Andy Beshear
GOVERNOR

TRANSPORTATION CABINET
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Frankfort, Kentucky 40601

Jim Gray
SECRETARY

November 22, 2022

CALL NO. 200
CONTRACT ID NO. 221059
ADDENDUM # 1

Subject: BOONE COUNTY, 121GR22D059-STP
Letting December 8, 2022

(1) Revised - Special Note - Pages 50-53(a) of 434
(2) Added - Waterline Notes - Pages 1-83 of 83

Proposal revisions are available at http://transportation.ky.gov/Construction-Procurement/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Rachel Mills,

Rachel Mills, P.E.
Director
Division of Construction Procurement

RM:mr
Enclosures

GENERAL UTILITY NOTES AND INSTRUCTIONS APPLICABLE TO ALL UTILITY WORK MADE A PART OF THE ROAD CONSTRUCTION CONTRACT

The contractor should be aware the following utility notes and KYTC Utility Bid Item Descriptions shall supersede, replace and take precedence over any and all conflicting information that may be contained in utility owner supplied specifications contained in the contract, on plans supplied by the utility owner, or any utility owner specifications or information externally referenced in this contract.

Where information may have been omitted from these notes, bid item descriptions, utility owner supplied specifications or plans; the KYTC Standard Specifications for Road and Bridge Construction shall be referenced.

PROTECTION OF EXISTING UTILITIES

The existing utilities shown on the plans are shown as best known at the time the plans were developed and are to be used as a guide only by the Contractor. The Contractor shall use all means at his disposal to accurately locate all existing utilities, whether shown on the plans or not, prior to excavation. The contractor shall protect these utilities during construction. Any damage to existing utilities during construction that are shown or not shown on the plans shall be repaired at the Contractor's expense.

PREQUALIFIED UTILITY CONTRACTORS

Some utility owners may require contractors that perform relocation work on their respective facilities as a part of the road contract be prequalified or preapproved by the utility owner**. Utility contractors may be added via addendum if KYTC is instructed to do so by the utility owner. Potential contractors must seek prequalification from the utility owner. Any revisions must be sent from the utility owner to KYTC a minimum of one week prior to bid opening.** Those utility owners with a prequalification or preapproval requirement are as follows:

Duke Energy Gas requires contractor preapproval with the company in order to be allowed to perform gas relocation work on this project.

Water and sanitary sewer utility owners on this project do not require contractor preapproval by the utility.

The bidding contractor needs to review the above and choose from a list of preapproved subcontractors contained elsewhere in the proposal. When the list of preapproved subcontractors is provided by a utility owner, only subcontractors shown on that list will be allowed to work on that utility as a part of this contract. In such instances, the utility subcontractor is not required to be prequalified with the KYTC Division of Construction Procurement.

IF A UTILITY SUPPLIED CONTRACTOR LIST IS NOT PROVIDED

When a list of preapproved subcontractors for the utility work is not provided, the utility work can be completed by the prime contractor, or a prime contractor-chosen subcontractor. In such instances, the subcontractor shall be prequalified with the KYTC Division of Construction Procurement in the work type of "Utilities" (I33). Those who would like to become prequalified may contact the Division of Construction Procurement at (502) 564-3500. Please note: it could take up to 30 calendar days for prequalification to be approved. The prequalification does not have to be approved prior to the bid, but must be approved before the subcontract will be approved by KYTC and the work can be performed.

CONTRACT ADMINISTRATION RELATIVE TO UTILITY WORK

All utility work is being performed as a part of a contract administered by KYTC; there is not a direct contract between the utility contractor and utility owner. The KYTC Section Engineer is ultimately responsible for the administration of the road contract and any utility work included in the contract.

SUBMITTALS AND CORRESPONDENCE

All submittals and correspondence of any kind relative to utility work included in the road contract shall be directed to the KYTC Section Engineer, a copy of which may also be supplied to the utility owner by the contractor to expedite handling of items like material approvals and shop drawings. All approvals and correspondence generated by the utility owner shall be directed to the KYTC Section Engineer. The KYTC Section Engineer will relay any approvals or correspondence to the utility contractor as appropriate. At no time shall any direct communication between the utility owner and utility contractor occur without the communication flowing through the KYTC Section Engineer be considered official and binding under the contract.

ENGINEER

Where the word "Engineer" appears in any utility owner specifications included in this proposal, utility owner specifications included as a part of this contract by reference or on the utility relocation plans, it shall be understood the "Engineer" is the Kentucky Transportation Cabinet (KYTC) Section Engineer or designated representative and the utility owner engineer or designated representative jointly. Both engineers must mutually agree upon all decisions made with regard to the utility construction. The Transportation Cabinet, Section Engineer shall make all final decisions in all disputes.

INSPECTOR OR RESIDENT PROJECT REPRESENTATIVE

Where the word "Inspector" or "Resident Project Representative" appears in the utility specifications included in this proposal, utility owner specifications included as a part of this contract by reference or on the utility relocation plans, it shall be understood the "Inspector" or "Resident Project Representative" is the utility owner inspector and KYTC inspector jointly. The Transportation Cabinet, Section Engineer shall make all final decisions in all disputes.

NOTICE TO UTILITY OWNERS OF THE START OF WORK

One month before construction is to start on a utility, the utility contractor shall make notice to the KYTC Section Engineer and the utility owner of when work on a utility is anticipated to start. The utility contractor shall again make confirmation notice to the KYTC Section Engineer and the utility owner one week before utility work is to actually start.

UTILITY SHUTDOWNS

The Contractor shall not shut down any active and in-service mains, utility lines or services for any reason unless specifically given permission to do so by the utility owner. The opening and closing of valves and operating of other active utility facilities for main, utility line or utility service shut downs are to be performed by the utility owner unless specific permission is given to the contractor by the owner to make shutdowns . If and when the utility owner gives the contractor permission to shutdown mains, utility lines or utility services, the contractor shall do so following the rules, procedures and regulations of the utility owner. Any permission given by the utility owner to the contractor to shutdown active and in-service mains, utility lines or services shall be communicated to the KYTC Section Engineer by the utility owner that such permission has been given.

Notice to customers of utility shut downs is sometimes required to be performed by the utility contractor. The contractor may be required; but, is not limited to, making notice to utility customers in a certain minimum amount of time in advance of the shut down and by whatever means of communication specified by the utility owner. The means of communication to the customer may be; but is not limited to, a door hanger, notice by newspaper ad, telephone contact, or any combination of communication methods deemed necessary, customary and appropriate by the utility owner. The contractor should refer to the utility owner specifications for requirements on customer notice.

Any procedure the utility owner may require the contractor to perform by specification or plan note and any expense the contractor may incur to comply with the utility owner's shut down procedure and notice to customers shall be considered an incidental expense to the utility construction.

CUSTOMER SERVICE AND LATERAL ABANDONMENTS When temporary or permanent abandonment of customer water, gas, or sewer services or laterals are necessary during relocation of utilities included in the contract, the utility contractor shall perform these abandonments as part of the contract as incidental work. No separate payment will be made for service line and lateral abandonments. The contractor shall provide all labor, equipment and materials to accomplish the temporary or permanent abandonment in accordance with the plans, specifications and/or as directed by the engineer. Abandonment may include, but is not limited to, digging down on a water or gas main at the tap to turn off the tap valve or corporation stop and/or capping or plugging the tap, digging down on a sewer tap at the main and plugging or capping the tap, digging down on a service line or lateral at a location shown on the plans or agreeable to the engineer and capping or plugging, or performing any other work necessary to abandon the service or lateral to satisfactorily accomplish the final utility relocation.

STATIONS AND DISTANCES

All stations and distances, when indicated for utility placement in utility relocation plans or specifications, are approximate; therefore, some minor adjustment may have to be made during construction to fit actual field conditions. Any changes in excess of 6 inches of plan location shall be reviewed and approved jointly by the KYTC Section Engineer or designated representative and utility owner engineer or designated representative. Changes in location without prior approval shall be remedied by the contractor at his own expense if the unauthorized change creates an unacceptable conflict or condition.

RESTORATION

Temporary and permanent restoration of paved or stone areas due to utility construction shall be considered incidental to the utility work. No separate payment will be made for this work. Temporary restoration shall be as directed by the KYTC Section Engineer. Permanent restoration shall be “in-kind” as existing.

Restoration of seed and sod areas will be measured and paid under the appropriate seeding and sodding bid items established in the contract for roadway work.

BELOW ARE NOTES FOR WHEN “INST” ITEMS ARE IN THE CONTRACT MEANING THE UTILITY COMPANY IS PROVIDING CERTAIN MATERIALS FOR UTILITY RELOCATION

MATERIAL

Contrary to Utility Bid Item Descriptions, those bid items that have the text **“Inst”** at the end of the bid item will have the major components of the bid item provided by the utility owner. No direct payment will be made for the major material component(s) supplied by the utility company. All remaining materials required to construct the bid item as detailed in utility bid item descriptions, in utility specifications and utility plans that are made a part of this contract will be supplied by the contractor. The contractor’s bid price should reflect the difference in cost due to the provided materials.

The following utility owners have elected to provide the following materials for work under this contract:

> *Duke Energy Gas will supply all piping, valves, fittings and other related major components for gas relocation. The contractor is to supply all bedding, backfill and other related materials.*
>
> *All water and sanitary sewer relocation materials shall be supplied by the contractor.*

SECURITY OF SUPPLIED MATERIALS

If any utility materials are to be supplied by the utility owner, it will be the responsibility of the utility contractor to secure all utility owner supplied materials after delivery to the project site. The utility contractor shall coordinate directly with the utility owner and their suppliers for delivery and security of the supplied materials. Any materials supplied by the utility owner and delivered to the construction site that are subsequently stolen, damaged or vandalized and deemed unusable shall be replaced with like materials at the contractor's expense.

Donaldson Highway 24-inch Water Main Relocation Project

Design Report – Cathodic Protection Services

Issued To: **Northern Kentucky Water District**

Prepared By: **Acuren Inspection Inc.**

Issue Date: **10/18/2022**

Document ID: **ACUUS-J22-40047-RDS-0.1**

Rev.	Date	Issued For	Summary of Changes	Originator	Reviewer	Approver
1	10/18/2022	Approval	Client Comments	Cesar Mbadinga Snr Corrosion Eng. – US CP	Matthew Buchynski Eng. Manager – US CP	Jordan Kennedy Operations Manager – US CP
0	10/11/2022	Review	First Issue	Cesar Mbadinga Snr Corrosion Eng. – US CP	Matthew Buchynski Eng. Manager – US CP	Jordan Kennedy Operations Manager – US CP

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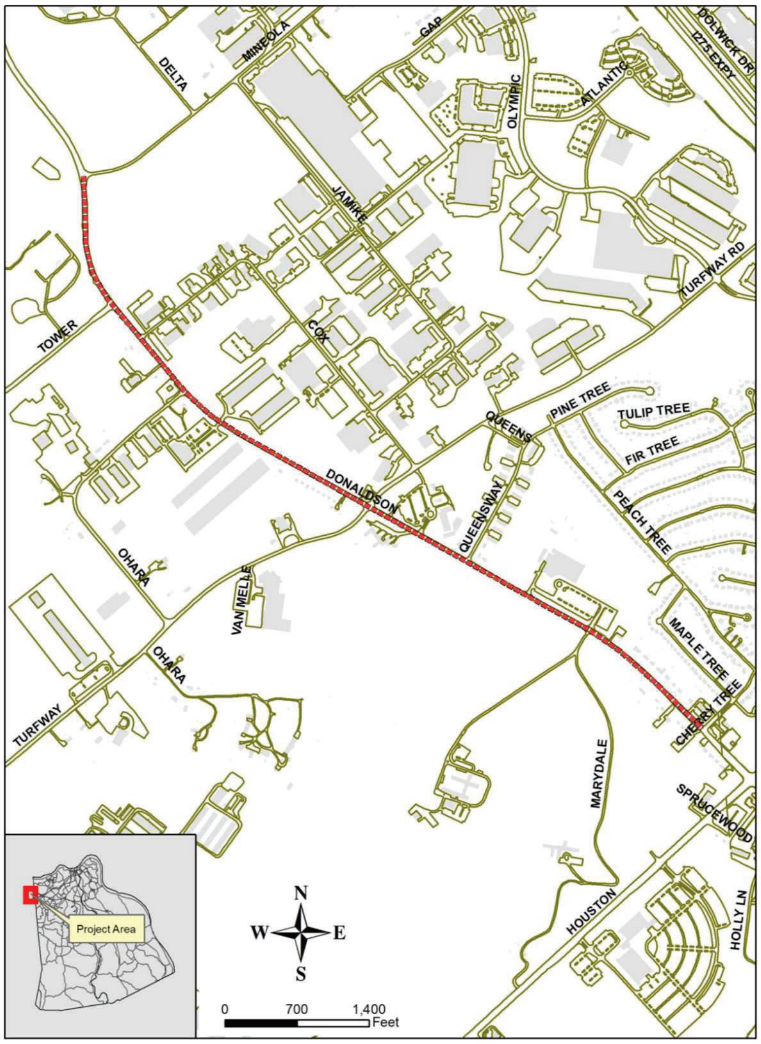
1 INTRODUCTION

Acuren was contracted by Northern Kentucky Water District (NKWD) to provide Cathodic Protection design of the pipeline 24” Ductile Iron Water Main located in Boone County, Kentucky. The pipeline is about 8,700 linear feet long and route from the Mineola Pike to Cherry Tree Lane along the Donaldson Highway.



**Donaldson Highway
Water Main Relocation**

This document outlines the Cathodic Protection system engineering, design considerations and assumptions, calculations, results, materials, and the installation chainage for the Donaldson Highway Water Main Pipeline Relocation project.

2 SCOPE OF WORK

The objective of this job is to provide the cathodic protection design system, materials, and technical support for the 24” x 8,700 feet Donaldson highway Water Main pipeline. This is a ductile cast iron pipe class 52 with POLYWRAP coating that will be buried for a lifetime of 20 years.

The scope of work covers:

- Site visit for soil resistivity survey by the Wenner four-pin method.
- Design of cathodic protection system for external corrosion mitigation of buried pipeline to achieve the applicable AMPP protection criteria.
- Provide recommendation for installation and commissioning.

The Cathodic Protection system shall be designed as a stand-alone system capable for operating independently of any other existing cathodic protection system and shall be a sacrificial system.

3 FIELD OPERATIONS

A site visit was conducted from 09-26-2022 to 09-27-2022 to collect soil resistivity data. The survey was performed using the Wenner four-pin method at 1 ft, 2 ft, 4 ft, 9 ft, and 16 ft pins spacing in order to have a shallow and deep soil layers resistivity profile along the pipeline routing. The Wenner four-pin method principle is to measure the voltage drop induced between pins after current is supplied to the external pins. The resistivity test instrument then reveals the system resistance by ohm’s law of the current supplied and voltage drop induced at the area of the test. Resistance collected will therefore be processed to estimate the soil resistivity layers to an average depth that is the same as the spacing between the two inside pins.

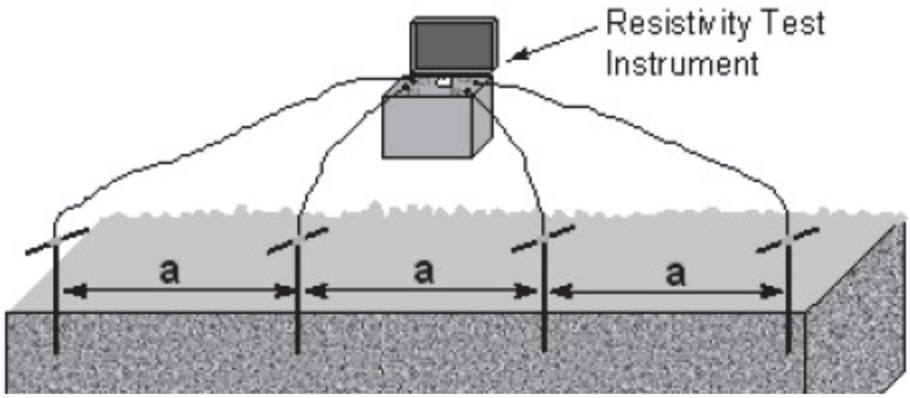


Figure 1 : Wenner 4-Pin Method Equipment Layout

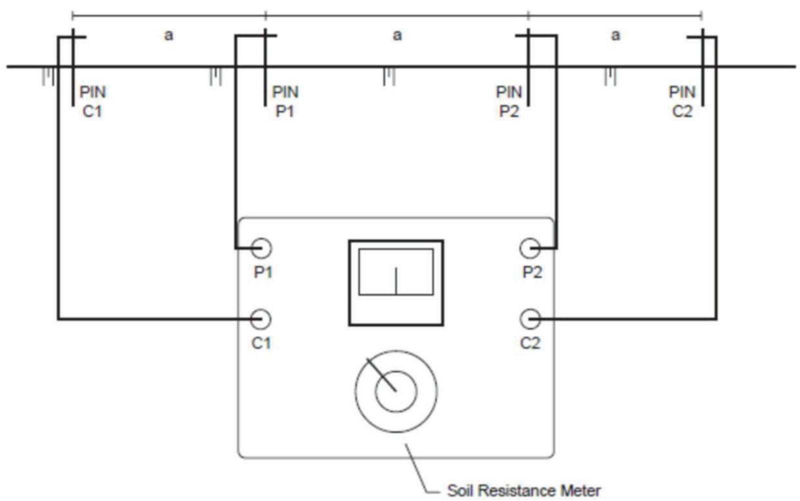


Figure 2 : Wenner 4-Pin Method Principle

The soil resistivity is function of the soil moisture and ionic concentrations of soluble salts. It is a major factor of Cathodic Protection (CP) system design since the soil resistivity measurements allows to predict severity of corrosive electrolyte and the efficiency of cathodic protection systems in such electrolyte. Typically, when the resistivity is lower, the higher will be the corrosivity of the soil and when the resistivity is high, then the lower will be the corrosivity of the soil.

3.1 SOIL RESISTIVITY SURVEY

Resistivity data were collected at strategic areas pre-selected to have an overall overview of the soil resistivity distribution along the pipeline routing. All the Soil Resistivity measurements collected along the Donaldson Highway pipeline routing during the survey are attached to Appendix 1.

Soil resistivity data analysis indicates that shallower layers are less conductive (or high resistive) than deeper layers with higher resistivity measurements collected at shallower depth. Hence, having anodes located at a depth greater than 4 ft is recommended for better anode efficiency and current distribution throughout the cathodic protection circuit loop. An average soil resistivity of 2,300 Ω-cm will be used for the design calculations.

Table 1: Soil Resistivity Survey per depth (Ω-cm)

Depth	Minimum	Average	Maximum
1ft	1371.22	6931.95	19151.15
2ft	1015.01	4350.37	11835.41
4ft	727.74	3064.18	6733.54
9ft	844.57	2228.62	5687.89
16ft	337.06	2543.27	6220.29

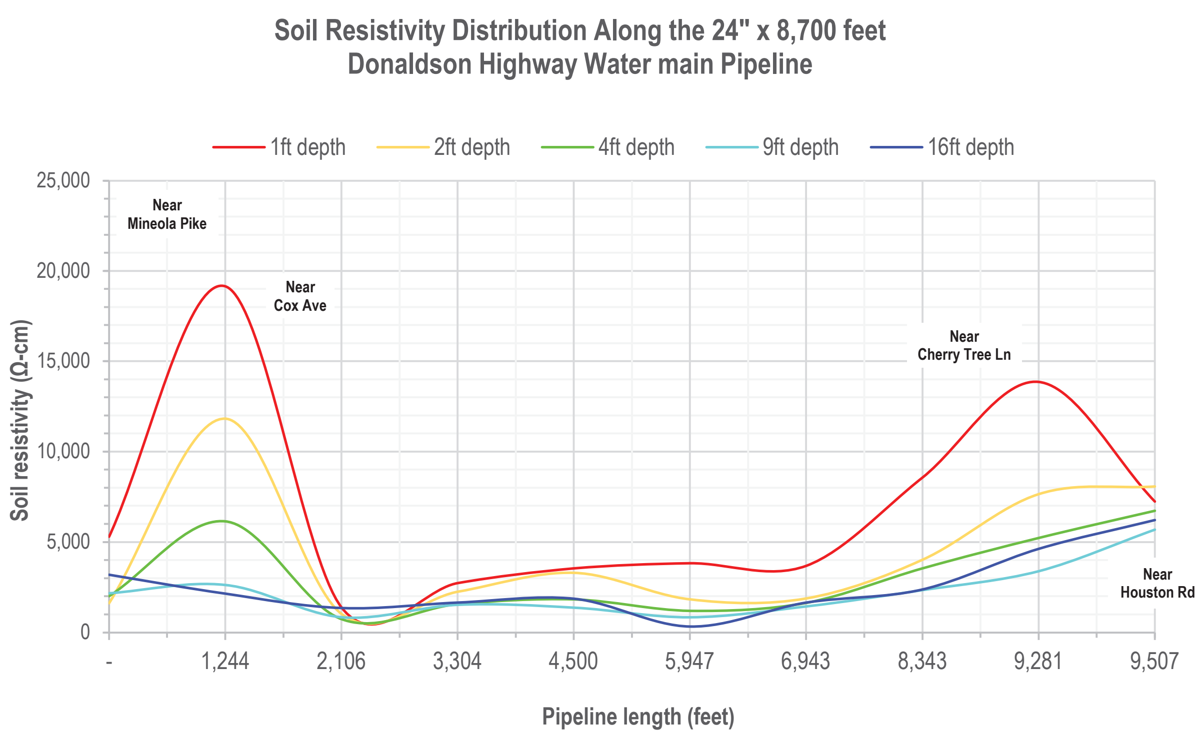


Figure 3: Soil Resistivity Profile Along the 24" Donaldson Highway Water Main Pipeline

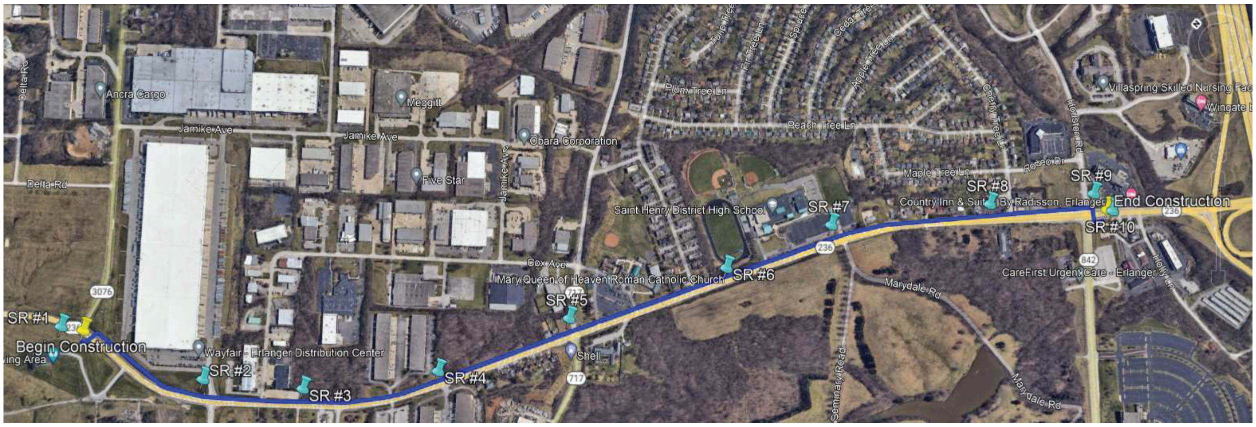


Figure 4 : Aerial View of the Pipeline Routing and Soil Resistivity Survey Areas

4 CATHODIC PROTECTION

4.1 CATHODIC PROTECTION PHILOSOPHY

Cathodic Protection (CP) is an electrochemical method used to control corrosion of metal exposed to the aggressive electrolyte such as soil. It aims to lower the potential of the metal (cathode) to the level where the anodic dissolution of the metal (corrosion) is significantly reduced. The metal is polarized to a more electronegative potential than the protection criteria due to the external current from a CP system with anodes.

Cathodic protection, to efficiently function, requires that both anodes and cathode (structures) be surrounded in the same environment and electrically continuous.

Sacrificial Anodes Cathodic Protection (SACP) system was selected to provide the corrosion control of the NKWD 24" Donaldson highway Water Main pipeline. Corrosion protection through the SACP is based on the galvanic corrosion principle. This means that a less noble material (anode) is connected to the pipeline (cathode) though bolting, welding or aboveground test stations and by the driving voltage between the anode and cathode, a DC protection current is supplied to the pipeline. The current will then flow through the electrolyte to polarize the structure and return to the anode via the bond cable.

The protected structure or pipeline will have to be polarized to a more electronegative potential than -850 mV vs $Cu/CuSO_4$, the accepted protection criteria from the industry. Once sufficient polarization to a more electronegative potential of -850 mV vs $Cu/CuSO_4$ is achieved, the corrosion is hence prevented over all the entire exposed surface regardless of whether a coating is present or not.

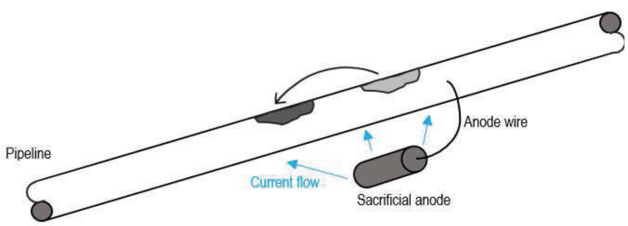


Figure 5: Sacrificial Anode System Principle

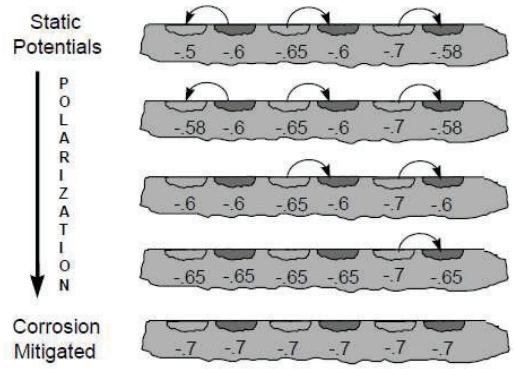


Figure 6: Metal Polarization Illustration
* from NACE Course Manual

4.2 DESIGN BASIS

The cathodic protection design and calculations methodology contained in this report follow the requirements and assumptions listed hereafter:

- All the calculations, design philosophy and parameters are in accordance with the ISO 15589-1, revision 2015 and AMPP standard SP0169, revision 2013.
- Design life of 20 years was considered for the operating service lifetime of the structures to be protected.
- Surface area considered was calculated for external exposed metal.
- Average soil resistivities were measured during the field survey at strategic areas for depth increment up to 16 ft underground. For the purpose of this design report, soil resistivity value of 2,300 Ω-cm will be used in the design calculations of the cathodic protection system.
- Internal and external operating temperature of the pipeline is assumed to be below 68°F. This value was used as baseline to estimate the current density of buried pipeline required to achieve the protection criteria.
- Current density of 2 mA/ft^2 was used to calculate the current requirement for the total structures to be protected.

- POLYWRAP Coating Breakdown Factor for the design purpose was estimated at 2% or 0.02 of bare metal exposed to the soil.
- Pipeline is assumed to be electrically isolated at all tie-ins from other structures with appropriate insulation flanges. No drain current that will lower the current capacity, thus anodes lifetime, is expected.
- Pre-packaged magnesium anodes, D48 type, was selected to provide the current protection required for the corrosion control of the pipeline.
- Anode utilization factor of 85% is assumed.
- All anode chemistry, electrochemical properties are in accordance to the ISO 15589-1 and ASTM B843-09 standards.
- Protection criteria of the external structure that must be achieved due CP polarization are -850 mV vs $Cu/CuSO_4$ per industries regulation and standards like 49 CFR Part 192, Appendix D, and AMPP SP0169, section 6.2.1.3.
- Test station will be used for direct connection of the pipeline and anode aboveground and for monitoring purpose. Typical flush mounted test station was chosen for this application.
- Dual cables connection will be welded to the pipeline and run up to the test station terminal board.

4.3 DESIGN METHODOLOGY

This section summarizes the calculation approach used for the cathodic protection design.

4.3.1 SURFACE AREA

Pipeline surface area exposed to the soil was calculated using formula below.

$$S_a = \pi \times D \times L$$

With:

- S_a: Surface Area in ft^2.
- D: Pipeline outer diameter in ft.
- L: Pipeline length in ft.

No contingency factor was applied to the surface area calculations.

4.3.2 CURRENT DENSITY

The current density (CD) required to apply an adequate polarized potential for buried bare metal is typically between 0.4 to 2.7 mA/ft² and depends on electrolyte conditions. For this design, a current density of 2.0 mA/ft² was used to calculate the current requirement of the underground 24" Donaldson Highway Water Main pipeline.

4.3.3 COATING BREAKDOWN FACTOR

The Coating Breakdown Factor (CBF) describes the barrier efficiency of the corrosion coating to metal in an aggressive electrolyte. It varies from 0 with no bare metal exposed to electrolyte to 1 with the entire structure fully exposed to the environment.

For this project, POLYWRAP coating will be used as the corrosion coating onto the cast iron pipeline. POLYWRAP is a tubular polyethylene coating applied with 8 mil minimum thickness providing an excellent barrier between the pipeline and the surrounding soil to prevent corrosion. From return of experience, a CBF of 2% was consider for the POLYWRAP.

4.3.4 CURRENT REQUIREMENT

The current required (I_{req}) to achieve the cathodic protection level of a bare metal shall be calculated as described below:

$$I_{req} = \mathrm{Sa} \times \mathrm{CBF} \times \mathrm{CD}$$

With:

- Ireq: The current required to achieve the minimum accepted industry protection criteria.
- S_a: Surface Area in ft^2.
- CBF: Coating Breakdown Factor or uncoated structure percentage
- CD: Current Density in mA/ft^2.

4.3.5 CIRCUIT RESISTANCE

The circuit resistance of the Sacrificial Andes Cathodic Protection system includes:

- **Anode resistance**: This is calculated considering the anode pre-package size using the Dwight equation.

- **Electrical cables resistance**: Electrical cables of the system include cable connection for anode, coupon, stationary reference electrodes, and the dual tieback bond cable to the pipeline. Total resistance is very small and negligible to affect the design calculations of the cathodic protection system circuit equivalent resistance.

Detailed calculations are provided in the Appendix 2.

4.4 DESIGN RESULTS

This section gives the outputs design calculations of the 24" Donaldson Highway Water main pipeline cathodic protection system.

Table 2: Cathodic Protection Design Calculations Outputs for Sacrificial Anode System

Parameters	Value	Unit
Surface area	54,663.7	ft^2
Current required	2.23	A
Total mass anode required	894	lbs
Anode resistance	8.5	Ω
Electrical cables resistance	0.003	Ω
Current output per anode	105.3	mA
Number of anodes required by weight	19	-
Number of anodes required by current	22	-
Total number of anodes	22	-
Average anode spacing along the line	395 - 410	ft

4.5 INSTALLATION LAYOUT

This section gives overall layout of the test stations for aboveground monitoring along with attached anodes, reference electrodes, and coupons.

Table 3: Cathodic Protection Monitoring Test Station Installation Layout

Test Station #	Anode #	Anode Polarization Coverage		Anode Location
		Start	End	
TS#1	Mg#1	STA. 20+24	STA. 24+20	STA. 22+22
TS#2	Mg#2	STA. 24+20	STA. 28+16	STA. 26+18
TS#3	Mg#3	STA. 28+16	STA. 32+12	STA. 30+14
TS#4	Mg#4	STA. 32+12	STA. 36+08	STA. 34+10
TS#5	Mg#5	STA. 36+08	STA. 40+04	STA. 38+06
TS#6	Mg#6	STA. 40+04	STA. 44+00	STA. 42+02
TS#7	Mg#7	STA. 44+00	STA. 47+96	STA. 45+98
TS#8	Mg#8	STA. 47+96	STA. 51+92	STA. 49+94
TS#9	Mg#9	STA. 51+92	STA. 55+88	STA. 53+90
TS#10	Mg#10	STA. 55+88	STA. 59+84	STA. 57+86
TS#11	Mg#11	STA. 59+84	STA. 63+80	STA. 61+82
TS#12	Mg#12	STA. 63+80	STA. 67+76	STA. 65+78
TS#13	Mg#13	STA. 67+76	STA. 71+72	STA. 69+74
TS#14	Mg#14	STA. 71+72	STA. 75+68	STA. 73+70
TS#15	Mg#15	STA. 75+68	STA. 79+64	STA. 77+66
TS#16	Mg#16	STA. 79+64	STA. 83+60	STA. 81+62
TS#17	Mg#17	STA. 83+60	STA. 87+56	STA. 85+58
TS#18	Mg#18	STA. 87+56	STA. 91+52	STA. 89+54
TS#19	Mg#19	STA. 91+52	STA. 95+48	STA. 93+50
TS#20	Mg#20	STA. 95+48	STA. 99+44	STA. 97+46
TS#21	Mg#21	STA. 99+44	STA. 103+40	STA. 101+42
TS#22	Mg#22	STA. 103+40	STA. 107+36	STA. 105+38

Some crossing pipelines under cathodic protection present possible risk of interference between. It is highly recommended to have monitoring test stations at crossing pipelines for future surveys purposes.

Table 4: Monitoring Test Stations Installation Layout at Crossing Pipelines

Test Station #	Location	Comments
TS#23	STA. 37+30	Monitoring of Crossing Pipelines 12" Sanitary sewer & 24" NKWD.
TS#24	STA. 44+00	Monitoring of Crossing Pipelines 16" BCWD & 24" NKWD.
TS#25	STA. 64+30	Monitoring of Crossing Pipelines 12" Sanitary sewer & 24" NKWD.
TS#26	STA. 65+48	Monitoring of Crossing Pipelines 12" BCWD & 24" NKWD.

All SACP system component and station locations are marked up in the construction drawings attached in the Appendix 6.

5 CATHODIC PROTECTION SYSTEM DESCRIPTION

Sacrificial Andes Cathodic Protection system was designed to provide the current required to meet the industry protection criteria. The cathodic protection system will consist of:

- (22) Pre-packaged Magnesium anodes with 20 ft of #12 AWG cable connected to each anode.
- (26) Flush mount test stations.
- (26) Reference electrodes with 20 ft of #12 AWG cable connected to each electrode.
- (22) Cast Iron Coupons with 20 ft of #12 AWG cable connected to each coupon.

A brief description of the most common materials expected to be used for the installation of the SACP systems are presented in the following subsections.

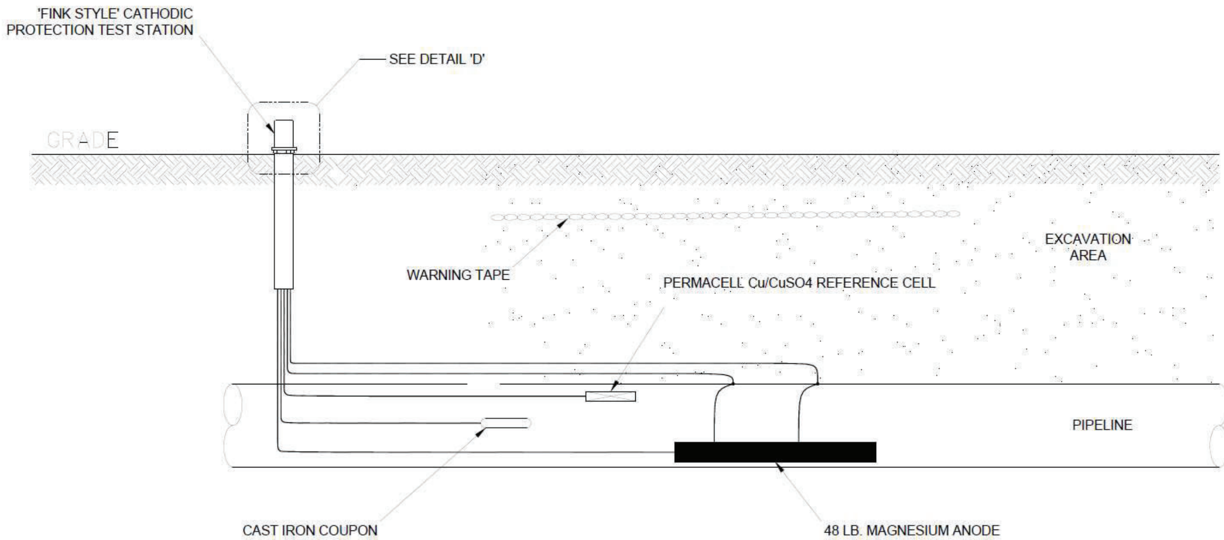


Figure 7: Sacrificial anode and monitoring systems Layout - Elevation View

5.1 MAGNESIUM ANODES

Magnesium anode with high electronegative potential and D type pre-packaged backfill mixture was selected for this SACP system.

Anode dimensions are given in the following table.

Table 5: Magnesium anode bare and pre-packaged dimensions

Parameters	Value	Unit
Anode length	28.9	in
Anode width	5.5	in
Anode height	5.7	in
Anode net weight	48	lb
Pre-packaged anode length	38	in
Pre-packaged anode diameter	8	in
Pre-packaged anode weight	100	lb

Figure 8: Magnesium anode bare and pre-packaged assembly

Chemistry composition and electrochemical properties of the anode is provided in the tables below.

Table 6: Magnesium Chemistry Composition

Parameters	**Value**
Aluminum	0.05 max
Zinc	0.03 max
Manganese	0.5 – 1.5
Silicon	0.05 max
Copper	0.02 max
Nickel	0.002 max
Iron	0.03 max
Other	0.3 max
Magnesium	Remainder

Table 7: Magnesium Electrochemical Properties

Parameters	Value	Unit
Electrochemical capacity	500	Ah/lb
Theoretical consumption rate	17.5	lb/Ay
Open Circuit Potential	-1.75	V vs Cu/$CuSO_4$
Current Efficiency	50	%
Utilization Factor	85	%

5.2 ELECTRICAL CABLES

Electrical cables for the SACP and monitoring systems include:

- Anode cable.
- Reference electrode cable.
- Coupon cable.
- Pipeline sections electrical continuity with dual tieback cables.

All cables shall be solid stranded copper wires and will be directly buried. Cables will be installed and supported to avoid undue stress on the cable termination. The cable size of #12 AWG to #8 AWG shall be used for cathodic protection and monitoring systems connections. Using size #12 AWG is large enough to carry anode output current with no risk of surcharge or overheat. However, for pipeline sections electrical continuity, size #2 AWG shall be used.

Electrical cable length was considered equal for all cathodic protection and monitoring systems connections component in the design calculations in order to keep the cable resistance and hence anode output uniform.

Table 8: Electrical Copper Cables Specifications

Temperature ^{O}C - Soil	#12 AWG Ampacity (A)	#10 AWG Ampacity (A)	#8 AWG Ampacity (A)	#2 AWG Ampacity (A)	Voltage (V)	Max. ^{O}C Insulator
26 - 75^{O}C	25	35	50	115	600	75 ^{O}C
21 - 25^{O}C	26	37	53	121	600	75 ^{O}C
15 - 20^{O}C	28	39	56	128	600	75 ^{O}C

5.2.1 PIPELINE CONTINUITY

For the SACP system efficiency, the entire 24" pipeline shall be to be electrically continuous between pipe sections and isolated from all tie ins and branches.

Electrical continuity shall be performed using dual bond cables and welded by CADWELD method. This will provide strong connection of the cable to the pipeline. Cable size shall be #2 AWG solid stranded copper wire. More details are given in the Appendix 5.

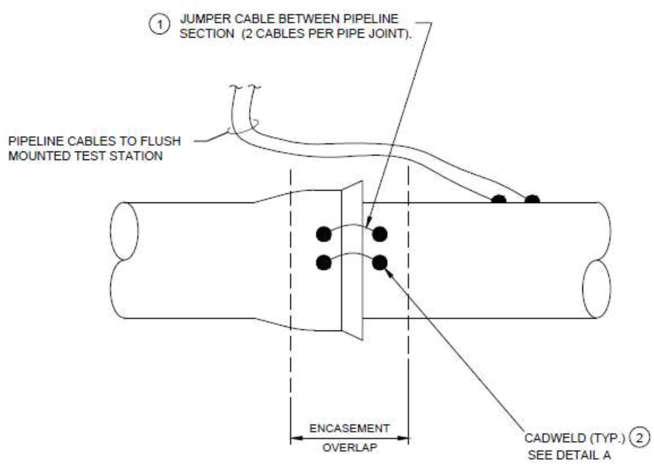


Figure 9: Pipeline Sections Electrical Continuity Description

Electrical isolation of all tie ins and branches to the 24" pipeline shall be performed using Pipe Isolation Couplings (PIC):

- Dresser Industries, Style 39 Pipe Isolation Coupling.
- Smith-Blair, Model 416 Pipe Isolation Coupling.
- Romac Industries, Style IC-400 Pipe Isolation Coupling (or approved equal).

All service lines shall be isolated using corporation stops with a dielectric bushing.

5.2.2 CADWELD

The application will be done following the guideline give below:

Step 1: Grind pipe surface (Approx. 2"x 2") to "mirror" finish with no moisture present.

Step 2: Inspect mold, all equipment, and materials are in good condition and ready to use.

Step 3: Strip the cable insulation. Clean and dry.

Step 4: Position the cable in center of the 2”x 2” exposed pipe area.

Step 5: Install the mold with CADWELD cup on top. Securely hold the mold firmly.

Step 6: Ignite the strip, exothermic welding will happen. Allow about 30 seconds to complete reaction.

Step 7: Remove debris. Apply Patch-Pad protector to seal the CADWELD connection.

Detailed procedure is given in the Appendix 10.

5.3 TEST STATION

Test station shall be used at each anode location and at crossing pipelines for aboveground the pipeline monitoring through current and polarization level tracking. Aboveground connection present advantages for future monitoring and survey purposes of the SACP system efficiency and interference risks. Each anode test station will consist of terminal enclosure, board for terminals connections of pipeline cables, anode, reference electrode and coupons, fixtures, and accessories. However, test station for crossing pipeline will consist of terminal enclosure, board for terminals connections of pipelines cables, reference electrode and fixtures, and accessories

Flush mounted test station shall be Fink type (or approved equal) as present lower profile to grade after installation. Concrete pad of 2’ x 2’ and 6” deep, flush to the ground, could be poured around the test station cables conduit.

Test station terminal enclosure shall be installed near the pipeline routing and in a safe location for future access to operators.

5.3.1 SHUNT

Having a shunt at the anode connection to the pipeline will allow to monitor the current output and estimate the remaining lifetime during the survey campaign. Shunt rated at 1 A or 2 A shall be consider to accurately read the expecting low current output from the anodes.

5.3.2 CAST IRON COUPON

Cast iron coupon is intended to be installed with the SACP system to determine the level of corrosion protection provided by the cathodic protection system. The pipe-to-soil potential measurement will be used as the basis to assess the efficiency of the protection level and compliance with the industry protection criteria. Coupon preparation, installation, monitoring and data analysis must be performed in accordance with the ANSI/NACE standard RP0104.

5.3.3 STATIONARY REFERENCE ELECTRODE

Stationary or permanent reference electrode of $Cu/CuSO_4$ is generally used as part of the monitoring system of buried pipeline under cathodic protection to track the efficiency of the protection system. A reference electrode with at least 20 years lifetime is recommended to be used. It usually comes with #12 AWG to #14 AWG cable connected to the electrode and backfill mixture bag to retain the moisture and minimize contamination of the half-cell.

6 COMMISSIONING

Upon completion of the installation of the SACP system and laying out all the wires to the flush mount type test stations aboveground, commissioning of the newly installed CP system can be conducted by connecting all the wires as specified and verify the system is operating as planned. The system should be allowed to operate up to 72 hours before structure-to-electrolyte potentials are recorded. Waiting 72 hours before taking readings allows time for the metal surfaces to polarize and allows for the CP system to reach its optimal operating state. At a minimum, the commissioning survey will include the following scope:

- Test station testing and readings for the anode, coupon, and structure.
- CP current reading measurements at all test stations.

7 CATHODIC PROTECTION CONSTRUCTION AND INSTALLATION SPECIFICATION

7.1 DEVIATIONS

Any deviations from the enclosed specification, drawings, and design, must be approved prior to execution of the installation scope. In general, deviations are not allowed.

7.2 SACRIFICIAL ANODE SYSTEM INSTALLATION PROCEDURE

- Excavation will be performed per NKWD specifications procedure.
- Layout test stations aboveground along the trench.

  Layout pre-packaged anodes in sequential order that they will be installed and uncoil anode lead cables to the test station terminal enclosure, placing cables to avoid entanglement. Remove the plastic bag and check each anode cable to ensure that insulation has not been damaged. Measure electrical resistance between the end of the cable and anode to ensure there is continuity. Anodes layout sequence shall alternate on both sides of the pipeline for better current polarization and current distribution.

- Layout the stationary reference electrodes with #12 AWG cable connected. Check each cable to ensure that insulation has not been damaged. Measure electrical resistance between the end of the cable and reference electrode end to ensure there is continuity.
  The reference electrodes shall be laid very close to the pipeline on the opposite side of the anode.
- Layout the cast iron coupons with #12 AWG cable connected. Check each cable to ensure that insulation has not been damaged. Measure electrical resistance between the end of the cable and coupon end to ensure there is continuity.
  Coupons shall be laid near the pipeline on the opposite side of the anode.
- Once all anodes, reference electrodes and coupons are installed and layout and continuity satisfy the installation plan, filled the trench with sand or native fill. However, before completing the trench fill, ensure the location of each component of the SACP and monitoring system at the right place and route of all cables inside and outside the trench are as per designated locations and path. Terminate all cables at the test station box, leaving sufficient slack in cables in the case of soil settlement.
- After trench filled, ensure that test stations terminal enclosures are flush mounted below ground terminal.

7.3 ANODE SPACING

Sacrificial anode system was designed to provide sufficient current and mass to the pipeline for protection lifetime of at least 20 years. To achieve this goal, anodes spacing were estimated to be minimum 395 ft and maximum 410 ft. This range will allow anodes to provide an optimal polarization attenuation over the pipeline section with current and mass requirement satisfying the minimum accepted protection criteria.

7.4 INSPECTION AND TESTING

As a minimum, the designated inspector shall perform QA/QC inspections and tests at designated steps during the installation process. Sample ITP and QA/QC sheets are attached to this specification and will be utilized during the installation of the tests stations, SACP, and monitoring systems outlined in this report.

7.4.1 AS-BUILT DOCUMENTATION

As-built documentation shall include updates to the cathodic protection bill of materials and drawings, as required. Updates shall include:

- Changes to the quantity and/or type of materials used as necessary
- Deviations of position or physical properties of installed systems as they relate to original design
- Redlined drawings
- Final drafted As-Built drawings

END OF REPORT

Appendix 1: Soil Resistivity Test Results

ACUREN

SOIL RESISTIVITY TEST - FIELD FORM

Client	Northern Kentucky Water District	**Date**	9/26/2022 to 9/27/2022
Project Name	Donaldson Highway 24-inch Water Main	**Site location**	Donaldson Hwy in Kentucky
Field Technician	Beau Boucher	**Field Technician**	Lee Winters

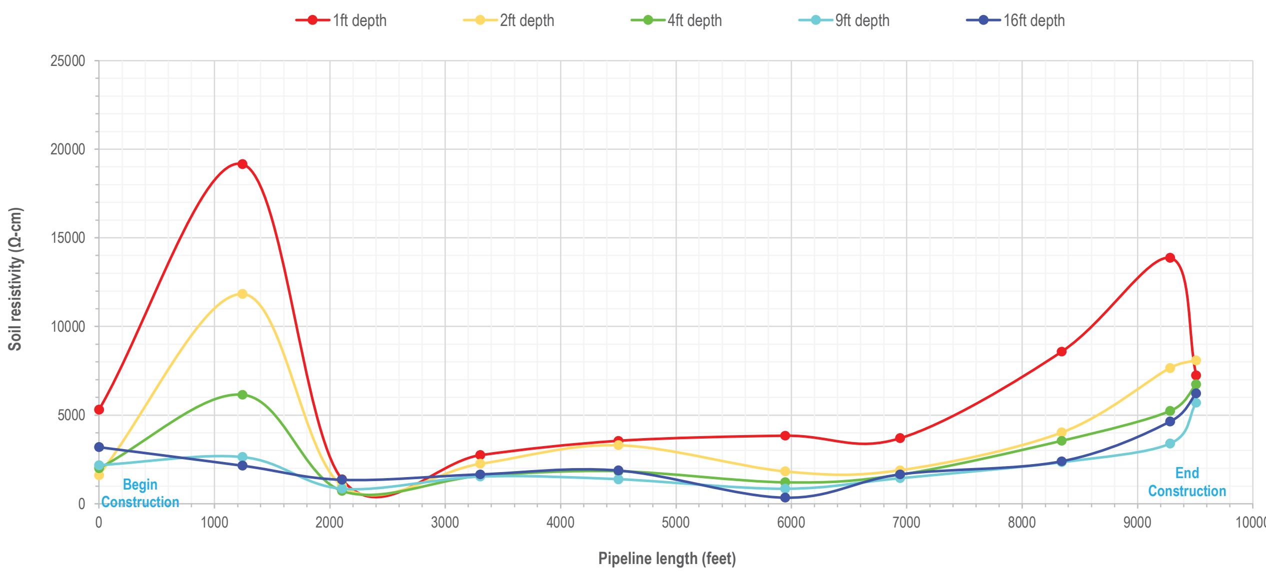
This form must be used to report the soil resistivity measurements data. It is specific for the site location and must includes pins spacings, distance from the pipe, layout of the pins vs the pipe, resistance readings, and any relevant comments related to the test.

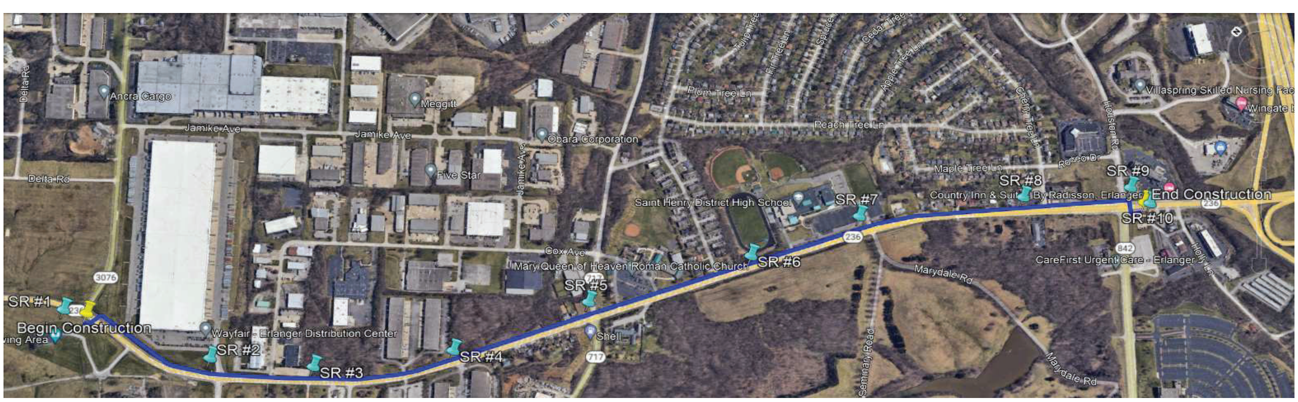
Area	Pins Spacing (in)		Pins Layout	Resistance	Latitude	Longitude	Avg Soil resistivity		Distance Along the
	Feet	inches	PER or PAR vs pipe	(Ω)			Ω-m	Ω-cm	24" line (feet)
1	1	12	PER	27.70	39° 2'42.72"N	84°38'26.16"W	53.05	5304.87	-
	2	24	PER	4.21	39° 2'42.72"N	84°38'26.16"W	16.13	1612.53	-
	4	48	PER	2.62	39° 2'42.72"N	84°38'26.16"W	20.07	2007.04	-
	9	108	PER	1.26	39° 2'42.72"N	84°38'26.16"W	21.72	2171.74	-
	16	192	PER	1.04	39° 2'42.72"N	84°38'26.16"W	31.87	3186.75	-
2	1	12	PER	100.00	39° 2'30.84"N	84°38'20.04"W	191.51	19151.15	1,244.00
	2	24	PER	30.90	39° 2'30.84"N	84°38'20.04"W	118.35	11835.41	1,244.00
	4	48	PER	8.02	39° 2'30.84"N	84°38'20.04"W	61.44	6143.69	1,244.00
	9	108	PER	1.53	39° 2'30.84"N	84°38'20.04"W	26.37	2637.11	1,244.00
	16	192	PER	0.70	39° 2'30.84"N	84°38'20.04"W	21.45	2144.93	1,244.00
3	1	12	PER	7.16	39° 2'24.00"N	84°38'13.56"W	13.71	1371.22	2,106.00
	2	24	PER	2.65	39° 2'24.00"N	84°38'13.56"W	10.15	1015.01	2,106.00
	4	48	PER	0.95	39° 2'24.00"N	84°38'13.56"W	7.28	727.74	2,106.00
	9	108	PER	0.49	39° 2'24.00"N	84°38'13.56"W	8.45	844.57	2,106.00
	16	192	PER	0.44	39° 2'24.00"N	84°38'13.56"W	13.48	1348.24	2,106.00
4	1	12	PER	14.30	39° 2'16.44"N	84°38'2.40"W	27.39	2738.61	3,304.00
	2	24	PER	5.89	39° 2'16.44"N	84°38'2.40"W	22.56	2256.01	3,304.00
	4	48	PER	2.05	39° 2'16.44"N	84°38'2.40"W	15.70	1570.39	3,304.00
	9	108	PER	0.89	39° 2'16.44"N	84°38'2.40"W	15.34	1534.01	3,304.00
	16	192	PER	0.54	39° 2'16.44"N	84°38'2.40"W	16.55	1654.66	3,304.00
5	1	12	PER	18.50	39° 2'11.04"N	84°37'48.72"W	35.43	3542.96	4,500.00
	2	24	PER	8.63	39° 2'11.04"N	84°37'48.72"W	33.05	3305.49	4,500.00
	4	48	PER	2.39	39° 2'11.04"N	84°37'48.72"W	18.31	1830.85	4,500.00
	9	108	PER	0.80	39° 2'11.04"N	84°37'48.72"W	13.79	1378.88	4,500.00
	16	192	PER	0.61	39° 2'11.04"N	84°37'48.72"W	18.69	1869.15	4,500.00
6	1	12	PER	20.00	39° 2'3.84"N	84°37'33.24"W	38.30	3830.23	5,947.00
	2	24	PER	4.77	39° 2'3.84"N	84°37'33.24"W	18.27	1827.02	5,947.00
	4	48	PER	1.57	39° 2'3.84"N	84°37'33.24"W	12.03	1202.69	5,947.00
	9	108	PER	0.49	39° 2'3.84"N	84°37'33.24"W	8.45	844.57	5,947.00
	16	192	PER	0.11	39° 2'3.84"N	84°37'33.24"W	3.37	337.06	5,947.00
7	1	12	PER	19.30	39° 1'59.52"N	84°37'22.08"W	36.96	3696.17	6,943.00
	2	24	PER	4.93	39° 1'59.52"N	84°37'22.08"W	18.88	1888.30	6,943.00
	4	48	PER	2.15	39° 1'59.52"N	84°37'22.08"W	16.47	1647.00	6,943.00
	9	108	PER	0.84	39° 1'59.52"N	84°37'22.08"W	14.48	1447.83	6,943.00
	16	192	PER	0.54	39° 1'59.52"N	84°37'22.08"W	16.55	1654.66	6,943.00
8	1	12	PER	44.80	39° 1'50.52"N	84°37'8.76"W	85.80	8579.71	8,343.00
	2	24	PER	10.50	39° 1'50.52"N	84°37'8.76"W	40.22	4021.74	8,343.00
	4	48	PER	4.63	39° 1'50.52"N	84°37'8.76"W	35.47	3546.79	8,343.00
	9	108	PER	1.36	39° 1'50.52"N	84°37'8.76"W	23.44	2344.10	8,343.00
	16	192	PER	0.78	39° 1'50.52"N	84°37'8.76"W	23.90	2390.06	8,343.00
9	1	12	PER	72.40	39° 1'44.40"N	84°37'0.12"W	138.65	13865.43	9,281.00
	2	24	PER	20.00	39° 1'44.40"N	84°37'0.12"W	76.60	7660.46	9,281.00
	4	48	PER	6.83	39° 1'44.40"N	84°37'0.12"W	52.32	5232.09	9,281.00
	9	108	PER	1.97	39° 1'44.40"N	84°37'0.12"W	33.95	3395.50	9,281.00
	16	192	PER	1.51	39° 1'44.40"N	84°37'0.12"W	46.27	4626.92	9,281.00

10	1	12	PER	37.80	39° 1'42.24"N	84°37'0.12"W	72.39	7239.13	9,507.00
	2	24	PER	21.10	39° 1'42.24"N	84°37'0.12"W	80.82	8081.78	9,507.00
	4	48	PER	8.79	39° 1'42.24"N	84°37'0.12"W	67.34	6733.54	9,507.00
	9	108	PER	3.30	39° 1'42.24"N	84°37'0.12"W	56.88	5687.89	9,507.00
	16	192	PER	2.03	39° 1'42.24"N	84°37'0.12"W	62.20	6220.29	9,507.00
						Average Resistivity :	**38.24**	**0.38**	10,000.00

Soil Resistivity per depth (Ω-cm)			
Depth	**Minimum**	**Average**	**Maximum**
1ft	1371.22	6931.95	19151.15
2ft	1015.01	4350.37	11835.41
4ft	727.74	3064.18	6733.54
9ft	844.57	2228.62	5687.89
16ft	337.06	2543.27	6220.29

Soil Resistivity Distribution Along the 24" x 8,700 feet Donaldson Highway Water main Pipeline





Appendix 2: Design Calculations

Design Parameters SACP System

Design Life=20 years
Total Current Required=2.23 A DC estimated
Soil Resistivity =2,300 Ω-cm

Anode Resistance

$$R_a = \frac{\rho}{2\pi L}\left\{\left(\ln\frac{2L}{d}\right)\right\}$$

where:

R_a: Resistance of the Magnesium anode.
ρ: Soil resistivity
L: Length of anode
d: Diameter of anode
ln: Natural logarithmic function

Anode Length (in)	Anode Diameter (in)	Soil Resistivity (Ω-cm)	Groundbed Resistance (Ω)
38.00	8.00	2,300	**8.5**

Cable resistance

$$\mathbf{Rc} = \frac{\textbf{Cable feet total} \times \textbf{Cable Resistance}}{\textbf{1000 feet} \times \textbf{total No. cables}}$$

#12 AWG cable resistance per 1,000 ft = 1.62 Ω.

Description	Resistance Ω	Comments
ELECTRICAL CABLES		
Magnesium Anode cable	**0.032**	Individual anode #12 AWG cable with 20ft length
Reference Electrode cable	**0.032**	Individual anode #12 AWG cable with 20ft length
Coupon cable	**0.032**	Individual anode #12 AWG cable with 20ft length
Pipeline dual bond cables	**0.016**	Individual anode #12 AWG cable with 20ft length
TOTAL CABLES RESISTANCE	0.006	**Consider the following resistances in series circuit:** - **Mg anode cable** - **Reference Electrode cable** - **Coupon cable** - **Pipeline dual bond cables**

Appendix 3: Standards, Acronyms, Definitions, and Cathodic Protection Criteria

National Association of Corrosion Engineers (NACE)	
NACE SP0169-2013	Standardized set of criteria regarding structure-to-soil potential measurements that evaluate the effectiveness of cathodic protection on a structure
NACE SP0572	Design, Installation, Operation, and Maintenance of Impressed Current Deep Anode Beds.
NACE SP0286	The Electrical Isolation of Cathodically Protected Pipelines.
NACE TM0497	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
NACE ASTM G193-12d	Standard Terminology and Acronyms Relating to Corrosion
NACE Course Manual	Cathodic Protection Technician Course Manual
NACE Course Manual	Cathodic Protection Technologist Course Manual

Abbreviations:

Term	Spelled Out
A	Amperes
AC	Alternating Current
AWG	American Wire Gauge
CP	Cathodic Protection
in	Inch
ft	Foot
ft^2	Square Foot
JB	Junction Box
lbs	Pounds
mA	Milliamperes
mV	Millivolts
NEMA	National Electrical Manufacturers Association
NACE	National Association of Corrosion Engineers

Term	Spelled Out
NPS	Nominal Pipe Size
OD	Outer Diameter
SACP	Sacrificial Anode Cathodic Protection
Ω	Ohm
ρ	Soil Resistivity
WT	Wall Thickness

Definitions

ANODE
The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away the anode in the external circuit. Corrosion usually occurs and metal ions enter solution at the anode.

CATHODE
The electrode of an electrochemical cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit.

CATHODIC DISBONDMENT
The destruction of adhesion between a coating and the coated surface caused by products of a cathodic reaction.

CATHODIC POLARIZATION
The change of electrode potential in the active (negative) direction caused by current across the electrode/electrolyte interface.

COATING
A liquid, liquefiable, or mastic composition that after application to a surface, is converted into a solid protective, decorative, or functional adherent film.

CONTINUITY BOND
A connection, usually metallic, that provides electrical continuity between structures that can conduct electricity.

CORROSION
The deterioration of a material, usually a metal, that results from a reaction with its environment.

CORROSION POTENTIAL

The potential of a corroding surface in an electrolyte relative to a reference electrode under open circuit conditions.

CRITERION
Standard for assessment of the effectiveness of a cathodic protection system.

CURRENT DENSITY
The current to or from a unit area of an electrode surface. The amount of current per unit area required for cathodic protection.

ELECTRIC ISOLATION
The condition of being electrically separated from other metallic structures or the environment.

ELECTRODE
A conductor used to establish contact with an electrolyte and through which current is transferred to or from an electrolyte.

ELECTROLYTE
A chemical substance containing ions that migrate in an electric field. For the purpose of this document, electrolyte refers to the soil or liquid adjacent to and in contact with a buried pipeline system including the moisture contained therein.

GROUNDBED OR ANODEBED
One or more anodes installed below the earth's surface for the purpose of supplying cathodic protection.

HOLIDAY
A discontinuity in a protective coating by that exposes unprotected metallic surface to the environment.

IMPRESSED CURRENT
An electric current supplied by a device employing a power source that is external to the electrode system.

INTERFERENCE
Any electrical disturbance on a metallic structure as a result of stray current.

IR DROP
The voltage across a resistance in accordance with Ohm's Law.

PIPE-TO-ELECTROLYTE POTENTIAL
The voltage measured between the soil and the pipe or structure through an electrode used as reference (normally copper/copper sulphate).

POLARIZATION
The change from the open-circuit potential as result of current across the electrode/electrolyte interface.

POLARIZED POTENTIAL

The potential across the structure/electrolyte interface that is the sum of the corrosion potential and the cathodic polarization.

REFERENCE ELECTRODE
An electrode whose open-circuit potential is constant under similar conditions of measurement, which is used for measuring the relative potentials of other electrodes.

STRAY CURRENT
Current through paths other than the intended circuit.

Cathodic Protection Criteria

Cathodic protection is the method of mitigating the natural electrochemical corrosion process which takes place on a metallic structure when buried or submerged in an electrolyte, such as soil or water. The direct current applied to the structure, from either sacrificial anodes or powered anodes, counteracts the natural corrosion current flow with the amount of current required being dependent primarily on the area of metal exposed to the electrolyte and the type of electrolyte.

NACE SP0169-2013 contains a standardized set of criteria regarding structure-to-soil potential measurements that evaluate the effectiveness of cathodic protection on a structure The presence of a protective potential should be verified after the vessel is polarized. Polarization normally occurs within two weeks in bare vessels and within a few minutes in coated vessels.

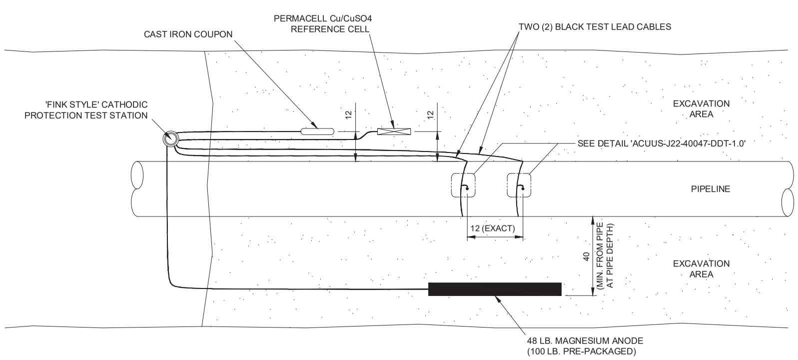
- Criteria that have been documented through empirical evidence to indicate corrosion control effectiveness on specific piping systems may be used on those piping systems or others with the same characteristics.
- A minimum of 100 mV of cathodic polarization. Either the formation or the decay of polarization must be measured to satisfy this criterion.
- A structure-to-electrolyte potential of -850mV or more negative as measured with respect to a saturated copper/copper sulfate (CSE) reference electrode. This potential may be either a direct measurement of the polarized potential or a current-applied potential. Interpretation of a current-applied measurement requires consideration of the significance of voltage drops in the earth and metallic paths

Appendix 4: Bill of Materials

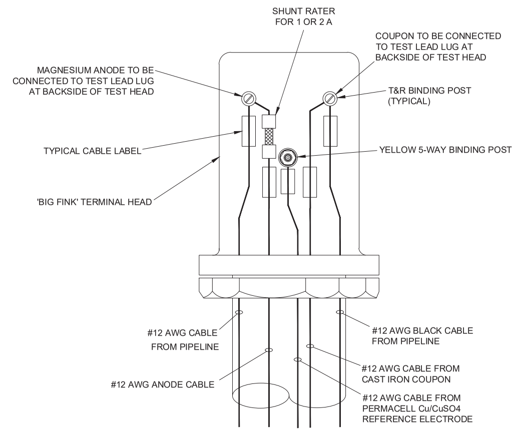
Material Description	Quantity	UoM
Pre-packaged Magnesium anodes, D48 type, with Magnesium alloy size (L x W x H) 28.9" x 5.5" x 5.7", Net weight 48 lbs and pre-packaged size (L x d) 38" x 8.0", Gross weight 100 lbs). 20 ft minimum electrical cable size range 12 AWG – 8 AWG connected to anode iron core.	22	EA
Flush Mounted Test Station, Fink type, with shunt rated for 1 or 2 A, 3 terminal lugs, terminal enclosure box, fixtures, and accessories.	26	EA
Permanent Reference Electrodes, $Cu/CuSO_4$ with 20 ft of cable – 20 years life.	26	EA
Monitoring corrosion/cathodic protection coupons with 20 ft of cable connected.	22	EA
CADWELD Mold materials, tool and accessories with +1,000 shots weld cartridges for cast iron welding.	1	EA
Electrical cable for pipeline section bond (dual connections), cable size #2 AWG.	Approx. 2,000	FT
Coating repair kit or +1,000 patch pads for cables weld coverage.	1	EA
Miscellaneous - Hand tools, multimeter, Clamp-on meter, etc.	1	EA

Appendix 5: Drawings

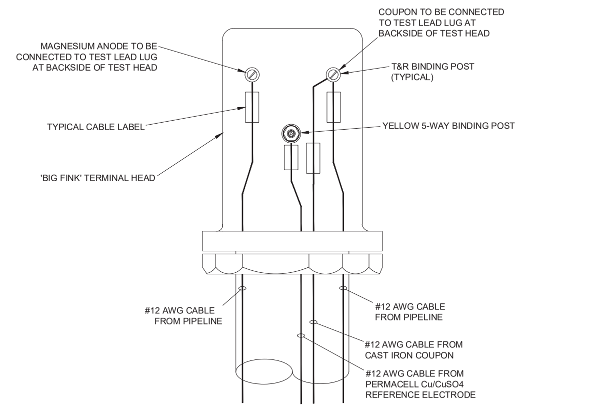
Drawing Number	Drawing Name
ACUUS-J22-40047-DDT-0.0	Sacrificial Anode Cathodic Protection Layout
ACUUS-J22-40047-DDT-1.0	Pipeline Sections Electrical Continuity



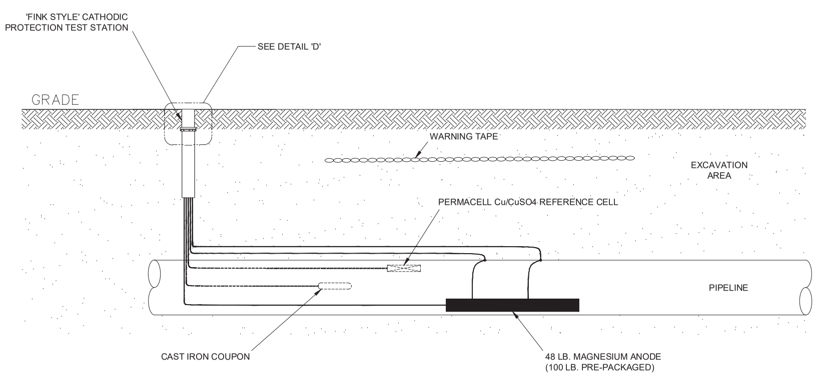
Ⓐ PIPE TRENCH AND CABLE ROUTING TO TEST STATION - PLAN VIEW
Scale: NTS



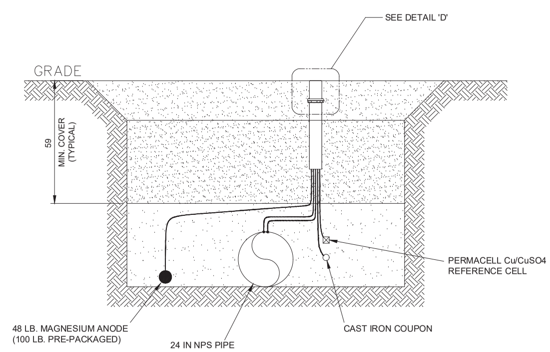
Ⓓ TEST STATION SCHEMATIC FOR CP MONITORING
Scale: NTS



Ⓔ TYPICAL 'BIG FINK' TEST STATION SCHEMATIC FOR MONITORING PIPELINE CROSSINGS
Scale: NTS



Ⓑ PIPE TRENCH AND CABLE ROUTING TO TEST STATION - ELEVATION VIEW
Scale: NTS



Ⓒ TYPICAL PIPE TRENCH AND CABLE ROUTING TO TEST STATION
Scale: NTS

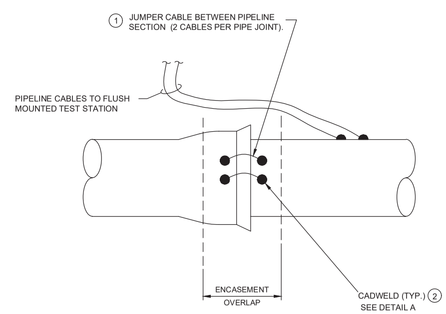
NOTES:

1. TEST LEADS TO BE TERMINATED AT TEST STATION ONLY.
2. ALL WIRES SHALL BE CLEARLY LABELED IN FINK TEST STATION CAP.
3. BACKFILL CAREFULLY TO AVOID STRAINING TEST LEADS.
4. MAGNESIUM ANODE, CAST IRON COUPON, AND PERMACELL TO BE INSTALLED AT LOCATIONS SPECIFIED AS PER CATHODIC PROTECTION MATERIALS AND CONSTRUCTION SPECIFICATION.
5. CABLE SIZES AND EQUIPMENT QUANTITIES VARY PER PROJECT AND WILL BE DEFINTED IN A BILL OF MATERIALS PROVIDED IN A COMPLETED CATHODIC PROTECTION DESIGN PACKAGE.
6. ALL DIMENSIONS ARE GIVEN IN INCHES.

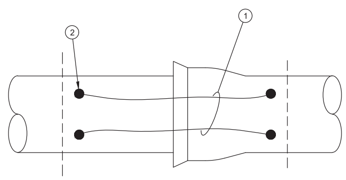
REV	DATE	DESCRIPTION	DES. / CHK. / JM / MM	NOTES	DWG NO.	REFERENCE DRAWINGS
A	10/10/2022	STANDARD DETAIL				

DESCRIPTION	CATHODIC PROTECTION TYPICAL TEST STATION & SACRIFICIAL ANODE SYSTEM INSTALLATION DETAIL
SURFACE LOCATION: DONALDSON HIGHWAY, KENTUCKY	PROJECT NO.: ACUUS-J22-40047
SCALE: NTS	DRAWING NUMBER: ACUUS-J22-40047-DDT-0.0 — REV: A

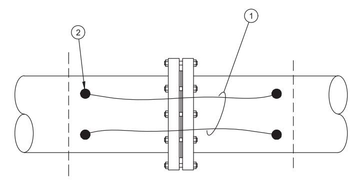
ACUREN



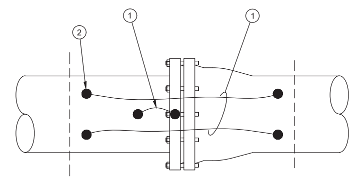
TYPICAL PIPELINE SECTION
Scale: NTS



SLIP-ON JOINT - TYPICAL PLAN VIEW
Scale: NTS



FLANGE JOINT - TYPICAL PLAN VIEW
Scale: NTS



MECHANICAL JOINT - TYPICAL PLAN VIEW
Scale: NTS

CADWELD PROCEDURE:

STEP 1: GRIND PIPE SURFACE (APPROX. 2"X 2") TO "MIRROR" FINISH WITH NO MOISTURE PRESENT.

STEP 2: INSPECT MOLD, ALL EQUIPMENT, AND MATERIALS ARE IN GOOD CONDITION AND READY TO USE.

STEP 3: STRIP THE CABLE INSULATION. CLEAN AND DRY.

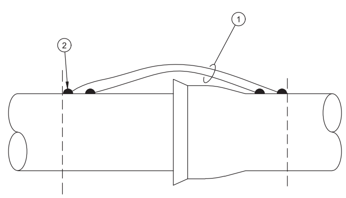
STEP 4: POSITION THE CABLE IN CENTER OF THE 2"X 2" EXPOSED PIPE AREA.

STEP 5: INSTALL THE MOLD WITH CADWELD CUP ON TOP. SECURELY HOLD THE MOLD FIRMLY.

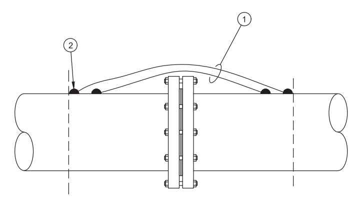
STEP 6: IGNITE THE STRIP, EXOTHERMIC WELDING WILL HAPPEN. ALLOW ABOUT 30 SECONDS TO COMPLETE REACTION.

STEP 7: REMOVE DEBRIS. APPLY PATCH-PAD PROTECTOR TO SEAL THE CADWELD CONNECTION.

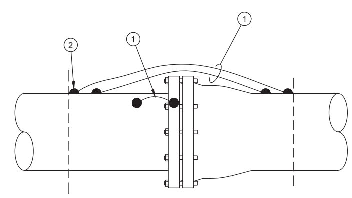
NOTE: PROCEDURE ABOVE IS TO BE USED AS A GENERAL GUIDELINE ONLY.



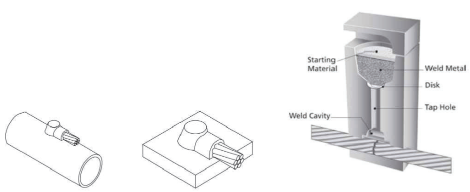
SLIP-ON JOINT - TYPICAL ELEVATION VIEW
Scale: NTS



FLANGE JOINT - TYPICAL ELEVATION VIEW
Scale: NTS



MECHANICAL JOINT - TYPICAL ELEVATION VIEW
Scale: NTS



(A) TYPICAL CADWELD INSTALLATION DETAILS
Scale: NTS

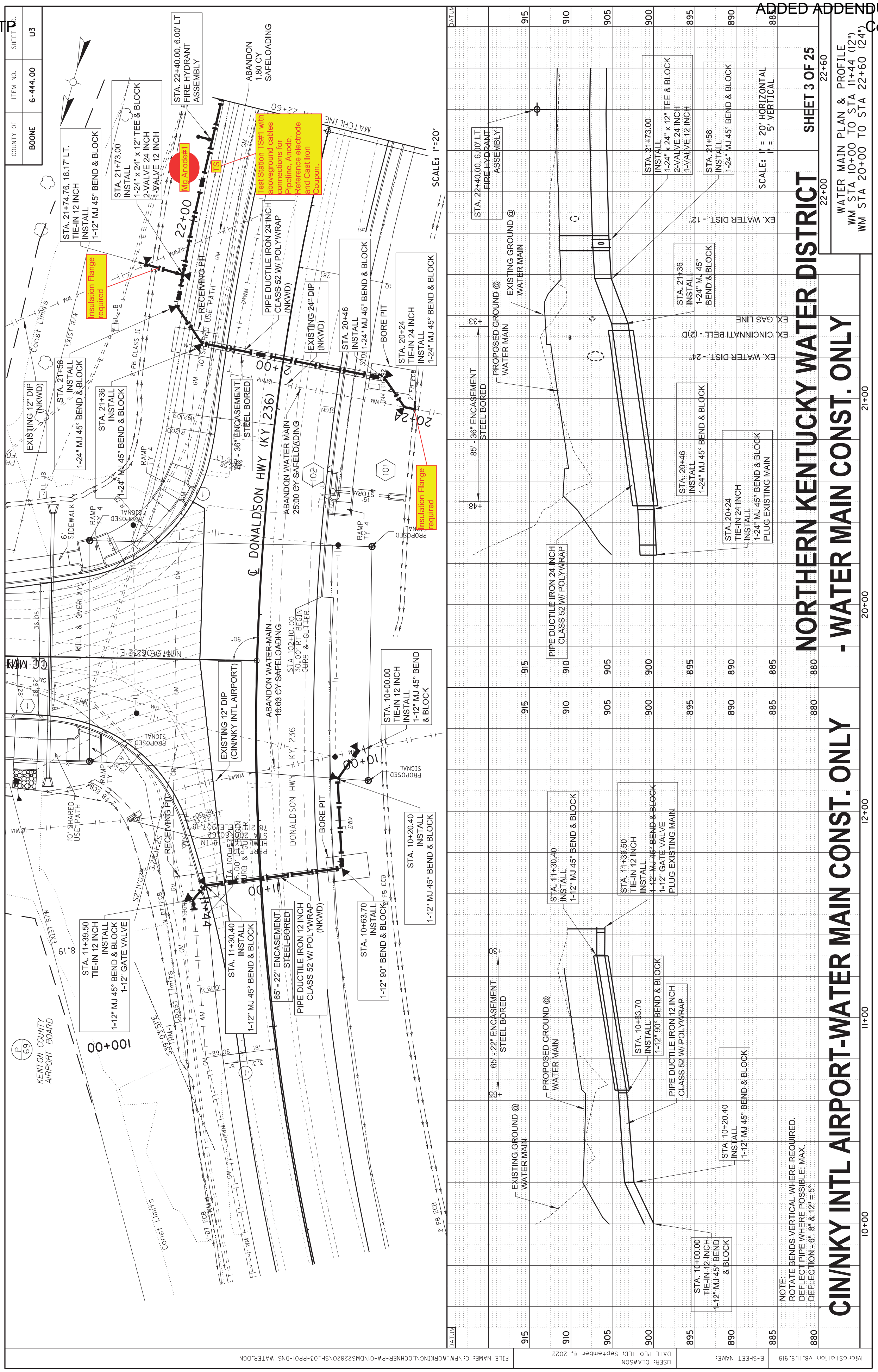
REV	DATE	DESCRIPTION	DES. / CHK. / JM / MM	NOTES	DWG NO.	REFERENCE DRAWINGS
A	12/10/2022	STANDARD DETAIL				

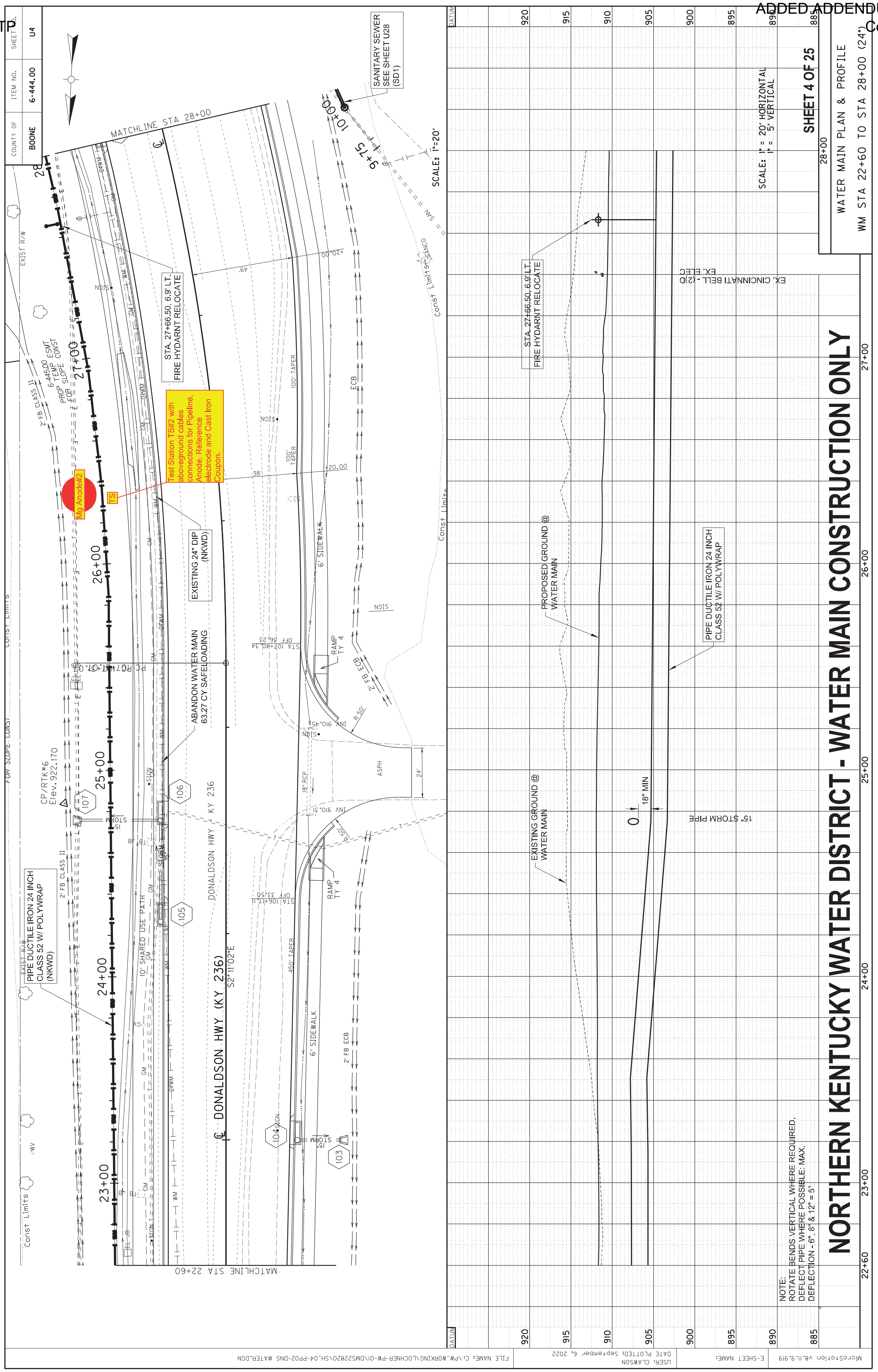
DESCRIPTION: PIPELINE SECTION ELECTRICAL CONTINUITY TYPICAL DETAILS

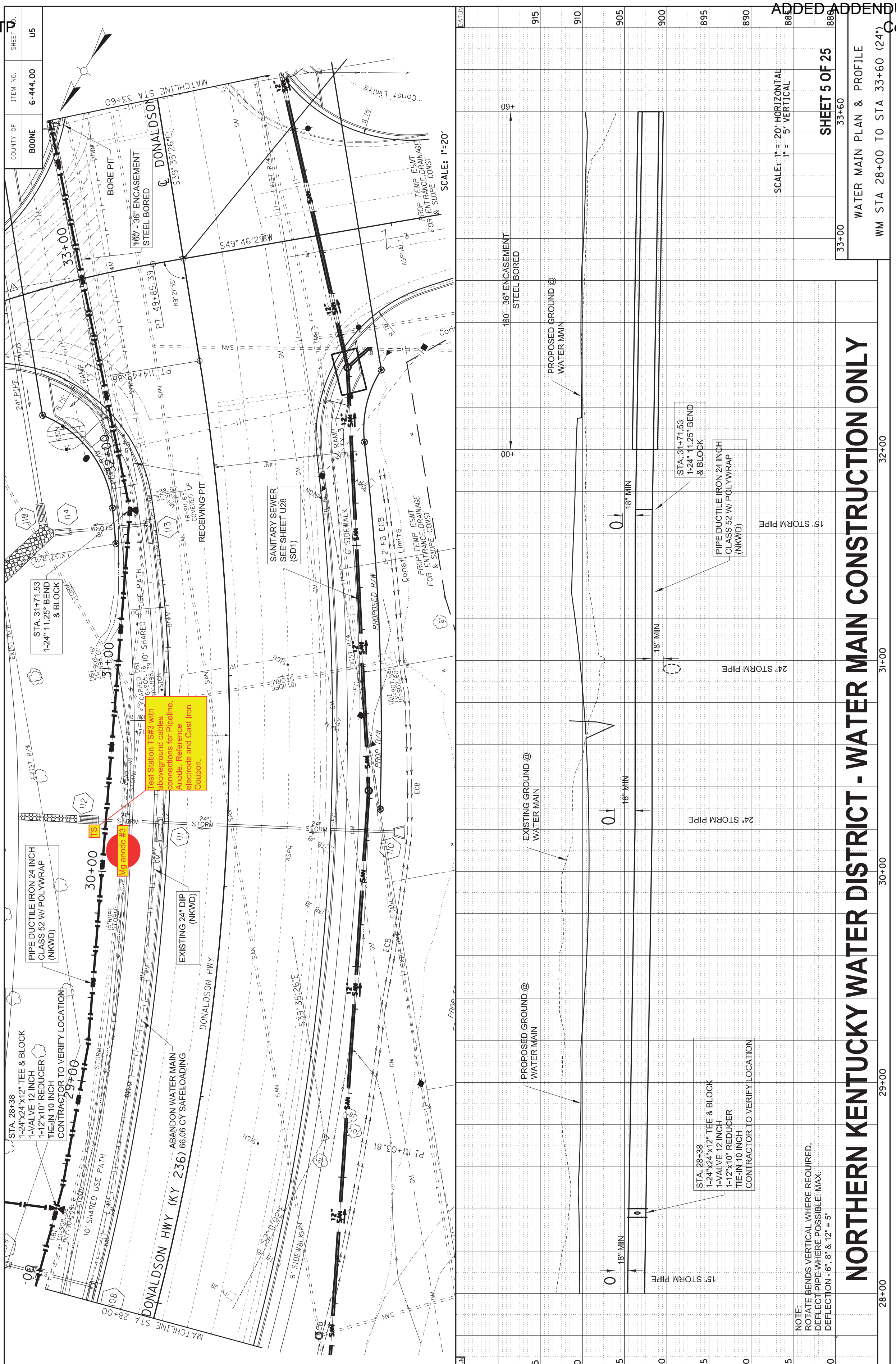
SURFACE LOCATION	PROJECT NO.	
DONALDSON HIGHWAY, KENTUCKY	ACUUS-J22-40047	
SCALE: NTS	DRAWING NUMBER: ACUUS-J22-40047-DDT-1.0	REV: A

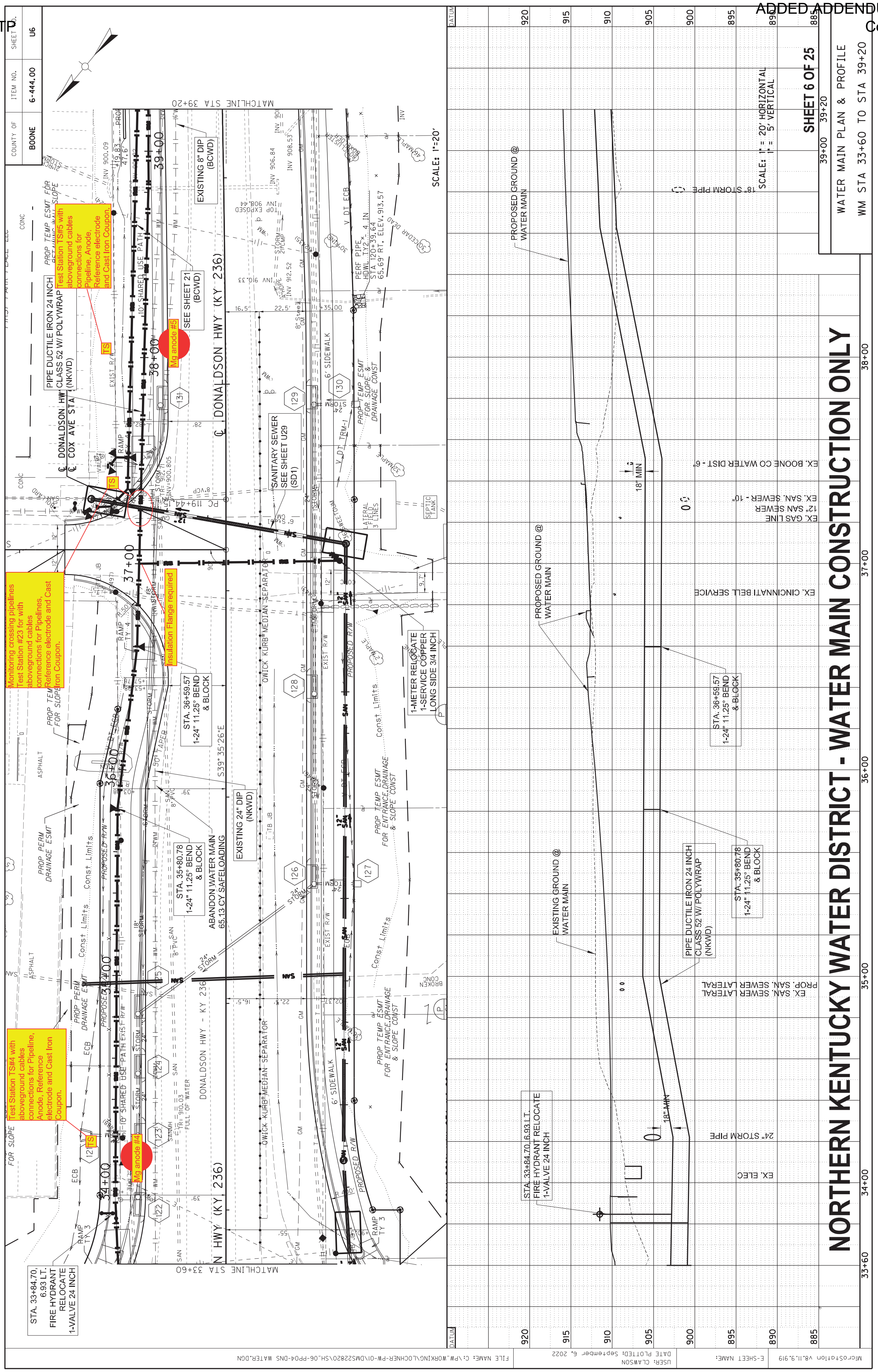
ACUREN

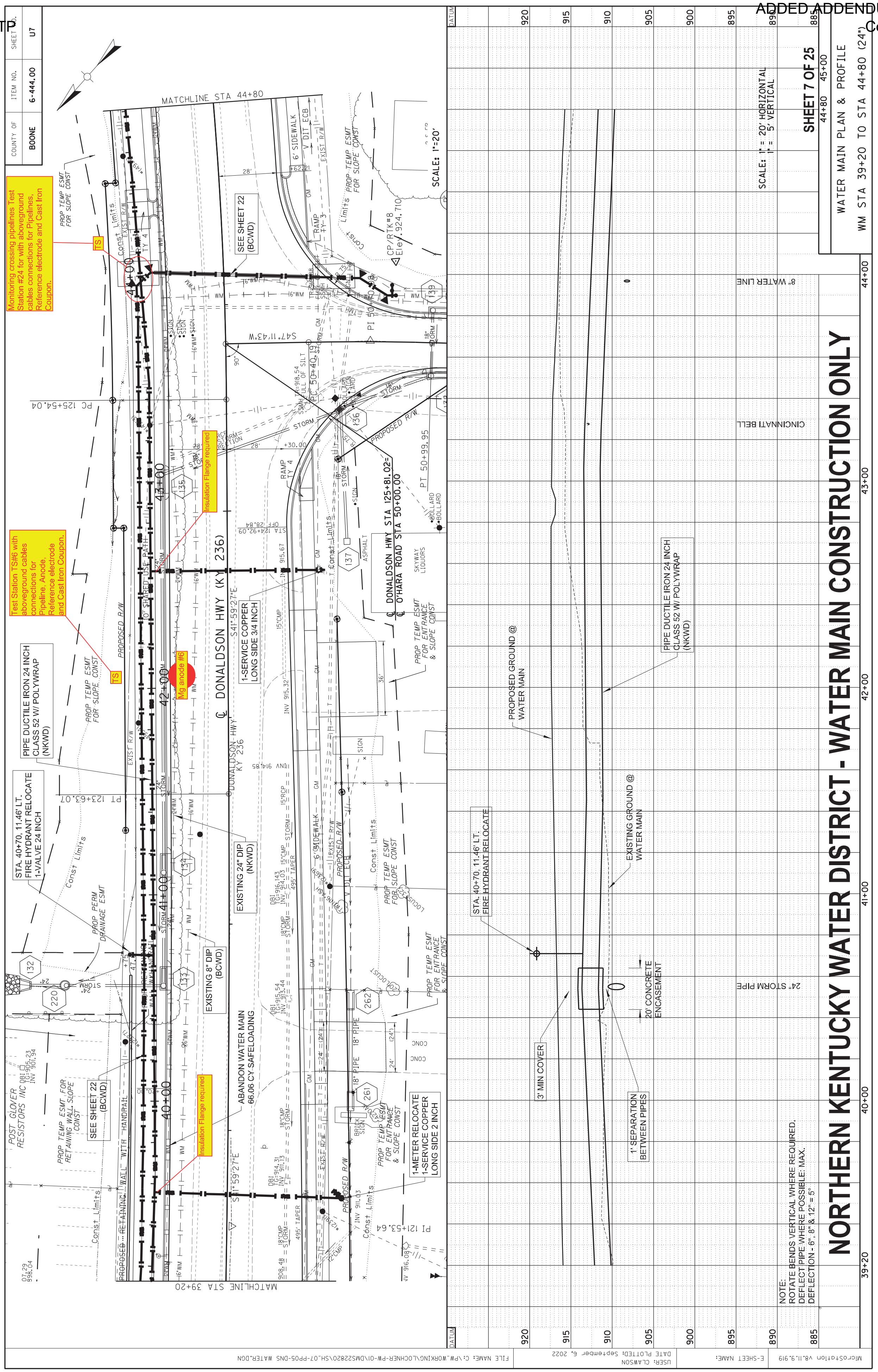
Appendix 6: Cathodic Protection System Layout (Markups) on Construction Drawings

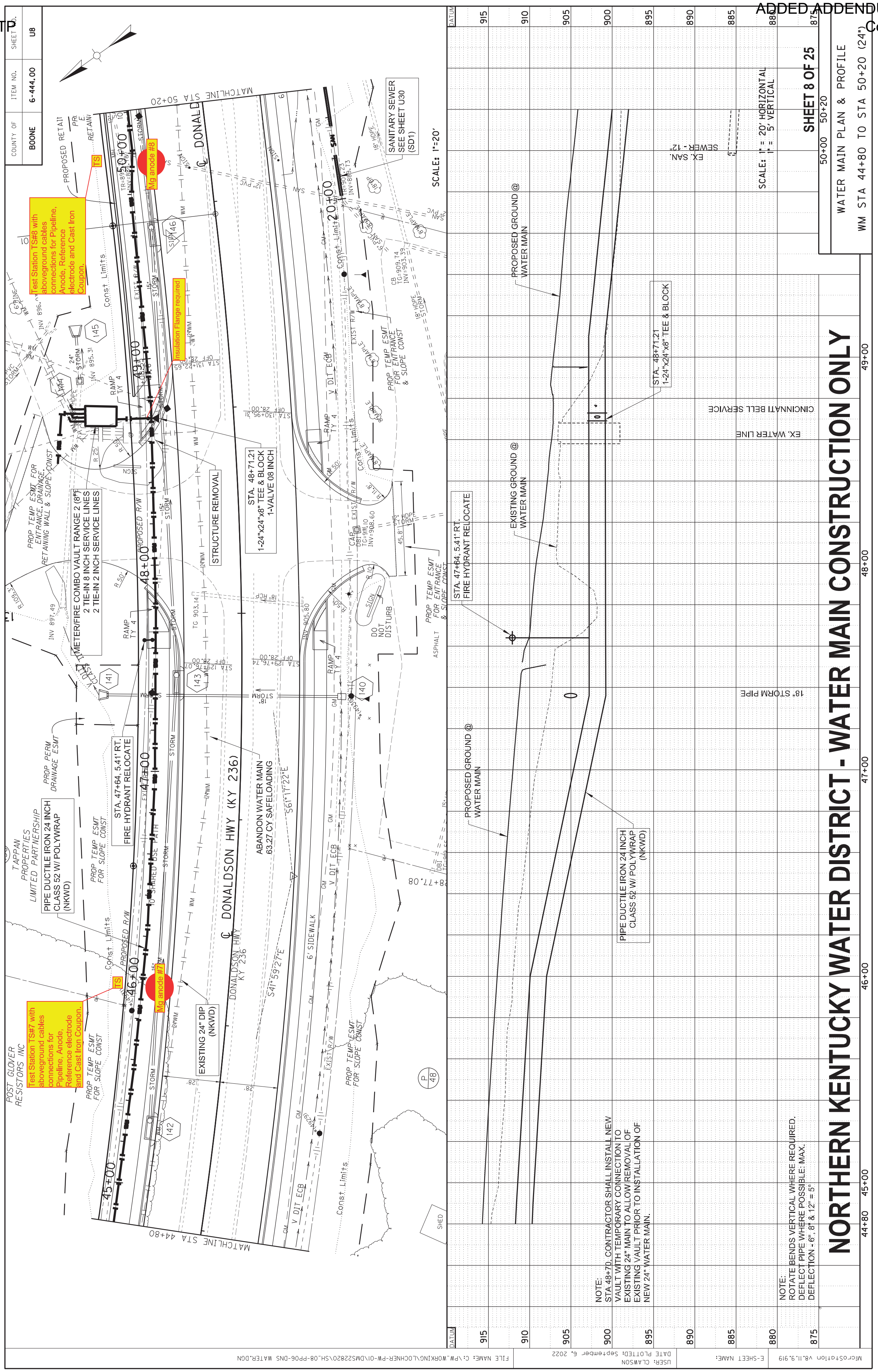

NORTHERN KENTUCKY WATER DISTRICT
- WATER MAIN CONST. ONLY
CIN/NKY INTL AIRPORT-WATER MAIN CONST. ONLY
SHEET 3 OF 25
WATER MAIN PLAN & PROFILE
WM STA 10+00 TO STA 11+44 (12")
WM STA 20+00 TO STA 22+60 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET U3
MATCHLINE
℄ DONALDSON HWY (KY 236)
STA. 22+40.00, 6.00' LT
FIRE HYDRANT
ASSEMBLY
ABANDON
1.80 CY
SAFELOADING
Mg Anode#1
TS
Test Station TS#1 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Insulation Flange required
STA. 21+73.00
INSTALL
1-24" x 24" x 12" TEE & BLOCK
2-VALVE 24 INCH
1-VALVE 12 INCH
STA. 21+74.76, 18.17' LT.
TIE-IN 12 INCH
INSTALL
1-12" MJ 45° BEND & BLOCK
STA. 21+58
INSTALL
1-24" MJ 45° BEND & BLOCK
STA. 21+36
INSTALL
1-24" MJ 45° BEND & BLOCK
EXISTING 12" DIP
(NKWD)
RECEIVING PIT
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
EXISTING 24" DIP
(NKWD)
STA. 20+46
INSTALL
1-24" MJ 45° BEND & BLOCK
BORE PIT
STA. 20+24
TIE-IN 24 INCH
INSTALL
1-24" MJ 45° BEND & BLOCK
85' - 36" ENCASEMENT
STEEL BORED
ABANDON WATER MAIN
25.00 CY SAFELOADING
ABANDON WATER MAIN
16.63 CY SAFELOADING
EXISTING 12" DIP
(CIN/NKY INTL AIRPORT)
STA. 10+00.00
TIE-IN 12 INCH
INSTALL
1-12" MJ 45° BEND
& BLOCK
STA. 10+20.40
INSTALL
1-12" MJ 45° BEND & BLOCK
STA. 10+63.70
INSTALL
1-12" 90° BEND & BLOCK
STA. 11+30.40
INSTALL
1-12" MJ 45° BEND & BLOCK
STA. 11+39.50
TIE-IN 12 INCH
INSTALL
1-12" MJ 45° BEND & BLOCK
1-12" GATE VALVE
65' - 22" ENCASEMENT
STEEL BORED
PIPE DUCTILE IRON 12 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
KENTON COUNTY
AIRPORT BOARD
10' SHARED
USE PATH
PROPOSED SIGNAL
Const Limits
EXIST R/W
PROPOSED GROUND @
WATER MAIN
EXISTING GROUND @
WATER MAIN
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
EX. WATER DIST. - 12"
EX. GAS LINE
EX. CINCINNATI BELL - (2)D
EX. WATER DIST. - 24"
STA. 20+24
TIE-IN 24 INCH
INSTALL
1-24" MJ 45° BEND & BLOCK
PLUG EXISTING MAIN
STA. 11+39.50
TIE-IN 12 INCH
INSTALL
1-12" MJ 45° BEND & BLOCK
1-12" GATE VALVE
PLUG EXISTING MAIN
PIPE DUCTILE IRON 12 INCH
CLASS 52 W/ POLYWRAP
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
DATUM
915
910
905
900
895
890
885
880
10+00
11+00
12+00
20+00
21+00
22+00
22+60
MicroStation v8.11.9.919
E-SHEET NAME:
USER: CLAWSON
DATE PLOTTED: September 6, 2022

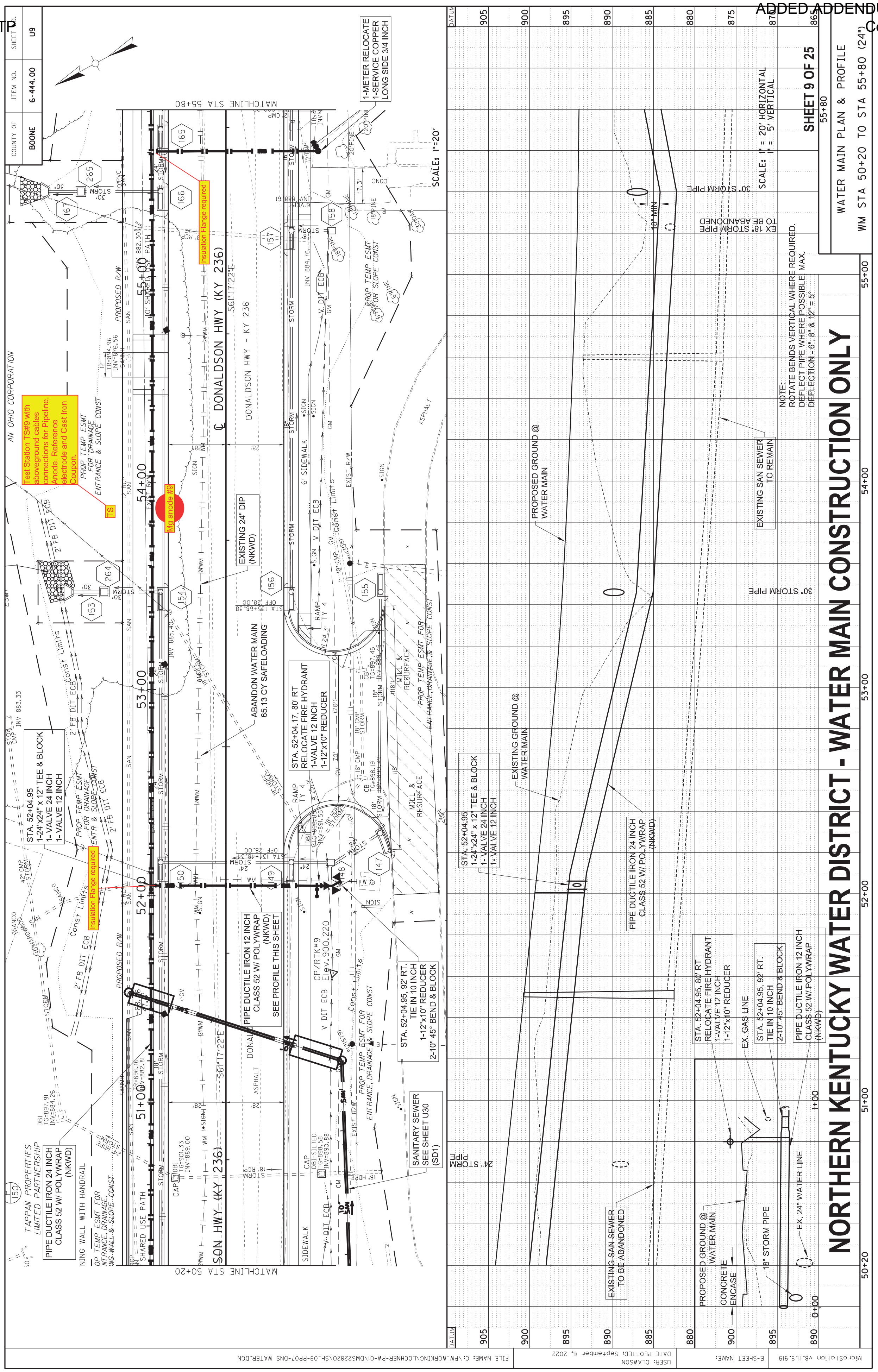

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 22+60 TO STA 28+00 (24")
SHEET 4 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U4
MATCHLINE STA 28+00
MATCHLINE STA 22+60
SANITARY SEWER SEE SHEET U28 (SD1)
STA. 27+66.50, 6.9' LT. FIRE HYDARNT RELOCATE
Test Station TS#2 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg Anode#2
TS
EXISTING 24" DIP (NKWD)
ABANDON WATER MAIN 63.27 CY SAFELOADING
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
CP/RTK#6 Elev. 922.170
DONALDSON HWY (KY 236)
S2°11'02"E
10' SHARED USE PATH
6' SIDEWALK
RAMP TY 4
2' FB ECB
Const Limits
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP
18" MIN
15" STORM PIPE
EX. CINCINNATI BELL - (2)D EX. ELEC
NOTE: ROTATE BENDS VERTICAL WHERE REQUIRED. DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°
22+60
23+00
24+00
25+00
26+00
27+00
28+00
920
915
910
905
900
895
890
885

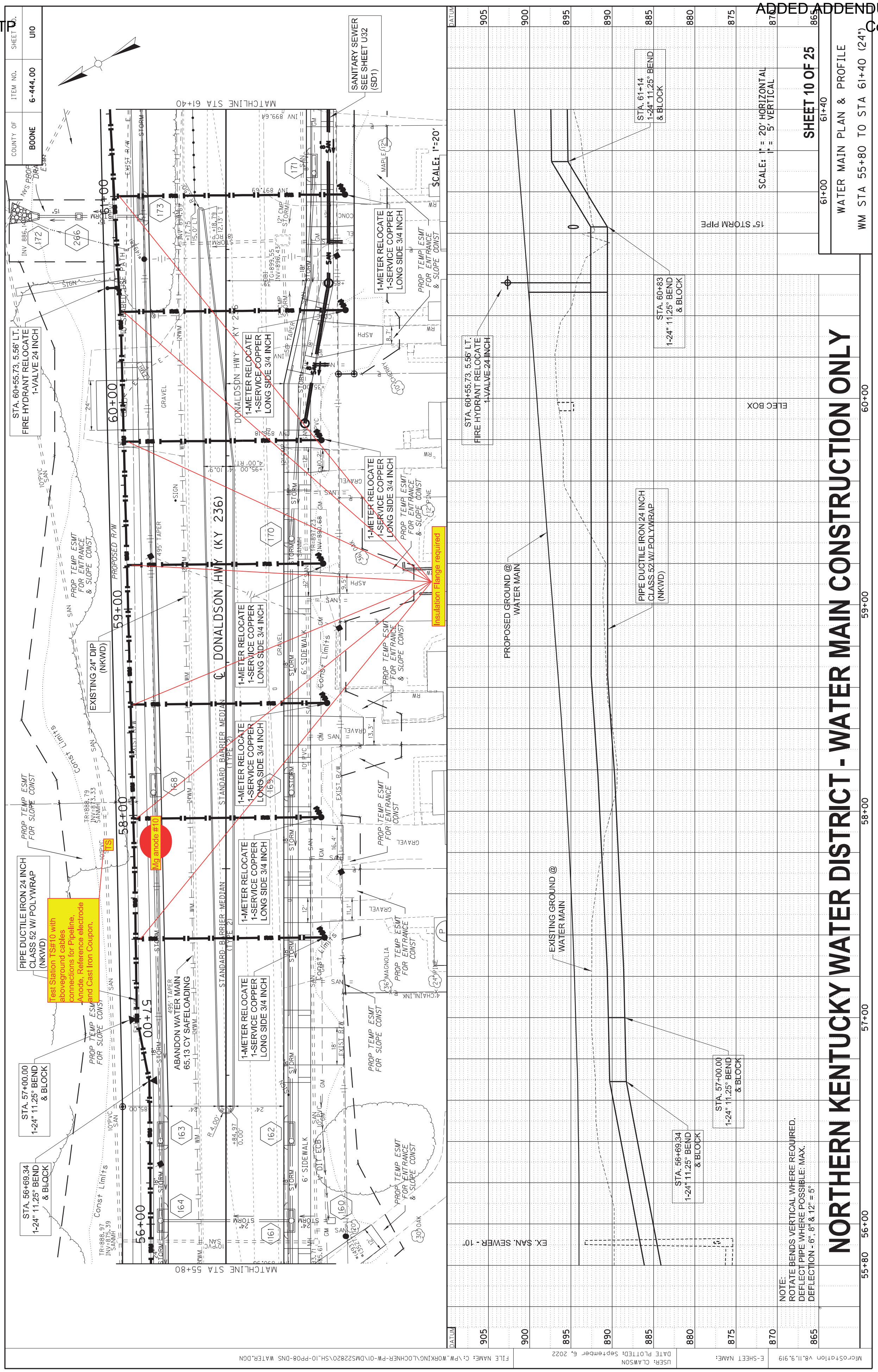

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 28+00 TO STA 33+60 (24")
SHEET 5 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U5
MATCHLINE STA 33+60
MATCHLINE STA 28+00
DONALDSON HWY (KY 236)
160' - 36" ENCASEMENT STEEL BORED
BORE PIT
RECEIVING PIT
STA. 31+71.53
1-24" 11.25° BEND & BLOCK
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
STA. 28+38
1-24"x24"x12" TEE & BLOCK
1-VALVE 12 INCH
1-12"x10" REDUCER
TIE-IN 10 INCH
CONTRACTOR TO VERIFY LOCATION
EXISTING 24" DIP (NKWD)
ABANDON WATER MAIN 66.06 CY SAFELOADING
SANITARY SEWER SEE SHEET U28 (SD1)
Test Station TS#3 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
TS
Mg anode #3
10' SHARED USE PATH
6' SIDEWALK
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
18" MIN
15" STORM PIPE
24" STORM PIPE
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°
28+00
29+00
30+00
31+00
32+00
33+00
33+60
915
910
905
900
895
890
885
880
DATUM
SCALE: 1"=20'
PROP TEMP ESMT FOR ENTRANCE, DRAINAGE & SLOPE CONST
Const Limits
MicroStation v8.11.9.919
USER: CLAWSON
DATE PLOTTED: September 6, 2022
E-SHEET NAME:

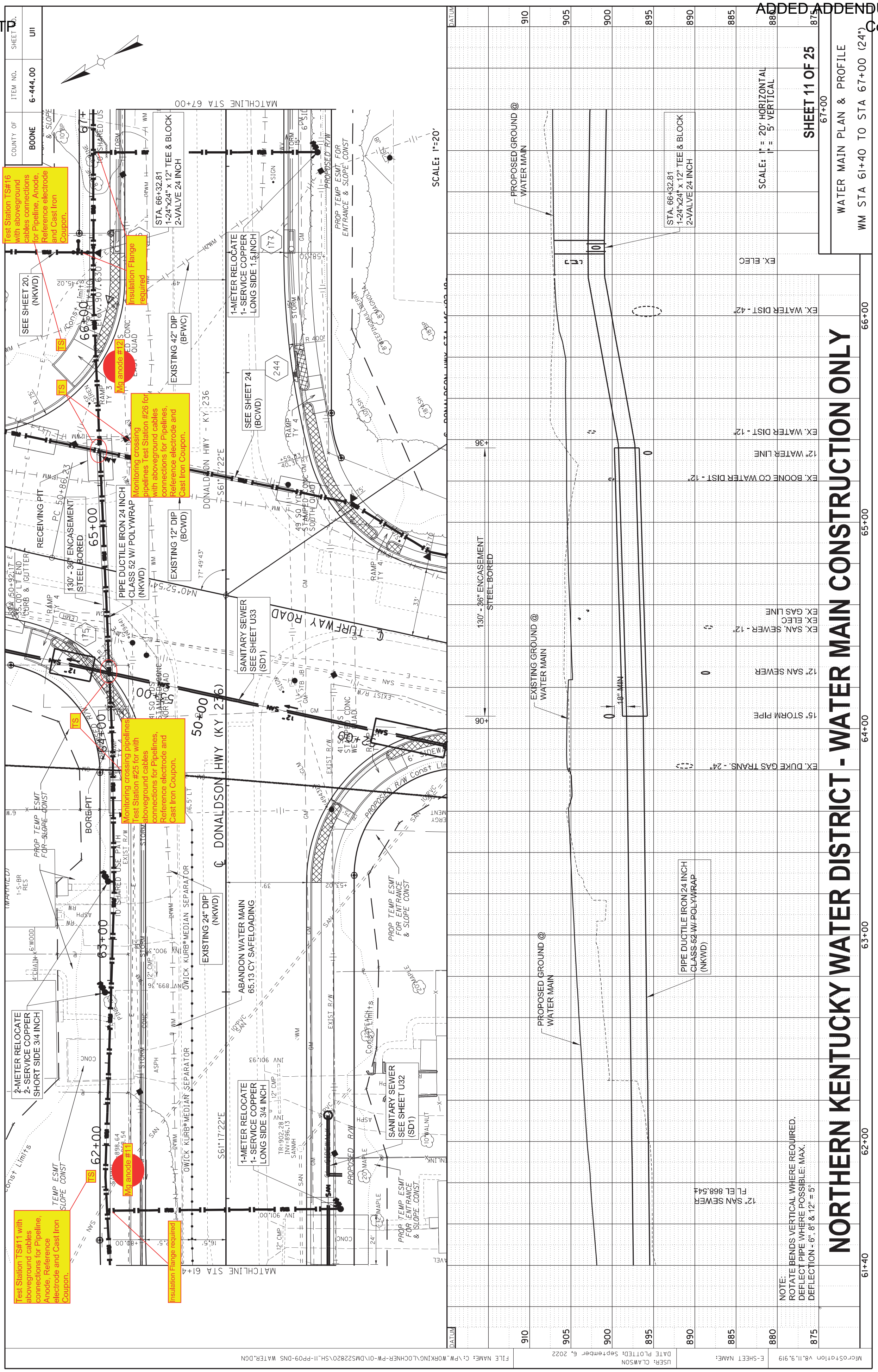

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 6 OF 25
WATER MAIN PLAN & PROFILE
WM STA 33+60 TO STA 39+20
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U6
MATCHLINE STA 39+20
MATCHLINE STA 33+60
Test Station TS#5 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #5
Monitoring crossing pipelines Test Station #23 for with aboveground cables connections for Pipelines, Reference electrode and Cast Iron Coupon.
Insulation Flange required
Test Station TS#4 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #4
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
STA. 36+59.57 1-24" 11.25° BEND & BLOCK
STA. 35+80.78 1-24" 11.25° BEND & BLOCK
STA. 33+84.70, 6.93 LT. FIRE HYDRANT RELOCATE 1-VALVE 24 INCH
ABANDON WATER MAIN 65.13 CY SAFELOADING
EXISTING 24" DIP (NKWD)
EXISTING 8" DIP (BCWD)
SEE SHEET 21 (BCWD)
SANITARY SEWER SEE SHEET U29 (SD1)
1-METER RELOCATE 1-SERVICE COPPER LONG SIDE 3/4 INCH
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
SCALE: 1"=20'

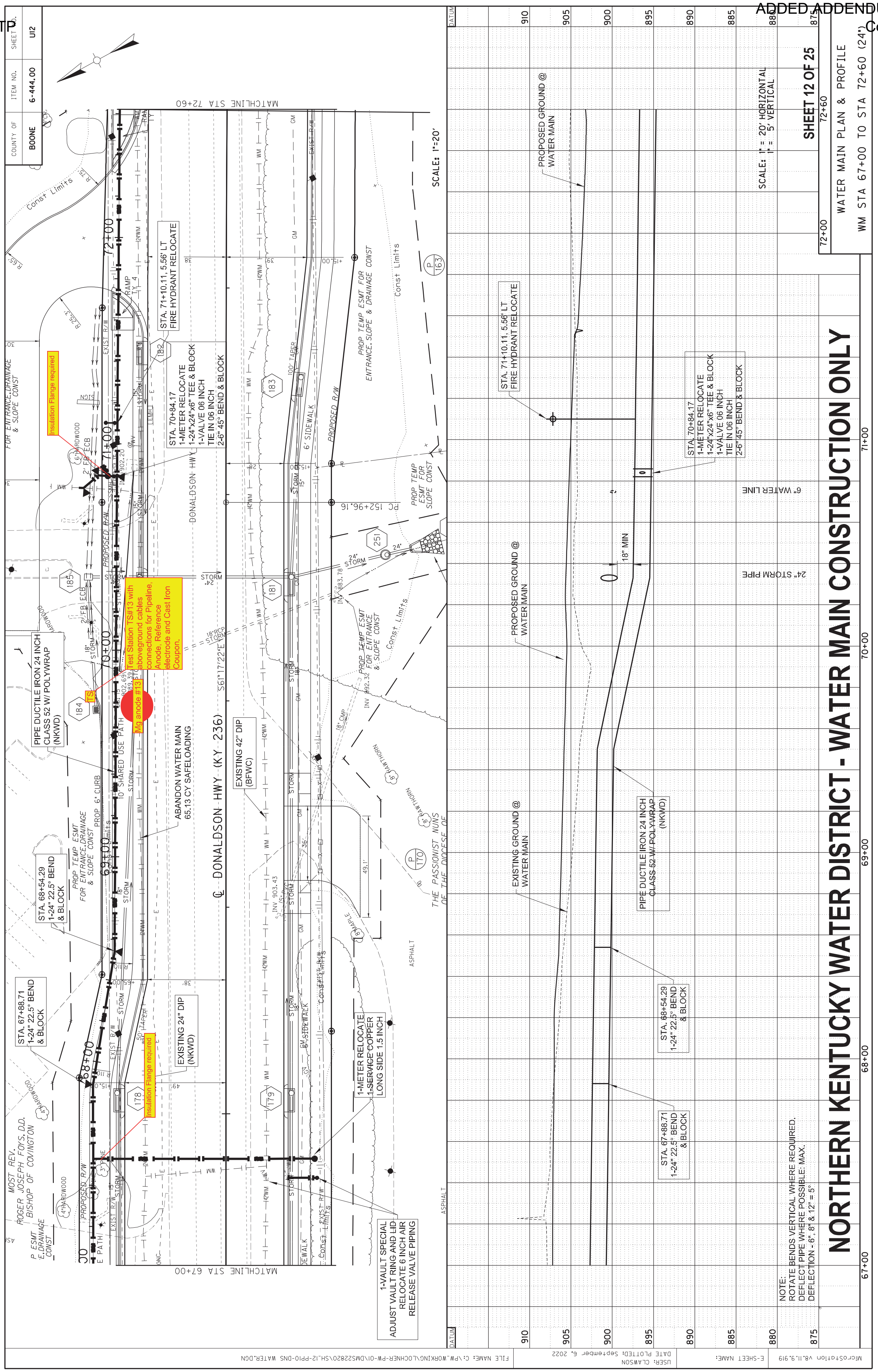

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 7 OF 25
WATER MAIN PLAN & PROFILE
WM STA 39+20 TO STA 44+80 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U7
MATCHLINE STA 44+80
MATCHLINE STA 39+20
DONALDSON HWY (KY 236)
Monitoring crossing pipelines Test Station #24 for with aboveground cables connections for Pipelines, Reference electrode and Cast Iron Coupon.
Test Station TS#6 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Insulation Flange required
Mg anode #6
TS
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
STA. 40+70, 11.46' LT. FIRE HYDRANT RELOCATE 1-VALVE 24 INCH
EXISTING 24" DIP (NKWD)
EXISTING 8" DIP (BCWD)
ABANDON WATER MAIN 66.06 CY SAFELOADING
1-SERVICE COPPER LONG SIDE 3/4 INCH
1-METER RELOCATE 1-SERVICE COPPER LONG SIDE 2 INCH
SEE SHEET 22 (BCWD)
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
STA. 40+70, 11.46' LT. FIRE HYDRANT RELOCATE
3' MIN COVER
1' SEPARATION BETWEEN PIPES
20' CONCRETE ENCASEMENT
8" WATER LINE
CINCINNATI BELL
24" STORM PIPE
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°

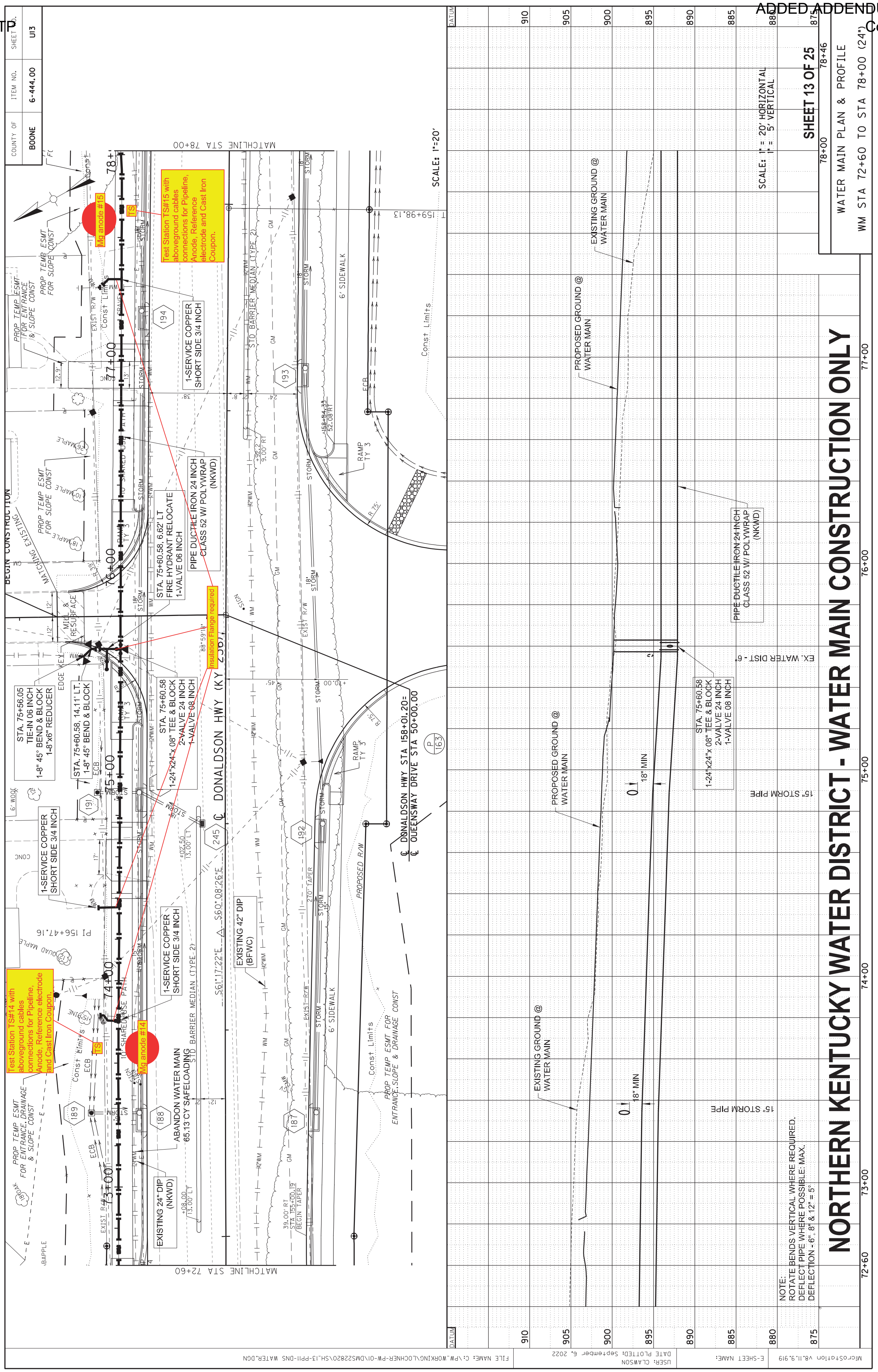

COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U8
NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 8 OF 25
WATER MAIN PLAN & PROFILE
WM STA 44+80 TO STA 50+20 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
MATCHLINE STA 50+20
MATCHLINE STA 44+80
Test Station TS#8 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Test Station TS#7 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #8
Mg anode #7
TS
Insulation Flange required
SANITARY SEWER SEE SHEET U30 (SD1)
METER/FIRE COMBO VAULT RANGE 2 (8")
2 TIE-IN 8 INCH SERVICE LINES
2 TIE-IN 2 INCH SERVICE LINES
STRUCTURE REMOVAL
STA. 48+71.21
1-24"x24"x8" TEE & BLOCK
1-VALVE 08 INCH
STA. 47+64, 5.41' RT.
FIRE HYDRANT RELOCATE
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
ABANDON WATER MAIN
63.27 CY SAFELOADING
EXISTING 24" DIP (NKWD)
DONALDSON HWY (KY 236)
TAPPAN PROPERTIES LIMITED PARTNERSHIP
POST GLOVER RESISTORS INC
PROP TEMP ESMT FOR SLOPE CONST
PROP PERM DRAINAGE ESMT
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
CINCINNATI BELL SERVICE
EX. WATER LINE
18" STORM PIPE
EX. SAN. SEWER - 12"
NOTE:
STA 48+70, CONTRACTOR SHALL INSTALL NEW VAULT WITH TEMPORARY CONNECTION TO EXISTING 24" MAIN TO ALLOW REMOVAL OF EXISTING VAULT PRIOR TO INSTALLATION OF NEW 24" WATER MAIN.
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED. DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°
44+80 45+00 46+00 47+00 48+00 49+00 50+00 50+20

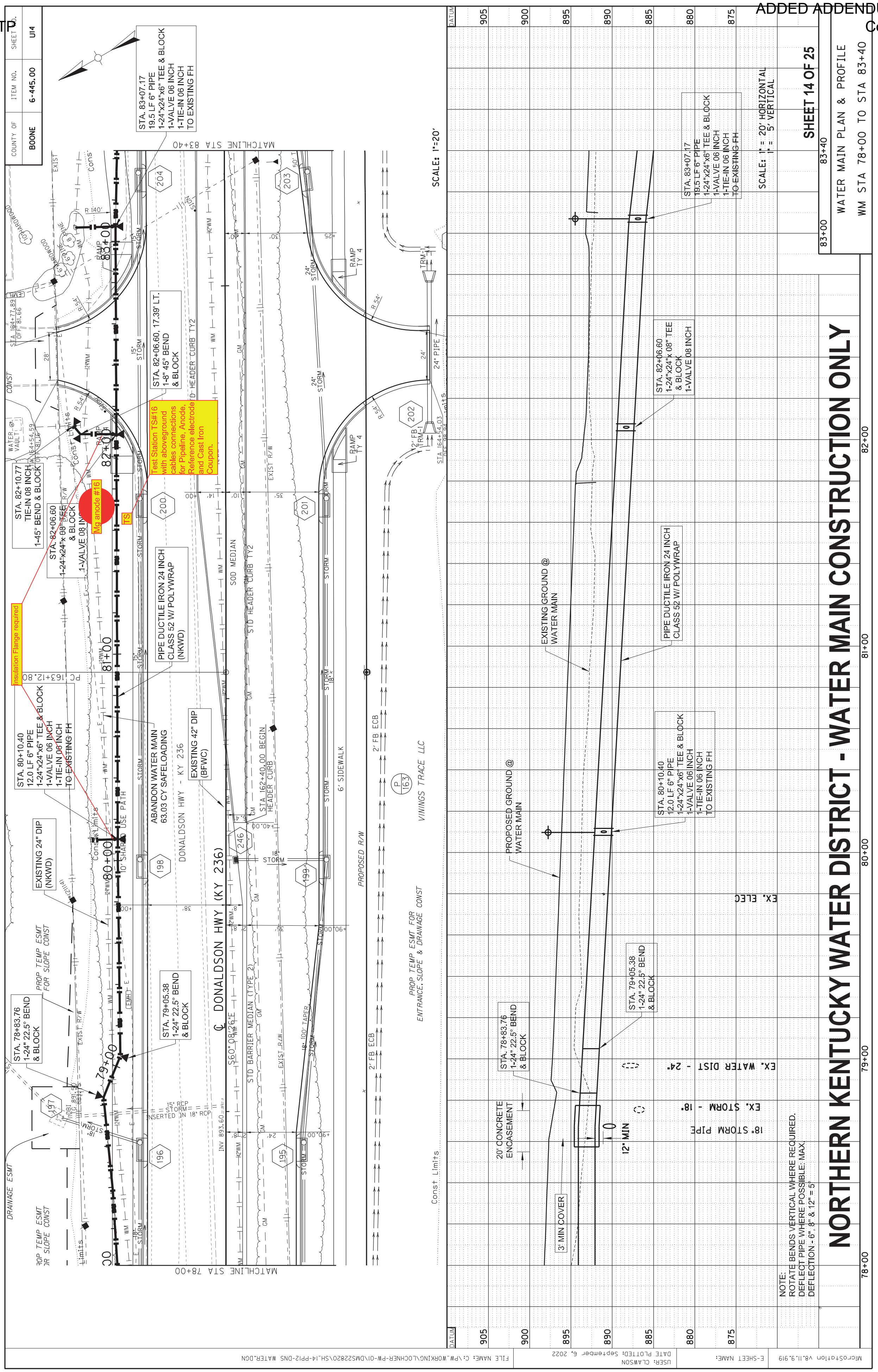

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 50+20 TO STA 55+80 (24")
SHEET 9 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U9
MATCHLINE STA 55+80
MATCHLINE STA 50+20
DONALDSON HWY (KY 236)
Insulation Flange required
Mg anode #9
Test Station TS#9 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
EXISTING 24" DIP (NKWD)
ABANDON WATER MAIN
65.13 CY SAFELOADING
STA. 52+04.95
1-24"x24" x 12" TEE & BLOCK
1- VALVE 24 INCH
1- VALVE 12 INCH
STA. 52+04.17, 80' RT
RELOCATE FIRE HYDRANT
1-VALVE 12 INCH
1-12"x10" REDUCER
STA. 52+04.95, 92' RT.
TIE IN 10 INCH
1-12"x10" REDUCER
2-10" 45° BEND & BLOCK
PIPE DUCTILE IRON 12 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
SEE PROFILE THIS SHEET
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
SANITARY SEWER
SEE SHEET U30
(SD1)
1-METER RELOCATE
1-SERVICE COPPER
LONG SIDE 3/4 INCH
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
EXISTING SAN SEWER TO REMAIN
EXISTING SAN SEWER TO BE ABANDONED
EX 18" STORM PIPE TO BE ABANDONED
30" STORM PIPE
24" STORM PIPE
18" STORM PIPE
EX. 24" WATER LINE
EX. GAS LINE
CONCRETE ENCASE
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE MAX.
DEFLECTION - 6", 8" & 12" = 5°

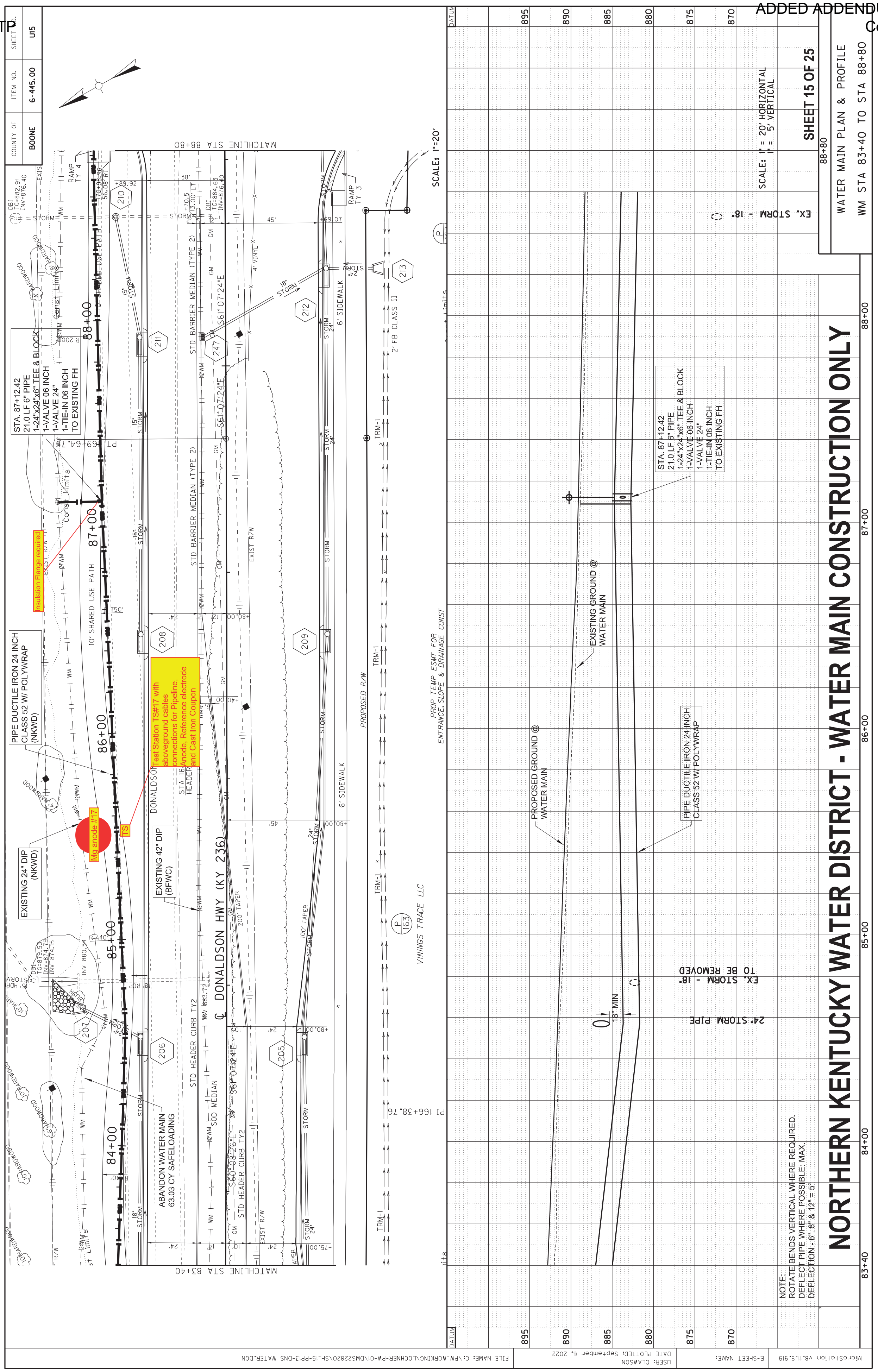

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 10 OF 25
WATER MAIN PLAN & PROFILE
WM STA 55+80 TO STA 61+40 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U10
MATCHLINE STA 61+40
MATCHLINE STA 55+80
SANITARY SEWER SEE SHEET U32 (SD1)
DONALDSON HWY (KY 236)
STANDARD BARRIER MEDIAN (TYPE 2)
PROPOSED R/W
EXIST R/W
Const Limits
PROP TEMP ESMT FOR ENTRANCE & SLOPE CONST
PROP TEMP ESMT FOR SLOPE CONST
1-METER RELOCATE 1-SERVICE COPPER LONG SIDE 3/4 INCH
STA. 60+55.73, 5.56' LT. FIRE HYDRANT RELOCATE 1-VALVE 24 INCH
EXISTING 24" DIP (NKWD)
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
ABANDON WATER MAIN 65.13 CY SAFELOADING
STA. 57+00.00 1-24" 11.25° BEND & BLOCK
STA. 56+69.34 1-24" 11.25° BEND & BLOCK
STA. 60+83 1-24" 11.25° BEND & BLOCK
STA. 61+14 1-24" 11.25° BEND & BLOCK
Test Station TS#10 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
TS
Mg anode #10
Insulation Flange required
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
EX. SAN. SEWER - 10"
15" STORM PIPE
ELEC BOX
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°
55+80
56+00
57+00
58+00
59+00
60+00
61+00
61+40
905
900
895
890
885
880
875
870
865
FILE NAME: C:\PW_WORKING\LOCHNER-PW-01\DMS22820\SH_10-PP08-DNS WATER.DGN
USER: CLAWSON
DATE PLOTTED: September 6, 2022
E-SHEET NAME:
MicroStation v8.11.9.919

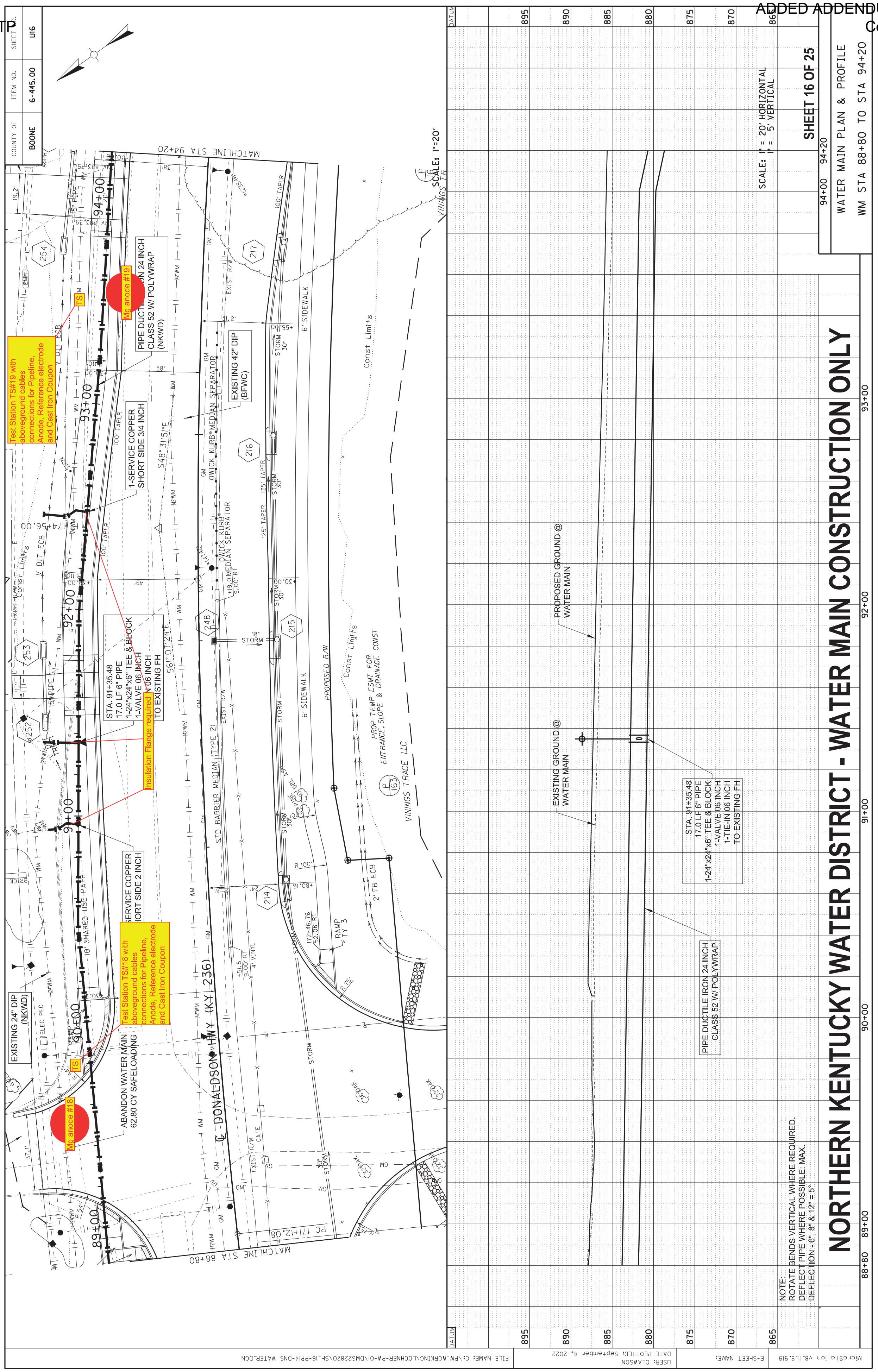

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 61+40 TO STA 67+00 (24")
SHEET 11 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. U11
MATCHLINE STA 67+00
MATCHLINE STA 61+40
STA. 66+32.81
1-24"x24" x 12" TEE & BLOCK
2-VALVE 24 INCH
Test Station TS#16 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Insulation Flange required
Mg anode #12
Mg anode #11
TS
Monitoring crossing pipelines Test Station #26 for with aboveground cables connections for Pipelines, Reference electrode and Cast Iron Coupon.
Monitoring crossing pipelines Test Station #25 for with aboveground cables connections for Pipelines, Reference electrode and Cast Iron Coupon.
Test Station TS#11 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
SEE SHEET 20 (NKWD)
SEE SHEET 24 (BCWD)
EXISTING 42" DIP (BFWC)
EXISTING 12" DIP (BCWD)
EXISTING 24" DIP (NKWD)
1-METER RELOCATE
1- SERVICE COPPER LONG SIDE 1.5 INCH
1-METER RELOCATE
1- SERVICE COPPER LONG SIDE 3/4 INCH
2-METER RELOCATE
2- SERVICE COPPER SHORT SIDE 3/4 INCH
RECEIVING PIT
BORE PIT
130' - 36" ENCASEMENT STEEL BORED
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
SANITARY SEWER SEE SHEET U33 (SD1)
SANITARY SEWER SEE SHEET U32 (SD1)
ABANDON WATER MAIN 65.13 CY SAFELOADING
DONALDSON HWY - KY 236
DONALDSON HWY (KY 236)
TURFWAY ROAD
PROP TEMP ESMT FOR ENTRANCE & SLOPE CONST
PROP TEMP ESMT FOR SLOPE CONST
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
18" MIN
EX. ELEC
EX. WATER DIST - 42"
EX. WATER DIST - 12"
12" WATER LINE
EX. BOONE CO WATER DIST - 12"
EX. GAS LINE
EX. ELEC
EX. SAN. SEWER - 12"
12" SAN SEWER
15" STORM PIPE
EX. DUKE GAS TRANS. - 24"
12" SAN SEWER FL EL 868.54
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
61+40
62+00
63+00
64+00
65+00
66+00
67+00
910
905
900
895
890
885
880
875
DATE PLOTTED: September 6, 2022
USER: CLAWSON

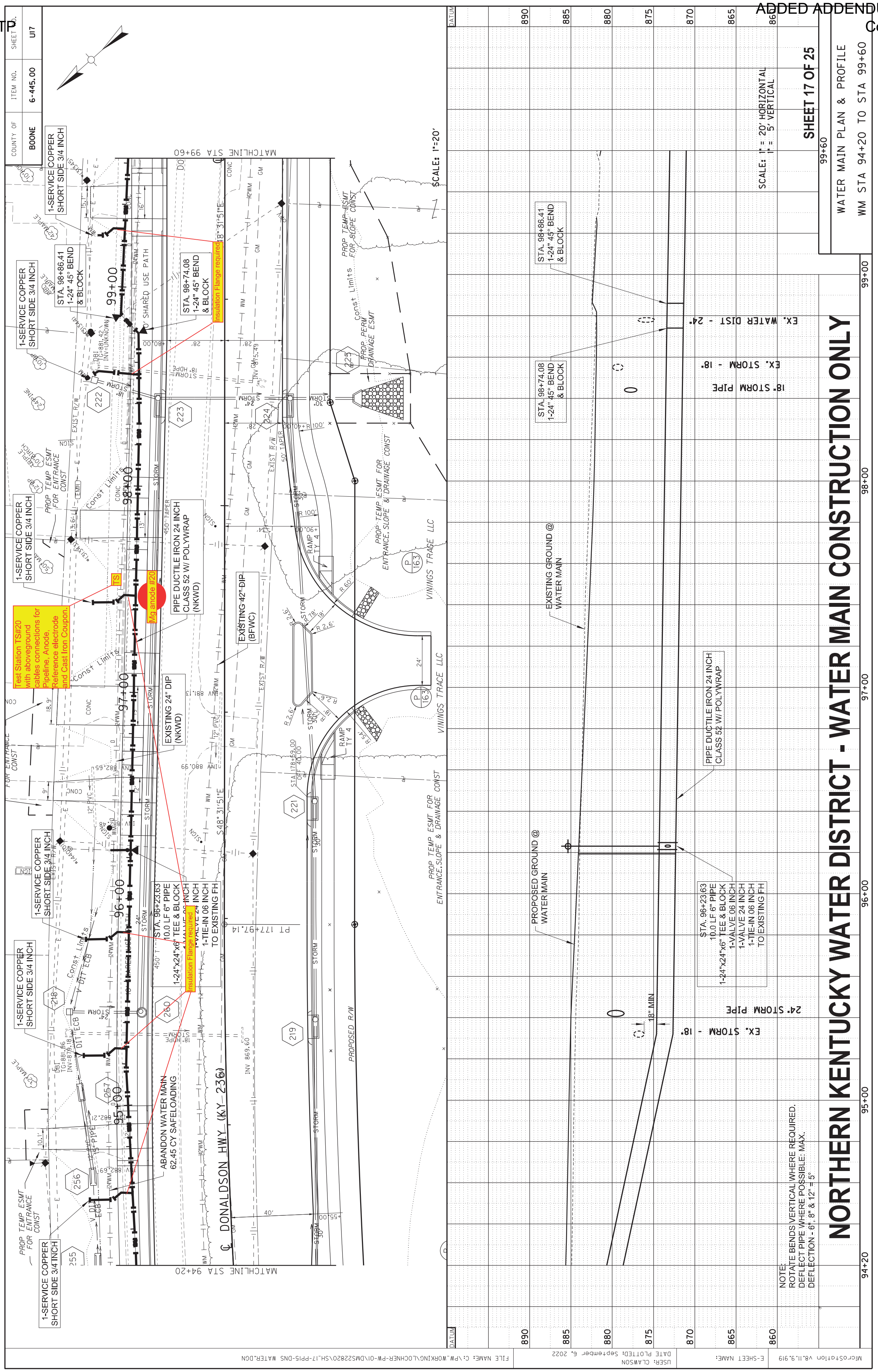

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 12 OF 25
WATER MAIN PLAN & PROFILE
WM STA 67+00 TO STA 72+60 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. UI2
MATCHLINE STA 72+60
MATCHLINE STA 67+00
DONALDSON HWY (KY 236)
STA. 71+10.11, 5.56' LT
FIRE HYDRANT RELOCATE
STA. 70+84.17
1-METER RELOCATE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
TIE IN 06 INCH
2-6" 45° BEND & BLOCK
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
ABANDON WATER MAIN
65.13 CY SAFELOADING
EXISTING 42" DIP
(BFWC)
EXISTING 24" DIP
(NKWD)
STA. 68+54.29
1-24" 22.5° BEND
& BLOCK
STA. 67+88.71
1-24" 22.5° BEND
& BLOCK
1-METER RELOCATE
1-SERVICE COPPER
LONG SIDE 1.5 INCH
1-VAULT SPECIAL
ADJUST VAULT RING AND LID
RELOCATE 6 INCH AIR
RELEASE VALVE PIPING
Insulation Flange required
Test Station TS#13 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #13
PROPOSED GROUND @
WATER MAIN
EXISTING GROUND @
WATER MAIN
6" WATER LINE
24" STORM PIPE
18" MIN
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
THE PASSIONIST NUNS OF THE DIOCESE OF
MOST REV. ROGER JOSEPH FOYS, D.D. BISHOP OF COVINGTON

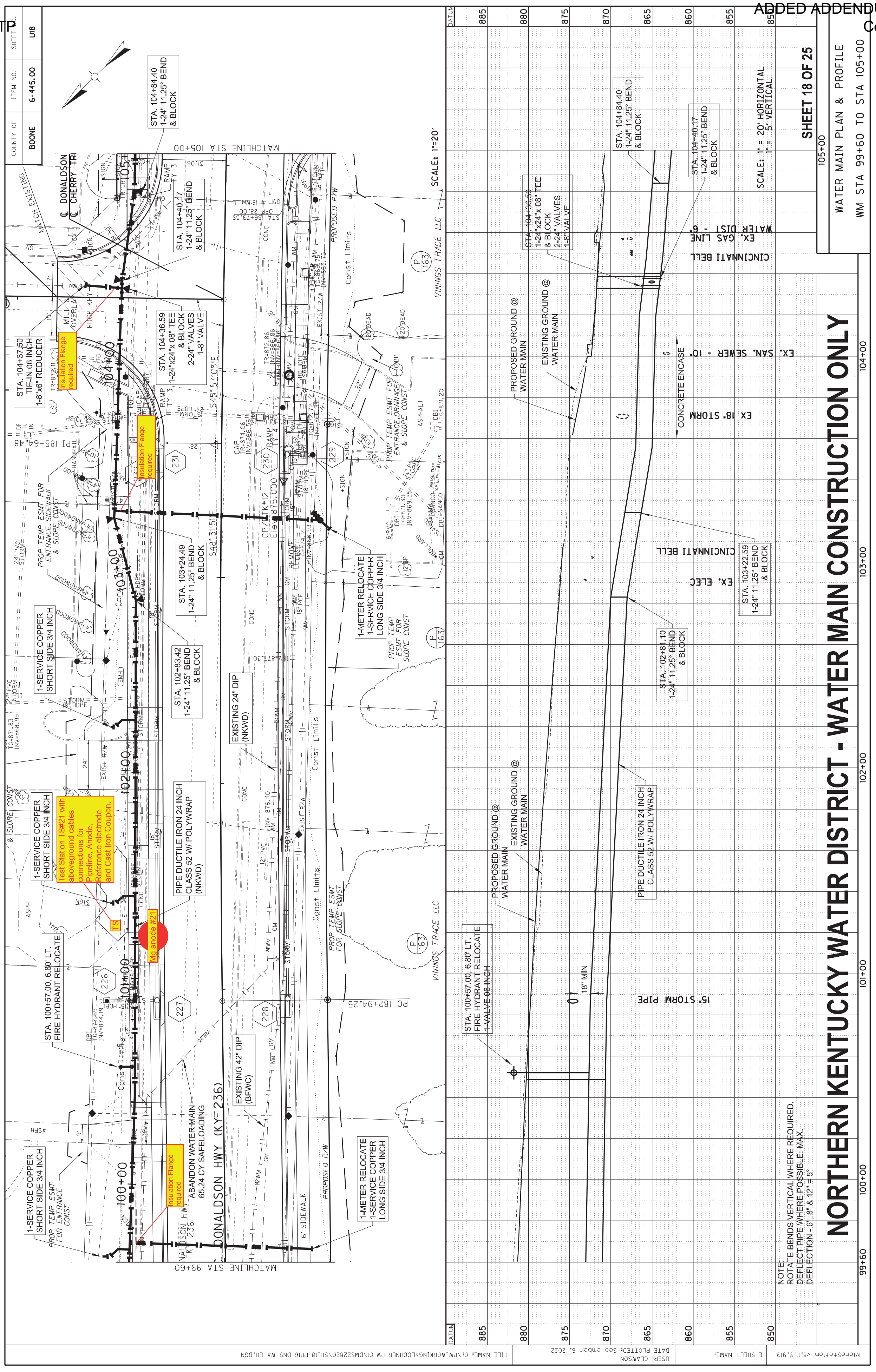

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 13 OF 25
WATER MAIN PLAN & PROFILE
WM STA 72+60 TO STA 78+00 (24")
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-444.00
SHEET NO. UI3
MATCHLINE STA 78+00
MATCHLINE STA 72+60
Test Station TS#15 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #15
Test Station TS#14 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #14
Insulation Flange required
1-SERVICE COPPER SHORT SIDE 3/4 INCH
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
STA. 75+60.58, 6.62' LT FIRE HYDRANT RELOCATE 1-VALVE 06 INCH
STA. 75+56.05 TIE-IN 06 INCH 1-8" 45° BEND & BLOCK 1-8"x6" REDUCER
STA. 75+60.58, 14.11' LT. 1-8" 45° BEND & BLOCK
STA. 75+60.58 1-24"x24"x 08" TEE & BLOCK 2-VALVE 24 INCH 1-VALVE 08 INCH
ABANDON WATER MAIN 65.13 CY SAFELOADING
EXISTING 24" DIP (NKWD)
EXISTING 42" DIP (BFWC)
DONALDSON HWY (KY 236)
DONALDSON HWY STA 158+01.20= QUEENSWAY DRIVE STA 50+00.00
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
EX. WATER DIST - 6"
15" STORM PIPE
18" MIN
NOTE: ROTATE BENDS VERTICAL WHERE REQUIRED. DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°

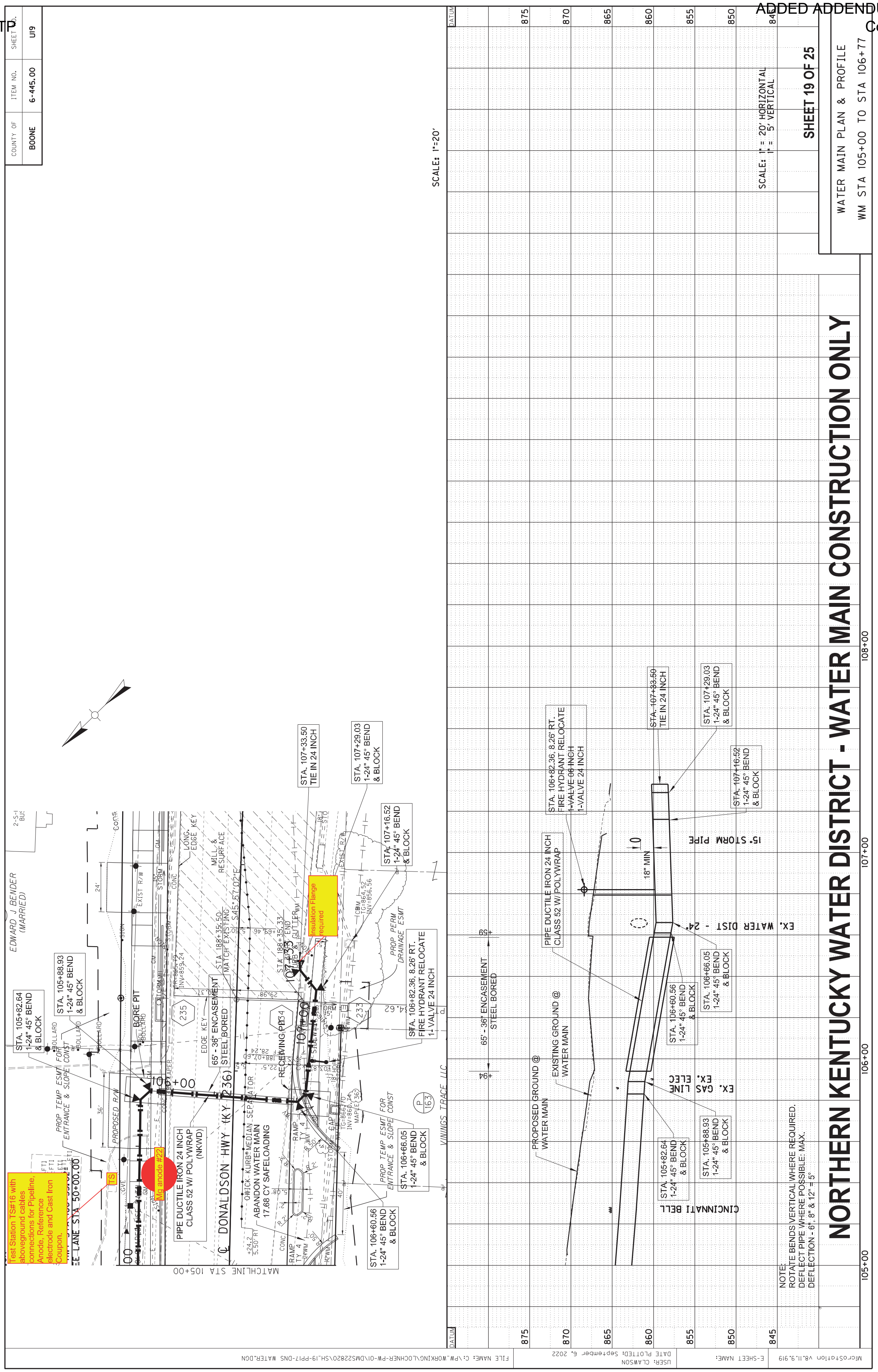

NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 14 OF 25
WATER MAIN PLAN & PROFILE
WM STA 78+00 TO STA 83+40
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. U14
MATCHLINE STA 83+40
MATCHLINE STA 78+00
STA. 83+07.17
19.5 LF 6" PIPE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
1-TIE-IN 06 INCH
TO EXISTING FH
STA. 82+06.60, 17.39' LT.
1-8" 45° BEND
& BLOCK
STA. 82+10.77
TIE-IN 08 INCH
1-45° BEND & BLOCK
STA. 82+06.60
1-24"x24"x 08" TEE
& BLOCK
1-VALVE 08 INCH
Test Station TS#16
with aboveground
cables connections
for Pipeline, Anode,
Reference electrode
and Cast Iron
Coupon.
Mg anode #16
TS
Insulation Flange required
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
STA. 80+10.40
12.0 LF 6" PIPE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
1-TIE-IN 06 INCH
TO EXISTING FH
ABANDON WATER MAIN
63.03 CY SAFELOADING
EXISTING 42" DIP
(BFWC)
EXISTING 24" DIP
(NKWD)
DONALDSON HWY (KY 236)
STA. 79+05.38
1-24" 22.5° BEND
& BLOCK
STA. 78+83.76
1-24" 22.5° BEND
& BLOCK
VININGS TRACE LLC
PROPOSED R/W
PROP TEMP ESMT FOR ENTRANCE, SLOPE & DRAINAGE CONST
EXISTING GROUND @ WATER MAIN
PROPOSED GROUND @ WATER MAIN
EX. ELEC
EX. WATER DIST - 24"
EX. STORM - 18"
18" STORM PIPE
20' CONCRETE ENCASEMENT
12" MIN
3' MIN COVER
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX
DEFLECTION - 6", 8" & 12" = 5°
78+00
79+00
80+00
81+00
82+00
83+00
83+40
905
900
895
890
885
880
875
DATUM
MicroStation v8.11.9.919
USER: CLAWSON
DATE PLOTTED: September 6, 2022


COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. UI5
NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 83+40 TO STA 88+80
SHEET 15 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
MATCHLINE STA 88+80
MATCHLINE STA 83+40
STA. 87+12.42
21.0 LF 6" PIPE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
1-VALVE 24"
1-TIE-IN 06 INCH
TO EXISTING FH
Insulation Flange required
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
Test Station TS#17 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon
TS
Mg anode #17
EXISTING 24" DIP
(NKWD)
EXISTING 42" DIP
(BFWC)
ABANDON WATER MAIN
63.03 CY SAFELOADING
DONALDSON HWY (KY 236)
10' SHARED USE PATH
STD BARRIER MEDIAN (TYPE 2)
STD HEADER CURB TY2
6' SIDEWALK
2' FB CLASS II
PROPOSED R/W
PROP TEMP ESMT FOR ENTRANCE, SLOPE & DRAINAGE CONST
VININGS TRACE LLC
PI 166+38.76
EXISTING GROUND @ WATER MAIN
PROPOSED GROUND @ WATER MAIN
EX. STORM - 18"
EX. STORM - 18" TO BE REMOVED
24" STORM PIPE
18" MIN
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
83+40
84+00
85+00
86+00
87+00
88+00
88+80
895
890
885
880
875
870
MicroStation v8.11.9.919
E-SHEET NAME:
USER: CLAWSON
DATE PLOTTED: September 6, 2022
FILE NAME: c:\PW_WORKING\LOCHNER-PW-01\DMS22820\SH_15-PP13-DNS WATER.DGN


COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. U16
NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 88+80 TO STA 94+20
SHEET 16 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
MATCHLINE STA 94+20
MATCHLINE STA 88+80
Test Station TS#19 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon
Test Station TS#18 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon
Mg anode #19
Mg anode #18
TS
Insulation Flange required
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
EXISTING 42" DIP (BFWC)
1-SERVICE COPPER SHORT SIDE 3/4 INCH
SERVICE COPPER SHORT SIDE 2 INCH
STA. 91+35.48
17.0 LF 6" PIPE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
1-TIE-IN 06 INCH
TO EXISTING FH
ABANDON WATER MAIN
62.80 CY SAFELOADING
EXISTING 24" DIP (NKWD)
DONALDSON HWY (KY 236)
STD BARRIER MEDIAN (TYPE 2)
VININGS TRACE LLC
PROP TEMP ESMT FOR ENTRANCE, SLOPE & DRAINAGE CONST
PROPOSED R/W
EXIST R/W
Const Limits
6' SIDEWALK
10' SHARED USE PATH
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
88+80
89+00
90+00
91+00
92+00
93+00
94+00
94+20
895
890
885
880
875
870
865
DATUM
MicroStation v8.11.9.919
USER: CLAWSON
DATE PLOTTED: September 6, 2022


NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
WATER MAIN PLAN & PROFILE
WM STA 94+20 TO STA 99+60
SHEET 17 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. U17
MATCHLINE STA 99+60
MATCHLINE STA 94+20
DONALDSON HWY (KY 236)
S48°31'51"E
VININGS TRACE LLC
Test Station TS#20 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
Mg anode #20
TS
Insulation Flange required
STA. 98+86.41
1-24" 45° BEND & BLOCK
STA. 98+74.08
1-24" 45° BEND & BLOCK
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
EXISTING 42" DIP (BFWC)
EXISTING 24" DIP (NKWD)
STA. 96+23.63
10.0 LF 6" PIPE
1-24"x24"x6" TEE & BLOCK
1-VALVE 06 INCH
1-VALVE 24 INCH
1-TIE-IN 06 INCH TO EXISTING FH
ABANDON WATER MAIN 62.45 CY SAFELOADING
1-SERVICE COPPER SHORT SIDE 3/4 INCH
EXISTING GROUND @ WATER MAIN
PROPOSED GROUND @ WATER MAIN
EX. WATER DIST - 24"
EX. STORM - 18"
18" STORM PIPE
24" STORM PIPE
18" MIN
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE; MAX. DEFLECTION - 6", 8" & 12" = 5°
PROPOSED R/W
EXIST R/W
PROP TEMP ESMT FOR ENTRANCE, SLOPE & DRAINAGE CONST
PROP PERM DRAINAGE ESMT
MicroStation v8.11.9.919
DATE PLOTTED: September 6, 2022
USER: CLAWSON


COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. U18
NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 18 OF 25
WATER MAIN PLAN & PROFILE
WM STA 99+60 TO STA 105+00
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
SCALE: 1"=20'
MATCHLINE STA 105+00
MATCHLINE STA 99+60
DONALDSON HWY (KY 236)
STA. 104+84.40
1-24" 11.25° BEND
& BLOCK
STA. 104+40.17
1-24" 11.25° BEND
& BLOCK
STA. 104+36.59
1-24"x24"x 08" TEE
& BLOCK
2-24" VALVES
1-8" VALVE
STA. 104+37.50
TIE-IN 06 INCH
1-8"x6" REDUCER
Insulation Flange required
STA. 103+24.49
1-24" 11.25° BEND
& BLOCK
STA. 103+22.59
1-24" 11.25° BEND
& BLOCK
STA. 102+83.42
1-24" 11.25° BEND
& BLOCK
STA. 102+81.10
1-24" 11.25° BEND
& BLOCK
1-METER RELOCATE
1-SERVICE COPPER
LONG SIDE 3/4 INCH
1-SERVICE COPPER
SHORT SIDE 3/4 INCH
EXISTING 24" DIP
(NKWD)
EXISTING 42" DIP
(BFWC)
PIPE DUCTILE IRON 24 INCH
CLASS 52 W/ POLYWRAP
(NKWD)
Test Station TS#21 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
TS
Mg anode #21
STA. 100+57.00, 6.80' LT.
FIRE HYDRANT RELOCATE
1-VALVE 06 INCH
ABANDON WATER MAIN
65.24 CY SAFELOADING
PROPOSED GROUND @
WATER MAIN
EXISTING GROUND @
WATER MAIN
CONCRETE ENCASE
EX. SAN. SEWER - 10"
EX 18" STORM
15" STORM PIPE
18" MIN
CINCINNATI BELL
EX. ELEC
EX. GAS LINE
WATER DIST - 6"
VININGS TRACE LLC
PROPOSED R/W
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX.
DEFLECTION - 6", 8" & 12" = 5°
99+60
100+00
101+00
102+00
103+00
104+00
105+00
850
855
860
865
870
875
880
885
DATUM
MicroStation v8.11.9.919
E-SHEET NAME:
USER: CLAWSON
DATE PLOTTED: September 6, 2022
FILE NAME: C:\PW_WORKING\LOCHNER-PW-01\DMS22820\SH_18-PP16-DNS WATER.DGN


COUNTY OF BOONE
ITEM NO. 6-445.00
SHEET NO. U19
SCALE: 1"=20'
NORTHERN KENTUCKY WATER DISTRICT - WATER MAIN CONSTRUCTION ONLY
SHEET 19 OF 25
SCALE: 1" = 20' HORIZONTAL
1" = 5' VERTICAL
WATER MAIN PLAN & PROFILE
WM STA 105+00 TO STA 106+77
EDWARD J BENDER (MARRIED)
STA. 105+82.64 1-24" 45° BEND & BLOCK
STA. 105+88.93 1-24" 45° BEND & BLOCK
STA. 106+60.56 1-24" 45° BEND & BLOCK
STA. 106+66.05 1-24" 45° BEND & BLOCK
STA. 106+82.36, 8.26' RT. FIRE HYDRANT RELOCATE 1-VALVE 24 INCH
STA. 107+16.52 1-24" 45° BEND & BLOCK
STA. 107+29.03 1-24" 45° BEND & BLOCK
STA. 107+33.50 TIE IN 24 INCH
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP (NKWD)
65' - 36" ENCASEMENT STEEL BORED
BORE PIT
RECEIVING PIT
ABANDON WATER MAIN 17.68 CY SAFELOADING
DONALDSON HWY (KY 236)
PROP TEMP ESMT FOR ENTRANCE & SLOPE CONST
PROP PERM DRAINAGE ESMT
MATCHLINE STA 105+00
VININGS TRACE LLC
Test Station TS#16 with aboveground cables connections for Pipeline, Anode, Reference electrode and Cast Iron Coupon.
TS
Mg anode #22
Insulation Flange required
STA. 106+82.36, 8.26' RT. FIRE HYDRANT RELOCATE 1-VALVE 06 INCH 1-VALVE 24 INCH
PIPE DUCTILE IRON 24 INCH CLASS 52 W/ POLYWRAP
PROPOSED GROUND @ WATER MAIN
EXISTING GROUND @ WATER MAIN
65' - 36" ENCASEMENT STEEL BORED
18" MIN
15" STORM PIPE
EX. WATER DIST - 24"
EX. GAS LINE
EX. ELEC
CINCINNATI BELL
NOTE:
ROTATE BENDS VERTICAL WHERE REQUIRED.
DEFLECT PIPE WHERE POSSIBLE: MAX. DEFLECTION - 6", 8" & 12" = 5°
105+00
106+00
107+00
108+00
875
870
865
860
855
850
845
MicroStation v8.11.9.919
E-SHEET NAME:
USER: CLAWSON
DATE PLOTTED: September 6, 2022
FILE NAME: C:\PW_WORKING\LOCHNER-PW-01\DMS22820\SH_19-PP17-DNS WATER.DGN

Appendix 7: Sample ITP and QA/QC Documentation

INSPECTION AND TEST PLAN –TEST STATION INSTALLATION
NORTHERN KENTUCKY WATER DISTRICT
CATHODIC PROTECTION DESIGN DONALDSON HIGHWAY 24-INCH WATER MAIN

Activity No.	Activity Description	Inspection/Test Requirements	Reference Document	Quality Record	Acuren	Sign/Date	Client	Sign/Date
1.0	Review Scope of work	• Review project specifications			R		R	
2.0	Correct drawings.	• Review latest revision of "Issued for Construction" engineered drawings	CP Drawings:		R		R	
3.0	Inspection of materials against BOM, for shipping damage and assemble for site specific location.	• Ensure all materials meet required specs	CP Drawings:		R		R	
4.0	Pre-job meeting to review test station install locations and any special requirements. Complete safety paperwork.	• Review installation procedure. • Verify the underground scans/locates have been completed and cleared. • Complete FLHA and other safety documents as required.	CP Drawings:		H		H	
5.0	Verify condition of reference electrodes and coupons.	• Visual inspection for any cracks or breaks in reference electrodes, coupons, or cables.		QA/QC Document	H		R	
6.0	Verify condition of cables to be connected to pipelines.	• Verity that there are no nicks or gouges in the cables. • Complete continuity checks between cable ends. • Label each cable clearly and effectively. The label must stand up to a long period of time and various weather conditions.	CP Drawings:	QA/QC Document	H		R	
7.0	Remove coating from pipelines.	• Follow procedure in drawing C-008 for coating removal and pipe surface preparation.	CP Drawings:		H		R	
8.0	Complete UT scan to check for wall thickness on pipeline.	• Refer to drawing C-008 for wall thickness limits.	CP Drawings:					
9.0	Thermite weld cables to applicable pipelines.	• Verify weld is strong and cables are continuous with the structure.	CP Drawings:	QA/QC Document	H		R	
10.0	Coating repair.	• Verify approved coating repair have been applied after thermite welding. • Trenton patch pads to be used for coating repair due to long reach limitations.	CP Drawings:	QA/QC Document	H		R	
11.0	Install anodes, reference electrodes, and coupons (as applicable).	• Place anodes, reference electrodes, and coupons as per specifications shown on installation drawings.	CP Drawings:		H		R	
12.0	Route all cables.	• Run cables to the test station location. • Ensure that the wires are tidy and free of danger of being damaged.	CP Drawings:	QA/QC Document	H		R	
13.0	Complete proper backfilling of pipelines and cables.	• Carefully backfill around the pipelines and cables to ensure that no damage is done. • Backfill with sand and native fill.	CP Drawings:		H		W	

INSPECTION AND TEST PLAN –TEST STATION INSTALLATION
NORTHERN KENTUCKY WATER DISTRICT
CATHODIC PROTECTION DESIGN DONALDSON HIGHWAY 24-INCH WATER MAIN

14.0	Obtain structure-to-soil potentials and continuity checks.	• Obtain structure-to-soil potentials using test leads to pipe and newly installed reference electrode. Perform continuity checks between test leads.	CP Drawings:	QA/QC Document	H		R	
15.0	Install Test Station	• Verify test station location is correct and according to the IFC drawings.	CP Drawings:	QA/QC Document	H		R	
16.0	Terminate all cables in test station.	• Verify proper installation of the termination point. • Test leads, anode, coupon, and reference electrode cables properly routed into the termination points.	CP Drawings:	QA/QC Document	H		R	
17.0	Obtain current outputs of temporary anodes (where applicable)	• Measure current flow from the anodes to the protected pipes using ammeter	CP Drawings:	QA/QC Document	H		R	
18.0	Verify integrity of installed cables by **continuity test** and then take **open circuit** structure-to-soil potentials	• Verify that the bond lead to the pipes are continuous • Obtain **open circuit** structure-to-soil potentials on anodes and bond leads to pipes via a portable reference cell	CP Drawings:	QA/QC Document	H		R	
19.0	As-Built Drawing	• As-Built drawing completed and accepted	CP Drawings:	QA/QC Document	H		H	
20.0	Final QA/QC documentation package review and turnover to client	• All documents Reviewed and accepted		T/O Documents	H		H	

Definitions

A) Hold Point (H): An activity designated by Acuren and/or CLIENT that requires inspection/ verification and acceptance by Acuren and/or CLIENT before any further processing is permitted.
B) Review (R): Characteristics (technical, chemical and mechanical), certified by the manufacturer of the materials, are contrasted with codes, standards and specifications.
C) Witness Point (W): An activity designated by Acuren and/or CLIENT that requires witnessing by the party inspector. Formal notification to Acuren and/or CLIENT is required.

NOTES: ______________________________

Acuren Representative Name:	**CLIENT Representative Name:**
Acuren Representative Signature:	**CLIENT Representative Signature:**
Date:	**Date:**

QA/QC CHECKLIST
TEST STATION INSTALLATION
NORTHERN KENTUCKY WATER DISTRICT
CATHODIC PROTECTION DESIGN DONALDSON HIGHWAY 24-INCH WATER MAIN

ACUREN

Location:	
GPS Coordinates:	

Description:	**Quantity**			**Date**	**Installer**	**Inspector**	**Remarks**
	Design	**Actual**	**Variance**				
48# Magnesium Anode c/w #12 AWG Stranded Cable							
Big Fink test station							
Permacell Plus $Cu/CuSO_4$ Reference Electrode c/w 100' #112 HMWPE Yellow Cable							
Steel Coupon c/w #10 RWU-90 Red Lead							
#8 AWG RWU-90 White Stranded Copper Cable							
Thermite Welding Materials - See Bill of Materials	--						

Installation Inspection	**Compliance Status**			**Date**	**Installer**	**Inspector**	**Remarks**
	Yes	**No**	**N/A**				
General							
Installation procedure reviewed with all personnel?							
Insulated Cables checked for nicks/damage? - Note any repairs and location							

Cable termination to pipe using Thermite weld	**Compliance Status**			**Date**	**Installer**	**Inspector**	**Remarks**
	YES	**NO**	**N/A**				
External; coating removed?							
Exposed pipe filed to a bright steel finish?							
Was UT test completed prior to welding?							
Was job procedure followed?							
Copper sleeve (if applicable) crimped to the wire?							
Is the weld securely attached to the pipe saddle?							
Was a continuity check between test leads conducted and recorded?							
Approved coating materials properly applied?							
Cables properly routed to test station location from pipe?							
Are all cables properly marked for future ID?							
Have cables been terminated inside test station properly?							

Packaged Anodes Installation	**Compliance Status**			**Date**	**Installer**	**Inspector**	**Remarks**
	YES	**NO**	**N/A**				
Were plastic bags removed from packaged anodes?							
Were packaged anodes free of damage (cracks, breaks, etc.)?							
Were anodes soaked in water for an hour? (Not applicable in winter)							
Have anode leads been T-Spliced to header cable properly?							
Have anodes been installed according to specification and drawings?							
Have anodes been buried in sand or native fill?							

QA/QC CHECKLIST
TEST STATION INSTALLATION
NORTHERN KENTUCKY WATER DISTRICT
CATHODIC PROTECTION DESIGN DONALDSON HIGHWAY 24-INCH WATER MAIN

ACUREN

Reference Cell Installation	Compliance Status			Date	Installer	Inspector	Remarks
	YES	NO	N/A				
Was plastic bag removed from reference cell?							
Was reference cell buried in native fill?							
Was reference cell installed according to specification and drawings?							

Steel Coupon Installation	Compliance Status			Date	Installer	Inspector	Remarks
	YES	NO	N/A				
Was plastic bag removed from steel coupon?							
Was steel coupon buried in native fill?							
Was steel coupon installed according to specification and drawings?							

Testing Requirements	Resistance(Ohms)			Date	Installer	Inspector	Remarks
Continuity Check							
#8 White Cable 1 End-to-End							
#8 White Cable 2 End-to-End							
#8 White Cable to #8 White Cable Aboveground (After Thermite Welded)							

Potential Checks (-mV_{CSE})	Before Connection (-mV_{CSE})	After Connection (-mV_{CSE})		Date	Installer	Inspector	Remarks
Permacell $Cu/CuSO_4$ wrt Portable $Cu/CuSO_4$ Reference Cell							
Steel Coupon wrt Permacell $Cu/CuSO_4$ Reference Cell							
Pipe to Soil Potential wrt Permacell $Cu/CuSO_4$ Reference - Test Lead 1							
Pipe to Soil Potential wrt Permacell $Cu/CuSO_4$ Reference - Test Lead 2							

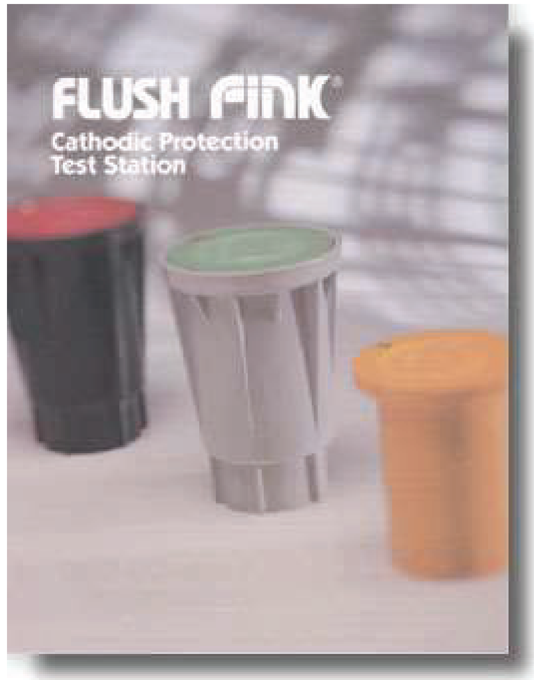
	YES	NO	N/A				
As-Built Drawing/Sketch Created:							

Remarks:

	Completed By	Verified By		Accepted By
Company				
Print Name				
Signature				
Date of Signing				

Appendix 8: Test Station

Flush Fink® Cathodic Protection Test Stations



The Flush Fink® cathodic protection test station and terminal enclosure is a high strength, maintenance free, non-conductive, flush mounted below ground terminal. It's patented "Bell Jar" design keeps test leads dry even when the enclosure is covered by flood water. Field proven since 1978, Flush Fink® is manufactured by Cott in Pittsburgh, Pennsylvania and Los Angeles, California. It is available from Cott distributors everywhere.

Features

CP Test Station

Watertight Bell, Terminal Board and Housing are made from Makroblend® polycarbonate alloy, one of the worlds toughest plastics. Flush Fink® is impervious to impact, traffic loads and chemical spills common to street usage.

Support Post

CottPipe® PE (standard) polyethylene blend has over 20 years of proven durability. CottPipe® PC (optional) polycarbonate is available for the toughest applications. Standard length 1 foot - available to 40 feet with Cott's Telescoping Extender.

Colors

Red, Orange, Yellow, Green, Blue, White, and Black are standard on Flush Fink® and CottPipe®. Any color is available as an option.

Hardware

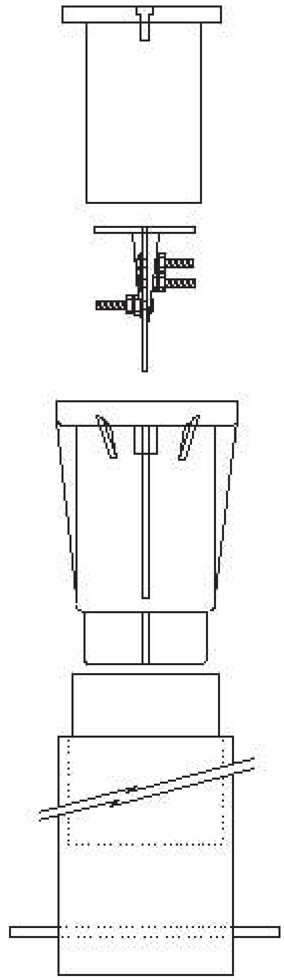
Standard nickel plated brass or optional stainless steel for guaranteed long service life. Up to 11 terminals accessible from both sides of the board.

Accessories

All Flush Fink® terminal boards can accommodate CottShunts® Slide Resistors, Rheostats, CottMeters® (Volt or Amp), Burndy connectors, Cott bonding/shorting straps, Banana Jacks, and lightning arrestors.

Dimensions

5-1/2" Diameter x 8" height fits 4" schedule 40 pipe.

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Literature Request

Appendix 9: Magnesium Anode Datasheet

Cathodic Protection
JENNINGS ANODES

GALVANIC / SACRIFICIAL ANODES

Bare Magnesium Anodes

Jennings Anodes has two foundries with a joint capacity of 4,000T per year, producing either cast or extruded magnesium anodes in a variety of sizes and shapes to meet our customers' requirements. Jennings Anodes casts all magnesium anodes in accordance with ASTM Standards ensuring that the High Potential Magnesium Anodes exceed 50% efficiency.

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Jennings Anodes USA Inc.

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Product Applications

1. Buried transmission pipelines
2. Foundations of tower structures
3. Under ground steel structures
4. Other steel structure in soil and brackish areas

Chemical Composition

Element	Grade ASTM B843 - M1C	Grade ASTM B843 - AZ63B
	High Potential (-1.75V)	Standard Potential (-1.55V)
Aluminum	0.01%	5.3 ~ 6.7%
Zinc	/	2.5 ~ 3.5%
Manganese	0.50 ~ 1.30%	0.15 ~ 0.70%
Silicon	0.05%	0.10%
Copper	0.02%	0.02%
Nickel	0.001%	0.002%
Iron	0.03%	0.003%
Other Each	0.05%	/
Others Total	0.30%	0.30%
Magnesium	Remainder	Remainder

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Electrochemical Properties

Anode Model	ASTM B843 - M1C	ASTM B843 - AZ63B
Open Circuit Potential (-V)	1.70 ~ 1.75	1.50 ~ 1.55
Close Circuit Potential (-V)	1.58 ~ 1.62	1.45 ~ 1.50
Current Capacity	500A.h/lbs (1100A.h/kg)	500A.h/lbs (1230A.h/kg)
Current Efficiency	50%	55%
Note	Open / Close Circuit Potential is with respect to a Saturated Calomel Reference Electrode	

Specifications

Generally, there are three types of standard magnesium anodes in the market: S Type, D Type and R Type.

S Type

Anode Model	Anode Weight	High Potential (-1.75V)			Standard Potential (-1.55V)		
		Length	Width	Height	Length	Width	Height
JA - MG - 3S3	3lbs (1.36kg)	4.7" (120mm)	3.8" (97mm)	3.0" (76mm)	4.5" (115mm)	3.8" (97mm)	3.0" (76mm)
JA - MG - 5S3	5lbs (2.3kg)	8.1" (205mm)	3.8" (97mm)	3.0" (76mm)	7.7" (195mm)	3.8" (97mm)	3.0" (76mm)
JA - MG - 9S2	9lbs (4.1kg)	29.5" (750mm)	2.8" (71mm)	2.0" (51mm)	28.0" (710mm)	2.8" (71mm)	2.0" (51mm)
JA - MG - 9S3	9lbs (4.1kg)	14.4" (365mm)	3.8" (97mm)	3.0" (76mm)	13.6" (345mm)	3.8" (97mm)	3.0" (76mm)
JA - MG - 17S3	17lbs (7.7kg)	26.6" (675mm)	3.8" (97mm)	3.0" (76mm)	25.6" (650mm)	3.8" (97mm)	3.0" (76mm)
JA - MG - 17S4	17lbs (7.7kg)	17.0" (432mm)	4.2" (106mm)	4.0" (102mm)	16.1" (408mm)	4.2" (106mm)	4.0" (102mm)
JA - MG - 32S5	32lbs (14.5kg)	22.0" (560mm)	5.0" (127mm)	5.0" (127mm)	21.1" (535mm)	5.0" (127mm)	5.0" (127mm)
JA - MG - 48S5	48lbs (21.8kg)	32.7" (830mm)	5.0" (127mm)	5.0" (127mm)	31.3" (795mm)	5.0" (127mm)	5.0" (127mm)
JA - MG - 60S4	60lbs (27.3kg)	59.6" (1515mm)	4.2" (106mm)	4.0" (102mm)	58.5" (1485mm)	4.2" (106mm)	4.0" (102mm)

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D Type

Anode Model	Anode Weight	High Potential (-1.75V)			Standard Potential (-1.55V)		
		Length	Width	Height	Length	Width	Height
JA - MG - 3D3	3lbs (1.36kg)	4.5" (115mm)	3.5" (89mm)	3.7" (95mm)	4.1" (105mm)	3.5" (89mm)	3.7" (95mm)
JA - MG - 5D2	5lbs (2.3kg)	12.2" (310mm)	2.8" (70mm)	3.0" (76mm)	11.8" (300mm)	2.8" (70mm)	3.0" (76mm)
JA - MG - 5D3	5lbs (2.3kg)	7.7" (195mm)	3.5" (89mm)	3.7" (95mm)	7.1" (180mm)	3.5" (89mm)	3.7" (95mm)
JA - MG - 9D2	9lbs (4.1kg)	22.2" (565mm)	2.8" (70mm)	3.0" (76mm)	21.5" (545mm)	2.8" (70mm)	3.0" (76mm)
JA - MG - 9D3	9lbs (4.1kg)	13.4" (340mm)	3.5" (89mm)	3.7" (95mm)	12.6" (320mm)	3.5" (89mm)	3.7" (95mm)
JA - MG - 14D2	14lbs (6.35kg)	39.8" (1010mm)	2.5" (63mm)	2.6" (66mm)	38.8" (985mm)	2.5" (63mm)	2.6" (66mm)
JA - MG - 17D2	17lbs (7.7kg)	47.8" (1215mm)	2.5" (63mm)	2.6" (66mm)	46.7" (1185mm)	2.5" (63mm)	2.6" (66mm)
JA - MG - 17D3	17lbs (7.7kg)	25" (635mm)	3.5" (89mm)	3.7" (95mm)	23.8" (605mm)	3.5" (89mm)	3.7" (95mm)
JA - MG - 17D4	17lbs (7.7kg)	16.9" (430mm)	4.3" (108mm)	4.0" (102mm)	16.1" (410mm)	4.3" (108mm)	4.0" (102mm)
JA - MG - 20D2	20lbs (9.1kg)	55.9" (1420mm)	2.5" (63mm)	2.6" (66mm)	54.5" (1385mm)	2.5" (63mm)	2.6" (66mm)
JA - MG - 32D5	32lbs (14.5kg)	19.5" (495mm)	5.5" (140mm)	5.7" (146mm)	18.5" (470mm)	5.5" (140mm)	5.7" (146mm)
JA - MG - 40D3	40lbs (18.2kg)	58.3" (1480mm)	4.1" (103mm)	3.5" (90mm)	57.1" (1450mm)	4.1" (103mm)	3.5" (90mm)
JA - MG - 48D5	48lbs (21.8kg)	28.9" (735mm)	5.5" (140mm)	5.7" (146mm)	27.6" (700mm)	5.5" (140mm)	5.7" (146mm)
JA - MG - 50D5	50lbs (22.7kg)	30.1" (765mm)	5.5" (140mm)	5.7" (146mm)	28.9" (735mm)	5.5" (140mm)	5.7" (146mm)
JA - MG - 60D4	60lbs (27.3kg)	59.8" (1520mm)	4.4" (112mm)	4.4" (112mm)	57.9" (1470mm)	4.4" (112mm)	4.4" (112mm)

Specification Notes

All weights and dimensions are nominal and subject to variation in material compositions and Jennings Anodes Foundry tolerance.

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R Type

Anode Model	Anode Weight	High Potential (-1.75V)		Standard Potential (-1.55V)	
		Length	Diameter	Length	Diameter
JA - MG - 1R8	1lbs (0.45kg)	7.9" (200mm)	1.6" (41mm)	7.5" (190mm)	1.6" (41mm)
JA - MG - R36	8lbs (3.6kg)	7.8" (198mm)	4.5" (114mm)	7.4" (187mm)	4.5" (114mm)
JA - MG - R41	9lbs (4.1kg)	9.6" (243mm)	4.5" (114mm)	8.4" (213mm)	4.5" (114mm)
JA - MG - R50	11lbs (5.0kg)	11.1" (283mm)	4.5" (114mm)	10.6" (269mm)	4.5" (114mm)
JA - MG - R77	17lbs (7.7kg)	17.2" (436mm)	4.5" (114mm)	16.3" (415mm)	4.5" (114mm)
JA - MG - R100	22lbs (10.0kg)	22.4" (570mm)	4.5" (114mm)	21.5" (545mm)	4.5" (114mm)
JA - MG - R145	32lbs (14.5kg)	19.7" (500mm)	5.7" (146mm)	18.5" (470mm)	5.7" (146mm)
JA - MG - R273	60lbs (27.3kg)	59.4" (1510mm)	4.5" (114mm)	57.5" (1460mm)	4.5" (114mm)
JA - MG - 50R8	50lbs (22.8kg)	16.0" (406mm)	8.0" (203mm)	15.6" (395mm)	8.0" (203mm)
JA - MG - 60R7	60lbs (27.3kg)	25.0" (635mm)	7.0" (178mm)	23.6" (600mm)	7.0" (178mm)
JA - MG - 100R8	100lbs (45.5kg)	32.3" (820mm)	8.0" (203mm)	30.7" (780mm)	8.0" (203mm)

Jennings Anodes Manufacturing Quality Control Procedures are employed and strictly adhered to guaranteeing the ultimate performance and life of the anodes.

Testing	Chemical Composition	Electrochemical Properties	Physical Appearance
Standards & Methods	ISO 9001:2015 Quality Management System and Foundry Internal Standards of Magnesium Anodes		
	ASTM B843	ASTM G97	Foundry ITP
Items	Chemical Analysis	Circuit Potential, Current Efficiency	Surface Finish , Size, Weight, Steel Core, Resistance etc.
Equipment & Devices	Optical Emission Spectrometer OBLF QSN 750	Electrochemical Analyzer EPI 200, Reference Electrode	Calibrated Digital Measuring Devices

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Packing

Anode Model	Packing Detail					
	Unit	No./Pallet	Pallet Dimension	Pallets/Container	Net Weight	Gross Weight
JA - MG - 5D3	EA	270	40" × 40" × 27" (1020 × 1020 × 690mm)	33	1370lbs (622kg)	1410lbs (635kg)
JA - MG - 9D3		270	41.5" × 41.5" × 32" (1050 × 1050 × 810mm)	19	2440lbs (1108kg)	2478lbs (1125kg)
JA - MG - 17D3		144	41.5" × 41.5" × 32" (1050 × 1050 × 810mm)	18	2478lbs (1108kg)	2522lbs (1125kg)
JA - MG - 20D2		120	57" × 32.5" × 32" (1450 × 810 × 800mm)	19	2406lbs (1092kg)	2456lbs (1110kg)
JA - MG - 32D5		80	41.5" × 41.5" × 33.5" (1050 × 1050 × 860mm)	18	2560lbs (1160kg)	2600lbs (1180kg)
JA - MG - 40D3		60	58" × 35.5" × 26.5" (1470 × 910 × 680mm)	19	2406lbs (1092kg)	2456lbs (1115kg)
JA - MG - 48D5		50	41.5" × 41.5" × 34" (1050 × 1050 × 870mm)	19	2405lbs (1090kg)	2450lbs (1112kg)
JA - MG - 50R8		50	43" × 35" × 42.5" (1100 × 900 × 1080mm)	18	2500lbs (1135kg)	2545lbs (1155kg)
JA - MG - 60S4		40	61.5" × 40" ×25.5" (1560 × 1020 × 650mm)	19	2405lbs (1092kg)	2460lbs (1116kg)
JA - MG - 60D4		40	60.5" × 32.5" × 28.5" (1540 × 810 × 710mm)	19	2405lbs (1092kg)	2460lbs (1116kg)

Cathodic Protection
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GALVANIC / SACRIFICIAL ANODES

Pre-packaged Magnesium Anodes

Jennings Anodes high efficiency bare magnesium anodes are packaged in a permeable cotton bag with backfill and firmly wrapped in a PE outer bag.

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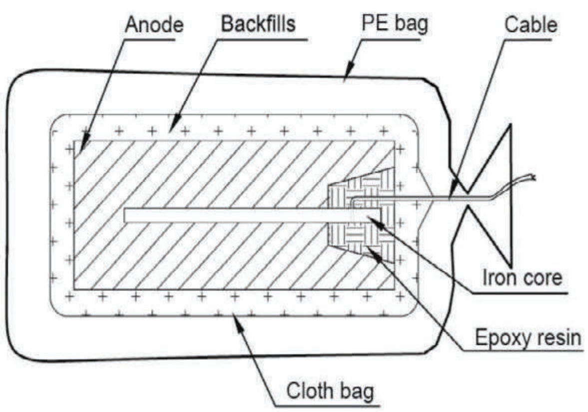
Product Applications

1. Buried transmission pipelines
2. Foundations of tower structures
3. Under ground tower structure
4. Other steel structure in soil and brackish areas



Cable Connection

Typical lead Cable:

10 feet of #12 AWG Solid THHN/THWN. Other cable types and colors are available. The cable is connected either by direct brazing or by mechanical processes to ensure a high pull strength and low resistance connection. Specialized 45% silver-based brazing or other weld connection methods are available upon special request.

Chemical Composition

Backfill Mixture Composition	Hydrated Gypsum	75%
	Bentonite	25%
	Sodium Sulphate	5%
Application Environment		≥ 20 Ω.m

Other special mixture composition are available per request. Jennings Anodes backfill is made of naturally degradable and recyclable materials, which are less harmful and environment friendly compared with the industry standards:

1. Cadmium ≤ 1 ppm
2. Arsenicum ≤ 1 ppm
3. Mercury ≤ 1 ppm
4. Phosphorus ≤ 10 ppm

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Electrochemical Properties

Anode Model	ASTM B843 – M1C	ASTM B843 – AZ63B
Open Circuit Potential (-V)	1.70 ~ 1.75	1.50 ~ 1.55
Close Circuit Potential (-V)	1.58 ~ 1.62	1.45 ~ 1.50
Current Capacity	500A.h/lbs (1100A.h/kg)	500A.h/lbs (1230A.h/kg)
Current Efficiency	50%	55%
Note	Open / Close Circuit Potential is with respect to a Saturated Calomel Reference Electrode	

Specifications

Anode Mode l	Anode Weight		Pre-packaged Anode Dimension	
	Bare	Pre-packaged	Diameter	Length
JA - MG - B5D3	5lbs(2.3kg)	19.8lbs (9kg)	6.3" (160mm)	11.80" (300mm)
JA - MG - B9D3	9lbs(4.1kg)	35.0lbs (16kg)	6.3" (160mm)	21.65" (550mm)
JA - MG - B17D3	17lbs (7.7kg)	48.5lbs (22kg)	6.3" (160mm)	30.70" (780mm)
JA - MG - B20D2	20lbs (9.1kg)	84.0lbs (38kg)	5.5" (140mm)	65.00" (1650mm)
JA - MG - B32D5	32lbs (14.5kg)	66.0lbs (30kg)	8.0" (200mm)	26.80" (680mm)
JA - MG - B40D3	40lbs (28.2kg)	88.0lbs (40kg)	6.3" (160mm)	63.00" (1600mm)
JA - MG - B48D5	48lbs (21.8kg)	100lbs (45kg)	8.0" (200mm)	38.00" (960mm)
JA - MG - B50R8	50lbs (22.7kg)	128lbs (58kg)	11.0" (280mm)	29.50" (750mm)
JA - MG - B60S4	60lbs (27.3kg)	128lbs (58kg)	6.9" (175mm)	65.00" (1650mm)
JA - MG - B60D4	60lbs (27.3kg)	150lbs (68kg)	7.5" (190mm)	65.00" (1650mm)

All pre-packaged weights and dimensions are subject to our Foundry tolerances.

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Cathodic Protection
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Quality Assurance & Testing

Jennings Anodes Manufacturing Quality Control Procedures are employed and strictly adhered to guaranteeing the ultimate performance & life of the anodes.

Testing	Chemical Composition	Electrochemical Properties	Physical Appearance
Standards & Methods	ISO 9001:2015 Quality Management System and Foundry Internal Standards of Magnesium Anodes		
	ASTM B843	ASTM G97	Foundry ITP
Items	Chemical Analysis	Circuit Potential Current Efficiency	Surface, Size, Weight, backfill Pull Test of cable connection, Sealing, Steel Core,Resistance etc.
Equipment & Devices	Optical Emission Spectrometer OBLF QSN 750	Electrochemical Analyzer EPI 200, Reference Electrode Ohmometer	Calibrated Digital Measuring Devices

Packing

Anode Model	Packing Detail with Standard 3M Cable					
	Unit	Anode Nos./ Pallet	Coil Dimension	Pallet/container	Net Weight	Gross Weight
JA - MG - B17D3	EA	50	46.5" × 42.5" × 40.5" (1180 × 1080 × 1030mm)	18	2478lbs (1125kg)	2600lbs (1180kg)
JA - MG - B20D2		20	72" × 32" × 25" (1830 × 810 × 630mm)	21	1695lbs (770kg)	1805lbs (820kg)
JA - MG - B32D5		40	43.5" × 45" × 42.5" (1110 × 1140 × 1080mm)	17	2687lbs (1220kg)	2780lbs (1270kg)
JA - MG - B40D3		20	68" × 35.5" × 28.5" (1730 × 910 × 720mm)	18	1785lbs (810kg)	1895lbs (860kg)
JA - MG - B48D5		24	2.5" × 51.5" × 35" (1080 × 1310 × 890mm)	16	2400lbs (1090kg)	2522lbs (1145kg)
JA - MG - B50R8		12	33.5" × 47.5" × 36.5" (850 × 1210 × 930mm)	20	1542lbs (700kg)	1663lbs (755kg)
JA - MG - B60S4		20	72" × 38.5" × 31" (1830 × 980 × 790mm)	12	2577lbs (1170kg)	2698lbs (1225kg)

Custom packing is available upon request.

Appendix 10: CADWELD Procedure

CP WELD METAL

thermOweld® Cathodic Protection weld metal is the most reliable and consistently-performing weld metal available worldwide. Our continuous-improvement manufacturing process is supplemented with multiple quality validation steps for every lot we produce. Upon final acceptance, our weld metal is specially packaged in moisture-resistant plastic cartridges with special closure caps. Then the cartridges and required metal discs are packaged in moisture-resistant boxes with unique manufacturing lot codes. These lot codes are a thermOweld® innovation, providing complete traceability from raw material origination, through our multiple processing stages to shipment. Finally, thermOweld® applies special shrink-wrap plastic to every weld metal box, insuring reliable storage, positive field ignition and superior welds every time.

Every individual weld metal cartridge is marked with the size and weight in grams for easy identification, even when separated from the host box. thermOweld® weld metal is shipped worldwide to more than 50 countries via ground, air and ocean freight. All sizes of weld metal are available immediately with thermOweld's Same Day Service (SDS) shipment program.

Our engineers have formulated our weld metal for cathodic protection application use.

12 CM
(Weld Metal)

Standard Cartridge Size	Cathodic Protection Cartridge Size	Cast Iron Cartridge Size	Packed Per Box
#15	#15CP, 15CPS*	—	20
#25	#25CP	#25CI	20
#32	#32CP	#32CI	10
#45	#45CP	#45CI	20
#65	#65CP	#65CI	20
thermOweld® Weld Metal is sold in box quantities only			

* 15CPS includes: 20 sleeves.

EZ Lite Remote® Electric Ignition System CP Weld Metal

12 CM
(Weld Metal)

Pre-packaged Weld Metal with Ignitors		
Cathodic Protection	Cast Iron	Packed per box
TW15CPEZ	—	20
TW25CPEZ	TW25CIEZ	20
TW32CPEZ	TW32CIEZ	10
TW45CPEZ	TW45CIEZ	20
TW65CPEZ	TW65CIEZ	20
thermOweld® Weld Metal is sold in box quantities only		

1.0 Purpose and Objective

The purpose of this document is to describe the steps involved in proper application and protection (coating) of an exothermic weld, via a keyhole access also known as "long reach tools''.

2.0 Scope

The scope of this document includes:

- preparation of the cable,
- preparation of the metallic structure,
- the welding procedure, and
- the application of the weld protector

3.0 Definitions

Cadweld

The trademark name for exothermic weld materials and equipment by Erico Products or equivalent.

Cadweld PLUS

A battery-powered controller box designed for remote ignition of the exothermic weld charge, by Erico Products or similar.

Exothermic Welding

A chemically powered welding process used to attach cable(s) to a metallic structure.

Keyhole

A small round or square hole whereby buried pipelines or structures can be accessed.

Patch-Pad

The trademark name for a weld protector by Trenton Corp.

thermOweld

The trademark name for exothermic weld materials and equipment by Continental Industries.

Weld Protector

A field-applied coating used to protect the exothermic weld, cable, and metallic structure.

4.0 References

Cadweld Exothermic Welding Manual (Cadweld PLUS Process), Document No. E1123LT08WWEN

Trenton Patch-Pad Exothermic Weld Protector Application Specification, Document No. 20045E REV1

5.0 Roles and Responsibilities

Field Technician

Ensure that all appropriate Personal Protective Equipment (PPE) is used, and all equipment and tools are in proper working order. All staff must have the proper and relevant documentation, pre-job hazards and work permits.

6.0 Safety and Hazards

6.1 Only manufacturer-approved equipment and materials should be used to make exothermic weld connections.

6.2 Do not connect items except as detailed in instruction sheets. Failure to comply may result in improper/unsafe connections, bodily injury, or damage.

6.3 Do not use worn or broken equipment which could cause leakage.

6.4 Do not alter equipment or material without authorization.

6.5 Do not use welding material package if damaged or not fully intact. When using Cadweld PLUS, do not tamper with or disassemble the welding material unit.

6.6 Personnel should be properly trained in the use of this product and must wear safety glasses and gloves.

6.7 Avoid contact with hot materials.

6.8 Advise nearby personnel of welding operations in the area.

6.9 Remove or protect fire hazards in the immediate area.

6.10 Provide adequate ventilation to the work area.

6.11 Do not smoke when handling starting material.

6.12 Avoid direct eye contact with “flash” of light from ignition of starting material.

6.13 To minimize the risk of burns and fire caused by hot molten spillage:

i. Make sure there is proper mold fit and assembly of equipment.

ii. Avoid moisture and contaminants in mold and materials being welded. Contact between hot molten metal and moisture or contaminants may result in spewing of hot material.

iii. Base material thickness must be sufficient for the size and type of connection being made to prevent melt-through and leakage of hot molten metal.

6.14 In case of fire, use of water or CO_2 will aid in control of burning containers. Large quantities of water will aid in controlling a fire should the exothermic materials become involved. Water should be applied from a distance.

7.0 Procedure

The following procedure is for the application of an exothermic weld via the use of "long reach tools" a Cadweld PLUS unit, and application of a Patch-Pad weld protector. For other materials, refer to the manufacturer's instruction manual.

Earthwork & Surface Preparation

7.1 Following all appropriate company specifications and safety procedures expose enough area of piping or pipeline to allows for "long reach tools". Typically, 18 +/- 5 inches in diameter is sufficient depending on depth and CP components to be installed.

7.2 Once the pipe is exposed, perform a magnet test to confirm material is metallic.

7.3 Utilizing the pneumatic long reach buffer with approved buffing disk, remove approximately 2 by 2 inch square piece of coating. Additional buffing may be required to ensure the metal surface is "mirror" finish.

7.4 Perform ultrasonic thickness test to ensure metal thickness meets specified thickness prior to thermite welding.

7.5 Record metal temperature using temperature gun. If metal temperature is less than 5 degree Celsius, preheat using a long reach heat gun is required. NOTE: ensure that heat is applied in a way that does not distort the coating.

7.6 Metal surface is considered prepared once mirror finish is achieved, no moisture is present, thickness meets specification, and temp is greater than 5 degree Celsius.

Exothermic Welding

7.7 Prepare the proper materials and equipment for the type of connection you are making. The Cadweld PLUS system requires:

- a graphite mold, mold clamp
- Cadweld PLUS welding material cup or equivalent "charge".
- natural bristle brush for mold cleaning
- wire brush for cleaning/ preparing conductors
- control unit
- propane torch

7.8 Check to ensure the graphite mold is not worn or broken, which could cause leakage of molten weld metal during the reaction.

7.9 Inspect the mold ID tag to ensure that it corresponds to the application, indicated by:

- mold part number
- conductor size
- welding material required
- other materials required

The mold must be correct for the conductor size and application. DO NOT MODIFY MOLDS.

7.10 Remove the small wire bracket which is used to temporarily hold the mold together before using. Set the bracket aside.

7.11 Slide the handle clamp into the pre-drilled holes with the proper orientation for the thumbscrews.

7.12 Tighten the clamp thumbscrews onto the mold.

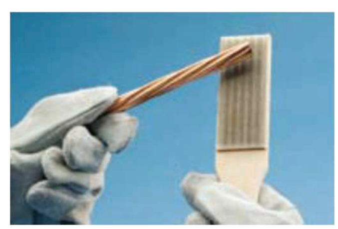
7.13 Close the grips to tightly lock the mold. Check for an appropriate seal on the mold.

7.14 If the mold does not seal properly, adjust to tighten/loosen the handle clamp.

7.15 Graphite absorbs moisture. Ignite the propane torch and dry out the inside of the mold thoroughly on both sides, heating the mold to approximately 250° F (120° C).

7.16 The conductors should be clean and dry before the connection is made. Use a propane torch to dry wire conductors and remove remaining cleaning residue, solvent, or water before making the Cadweld connection.

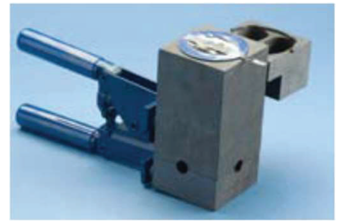
7.17 Next, use a wire brush to further prepare the surface of the conductors. Scrape the outer surface to remove dirt and oxidation. You will notice a slight color change.



7.18 Insert the conductors and position them for the connection. Close the clamp tightly once the conductors are properly positioned.

7.19 Remove the proper Cadweld PLUS welding material cup from the plastic container. Inspect the cup to ensure it is tightly sealed and the ignition strip is securely attached to the seal. Equivalent thermite welding charges and ignition strips are approved for use providing they meet the owner's specification.

Exothermic Welding (Keyhole)



7.20 Place the cup into the top of the mold. Make sure the ignition strip nests into the recess on the top edge when the cover is closed.

7.21 Place the ignition strip into the control unit connector. Remove or protect fire hazards in close proximity to the connection.

7.22 Close the graphite mold lid. Advise nearby personnel of welding operations in the area.

7.23 Using the control unit, press the button and hold, while you observe the “ready” indicator light. A green light will blink for a few seconds and then will change to a constant light. At this time, the unit will send a charge to the ignition strip. The ignition strip will spark inside the metal cup, initiating the Cadweld PLUS exothermic reaction. Allow approximately 30 seconds for completion of the reaction and solidification of the molten material.

7.24 Remove the control unit connector from the ignition strip. Open the lid and remove the used Cadweld PLUS cup from the mold.

7.25 Open the mold and remove the connection. Use care to prevent chipping the mold. Avoid contact with hot materials.

7.26 Cadweld graphite molds will last approximately 50 connections. Use a soft cotton cloth or a soft bristle brush (Erico Part No. T394) to clean inside the mold cavity and cover.

Exothermic Weld Protector Application

7.27 Wire brush the surface, so it is free of loose rust, scale, dirt, and loose coating. Using a cloth rag, remove any oil, grease, and moisture.

7.28 Remove release liner from the adhesive side of the Patch-Pad protector by pulling back at a 180-degree angle in a quick motion.

7.29 Attach the application tool to a suitable modified painter’s extension pole.

7.30 Attach the Patch-Pad protector to the application tool using the Velcro strips located on the top of the polymer backing and bottom of the application tool.

7.31 Lower the Patch-Pad to the application site and adhere it to the application area by pressing down on the applicator tool.

7.32 Use the finishing tool to press down on the Patch-Pad, using even force until the adhesive flows out and around all edges of the polymer backing by approximately one centimeter.

7.33 Patch-Pad may be backfilled immediately. No drying or curing time is required.