motion by Smeby, second by Loberg, carried to approve the March 29, 2021 board minutes.

Motion by Loberg, second by Smeby, carried to engage Bolton & Menk, Inc. to investigate repairs/improvements in DD #2 and DD #14.

Motion by Smeby, second by Loberg, carried to acknowledge county receipt of manure management plan annual update for Facility #59612 located in Section 3, Union Township, Worth County.

Motion by Loberg, second by Smeby, carried to start the process to repeal Ordinance 2018.12.03 Renewable Energy Provisions.

Motion by Loberg, second by Smeby, carried to adjourn at 9:57 A.M. The next meeting of the Board of Supervisors will be Monday, April 12, 2021 at 8:30 A.M.

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Jacki A. Backhaus  
Auditor

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Aaron Stone  
Chairperson

## Appendix B: Engineer's Opinion of Probable Cost

# ENGINEER'S ESTIMATE

DRAINAGE REPAIRS- OPEN DITCH  
DRAINAGE DISTRICT NO. 2  
WORTH COUNTY, IOWA  
BMI PROJECT NO. 0A.1124364



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Date: 9/30/2022

Item No.	Item	Notes	Estimated Quantity	Unit	Unit Price	Total Amount
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## SECTION 1 - MAIN & BRANCH 1 OPEN DITCH REPAIR

101	EXCAVATION		130,000	CY	\$3.00	\$390,000.00
102	CLEARING & GRUBBING		1	LS	\$60,000.00	\$60,000.00
103	SPOIL LEVELING (BOTH SIDES)		505	STA	\$200.00	\$101,000.00
104	SEED & FERTILIZE BANKS		505	STA	\$100.00	\$50,500.00
105	TILE EXTENSION, 12" CMP		1,440	LF	\$35.00	\$50,400.00
106	TILE EXTENSION, 15" CMP		200	LF	\$40.00	\$8,000.00
107	TILE EXTENSION, 18" CMP		180	LF	\$45.00	\$8,100.00
108	TILE EXTENSION, 24" CMP		60	LF	\$55.00	\$3,300.00
109	SURFACE DRAIN, 18" CMP		1,000	LF	\$45.00	\$45,000.00
110	SURFACE DRAIN, 24" CMP		400	LF	\$60.00	\$24,000.00
111	SURFACE DRAIN, 30" CMP		120	LF	\$75.00	\$9,000.00
112	RIPRAP, CLASS D		1,000	TN	\$50.00	\$50,000.00
113	EROSION MANAGEMENT PLAN		1	LS	\$500.00	\$500.00
114	MOBILIZATION		1	LS	\$42,000.00	\$42,000.00
					<b>SUBTOTAL</b>	<b>\$841,800.00</b>

## SECTION 2 - LATERAL A OPEN DITCH REPAIR

201	EXCAVATION		2,000	CY	\$3.00	\$6,000.00
202	CLEARING & GRUBBING		1	LS	\$500.00	\$500.00
203	SPOIL LEVELING (BOTH SIDES)		25	STA	\$200.00	\$5,000.00
204	SEED & FERTILIZE BANKS		25	STA	\$100.00	\$2,500.00
205	TILE EXTENSION, 12" CMP		100	LF	\$35.00	\$3,500.00
206	TILE EXTENSION, 15" CMP		20	LF	\$40.00	\$800.00
207	TILE EXTENSION, 18" CMP		20	LF	\$45.00	\$900.00
208	SURFACE DRAIN, 18" CMP		80	LF	\$45.00	\$3,600.00
209	SURFACE DRAIN, 24" CMP		40	LF	\$60.00	\$2,400.00
210	RIPRAP, CLASS D		50	TN	\$50.00	\$2,500.00
211	EROSION MANAGEMENT PLAN		1	LS	\$500.00	\$500.00
212	MOBILIZATION		1	LS	\$1,500.00	\$1,500.00
					<b>SUBTOTAL</b>	<b>\$29,700.00</b>



# ENGINEER'S ESTIMATE

DRAINAGE REPAIRS- OPEN DITCH  
DRAINAGE DISTRICT NO. 2  
WORTH COUNTY, IOWA  
BMI PROJECT NO. 0A.1124364



Real People. Real Solutions.

Date: 9/30/2022

Item No.	Item	Notes	Estimated Quantity	Unit	Unit Price	Total Amount
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## SECTION 3 - LATERAL D OPEN DITCH IMPROVEMENT

301	EXCAVATION		2,000	CY	\$3.00	\$6,000.00
302	CLEARING & GRUBBING		1	LS	\$500.00	\$500.00
303	SPOIL LEVELING (BOTH SIDES)		8	STA	\$200.00	\$1,600.00
304	SEED & FERTILIZE BANKS		8	STA	\$100.00	\$800.00
305	TILE EXTENSION, 12" CMP		40	LF	\$30.00	\$1,200.00
306	SURFACE DRAIN, 18" CMP		40	LF	\$45.00	\$1,800.00
307	ROCK RIFFLE		1	EA	\$1,000.00	\$1,000.00
308	RIPRAP DROP STRUCTURE		1	EA	\$1,000.00	\$1,000.00
309	RIPRAP, CLASS D		50	TN	\$50.00	\$2,500.00
310	EROSION MANAGEMENT PLAN		1	LS	\$500.00	\$500.00
311	MOBILIZATION		1	LS	\$900.00	\$900.00
					<b>SUBTOTAL</b>	<b>\$17,800.00</b>

## SECTION 4 - LATERAL H OPEN DITCH REPAIR

401	EXCAVATION		12,000	CY	\$3.00	\$36,000.00
402	CLEARING & GRUBBING		1	LS	\$20,000.00	\$20,000.00
403	SPOIL LEVELING (BOTH SIDES)		168	STA	\$200.00	\$33,600.00
404	SEED & FERTILIZE BANKS		168	STA	\$100.00	\$16,800.00
405	TILE EXTENSION, 12" CMP		680	LF	\$30.00	\$20,400.00
406	TILE EXTENSION, 15" CMP		140	LF	\$35.00	\$4,900.00
407	TILE EXTENSION, 18" CMP		120	LF	\$45.00	\$5,400.00
408	SURFACE DRAIN, 18" CMP		680	LF	\$45.00	\$30,600.00
409	SURFACE DRAIN, 24" CMP		280	LF	\$60.00	\$16,800.00
410	SURFACE DRAIN, 30" CMP		80	LF	\$75.00	\$6,000.00
411	RIPRAP, CLASS D		300	TN	\$50.00	\$15,000.00
412	EROSION MANAGEMENT PLAN		1	LS	\$500.00	\$500.00
413	MOBILIZATION		1	LS	\$11,000.00	\$11,000.00
					<b>SUBTOTAL</b>	<b>\$217,000.00</b>

# ENGINEER'S ESTIMATE

DRAINAGE REPAIRS- OPEN DITCH  
DRAINAGE DISTRICT NO. 2  
WORTH COUNTY, IOWA  
BMI PROJECT NO. 0A.1124364



Real People. Real Solutions.

Date: 9/30/2022

Item No.	Item	Notes	Estimated Quantity	Unit	Unit Price	Total Amount
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## SECTION 5 - LATERAL M OPEN DITCH REPAIR

501	EXCAVATION		2,000	CY	\$3.00	\$6,000.00
502	CLEARING & GRUBBING		1	LS	\$500.00	\$500.00
503	SPOIL LEVELING (BOTH SIDES)		28	STA	\$200.00	\$5,600.00
504	SEED & FERTILIZE BANKS		28	STA	\$100.00	\$2,800.00
505	TILE EXTENSION, 12" CMP		120	LF	\$30.00	\$3,600.00
506	TILE EXTENSION, 15" CMP		20	LF	\$35.00	\$700.00
507	TILE EXTENSION, 18" CMP		20		\$45.00	\$900.00
508	SURFACE DRAIN, 18" CMP		120	LF	\$45.00	\$5,400.00
509	SURFACE DRAIN, 24" CMP		40	LF	\$60.00	\$2,400.00
510	RIPRAP, CLASS D		50	TN	\$50.00	\$2,500.00
511	EROSION MANAGEMENT PLAN		1	LS	\$500.00	\$500.00
512	MOBILIZATION		1	LS	\$1,500.00	\$1,500.00
					<b>SUBTOTAL</b>	<b>\$32,400.00</b>

**TOTAL ESTIMATED DISTRICT CONSTRUCTION COST \$1,138,700.00**

# ENGINEER'S ESTIMATE

DRAINAGE REPAIRS- OPEN DITCH  
DRAINAGE DISTRICT NO. 2  
WORTH COUNTY, IOWA  
BMI PROJECT NO. 0A.1124364



Real People. Real Solutions.

Date: 9/30/2022

Item No.	Item	Notes	Estimated Quantity	Unit	Unit Price	Total Amount
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## SECTION 6 - WORTH COUNTY SECONDARY ROADS

601	REMOVE AND RELAY 10' X 10' BOX CULVERT		1	LS	\$50,000.00	\$50,000.00
602	REMOVE AND RELAY 2-54" CMP CULVERTS		1	LS	\$5,000.00	\$5,000.00
603	PCC PATCH- 6" DEPTH		100	SY	\$150.00	\$15,000.00
604	CLASS 1 ROAD STONE		250	TN	\$30.00	\$7,500.00
605	SEED & FERTILIZE DITCH		2	EA	\$500.00	\$1,000.00
606	MOBILIZATION		1	LS	\$1,000.00	\$1,000.00
607	TRAFFIC CONTROL		2	EA	\$1,000.00	\$2,000.00

**TOTAL ESTIMATED COUNTY ROADS CONSTRUCTION COST** **\$81,500.00**

CONSTRUCTION RELATED DAMAGES \$45,000.00

### BASIC ENGINEERING SERVICES

SURVEY, STUDY & REPORT. MEETINGS & HEARING	\$90,000.00
CONSTRUCTION PLANS, SPECIFICATIONS, & BID LETTING	\$10,000.00
CONSTRUCTION ENGINEERING SERVICES	\$50,000.00
LEGAL SERVICES, PUBLICATIONS, MAILINGS, ETC.	\$3,500.00
FINANCE & INTEREST	\$226,700.00

**ESTIMATED ASSOCIATED PROJECT COSTS TOTAL:** **\$425,200.00**

**TOTAL ESTIMATED PROJECT COST :** **\$1,645,400.00**

**TOTAL ESTIMATED COST ASSESSED TO LANDOWNERS :** **\$1,564,000.00**

Estimated Average Cost Per Currently Assessed Acre (10,980 ac) \$142

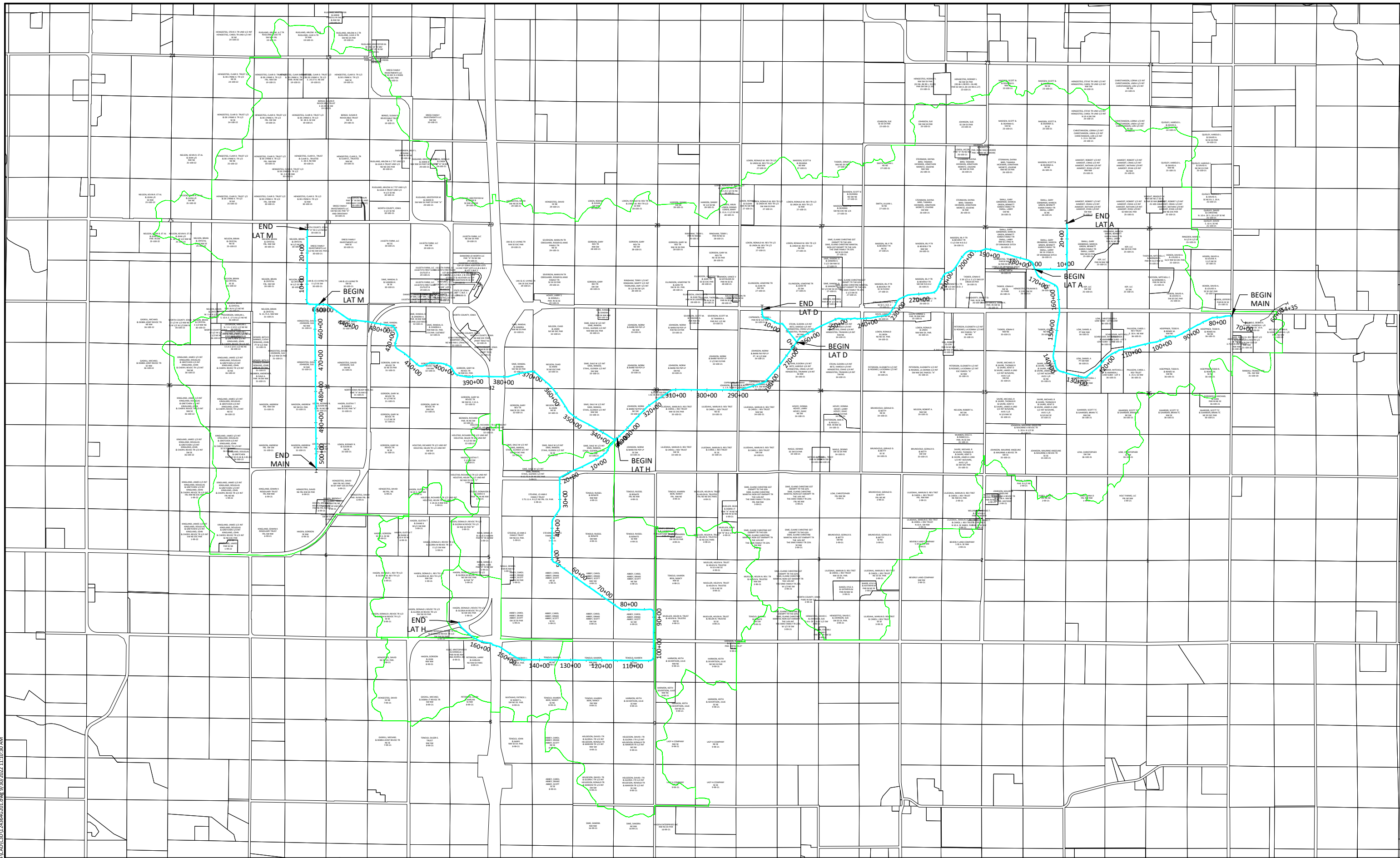
Estimated Average Cost Per Acre Per Year (10 years) \$19

Estimated Average Cost Per Acre Per Year (20 years) \$12

## Preliminary Plans



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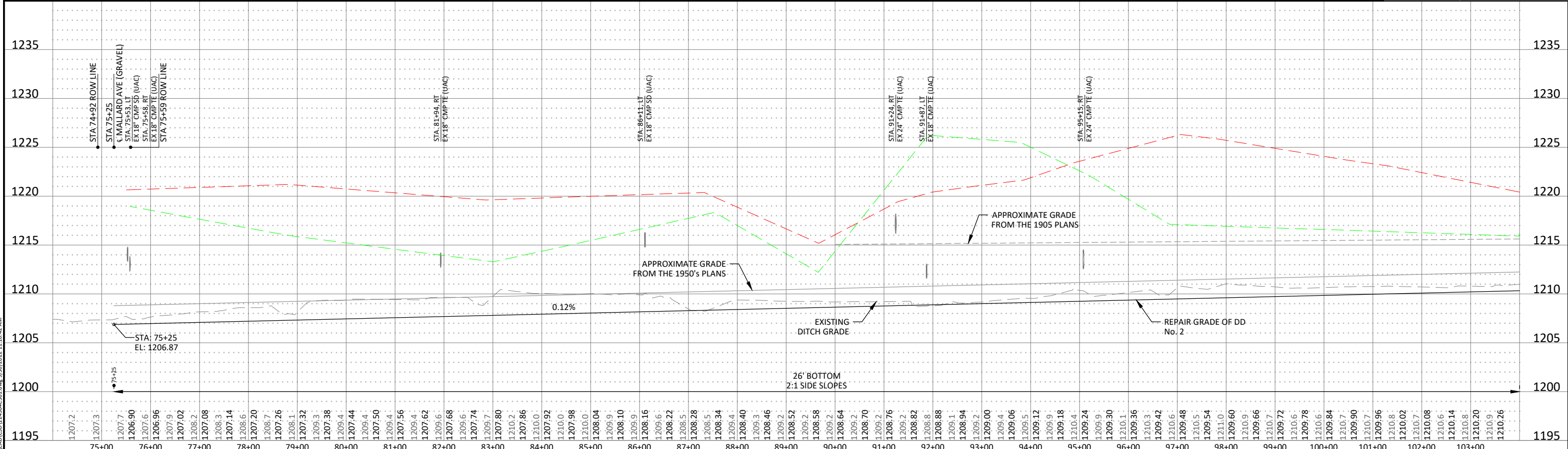
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WORTH COUNTY, IOWA  
LANDOWNER PLAT

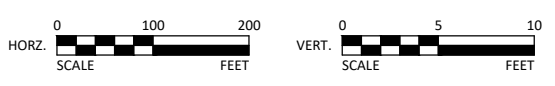
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	LEFT DITCH BANK



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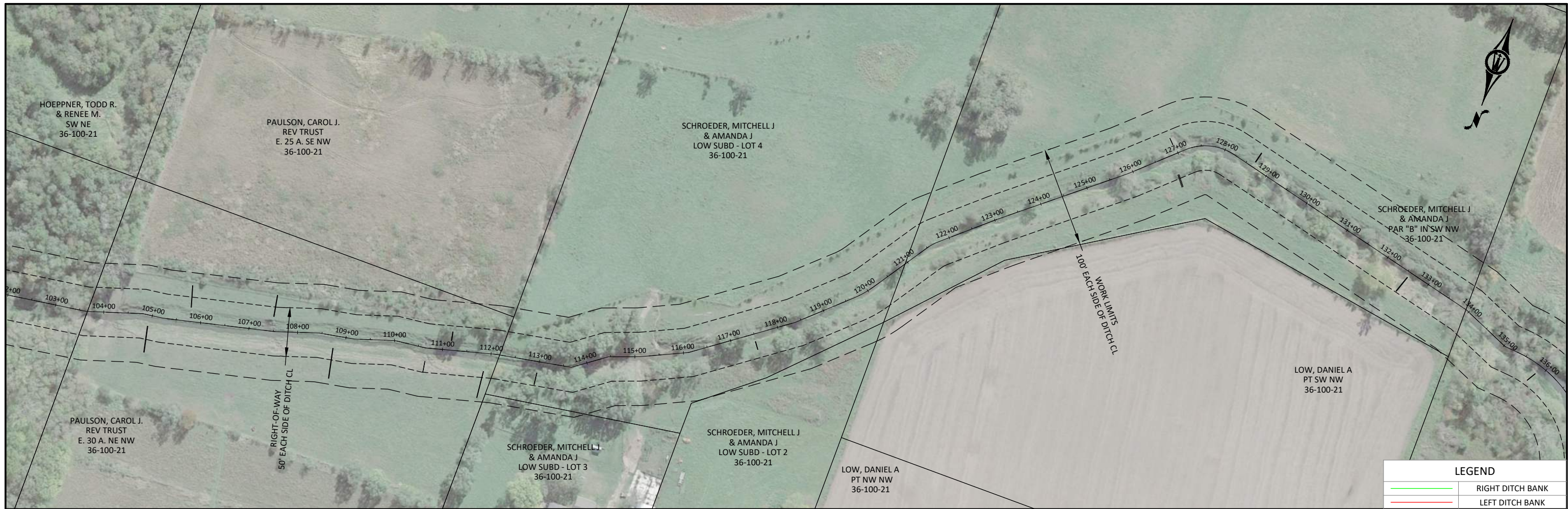
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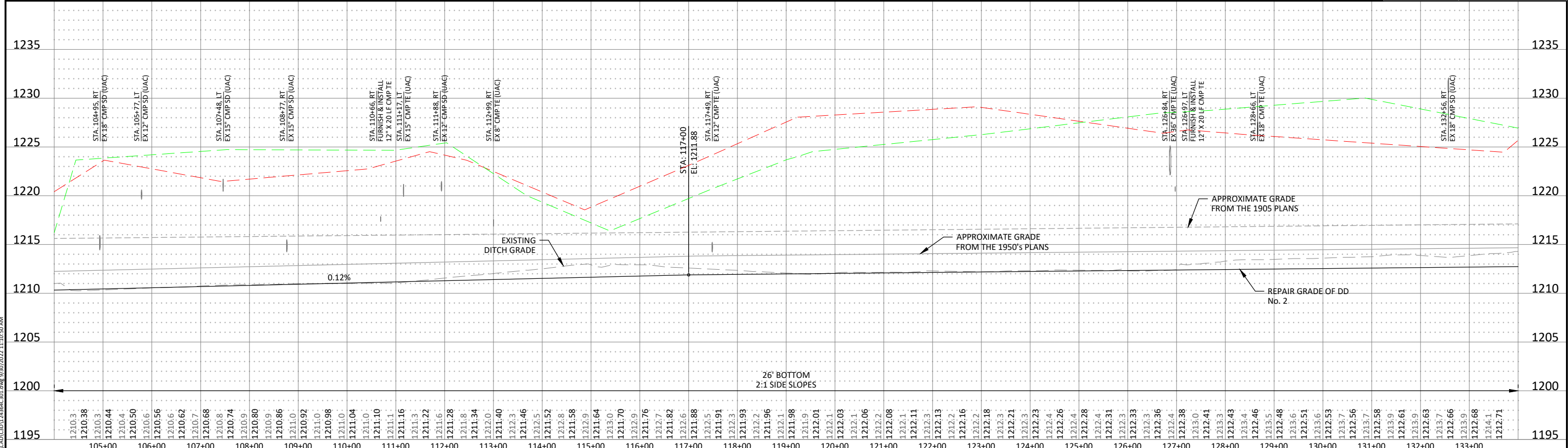
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 WORTH COUNTY, IOWA

**PLAN & PROFILE - DD NO 2 - LOWER MAIN OPEN DITCH**

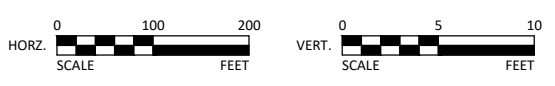
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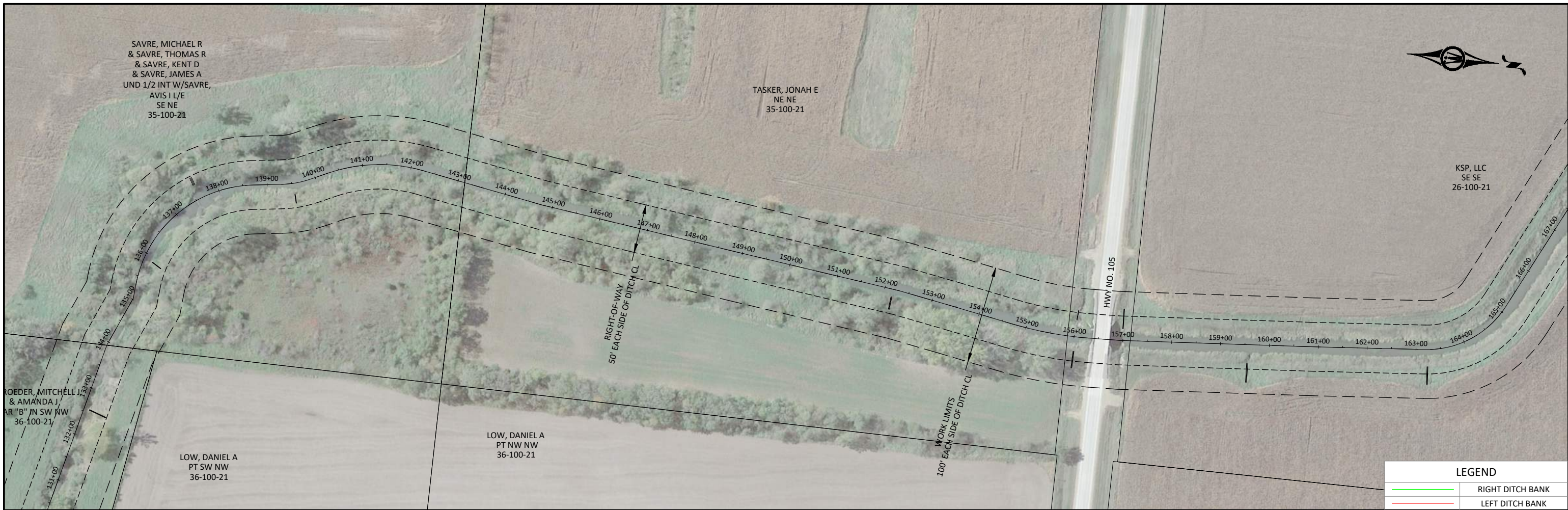
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 WORTH COUNTY, IOWA

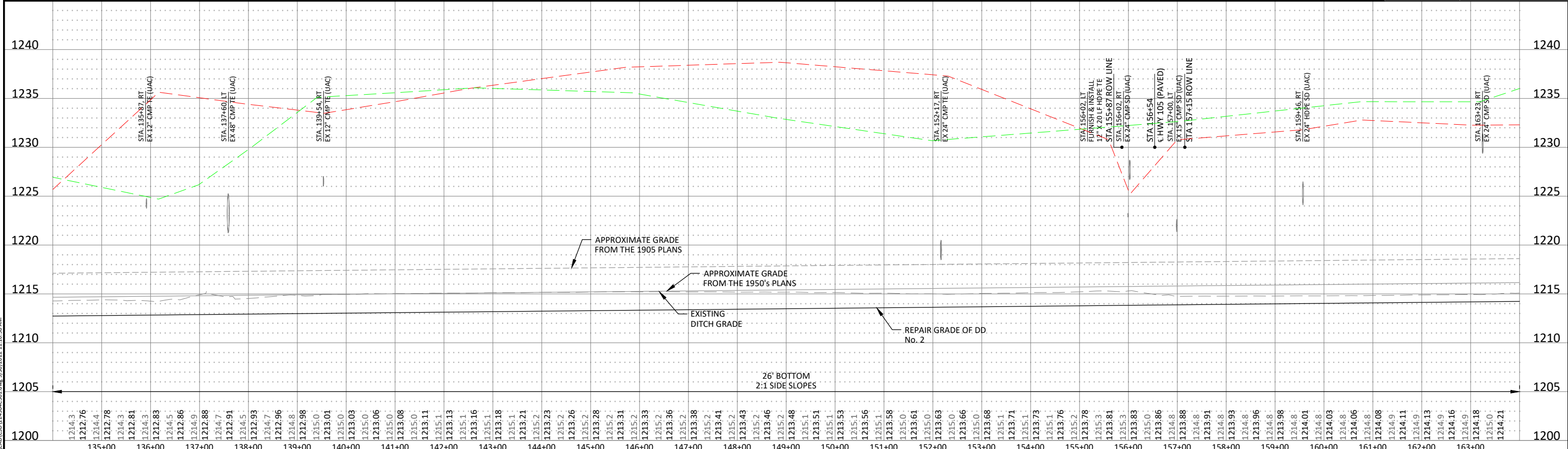
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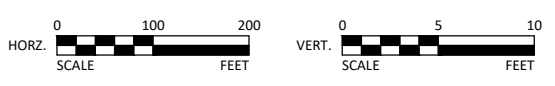




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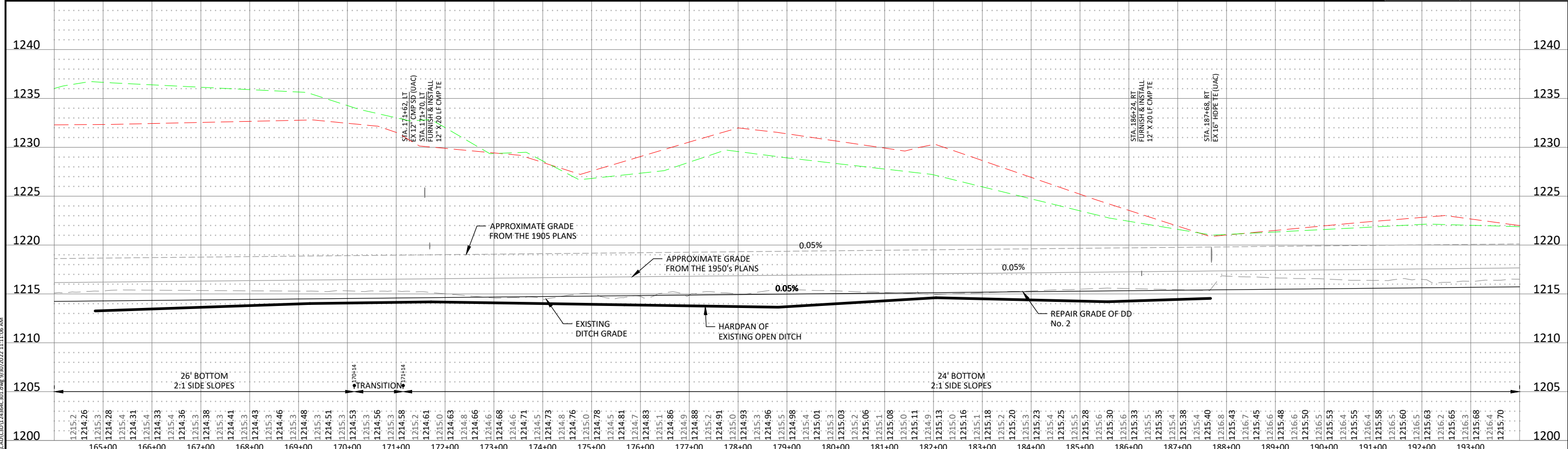
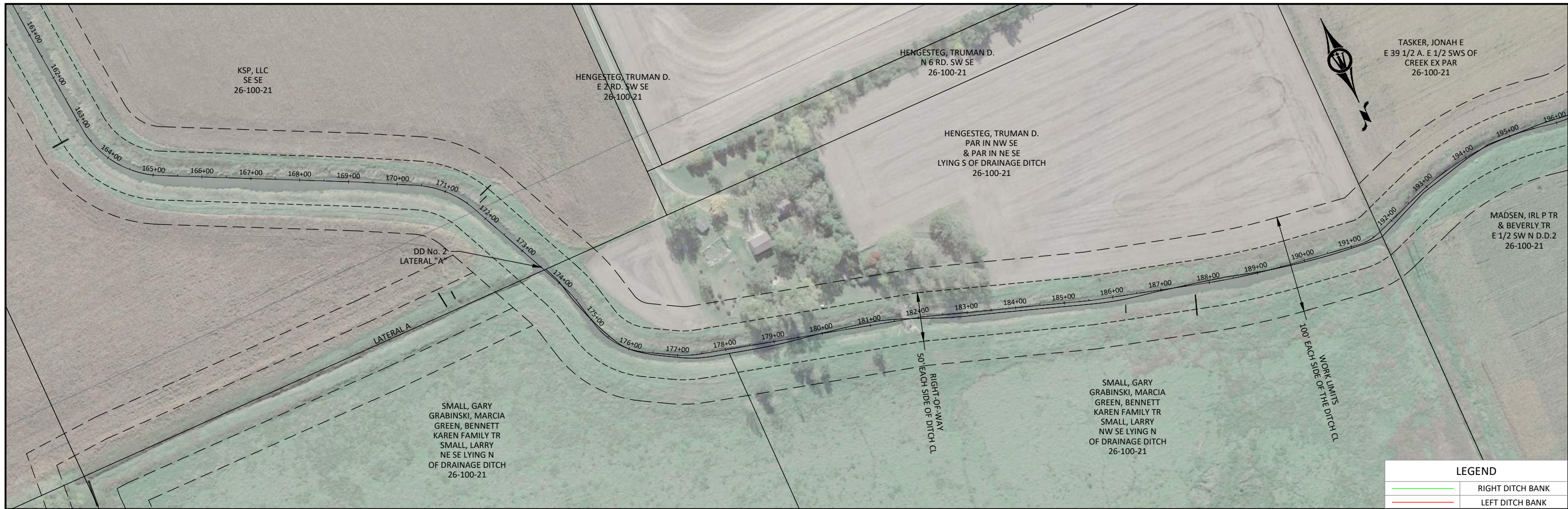
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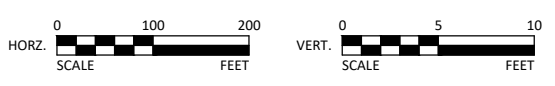
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WORTH COUNTY, IOWA

**PLAN & PROFILE - DD NO 2 - LOWER MAIN OPEN DITCH**

SHEET  
**D.03**



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**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA

**PLAN & PROFILE - DD NO 2 - LOWER MAIN OPEN DITCH**

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26-10-21

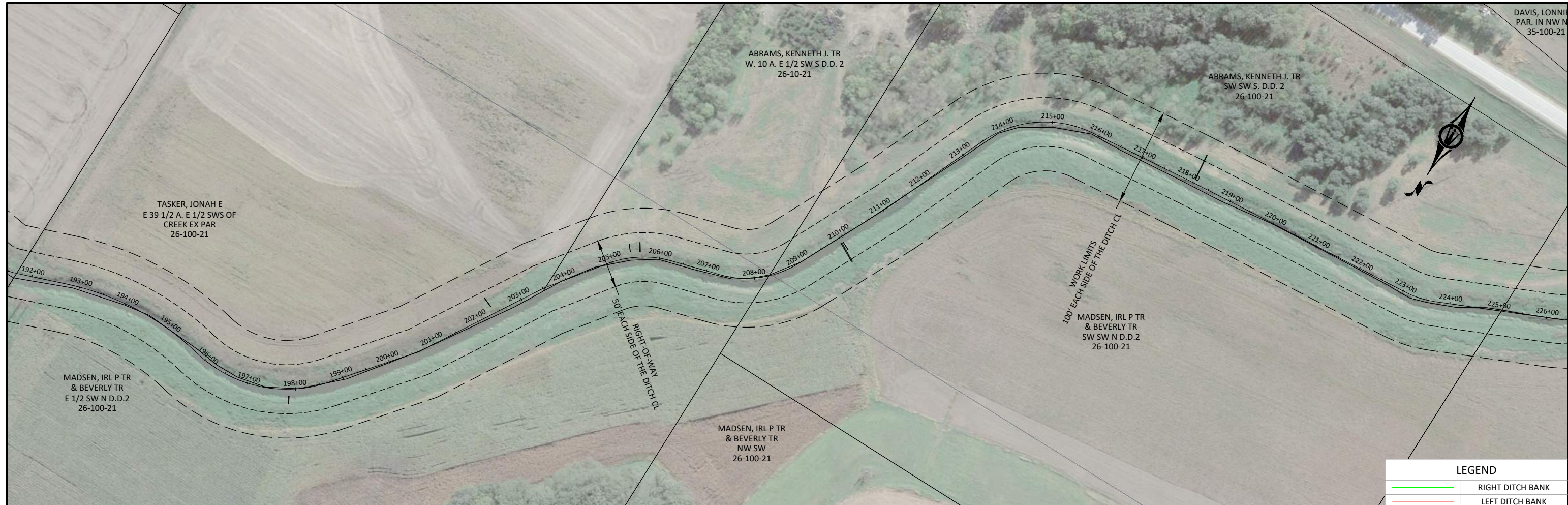
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26-100-21

TASKER, JONAH E  
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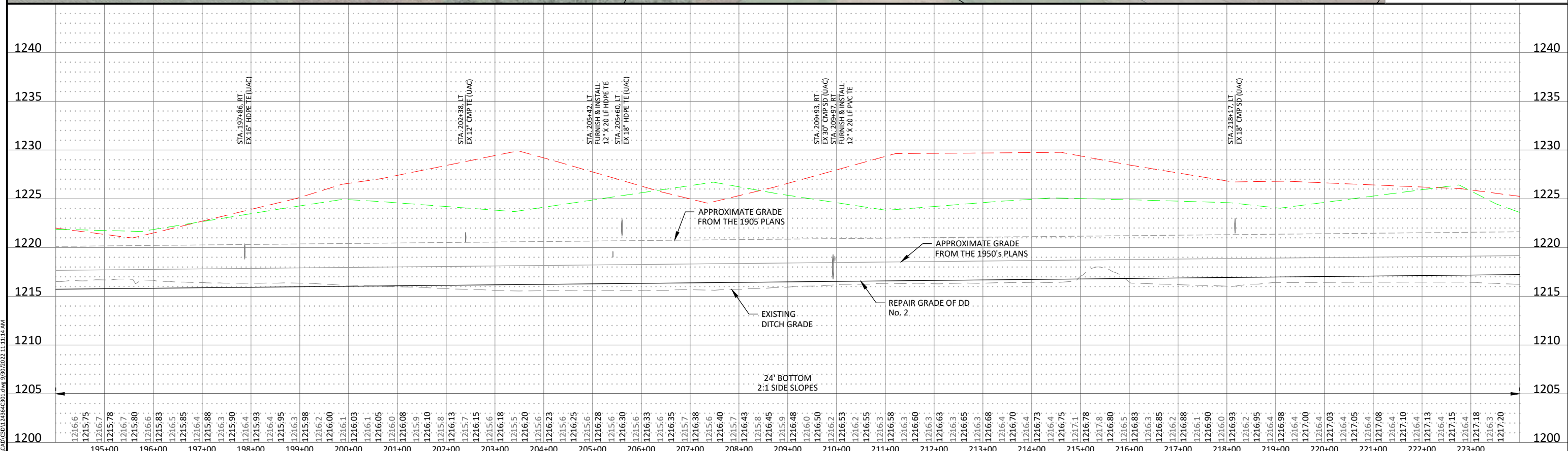
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MADSEN, IRL P TR  
& BEVERLY TR  
NW SW  
26-100-21

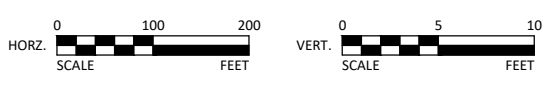
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& BEVERLY TR  
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26-100-21



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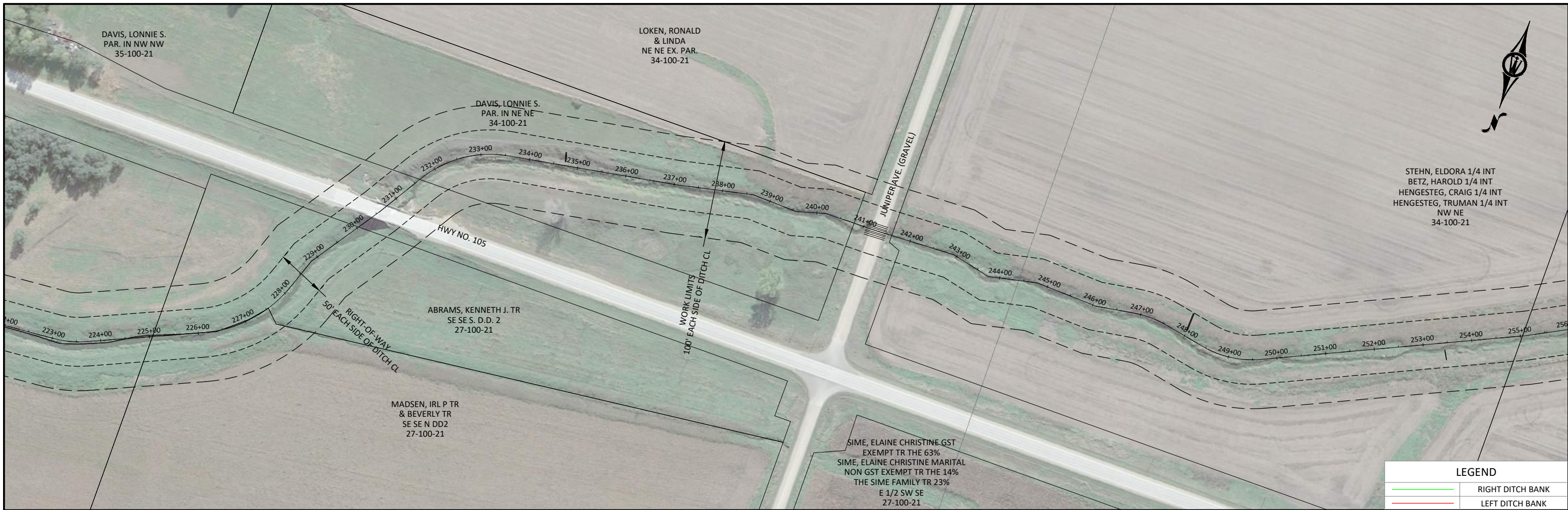
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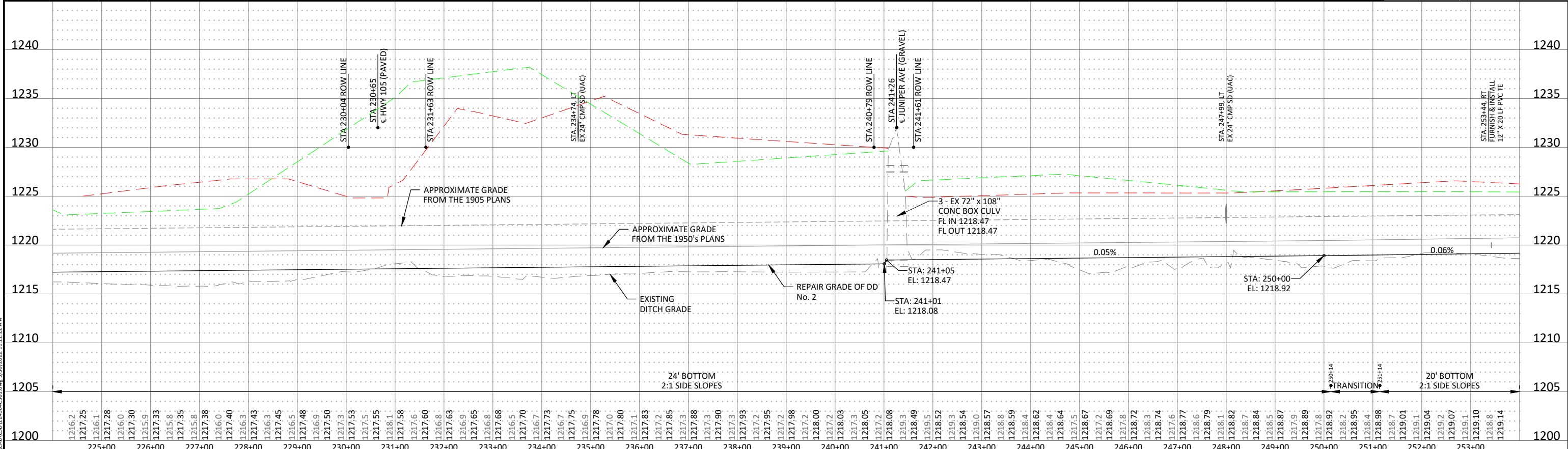
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**D.05**



STEHN, ELDORA 1/4 INT  
 BETZ, HAROLD 1/4 INT  
 HENGESTEG, CRAIG 1/4 INT  
 HENGESTEG, TRUMAN 1/4 INT  
 NW NE  
 34-100-21

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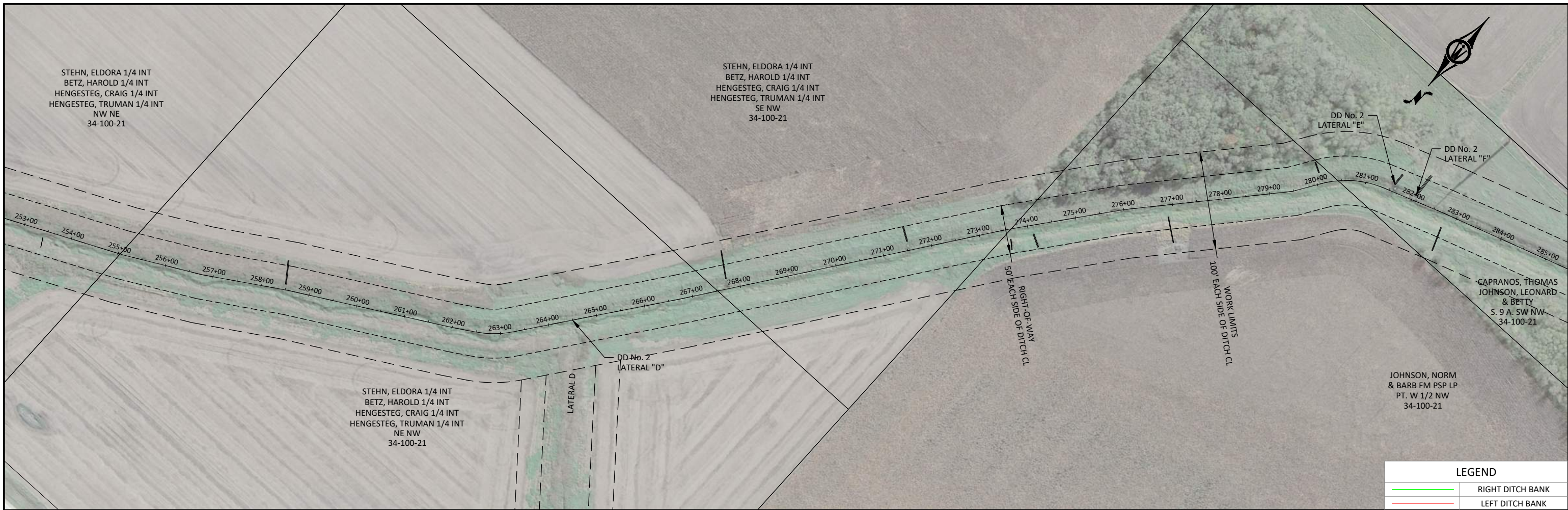
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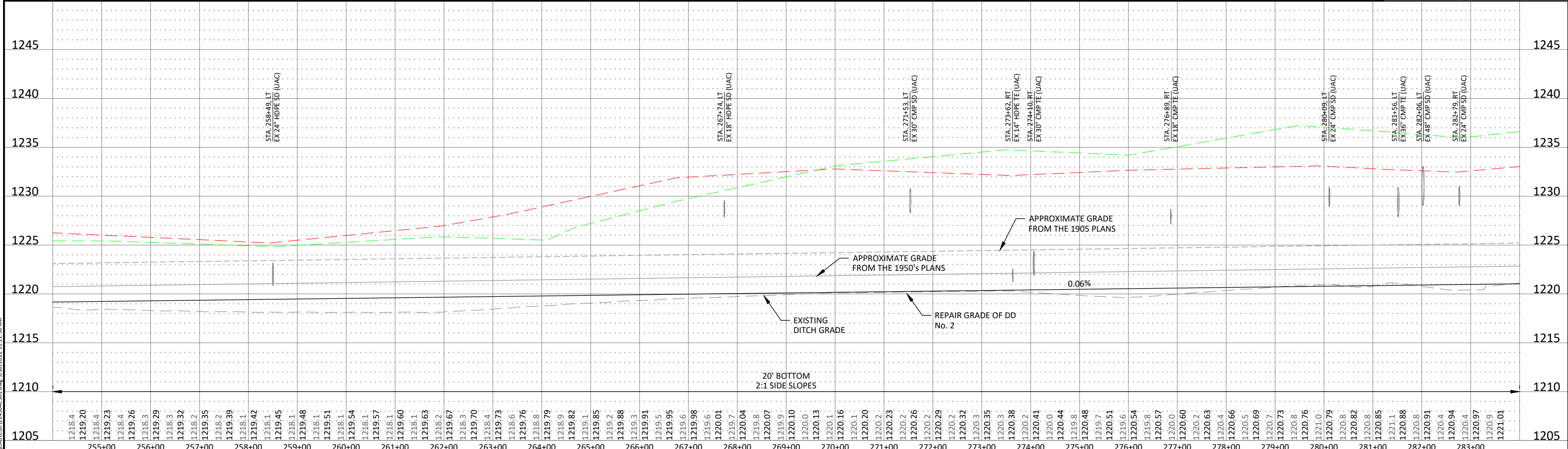
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 WORTH COUNTY, IOWA

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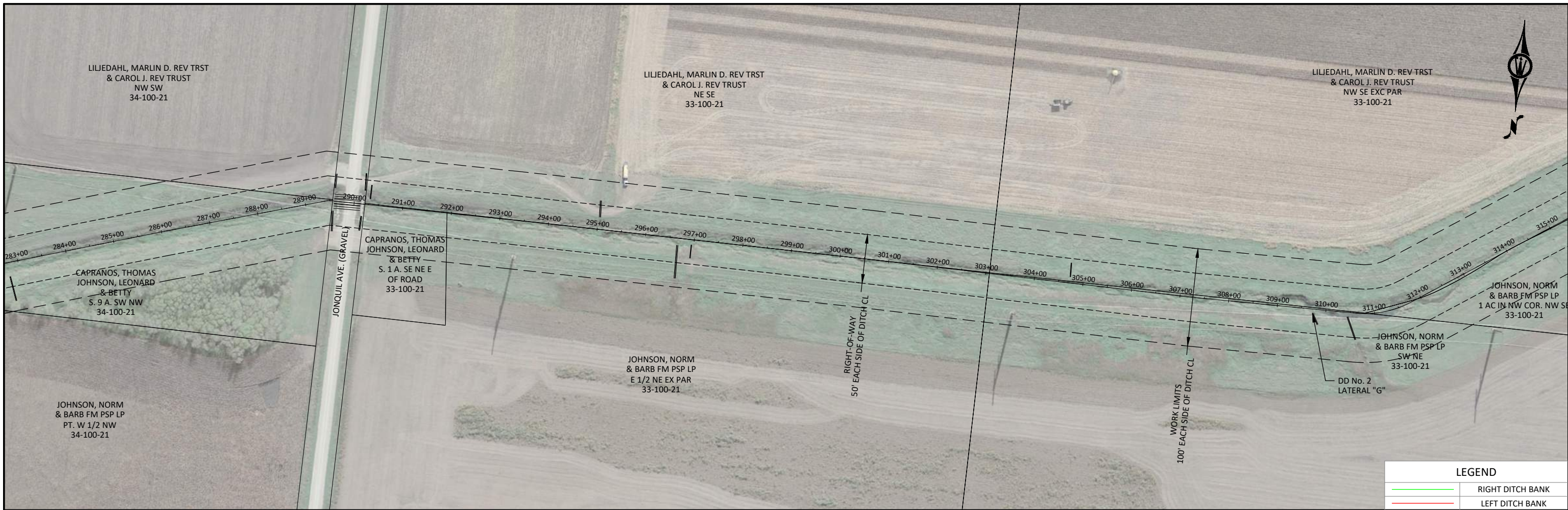
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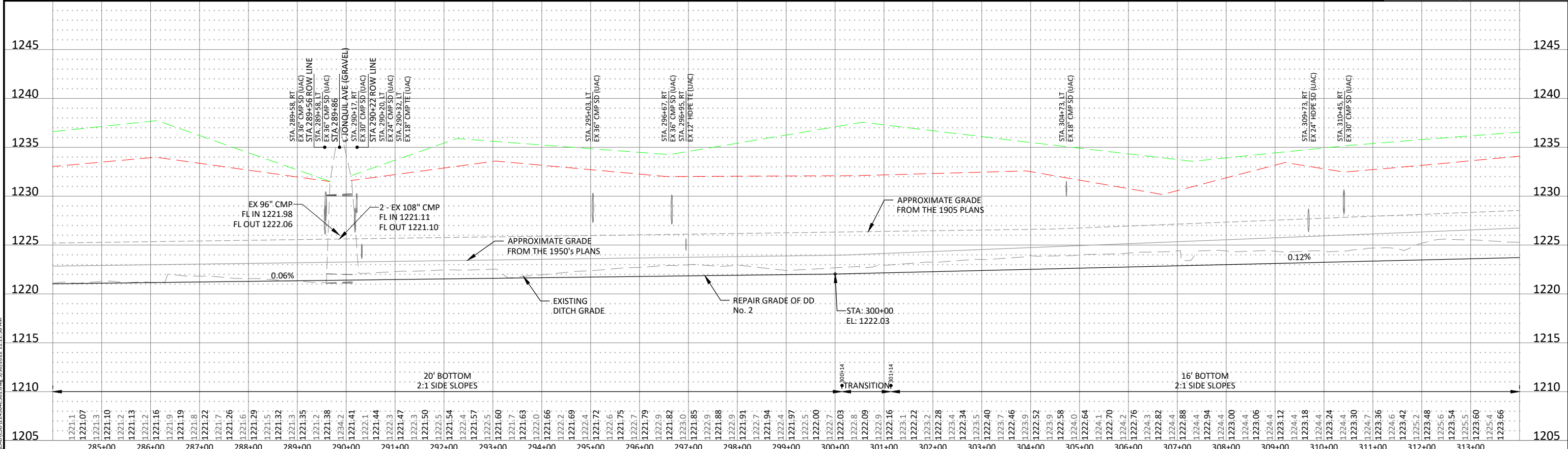
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WORTH COUNTY, IOWA

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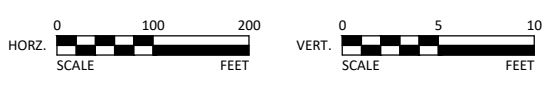
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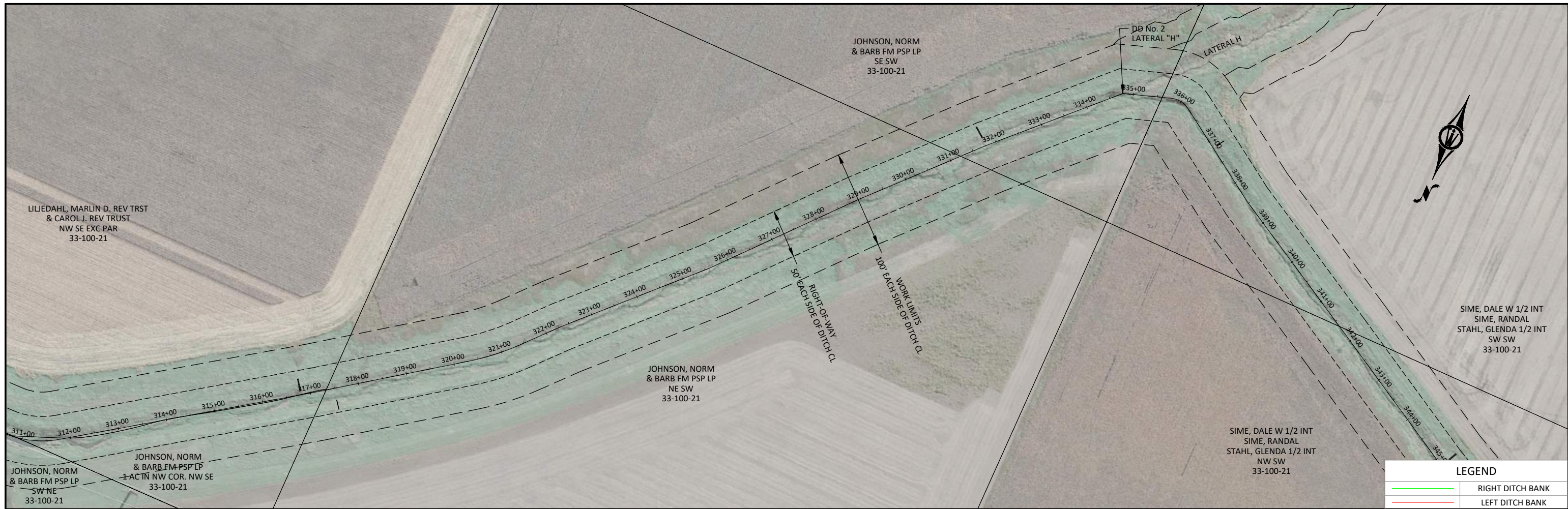
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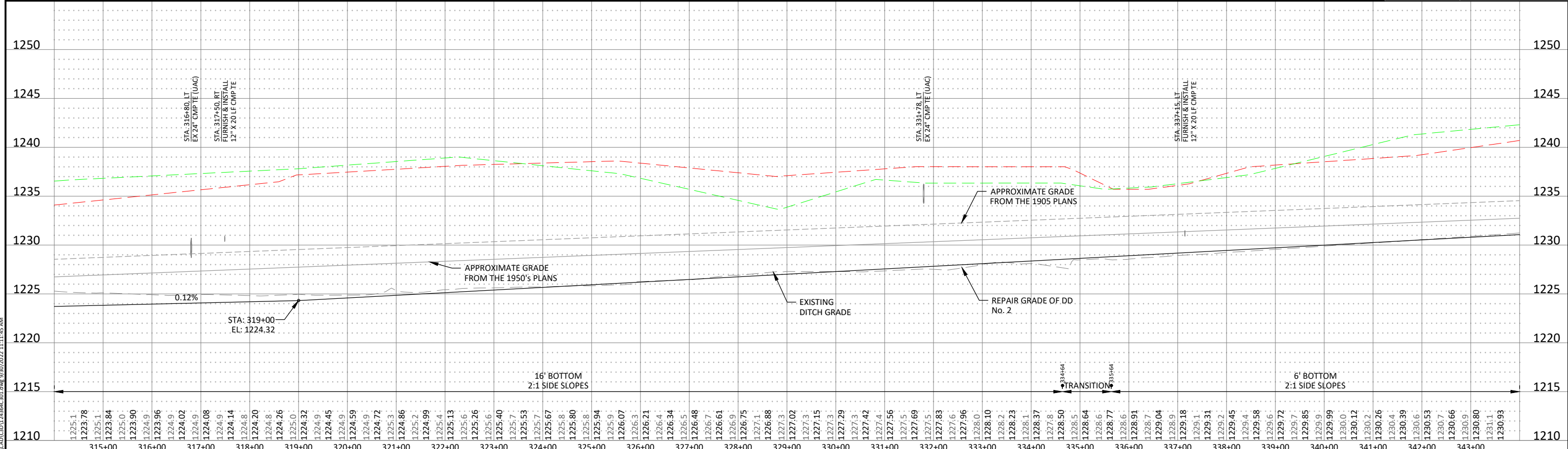
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WORTH COUNTY, IOWA

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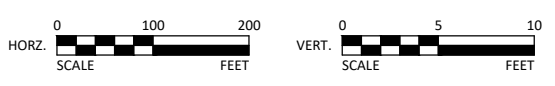
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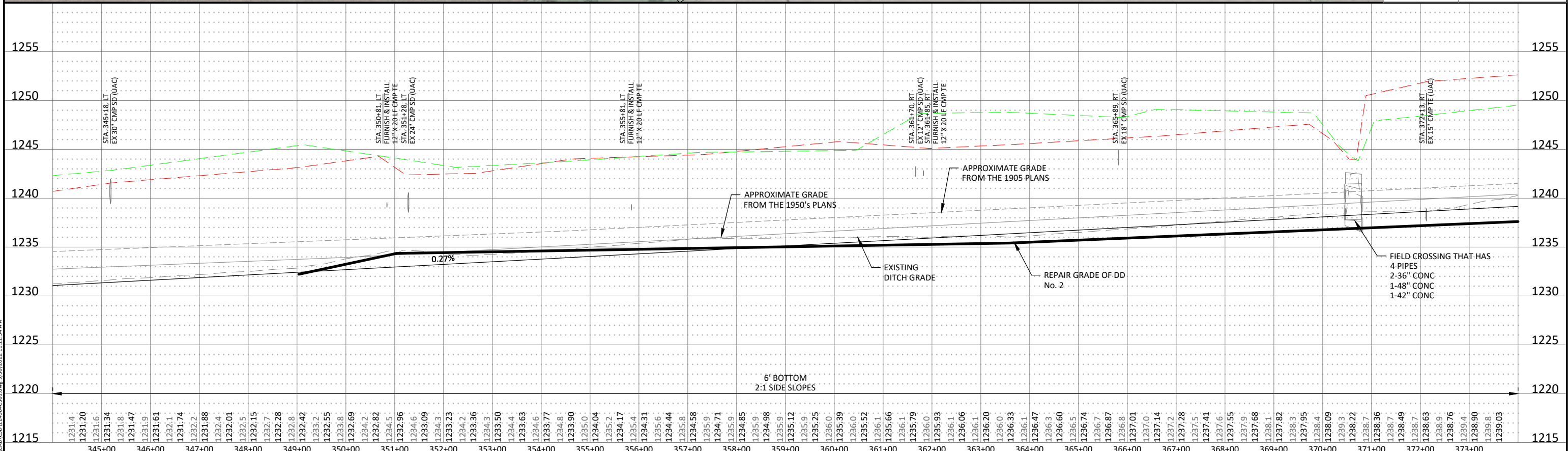
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WORTH COUNTY, IOWA

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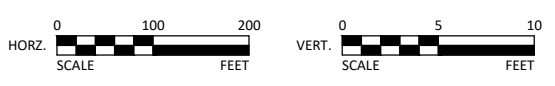
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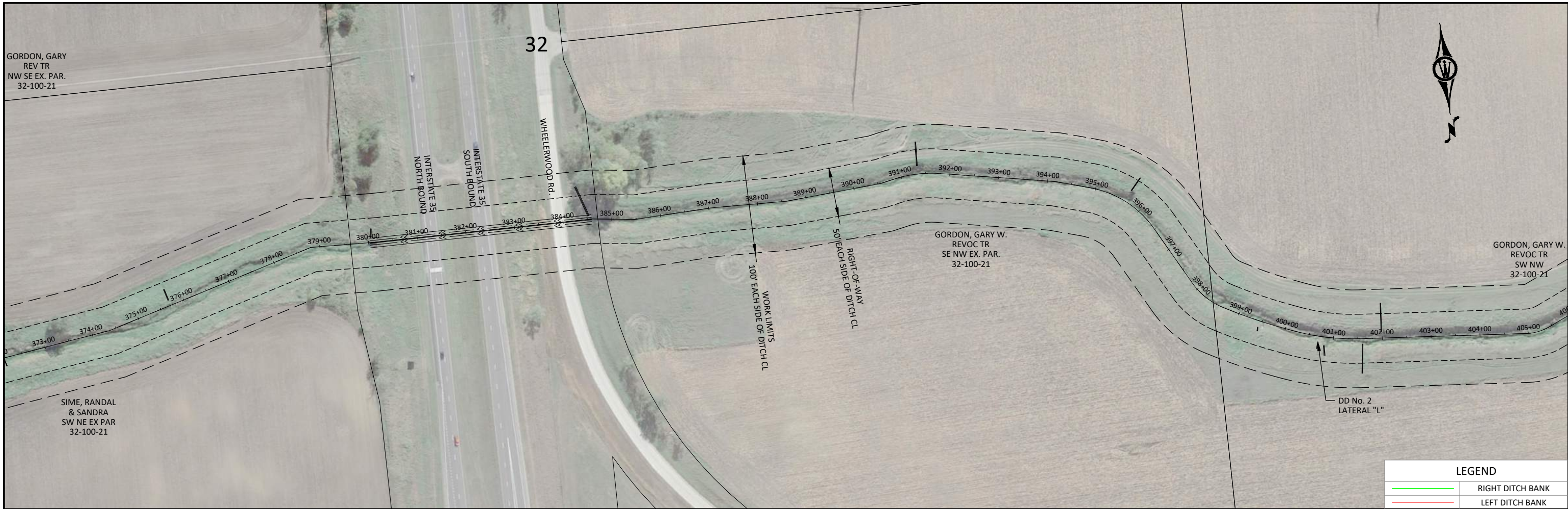
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WORTH COUNTY, IOWA

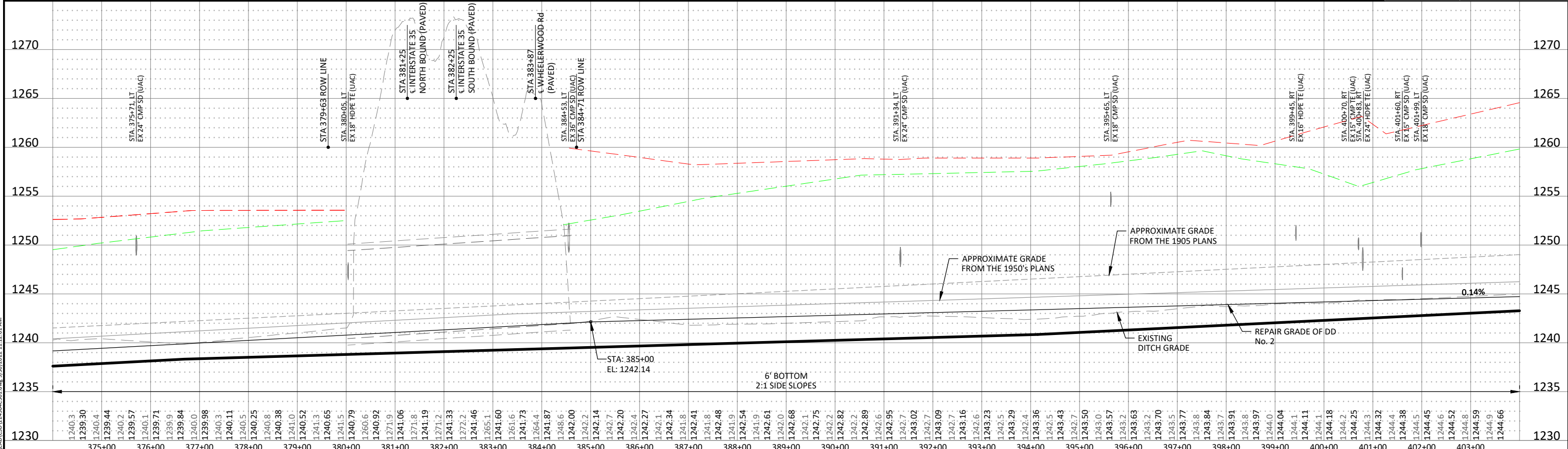
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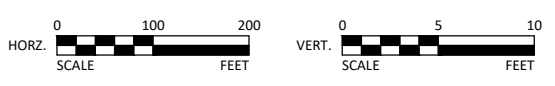




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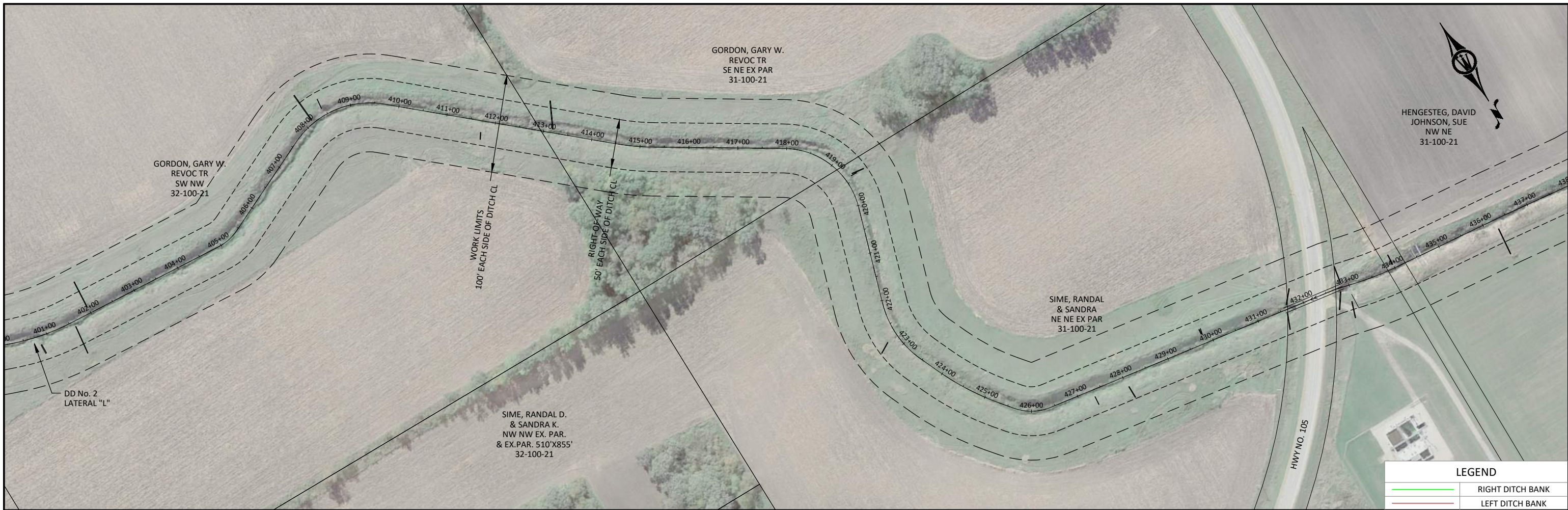
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CLH			
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CLIENT PROJ. NO.			

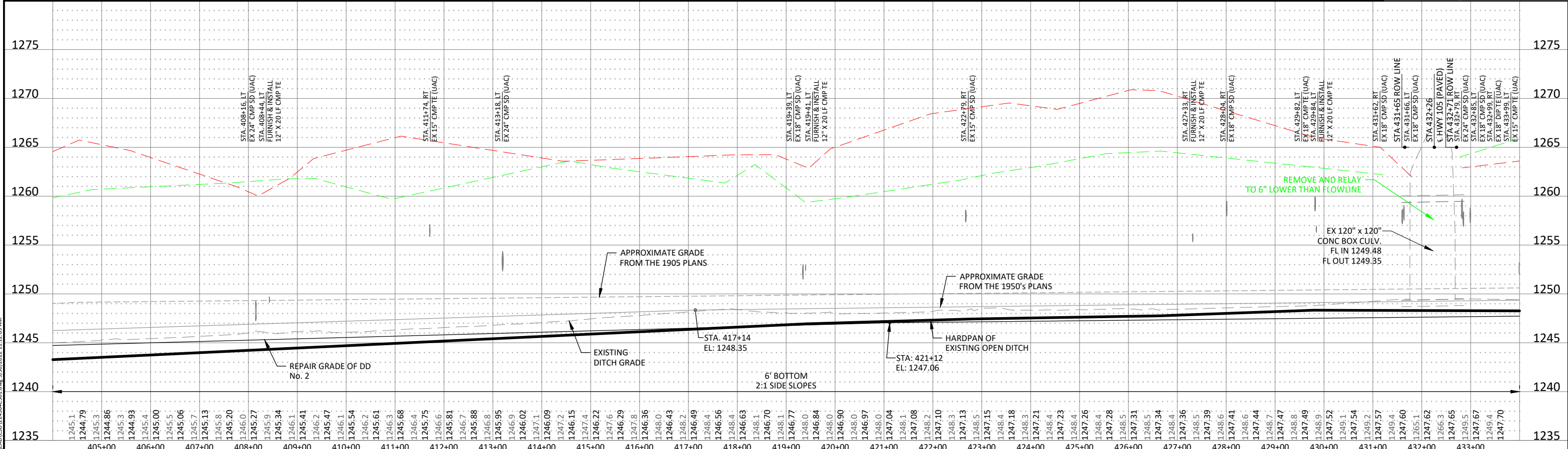
**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA

**PLAN & PROFILE - DD No 2 - LOWER MAIN OPEN DITCH**

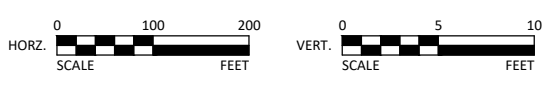
SHEET  
**D.11**



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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 www.bolton-menk.com

DESIGNED	REV	DESCRIPTION	DATE
JLH			
CLH			
JLH			
CLIENT PROJ. NO.			

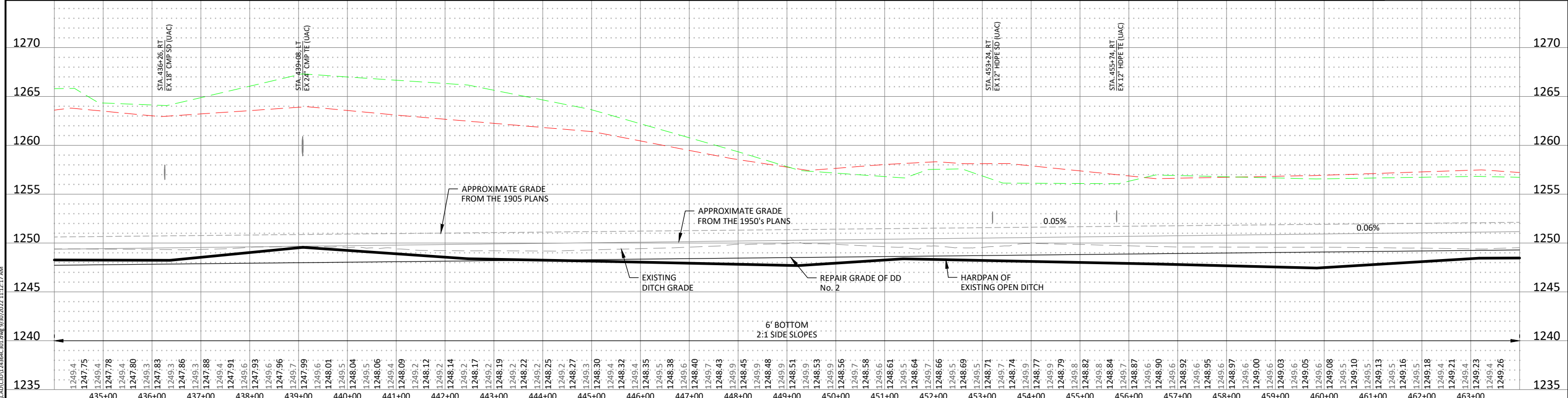
**DD No. 2 DRAINAGE IMPROVEMENTS**  
 WORTH COUNTY, IOWA

**PLAN & PROFILE - DD NO 2 - LOWER MAIN OPEN DITCH**

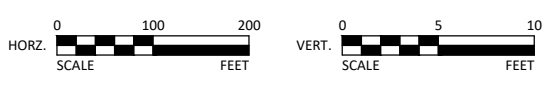
SHEET  
**D.12**



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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[www.bolton-menk.com](http://www.bolton-menk.com)

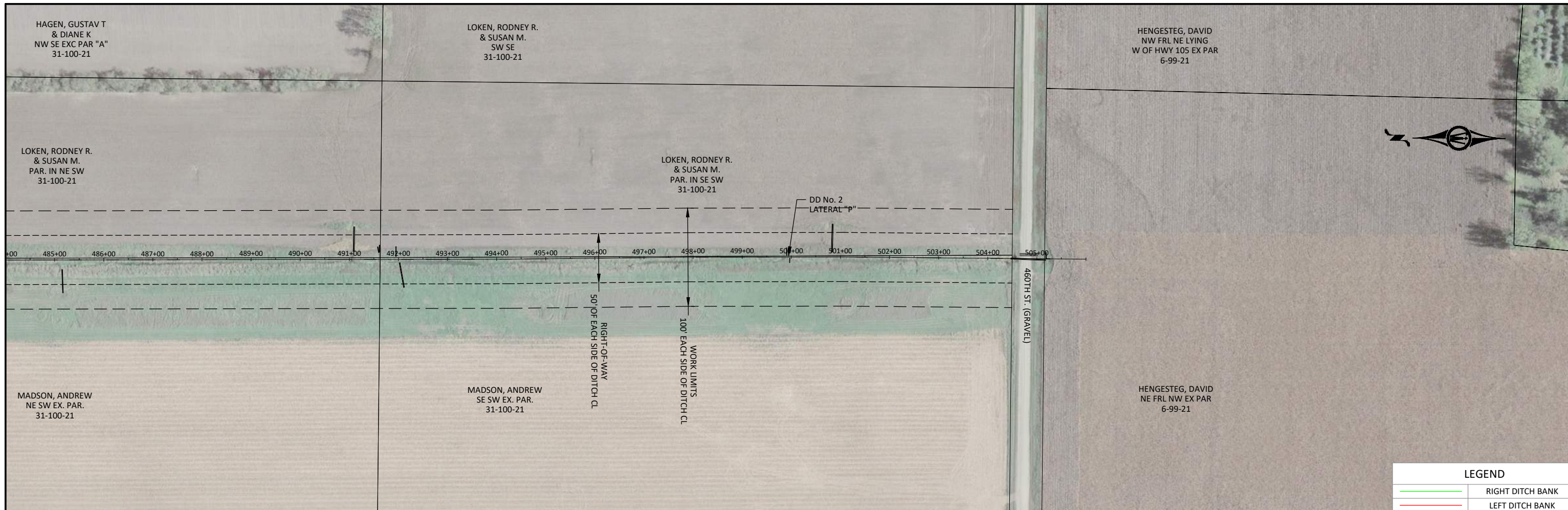
DESIGNED	REV	DESCRIPTION	DATE
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CLH			
JLH			
CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA

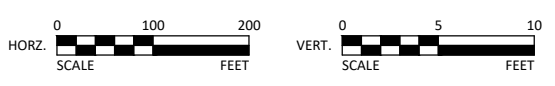
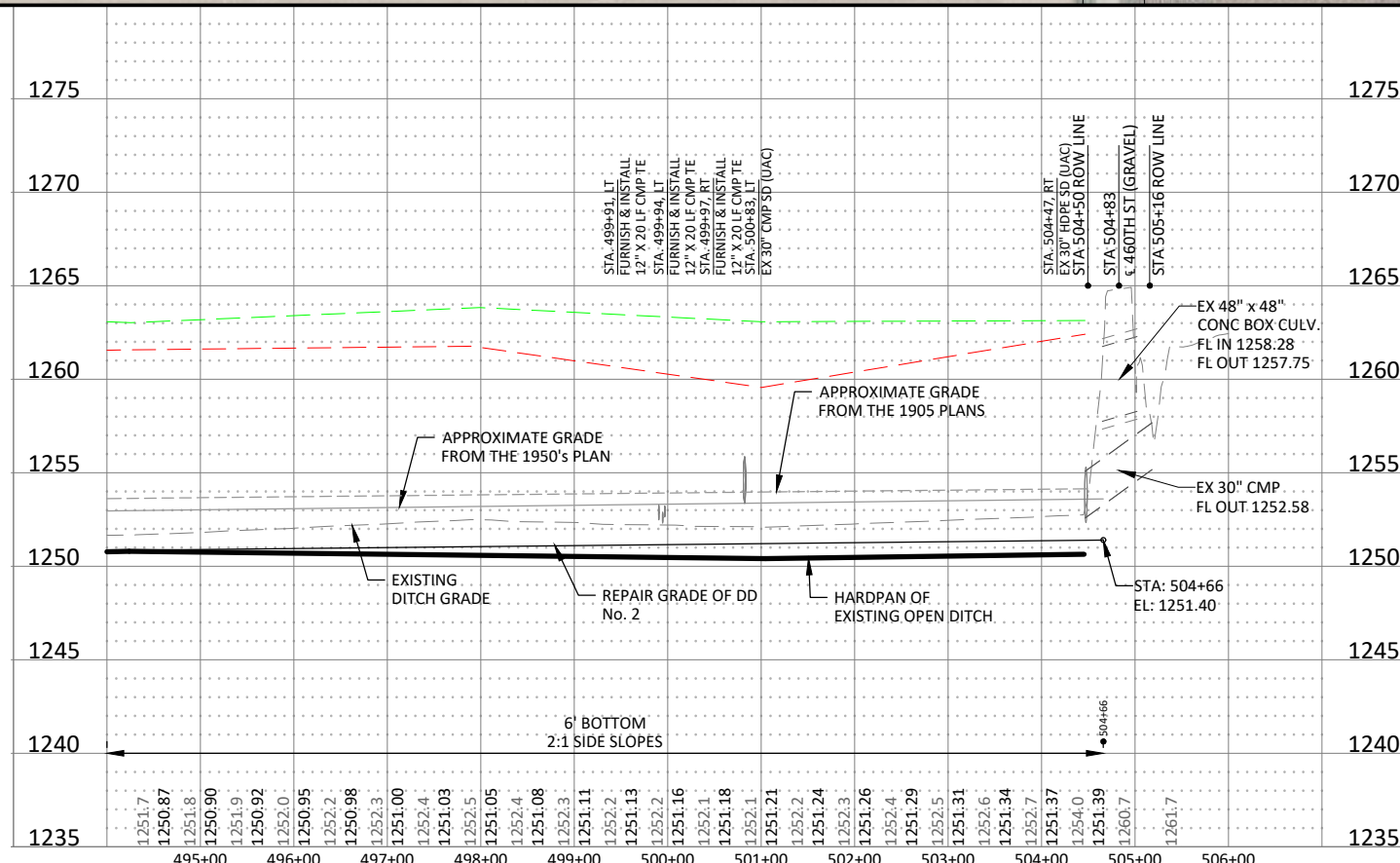
**PLAN & PROFILE - DD NO 2 - LOWER MAIN OPEN DITCH**

SHEET  
**D.13**





LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



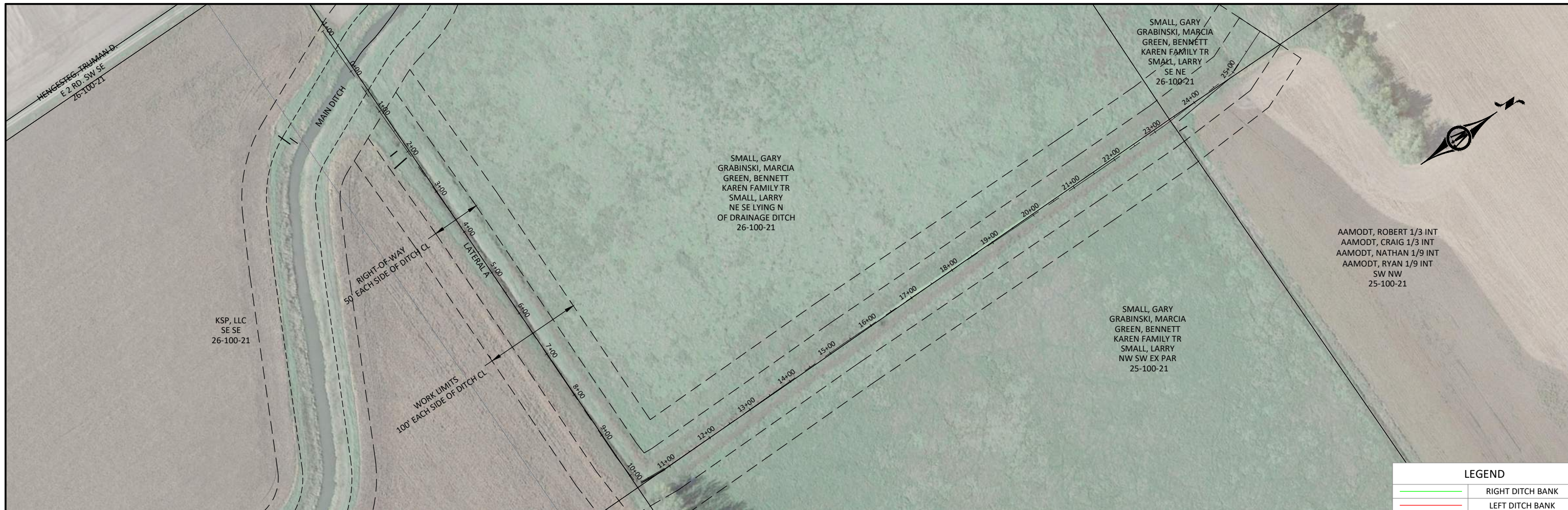
**BOLTON & MENK**  
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 Email: jefferson@bolton-menk.com  
 www.bolton-menk.com

DESIGNED	REV	DESCRIPTION	DATE
JLH			
DRAWN	CLH		
CHECKED	JLH		
CLIENT PROJ. NO.			

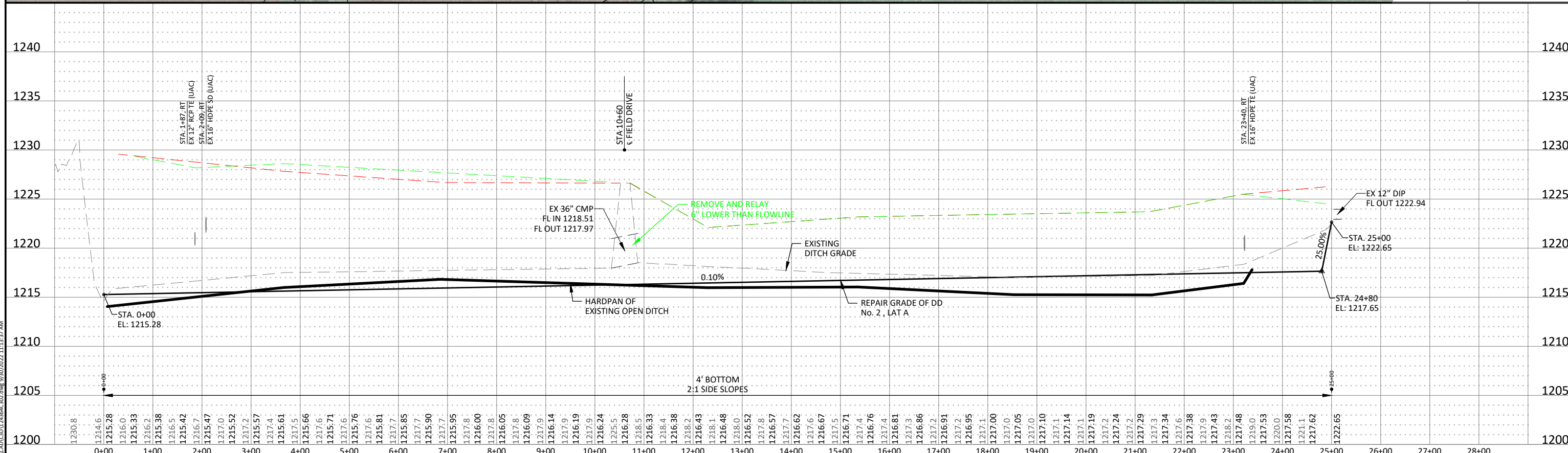
**DD No. 2 DRAINAGE IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
**PLAN & PROFILE - DD No 2 - LOWER MAIN OPEN DITCH**

SHEET  
**D.15**

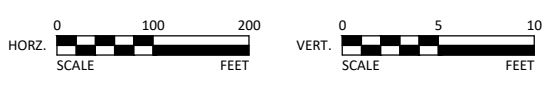
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LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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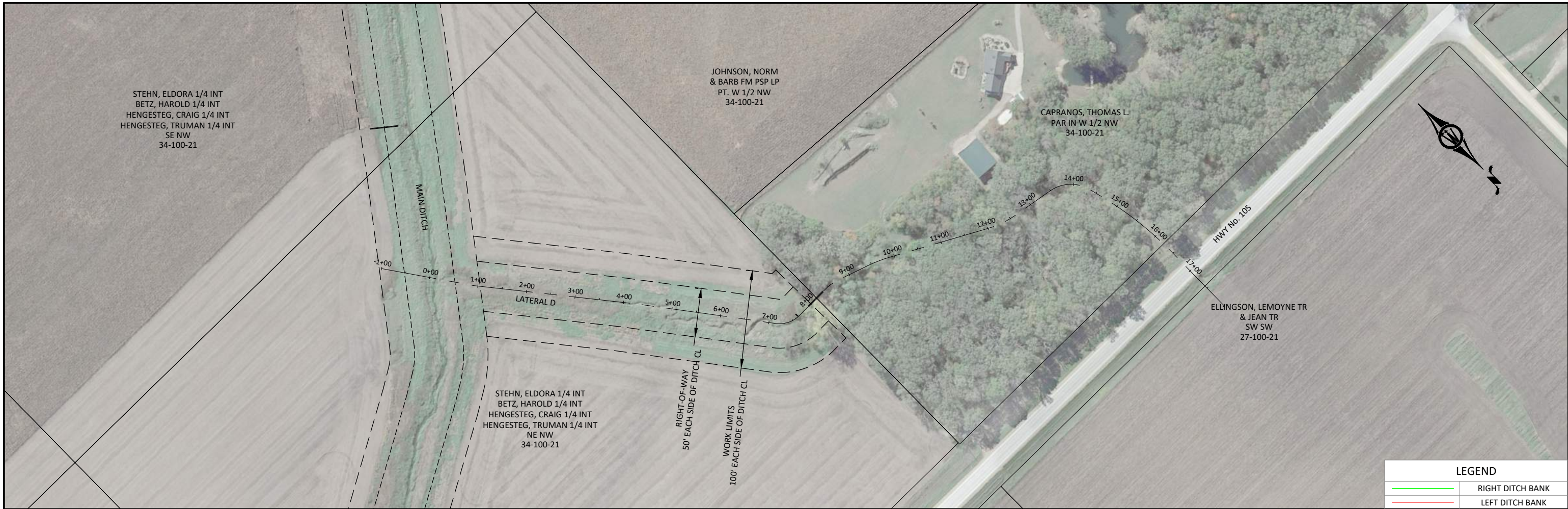


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[www.bolton-menk.com](http://www.bolton-menk.com)

DESIGNED	REV	DESCRIPTION	DATE
JLH			
DRAWN	CLH		
CHECKED	JLH		
CLIENT PROJ. NO.			

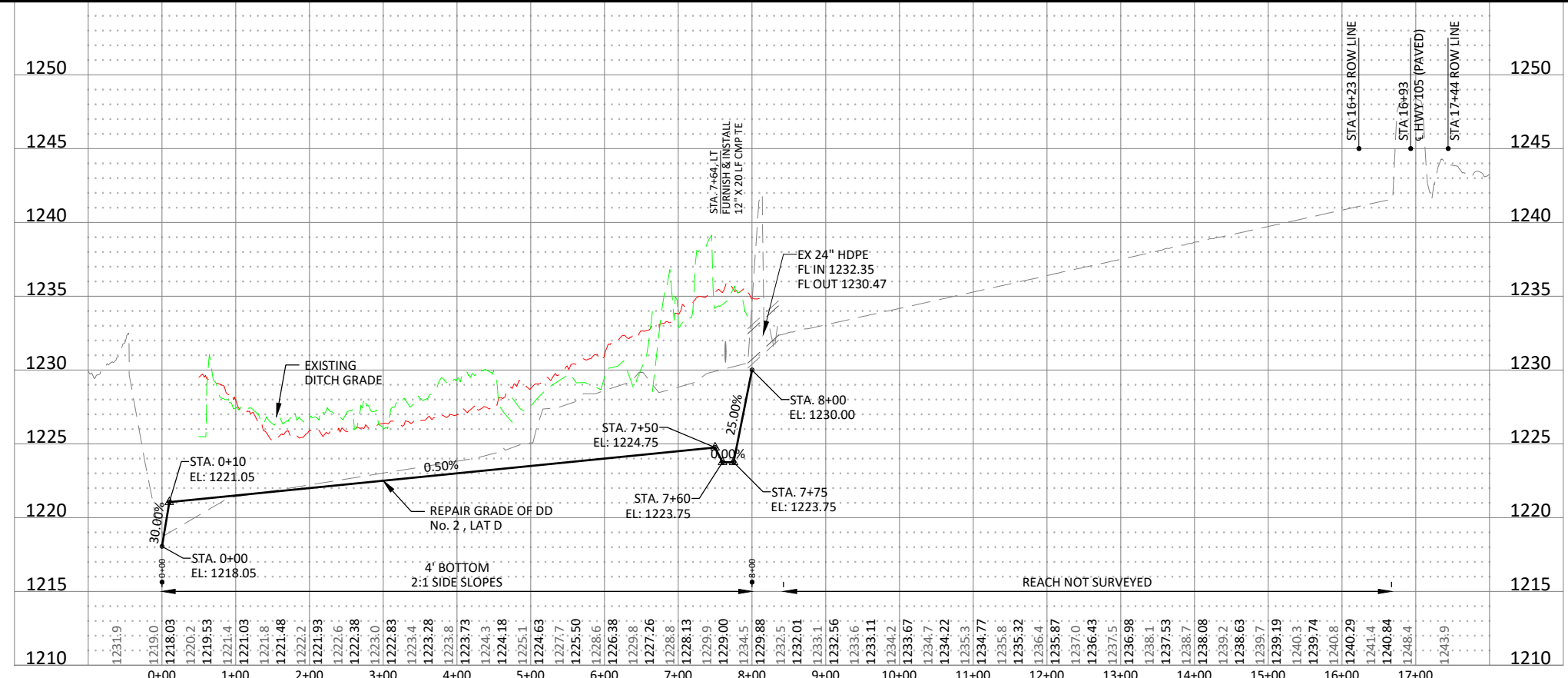
DD No. 2 DRAINAGE IMPROVEMENTS  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 2 - LATERAL A

SHEET  
**D.16**



**LEGEND**

	RIGHT DITCH BANK
	LEFT DITCH BANK

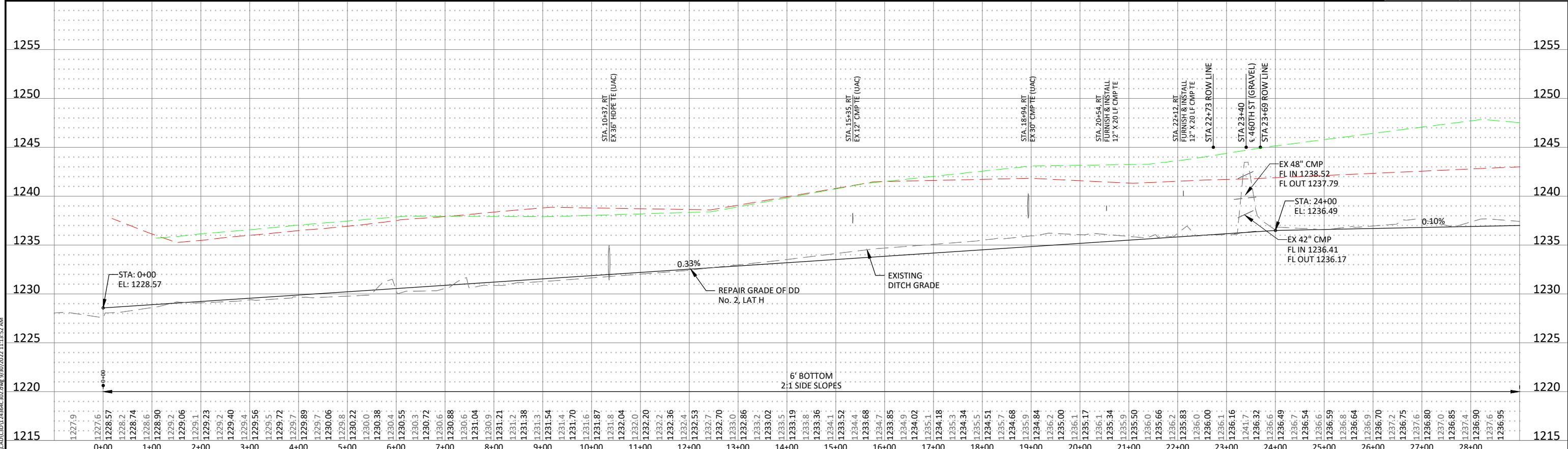
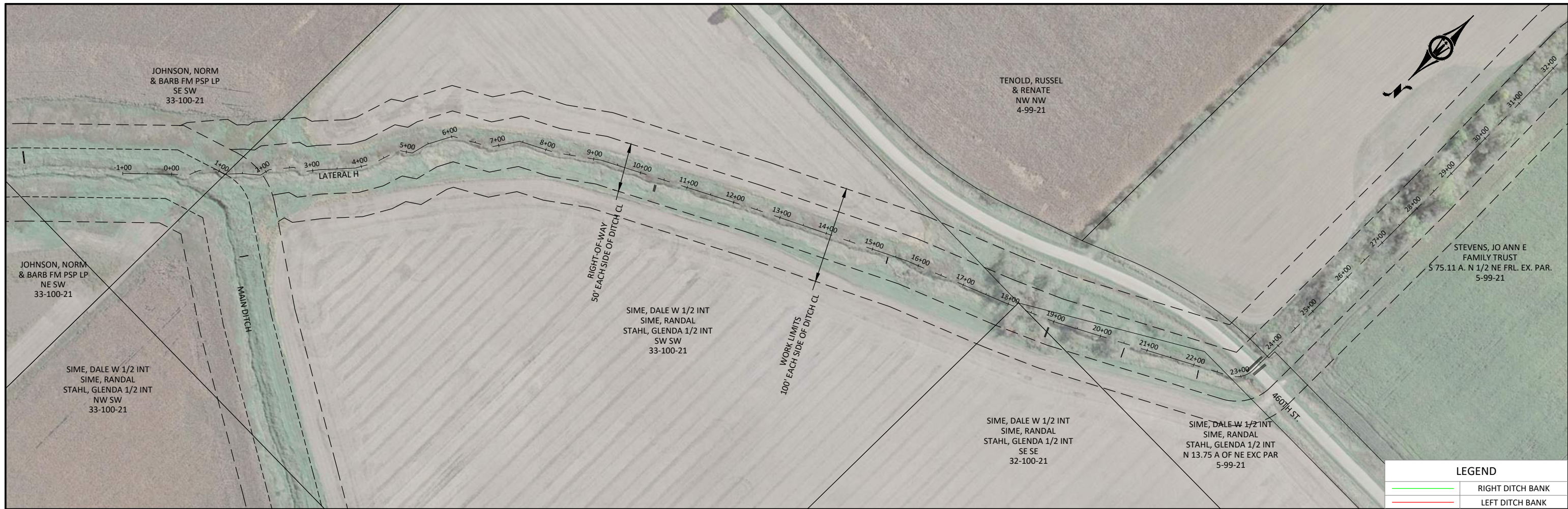


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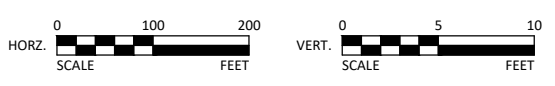
DESIGNED	REV	DESCRIPTION	DATE
JLH			
DRAWN			
CLH			
CHECKED			
JLH			
CLIENT PROJ. NO.			

DD No. 2 DRAINAGE IMPROVEMENTS  
WORTH COUNTY, IOWA  
PLAN & PROFILE - DD NO. 2 - LATERAL D

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DESIGNED	REV	DESCRIPTION	DATE
JLH			
CLH			
JLH			
CLIENT PROJ. NO.			

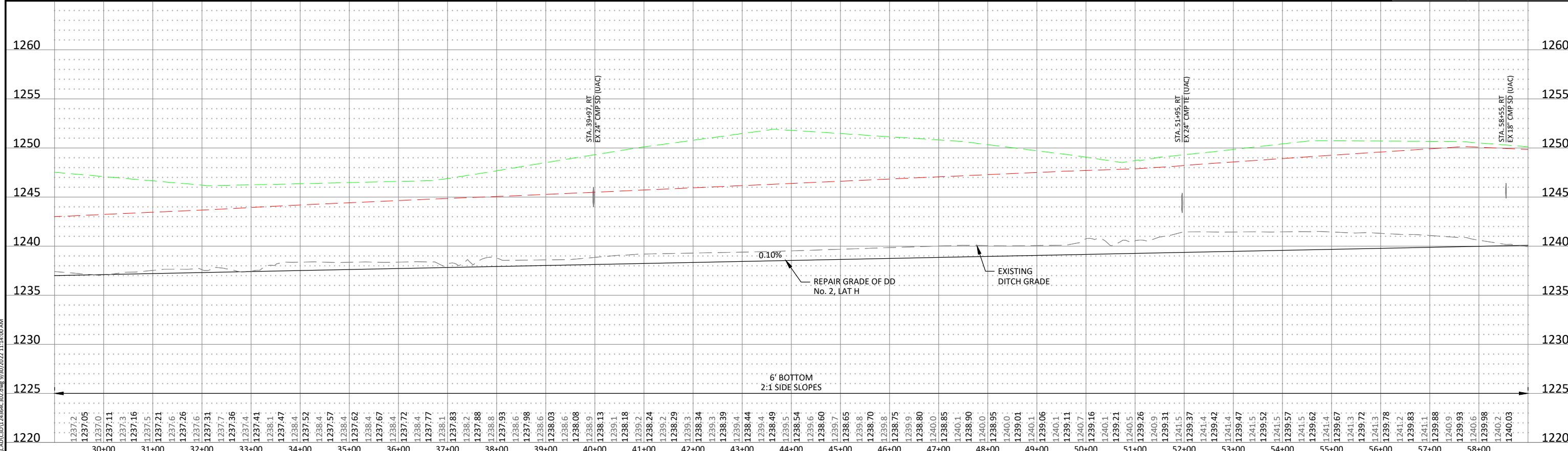
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WORTH COUNTY, IOWA  
**PLAN & PROFILE - DD NO. 2 - LATERAL H**

SHEET  
**D.18**

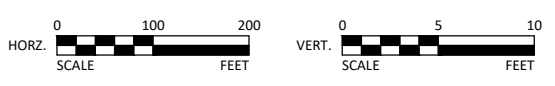




LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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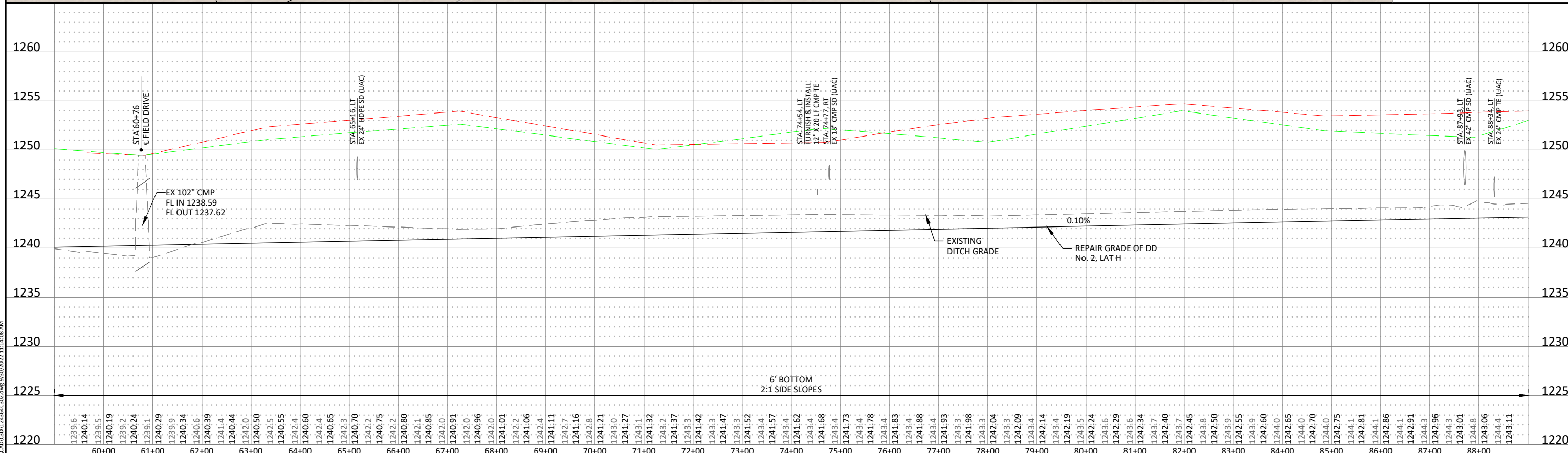
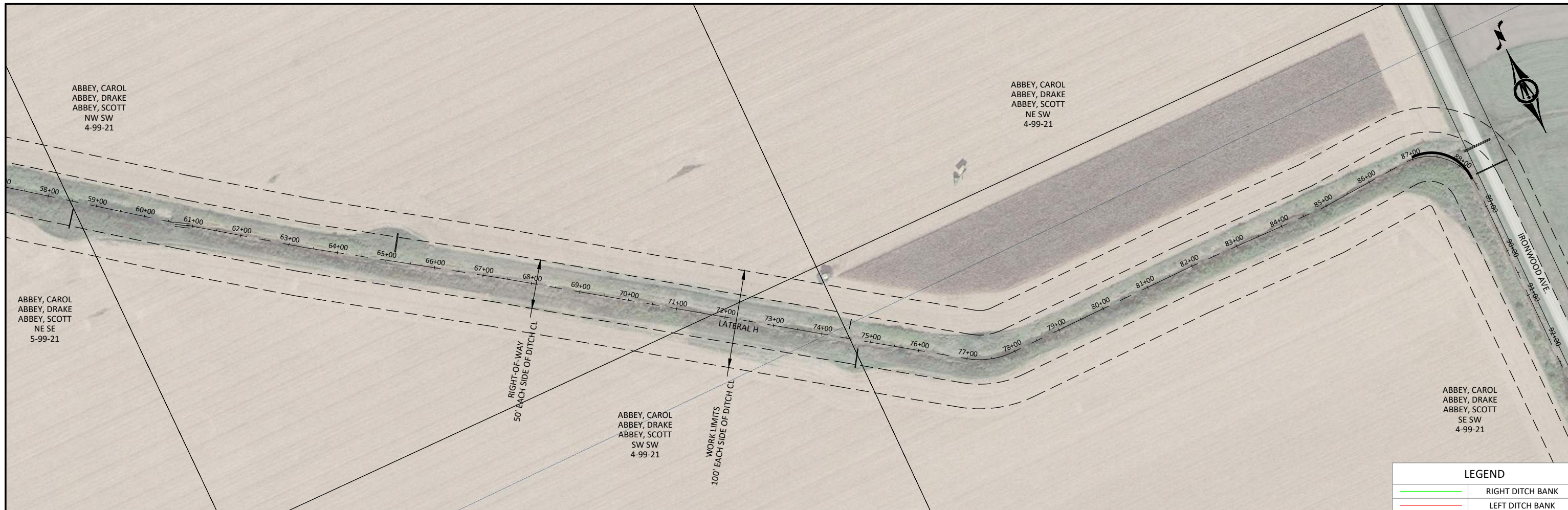


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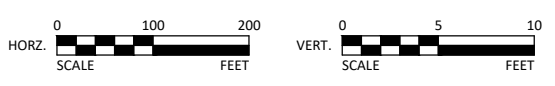
DESIGNED	REV	DESCRIPTION	DATE
JLH			
CLH			
JLH			
CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA  
**PLAN & PROFILE - DD NO. 2 - LATERAL H**

SHEET  
**D.19**



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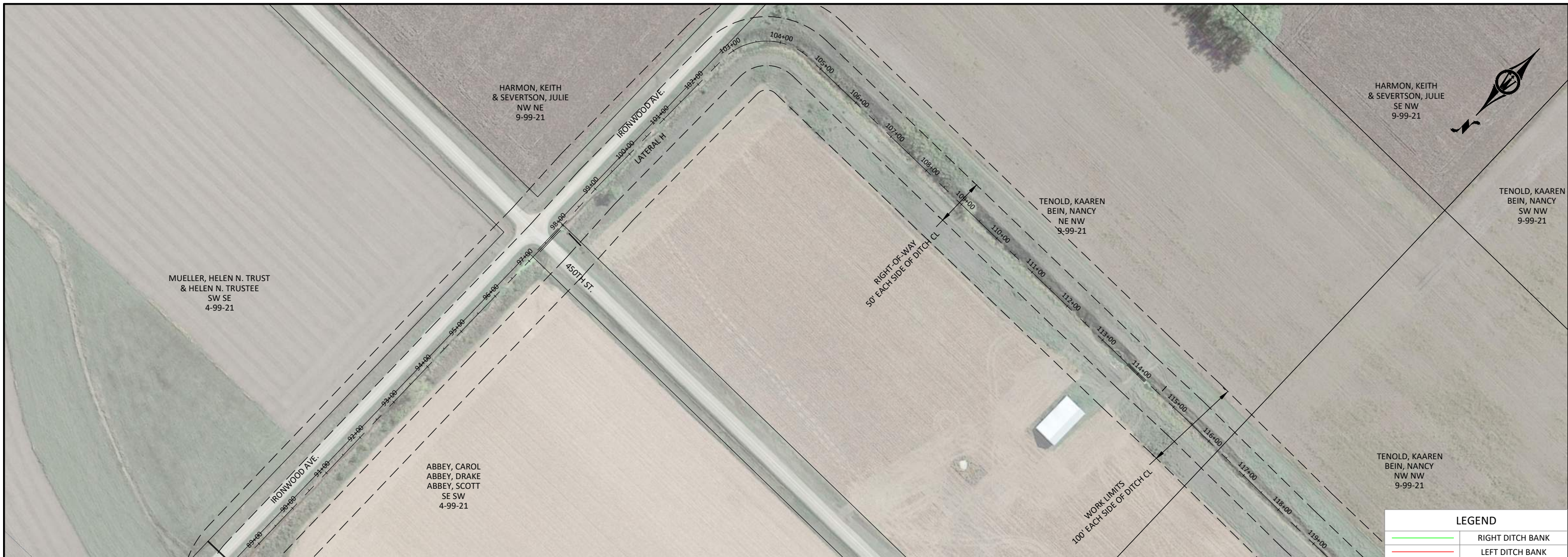


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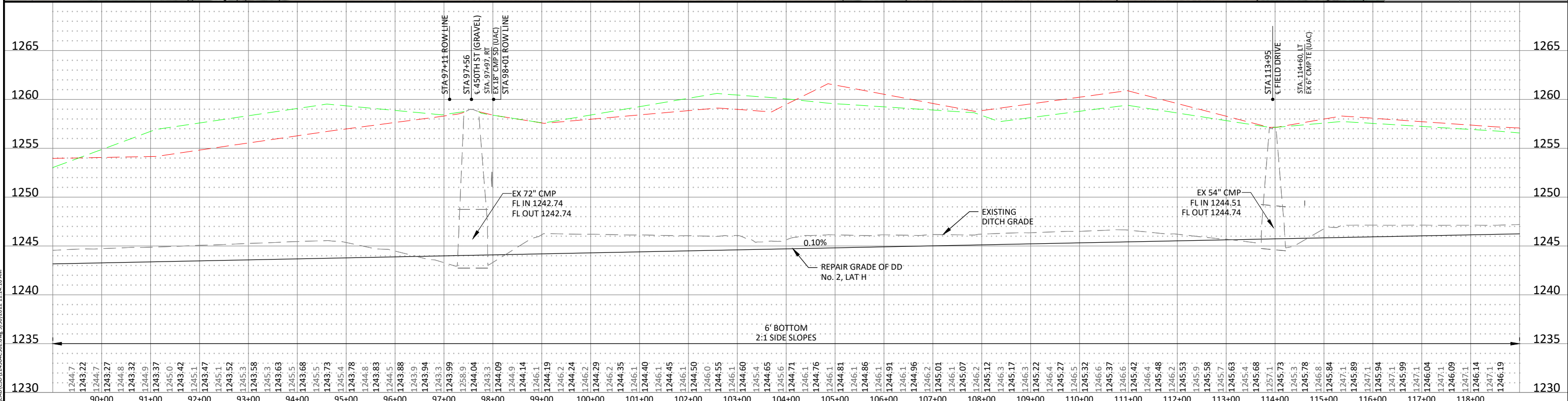
DESIGNED	REV	DESCRIPTION	DATE
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CLH			
JLH			
CLIENT PROJ. NO.			

DD No. 2 DRAINAGE IMPROVEMENTS  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 2 - LATERAL H

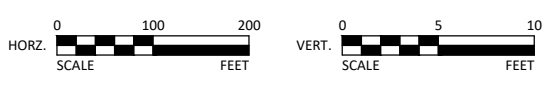
SHEET  
**D.20**



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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DESIGNED	REV	DESCRIPTION	DATE
JLH			
DRAWN			
CHEKED			
JLH			
CLIENT PROJ. NO.			

DD No. 2 DRAINAGE IMPROVEMENTS  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 2 - LATERAL H

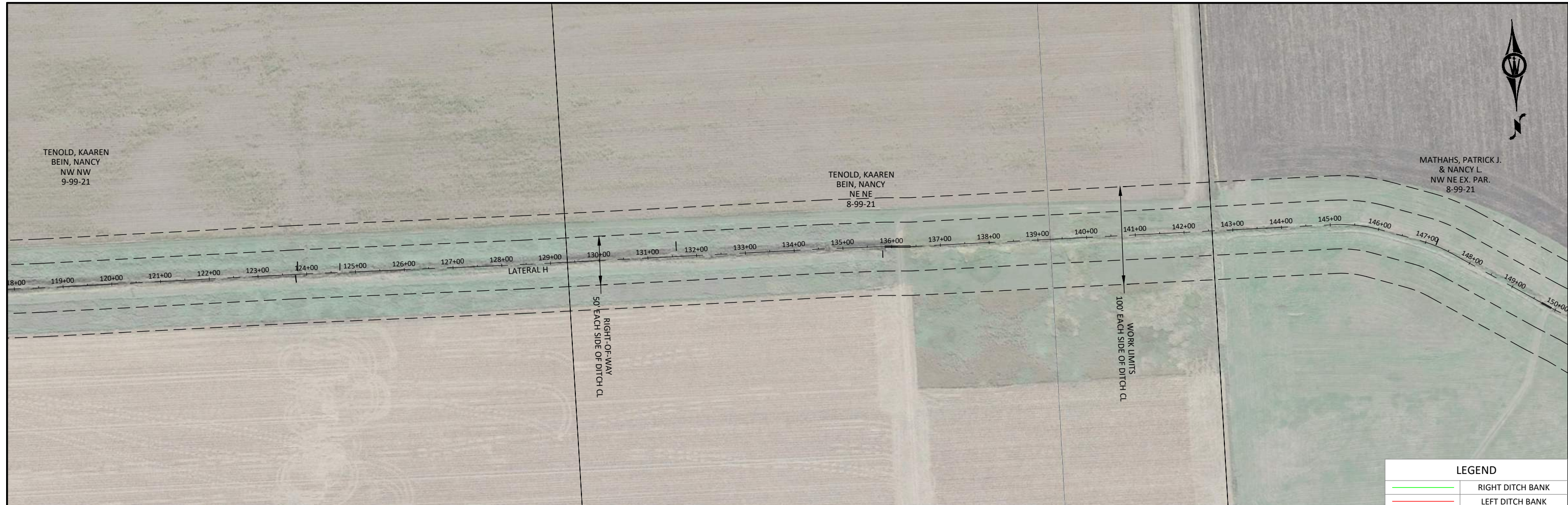
SHEET  
**D.21**



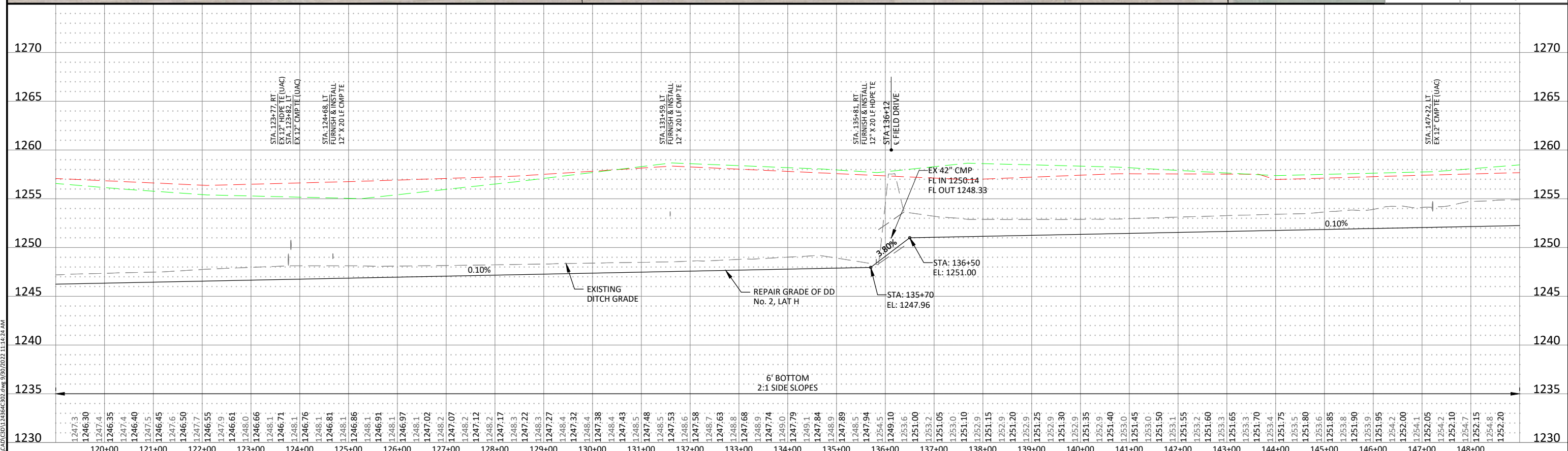
TENOLD, KAAREN  
BEIN, NANCY  
NW NW  
9-99-21

TENOLD, KAAREN  
BEIN, NANCY  
NE NE  
8-99-21

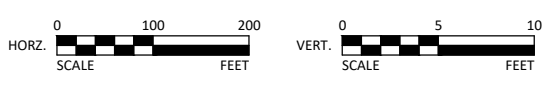
MATHAHS, PATRICK J.  
& NANCY L.  
NW NE EX. PAR.  
8-99-21



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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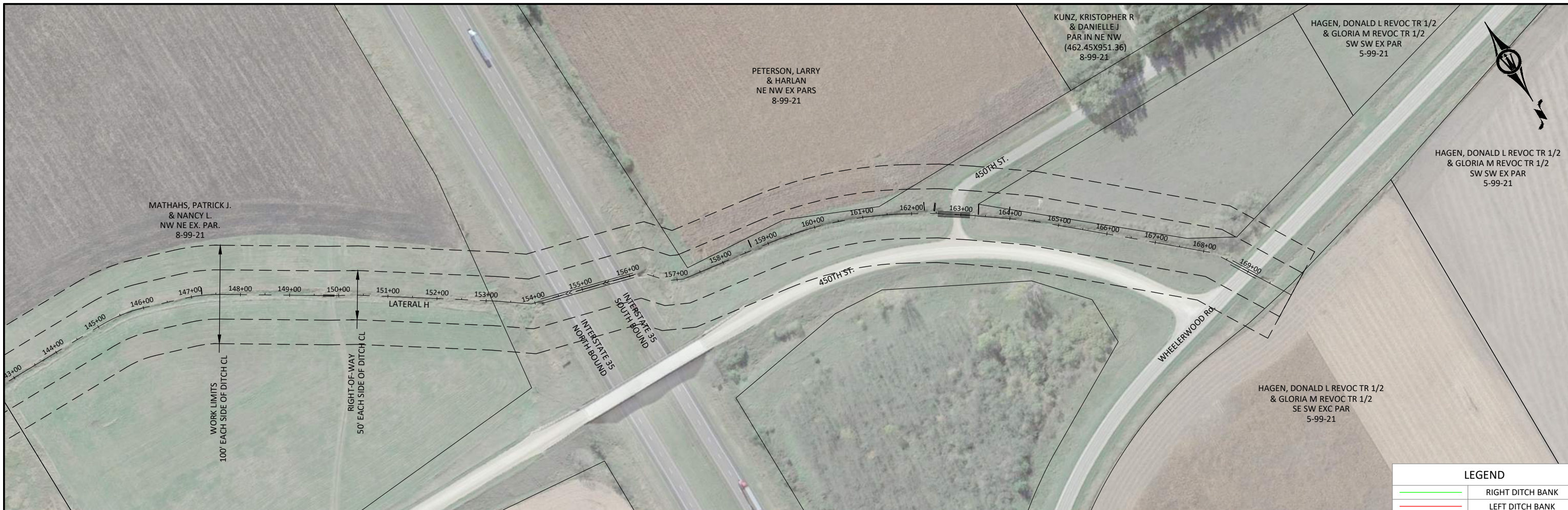


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[www.bolton-menk.com](http://www.bolton-menk.com)

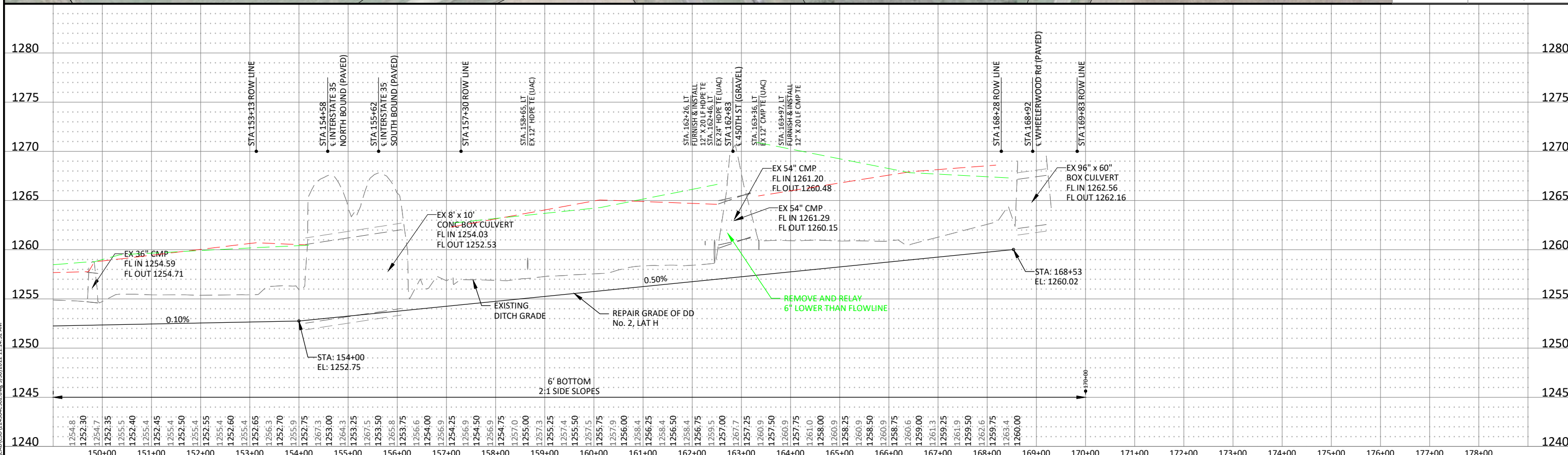
DESIGNED	REV	DESCRIPTION	DATE
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DRAWN	CLH		
CHECKED	JLH		
CLIENT PROJ. NO.			

DD No. 2 DRAINAGE IMPROVEMENTS  
WORTH COUNTY, IOWA  
PLAN & PROFILE - DD NO. 2 - LATERAL H

SHEET  
D.22



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



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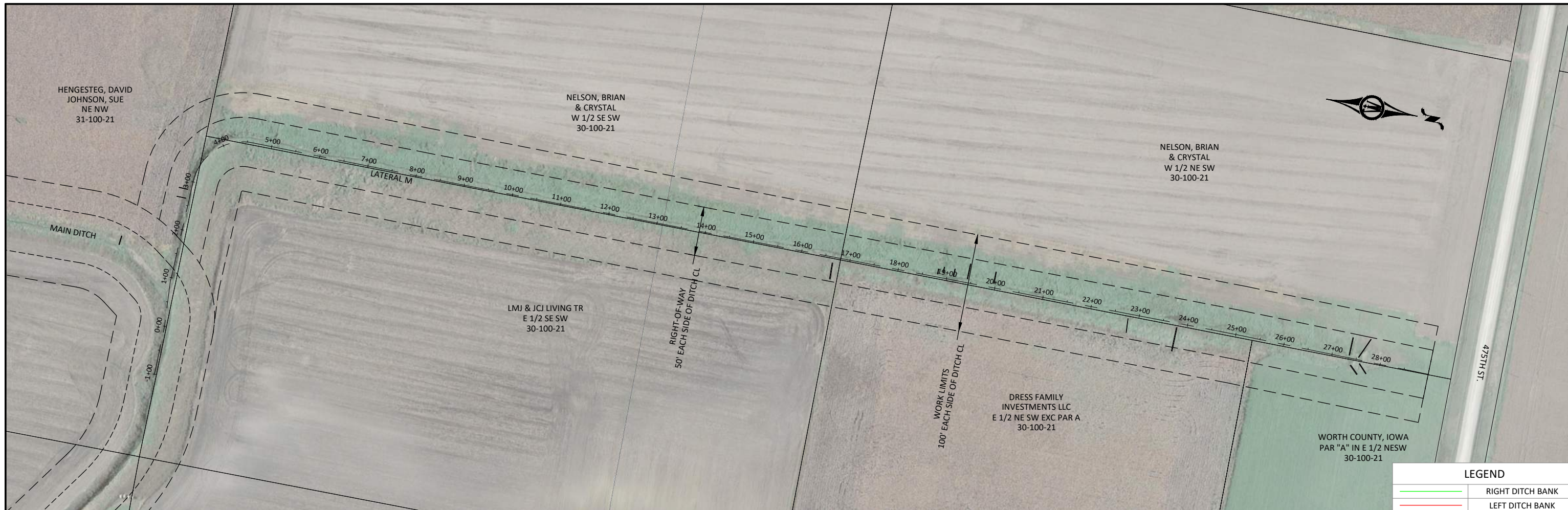


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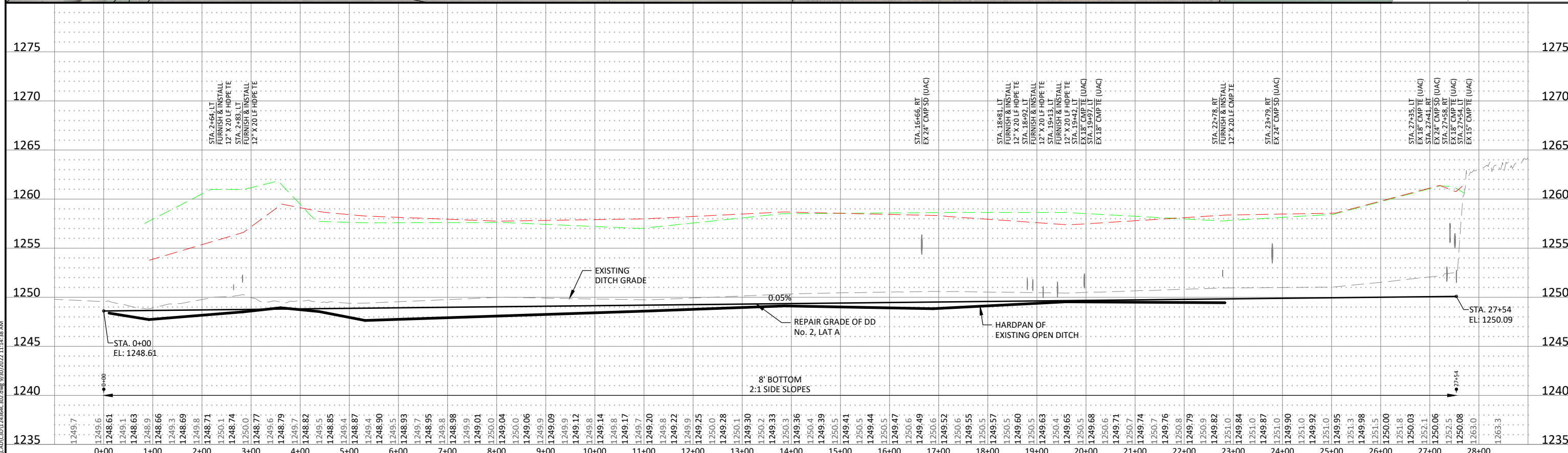
DESIGNED	REV	DESCRIPTION	DATE
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DRAWN			
CLH			
CHECKED			
JLH			
CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 2 - LATERAL H

SHEET  
**D.23**



LEGEND	
	RIGHT DITCH BANK
	LEFT DITCH BANK



STA. 2+64, LT  
FURNISH & INSTALL  
12" X 20 LF HDPE TE  
STA. 2+83, LT  
FURNISH & INSTALL  
12" X 20 LF HDPE TE

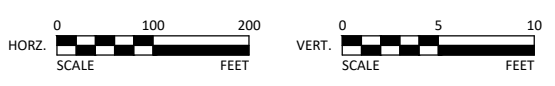
STA. 16+66, RT  
EX 24" CMP SD (UAC)

STA. 18+81, LT  
FURNISH & INSTALL  
12" X 20 LF HDPE TE  
STA. 18+92, LT  
FURNISH & INSTALL  
12" X 20 LF HDPE TE  
STA. 19+13, LT  
FURNISH & INSTALL  
12" X 20 LF HDPE TE  
STA. 19+42, LT  
EX 18" CMP TE (UAC)  
STA. 19+97, LT  
EX 18" CMP TE (UAC)

STA. 27+35, RT  
FURNISH & INSTALL  
12" X 20 LF CMP TE  
STA. 27+41, RT  
EX 24" CMP SD (UAC)

STA. 27+95, LT  
EX 18" CMP TE (UAC)  
STA. 27+41, RT  
EX 24" CMP SD (UAC)  
STA. 27+58, RT  
EX 18" CMP TE (UAC)  
STA. 27+54, LT  
EX 15" CMP TE (UAC)

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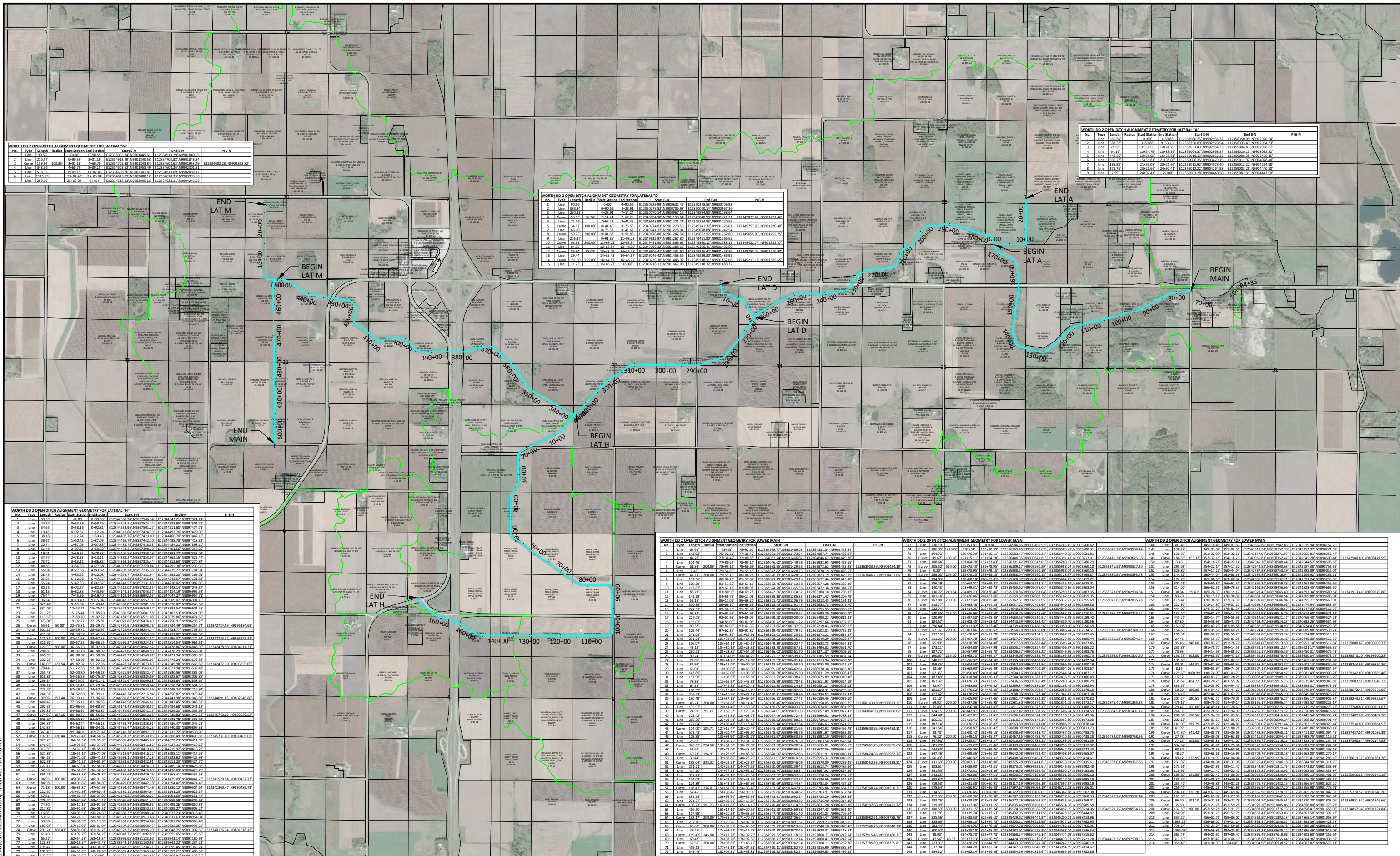


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[www.bolton-menk.com](http://www.bolton-menk.com)

DESIGNED	REV	DESCRIPTION	DATE
JLH			
CLH			
JLH			
CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA  
**PLAN & PROFILE - DD NO. 2 - LATERAL M**

SHEET  
**D.24**



**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LATERAL "M"**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11234567.00	11234667.00	11234567.00
2	Line	100.00	0.00	0+100.00	0+200.00	11234667.00	11234767.00	11234667.00
3	Line	100.00	0.00	0+200.00	0+300.00	11234767.00	11234867.00	11234767.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11234867.00	11234967.00	11234867.00
5	Line	100.00	0.00	0+400.00	0+500.00	11234967.00	11235067.00	11234967.00
6	Line	100.00	0.00	0+500.00	0+600.00	11235067.00	11235167.00	11235067.00
7	Line	100.00	0.00	0+600.00	0+700.00	11235167.00	11235267.00	11235167.00
8	Line	100.00	0.00	0+700.00	0+800.00	11235267.00	11235367.00	11235267.00
9	Line	100.00	0.00	0+800.00	0+900.00	11235367.00	11235467.00	11235367.00
10	Line	100.00	0.00	0+900.00	1+000.00	11235467.00	11235567.00	11235467.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LATERAL "D"**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11235678.00	11235778.00	11235678.00
2	Line	100.00	0.00	0+100.00	0+200.00	11235778.00	11235878.00	11235778.00
3	Line	100.00	0.00	0+200.00	0+300.00	11235878.00	11235978.00	11235878.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11235978.00	11236078.00	11235978.00
5	Line	100.00	0.00	0+400.00	0+500.00	11236078.00	11236178.00	11236078.00
6	Line	100.00	0.00	0+500.00	0+600.00	11236178.00	11236278.00	11236178.00
7	Line	100.00	0.00	0+600.00	0+700.00	11236278.00	11236378.00	11236278.00
8	Line	100.00	0.00	0+700.00	0+800.00	11236378.00	11236478.00	11236378.00
9	Line	100.00	0.00	0+800.00	0+900.00	11236478.00	11236578.00	11236478.00
10	Line	100.00	0.00	0+900.00	1+000.00	11236578.00	11236678.00	11236578.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LATERAL "A"**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11236789.00	11236889.00	11236789.00
2	Line	100.00	0.00	0+100.00	0+200.00	11236889.00	11236989.00	11236889.00
3	Line	100.00	0.00	0+200.00	0+300.00	11236989.00	11237089.00	11236989.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11237089.00	11237189.00	11237089.00
5	Line	100.00	0.00	0+400.00	0+500.00	11237189.00	11237289.00	11237189.00
6	Line	100.00	0.00	0+500.00	0+600.00	11237289.00	11237389.00	11237289.00
7	Line	100.00	0.00	0+600.00	0+700.00	11237389.00	11237489.00	11237389.00
8	Line	100.00	0.00	0+700.00	0+800.00	11237489.00	11237589.00	11237489.00
9	Line	100.00	0.00	0+800.00	0+900.00	11237589.00	11237689.00	11237589.00
10	Line	100.00	0.00	0+900.00	1+000.00	11237689.00	11237789.00	11237689.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LATERAL "H"**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11237890.00	11237990.00	11237890.00
2	Line	100.00	0.00	0+100.00	0+200.00	11237990.00	11238090.00	11237990.00
3	Line	100.00	0.00	0+200.00	0+300.00	11238090.00	11238190.00	11238090.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11238190.00	11238290.00	11238190.00
5	Line	100.00	0.00	0+400.00	0+500.00	11238290.00	11238390.00	11238290.00
6	Line	100.00	0.00	0+500.00	0+600.00	11238390.00	11238490.00	11238390.00
7	Line	100.00	0.00	0+600.00	0+700.00	11238490.00	11238590.00	11238490.00
8	Line	100.00	0.00	0+700.00	0+800.00	11238590.00	11238690.00	11238590.00
9	Line	100.00	0.00	0+800.00	0+900.00	11238690.00	11238790.00	11238690.00
10	Line	100.00	0.00	0+900.00	1+000.00	11238790.00	11238890.00	11238790.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LOWER MAIN**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11238901.00	11239001.00	11238901.00
2	Line	100.00	0.00	0+100.00	0+200.00	11239001.00	11239101.00	11239001.00
3	Line	100.00	0.00	0+200.00	0+300.00	11239101.00	11239201.00	11239101.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11239201.00	11239301.00	11239201.00
5	Line	100.00	0.00	0+400.00	0+500.00	11239301.00	11239401.00	11239301.00
6	Line	100.00	0.00	0+500.00	0+600.00	11239401.00	11239501.00	11239401.00
7	Line	100.00	0.00	0+600.00	0+700.00	11239501.00	11239601.00	11239501.00
8	Line	100.00	0.00	0+700.00	0+800.00	11239601.00	11239701.00	11239601.00
9	Line	100.00	0.00	0+800.00	0+900.00	11239701.00	11239801.00	11239701.00
10	Line	100.00	0.00	0+900.00	1+000.00	11239801.00	11239901.00	11239801.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LOWER MAIN**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11239902.00	11240002.00	11239902.00
2	Line	100.00	0.00	0+100.00	0+200.00	11240002.00	11240102.00	11240002.00
3	Line	100.00	0.00	0+200.00	0+300.00	11240102.00	11240202.00	11240102.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11240202.00	11240302.00	11240202.00
5	Line	100.00	0.00	0+400.00	0+500.00	11240302.00	11240402.00	11240302.00
6	Line	100.00	0.00	0+500.00	0+600.00	11240402.00	11240502.00	11240402.00
7	Line	100.00	0.00	0+600.00	0+700.00	11240502.00	11240602.00	11240502.00
8	Line	100.00	0.00	0+700.00	0+800.00	11240602.00	11240702.00	11240602.00
9	Line	100.00	0.00	0+800.00	0+900.00	11240702.00	11240802.00	11240702.00
10	Line	100.00	0.00	0+900.00	1+000.00	11240802.00	11240902.00	11240802.00

**WORTH DD 2 OPEN DITCH ALIGNMENT GEOMETRY FOR LOWER MAIN**

No.	Type	Length	Radius	Start Station	End Station	Start E.N.	End E.N.	PI E.N.
1	Line	100.00	0.00	0+00.00	0+100.00	11240903.00	11241003.00	11240903.00
2	Line	100.00	0.00	0+100.00	0+200.00	11241003.00	11241103.00	11241003.00
3	Line	100.00	0.00	0+200.00	0+300.00	11241103.00	11241203.00	11241103.00
4	Curve	100.00	100.00	0+300.00	0+400.00	11241203.00	11241303.00	11241203.00
5	Line	100.00	0.00	0+400.00	0+500.00	11241303.00	11241403.00	11241303.00
6	Line	100.00	0.00	0+500.00	0+600.00	11241403.00	11241503.00	11241403.00
7	Line	100.00	0.00	0+600.00	0+700.00	11241503.00	11241603.00	11241503.00
8	Line	100.00	0.00	0+700.00	0+800.00	11241603.00	11241703.00	11241603.00
9	Line	100.00	0.00	0+800.00	0+900.00	11241703.00	11241803.00	11241703.00
10	Line	100.00	0.00	0+900.00	1+000.00	11241803.00	11241903.00	11241803.00



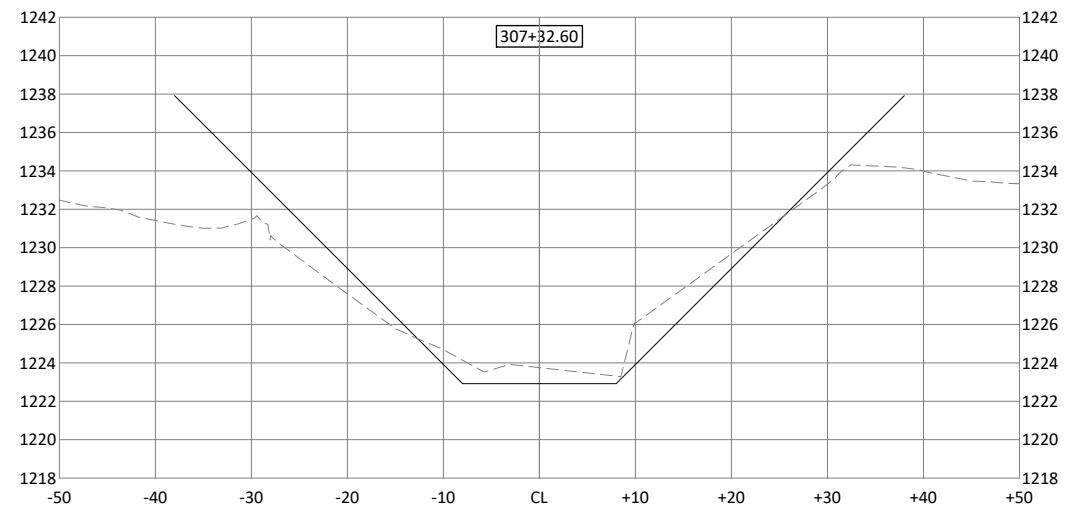
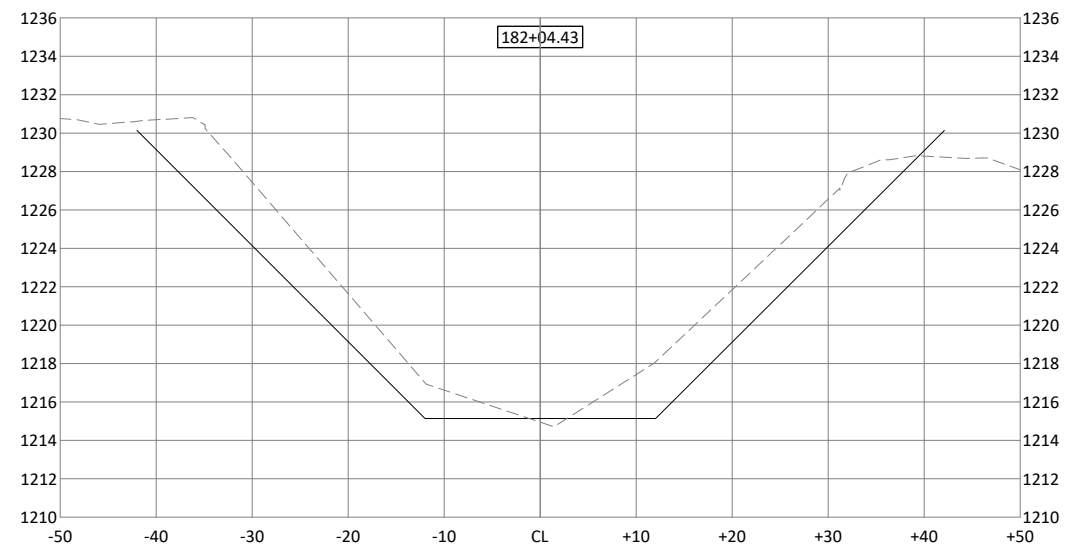
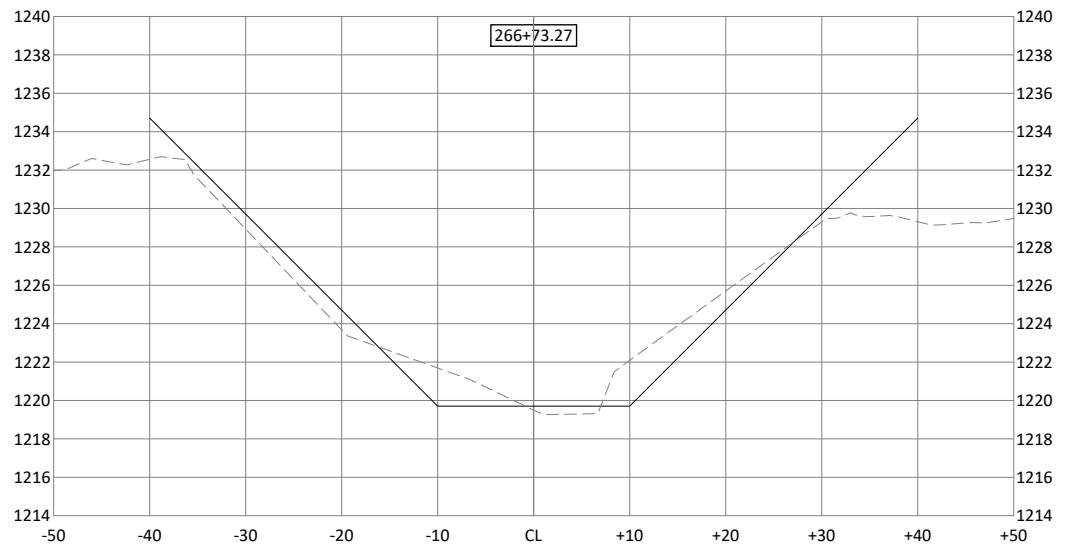
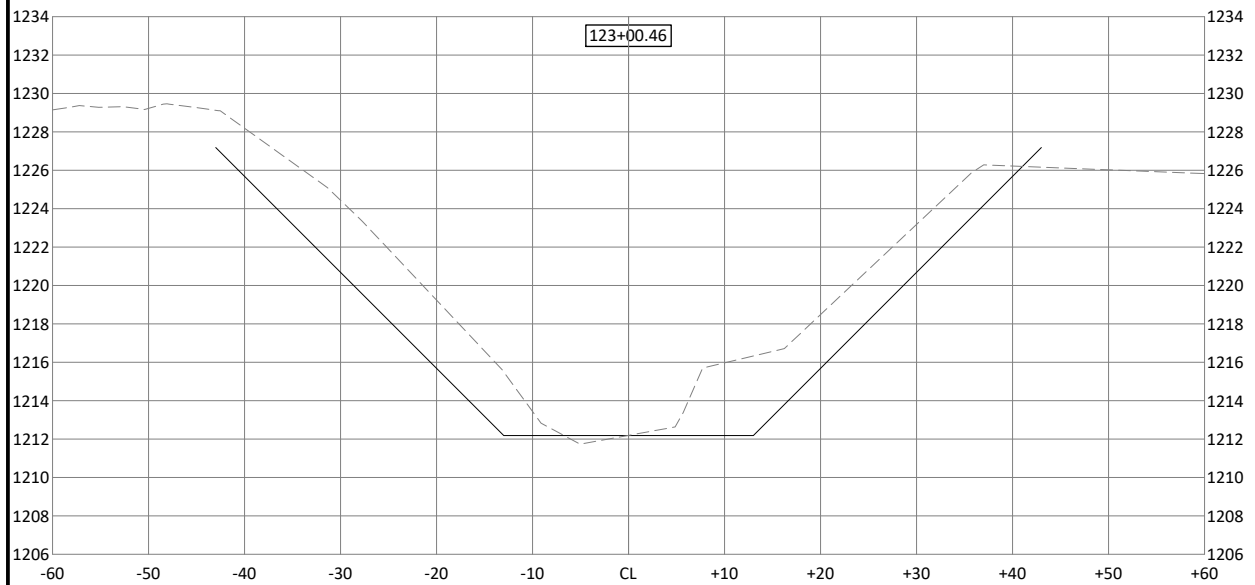
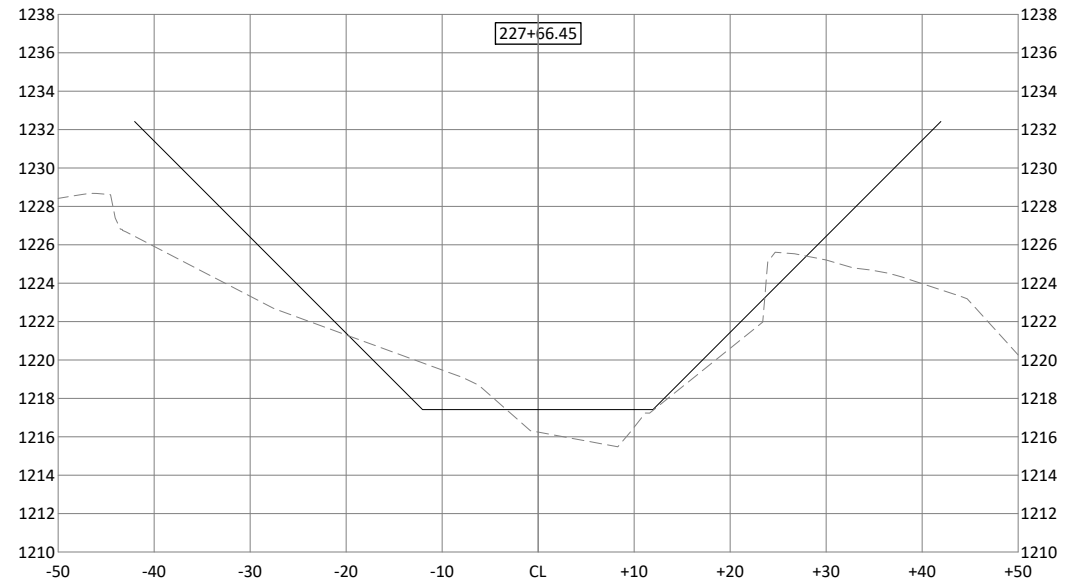
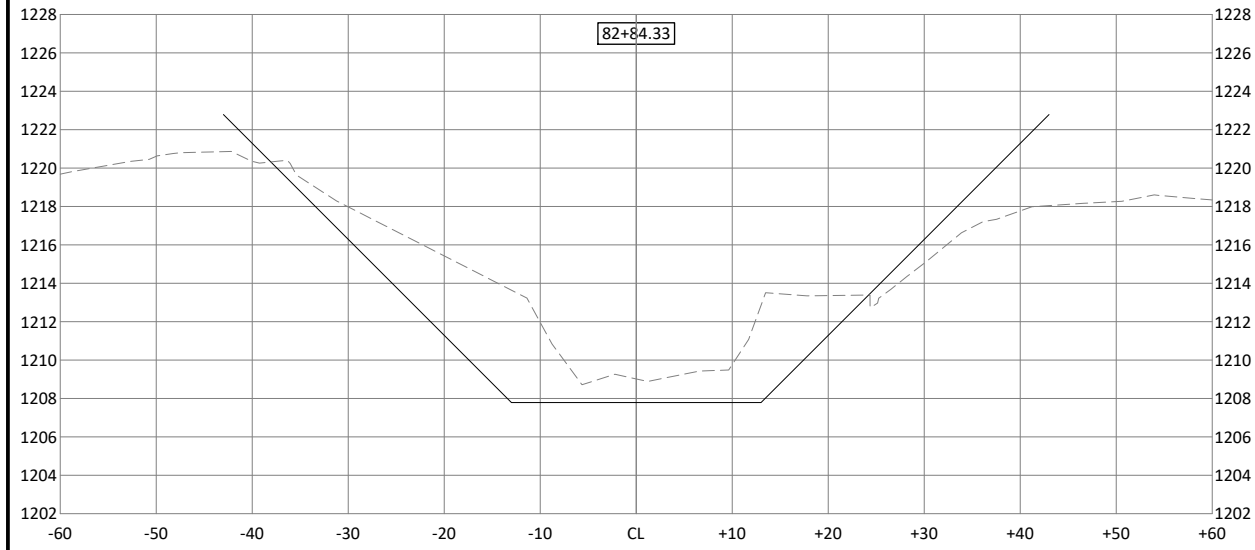
300 WEST MCKINLEY ST, P.O. BOX 68  
JEFFERSON, IOWA 50129  
Phone: (515) 386-4100  
Email: jefferson@bolton-menk.com  
www.bolton-menk.com

DESIGNED	JLH	REV	DESCRIPTION	DATE
DRAWN	CLH			
CHECKED	JLH			
CLIENT PROJ. NO.				

**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA  
**ALIGNMENT GEOMETRY**

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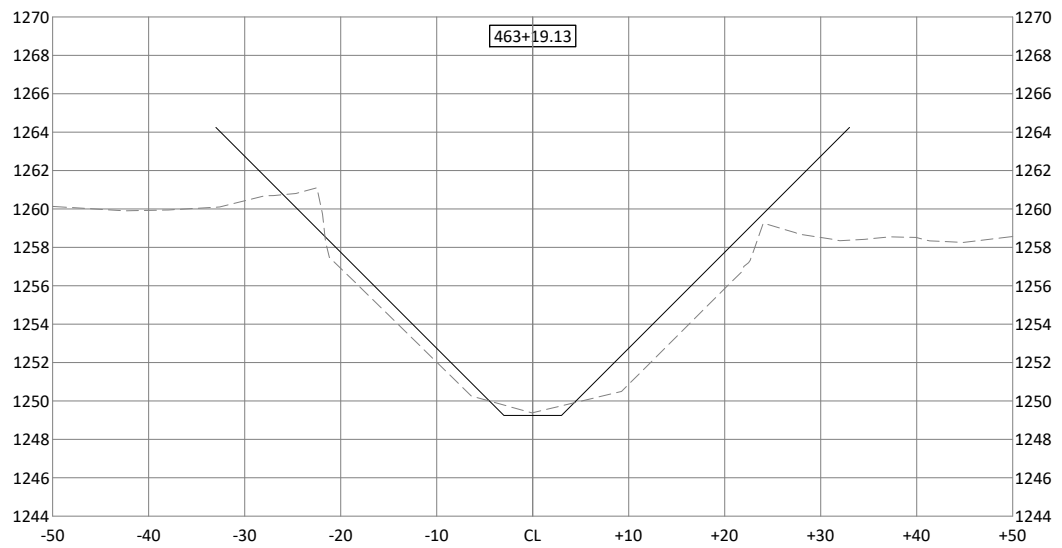
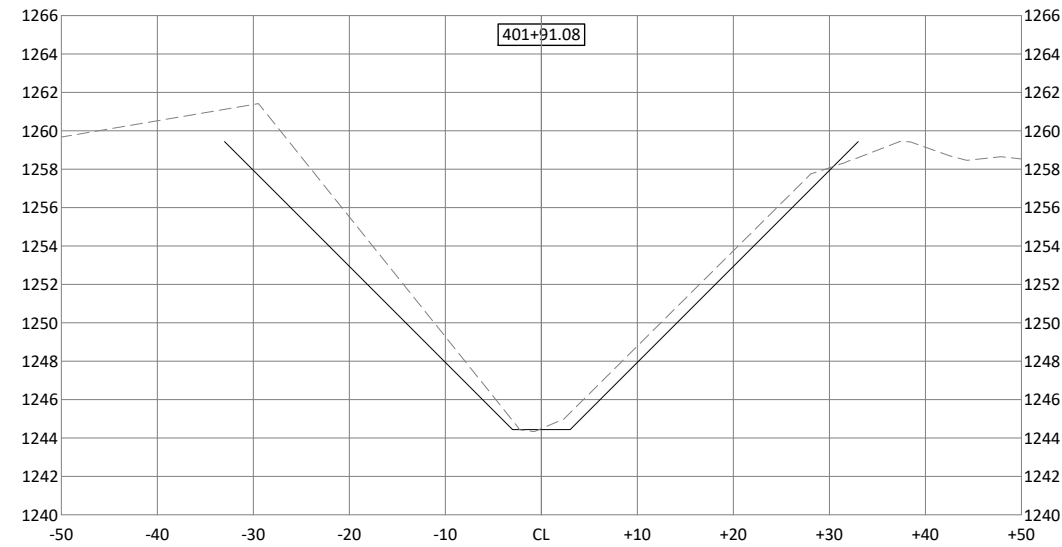
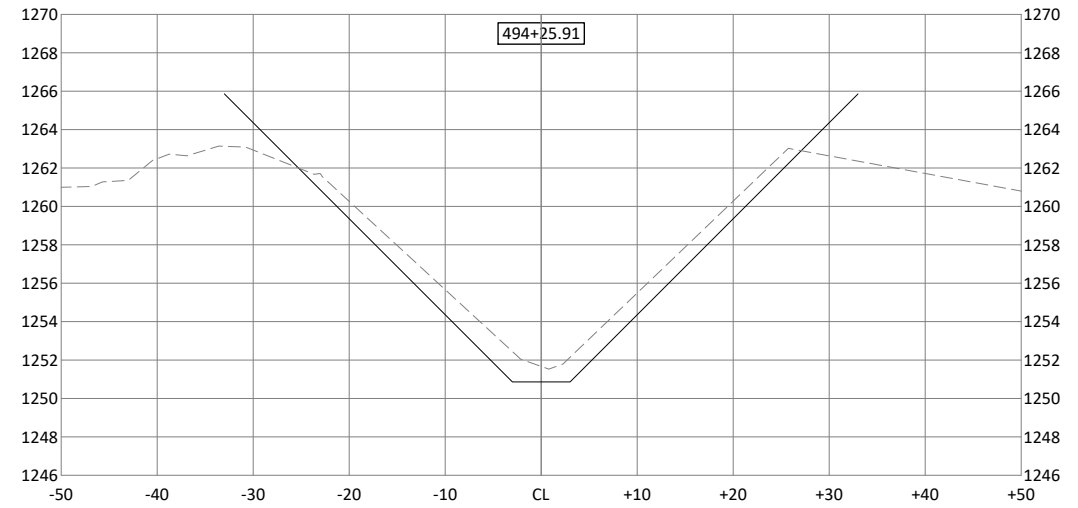
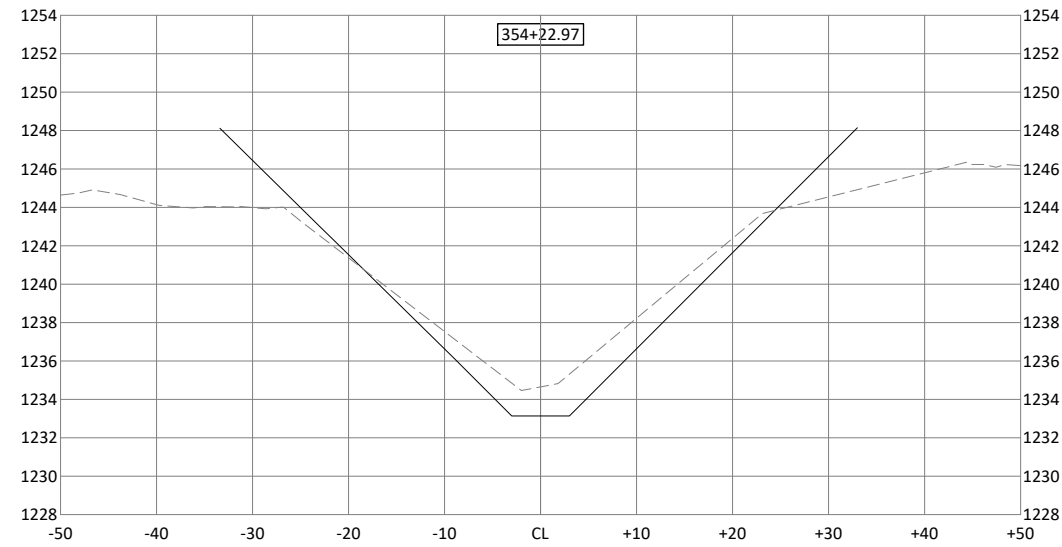
300 WEST MCKINLEY ST, P.O. BOX 68  
JEFFERSON, IOWA 50129  
Phone: (515) 386-4101  
Email: [Jefferson@bolton-menk.com](mailto:Jefferson@bolton-menk.com)  
[www.bolton-menk.com](http://www.bolton-menk.com)

DESIGNED	REV	DESCRIPTION	DATE
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CHECKED	JLH		
CLIENT PROJ. NO.			

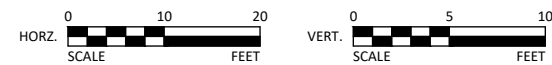
DD No. 2 DRAINAGE IMPROVEMENTS  
WORTH COUNTY, IOWA  
CROSS SECTIONS - DD NO. 2 - LOWER MAIN OPEN DITCH

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300 WEST MCKINLEY ST, P.O. BOX 68  
JEFFERSON, IOWA 50129  
Phone: (515) 386-4101  
Email: [Jefferson@bolton-menk.com](mailto:Jefferson@bolton-menk.com)  
[www.bolton-menk.com](http://www.bolton-menk.com)

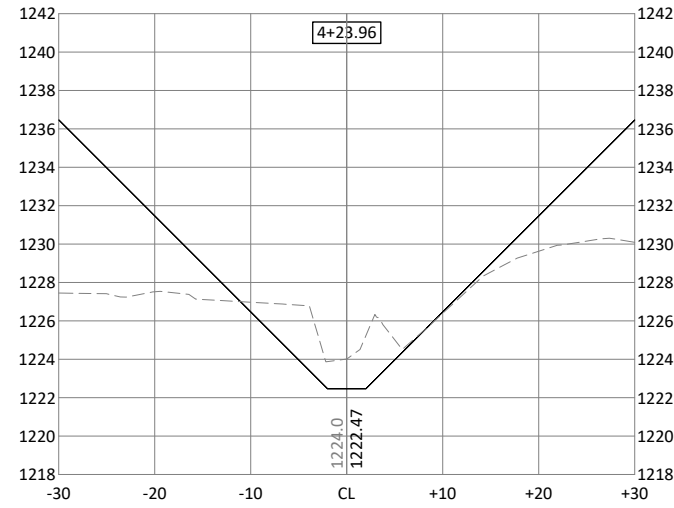
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CLH			
CHECKED			
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CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
WORTH COUNTY, IOWA  
**CROSS SECTIONS - DD NO. 2 - LOWER MAIN OPEN DITCH**

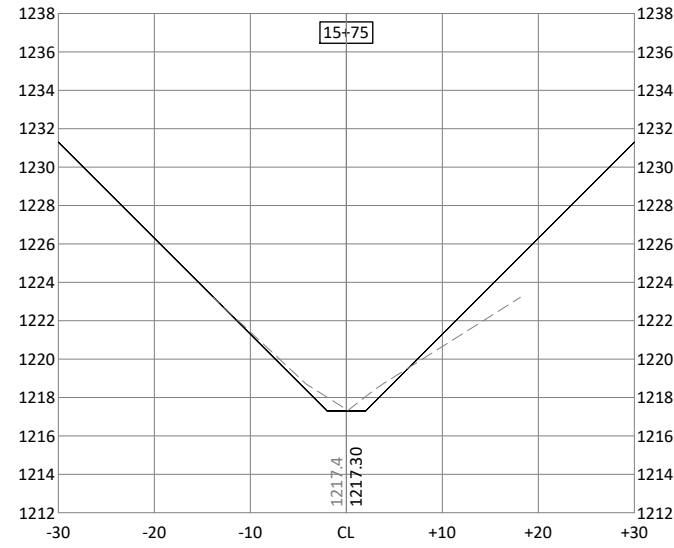
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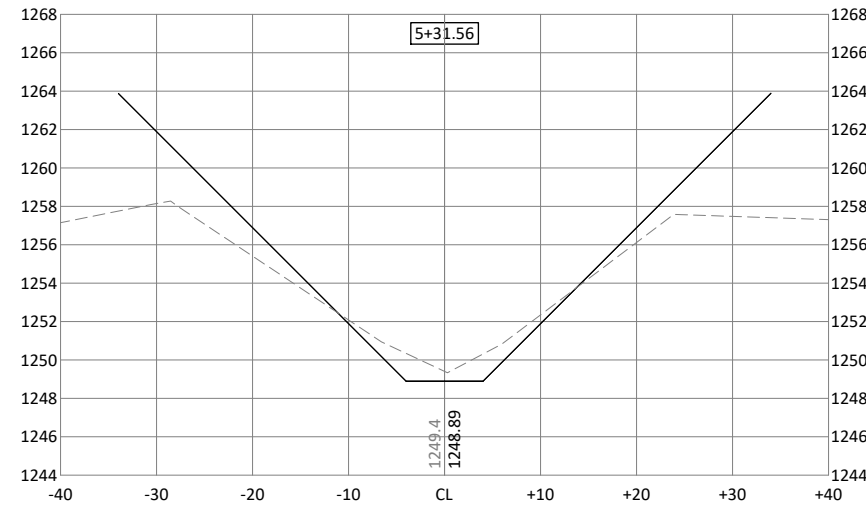
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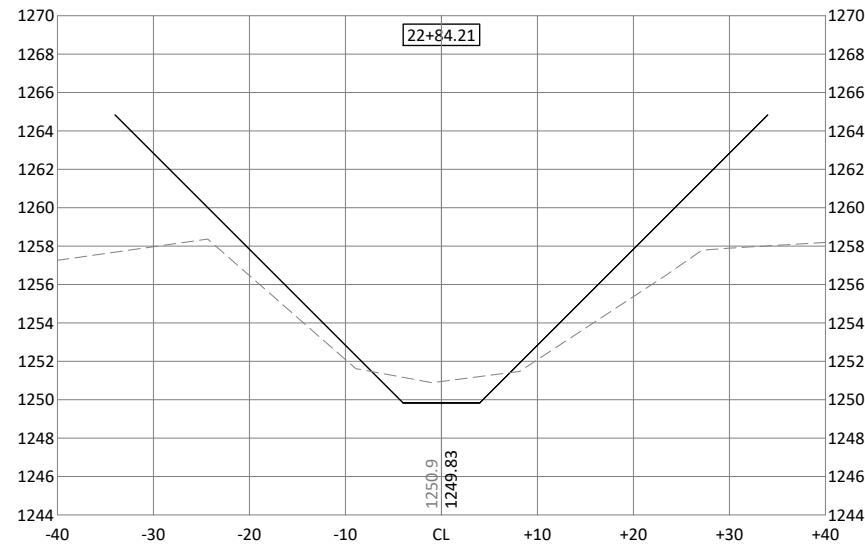
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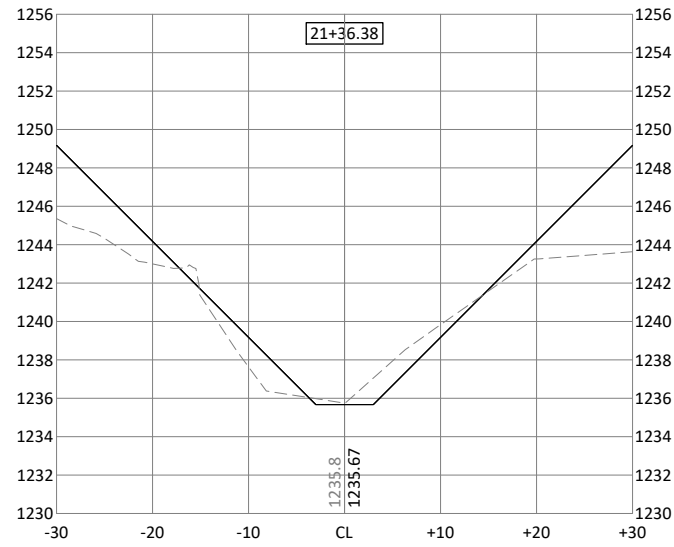
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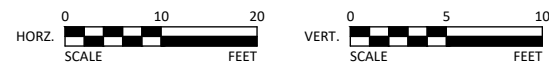
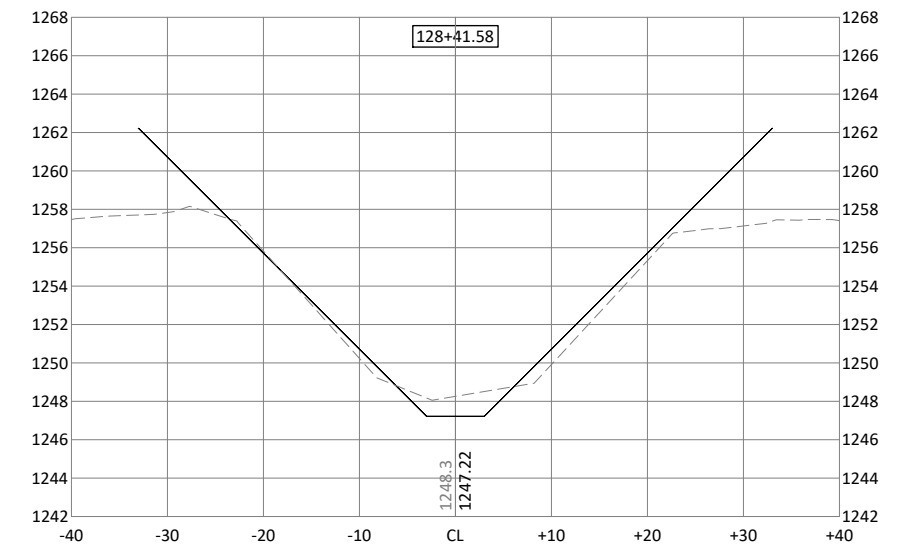
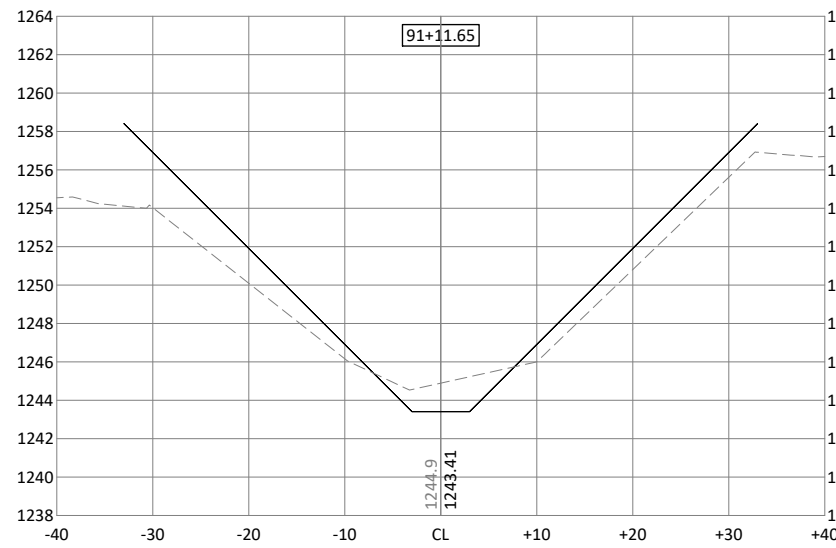
LAT M



LAT H



LAT H



**BOLTON & MENK**  
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 www.bolton-menk.com

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JLH			
DRAWN	CLH		
CHECKED	JLH		
CLIENT PROJ. NO.			

**DD No. 2 DRAINAGE IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
 CROSS SECTIONS - DD NO. 2 - LATERALS

SHEET  
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