

ADDENDUM NO. 3

TO: ALL PLAN HOLDERS

RE: North Texarkana Wastewater Treatment Plant Improvements

ADDENDUM DATE: September 3, 2026

The Plans, Specifications and Contract Documents for the above referenced project are hereby modified as follows:

1. Replace plans and specifications with attached documents.
2. Estimate is revised to \$5,250,000 to include added items

PROJECT CLARIFICATIONS

1. Project location is in the state of Arkansas and as such Arkansas laws, taxes, standards, bonding and applicable Arkansas state agencies govern. Project is not tax exempt.
2. Geotechnical report added as appendix to specifications.
3. Retainage modified to be on project progress schedule of 10% that reduces to 5% at 50% project completion.
4. Project is locally funded so no AIS, BABA or Davis Bacon wage rates are applicable.
5. All applicable submittals requiring signed and sealed drawings shall be signed and sealed by a registered Arkansas engineer.
6. Submittals may be submitted electronically.
7. O&M manuals for relevant equipment shall include 1 physical copy and an electronic copy as applicable.
8. General Conditions in attached specifications are only relevant conditions due to project being locally funded.
9. Leakage testing in Section 01205 only applies to new structures prior to being put into service.
10. Grit screw modified to Grit Cleanse system. Plans and specifications updated.
11. RAS collection box removed, RAS line to flow to new manhole along previous alignment with valve. Clarifier mechanisms updated to stainless steel components.
12. Contractor will have access to onsite water at no charge. Water will be metered throughout construction and will be billed to the contractor in the event of negligence by the contractor or any of its subs as applicable.
13. \$40,000 allowance for testing added to bid proposal to be reimbursed to contractor through submitted invoices.
14. Mobilization for sludge removal and sludge removal estimate added to bid proposal. Sludge removed will need to be disposed of offsite. Upper Southwest Regional Solid Waste Management District in Nashville, AR should be closest landfill capable of accepting sludge.
15. No sales tax report required as referenced in Section 01340

16. Notice of Award modified to 15 calendar days.
17. No geofabric required for access road.
18. In the event of conflicting testing requirements, the more stringent requirement applies.
19. All rubber gasket joints for ductile iron pipe, fittings and valves shall conform to AWWA C111
20. All above ground piping shall transition to flanged connections.
21. 1998 Asbuilt plans attached
22. Air piping not shown as stainless steel shall be asphaltic lined pipe.
23. The 1" corp stop shown on Sheet 9 Yard Piping and also shown on Sheet 21 Clarifier #3 Plan is a proposed line for the yard hydrant as shown on Sheet 21
24. Handrails and treads to be aluminum. Sheet 30 revised to show allowable deflection.

ADDENDUM NO.3 ISSUED BY:

A.L. FRANKS ENGINEERING



9-3-26

Caleb Mudford, P.E.
Project Manager

TEXARKANA WATER UTILITIES

**NORTH TEXARKANA WASTEWATER
TREATMENT PLANT IMPROVEMENTS**

A.L. FRANKS ENGINEERING
JOB NO.: TWU-02-22

FINAL

COMPLETED FOR BIDDING OR CONSTRUCTION
PURPOSES (PLANS / SPECIFICATIONS NOT FOR
BEARING THIS NOTE MAY HAVE REVISED
AND SHOULD NOT BE USED FOR BIDDING
OR CONSTRUCTION PURPOSES



8-20-26

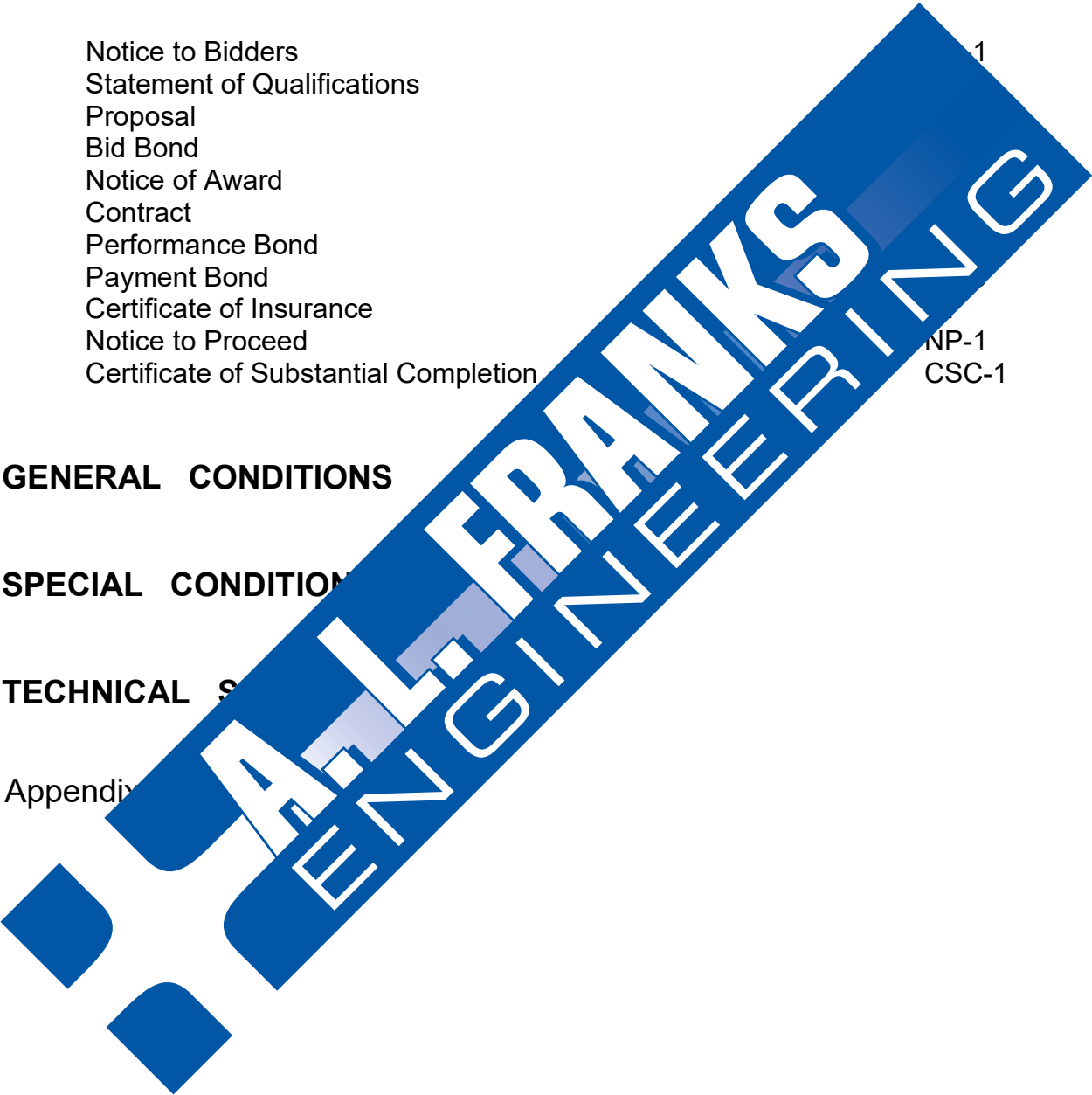
ENGINEER / DATE

2026

118 E. Broad Street
Texarkana, Arkansas 71854
(870) 216-1906
FAX (870) 216-1907

TABLE OF CONTENTS

	<u>PAGE</u>
CONTRACT DOCUMENTS	
Notice to Bidders	1
Statement of Qualifications	
Proposal	
Bid Bond	
Notice of Award	
Contract	
Performance Bond	
Payment Bond	
Certificate of Insurance	
Notice to Proceed	NP-1
Certificate of Substantial Completion	CSC-1
GENERAL CONDITIONS	
SPECIAL CONDITIONS	
TECHNICAL SPECIFICATIONS	
Appendix	





CONTRACTS

NOTICE TO BIDDERS OF THE INTENTION OF THE TEXARKANA WATER UTILITIES TO LET CONTRACT FOR CONSTRUCTION OF WASTEWATER TREATMENT PLANT IMPROVEMENTS.

SEALED PROPOSALS addressed to Executive Director, Texarkana Water Utilities, 801 Wood Street Texarkana, Texas 75501 will be received until **2:00 P.M., on September 9, 2026** for furnishing all labor, equipment, materials, supplies, and supervision necessary for the construction of proposed wastewater treatment plant improvements as described in the plans and specifications. Bids will be opened and read aloud at such time at Texarkana Water Utility office at the address.

PLANS AND SPECIFICATIONS may be examined without charge at A.L. Franks Engineering, 118 East Broad Street, Texarkana, Texas 75501. A hard copy of each set of documents may be purchased from A.L. Franks Engineering for \$ 100.00. A PDF copy will be furnished to the bidder on site. Documents may be purchased/requested at www.alfranksengineering.com. No refunds will be made.

A CERTIFIED OR CASHIER'S CHECK must be submitted with each bid in an amount not less than five percent (5%) of the bid amount. This check shall serve as a guaranty that, if awarded the contract, the bidder will enter into contract with the Texarkana Water Utilities within the time frame provided.

THE SUCCESSFUL BIDDER shall be required to furnish a Performance and Payment bond in the amount of the contract, written by a responsible surety company licensed to do business in the State of Arkansas that is satisfactory to the Owner.

BIDDERS ARE advised to visit the site of the work and to inform themselves of all local conditions. The time for completion shall be **400 calendar days** including legal holidays.

ATTENTION OF BIDDERS is directed to Section 4 of Act 74 of 1969, requiring that the prevailing rates of per diem wages for work of the locality where the work is performed shall be paid all mechanics employed in the construction of public works.

EQUAL OPPORTUNITY IN EMPLOYMENT: All qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

ATTENTION OF BIDDERS is advised that the Contractor who is awarded the contract will have to have an Arkansas State Contractor's License. Evidence of licensure shall be provided to the Owner prior to award of the project.

NO BID may be withdrawn after the scheduled closing time for receipt of bids for at least 90 calendar days.

IN CASE of ambiguity or lack of clearness stating the price in the bids, the Texarkana Water Utilities reserves the right to consider the most advantageous construction thereof, or to reject the bid.

THE TEXARKANA WATER UTILITIES reserves the right to reject any and all bids, waive any or all informalities, and to award the contract to the bidder who, in the opinion of the Owner, offers the proposal to the best advantage. Award of the contract may be denied if the Statement of Work is not appropriately completed.

CONTRACTORS are cautioned that qualified bids will

CONTRACTORS are specifically advised that no subcontract shall be made by a party to whom it is proposed to award a subcontract unless the subcontract is first acceptable to the Owner.

The Texarkana Water Utilities hereby certifies that this contract is subject to applicable labor laws, no strike laws, minimum wage rate laws and other federal laws including the Fair Labor Standards Act of 1938. The Work Hours Act of 1962 and Title VII of the Civil Rights Act of 1964 also apply.

Texarkana Water Utilities

STATEMENT OF QUALIFICATIONS:

Bidder

Address

Similar Projects Completed by Bidder:

1. NAME OF PROJECT: _____

OWNER: _____ ADDRESS: _____

DATE STARTED: _____ DATE COMPLETED: _____

APPROX. QUANTITIES OF MAJOR ITEMS: _____

VALUE OF CONTRACT: _____

2. NAME OF PROJECT: _____

OWNER: _____ ADDRESS: _____

DATE STARTED: _____ DATE COMPLETED: _____

APPROX. QUANTITIES OF MAJOR ITEMS: _____

VALUE OF CONTRACT: _____

3. NAME OF PROJECT: _____

OWNER: _____ ADDRESS: _____

DATE STARTED: _____ DATE COMPLETED: _____

APPROX. QUANTITIES OF MAJOR ITEMS: _____

VALUE OF CONTRACT: _____

4. OTHER PROJECT REFERENCES: _____

PROPOSAL

TO: Executive Director
Texarkana Water Utilities

FOR: North Texarkana
Wastewater Treatment Plant
Improvements

The undersigned, as bidder, declares that the only person or parties interested in this proposal as principals are those named herein; that this proposal is submitted without collusion with any other person, firm, or corporation; that he has carefully examined the form of Contract, Notice to Bidders, and Specifications therefor; that he has carefully examined the locations, conditions and classes of work to be performed; and agrees that he will provide all the necessary equipment, apparatus, and other items incidental to construction; that he will furnish all the materials called for in the Contract and Specifications; and that he will perform the work prescribed therein and according to the requirements and standards therein set forth.

It is further agreed that the quantities of work to be performed and materials to be furnished may be increased or diminished as may be deemed necessary, in the opinion of the Engineer, to complete the work and contemplated, and that all quantities of work, when ordered, are to be performed at the unit prices set forth below in the Specifications.

It is further agreed that lump sum prices may be increased to cover additional work ordered by the Engineer, and decreased to cover deletion of work so ordered, in accordance with the provisions of the Specifications; and that, if necessary, they may be decreased to cover deletion of work so ordered.

It is understood that the work to be completed in full within **400 calendar days** beginning on the date of the work order on which work is to be commenced. The Texarkana Water Utilities shall withhold, permanently from the Contract sum of Five Hundred Dollars (\$500.00) per calendar day for each day of delay.

The bid security is a certified or cashier's check or bid bond, payable to the Texarkana Water Utilities for

_____ Dollars (\$_____).

The bid security accompanying this proposal shall be returned to the bidder, unless in case of the acceptance of the proposal the bidder shall fail to execute a Contract and to file a performance and payment bonds within fifteen days after its acceptance, in which case the bid security shall become the property of the Texarkana Water Utilities and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner on account of such failure of the bidder. It is understood that the Texarkana Water Utilities reserves the right to reject any and all bids and to waive any informalities in the bidding.

**TEXARKANA, ARKANSAS
NORTH WWTP EXPANSION**

BID PROPOSAL

ITEM	QTY	UNIT	DESCRIPTION	TOTAL PRICE
1	1	L.S.	Provide and install all necessary materials, equipment labor, disinfection, supplies, and all necessary appurtenances for the operational expansion of the Texarkana WWTP Expansion as shown in the specifications and following all applicable AR requirements for the lump sum price of	\$ _____

2	1	L.S.	Provide testing for the expansion of the Texarkana WWTP Expansion by _____ such as E TTL Engineers & _____ estimate payable by subcontractor laboratory for the testing all _____	\$ _____
			_____ Dollars and	\$ 40,000
			_____ Cents/L.S	\$ 40,000

BID PROPOSAL CONTINUED

ITEM	QTY	UNIT	DESCRIPTION	TOTAL PRICE
3	1	L.S.	Provide mobilization associated with the removal of sludge from existing clarifier and aeration basins for the lump sum price of _____ Dollars and _____ Cents/L.S.	\$ _____
4	20	C.Y.	Remove and dispose of sludge from existing clarifier and aeration basins following all applicable ADEQ requirements for the unit price of _____ Dollars and _____ Cents/C.Y.	\$ _____
TOTAL BASE BID				\$ _____

BID PROPOSAL CONTINUED

NOTES: Contractor shall provide a separate document that includes a Schedule of Values including items included within the Base Bid shown above for the construction of the North Texarkana WWTP Expansion

Contractor shall submit bids and hold price for a period of no more than 90 days. All work shall be done in accordance with ADEQ requirements and permits as provided in the specifications.

Unit prices and total prices must be specified in both words and figures. All amounts shall be in United States Dollars and No Cents. In case of a discrepancy, the amount in words will govern.

Items that are subsidiary to performing the work shall include but not be limited to. All materials shall be supplied by the contractor. Existing utilities, trees and improvements shall be protected. Construction and contractor shall coordinate with City of Texarkana for existing utilities encountered. Prior to construction, all work shall be approved by the engineer prior to construction.

Haul routes approved designated by the city shall be used. Conditions upon completion of the work. This area is not included in seeding / revegetation and shall be maintained for the work.

Owner reserves the right to select either party. All deductives and will notify contractor at the time of awarding the contract.

Time required to complete base bid shall be 90 calendar days. Bidder further agrees to pay as liquidated damages, the sum of \$500.00 for each calendar day thereafter.

In the event of the award of a Contract to the undersigned, the undersigned will furnish a Performance **and** Payment Bond each for the full amount of the Contract to secure proper compliance with the terms and provisions of the Contract, to insure and guarantee the work until final completion and acceptance, and to guarantee Payment of all lawful claims for labor performed and materials furnished in the fulfillment of the Contract.

The undersigned certifies that the bid prices contained in this proposal have been carefully checked and are submitted as correct and final.

NOTE:--Unit and lump sum prices must be shown in words and in figures for each item listed in this Proposal, and in the event of discrepancy, the word in figures should prevail. If bid prices on any items be omitted, the right is reserved to accept or reject the bids submitted under this Proposal. In the event of discrepancy, the right to accept or reject informalities.

Receipt is hereby acknowledged of the following addendums:

Addendum No. 1 dated _____ Rec. via fax _____
Addendum No. 2 dated _____ Rec. via fax _____
Addendum No. 3 dated _____ Rec. via fax _____
Addendum No. 4 dated _____ Rec. via fax _____
Addendum No. 5 dated _____ Rec. via fax _____

CONTRACTOR: _____

BY: _____

NAME: _____

TITLE: _____

ADDRESS (Address or Physical Address): _____

CITY: _____
(P. O. Box)

STATE: _____

TELEPHONE: _____

FAX TELEPHONE: _____

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,
_____, Principal, and
_____ as Surety, are bound together and firmly
bound unto _____, as Owner, of
_____, which,
well and truly to be made, we hereby jointly and severally bind ourselves and assigns.
Signed, this _____ day of _____, Condition of
the above obligation is such that when submitted to
_____, attached hereto and hereby
made a part hereof to enter into a contract with _____

NOW, THEREFORE,

- (a) If _____ and the Principal shall execute and deliver a contract in
(b) _____ attachment hereto (properly completed in accordance with said
_____ furnish a BOND for faithful performance of said contract, and for the
_____ persons performing labor furnishing materials in connection therewith,
_____ in all other respects perform the agreement created by the acceptance of said
_____, then this obligation shall be void, otherwise the same shall remain in force and
effect; it being expressly understood and agreed that the liability of the Surety for any
and all claims hereunder shall, in no event, exceed the penal amount of this obligation
as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

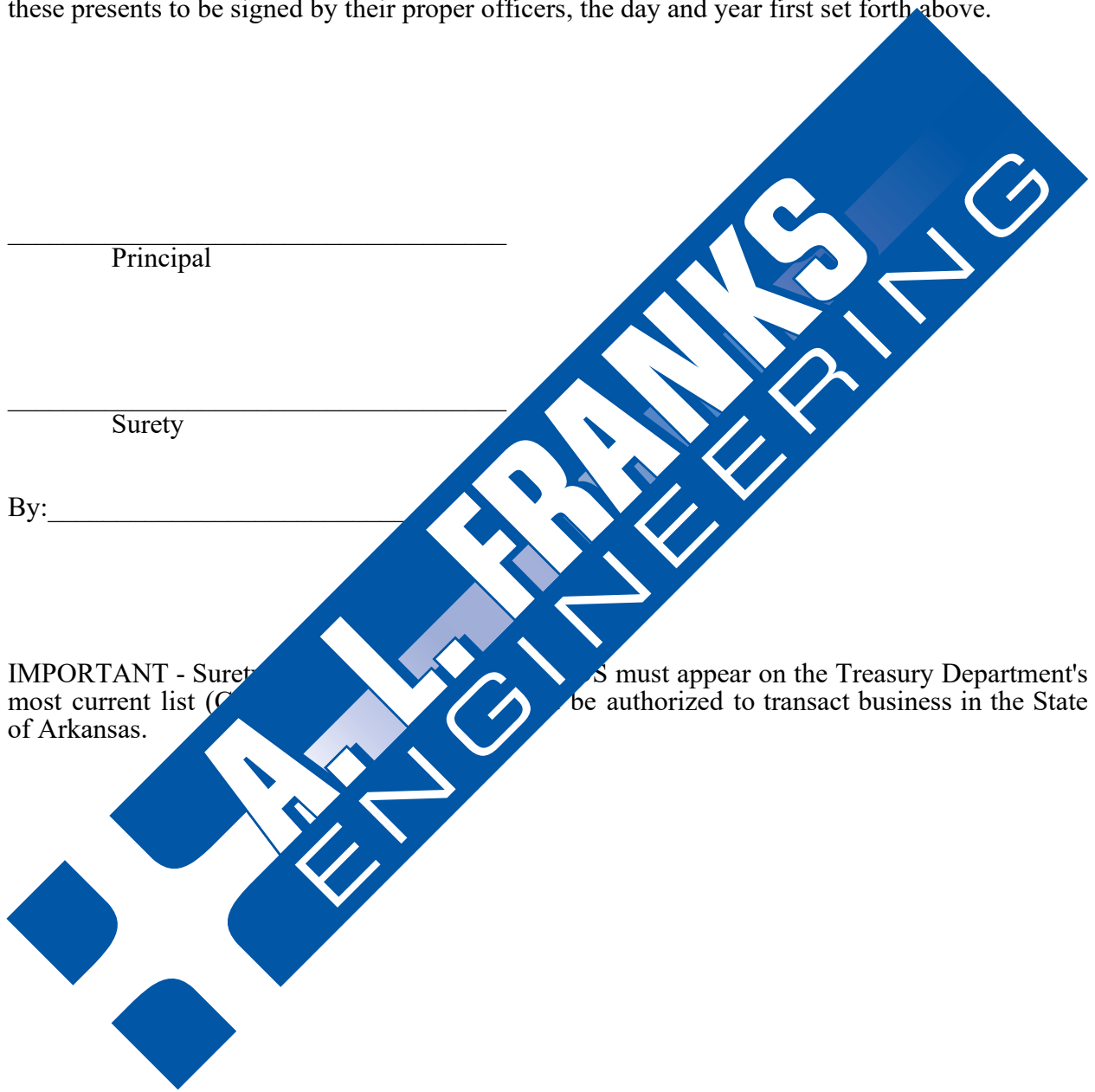
IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal

Surety

By: _____

IMPORTANT - Surety must appear on the Treasury Department's most current list (C) be authorized to transact business in the State of Arkansas.



NOTICE OF AWARD

TO: _____

Project Description:

Texarkana Water Utilities – North Texarkana Wastewater Treatment Plant Improvements

The Owner considered the Bid submitted by you for _____ Work in response to its Advertisement for Bids, dated _____.

You are hereby notified that your Bid _____ is in the amount of \$ _____.

You are required by the Instructions to execute the Agreement and furnish the required Contract Payment Bond and certificates of insurance within fifteen (15) days from the date of this Notice to you.

If you fail to execute the Agreement and to furnish said Bonds within fifteen (15) days from the date of this Notice, the Owner will be entitled to consider all your rights arising from the Bid as abandoned and as a forfeiture of your Bid. The Owner will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the Owner.

Dated: _____

TEXARKANA WATERWORKS

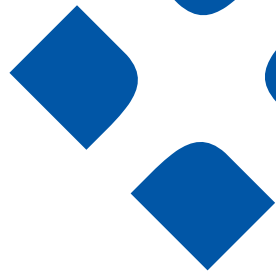
By: _____

DIRECTOR

Receipt of the award hereby acknowledged by :

By: _____

Title: _



CONTRACT

THIS AGREEMENT, made this _____ day of _____, 2026 by and between the

TEXARKANA WATER UTILITIES, herein called "Owner",
(Corporation Name of Owner)

acting herein through its EXECUTIVE DIRECTOR and _____
(Title of Authorized Official)

STRIKE OUT (a corporation) (a partnership)
INAPPLICABLE (an individual doing business as _____)
TERMS

of _____ Contractor."

WITNESSETH: That for and in consideration of the agreements hereinafter mentioned, to be made and performed by the CONTRACTOR hereby agrees with the OWNER to complete the construction described as follows:

NORTH TEXARKANA WATER PLANT IMPROVEMENTS

hereinafter called the _____
_____ (\$_____)

and all extra work, under the terms as stated in the General and Special Conditions and at his (its or their) own proper cost and expense to furnish materials, machinery, equipment, tools, superintendence, labor, and all other materials and services necessary to complete the said project in accordance with the conditions and prices stated in the Proposal, the General Conditions, Supplemental General Conditions and Special Conditions of the Contract, the plans, which include maps, plats, blue prints, and other drawings and printed or written explanatory matter thereof, the specifications and contract documents therefore as prepared by **A.L. FRANKS ENGINEERING**, herein entitled the Architect/Engineer, and as enumerated in Paragraph 2 of the Supplemental Special Conditions, all of which are made a part hereof and collectively evidence and constitute the contract.

The Contractor hereby agrees to commence work under this contract on or before a date to be specified in a written "Notice to Proceed" of the Owner and to fully complete the project within **400 consecutive calendar days** thereafter. The Contractor further agrees to pay, as liquidated damages, the sum of **\$500.00** for each consecutive calendar day thereafter as hereinafter provided in Section 9 of the Special Conditions.

The OWNER agrees to pay the CONTRACTOR in current dollars for the performance of the contract, subject to additions and deductions as provided in the General Conditions of the Contract, and to make payments as provided in Section 5, "Measurement and Payment," of the

IN WITNESS WHEREOF, the parties to these contracts have signed this contract in six (6) counterparts, each of which shall be deemed to be a true and correct copy of the original contract, and all of which when taken together shall constitute the entire contract as of the year and day first above mentioned.

(Seal)

ATTEST:

(Secretary)

(Witness)

(Seal)

()

EXECUTIVE DIRECTOR
(Title)

(Contractor)

By _____

President
(Title)

(Address and Zip Code)

NOTE: Secretary of the Owner should attest. If Contractor is a corporation, Secretary should attest.

ARKANSAS STATUTORY PERFORMANCE BOND

We _____

as Principal, hereinafter called Principal, and _____, a
corporation organized and existing under the law of the State of _____
and authorized to do business in the State of Arkansas, as Surety, jointly
bound unto _____, hereinafter
called Owner, in the amount of _____

Dollars (\$ _____), for the purpose of _____ and Surety bind
themselves, their heirs, personal representatives, assigns, jointly and
severally, firmly by these presents.

Principal has by written _____
entered into a contract with _____

NORTH TEXARKIA WASTEWATER TREATMENT PLANT IMPROVEMENTS **NOV-02-23**

which contract is a part hereof, and is hereinafter referred to as the
Contract.

Principal's OBLIGATION is such that if the Principal shall faithfully
perform the Contract and shall fully indemnify and save harmless the Owner
from all loss and damage which he may suffer by reason of failure so to do and shall fully
reimburse and pay the Owner all outlay and expense which the Owner may incur in
making good any such default, and, further, that if the Principal shall pay all persons all
indebtedness for labor or materials furnished or performed under said Contract, failing
which such persons shall have a direct right of action against the Principal and Surety,

jointly and severally, under this obligation, subject to the Owner's priority, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

No suit, action or proceeding shall be brought on this bond outside the State of Arkansas. No suit, action or proceeding shall be brought on this bond except by the Owner after six months from the date final payment is made on the Contract, nor shall any suit, action or proceeding be brought by the Owner after two years from the date on which the final payment under the Contract falls due.

Any alterations which may be made in the terms of the Contract, or any work to be done under it, or the giving by the Owner of any extension of time for performance of the Contract, or any other forbearance on the part of the Sureties, or either of them, shall not in any way release the Principal from his liability hereunder, notice to the Sureties of such alteration, extension or forbearance being hereby waived.

In no event shall the liability of the Surety exceed the sum set out herein.

Executed on _____, 20____

Principal

By _____

Surety

By _____
Attorney-in-Fact

ARKANSAS STATUTORY PAYMENT BOND

We _____

as Principal, hereinafter called Principal, and _____, a corporation organized and existing under the law of the State of _____ and authorized to do business in the State of Arkansas, as Surety, jointly bound unto _____, hereinafter called Owner, in the amount of _____ Dollars (\$ _____), for the payment of _____ Surety bind themselves, their heirs, personal representatives, assigns, jointly and severally, firmly by these presents.

Principal has by written agreement _____ entered into a contract with Owner _____

NORTH TEXARKANA WASTEWATER TREATMENT PLANT IMPROVEMENTS 10-02-23

which contract is a part hereof, and is hereinafter referred to as the Contract.

THE SURETY'S OBLIGATION is such that if the Principal shall faithfully perform the Contract in all respects, the Surety shall stand discharged; but if the Principal shall fail to perform the Contract in all respects, the Surety shall, at the option of the Owner, make good the Principal's part and shall fully indemnify and save harmless the Owner from and against all loss, damage, expense, and cost which he may suffer by reason of failure so to do and shall fully reimburse and pay the Owner all outlay and expense which the Owner may incur in making good any such default, and, further, that if the Principal shall pay all persons all indebtedness for labor or materials furnished or performed under said Contract, failing which such persons shall have a direct right of action against the Principal and Surety,

jointly and severally, under this obligation, subject to the Owner's priority, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

No suit, action or proceeding shall be brought on this bond outside the State of Arkansas. No suit, action or proceeding shall be brought on this bond except by the Owner after six months from the date final payment is made on the Contract, nor shall any suit, action or proceeding be brought by the Owner after two years from the date on which the final payment under the Contract falls due.

Any alterations which may be made in the terms of the Contract, or any work to be done under it, or the giving by the Owner of any extension of time for the performance of the Contract, or any other forbearance on the part of the Owner to the Principal to the other shall not in any way release the Principal, the Sureties, or either or any of them, their heirs, personal representatives or assigns from their liability hereunder, notice to the Sureties of such alteration, extension or forbearance being hereby waived.

In no event shall the liability of the Surety exceed the sum set out herein.

Executed on _____, 20____

Principal

By _____

Surety

By _____
Attorney-in-Fact

CERTIFICATE OF INSURANCE

TO:

Date _____

Owner

Project No. _____

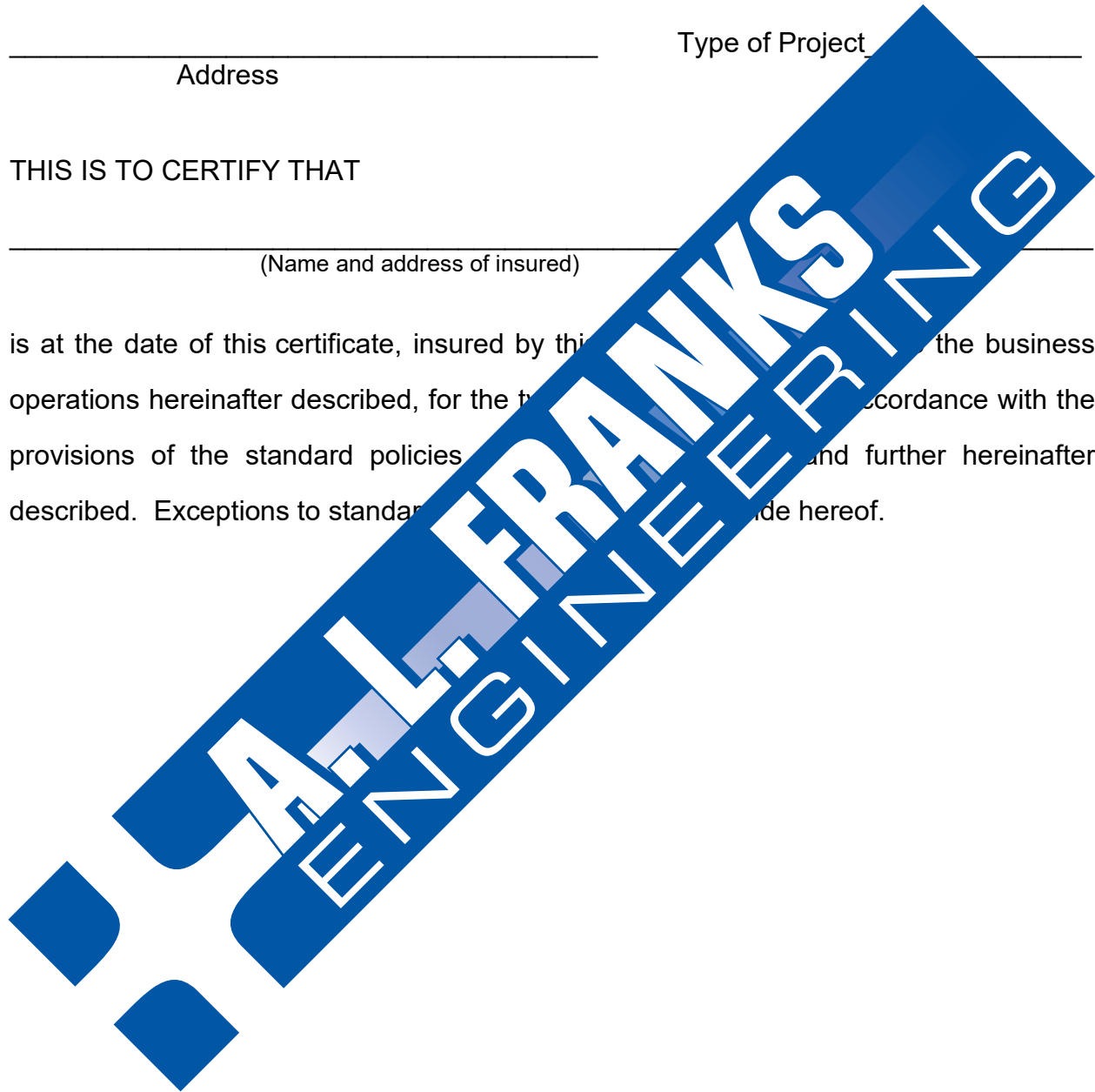
Address

Type of Project _____

THIS IS TO CERTIFY THAT

(Name and address of insured)

is at the date of this certificate, insured by this company in the business operations hereinafter described, for the term of years hereinafter described, in accordance with the provisions of the standard policies of this company and further hereinafter described. Exceptions to standard policies are set forth in the schedule hereof.



TYPE OF INSURANCE

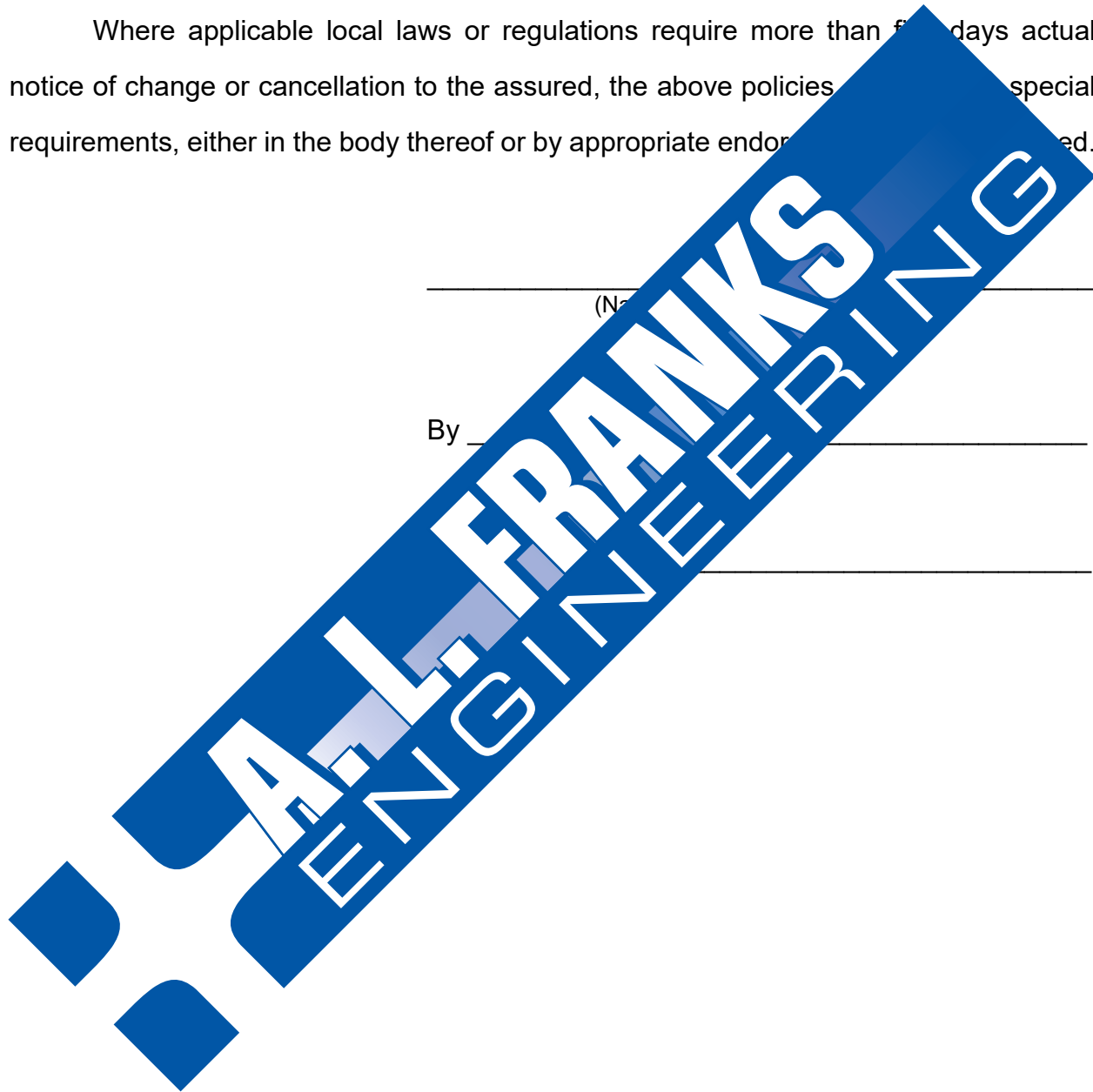
	Policy No.	Effective	Expires	Limits of Liability
Workmen's Compensation				
Public Liability				
Contingent Liability				\$ _____ Per Occident \$ _____
Property Damage				
Builder's Risk				
Automobile				
Other				
The foregoing _____ over all sub-contractors.				
Location _____				
Descriptions Covered: _____				

The above policies either in the body thereof or by appropriate endorsement provide that they may not be changed or cancelled by the insurer in less than five days after the insured has received written notice of such change or cancellation.

Where applicable local laws or regulations require more than five days actual notice of change or cancellation to the assured, the above policies shall meet special requirements, either in the body thereof or by appropriate endorsement.

(Name)

By _____



NOTICE TO PROCEED

To: _____

Date: _____
Project: Texarkana Water Utilities
North Texarkana Wastewater
Plant Improvement

You are hereby notified to commence Work in accordance with the attached
_____, on or before _____ to complete
the Work within 400 consecutive calendar days. Completion of all Work is
therefore _____.

Texarkana Water Utilities
Owner

Title: Executive Director

Acceptance of Notice

Receipt of the above

is hereby acknowledged

By: _____

T

SUBSTANTIAL COMPLETION CERTIFICATE

OWNER'S Project No.:

ENGINEER'S Project No. TWU-02-23

PROJECT:

Texarkana Water Utilities
North Texarkana Wastewater Plant
Improvements

CONTRACTOR: _____

CONTRACT:\$ _____ DATE: _____

This Certificate of Substantial Completion is issued for the work under the Contract Documents on the following date:

To

At

(Contractor)

The work which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that WORK is hereby declared to be substantially complete in accordance with the Contract Documents on

Date of Completion

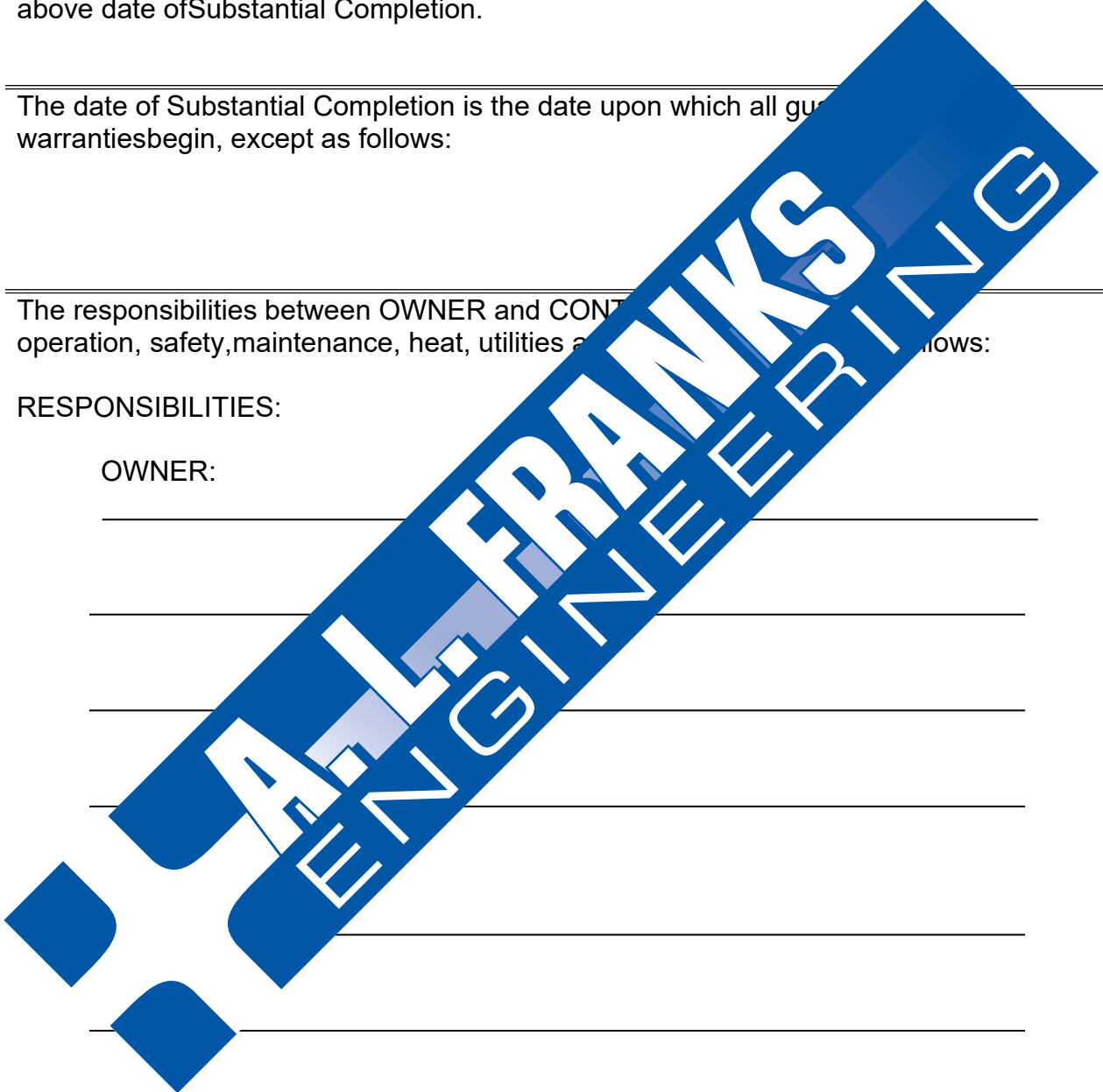
A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of the CONTRACTOR to complete all the Work in accordance with the Contract Documents. When this Certificate applies to a specified part of the Work the items in the tentative list shall be completed or corrected by CONTRACTOR within _____ calendar days of the above date of Substantial Completion.

The date of Substantial Completion is the date upon which all guarantees and warranties begin, except as follows:

The responsibilities between OWNER and CONTRACTOR for the operation, safety, maintenance, heat, utilities and _____ are as follows:

RESPONSIBILITIES:

OWNER:



The following documents are attached to and made part of this Certificate:

EXECUTED by ENGINEER this ____ day of _____

A.L. FRANKS ENGINEERING, INC

Project Engineer

The CONTRACTOR and ENGINEER hereby certify that the above is a true and correct copy of the Completion Certificate on this ____ day of _____

CONTRACTOR

Contractor

GENERAL CO

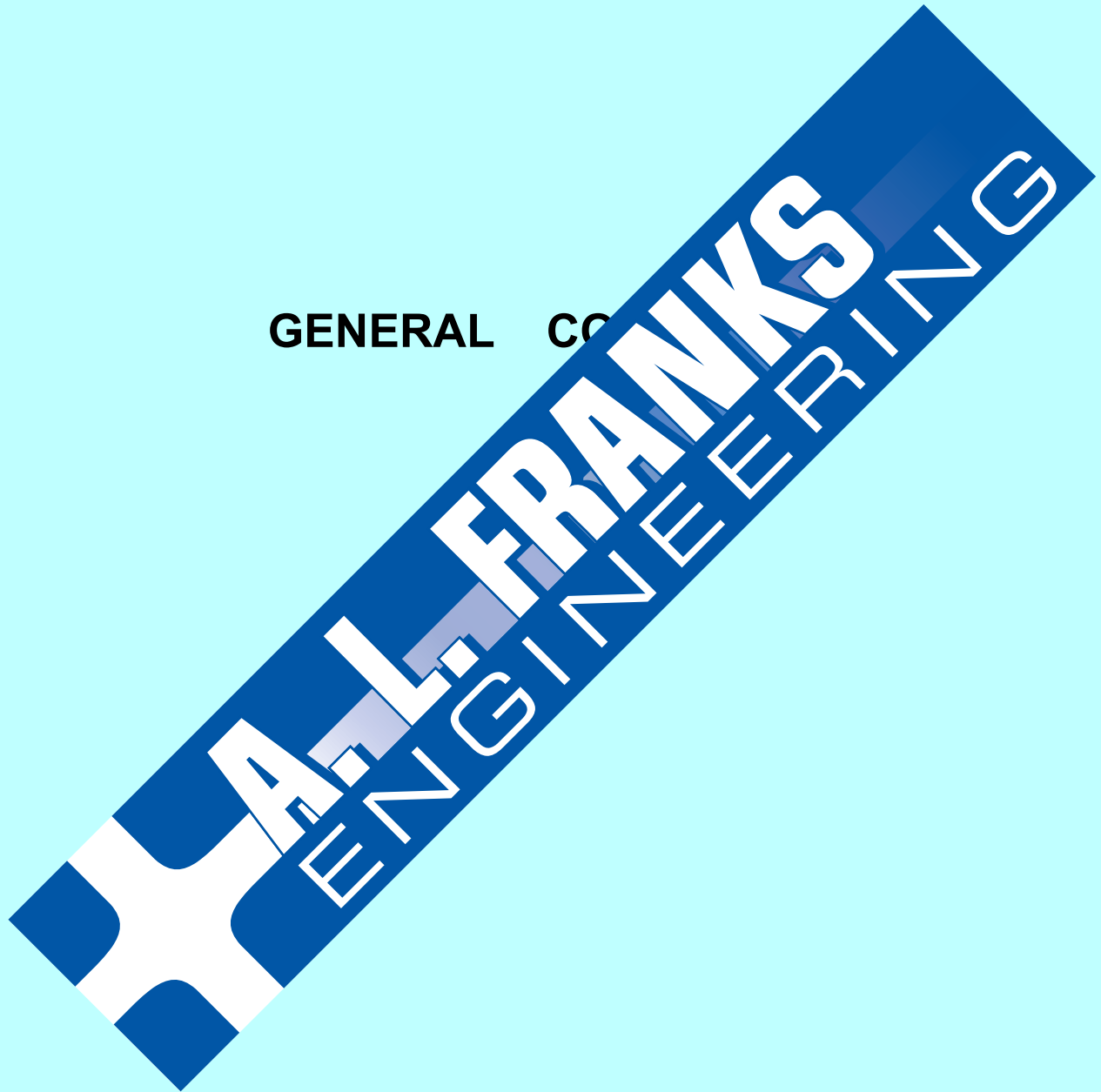


TABLE OF CONTENTS

FOR

GENERAL CONDITIONS OF AGREEMENT

	<u>PAGE</u>
1. Definition of Terms	
1.01 Owner, Contractor and Engineer	1
1.02 Contract Documents	G - 2
1.03 Sub-Contractor	G - 2
1.04 Written Notice	G - 2
1.05 Work	G - 2
1.06 Extra Work	G - 2
1.07 Working Day	G - 2
1.08 Calendar Day	G - 2
1.09 Substantially Completed	G - 2
1.10 Conflicts	G - 2
2. Responsibilities of the Contractor	
2.01 Owner-Engineer	G - 2
2.02 Professional Liability	G - 2
2.03 Payments for Work	G - 3
2.04 Initial Deposit	G - 3
2.05 Object of Work	G - 3
2.06 Limit of Work	G - 3
2.07 General Maintenance	G - 4
2.08 General Maintenance	G - 5
2.09 General Maintenance	G - 5
2.10 General Maintenance	G - 5
2.11 General Maintenance	G - 5
2.12 General Maintenance	G - 5
2.13 Professional Approval	G - 6
2.14 Defects and Their Remedies	G - 6
2.15 Changes and Alterations	G - 7
3. General Obligations and Responsibilities	
3.01 Keeping of Plans and Specifications Accessible	G - 7

TABLE OF CONTENTS
FOR
GENERAL CONDITIONS OF AGREEMENT
(Cont'd)

	3. General Obligations and Responsibilities	GE
	(Cont'd)	
3.02	Ownership of Drawings	
3.03	Adequacy of Design	
3.04	Right of Entry	
3.05	Collateral Contracts	- 8
3.06	Discrepancies and Omissions	G - 8
3.07	Equipment, Materials and Construction	G - 8
3.08	Damages	G - 8
3.09	Protection Against Accident to Employees	G - 8
3.10	Performance and Payments By	G - 9
3.11	Losses from Natural Causes	G - 9
3.12	Protection of Adjoining Property	G - 9
3.13	Protection Against Claims	G - 9
3.14	Protection Against Pollution	G - 10
3.15	Laws and Ordinances	G - 10
3.16	Assignment and Subcontracting	G - 11
3.17	Indemnification	G - 11
3.18	Contractors	G - 11
	4. Prosecution and Progress	
4.01	Completion	G - 12
4.02		G - 12
4.03	Delays	G - 12
	5. Measurement and Payment	
5.01	Quantities and Measurements	G - 12
5.02	Estimated Quantities	G - 13
5.03	Price of Work	G - 13
5.04	Partial Payment	G - 13

TABLE OF CONTENTS
FOR
GENERAL CONDITIONS OF AGREEMENT
(Cont'd)

5. Measurement and Payment		
(Cont'd)		
5.05	Use of Completed Portions	14
5.06	Final Completion and Acceptance	G - 14
5.07	Final Payment	G - 15
5.08	Payments Withheld	G - 15
5.09	Delayed Payments	G - 15
6. Changes		
6.01	Change Orders	G - 16
6.02	Minor Changes	G - 16
6.03	Extra Work	G - 16
6.04	Time of Completion	G - 17
6.05	Arbitration	G - 18
7. Termination and Abandonment of Contract		
7.01	Termination by Contractor	G - 18
7.02	Termination by Owner	G - 20

GENERAL CONDITIONS

1. DEFINITIONS OF TERMS

1.01 OWNER, CONTRACTOR AND ENGINEER. The OWNER, the CONTRACTOR and the ENGINEER are those persons or organizations identified as such in the Agreement and are referred to throughout the Contract Documents as if singular in number and masculine in gender. The term ENGINEER means the ENGINEER or his duly authorized representative. The ENGINEER shall be understood to be the ENGINEER of the OWNER, and nothing in the Contract Documents shall create any contractual or agency relationship between the ENGINEER and the CONTRACTOR.

1.02 CONTRACT DOCUMENTS. The Contract Documents consist of the Notice to Contractors (Advertisement), Special Conditions to Bidders), Proposal, signed Agreement, Performance Bonds (when required), General Conditions of the Agreement, Specifications, Plans, and all modifications thereof incorporated into the Contract before the execution of the agreement.

The Contract Documents are binding on all parties. In the event of a conflict between any of the Contract Documents, priority shall be in the following order: Signed Agreement, Performance Bonds, Special Bonds (if any), Proposal, Special Conditions to Bidders, Notice to Contractors, Technical Specifications, Plans, and General Conditions of the Agreement.

1.03 SUPERVISOR. A Sub-Contractor, as employed herein, includes only one who has a direct contract with the CONTRACTOR and it includes one who is employed to a special design according to the plans or specifications but does not include one who merely furnishes materials or labor.

1.04 NOTICE. Written notice shall be deemed to have been given to a person to the individual or to a member of the firm or to an authorized representative of the corporation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

1.05 WORK. The CONTRACTOR shall provide and pay for all materials, supplies, machinery, equipment, tools, superintendence, labor, services, insurance, and all water, light, power, fuel, transportation and other facilities necessary for the execution and completion of the work covered by the Contract Documents. Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of a good quality. The CONTRACTOR shall

if required, furnish satisfactory evidence as to the kind and quality of materials. Materials or work described in words which so applied have a well known technical or trade meaning shall be held to refer to such recognized standards.

1.06 EXTRA WORK. The term "Extra Work" as used in this contract shall be understood to mean and include all work that may be required by the ENGINEER or OWNER to be done by the CONTRACTOR to accomplish any change, alteration or addition to the work shown upon the plans, or reasonably implied by the specifications, and not covered by the CONTRACTOR's proposal, except as provided under "Changes and Alterations", herein.

1.07 WORKING DAY. A "Working Day" is defined as any day other than Saturdays, Sundays or legal holidays, in which weather conditions, not under the control of the CONTRACTOR, will permit the performance of all units of the work for a period of not less than seven (7) hours between 7:00 a.m. and 6:00 p.m.

1.08 CALENDAR DAY. "Calendar Day" means any day of the week or month, no days being excepted.

1.09 SUBSTANTIALLY COMPLETED. The term "substantially completed" is meant that the work is in such a state as to be suitable for use or occupancy or the facility is in such a state as to be suitable for its intended purpose, but still may require minor miscellaneous work.

1.10 CONFLICT. In the event of a conflict or discrepancy between these General Conditions and the specifications supplied by the Arkansas Soil and Water Conservation Commission, the ASWCC General Conditions shall govern.

2. RELATIONSHIP OF THE ENGINEER AND THE CONTRACTOR

2.01 ENGINEER RELATIONSHIP. The ENGINEER will be the OWNER'S representative during construction. The duties, responsibilities and authority of the ENGINEER as the OWNER'S representative during construction are set forth in the Contract Documents and shall not be extended or modified without the written consent of the OWNER and ENGINEER. The ENGINEER shall advise and consult with the OWNER, and all of OWNER'S instructions to the CONTRACTOR shall be issued through the ENGINEER.

2.02 PROFESSIONAL INSPECTION BY ENGINEER. The ENGINEER shall make periodic visits to the site to familiarize himself generally with the progress of the executed work and to determine if such work generally meets the essential performance and design features and the technical and functional engineering requirements of the Contract Documents; provided and except, however, that the ENGINEER shall not be responsible for making any detailed, exhaustive, comprehensive or continuous on-site inspection of the quality or

quantity of the work or be in any way responsible, directly or indirectly, for the construction means, methods, techniques, sequences, quality, procedures, programs, safety precautions or lack of same incident thereto or in connection therewith. Notwithstanding any other provision of this agreement or any other Contract Document, the ENGINEER shall not be in any way responsible or liable for any acts, errors, omissions or negligence of the CONTRACTOR, any subcontractor or any of the CONTRACTOR'S or subcontractor's agents, servants or employees or any other person, firm or corporation performing or attempting to perform any of the work.

2.03 PAYMENTS FOR WORK. The ENGINEER shall review and approve the CONTRACTOR'S applications for payment and supporting documents for the amount owed to the CONTRACTOR and approve the CONTRACTOR'S billings for the amount owed to the CONTRACTOR in such amounts; such approval of the CONTRACTOR'S billings constitutes a representation to the OWNER that the ENGINEER has made in his judgment that the work has progressed to the extent of his knowledge, information and belief, but such approval of the CONTRACTOR'S billings to CONTRACTOR shall not be deemed an admission by the ENGINEER that the ENGINEER has made any examination of the work or for what purpose the CONTRACTOR has used the money paid for the contract price.

2.04 INITIAL DETERMINATION. The ENGINEER shall initially shall determine all claims, disputes and other matters between the CONTRACTOR and the OWNER relating to the work or the interpretation of the Contract Documents. The ENGINEER's decision shall be rendered in writing within a reasonable time. If the ENGINEER fail to make such decision within a reasonable time, the CONTRACTOR may be taken as if his decision had been rendered as such.

2.05 ARBITRATION. If the ENGINEER renders any decision which, in the opinion of the CONTRACTOR, is not in accordance with the meaning and intent of the Contract Documents, the CONTRACTOR may file with the ENGINEER within thirty days of the date of the decision, and by such action may reserve the right to the CONTRACTOR to be referred to arbitration as hereinafter provided.

2.06 LINE AND GRADES. Unless otherwise specified, all lines and grades shall be established by the ENGINEER or his representative. Whenever necessary, construction work shall be suspended to permit performance of this work, and such suspension will be as brief as practicable and the CONTRACTOR shall be allowed no extra compensation therefor. The CONTRACTOR shall give the ENGINEER ample notice of the time and place where line and grades will be needed. All stakes, marks, etc., shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by or his employees, such stakes, marks, etc., shall be replaced at the CONTRACTOR'S expense.

2.07 CONTRACTOR'S DUTY AND SUPERINTENDENCE. The CONTRACTOR shall give adequate attention to the faithful prosecution and completion of this contract and shall keep on the work, during its progress, a competent superintendent and any necessary assistants. The superintendent shall represent the CONTRACTOR in his absence and all directions given to him shall be as binding as if given to the CONTRACTOR.

The CONTRACTOR is and at all times shall remain an independent contractor, solely responsible for the manner and method of completing work under this contract, with full power and authority to select the means and manner of performing such work, so long as such methods do not conflict with the completed improvements, the OWNER and ENGINEER. The CONTRACTOR shall be responsible for the result obtained and conformity of such completed improvements with the specifications and contract.

Likewise, the CONTRACTOR shall be solely responsible for the safety of himself, his employees and other persons, as well as the safety of the improvements being erected and the safety of any other person, as a result of his operations hereunder. The CONTRACTOR shall be responsible for the drawings and specifications as well as any additional instructions given to the work to be performed passing from or through the CONTRACTOR. The CONTRACTOR shall be fully and completely liable, at his own expense, for the installation and use, or non-use, of all items and methods used in the performance of the contract, and for all loss, damage or injury to any person or property, including, without limitation, the CONTRACTOR's equipment, supports, shoring, bracing, scaffolding, machinery, tools, cautions or devices, and similar items or devices used in the performance of the contract.

The CONTRACTOR shall be responsible for the construction process, or any visit or observation during the construction process, or any visit or observation during the construction process, by the ENGINEER, or any representative of either of them whether through personal observation on the project site or by means of approval of shop drawings for the construction processes, or by other means or method, is authorized for the CONTRACTOR to be for the purpose of observing the extent and nature of the work completed or being performed, as measured against the drawings and specifications constituting the contract, or for the purpose of enabling the CONTRACTOR to more fully understand the plans and specifications so that the completed construction work will conform thereto, and shall in no way relieve the CONTRACTOR from full and complete responsibility for the proper performance of his work on the project, including but without limitation the propriety of means and methods of the CONTRACTOR in performing said contract, and the adequacy of any designs, plans or other

facilities for accomplishing such performance. Deviation by the CONTRACTOR from plans and specifications that may have been in evidence during any such visitation or observation by the ENGINEER, or any of his representatives, whether called to the CONTRACTOR'S attention or not shall in no way relieve CONTRACTOR from his responsibility to complete all work in accordance with said plans and specifications.

2.08 CONTRACTOR'S UNDERSTANDING. It is understood and agreed that the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, water, quality and quantity of the materials to be encountered, the character and facilities needed preliminary to and during the prosecution of the work, general and local conditions, and all other matters which may affect the work under this contract. No verbal agreement or communication, by agent, agent or employee of the OWNER or ENGINEER, shall affect or modify the obligations herein contained.

2.09 CHARACTER OF WORK. The CONTRACTOR agrees to employ only orderly and competent men, and to exercise the best judgment of the type of work required under this contract. It is further agreed that whenever the ENGINEER shall inform him in writing that men on the work are, in his opinion, incompetent, unfait, or otherwise unsatisfactory, such man or men shall be discharged from the work and no other men shall be employed on the work without the ENGINEER'S written consent.

2.10 CONSTRUCTION. The building of structures for housing men, or the erection of any structure for protection, will be permitted only at such places as may be approved by the ENGINEER, and the sanitary conditions of the grounds in and about the same shall at all times be maintained in a manner satisfactory to the ENGINEER.

The CONTRACTOR shall provide necessary sanitation conveniences for the use of his men, which shall be properly secluded from public observation, shall be approved by the CONTRACTOR in such manner and at such places as may be approved by the ENGINEER, and their use shall be strictly limited to the purposes intended.

2.11 SHOP DRAWINGS. The CONTRACTOR shall submit to the ENGINEER, with such promptness as to cause no delay in his own work or in that of any other Contractor, four checked copies, unless otherwise specified, of all shop and/or setting drawings and schedules required for the work of the various trades, and the ENGINEER shall pass upon them with reasonable promptness, making desired corrections. The CONTRACTOR shall make any corrections required by the ENGINEER, file with him two corrected copies and furnish such other copies as may be needed. The ENGINEER'S approval of such drawings or schedules shall not relieve the CONTRACTOR from responsibility for deviations from drawings or specifications, unless he has in

writing called the ENGINEER'S attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules. It shall be the CONTRACTOR'S responsibility to fully and completely review all shop drawings to ascertain their effect on his ability to perform the required contract work in accordance with the plans and specifications and within the contract time.

Such review by the ENGINEER shall be for the sole purpose of determining the sufficiency of said drawings or schedules to result in finished products in conformity with the plans and specifications, and shall not constitute the CONTRACTOR of his duty as an independent contractor as to the propriety of the work being expressly understood and agreed that the ENGINEER shall not have the duty to pass upon the propriety or adequacy of such drawings or schedules or the means or methods reflected thereby, in relation to the safety of the work or property during CONTRACTOR'S performance hereunder.

2.13 PRELIMINARY APPROVAL. The ENGINEER shall not have the power to waive the obligations of this contract. The CONTRACTOR shall be responsible for the quality of good material, and of his performing the work in accordance with the plans and specifications. The omission of the ENGINEER to discover, object to or reject defective work or material shall release the CONTRACTOR from the obligation to tear out, remove and properly replace the same at his expense upon the discovery of said defective work or material. That the ENGINEER shall, upon request of the CONTRACTOR, accept or reject any material furnished, and in every case, material once accepted by the ENGINEER, such acceptance shall constitute acceptance by the ENGINEER, unless it can be clearly shown that such material does not conform to the specifications for this work.

Any work or material ordered taken up or removed for re-examination prior to final acceptance, and if found not in accordance with the specifications for said work, all expense of removing, re-examination and replacement shall be borne by the CONTRACTOR, otherwise the expense shall be allowed as EXTRA WORK, and shall be paid for by the CONTRACTOR. That, where inspection or approval is specifically required prior to performance of certain work, should the CONTRACTOR proceed with such work without requesting prior inspection or approval, he shall bear all expense of taking up, removing, and replacing this work if so ordered by the ENGINEER.

2.14 DEFECTS AND THEIR REMEDIES. It is further agreed that if the work or any part thereof, or any material brought on the site of the work for use in the work or selected for the same, shall be deemed by the ENGINEER as unsuitable or not in conformity with the specifications, the CONTRACTOR shall, after receipt of written notice thereof from the ENGINEER, forthwith remove such

material and rebuild or otherwise remedy such work so that it shall be in full accordance with this contract.

2.15 CHANGES AND ALTERATIONS. The CONTRACTOR further agrees that the OWNER may make such changes and alterations as the OWNER may see fit, in the line, grade, form, dimensions, plans or materials for the work herein contemplated, or any part thereof, either before or after the beginning of the construction, without affecting the validity of this contract and the accompanying Performance and Payment Bonds.

If such changes or alterations diminish the quantity of the work, they shall not constitute the basis for a claim for damages, or for the work that may be dispensed with, except as provided for in Section 5 "Measurement and Payment." If the amount of the work can fairly be classified under the specifications, it shall be paid for according to the quantity actually done, at the unit price established for such work under this contract. If the work is of a nature that price items under Section 5 "Measurement and Payment" do not cover, additional work shall be paid for as provided under Section 5. If the OWNER shall make such changes or alterations as shall require work already done or material already furnished or used, the OWNER shall recompense the CONTRACTOR for the work so used, and for any actual loss occasioned by such changes, and for any expenses incurred in preparation for the work as ordered.

3. GENERAL RESPONSIBILITIES

3.01 KEEPING SPECIFICATIONS ACCESSIBLE. The ENGINEER shall provide the CONTRACTOR with an adequate and reasonable number of copies of the specifications without expense to him, and the CONTRACTOR shall keep the same constantly accessible on the work, with the drawings thereon.

3.02 RETURN OF DRAWINGS. All drawings, specifications and contract documents shall be the property of the ENGINEER and shall not be reused on other work, and, when the contract sets, are to be returned to him on request, and the CONTRACTOR shall not use them on any other work. All models are the property of the OWNER.

3.03 ADEQUACY OF DESIGN. It is understood that the OWNER believes it has employed a competent engineer and designers. It is, therefore, agreed that the OWNER shall be responsible for the adequacy of the design, sufficiency of the Contract Documents, the safety of the structure and the practicability of the operations of the completed project; provided the CONTRACTOR has complied with the requirements of the said Contract Documents, all approved modifications thereof, and additions and alterations thereto approved in writing by the OWNER. The burden of proof of such compliance shall be upon the CONTRACTOR to show that he has complied with

the said requirements of the Contract Documents, approved modifications thereof and all approved additions and alterations thereto.

3.04 RIGHT OF ENTRY. The OWNER reserves the right to enter the property or location on which the works herein contracted for are to be constructed or installed, by such agent or agents as he may elect, for the purpose of inspecting the work, or for the purpose of constructing or installing such collateral work as said OWNER may desire.

3.05 COLLATERAL CONTRACTS. The OWNER agrees that by separate contract or otherwise, all labor and material essential to the progress of the work specifically excluded from this contract, in such cases as the progress of the work, or damage said CONTRACTOR may incur, or delays are specifically mentioned elsewhere in the Contract Documents.

3.06 DISCREPANCIES AND OMISSIONS. It is the intent of this contract that all work must be done in accordance with the generally accepted practice of the industry. In the event of any discrepancies between the separate documents, the priority of interpretation defined under "Contract Documents" shall apply. In the event that there is still any doubt as to the meaning or intention of the contract, specifications or drawings, the Engineer's interpretation is intended to apply to the work.

3.07 EQUIPMENT AND MATERIALS. The CONTRACTOR shall be responsible for the preservation, conservation, and protection of all property, machinery, equipment, tools, apparatus, accessories, facilities, and any and all parts of the work, whether the CONTRACTOR is paid, partially paid, or not paid for such work, until the work is completed and accepted.

3.08 DAMAGE TO PROPERTY. In the event the CONTRACTOR is damaged in the course of the work by the act, neglect, omission, mistake or default of the OWNER, or of any other CONTRACTOR, the OWNER agrees to reimburse the CONTRACTOR for such loss. In the event the OWNER is damaged in the course of the work by the act, neglect, omission, mistake or default of the CONTRACTOR, or should the CONTRACTOR unreasonably delay the progress of the work being done by others on the job so as to cause loss for which the OWNER becomes liable, then the CONTRACTOR shall reimburse the OWNER for such loss.

3.09 PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC. The CONTRACTOR shall at all times exercise reasonable precautions for the safety of employees and others on or near the work and shall comply with all applicable provisions of Federal, State, and Municipal safety laws and building and construction codes. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention

in Construction" of the Associated General Contractors of America except where incompatible with Federal, State, or Municipal laws or regulations. The CONTRACTOR shall provide such machinery guards, safe walkways, ladders, bridges, gangplanks, and other safety devices. The safety precautions actually taken and their adequacy shall be the sole responsibility of the CONTRACTOR, acting at his discretion as an independent contractor.

3.10 PERFORMANCE AND PAYMENT BONDS. Unless otherwise specified, it is further agreed by the parties to this Contract that the CONTRACTOR will execute separate performance and payment bonds, each for one hundred (100) percent of the total contract price, in standard form, guaranteeing faithful performance of the work and the fulfillment of the contract required, and further guaranteeing payment to all persons furnishing materials or furnishing him any equipment in the execution of the contract. It is agreed that this Contract shall not be in effect until the performance and payment bonds are furnished and approved by the OWNER.

Unless otherwise approved in writing, the surety company underwriting the bonds shall be acceptable to the OWNER. The CONTRACTOR shall hold certificates of authority from the Secretary of the United States.

Unless otherwise specified, the premium for the performance and payment bonds shall be the CONTRACTOR'S proposal.

3.11 LOSSES AND DAMAGES. Unless otherwise specified, all loss or damage to the property of the OWNER, or out of the nature of the work to be done, or from the work, or from any unforeseen circumstance in the prosecution of the work, or from any obstructions or difficulties which may be encountered in the work, shall be sustained and borne by the CONTRACTOR and expense.

3.12 PROTECTION OF ADJOINING PROPERTY. The said CONTRACTOR shall take proper means to protect the adjacent or adjoining property in any way encountered, which might be injured or seriously damaged by reason of said process of construction; and he shall be liable for all claims for such damage on account of his failure to fully protect all adjoining property. The CONTRACTOR agrees to indemnify, save and hold harmless the OWNER and ENGINEER against any claim or claims for damages due to any injury to any adjacent or adjoining property, arising or growing out of the performance of the contract; but any such indemnity shall not apply to any claim of any kind arising out of the existence or character of the work.

3.13 PROTECTION AGAINST CLAIMS OF SUB-CONTRACTORS, LABORERS, MATERIALMEN AND FURNISHERS OF MACHINERY,

EQUIPMENT AND SUPPLIES. The CONTRACTOR agrees that he will indemnify and save the OWNER and ENGINEER harmless from all claims growing out of the lawful demands of sub-contractors, laborers, workmen, mechanics, materialmen and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this contract. When so desired by the OWNER, the CONTRACTOR shall furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged or waived. If the CONTRACTOR fails so to do, then the OWNER may at the option of the CONTRACTOR either pay directly the unpaid bills, of which the OWNER has written notice, or with the consent of the CONTRACTOR'S unpaid compensation a sum of money, which shall be sufficient to liquidate any and all such lawful claims until the CONTRACTOR has furnished that all liabilities have been fully discharged, whereupon the CONTRACTOR shall be resumed in full, in accordance with the provisions of this contract, but in no event shall the provisions of this contract be construed to impose any obligation upon the OWNER by or for his Surety.

3.14 PROTECTION AGAINST PATENT AND COPYRIGHT INFRINGEMENT. The CONTRACTOR shall pay all royalties and shall provide for the use of any design, device, machine, or process, whether protected by letters patent or copyright by suitable legal action, and shall indemnify the OWNER. The CONTRACTOR shall defend the OWNER against the infringement of any patent or copyright rights and shall hold the OWNER and ENGINEER harmless from any loss or expense incurred by the OWNER that the OWNER shall defend all such suits and claims and pay for all such loss when a particular design, device, machine, or process is the product of a particular manufacturer or manufacturers in which the OWNER has a proprietary interest; provided, however, if choice of alternative material or process is allowed to the CONTRACTOR, the CONTRACTOR shall indemnify and save OWNER harmless from any loss or expense incurred by the OWNER thereof. If the material or process specified or required in the contract is found to be in infringement, the CONTRACTOR shall be responsible for the same, unless he promptly gives such information to the OWNER.

3.15 COMPLIANCE WITH LAWS AND ORDINANCES. The CONTRACTOR shall at all times comply with all Federal, State and local laws, ordinances and regulations, and shall not in any manner affect the contract or the work, and shall indemnify and save harmless the OWNER and ENGINEER against any claim arising from the violation of any such laws, ordinances, and regulations whether by the CONTRACTOR or his employees, except where such violations are called for by the provisions of the Contract Documents. If the CONTRACTOR observes that the plans and specifications are at variance therewith, he shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted as provided in the contract for changes in the work. If the CONTRACTOR performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the ENGINEER, he shall bear all costs arising therefrom. In case the OWNER is a body politic and corporate, the law

from which it derives its powers, insofar as the same regulates the objects for which, or the manner in which, or the conditions under which the same regulates the objects for which, or the manner in which, or the conditions under which the OWNER may enter into contract, shall be controlling, and shall be considered as part of this contract, to the same effect as though embodied herein.

3.16 ASSIGNMENT AND SUBLETTING. The CONTRACTOR further agrees that he will retain personal control and will give his personal attention to the fulfillment of this contract and that he will not assign by Power of Attorney, or otherwise, or sublet said contract without the written consent of the OWNER, and that no part or feature of the work will be sublet to anyone without the written consent of the ENGINEER or the OWNER. The CONTRACTOR further agrees that the assignment of any portion or feature of the work, or materials required for the fulfillment of this contract, shall not relieve the CONTRACTOR from his obligations to the OWNER, as provided by this Agreement.

3.17 INDEMNIFICATION. The CONTRACTOR shall indemnify and hold harmless the OWNER and the ENGINEER, their respective officers, agents and employees, from and against all damages, claims, demands, suits, judgments and costs, including reasonable attorneys' fees and expenses, arising out of or resulting from the performance of the work, provided that any such damages, claim, loss, demand, suit, judgment or expense is caused in whole or in part by:

- (1) Is attributable to the negligence, business, disease or death or to injury to or damage to any property (other than the work itself) including the work itself, arising out of or resulting from the performance of the work herefrom; and,
- (2) Is caused in whole or in part by any negligent act or omission of the CONTRACTOR, anyone directly or indirectly employed by the CONTRACTOR or anyone for whose acts any of them is responsible, whether or not it is caused in part by the negligence of the OWNER hereunder.

The liability of the CONTRACTOR under this Paragraph shall not extend to the liability of the CONTRACTOR for damages arising out of the preparation or approval of maps, drawings, reports, specifications or specifications, or the giving of or the failure to give directions or instructions by the OWNER, his agents or employees, provided such giving or failure to give is the proximate cause of the damage or injury.

3.18 CERTIFICATE OF INSURANCE. Before commencing any of the work, CONTRACTOR shall file with the OWNER valid Certificates of Insurance acceptable to the OWNER and the ENGINEER. Such Certificates shall contain a provision that coverages afforded under the policies will not be cancelled until at least fifteen days' prior written notice has been given to the OWNER.

The CONTRACTOR shall also file with the OWNER valid Certificates of Insurance covering all sub-contractors.

4. PROSECUTION AND PROGRESS

4.01 TIME AND ORDER OF COMPLETION. It is the meaning and intent of this contract, unless otherwise herein specifically provided, that the CONTRACTOR shall be allowed to prosecute his work at such times and seasons, in such order of precedence, and in such manner as shall be most conducive to economy of construction: provided, however, that the order and the time of prosecution shall be such that the work shall be substantially completed as a whole and in part, in accordance with this contract, the plans and specifications, and within the time of completion designated in the Proposal; provided, however, when the OWNER is having other work done, either by contract or otherwise, the ENGINEER may direct the time and manner of construction under this contract, so that conflict will be avoided and the construction of the works being done for the OWNER shall be harmonized.

The CONTRACTOR shall submit, at such times and in such manner as may be requested by the ENGINEER, schedules which shall show the order in which the CONTRACTOR proposes to carry on the work, and the times at which the CONTRACTOR will start the several parts of the work, and the estimated dates of completion of the several parts.

4.02 EXTENSION OF TIME. If the CONTRACTOR be delayed in the completion of the work by any cause beyond the control of the CONTRACTOR, or by any employee of either, or by any person employed by the OWNER, or by changes ordered in the work, or by strikes, fires, and unusual delays by common carriers, or by any other causes beyond the CONTRACTOR'S control, or by any other cause which the ENGINEER shall decide justifies the delay, then an extension of time for completing the work, sufficient to compensate for the delay, shall be determined by the ENGINEER. The CONTRACTOR shall give the ENGINEER notice of the cause of such delay.

4.03 STOPPAGE AND DELAYS. No claims shall be made by the CONTRACTOR for expenses resulting from hindrances or delays from any cause (including stoppage by order of the OWNER) during the progress of the work embraced in this contract. In case said work shall be stopped by order of the OWNER, then such expense as in the judgment of the ENGINEER shall be caused by such stoppage of said work shall be paid by the OWNER to the CONTRACTOR.

5. MEASUREMENT AND PAYMENT

5.01 QUANTITIES AND MEASUREMENTS. No extra or customary measurements of any kind will be allowed, but the actual measured and/or

computed length, area, solid contents, number and weight only shall be considered, unless otherwise specifically provided.

5.02 ESTIMATED QUANTITIES. This agreement, including the specifications, plans and estimate, is intended to show clearly all work to be done and material to be furnished hereunder. Where the estimated quantities are shown for the various classes of work to be done and material to be furnished under this contract, they are approximate and are to be used only as a basis for estimating the probable cost of the work and for comparing the proposals offered for the work. It is understood and agreed that the actual amount of work to be done and material to be furnished under this contract may differ somewhat from these estimates. The basis for payment under this contract is the unit price shown in the estimate for the actual amount of such work done and the material actually furnished.

Where payment is based on the unit price, the CONTRACTOR agrees that he will make no claim for damages, compensation or otherwise on account of any differences which may be found between the quantities of work actually done, the material actually furnished and the estimated quantities contemplated and contained in the estimate. However, that in case the actual quantity of any major item is more than, or 20% more than, or 20% less than the estimate, the CONTRACTOR or such items, then either party to this Agreement shall be entitled to a revised consideration upon the portion of the estimate showing 20% of the estimated quantity.

A "Major Item" shall mean any individual bid item incurred in the proposal that bears a cost greater than five (5) per cent of the total contract cost, or more than 1% of the proposal quantities and the contract unit price.

Any change in the estimate shall be determined by agreement between parties to this Agreement, as provided under "Extra Work."

5.03 PAYMENT FOR WORK. In consideration of the furnishing of all the material and labor, and the completion of all work by the CONTRACTOR, the OWNER agrees to pay the CONTRACTOR the sum of the contract price in full conformity with the specifications and quantities contained, the OWNER agrees to pay the CONTRACTOR the prices shown in the Proposal hereto attached, which has been made a part of this contract. The CONTRACTOR hereby agrees to receive such prices in full for furnishing all material and all labor required for aforesaid work, also for all expense incurred by him, and for well and truly performing the same and the whole thereof in the manner and according to this Agreement.

5.04 PARTIAL PAYMENTS. On or before the 10th day of each month, the CONTRACTOR shall prepare and submit to the ENGINEER for approval or

modification a statement showing as completely as practicable the total value of the work done by the CONTRACTOR up to and including the last day of the preceding month; said statement shall also include the value of all sound materials delivered on the site of the work that are to be fabricated into the work.

The OWNER shall then pay the CONTRACTOR on or before the 15th day of the current month the total amount of the approved statement, less 10 per cent of the amount thereof, which 10 per cent shall be retained until final payment, and further less all previous payments and all further sums that may be due by the OWNER under the terms of this Agreement. It is understood that in case the whole work be near to completion and some unexpected delay occurs due to no fault or neglect on the part of the CONTRACTOR, the OWNER may upon written recommendation of the ENGINEER, pay to the CONTRACTOR an equitable portion of the retained percentage to enable the CONTRACTOR to complete the work and, thereupon, the CONTRACTOR shall be paid the balance due him under the contract subject to the retention of the balance under "Final Payment."

5.05 USE OF COMPLETED PORTIONS. The CONTRACTOR shall have the right to take possession of and use any completed portions of the work, notwithstanding the time for completion of the work or such portions may not have expired but such taking shall not be deemed an acceptance of any work or compliance with the Contract Documents. If such possession of or delays the work, the CONTRACTOR shall be liable for compensation, or extension of time, or both, as the ENGINEER may determine.

The CONTRACTOR shall notify the ENGINEER when, in the CONTRACTOR's opinion, the work is "substantially completed" and when so notifying the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER in writing a list of the work completed. The ENGINEER will review the work completed and will add thereto such items as the ENGINEER may deem proper to include. The "substantial completion" of the structure shall release the CONTRACTOR from performing all of the work of a minor or major nature, and thereby completing the work in accordance with the Contract Documents.

FINAL COMPLETION AND ACCEPTANCE. Within ten (10) days after the CONTRACTOR has given the ENGINEER written notice that the work has been completed, or substantially completed, the ENGINEER and the OWNER shall inspect the work and within said time, if the work be found to be completed or substantially completed in accordance with the Contract Documents, the ENGINEER shall issue to the OWNER and the CONTRACTOR his Certificate of Completion, and thereupon it shall be the duty of the OWNER within ten (10) days to issue a Certificate of Acceptance of the work to the CONTRACTOR or to advise the CONTRACTOR in writing of the reason for non-acceptance.

5.07 FINAL PAYMENT. Upon the issuance of the Certificate of Completion, the ENGINEER shall proceed to make final measurements and prepare final statement of the value of all work performed and materials furnished under the terms of the Agreement and shall certify same to the OWNER, who shall pay to the CONTRACTOR on or before the 30th day, and before the 35th day, after the date of the Certificate of Completion, the balance due the CONTRACTOR under the terms of this Agreement, provided he has fully performed his contractual obligations under the terms of this contract; and said payment shall be due in any event upon said performance by the CONTRACTOR. Neither the date of Acceptance nor the final payment, nor any provision in the Contract shall relieve the CONTRACTOR of the obligation for fulfillment of the work which may be required.

5.08 PAYMENTS WITHHELD. The CONTRACTOR shall, in the event of subsequently discovered evidence, withhold or cause to be withheld from any certificate to such extent as may be necessary to protect the OWNER from loss on account of:

- (a) Defective work not conforming to the requirements of the Contract.
 - (b) Cost of rework or repair of defective work, or evidence indicating probable filing of a claim for recovery of such costs.
 - (c) Failure of the CONTRACTOR to make payment to subcontractors or for material or labor.
- (d) Failure of the CONTRACTOR to make payment to any other contractor.
- (e) Doubt that the work can be completed within the balance of the contract amount.
- (f) Any other indication that the work will not be completed within the contract time.

When the CONTRACTOR is required to provide a Surety Bond, the CONTRACTOR shall provide a Surety Bond, which will protect the OWNER in the amount withheld for amounts withheld because of them.

5.09 DELAYED PAYMENTS. Should the OWNER fail to make payment to the CONTRACTOR of the sum named in any partial or final statement, when payment is due, the OWNER shall pay to the CONTRACTOR, in addition to the amount due by such statement, interest thereon at the rate of six (6) per cent per annum, unless otherwise specified, from date due as provided under "Partial Payments" and "Final Payments," until fully paid, which shall fully liquidate any injury to the CONTRACTOR growing out of such delay in payment, but the right is expressly reserved to the CONTRACTOR in the event payments be not promptly made, as provided under "Partial Payments," to at any time

thereafter treat the contract as abandoned by the OWNER and recover compensation, as provided under "Abandonment of Contract," unless such payments are withheld in accordance with the provisions of "Payments Withheld."

6. EXTRA WORK AND CLAIMS

6.01 CHANGE ORDERS: Without invalidating this Agreement, the OWNER may, at any time or from time to time, order deletions or revisions to the Work; such changes will be authorized by Change Order to be prepared by the ENGINEER for execution by the OWNER and the CONTRACTOR. The Change Order shall set forth the basis for any change in contract price, as hereinafter provided for Extra Work, and any change in contract time which may result from the Change Order.

In the event the CONTRACTOR shall refuse to execute any Change Order which has been prepared by the ENGINEER and approved by the OWNER, the ENGINEER may in writing instruct the CONTRACTOR to execute the work as set forth in the Change Order and the CONTRACTOR shall be liable against the OWNER for Extra Work involved thereunder.

6.02 MINOR CHANGES: The CONTRACTOR shall execute minor changes in the work not inconsistent with the Contract Documents and not involving an increase in Contract Price. If the CONTRACTOR believes that any minor change or alteration involves Extra Work and entitles him to an increase in Contract Price, the Contractor shall make written request to the ENGINEER for a Change Order.

In such case, the CONTRACTOR shall submit a copy of his communication to the ENGINEER or otherwise advise the OWNER of his request to the ENGINEER for a Change Order. If the CONTRACTOR believes that the work involved may result in an increase in Contract Price, the CONTRACTOR shall make written request to the ENGINEER for a Change Order.

The CONTRACTOR for a change in Contract Price shall be made by the CONTRACTOR for the work covered by the proposed change.

6.03 BASIS OF COMPENSATION: It is agreed that the basis of compensation to the CONTRACTOR for work either added or deleted by a Change Order or for which the CONTRACTOR is entitled to an increase in Contract Price shall be determined by one or more of the following methods:

- Method (A) - By agreed unit prices; or
- Method (B) - By agreed lump sum; or
- Method (C) - If neither Method (A) nor Method (B) be agreed upon before the Extra Work is commenced, then the

CONTRACTOR shall be paid the "actual field cost" of the work, plus fifteen (15) percent.

In the event said Extra Work be performed and paid for under Method (C), then the provisions of this paragraph shall apply and the "actual field cost" is hereby defined to include the cost to the CONTRACTOR of all workmen, such as foreman, timekeepers, mechanics and laborers, and materials, supplies, teams, trucks, rentals on machinery and equipment, for the time actually employed or used on such Extra Work, plus actual transportation charges necessarily incurred, together with all power, fuel, lubricants, water and similar operating expenses, also all necessary incidental expenses incurred directly on account of such Extra Work, including Social Security, Old Age Benefits and other payrolls, and the proportion of premiums on Performance and Payment Bonds, Public Liability and Property Damage and Workers Compensation and all other insurance as may be required by any law of the State of the OWNER, or by them agreed to. The ENGINEER shall keep accounts of the "actual field cost" shall be kept by the CONTRACTOR, and the accounts shall be made available to the ENGINEER. The OWNER may also specify in writing, before the work commences, the type and kind of machinery and equipment to be used in the work and the type and kind of machinery and equipment to be used in the work. These matters shall be determined by the CONTRACTOR and the OWNER, and if they are agreed upon, the prices for the use of machinery and equipment shall be determined by using 100 per cent, unless otherwise specified in the schedule of Equipment Ownership Expense adopted by the National Contractors of America. Where practicable the terms of the schedule of machinery and equipment shall be incorporated in the contract. The fifteen (15%) per cent of the "actual field cost" of the work shall cover and compensate him for his profit, his residence and field office expense, and all other elements not embraced within the "actual field cost" as herein defined. The CONTRACTOR'S Camp or Field Office must be maintained on account of such Extra Work; then the cost to maintain the same shall be included in the "actual field cost."

Work of any kind will be allowed unless ordered in writing. If any orders or instructions, either oral or written, appear to involve Extra Work for which he should receive compensation, the CONTRACTOR shall make written request for adjustment in the construction time, he shall make written request for the ENGINEER for written order authorizing such Extra Work. Should a difference of opinion arise as to what does not constitute Extra Work, or as to the payment therefor, and the ENGINEER insists upon its performance, the CONTRACTOR shall proceed with the work after making written request for written order and shall keep an accurate account of the "actual field cost" thereof, as provided under Method (C). The CONTRACTOR will thereby preserve the right to submit the matter of payment to arbitration, as hereinbelow provided.

6.04 TIME OF FILING CLAIMS. It is further agreed by both parties hereto that all questions of dispute or adjustment presented by the CONTRACTOR shall

be in writing and filed with the ENGINEER within thirty (30) days after the ENGINEER has given any directions, order or instruction to which the CONTRACTOR desires to take exception. The ENGINEER shall reply within thirty (30) days to such written exceptions by the CONTRACTOR and render his final decision in writing. In case the CONTRACTOR should appeal from the ENGINEER'S decision, any demand for arbitration shall be filed with the ENGINEER and the OWNER in writing within ten (10) days after the date of delivery to CONTRACTOR of the ENGINEER'S final decision. It is further agreed that final acceptance of the work by the OWNER and the account by the CONTRACTOR of the final payment shall be a bar to any claim by either party, except where noted otherwise in the Contract Documents.

6.05 ARBITRATION. All questions of dispute shall be submitted to arbitration if agreed to by both parties. If the parties agree upon one arbiter, otherwise, there shall be three arbiters, one chosen by each party, and the third chosen by the two arbiters selected. If either party fail to select a third within ten (10) days, he shall be deemed to have selected the County in which the major portion of the work is being performed, as otherwise specified. Should the party demanding arbitration fail to select an arbiter within ten (10) days of the demand, his right to arbitration shall be waived. The decision of the ENGINEER shall be final and binding on the party failing to choose an arbiter within ten(10) days, the decision of such arbiter. Should either party refuse or neglect to submit any papers or information demanded in writing, the arbitration shall proceed in the absence of both parties to take ex parte proceedings.

The arbiters shall be sworn to perform their duties impartially. The decision of any two shall be binding on both parties. The decision of the arbiters upon any question submitted to them under this contract shall be a condition precedent to any right to sue in court. An appeal from the decision of the arbiter or arbiters may be filed in court to the same effect as an appeal from a judgment of a court.

The arbiters, when the case demands it, are authorized to award the money or sums sustained, such sums as they deem proper for the time, and to award damages for any delay occasioned thereby. The arbiters may award damages for any delay occasioned thereby. The arbiters shall assess their own compensation, unless otherwise provided by agreement. The arbiters shall assess the cost and charges of the arbitration upon either or both parties. The award of the arbiters must be made in writing.

7. ABANDONMENT OF CONTRACT

7.01 ABANDONMENT BY CONTRACTOR. In case the CONTRACTOR should abandon and fail or refuse to resume work within ten (10) days after written notification from the OWNER, or the ENGINEER, or if the CONTRACTOR fails to comply with the orders of the ENGINEER, when such orders are consistent with the Contract Documents, then, and in that case, where

performance and payment bonds exist, the Sureties on these bonds shall be notified in writing and directed to complete the work, and a copy of said notice shall be delivered to the CONTRACTOR.

After receiving said notice of abandonment the CONTRACTOR shall not remove from the work any machinery, equipment, tools, materials or supplies then on the job, but the same, together with any materials and equipment under contract for the work, may be held for use on the work by the OWNER or the Surety on the performance bond, or another contractor in completion of the work and the CONTRACTOR shall not receive any rental or credit therefore (except as provided in connection with Extra Work, where credit shall be allowed as provided in Section 6, Extra Work and Claims), it being understood that the use of such equipment and materials will ultimately reduce the cost of completion of the work to be reflected in the final settlement.

Where there is no performance bond provided, the CONTRACTOR should fail to commence compliance with the notice of abandonment as provided for, within ten (10) days after service of such notice, the OWNER may provide for completion of the work in either of the following ways:

7.01.1 The OWNER may take possession of the work and use of men and use such machinery, equipment, tools and materials as said OWNER may deem necessary to complete the work at the expense of such labor, machinery, equipment, tools and materials as charged to said CONTRACTOR, and expense so charged shall be paid by the OWNER out of such moneys as may be due to the CONTRACTOR at any time become due to the CONTRACTOR under this agreement. In case such expense is less than the sum payable under this contract, if the same had been completed by said CONTRACTOR, then said CONTRACTOR shall receive the difference. If the expense is greater than the sum which would have been payable under this contract, if the same had been completed by said CONTRACTOR, then said CONTRACTOR and/or his Surety shall pay the amount of such difference, or

The OWNER under sealed bids, after five (5) days notice published in a newspaper having general circulation in the county of the work, may let the contract for the completion of the work under such same terms and conditions which are provided in this contract. In case the increase in cost to the OWNER under the new contract as compared to what would have been the cost under this contract, such increase shall be charged to the CONTRACTOR and the Surety shall be and remain bound therefore. However, should the cost to complete any such new contract prove to be less than what would have been the cost to complete under this contract, the CONTRACTOR and/or his Surety shall be credited therewith.

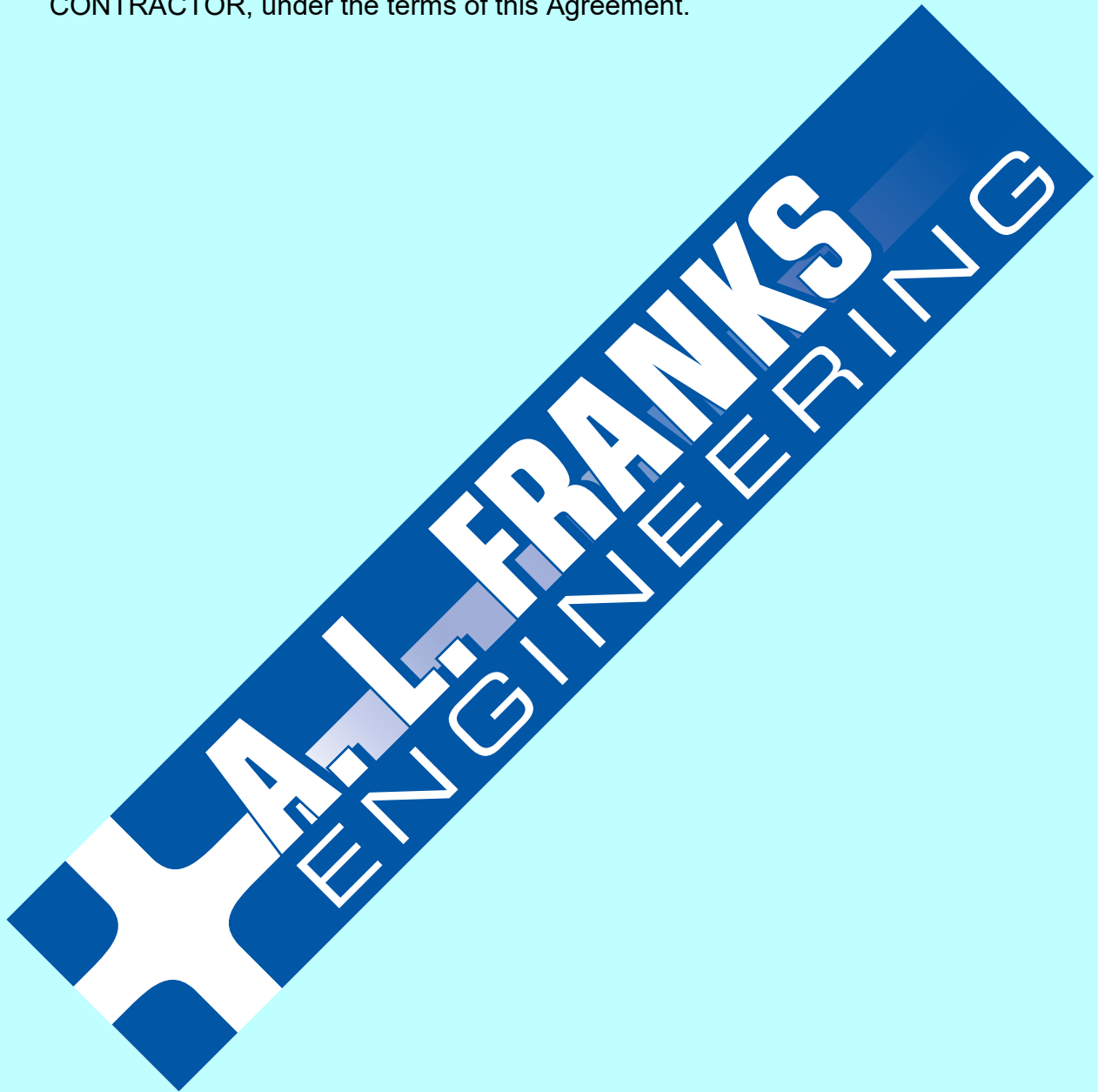
When the work shall have been substantially completed the CONTRACTOR and his Surety shall be so notified and Certificates of Completion

and Acceptance, as provided in Paragraph 5.06 hereinabove, shall be issued. A complete itemized statement of the contract accounts, certified to by the ENGINEER as being correct, shall then be prepared and delivered to the CONTRACTOR and his Surety, whereupon the CONTRACTOR and/or his Surety, or the OWNER as the case may be, shall pay the balance due as reflected by said statement, within fifteen (15) days after the date of such Certificate of Completion.

In the event the statement of accounts shows that the cost to complete the work is less than that which would have been the cost to the OWNER if the work had been completed by the CONTRACTOR under the terms of this contract, then the CONTRACTOR and/or his Surety shall pay the balance due to the OWNER, and if they fail to do so, then all machinery, equipment, tools, materials or supplies left on the site of the work shall be turned over to the OWNER or his Surety. Should the cost to complete the work exceed the amount paid to the CONTRACTOR and/or his Surety fail to pay the balance due within the time designated hereinabove, and there remain on the site of the work any machinery, equipment, tools, materials or supplies, the OWNER may, after giving written notice, remove such property with an itemized list of such equipment and materials, and the same shall be turned over to the CONTRACTOR and his Surety at the time and place designated in this contract, provided, however, that such property shall be held in any manner will satisfy this condition. After mailing such notice, such property shall be held at the risk of the CONTRACTOR and his Surety subject only to the duty of the OWNER to exercise reasonable care in the handling of such property. After fifteen (15) days from the date of such notice, the OWNER may sell such machinery, equipment, tools, materials or supplies, and the net sum derived from such sale shall be paid to the credit of the CONTRACTOR and his Surety. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall not be liable for the loss of any machinery, equipment, tools, materials, or supplies, which remain on the site of the work, to any persons other than the CONTRACTOR or his Surety. The CONTRACTOR and his Surety shall keep accurate books on all operations provided herein and shall be responsible for the same, and his Surety.

BY OWNER. In case the OWNER shall fail to pay the balance due to the CONTRACTOR and his Surety, and should fail or refuse to comply with said contract, and should fail or refuse to comply with said contract, then the OWNER, after written notification by the CONTRACTOR, then the OWNER may suspend or wholly abandon the work, and may remove from the site of the work all machinery, tools and equipment, and all materials on the site of work that have been included in payments to the CONTRACTOR and have not been wrought into the work. And thereupon the ENGINEER shall make an estimate of the total amount earned by the CONTRACTOR, which estimate shall include the value of all work actually completed by said CONTRACTOR (at the prices stated in the attached proposal where unit prices are used), the value of all partially completed work at a fair and equitable price, and the amount of all Extra Work performed at the prices agreed upon, or provided for by the terms of this contract, and a reasonable sum to cover the cost of any provisions made by the CONTRACTOR to carry the whole work to completion and which cannot be

utilized. The ENGINEER shall then make a final statement of the balance due the CONTRACTOR by deduction from the above estimate all previous payments by the OWNER and all other sums that may be retained by the OWNER under the terms of this Agreement and shall certify same to the OWNER who shall pay to the CONTRACTOR on or before thirty (30) days after the date of the notification by the CONTRACTOR the balance shown by said final statement as due the CONTRACTOR, under the terms of this Agreement.





SPECIALTIES

TABLE OF CONTENTS

FOR

SPECIAL CONDITIONS

	<u>PAGE</u>
1. Owner	
2. Engineer	
3. Examination of Site of Project	
4. Qualification of Low Bidder	
5. Award of Contract	
6. Addenda	
7. Basis for Bid Award	
8. Time for Completion	SC-2
9. Liquidated Damages for Delay	SC-2
10. Rights of Various Interests	SC-2
11. Corporate Contractors	SC-2
12. Proposals	SC-2
13. Irregular Proposals	SC-3
14. Return of Bid Security	SC-3
15. Failure to Execute Contract	SC-3
16. Right-of-Entry	SC-3
17. Permits and Right-of-Way	SC-4
18. Construction in Front of Private Driveways	SC-4
19. Reference Specifications	SC-4
20. Trade Name Materials	SC-5
21. Quality Control	SC-5
22. Material Storage	SC-5
23. Work Equipment, and Storage	SC-5
24. Material Inspection	SC-6
25. Night Watchmen	SC-7
26. Surplus Excavation	SC-7
27. Defective Work	SC-7
28. Site & Cleanup	SC-8
29. Bond and Subcontractor's Insurance	SC-8
30. Traffic Control	SC-11
31. Existing Utilities and Service Lines	SC-11
32. During Construction	SC-11
33. Copies of Plans and Specifications Furnished	SC-11
34. Light and Power	SC-11
35. Existing Structures	SC-11
36. Use of Explosives	SC-12
37. Sundays, Holidays, and Overtime	SC-12
38. Payments No Evidence of Performance	SC-12

TABLE OF CONTENTS

FOR

SPECIAL CONDITIONS

(Cont'd)

39.	Temporary Suspension of the Work	
40.	Owner's Right to do Work	
41.	Right of Owner to Terminate Contract	
42.	Terminology	SC-13
43.	Certificates and Guarantees	SC-13
44.	Coordination with Others	SC-13
45.	Dewatering Excavation	SC-13
46.	Public Utilities and Other Properties	SC-13
47.	Pay Items	SC-13
48.	Mutual Responsibility of Contractor and Owner	SC-14
49.	Protection of Property	SC-14
50.	Extension of Contract Period	SC-14
51.	Failure to Complete Contract Period	SC-14
52.	Contracts in Default	SC-15
53.	Completion	SC-15
54.	Excavation and Shoring	SC-16
55.	Provision for Maintenance of Traffic	SC-16
56.	Repair and Replacement of Existing Pipe Culverts	SC-16
57.	Shoring	SC-16
58.	Shoring	SC-17
59.	Shoring	SC-17
60.	Shoring	SC-17
61.	Shoring	SC-17
62.	Shoring Requirements in State Highway	SC-17
63.	Shoring Documents	SC-18
64.	Shoring Signs, Guy Wires, Etc.	SC-18
65.	Protection of Trees, Plants and Shrubs	SC-18
66.	Property Lines and Monuments	SC-18
67.	Confined Space Entry	SC-18

SPECIAL CONDITIONS

1. OWNER. Whenever the term "Owner" appears in these specifications, it shall be understood to mean Texarkana Water Utilities.

2. ENGINEER. The word "Engineer" in these specifications shall be understood as referring to A.L. Franks Engineering, 118 East Broad Street, Texarkana, Arkansas 71854, Engineer of the Owner, or such other Engineer, Supervisor or Inspector as may be authorized by said Owner to act in that particular position.

3. EXAMINATION OF SITE OF PROJECT. Prospective bidders shall make a careful examination of the site of the project, soil and conditions to be encountered, improvements to be protected, disposal of materials not designated to be salvaged materials, and means of access to and egress to private properties and of handling traffic throughout the entire project.

4. QUALIFICATION OF LOW BIDDER. Prior to awarding a contract, the low bidder shall submit such evidence as the Engineer may require to establish his financial responsibility, experience, and equipment as may be needed to prosecute the work in a satisfactory manner.

Should the low bidder fail to furnish satisfactory evidence to the Engineer on any of the foregoing points, the Engineer may award the work awarded to the next low bidder so qualified.

5. AWARD. The Owner, acting through its authorized representative, shall award the contract to the low bidder, in writing, within ninety (90) days after the date of acceptance of this proposal. The Contractor shall complete the required Bond and Contract within fifteen (15) days.

6. ADDENDUMS. Bidders desiring further information or interpretation of the Plans and Specifications must make request for such information to the Engineer, before the bid opening. Answers to all such requests will be given in writing in Addendum form, and all Addenda will be bound with, and made a part of, the Contract Documents. No other explanation or interpretation will be considered official or binding. Should a bidder find discrepancies in, or omissions from the Plans, Specifications, or other Contract Documents, or should he be in doubt as to their meaning, he should at once notify the Engineer in order that a written Addendum may be sent to all bidders. Any addenda issued prior to 48 hours of the opening of bids will be mailed or delivered to each Contractor contemplating the submission of a proposal on this work. The proposal as submitted by the Contractor will be so constructed as to

Proposals will be made in the name of the principal and, in a co-partnership, the names of all partners shall be given. Exact post office address shall be given in all cases. If proposals are submitted by an agent, satisfactory evidence of agency authority must accompany the proposal.

13. IRREGULAR PROPOSALS. Proposals shall be considered irregular and may be rejected for the following reasons unless otherwise provided below:

- a. If the proposal form furnished to the Contractor by the Owner's Engineer is not used or is altered;
- b. If there are unauthorized additions or irregularities of any kind which may make the proposal incomplete, indefinite, or ambiguous;
- c. If the bidder adds any provision to accept or reject any award, or to enter into an award;
- d. If the unit or lump sum or bid schedule are obviously unbalanced from the reasonable cost analysis values;
- e. If the bidder fails to bid for every pay item indicated except in the case of alternate pay items;
- f. If the bidder proposes in any other particulars which may be considered irregular, so bidder's proposal may be properly rejected.

The Owner reserves the right to reject any or all bids and to waive irregularities as may be in the Owner's interest.

14. BID SECURITY. Bid security of the lowest two or more bidders shall be retained until a contract is executed or rejection made by the Owner. Bid security will be returned only after the canvass and tabulation of bids.

15. FAILURE TO EXECUTE CONTRACT. Should the successful bidder fail to execute the contract and furnish bonds satisfactory to the Owner to validate the same within fifteen (15) days after award of contract, his bid security shall be forfeited to the Owner as liquidated damages.

16. RIGHT-OF-ENTRY. Contractor shall provide the Owner, the Owner's Architect or Engineer, or representative of the Federal, State, County, District and Municipal governmental services proper facilities for access to the work wherever it is in preparation or progress.

17. PERMITS AND RIGHT-OF-WAY. The Owner will provide rights-of-way for the purpose of construction without cost to the Contractor by securing permits in areas of public dedication or by obtaining easements across privately owned property. It shall be the responsibility of the Contractor, forty-eight (48) hours prior to the initiation of construction on easements through private property, to inform the property owner of his intent to begin construction. Before beginning construction in areas of public dedication, the Contractor shall inform the agency having jurisdiction in the areas forty-eight (48) hours prior to initiation of the work.

18. CONSTRUCTION IN PUBLIC ROADWAYS AND PRIVATE DRIVEWAYS. No public road shall be entirely closed overnight. It shall be the responsibility of the Contractor to build and maintain all weather by-pass roads, if necessary, and to properly light, barricade and mark all highways. The Contractor might be required on and across the road involved in the construction of this contract.

The Contractor shall make every effort to keep the roadway open and allow immediate access to adjacent property at all times. If a road is closed along the roadway, Owners or tenants of improvements, including entrance drives, are located shall be notified at least eight (8) hours before the construction will be started at their drive-ins or entrances. The Contractor shall estimate the length of time driveways will be closed, which shall not exceed (6) hours.

The Contractor shall be responsible for entrance reconstruction, and repairs and maintenance for one year from the date of such reconstruction. In the event repairs and maintenance are not made immediately to the satisfaction of the Owner, and it becomes necessary for the Owner to make such repairs, the Contractor shall reimburse the Owner for the cost of such repairs.

The Contractor shall keep a sufficient width of the roadway clear of dirt and debris to insure free flow of traffic. The Contractor shall assume any and all liability for damage, personal or otherwise, that may be caused by the Contractor on public roadways or private driveways.

STANDARD SPECIFICATIONS. Where reference is made in these specifications to standard specifications compiled by other agencies, organizations or departments, such reference is made for expediency and standardization from the material of the Owner's point of view, and such specifications referred to are hereby made a part of these specifications. Any reference to standard specifications in any of the Contract Documents shall always imply the latest edition of said standard specification or specifications available at time notice inviting Contractors to bid is published unless otherwise stated.

20. TRADE NAMES AND MATERIALS. No material which has been used by the Contractor for any temporary purpose whatever is to be incorporated in the permanent structure without written consent of the Engineer.

Where materials or equipment are specified by a trade or brand name, it is not the intention of the Owner to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality of performance, and to establish an equal basis for the evaluation of bids. When the words "equivalent", "proper", or "equal to" are used, they shall be understood to mean that the thing referred to shall be proper, the equivalent of, or equal to, the thing, in the opinion or judgment of the Engineer. Unless otherwise specified, all materials shall be the best of their respective kinds and shall be equal to approved samples. Notwithstanding that the words "equivalent", "proper", or "equal to" may be used in the specifications in reference to a particular manufactured article or process, the materials, articles or processes actually designated shall be used, unless a substitute shall be approved by the Engineer, and the Engineer shall have the right to reject any material of such specifically designated material, article or process.

21. QUALITY OF MATERIALS. In all specifications in other sections, all materials shall conform to the standards of the American Society for Testing Materials.

22. MATERIALS, SERVICE, AND FACILITIES. It is understood that except as otherwise specifically provided in the documents, the Contractor shall provide and pay for all materials, equipment, equipment rental, water, heat, light, fuel, power, and service, and shall provide temporary construction of every nature and all facilities of every nature whatsoever necessary to complete the work within the specified time.

23. WORKMANSHIP, TOOLS, EQUIPMENT, AND STORAGE. All work done by the Contractor shall conform to the drawings and specifications. Competent labor, mechanics, and foremen shall be provided to supervise the installation of equipment as may be required. Any special tools or equipment which may be required shall be provided by the Contractor.

The rejection at any time of materials by or in behalf of the Owner shall not be a bar to rejection if they are subsequently found to be defective or inferior in quality or conformity to the material specified, or are not as represented to the Engineer or Owner.

Contractor shall be responsible for the care and storage of materials delivered on the work site or purchased for use thereon. Stored materials shall be carefully and continuously protected from damage or deterioration and so located as to facilitate inspection by the Owner and Engineer. This responsibility for the care

and storage of materials shall be with the Contractor whether such materials are furnished by the Contractor or by the Owner.

24. INSPECTION AND TESTING OF MATERIALS.

a. During the progress of the work, it shall be subject to the inspection and observance of the Engineer, and the contractor shall afford every reasonable facility and assistance to the Engineer to make such inspection thorough and intelligent. No work is covered up without approval or consent of the Engineer. If required by the Engineer, be uncovered for the Contractor's expense.

b. The fact that the Engineer is on the job shall not constitute acceptance of the Contractor's work. When the Contractor shall notify the Engineer upon completion of the work shall be given final inspection by the Engineer. If the work is acceptable and substantially comply with the drawings, and specifications, a recommendation will be made by the Engineer to the Owner. If the work is not acceptable and require additional work to complete the project, necessitating additional work by the Engineer, the cost of such additional inspection, travel, and lodging, shall be paid for by the Owner who will reimburse the Engineer.

c. Contractor shall notify the Engineer seven (7) days in advance of the time when he will use and shall not use these materials until approval from the Engineer.

d. Contractor shall direct and furnish all items necessary for the testing called for in the specifications. The Owner shall pay for the tests, including all transportation charges unless noted in the specifications. The cost of re-testing any specimens shall be paid by the Contractor.

e. All tests, unless otherwise provided, shall be in accordance with the pertinent sections of the latest edition of the standards applicable to the material or devices to be tested. A partial list of the principal societies referred to and their abbreviations follows:

ASTM	American Society for Testing Materials
AISC	American Institute of Steel Construction
ACI	American Concrete Institute
FS	Federal Specifications

AASHTO
Officials
AWWA

American Association of State Highway
American Water Works Association

- f. All parts of the improvements shall conform to the standard of construction as given in detail under the various items, and in general to the intent thereof, and if they do not conform, shall be made to do so by rebuilding or replacing or otherwise as directed by the Engineer or Owner before acceptance shall be made.

25. BARRICADES, LIGHTS, AND WATCHMEN. Where work is done on in or adjacent to any street, alley or public place, the Contractor shall at his own cost and expense furnish and erect such barricades, flags, signs, signals, shall provide such watchmen, and shall provide such other measures for the protection of persons or property as may be necessary. Barricades shall be painted in a color as directed by the Engineer. From sunset to sunrise the Contractor shall furnish and maintain a light at each barricade and sufficient number of watchmen to be kept to keep vehicles from being driven on or into any work area. The Contractor shall furnish watchmen in sufficient number to be kept at all times.

The Contractor will be held responsible for any damage to work due to failure of barricades, signs, lights, and watchmen. Whenever evidence is found of such damage, the Contractor shall immediately remove and replace the damaged portion at his own expense. The Contractor's responsibility for the maintenance of signs, and lights, and for providing watchmen shall not be waived if they have been accepted by the Owner.

The Contractor shall provide powered lights, enclosed lanterns or other lights satisfactory to the Engineer. Mud pots or other lights which have an open flame shall not be used.

26. EXCESS MATERIAL AND SURPLUS EXCAVATION. All trees, stumps, and surplus material removed from the job site as a preliminary to the work shall be removed from the property in a manner approved by the Engineer.

All surplus material in excess of that required for backfilling shall be removed from the job site and disposed of in a satisfactory manner except in locations where, in the judgment of the Engineer, it can be neatly spread over and along the right-of-way.

27. GUARANTY AGAINST DEFECTIVE WORK. The Contractor shall indemnify the Owner against any repairs which may become necessary to any part of the work performed under the contract, arising from defective workmanship or materials used therein, for a period of one (1) year from the date of final acceptance of the work.

28. RESTORATION OF SITE & CLEANUP. Upon completion of the project (or major portions thereof) the Contractor shall restore the site to its original condition or better. Driveways and streets shall be compacted and resurfaced as originally found. All private property disrupted during construction including fences, patios, retaining walls, sidewalks, wooden decks, etc. shall be mended or repaired to their original condition. At the conclusion of the work, all tools, temporary structures and materials belonging to the Contractor shall be promptly removed and all dirt, rubbish and other foreign substances shall be disposed of.

The Contractor shall thoroughly clean all equipment and materials used on the project and shall deliver over such materials and equipment in good condition.

29. CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE. The Contractor shall not commence work under this Contract until he has obtained at his expense all insurance required under this Contract, including conditions and by the Contract Documents, and such insurance shall be approved by the Owner, nor shall the Contractor allow any subcontractor to perform any work on any subcontract until all similar insurance has been obtained and approved by the Owner. Such insurance shall be in full force and effect on all phases of the work, whether or not the subcontractor is utilized by the Owner, until all work under the Contract has been accepted by the Owner.

Nothing contained in this Contract shall be construed as limiting the extent of the Contractor's liability for payment of damages resulting from his operations under this Contract.

Any insurance policy of performance will be maintained after completion of the project for the full guarantee period.

The Contractor shall maintain for the full period of the Contract the full amount of insurance in the form, minimum limits and amounts herein specified, or otherwise required in the Contract Documents. The Contractor shall automatically renew any policy which expires during the term of the Contract and notify the Owner and Engineer of such a renewal prior to the expiration date.

A. Workmen's Compensation including Occupational Disease, and Employer's Liability Insurance. Before commencement of the work, the Contractor shall take out and maintain during the life of this contract Statutory Workmen's Compensation Insurance and Occupational Disease Disability Insurance for all of his employees to be engaged in work under this Contract, and in case any work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation and occupational Disease Disability Insurance for the latter's employees engaged in such work unless such

employees are covered by the protection afforded by the Contractor's insurance. In case any class of employees engaged in hazardous work under the Contractor is not protected under the Workmen's Compensation statute, or in case there is no applicable Workmen's Compensation Statute, the Contractor shall provide, and shall cause each subcontractor to provide adequate insurance for the protection of his employees not otherwise protected.

B. Public Liability and Property Damage Insurance: (Note "Indemnity" clause hereinafter). Before commencement of the work, the Contractor shall submit written evidence that he and all his subcontractors have obtained each of the Contract full Comprehensive General Liability and Property Damage coverage. This coverage shall protect the Contractor; the Contractor's employees, its architects and engineers; and each of their officers, directors, and agents, from claims for damages for bodily or personal injury, including death, and from claims for damages to property, whether directly or indirectly out of, or in connection with the performance of the Contractor's Contract by the Contractor, by any of his Subcontractors, or by any person directly or indirectly employed of either of them, or by any person in the service of them, and the minimum amount of such insurance shall be not less than the higher minimum amounts are otherwise required in the Contract.

Public Liability Insurance shall be in the amount of Two Hundred Fifty Thousand Dollars (\$250,000) for all damages arising out of bodily or personal injury, sickness or disease, including death, of one person and subject to the same limit in an amount not less than Five Hundred Thousand Dollars (\$500,000) in any one occurrence; and Property Damage Insurance in an amount not less than Three Hundred Thousand Dollars (\$300,000) for all damages arising out of loss of or damage to property of others in any one occurrence, subject to the same limit in the same amount.

The Policy for this coverage shall include where applicable extended coverage for underground exposure coverage. In addition, where Coverage is applicable, such coverage will be required for the full guarantee of the Contractor and acceptance of the project for the full guarantee.

C. Automobile Liability and Property Damage Insurance: Before commencement of the work, the Contractor shall submit written evidence that he and all his subcontractors have obtained Automobile Liability and Property Damage Insurance coverage on all self-propelled vehicles used in connection with the Contract, whether owned, non-owned, or hired. The liability limits shall be not less than Two Hundred Fifty Thousand Dollars (\$250,000) for injury or death of one person and in an amount not less than Five Hundred Thousand Dollars (\$500,000) in any one occurrence; and Property Damage limits of not less than Three Hundred Thousand Dollars (\$300,000) in any one occurrence.

D. Contractual Liability Coverage: Each and every policy for Liability Insurance carried by each Contractor and Subcontractor will include a "Contractual Liability Coverage" endorsement sufficiently broad to insure the provision titled "Indemnity" hereinafter set forth.

E. Indemnity: The Contractor shall defend, indemnify and hold harmless the Owner; the Engineer, its Engineers; and each of their officers, agents, servants and employees; from any and all suits, actions, claims, losses or damages of any character and from all expenses incidental to the defense of such suits, actions or claims, based upon or arising out of or alleged to be based upon any one or more of (1) any injury, disease, sickness or death of any person, (2) any damages to any property including in part loss of use thereof, (3) any claim, suit, action or omission of the Contractor, of any Subcontractor of the Contractor's officers, agents, servants, employees, or anyone acting under the Contractor's direction and control, and arising out of, occurring in connection with, or from, or caused by the performance or failure to perform any work or services called for by the Contract or from completion or non-completion or performance or non-performance of said work or services, or from the negligence of any party herein indemnified.

F. Builder's Risk "All-Risk" Insurance: The Contractor shall obtain Fire and extended Insurance coverage which the Contractor elects to carry for their own protection, the Contractor shall obtain and maintain for the Contractor's Risk "All-Risk" Completed Value Insurance coverage for the full value of all portions of the project which is the subject of the Contract, and shall include completed work and work in progress, and shall be with an insurance company or companies acceptable to the Owner.

Such insurance shall include as Additional Named Insureds: the Owner; The Engineer, its Engineers; and each of their officers, agents, and employees; and any other persons with an insurable interest designated by the Contractor as an Additional Named Insured.

The policy of insurance required herein shall be furnished to the Owner in the form of a Certificate of Insurance provided under "Evidence of Insurance Coverage" hereinafter.

G. Evidence of Insurance Coverage: Before commencement of any work, the Contractor shall submit written evidence that he and all his Subcontractors have obtained the minimum insurance required by the Contract Documents. Such written evidence shall be in the form of a Certificate of Insurance (see attached form) executed by the Contractor's insurance carrier showing such policies in force for the specified period or by furnishing a copy of the actual policy or policies. Each policy or certificate will bear an endorsement or

statement waiving right of cancellation or reduction in coverage without ten (10) days notice in writing to be delivered by registered mail to the owner.

The Contractor shall furnish duplicate originals of Builders' Risk "All-Risk" Completed Value Insurance coverage to the Engineer, one copy of which shall be for the Owner and one copy for the Engineer.

30. SAFETY.

- a. In accordance with generally accepted construction practices, the Contractor alone will be solely and completely responsible for the safety of all conditions of the job site, including safety of all persons and property, during performance of the work. This responsibility shall be exercised continuously and not be limited to normal hours of work.
- b. The duty of the Engineer or Architect shall be to conduct a review of the Contractor's performance and to report the results of such review of the adequacy of the Contractor's performance to the Owner, on or near the construction site.

31. EXISTING UTILITIES AND The Contractor shall be responsible for the protection of all existing utilities and service lines crossed or exposed by his construction. If any existing utilities or service lines are cut, broken or damaged, the Contractor shall immediately replace or repair the utilities or service lines with the same or better material and construction, or better, at his own cost and expense.

32. DURING During construction of the work, the Contractor shall keep the site of the work and adjacent premises as free from material, debris, or rubbish as is practicable and shall remove same from any area, in the opinion of the Engineer, such material, debris, or rubbish is objectionable.

The Contractor shall remove from the site all of his surplus materials and equipment when no further need therefore develops.

33. PLANS AND SPECIFICATIONS FURNISHED. Three (3) sets of plans and specifications shall be furnished to the Contractor, at no charge, for construction purposes. Additional copies may be obtained at cost of reproduction upon request.

34. LIGHT AND POWER. The Contractor shall provide, at his own expense, temporary lighting and facilities required for the proper prosecution and inspection of the work.

35. EXISTING STRUCTURES. The plans show the locations of all known surface and subsurface structures. However, the Owner assumes no responsibility for failure to show any or all of these structures on the plans, or to

show them in their exact location. It is mutually agreed that such failure shall not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as to necessitate changes in the lines or grades, or requires the building of special work, provisions for which are not made in the plans and proposal, in which case the provisions in these specifications for extra work shall apply.

36. USE OF EXPLOSIVES. Use of explosives will be allowed only with written approval of their use by the Engineer.

Should the Contractor elect to use explosives in the prosecution of the work, the utmost care shall be exercised so as not to endanger life or property. The Contractor shall not be held liable for damages done by the use of explosives. The Contractor shall notify the proper authorities, including the public service corporation, any company, or any individual, at least 48 hours in advance of the use of explosives which might affect their or his property along or adjacent to the work. When stored or kept, they shall be stored in a safe and secure place and the places be plainly marked "DANGER EXPLOSIVES", and be guarded by a competent watchman at all times.

37. SUNDAYS, HOLIDAYS. Any work necessary to be performed after regular working hours or on legal holidays, shall be performed without additional compensation. The Contractor shall notify the Engineer if any work is done on Sundays or holidays.

38. PAYMENT FOR DEFECTIVE WORK. No progress or final estimate certificate made under this contract shall be evidence of the performance of the work, nor shall it be construed to be acceptance of defective work or improvement of the work in part.

39. SUSPENSION OF THE WORK. The Engineer shall have the right to suspend the work wholly or in part for such period or periods of time as may be necessary due to unsuitable weather or other conditions which prevent the suitable prosecution of the work; or for the failure of the Contractor to carry out instructions or to perform any provisions of the contract. During periods of suspension, the Contractor shall properly protect the work from possible injury.

40. OWNER'S RIGHT TO DO WORK. If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this contract, the Owner, after seven (7) days written notice to the Contractor, may, without prejudice to any other remedy the Owner may have, make good such deficiency and may deduct the cost thereof from the payment then or thereafter due the Contractor. Any money due the Owner after such deduction shall be paid by the Contractor or his sureties who hereby agree to these provisions.

41. RIGHT OF OWNER TO TERMINATE CONTRACT. Should it appear at any time that the work is not being prosecuted with sufficient competence or rapidity to insure the proper completion of the work within the stipulated time, and, if upon seven (7) days written notice to the Contractor, he fails to increase the quality or the quantity of his work, or both, the Owner reserves the right to annul and cancel this contract and relet the work or any part thereof, or at the Owner's option to complete it by day labor. The Contractor shall not be entitled to any claims for damages on account of such annulment, and he will be held liable for costs and expenses incurred in reletting or completing the work under this contract. All money due the Contractor will be retained until the work is completed. All expenses and costs have been deducted and any money due the Contractor, after such deductions have been made, shall be paid by the Contractor. The Contractor who hereby agree to these provisions.

42. TERMINOLOGY. Throughout these specifications, the word "shall" denotes mandatory. The word "may" implies optional. The word "items" or "word phrases" shall be interpreted as having the same meaning ascribed to them by the several building trades of the local area.

43. CERTIFICATES AND GUARANTY. Copies of any manufacturer's guaranty or certificate shall be submitted to the Owner by the Contractor before acceptance of the work by the Owner.

44. COORDINATION. If other contractors are doing work in the same area as this project, the Contractor shall coordinate his program with the other contractors.

45. DEWATERING. The prospective bidders shall make sufficient study to determine the location of groundwater which might be encountered. The Contractor shall, at his own expense, utilize a pumping system to dewater excavations.

46. EXISTING AND OTHER PROPERTY TO BE CHANGED. In case the Contractor or move the property of any owner or of a public utility, the Contractor shall be moved or interfered with until ordered to do so by the Owner. It is reserved to the owner of public utilities to enter upon the limits of the project for the purpose of making such changes or repairs of their property as may be made necessary by performance of this Contract.

Any time the Contractor intends to expose, cross, or otherwise work in the area of the existing petroleum pipelines, telephone lines, water lines, etc., the Contractor shall notify the Owner(s) of the respective facilities forty-eight (48) hours in advance.

47. PAY ITEMS. Pay items are listed in the Proposal. All other items necessary to complete the work as shown and specified shall be considered subsidiary obligations of the Contractor.

48. MUTUAL RESPONSIBILITY OF CONTRACTORS. If, through acts or neglect on the part of the Contractor, any other Contractor or Subcontractor shall suffer loss or damage to his work, the Contractor agrees to settle with such other Contractor or Subcontractor by agreement or arbitration, if such other Contractor or Subcontractor will so settle. If such other Contractor or Subcontractor asserts been so sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against such claims and for any costs in connection with such claims.

49. PROTECTION OF PROPERTY. The Contractor shall, at his own expense to the Owner, protect by false work, braces, shoring, etc., any work along his line of work or affected directly by his work, against damage and repair the damages or repay the injured Owners if such damage occurs.

The Contractor shall exercise care to protect from damage any existing sewer pipes, gas mains, telephone cables, electric lines, and other utilities or fixtures which may be encountered in his work. All utilities and other service facilities or fixtures damaged or destroyed by the Contractor without additional compensation shall be repaired by the Contractor.

The Contractor shall personally check the location of all utilities on the plans. Where existing utilities or structures are shown on the plans or drawings, they are believed to be accurate but are not guaranteed by the Contractor. Protection is Contractor's responsibility and he must be bound to see that the existence and location of all utilities and structures are properly protected.

The Contractor shall give at least 48 hours before breaking ground, to all persons, owners, or those otherwise in charge of property, structures, sewer pipes, telephone cables, electric cables, etc., notice that they may be affected by the Contractor's operation, in order to remove any obstruction for which they are responsible and have them bound to see that their property is properly protected.

50. EXTENSION OF CONTRACT PERIOD. The Contractor may be granted an extension of the contract period due to Acts of God, Acts of War, Strikes, or non-delivery of materials. The Contractor must submit a request in writing to the Engineer not later than ten days after the date of such occurrence. A separate request must be made for each occurrence.

51. FAILURE TO COMPLETE WORK WITHIN CONTRACT PERIOD. If the Contractor fails to complete his work within the contract period, or any extension thereof, as provided in the "Extension of Contract Period" said contract shall upon written notice to the Contractor and Surety be in default.

The Owner may, at its (his) option, permit the Contractor or his surety to complete the work included in the contract, or may proceed to complete the work in accordance with "Completion of Contract in Default". In either event, the Contractor or his Surety shall be responsible for all costs incidental to the completion of the work and also for the liquidated damages stipulated in the proposal form. The Owner may waive such portion of the liquidated damages as may occur after the work is in condition for the safe and convenient use by the Owner.

52. CONTRACTS IN DEFAULT. The Owner may declare a contract in default for any one or more of the following reasons:

- a. Failure to complete the work within the time specified in the contract or any extension thereof.
- b. Failure or refusal to comply with an order of the Architect within a reasonable time.
- c. Failure or refusal to remove any defective or unacceptable work.
- d. Failure or refusal to employ any defective or unacceptable workmen.
- e. Bankruptcy or assignment of an assignment for the benefit of creditors.
- f. Failure to employ a sufficient number of competent workmen or subcontractors to complete the work in an acceptable manner or to complete the work according to the agreed schedule of completion.
- g. Failure to comply with any other important provisions of the contract as determined by the Engineer.

CONTRACTS IN DEFAULT. If for any reason, a contract is declared in default, the Owner shall have the right, without process or delay, to take over all or any portion of the work and complete it at its (his) option by its own labor or by reletting same. Written notice shall be given the Contractor by the Owner that his contract has been declared in default and upon receiving such notice, the Contractor shall peaceably relinquish possession of said work or the parts thereof specified in the notice.

The Owner may, at its (his) option and at a rental which it considers reasonable, retain all materials, equipment, and tools on the work until the work is complete.

Neither the Owner nor the Owner's officers, agents, or employees shall be in any way liable or accountable to the Contractor or his Surety for the method by which the completion of the said work, or any portion thereof, may be accomplished, or

for the price paid therefor. Should the cost of completing the work be in excess of the original contract price, the Contractor and his Surety shall be held responsible for such excess cost. Should the cost of such completion including all proper charges, be less than the original contract price, the amount so saved shall be paid to the Contractor. Neither by taking over the work nor by declaring the contract in default shall the Owner forfeit the right to recover damages from the Contractor or his Surety for failure to complete the entire contract. Maintenance of the work shall continue to be the Contractor's and Surety responsibilities as provided for in the Bond and Guaranty of the Contractor.

54. EXCAVATION IN HIGHWAY RIGHTS-OF-WAY. No excavation within a highway right-of-way shall be carried closer than 10 feet to the edges. No dirt from trench excavation shall be piled on road shoulders, ditches, and berms shall be restored to their original condition.

The Contractor shall notify the Highway Department of any excavation not less than five (5) days prior to commencing work within the right-of-way. The Contractor shall conform to the regulations of the Kansas Highway Department as to details of construction and traffic control.

55. PROVISIONS FOR REROUTING OF TRAFFIC. The Contractor will be required to furnish lights, signs, and flagmen where it becomes necessary to reroute traffic while construction is in progress in the City street. The rerouting will be determined by the Engineer and approved by the Kansas Highway Department.

56. REMOVAL AND REPLACEMENT OF EXISTING PIPE CULVERTS. Existing pipe culverts proposed for construction shall be unearthed carefully, disintegrated, and removed to the right-of-way. The pipe culverts shall be cleared completely after the sewer line construction is clear so as to avoid any inconvenience to the property owners and to allow access to the property as possible. Pipe culverts shall be laid to grade on the original ground surface and backfilled and mechanically tamped to a density of 95% of the maximum density of the material. Where existing rubble or concrete headwalls are removed, they shall be replaced in an equal or better condition as approved by the Engineer.

Removal and replacement of existing pipe culverts will not be measured and paid for separately. Separate payments will be made for removing and replacing headwalls on culverts and all costs in connection therewith shall be included in other items listed in the Proposal.

57. SCHEDULE OF WORK SEQUENCE. Upon award and prior to any construction, it shall be the responsibility of the Contractor to present, to the Owner and Engineer for approval, a tentative schedule of the sequence in which the work will be performed. The schedule should include the following information:

- a. The sequence of work in which the construction will be done.
- b. The approximate period of time in constructing and testing of the facilities.
- c. Coordination of work using two (2) or more crews.
- d. Schedule of possible night work in making tie-ins and road crossings.

58. COST BREAKDOWN. Immediately after being awarded the work, the Contractor shall furnish the Engineer with a cost breakdown of the sum bid. Such a breakdown shall be in sufficient detail to enable the preparation of progress estimates by the Engineer. The quantities of materials and equipment on hand shall be based on the actual inventory. Copies must be presented to the Engineer.

59. FINAL FIELD TESTS. Upon completion of the work prior to final payment, all equipment and appliances used in the work shall be subjected to acceptance tests as specified in the Contract Documents to ensure compliance with the Contract Documents.

The Contractor shall furnish labor, tools, and all other material, equipment, and instrument necessary for the tests, at no additional cost to the Owner.

60. WATER FOR CONSTRUCTION. Water used for testing and flushing of the pipe line or any other part of this project will be furnished by the Contractor. The Contractor shall make necessary arrangements for securing and/or transporting water. The Contractor shall take such water in a manner and at such times that will not cause any damage to the source of water. The Contractor shall be responsible for the cleaning and disposal of all water used in flushing and testing. The Contractor shall obtain approval of the Owner and Engineer of the method of disposal. All water used will be drained and disposed of.

POWER FOR CONSTRUCTION. Except as provided elsewhere in the Contract Documents, the Contractor shall provide all electricity required.

62. CONSTRUCTION REQUIREMENTS IN STATE HIGHWAY RIGHT-OF-WAY.

- a. All Highway signs removed or disturbed shall be restored to original condition.
- b. All surplus material shall be removed from right-of-way and the excavation finished flush with surrounding natural ground.

- c. Operation along highways shall be performed in such a manner that all excavated materials be kept off the pavements at all times as well as all operating equipment.
- d. Barricades, warning signs and flagmen shall be provided by the Contractor.

63. CONTRACT DOCUMENTS. The Contract Documents shall consist of all documents contained herein as stated in the Table of Contents including Notice to Bidders (Advertisement), Special Conditions, Instructions to Bidders, signed Agreement, Performance and Payment Bonds (when required), General Conditions of Contract, Specifications, Plans, and all modifications thereof in the documents before the execution of the Agreement.

64. POLES, SIGNS, GUY WIRES, ETC. All private sign posts, signs, and similar private obstructions in the vicinity of this project will be removed and replaced by the Contractor at his own expense.

The removal and replacement of private signs and signs is the responsibility of the Contractor. The Contractor shall be responsible for all damage to street sign posts and signs with signs that remain in place or are removed and replaced.

In event street sign posts are destroyed by the Contractor's operations, they shall be replaced by the Contractor. No separate compensation will be paid for this work. It shall be included in such contract pay items as are specified.

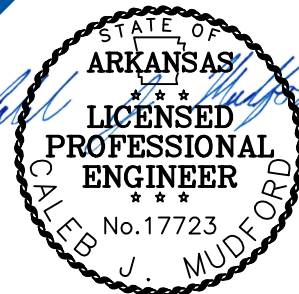
65. PROTECTION OF TREES, PLANTS AND SHRUBS. The Contractor shall make every effort to protect trees, plants, and shrubs encountered during construction. Property owners, as specified above, before removal of any trees, plants, and shrubs, where questions arise, the Contractor shall request permission from the owner.

PROTECTION OF UTILITIES AND MONUMENTS. The Contractor shall protect all monuments and stakes encountered in his work. All monuments, and other use, that are disturbed or destroyed by the Contractor shall be replaced at his own expense.

67. CONFINED SPACE ENTRY. The Contractor shall be responsible for compliance with any and all Federal and State confined space entry and permitting requirements.

TECHNICAL SPECIFICATION

**A. L. FRANKS
ENGINEERING**



8-20-26

**A. L. FRANKS
ENGINEERING**

118 E. Broad Street
Texarkana, Arkansas 71854
PHONE (870) 216-1906
FAX (870) 216-1907

TABLE OF CONTENTS

Page

SECTION

01010	Summary of Work	01010-1
01033	Allowances	01033-1
01060	Standards and Materials	01060-1
01205	Procedures and Quality Control	01205-1
01340	Submittals	01340-1
01350	Requirements for 'Equal' and 'Pre-Approved Equal'	01350-1
01360	Miscellaneous General Requirements	01360-1
01500	Temporary Facilities and controls	01500-1
01580	Measurement and Payment	01580-1
01800	Facility Operations and Work Sequence	01800-1
02060	Demolition	02060-1
02110	Site Clearing	02110-1
02151	Sheeting and Bracing	02151-1
02200	Earthwork	02200-1
02400	Erosion Control	02400-1
02410	Storm Water Permit for	02410-1
02420	Fertilizing, Seeding	02420-1
02515	Portland Cement	02515-1
02730	Manhole and	02730-1
03310	Concrete	03310-1
05120	Structural	05120-1
05500	Metal	05500-1
05510	Metal	05510-1
05520	Metal	05520-1
05530	Metal	05530-1
06800	Plastic Products	06800-1
09900	Other	09900-1
11000	Manhole Cleaned Fine Bar Screen	11000-1
11100	Compactor	11100-1
11219	Large Centrifugal Blower	11219-1
11310	Immersible Wastewater Pumps for Wet Well	11310-1
11330	Silt Removal System	11330-1
11350	Clarifier Mechanism	11350-1
11950	Ultraviolet Disinfection Equipment	11950-1
15001	Pipe Work General Provisions	15001-1

SECTION M - MATERIALS

M1	Description	M1-1
M2	Sewer Main Pipe and Fittings	M2-1
M3	Manholes and Cleanouts	M3-1
M4	Concrete and Reinforcing Steel	M4-1
M5	Water Main Pipe and Fittings	M5-1

SECTION C - CONSTRUCTION METHODS

C1	Site Work	C1-1
C2	Excavation and Backfill	C2-1
C3	Dewatering of Trenches	C3-1
C4	Trench Safety Systems	C4-1
C5	Pipe Laying	C5-1
C6	Pipe Joints	C6-1
C7	Pipe Fittings	C7-1
C8	Manholes	C8-1
C9	Restoration of Special Structures	C9-1
C10	Cast-In-Place Concrete	C10-1
C11	Steel Reinforcement	C11-1
C12	Concrete Formwork	C12-1
C13	Construction	C13-1
C14	Wastewater Treatment	C14-1

SECTION T - TESTS

T1	Tests	T1-1
T2		T2-1
T3		T3-1

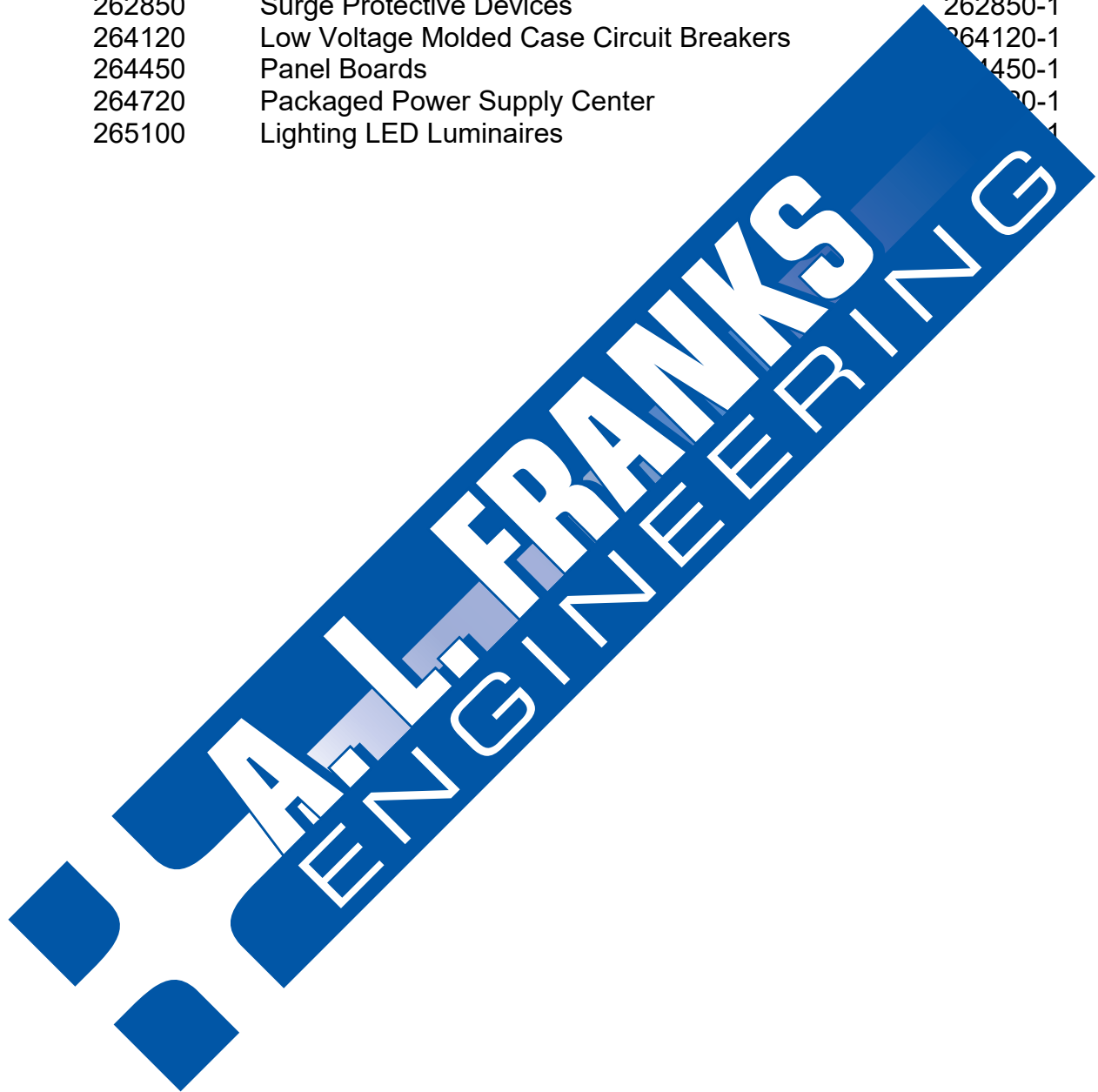
SECTION P - MEASUREMENT AND PAYMENT

P1	Measurement and Payment	MP1-1
----	-------------------------	-------

SECTION 26 - ELECTRICAL

260500	Common Work Results for Electrical	260500-1
260510	Qualification for Electrical Contractor	260510-1
260520	Hazardous Classified Area Construction	260520-1
260600	Grounding and Bonding	260600-1
260700	Hangers and Supports	260700-1
260750	Identification for Electrical Systems	260750-1

261230	600-Volt or Less Wires and Cables	261230-1
261300	Conduits	261300-1
261330	Duct Banks	261330-1
261340	Boxes	261340-1
261360	Wireway	261360-1
262720	Dry-Type Transformers	262720-1
262850	Surge Protective Devices	262850-1
264120	Low Voltage Molded Case Circuit Breakers	264120-1
264450	Panel Boards	264450-1
264720	Packaged Power Supply Center	264720-1
265100	Lighting LED Luminaires	265100-1



SECTION 1-MOBILIZATION

1. **DESCRIPTION:** This item shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of the Contractor's offices, buildings, and other facilities necessary to undertake the work on the project.

This item shall also include other work and operations that may be required, or for expenses incurred, before beginning work on the various items on the project site. It shall also include pre—construction costs, including direct costs to the project and are of general nature not attributable to other pay items under the Contract.

2. **MEASUREMENT AND PAYMENT:** Mobilization shall be measured on a complete unit price and will be paid for at the contract unit price. In computing the allowable partial payments from the schedule of payments of the original Contract earned will be based on the percentage of the Mobilization and any materials estimated for Mobilization at any of the listed stages of completion with the percentage of item allowed less all payments made.

PARTIAL	Percentage of Original Contract Amount	Percentage of Bid Price Mobilization Allowed
---------	--	--

*First Progress Payment	25
*4th Progress Payment	50
*Final Progress Payment	100

This item shall be measured on a complete unit price basis. Payments on percentages of the original contract amount greater than those set out above will not be considered. No separate bid for this item will be made for additional work required to satisfactorily complete the Contract.

THE AMOUNT BID FOR THE ITEM OF "MOBILIZATION" SHALL BE ADDED TO THE TOTAL CONTRACT AMOUNT FOR ALL OTHER ITEMS IN THE PROPOSAL. Should the amount entered in the Proposal for this item be less than 5%, the Engineer will reduce it to the maximum allowed amount to determine the correct total bid.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the Contract.

Payment will be made under:

Pay Item	Pay Unit
Mobilization	Lump Sum

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This project consists of the expansion of a 1.0 MGD Wastewater Treatment Plant to a 2.0 MGD WWTP at the existing TEXARKANA NORFOLK WASTEWATER TREATMENT PLANT.
- B. Significant amounts of Structural, Mechanical, Civil, and Electrical work are included in the project. This work will be performed under separate contracts.

Contract 1 – TEXARKANA NORFOLK WASTEWATER TREATMENT PLANT 2.0 MGD

1.2 CONTRACT 1

- A. Site Development: Site development includes clearing and grubbing to noted limits, excavation, backfill, roadways, paving, and sediment and erosion control.
- B. The general tree removal and equipment are described in the following paragraph.
- C. Influent Wastewater Treatment Station:
 - 1. Influent wastewater will pass through a new mechanically cleaned filter screen. The screenings will be discharged directly into a dewatering compactor which will transport the screenings to a roll-off dumpster to be provided by the Owner. A manually cleaned bar screen is provided in a channel for by-passing the mechanically cleaned bar screen.
 - 2. The existing wet well structure will be upgraded to include a new submersible pump bringing the total to three submersible pumps with associated piping and force main.
- D. Grit Removal & Flow Split:
 - 1. After screening, flow will proceed to an elevated grit removal structure. This will be a rectangular concrete tank with gravity discharge to a grit washer/dewatering screw. Grit will be discharged directly from the washer into a roll-off dumpster provided by the Owner. Overflow from the washer will return to the influent structure.

2. Flow then enters the splitter box and is distributed to aeration basins.

E. Aeration Basin:

1. The aeration will be provided by fine bubble diffused air

F. Clarification:

1. Clarification will be provided by 65 feet diameter circular clarifier with a central rake device.
2. Sludge will be removed from the clarifier by a scraper and transferred to the waste activated sludge (WAS) pump. The waste activated sludge (RAS) will be pumped to the aeration basin by the sludge pump at the main lift station.
3. Clarified effluent will flow to the UV disinfection facility.

G. Ultraviolet Disinfection Facility:

1. Effluent from the clarifier will flow through an ultraviolet (UV) disinfection facility. The UV facility will be used to disinfect the wastewater before it enters the reuse system.
2. Flow will then pass through a parshall flume and then to the headworks.

H. Sludge Handling System:

Sludge from the clarifier will flow to the waste activated sludge pump and then be pumped to the headworks.

Electrical controls, panels, and miscellaneous items will be performed.

Grading, excavation, paving, sidewalks and associated earthwork.

Installation of blowers, and air piping, valves, and controls will be performed for which will be installed to existing treatment plants.

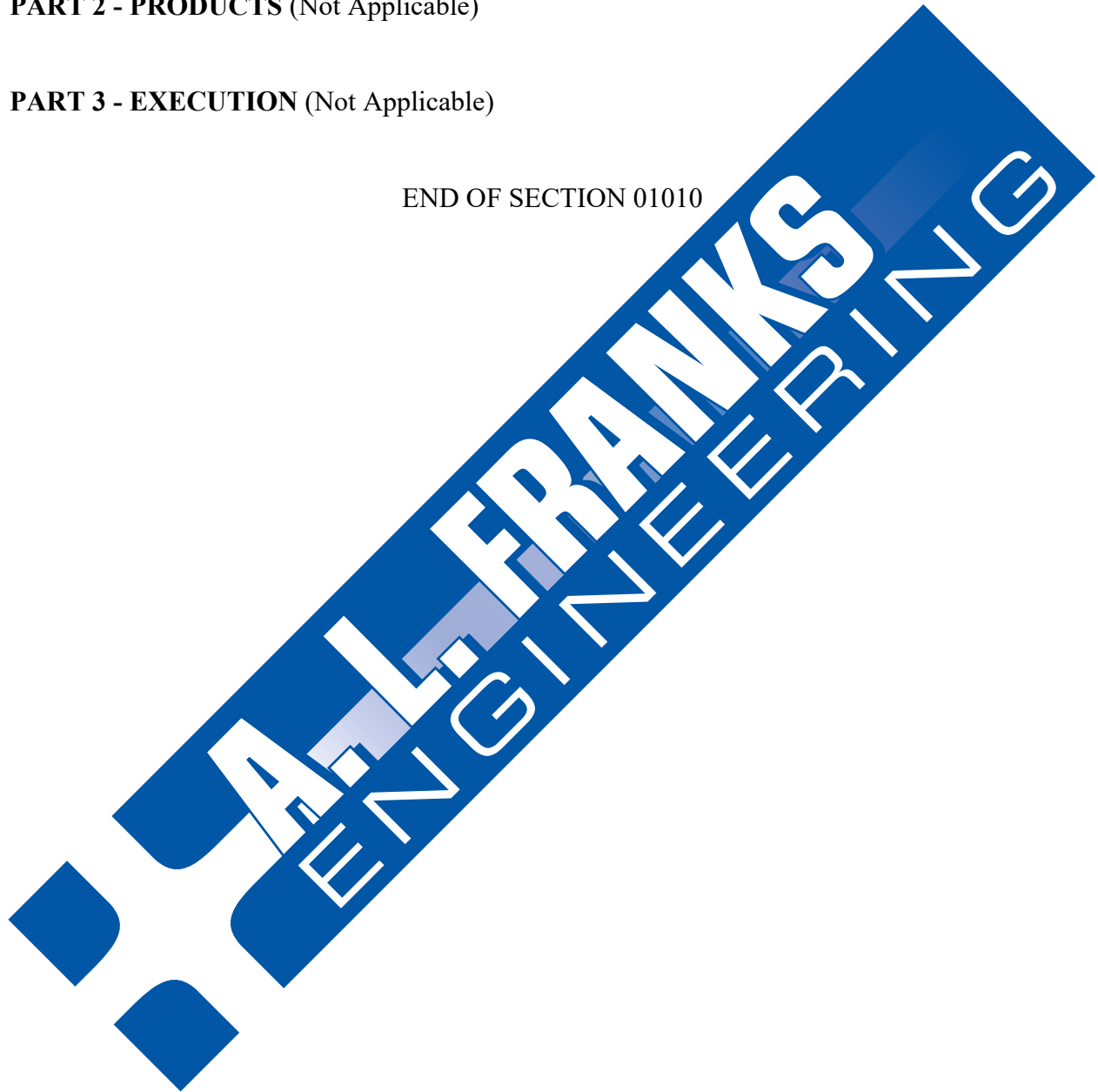
1.3 PROJECT LOCATION

- A. The project is located in Miller County, Arkansas. The site location is shown on the cover sheet of the Drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01010



SECTION 01033 - ALLOWANCES

PART 1 - GENERAL

1.1 CONTRACT CONSIDERATIONS

A. Allowances:

1. Allowances shall be included in the contractor's Bid form.
2. Refer to Paragraph 11.02 of the Standard Specifications for further considerations.
3. The Contractor shall be reimbursed for allowances on a monthly basis by including monthly applications for partial payment. Each application shall be attached to each application that is submitted for reimbursement. Adjustments to allowances shall be made in the same order.

1.2 ALLOWANCE LIST

A. Testing Allowances:

1. See Contract 1: Allow eight thousand dollars for concrete testing and other on-site testing.

PART 2 - MATERIALS AND METHODS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01033

SECTION 01060 - STANDARDS AND MATERIALS

PART 1 - GENERAL

1.1 STANDARDS AND REGULATIONS

- A. Industry Standards: Referenced standards of construction industry have the same force and effect on performance of the work as if copied directly into the contract documents or bound and published therewith. Standards referenced in the contract documents or in governing regulations have precedence over other standards, insofar as different standards may contain conflicting requirements. Comply with standards in effect as of the date of the contract, unless otherwise indicated.

1.2 GENERAL LIMITATIONS

- A. Where possible, provide entire requirements for each product, material, or equipment from a single source. Where necessary, do so, match separate procurements as closely as possible. Where the procurement process is under Contractor's control, provide complete specifications for materials, and equipment. Where available and complying with requirements, provide standard products which have been used previously in similar applications, and which are recommended by the Engineer. See specifications indicated.

1.3 PRODUCT SELECTION

- A. Compliance with requirements of products, materials, and equipment:
1. Selection from named products is Contractor's responsibility. Selection fully complies with requirements.
 2. Unnamed products: Provide unnamed product which fully complies with all requirements. See Section 01350 for "or equal" and "pre-approved equal" products.

Substitutions: Requests by Contractor for substitute products will be considered when reasonable, timely, fully documented, and submittals are received by the Engineer.

The burden of proof of equality is the responsibility of the Supplier/Contractor.

PART 2 - PRODUCTS

2.1 NAMEPLATES

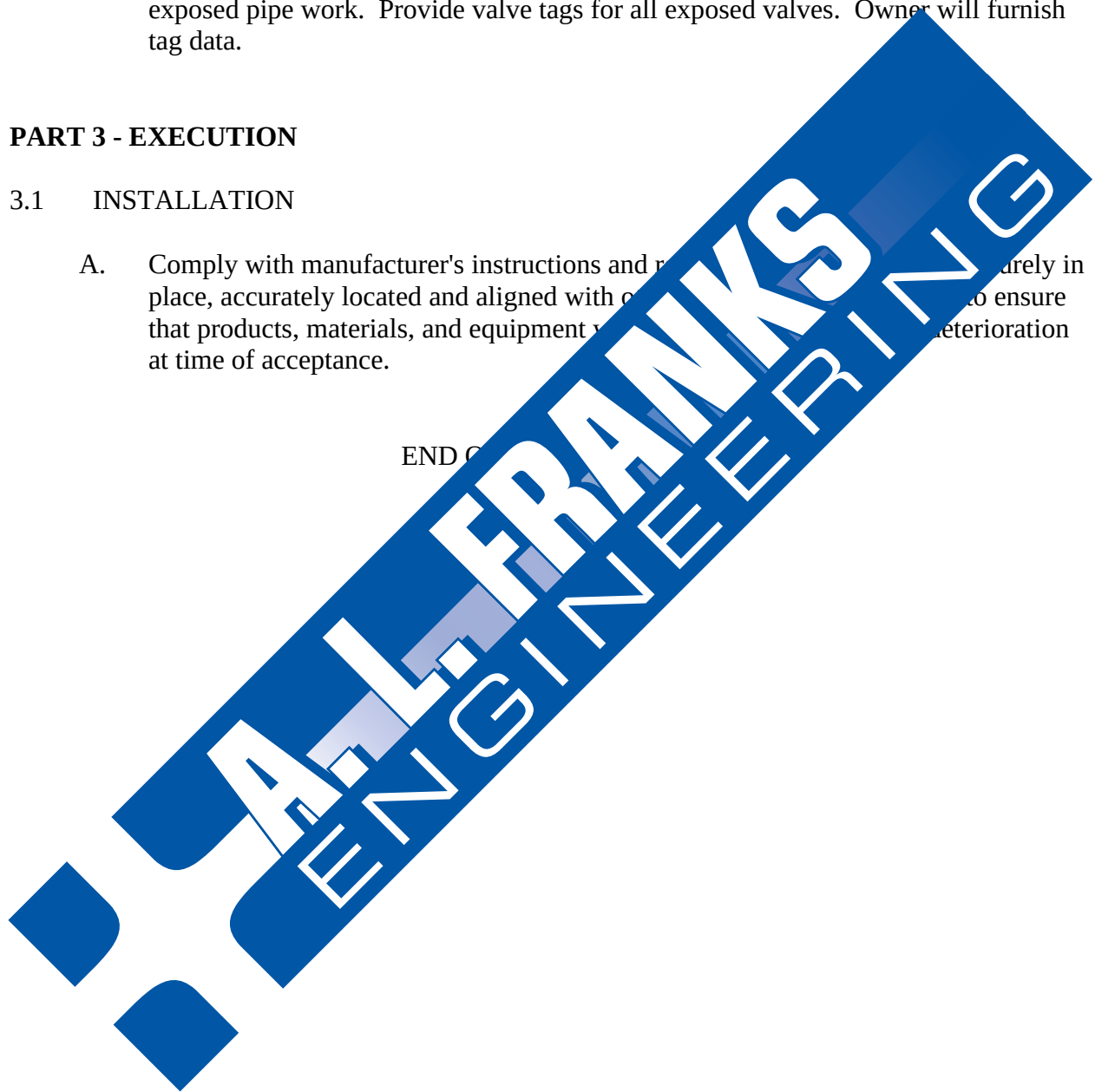
- A. Provide permanent nameplates on equipment, located in conspicuous places, and containing suitable information and operational data. Provide nameplates on all exposed pipe work. Provide valve tags for all exposed valves. Owner will furnish tag data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions and requirements. Install equipment in place, accurately located and aligned with centerline. Install equipment to ensure that products, materials, and equipment will not deteriorate or corrode at time of acceptance.

END C



SECTION 01205 - PROCEDURES AND QUALITY CONTROL

PART 1 - GENERAL

1.1 COORDINATION

- A. **Coordination Between Prime Contractors:** All Prime Contractors involved in the project shall be required to cooperate in the performance of the work and to coordinate scheduling where any portion of the work of one Contractor may influence the work of the other Contractor(s). Each Contractor shall be required to give other Contractor(s) sufficient notice prior to beginning work that will require on-site work by other Contractor(s). The General Contractor shall be responsible for coordination of the entire project.
- B. **Schedules:** The General Contractor, will submit a schedule of work to the Engineer. Schedules submitted by other Prime Contractors shall be submitted to the General Contractor for coordination between Contractors. Once schedules are coordinated, they shall be submitted to the Engineer for approval. Once schedules have been approved, Contractors shall be required to coordinate their work with regard to where they require coordination by other Contractors.

1.2 QUALITY CONTROL

- A. **Testing Piping Systems:** Piping systems shall be performed as set forth in Section 1-03310.
- B. **Testing Concrete (Contract 1):**
1. **Concrete Testing:** Concrete shall be conducted by a testing agency as set forth in Section 1-02200 and Section 1-03310. The testing agency shall be selected by the Contractor under a testing allowance set forth in the contract. Additional testing required due to failing tests will be paid by the Contractor and will not be deducted from the testing allowance.
2. **Testing Results:** The testing lab shall submit results of field tests immediately to the Resident Project Representative and the Contractor. Lab tests and final copies of all tests shall be submitted to the Engineer (2 copies), the Resident Project Representative (1 copy), and the Contractor (1 copy).
- C. **Structure Leakage Testing:**
1. The General Contractor shall perform leakage testing for the following concrete structures: Treatment Plants, Grit Removal Structure, UV

Structure, Splitter Box, Plant Drain Pump Station, and the Re-use Pump Station.

2. Testing procedure shall include:
 - a. Outlet pipes shall be temporarily plugged watertight.
 - b. Tank shall be filled with clean water to the maximum level to be specified by the Engineer.
 - c. Tank shall stand full of water for 24 hours and then be topped off to level specified by the Engineer.
 - d. A staff gauge shall be temporarily installed in the tank wall at a location selected by the Engineer. The water level on the staff gauge shall be recorded.
 - e. Tank shall stand full for 72 hours or as determined by the Engineer. The final level and interim levels on the staff gauge shall be recorded.
 3. For acceptable test results, the levels must be essentially equal. There shall be no leaks, as determined by the Engineer.
 4. If required, the Contractor shall repair leaking areas and retest to the satisfaction of the Owner.
 5. The number of tests shall be determined by the Engineer.
- The Project Representative shall be present during the testing. The Contractor shall schedule testing with the Resident Project Engineer.

PART 3 - TESTING (NOT APPLICABLE)

PART 3 - TESTING (NOT APPLICABLE)

END OF SECTION 01205

SECTION 01340 - SUBMITTALS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Each prime contractor is responsible for the minimum submittals identified below, as applicable. Include full documentation, including material samples where appropriate, detailed performance comparisons and laboratory reports where applicable, coordination information, work and time schedule, cost information for proposed substitutions, general certification of recommended substitution, and information on installation of each item, and similar information.
- B. Submittals Prior to Bid: Equipment pre-qualified for use. Submittals submitted in accordance with Section 01350.
- C. Submittals During Contract Award
1. List of Subcontractors: Prior to opening, by apparent low bidder and other subcontractors. Ref. General Conditions, paragraph 6.0.
 2. Execution of Documents: Documents prior to Notice to Proceed with work. Ref. General Conditions, Article 2.
 3. Commencement of Work: Prior to any work on the site. Ref. General Conditions, Article 5.
- D. Progress Payments: Prior to preconstruction conference. Ref. General Conditions 2.05.B.1 and Supplementary Conditions - Progress Payments.
- E. Schedule of Values: With revised construction schedule and prior to first payment for payment. Ref. General Conditions 2.05.B.3, 2.06 - 2.07, and 14.01.
- F. Schedule of Shop Drawings and Sample Submittals: Prior to submittal of any shop drawings for review. Ref. General Conditions 2.05.B.2.

D. Submittals During the Construction Period:

1. Shop Drawings, Samples, and Certification of Materials:

- a. General: Prior to fabrication, shipment to the job site, or installation. Ref. General Conditions 6.17 and Supplementary Conditions - Shop Drawings, and Samples.
- b. Prior to fabrication, the Contractor shall submit for review complete assembly drawings which show a complete assembly of each major component of equipment and identify the type of construction, sizes of principal members, and the type of motor and controller connections for each motor.
- c. Prior to fabrication of electrical equipment, the Contractor shall submit for review drawings of motor control centers which shall be installed in or on the proposed enclosed room. The drawings shall be submitted to ensure that the equipment will be installed in the space provided.
- d. The Contractor shall place a statement on the cover sheet of each shop drawing that the equipment or equipment complies with the specifications. The Contractor shall list any exception to specifications on the drawings.
- e. Equipment submitted as a package, group, or system shall be submitted as a single submittal.
- f. For all equipment, contractor shall submit manufacturer installation instruction and drawings.

2. Maintenance Instructions:

The Contractor shall furnish to the Owner, via the Engineer, three copies of an operator's manual for each piece of equipment. Manuals shall be delivered prior to 70% project completion or equipment start-up. Include complete information for all equipment. The manuals shall be furnished in a three-ring binder format, including appropriate section dividers.

- b. Set forth in the operator's manual shall be complete specifications for the lubricating oils and grease lubricants recommended for the specific equipment and drives. In addition to the lubricating oil's saybolt viscosity readings and grease lubricant's class numbers, the trade names of lubricants which meet the manufacturer's

specifications also shall be listed in the lubricant specifications of the operator's manual. Trade names of recommended lubricants produced by not less than four major (nationally recognized) oil companies shall be listed.

c. Complete written instructions, diagrams, charts, schedules, etc. shall be furnished by the equipment manufacturer for applying lubricants or other maintenance tasks to all components and accessories.

d. Provide assembly diagrams, parts lists, trouble shooting, and maintenance instructions for all equipment.

3. Applications for Partial Payment: Submit applications for partial payment as required. Ref. General Conditions 14.02 and Special Conditions for Partial Payments to Contractor and Completion.

4. Sales Tax Report: Submit sales tax report for partial payment. Ref. Special Conditions for Sales Tax.

5. Insurance Renewal: Submit insurance renewal certificate at expiration of previous certificate.

6. Documentation: Submit documentation as required.

7. Monthly Progress Report: Submit monthly progress report showing progress and work scheduled for following month. Report to be delivered to the Engineer at the monthly meeting.

E. Submittal Schedule:

1. Beginning and ending dates for warranties for each item, piece of equipment, etc. List to be agreed upon in writing by the Contractor, Engineer, and Owner.

2. Drawings: Maintain a complete set of full-size blue/black-line prints of contract drawings and shop drawings for record mark-up purposes throughout the contract time. Mark up drawings during the course of the work to show changes and actual installation conditions, sufficient to form a complete record for Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly work which may require servicing or replacement during the life of the project. Bind prints into manageable sets, with durable paper covers, appropriately labeled, and submit them to

the Engineer when the construction is completed. Ref. General Conditions 6.12 and 14.07.A.1 and Supplementary Conditions - Record Drawings.

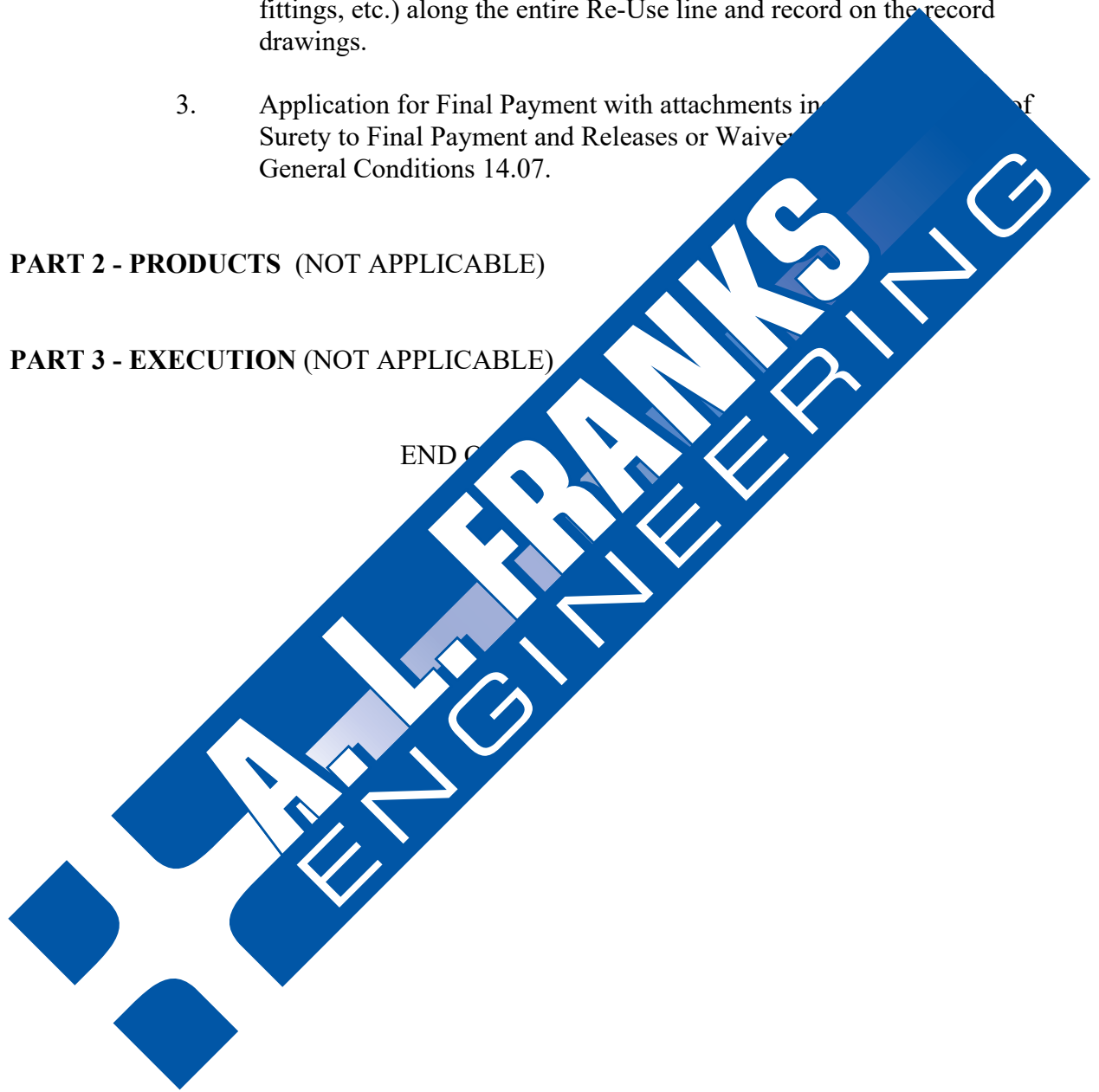
For the Re-use Distribution System, the Contractor shall record the northing/easting coordinates (based on NC Grid NAD 83) at 100-foot stations and at all pipe nodes (i.e., valves, vaults, manholes, bends, fittings, etc.) along the entire Re-Use line and record on the record drawings.

3. Application for Final Payment with attachments in accordance with General Conditions 14.07.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END C



SECTION 01350
REQUIREMENTS FOR "EQUAL" AND "PRE-APPROVED EQUAL"
EQUIPMENT AND PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Specifications for all Prime Contracts have listed, where appropriate, one or more satisfactory sources for equipment and other products. The Contractor shall select the most suitable for the anticipated service. It is recognized that satisfactory alternate products of equal quality and efficiency may be available from other sources. The Contractor shall identify such sources and no attempt is made to prohibit the use of such quality items by other manufacturers. The Contractor shall obtain pre-bid approval but must fully comply with the intent of the Specifications.
- B. Specifications for equipment and products that include an "or equal" or "pre-approved equal" statement shall be considered if it can be demonstrated that the proposed items have equal or superior construction, performance, and life expectancy; do not increase costs; offer a present worth value equal to or greater than the specified items; and do not adversely affect other system components.
1. Unless otherwise specified, products proposed as "equal" alternates do not require pre-bid approval. They must comply with the intent of the Specifications and be approved during Shop Drawing submittal if they are required.
 2. Products specified as "pre-approved equal" must receive pre-bid approval from the Engineer as described below.
 3. When a package of related items from various manufacturers is specified as part of a package and one or more of the items are specified as "pre-approved equal," then submittals for the entire package must receive pre-bid approval.
- The Contractor will include in the bid price all the costs of any and all structural, mechanical, and electrical changes required to accommodate the alternate equipment and other products. The Contractor will be required to secure and pay for the services of a registered Professional Engineer to provide calculations and drawings to modify the project Plans to accommodate the alternate equipment. All such changes shall be submitted to and approved by the Engineer prior to fabrication of the equipment or making preparations for installation.

1.2 PRE-BID APPROVAL SUBMITTAL

- A. Manufacturers and suppliers desiring equipment or products to be included as "pre-approved equal" shall submit data directly to the Engineer. Pre-bid packages not received by Engineer 21 calendar days prior to the Bid date will not be reviewed.
- B. Pre-bid approval packages must include the following information. Packages that do not include the following information will not be reviewed:
1. Current catalog data sheets and complete technical specifications for all items. All items must meet or exceed the Specification compliance.
 2. A point-by-point list clearly stating the differences between the specified items and the proposed alternate and the reasons for the differences. All exceptions to the Specifications. If no exceptions are noted, the Engineer will allow no exceptions to the Specifications for review.
 3. Installation list with the name and contact person(s) for at least five (5) installations where the equipment has been in similar service and satisfactory for at least two (2) years. See Supplemental Specifications for bonds in lieu of experience.
 4. When applicable, test data and report by independent laboratory showing performance meets or exceeds published performance of the specified product.
 5. All submittals must be submitted in an 8½" x 11" binder. Three (3) copies must be submitted. Coordination with Engineer for electronic submission is required. An approved alternate submission method.
- Equipment and products that meet the Specifications will be considered for approval by the Engineer via Addendum no later than seven (7) days prior to the Bid date. Approval to include items in a Contractor's bid in no way eliminates the requirement for complete submittals at a later date, nor does it guarantee acceptance of the submitted package.

D. Following is the list of Specification Sections containing equipment and products requiring pre-bid approval:

1. General Construction - Contract I

<u>Specification Section</u>	<u>Description</u>
Section 11000	Mechanically Cleaned Filter Screens
Section 11219	Centrifugal Blower
Section 11310	Submersible Pumps
Section 11330	Vortex Grit Removal System
Section 11340	Vortex Grit Classifier
Section 11901	Fine Bubble Aeration Equipment
Section 11915	Clarification Equipment
Section 11950	Ultraviolet Light

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

SECTION 01360 - MISCELLANEOUS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORKMANSHIP AND MATERIALS

- A. All materials and equipment to be provided by the Contractor shall be new and of the best quality for the use intended. The quality of workmanship and material entering into any and all of the items shall conform to provisions of the specifications, paragraphs, and sentences, both directly and indirectly referred to, and to all specifications whether or not direct reference to such specifications is made.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall make all measurements and details in order that his work may be coordinated with the other sections of the work. The Contractor shall make all measurements in order that his work shall fit and be coordinated with the other sections of the work.
- B. All existing pipes or other facilities will be excavated and verified prior to beginning the installation of new facilities. Payment shall be made for modifications to elevation or location within 2 feet (+/-) of the connection or location shown on the drawings. The alignment shown on the drawings shall always be considered correct unless otherwise noted and shall be field routed to their points of origin as approved by the Engineer.

END OF SECTION 01360

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. General Contractor shall provide temporary services and facilities required by all Prime Contractors and the Engineer except as otherwise herein specified. Do not remove temporary facilities until authorized use of permanent facilities.

1.2 USE CHARGES

- A. Usage charges for temporary services or facilities shall be as specified by General Contractor.

1.3 WATER FOR TESTING

- A. Contractor responsible for providing water for testing.

1.4 REGULATIONS AND LIMITATIONS

- A. Comply with requirements of applicable regulations governing construction and local industry standards for installation and maintenance of temporary services and facilities.
- B. The Contractor shall perform all work within the property limits of the site and shall take necessary precautions to avoid damage to all existing structures and utilities.

1.5 TEMPORARY ELECTRICAL INSTALLATION

- A. Hire a qualified utility company to install temporary services. As early as possible, coordinate use of permanent service, to enable removal of the temporary facilities and eliminate possible interference with completion of the work.

Temporary Power Service: Provide weathertight, grounded temporary electrical service-entrance and distribution system, with ground-fault circuit interrupters and ground-fault interrupter features of proper types, sizes, electrical ratings and characteristics to fulfill project requirements. Comply with applicable requirements of NEMA, NECA and UL standards and governing regulations. Install temporary lighting of adequate illumination levels to perform the work specified. Temporary electric service for construction purposes shall be for use by all prime contractors.

- C. Temporary Heat: Provide temporary heat where needed for performance of work, for curing or drying of recently installed work or for protection of work in place from adverse effects of low temperatures or high humidity. Provide UL or FM tested and labeled heating units known to be safe and without adverse effect upon work in place or being installed. Maintain a minimum temperature of 45 degrees F (7 degrees C) in permanently enclosed portions of the building and areas where finished work has been installed.

1. Except where use of the permanent heating system is specified and authorized, provide properly vented self-contained heaters with individual space thermostatic controls. Do not use open burning or salamander type heaters.

1.6 FIELD OFFICES

- A. General Contractor's Field Office: Provide a mobile unit to accommodate the Contractor's personnel. The Contractor's office shall be equipped throughout the entire period of construction.

1. Telephone service.
2. Copies of drawings, change orders, and shop drawings.

- C. Field Office: The prime contractor will be required to furnish the field office. The General Contractor will provide space for the field office and shall provide and maintain all drawings for all field offices, including those of other prime contractors.

1.8

- Site for trailers, materials storage, and staging is as indicated. Contractors shall obtain approval of the plant superintendent for any equipment which may be used that will not interfere with plant operations.

1.9

ROADS AND PAVING

- A. Provide temporary graveled roads and graveled parking facilities during the course of the work. Locate in the same locations as permanent facilities.
- B. Coordinate temporary drives with grading and compaction of the subgrade, installation and stabilization of subbase and installation of base and finish courses of permanent paving.

- C. Construct and maintain temporary roads to support loading and to withstand exposure to traffic. Provide a graded and well compacted, well drained subgrade, and a gravel paving course of a well graded subbase material not less than 3" thick, roller compacted to a level, smooth surface.
- D. Delay installation of the final course of permanent paving in areas exposed to temporary use, until immediately before substantial completion.
- E. Unless noted to remain, completely remove temporary roadways that are not to receive permanent paving, prior to seeding.

1.10 SANITARY FACILITIES

- A. Sanitary facilities include temporary toilets for prime contractors.
 - 1. Supply toilet tissue, paper towels and disposable materials as appropriate for use in appropriate covered waste containers for used.
 - 2. Toilets: Install single-stall self-contained units of the chemical, aerated recirculation or vacuum type. Units must be properly vented and fully enclosed with a secure door and lock. Units must have a sturdy shell. Use of pit-type privies will not be allowed.
 - 3. Provide separate male and female construction personnel.
- B. Provide cap-dispenser bottled-water type drinking water for prime contractors and subcontractors.

1.11 STORAGE AND MATERIAL HANDLING FACILITIES INSTALLATION

Store materials in a safe, lawful and publicly acceptable manner. Each prime contractor shall be responsible for security of their own office and storage

1.12 SAFETY, WARNING SIGNS AND LIGHTS

- A. Comply with recognized standards and code requirements for erection of substantial barricades where needed to prevent accidents. Paint with appropriate colors, graphics and warning signs to inform personnel at the site and the public, of the hazard being protected against. Provide lighting where needed, including flashing red lights where appropriate.

1.13 MAINTENANCE

- A. Operate and maintain temporary services and facilities in good operating condition and in a safe and efficient manner until removal is authorized. Do not overload services or facilities. Protect from damage by freezing temperatures and similar elements. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist on the site.

1.14 TERMINATION AND REMOVAL

- A. Remove each temporary service and facility promptly when replaced by use of a permanent facility, but not later than substantial completion. Complete, or, if necessary, restore project area free of interference with the temporary service or facility. Clean exposed surfaces and replace work which has been damaged during the construction period.
- B. At substantial completion, clean and remove all temporary services and facilities that have been used to provide temporary services during the construction period.

1.15 SAFETY MEASURES

- A. In addition to compliance with all applicable requirements of the General Conditions, the Contractor shall comply with the following:
 - 1. Inform all personnel with all applicable requirements of the Worker Safety and Health Act of 1970 in the performance of work under this contract.
 - 2. Comply with the rules, regulations, and interpretations of the Department of Labor relating to safety and health for construction work which are hereby incorporated into these requirements.
 - 3. Comply with the rules set out in the regulations and recommendations published by the Associated General Contractors and the Arkansas Department of Labor, and the Contractor shall use every effort to safeguard life and property throughout his operations.

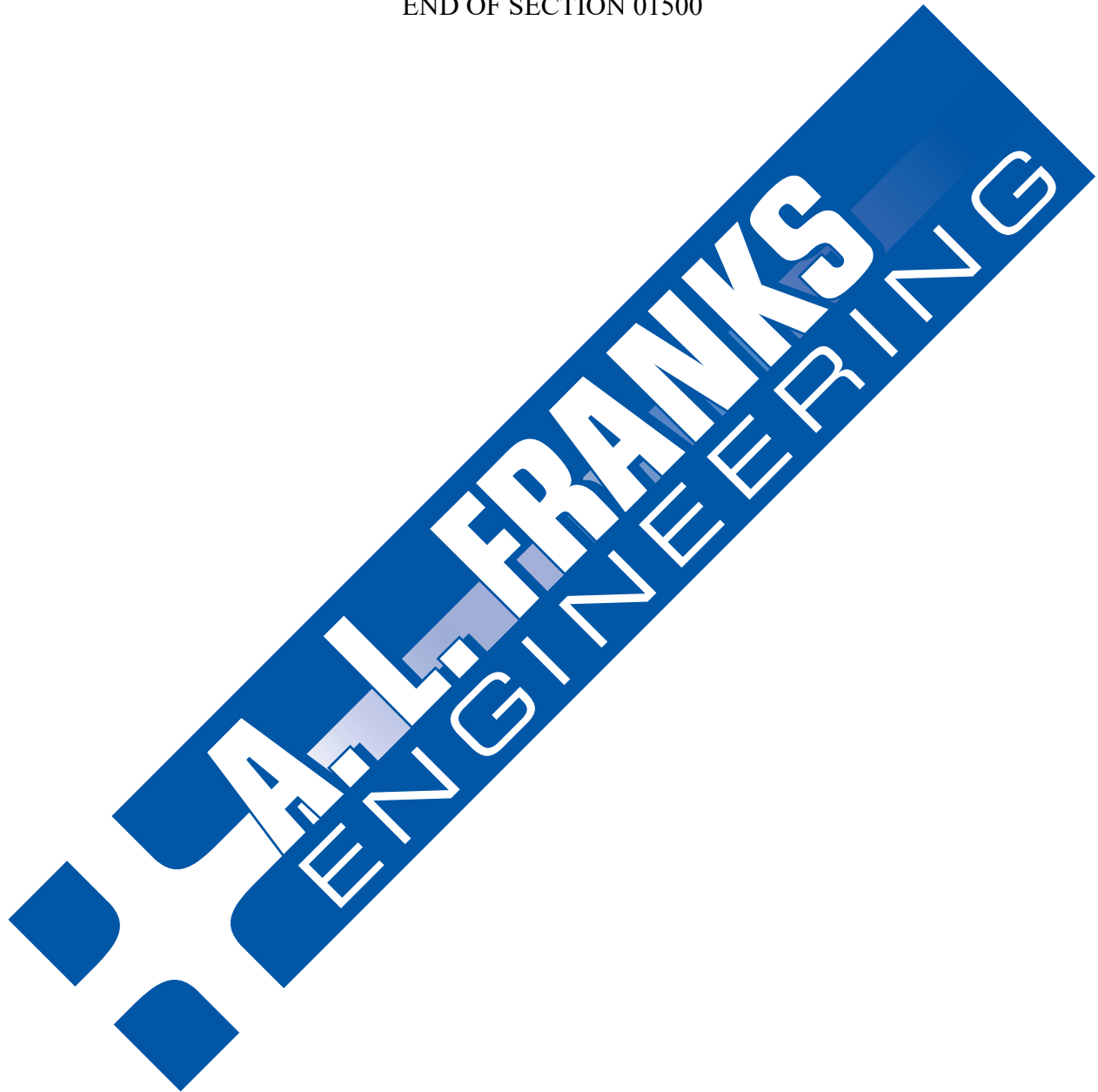
1.16 SIGNAGE

The contractors for Contracts 1 shall each furnish and erect one project sign of exterior type high density plywood ½"x4'x8'. The sign shall be painted by a professional sign painter. The sign shall include lettering to identify Owner, Engineers and Contractors, project description and any other applicable funding agency requirements.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 01500



SECTION 01580 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 LUMP SUM

- A. Payment for all work accomplished under the contract shall be on the basis of the LUMP SUM PRICES as stated in the Bid, except where:
1. Unit prices are identified in the contract and quantities are determined by field measurements. These items are paid on the stated unit price basis for quantities installed as indicated below.
 2. Allowance Items: These items are paid on the basis of actual invoice cost without Contractor mark-up. Items are paid on the basis of payment requests. Sales taxes are as shown on the invoice.
- B. Final Payment for Base Bid: Payment for the Base Bid shall be made on the basis of actual quantities determined by field measurements, in accordance with the approved shop drawings. Item numbers are referenced to the Bid.
- C. Texarkana AR 01580 - MEASUREMENT AND PAYMENT
1. Items shall be paid on the basis of actual quantities of items on the approved shop drawings.
 2. Allowance: See Section 01033 – Allowances.
- Payments for quantities of work completed shall be based on the
- Authorized Trench Widths: The maximum authorized trench width for use in making field measurements of select backfill or stabilization stone shall be the pipe diameter plus 2'. The maximum authorized trench width for use in making field measurements of sidewalk, aggregate base course, and pavements shall be pipe diameter plus 4'.
2. Measurements: Pipe line measurements shall be made along and to the centerline of the pipe or fittings. Measurements shall be recorded daily by

the Contractor, and the quantities shall be submitted to the Resident Observer for approval at the close of each working day.

3. Measurements: Cut and fill quantities shall be as measured in place quantities as determined by before and after surveys by the Engineers.

E. Summary: It is intended that payments noted above shall constitute full compensation for all work shown and required by the Plans and Specifications for this Contract. The cost of other auxiliary operations and/or materials required to make a completed project shall be absorbed in the appropriate Unit Price items for which bids are requested.

F. Quantity Logs: The Contractor will be furnished quantity logs which shall be the basis of payment for the Sewer and Water System.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

SECTION 01800 - FACILITY OPERATIONS AND WORK SEQUENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General and specific requirements for facility shutdowns
2. Operational requirements of the facility during shutdowns
3. Sequencing and scheduling constraints

1.2 SUBMITTALS

- A. Schedules for plant shutdowns shall be submitted to the Engineer for review and approval. The Supplementary Conditions.

1.3 GENERAL FACILITY SHUTDOWN REQUIREMENTS

- A. The scheduling of facility shutdowns shall be subject to the approval of the Owner and the Engineer.
- B. All necessary materials, equipment, and labor shall be on hand and ready prior to taking any treatment facility offline for maintenance or modification.
- C. Shutdowns for tie-ins or modifications should be scheduled during off-peak hours or other low flow periods. The Contractor's bid pricing shall include the cost of facility shutdowns outside of standard working hours for events requiring facility shutdowns.
- D. Operational portions of all facilities must be maintained at all times.

1.4 FACILITY SHUTDOWN REQUIREMENTS

- A. This specification section is not intended to describe or outline each facility shutdown, flow diversion, or temporary interruption that may occur during the progress of the construction. The intent of this section is to outline shutdowns, flow diversions, or temporary interruptions in which special requirements must be met.

B. New Air Main Connection

1. Contractor shall have the proposed air main completely installed with the exception of the final connections to the existing air mains at each end. Final connection should be coordinated to allow for a maximum blower shutdown of three (3) hours.

C. Electric Power Transfer

1. See sheet **E6** for the proposed electrical layout and connections. Contractor should have all electrical work completed prior to the final connection to the existing power supply. The final connection should be coordinated to allow for a maximum power outage of three (3) hours.

D. Existing Influent Structure

1. Modifications to the existing Influent Structure shall be made at the Influent Structure be temporarily bypassed. The bypass shall be accomplished using piping that is already in place. The bypass shall be completed using pumps to the existing 18" force main. The bypass shall be completed by the Contractor. The Contractor shall provide a minimum of 18" of freeboard for a flow of 1 MGD to 2 MGD.

PART 2 – PRODUCTS

Not Applicable

PART 3 –

Not

END OF SECTION 01800

SECTION 02060 - DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. The general extent of demolition work is shown on Drawings. Demolition/cutting and patching may be required in order to complete the indicated renovations.
- B. Demolition includes removal and disposal of demolition materials.

1.2 SCHEDULE

- A. Submit proposed methods, operations and sequence of work to the Engineer for review prior to start of work. Include details of utility shut-off, capping and continuation of utilities. The Contractor will be permitted to proceed with demolition work only after approval by the Engineer. The Contractor shall be responsible to the expeditious execution of his work, subject to compliance with the Facility Operations and Maintenance Manual (FOMM), and to the following requirements:
 - 1. The existing facilities will remain in operation during the demolition period, except as provided for in the plans.

1.3 PROJECT REQUIREMENTS

- A. The Contractor shall identify the location of all capped utilities.
- B. The Contractor shall indicate unanticipated structural, electrical, or mechanical conditions.

PART 2 - MATERIALS

Not Applicable

PART 3 - EXECUTION

3.1 CONDITION OF STRUCTURES

- A. The Owner assumes no responsibility for actual condition of structures to be demolished.
- B. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations in condition of structures may occur by Owner's removal and salvage operations as part of demolition work.

3.2 PARTIAL REMOVAL

- A. Items of salvageable value to contractor which are to be removed from structure as work progresses may be removed from structure as work progresses and items from the site as they are removed.
- B. Storage or sale of removed items.

3.3 TRAFFIC

- A. Conduct demolition operations to ensure minimum interference with adjacent occupied or used facilities.
- B. Do not close streets without permission from the Owner.

3.4 PROTECTION

- A. Establish safety zones around areas of demolition. Conduct operations to protect buildings, structures, work to remain, other facilities, and exterior shoring, bracing, or support to prevent movement, collapse of structures to be demolished and adjacent facilities to be demolished.
- C. Provide suitable barricades to ensure safety of Contractor's personnel and Owner's personnel.

3.5 DAMAGES

- A. Repair damages caused to adjacent equipment, finish surfaces, or other facilities by demolition operations within ten (10) days or as otherwise approved by the Engineer at no cost to Owner.

3.6 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

3.7 POLLUTION CONTROLS

- A. Use water sprinkling, temporary enclosures, and other measures to prevent dust and dirt rising and scattering in air to local area in accordance with governing regulations pertaining to environmental protection.
- B. Do not use water when it may create hazardous conditions such as ice, flooding, and pollution.
- C. Clean adjacent structures and areas of dust, dirt, and debris caused by demolition operations, and remove debris as required by governing authorities. Return adjacent areas to condition for subsequent work.

3.8 BELOW-GRADE CONSTRUCTION

- A. Demolish existing below-grade construction and concrete slabs on grade, where required.

3.9 FILLING

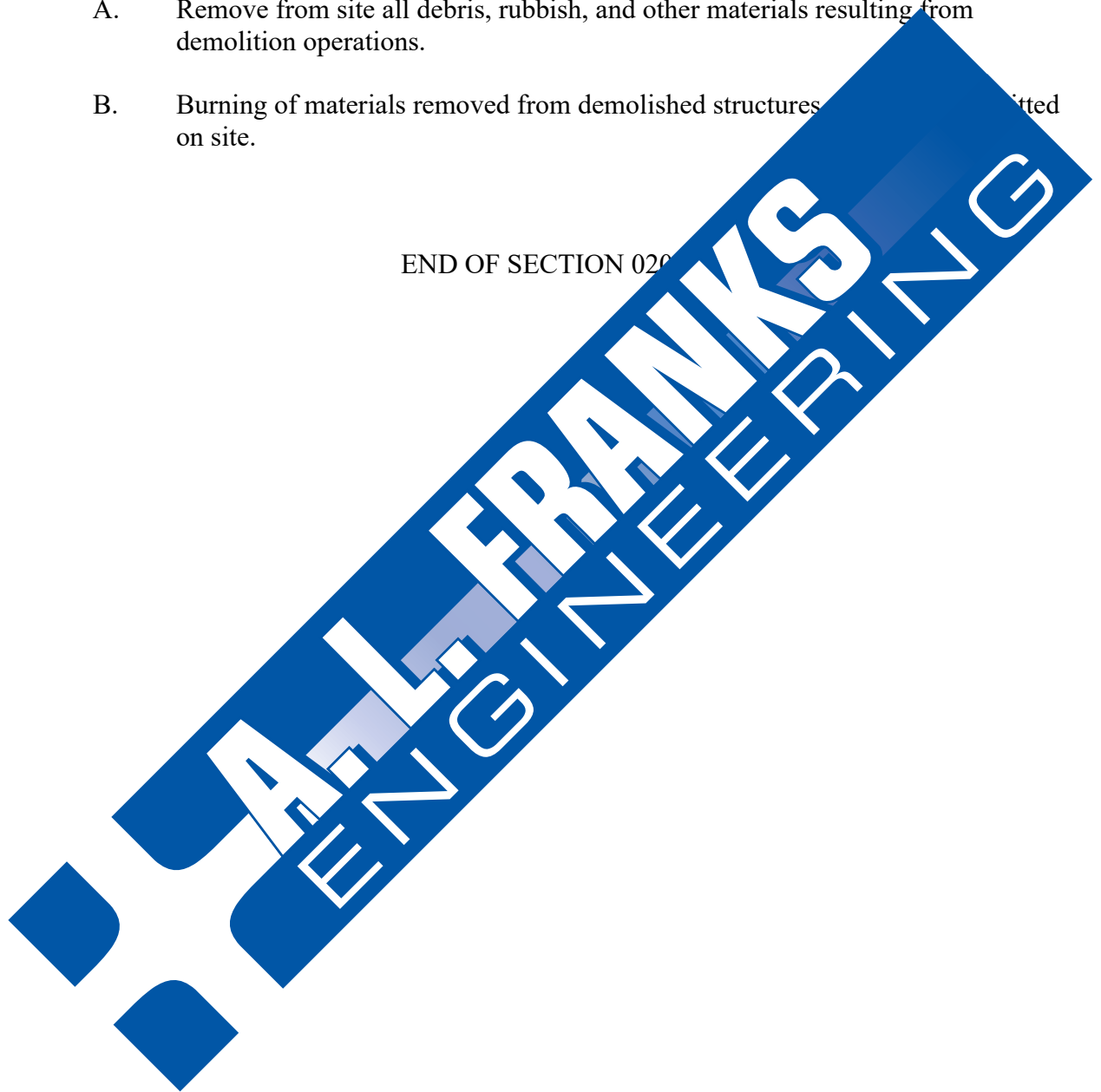
- A. Fill voids and areas resulting from demolition of existing structures with clean, well-sorted soil materials consisting of stone, gravel, and sand, free from frozen materials, roots and other organic matter.
- B. During placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash and debris.
- D. Place fill materials in horizontal layers not exceeding 8" in loose depth unless otherwise specifically approved in writing by the Engineer. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, unless subsequent excavation for new work is required.

- E. After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures or to suit subsequent required construction.

3.10 DISPOSAL

- A. Remove from site all debris, rubbish, and other materials resulting from demolition operations.
- B. Burning of materials removed from demolished structures is prohibited on site.

END OF SECTION 020



SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Site clearing includes, but is not limited to, protection of existing trees to remain, removal of stumps and other vegetation, topsoil stripping, grubbing, and removal of existing improvements as indicated or as directed by the Resident Project Representative.

1.2 PROTECTIONS

- A. Provide temporary fences, barricades, coverings, and other protective measures to preserve existing items indicated to remain and to protect persons or property.
- B. Protection of Existing Trees and Other Vegetation: Preserve trees and other vegetation, which is to remain, by preventing cutting, breaking, or skinning of roots, skinning of trunks, or other damage to trees by stockpiling construction materials within drip line, excess foot or vehicular traffic within drip line. Provide temporary guards to protect trees to be left standing.
- C. Provide protection for trees to be removed by a diameter cut during construction operation. Use mulch, mulchified asphalt, or other acceptable coating to protect exposed plant tissues. Temporarily cover exposed roots to protect roots from drying out; cover with earth as soon as possible.
- D. Repair damaged vegetation indicated to remain which are damaged by construction in a manner acceptable to the Resident Project Representative.

PART 2 - EXECUTION (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. Contractor shall clear only areas within the clearing limits or as required in highway rights-of-way. Consult the Resident Project Representative if there are

any questions concerning removal of a tree or group of trees. Remove stumps and vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items elsewhere on the site or premises as specifically indicated. Removal includes stumps and roots.

- B. Carefully and cleanly cut roots and branches of trees not indicated to be removed where such roots and branches obstruct new construction.

3.2 TOPSOIL

- A. Topsoil is defined as friable clay loam surface soil found to a depth of more than 4". Satisfactory topsoil is free of subsoil, clay lumps, stones, and other objects over 3/4" in diameter, and without weeds, roots, or other objectionable material. All topsoil is subject to inspection and approval by the Project Representative.
- B. Strip topsoil to whatever depths encountered, avoiding intermingling with underlying subsoil.
- C. Remove heavy growths of grass and weeds.
 - 1. Where trees are indicated to be removed, strip topsoil stripping a sufficient distance to encompass the entire root system.
- D. Stockpile satisfactory topsoil in areas where shown on the drawings. Place topsoil as required in preparation of a seed bed. Construct a drainage ditch to prevent surface water. Cover storage piles if required by the Project Representative. Install silt fence around stockpiles to prevent erosion.

3.3 GRUBBING

- A. Remove stumps, roots, and other debris protruding through the ground surface prior to commencement of earthwork operations.
 - 1. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
- C. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact to a density equal to adjacent original ground.

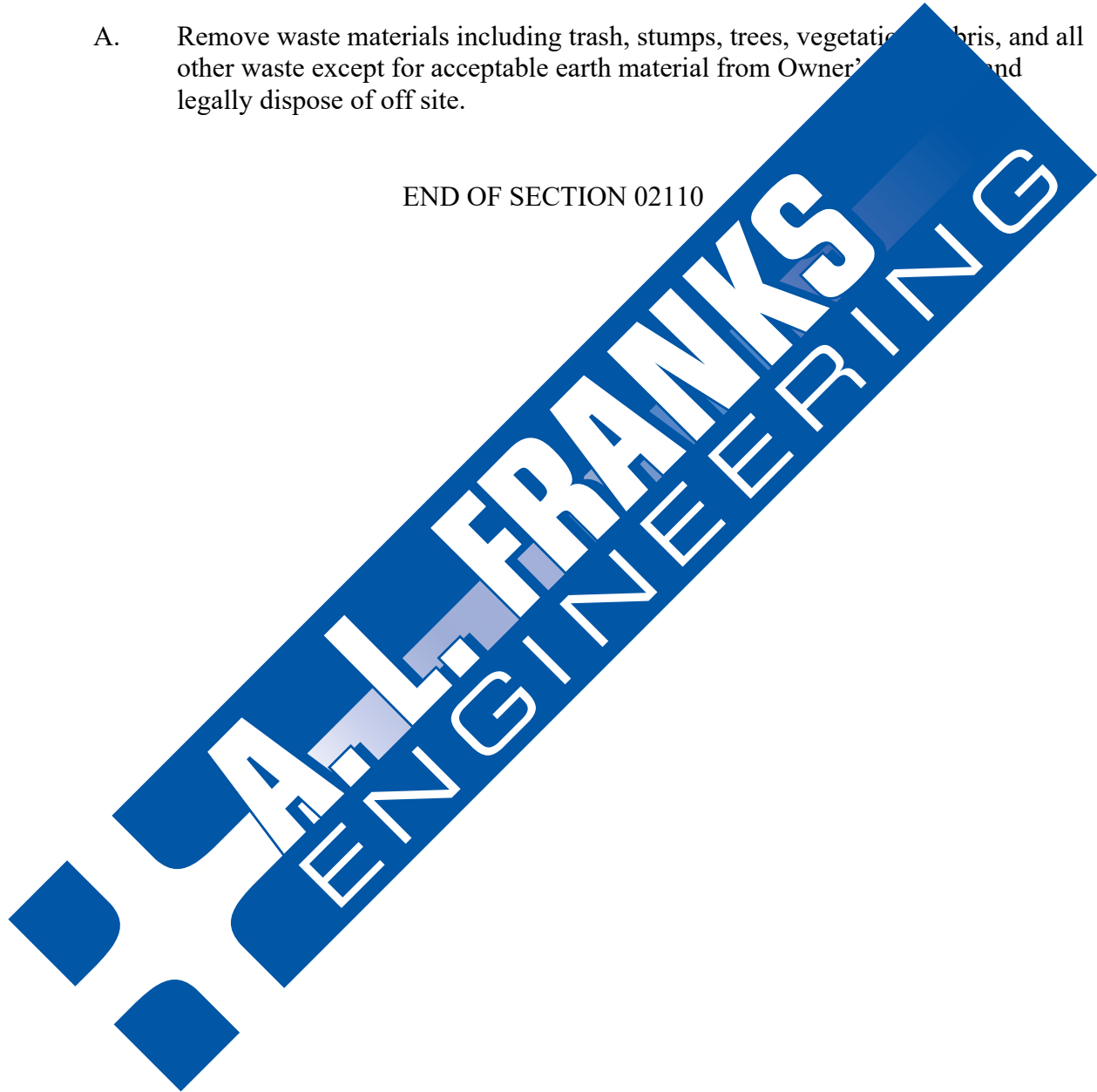
3.4 BURNING ON OWNER'S PROPERTY

- A. Burning will not be permitted on the project site.

3.5 DISPOSAL OF WASTE MATERIALS

- A. Remove waste materials including trash, stumps, trees, vegetation, debris, and all other waste except for acceptable earth material from Owner's property and legally dispose of off site.

END OF SECTION 02110



SECTION 02151 - SHEETING AND BRACING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Where required to properly support the surfaces of the excavation, to permit construction, to protect the construction work, adjacent work, existing structures, adjacent pipe lines, and roadways, provide sheeting, bracing, and shoring.
- B. Failure to sheet and brace trenches or other excavations shall be the Contractor's risk, and he will be held responsible for all damages or injuries resulting therefrom.
- C. Sheeting and bracing are incidental, and are included in the appropriate lump sum or unit price for excavation.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Part 1926, Occupational Safety and Health Standards for Excavation.

PART 2 - PRODUCTS

2.1 SHEETING AND BRACING

- A. Provide sheeting and bracing components as may be necessary to excavate as shown in this Section.

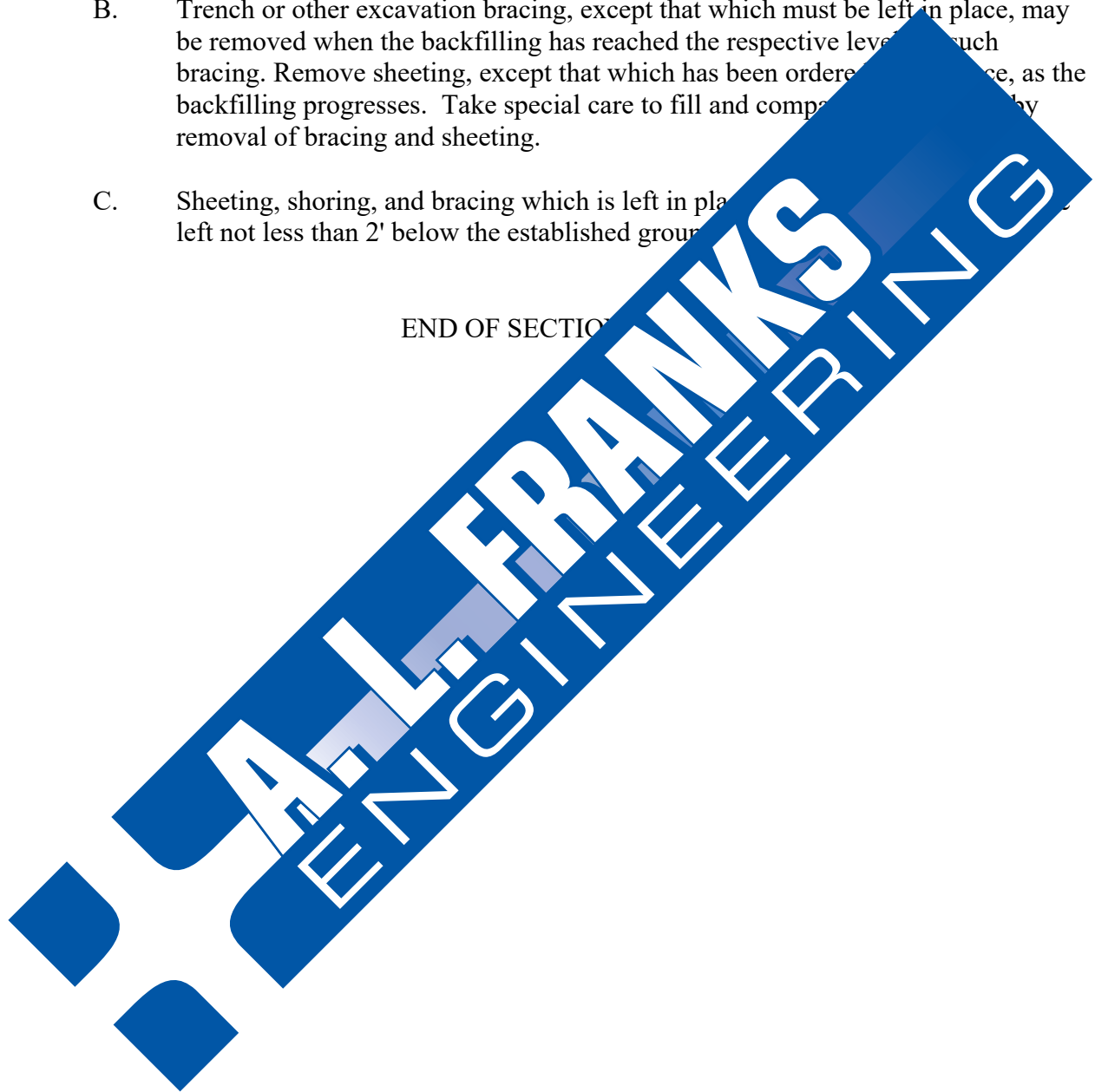
PART 3 - EXECUTION

- 3.1 Installation: The Contractor is responsible for selecting installation methods for sheeting and bracing.

3.2 REMOVAL

- A. In removing sheeting and bracing after the construction has been completed, take special care to prevent any collapse of the excavation and injury to the completed work or adjacent property.
- B. Trench or other excavation bracing, except that which must be left in place, may be removed when the backfilling has reached the respective level of such bracing. Remove sheeting, except that which has been ordered to remain, as the backfilling progresses. Take special care to fill and compact the excavation by the removal of bracing and sheeting.
- C. Sheeting, shoring, and bracing which is left in place shall be left not less than 2' below the established ground level.

END OF SECTION



SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of earthwork is as follows:

1. Excavating and constructing embankments for Clarifier, aeration basin and pipelines.
2. Preparation of subgrade for building slabs.
3. Excavating, filling and compaction of embankments.
4. Backfilling of foundations and structures.
5. Placement of crushed stone for embankments.
6. Trenching and backfilling for structures.
7. Other miscellaneous earthwork, off-site borrow, disposal on site, and grading.

1.2 QUALITY ASSURANCE

A. Code of practice for excavation work in compliance with applicable regulations and standards of authorities having jurisdiction.

B. Testing agency services (Allowance Item):

1. The General Contractor shall allow for testing agency to perform soil testing and inspection for quality control during earthwork operations.

2. The Owner will select the testing agency.

3. The testing agency will be paid by the General Contractor through an allowance in the Contract. See Section 01033.

C. The quantity of cut and fill for roads and embankments will be determined by comparing the original site survey with an Owner-performed survey after the earthwork is complete.

1.3 JOB CONDITIONS

- A. Site Information: Subsurface investigation reports were prepared by S&ME. Refer to Supplementary Conditions for obtaining a copy of the report.
- B. The Contractor is specifically advised that the information contained in these reports is not a part of this specification or contract documents. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy of continuity between soil borings. It shall be expressly understood that neither the Engineers, Resident Project Representative, nor the Contractor shall be responsible for interpretations or conclusions drawn therefrom.
- C. Additional test borings and other exploratory operations shall be performed by the Contractor at no cost to Owner.
- D. Use of Explosives: The use of explosives shall be prohibited.
- E. Carefully maintain all survey reference points, including all right-of-way markers, bench marks, etc. and a record of their locations.
- F. The presence of groundwater shall be a condition for which an increase in the contract price shall not be allowed.
- G. Existing Utilities:
 - 1. The Contractor shall locate all utilities and protecting them from damage. The Owner(s) and Utility Companies for the project shall be notified. No break any utility connection without the approval of the Owner(s) a minimum of 48 hours in advance and provide temporary services as required.
 - 2. The Contractor shall be responsible for repairing any damage to existing utilities. All damaged utilities shall be replaced as directed by the Owner(s) or the Utility Company.

PART 2

2.1 MATERIALS

- A. Fill material used on the project will be subject to inspection and testing by the materials testing firm and will be used only if it meets the requirements for fill material listed below and is considered suitable for this project by the soil testing firm.
- B. Contractor is responsible for identifying and obtaining offsite borrow.

C. Definitions:

1. Satisfactory (Acceptable) Embankment and Backfill Soil Materials: Those subsurface materials found beneath the upper layer of cohesive clays or silts that meet the following conditions:
 - a. Must be free of rock or gravel larger than 2" in any dimension.
 - b. Must be free of debris, organic, or other deleterious materials.
 - c. Must be generally described as Sands.
 - d. Must be capable of providing C_u values greater than 60 when compacted to 100% compaction.
 - e. Must have density greater than 120 pcf when compacted to 100%.
 - f. Must have a liquid limit less than 25.
 - g. Must have a plasticity index less than 7.
 - h. All materials must be approved by the soils testing service.
2. Unsatisfactory Embankment and Backfill Soil Materials: Those materials found in the upper layer of the embankment consisting of clays and silts, organic, frozen, or other materials that do not meet the specific requirements listed above.
3. Base Course (CABC): Provide crushed aggregate base course (CABC), in accordance with the ARDOT Standard Specifications for Roads and Structures.
4. Subgrade or Stabilization Stone (Washed Stone): Washed, uniformly graded, and free of fines, crushed stone, or crushed or uncrushed gravel, conforming to Coarse Aggregate No. 57 of ASTM C-33.
5. Drainage Sand: Natural or manufactured sand conforming to ASTM C-33 for fine aggregate.
6. Bedding Sand: Natural or manufactured sand.
7. Select Backfill: Satisfactory soil materials from an on-site or off-site source to be used as directed by the Resident Project Representative when unsatisfactory soils are encountered at or below subgrade levels.

8. Backfill material for trench (from top of bedding material to one foot above top of pipe):
 - a. Must be free of rock or gravel larger than $\frac{3}{4}$ " in any dimension.
 - b. Must be free of debris, organic, or other deleterious material.
 - c. Must have density greater than 95 lbs per cubic foot when compacted to 100% compaction (ASTM D-698).
 - d. All materials are subject to the approval of the Resident Project Representative.
9. Pipe Bedding Material: Coarse sands and gravels, free of fines, size of $\frac{3}{4}$ ", including variously graded sands and gravels with small percentages of fines, generally granular, clean, and free of organic or dry.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavation consists of removal of all material encountered when establishing the required elevations.
- B. Excavation is unclassified.

1. Excavation consists of removal of materials beyond the required elevations or dimensions without specific direction by the Resident Project Representative. Unauthorized excavation, as well as excavation directed by Resident Project Representative, shall be at the contractor's expense.

2. For footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Resident Project Representative.

3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Resident Project Representative.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Resident Project Representative who will make an inspection of conditions.

1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Resident Project Representative.
2. Removal of unsuitable material and its replacement as directed will be paid for under the unit price items in the Bid Form.

D. Stability of Excavations: Slope sides of excavations shall be maintained in accordance with applicable codes and ordinances having jurisdiction. Shore and bracing shall be provided as required because of space restrictions or stability of material.

1. Maintain sides and slopes of excavations until completion of backfilling.

E. Shoring and Bracing:

1. Provide materials for shoring and bracing in excavations, including sheet piling, uprights, stringers and cross-bracing in accordance with applicable conditions.
2. The Contractor shall be responsible for the design and installation of temporary shoring for the deeper excavations in accordance with applicable regulatory requirements. Potential obstructions such as existing fill may hinder sheet pile driving and the installation of trenches through the fill along sheet pile walls.

Shoring and bracing in excavations regardless of time period shall be maintained until the excavation is open. Carry down shoring and bracing as excavation progresses.

The Contractor is responsible for the design and installation of the dewatering system:

Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area. Eight-inch diameter PVC sampling wells may be required up to four points around an excavation in order to monitor the location of the water table.

3. For open cut excavations, the groundwater level should be lowered at least three feet below the bottom of the proposed excavations at all times to provide base stability.
4. For deep excavations when sheet piling is used for bracing, interior sump or wells shall be used for dewatering. The groundwater level should be lowered at least two feet below the bottom of the proposed excavation at all times to provide bank stability.

5. Do not allow water to accumulate in excavations. Prevent water from entering excavations to prevent softening of foundation bottoms, undercutting, and other changes detrimental to stability of subgrades. Maintain pumps, well points, sumps, and other dewatering system components near excavations. Do not allow failure to keep all water from standing in excavations to be a basis for claim by the Contractor for additional work.

6. During dewatering operations, discharge water away from excavations to collection system in accordance with the Federal Sedimentation Pollution Control Act. Install and maintain temporary drainage ditches outside excavation limits for each structure. Install and maintain appropriate sediment basins or sediment traps (approved by Contractor) which ultimately discharge to creeks and streams will not be allowed to be used as temporary drainage ditches.

- G. Material excavated from temporary excavations until required for backfill. Shape stockpiles for proper drainage and provide sediment traps to prevent sediment-laden run-off.

- H. Keep excavated materials away from edge of excavations.

- I. Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings to permit placing and removal of concrete formwork, installation of reinforcement, other construction, and for inspection.

- J. Footings and Foundations:

1. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

2. Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. If the bearing soils are softened by surface or ground water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete.

K. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

L. Excavation for Pipes (Trenching):

1. Trenching consists of the excavation of earth for the installation of pipes.
2. Accomplish trenching with equipment suitable for the type of soil encountered. Carry the depths of trenches as required by the design. Indicated flow lines and invert elevations shall be maintained. Refer to Section 600 for further information regarding pipe installation.
3. Construct sides of trench to be suitable to a point 1 foot above the crown of the pipe. Consideration shall be given to the type of soil encountered and the weight of the pipe. Operations resulting in wide top dimensions of the trench shall not be permitted. The trench shall be excavated to the crown of the pipe to the bed of the trench. The diameter of the pipe bell plus 12" on each side shall be maintained. The permission of the Resident Project Representative shall be obtained to excavate a space under and around each bell to provide for any load and to assure solid uniform support of the pipe.

If the invert of the pipe is found to be unstable or that the subgrade does not have sufficient bearing strength to support the pipe and its loads, the Resident Project Representative may require the contractor to consolidate the subgrade by tamping and provide dewatering as specified. In the event that tamping, dewatering, or other measures will not prevent or cure this condition, the Resident Project Representative may require that the subgrade be undercut and that suitable stabilization material be placed in the trench.

Where the pipe is to be installed above the existing ground in filled material, the area shall be filled and compacted to not less than 2' above the crown of the pipe. The trench shall then be excavated in the filled material in the same manner required for pipe located beneath the existing ground.

7. Pavements: Compact top 12" of subbase and each layer of backfill or fill material at 98% maximum dry density.
 8. Crushed Aggregate Base Course: Compact top 12" of subgrade and each 4" layer of crushed aggregate base course material to 100% maximum dry density.
 9. Embankments, Pond and Lagoon Embankments: Compact to a density no less than 95% maximum dry density at moisture content from -3 to +4 percent of optimum.
- C. Moisture Control: Where subgrade or layer of soil material is not properly conditioned before compaction, uniformly apply water to the surface of each layer of soil material, taking care to prevent free water from being present during or subsequent to compaction operations.
- D. Remove and replace, or scarify and air, soil material that is too wet to permit compaction to specified density.
1. Soil material that has become too wet to permit compaction may be allowed to dry. Assist drying by discing, harrowing, or other means until moisture content is reduced to a satisfactory value as determined by the materials testing agency.
- ### 3.3 BACKFILL AND FILL
- A. General: Place backfill and fill material in layers to required subgrade elevations, for each layer as shown on drawings.
1. For embankment fill areas, use satisfactory excavated or borrow material.
 2. For areas, use satisfactory excavated or borrow material.
 3. For ditches and pavements, use subbase material or satisfactory excavated or borrow material, or combination of both.
- Remove excavations as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing and perimeter insulation.
 2. Inspection, testing, approval, and recording locations of underground utilities.

3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 5. Removal of trash and debris.
 6. Permanent or temporary horizontal bracing is in place on fully supported walls.
- C. Ground Surface Preparation: Remove vegetation, materials, obstructions, and deleterious material from the area of placement of fills. Plow, strip, or break-up surface material to 4 horizontal so that fill material will be placed vertically.
- D. After rough grade has been established, any fill is placed in fill areas, the exposed subgrade shall be approved by the soils testing agency.
- E. Prepare subgrade as required.
- F. Proof roll the exposed subgrade after it has been completed with a heavy roller or tamper. Any areas which rut or pump should be uniformly compacted fill.
- G. When the dry density is less than that specified under "Compaction" classification, break up ground surface, remove to optimum moisture content, and compact to required percentage of maximum density.
7. Moistening or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density for each area classification. Do not place backfill on surfaces that are muddy, frozen, or contain frost or ice.
8. Place backfill and fill materials evenly adjacent to structures, to required dimensions. Take care to prevent wedging action of backfill against structures by spreading material uniformly around structure. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand-operated tampers. Compact as required for area classification. Monitor structure walls as required by the Resident Project Representative to protect the wall. Accomplish compaction immediately behind

walls by hand tamp methods. Do not use heavy equipment within 10 feet of any wall.

K. Backfilling of Pipes:

1. Standard Trench: After the trench has been excavated as required to assure the correct invert and a space has been excavated for the pipe bells, the pipe is to be lowered into the trench. The pipe shall be placed as near to the center of the trench allowing ample room for compaction on each side. After the joint has been made, backfill with 4" layers of satisfactory soil material. Compact backfill by hand tamping. Care shall be taken of the pipe barrel to assure a firm circular bearing. Care shall be taken to not move or raise the pipe or in any way disturb the bearing surface.
2. Backfilling Sides of Pipe: Proceed in a careful and cautious manner. Support sides of pipe with sand or soil material after the joints have been made. Place sand or soil material from pipe bedding to the crown of the pipe in 4" layers. Compact by tamping. Layers of backfill shall be placed in even lifts on both sides of the pipe and shall be placed so as not to move, injure, or disturb the pipe and to assure uniform support throughout the length of the pipe barrel.
3. Backfilling Top of Pipe: Backfill with satisfactory soil material from top of pipe to the crown of the pipe providing sufficient support to prevent injuring or moving the pipe. Place backfill in 4" layers. Compact by hand or approved mechanical means as shown on drawings.
4. Backfill and compact from 12" above the crown of the pipe to finished grade with satisfactory soil material, compacting some 6" layers. The finished grade shall be compacted to the required for the area classification. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings. The contractor shall be held responsible for settlement over all trenches, and shall be required to add material and compact as directed if such settlements occur.

3.4

- C.
- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
- C. Finish surfaces free from irregular surface changes, and as follows:
 - 1. Lawn, Ponds, Lagoons, or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
 - 2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10' above or below required subgrade elevation.
 - 3. Pavements: Shape surface of areas under pavements to line, grade, and cross-section, with finish surface not more than 0.10' above or below required subgrade elevation.
- D. Grading Surface of Fill Under Building Lines: Grade areas under building lines, free of voids, compacted as specified, and to within 1/2" of final grades within a tolerance of 1/2" when tested.
- E. Compaction: After grading, compact to the depth and percentage of maximum density as specified.

3.5 PAVEMENT SUBBASE

- A. General: Subbase material, in layers of specified thickness to support a pavement base course.
 - 1. Follow specifications for paving specifications.
- B. Construction, maintain lines and grades including crown and cross-slopes.
 - 1. Construct shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such a manner as to compact to thickness of each subbase course layer. Compact and roll 2' width of shoulder simultaneously with compacting and rolling of subbase course.
- D. Laying: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section of thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
- E. When a compacted subbase course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal

layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.6 BUILDING AND STRUCTURAL SLAB DRAINAGE COURSE

- A. Building and Equipment Slabs: Drainage course consists of placement of drainage fill material, in a minimum thickness of 6", over subgrade surface to support all concrete building slabs or equipment slabs.
- B. Sanitary Structures: For all sanitary structures place a layer of drainage fabric on the excavated subgrade prior to placing a 12 inch layer of drainage stone. The drainage stone and fabric will extend two feet on each side of the structure. The fabric will wrap around the outside of the structure to the top of the stone, with at least one foot of the fabric extending beyond the top of the stone to be placed. The fabric shall be Trevira 112 or equivalent, or equal.
- C. Placing: Place drainage fill material in layers of uniform thickness, conforming to indicated thicknesses. Maintain optimum moisture content for compaction during placement operations.

3.7 FIELD QUALITY CONTROL

- A. Quality Control Tests: Allow materials testing service to inspect and approve all materials before further construction work is performed.
 - 1. Soil Compaction: Test soil compaction in accordance with ASTM D 1556 (sand cone method), or ASTM D2922 (rubber balloon method), or ASTM D2922 (nuclear density gauge) as applicable.
 - 2. Subgrade Verification: For each strata of soil on which footings will be placed, make at least one test to verify required design bearing capacity. Subsequent verification and approval of each footing subgrade shall be based on a visual comparison of each subgrade with related tested subgrade, when acceptable to Resident Project Representative.
 - 3. Paved Areas and Building Slab or Structure Subgrade: Make at least one field density test of subgrade for every 2000 square feet of paved area or building slab, but in no case less than three tests. In each compacted fill layer, make one field density test for every 2000 square feet of overlaying building slab or paved area, but in no case less than three tests.
 - 4. Underground Piping at Wastewater Treatment Plant Site: Make at least one field density test per 100 feet of trench length per 2 feet of backfill.

5. General Fill, Holding Pond, and Lagoons: Make at least one (1) field density test of subgrade for every 8000 square feet of general fill area.
- B. Foundation Wall Backfill: Take at least two field density tests at locations and elevations as directed.
- C. After testing or inspection and subsequent approval of subgrade, concrete or base course as soon as possible. If concrete placement is not possible the same day, protect approved subgrade from freezing, thawing, or other damage. All excavations for which concrete placement is delayed must be protected before pouring.
- D. If, in the opinion of Resident Project Representative, after review of test reports and inspection, subgrade or fills do not meet specified density, provide additional compaction at additional expense.

3.8 MAINTENANCE

- A. Protection of Graded Areas: Protect graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and re-compact eroded, and rutted areas to specified tolerances.
- C. Reconditioning: Where completed compacted areas are disturbed by construction operations or adverse weather, scarify and re-compact to required density prior to further construction.
- D. Erosion Control: Implement erosion control measures for further maintenance requirements.

3.9 DEBRIS AND WASTE MATERIALS

- A. Debris and Waste Materials: Remove all debris and waste materials including trash and debris and legally dispose of it off site.
- B. Spoil: Spoil soil shall be disposed of on site as indicated on plans.

END OF SECTION 02200

SECTION 02400 - EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The work shown on the Drawings and specified herein shall include the erosion control plan for this contract in conformance with the Federal Erosion Control Act of 1972 with amendments, and Arkansas Department of Environmental Quality (ADEQ) requirements. The plan shall be based on the anticipated construction methods and shall include permanent and temporary measures as required. The Contractor shall be at no additional cost to the Owner any other measures necessary to prevent erosion as a result of construction activities.
- B. Temporary erosion control measures shall include, but not be limited to, check dams, diversion ditches, silt fences, straw bales, geotextiles, fabric, netting, construction entrances, or any other measures necessary to control or restrict erosion. Measures may include work outside the right-of-way where such work is necessary as a result of construction activities, haul roads, plant sites, equipment storage areas, and debris. The Contractor shall be liable for all damage to property caused by silting or slides originating in the project area.

1.2 CONTRACT REQUIREMENTS

- A. The Contractor shall be responsible for installing and maintaining erosion control measures properly and to satisfy the representatives of the Arkansas Department of Environmental Quality (TCEQ).
- B. If the project is in compliance with the regulations, the Contractor shall conduct a complete site inspection of the erosion control measures every time it rains on site. Required corrective/maintenance work shall be noted and implemented within three working days.
- C. Time delays experienced due to a shutdown by the ADEQ or due to anticipated corrective work will not receive any time extensions on the contract.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All construction activities required under this project shall comply with the Federal Water Pollution Control Act and ADEQ requirements and the rules and regulations promulgated pursuant to the provisions of that law.

B. In the event of conflict between the regulations listed above and the requirements of these Specifications, the more restrictive requirements shall govern.

1.4 SUBMITTALS

A. Materials and facilities for temporary erosion control shall be approved by the Engineer before being used. Materials different from those shown on the Drawings or specifications shall be submitted to the Engineer for approval.

B. Product Data: Submit manufacturer's data for silt fence fabrics, ditch liner, filter fabrics, and other manufactured materials if required.

C. Material Certificates: Submit certificates signed by manufacturer and Contractor certifying materials for posts, woven wire, filter stone, rip rap, and other materials.

D. Drawings: Submit changes in facilities shown on Drawings and additional facilities to the Engineer. Do not use site plans in erosion control facilities.

1.5 GENERAL CONSTRUCTION SCHEDULE

A. Erosion control facilities shall be installed and construct or install silt fences, temporary diversion channels, check dams, temporary sediment traps, inlet protection, and the facilities where indicated on the Drawings.

B. Erosion control measures are installed begin clearing, grubbing, stripping topsoil to limits of construction and begin excavation and grading activities.

C. Stockpile topsoil and suitable fill material where indicated on the drawings and protect from siltation. Dispose of waste materials in accordance with the specifications.

D. Begin construction, install necessary temporary and permanent erosion control measures as indicated on the drawings.

- E. Establish finished grades at earliest possible date. Apply temporary or permanent soil stabilization to areas within seven (7) days after final grades are established.
- F. Areas to be left dormant for longer than 15 days shall be temporarily stabilized within 15 days; otherwise, permanent ground cover shall be established within 30 days.
- G. All erosion and sedimentation control measures shall be inspected daily and after each heavy runoff-producing rainfall. Any needed repairs shall be made immediately.
- H. Refer to Specification Section 02420 - Fertilizing permanent and temporary vegetation schedules.
- I. After ground cover is well established and erosion control measures are no longer needed, remove all temporary measures and install permanent ground cover. Repair any areas disturbed by the temporary measures.
- J. Remove temporary erosion control measures after final site stabilization.

PART 2 - PRODUCTS

2.1 RIP RAP

- A. Comply with Specifications Section 432 - Rip rap.

2.2 PERMANENT SEEDING AND MULCHING

- A. Comply with Section 02420 - Fertilizing Seeding and Mulching.

2.3 TEMPORARY SEEDING AND MULCHING

- A. Comply with Section 02420 - Fertilizing Seeding and Mulching.

2.4 EROSION CONTROL MATS

- A. Comply with ARDOT Standard Specification Section 626 "Erosion Control Matting."

2.5 TEMPORARY MULCHING

- A. Comply with Section 02420 - Fertilizing, Seeding, and Mulching.

2.6. CHECK DAM

- A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.7. SILT FENCE

- A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.8. EROSION CONTROL STONE

- A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.9. DRAINAGE STONE

- A. Drainage stone, washed, uniform, angular, crushed stone, or crushed or uncrushed gravel conforming to the requirements of ASTM C-33 to be used as specified.

PART 3 - EXECUTION

3.1. GENERAL

- A. Comply with the erosion control measures as shown on the plans and as directed by the Resident Project Representative. All permanent erosion control measures shall be incorporated into the project at the earliest practicable time. Temporary erosion control measures shall be coordinated with the permanent erosion control measures and all other work on the project to assure proper installation, maintenance, and continuous erosion control throughout the construction period and to minimize siltation of rivers, streams, lakes, and other impoundments, ground surfaces, or other property.

- B. Temporary and permanent erosion control measures in accordance with the specifications and with the ARDOT Standard Specifications for Highway Construction, latest edition.

- C. Driveways, roadways, and parking areas shall be graveled immediately upon completion of grading.

- D. Permanent or temporary soil stabilization, which includes seeding, mulching, or ground cover sufficient to prevent erosion, must be applied to portions of the

disturbed area within seven (7) days after final grade is reached anywhere on the site. This includes disturbed areas which are not at final grade but will remain dormant for longer than 15 days.

- E. Clean sediment transported onto public roads at the end of each day. Sediment shall be removed by shoveling or sweeping and be transported to a controlled disposal area. Street washing shall be allowed after sediment is removed in this manner.

3.2 TEMPORARY EROSION CONTROL MEASURES

A. Diversion Ditch:

1. Construct sediment traps prior to construction.
2. Strip topsoil and clear area in accordance with Section 02110 - Site Clearing.
3. Construct diversion ditch in locations shown on the Drawings and as required.
4. Construct the ditch so that it is not lower at any point than the design depth.
5. Vegetate ditch after construction unless it will remain in place.
6. Refer to the Drawing to reduce erosion in the ditch.

B.

Fabric to be of polypropylene, nylon, polyester, or polyethylene yard material with a tensile strength of 30 lb/lin. inch (minimum), 85% (minimum) efficiency, and a slurry flow rate of 0.3 gal/sq. ft./minute (minimum). Fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum construction life of six months.

Posts to be either 4" diameter pine, 2" diameter oak, or 1.33 lb/linear foot steel with a minimum length of four feet.

3. Install silt fence on low side of stockpiles and in locations shown on the Drawings. Extend fence around approximately 90% of the perimeter of the stockpile.
4. Construct silt fence as shown on the drawings.

C. Check Dams:

1. Class B erosion control stone shall be used.
2. Place filter fabric between soil and rip rap and extend across ditch.
3. Rip rap shall not exceed 24" in height at center and slope shall be 2:1.
4. Place rip rap over the ditch banks to keep water from undercutting the dam.
5. Construct check dam to dimensions shown.

D. Block and Gravel Inlet Protection

1. Lay concrete blocks on firm, stable surface below storm drain top. Place blocks against each other for support.
2. Place at least one concrete block in the bottom row of blocks.
3. Place wire mesh over the top of the blocks. Check openings used for drainage.
4. Use No. 40 mesh wire mesh. Allow water to flow over the mesh at a slow rate but allow drainage. Place stones on top of the mesh. Place stones on top of block.
5. The block and concrete drain inlet should be placed on a firm surface to prevent washing when water flows over.

E.

Place 2 x 4-inch wood (or equivalent metal) stakes evenly around the perimeter of the inlet a maximum of three feet apart, and securely drive into the ground a minimum of 24" deep.

To provide needed stability, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1.5 feet above the drop inlet crest.

3. Place the bottom 12 inches of fabric in a trench and backfill the trench with at least four inches of crushed stone or 12 inches of compacted soil.
4. Fasten fabric securely to the stakes and frame so that joints overlap to the next stake.

5. It may be required to build a dike on the down slope side of the inlet in order to prevent bypass flow.

F. Sediment Trap:

1. Strip topsoil and clear area in accordance with Specification Section 02110 - Site Clearing.
 2. Place acceptable fill for the embankment in accordance with Specification Section 02200 - Earthwork. Over fill the embankment to allow for settlement.
 3. Construct the outlet section in the center of the spillway. Place riprap between the soil and riprap. Establish a firm foundation and sides of the outlet section.
 4. Clear the pond area below the spillway of the spillway to facilitate sediment transport.
 5. Construct the outlet section to the dimensions, elevations, and slopes as shown on the drawings.
 6. The riprap used in the stone section shall be a well-graded material with a maximum size of 9" and a maximum stone size of 18". Place the riprap into the voids of the larger stones. Use No. 57 stone for the outlet section.
- Construct the spillway outlet section downstream past the toe of the embankment until stable conditions are reached. Shape the center to follow the natural flow stream.

Drainage/Exit:

1. Strip topsoil and clear area in accordance with Specification Section 02110, Site Clearing.

Place gravel to the specific grade and dimensions as shown on the drawings.

- H. Temporary Seeding and Mulching: See Section 02420, Fertilizing, Seeding, and Mulching.

3.3 PERMANENT EROSION CONTROL MEASURES

A. Outlet Stabilization:

1. Ensure that the subgrade for the filter and riprap follows the required lines and grades shown on the drawings. Compact any fill required in the subgrade to the density of the surrounding undisturbed soil. Low areas in the subgrade on undisturbed soil shall be filled by increasing the riprap thickness.
2. The riprap and filter shall conform to the dimensions shown on the drawings.
3. Filter cloth shall meet design requirements and shall be installed without puncturing and tearing during installation. Lay out the filter cloth, lay the riprap and placing another piece of filter cloth over the riprap. All connecting joints should overlap by at least 6 inches. Replace the entire filter cloth as directed by the Engineer.
4. Construct the apron on zero slope at the downstream end. The top of the riprap at the downstream end shall be at the same elevation as the receiving area.
5. Construct the apron to be at least 10 feet wide with the receiving stream.

B. Permanent Seeding, Fertilizing, and Mulching: See Division Section 02420, Fertilizing, Seeding, and Mulching.

3.4 MAINTENANCE

- A. All structures shall be inspected weekly and after each heavy rain. Needed repairs shall be made immediately to prevent erosion. Structures and measures that shall be

Outlet Stabilization: Check for erosion around or below the riprap and if riprap has been dislodged. Make needed repairs to prevent further erosion.

Seeding, Fertilizing, and Mulching: Seeded areas shall be inspected for failure and necessary repairs shall be made within the same season, if possible.

3. Silt Fence: Any fabric which collapses, tears, decomposes, or becomes ineffective will be replaced immediately. Remove sediment deposits behind fence when sediment accumulates to 6".

SECTION 02410 - STORM WATER PERMIT FOR CONSTRUCTION ACTIVITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Federal and State rules require a permit to discharge storm water runoff from construction sites. Construction activities are covered under the "Construction Activities TPDES General Permit No. AFD-0000001". The Contractor will file the Notice of Intent to be covered under the permit.

1.2 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor is completely responsible for compliance with all requirements of the General Permit. The requirements are listed in the permit. A copy of all requirements contained in the permit is included at the end of the permit. A copy of the General Permit is included at the end of the permit.

1.3 SUMMARY OF PERMIT REQUIREMENTS

- A. The Contractor shall implement an approved Sedimentation and Erosion Control Plan. The Contractor shall keep a signed copy of the letter of approval and a copy of the approved Plan on-site at all times. During construction, or approved amendment to the Plan, shall comply with all requirements and conditions of the Permit.
- B. The Contractor shall provide the operation and maintenance necessary to keep all storm water controls at optimum efficiency.
- C. The Contractor shall inspect all sedimentation and erosion control facilities at least once per calendar day and within 24 hours after any storm event of 0.5 inches of rain per 24 hour period.
- D. The Contractor shall inspect storm water runoff discharges by visual observation at least once per calendar day, or more frequently if necessary, to evaluate the effectiveness of the pollution control facilities or practices. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.
- E. The Contractor shall keep a detailed record of inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. The record shall be made available to State

agencies upon request.

- F. The Contractor shall not discharge any sanitary wastewater from the construction activity.
- G. The Contractor shall not add any chemicals to the storm water discharge.
- H. Herbicide, pesticide, and fertilizer usage during construction activities shall be restricted to those materials approved by EPA and shall be in accordance with label restrictions.
- I. The Contractor shall dispose of all wastes composed of hazardous materials in accordance with Arkansas Department of Health and Environmental Quality, and rules governing the disposal of hazardous materials.
- J. Equipment utilized during the construction activities shall be properly operated and maintained in such a manner as to prevent the release of any oil, fuel, or other fluids to the surface or ground waters. Fuels, lubricants, hydraulic fluids, or any other petroleum products, shall not be stored, used, or disposed of in a manner that could result in the release of these fluids into the surface or ground waters. Spent fluids shall be properly stored and disposed of in accordance with state and Federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner that prevents the fluids from entering the surface or ground waters.

PART 2 - PRODUCTS

PART 3 - EXERCISES

END OF SECTION 02410

SECTION 02420 - FERTILIZING, SEEDING, AND MULCHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Permanent Seeding: Permanent seeding is required for all areas exposed by construction (except for areas covered by structures, pavements, etc.) within 15 days of completion of construction in any given location. Erosion control measures sufficient to restrain erosion must be provided within the specified time frame.
- B. Temporary Seeding: Temporary seeding is required for areas exposed by construction and left exposed for periods of 30 days or more. Areas must be brought to final grade and permanently seeded or mulched within the specified time frame or the specified planting season for the permanent seeding.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: In general, the work shall conform to the standards and guides published by the Soil Conservation Service and the National Association of Public Works Engineers.

1.4 SUBMITTALS

- A. Submit material samples to the supplier that the materials used for fertilizing and seeding comply with these specifications.

PART 2 - PRODUCTS

2.1

Seeding shall be based upon guidance in ARDOT Standard Specifications Section 620 "Seeding"

2.2

- A. Provide seed based upon guidance in ARDOT Standard Specifications Section 620 "Seeding"

2.3 MULCH

- A. Mulch all seeded areas except where jute mesh is required. Use undamaged, air-dry, threshed small grain straw free of undesirable weed seed.

2.4 JUTE MESH

- A. Use jute mesh on seeded areas where slope is steeper than three horizontal to one vertical (3:1 slope). Use woven jute yarn weighing approximately 10 lbs. per 100 sq. yds. and having 3/4" openings.

2.5 CURLED WOOD MATTING (EXCELSIOR MATTING)

- A. Use curled wood matting on temporary and permanent erosion control of existing dikes as indicated on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Follow procedures set forth in the Specification, latest edition, Section 621 "Temporary Erosion Control Devices"

3.2 SEED BED PREPARATION

- A. Remove all vegetation from the entire area to even out high and low spots.
- B. Spread a minimum of 6 inches of topsoil over all disturbed areas to the finish elevations shown on the drawings.
- C. Spread a minimum of three (3) inches and work into a satisfactory seed bed by rakes, harrows, drags or other approved means.
- D. Seeding operations shall not be done when the soil is frozen, wet or in an unfavorable condition.
- E. Complete seeding operations as outlined below as soon as possible after final or intermediate grading is completed.
- F. Distribute lime and fertilizer, as required, uniformly over seed bed and harrow, rake, or otherwise work same into seed bed.
- G. Distribute seed uniformly over seed bed. Lightly rake surface of seed bed to cover seed to a maximum depth of one-quarter (1/4) inch.

- H. Compact seed bed after covering seed with an approved roller or drag.
- I. No lime, fertilizer, or seed shall be applied during a strong wind, when soil is wet or otherwise unworkable. Should rain follow seeding before rolling is begun, the bed shall not be rolled.
- J. No riprap is to be placed along the banks of new fill. Maintain the area and repair any erosion damage until a permanent ground cover is established. Mulch or mesh as required.

3.3 APPLICATION OF LIME AND FERTILIZER FOR PERMANENT SEEDING:

- A. Lime with 90 lbs. per 1,000 sq. ft. before seeding.
- B. Fertilize with 15 lbs. per 1,000 sq. ft. when cover is established.
- C. Provide permanent seeding to complete permanent seeding period. If grading is complete, provide temporary seeding by the Engineer until the appropriate planting season.

3.4 APPLICATION OF FERTILIZER FOR TEMPORARY SEEDING:

- A. Fertilize with 15 lbs. per 1,000 sq. ft. before seeding. Top dress with 10 lbs. per 1,000 sq. ft. when cover is established.
- B. Liming as required.

3.5 APPLICATION OF JUTE MESH

- A. Apply temporary and permanent seeding at the rate of 100 lbs. per 1,000 sq. ft. and cover with asphalt.

Apply mesh according to the manufacturer's recommendations. Anchor with U-shaped wire staples.

3.6 REPAIR AND MAINTENANCE

- A. Maintain the grass on the area until dense grass growth is established. Reseed bare areas and repair all eroded areas as required to establish dense vegetation.

END OF SECTION 02420

SECTION 02515 - PORTLAND CEMENT CONCRETE PAVEMENT AND PATCHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of Portland cement concrete is shown on drawings, including curbs and paving.
- B. Prepared subbase is specified in "Earthwork" Section.
- C. Forms:
 - 1. Steel, wood, or other suitable material to resist movement during concrete placement and vertical alignment until removal. Use to prevent surface cracking and defects.
 - 2. Use flexible spring steel to form radius bends as required.
 - 3. Coat forms with release agent that will not discolor or deface surface.

PART 2 - PRODUCTS

2.1 WELDED FABRIC

- A. Steel wire fabric, ASTM A185.
- B. Fabric not rolls, unless otherwise acceptable to Resident Project Engineer.

2.2 REINFORCING BARS

- A. Deformed steel bars, ASTM A 615, Grade 60.

2.3 FABRICATED BAR MATS

- A. Welded or clip-assembled steel bar or rod mats, ASTM A184. Use ASTM A615, Grade 40 steel bars, unless otherwise indicated.

2.4 CONCRETE MATERIALS

- A. Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.

2.5 EXPANSION JOINT MATERIALS

- A. Comply with requirements of applicable Division 7 sections for expansion joint fillers and sealers.

2.6 ANTI-SPALLING COMPOUND

- A. 50% (by volume) boiled linseed oil and 50% (by volume) anti-spalling compound (AASHTO M233).

2.7 CURING AND SEALING COMPOUND

- A. TT-C-800, with 30% solids content.

2.8 CONCRETE MIX, DESIGN AND PROPORTIONS

- A. Comply with requirements of applicable Division 3 Sections for concrete mix design, sampling, curing, and as herein specified.
- B. Design mix for concrete consisting of Portland cement, aggregate, and a large water-reducing admixture (super-plasticizer) and water to produce the following properties:
 - 1. Compressive strength: 3000 psi minimum at 28 days.
 - 2. Air content: 2" - 4".
 - 3. Moisture content: 5% to 8%.

PART 3 - PREPARATION

3.1 PREPARATION

- A. Surface Preparation: Remove loose material from compacted subbase surface immediately before placing concrete.

- B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

- A. Set form to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work, so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed form work for grade and alignment to:
 - 1. Top of forms not more than 1/8" in 10'.
 - 2. Vertical face on longitudinal axis, not more than 1/8" in 10'.
- C. Clean forms after each use, and coat with oil or release agent as required to ensure separation from concrete.

3.3 REINFORCEMENT

- A. Locate, place, and support reinforcement in accordance with Division 3 sections unless otherwise indicated.

3.4 CONCRETE PLACEMENT

- A. Comply with Division 3 sections for mixing and placing concrete, and as indicated.
- B. Before concrete is placed, base and forms have been checked for line and level. Forms must be required to provide uniform dampened condition at all times. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- C. Use proper placing methods which prevent segregation of mix. Consolidate concrete by rodding face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint assemblies.
- D. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

3.5 JOINTS

A. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas 25' square. Construct weakened-plane joints for a depth equal to at least $\frac{1}{4}$ concrete thickness, as follows:

a. Tooled Joints: Form weakened-plane joints by forming by grooving top portion with a recommended tool. Finish edges with a jointer.

b. Sawed Joints: Form weakened-plane joints by sawing with saws equipped with shatterproof blades. Cut joints into hardened concrete. Joints shall not be torn, abraded, or otherwise damaged.

c. Inserts: Use embedded wood to form weakened-plane joints in concrete and carefully remove wood after concrete has hardened.

2. Construction Joints:

a. Place construction joints at planned placements and at locations where concrete is stopped for a period of more than $\frac{1}{2}$ hour, unless otherwise indicated. Construction joints terminate at expansion joints.

b. Use forms shown or if not shown, use standard metal forms.

c. Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

d. Locate expansion joints at 50' o.c. for each pavement lane, unless otherwise indicated.

B. Joint Fillers:

1. Extend joint fillers full width and depth of joint, and not less than $\frac{1}{2}$ " or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

2. Furnish joint fillers in one piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
3. Protect top edge of joint filler with metal cap or other material during the concrete placement.

3.6 FILLERS AND SEALANTS

- A. Comply with the requirements of applicable Division 7 sections for joints, materials, installation, and performance.

3.7 FINISHING

- A. After striking off and consolidating concrete, float and finish and floating. Use hand methods only when machine methods are not possible. Adjust floating to compact surface.
- B. After floating, test surface for hardness. If necessary, distribute concrete as required to remove soft spots. Refloat repaired areas to provide a continuous smooth surface.
- C. Work edges of slab with edging tool and round to $\frac{1}{2}$ " radius, unless otherwise specified. Do not leave tool marks on concrete surface.
- D. After completion of floating when excess moisture or surface sheen has disappeared, finish as follows:
 1. Sweep with a fine-hair broom across concrete surface, in direction of traffic. Repeat operation if required to provide a uniform finish.
- E. Formwork: Remove forms for 24 hours after concrete has been placed. After removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- F. Curing: Protect and cure finished concrete paving, complying with applicable requirements of Division 3 sections. Use curing and sealing compound or approved moist-curing methods.

Do not use membrane forming materials where anti-spalling treatment will be applied.

- F. Anti-Spalling Treatment: Apply compound to concrete surfaces no sooner than 28 days after placement. Apply to clean, dry concrete free of oil, dirt, and other foreign materials, in two (2) sprayed applications. First application at rate of 40 sq. yds. per gallon, second application at 60 sq. yds. per gallon. Allow complete drying between applications.

3.8 REPAIRS AND PROTECTION

- A. Repair or replace broken or defective concrete, as directed.
- B. Protect concrete from damage until acceptance of work. Cure concrete pavement for at least 14 days after placement. When permitted, maintain pavement as clean as possible and prevent spillage of materials as they occur.
- C. Sweep concrete pavement and wash free of dirt, oil, and other foreign material just prior to final inspection.

END OF

SECTION 02730 - MANHOLE AND VAULT CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of number, size, and type of manholes and vaults to be constructed is shown on the Drawings.
- B. Installation of manholes and vaults includes, but is not limited to, the following:
 - 1. Preparation of subgrade.
 - 2. Installation.
 - 3. Pipe connection and sealing.
 - 4. Waterproofing.
 - 5. Frames and covers.
 - 6. Backfilling.
- C. All manholes and vaults shall be constructed of precast concrete sections with watertight joints.

1.2 SUBMITTALS

- A. Shop drawings for the system, details of underground pipe, fittings, connections, and anti-flotation calculations shall comply with 01340 of these Specifications.

PART 2

2.1 MANHOLES AND VAULTS

- A. Concrete Base: Precast or cast-in-place as shown on the Drawings.
- B. Precast Concrete Manholes and Vaults: ASTM C 478, sized as indicated, with an eccentric cone or flat precast top as shown and O-ring joint conforming to ASTM C 493 or butyl rubber gasket conforming to AASHTO M198. Use flexible connectors with dual stainless steel pipe clamps meeting ASTM C 923 for all pipe diameters. Minimum wall thickness of precast vaults shall be 6". Minimum

manhole thickness shall be 5". All precast manholes and vaults shall be certified as sufficient for the service conditions.

2.2 ACCESSORIES

A. Manhole Frames and Covers: Grey cast iron, ASTM A 48, Class 30 B.

1. Manhole rings and covers shall comply with the following criteria:

- a. Minimum Total Weight: 300 lbs.
- b. Minimum Weight of Cover: 120 lbs
- c. Minimum Clear Opening: 24 in
- d. Unvented.
- e. Design Live Load: 1
- f. Bearing Surface
- g. Finish: U

2. Furnish manhole covers with "SANITARY SEWER" or "STORM SEWER" marking.

3. The manhole rings shall be fully bedded in a bitumastic material when secured to the top of the concrete

manhole ring and cover designed for H-20 loading.

bedded plastic, steel reinforced, integrally cast into sidewalls indicated.

PART 1 MANHOLE AND VAULT CONSTRUCTION

3.1 INSULATION OF CONDUIT

A. Precast Concrete Manholes:

1. Inspect precast sections before installation to detect any apparent defects. Mark defective materials with white paint and promptly remove from the site.

2. Particular care shall be taken to prevent damage to sections during handling and installation.
3. Place bell ends of manhole sections or the groove end of concrete facing down. Preparatory to making joints, all surfaces of the portion of the section to be jointed and the factory-made jointing materials shall be clean and dry.
4. Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special instructions.
5. Set tops of manhole frames and covers 3" above finished grade, unless otherwise indicated.

3.2 BACKFILLING

- A. See Section 02200.

3.3 TESTING

- A. Perform testing of completed manhole in accordance with Section 15001.

1-02730

SECTION 03310 - CONCRETE WORK

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. Extent of concrete work is shown on Drawings.

1.2 SUBMITTALS

- A. Product Data: Submit data for proprietary materials, reinforcement and forming accessories, admixtures, waterstops, joint systems, curing compounds, and others as requested by Engineer.
- B. Show Drawings; Reinforcement: Submit drawings for fabrication, bending, and placement of concrete reinforcement with ACI 315 "Manual of Standard Practice for Reinforced Concrete Structures" showing bar schedules, stirrups, cross bars, arrangement of concrete reinforcement, and details required for openings through concrete structure.
1. Engineer shall review structural applications and features only for structural stability and efficiency is
- C. Concrete: Submit laboratory test reports for concrete materials and methods as specified.
- D. Materials: Provide materials certificates in lieu of materials test results when permitted by Engineer. Materials certificates shall be provided by Manufacturer and Contractor, certifying that each material item meets or exceeds, specified requirements. Provide certification from Manufacturer that chloride content complies with Specification requirements.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, Specifications, and standards, except where more stringent requirements are shown or specified:
1. ACI 301 "Specifications for Structural Concrete for Buildings".
 2. ACI 318 "Building Code Requirements for Reinforced Concrete".

3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- B. Concrete Mix Design: Employ a testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes. Concrete mix design shall be at Contractor's expense. Field quality control testing of concrete is an allowance item.
- C. Materials and installed work may require testing and retesting during progress of work. Retesting of rejected materials for installation shall be done at Contractor's expense.

1.4 PROJECT CONDITIONS

- A. Protection of Footings Against Freezing: Contractor shall maintain footing level with sufficient temporary or permanent cover to prevent freezing of footings and adjacent subgrade against possibility of frost during winter time period as necessary.
- B. Protect adjacent finish materials from concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for walls: Plywood, metal, metal-framed plywood faced, or other materials, to provide continuous, straight, smooth surfaces in largest practicable sizes to minimize joints. Refer to joint system shown on Drawings.
- B. Formwork for Slab-on-Ground Concrete: Plywood, lumber, metal, or other materials. Provide lumber dressed on at least two (2) edges and one (1) end.
- C. Formwork Release Agents: Provide commercial formulation form-coating compounds that will not bleed through, stain, nor adversely affect concrete surfaces, and will not interfere with subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties with cones, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface.
 1. Provide ties with cones which, when removed, will leave holes not larger than 1" diameter in concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric - flat sheets only.
- D. Welded Deformed Steel Wire Fabric: ASTM A 497.
- E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and fabric in place. Use wire bar type supports complying with:
 - 1. For slabs-on-grade, use supports with flat base plates or concrete blocks where base material will not support the weight of the concrete blocks meeting CRSI requirements.
 - 2. For exposed-to-view concrete, use supports that are plastic protected (CRSI, Class 1) or painted (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: Type I or II.
- B. Use one (1) cementitious material per project, unless otherwise acceptable to Engineer.
- C. Fly Ash: Type C or Type F. Amount of fly ash not to exceed 25% of total cementitious material.
- D. Blast Furnace Slag: ASTM C-989. Amount of slag not to exceed 25% of total cementitious material.
- E. Aggregates: ASTM C 33, and as herein specified. Use No. 57 (467 (1-1/2") coarse aggregate. Provide aggregates from a single source for exposed concrete.

For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
- F. Water: Drinkable.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

- d. "Sikament"; Sika Chemical Corp.
- e. "Mighty 150"; ICI Americas Corp.
- f. "Eucon 37"; Euclid Chemical Co.
- g. "PSI Super"; Gifford-Hill.
- h. "Rheobuild"; Master Builders.
- J. Water-Reducing, Non-Chloride Accelerator Admixture, Type E, and containing not more than 0.1 percent chloride ion.1.
 - Products: Subject to compliance with requirements, provide product equal to one (1) of the following:
 - a. "Accelquard 80"; Euclid Chemical Co.
 - b. "Pozzolith High Flow"; Euclid Chemical Co.
 - c. "Gilco Accelerator"; American Admixtures
- K. Water-Reducing, Retarding Admixture, Type D, and containing not more than 0.1 percent chloride ion.1.
 - Products: Subject to compliance with requirements, provide product equal to one (1) of the following:
 - a. "Rheobuild"; Master Builders.
 - b. "Eucon 37"; Euclid Chemical Co.
 - c. "W.R. Grace"; W.R. Grace.
 - d. "PSI R"; Gifford-Hill/American Admixtures.
 - e. "Plastiment"; Sika Chemical Co.
- L. Retarding Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

2.4 RELATED MATERIALS

- A. Expanding Rubber Waterstops: Use expanding rubber waterstops in all joints of sanitary slabs and walls which retain water. Waterstops and accessories shall be "Adeka Ultra Seal" or equal. For pricing and availability call Adeka Ultra Seal at 1-800-999-3959.

1. At joints use Adeka Ultra Seal MC-2010M preformed rubber waterstop or equal.
 2. Use Ultra Seal P-201 hydrophilic caulk (or equal) and accessories as required for proper installation of MC-2010M.
- B. Vapor Barrier: Provide a vapor barrier where indicated on Drawings below slabs on grade. Use a laminated vapor barrier which is resistant to puncture and tested in accordance with ASTM E 154.
1. Select one (1) of the following or an approved equal:
 - a. Moistop by Fortifiber Corp.
 - b. T-65 by Griffolyn
 - c. Rufco 400 by Raven
- C. Non-Shrink Grout: CRD-C 660 or approved equal pre-mixed grout.
1. Products: Subject to approval of the Engineer, provide product equal to one (1) of the following:
 - a. "Moistop" by Fortifiber Corp.
 - b. "T-65" by Griffolyn
 - c. "Rufco 400" by Raven
 - d. "Sonneborn-Rexnord" by Sonneborn-Rexnord.
 - e. "Euclid NS" by Euclid Chemical Co.
 - f. "Gifford-Hill/American" by Gifford-Hill/American; Admixtures.
 - g. "Crystex" by L & M Const. Chemical Co.
 - h. "Sure-Grip Grout" by Dayton Superior Corp.
 - i. "Horngrout" by A.C. Horn, Inc.
 - j. "Five Star Grout" by U.S. Grout Corp.
- D. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

E. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

F. Curing Compound: ASTM C-309

1. Formed surfaces shall be cured with an oxidizing compound, such as Resi-Chem Clear Cure by Symons.
2. Slabs shall be cured with one (1) of the following brands:
 - a. "Masterkure" by Master Builders Products
 - b. "Super Rez-Seal" by Resi-Chem
 - c. "Kure-N-Seal 2" by Resi-Chem Products
 - d. "Dress & Seal" by Resi-Chem Chemicals Co.

H. Bonding Compound: One of the following, applied to the base.

1. Products meeting the following requirements, provide product equal to or better than:
 - (1) "Hornweld"; Euclid Chemical Co.
 - (2) "Weldcrete"; Larsen Products Corp.
2. Acrylic or Styrene Butadiene:
 - (1) "J-40 Bonding Agent"; Dayton Superior Corp.
 - (2) "Everbond"; L & M Construction Chemicals.
 - (3) "Hornweld"; A.C. Horn, Inc.
 - (4) "Sonocrete"; Sonneborn-Rexnord.
 - (5) "Acrylic Bondcrete"; The Burke Co.

(6) "SBR Latex"; Euclid Chemical Co.

(7) "Daraweld C"; W.R. Grace

I. Epoxy Adhesive: ASTM C 881, two (2) component materials suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. "Thiopoxy"; W.R. Grace.

b. "Epoxcite"; A.C. Horn, Inc.

c. "Edoco 2118 Epoxy Adhesive"; Euclid Chemical Co.

d. "Sikadur Hi-Mod"; Sika Corp.

e. "Euco Epoxy 4000"; Euclid Chemical Co.

f. "Patch and Repair"; Euclid Chemical Co.

g. "Concrete Repair"; Engineering Co.

J. Concrete Repair: For repairing defective areas of concrete.

1. Products: For repair of concrete surfaces, use one (1) of the following:

a. "Five Star Structural Concrete V/O"; Five Star Products, Inc.

b. "Concrete Coat"; Euclid Chemical Co.

c. "Sikatop 122"; Sika Corp.

d. For horizontal surfaces, use one (1) of the following:

a. "Five Star Structural Concrete"; Five Star Products, Inc.

b. "Concrete Coat"; Euclid Chemical Co.

c. "Sikatop 122"; Sika Corp.

K. Concrete Coating: For finishing all new formed concrete exposed to view, exterior and interior.

1. Products: Use Thoroseal by Thoro or approved equal. Color to be pearl gray to match existing concrete finishes.

2.5 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports to Structural Engineer of each proposed class of concrete at least 25 days prior to start of work. Do not start production until mixes have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following characteristics and proportions:
 1. Compressive strength shall be as specified on Drawings.
 2. Design mix for sanitary walls shall contain either 12% to 25% fly ash or 25% to 35% blast furnace slag as a percent of total cementitious material.
 3. Maximum water/cement ratio shall be as specified on Drawings and shall be measured before the concrete is placed. Use the following maximum water/cement ratios for concrete Admixtures below for where a H.R.V. is not specified.
 4. Maximum water/cement ratio shall be 0.45 for all concrete used in sanitary walls.
- D. Grout for filling CMU cells or as leveling grout shall be a minimum of 1 part cement and 3 parts sand and shall have a compressive strength of 3000 psi unless noted otherwise on Drawings.
- E. Grout used for the first lift in sanitary walls (see Paragraph 3.8, C.) shall have pea gravel for a coarse aggregate and a maximum water/cement ratio of 0.45 and a minimum compressive strength of 4000 psi at 28 days.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

E. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (H.R.W.R.) in concrete as required for placement and workability. An H.R.W.R. is required for all concrete in walls and for other concrete which is pumped. It is optional for other concrete which is not pumped.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).
3. Use air-entraining admixture in all concrete. Admixture shall be added at manufacturer's prescribed rate to result in concrete having total air content within following limits:
 - a. Concrete structures and slabs exposed to freezing, thawing, deicer chemicals, or subjected to other conditions requiring air-entrainment:
 - (1) 5.5 ± 1 percent for concrete with maximum aggregate size (1½")
 - (2) 6.0 ± 1 percent for concrete with maximum aggregate size (¾")
 - b. Other Concrete structures not exposed to freezing, thawing, or hydraulic pressure shall contain 4.0 to 6.0 percent air.

2.6 CONCRETE MIXING

- A. Ready-Mix Concrete shall conform to the requirements of ASTM C 94, and as herein specified.
- B. Precautions shall be taken to avoid conditions contributing to rapid setting of concrete, and any special precautions specified in ASTM C 94 may be required.

When the ambient temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1-1/2 hours to 1 hour, and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

For concrete structures greater than 3 feet in thickness, the temperature of the mix shall be controlled by approved methods to a temperature not greater than 70 degrees F at the time of placement.

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

A. Design, erect, support, brace, and maintain formwork to sustain all lateral, static, and dynamic loads that might be applied to and supported by concrete structure. Construct formwork for all structures are of correct size, shape, alignment, elevation, and formwork construction tolerances complying with the following:

B. Design formwork to be readily removable without damage to cast-in-place concrete surfaces and adjacent structures.

C. Construct forms to sizes, shapes, and locations required and to obtain accurate alignment, location, and finish of all surfaces in finished structures. Provide for openings, offsets, and details such as, but not limited to, moldings, rustications, reglets, chases, and other details. Use of heads, anchorages and inserts, and other features to obtain required finishes. Provide back-up at joints to prevent leakage of cementitious materials.

D. Fabricate forms so that hammering or prying against concrete surfaces or stripping plates where stripping may damage cast-in-place concrete. Use of forms for inclined surfaces where slope is too steep for standard forms only. Kerf wood inserts for forming and the like, to prevent swelling and for easy removal.

E. Provide openings where interior area of formwork is inaccessible for inspection before concrete placement, and for placement of concrete. Provide temporary openings and set tightly to forms to prevent loss of concrete. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer all exposed corners and edges unless noted otherwise, using wood, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

- A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of placement.
- B. Lap joints 6" and seal with appropriate tape.

3.4 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute (CRSI) Manual for "Placing Reinforcing Bars", for details and methods of placement and supports, and as herein specified.
 - 1. Avoiding cutting or puncturing reinforcement during placement and concrete placement.
- B. Clean reinforcement of oil, grease, ice, and other materials which reduce or destroy bond.
- C. Accurately position reinforcement against displacement by formwork, concrete placement operations. Locate and support reinforcing bars with chairs, spacers, and hangers, as required.
- D. Place reinforcement to meet minimum coverages for concrete protection. Arrange bars and bar supports to hold reinforcement in position during placement operations. Set wire ties so ends are directed away from exposed concrete surfaces.
- E. Lay out fabric in as long lengths as practicable. Lap adjoining pieces of fabric with all mesh and lace splices with wire. Offset end laps in adjacent direction. Do not have continuous laps in either direction.

3.5

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.
- B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

- C. Waterstops: Provide waterstops in all joints of walls and slabs which retain water, whether indicated on the Drawings or not. Follow manufacturer's instructions for installation of all other type waterstops. Make provisions to support and protect exposed waterstops during progress of work. Install waterstops to form a continuous diaphragm by connecting waterstops at intersecting joints. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

1. Allow a minimum of 2 inches of concrete cover (more if required by manufacturer) on all sides of waterstop.
2. Over rough surfaces apply a continuous layer of hydrophilic compound (Adeka P-201) over the rubber waterstop over the caulk.
3. At straight intersections lap waterstops and apply hydrophilic caulk over joint.
4. At corners cut the waterstop at 45° angle and apply hydrophilic caulk.

- D. Isolation Joints in Slabs-on-Ground: Provide isolation joints in slabs-on-ground at points of contact between slabs and vertical structural surfaces, such as column pedestals, footings, walls, and elsewhere as indicated.

1. Joint fill as specified in Division-7 Sections of these Specifications.

- E. Contraction Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade in channels of patterns as shown. Use saw cuts 1/8" x 1/2" deep as indicated.

3.6 PRECAST AND CAST-IN-PLACE CONCRETE

- A. Embedment: Embed into work anchorage devices and other embedded items for work that is attached to, or supported by, cast-in-place concrete. Follow drawings, diagrams, instructions, and directions provided by manufacturer for items to be attached thereto.

- B. Wall and Floor Reglets: Provide reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

- C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of same kind and under conditions of form-coating compound manufacture. Do not allow excess form-coating material to accumulate in areas of contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-inhibiting compound to protect against rusting. Rust-stained steel forms shall be removed and replaced.

3.8 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before concrete is placed, inspect and complete formwork installation, repair, and reinforcement. Notify other crafts to coordinate work; cooperate with other trades in setting such work. Notify the A/E Field Representative immediately before placing concrete where formwork is used.
 - 1. Avoid placing concrete against or within 2' of finished walls adjacent to existing structures. Use proper bracing and shoring conditions, and guard against spattering.
- B. Concrete shall be placed in accordance with ASTM C 94 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", and as herein specified.
 - 1. Deposit concrete continuously or in layers of such thickness that no layer will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
 - 2. Water shall not be added at the site without permission from the A/E Field Representative. Any water which is added shall be recorded on the Delivery Ticket and Test Report.
- C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still

plastic to avoid cold joints. Do not drop concrete a vertical distance greater than five (5) feet. To place concrete lifts greater than five (5) feet, use a hose, drop chute, or other approved method.

1. First lift at bottom of wall is to be a 6" (minimum) layer of wall base grout (see mix design) to avoid honeycombing around key. Grout lift may be omitted at non-critical walls at the discretion of the Engineer.
2. Consolidate placed concrete by mechanical vibrating supplemented by hand-spading, rodding, or tamping. Refer to Appendix A and procedures for consolidation of concrete in accordance with ACI 306.
3. Do not use vibrators to transport concrete. Withdraw vibrators vertically at uniform rate. Do not use vibrators until visible effectiveness of machine is achieved. Do not penetrate placed layer and at least 6" into previously placed concrete. Do not insert vibrators into lower layers of concrete than the layer immediately above. Limit duration of vibration to the minimum time necessary for complete embedment of reinforcement and other embedded items without causing segregation of concrete.

D. Placing Concrete Slabs: Place concrete slabs in a continuous operation, within limits of one lift per panel. Complete the placing of a panel or section is complete before starting the next panel or section.

1. Consolidate concrete by mechanical vibrating operations so that concrete is thoroughly consolidated around reinforcement and other embedded items and around all corners and edges.
2. Finish top surface of concrete to correct level with straightedge and strikeoff. Use broom or other approved method to smooth surface, free of humps or hollows. Do not use broom or other method to finish surface prior to beginning finishing operations.

3. Maintain reinforcement in proper position during concrete placement and curing.

4. Winter Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in accordance with ACI 306.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

F. Hot Weather Placing: When the ambient air temperature is above 85 degrees F, provisions shall be made to account for hot weather.

1. During hot weather concreting, the Contractor shall submit to the A/E Field Engineer for acceptance the method of maintaining proper temperature and moisture during the mixing, placing, and curing period. In general, concrete shall be controlled as recommended in ACI 305R.
2. The temperature of the concrete as placed shall not exceed 90 degrees F. The mixing water and/or aggregates shall be cooled as necessary to maintain a satisfactory placing temperature.
3. See "Concrete Curing and Protection" and specify curing methods required during hot weather.

3.9 FINISH OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces exposed to view in the finish work or by other construction. This would include wall surfaces one (1) foot below the normal water level. This is the concrete finish obtained by form facing material used, with tie holes patched and fins and other projections exposed and chipped off.
- B. Smooth Form Finish: For concrete surfaces that are to be covered with a coating material, or a covering material applied directly to the concrete surface, such as painting, dampproofing, veneer plaster, or other similar material. The concrete surface obtained with selected form facing material and symmetrically with a minimum of seams. Projections with fins or other projections completely

1. For all new formed concrete exposed to view, exterior surfaces should include exposed wall surfaces extending to one foot below the lower limit of the normal water line. Use quality forms. Chip away all high spots.

1. Surfaces shall be wet cured or cured with a curing compound compatible with the coating.
2. Prepare substrate by wet blasting or other approved method. Follow manufacturer's recommendations for surface preparation.
3. Apply two coats of concrete coating with each coat being 1/16" thick minimum. Follow manufacturer's recommendations for application and curing.

4. A manufacturer's representative shall be present at the site during the first application to assure that all recommendations are being followed.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

- A. Float Finish: Apply float finish to monolithic slab surfaces, and other finishes as hereinafter specified, and slab surfaces to be covered with membrane or elastic waterproofing, or sand-bed terrazzo, and as otherwise indicated.
 1. After screeding, consolidating, and striking off, do not work surface until ready for floating. Wait until surface water has disappeared or when concrete is sufficiently stiff to permit operation of power-driven floats. Finish with power-driven floats, or by hand-floated, if necessary to power units. Check and level surface to tolerances of FF 18 - FL 15. Cut down high spots and depressions to drain. Immediately finish to a uniform, smooth, granular texture.
- B. Trowel Finish: Interior monolithic slab surfaces to be exposed, or to be covered with resilient flooring, carpet, ceramic tile, or other thin film finish coating, system.
 1. First trowel finish operation using a power-driven trowel. Stop troweling when surface produces a ringing sound as trowel passes over surface. Consolidate concrete surface by final troweling operation, free of trowel marks, uniform in texture and finish, and with surface leveled to tolerances of FF 20 - FL 17. Grind surface defects which would telegraph through applied floor covering system.
- C. Level and Fine Broom Finish: At all interior ramps, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- D. Float and Medium Broom (Non-Slip) Finish: Apply non-slip broom finish to exterior concrete platforms, steps, ramps, walkways, tank slabs, channel slabs, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- E. Scratch Finish: Slab surfaces to receive a grout overlay or other cementitious application shall be thoroughly raked or wire broomed after partial setting (within two (2) hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.

3.11 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying by cold or hot temperatures.
- B. All concrete surfaces shall be cured for a minimum of 7 days by one of the following methods and in accordance with the following:
- C. Curing Methods: Perform curing of concrete surfaces by one of the following methods, by moist curing, by moisture-retaining compound, or by any other method approved by the Engineer, as herein specified.
- D. Provide moisture curing by the following methods:
1. Keep concrete surfaces continuously wet by covering with water.
 2. Continuous wet curing by ponding or spraying with water.
 3. Cover concrete surfaces with specified absorptive cover, thoroughly wetted and keeping continuously wet. Place cover material to provide full coverage of concrete surfaces and edges, with absorptive covers.
- E. Curing by membrane curing compound as follows: Cover concrete surfaces with membrane curing compound for curing concrete, placed in widest practicable width with joints lapped at least 3" and sealed by waterproof tape of adhesive. Repair any holes or tears during curing period using cover material and waterproof tape.
- F. Provide curing by membrane curing compound as follows:
1. Apply one (1) coat of specified curing compound to concrete at the manufacturer's recommended rate. Apply uniformly in continuous operation by power-spray or roller. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Do not use membrane curing compounds on concrete surfaces which are to receive liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, or other coatings and finish materials, unless the Contractor obtains written verification from the manufacturer that his product is compatible with the curing compound.

3. During hot weather concreting if a curing compound is used, the slab shall still be moist cured for 12 hours immediately following placement.

- G. Curing Formed Surfaces: Cure formed concrete surfaces, including beams, supported slabs, and other similar surfaces by keeping forms in place for full curing period. In hot weather keep the forms moist and removed before the end of the curing period, cover with curing compound, as specified above, as applicable. See Part 2 for details on use on walls.

1. Hot Weather Curing: During hot weather, keep forms moist and covered with plastic until forms are removed before the end of the curing period. If a curing compound, keep walls moist, and cover with plastic during the curing period.

- H. Curing Unformed Surfaces: Curing methods, such as slabs, floor topping, and other flat surfaces, shall be as specified in the curing methods.

3.12 REMOVAL OF FORMS

- A. Formwork for concrete, such as sides of beams, walls, columns, and other work, except gravity walls may be removed after concrete has attained a minimum temperature of 50 degrees F (10 degrees C) for 48 hours after placement and provided curing and protection operations are completed.

B. Formwork for supporting weight of concrete, such as beam soffits, joists, slabs, and other elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days.

C. Determine the potential compressive strength of in-place concrete by testing cured specimens representative of concrete location or members.

- C. Form facing material may be removed four (4) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.13 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

3.14 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete by other trades, unless otherwise shown. If other trades is in place. Mix, place, and cure concrete to blend with in-place construction. Provide other details as shown or required to complete work.
- B. Curbs: Provide monolithic curbs using chipping forms while concrete is still green and finish with a hard, dense finish with corners, intersections, and ends as indicated.
- C. Equipment Bases: Provide machine and equipment bases and foundations as indicated. Provide anchor bolts for machines and equipment as indicated, complying with certified diagrams or templates for machines and equipment.
- D. Foundations: Provide foundations as indicated, using specified non-shrink concrete. Use non-shrink grout for exposed conditions, unless otherwise indicated.
- E. Grout: Provide concrete grout for reinforced masonry lintels and as indicated on Drawings and as scheduled. Maintain accurate placement of reinforcing steel during concrete placement.

3.15 REPAIR OF EXISTING CONCRETE

- A. Refer to Drawings for locations of existing walls and slabs to be removed. See Drawings for dowels and other requirements which may not be stated below.
- B. Where new concrete is to be placed against the cut surface of an existing wall or slab, then the wall or slab may be sawcut clear through or it may be sawcut 1" deep (minimum) on exposed surfaces and the remainder chipped away. If chipping is done, then the Contractor must take precautions not to damage the existing concrete which is to remain.

- C. Where the cut surface of the wall or slab is to be exposed to water or earth but not exposed to view, then the wall or slab is to be sawcut clear through. At all exposed rebars, chip out the concrete around the rebar for a distance of 2" and to a depth of 1/4". Apply Five Star Structural Concrete (V.O.) to the chipped-out area with a trowel to obtain a 1/2" cover over the rebar.
- D. Where the cut surface of the wall or slab is to be exposed-to-view, the entire cut surface is to be roughened to obtain a 1/8" amplitude. Five Star Structural Concrete is to be applied with forms to achieve a smooth surface at least 1" thickness.

3.16 CONCRETE SURFACE REPAIRS

- A. Formed Surfaces: Normal form tie holes shall be filled with repair grout applied with a bonding agent. Defective areas, including surface scaling, honeycombing, or segregation with a depth (measured from the surface to the bottom of the defect) greater than or equal to 1/2" shall be repaired with repair grout specified in this Section. The depth of the repair shall be cut out to solid concrete such that the thickness of patch is at least 1" around. Do not feather-edge. At defective areas, the Contractor may substitute a sand-cement grout applied with a bonding agent that closely match the color of the wall.
 - B. Slabs:
 - 1. Repair areas greater than 12" x 12" shall be cut with square cuts and chipping to a depth of 1/2" and shall be filled with a concrete repair grout specified in this Section.
 - 2. Cracks 1/8" to 1/4" are to be filled with "Crack Fill 4" by Duro-Flex. Cracks greater than 1/4" are to be filled with "MM-80" by Masticrete. Follow manufacturer's recommendations.
 - 3. Defective areas which cannot be repaired by one (1) of the above methods shall be removed and replaced at the Contractor's expense.
- For surface preparation and installation of concrete repair grouts, follow manufacturer's recommended procedures.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. A testing laboratory will be employed by the Owner and paid by the Owner to perform tests and to submit test reports. The testing laboratory must be approved by the Engineer.

- B. Sampling and testing for quality control during placement of concrete shall include the following, as directed by Engineer.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one (1) test at point of truck discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 2. Air Content: ASTM C 173, volumetric method for normal weight concrete; ASTM C 231 pressure method for lightweight concrete; one (1) for each day's pour of each type of concrete.
 3. Concrete Temperature: Test hour after placement, at 4 degrees F (4 degrees C) and below, and at 4 degrees F (4 degrees C) and above; and each time a set of test specimens is made.
 4. Compression Test Specimens: One (1) set of four (4) standard cylinders for each day's pour of each type of concrete, unless otherwise directed. Mold and store test specimens in accordance with ASTM C 31 except when field-cure test specimens are required. Contractor shall provide the testing laboratory with a container to store test cylinders on site for 24 hours.
 5. Compressive Strength: ASTM C 39; one (1) set for each day's pour of each type of concrete. As additional sets for each 100 cu. yds. over 100 cu. yds. of each concrete class placed in any one (1) batch, one (1) set of test specimens shall be made. One (1) specimen tested at seven (7) days, two (2) specimens tested at 28 days. One (1) specimen retained in reserve for later testing if required.
- If the frequency of testing will provide less than five (5) strength tests for the life of the project for a given class of concrete, conduct testing on at least five (5) randomly selected batches or from each batch if more than five (5) are used.
- D. Test results will be reported in writing to the Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

- E. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.
- F. Substandard Concrete: Any concrete furnished under this Specification that fails to reach the required design compressive strength after 28 days as determined by the compressive strength test specified herein shall be considered substandard.
1. The procedure specified in ACI 318 for the Field Test of Concrete shall be used to determine if the concrete is substandard. Any substandard concrete which is removed and replaced shall be so at the Contractor's expense.
 2. For substandard concrete which is removed and replaced, the Contractor shall reimburse the Owner an amount equal to the difference between the actual 28-day concrete strength and the specified compressive strength for each cubic yard of concrete removed. The reimbursement shall be based on the one (1) lowest of the 28-day compressive strength test results. The reimbursement shall be deducted from the Contractor's payment for the work under Change Order.

1-03310

PART 1 - GENERAL

A. The work under this Section consists of furnishing all labor, materials, equipment and all other items necessary for the complete and approved installation of the structural steel as indicated on the Contract Documents as specified herein. All work shall be in agreement with the General and Supplementary Conditions.

A. All welding work shall be in conformance with the following:

B. All welders, both shop and field, who are not permitted, shall have satisfactorily passed the written and practical tests of AWS D1.1. The welder must have been employed in the previous twelve (12) months, or within the previous twelve (12) months, if a statement is provided stating that the welder has been employed in a similar welding capacity.

C. The Contractor shall ensure that all welders are in full compliance with these Specification requirements.

A. The following standards shall form a part of this Specification to the extent that they are referred to in the text by the basic designation and shall be the latest edition.

- STRUCTURAL STEEL
1-05120 - 1

2. American National Standards Institute (ANSI) Publications: B.18.22.1 - Plain Washers.
3. American Society for Testing and Materials (ASTM) Publications:
 - (a) A 36 - Structural Steel.
 - (b) A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated and Welded and Seamless.
 - (c) A 108 - Steel Bars, Carbon, Cold-Finish.
 - (d) A 153 - Zinc Coating (Hot Dip) on Iron and Steel.
 - (e) A 307 - Carbon Steel Bolts and Nuts, High-Strength, Hex Headed and Hex Headed Flange.
 - (f) A 325 - High-Strength Low-Alloy Columbium-Vanadium Bolts and Nuts.
 - (g) A 490 - Heat Trengthened High-Strength Low-Alloy Columbium-Vanadium Bolts and Nuts, Hex Headed and Hex Headed Flange.
 - (h) A 500 - Structural Steel Shapes, High-Strength Low-Alloy Columbium-Vanadium Steels of Wide Flange Shapes.
 - (i) A 515 - Structural Steel Shapes, High-Strength Low-Alloy Columbium-Vanadium Steels of Wide Flange Shapes.
4. American Welding Society (AWS) Publication: D1.1 - Structural Welding Code, Steel.
5. Research Council on Riveted and Bolted Structural Joints of the American Institute of Steel Construction (RCRBSJ) Publication: Specification for Structural Joints Using ASTM A325 or A490 Bolts.
6. Steel Structures Painting Council (SSPC) Publications:
 - (a) SSPC-SP3 - Power Tool Cleaning.
 - (b) SSPC-SP6 - Commercial Blast Cleaning.

1.4 SUBMITTALS

- A. Make submittals in accordance with Division 1.
- B. Certificates of Conformance: Submit certificates of conformance for the following upon request:
1. Steel.
 2. Common Bolts.
 3. High-Strength Bolts.
 4. Welding Electrodes and Rods.
 5. Zinc - Coating.
 6. Shop Primer.
 7. Welder Qualification.
- C. Shop Drawings:
1. Submit Shop Drawings with Division 1 prior to fabrication of structural steel. Shop Drawings shall:
 - a. Provide details and schedules for fabrication and shop drawings. Indicate connections and details of cuts, connections, camber, and other pertinent data. Indicate welds by standard AWS symbols. Indicate weld size, length, and type of each weld.
 - b. Indicate primer to be used and final dry film thickness.
 - c. Provide setting or erection Drawings for the installation of anchor bolts and other anchorages or embedded items to be installed by others.
- In review of Shop Drawing A/E shall not be deemed to have conducted structural analyses or detailed review of standard details prepared under fabricator's design responsibility.
- D. The Contractor shall check and stamp all submittals for conformance with these Specifications and with the Drawings before submission to the A/E.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Handle, ship and store material in a manner that will prevent distortion of other damages. Store materials to permit easy access for inspection and identification. Place material in a clean, properly drained location out of contact with the ground. Replace all damaged material with new material or repair the damaged material in a manner approved by the A/E.

1.6 SEQUENCING/SCHEDULING

- A. Shop fabrication shall be sequenced/scheduled so that delivery, erection, will minimize field handling of materials, and progress of the work.

PART 2 - MATERIALS, PRODUCTS, AND DESIGN

2.1 MATERIALS

- A. Steel and accessories shall conform to the following specifications and conditions herein. Materials not otherwise specified shall conform to the recommendations in the AISC "Manual of Steel Construction".
 - 1. Angles, Channels, and Plates (Carbon Steel): ASTM A36.
 - 2. Steel Pipes: ASTM A53, Types E or S, Grade B.
 - 3. Structural Tees: ASTM A992, Grade B.
 - 4. High-Strength Steel (High-Strength Steel): ASTM A572, Grade 50 or ASTM A514, Grade 50.
 - 5. Bolts and Nuts: ASTM A307 with cut threads.
 - 6. High-Strength Steel Bolts: ASTM (A325, Type N) (A490, Type N).
 - 7. Circular Washers for Anchor Bolts and Common Bolts: ANSI B18.22.1.
 - 8. Welding Electrodes and Rods: AWS Code D1.1.
 - 9. Zinc-Coating: ASTM A123 for steel and ASTM A153 for threaded products.

11. Welded Steel Studs or Concrete Anchors: ASTM A108 Grade 1015 cold drawn steel, automatic weld type.

2.2 FABRICATION

- A. Except as otherwise stated in these Specifications, fabricate structural steel with the applicable provisions of the Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings as set forth in Part 5 of the AISC "Manual of Steel Construction", with the AISC "Quality Criteria and Inspection Standards", and with the final approved Shop Drawings. Fabricate and assemble structural components in the shop to the greatest extent possible.
 1. Welding: Only shielded electric arc welding shall be used.
 2. Identification: Properly mark and maintain identification of each member and assembly. Painted assembly marking shall be applied to the surface to be welded or bolted.
 3. Connections: Fabricator shall provide details of connections for which details are not in the Specifications. The design shall be in accordance with the AISC "Manual of Steel Construction".
 - a. Unless otherwise specified for on the Drawings, all shop bolted connections shall be bolted. Unless otherwise shown, connections shall be bolted with 3/4" diameter A325 bolts. Drawings for location of slip critical bolted connections shall be provided.
 - b. All connections shall have milled end bearings and cap plates.
 - c. Angle beam connections shall be used unless shown on Drawings.
 - d. Do not cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Provide holes required for securing other work to structural steel framing. Oversized holes in base plates for anchor bolts shall not exceed the anchor bolt size plus 5/16". When oversized holes are used in base plates, provide 3/8" plate washers in addition to circular washers for anchor bolts.
 4. Shop Painting: Except as otherwise specified, shop paint all structural steel work, except zinc-coated surfaces, slip critical connection surfaces, and steel work to be embedded in concrete.

- a. Surfaces to be welded shall not be coated within 2" from the specified toe of the weld prior to welding, except that paint will be allowed on surfaces to which metal decking is to be welded.
 - b. Ensure that surfaces are thoroughly dry and clean when the paint is applied.
 - c. Apply paint in a workmanlike manner, and coat all surfaces and crevices thoroughly.
 - d. No material shall be shipped until the surfaces are sufficiently dry to prevent scarring of the paint.
 - e. Remove loose mill scale, heat-affected metal, weld deposits, and other foreign material from surfaces to be painted in accordance with SSPC-PA 1.
 - f. See Section 09900 for painting requirements.
 - g. Repair any damaged areas with the same primer.
5. Galvanizing: Surfaces noted on the Drawings as being galvanized shall be galvanized. Thoroughly clean all weld slag, weld spatter, and other foreign matter from surfaces to be galvanized by mechanical cleaning methods. Before any visible rust appears, treat the surfaces in accordance with ASTM A153. Repair damaged areas with a galvanizing repair paint.

PART 3 - EXISTING CONDITIONS

3.1

Examine and check the areas and field conditions for the proper location, elevation, and orientation of anchor bolts, bearing plates and other items that are embedded in concrete or masonry work to which the structural steel is to be installed. The erector must notify the Contractor and the Architect in writing of conditions detrimental to the proper and timely completion of the work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the erector (and the A/E).

3.2 INSTALLATION/APPLICATION/ERECTION

A. Erect steel in accordance with the AISC "Manual of Steel Construction" and Code of Standard practice for Steel Buildings and Bridges. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Contractor and A/E and obtain approval therefrom for the methods of correction before proceeding with making any corrections.

1. All holes fabricated in the field for connections to steel, or any other required field-fabrications, shall be
2. Misaligned holes in members shall not be use of drift pins.
3. Gas cutting torches shall not be use fabrication errors in the structural framing
4. The erector shall provide temporary guys, braces, shoring, etc. to a steel framing against loads comparable in the completed structure is designed.
5. The erector shall accurately to the lines and elevation a part of a complete frame or structure permanently fastening. Bearing surfaces and in permanent contact shall be cleaned shall perform necessary adjustment to in elevations and alignment. Temporary guy to achieve proper alignment of the structure as
6. All clean concrete bearing surfaces of bond reducing and roughen the surface to improve bond prior to setting bases plates. Set loose and attached base plates and bearing plates structural members on steel wedges or other adjusting devices. Tighten anchor bolts after the supported members have been positioned and grumbed. Do not use impact torque wrenches to tighten anchor bolts set in concrete. Wedges or shims shall be removed after initial grouting has set. The resulting holes shall be packed with grout. Grout the area under the plate solidly with a nonshrinking grout in accordance with Section 03300 Cast-In-Place Concrete of these Specifications.
7. High-strength bolts shall be tightened to the snug tight condition (unless noted otherwise on the Drawings) by the prescribed methods in

accordance with the RCRBSJ Specification for Structural Joints Using ASTM A325 or A490 bolts.

8. Immediately after erection, field welds, bolted connections, and abraded areas of the shop finish shall be cleaned. Exposed areas of the shop primer shall be touched-up with the same material as used for shop painting to provide the minimum dry film thickness. Zinc-coating shall be repaired with a galvanizing repair paint.
9. The erected structural steel shall be within the tolerances specified with the AISC Code of Standard Practice for Steel Erection, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, and the Quality Criteria and Inspection Manual for Steel Erection.

3.3 FIELD QUALITY CONTROL

- A. The Contractor shall inspect the work to ensure compliance with the Drawings and Specifications. He shall check the quality of materials, connections, completeness, paint touch-up, and the interface with related work.
- B. The Owner may engage a third party testing and inspection agency to inspect building alignment, connections and welded connections, to perform tests and tests. Such inspection and testing shall not relieve the Contractor of his responsibility for field quality control. The testing agency shall interpret the tests and state in each report whether the work complies with the requirements, Specifications and Drawings or not. The Contractor shall provide access to the testing agency to places where structural steel work is being erected and where the required inspection and testing can be accomplished.
- C. The Contractor shall correct deficiencies in structural steel work which field tests have indicated to be not in compliance with requirements, Specifications and Drawings. The erector or Contractor, at his expense, shall provide additional inspection and testing as may be necessary to reconfirm any compliance of the original work and as may be necessary to show compliance of the corrected work.

3.4 PROTECTION

- A. The erected steel shall be protected by the Contractor from damage by construction equipment and vehicles, and other trades involved in the project.

END OF SECTION 05120



SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 CODES AND STANDARDS

- A. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings"; AWS "Structural Welding Code"; Specifications for Aluminum Structures by the Aluminum Association.
- B. Comply with applicable provisions unless otherwise specified.

1.2 SHOP DRAWINGS

- A. Show complete details and instructions for fabrication and installation. Furnish anchor bolts required for installation. Provide templates for bolt installation.

PART 2 - PRODUCTS

2.1 INSERTS AND ANCHORS

- A. Furnish inserts and anchors to be built into other work for installation of miscellaneous metal. Deliver to job site to avoid delay.

2.2 STEEL

- A. Structural Steel: ASTM A 36.
- B. Welding: ASTM A 500, Grade B.
- C. Pipe: ASTM A 53, Type E or S, Grade B.
- D. Cold-Rolled Steel Sheets: ASTM A 570.
- E. Galvanized Structural Steel Sheets: ASTM A 446, Coating Designation G235.
- F. Stainless Steel: Alloy 304, ASTM A167, A269, A276 or A312.

2.3 ALUMINUM

- A. Aluminum Plates: ASTM B209, Alloy 6061-T6.
- B. Aluminum Shapes: ASTM B308.
- C. Aluminum metal plate fabrications shall be a minimum of 1/4" thick unless otherwise specifically required.

2.4 CONCRETE INSERTS

- A. Malleable iron (ASTM A 47) or cast steel (ASTM A 27) bolts, nuts, washers and shims; hot dip galvanized.

2.5 SHOP PAINT

- A. FS TT-P-86, Type II; or SSPC-Paint 14. Shop paint all steel surfaces at rate to provide a 2.0-mil dry film thickness.

2.6 GALVANIZING

- A. ASTM A 386 for assembly of steel hardware.

2.7 FABRICATION, GENERAL

- A. Use materials of the same grade as specified, if not shown, of required size, grade and thickness for strength and stability in finished product. Shop-paint all items before fabrication.
- B. Welds shall be made as specified; grind exposed welds smooth and flush.
- C. Welds shall be made with hairline, flush joints; use concealed fasteners

2.8

- A. Fabricate bolts, plates, anchors, hangers, dowels, and other steel and iron shapes for framing and supporting and anchoring work.
- B. Galvanize, unless otherwise indicated.

2.9 LOOSE BEARING PLATES

- A. Provide for steel items bearing on masonry or concrete, as shown. Drill plates to receive anchor bolts. Galvanize after fabrication.
- B. Loose Steel Lintels: Fabricate to sizes shown.

2.10 MISCELLANEOUS

- A. Miscellaneous Framing and Supports: Provide as required for work and not included with structural steel framework. Fabricate in units as large as possible; drill and tap as required to receive bolts for items. Include required anchors for building into concrete, not less than 24" on center.
- B. Miscellaneous Steel Trim: Fabricate to sizes shown; continuous welded joints and concealed field splices wherever possible. Provide for coordination with other trades; coordinate assembly and installation with other trades.

2.11 NOSINGS

- A. Fabricate of shapes and sizes shown. Provide anchors 6" from ends or corners. Galvanize after fabrication.

2.12 BENT ALUMINUM

- A. Fabricate to sizes shown.

2.13 ACCESS DOORS

- A. Access doors of the size and type shown shall be installed at locations shown on the plans. Hatches shall be as manufactured by the American Hinge Company, Babcock Davis, or approved equal.

Access doors shall be 1/4" aluminum diamond plate reinforced with aluminum angles as required. Hatches for interior service shall be equipped with a built-in cushion. Stainless steel hinges shall be bolted to underside and be equipped with counterbalance mechanisms for easy operation. The door shall swing to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. Doors shall be built to withstand a live load of 300 lbs. per sq. ft. (exterior service), and equipped with a snap lock and removable handle. Mill finish, with bituminous coating to be applied to exterior of frame by manufacturer. Hardware shall be cadmium plated. Installation shall be in accordance with manufacturer's instructions.

Manufacturer shall guarantee against defects in material or workmanship for a period of five (5) years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform cutting, drilling and fitting required for installation; set accurately in location, alignment and elevation, measured from established levels. Provide anchorage devices and fasteners where necessary for other work.
- B. Set loose items on cleaned bearing surfaces, using shims as required. Solidly pack open spaces with compressed air material.
- C. Coat all aluminum surfaces in contact with steel with alkali resistant bituminous paint.
- D. Touch-up shop paint after installation of bolted connections and abraded areas, and apply sealant. Shop paint shall be compatible with specified existing repair paint on damaged galvanized steel.

5500

SECTION 05510 - METAL STAIRS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work under this Section includes designing, furnishing, and installing metal stairs and platforms at locations shown on the Drawings.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with Section 01700.
- B. Submittals shall include the following:
 - 1. Plan and elevation views of each stair and platform.
 - 2. Jointing and connections, including welded connections using standard practice.
 - 3. Sections and reinforcement details.
 - 4. Fasteners, including details for assembly and field installation.
 - 5. Protection details for fabrication and installation.

1.3 QUALITY

- A. All stair and platform assemblies sealed by a professional engineer in the State of Arkansas.

1.4

shall be accurately to actual construction. If it is not possible to take field measurements before fabrication, allow adequate fabrication tolerances and trim

PART 2 - PRODUCTS

2.1 GENERAL

- A. All stair assemblies shall be designed to meet requirements of the most recent edition of the Southern Building Code as well as all OSHA requirements.

2.2 ALUMINUM STAIR CONSTRUCTION

- A. Construct stairs to conform to sizes and arrangements indicated. Stair widths to be 3'-8". Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, handrails, balusters, newels, balusters, struts, clips, brackets, bearing plates, and other hardware necessary for the support of stairs and platform. Stairs shall be anchored and contain the stairs on the supporting structure.
- B. Comply with "Recommended Voluntary Consensus Standards for Fabricated Metal Stairs" in NAAMM "Metal Stair Manufacturers Association" standards.
- C. Stair Framing: Fabricate stringers, channels, or plates or a combination thereof. Provide adequate support of stringers. Construct platforms of structural steel or aluminum. Weld all structural framing members as indicated. Bolt or weld all framing members to strings and header plates. If used, do not appear on finish surface.
- D. Treads to be aluminum grating construction with abrasive nosing. Nosing to be manufactured by IKG Borden, Ohio Grating, or equivalent.
- E. Handrails to be aluminum grating and aluminum structural shapes. Handrails to be installed in Section 05530.
- F. Handrails shall comply with Section 05520 of the Specifications.
- G. Fasteners shall be 316 stainless steel.

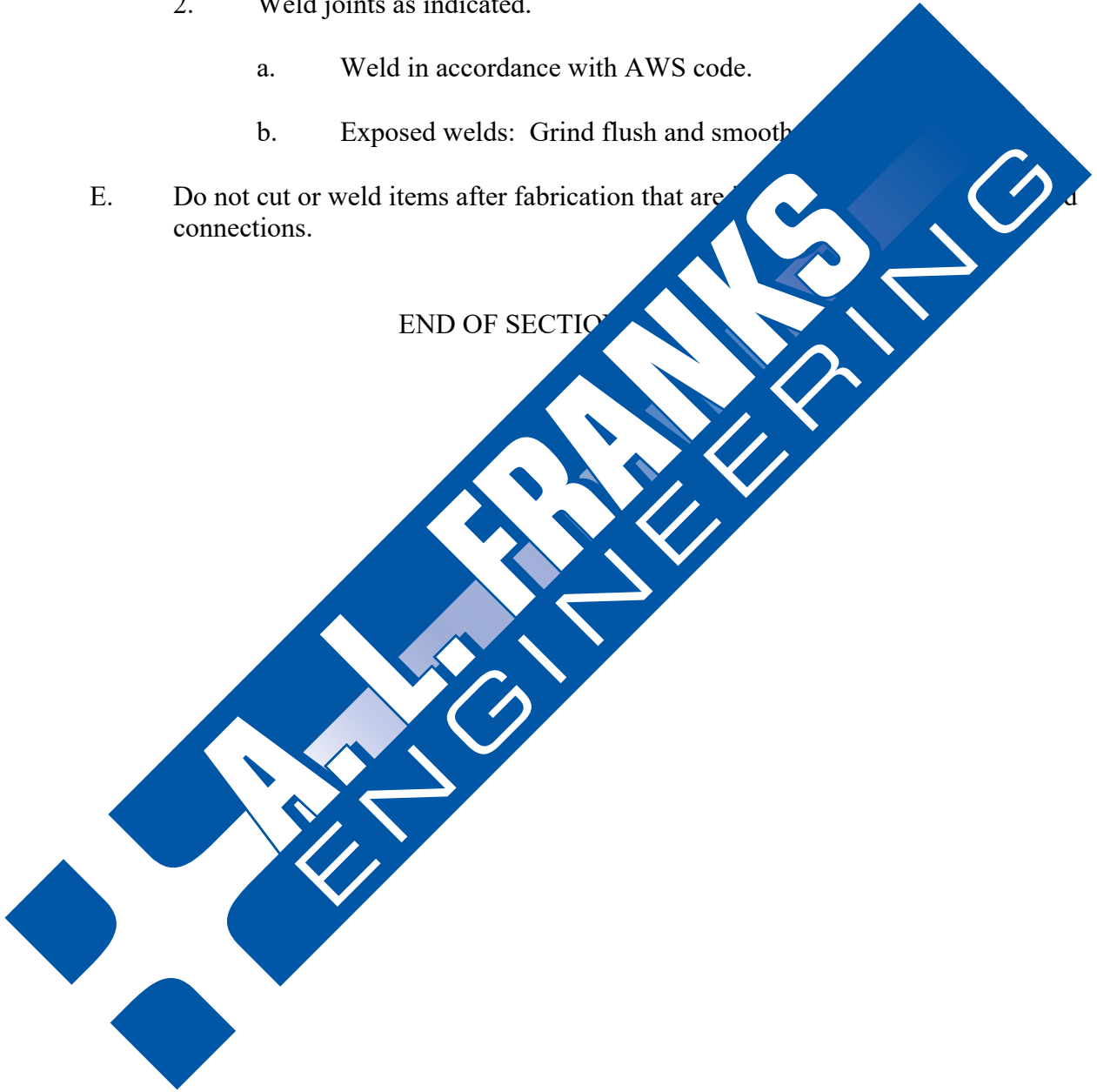
PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Install items in correct location, plumb and level, without rack or warp.
- B. Provide temporary supports and bracing as required.

- C. Anchor to substrates indicated. Provide all fasteners required.
- D. Perform all field fabrication required for installation.
 - 1. Fit joints tightly.
 - 2. Weld joints as indicated.
 - a. Weld in accordance with AWS code.
 - b. Exposed welds: Grind flush and smooth.
- E. Do not cut or weld items after fabrication that are part of the main structure and connections.

END OF SECTION



SECTION 05520 - HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of handrails and railings is shown on the drawings and includes miscellaneous handrails and railings not included in other sections in other sections of these specifications.

1.2 SUBMITTALS

- A. Samples, Handrails and Railings: Submit 2 samples of each finish and connection, including typical non-welded connections, less than 6" long. Samples will be reviewed for compliance with all other requirements is the exclusive responsibility of the contractor.

1.3 DELIVERY

- A. Deliver railing with factory finish to prevent scratching during shipment. Remove finish after railing is fully installed.
- B. Coat all aluminum railings with alkali resistant bituminous paint.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: alloy 6063-T5, except alloy 6063-T6 for pipe, unless otherwise indicated.
- B. Aluminum to be satin mill finish.
- C. Aluminum Sheet or Plate: ASTM B 209, alloy 6061-T4, unless otherwise indicated. Mill finish.
- D. Aluminum Castings: ASTM B 108, alloy 214, unless otherwise indicated.
- E. Stainless steel Finish: No. 4 unless otherwise indicated.
- F. Bolts, Chains, Hardware, Anchors, and Fasteners: Stainless steel Type 316.

- F. Nonshrink, Nonferrous Grout: CE CRD C588.
- G. All handrails shall be designed to meet the load requirements of the most recent edition of the Arkansas Department of Labor and Licensing as well as all OSHA requirements. Post spacing or other arrangements shown on the plans are secondary to the requirements of these codes. Handrails will be a minimum 1-1/2" in diameter.

PART 3 - EXECUTION

3.1 FABRICATION

- A. General: Form exposed work true to line and level. All surfaces and straight sharp edges. Ease edges to a minimum of approximately 1/32", unless otherwise specified. All corners to the smallest radius possible without causing undue stress or otherwise impairing the work.
- B. Nonwelded Connections: For intermediate post-to-rail connections may be made with locking devices, such as locks and Allen screw fasteners. Locking devices shall be flush, smooth, rigid, hairline joints will not be acceptable.
- C. Welded Connections:
 - 1. All welds shall be made on posts, weld joints, and grind smooth. Butt joints shall be made with fillet welds or use welding connectors, at fabricator's discretion.
 - 2. All welds shall be ground continuously and in accordance with the provisions of AWS. Grind exposed welds smooth and flush to the surface and blend with adjoining surfaces. Discoloration of finished surfaces will not be acceptable.
 - 3. All exposed connections with flush, smooth, hairline joints using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flathead (countersunk) screws or bolts.
 - 4. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support.
- D. Brackets, Flanges, Toe Plate, and Anchors:

1. Provide brackets, flanges, and anchors for railing posts and for handrail supports. 4" toe plates to be provided wherever handrails are installed along walkways above tanks or other raised areas.
2. Furnish extruded metal brackets and flanges of the same material and finish as supported rails, unless otherwise indicated. Anchor and other hardware to be stainless steel as previously specified.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchors where necessary for securing handrails and railings to walls; including threaded fasteners for concrete and steel connectors as shown on the drawings.
- B. Cutting, Fitting, and Placement: Perform all work required for installation. Set the work accurately to elevation, plumb, level, true, and free of rack, meander, and levels.
- C. Fit exposed connections and hairline joints. Weld connections which are not shop-welded but cannot be shop-welded because of shipping or handling. Smooth and touchup shop paint coat. Do not weld on units which have been coated or finished after fabrication. Field connections.
- D. Adjust railing to ensure proper matching at butting joints and cut to their length. Space posts not more than 8 feet as shown. Plumb posts in each direction. Secure railing construction as follows:

Embed posts in concrete by core drilling holes 5" deep and not less than the outside diameter of post. Clean holes of all loose material, insert posts, and fill the space between post and concrete with nonferrous grout.

END OF SECTION 05520

SECTION 05530 - GRATING AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the grating work is shown on the Drawings and includes frames, grating, and support beams which are not a part of other materials or other Sections of these Specifications.
- B. The types of grating include aluminum bar grating.
- C. The supplier of these materials is responsible for the fabrication of the grating and support framing.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with the Division 5 Specifications.
- B. Shop Drawings: Shop drawings shall include plans and complete details and schedules for fabrication of frames, beams and grating. Indicate welds by standard symbols. Include erection drawings for the installation of grating and frames to be installed by others.
- C. Design Calculations shall be prepared and sealed by a professional engineer registered in the state in which the project is located.

PART 2 - MATERIALS

2.1

- A. Aluminum Grating: ASTM B 221, Alloy 6061 or 6063-T6 for bearing bars; ASTM B 221 or B 210 for cross bars or bent connecting bars.
- B. Anodized Aluminum Frame: ASTM B 221, Alloy 6063-T6.
- C. Aluminum Support Beams and Channels: ASTM B308, Alloy 6061-T6.

2.2 ALUMINUM GRATING

- A. Provide aluminum plank grating where grating is shown on Drawings. Provide full frame for each opening using an extrusion frame which provides a continuous frame anchor and a continuous recess for anchoring the grating. The strength of in-place grating shall be designed to meet or exceed live load and deflection requirements as follows:
1. 100 lbs. per sq. ft. uniform load or 500 lbs concentrated.
 2. 0.250" maximum deflection.
 3. Minimum depth not less than 1-1/2".
- B. The weight of individual grating sections shall be determined without approval of the Engineer.
- C. The grating shall be IKG Borden A, WACO Type ZF, or Thompson, upset pattern grating or equal. Grating will be anodized or painted aluminum finish.
- D. Provide removable grating with clips for each panel and clip anchors as shown on the drawings.
- E. Adjacent grating panels shall be laid out as required to maintain patterns or design in a proper manner.
- F. Notch grating shall be avoided. Layout units to allow grating removal without penetrating grating.
- G. Provide openings in grating of same material and size as indicated.
- H. Grating at supports to maintain elevations will not be permitted.

2.3 GRATING AND PLATFORMS

- A. Provide full frames for each opening using an extrusion containing a continuous frame anchor and a continuous recess for anchoring the grating to the frame. Weld all frame corners. All aluminum surfaces in contact with concrete shall receive protective bitumastic coating at the source of fabrication. The coating shall be checked and touched up as necessary prior to installation. Frames shall be IKG Borden, WACO Type ZF, or Thompson.
- B. Platforms shall comply with Specification Section 05510.

PART 3 - EXECUTION

3.1 FABRICATION, GENERAL

- A. Use materials of the size and thickness shown, or if not shown, of the size recommended by product manufacturer. Work to the dimension shown or accepted on final shop Drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various parts of the work. Furnish load tables, deflection values, and erection instructions for each type of grating used to Engineer.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide fasteners and clips wherever required for securing grating to supporting members and openings.
- B. Cutting, Fitting and Placement: Perform cutting and fitting required for installation. Set the work according to drawings, and elevation, plumb, level, true and free of distortion.
- C. Wherever gratings are placed over structural members, cut openings neatly and square. Provide a lap collar not less than 1/8" thick to the cut ends of structural members.
- D. Divide the panels to the extent required for installation wherever they cross over and previously installed pipe, ducts, and structural members.
- E. Fit panels tightly together to form tight hairline joints.
- F. Fasten gratings to supporting members or framework with clip units as shown on drawings.

END OF SECTION 05530

SECTION 06800 - FIBERGLASS AND PLASTIC PRODUCTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Work to be accomplished under this Section consists of furnishing and installing reinforced fiberglass plastic flumes, staff gauges, and other

1.2 QUALITY ASSURANCE

- A. Provide products manufactured by a single firm of proven capability and experience of the type of units required. The supplier shall maintain a quality control program and procedures and supply certified reports of test results and inspection on the manufactured products.
- B. Manufacturers: Furnish units manufactured by Leopold, Warminster Fiberglass, or equivalent.

1.3 SUBMITTALS

- A. Submit Shop Drawings as required. Include details of all construction, materials, dimensions, and hardware schedules, properly identified by the engineer's nomenclature. Submit product test results and handling requirements.

PART 2 - PRODUCTS

2.1 RESIN

Resistance to sewage having pH range of 6.0 to 9.0.

2.2 REINFORCEMENT MATERIAL

A maximum of 4% by weight of thixotropic agent may be added to the resin to prevent run-off. Resin with sufficient thixotropic agent added to form a paste shall be used to seal any machined edges.

- B. Glass reinforcement shall consist of chemically bonded surfacing mat and either chopped strand, chopped strand mat, woven roving, or woven cloth, or any combinations thereof as required by the finished product. Surfacing mat shall be Type A or Type C, 20 mils thick, with a saline finish and a styrene-soluble binder.

The glass content of this layer shall not exceed 23% by weight. Chopped strand and chopped strand mat shall be Type E glass with saline finish and styrene-soluble binder. Strand shall not be larger than Number 130. The glass content of the finished laminate shall not be less than 30% by weight. Woven cloth or woven roving (60 end maximum) shall be Type E glass with "Volan" methacrylate chromic chloride or saline type finish.

- C. Procedure to be used in determining the properties listed in Table shall be in accordance with current ASTM standards, Part 9, and the following designations: Ultimate Tensile Strength - ASTM designation D 636-61T; Elongation at Break - ASTM designation D 790-61; Modulus of Elasticity - ASTM designation D 790-61.
- D. Hardness tests shall be made of the resin-rich surface. Hardness tests shall be made with the resin-rich surface in contact with the testing surface.
- E. Test samples shall be full thickness of the laminate and shall not be machined on the surface.
- F. Mechanical properties shall be determined as listed below.

	Matched Die	Hand Lay-up
Laminate Physical Properties		
Ultimate Tensile Strength (Min.)	14	12
Flexural Strength (Min.)	25	19
Flexural Modulus (PSI)	.94	.80
Bar Charpy Impact (ft-lb)	35	35

2.3

Unless steel or molded plastic gauge shall be permanently installed at the following locations.

Each parshall flume.

- 2. Each sliding weir gate in the new splitter box.

- B. The gauges shall be calibrated to read in feet, tenths, and hundredths of a foot.

2.4 FLUMES

- A. One (1) 18" throat parshall flume without stilling well is required for flow measurement and control at the effluent structure.
- B. Flume shall be of the standard dimension with both upstream and downstream diverging sections. Materials of construction shall be a reinforced polyester resin which affords maximum protection from chemical attack and is suitable for use in wastewater flumes and remains dimensionally stable. The interior shall be "glass like" smooth, easily cleaned and resistant to organism growth. Ends and top shall be flanged to provide strength with non-corroding material. Flume shall be suitable for flow measurement with a flow meter.
- C. An engraved stainless steel or molded plastic scale shall be installed and properly located in the upstream throat. Scale shall be calibrated to read in feet, tenths and hundredths.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all flumes and scales in accordance with manufacturer's recommendations and according to

SECTION 06800

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General: Under this Section, the Contractor shall furnish all labor, materials, equipment, transportation, and shop service required for all painting, including piping, equipment, and electrical work visible or requires protective coating. The Contractor shall thoroughly familiarize himself with all the drawings and Specifications for the various other contracts and shall coordinate with the other contractors for the painting and finishing.
- B. Work Included:
1. All exposed or submerged steel structures shall be painted. This work shall be limited to, conduit, piping, equipment, structural steel, metal, metal frames, doors, louvers, and all other equipment attached to the plant. All work scheduled in the contract documents shall be included.
 2. All equipment without a prime coat shall be cleaned and primed immediately after arrival on site. The remaining finish coats and painting will be applied after the equipment is installed.
- C. Items will not be required on items delivered with specified prime or shop coat already on, except for touch up with primer and except for items specifically designated in the contract to receive additional prime coats.
- Exterior cast-in-place concrete surfaces will not be painted except where otherwise noted. Brick and/or concrete masonry units shall not be painted unless otherwise noted.
3. Brass, bronze, nickel, copper, aluminum, galvanized, or factory-finished items which are concealed from public view or which are in areas designated not to be painted will not be field painted except for touch up.
 4. Fiberglass and stainless steel items will not be painted.

5. Field painting will not be required on buried or concealed piping.
6. Aluminum grating, handrails, and stairs shall not be painted.
7. Factory finished items shall not be painted unless indicated otherwise.

1.2 QUALITY ASSURANCE

- A. Guarantee: The Contractor shall guarantee all painting for a minimum of 12 months after acceptance against:
1. Bleaching, fading, and changing color.
 2. Peeling, cracking, or powdering.
 3. Being affected by water from routine cleaning.
 4. Rust from metals showing through the paint.
 5. Alligatoring effect of the paint.

1.3 SUBMITTALS

- A. Submittals shall be in accordance with Section 1340 of these Specifications.
- B. Colors shall be selected from the manufacturer's color chart. Mixtures of colors shall be supplied if required. A range of colors as produced by the manufacturer shall be provided for color selection.
- C. A schedule of work for the painting of items, including cleaning, priming, first coat, and second coat, shall be submitted. The schedule follows this page. Initialing of the schedule by the project representative in no way changes the Contractor's responsibility for the work. In the event that the coating does not perform

1. A secure storage area will be made by the Contractor for a secure space for the storage of all painting materials and equipment for the exclusive use of the painting subcontractor. The Contractor will, in turn, maintain and leave it free from fire hazards due to improperly stored rags and thinners.

<u>Material</u>	<u>Color</u>
Process Air Piping	Green
Compressed Air	Green with Red Stripes
Plant (Non-Potable) Water	Blue with Black Stripes
Potable Water	Blue
Sewage (Wastewater)	Gray
Sludge	Red
Vents	Red Stripes
Electric Conduit	Orange
Reuse Water	Blue (see 522)

* Where electrical conduits are installed in a finished room or area, color shall match room finish.

- b. Stripes shall be applied in the form of 6-inch wide bands composed of 3-inch wide bands of color. On a length of 36 inches, one color band shall be applied. On a length of 72 inches, two color bands shall be applied.
3. All piping shall be painted in accordance with the following color guidelines for various building components:

<u>Building Components:</u>	<u>Color</u>
Interior and Exterior Doors, Door Frames and Windows	Owner Selected
Tanks, Stairs, Walkways, and Support Steel	Owner Selected
Wallboard, Roof Deck, Joists and Overhead Steel	Owner Selected

b. Equipment:

Stationary Machines and Frames	Owner Selected
Motors	OSHA Blue
Rotating Machinery Guides	OSHA Yellow
Moving Equipment	Safety Orange
Control Panels (Requiring Paint)	
Fire Protection Equipment	
Fire Boxes	Safety Red
Extinguishers	Safety Red
Exit Signs	Safety Red
Sprinkler Heads	Safety Red
Fire Alarms	Safety Red
Emergency Stop Buttons	Safety Orange
Conveyors, Pulleys,	Safety Orange
Emergency Stop Button	Safety Orange
Warning Signs	Safety Yellow

PAINTING

3.1 PROTECTION OF ADJACENT SURFACES AND EQUIPMENT

- A. Provide all necessary drop cloths and/or other covers for protection of adjacent areas or equipment against cleaning operations and foreign paint. The Contractor shall be responsible for any damage he may inflict on any existing materials or equipment or any equipment or work accomplished by other contractors. He shall be responsible for the repair or cleaning of such damage to the satisfaction of the A/E.

- B. Before painting, remove hardware accessories, plates, lighting fixtures, and similar items or provide ample protection of such items. Reinstall all such items upon completion of painting. Replace all such items damaged by painting operations.

3.2 SURFACE PREPARATION

- A. General: The Contractor shall be held responsible for the finished appearance and satisfactory completion of his work; and, therefore, he shall not commence any painting until surfaces to be painted are in a proper condition to be painted. All surfaces shall be clean and free of dirt, grease, and any foreign matter that would adversely affect the finished appearance or protective coating to be applied. All surfaces to be painted shall be prepared by sanding, grinding, or other means with the objective of obtaining a smooth, clean surface free of all loose, improper, loose, or peeling previous coating. Incidental, necessary minor cleaning, sanding, or grinding of surfaces shall be done so that they are in perfect condition to be painted. If, for any reason, the surfaces cannot be properly prepared by sanding, grinding, or other means, the Contractor shall promptly report the same to the A/E, or the Contractor shall be responsible for rectifying any unsatisfactory finish resulting therefrom.

- B. Specific Requirements: The following requirements for each general material type are of general application and are referred to in the Painting Systems Schedule as set forth or referenced for each material type.

1. Surface Preparation Requirements, as numbered and outlined in the Painting Systems Schedule, shall correspond to the numbered requirements which are listed under Metals in the Painting Systems Schedule. These requirements have been adopted from the various SSPC Surface Preparation Specifications as published by the Steel Structures Painting Council. The specifications which are described below shall be included as part of this Specification as if bound herein.

All equipment delivered to the site with a manufacturer's prime coat will receive a brush blast cleaning prior to being painted. Any areas which do not retain their prime coating during the brush blast will be completely cleaned and primed as specified herein.

- (1) SSPC-SP1 Solvent Cleaning:
 - (a) Remove oil, dirt, grease, and foreign matter with solvents or commercial cleaners using various

methods of cleaning such as wiping, dipping, steam cleaning, or vapor degreasing.

- (b) The removal of oil and grease by solvent cleaning is included in all other SSPC Surface Preparation Specifications.

- (2) SSPC-SP2 Hand Tool Cleaning: Remove all loose rust and mill scale by hand wire brushing, scraping, chipping, or sanding. Hand tool cleaning will not remove tightly adhering residue or intact, firmly adhering mill scale.

- (3) SSPC-SP3 Power Tool Cleaning:

- (a) In conjunction with hand tool cleaning, use power tools such as power wire brushes, sanding hammers, abrasive wheels, and sanding guns. Use each type of tool required to obtain an acceptable surface.

- (b) For blast cleaning, as specified in the specifications, use surfaces which receive shop priming and delivery to the job site.

Special Blast Cleaning:

- (a) Remove at least 2/3 of all visible rust, mill scale, and other foreign matter from each square inch of surface by any of the recommended methods outlined in the Steel Structures Painting Council SP6.

- (b) Blasting shall be done with centrifugal wheel or compressed air blast nozzles using either steel grit or flint silica sand. Abrasive should provide a 1.5 mil maximum profile with a maximum depth of 2 mils. Steel grit #G-80 or flint silica sand 16-35 mesh is recommended to obtain proper profile depth. Remove all dust and sand by vacuuming.

- (c) The blast cleaned surface shall be primed before any rust bloom forms.

- (5) SSPC-SP10 Near-White Metal Blast Cleaning: Remove 95% of all visible rust, mill scale, and other foreign material from each square inch of surface by compressed

air nozzle blasting, centrifugal wheels, or other method recommended by Steel Structures Painting Council SP10. Use for all surfaces subject to immersion.

2. Masonry:

- a. Prepare cementitious surfaces of concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, and by roughening as required to remove glaze.
- b. Determine the alkalinity and moisture content of masonry to be painted by performing appropriate tests. Alkalinity shall be sufficiently alkaline to cause limescale. If not, correct this condition before application. Do not apply over surfaces where the moisture content is greater than indicated in the manufacturer's printed directions.
- c. Correct surface defects such as surface irregularities, spatter by grinding, and mortar joints. Use a graded release agent, oil, wax, or other release agent to remove heavy deposits and solvent clean. Use a sodium phosphate solution (160 d.p.h.) to each gallon of hot water (160 d.p.h.) for operations until the compound is removed. Wash the area with clean water to remove the compound. Allow to dry thoroughly before painting.

3.3 PAINTING

- A. When painting over previously painted surfaces, primers shall be used which will provide for "lifting" and primers shall be used which will provide for compatibility between old and new and prime and finish coats.

Thickness in mils shall be checked by the use of a mil thickness gage, for all of the following gages: Elcometer (magnetic), Micro-Tester (destructive), Tinkor and Rasor (holiday). Minimum allowable thickness for each surface shall take precedence over the indicated number of coats required, but in no case shall fewer than the indicated number of coats be applied.

3.4 WORKMANSHIP

- A. All materials shall be applied and cut in neatly so as to dry uniformly to the color and sheen specified, free from runs, sags, wrinkles, shiners, streaks, and brush marks.

- B. During the actual application and drying of interior painting systems and until normal occupancy of buildings occurs, a minimum temperature of 60 degrees F. shall be maintained. This temperature shall be held as constant as possible to prevent condensation. Adequate ventilation shall be provided at all times so that the humidity cannot rise above the dew point at the coldest wall.
- C. No exterior painting shall be undertaken at temperatures under 45 F. or immediately following rain, frost, or dew.
- D. All coats of paint shall be thoroughly dry before applying succeeding coats. All primer and intermediate coats of paint shall be sanded lightly before the succeeding coats of paint are applied.
- E. The areas in which the Contractor has been contracted to paint shall be kept in a clean and orderly condition with all paint spills and excess paint promptly removed.

3.5 MANUFACTURER'S INSTRUCTIONS

- A. In the preparation of surfaces for painting and the selection of paints, in method of paint application, and in all other matters, the Painting Contractor shall follow the instructions of the paint manufacturer and the standard published instructions of the paint manufacturer.
- B. In every case the manufacturer which are used shall be those which are recommended by the manufacturer for the type of surface to be painted, the conditions under which the paint is to be applied, and the conditions under which the paint is to be maintained.
- C. In the event the manufacturer's instructions conflict with these Specifications, the manufacturer's instructions shall govern unless otherwise approved by the Architect.

3.6

The Contractor shall be responsible for removal of all spilled paint, damage, etc. due to his work. Paint shall be removed by the best method which shall leave damaged surfaces in original condition.

3.7 PAINTING SYSTEMS SCHEDULE

<u>Item</u>	<u>Surface Prep. Number</u>	<u>Product Name</u>	<u>No. Coats</u>	<u>Dry Mill Thick Min. Per Coat</u>
-------------	-------------------------------------	---------------------	----------------------	---

MASONRY

Int., exposed,
block masonry

Prime	2-a,b,c	Block Filler, 561 (Modified Polyester)		
Finish		Hi-build Epoxoline		

METALS

Ext., non-submerged
non-buried, exposed-
to-view piping, valves,
operators, tanks, structural
steel, miscellaneous
steel, doors, frames,
sash angles, brackets,
hangers, etc.)

Prime		Primer	1	4.0
Intermediate		Hi-build Epoxoline 66	1	5.0
Finish		Endura Shield, 71	1	2.0

Ext.
gr
va
angl

Prime	1-e	Epoxoline Primer	1	4.0
Finish		Hi-Build Epoxoline 66	2	5.0

<u>Item</u>	<u>Surface Prep. Number</u>	<u>Product Name</u>	<u>No. Coats</u>	<u>Dry Mill Thick Min. Per Coat</u>
Ext., in vaults, non-submerged (pumps, pipe, valves, equipment, hangers, angles, brackets, etc.)				
Prime	1-d	Standard AWWA Bit. Shop coating or Topox 272 as applicable		
Finish		Topox 272		2.0
Int., non-submerged (pumps, valves, structural steel, doors, frames, sash, brackets, hangers, angles, etc.)				
Prime		Primer	1	4.0
Intermediate		Epoxoline 66	1	5.0
Finish		Dura Shield, 73	1	2.0
Exposed to bar joist roof				
1	1-b	Shop Prime/Galv.		
Finish		Chem-Build 135-DC 74	1	2.5

<u>Item</u>	<u>Surface Prep. Number</u>	<u>Product Name</u>	<u>No. Coats</u>	<u>Dry Mill Thick Min. Per Coat</u>
-------------	-------------------------------------	---------------------	----------------------	---

Galvanized-miscellaneous
exposed-to-view

(Galvanized electrical conduit will be painted to match the underlying surface.)

Prime/Finish	1-b	Hi-build Epoxoline 66	2	
--------------	-----	-----------------------	---	--

Interior Gypsum Board

Prime		PVA Sealer 51-792		
-------	--	-------------------	--	--

Finish		Series 7 Tneme-C		
--------	--	------------------	--	--

Exterior Gypsum Board

Interior and exterior
wood excluding hardwood
doors and trim receiving
transparent finish

Prime			1	2.0
-------	--	--	---	-----

Finish		Cryl	2	2.5
--------	--	------	---	-----

Wood

Interior doors and
hardwood trim
finish (shar
existing

Prime		PPG Rez Alkyd Oil Stain	1	2.0
-------	--	-------------------------	---	-----

Finish		PPG Rez Polyurethane Stain	2	2.5
--------	--	-------------------------------	---	-----

INSULATION

Pipe Insulation

Prime		Hi-build Epoxoline 66	1	2.0
-------	--	-----------------------	---	-----

Finish		Hi-build Epoxoline	1	5.0
--------	--	--------------------	---	-----

Concrete

Exposed-to-view

See Specification Section 03310.

END OF SECTION 09900



Section 11000

MECHANICALLY CLEANED FULL PENETRATION FINE BAR SCREENS - 304 SSTL

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the furnishing of a front-cleaning, front-return link driven mechanically cleaned bar screen assembly and any auxiliary equipment or accessories to be installed at location as indicated on the drawings and as specified herein.

Number of units: [1]

Equipment designation: Duperon® FlexRake® IQ™

Equipment location: Outdoor Installation

- B. All equipment supplied under this section shall be furnished by the manufacturer or supplier who shall coordinate with the Contractor the installation, testing, and commissioning of the screening components. The supplier shall be responsible for the coordination and performance of the screening system with the performance and design criteria specified in the drawings.
- C. The Contractor shall be responsible for coordinating the screening equipment with other related parts of the work, including piping, electrical wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the work required for the screening equipment in dimensions or other characteristics from that shown on the drawings or Specifications.

1.2 RELATED SECTIONS

- A. The following sections are included for the convenience of the Contractor and is for reference only. These sections are generally applicable to all equipment (see specification index).
- B. Submittal Procedures, Shop Drawings, and Samples, Operating and Maintenance information, Protection and Preservation, Installation, Testing, and Commissioning, Instruction of Maintenance Personnel, and Spare Parts Maintenance Manuals.
- C. Storage
- D. Coating Systems
- E. General Requirements for Equipment
- F. Electric Motors
- G. Control Panels

1.3 STANDARDS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
- C. American Welding Society (AWS)
- D. American Institute of Steel Construction (AISC)
- E. American Bearing Manufacturers Association (ABMA)
- F. American Gear Manufacturers Association (AGMA)
- G. National Electrical Manufacturers Association (NEMA)
- H. Underwriters Laboratory (UL)
- I. National Fire Prevention Association (NFPA)
- J. Society of Automotive Engineers (SAE)

1.4 SUBMITTALS

- A. The equipment manufacturer shall submit the following items:
1. Six (6) Sets of General Arrangement Drawings that illustrate the layout of the equipment, equipment weight, and principal dimensions with related verifications required for installation including anchorage locations. Other related data includes descriptive literature, electrical control drawings, catalog cut sheets for individual components and drive motor data.
 2. A list of recommended spare parts including any special tools and maintenance of the equipment is provided in Section 2.5.
 3. Six (6) Sets of Operation & Maintenance manuals including mechanically cleaned bar screen arrangement, components, and drawings provided in digital format after equipment ship for the manufacturer's process.
 4. For sites that have three (3) feet or greater water depth, the manufacturer shall provide a structural review.

1.5 QUALITY ASSURANCE

- A. The mechanically cleaned bar screen equipment shall be tested at the manufacturing facility prior to shipment for a minimum of four (4) hours of run time. The Contractor, the Engineer, and the manufacturer shall have the right to witness the shop test. The manufacturer reserves the right to cancel the test if the Contractor or the Engineer does not provide a minimum of three (3) week notice shall be provided for travel coordination.
- B. To assure quality and consistency, the equipment manufactured under this Section and related sections shall be of a single manufacturer. The Contractor shall engage in the design and manufacture of the equipment and the Engineer shall verify that the quality is equal to equipment manufactured by the manufacturer named herein. The screen manufacturer shall have at least ten (10) years of experience in manufacturing mechanically cleaned bar screen equipment that has been in successful operation for at least ten (10) years. Upon request, the manufacturer shall provide a list of installation sites along with the relevant contact information for each site.
- C. The equipment shall be fabricated, assembled, installed, and placed in proper operation in accordance with the approved drawings, specifications, engineering data, and/or instructions provided by the equipment manufacturer.
- D. The equipment shall be considered by the Engineer as an "or equal" by simply meeting the specifications.
- E. The equipment shall have operations, origin of manufacture, and aftersales service and support located in the United States of America.
- F. The equipment manufacturer shall have in-place a dedicated quality control / quality assurance system that conforms to the International Organization for Standardization (ISO)-9001:2015.

1.6 WARRANTY

- A. Manufacturer shall provide a written one (1) year standard warranty from the date of use of the mechanically cleaned bar screen equipment to guarantee that there shall be no defects in material or workmanship in any item supplied.
- B. Manufacturer shall warrant for the period of five (5) years all rotating parts of the mechanically cleaned bar screen including the gear motor, bearing, drive head, and the link system including the

links, castings, pins and retaining rings. Manufacturer warrants that these components shall be replaced if damaged or defective in the normal use of the equipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

The basis of design for the Screening System shall be as manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, toll-free 800.383.8479. The screening system shall be the FlexRake® Model, Full Penetration Fine Screens FR IQ™ no equal.

2.2 BASIS OF DESIGN

- A.** The mechanically cleaned bar screen shall have a head sprocket, idlers, or similar drive components under water to trap the chain and prevent rake arms or lower bearings/sprockets/tracks below the water surface.
- B.** The mechanically cleaned bar screen shall clean the water at a rate of 7.1 seconds at high speed.
- C.** The flowability of the screen area, specifically the coefficient of resistance number representing the specific flowability of a screen, shall be determined by the hydraulic head loss coefficient shape factor, the bar width and the screen area per formula below.
- $$(\text{Coefficient Shape Factor}) \times (\text{Bar Width}) \times (\text{Screen Area})$$
- D.** The mechanically cleaned bar screen shall operate continuously (24/7) without an operator.
- E.** The equipment shall clean the bar screen at one time cleaning continuously from bottom to top. The drive output shaft rotation shall be constant and shall be designed for maintenance and increase product life. Units which have single cleaning times shall not be allowed. Cleaning mechanisms that use single cleaning times or hydraulic actuators are unacceptable.
- F.** The equipment shall have the capability by flexing around and collecting large objects such as balls and surges of solids at peak loading times without overloading the link system shall be such that it bends in one direction only, which shall be lower sprocket and frame and shall have a 1,000-pound lifting capacity.
- G.** The use of endless moving media or cables and hydraulic cylinders to remove the screen and units using proximity or limit switches for reverse cycles are not acceptable.
- H.** Using a motor greater than 1 HP motor to complete a screen cleaning cycle is not acceptable.
- I.** The design shall be such to ensure that all maintenance can be accomplished at the operating floor level or above. No part of the drive system including sprockets shall be located below the water surface at maximum design flow.

J. Design Conditions:

Site Installation Information:					
		Quantity of Screens:	1		
		Channel Width:	4 ft		
		Channel Height:	5 ft		
		Bar Opening Size:	1/4 inch		
		Angle of Installation:	30°		
		Average Flow:	1.9 MGD		
		Minimum Downstream Operating Water Level for Average Flow	Provide		
		Number of Screens in Operation During Average Flow:	1		
		Maximum Flow:	6 MGD		
		Minimum Downstream Operating Water Level for Maximum Flow:	Provide		
		Number of Screens in Operation During Maximum Flow:	1		
		Maximum Head Differential:			
		Equipment Location:			
Outdoor Installation:					
		Site Access Constraints:			
		Below Freezing Temperature:			
		Installation Area NFPA Classification:			
Collection and Conveyance:					
		Conduit Material:			
		Pipe Diameter:			
		Slope:			
		Dewatering Method:			
		Liner Design:			

2.3 COMPONENTS

- A. **Bar screen assembly** shall be of stainless steel and designed to withstand 1 foot head of water in Section 2.2 J Design Conditions. Unless noted otherwise, the bar screen assembly shall be of 304 stainless steel. A stainless steel channel bottom plate shall be welded to the bar screen assembly to fully engage scrapers in the bar screen at the bottom of the tank. The raking mechanism reaches the bottom of the screen to the bottom of the channel. The bar screen assembly shall be shipped in one piece.

shall be 316L stainless steel and be tear-shaped with a hydraulic factor of 0.76 and the minimum dimensions of 0.25 inch x 0.75 inch x 0.25 inch. Screen bars shall be individually replaceable without welding. Screen bars shall have a 1/4 inch radius curve at the base of the screen to allow for increased flowable area.

Specification: The screen framework shall be 304 stainless steel bent plate with thickness of 3/16 inch cross section. Horizontal members shall be of stainless steel bent plate or stainless steel pipe. Support members and frame shall adequately support the bar screen based on site-specific requirements.

Dead Plate: Dead plate shall be 0.25 inch thick 304 stainless steel. The dead plate shall be flat and true; span the entire width of the unit; and transition from bar screen to discharge point.

4. **Discharge Chute:** The discharge chute shall be 11 gauge, 304 stainless steel. The discharge chute shall be bolted to the dead plate and shall be designed to allow debris to be transferred from discharge point into the debris containment.

5. **Link Slides:** Link slide assembly shall be provided per manufacturer standard design and shall be constructed of UV Stable UHMW PE and 304 stainless steel supports and components.
- B. **Return Guide/Closeouts:** Return guide/closeouts shall be 304 stainless steel and shall assure proper alignment of scrapers as they enter the bar screen and assure that there is no space wider than the clear opening between bars to prevent passage of larger solids than allowed through the screen.
- C. **Debris Blade:** A 304 stainless steel and UV Stable UHMW-PE debris blade assembly, which does not require a separate drive, shall be installed to assist in removing debris from the scraper on the mechanically cleaned bar screen unit as recommended by the manufacturer. Shock, or spring controlled debris blade mechanisms are not acceptable.
- D. **Screen Enclosure:** A 14 gauge #4-brushed satin finish 304 stainless steel enclosure shall be installed to cover the screen above the operating deck level. Freestanding panels for access to equipment. Removable panels shall be provided with a lift off option for "no tool required" access. Removable doors shall be provided with removable doors and shall be secured with a magnetic lock.
- E. **Link System:** The link system shall be passivated. The link system shall have a minimum ultimate strength of 60,000 pounds. with a minimum link weight of 5 pounds each. Parts must meet a minimum of 5 pounds each. Parts must meet a minimum of 5 pounds each. Link bearing shall be SAE 841 Bronze type for use between the pin and bearing surface.
1. 304 stainless steel system including rings and 304 stainless steel pins.
- F. **Scrapers:** Scrapers shall be designed for long product life the scraper shall move at no greater than .55 rpm allowing for approximately 1.1 debris per revolution. Scrapers shall be minimum .25 inch thick x 4.2 inches x 4.2 inches 304 stainless steel.
- G. **Drive Head:** The drive head shall be located on top of the mechanically cleaned bar screen.
1. The drive head shall operate independently and shall be composed of the following components.
 - a. The drive sprockets and 304 stainless steel drive shaft shall be shaft-mounted, right angle type and include spiral bevel gear. The output shaft speed shall be controlled by a vector type inverter. It shall be at least a 1.39 or greater service factor based on machine torque requirements. The gearbox shall not be vented to the outside atmosphere. The gearbox shall be grease filled. Oil filled gearboxes are not allowed.
 - b. The motor shall be AC induction type, inverter duty, and mounted to the gear reducer. The motor shall be 1 HP, and rated for Class I, Groups C & D, and NEMA design B. Service factor shall be 1.0 or greater with Class F insulation. The motor must be UL listed and designed for continuous operation.
 - c. The motor shall have a built in, normally closed, thermostat to protect from overheating that is to be field wired to corresponding terminals in the Main Control Panel for overload protection.
 - d. All drive head components shall be of components available in the United States.
 2. **Bearing:** Bearing shall be a non-lubricated no maintenance engineered polymer Thordon® or Vesconite® bearings and shall have a PV value that is less than the limiting PV value of the material. Bearings containing grease are not acceptable.

3. **Speed Reducer:** Speed reducer shall be a double-reduction, cycloidal style and shall comply with all applicable AGMA standards. The speed reducer shall be capable of a 6/1 speed range with variable output speeds between 0.55 to 4.13 output RPMs (in high flow conditions). The speed reducer shall produce an output torque of 11,000 in.lb. and have a gear ratio of 424:1.

- H. **Standard Coating:** All non-stainless bar screen components shall be coated in strict accordance with the paint manufacturer's specification. Surface preparation shall be done in accordance with SSPC-SP-10 near-white. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tnemec Zinc at 2.5-3.5 mils DFT, Intermediate Coat Series 27 F.C. Typoxy at 3.0-5.0 mils DFT, and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all state and federal and other regulatory requirements.

Alternatives: Any alternate products must provide certified test results for properties other than those specified herein. Test reports shall indicate the test results and compare the requirements for those products being submitted, and shall include the test results and performance values of the specified coatings herein.

2.4 ELECTRICAL, CONTROLS, INSTRUMENTATION

- A. **General:** Controls for each rake shall be provided by the bar screen manufacturer. The bar screen manufacturer shall be responsible for the design and construction of the controls for a site supply voltage of 480V, unless otherwise specified.

1. Controls shall be designed to meet the requirements of the applicable code and shall include a step-down transformer to provide 120VAC. Controls shall be designed to comply per plans/specs and shall include a step-down transformer to provide 120VAC.
2. Control enclosure shall meet the appropriate NEMA classification requirements and shall be constructed in a UL certified control panel build facility and will include appropriate labeling.
3. Controls shall be the property of the owner. The rake manufacturer shall verify all settings and parameters to ensure proper overload and speed settings are programmed.

Wiring shall be complete with a minimum of #16 MTW wire in the conduit. All control circuits being supplied. 120VAC control shall be red, grounded neutral, DC control shall be blue, DC neutral shall be white with blue ground. Ground shall be green and all incoming and outgoing external power shall be yellow. All AC power wiring shall be a minimum of #12 black. All wiring shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be in non-flammable, covered wire way.

Control(s) and panel mounted devices shall be labeled with engraved I.D. markers that correspond back to the system schematics. Tags shall be white with black core and engraved as required.

All field wiring and power cables between the bar screen's Main Control Panel and the Local Control Station shall be provided by others under the Electrical Section. VFD rated motor cable (Belden #29502 or equal) is recommended for all motors. Motor cables shall be less than 80 feet unless otherwise specified.

B. Components:

1. Main Control Panel (MCP)

- a. MCPs mounted outdoors require shading from the sun and shall be operated within a temperature range between 35°F and 104°F. Sunshields, visors or other

structures needed to provide shade are by others. If the controls will experience temperatures outside this range, then special climate controls can be provided.

- b. MCP shall be NEMA 4X 304 stainless steel.
- c. MCP shall not be in an explosive environment per NFPA 820.
- d. MCP shall be designed with a SCCR rating of 18KA at 480VAC minimum and labeled as such, unless otherwise specified.
- e. All terminals used in the MCP shall be rated for 600V and 50% more terminal space shall be provided for any potential future revisions.
- f. The MCP shall include at a minimum the following:
 - Main fusible disconnect with lockable open position
 - E-Stop maintained contact pushbutton
 - Physical or virtual Hand/Off/Auto (H/O/A) selector switch for the equipment.
 - Elapsed run-time meter for each piece of equipment
 - Indication for "Power On", "Power Off", "Fault", and "Emergency Stop"
- g. Relay Based Controls shall include:
 - Variable Frequency Drive (VFD)
 - Dry contact Safety Relay
 - Adjustable Time Delay Relay

2. Local Control Panels

- a. Enclosures shall be rated for NFPA classified area installation. Installation shall be in accordance with applicable safety codes as determined by the Authority Having Jurisdiction (AHJ).
- b. Each piece of equipment controlled by the MCP shall have a Local Control Panel (LCP) as close to the equipment as safely possible and shall be installed by a qualified electrical subcontractor to the corresponding terminals in the MCP. The LCPs must be able to carefully observe equipment operation.
- c. Each LCP shall include Forward and Jog Reverse pushbuttons and a maintained Emergency Stop pushbutton.
- d. Each raking assembly shall have a separate level system that shall be installed and field wired by others per the manufacturer's instructions. Note that the HydroRanger® can be installed in the MCP or remotely and wired to the MCP.
- e. Single Level/Speed Control: When the level switch trips, the rake runs. When the level switch returns to the normal position, an off-delay timer is initiated to prevent intermittent equipment starting/stopping. Cycle timing logic shall also be included that functions in parallel with the level control for optimal rake run time.
- f. Siemens HydroRanger® 200 with (1) Siemens Echomax ultrasonic level transducer. Transducer shall be installed upstream of the rake, at least 1 foot above the highest anticipated water elevation and the beam angle shall not have obstructions between the transducer face and the water surface. The HydroRanger® will be configured with one level set point. A mechanical float switch can be used in conjunction with the HydroRanger® as backup control.

C. Controls Design Conditions:

Incoming Power: (Voltage/Phase)	???V / ? phase / ? Hz
Main Control Panels:	One MCP for all screening equipment
MCP installation location:	Outdoors
Approx. distance between main panel and equipment motor	10'
If indoors, climate controlled location?:	N/A
If outdoor location, choose one of the 2 options below.	MCP to be shaded. Shade provided by _____
If temperatures will not regularly exceed 104° F:	MCP to have thermostat, _____ grilles _____ stands for _____
If temperatures will regularly exceed 104° F:	MCP to have thermostat, _____ grilles _____ stands for _____
Transducer/Float cable length:	_____ (_____ ft.).

2.5 SPECIALTY TOOLS, SPARE PARTS, AND ACCESSORIES

- A.** Manufacturer shall provide any specialty tools and spare parts required for maintaining the equipment as follows:

1. Snap/Retaining Bolt
2. Link Clevis Pin
3. Button Head Bolt
4. 3/8"-16 Nut
5. Snap Bolt
6. Anti-Siphon Valve

PART 3 – EXECUTION

3.1 SHIPMENT

Shipment shall be coordinated to allow the screen shipment as one complete unit unless otherwise specified by the Contractor, Engineer, Owner or Owner's Representative.

Equipment shall be installed in strict conformance with the manufacturer's installation instructions, with shop drawings, operation and maintenance manuals and/or any pre-installation instructions. Installation shall use standard torque values and be installed securely in position and in accordance with the manufacturer's appearance. Installation shall include any site preparation tasks as required by the engineer or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the customer and/or specified by the manufacturer.

- B. Anchors:** Anchors and nuts shall be 304 stainless steel and furnished for each item of equipment by the CONTRACTOR.

1. Anchors template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete.

2. Anchors sizes, quantity, and requirements will be indicated on the submittal drawings. Quantity is site specific but typically each bar screen assembly requires (8) to (12) 1/2" dia. x 4 1/2" Lg. embed HILTI KWIK bolt TZ for mechanical screen anchorage and typically (8) to (12) 3/8" dia. x 3 3/8" Lg. embed HILTI KWIK bolt TZ anchors for the return guide/closeouts anchorage.

3.3 TESTING

- A. After completion of installation, CONTRACTOR shall provide for testing performance to strict conformance with the manufacturer's start up instructions. Testing of the bar screen shall demonstrate that the equipment is fully operational by picking up and depositing debris into specified containment.
- B. Field certification shall include inspection of the following:
 1. Verify equipment is properly aligned and anchored to submittal drawings. Assure the bar screen unit is square, free of obstructions, and all clearances maintained.
 2. Assure controls and instrumentation work properly.
 3. Check equipment for proper operation and safety features, as well as completion of the start-up requirements.

3.4 ONSITE TECHNICAL ASSISTANCE

- A. Manufacturer shall provide on-site technical assistance, and shall include (1) day for Start-Up and (1) day for training. Minimum 14 days notification prior to the need for such services shall be provided to the Owner and Contractor, the Contractor shall provide a PRE-COMMISSIONING CHECKLIST.

Section 11100

WASHER COMPACTOR 3.0 WC3.D2.5 (1 HP MOTOR)

PART 1 – GENERAL

1.1 SUMMARY

A. SCOPE OF WORK

Duperon Corporation shall furnish an interleaving, dual auger washer compactor assembly as shown on the drawings and as specified herein. A single unit shall provide washing and screening action on wastewater screenings. The equipment shall be manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, 48601, (800) 383-8479, in accordance with the following:

B. RELATED WORK

1. Bar Screen
2. Conveyor
3. Receptacle

C. QUALITY ASSURANCE

1. All equipment supplied under this section shall be tested, inspected, and demonstrated, to the satisfaction of the Engineer, to equipment made by those manufacturers specified herein.
2. The equipment furnished shall be tested, inspected, and placed in proper operating condition in full accordance with the manufacturer's specifications, engineering data, and/or recommendations.

1.2 RELATED SECTIONS

- A. The following list of related sections is for the convenience of the Contractor and is for reference only to those sections that are in-general applicable to all equipment supplied under this section (see specification index.)

1. Related sections include but not limited to Submittal Procedures, Shop Drawings, Examples, Operating and maintenance information, Protection of Work, Installation, Testing, and Commissioning, Instruction of Personnel, and Spare Parts Maintenance Manuals.

STANDARDS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
- C. American Welding Society (AWS)
- D. American Institute of Steel Construction (AISC)
- E. American Bearing Manufacturers Association (ABMA)
- F. American Gear Manufacturers Association (AGMA)
- G. National Electrical Manufacturers Association (NEMA)
- H. Underwriters Laboratory (UL)

1.4 SUBMITTALS

- A. The equipment manufacturer shall submit the following items:

1. (4) Sets of Shop Drawings, including: Main Layout Drawings, List of Equipment Specifications, and Recommendations furnished by the Equipment Manufacturer.
2. (4) Sets As-Built Drawings of Washer Compactor Structure, Controls, and Accessories (as applicable).
3. List of Spare Parts and Special Tools (as applicable).
4. (4) Sets O&M Manuals (including As-Built Drawings) to be provided after equipment ships for inclusion in the close-out Submittal process.

1.5 QUALITY ASSURANCE

- A. The Washer Compactor shall be fully assembled and shop tested at the Manufacturer's facility prior to shipment. Shop testing shall include a minimum of 4 hours of run time.
- B. To assure quality and performance: All equipment furnished under this contract shall be of a single manufacturer who has been regularly employed for a minimum of 5 years of the equipment and demonstrates, to the satisfaction of the Engineer, the ability to produce quality equipment made by those manufacturers specifically named in the specification. The Washer Compactor manufacturer shall have at least 25 installations of the Washer Compactor equipment that has been in successful operation for a minimum of 5 years. Upon request, the manufacturer shall provide a list of references along with the relevant contact information.

Possible consideration may be given to the Manufacturer's experience but only upon submission and approval of drawings, specifications, engineering data, and O & M Manuals. Additionally, a complete product data sheet including all applicable alpha and beta testing shall be provided for the Engineer's review.

Approval of any manufacturer shall be contingent upon the Manufacturer's experience defined herein shall be contingent upon submission and approval of the Manufacturer's defined information. Additionally, such manufacturers shall maintain a performance bond issued in favor of the owner, covering the full amount of the contract and for the entire warranty period of the project.

- C. The equipment shall be fully assembled, installed and placed in proper operation under the supervision of the Manufacturer. The Manufacturer shall provide all drawings, specifications, engineering data, and/or recommendations to the Engineer for approval.
- D. The Manufacturer shall have in-place a dedicated quality control / quality assurance system in accordance with the International Organization for Standardization (ISO)-9001:2015.

1. The Manufacturer shall provide a written one year standard warranty from the date of use of the Washer Compactor to guarantee that there shall be no defects in material or workmanship in any part of the equipment.

PART 2

2.1 MANUFACTURERS

- A. Washer Compactor[s] shall be as manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, TF 800.383.8479.
- B. Or pre-approved equal. Washer Compactor manufacturer seeking pre-approval must submit application a minimum of three (3) weeks prior to bid day. Charges for additional engineering to alter site drawings to meet the intention of the specification shall be at the cost of the manufacturer requesting such change. The necessary submission to be considered a pre-approved equal shall include the following information:

- a. Product data sheet
- b. Site Specific Proposal Drawing
- c. Installation drawings and instructions
- d. O & M Manual
- e. An employee list of in-house design engineers along with their respective locations and resumes.
- f. An employee list of in-house controls engineers along with their respective locations and resumes.
- g. An employee list of in-house application engineers along with their respective locations and resumes.
- h. An employee list of in-house project managers along with their respective locations and resumes.
- i. An employee list of in-house field service technicians along with their respective locations and resumes.

2.2 BASIS OF DESIGN

- A. Compacting Action:** The Washer Compactor shall be designed to provide positive displacement action. Augers shall rotate in opposing directions. Augers shall be intermeshed and lead. Augers shall be designed with a limited float on top to provide accommodation of irregular debris.
- B. Washing Action:** The Washer Compactor shall have a wash water manifold integrated into the main housing. Two medium pressure streams of wash water shall run continuously within the housing. Continuous operation (non-batching) equipment is required. Equipment shall not be accepted.
- C. Operation:** The Washer Compactor shall be designed for continuous run, not requiring an operator. The Washer Compactor shall be designed to accept non-streetable debris, including but not limited to: rocks; broken concrete; (shape) up to 4 inches long. The Washer Compactor shall have the ability to handle clothing, variable volumes of debris, and unprocessed septage. The Washer Compactor shall move at a normal operating speed of 0.5 to 2.2 RPM and shall be designed to intermittently sync with upstream equipment.

Option (DEO): Washer Compactor is equipped with a single drive motor and shall be designed to transport washed and compacted screenings from the compactor to a receptacle at a distance of 40 feet. Transportation of screenings are fully enclosed to contain odors and maintain cleanliness. Equipment utilizing a separate motorized conveyance system shall be accepted.

3. Fabrications:

- 1. Fabrications:** All welded fabrications shall be made from stainless steel. All welded connections and welding procedures shall comply with AWS "Structural Welding Code – Sheet Steel" D1.3/D1.6.
- 2. Select Parts:** Select power transmission parts to be made from cast iron; however, shall conform to standard coating as follows.
- 3. Standard Coating:**

a. Motor gearbox shall be coated in strict accordance with the paint manufacturer's specification. Surface preparation shall be done in accordance with SSPC-SP-10 near White. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tnemec Zinc at 2.5-3.5 mils DFT; Intermediate Coat Series F.C.Typoxy at 3.0-5.0 mils DFT; and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all State and Federal VOC and other regulatory requirements.

b. Alternatives: Any alternate product must provide certified test reports when submitting products other than those specified herein. Test reports shall indicate the test method, system, and requirements for those products submitted and shall meet or exceed the test criteria and performance of the coatings specified herein.

4. **Non-Metal:** Parts not covered in the specifications above shall be UHMW polyethylene.

F. Design Conditions:

Washer Compactor W	
Peak Capacity:	
Average Capacity (Continuous):	
Wastewater Application (1/4" barscreen)	
Water: Typical	effluent or municipal
	3-10 GPM
	40-60 PSI
	1/2" NPT supply (female threads)
	1/2" NPT drain (male threads)
Materials of Construction	304 SSTL 17-4 Spur Gears - Delrin (or equivalent) thrust and plane bearings - UHMW Auger Supports - Perforated Screen
Strain	
Horizontal	38"
Vertical	43"
	No
	transition and power by
Performance Data (Typical Wastewater Debris)	
	30%-60%
Production:	60%-70%
Operation:	70%-80%
	Significantly decreases odor/fecal
Motor/Drive	
Size:	1 HP
Paint:	Duperon® Standard Tnemec Coating
Motor Service Factor (Minimum):	1.0
Output Speed:	2.2 RPM
Speed Reducer Ratio/Output:	809:1
Speed Reducer Paint:	Duperon® Standard Tnemec Coating
Site Power	
Phase/Voltage:	240/480 volt
Controls	
	- NEMA 4X SSTL enclosure - Main Disconnect

	- Emergency Stop - HOA (Auto is discreet "Run" input) - Fwd/Jog Reverse/E-Stop Push Button Station "Run" and "In Auto" discrete outputs - Explosion-Proof station (local standard)
Mounting:	- Wall - Pedestal (by others)
Project Management	
Submittal Quantity:	2 – 4
O&M Manual Quantity:	2 – 4
Warranty Period:	1 year
Shipping	
	- Main - C

2.3 COMPONENTS

- A. Main Housing:** The main housing of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 14 gauge. Support and flange connections shall be 3/8 inch.
- B. Hopper:** The hopper of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 14 gauge.
- C. Augers:** The augers shall be constructed of stainless steel (material options contained in table) with 8 inch diameter flights, 3/8 inch thick. The augers shall be coupled to a transmission at the drive end with UHMW plane bearings. This arrangement shall be designed to handle regular debris. The auger shaft shall be 2 inch stainless steel. The auger support shall be 1/2 inch stainless steel stub shaft.
- D. Compaction Housing:** The compaction housing of the Washer Compactor shall be 1/4 inch stainless steel (material options contained in table). The compaction housing shall contain the auger support.
- E. Discharge Chute:** The discharge chute of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 14 gauge. Support and connections shall be 3/8 inch. The discharge chute shall be tapered outward toward the discharge point.
- F. Water Supply:** The water supply shall connect at a single point with a 1/2 inch NPT female. An explosion proof solenoid valve is provided to limit the wash water flow to the compactor is running. Ball valves shall be provided to distribute flow to the washer and sprayer connections.
- G. Strainer:** The strainer shall be located beneath the lower auger to filter the washed solids. The strainer shall be removable via drain trough and pressed against the lower auger with spring. The strainer shall be self-cleaning through continuous, even contact with the lower auger. Strainers requiring auger-mounted brushes will not be accepted.
- H. Main Trough:** A removable pan shall be provided beneath the main housing to collect washwater. Washwater shall be drained through a 3 inch NPT male drain port. The pan shall be a minimum of 11 gauge stainless steel (material options contained in table).
- I. Drive Assembly:**
- Each Washer Compactor unit shall operate independently, with its own drive unit and driven components. The gearbox shall not be vented to the outside atmosphere.

2. The gearbox shall be grease lubricated and designed for 5 years (or 20,000 hours of operation) between recommended clean and re-grease services. The gearbox shall be right angle type, and shall incorporate cycloidal and spiral bevel gearing with a total ratio of 809:1. The gear reducer output shaft speed shall be 0.5 RPM minimum to 2.2 RPM maximum and controlled by a vector-type inverter (or greater service factor) based on unit torque requirements. It shall be shaft-mounted utilizing the keyless Taper-Grip® bushing.
3. The motor shall be mounted to the gear reducer by utilizing a quill, C-Face mounting style. The motor shall be AC induction type, 1 HP, 3/60/230/460 volt, explosion-proof, inverter-duty model.
4. The drive assembly shall incorporate the Duperon® standard coat

J. Auger Transmission:

1. The Drive Assembly shall be coupled to a dual gear transmission for rotation in a counter-rotation.
2. The spur gears are contained in a stainless steel housing (or equivalent) plane bearing.
3. Grease fittings shall be located outside the housing for lubrication to the gears.

K. Speed Reducer: The Speed Reducer shall be designed for 1/2 HP, 809:1 reduction ratio with 18,900 in-lb. of output torque.

L. Thrust Bearings: Thrust Bearings shall be self-lubricating, and be capable of withstanding a minimum of 2.2 RPM for life of machine.

M. Screw Supports: Screws shall be self-lubricating, and fastened into place using stainless steel washers.

2.4 ELECTRICAL, CONTROL AND INSTRUMENTATION

A. General: All electrical components shall be in enclosures provided by the washer compactor manufacturer. The manufacturer shall be responsible for proper sizing and fitting of components as specified otherwise. **Note that the washer compactor controls shall be located in the main control panel of the bar screen if provided by the manufacturer.**

Controls shall require shading from the sun and shall be operated within a temperature range between 35°F and 104°F. Sunshields, visors or other structures that provide shade are by others. (If the controls will experience temperatures outside this range, then special climate provisions are available.)

Controls shall be designed to accept incoming power supply per plans/specs and shall include a step-down transformer as needed to achieve 120V.

3. Control Panel(s) shall be constructed to meet the appropriate NEMA classification requirements and will include a main, lockable disconnect. The panel will be constructed by a UL certified control panel build facility and will be supported by the appropriate UL labeling.
4. Controls shall be tested prior to shipment to owner. The washer compactor manufacturer shall verify all overload settings in the motor controller to insure proper overload and speed settings required for the application are properly programmed.
5. Control panel(s) shall be wired complete with a minimum of #16 MTW wire in the appropriate colors for the circuits being supplied. 120VAC control shall be red, grounded

AC neutral shall be white, DC control shall be blue, DC neutral shall be blue with a white tracer, equipment ground shall be green and all incoming and outgoing external power source wires shall be a yellow configuration. All AC power wiring shall be a minimum of #12 Black. All wires shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be contained in non-flammable, covered wire way.

6. All panel(s) and panel mounted devices shall be labeled with engraved I.D. markers that reference back to the system schematics. Tags shall be white with black core, engraved as required.
7. All field wiring and power cables between the washer compactor Main Control Panel and the Local Push Button Station shall be provided by others under the provisions of Section. VFD rated motor cable (Belden #29502 or equal) is recommended. Motor cables shall be less than 80 ft unless otherwise specified.

B. Components:

1. Main Control Panel

- a. Enclosure(s) can be NEMA 4X 30" or larger.
 - b. Enclosure shall not be located in a hazardous area.
 - c. Main Control Panel shall be rated for 18KA at 480VAC minimum and labeled accordingly.
 - d. All terminals utilizing screw type terminals and 20% spare terminals for potential future revisions.
 - e. The Main Control Panel shall include the following:
 - Emergency Stop (E-Stop) button, unless otherwise specified
 - Auto (HOA) Selector and Push/pull E-Stop button
 - "On", "Forward" and necessary faults for the washwater solenoid.
- The Main Control Panel shall include the following:
- Variable Frequency Drive (VFD)
 - Torque control
 - Contact SCADA Interlock(s)
 - Adjustable off delay timer

2. Local Push Button Station

- Enclosure shall be NEMA 4/7/9 rated for Classified area installation. Local push button station must be local to the equipment to maintain requirements of local safety codes as determined by the Engineer.
- b. Local station shall be mounted within 10 feet or as close to the equipment as safely possible and be field wired by the electrical subcontractor to the corresponding terminal inputs in the main control panel.
 - c. The remote pushbutton station shall include Forward, Jog Reverse and E-Stop buttons.

3. Sequence of Operations:

- a. The Washer Compactor controls shall enable the push button station installed

near the Washer Compactor when in "Hand" mode and utilize an input signal from a remote source when in "Auto" mode. Upon receiving a disruption of "remote source" signal in "Auto" mode, the Washer Compactor shall utilize an off-delay timer to allow debris to finish depositing. The washwater solenoid is energized any time that the washer compactor is running.

- b. The Duperon® Speed Controller fault shall be cleared by turning off the Washer Compactor, then waiting approximately three minutes (or time designated per current UL standards) and then turning the HOA back to the desired setting. A motor overtemp fault shall clear automatically when the motor cools to a temperature within the normal operating range.

4. Miscellaneous:

- a. The following shall be provided by the electrical contractor within the scope of the Washer Compactor manufacturer scope of supply:
 - a. Mounting stands
 - b. Mounting hardware
 - c. Field wiring and conduit
 - i. VFD-rated (minimum 100 ft. long unless specified)
 - ii. VFD-rated (minimum 100 ft. long unless specified)
 - d. VFD-rated (minimum 100 ft. long unless specified)
- b. The following shall be provided by the electrical contractor (limited to) the following connections as required by the manufacturer:
 - i. VFD-rated (minimum 100 ft. long unless specified)
 - ii. VFD-rated (minimum 100 ft. long unless specified)
- c. Remote station contacts to the corresponding terminal inputs in the main control panel.

2.5 SPECIALTY TOOLS, SPARE PARTS AND LUBRICATION

- A. Duperon does not typically recommend the purchase of additional spare parts, though some customers prefer to have them on hand.

B. Plane Bearing Kit includes:

- | | | |
|----|-----------------------------|------|
| 1. | Side Auger Supports | (2) |
| 2. | Upper/Lower Auger Supports | (2) |
| 3. | FHSCS: 1/4-20 x 1.00 LG | (24) |
| 4. | Washer: 1/4 Flat SAE | (24) |
| 5. | Nut: 1/4-20 Nylock | (24) |
| 6. | Grease Tube (14oz.) | (1) |
| 7. | Anti-Seize Lubricant (1oz.) | (1) |

- C. Drop Sleeve:** A flexible canvas sleeve shall be connected to the end of the auger for the steel chute. The sleeve shall provide a guidance for dropping screen material into the chute to contain the debris as it falls and prevent debris from being scattered. The sleeve shall be constructed to impact the immediate environment. The sleeve shall be constructed to be tethered to the surroundings as required (by others).

PART 3 – EXECUTION

3.1 SHIPMENT

Shipment of all equipment shall be coordinated with the manufacturer for shipment as one complete integrated assembly unless otherwise specified by the contractor, or engineer.

3.2 INSTALLATION

- A.** Equipment shall be installed in accordance with the manufacturer's installation instructions, as submitted with Shop Drawings, Manuals and/or any pre-installation checklists. Installation shall be completed and the equipment shall be installed secure in position and neat in appearance. The contractor shall perform all preparation tasks as required by the engineer or manufacturer; including but not limited to, site preparation, etc. and any other installation tasks and materials such as those determined by the customer and/or specified by the manufacturer. Installation shall be performed on site by a qualified individual in accordance with all applicable codes and standards.

- B. Anchoring:** 4 stainless steel and furnished for each item of equipment by the manufacturer.

Drawings shall be included in the submittal to permit verification of the equipment's placement, new or existing in the concrete.

Quantity and requirements will be indicated on the submittal drawings. Site specific but typically each Washer Compactor assembly requires (4) 1/2" diameter, 12" Lg. embed HILTI HAS RODS w/ RE-500v3 Adhesive system anchors.

Upon completion of installation, CONTRACTOR shall provide for testing and shall be performed in accordance with the manufacturer's start up instructions. Testing of the Washer Compactor shall demonstrate that the equipment is fully operational and that the equipment will wash, compact, and deposit materials not to exceed 4 inches.

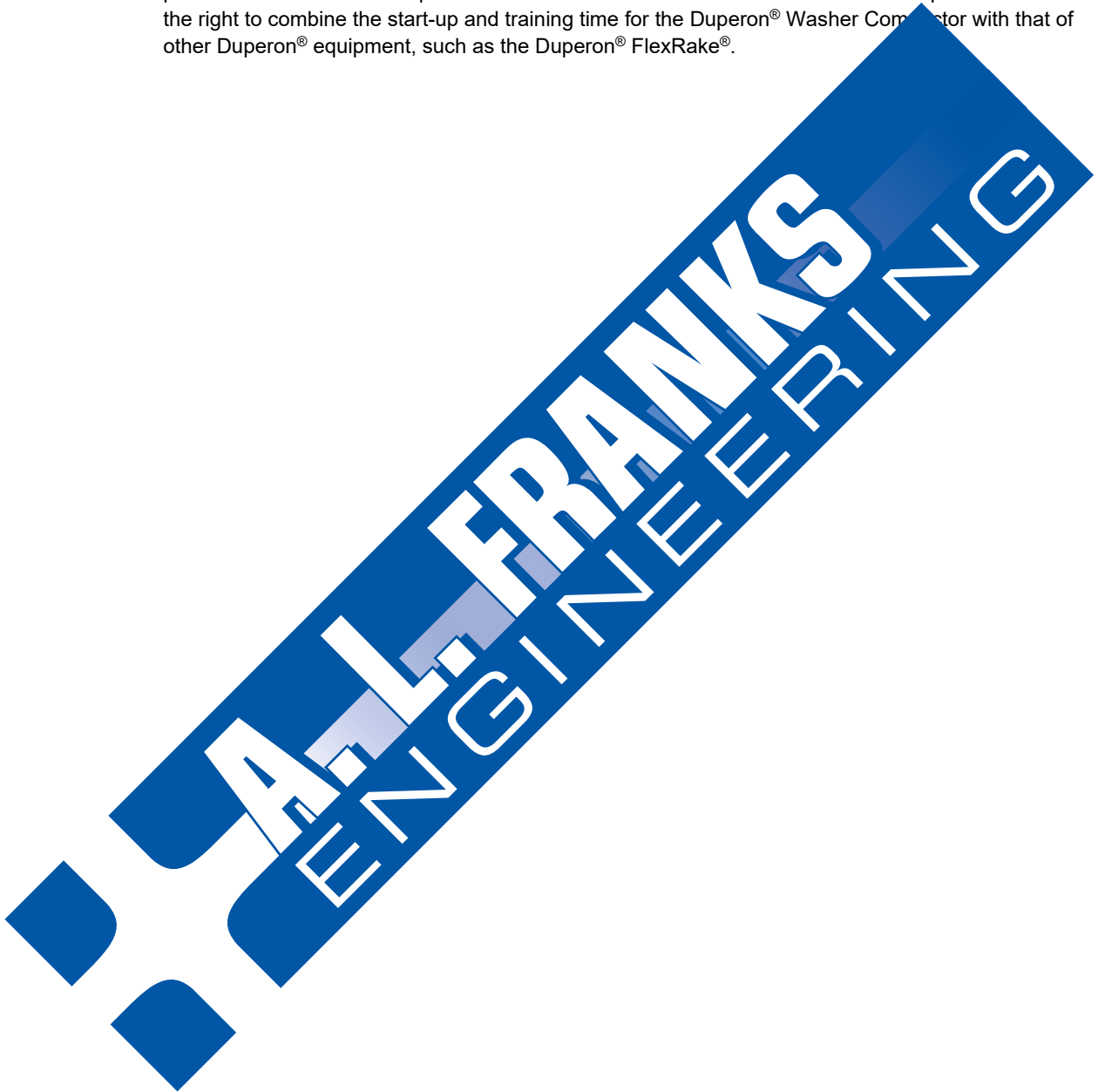
- B. Field certification shall include inspection of the following:**

1. Verify Washer Compactor is properly leveled and anchored per the installation instructions and site drawings.
2. Assure controls and instrumentation work in all modes.
3. Assure proper auger rotation.

4. Check to assure all Start-Up requirements are completed per the Installation Guide.

3.4 ONSITE TECHNICAL ASSISTANCE

- A. Manufacturer shall provide services to include Installation Certification, and shall include (1) day for Start-Up and Training. Manufacturer shall be given minimum 14 days notification prior to the need for such services. To assure the best outcome for the Owner and Contractor, the Contractor shall provide certification for completion of the PRE-COMMISSIONING CHECKLIST. Duperon reserves the right to combine the start-up and training time for the Duperon® Washer Compactor with that of other Duperon® equipment, such as the Duperon® FlexRake®.



SECTION 11219 - MULTISTAGE CENTRIFUGAL BLOWER

PART1 – GENERAL

1.1 SCOPE OF WORK

- A. This specification covers the supply of multistage centrifugal air blower to be used to provide air to the aeration basins. The principal items to be furnished are:
 - 1. One (1) multistage centrifugal blower
 - 2. Electric motor drivers.
 - 3. All accessory items and blower protection panels as described in the contract plans, which are required for proper operation of the equipment.

1.2 SUBMITTALS

- A. Drawings and Documentation
 - 1. An electronic set of submittals shall be submitted with the drawings and documentation and equipment catalog cut sheets indicating manufacturer, model and model where appropriate. Submittals shall include drawings of the equipment and accessories such as filters, silencers, expansion joints, and other equipment that would affect equipment package layout.
- B. Operation and Maintenance
 - 1. The blower manufacturer shall submit an electronic file containing Operation & Maintenance manuals as specified. All manuals shall consist of Continental standard drawings, and all applicable instructions for the proper installation and operation of the equipment.

1.3 WARRANTY

- A. The manufacturer warrants its products of its manufacture to be free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of installation. Accessories, and other equipment not manufactured by the blower manufacturer shall be warranted by their own individual manufacturer's warranties.

2. QUALITY REQUIREMENTS

- A. Equipment covered by this specification is intended to be standard equipment of proven design and quality as manufactured by a reputable manufacturer having experience in the production of such equipment. The equipment furnished shall be designed, manufactured, and installed following the best practices and methods and shall operate properly when installed in accordance with the contract drawings and operated per manufacturer's recommendations.
- B. Each blower unit shall be of the multistage centrifugal type, as manufactured by Continental Blower, LLC.

- C. The impellers shall be mounted on a single shaft supported on each end by ball bearings mounted in outboard bearing housings. The blower shall be built from parts cast in patterns from which previous units have been built and tested. The blower shall be of the manufacturer's standard design.

2.2 PERFORMANCE

- A. Each aeration blower (Quantity 1) shall be designed for a capacity of 1,270 CFM. Discharge pressure at the specified capacity shall be 8.2 PSIG, when operating at standard conditions of 14.5 PSIA, 105 Deg F, and 80% relative humidity.

2.3 COMPONENTS

A. Blower Housings

1. The blower housings shall consist of vertically aligned sections held securely between cast iron inlet and outlet heads by tie rods. Two-piece fabricated construction with rope nuts shall be used for the rods.
2. No contact shall be made between the shaft and the housing other than through the bearings. Where the blower shaft passes through the inlet and outlet heads, suitable carbon graphite ring seals shall be provided.

B. Impellers

1. The impellers shall be cast or fabricated composite aluminum construction. Impellers shall be mounted on the shaft through one-piece metal spacers and be securely keyed.
2. Impellers shall be dynamically balanced, then assembled to the shaft and the entire rotor assembly shall be dynamically balanced as an assembly. Blower shall be designed for a vibration level of 1.25 mils in the vertical plane when measured at 1800 RPM.

C. Diffusers

1. Diffusers shall receive air from the impeller and guide the air to the eye of the next stage. Diffusers shall be cast or fabricated as an integral part of the housing casting.

1. Incorporating baffle rings at the inlet and intermediate sections shall be provided. Baffle rings shall be one-piece stainless-steel baffle rings, securely mounted to the head and sections either directly or through one-piece stainless-steel mounting brackets.

E. Shaft

1. Blower shaft shall be fully ground high-grade carbon steel of sufficient diameter to operate at a minimum of 20% below first critical speed. Shaft speed shall not exceed 3600 RPM.

F. Bearings

1. Each blower shall be provided with oil lubricated anti-friction ball bearings.
2. Bearings shall be sized to provide a bearing life of minimum 10 years per AFBMA B-10 standards.

G. Bearing Housing

1. Bearings shall be mounted in cast iron outboard mounted bearing housings designed to isolate the bearings from blower temperature. Bearing housings shall be designed to allow removal and replacement of the bearings without dismantling the machine or disconnecting piping.

H. Flexible Coupling

1. The blower shall be connected to the motor through a flexible coupling. The contractor shall check, and if necessary, adjust the coupling in accordance with manufacturer's instructions. Each coupling shall be protected by a coupling guard in compliance with OSHA standards.

I. Baseplate

1. Each blower and motor shall be mounted on a heavy duty structural steel baseplate designed for resilient mounting. The baseplate shall be supplied by the blower manufacturer. Baseplate shall not be mounted on a concrete foundation.

J. Motor

1. Electric motors shall be designed in accordance with NEMA and IEEE standards. Motors shall operate at 3600 RPM on 3 phase, 60 cycle, 460-volt electrical service. Motors shall have a 1.15 service factor and be sized to operate below their rated capacity under specified capacity and design conditions. Motor enclosure shall be NEMA 3. A separate motor shall be provided for each aeration blower.

K. Starter

1. Blower motor shall be started by a soft starter. Refer to manufacturer's recommendations for

2.4

connectors shall be provided for outlet piping.

operated butterfly valves designed for low pressure air throttling service shall be provided for mounting in the blower inlet and discharge piping.

- C. A 15" style check valve for low-pressure air service shall be provided for mounting in the blower discharge piping.

- D. Suitable inlet filter/silencer shall be provided. Filter element shall be cleanable and replaceable. Filter shall be sized for the specified flow. Filter efficiency shall be minimum 98% on 10-micron particles. A differential pressure gauge shall be provided.

- E. A discharge pressure gauge shall be provided for all blowers.

F. Blower Protection Panel:

- a. Provide a NEMA 4X 304 stainless steel control panel at each blower.
- b. Panel will be fed with 120VAC power.
- c. Provide fuse holders and fuses as required.
- d. Provide a digital panel meter for amps display and surge/overload.
- e. Provide a current transformer to ship loose for field mounting on the existing starters. Mounting to be provided by contractor.
- f. Provide amp transducer to convert the current transformer signal to 4-20mA signal to send to the Amps digital meter.
- g. Provide a digital panel meter for CFM display. Provide the blower performance curves.
- h. Panel door devices shall include:
 - i. BLOWER RUNNING pilot light
 - ii. SURGE alarm pilot light.
 - iii. OVERLOAD alarm pilot light
 - iv. ALARM RESET push button
 - v. MOTOR AMPS digital display
 - vi. CFM digital panel meter
 - vii. Nameplates as required
- i. Provide dry contacts for alarm system.
- j. Relays/Socket as required
- k. Time delay relay
- l. Terminal block
- m. Control panel
- n. Digital panel meter digital PD6000 series with 4-20mA input.

PART 3 - EXHAUST

3.1 TESTS

Blower shall be tested at the manufacturer's facility for a minimum of 24 hours. Mechanical run test at the manufacturer's facility for a minimum of 24 hours. Bearing vibration and temperature shall be checked to ensure compliance with manufacturers standards.

Blower shall conform to ASME Power Test Code and shall extend from surge to beyond design flow. ASME tests are not required for blowers built from parts cast in patterns. Previous units have been cast, built and tested.

3.2 INSTALLATION

- A. Blower shall be installed in accordance with manufacturer's recommendations. The installing contractor shall provide qualified personnel to check the coupling alignment and make any necessary adjustments. All piping and accessories shall be fully supported to prevent the transmission of excessive forces to the blower connections. Blower shall be installed on suitable resilient foundation pads supplied by the blower manufacturer.

END OF SECTION



SECTION 11310

SUBMERSIBLE WASTEWATER PUMPS FOR WET WELL

PART 1. GENERAL

1.1. SCOPE OF WORK

- A. The work in this section shall include furnishing and placing into service on 3 submersible pumps, with discharge connections, lifting chains and lugs as specified herein and as indicated on the drawings. The complete pump assembly shall be submersible up to 65 feet above the inlet pipe level.

1.2. RELATED SECTIONS

- A. Section ME-4 MONITORING AND CONTROL EQUIPMENT FOR PUMP STATION

1.3. REFERENCES

- A. American Society for testing and materials
 - 1. A 48: Standard Specification for Cast Iron Pipe and Fittings
 - 2. A743: Standard Specification for Cast Iron Pipe, Corrosion Resistant, with Polyethylene Linings
- B. American National Standards Institute
 - 1. B16.1: Standard Specification for Wrought Iron Pipes and Flanged Fittings, 125 lb. class
- C. Hydraulic Institute
 - 1. HI 1.1: Hydraulic Performance Acceptance
 - 2. HI 1.2: Hydraulic Performance Tests

1.4. SUBMITTALS

- A. The manufacturer shall be required to show compliance with these specifications, plans and specifications. The manufacturer's submittal data will influence the proper operation of the pump(s).

B. The manufacturer's submittal data for approval must consist of:

- 1. Performance Curves.
- 2. Pump Outline Drawing.
- 3. Installation Drawing for Accessories.
- 4. Electrical Motor Data.
- 5. Typical Installation Guides.
- 6. Technical Manuals and Parts List.
- 7. Printed Warranty.
- 8. Management system certificate ISO 9001.
- 9. Manufacturer's Equipment Storage Recommendations.
- 10. Manufacturer's Standard Recommended Start-Up Report Form.

- C. Lack of the above requested submittal data is cause for rejection.

1.5. QUALIFICATION REQUIREMENTS

- A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.
- B. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacturer's authorized representative. 8 hours of field service shall be provided by an authorized, factory-trained representative of the pump manufacturer. Services shall be limited to, inspection of the completed pump station installation, start-up, and testing performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing, and demonstration of the Manufacturer's Warranty. The test shall demonstrate to the Owner that the equipment meets all specifications, is properly installed and anchored, and operates smoothly at full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Manufacturer.

1.6. DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle pumps in accordance with the provisions of General & Special Condition Sections.

1.7. OPERATIONAL REQUIREMENTS

- A. The contractor shall provide a submersible sewage pump with discharge connection, lifting chain, cable holder lifting chains.
- B. The pump shall have a semi open multi vane self-cleaning impeller design to prevent clogging with fibrous materials like wet wipes.
- C. The impeller shall be resistant and made of high chromium cast iron with at least 10% chromium content and capable of handling sand and grit which is expected to enter the pump from the sanitary or storm water. Impellers that have surface hardening (e.g., nitriding, etc.) will not be allowed.
- D. The pump shall be capable to lift 2149 **USgpm** at a total dynamic head of 46 **feet**.
- E. The pump efficiency in this duty point shall be not less than **75 %** and approved by the local authorized factory.
- F. The pumps shall be provided with 60 months (5 years) warranty against defects in materials and or workmanship. The warranty shall cover the entire pump, not individual components. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.
- G. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory.

representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and/or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall, either travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost or reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2. PRODUCTS

2.1. SUBMERSIBLE SEWAGE PUMPS (FLYGT NP 3202 OR EQUIV)

- A. Each station shall be equipped with 1 submersible pumps.
- B. Each pump shall be equipped with a **60 HP** submersible motor to operate on a **460** volt, 3 phases, 60 hertz voltage.
- C. The hydraulic of the pump shall be capable of pumping domestic wastewater and storm water with fibrous materials like hair.
- D. The impeller blades shall be self-cleaning as they pass across a sharp relief groove in the Insert. The impeller blades clear of debris. The clearance between the impeller blades and the housing edges shall be adjustable.
- E. Due to the presence of abrasives, the impeller shall be made of high chromium cast iron with at least 24% chromium. The impeller surface hardening (by thermal, coating, etc.) will not be required.
- F. The pump shall operate without any limitation between 50% and 125% of the Best Efficiency Point (BEP) on the performance curve.

Flow (Q) in Gpm	TDH in feet	Hydraulic efficiency %	NPSHre in feet
4,298	46	75	21.8

- G. The input power (P2) in the guaranteed duty point shall be less than **50 HP**. The maximum speed shall be max. : **1200 rpm**. A performance chart shall be provided showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics.
- H. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.
- I. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according standard IEC 60034 and protection class IP 68.

- J. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.
- K. The pump shall be capable of operating in a continuous condition with a temperature up to 104°F even when the motor is not submerged.
- L. The motor shall be capable of no less than 30 even starts and shall be able to operate throughout the entire pump performance range without run-out.
- M. The stator windings shall be insulated with a minimum insulation rated for 356°F.
- N. Sealing of the pumping unit to the discharge shall be accomplished by a machined metal to metal weld at the discharge interface with a diaphragm, O-ring or other acceptable.
- O. It shall be possible to connect the pumps on parallel guide bars and connect them to wet well connection. There shall be no need for personal to enter the wet well for removing or reinstalling the pumps.
- P. The pump housing shall be the assembling of a sump mixing valve. The discharge piping shall be 12".
- Q. The terminal board shall be hermetically sealed from the wet well with a compression seal. Connection between the leads shall be made with threaded compression type fittings affixed to a terminal board. The motor and the pump shall be the same manufacturer.
- R. The motor shall be protected by 3 thermal switches embedded in the stator set to 140°C (140°C) and one leakage sensor floating type located in the stator winding. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.
- S. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.
- T. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently

seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall consist of one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall consist of one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small grooves cast into it and inscribed upon its face to act as a pump as it rotates. The seal rings shall not be able to enter the dry motor chamber back into the lubricant. The seal rings shall be individual solid sintered rings. Each seal interface shall have its own independent spring system. The seals shall not depend on the pumped media for sealing. Mounting of the lower seal on the impeller shaft shall be accomplished by shaft seals without positively driven rotating members or by mechanical seals containing a rotating member. Either a common single or double seal interface between the upper and lower seal faces are not acceptable. The seal system shall prevent leakage from the pumped media to prevent materials from packing the seal and impairing performance. Any leakage passing the sealing shall be detected before it reaches the bearings the liquid shall create an alarm at the sensor.

V. Each pump shall have a seal chamber for the shaft sealing system. The lubricant shall be used to prevent overfilling and to provide lubricant for the seal. The seal chamber shall have an inspection and inspection plug, with positive anti-leak seal shall be used to prevent leakage to the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

W. The seal chamber shall have a seal in the seal chamber, the area about the exterior of the seal chamber shall be cast in the cast iron housing shall have cast in an integral concentric seal chamber. The seal chamber shall protect the seals by causing abrasive particulate to be forced out away from the seal due to centrifugal action.

The seal chamber of construction shall be as follows:

- 
- b. npe

Y. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Z. The motor shall be equipped with 32 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

AA. Each completed and assembled pump/motor unit shall pass the following factory tests at the manufacturer's plant prior to shipment. The manufacturer shall provide on demand a copy of his quality control plan for the pump/motor unit and a factory certificate:

- a. Minimum 3-point hydraulic performance test
- b. No-Leak seal integrity test
- c. Electrical integrity test

2.2. EQUIPMENT FOR WET WELL INSTALLATION

- A. For each pump the contractor shall provide a discharge connection made of cast iron ASTM A-48.
- B. The outlet flange of the discharge connection shall be 12" drilled according ANSI B16.1-89; tab.5.
- C. The pump(s) shall be directly connected to the discharge connection. Parallel guide bars extending from the top of the station to the discharge connection. The material of the guide bars shall be stainless steel AISI 316.
- D. The guide bars shall be 19 feet and they shall be fasten at the top of the station made of Stainless steel AISI 316.
- E. The contractor shall supply and install a cable holder made with 4" diameter stainless steel AISI 316.
- F. A platform shall be provided for personnel to enter the wet-well.
- G. The connection of the pumping unit to the discharge connection shall be accomplished by metal to metal contact. Sealing of the discharge interface with a gasket, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
- H.

2.3. LIFTING EQUIPMENT FOR PUMPS

- A. Each pump shall be fitted with 20 feet of stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.
- B. A removable davit crane shall be supplied with the pumps for pump removal, etc.



Performance Objective

Hydro International is pleased to propose the following HeadCell® grit removal, washing, and dewatering system to be installed in an existing plant which has flows of 1.9 mgd average and 6.0 mgd peak. Each component of the grit removal system's performance shall be outlined below.

Proposed Equipment Summary

HeadCell® Grit Concentrator Unit

The HeadCell® is an all-hydraulic grit concentrator, which uses vortex flow and a stacked tray design to efficiently capture and settle fine grit via large surface area and short settling distances. The unit can be installed in an existing flow, downstream of screening, in any system where limited head is available. The unit requires no external power, has no internal moving parts, is self-cleaning, and has a compact modular construction. Wide turndown is achieved by the HeadCell® when it is combined with Hydro's high performance washing system.

Hydro has standardized on a new HeadCell® collection sump design. The sump is constructed from concrete/grout below the trays. The larger grit sump will allow for the intermittent pumping of grit. The sump includes a fluidizing ring to resuspend settled grit more aggressively. It does not require a pump to be run intermittently the resulting water usage is lower. The larger sump does allow for intermittent grit pumping in situations where overnight flows are low or other project drivers make intermittent grit pumping necessary.

Specifications	
Quantity:	1
Size:	8412
Design Flow/Unit:	250 gpm with 3" headloss
Influent Solids Concentration:	≤1.5%
Influent Connection:	4" flanged pipe
Capacity:	Up to 1.5 cy/hr
Screw Diameter:	12"
Clarifier Size:	84"

Number of Trays:	12
Surface Area:	1,200 sq ft
Loading Rate @ Peak:	1.5 gpm/sq ft
Performance @ 12" headloss:	Removal of all grit (SG 2.65) ≥ 106 microns
Performance @ 2" headloss:	Removal of all grit (SG 2.65) ≥ 75 microns
Inlet Connection:	4" flanged pipe
Outlet Connection:	4" flanged pipe
Support Structure:	304 SS Support Structure/Duct/Underflow
Trays:	Low Density Polyethylene Trays
Weight (Estimate):	2,200 lbs

Hydro Grit Washer

The Hydro Grit Washer is a high efficiency unit that effectively removes, washes, and dewater fine grit, sugar sand, and other solids from grit slurries. The large conical clarifier with tangential inlet and internal baffle enhances the settling of solids and the fluidized sand bed scrubs off and separates attached organics, resulting in a dry grit with extreme water content suitable for landfill disposal.

Specifications	
Quantity:	1
Size:	8412
Design Flow/Unit:	250 gpm with 3" headloss
Influent Solids Concentration:	≤1.5%
Influent Connection:	4" flanged pipe
Capacity:	Up to 1.5 cy/hr
Screw Diameter:	12"
Clarifier Size:	84"

Min. Free Water Surface Area:	38.5 ft ²
Auger Motor:	2 hp, TENV, 460V/3 phase/ 60 Hz
Agitator Motor:	1 hp, TENV, 460V/3 phase/ 60 Hz
Effluent Connection:	8" flanged pipe
Organics Discharge Connection:	4" flanged pipe
Drain Connection:	3" NPT pipe
NPW Connection:	1" NPT (2 No.)
NPW Requirement Fluidized Bed:	25 gpm @ 50 psig Continuous
NPW Requirement Organics Flush:	25 gpm @ 50 psig (20-30 sec. hourly)
Operation:	Continuous or a minimum of 10-15 minutes
Body Material:	304 SS
Weight Dry/Wet (approximate):	3,600 / 10,400 lbs.
Performance:	95% removal of all grit (smaller than 75 microns with less than 5% fines) and more than 90% total solids removal during normal operation and <0.5% fines

Control Panel

The panel shall contain all timers, VFDs, switches, and indicator lights to control the system, one (1) GritCleanse™ unit, and one (1) grit pump in either fully automated or manual operation.

Specifications

Quantity:	1
Enclosure Material:	304 SS
Enclosure Temperature:	300°F
Power Source:	460V/3 phase/ 60 Hz
Control System:	PanelView Plus 600 OIU
Grit Pump:	Hydro GritCleanse™

System Hydraulics

System hydraulics is the responsibility of the user. Hydro International can provide information on HeadCell® hydraulics and pumping and piping design. For determining system hydraulics and pump requirements, upon request.

Design Recommendations

- 1/2" or finer screen for the system
- Velocity through the system should not exceed 4 ft/s at peak flow as recommended by industry design manuals
- Estimate the system flow rate in gpm/hr.
- State the system flow rate in gpm/hr. (volatile solids) is based on a minimum plant influent grit quantity of 50 pounds
- Fixed equipment must be supported by other means than the Hydro equipment
- 2 – 3 ft clearance around all equipment and minimum 3' of access clearance above equipment
- 4 – 7 ft/s velocity as recommended by industry design manuals
- Incorporate a floor drain, in the grit dumpster to allow for further dewatering prior to disposal
- A minimum 18" clearance around all equipment and minimum 3' of access clearance above equipment
- Operators find it useful to locate a spray hose adjacent to the equipment so that they can spray all equipment down during an inspection
- Incorporate a minimal access platform to facilitate inspection access to the top of the equipment
- Equipment not recommended to be placed outdoors in freezing climates
- Discharge chutes for grit should be at a minimum 45° incline if it is open chute. If it is an enclosed chute/pipe/tube then a minimum angle of 60° is required to ensure plugging does not occur.
- Discharge from Hydro's equipment shall be to the atmosphere. There shall be no backpressure created by downstream piping connected to Hydro's equipment.

- Control panels with VFD's shall be placed < 100 ft of wiring/conduit away from the equipment being controlled to prevent degradation of signal

Start-up

One (1) factory trained representative, two (2) trips, for start-up and instruction services as required totaling four (4) days.

Quote Validity: 30 days After expiration of validity Hydro International reserves the right to adjust pricing to account for any significant increases in material costs.

Exclusions

Any item(s) not specifically described above are excluded and are not to be supplied by Hydro International including but not limited to the following:

- Field assembly, erection, and installation
- Pipe connections and fittings not expressly stated above
- All pipe supports, hangers and braces
- Controls, switches, control panels and instrumentation of any kind not
- Wiring and conduit
- Field or touch-up paint, painting, blasting and touch-up of surface
- Spare parts not specifically stated above
- Unloading, hauling and storage charge
- Lubricating oil and greases
- Grit study, field performance testing, laboratory testing
- All concrete and grouting work
- Insulation and heat tracing of any kind
- Performance, Warranty, Efficacy and/or Supply
- Grit dumpsters
- Translation Services
- Interconnecting piping and valving not
- Grit pump(s) and associated piping, bellmouth on grit slurry suction line
- Covers and access hatches
- Structural / Seismic anchorage
- Anchor Bolts

Options

Quotes will be provided upon request for the following features:

- Stainless steel
- Additional field
- Explosion
- Upgrade
- Structural modifications
- Field performance testing and sample collection and analysis
- Serv
- Extend
- Grit Pump

Warranty

Hydro International's Standard Warranty shall apply per the Terms and Conditions of Sale.

Delivery

Please allow 14-16 weeks after receipt of purchase order for approval drawings. Shipment is typically a maximum of 18-20 weeks after receipt of "Approved" or "Approved as Noted, Resubmittal Not Required" submittal package. Price includes truck freight to jobsite but does not include any state, or local taxes if required. Timelines are based on typical workloads and can vary, with current market conditions timing will be longer.

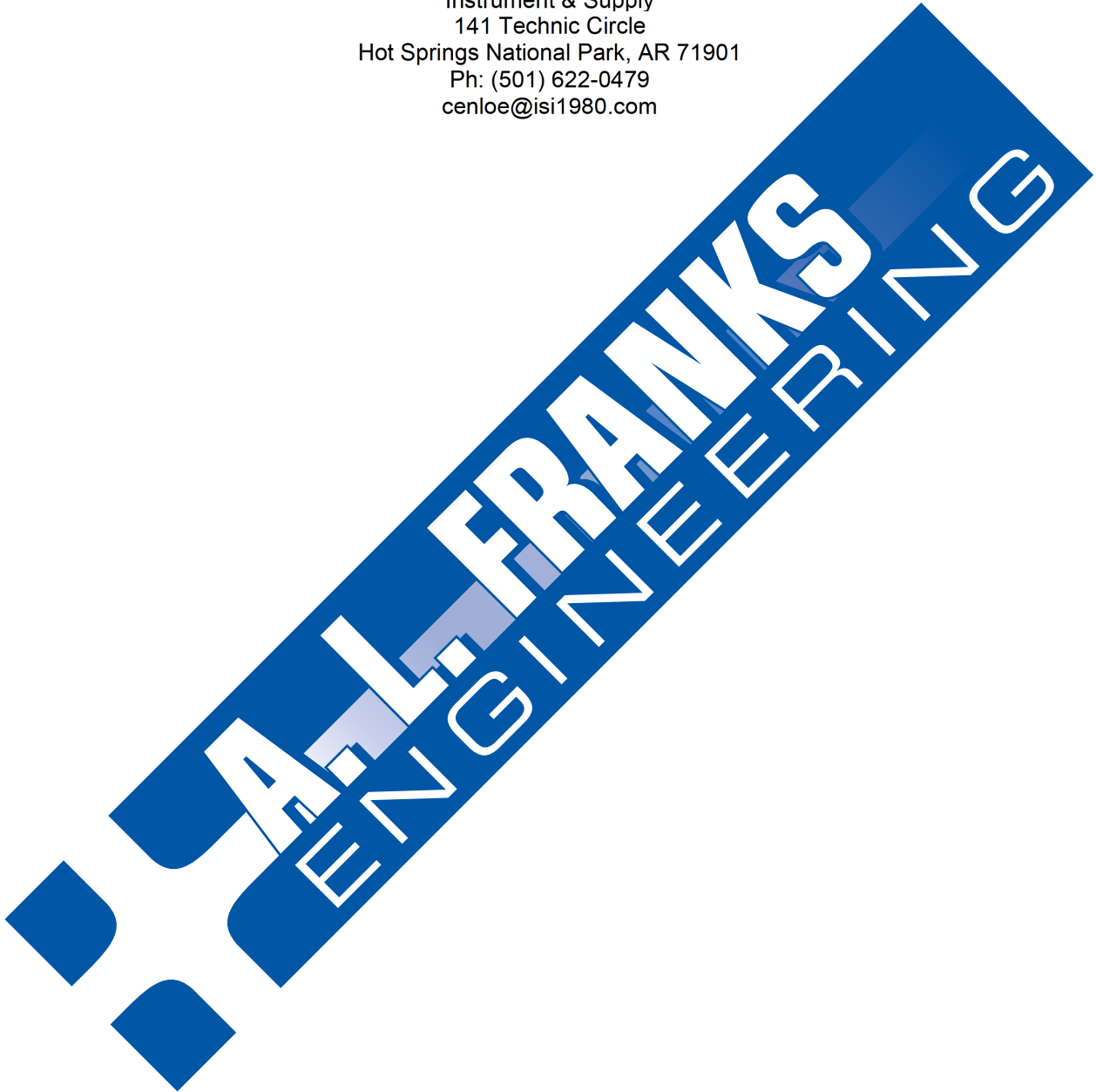
Terms & Conditions

This proposal is made pursuant to Hydro International's standard Terms & Conditions of Sale, attached hereto, and made a part hereof.

Contact

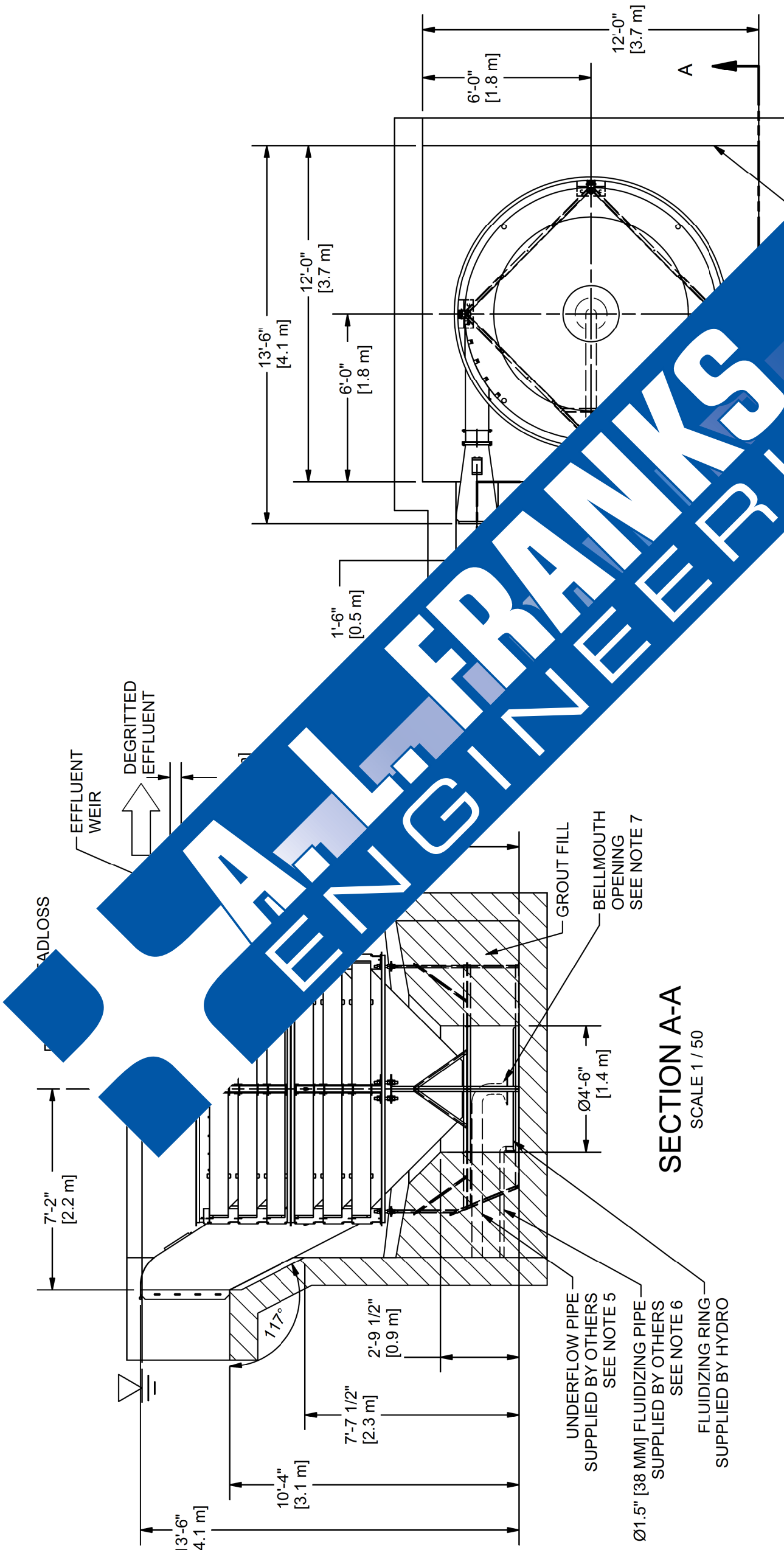
Plant Representative:

Mr. Chris Enloe
Instrument & Supply
141 Technic Circle
Hot Springs National Park, AR 71901
Ph: (501) 622-0479
cenloe@isi1980.com



DO NOT CHANGE DUCT LAYOUT OR PIPE ORIENTATION
WITHOUT CONSULTING HYDRO INTERNATIONAL

- 1. ALLOW GRIT PUMP TO FULLY DRAIN HEADCELL TANK.
- 2. PLANT FLOW BYPASS RECOMMENDED TO ALLOW THE HEADCELL TO BE TAKEN OUT OF SERVICE FOR MAINTENANCE.
- 3. CLOCKWISE & COUNTERCLOCKWISE UNITS ARE AVAILABLE. CW SHOWN.
- 4. ALTERNATE EFFLUENT CONFIGURATIONS ARE AVAILABLE.
- 5. THE GRIT PUMP SUCTION PIPE SHOULD BE DESIGNED FOR A 4-7 FT/S [1.2-2.2 M/S] PIPE VELOCITY.
- 6. FLUIDIZING WATER REQUIREMENTS INTERMITTENT 32 GPM [2.0 L/S] AT 50 PSIG
- 7. DISTANCE BETWEEN BELL MOUTH AND BOTTOM OF TANK 1.25 X SUCTION PIPE DIAMETER



SECTION A-A
SCALE 1 / 50

PROJECTION

IF IN DOUBT ASK

DATE: 10/25/2022
SCALE: 1 / 50

DRAWN BY: LS
CHECKED BY: AS
APPROVED BY: LS

Title

HEADCELL
PROPOSAL
9' DIAMETER
6 TRAY

Hydro International®
hydro-int.com

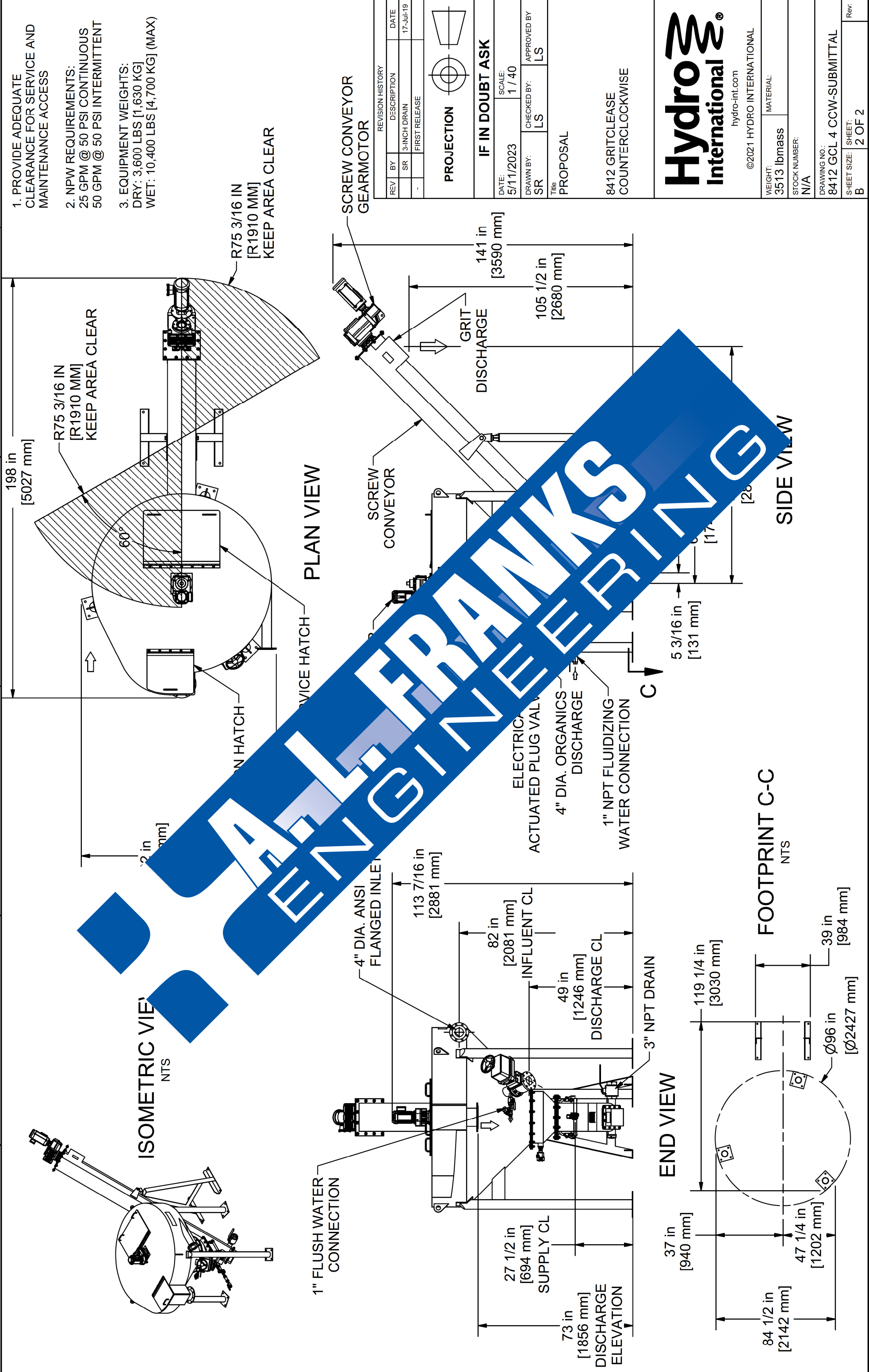
©2021 HYDRO INTERNATIONAL

WEIGHT: 2143 lbmass
STOCK NUMBER:

MATERIAL:

DRAWING NO.: 9' 6T 1.08 INT
SHEET SIZE: B
SHEET: 1 OF 1
Rev: -

ANY WARRANTY, INCLUDING HYDRO INTERNATIONAL WILL APPLY ONLY TO THOSE ITEMS SUPPLIED BY IT. HYDRO INTERNATIONAL CANNOT ACCEPT ANY RESPONSIBILITY FOR ANY STRUCTURE, PLANT, OR EQUIPMENT, OR THE PERFORMANCE THERE OF) DESIGNED, BUILT, MANUFACTURED, OR SUPPLIED BY ANY THIRD PARTY. HYDRO INTERNATIONAL HAVE A POLICY OF CONTINUOUS DEVELOPMENT AND RESERVE THE RIGHT TO AMEND THE SPECIFICATION. HYDRO INTERNATIONAL CANNOT ACCEPT LIABILITY FOR PERFORMANCE OF ITS EQUIPMENT, (OR ANY PART THEREOF), IF THE EQUIPMENT IS SUBJECT TO CONDITIONS OUTSIDE ANY DESIGN SPECIFICATION. HYDRO INTERNATIONAL OWNS THE COPYRIGHT OF THIS DRAWING WHICH IS SUPPLIED IN CONFIDENCE. IT MUST NOT BE USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SUPPLIED AND MUST NOT BE REPRODUCED, IN WHOLE OR IN PART, WITHOUT PRIOR PERMISSION IN WRITING FROM HYDRO INTERNATIONAL.



- 1. PROVIDE ADEQUATE CLEARANCE FOR SERVICE AND MAINTENANCE ACCESS
- 2. NPW REQUIREMENTS: 25 GPM @ 50 PSI CONTINUOUS 50 GPM @ 50 PSI INTERMITTENT
- 3. EQUIPMENT WEIGHTS: DRY: 3,600 LBS [1,630 KG] WET: 10,400 LBS [4,700 KG] (MAX)

REVISION HISTORY			
REV	BY	DESCRIPTION	DATE
	SR	3-INCH DRAIN	17-Jul-19
-		FIRST RELEASE	

PROJECTION			
IF IN DOUBT ASK			
DATE:	5/11/2023	SCALE:	1 / 40
DRAWN BY:	SR	CHECKED BY:	LS
APPROVED BY		LS	
Title			
PROPOSAL			
8412 GRITCLEASE COUNTERCLOCKWISE			

Hydro International [®]		hydro-int.com	
©2021 HYDRO INTERNATIONAL			
WEIGHT:	3513 lbmass	MATERIAL:	
STOCK NUMBER:	N/A		
DRAWING NO.:			
8412 GCL 4 CCW-SUBMITTAL			
S-SHEET SIZE:	B	SHEET:	2 OF 2
Rev:			

North American Grit Gradations

Hydro International is pleased to announce the availability of national and regional grit gradation data. This data, which has been compiled from over 120 tests across North America, contains average physical size data as well as settling velocity (SES) data, making it the most comprehensive information available on grit and its behavior.

Virtually all conventional grit removal processes rely on gravity sedimentation to achieve the separation of grit from wastewater. Most conventional grit removal processes are designed based on the assumption that grit is spherical and has a specific gravity 2.65. However, not all grit maintains a specific gravity of 2.65. Other factors such as shape and encapsulation by fats, oils and grease significantly impact its settling velocity. The best means to analyze grit is to determine the settling velocity for given particle size. This velocity data can be correlated to the measured settling velocity of a clean sand sphere. The sand particle size is called as the Sand Equivalent Size (SES), which is the sand particle size having the same settling velocity as the buoyant grit particle. The correlated particle size, or Sand Equivalent Size can then be used in the grit removal process.

When settling velocity is considered in the design actual removal efficiency can be estimated more realistically.

Data is available for the following regions:

Region	States / Provinces
Northeast	ME, VT, NH, MA, CT, RI, PA, NY, NJ, DE, MD, VA
Mid-Atlantic	PA, NY, NJ, DE, MD, VA
Southeast	NC, SC, GA, FL
North Central	MI, WI, IA, MN, ND, SD, NE
South Central	TX, OK, KS, MO, CO, ID, MT, UT, WY
West	CA, AZ, NV, NM, CO, ID, MT, UT, WY
Canada	ON, QC, AB, SK, MB, BC, YT, NT, NW

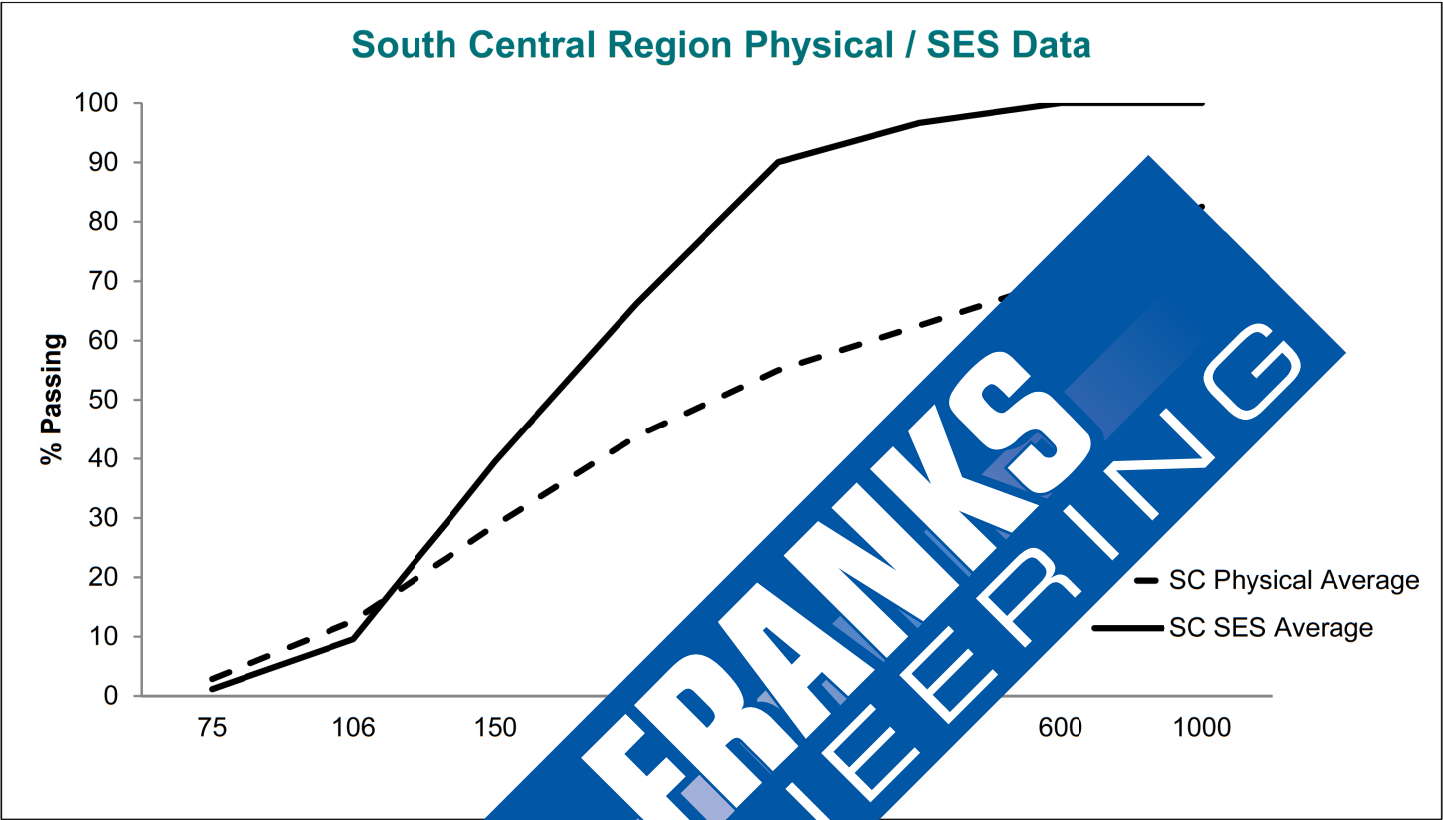
State data is available for those states where more than 5 data points are available; those states currently include: Georgia, North Carolina, and Virginia.

Hydro International

2925 NE Alcock Suite 140 · Hillsboro, OR 97124

Tel: (866) 615-8130 Fax: (503) 615-2906 Web: hydro-int.com

South Central Regional Gradation



	% Passing							
	75	150	212	300	425	600	1000	
SC Physical Average	2.1	21.2	42.6	62.7	71.9	81.2	93.2	Physical
SC SES Average	1.2	31.9	56.6	83.4	90.3	94.1	97.9	SES

The above graph shows the gradation of the material passing through various sieve sizes based on physical size (unshaded) and Sand Equivalent (SES). SES provides the settling velocity distribution of the grit particles.

Standard Terms and Conditions of Sale

- 1. **DEFINITIONS.** "Hydro" is Hydro International with an address of 2925 NE Aloclek Drive #140 in Hillsboro, Oregon. "Buyer" is the party purchasing the goods from Hydro.
- 2. **ENTIRE AGREEMENT.** Hydro's agreement is based on these terms and conditions of sale. This document, together with any additional writings signed by Hydro, represents a final, complete, and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained, or waived by parol evidence, Buyer's purchase order, any course of dealing, Buyer's payment or acceptance, or in any other way except in writing signed by Hydro through its authorized representative. These terms and conditions are intended to cover all activity of Hydro and Buyer hereunder, including sales and use of products, parts, and work, and all related matters (references to products include parts and references to work include construction and installation). Hydro's obligations hereunder are expressly conditioned on Buyer's assent to the terms and conditions. Hydro objects to any terms that are different from, or additional to, these terms and conditions. Any drawings and specifications are hereby incorporated and made a part of these Terms and Conditions of Sale only to the material supplied hereunder.
- 3. **SPECIFICATIONS.** Products are supplied in accordance with information received from Buyer. Hydro shall have no responsibility for products created or sold based on information supplied to it. Buyer shall ensure that Hydro receives all relevant information to produce appropriate products.
- 4. **INSTALLATION AND APPLICATION OF PRODUCTS.** Products supplied by Hydro shall be used only in the application for which they were specifically designed. Buyer shall not use products supplied by Hydro for any application other than those specified; nor shall Hydro be responsible for any limitation, any warranty obligations, survive Buyer's transfer of products supplied hereunder. Products are transferred with Hydro's consent. In addition, Buyer shall not use any product supplied by Hydro at the location for which Hydro has previously received notice from Buyer. Any breach of this section shall constitute an infringement of the patent for the products in question and will in any event constitute a breach of the terms of sale hereunder.
- 5. **PURCHASE PRICE AND PAYMENT TERMS.** All payments shall be made in U.S. dollars. Payment terms are as follows:

	Payment	Cumulative Payment
Upon Approval	10%	10%
Upon Delivery	80%	90%
Upon Final Acceptance	10%	100%

If payments are not made in accordance with the terms stated herein, any unpaid balance shall be subject to interest at a rate of 11½% per month, or the maximum rate permitted by law. If shipment is delayed by Buyer, the previously agreed date of reading shall be the date of shipment for payment purposes. If manufacture is delayed by Buyer, a percentage of completion shall be determined by Hydro's judgment. Buyer may be or may become unable or unwilling to meet the terms of the agreement, in which case Hydro reserves the right to suspend or full or partial payment as a condition to commencing, or continuing, manufacture.

Until full payment is received by Hydro, this Standard Terms and Conditions of Sale shall constitute a security agreement and Buyer grants Hydro a purchase money security interest in and to the products produced by Hydro hereunder, and any products or proceeds thereof, in particular:

- a. Hydro shall have an express purchase money security interest in and to the products and all proceeds thereof.
- b. Until full payment for the products is received by Hydro, Hydro reserves the right to retake possession of the products at any time and for this purpose Buyer authorizes Hydro or its duly authorized agent to enter upon land or premises where it believes the product may be.
- c. Proceeds of any disposal of the products shall be held in trust for Hydro pursuant to the terms of the Maine Uniform Commercial Code.
- d. Buyer grants Hydro a power of attorney for the purpose of filing a UCC-1 financing statement in the name of Buyer to evidence Hydro's security interest in the products.

- [illegible]

This warranty does not cover any defects or costs caused by: (1) normal wear and tear of equipment from designed operation; (2) modification, alteration, repair or service of the goods by anyone other than Hydro; (3) physical abuse to, or misuse of, the goods, or operation thereof in a manner contrary to Hydro's instructions; (4) any use of the goods other than that for which they were intended; (5) chemicals or components which were not disclosed to Hydro; (6) storage contrary to Hydro's instructions; or (7) failure to maintain the goods in accordance with Hydro's instructions.

This warranty does not apply to component parts of the goods that were not both originally designed and manufactured by Hydro, including, but not limited to, valves and controls. These component parts do not carry any warranties by Hydro, and only carry the warranties, if any, of their manufacturers.

requirements. Buyer assumes all responsibility for the readiness of the system when it requests Field Service Engineer arrive at the jobsite and determine that the system cannot be started. Buyer shall have the option to bring the Field Service Engineer home and bill Buyer for the travel. Field service is available from Hydro at the prevailing per-diem rate at the time of request for service, portal-to-portal. A purchase order or change order will be required for all services.

HYDRO'S LIABILITY. Hydro assumes no liability or responsibility for damages, claims, suits or awards to, or assigns, or other use inconsistent with the use approved by Hydro, and Buyer agrees to indemnify and hold harmless Hydro from and against all claims, suits or awards put to as a result of misuse or inconsistent use of the system. Hydro shall not be liable for any loss which results from, but not limited to, acts of God, casualty, civil disturbance, transportation or services, any interruption of its facilities, or act of any third party. Hydro's total liability shall not exceed the Contract Sum.

DELIVERIES AND DELAYED DELIVERIES. In the event of a delay in delivery for any reason beyond Hydro's control, including but not limited to, acts of God, casualty, civil disturbance, transportation or services, including related to supply chain, pandemics, transportation or services, any interruption of its facilities, or act of any third party, the time for delivery shall be extended for the duration of the delay and the continuance of such conditions.

INTELLECTUAL PROPERTY. Hydro shall not own or claim any intellectual property used or produced by Buyer, including but not limited to, software, hardware, written materials, manuals, marks or other intellectual property that is not owned by Hydro. Buyer shall own all copyright or trademark (whether or not such property is used or produced by Hydro) except for the purpose of confirming the quality of the product. Buyer shall not use or reproduce any intellectual property for any purpose other than for the purpose of the product. Buyer shall not photocopy, duplicate or otherwise reproduce any intellectual property for any purpose other than for the purpose of the product. Buyer shall not use or reproduce any intellectual property protected by this paragraph for any purpose other than for the purpose of the product. Buyer shall not use or reproduce any intellectual property for all third-party software (not provided by Hydro) for any purpose other than for the purpose of the product. Buyer shall not use or reproduce any intellectual property for all claims by licensors of such software. Hydro makes no warranty as to the performance of the software to be developed by Hydro for the purpose of the product. Buyer to the extent that such software causes or contributes to the performance of the software to be developed by Hydro for the purpose of the product. Hydro will grant to the Owner a non-transferable, non-exclusive license to use the software in the form of the license agreement attached as Exhibit A. Patent rights in the software shall be owned by the licensor.

TAXES. Hydro shall be responsible for any tax, excise, duty or levy now or hereafter enacted or imposed, by any government, on the manufacture, sale, delivery and/or use of any item delivered. An additional charge will be assessed if Hydro is furnished with a proper exemption certificate relieving Hydro of paying taxes on the items delivered.

FORCE MAJEURE. This contract shall be construed according to the laws of the State of Maine.

- F FOR buy

20. **ATTORNEYS' FEES.** If any judicial or non-judicial proceeding is initiated for the purpose of enforcing a provision of this contract, the prevailing party shall be awarded reasonable attorneys' fees in addition to all other costs associated with the proceeding, whether or not the proceeding advances to judgment.
21. **SEVERABILITY.** If any provisions of this contract are held invalid by a court of competent jurisdiction, the remainder of this contract shall not be rendered invalid, and such invalid provisions shall be modified, in keeping with the letter and spirit of this contract, to the extent permitted by applicable law so as to be rendered valid.
22. **ANTI-BRIBERY.** Hydro International will not engage in any form of bribery or corruption. The offering, giving or receiving of bribes is contrary to Hydro International's values and can play no part in the way in which it carries out its business. Hydro requires you to support our approach and implement provisions consistent with our policy through your own organization and your supply chain. Please find a copy of our Anti-Bribery and Corruption Policy on our website at: <https://hydro-int.com/default/files/hydro-international-anti-bribery-and-corruption-policy-february-2022.pdf>



SECTION 11350

CLARIFIER MECHANISM

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall furnish and install one (1) center feed/skimmer type clarifier suitable for installation in a new concrete tank with a minimum 10' nominal side water depth with 1'-6" free board, and a minimum 10' diameter. Each mechanism shall be a center-column support type with a sludge removal, peripheral overflow type with a center column support arm, and a suspended cage with one (1) sludge removal arm and one (1) skimmer support arm attached.
- B. The equipment furnished for each clarifier shall not be limited to: walkway with handrails, center arm, center column, influent feedwell, center cage, suction sludge removal arm, skimmer support arm, sludge manifold, scum skimmer, and anchor bolts.
- C. Like items of equipment shall be the end products of one manufacturer in order to facilitate operation, maintenance, spare parts, and manufacturing.
- D. Except where specified, all plates and structural members designated for stress shall have a minimum thickness of 1/4". 304 stainless steel nuts and washers, shall be provided for all parts to be secured to the tank. All fasteners shall also be 304 stainless steel.

1.2 REFERENCES

- A. AISC 360-10 Steel Specification
- B. AISC 360-10 Steel Specification
- C. AISC 360-10 Steel Specification
- D. AISC 360-10 Steel Specification
- E. AISC 360-10 Steel Specification
- F. AISC 360-10 Steel Specification
- G. AISC 360-10 Steel Specification
- H. AISC 360-10 Steel Specification
- I. AISC 360-10 Steel Specification
- J. AWS D1.1 Structural Steel Welding
- K. AISC 360-10 Steel Specification
- L. AISI 304 Stainless Steel
- M. SSPC-PA 1 Steel Structures Painting Council

1.3 QUALITY ASSURANCE

- A. The clarifier mechanisms shall be manufactured by Envirodyne Systems Inc. or pre-approved equal. The clarifier equipment manufacturer shall modify its standard equipment to meet the minimum values specified for dimensions, design, and the intent of this specification. ISO 9001:2015 certification is required.
- B. The manufacturer of the replacement clarifier equipment shall be responsible for performing LiDAR scans and performing measurements of the existing structure, as necessary, for design and manufacturer of the clarifier equipment. The production of final shop drawings. The LiDAR scans shall be performed by a bona fide full-time employee of the manufacturer to ensure proper (and accessible) critical items of the existing structure. The contractor shall ensure the tank to be scanned is completely drained of any water. The contractor shall ensure the manufacturer, prior to and during the manufacture of the equipment. The contractor and owner shall assist the manufacturer in the LiDAR scans satisfactory to the manufacturer.
- C. Manufacturers regularly engaged in the manufacture of equipment as specified herein and who can demonstrate a minimum of 10 years of design, in actual service for a period of not less than 5 years, shall be considered as acceptable manufacturers. The Contractor shall submit a list of (5) similar installations to be verified by the Engineer. The equipment must be operational for a minimum of 1 year. The manufacturer shall show evidence of quality assurance in manufacturing the equipment essential in details to the equipment herein specified.
- D. Manufacturers not meeting the requirements as set forth above must submit, 30 working days prior to the bid date, a complete pre-qualification package including a line-by-line comparison of the proposed equipment to the specifications. The pre-qualification package shall include a list of similar type equipment comparable to the equipment specified in satisfactory use for a period of not less than 1 year. The package must include, but not be limited to the following:
- 1. Name and location of installation
 - 2. Name of person in direct responsible charge for the equipment
 - 3. Address and phone number of person in direct responsible charge
 - 4. Month and year the equipment was placed in operation
 - 5. Brief description of equipment

1.4 CONTRACTOR SUBMITTAL

- A. The manufacturer shall modify their standard equipment to meet the minimum values specified for dimension, design and intent of this specification.
- C. The complete machine shall be of sufficient strength to sweep in 2" grout on the tank bottom under its own power. Such grouting shall be done in strict accordance with the manufacturer's instruction.
- D. Information required for approval by the Engineer prior to incorporation into the project shall include the following as a minimum requirement:

1. Certified dimension prints detailing all required anchor bolt locations.
2. Submit drive calculations certified by a registered professional engineer and member of AGMA which shall substantiate the output torque rating of the drive, the reduction gearing ratios and torques, and the motor capacity. The PE shall be a bona fide full-time employee of the clarifier manufacturer. The calculations shall clearly specify the values used for each of the following:

- a. Worm and Worm Gear Diameters
- b. Number of Pinions
- c. Actual Face Width
- d. Tooth Geometry Factor (I and J factors)
- e. Load Distribution Factor
- f. Allowable Contact Stress
- g. Allowable Bending Stress
- h. Pinion Pitch Diameter
- i. Tooth Diameter Pitch
- j. Hardness Ratio Factor
- k. Elastic Coefficient
- l. Stress Cycle

The load distribution factor shall be determined in accordance with AGMA 2001-C95 for C_m and K_m shall be determined and must be substantiated. The net face width calculation shall not exceed the actual face width of the two mating gears. For parameters that are not specified, the manufacturer shall determine the allowable contact stress, the calculations shall be based on the properties of the materials and heat treatment used.

3. Submit electrical and mechanical components and complete drawings for overload drive control.

Recommended procedures for jobsite storage and handling

Maintenance Manuals: Prior to delivery of equipment and updated during installation of the equipment, the manufacturer shall furnish detailed installation, operation and maintenance manuals which shall contain the following information as a minimum requirement:

1. Assembly, erection, installation and adjustment instructions & drawings.
2. Operating, lubrication and maintenance instructions.
3. Complete descriptive literature of all materials and components furnished.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All submerged and non-submerged structural steel members shall have a minimum thickness of 1/4" unless noted and shall be capable of withstanding the momentary peak load without failure or plastic deflection. The clarifier shall be so designed that there will be no chains, sprockets, bearings or operating mechanism below the liquid surface or in contact with the liquid.

2.3 EQUIPMENT

- A. The center-column supported, center feed, rapid sludge removal, manual overflow type clarifier mechanism shall be model HBS-1AB with one (1) sludge removal arm and one (1) counterweight/skimmer support arm attached. The clarifier shall be designed to remove sludge uniformly from the tank.

2.4 DRIVE ASSEMBLY

- A. The Drive Mechanism shall be the Hercules™ of an electric drive motor with a hydraulic torque reducer, shear pin coupling, intermediate pinion gear with enclosed spur gear in a heavy duty welded frame.
- B. Gear Design and Rating Criteria:
1. The drive assembly shall have a minimum Continuous Torque of 16,000 ft. lbs. The design torque required for normal operation of the mechanism shall be based on a continuous 20-year service basis with an operating speed of 100 RPM.
 2. The Alarm Torque shall be set at a level that the mechanism can achieve before active torque is set at approx. 100% of the drive Continuous Torque.
 3. The Maximum Running Torque shall be the maximum running torque for which the mechanism is designed. The maximum running torque shall be based on the motor Cut-Out Torque is set at approx. 120% of the Continuous Torque, a value equivalent to 19,200 ft. lbs. The Maximum Running Torque is the rating based on the safe dynamic loading of the gear teeth to withstand the repeated impact loads of the mechanism. The surface endurance of the gear materials and life of the mechanism shall be adequate to withstand short periods of the dynamic load on the gears. Shear pin sizing shall be based on this Maximum Running Torque and set to 24,000 ft lbs.
 4. The Momentary Peak Torque is the dynamic load capacity of the drive assembly developed momentarily as starting torque or a sudden buildup of torque. This Momentary Peak Torque is set at 32,000 ft. lbs.
 5. All gears shall be designed for surface durability, strength & geometry in accordance with the latest applicable standards of the AGMA, ANSI and British Standard of spur, worm and helical gearing. All bearings shall be selected in accordance with applicable AFBMA-ANSI standards.
 7. All cylindrical worm gearing shall conform to AGMA 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.

8. All pinions and spur gears shall conform to AGMA 2001-D04, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
 9. The output torque rating of the drive shall be based on the smaller of the values determined from the above AGMA standards.
- C. Drive Motor, Primary and Intermediate Gear Reducers
1. The drive motor shall be a constant speed, TEFC, "C" face mount, NEMA Design B "squirrel cage" for 230/460 volt, 3 phase, 60 Hz, 100% efficient, chemical "dirty duty" service with 1.15 S.F., Class F insulation, 100% Class B temperature rise. The motor shall be rated for minimum torque and shall be adequate to start and continuously operate the mechanism at maximum load encountered under any operating conditions without the motor exceeding the nameplate rating. The drive motor shall be direct connected to the primary speed reducer. Belts or exposed shaft couplings between the motor and the reducer will not be accepted.
 2. The primary speed reducer shall be a single reduction helical gear unit in an ASTM A48 cast iron housing. It shall be furnished with an adapter mounting the motor. The reducer shall be sized for the motor.
 3. The primary and intermediate reducers shall be connected through a spline shaft adapter. Keyway engagements are not acceptable.
 4. The intermediate reducer shall be a single reduction gear unit, planetary type design in an ASTM A48 cast iron housing with oil injection. Rated reducers (e.g. cycloidal drives) are not acceptable. The reducer is to have anti-friction tapered roller bearings to prevent tipping of the gear. The housing is to be furnished with a tapered fit (min 3/8" deep) to insure proper mounting under operating load conditions.
- D. Main Gear Housing
1. The main gear housing shall be an oil-bath lubricated solid one-piece internal gear housing with four-point contact precision design ball bearing mounted in a steel weldment housing. The main gear housing shall be mounted on the top of the stationary center column and shall be capable of supporting the mechanical design strength.
 2. The main gear housing shall be a heavy duty ASTM A36 steel weldment sealed and designed to support the drive cage, arms, access bridge and other applied loads. Cast iron housings will not be acceptable due their potential to develop cracks, pinholes and leaks. The housing shall be constructed using proper wall thickness designed to resist deflection at full peak torque. The oil dam in the main gear housing shall be full sidewall construction integral with the turntable base. A condensation collection sump shall be provided below the lower pinion bearing.
 3. The main spur gear shall be forged of alloy hardened steel and conform to AGMA 6 or better and have a minimum Brinell hardness of 300. The gear shall have a minimum pitch diameter of 32" and shall be supported by and rotated upon the main bearing. The spur gear face surface area shall have a

minimum of 351 sq. inches to insure minimal contact stress and mechanical stability and shall match the face and teeth of the pinion gear. The face surface area is defined as the spur gear pitch diameter times the spur gear face width times 3.14.

4. The bearing raceway shall be precision ground and deep induction hardened to Rockwell C60 for maximum capacity and to provide true rolling action without the need for strip liners. Drives that require strip liners are not acceptable due to the fact that strip liner wear causes non uniform rolling action of the balls which could cause the mechanism to become out of plumb. The balls shall be matched precision chrome-alloy steel balls. Spherically faced spacers designed to provide uniform load distribution between the spur gear shall run in an oil bath with minimum viscosity of 150 SUS at 100°F. Both bearing rings shall be minimum 123,000 PSI ultimate tensile strength and hardness of minimum Rc56. Bearing life shall be minimum 10 years per AFBMA L-10.
 5. The main bearing shall have a minimum clearance of .001" and shall be capable of withstanding an ultimate load of 100,000 lbs. without the aid of any underwater guides or bearing guides. The bearing shall be in contact for AGMA rating of the main gear.
 6. The pinion gear shall be made of steel. The pinion gear shall be keyed to the intermediate speed reducer and supported by bearings mounted into machined pilots.
 7. The drive base shall be inspected for seep holes or inclusions and given a full inspection for leaks in the oil containment area. The component shall be tested in the manufacturer's shop and tested to assure proper operation and to calibrate the drive control. A certificate of test shall be submitted to the engineer verifying that the drive meets the manufacturer and engineer.
- E. Torque Control:
1. The drive unit shall be equipped with a hydraulic torque control system in a stainless steel weatherproof housing. The torque control shall be factory set and field adjustable. The torque control shall have two switches - one to energize an alarm when the loading reaches the maximum torque, the other to actuate the motor cutout switch when the loading reaches the specified motor cutout torque. Torque switches shall be single-throw, double-throw contacts rated at 10 amps, 120 VAC mounted in a NEMA 4X housing. A 6" dia. torque dial indicator shall be provided for a readout in "ft.-lbs." which can be easily read from the walkway. Additional overload protection shall be provided by a shear pin device mounted at the primary speed reducer.
- F. Walkway and Drive Platform:
1. The clarifier shall be provided with a 36" wide walkway with handrails. The walkway shall be supported at the center by the drive unit and supported on the opposite end by the tank wall. The walkway shall be designed to safely withstand all dead loads plus a live load of 50 pounds per linear foot with a maximum deflection of 1/360, over the entire span. The walkway shall consist

of two (2) beams diagonally and cross-braced to resist the specified torque and wind loads. The walkway surface shall be 1-1/4" aluminum grating.

2. A center drive platform shall be provided. It shall be a minimum of 8' x 10' to provide clearance around the center assembly and drive control for maintenance and service. It shall consist of 3/16" thick aluminum checkered floor plate with necessary stiffeners and supports, resting on the center assembly and provided with connections to the walkway.
3. Handrails shall be 42" high of mechanically-fastened 2" diameter Schedule 40 double-row horizontal aluminum pipe and spaced along both sides of the walkway and surrounding the center drive platform. A 4" x 1/4" thick aluminum toe board shall be provided on the drive platform and walkway handrails.
4. Steel bearing plates, UHMW polyethylene or other suitable material for the wall supports shall be supplied by the contractor.

G. Center Column:

1. A minimum 18" diameter x 1/4" thick steel column shall be provided. One end shall have a flange for bolting to the foundation, with a minimum of 4 bolts. A similar flange shall be provided at the other end for bolting the center drive assembly.
2. Influent openings shall be provided in the column to allow unrestricted passage of influent to the well. Influent velocity shall be reduced by the column to a minimum of 135 percent of the center column diameter.
3. Prior to the column being installed in place, the drive unit shall be installed and tested.

H. Center Cage:

1. The center cage shall be fabricated of welded steel box truss construction, a minimum of 12" x 12" x 1/4" steel. It shall be provided with the connections for the one (1) sludge skimmer support arm and influent well. The cage shall be bolted to the main gear, which shall rotate the cage with the main gear. The minimum angle size used for the cage and rake arms shall be 1/4".

The well shall be fabricated out of 3/16" steel plate.

Reinforcing rim angles shall be provided as required. The well shall be rotating and supported by the center cage.

Well diameter and side depth shall be as shown on the Plans.

J. Sludge Removal Arm:

1. The mechanism shall include one (1) sludge removal suction header fabricated from 1/4" steel and supported by a full radius truss arm.
2. The clarifier mechanism shall be designed to meet the following design criteria:

a. Hydraulics:

1. Minimum RAS flow: 0.55 MGD
2. Design RAS flow: 1.20 MGD
3. Maximum RAS flow: 1.55 MGD

b. Suction Header:

1. Maximum headloss: 1.5 ft.
2. Minimum velocity: 0.5 FPS
3. Minimum orifice diameter 1.5 in.
3. The suction header shall be rectangular shaped, full tapered sections varying in size from maximum near the tank center to minimum at the outer end for uniform sludge draw-off velocities. The header is to be 316 stainless steel.
4. The longitudinal cross section axis of the header is to be rotated at a 45° angle with the tank bottom to provide a peaked top. The edge of the header shall have an neoprene squeegee, extending down to provide a fluidizing vane as an integral part of the header extending into the area of influence of the orifices.
5. The orifices shall be located at 30" centers and shall be designed to only removing the proportionate volume of sludge at the specified flow range. The orifices shall be 1.5" diameter near the tank center to a maximum of 2.0" diameter at the outer end.
6. The header shall have a center slot for cleaning the tank bottom around the manifold.
7. A full radius truss type cage shall be provided 180° from the sludge removal arm. The cage shall be designed to offset the weight of the sludge.
8. Combined cage and header design shall be such that they do not exceed the AISC allowable design torque.

K. Sludge Manifold

1. The sludge removal header shall be constructed of minimum 1/2" thick plate and reinforced as required to operate under a maximum of 100 psi. The manifold unit shall consist of a stationary ring and a stationary outer housing anchored to the tank bottom. The manifold shall be sealed with inner and outer seal assemblies. The inner ring shall be attached to the drive cage in a manner that allows for adjustment of the horizontal and vertical alignment to insure proper sealing and to compensate for the applied hydraulic load when the tank is filled.
2. The manifold shall be self-cleaning. Designs lacking this important self-cleaning feature are not acceptable.
3. The manifold seal assemblies shall be located at least 8" off the tank bottom to minimize seal wear due to abrasive material in the sludge. All seals are to be oriented horizontally and riding flat. Seals riding vertically or partially vertical shall not be acceptable. The seal assemblies shall be designed so that replacement can be made without disassembling the manifold. A 10-year seal warranty shall be provided.
5. Each seal assembly shall consist of two (2) 1/4" thick fabric-reinforced neoprene seals riding on a stationary UHMW polyethylene plate and shall include a steel backup plate.

6. The sludge removal header shall be attached to the manifold so that all static, hydraulic and buoyant forces are transmitted from the headers to the drive cage and not to the manifold.
7. The sludge shall flow by direct suction from the sludge removal header into the sludge withdrawal manifold and then into the bottom sludge draw-off line.

L. Scum Removal Equipment:

1. Surface scum skimming equipment shall be furnished with each clarifier mechanism. One (1) scum skimmer shall be provided to skim the surface scum twice per revolution.
2. The skimmer arm shall be comprised of a rotating arm with a blade extending tangentially from a point near the influent pipe into the scum trough with an aluminum hinged end blade for skimming.
3. The hinged blade shall be aluminum constructed with a rubber squeegee to properly seal entrapped scum and push it up the collected scum up an inclined shelf plate.
4. The scum trough shall be 4'-0" wide x 1'-0" high x 1/4" thick stainless steel with a 6" plain end discharge pipe. Adequate bracing shall be provided to support the trough from the tank wall.
5. The scum trough shall have a flush valve assembly for automatic flushing of the scum trough. The flush valve assembly shall allow approximately 2" of water to enter the box as the skimmer assembly rotates. It shall consist of an adjustable trip lever and a float valve that will lift to open the valve. A counterweight shall be provided to return the valve to its closed position after the flush cycle.

M. Effluent Trough

1. The effluent trough shall consist of 9 inch deep x 1/4 inch thick FRP sections with 1/2 inch deep V-notches at 4 inch intervals on the inboard side and 1/2 inch deep FRP sections with 2 inch deep 90 degree V-notches on the outboard side and as shown on the drawings. The trough sections shall be fastened to each side of the effluent trough using 304 stainless steel bolts, hex nuts and 5 inch diameter washers, allowing for vertical adjustment. To prevent leakage all surfaces between the effluent trough and the tank wall shall be given a seal coat of suitable mastic by the contractor.

2. The scum baffle plates shall consist of 12 inch deep x 1/4 inch thick FRP sections supported from the effluent trough by FRP brackets secured with 304 stainless steel bolts and hex nuts, allowing for vertical and radial adjustment.
3. The effluent trough shall be as shown on the Drawings and constructed of minimum 1/4-inch thick steel. The trough sections shall be suspended from the tank wall by steel supports which permit adjustment for leveling.

N. Algae Brush Cleaning (ABC) System:

1. The ABC system shall be static brush-type custom designed to clean the following surfaces:
 - a. inside & outside of weir
 - b. inside & of scum baffle
 - c. flat spillway surfaces
 - d. angled spillway surfaces
 - e. inner effluent launder wall
 - f. effluent launder bottom
 - g. outer effluent launder wall
2. All system components shall be type 304 stainless steel.
3. Brushes shall be constructed with durable polypropylene bristles.
4. Brush arms shall be spring-loaded so that they maintain contact with the surfaces being cleaned.
5. A breakaway component shall be provided to allow removal of the brush at less than 100 lbs. force. Each brush shall be tested by the Engineer/Owner to demonstrate breakaway capability. Breakable pins shall not be used.
6. Algae cleaning system shall be provided as part of the clarifier equipment manufacturer to ensure proper operation. Units purchased from third party vendors shall not be allowed.

2.4 PAINTING AND SURFACE PREPARATION

- A. All non-submerged surfaces shall be prepared to SSPC-SP-6 specifications and given one coat of manufacturer's epoxy primer. All submerged steel shall be sandblasted to SSPC-SP-6 MDFT. All submerged steel shall be given one coat of manufacturer's epoxy primer. Components do not need coating.
- B. Surfaces shall receive a surface preparation of SSPC-SP6 prior to application of manufacturer's standard paint system.
- C. Surfaces shall be furnished with manufacturer's standard enamel.
- D. Surfaces shall be painted in accordance with Division 9.

2.5 MAINTENANCE

- A. The purpose of this specification is to provide non-interrupted continuous operation. The manufacturer shall supply as a minimum, the following spare parts:
 1. Six (6) shear pins.
 2. Two (2) neoprene skimmer wipers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment shall be erected in strict accordance with manufacturer's recommendations. A 2" layer of grout shall be applied to the tank floor, using screeds

attached to the arms. The mechanism shall sweep the grout, consisting of a mixture of sand and cement accepted by the Engineer, under its own power.

3.2 SERVICE

- A. The equipment manufacturer shall provide a service man properly trained in inspection and operation of the mechanism to approve the installation, certify torque, run the test and instruct the owner personnel on maintenance and operation. This service shall be in the form of two (2) trips to the site and minimum of three (3), eight (8) hour days of service. Any additional service shall be provided by the contractor at his expense for improper installation or delayed check-out of the mechanism.

3.3 TESTS

- A. The purpose of the test shall be to verify the structural integrity of the mechanism and drive. The manufacturer shall provide a qualified person to supervise the testing.
- B. The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer and shall be completed before the mechanism is approved and placed in service.
- C. The torque test shall consist of securing the anchor bolts installed by the contractor in the tank. The torque shall be applied by the equipment manufacturer and the Engineer. The torque shall be applied to the scraper arm by means of a ratchet lever and a torque wrench. The torque shall be applied to the scraper arm by means of a ratchet lever and a torque wrench.
- D. The magnitude of the torque shall be determined by calculating the torque from the distance of the anchor bolts from the centerline of the mechanism. Readings shall be taken at 50% of design torque value. The test load shall be applied to the overload device.
- E. The manufacturer shall certify that the alarm and motor cut-out functions specified in the manufacturer's shop are in proper operation.
- F. All testing shall be provided by the manufacturer. After the testing is completed, the mechanism shall be returned to the equipment manufacturer.

END OF SECTION

SECTION 11950 – ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 - GENERAL

1.01 GENERAL:

The Contractor shall provide all labor, materials, tools, and equipment required to furnish and install a vertical format UV disinfection system including startup, commissioning and performance testing and shall be suitable for continuous service as shown on the plans and as specified.

A. Work and Components to be provided by UV System Manufacturer (But Not Limited To):

1. Vertical UV disinfection modules.
2. Power distribution/data center (PDDC) and data center equipment and data center cables to modules.
3. UV Intensity Monitoring System.
4. UV eye shields.
5. Personnel safety equipment.
6. Automatic dose/flow pacing (Row-By-Row).
7. Automatic fault compensation.
8. Effluent level control device (reuse existing already installed).
9. Spare Parts.
10. Start-up, testing.
11. Module lifting equipment.
12. Automatic cleaning system.
13. Cleaning station.
14. Step-down.

B. Work to be provided by Contractor (But Not Limited To):

1. Provide channels, conduits, handrails and stairs.
2. Provide equipment.
3. Provide equipment.
4. Provide equipment.
5. Provide power supply including a properly grounded neutral.
6. Provide wiring and installation for remote signals.
7. Provide channel drains and valves.
8. Provide Grating.
9. Provide channel isolation gates and motorized gate actuators.
10. Provide lifting crane and hoist (reuse existing).
11. Provide stainless steel tank for cleaning station (reuse existing).
12. Interconnect conduits between the wireways and the PDDC.

C. Manufacturer:

1. The process design and equipment layout specified and as shown on the contract drawings is based upon the Aquaray® 40 "HO" High Output Vertical Lamp System as manufactured by Veolia. If an alternate UV system manufacturer is proposed, the Contractor is responsible for all costs associated with the system evaluation and redesign including all electrical, mechanical,

structural and civil aspects of installation. No alternate shall be considered unless pre-approved by the owner/engineer 14 days prior to bid opening.

2. Any alternate "approved as equal" manufacturers shall only be reviewed following bid submittal if elected by the Engineer and Owner.
 - a. To be considered, the manufacturer will be regularly engaged in the manufacture of UV systems with a proven track record of at least fifty (50) installations of 10 MGD or more in Continental United States
 - b. The manufacturer will provide documentation of previous experience with at least 5 references – location, names and contact information for all UV disinfection systems in wastewater applications and model of equipment proposed.
 - c. Alternate submittals from manufacturer shall include a detailed proposal of equipment offered, including a list of lamps proposed and a detailed description of the equipment and its performance specification.
 - d. To be considered, the alternate manufacturer shall submit a bioassay evaluation for the proposed system. The bioassay must follow protocols described in the American Water Works Association (AWWA) Ultraviolet Disinfection Handbook, 2nd Edition (American Water Works Association, 2000), Third Edition (AWWA, 2005), without exception. The manufacturer shall demonstrate that the proposed UV system design will deliver the specified dose.
 - e. Independent lamp aging factor and lamp aging factor must be submitted and specified default values are being provided.
 - f. The manufacturer's service capabilities including location and response time, performance guarantee including scope and duration

D. UV System

The disinfection system complete with UV modules, Power Distribution Units (PDUs), UV intensity sensor(s), module cleaning system, and eye shields shall be as shown on the contract drawings and as herein specified.

The disinfection system shall be designed for maximum energy conservation and shall be capable of partial system shutdown by automatic flow pacing in increments not to exceed 10% in response to plant flow and UVT meter signals.

3. System sizing and dose calculations shall be based on a third-party bioassay. Dose calculations based on the Point Source Summation model, or any UV intensity model, will not be accepted.

E. Lamp Array Configuration:

1. The lamp array configuration shall be vertical, with a uniform staggered array, with all lamps parallel to each other and 90° perpendicular to the flow. The

lamps shall be spaced in vertical rows with centerline spacing which will ensure effective disinfection and low system head loss.

2. System with inclined or horizontal lamp array configurations that are not 90° perpendicular to the flow direction shall not be allowed.

1.02 SUBMITTALS:

- A. The Contractor shall furnish the following information to insure a successful fast track completion of this project. Failure to comply with these requirements shall result in the rejection of submittal.

1. UV system manufacturer references for a minimum flow rate of 10 MGD or greater within the Continental United States for a vertical lamp concept.
2. An Independent third party bioassay for a typical UV High Output Lamp arrangement and specific lamp configuration shall be provided. This bioassay must follow the protocol of the NAWRI (National Water Research Institute) Ultraviolet Disinfection Bioassays for Drinking Water and Water Reuse, Third Edition, 1998.

- B. The manufacturer shall provide the following submittals, these shall include interconnections and interconnections and locations of all major elements of the UV system and components. Once approved no changes may be made without the written approval of the Engineer and the UV equipment supplier. Information should include the following:

1. Detailed drawings of the UV system to permit a thorough comparison with the specification section(s).
2. Dimensions and installation requirements.
3. Description in sufficient detail to permit a thorough comparison with the specification section(s).
4. Narrative summary of the UV system provided.
5. Electrical and major component layouts.
6. Head loss calculations demonstrating compliance with the specified hydraulic characteristics.
7. UV dosage calculations. Dose calculations shall be based on bioassay third-party calculations.
8. Preliminary UV equipment O & M manuals prepared for this project.

- C. Project Specific Operation and Maintenance Manuals:

Final Operation and Maintenance (O&M) manuals for this specific project shall be submitted to the Engineer upon approval of shop drawings and delivery of the equipment. The O&M manuals shall include instructions on equipment storage, installation, start-up, and operation and maintenance, together with a thorough troubleshooting guide and recommended spare parts list.

1.03 WARRANTY AND REMEDIES:

- A. Seller warrants that Equipment shall be delivered free from defects in material, workmanship and title and that Services shall be performed in a competent, diligent manner in accordance with any mutually agreed specifications for one (1) year from start-up or (18) months from shipment, whichever occurs first. Seller's warranty shall not apply to results of improper handling, storage, installation, commissioning, or use of the Equipment by Buyer or third parties, repairs or alterations made without Seller's written consent or fair wear and tear.

1.04 QUALITY ASSURANCE:

- A. The vertical UV disinfection system shall be designed to handle the specified flows based on the minimum influent water quality.
- B. Acceptance Test. The UV manufacturer shall provide a test protocol for the UV system to be followed after initial start-up. Within 10 days of continuous plant operation, the installing contractor shall notify the Owner and UV manufacturer in writing, that he is prepared to perform the acceptance testing. The Owner shall then provide written notification to the Contractor to begin acceptance testing. Results of the test done by the contractor shall be submitted to the UV manufacturer.

1.05 DESIGN CRITERIA:

- A. Provide a disinfection system to treat and infect an effluent with the following characteristics:

6 MGD

<30 mg/L (30-day geometric mean)

<45 mg/L (Single sample maximum)

Transmittance

@ 253.7 nm:

65% (Assumed minimum)

Effluent Standards to be achieved:

Fecal Coliform:

<200 MPN/100 mL (Monthly average)

< 400 MPN/100 mL (7-day average)

- B. The system shall be installed in an open channel having the following dimensions.

Length:

Existing

Width:

Existing

Depth:

Existing

- C. The effluent depth in the channel shall be automatically maintained at a nominal 60 inches water depth ($\pm 1.5''$).
- D. A total of two (2) channels shall be provided. The two (2) existing UV channels shall be retrofitted with new UV equipment. The UV system shall deliver a minimum UV dose of 30 mJ/cm² at peak flow of 6 MGD and minimum UV transmittance of 20. The system shall be capable of operating with one (1) module out of service per channel.
- E. The system supplied shall, as a minimum, include:

Number of Channels:

Number of UV Modules/Channel :

Module Layout:

Lamps in Series

UV Modules, Total:

Number of Lamps in Each Module:

UV Lamps, Total:

Number of Power Distribution Units:

And Data Logger:

1

Number of Manholes:

6

Number of Valves:

2 sets

Number of Flap Gates:

6

Flap Gate (if not already installed)

1.06 PERFORMANCE REQUIREMENTS:

A. System Performance

1. The end of lamp life third-party bioassay UV dose produced by the system shall not be less than 30.0 mJ/cm² with all UV modules in service, in an effluent with 65% UV transmission at 253.7 nm. Lamp output must be at least 90% of initial level after 13,000 hours of operation and with no fouling on the lamp sleeves.
2. The system design shall be based on third-party bioassay dose calculations taking into consideration the criteria listed below. Dose calculations based on the Point Source Summation model, or any UV intensity model, will not be accepted.

- a. UV transmission (T_{10}) 65%.
- b. UV lamp end of life derating factor (f_P) = 0.90.
- c. Sleeve fouling derating factor (f_P) = 0.90 (in addition to 10% quartz sleeve loss).

3. Total head loss for each channel shall not exceed 0.93 inches, this being confirmed by measurements in the field after start-up.

B. Energy and Lamp Conservation (Automatic Flow Pacing)

1. The UV control system shall automatically turn on and off rows in relation to variations in plant flow and UV transmission. The signal, by others, shall be 4-20 ma or numerical via Ethernet.
2. For this project, the UV system shall be capable of minimum 7% increments within each channel for power and economy.
3. The UV system design shall allow the operator to operate the UV system in either manual or automatic mode.
4. To reduce energy consumption, the system shall be capable of automatically adjusting the number of lamp increments within each UV module.

C. Automatic Fault Compensation

1. Flow control shall compensate for failed lamps by automatically turning on additional lamps.
2. The system shall ignore the dose contribution of a row when 2 or more lamps are reported failed.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General:

1. All metal components in contact with effluent shall be Type 316L stainless steel.
2. All material exposed to UV light shall be Type 304L or Type 316L stainless steel, Type 214 quartz, Teflon, or other suitably UV resistant material.

B. Ultraviolet Lamps:

Lamps shall meet the following requirements:

1. Low pressure High Output UV lamps shall emit maximum UV light with at least 90% of the UV emission at 254 nm.
2. Low pressure mercury of the tubular design in which the coiled filament cathodes are hermetically sealed.
3. The filament of the lamp shall be of a design, significantly rugged to withstand shock.
4. The electrical connections at one end shall be through a non-proprietary connector.
5. The power consumption shall be approximately 52.0 UVC watts.
6. The irradiance at a distance of 1 meter in air shall be 370 microwatts per square centimeter.
7. The arc length shall be 58 inches.
8. The lamp shall not produce any ozone.
9. The lamp bases shall be of a durable construction resistant to UV.
10. The lamp design shall prevent electrical arcing between electrical connections in moist conditions.
11. The power consumption of the system, on a per lamp basis, should not exceed 172 watts.

C. Ultraviolet Lamps Guarantees:

1. The UV supplier shall warrant that after 13,000 hours of operation the average UV lamp output will be no less than 90% of a new lamp (after 100 hours initial burn-in).
2. The number of UV lamps required shall be as determined sufficient by the UV manufacturer to meet the required disinfection standard at the minimum UV dosage specified.
3. The UV lamps will be warranted for 13,000 hours of operation. The warranty is to be pro-rated against actual lamp use.

D. UV Lamp Sleeve.

1. The UV lamps are to be protected from UV radiation by a 99.9% silicon dioxide quartz sleeve with a minimum UV radiation at the 253.7 nanometer wave length and a nominal wall thickness of 1.25 mm.
2. One end of the quartz sleeve shall be closed tube end and the other open with smooth radius.

E. Electronic Lamp Controller

1. Each module shall contain a performance electronic lamp controller, or ballast, which shall be designed such that the failure of one lamp does not impact the operation of the other lamp. The ELC shall be designed for use with the UV lamps. The ELC shall turn on and off lamps upon request and shall be controlled by the UV system controls such as lamp current and lamp voltage. The ELC will automatically shut down lamps upon lamp failure or ELC over-temperature.

The ELC shall comply with the following requirements:

- a. The ELC shall be specifically designed to power two (2) UV germicidal low pressure high output lamps, each lamp, with a UVC output of not less than 52 watts. Powers each UV lamp to produce lamp-output of 370 microwatts/cm² UV at a distance of one meter in air.
 - b. With two (2) lamps in operation, the electrical power draw shall not 172 watts per lamp.
 - c. Electronics shall be housed inside an aluminum casing.
 - d. Housed inside the top enclosure of the UV module and attached to heat sinks for optimum cooling.
3. Separate enclosures for the ELCs, if used, must meet UL/NEMA 4X specifications. Force ventilated enclosures which permit introduction of outside air shall not be acceptable unless equipped with an active air filtration system or an automatic signal to advise operators when replacement of filter is required.

2. The DCA card will command:
 - a. Rows of lamps to turn on and off.
 - b. Cleaning plate to move up and down.
 - c. UV module cooling fans to run, or not.
3. The DCA card will gather the following information:
 - a. Lamp on/off status, current, hours
 - b. Cleaning plate end travel (bottom)
 - c. Ballast temperature.
 - d. UV sensor intensity reading
 - e. Various faults including (but not limited to) high temperature fault) and ELC over temperature shutdown
4. Each DCA must include a DIP switch to select the last three digits of the DCA card IP address. The DIP switch will be labeled:
5. Each DCA must include a DIP switch to select a proper reset mode following communication with the PLC:
6. Each DCA must include LED indicators, which will simplify diagnosis and troubleshooting.

G. UV Module

The UV module shall be precision fabricated in type 316L stainless steel to meet the NEMA-4X standards. Six individual compression bolts shall be used to clamp the module lid tight against a foam in place gasket. Each module shall connect the module enclosure to a bottom pan.

The module shall be completely serviceable in the field while located in the channel and shall be fitted with water resistant UL & CE rated multi-pin connector for power and an RJ-45 connection port for data.

3. All electrical connections shall be above maximum operating water elevation

- ## G. UV Mod

The module shall be completely serviceable in the field while located in the channel and shall be fitted with water resistant UL & CE rated multi-pin connectors for power and an RJ-45 connection port for data.

3. All electrical connections shall be above maximum operating water elevations to protect against electrical hazard.
4. Ultraviolet lamps, electronic controls and individual ELCs shall be arranged so that they may be easily tested in place. When necessary, any malfunctioning device or unit shall be capable of being replaced without removal of the entire module from the channel.
5. To maintain proper operating temperatures each module shall be equipped with a stainless steel shroud and high efficiency-cooling fans. The fans and shroud will

automatically direct cooling air across the exterior surfaces of the module. In addition to the cooling fan, each module must be fitted with passive aluminum heat sink material to maintain proper operating temperatures inside the module with ambient air temperature from 32°F to 130°F.

6. Each module will be equipped with lifting lugs to allow for the attachment of a lifting spreader so that the modules or banks of modules can be easily lifted with a standard hoist or similar lifting device specified elsewhere.
7. Automatic interlock protection will be incorporated into the module enclosure such that with the opening of the module enclosure, the UV system will be automatically shut off.
8. Each module shall be identified by the element number and a color-coded IDCA card.
9. To minimize chemical cleaning frequency, the module shall be equipped with a sleeve cleaning plate fitted with wipers. The wiper drive must be motor driven and can be operated in manual or automatic mode from the UV system controls. In automatic mode, the wiper cycles are triggered at regular time intervals which can range from once per day to once per week. The wiper drive shall include a current overload detection feature that stops the wiper drive if the motor torque tender disengages.
10. Wipers
 - a. Wipers shall clean the sleeve external surface by friction and shall be capable of applying chemical or detergent in-situ.
 - b. Wipers shall be made of UV resistant material and installed in a manner that accommodates any irregularities associated with the sleeve and precludes any binding during operation.
 - c. Wipers shall be replaceable without having to dismantle the wiper drive or complete removal of the quartz sleeves, or disassembly of the module structure.
 - d. To further extend the life of the wipers, the wipers shall be normally stored above the water level elevation when not in use. This will also prevent disturbance to the flow hydrodynamics of the module during normal disinfection operation.
 - e. The wiper system shall be mechanically driven with a single drive assembly. The drive shall incorporate a centrally located means of supporting and aligning the wipers properly throughout the travel.
 - f. The wipers shall travel the full length of the UV lamp sleeves. Designs with the wipers traveling only part way along the sleeves will not be considered acceptable.
11. Module cleaning systems which rely on a centralized method (such as a compressor or hydraulic pump) for driving the wiper where the failure of that component would result in a loss of wiping capability in the whole system, shall be equipped with a back-up compressor or pump and associated automated valves to insure adequate cleaning of the quartz sleeves.

12. Each UV module housing 40 low pressure high output UV lamps shall be equipped with protruding flow dispersion baffles to improve hydraulic mixing and to create a uniform UV intensity field within the reactor.
13. The baffles shall be an integral part of the UV module.
14. The baffle material shall be 316L stainless steel.

H. Electrical:

1. Power requirement of 400V, 3-phase, Wye, 3 wire, 60 Hz, per channel shall be provided. If necessary, the Contractor shall be responsible in providing one (1) 480V Delta ground /3Phase/50/60Hz/63KVA stepdown transformer.
2. Maximum power consumption per UV module low pressure high output lamps shall be 6.88 kW and shall be provided per channel.
3. Each module shall be completely housed in the channel and shall be fitted with water resistant connectors for power and data. Combined power and data connections shall be made by the Contractor.
4. Power interconnections shall be provided in between the UV modules and PDDC. All power and interconnections be made by the Contractor.
5. Power interconnections between the wireways and the PDDC shall be made by the Contractor.

2.02 INSTRUMENTATION

A. Power Distribution Control Center (PDDC):

1. The PDDC shall be NEMA 4X rated for indoor/outdoor use and conveniently located as shown on the drawings. The minimum size of the PDDC shall be 48 inches in height, 36 inches width, and 12 inches depth. The maximum size of the PDDC shall be 60 inches in height, 36 inches width, and 12 inches depth. NEMA-3R with forced ventilated enclosures, which allow introduction of outside air shall not be acceptable unless equipped with an active air filtration system or automatic signal to advise operators when replacement of filter is required.
2. Mains power supply will enter the PDDC from below and terminate into an MCB. From the MCB power supply will be split between circuit breakers dedicated to provide power to each module and peripheral equipment.
3. Each UV module shall be protected by a panel mounted thermal magnetic circuit breaker device per NEC Code. These circuit breakers shall be mounted inside the PDDC. Each circuit breaker shall provide visual trip indication, be capable of

regular testing. To ensure safe operation, ground fault circuit detection systems, which permit remote reset, shall not be used.

4. The PDDC will include a Local Operator Interface (LOI) as described below. All equipment for the local control and monitoring of the UV system shall be mounted on or in the PDDC.

B. Local Operator Interface (LOI) Description

1. The LOI shall be PLC based. The Programmable Logic Controller (PLC) shall be an Allen Bradley CompactLogix. The Operator Interface (OIT) shall be a programmable NEMA 4X rated Panelview Plus 7" color touch screen display which shall be mounted on the PDDC. The PLC will communicate with each UV module DCA using TCP/IP communication protocol.
2. System operating information will be displayed on the screen in both color graphic and text format. The information shall be categorized. As a minimum the following information shall be displayed on the screen simultaneously:
Number of channels/rows
Channel actual vs. target dose, UV intensity, current lamp status.
3. System commands shall be accomplished through the OIT. In the event of an alarm, the screen shall turn a red background until the alarm has been manually reset.
4. Alarms shall be categorized as follows:
 - a. High pressure switch.
 - b. High and low-low.
 - c. Lamp failure.
 - d. Master com link failure.
 - e. Over-temperature.
 - f. (DCA) fault.
 - g. Lamp fault.
 - h. Multi-lamp failure.
 - i. Module adjacent lamp failure.
 - j. Module ELC over-temperature shutdown (OTSD).
 - k. Module ELC GFI.
 - l. UV intensity sensor out of range.
 - m. UV intensity sensor low and low-low
 - n. Cleaning fault
 - i. Limit switches
 - ii. Motor overload
 - iii. Motor timeout
5. The alarm display will identify the affected module and then the actual component.
6. Information, such as individual lamp hours and cycles, normally stored in the DCA shall be accessed using the OIT. Lamp cycles and hours shall be reset via a password protected screen.

7. The Automatic Module Wiper Cleaning system shall be controlled and monitored by the DCA card. Automatic control of each module wiper plate shall be based on time and controlled from the UV system PLC whereby the operator shall be able to alter the interval between cleaning cycles. Manual control of the module wiper cleaning system shall be provided as well (up, down, cleaning cycle, stop).

2.03 AUTOMATIC LEVEL CONTROL

- A. Flap gates, if not already in place, shall be placed at the discharge of the disinfection channel(s) to ensure that the UV lamps are properly protected regardless of the plant flows.
- B. The level of the water shall be maintained between design flow conditions.

2.04 MODULE CLEANING STATION:

- A. The existing 304L stainless steel line shall be reused. The module cleaning station accommodate UV lamps immersed in citric or phosphoric acid (5-10% concentration (5.0)).

2.05 SPARE PARTS AND SAFETY

- A. The UV supplier shall provide the following spare parts and safety equipment:

1. Two (2) UV Intensity Sensors.
2. Two (2) UV Intensity Sensors.
3. Two (2) UV Intensity Sensors.
4. Two (2) UV Intensity Sensors.
5. Two (2) UV Intensity Sensors.
6. Two (2) UV Intensity Sensors.
7. Two (2) pairs of personnel goggles for protection against UV energy between 200 - 400 nanometers wave length.
8. Two (2) UV area warning signs.
9. One (1) 50 lb. bag of citric acid.
10. One (1) Cleaning System Exerciser.

11. One (1) Lifting Frame

12. Gloves

B. All spare parts and safety equipment are to be separately packaged. All packages are to have with quantity, item description and part number.



PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall construct the disinfection channels for the Ultraviolet Disinfection system as shown on the drawings and as recommended by the UV manufacturer.
- B. Equipment shall be installed in accordance with the manufacturer's drawings and written installation instructions.

3.02 ELECTRICAL CONNECTIONS AND WIRING

- A. The UV manufacturer shall furnish power and data connections and the PDDC. The incoming power supply, conduit, and wiring shall be the responsibility of the contractor.
- B. Equipment shall be delivered to site requiring minimal installation. Systems requiring extensive on-site wiring shall be systems with more than one power and one data connection.

3.03 MANUFACTURER'S FIELD SERVICE

- A. Installation and Start-Up shall be completed within a maximum of five (5) eight hour days in two (2) trips. Training of maintenance staff will be coordinated between the Owner and the manufacturer to ensure maximum effectiveness.
- B. Service personnel shall be full-time employees of the UV system manufacturer.
- C. Performance testing, if required, will be the Contractor's responsibility.
- D. The Contractor shall submit for engineer's approval a formal test protocol for use

- End -

PART 1 - GENERAL

1.2 QUALITY AS

- A. Comply with the provisions of the following codes and standards, as shown or specified.

1.3

- PIPE WORK GENERAL PROVISIONS
1-15001-1

- B. Shop Drawings: Submit Shop Drawings for all valves and special items, restrained joint systems for all systems, and laying schedules in accordance with Section 01340 of these Specifications.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 TEST RESULTS

- A. The Contractor shall conduct all tests in the presence of the Engineer. Test results shall be certified to the Owner in writing.

3.2 TESTING NEW WATER LINES AND FOR FUTURE SYSTEMS

- A. Each section of piping shall be tested at a pressure of 150 psi (minimum) or 50 psi above the design pressure. The Contractor is required to furnish all pumps, gauges, valves, and personnel required for the tests, and make provisions for equipment and draining of pipes after tests have been completed. Tests shall be made in the presence of the Engineer.

- B. The pressure shall be maintained for not less than one (1) hour and as much longer as necessary to assure that:

1. No leaks occur in the line.

2. No defective materials are in the line.

3. All joints have been made.

During the specified test pressure, all air shall be expelled from the pipe. If air vents are not available at high places, the Contractor shall make the necessary provisions at points of highest elevations before the test is made. After the test has been completed, corporation cocks shall be installed at these points and marked by the installation of a valve box.

- D. Tests may be made of isolated portions of such piping as will facilitate general progress of the installation. Any revisions made in the piping systems will subsequently necessitate re-testing of such affected portions of the piping systems.

- E. The contractor shall provide all water needed for flushing and testing at no additional cost to the owner.
- F. Any defective material or defects in workmanship that become apparent during the tests shall be remedied and the subject piping shall be retested.
- G. Prior to pressure testing of buried piping, backfill shall have been initially placed and tamped to provide adequate side support for all pipe and for full reaction backing shall have been in place at least five (5) days. At the time of test shall be sufficiently open for joint inspection.
- H. All piping systems shall be thoroughly flushed by water at a minimum velocity of one-half (2-1/2) feet per second in the line being flushed.
- I. Do not test against closed valves at pressure. Test seating pressures for individual valves. Contractor shall test at pressures up to that specified for the valve bodies. If the test pressures are greater than the allowable working pressures of the valves, the Contractor shall provide temporary reinforcement.
- J. The leaking tests which shall be sustained for the same time as the pressure tests shall be sustained for. The leakage shall be defined as the quantity of water which leaks from the newly laid pipe or any valved section thereof at the average test pressure after the air in the pipe line has been displaced and the pipe has been filled with water.
- K. No pipe shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{Q}{P \times D \times L}$$

where:
L = leakage in gallons per hour
Q = quantity of water leaked in gallons
P = average test pressure during leakage test in pounds per square inch
D = nominal diameter of pipe in inches
L = length of pipe line tested in feet

3.3 TEST PRESSURES FOR OTHER PRESSURE PIPING SYSTEMS

- A. Either hydraulic or air tests may be used for piping systems listed below:

Non Pumped Process Piping (Under Tanks)	25 psi
Non Pumped Process Piping (Buried/Exposed)	2 times maximum static head
Drain Piping	5 psi

- B. Tests shall be considered acceptable when pressures are maintained for (2) hours without pressure drop or within other limits specified in the test procedures.
- C. Tests for under-tank piping shall be conducted with the piping system insulated. Exposed piping systems shall be insulated.

3.4 TESTING GRAVITY FLOW PIPING

- A. General

1. The following tests shall be conducted for storm drainage and plant drain systems.
2. Field tests, including manholes, for joint integrity and leakage shall be conducted by either an infiltration test or an exfiltration test. The Contractor shall furnish all plugs, pumps, piping, and equipment, required test apparatus, and all labor required for conducting the test, and removing the equipment after the tests have been completed. All testing shall be under the supervision of the Engineer.

The Engineer will determine the type of test required for each section after the ground water table has been measured by the Contractor. The following general criteria will govern the type of test to be conducted.

- a. Wherever the ground water table is measured to be not less than one (1) foot above the top of the pipe throughout the full length in the section being tested, an infiltration test shall be used.
- b. Wherever the ground water table is measured to be less than one (1) foot above the top of the pipe at the highest point in the section being tested, an exfiltration test shall be used.

B. Infiltration/Exfiltration

1. Maximum allowable leakage permitted under this Specification is 100 gpd/inch/mile for sanitary lines and 200 gpd/inch of pipe diameter/mile of pipe for storm water systems. The permissible leakage rate is established for either the infiltration or exfiltration test.
2. Equivalent leakage rates for various pipe diameters for one hundred (100) foot segments are:

<u>Pipe Diameter</u>		<u>Permissible Leakage/100' at</u>
<u>gpm</u>	<u>gph</u>	
8"	.010	0.62
10"	.013	0.79
12"	.016	0.95
15"	.020	1.18
18"	.024	1.41
24"	.032	
30"	.040	
36"	.048	
42"	.055	

3. Testing, whether by infiltration or exfiltration, is to be performed by standard methods approved by the Engineer prior to construction.

- C. Testing and Inspection: All gravity flow sewers eighteen (18) inches or smaller shall be subject to testing by visual inspection. A section of pipe between two manholes will be considered satisfactory if a light held in a manhole will show a full circle when viewed through the carrier pipe. Visual inspection is

If, for any reason, a section of pipe fails either of the tests previously described, the Contractor shall, at his expense, substitute test procedure approved by the Engineer, the Contractor shall remove the defective materials and/or installation and make any necessary repairs. After the corrective actions have been taken, the section of pipe shall be subject to the same provisions or requirements outlined above.

3.5 RELATIONSHIP OF SEWERS TO WATER MAINS

- A. Sewer Parallel to Water Main: Sewers shall be located, during design, at least ten (10) feet horizontally from any existing or proposed water main. If, for absolutely essential reasons, it is not possible to achieve such separation, the sewer may be located not less than three (3) feet from a water main - horizontally,

provided there is at least eighteen (18) inches vertical separation between the bottom of the water main and the top of the sewer, with the sewer below the water main.

- B. Vertical Separation: Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least eighteen (18) inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstructed with slip-on or mechanical-joint ferrous pipe for a distance of ten (10) feet on each side of the crossing. The full length of water main should be centered over the sewer and shall be as far from the sewer as possible.
- C. Special Conditions: When it is impossible to obtain the required vertical separation as stipulated above, the water main shall be reconstructed with slip-on or mechanical-joint ferrous pipe and the sewer shall be reconstructed with slip-on or mechanical-joint ferrous pipe, pressure rated to at least 150 psi. The water main shall be pressure tested to assure watertightness.

3.6 DISINFECTION OF NEW POTABLE

- A. Before being placed into service, upon completion by the Engineer, all new water supply systems, including existing systems or valved section of such existing systems, shall be thoroughly disinfected according to the requirements of the applicable code.

"1001 DISINFECTION OF POTABLE WATER SUPPLY SYSTEMS"

- (a) All new potable water supply systems, including wells, distribution lines shall be thoroughly disinfected by the addition and thorough dispersion of a chlorine solution, after which bacteriological test samples shall be collected.

After the water supply shall not be placed into service until bacteriological test results of representative water samples analyzed in an approved laboratory are found to be satisfactory."

3.7 DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

- (a) Water distribution systems, including storage tanks and water mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of

at least 50 milligrams per liter (or ppm) in the water throughout the distribution system, including all water mains and storage tanks.

(b) The chlorine solution shall remain in contact with interior surfaces of the water system for a period of 24 hours. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled.

(c) Representative samples of the water shall then be collected for microbiological tests of the samples indicate that the water quality is satisfactory, water mains and storage tanks may be placed in service.

(d) In unusual situations where large volume tanks are involved and there is not sufficient water available to fill the tanks, the Contractor shall provide a suitable drainage area for the chlorinated water. An alternative procedure for tanks may be proposed. The Contractor shall submit in writing completely describing the proposed alternative procedure and substantiating the need for an alternative procedure in unusual circumstances. Such alternative procedure shall be approved before being implemented. The contractor shall be responsible for the final.

B. The Contractor shall be responsible for having tests conducted. All expenses for tests shall be borne by the Contractor and should be included in the bid.

C. All chlorinated water from the potable water lines shall be dechlorinated before disposal. The Contractor shall be responsible for dechlorination shall be borne by the Contractor and his bid.

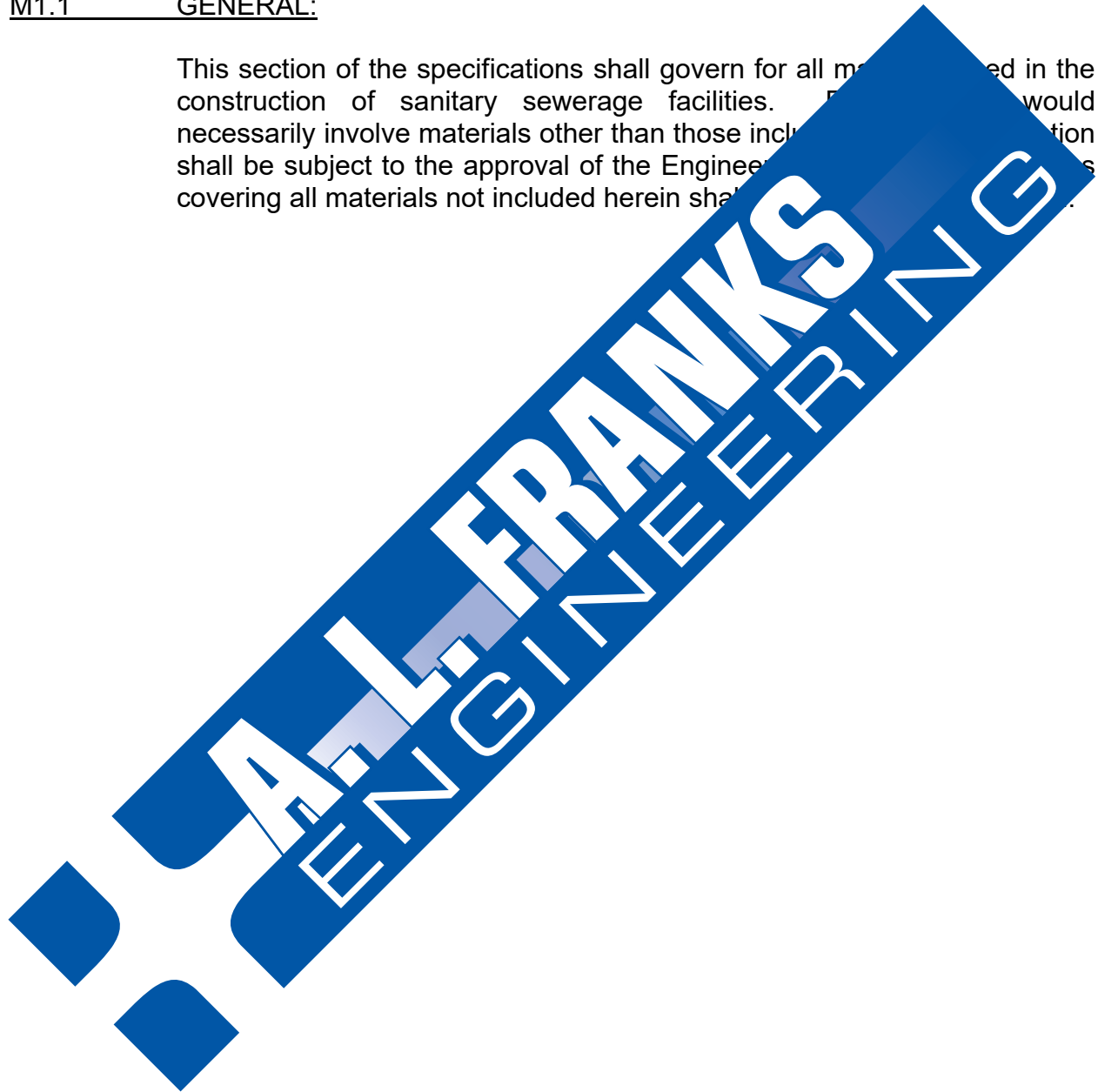
OF SECTION 15001

TECHNICAL SPECIFICATIONS

SECTION M1 – DESCRIPTION

M1.1 GENERAL:

This section of the specifications shall govern for all materials used in the construction of sanitary sewerage facilities. Materials not specified would necessarily involve materials other than those included herein. All materials shall be subject to the approval of the Engineer. The Engineer's specifications covering all materials not included herein shall govern.



TECHNICAL SPECIFICATIONS

SECTION M2 – SEWER / FORCE MAIN

PIPE & FITTINGS

M2.1. DESCRIPTION: The different kinds and strengths of pipe outlined in this section shall be used in the construction of sewer and force mains unless otherwise specified in Section C - Construction. For all appropriate sizes specified below, all pipe materials listed in this section shall be considered suitable for use at depths up to 25 feet. Unless otherwise specified on the drawings, all pipe materials listed in this section shall be of the same material.

M2.2. SDR 21 PVC HEAVY WALL NON-PRESSURE-TYPE SEWER FORCE MAIN (4" – 36"): All pipe shall be of the size and kinds shown on the plans.

Pipe shall be heavy wall (PVC) pipe with intergrall wall bell and spigot joints. Pipe shall have unskirted unrestrained joints unless specified otherwise. Pipe shall conform to ASTM D2241 for pressure class 200 and minimum DR-21 rating.

M2.3. DUC TOILET: All pipe shall be circular. The pipe shall be of the size and kinds shown on the plans or as required.

Pipe shall conform to ANSI 21.51 (AWWA C151) and shall have a cement mortar lining conforming to ANSI 21.4 (AWWA C104). The pipe class shall be Class 50 unless otherwise specified.

M2.4. SDR 26 HEAVY WALL NON-PRESSURE-TYPE SEWER PIPE

Scope: This specification designates general requirements for SDR 26 heavy wall polyvinyl chloride (PVC) non-pressure type pipe with integral wall bell and spigot joints. This pipe may be used at depths up to 25 feet. Pipe shall conform to ASTM D2241.

- B. Materials: All pipes must meet requirements as set forth in PS 22-70, with standard dimension ratio SDR 26, and bearing the National Sanitation Foundation seal for potable water pipe. Provisions must be made for contraction and expansion at each joint with a rubber ring, and integral thickened bell as part of each joint. Pipe and fitting must be assembled with a non-toxic lubricant.

Pipe shall be made from clean, virgin, NSF approved Class 12454-A PVC Compound conforming to ASTM resin specification D 1784. Clean reworked material generated from the manufacturer's own pipe production may be used.

- C. Testing Requirements: All Physical and Mechanical tests shall be conducted at 73 deg. F.

The pipe shall be designed to withstand a pressure of 640 psi applied to 60 to 70 seconds in accordance with PS 22-70 as referenced in ASCE 900.1.

The pipe shall be designed to withstand for 1,000 hours a pressure of 400 psi in accordance with PS 22-70 as referenced to ASCE 900.1.

After two weeks in a sealed container of anhydrous (99.5% minimum purity) calcium chloride, a sample ring shall show no visible spalling, cracking, or softening is not a failure.) In accordance with PS 22-70 as referenced to ASTM D 2152.

The pipe shall be tested between two parallel plates a 2" long ring and compress in to 100% flattening. There shall be no cracking or shattering.

The pipe shall withstand a impact load from a freely falling missile having a 1/2" diameter rounded 1" long nose shall be imparted on a 6" long specimen sample. No shattering or splitting (cracking is not a failure) shall be evident when the following energy is imposed:

nominal size	1½"	2"	2½"	3"	4"	5"	6"	8"
ft.-lbs.	24	34	43	57	86	100	100	100

M2.5. PIPE JOINTS:

- A. All PVC Pipe: Provision shall be made for expansion and contraction at each joint with a rubber ring and integral thickened

bell as a part of each joint. Pipe and fittings must be assembled with a nontoxic lubricant.

- B. Cast Iron Pipe: All joints shall be slip-type or mechanical and shall conform to the requirements of ANSI Specification A 21.11 unless otherwise specified on the Plans.
- C. Ductile Iron Pipe: All joints shall meet with the requirements for cast iron pipe, Paragraph M2.6 (B), ANSI-A 21.11 (C111).

M2.6. PIPE FITTINGS:

- A. Standard Fittings: All bends, tees, plugs and other fittings shall meet with the requirements of the pipe used and all joints shall meet with the joints listed above.
- B. Special Fittings: All special fittings shall conform with the pipe manufacturer's specifications as approved. Connections between pipe and for future connections shall be made with fittings designed for this purpose and designed by the Engineer for approval.

M2.7. SEWER LOCATIONS: Sewer pipe shall be placed 12" above the center of the road.

TECHNICAL SPECIFICATIONS

SECTION M3 - CONCRETE AND REINFORCING STEEL

M3.1 DESCRIPTION: This section covers materials for concrete and reinforcing steel used in sanitary sewer line construction.

M3.2 CEMENT:

- A. Cement shall be Portland Cement conforming to ASTM Designation M 85, Type I. Type III cement may be used if approved by the Engineer.
- B. When concrete is mixed on the job, cement shall be delivered in plainly marked paper sacks weighing 94 pounds net weight.

M3.3 WATER: Water used in mixing concrete shall be free from injurious amounts of acids, alkalis, salts, or vegetable matter. It shall be fit for drinking.

M3.4 COMPOSITION AND PROPORTIONS:

- A. Concrete shall be composed of Portland Cement, fine and coarse aggregate, and water mixed in keeping with the following:

	<u>Class "A"</u> <u>Concrete</u>	<u>Class "B"</u> <u>Concrete</u>
Cement - Per Cubic Yd.	5½	4½
Maximum Slump - In.	2 - 4	2 - 4

Proportioning of concrete shall be by weight except that water may be measured by volume.

- (1) A 1 cubic foot sack of Portland Cement will be considered as 94 pounds in weight.
- (2) A gallon of water will be considered as weighing 8.33 pounds.

- C. Class "A" concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 3,000 psi. If made with high early strength cement, those strengths shall be attained at the age of 7 days.

M3.5 USE:

- A. Class "A" concrete shall be used on all manholes and other structures and for Class "A" pipe bedding.
- B. Class "B" concrete may be used for all concrete as specified in Paragraph M3.5.A and as shown in details.

M3.6 REINFORCING STEEL:

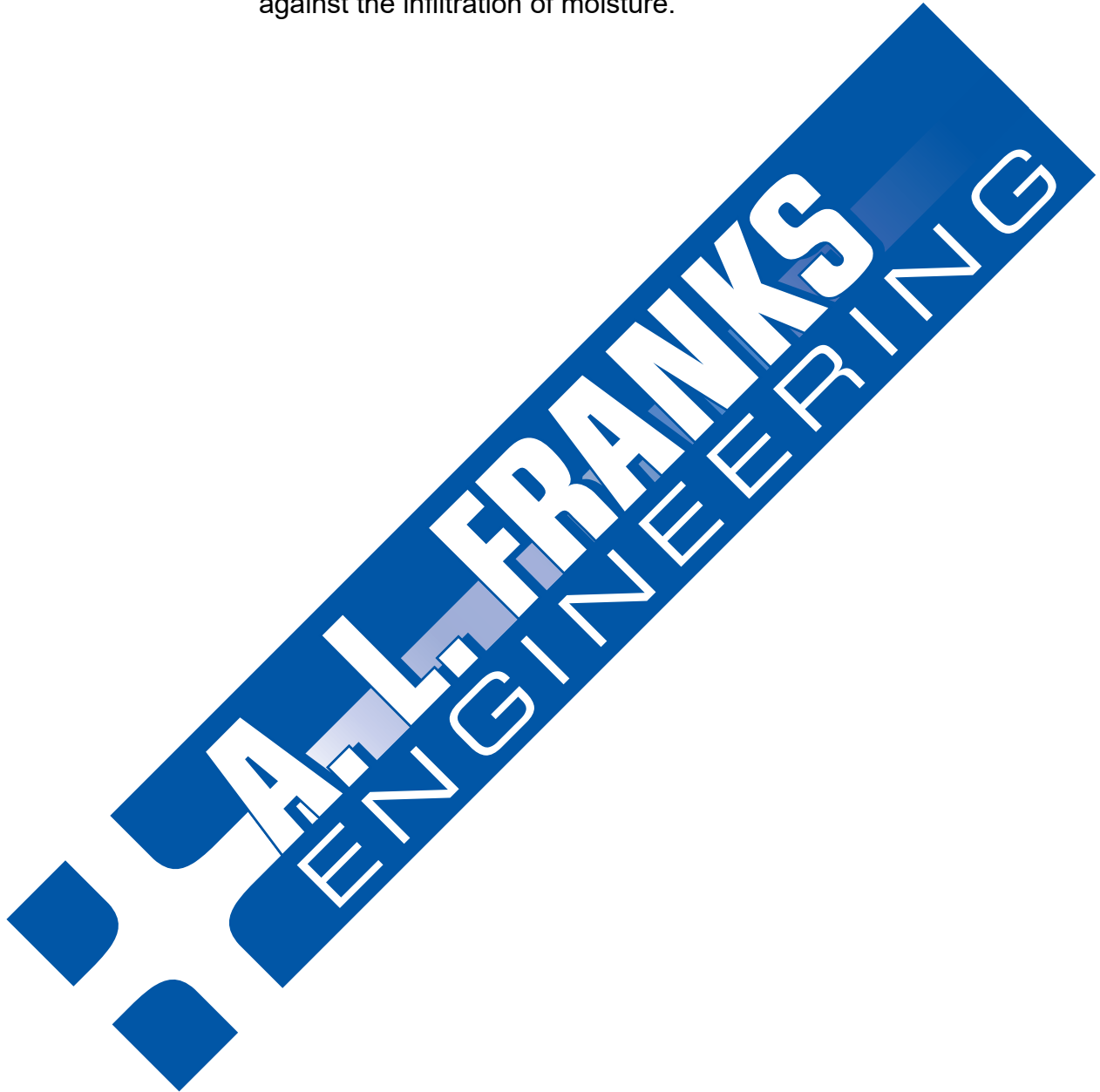
- A. Shop Drawings for all reinforcing steel shall be in accordance with contract documents and shall be fabricated or delivered to job site prior to construction. Shop drawings to Contractor. Shop drawings shall be complete in detail and dimensions that shall be sufficient for fabricating. Accessories may be placed without reference to drawings.
- B. Reinforcing steel for columns and beam and joist stirrups shall comply with ASTM A615, Grade 40. The supplier shall provide certification as to type and grade at the time of delivery.
- C. Reinforcing steel shall conform to ASTM A185.
- D. Reinforcing Bars: Where specified or indicated on drawings, reinforcing shall be hot-dip galvanized after fabrication in accordance with ASTM A153.

E. Dowel Bars for Wall and Floor Construction Joints shall be fabricated of round plain carbon steel bars complying with ASTM A615, Grade 40. Where indicated on drawings, a metal dowel cap shall be placed at one end of dowel to permit longitudinal movement of dowel within concrete section. The magnitude of movement shall equal joint width plus ½-inch.

M3.7 EXPANSION AND CONTRACTION JOINTS:

- A. Asphalt mastic strips (preformed) shall be composed of approximately 75% asphalt, 15% fiber, and 10% mineral matter.

- B. Mastic for poured joints shall be composed of refined asphaltic pyrobitumen and natural asphalt bitumens and show no tendency to separate.
- C. Waterstops shall consist of a durable, elastic cured rubber compound, PVC, or vinyl capable of effectively sealing joints against the infiltration of moisture.



TECHNICAL SPECIFICATIONS

SECTION M4 - CONCRETE AND REINFORCING STEEL

M4.1. DESCRIPTION: This section covers materials for concrete and reinforcing steel used in sanitary sewer line construction.

M4.2. CEMENT:

- A. Cement shall be Portland Cement, Designation M 85, Type I. Type I may be used if approved by the Engineer.
- B. When concrete is mixed on site, cement shall be delivered in plainly marked paper bags, 94 pounds net weight.

M4.3. WATER: Water used in concrete shall be free from injurious amounts of oil, acid, alkali, salt, and vegetable matter. It shall be fit for drinking.

M4.4. COMPOSITION:

- A. Concrete shall be composed of Portland Cement, fine and coarse aggregate, and water, proportioned in keeping with the following:

	<u>Class "A"</u> <u>Concrete</u>	<u>Class "B"</u> <u>Concrete</u>
Cement	5½	4½
Slump Range in Slump - In.	2 - 4	2 - 4

Proportioning of concrete shall be by weight except that water may be measured by volume.

- (1) A 1 cubic foot sack of Portland Cement will be considered as 94 pounds in weight.
- (2) A gallon of water will be considered as weighing 8.33 pounds.

- C. Class "A" concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 3,000 psi. If made with high early strength cement, those strengths shall be attained at the age of 7 days.
- D. Admixtures: A cement reducing admixture conforming to ASTM C-618 will be used for all concrete at the Contractor's option. Concrete mix designs shall include the admixture and should this option be exercised.

Admixture shall be a cement dispersing admixture used in accordance with manufacturer's directions. The dispersing admixture shall be subject to the approval of the Engineer. The Contractor shall notify the Engineer in writing that he is taking advantage of this option.

A retarding admixture, conforming to ASTM C-494, shall be tested with job materials under job conditions. If approved, it shall be used, whenever necessary to the quantity of concrete placed, to offset the effects of high concrete temperature and to reduce the maximum temperature of concrete.

M4.5. USE:

- A. Class "A" concrete shall be used on all manholes and other structures on pipe bedding.
- B. Class "A" concrete shall be used for all concrete work except as shown in paragraph M4.5.A and as shown on the standard drawings.

M4.6. REINFORCING:

Shop drawings for all reinforcing shall be submitted in accordance with contract documents. Material shall not be fabricated or delivered to job site prior to return of approved shop drawings to Contractor. Shop drawings shall be sufficient in detail and dimensions that reinforcing steel and accessories may be placed without reference to drawings.

- B. Reinforcing bars, including column ties and beam and joist stirrups shall conform to requirements of ASTM A615, Grade 40. The supplier shall provide 3 copies of certification as to type and grade at time of delivery.

- C. Welded wire fabric shall conform to ASTM A185.
- D. Galvanized Reinforcing Bars: Where specified or indicated on drawings, reinforcing shall be hot-dip galvanized after fabrication and bending in accordance with ASTM A153.
- E. Smooth Dowel Bars for Wall and Floor Construction Joints shall be fabricated of round plain carbon steel bars complying with ASTM A663, Grade 40. Where indicated on drawings, a dowel cap shall be placed at one end of dowel to prevent longitudinal movement of dowel within concrete section. Allowance of movement shall equal joint width plus $\frac{1}{2}$ inch.

M4.7. EXPANSION AND CONTRACTION JOINTS

- A. Asphalt mastic strips (precast or poured) shall be composed of approximately 75% asphalt and 25% mineral matter.
- B. Mastic for poured joints shall be composed of refined asphaltic pyrobitumen and natural sand, and shall show no tendency to separate.
- C. Waterstops shall be made of a durable, elastic cured rubber compound capable of effectively sealing joints against water.

TECHNICAL SPECIFICATIONS

SECTION M5 – WATER MAIN

PIPE & FITTINGS

M5.1 WATER MAINS:

- A. AWWA C-900 PVC Pipe: (6" - 12") The pipe shall be Class 150 psi (minimum), cast iron pipe o.d. base that meets all the requirements of AWWA C-900, ASTM D1784, and ANSI/NSF standard 61. All pipe shall be suitable for use as a pressure conduit at a maximum hydrostatic working pressure of 150 psi at 73 deg. F. Provisions must be made for expansion and contraction at each joint with an elastomeric ring and integral thickened bell as part of each joint. The dimensions of the gasket joint shall meet the requirements provided in ASTM D 3139 when measured in accordance with ASTM D2122.

All pipe shall bear the National Sanitation Foundation seal for potable water pipe.

The manufacturer shall furnish an affidavit that all delivered materials comply with requirements of the above specifications:

150 PSI

- B. AWWA C-900 PVC Pipe: (1" - 8") The pipe shall be SDR 21 (minimum), cast iron pipe o.d. base that meets all the requirements of AWWA C-900, Class 200, ASTM D1784, and ASTM D2241. All pipe shall be suitable for use as a pressure conduit at a maximum hydrostatic working pressure of 200 psi at 73 deg. F. Provisions must be made for expansion and contraction at each joint with an elastomeric ring and integral thickened bell as part of each joint. The dimensions of the gasket joint shall meet the requirements provided in ASTM D3139 when measured in accordance with ASTM D2122.

All pipe shall bear the National Sanitation Foundation seal for potable water pipe.

The manufacturer shall furnish an affidavit that all delivered materials comply with requirements of the above specifications:

1" – 8" – SDR 21, Class 200 psi

- C. Ductile Iron Pipe: (4" - 12") The pipe shall conform to ANSI A21.51 (AWWA C 151) and ANSI A21.50 (AWWA C150). The minimum tensile strength shall be 42,000 psi, and the modulus of rupture 60,000 psi. The pipe shall have a cement mortar lining and seal coat conforming to ANSI A21.4 (AWWA C 104). Joints shall conform to ANSI A21.11 (AWWA C 111) and may be mechanical joint or push-on joint unless otherwise specified.

The minimum thickness class shall be as follows or as specified:

4" - 12" - Metal Thickness Class 50.

The pipe shall be wrapped in polyethylene and tape conforming to AWWA C105. Polyethylene material shall conform to AWWA C105. Min. Nominal Thickness = 9 mils.

- C. Steel Pipe and Fittings:

- D. Gray and Ductile Iron Fittings: Fittings shall be designed for working pressures of 350 psi in accordance with ANSI A21.51 (AWWA C153). Joints may be mechanical joint or push-on joint and bell and spigot joint as specified. Mechanical joints shall conform to ANSI A32.22 (AWWA C111) and shall be made of gray or ductile iron glands, bolts and nuts, and nuts shall contain no more than 8.0% lead. The radius of curvature of push-on joint fittings shall conform to ANSI A32.22 (AWWA C111). Standard bell and spigot fittings shall conform to ANSI A32.4 (AWWA C111). All fittings except sleeves and plugs shall be designed in accordance with ANSI A 32.4 (AWWA C111) and shall conform to ANSI A32.22 (AWWA C111) and may be mechanical joint or push-on joint unless otherwise specified. The minimum thickness shall be Class 50 unless otherwise specified.

- E. Mechanical Joint Restraint Glands: Mechanical joint restraint glands shall be made of cast iron or ductile iron and shall be designed for a minimum working pressure of at least 200 psi, Megalug Series 1100 for Ductile Iron Pipe and Series 2000PV for PVC Pipe or approved equal. The set screws shall be extended through the outer most part of the gland. Glands shall be designed to fit standard mechanical joint fittings (AWWA C111). The minimum number and minimum size set screws shall be as follows:

<u>Size Gland</u>	<u>Size Set Screws</u>	<u>No. Set Screws</u>
4"	1/2"	4
6"	5/8"	6
8"	5/8"	9
10"	5/8"	
12"	5/8"	
16"	5/8"	
20"	5/8"	
24"	5/8"	

F. JOINTS:

- A. Plain End: Plain ends for use with mechanical joint pipe shall be square cut and the inside and outside edge of the pipe shall be sufficiently free from indentation and burrs at each end to make a tight joint.
- B. Rubber "O" Ring: Rubber "O" rings shall conform to AWWA C208 for bell and spigot ends with the exception that the rubber "O" ring gasket materials shall conform to AWWA C300.

G. GATE VALVES

- A. General: Gate valves for sizes four (4) inches through twenty-four (24) inches shall be of the double flange, pressure of 200 psi. Valves shall conform to ANSI B16.1, Class 125, bronze mounted, nonrising stem double-flange, o-ring stem seals and 2" x 2" square operating nut. The operating nut is turned to the left to open the valve. Valve ends shall be mechanical joint complete with o-ring stem seals as specified. Tapping valves shall conform to above except that the connections shall be ANSI B16.1, Class 125, bronze mounted, one side (inlet) and mechanical joint on the other (outlet) or as specified. Tapping Sleeves are to be Grade 304 Stainless Steel.

Gate valves shall be model A-2360-20 as manufactured by the Mueller Company or approved equal.

- B. Valve Boxes: Valve boxes shall be the H-10346, 562-A, two-piece, screw type, 5 1/2" shaft, 24-36" extension, with drop cover marked water as manufactured by the Mueller Co. or equal. Valve boxes shall be set vertical and concentric with the valve stem. Any valve box which is so

moved from its original position as to prevent the application of the valve key shall be satisfactorily reset by the contractor at his own expense. A concrete pad of the dimensions shown on the details of the plans shall be poured around all valve boxes.

- C. Installation of Valves: Valves shall be jointed in accordance with the methods of jointing pipe as specified elsewhere herein. Valve stems shall be plumb and there shall not be any obstructions which will inhibit the installation of valve boxes directly over the stem.

Concrete anchor collars shall be provided around each end of pipe for all valves 16-inches in diameter or larger when specified on the Plans. Mechanical joints shall be installed on all valves with mechanical joints 16-inches or larger when cast iron or ductile iron pipe is used for valves when specified on the Plans. All valves shall be set in concrete with an adequate bearing area to prevent movement between the valve and pipe.

When the distance between the valve and the finished surface exceeds five (5) feet, a stem extension shall be provided. The stem shall be round 1 1/8 inch in diameter with a 2-inch square opening at each end and of length adequate to reach the operating nut to a point within 18-inches to 12-inches of the valve box. A box wrench made from steel 1/4 inch shall be used on the stem extension which will fit over the stem. A bolt which shall pass through the stem extension shall be attached to the valve operating nut. The hole for the 1/4 inch nut shall be 1/8 inch from the upper end. A round center guide made from 3/16 inch or less shall be welded to the valve stem extension from the upper end. the diameter of the guide shall be 1/8 inch in diameter than the inside diameter of the valve box. All drawings shall be submitted to the Engineer for approval prior to construction of extension pieces.

H. AIR RELEASE VALVE:

- A. General: The air release valve shall have a combination of large and small orifice units for allowing air to enter or exit the transmission main. The valve shall have a cast iron body and the only moving part shall be a stainless steel ball. The valve shall be capable of fully automatic operation within the full range of pipeline operating conditions and shall not blow shut or collapse the ball during operation. The large orifice seat shall be replaceable.

Normal operating pressure shall be less than 150 psi. All valves shall have flanged inlets and outlets. The valve flange shall be 125 pound and conform to ANSI 16.1 for 150 psi working pressure.

The valve shall be in every way similar to a APCO Model 50C manufactured by APCO Valve Corp., Schaumburg, IL, or approved equal.

- B. Connection: Each valve installation shall include a flanged butterfly valve installed below the air release valve between the release and the pipeline. The butterfly valve shall be a Pratt Model 25 or approved equal.

The butterfly valve shall have a handle operated position indicator.

All piping shall be ductile iron, Class 5.

- C. Location: The valves shall be in the locations shown on the plans or as directed by the Engineer.

- I. BLOW-OFF VALVE INSTALLATION: Blow-off valves shall be installed at the locations shown on the plans. Work shall consist of furnishing and installing all required materials, including ductile iron piping and fittings, and concrete required for all operations necessary for the installation of a blow-off valve with the details shown on the plans.

- J. FREEZEPROTECTIVE HYDRANTS: Hydrants shall be Woodford Model Y34 (3/4" NPT) and shall be installed at the locations shown on the plans. Work shall consist of furnishing and installing all required materials, including valves, gravel packing, and reinforcing pipes to install a freeze-protective hydrant for use.

Hydrants shall be labeled with a permanent sign as non-potable water use.

TECHNICAL SPECIFICATIONS

SECTION 1A - SITE WORK

1.1. DESCRIPTION: The work to be performed under this section shall consist of furnishing all labor, equipment, and materials, and in performing all operations necessary in connection with site clearing and restoration as shown in the plans and specifications herein.

It shall be the responsibility of each bidder to determine the quantity of work to be done and make his own calculations as to costs to complete the work in accordance with the requirements of this section.

The construction right-of-way for water and sewer construction will be provided by the Owner.

Site clearing and restoration shall include the following:

A. The cutting and removal of trees, underbrush, and the removal of any obstructions from the natural ground surface and within the limits of the right-of-way to permit the construction of the improvements. Stumps, underbrush, and debris removed shall be disposed of by the Contractor.

B. The reconstruction of fences where they are located within the right-of-way for the construction of the improvements. As the work has been performed, fences shall be reconstructed in conditions at least as good as the original. The Contractor shall furnish new materials as necessary to permit reconstruction.

C. The reconstruction of yards and lawns that are within the construction right-of-way. Disturbed lawns in the right-of-way shall be graded and covered with topsoil to their original grade, and grass will be replaced. Likewise, shrubbery, trees, and other plants which must be removed by construction activities within the right-of-way will be replaced. The Contractor should, however, make every reasonable effort to avoid the unnecessary removal of trees, shrubbery and other plants in inhabited areas.

D. The reconstruction of dirt and gravel roads or drives. The alignment and grade shall be restored, as close as possible, to that existing prior to construction. Roads or drives that had a gravel

surface shall be replaced using native iron ore base course to a minimum compacted thickness of four inches.

- E. The removal and subsequent replacement of sidewalks, curbs, patios, retaining walls, wooden decks, or other man-made structures which are displaced by the Contractor's operations. The Contractor shall furnish new materials necessary to permit replacement to a condition better than or equal to the existing prior to construction.
- F. Where trees, plants, shrubbery, etc. are outside the construction right-of-way and are not to be removed, the Contractor shall protect such trees, plants, shrubbery, etc. by substantial wooden boxes and shall not permit machinery or employees to scrape, dig, or damage, or attach guy cables to them, without the permission of the Engineer. If such trees, plants, shrubbery, etc. are damaged by machinery, etc., hand excavation shall be required. The Contractor shall be responsible for the replacement of trees, plants, shrubbery, etc. outside the construction right-of-way.
- H. Where construction is within a city or state owned right-of-ways, sitework shall be in accordance with the governing authority. Refer to applicable codes and ordinances. The Contractor shall be responsible for obtaining the necessary permits from the City at least 48 hours prior to construction.

1.2. MEASUREMENT: Site work shall not be measured for separate items but shall be considered subsidiary to the item of the contract which it applies.

TECHNICAL SPECIFICATIONS

SECTION 1B - EXCAVATION AND BACKFILL

2.1. DESCRIPTION: This section covers the excavation and backfill of sanitary sewer lines, manholes, or other structures.

2.2. EXCAVATION:

- A. General Requirements: Excavation work shall be done in a safe and proper manner with suitable shoring and bracing against all hazards. Excavations shall be kept clear of working space and clearance for the workmen and for the installation and removal of components.

Subgrade surfaces shall be protected from material of any kind when concrete is in place. The excavation and construction of fills and embankments shall be done in all weather shall not be done except by the Engineer. All open ditches shall be protected of each working day in order to protect against a safety hazard.

- B. Classification of Materials: No classification of excavation materials shall be made. Excavation and trenching work shall be done in a safe and proper manner with suitable shoring and bracing against all hazards. The subsequent handling of all materials, removed in performance of the contract shall be done in a safe and proper manner with suitable shoring and bracing against all hazards, type, character, composition, or condition.

Excavation shall not be permitted on this project.

Trench Widths: Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for pipe installation, jointing, and embedment. However, the trench widths below an elevation 12-inches above the top of the installed pipe and each trench wall, expressed in inches, shall be as shown on the drawings.

Stipulated minimum clearances are not minimum average clearances, but are minimum clear distances which will be required.

Where necessary to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe. Where for any reason, the width of the lower

portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by leading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

E. Removal of Water: The Contractor shall provide and maintain adequate dewatering equipment to remove a sufficient amount of all ground water entering excavations, trenches, and other parts of the work. Each excavation shall be kept free of water from the time of preparation and continuously thereafter until the pipe is installed. If the pipe to be installed therein is connected to the ground, no damage from hydrostatic pressure shall result.

F. Whenever so ordered by the Engineer, the Contractor shall excavate to such depth as the Engineer may direct and the trench shall be filled to original grade with such material as the Engineer may direct. All timber, concrete foundations, pipe, and/or gravel made necessary by the work shall be installed as directed by the Engineer. Cost of excavation, timber, concrete, or other foundations shall be provided by contract unit prices, shall be provided by the contract provisions for extra work.

G. Where an unstable or running soil is encountered in the trench wall, such as may be found in the presence of ground water, stabilize this condition before excavation. Depending upon the severity of the condition, tight trenching, or a trench box may be used to control such conditions during the course of pipelaying operations. If the condition is too severe, it may be necessary to leave the sheeting in place to prevent lateral migration of both the material used beneath the trench and the material used around the pipe and trench wall material. Well points or underpinning may also be used to control excessive ground water conditions.

Over-Excavation: During the course of construction, should the trench be inadvertently over-excavated below a point greater than 6-inches below the bottom of the pipe, but not beyond a point 12-inches below the bottom of the pipe, fill that area of over-excavation with an acceptable class of embedment material and compact to a minimum of 90 percent Standard Proctor Density, regardless of soil type. Fill any area of over-excavation beyond a point 12-inches

below the bottom of the pipe with processed stone or processed gravel. Any such over-excavation shall be replaced by, and at the expense of the Contractor.

- I. Disposal of Excavated Materials: Excavated material shall be piled adjacent to the work to be used for backfilling as required. Excavated material which is unsuitable for backfilling and excess material shall be disposed of in a manner approved by the Engineer.
- J. Excavation Below Pipe Subgrade: Except as otherwise noted, pipe trenches shall be excavated approximately 6-inches below the finished pipe subgrade to allow for the placement of bedding materials.

2.3. PIPE EMBEDMENT FOR PVC PIPE: The bedding shall consist of bedding, haunching, and initial backfill. The bedding shall be in accordance with the standard detail sheets of the plans. The bedding shall be placed below and above the pipe and placement of bedding material shall conform to the requirements of the standard detail sheets and to the following specifications:

- A. Embedment Materials: The following are descriptions of the classification of materials which may be used for pipe embedment. Refer to the standard detail sheets of the plans:

Class I (1) graded stone, including a number of angular particles of regional significance such as coral, slag, and crushed shells.

Class II (2) native material including fine sands, sandy clay, and gravel/clay mixtures. This also includes excavated material if suitable.

Placement and Composition: Prior to pipe installation, bedding material shall be brought to grade along the entire length of the pipe to be installed. To ensure that adequate and uniform support is provided under the pipe and to avoid differential settlement of the pipe, certain procedures should be adhered to and precautions taken as outlined herein. Blocking shall not be used to bring the pipe to grade.

- (1) Class I Material: When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 6-inches of Class I material is sufficient to provide uniform bedding. However, in the initial

stage of placing this type of material, take care to ensure that sufficient Class I material has been worked under the haunch of the pipe to provide adequate side support. Take precautions to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe from large particles of backfill material, little care need be taken and no compaction is necessary in placing initial backfill to a distance of 6-inches above the top of the pipe.

- 2.4. TRENCH BACKFILL: Backfilling from a point 6" above the top of the trench shall be done with good earth free from lumps and rocks. No material of a perishable, spongy or friable nature shall be used in backfilling.

Where trenches are not under existing or proposed pavements, backfill need not be mechanically tamped. For the remainder of the trench, the trench shall be flooded with water to a depth of 12 inches and consolidated. Consolidation of backfill above the water level shall not be allowed.

Where trenches are under existing or proposed paved areas, the entire trench up to a point 6" above the proposed subgrade shall be backfilled with select material compacted to a density of 90% AASHO T-180. The remaining 6" shall be similarly backfilled, but the compacted density shall be 95% AASHO T-180 modified.

The bottom of trenches under existing or proposed paved areas shall be compacted with mechanical devices manufactured for that purpose to the pipe to the top of the existing or proposed pavement.

- 2.5. TESTING: A moisture-density test may be ordered by the Engineer to determine if trench backfill complies with the requirements of the specifications. Tests will be performed by a recognized testing laboratory, the cost of which will be paid for by the Owner. Copies of all test results will be furnished to the Contractor.

- 2.6. COMPACTION: All trench backfill in areas under paved or unpaved roads, parking areas, sidewalks and other structures, as determined by the Engineer shall be compacted to a density of at least 90% of the maximum dry density as determined by the AASHO Method T99 to a point 6 inches below the top of the backfill. The top 6 inches shall be compacted to a density of 95% of the maximum dry density as determined by AASHO Method T99. In all other locations, compaction of backfill from the bottom of the trench to a distance of one foot above the top of the

pipe. From a point one foot above the top of the pipe to the top of the trench, the backfill need not be mechanically tamped. Before reaching the top of the trench, the trench shall be flooded with water or rolled by passing the wheel or track of a piece of equipment along the trench line to achieve some degree of consolidation.

In place moisture-density test may be ordered by Engineer to ensure that all trench backfill complies with the requirements of the specification. Tests will be performed by a recognized testing laboratory. All costs will be paid for by the Owner. Copies of all test results shall be furnished to the Contractor.

2.7. SPECIAL PROBLEMS:

A. Bell Holes: When the pipe is installed with elastomeric seal joints, bell holes shall be filled with bedding material to allow for unobstructed movement of the joint. Care should be taken that the bedding is properly placed. It is necessary to accomplish proper joint placement. Once it has been made, the bell hole should be filled with bedding or haunching material to provide uniform support of the pipe throughout its entire length.

B. Minimum Cover: Provide at least 36 inches of cover over the pipe before the trench is wheel-loaded. When the trench is 36" deep, avoid the use of heavy equipment.

C. Compaction Equipment: Take care to avoid contact between the pipe and compaction equipment. Compaction of the backfill, and backfill material should generally be done in a way so that compaction equipment is not used directly against the pipe until sufficient backfill has been placed to support the pipe. Such compaction equipment will not have a damaging effect on the pipe.

Removal of Trench Protection: If sheeting or other trench protection is removed, take care so as not to disturb previously constructed foundation bedding, haunching, and initial backfill. If it has been necessary to place or drive sheeting or other trench protection below the top of the pipe, consideration should be given to leaving in place this portion of the sheeting or trench protection, since its removal could jeopardize the side support necessary for the pipe.

TECHNICAL SPECIFICATIONS

SECTION C3 - DEWATERING OF TRENCHES

C3.1. DESCRIPTION:

This section covers the dewatering of trenches to the extent that bedding material and sanitary sewer pipe can be placed on dry trench bottom.

C3.2. WELLPOINTING:

Wellpointing where required to keep the excavation grade stable, shall be installed when the excavation is below the water table, except as hereinafter provided, and the excavation shall remain until backfill is completed to this level. Wellpointing is to be operated in an area that has been previously dewatered. Wellpointing is required to keep trench excavation dry. When the water table is within (2) feet of the water table. There shall be a pump, in good working order, available at all times to pump out water that accumulates in excavations to the extent that the grade is obtained. Where the pipe line crosses a public utility, the work shall be conducted in such a manner as to avoid damage or delays in the prosecution of the work. Provision shall be made for the satisfactory disposal of water pumped so as to prevent damage to public utilities.

C3.3. TRENCH DRYING:

Trench drying other than by wellpointing shall be accomplished by methods selected by the contractor; however, bedding material shall not be placed in wet or unstable trenches. Soil that can not be dewatered shall be excavated and dry material tamped in place to a depth as may be required to provide a firm trench bottom.

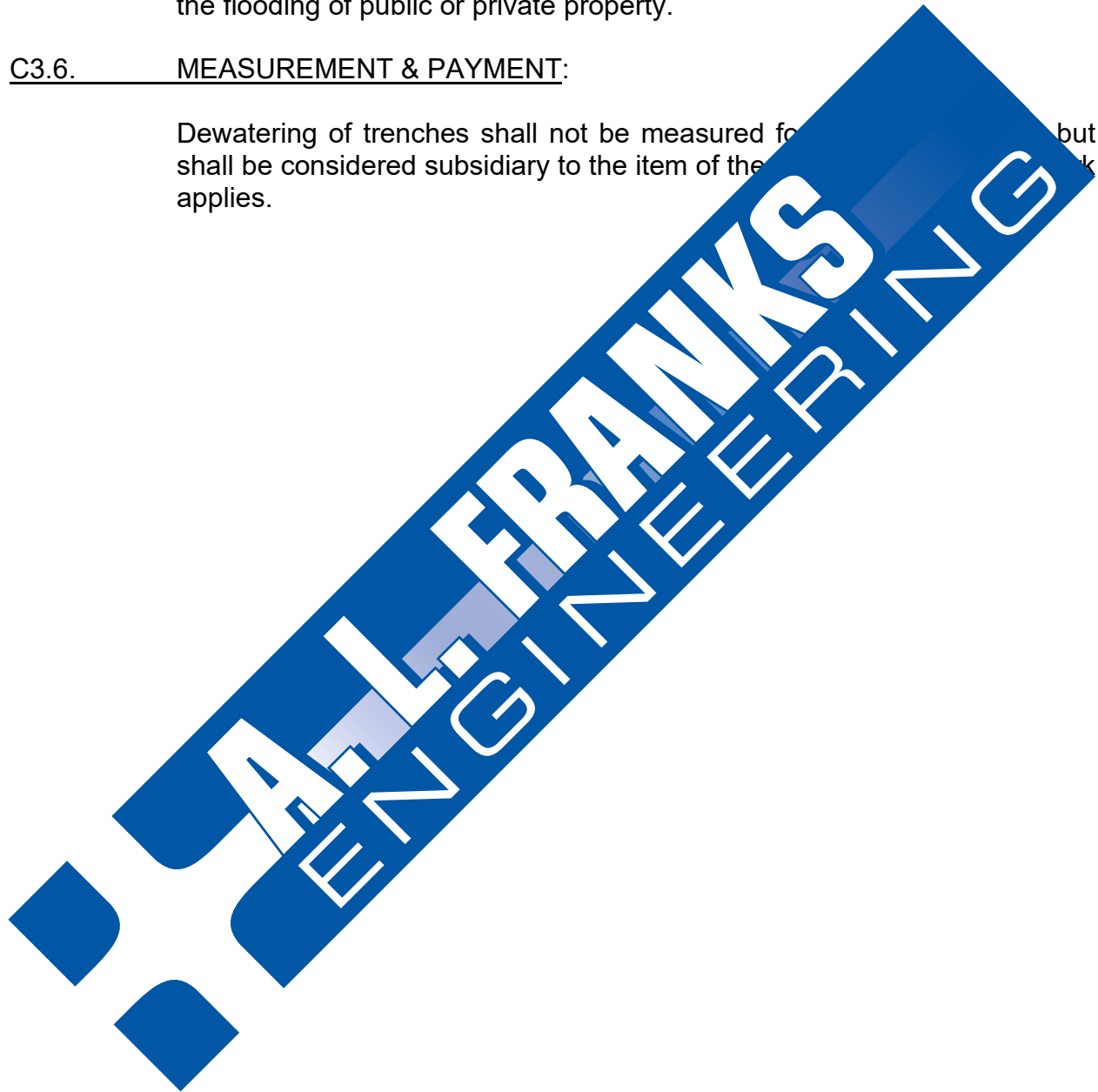
C3.4. SURFACE RUNOFF: Surface runoff water shall be diverted away from trenches. Such diversion shall be into existing drainage structures, such as storm sewers, ditches or streams. Diversion of surface runoff shall be in such a manner to prevent flooding of streets or private property. Sitework and grading shall include work to maintain positive drainage during construction.

C3.5. DISPOSITION OF WATER FROM DEWATERING:

All water removed from the trenches by wellpointing or any other means shall be pumped, piped or drained into existing drainage structures, such as storm sewers, ditches or streams. The disposition of water from dewatering operations shall be accomplished in a manner that will prevent the flooding of public or private property.

C3.6. MEASUREMENT & PAYMENT:

Dewatering of trenches shall not be measured for _____ but shall be considered subsidiary to the item of the _____ it applies.



TECHNICAL SPECIFICATIONS

SECTION 1C – TRENCH SAFETY SYSTEMS

4.1. DESCRIPTION:

This section covers excavation and supporting systems to protect the safety of workers, provide suitable access to existing utility lines, and to protect public or private property and utilities.

The Contractor's attention is directed to the "Trench Safety Systems" under which full compensation will be provided for materials, equipment, fabrication and labor to install, maintain, and remove trench excavation, shoring, bracing, and trench shields.

Trench safety shall fully comply with the Contractor's "Trench Safety System and Construction" and shall be approved by the Engineer.

4.2. EXISTING STRUCTURES:

Where existing structures, streets, highways, or other structures are adjacent to the trench, adequate protection shall be provided by shoring and shoring to protect the structure, street, or highway from damage. In the case of utilities, the Contractor shall provide the utility provided that the removal and replacement of the structure meets with the approval of the Engineer, the Engineer has jurisdiction of the structure. In all cases, it shall be the responsibility of the Contractor to protect public and private property and person or persons who might, as a result of the excavation, be injured.

4.3. TRENCHING, TRENCHING, AND SHORING:

The Contractor shall include in his bid price and be solely responsible for all safety provisions meeting the requirements of the United States Department of Labor Occupational Safety and Health Administration. The following regulations, as contained in Subpart P, Part 1926 of the Code of Federal Regulations, shall be complied with along with all other applicable Subparts and Regulations not herein contained:

TECHNICAL SPECIFICATIONS

SECTION C5 - PIPE LAYING

C5.1. DESCRIPTION:

This section covers the laying of pipe for sanitary sewer and force mains. All material shall be in accordance with PART M - MATERIALS of these specifications.

C5.2. GRAVITY SEWER and FORCE MAINS:

- A. Each joint of pipe shall be inspected before the pipe is placed in the trench. Any joint found to be damaged or defective shall be removed as to impair its usefulness, shall be replaced in such a manner that the marking will not be obscured. Defective joints shall be removed from the site.
- B. All sewer pipe shall be laid to plan line and grade. Each pipe shall be laid to plan line and grade directed by the Engineer, using a transit, level, or laser beam grade light. Where both line and grade are required, each pipe shall be plumbed for line and checked for elevation with a grade stick. Care shall be taken to ensure that the spigot is centered properly in the bell of the pipe. After the pipe is properly seated, and that each pipe is solidly seated in the trench, the pipes shall be cleaned of all dirt and debris. They shall be maintained clean until service.
- C. At the end of each day's work, and when for any reason the laying of pipe is discontinued for an appreciable period, the open ends of the pipe shall be closed temporarily.
- D. Cutting of pipe for any reason shall be done in a neat and workmanlike manner without damage to pipe or pipe lining.
- E. Pipe shall be lowered carefully into the trench in such manner that spigot and bell will not become contaminated. Spigot and bell shall be checked for cleanliness immediately before insertion of spigot into bell.
- F. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water and no pipe shall be laid when trench conditions or weather are unsuitable for

such work. Full responsibility for the diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor.

- G. Spigot and bells shall be cleaned thoroughly before the application of lubricant and attachment of the preformed joint gasket. Application of lubricant and attachment of the gasket shall be in strict accord with the joint.
- H. Pipe shall not be placed in the trench without setting the bells so that the entire barrel of the pipe is uniformly supported on the pipe bedding.
- I. Pipe shall be supported to proper line and grade to prevent against upheaval or floating during the trenching, bedding or encasement.

C5.3. STEEP GRADES:

- A. Concrete Pipe Anchors for concrete sewer lines are constructed on grades of fifteen percent or greater. Concrete anchors shall be provided as follows: The first anchor will be placed just below the bottom of the trench at the downstream manhole. Anchors will be placed at intervals of not greater than one hundred fifty (150) feet.
- B. Trenches for 12" or Ductile Iron Pipe, meeting the requirements of M2 – SANITARY SEWER PIPE, shall be supported when the grade is fifteen percent (15%) or greater.

C5.4. CONNECTIONS TO EXISTING SEWERS:

Connections to existing sewers shall not be made until all of the new sewer lines and manholes have been constructed, cleaned and approved by the Engineer for making connection. No connection to existing sewers shall be made until new sewers have passed specified leakage tests.

All work shall be completed in a workmanlike manner using materials specified or as approved by the Engineer. Watertight connections shall meet with the requirements concerning tests of these specifications.

TECHNICAL SPECIFICATIONS

SECTION C6 - PIPE JOINTS

C6.1 DESCRIPTION:

This section covers the installation of pipe joints. Joint materials shall be as specified in SECTION M2 – SANITARY SEWER PIPE.

C6.2 PIPE JOINT INSTALLATION:

All pipe joints other than those specifically noted shall be made in strict accordance with the manufacturer's recommendations. All joints shall be made watertight in accordance with the latest ASTM Standards. Excavation for bells shall be made to insure that the bottom of the pipe is properly bedding for entire length of the pipe.

C6.3 INSTALLATION OF

- A. Prior to installation, the end of the pipes shall be cleaned thoroughly. If necessary, wire brushes are necessary to remove all foreign matter. A wire brush shall be used to clean the gasket.

The rubber gasket shall be cleaned and inserted into the seat within the bell. The spigot end of the pipe shall be inserted into the bell of the pipe to which connection is being made, and shall be seated against the shoulder of the bell. Pipe alignment shall be maintained and shall not be deviated from true alignment according to the pipe manufacturer's recommendation.

C6.4 INSTALLATION OF MECHANICAL JOINTS:

- A. The spigot end of pipe and the bell of fitting and the rubber gasket shall be cleaned thoroughly as specified for pipe joints in paragraph C6.3 above. The gland shall also be cleaned in like manner.
- B. After the gland and gasket are placed on the spigot end of the pipe a sufficient distance from the end to avoid fouling the bell, the spigot

end shall be inserted in the fitting bell to firm contact with the bell shoulder. The rubber gasket then shall be advanced into the bell and seated in the gasket seat. Care shall be exercised to center the spigot end within the bell.

- C. The gland shall be brought into contact with the gasket, all bolts entered, and all nuts made hand tight. Continued care shall be exercised to keep the spigot centered in the bell. The joints shall be made tight by turning the nuts with a wrench, first partially tightening a nut, then partially tightening the nut 180 deg. then working thus around the pipe with uniformly applied torque. Required torque is applied to all nuts. Required torque and wrench lengths for standard cast iron h

<u>Diameter</u> <u>Inches</u>	<u>Range of</u> <u>Foot</u>	<u>Wrench</u> <u>Inches</u>
5/8	40	8
3/4		10
1		12
1 1/4		14

TECHNICAL SPECIFICATIONS

SECTION C7 - PIPE FITTINGS

C7.1 DESCRIPTION:

This section covers the installation of pipe fittings for lines.

C7.2 PIPE FITTINGS INSTALLATION:

All pipe fittings shall be installed in strict accordance with the manufacturer's recommendations. Joints shall be made in accordance with the requirements of the manufacturer. Pipe fittings shall meet with the requirements of the manufacturer. JOINTS. Pipe fittings shall meet with the requirements of the manufacturer. M2 – SANITARY SEWER PIPE.

TECHNICAL SPECIFICATIONS

SECTION C8 - MANHOLES

C8.1. DESCRIPTION:

This section covers the construction methods for manholes, drop manholes, and watertight manholes.

C8.2. EXCAVATION AND BACKFILL:

- A. Excavation: Excavation for manholes shall be in a workmanlike manner. The area excavated shall be only that necessary to provide for the manhole. Its sides shall be poured against undisplaced earth. The excavation shall be dewatered in accordance with the provisions of SECTION C4 - TRENCH SHIELDING before excavation is started. Sheet piling and shoring shall be in accordance with the provisions of SECTION C4 - TRENCH SHIELDING.

Where excavation is below plan grade because of unsuitable ground conditions, the space below plan grade shall be backfilled and thoroughly tamped or the space may be filled monolithically with the base.

- B. Backfill: Backfill shall be compacted to a density of not less than 90% of the density obtained in the laboratory. Moisture content of soils shall be determined in accordance with the provisions of Section T 180 modified. 90% density shall be required for the full depth of excavation except in public streets or alleys where a density of 95% shall be obtained for the top 6 inches.

Backfill around manholes shall not be completed until adequate strength has been obtained to support the backfill without damage to the manhole. In no case will backfill be allowed on brick manholes, precast manholes, or poured-in-place manholes until the concrete is at least 48 hours old except as approved by the Engineer.

C8.3. INVERTS:

- A. All pipe lines shall extend entirely through the manhole to a joint approximately 6" outside the manhole except where change in

direction or in sizes of pipes makes such construction unfeasible. Pipe in a manhole at the upper end of the line or discharging into an existing manhole shall not extend entirely through the manhole. In all cases, the pipe or pipes shall extend entirely through the manhole wall so that a joint occurs approximately 6" outside the manhole wall. Depth of the invert along the line of flow shall be approximately $\frac{1}{2}$ the diameter of the abutting pipe. Curves in inverts shall have as long radius as feasible to facilitate flow. Shape of the invert shall be that approximating one-half of the pipe and inverts shall be brushed smooth.

- B. The surface of the concrete slab shaped to the pipe shall be sloped upward from the edge of the invert to the top of the pipe. The upper half of any pipe extending into the manhole shall be cut substantially flush with the manhole wall. The cut shall be smoothed with mortar.
- C. Mortar used in manholes shall be in the proportions by volume of one part cement to three parts sand. If carefully done, mortar may be mixed with water. Mortar shall have a workable consistency, but shall not be too dry.
- D. Before construction of precast section manholes, the groove of the pipe shall be cleaned thoroughly. Care shall be exercised to ensure the groove is completely filled with mortar.
- E. Invert shall be in conformity with the manhole's concrete base in accordance with the details shown on the standard manhole details.

C8.4.

- F. Precast sections shall be positioned carefully upon the invert and be raised in a truly vertical plane. Space between pipe and periphery of cut-out shall be entirely filled with concrete as is appropriate for space to be filled. A collar approximately 8" wide shall be formed around the pipe against the side of the manhole.

Minimum wall thickness for manhole risers shall be as listed under wall "B" of the "Class Tables" of ASTM C76.

- C. All precast manholes shall be constructed with a 1' section of pipe immediately below the cone or top section in order to lower the manhole for any future change in grade.

- D. The base concrete shall be Class "A", and deposited on an undisturbed bearing surface. The base shall have a minimum diameter 6" greater than the outside diameter of the manhole and the minimum thickness of the slab (as measured from the bottom of the sewer mains) shall be as follows:

0-8' manholes	-	8"
8-12' manholes	-	10"
12' and above	-	12"

C8.5. POURED-IN-PLACE MANHOLES:

- A. Forms for poured-in-place manholes shall be set around the sewer pipe entering the manhole. The invert rests upon the concrete base. The space between the forms shall be filled in accordance with the requirements of the specifications.
- B. Poured-in-place manholes shall be constructed in accordance with requirements and details as shown on the drawings. The top section or cone shall be concentric.
- C. Construction of manholes shall be in accordance with all applicable specifications.
- D. The base shall be poured concurrently with the rest of the manhole. The base shall be formed during or immediately after the concrete is placed and brush-finished as soon as possible. The concrete must set for 24 hours before the manhole is trimmed.

The base shall be 3,000 psi, maximum slump 4", vibrated on undisturbed bearing. The base shall have a minimum diameter 6" greater than the outside diameter of the manhole, and the minimum thickness including the area under the pipe as follows:

0-8' manhole	-	8"
8-12' manhole	-	10"
12 and above	-	12"

All invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the inside of the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base or may be constructed by laying full section sewer pipe straight through the manhole and breaking out the top half after the base is constructed. Inverts shall extend up at least half of the diameter of the pipe. Changes in the direction of the sewer and

entering branches shall have a true curve of as large a radius as the size of the manhole will permit. Where the pipe is laid through the manhole, the invert shall be finished to 1/4" below the center of the pipe. The pipe shall be trimmed down to 1/4" below the surface of the invert, and the edges of the pipe along the invert and at the walls of the manhole shall be plastered and brush-finished. Plaster shall be 2 parts of masonry sand to 1 part of Portland cement.

- F. The vertical forms, wall spacers, and placing cones shall be carefully positioned and firmly clamped in place before concrete placement is made. The wall spacers must be located 9" from the center of the manhole. The manhole shall be cast of 3,000 psi concrete with a maximum slump of 4". The first placement shall be 12" thick. The remaining 1/2 yard of concrete deposited evenly until there is a minimum slope of 1/4" per foot from the top of the forms to the bearing surface of the pipe. When this is completed, concrete is added, the concrete must be placed on each side of each pipe. Additional concrete is deposited in evenly distributed layers of 12" thick. Each layer must be vibrated to bond it to the preceding layer. The forms must be raised as the placements are made. The spacers must be removed from which the space is withdrawn by the use of a vibrator. Excessive vibration is to be avoided.

Formwork shall be 1" thick. No more than 1" will be permitted on the outside surface. All marks and offsets up to 1/2" will be permitted on the inside of the manhole. All offsets on the inside surface of the manhole shall be smoothed and plastered so there is no roughness or protrusion capable of scratching a worker or catching debris or solid materials. Honeycomb will be plastered with a mixture consisting of 3 parts of masonry sand to 1 part of Portland cement immediately upon removal of the forms.

The specific ring and cover and the method of installing it will be determined by the Owner or Engineer.

Backfilling will be performed evenly and carefully around the manhole 24 hours or more after the placement of concrete is completed.

Should circumstances make a cold joint necessary, a formed groove or reinforcing dowels will be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly

C8.6. MANHOLE DETAILS:

C8.7. CONNECTION TO EXISTING MANHOLES:

- C8.8. END COVERS:**

C8.9. ANHOLE CONNECTIONS FOR PVC SEWER PIPE:

C8-5

Series, 0.024" thick, or equal. An equal connection shall be recommended by the respective pipe manufacturer.



TECHNICAL SPECIFICATIONS

SECTION C9 - RESTORATION OF SPECIAL SURFACES

C9.1. DESCRIPTION:

This section covers replacement of special services, private drives, parking areas and paved street surfaces.

Restoration of other surfaces is covered under Section C2 -

C9.2. BACKFILL UNDER SPECIAL SURFACES

Backfill under special surfaces shall be in accordance with Section C2 - Excavation and Backfill of these special surfaces shall be in.

Backfill from 6-inches above the existing surface with suitable materials from the spoil bank brought to the surface. Backfill not exceeding 6-inches in depth of loose material shall be carefully placed and thoroughly done. Backfill shall be placed in layers from their original positions. All the backfill shall be compacted to optimum moisture and shall be thoroughly compacted to maximum density as determined by the Modified Proctor Test. However, the top 6-inches of the backfill shall be compacted to 95% maximum density as determined by the Modified Proctor Test.

C9.3. STREET

Street replacement as specified herein for "paved street open-cut repair" shall be in accordance with the specifications for street replacement used in specific locations shall be in accordance with the Engineer.

Street Open-Cut Repair: After the backfill material has been placed within 7½" of the finish surface, the material on either side of the trench shall be removed for a horizontal distance of 12" from the widest point of the trench to a depth of 8". This will provide a shoulder of undisturbed bearing along each side of the trench 12" wide. The cut shall have a uniform width as nearly as is practicable, and shall be made perpendicular to the surface of the pavement in order that the repair shall result in a uniform, neat appearance. If the street is asphalt, 6" of Class "B" concrete will be poured to within 1½" of the surface. As soon as the concrete has obtained its final set, the surface will be tack coated and surfaced with 1½" hot mix asphaltic concrete meeting the Arkansas Highway

Department specifications. The above requirements shall apply for all pavement thicknesses up to and including the thickness outlined above, but in no case shall the total thickness of repairs to streets be less than the total thickness of the pavement in each individual case.

B. Oiled Street Open-Cut Repair: Backfill on streets which are oil streets and as described by the Engineer shall be done in the following manner:

- (1) Compaction requirements will be the same as specified in Section C9.2.
- (2) The backfill will top within 1/2" of the finished surface. Compacted native iron ore shall be used within 4" of the finished surface. The remainder of a road oil and sand mixture shall be of the same proportions as the portion one gallon of oil to one foot of sand.

TECHNICAL SPECIFICATIONS

SECTION C10 - CAST-IN-PLACE CONCRETE

C10.1. GENERAL:

- A. Standards: Concrete work shall conform to all requirements of ACI-301 "Specifications for Structural Concrete for Buildings", ACI-318 "Building Code Requirements for Reinforced Concrete", ACI-308 "Concrete Sanitary Engineering Structures", and ACI-309 "Recommended Practice for Hot (Cold) Weather Concrete". The provisions of these specifications shall govern.
- B. Scope: Work consists of furnishing materials, equipment, and appliances necessary for the completion of the work in connection with installation of concrete. Work shall be complete, in strict accordance with the Specifications.
- C. Inspection: Embedment and tests for concrete and other materials shall be completed and approved by the Engineer before concrete is placed.

C10.2. MATERIALS: All materials shall conform to the latest revised ASTM Designation.

- A. Aggregates: Aggregates shall consist of gravel, crushed gravel, crushed stone, or a combination thereof, conforming to ASTM C-33 with a maximum size of 1½".
- B. Washed Aggregates: Aggregates shall conform to ASTM C-33 and shall be washed and free of fines. Aggregates shall be composed of clean, uncoated grains of strong materials.
- C. Cement: Cement shall be Portland cement conforming to ASTM Specification C-150, Type I, Type IA, Type III, or Type IIIA. Only one brand of cement shall be used for exposed concrete.
- D. Water: Clean, fresh and free from oil, acids, alkali, vegetable, sewage, organic or other deleterious matter.
- E. Admixtures: A retarding admixture, conforming to ASTM C-494, pretested with job materials under job conditions, shall be used, if approved, whenever necessary to prevent cold joints due to the quantity of concrete placed, to permit revibration of the concrete, to

offset the effects of high concrete temperature, or to reduce the maximum temperature and rate of temperature rise.

- F. Premolded Expansion Joint Filler Strips shall be non-extruding type conforming to the current AASHTO Designation M153.
- G. Abrasive Aggregate shall be equal to fine (c.f.) "Alundum" aggregate as manufactured by Norton Company, Worcester, Mass. or "Frictex NS" as manufactured by Sonneborn-Clayton Co., St. Louis, Mo.
- H. Curing Compound: Concrete curing compound shall be of pure nature and composition not deleterious to concrete. It shall be of standard and uniform quality ready for use as received from the manufacturer. At the time of use, the compound shall be in a thoroughly stirred condition. Compound shall not be diluted by the addition of solvent or other material in any manner without the specific approval of the Engineer as prescribed by the manufacturer. Curing compound shall conform to the requirements of ASTM C672.

The curing compound shall be transparent and free from color that there shall be no change in the color of the concrete. The compound may, however, contain a temporary dye of sufficient intensity to be clearly visible for a period of at least 7 days.

- I. Grout shall be used for grouting as specified.

Grout shall be composed of cement, sand, and water proportioned and mixed as herein-specified.

Cement: Cement for grout shall be Type I normal Portland cement conforming to the specifications for cement in concrete. Type III high early strength Portland cement may be used only when approved by the Engineer.

- (3) Sand: Sand shall conform to ASTM C33 and shall be graded so that 100% by weight will pass a standard No. 8 mesh sieve, and at least 45% by weight will pass a standard No. 40 mesh sieve.

- (4) Design Mix: Grout shall be a mixture of one part cement to two parts sand with a water cement ratio of 0.55. Drypack grout shall be a mixture of one part cement, two parts sand

and the minimum amount of water required for mixing and placing. When shrinkage control of standard grout is required, aluminum powder shall be added as herein specified.

- (5) Mixing: Mixing and placing apparatus shall be similar to that specified for concrete. Grout shall be mixed for a period of at least one minute. Diluted grout shall be agitated from time to time as considered necessary to keep the elements well mixed and in suspension. Sand and cement shall be free from lumps when placed in the mixer. Grout shall be screened to remove coarse particles.

- J. Nonshrink Cement-Based Grout: Grout for column and other bases and anchors shall be cement-based grout. Nonshrink grout shall consist of pre-measured, prepackaged bags of grout, as manufactured, requiring only the addition of water. The manufacturer's instructions shall be printed on the outside of each bag.

The manufacturer shall provide instructions for verifying the cement-based grout properties:

- (1) Moisture - A maximum of 0.0% and a maximum 4.0% moisture in accordance with ASTM C-827. No more than a maximum of 0.2% expansion in the grout when tested in accordance with CRD-C 621.

Strength - A minimum 28-day compressive strength of 5,000 psi when tested in accordance with ASTM C-109.

Setting Time - A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.

Composition - No metallic particles (aluminum powders, iron filings) or expansive cement.

The contractor shall perform all grouting in accordance with the manufacturer's recommendations. Technical service shall be supplied upon request.

Grout shall be Five Star Grout, as manufactured by U.S. Grout Corporation, Fairfield, CT or equal.

- K. Nonshrink Epoxy-Based Grout: Nonshrink Epoxy-based Grout shall be a pourable, 100% solids epoxy system consisting of three, pre-measured, prepackaged components: resin, hardener, and specially-blended aggregate. Resin component shall not contain any non-reactive diluents. Variation of component ratios is not permitted unless specifically recommended by the manufacturer.

The manufacturer shall submit information verifying the epoxy grout exhibits the following properties:

- (1) Grout for bonding new cement to old concrete. Grout shall be an epoxy grout mixed in accordance with the manufacturer's instructions.
- (2) Nonshrink - No shrinkage and a minimum 0.0% expansion when tested according to ASTM C-827.
- (3) Compressive Strength - Minimum compressive strength of 10,000 psi in 28 days when tested according to ASTM C-579, Method B.
- (4) Heat Resistance - No loss of strength at 100 degrees F peak exposure. High sample when tested at laboratory temperatures.
- (5) Thermal Expansion - Maximum 30×10^{-6} in./in./degree F when tested according to ASTM C-531.

perform all grouting in accordance with the manufacturer's recommendations. Technical service shall be requested.

Use Five Star Epoxy Grout, as manufactured by U.S. Grout Corporation, Fairfield, CT or approved equal.

Drypack Mortar: Drypack mortar shall be composed of approximately one part Type II Portland cement, 1½ to 2 parts sand, 2 to 3 fluid ounces water reducing densifier per sack of cement, aluminum powder as required for shrinkage control, and sufficient water to make a stiff workable mix. Sand, cement, water, and water reducing densifier shall be as specified for concrete.

C10.3. QUALITY AND CONTROL

- A. Design: Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate and water. All concrete shall be designed by an approved testing laboratory in accordance with the ACI Standard Recommended Practice for Selecting Proportions for Concrete (ACI-211) to produce the strength for each class of concrete specified, and with slumps and maximum size of coarse aggregate in accordance with the requirements of the specification. The concrete shall be so designed that the concrete will not segregate and excessive bleeding will not occur. The Contractor shall submit the design data to the testing laboratory for designing concrete. The design shall be approved by the Contractor.

Prior to placing any concrete, the Contractor shall review the mix designs for each specified class of concrete. The design data shall include the name of the testing laboratory; the name of the manufacturer/supplier and the type of aggregate; proportional parts of cement, aggregate, and water per cubic yard of concrete; and the name of the admixture used. Trial batches shall be made and the following data shall be submitted: 1-slab test for 28 day compressive strength test; slump; and percent of air content for each of the accepted mix designs will be permitted for use without further approval by the Engineer.

Concrete shall be as follows:

	-	4000 psi @ 28 days; minimum 6 sack mix (To be used for all work unless otherwise specified)
	-	4 ± 1%
Water-Cement Ratio	-	0.45
Class B Concrete	-	2000 psi @ 28 days; minimum 4 sack mix (To be used only as concrete fill)

MAXIMUM SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION

<u>Types of Construction</u>	<u>Hand Placed Maximum</u>	<u>High Frequency Vibrator Used Maximum</u>
Reinforced Foundation Walls and Footings	4"	
Slabs, Beams, and Reinforced Walls	4"	
Building Columns	4"	
Pavements	3"	

The slump shall not exceed the maximum shown above for the type of construction for which it is specified. The slump may be increased for concrete having a compressive strength determined in accordance with current ASTM Specifications C-39 and C-43, provided the increase is made in accordance with C-39. The increase shall not be more than that shown above for the specified class of construction. The increase shall be added after the amount specified above.

- B. Production Ready-mixed concrete shall be batched, mixed, and delivered in accordance with "Specifications for Ready-Mixed Concrete" (ASTM C-94)". Plant equipment and facilities shall conform to the "Check List for Certification of Ready-Mixed Concrete Plants" of the National Ready-Mixed Concrete Association. Site mixed concrete shall conform to the "Specifications for Structural Concrete" (ACI-301). The Contractor may elect to use either ready-mixed or site mixed concrete for the project provided he informs the Engineer of his choice.

Laboratory Testing: The Owner shall engage an independent testing laboratory to conduct concrete tests. Unless otherwise specified, the Contractor will be responsible for sampling concrete for test cylinders, recording, and delivering them to the laboratory, providing all materials required, and for making all slump tests in the field directed by the Engineer. All costs in connection with work performed by the laboratory will be paid by the Owner. The Contractor shall be responsible for the costs of work performed by the laboratory required for redesign of concrete proportions and retesting of in place concrete when cylinders indicate low strength concrete has occurred.

At least one test shall be made on fresh concrete for each sixty (60) cu. yds. of each class of concrete (or fraction thereof) placed on any one day and in any event, not less than one test for each class of concrete each day it is used. Testing shall be done in accordance with the following ASTM Specifications, latest edition:

- C172, Standard Method of Sampling Fresh Concrete
- C31, Standard Method of Making and Curing Concrete Compression & Flexure Test Specimens in the Field
- C39, Standard Method of Test of Compressive Strength of Molded Concrete Cylinders
- C143, Standard Method of Slump Test for Fresh Cement Concrete

Before any concrete is poured, the Engineer shall require that a storage box in accordance with ASTM C31 be provided. Each set of tests shall consist of one compression test and two flexure test cylinders. All cylinders shall be stored in the storage box for the first 24 hours. The three cylinders shall be cured and tested for adequacy of the concrete in accordance with ASTM C31. One cylinder shall be tested at 7 days.

- D. Failure of Concrete Strength Requirements: The concrete shall be tested for any one class of concrete, the average of three consecutive tests is equal to or greater than the specified strength, provided that no more than one cylinder is less than 90% and 100% of the specified strength. If the cylinders to be used for determination of strength will be those laboratory cured and tested at 7 days, it appears the tests of laboratory-cured cylinders will meet these requirements, the Engineer may require the proportions of concrete for the remainder of the structure to meet the strength requirements. In addition, the Engineer may also require additional curing not to exceed a total of 7 days on portions of the concrete already poured.

The Engineer may also require tests in accordance with Methods of Securing, Preparing and Testing Specimen from Hardened Concrete for Compressive and Flexural Strengths (ASTM Specifications C42) when the concrete cylinder tests fail to meet strength requirements. In the event there still is questions as to the quality of the concrete in the structure, the Engineer may require load tests for that portion where the questionable concrete has been placed. Such load tests will be made as outlined in Chapter

20 of American Concrete Institute Building Code. (ACI 318-71), and shall be at the expense of the Contractor.

- E. Removal of Under Strength Concrete: If the above tests indicate that a particular batch of previously placed concrete is under strength, the Engineer may direct that the under strength batch be removed and replaced. The removal of the under strength concrete shall also include the removal of concrete that has gained the required strength if the Engineer deems this necessary to obtain structural or visible continuity when the concrete is replaced.

The removal, and replacement of any under strength concrete shall be made at no additional cost to the Contractor. The Contractor shall be responsible for any new formwork required or any new reinforcement required. The Owner shall not be responsible for any extra work that is required to meet the minimum strength of concrete to meet the minimum requirements.

C10.4. INSTALLATION:

- A. Preparation Before Pouring: All excavations before concrete is poured shall be removed from excavations before concrete is poured. Hardened concrete, wood chips, and other debris shall be removed from interior of forms. All mixing and conveying equipment shall be cleaned or, except in freezing weather, shall be covered in advance of pouring. Reinforcement shall be inspected and approved by the Engineer before pouring of concrete.

- B. Placing: Concrete shall be conveyed from mixer to forms as nearly as possible and by methods which will prevent segregation of ingredients. It shall be deposited as nearly as possible in its final position. Chutes used shall be such that concrete does not flow. Chutes, if permitted, shall have a slope of less than 1 on 2. Where a vertical drop of more than five (5) feet is necessary, placement shall be through chutes or similar devices to prevent segregation.

Placing: Concrete shall be placed before initial set has occurred and in no event after it has contained its water content for more than 30 minutes. Unless otherwise specified, all concrete shall be placed upon clean, damp surfaces free from running water, or upon properly consolidated fills, but never upon soft mud or dry, porous earth. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures as to prevent

segregation of the coarse aggregate. Construction of forms for the lifts of vertical walls shall be such as to make all parts of the walls easily accessible for the placement, spading, and consolidation of the concrete as specified herein.

- D. Vibration: All concrete shall be placed with the aid of mechanical vibration equipment as approved by the Engineer. Vibration shall be transmitted directly to the concrete; in no case shall it be transmitted through forms. The duration of vibration at each location in the forms shall be held to the minimum necessary to secure thorough compaction. Vibrations shall be supplemented by spading or spading by hand, and adjacent to the forms. Care shall be taken in order to secure smooth, dense and even surfaces. Care shall be taken to prevent coarse aggregate from being placed too near any surfaces that are to be exposed.
- E. Construction Joints: Construction joints shall be indicated on the Drawings and shall be approved by the Engineer. Where indicated, construction joints shall be used. All concrete at the joint shall be at least 12 hours, and longer if necessary, before concrete resting thereon is resumed, or concrete shall be removed, and concrete shall be necessary, to insure a strong dense bond. In order to secure adequate bond, the surface of the joint shall be cleaned, roughened, and a half (1/2) inch layer of mortar of the same composition as is used in the concrete, immediately be deposited. The unit of operation is not to be in any horizontal direction, unless otherwise specified on the Drawings. Construction joints, if required, shall be at mid-point spans for slabs, beams or girders. Construction joints on piers shall be made at the underside of the beam or girder at least five (5) hours before any overhead concrete is placed thereon. Joints not shown or specified shall be so placed as to least impair strength and appearance of work. Construction joints in wall footings shall be reduced to a minimum. The rate of placement of concrete shall be at such a rate that surfaces of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Girders, beams and slabs shall be placed in one operation. To insure a level straight joint in exposed vertical surfaces, a strip of dressed lumber may be tacked to the inside of the forms at the construction joint. The concrete shall be poured to a point one (1) inch above the underside of the strip. The strip shall be removed one (1) hour after concrete has been placed and any irregularities in the joint line

leveled off with a wood float and all laitance removed. Waterstops shall be installed in all construction joints below grade or in liquid containing structures as noted on the Plans. Install as per SECTION C13 - CONSTRUCTION JOINTS & WATERSTOPS.

- F. Patching: Any concrete which is not formed as shown on the Plans, or for any reason is out of alignment or level or shows a defective surface shall be considered as not conforming with the intent of these Specifications and shall be removed and replaced by Contractor at his expense, unless the Engineer permits the Contractor to patch defective area, which shall be done in accordance with the following procedure. Permission to patch shall not be considered a waiver of the Engineer's requirement for removal of defective work if patching does not satisfactorily restore quality and appearance. Patching shall be done with non-shrink, latex or epoxy mortar. The mortar shall be applied and repairing defective surface if necessary.

After removing forms, the surface shall be inspected and any poor joints, voids, honeycombs, or other defective areas shall be patched by the Contractor. Where necessary, defective areas shall be removed away to a depth of not less than one inch, and the surface shall be perpendicular to the surface. Area to be patched shall be at least six (6) inches wide entirely surrounded by sound concrete to prevent absorption of water from the patch. The mortar shall be made of equal parts Portland cement and sand, mixed to produce a brushing consistency, shall be applied to the surface followed immediately by the patch. The patch shall be made of the same material and proportions as the surrounding concrete, and shall not be richer than the surrounding concrete. White Portland cement shall be used in the proportion of one part of the gray Portland cement to match color of the surrounding concrete. The proportion of white and gray cement shall be determined by making a trial patch. The amount of water shall be as little as consistent with the requirements for handling and placing. The mortar shall be retempered without addition of water by allowing it to stand for a period of one (1) hour during which time it shall be mixed occasionally with a trowel to prevent setting.

The mortar shall be thoroughly compacted into place and screeded off so as to leave patch slightly higher than surrounding surface. It shall then be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. The patch shall be finished in such a manner as to match the adjoining surface. On exposed surfaces where unlined forms have been used, the final

Tie holes left by withdrawal of rods or the holes left by removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted.

- Place vapor barrier below interior slope. Sprinkling of fill is not necessary. Lay vapor barrier 6" in direction of slope. Seal mastic. Repair all ruptures before concrete is placed. Night occur

H. Edging: Edging shall be on the outside of structures, footings, and walls. Edging shall be on the inside of structures shall be on the inside of structures. Edging shall be neatly edged with a radius tool as an edge. The level shall be at an angle of 45 degrees. The edge shall be 1/4 inch on a side. If so required by the Contractor shall provide square edges for

Walks & Paving: The top surface shall be "slip-resistant"

Steel troweled as noted in SECTION C10.5B and have a final finish applied in brushing lightly with a soft bristle brush to form a slightly roughed surface.

- C10-11

imprint, it shall be wood floated to a true and even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. After surface moisture has disappeared, surfaces shall be steel-trowelled to a smooth, even, impervious finish, free from trowel marks. After cement has set enough to ring the trowel, surface of all slabs shall be given a second steel trowelling to a burnished finish.

C. Interior slabs to receive fill or mortar setting bed shall be finished by tamping concrete with special tools to force concrete to required finish plane below the surface, and screeded with straight edge to required finish plane. Surface shall be burnished with steel trowel to produce good bond with topping material.

D. Top and bottom slabs of all structures and conduits except as noted otherwise on the Drawings shall be finished as follows: The top of the slab shall be finished with a straight edge section; lightly tamped as required, and screeded with straight edge and mortar for finishing and re-screeded with straight edge. Surface shall then be finished with a wood float. No further finish will be required on top of slabs and conduits which are to be buried. In the case of slabs of structures and conduits, the surface shall be finished with a wood float and a light broomed, slip resistant finish which conforms with accuracy of grade. Slabs shall be edged as indicated on the Drawings.

E. Slabs not to receive any finish floor covering shall be finished as follows: The top surface shall be finished in accordance with C3.5B above and have a final finish of light broom. Surface shall be lightly brushed with a soft bristle brush to form a slightly rough surface.

Surfaces of basins in which raking mechanisms are to be installed shall be finished, as indicated on the Drawings, by tamping in cement grout with the mechanism. The cement grout to be used shall be composed of one part Portland cement and two parts sand by weight.

The sweeping-in process shall be performed under the supervision of the Engineer or, if necessary, under the supervision of a factory representative of the equipment manufacturer.

The slab upon which the grout is to be applied shall be finished in accordance with the provisions of paragraph C10.5D above except that after leveling and floating, it shall be raked in such a manner as

to provide a good bond for the grout. Before grout is deposited on the slab, it shall be thoroughly cleaned, wet down with clean water, and lightly dusted with neat cement immediately prior to placement of the grout.

- G. Concrete Hardener shall be applied to the floors where scheduled to be exposed concrete. Concrete surfaces to be treated must be thoroughly set and dry, clean and free of dust. Three applications of "lapidolith", "saniseal", "hornolith", "vitrox", or an equal liquid are required, using one gallon per 100 sq. ft. for complete treatment. Apply hardener strictly in accordance with manufacturer's printed instructions. Any other specified hardeners must be of the same type, i.e., silicate or fluosilicate types.

C10.6. FINISH OTHER THAN FLOORS:

- A. All top surfaces, other than those of beams, and which are not to be covered by other work, shall receive a wood float finish with a trowel finish. It shall be taken that no excess water is to be used in the finish. Other surfaces shall be brought to a true and regular finish. All exposed interior surfaces shall be smoothed and give a cement wash of one part of Portland cement and two parts fine sand, mixed with water to consistency of thick paint. Grout shall be used to fill all pits, air bubbles, and surface irregularities. Excess grout shall be scraped off with a trowel and the surface shall be finished to a true and regular finish. Surface shall be finished during the curing period. The finish for any area shall be continuous and the limits of a finished area shall be clearly marked by lines in the finished surface.

Unless otherwise indicated, all faces (except top surfaces of slabs) exposed to view, such as walls, grade beams, beams, canopy soffits and fascias, etc. shall be finished as follows:

Forms shall be removed, as specified in SECTION C12 - CONCRETE FORMWORK, and all fins removed, offsets leveled, damaged places and depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the proportion which has been employed for the particular class of concrete treated. The surface film of all such pointed places shall be carefully removed before setting occurs. After the point has set sufficiently to permit it, all exposed surfaces shall be dampened and rubbed with a No. 16 carborundum stone,

to a smooth even plane. Final rubbing shall be done with a No. 30 carborundum stone, or an abrasive of equal quality, to obtain an entire surface of a smooth texture and uniformity in color. Mortar or grout worked up during rubbing shall be promptly removed by sacking with burlap or other suitable means so that no visible grout film or paste will remain. A cement wash or plaster coat shall not be used. All surfaces shall be finished uniformly smooth and washed clean. The rubbed finish for any area shall be completed in the same day and the limits of a finished area shall be at natural breaks in the finished surface. If the Contractor cannot provide suitable surface finish using carborundum as specified above, the Engineer, without additional cost to the Contractor, may require the use of a power operated grinding machine to obtain the desired finish.

C10.7. CURING:

- A. Unformed concrete surfaces shall be protected to prevent check of the fresh concrete surface. If surface conditions are severe, as determined by the Engineer, a curing compound shall be employed to prevent checking. Fog spraying shall be employed. Fog spraying shall be continued until the concrete surface has attained sufficient strength. Surfaces shall be covered with burlap mats. Where drying is severe, as determined by the Engineer, surfaces shall be covered with wet burlap. Concrete has sufficiently set, and shall then be covered with burlap.

Interior and exterior, shall be water cured by spraying with water beginning as soon as the forms are removed. To stripping of forms, the concrete and forms shall be kept moist by the water sprays.

Otherwise specified, surfaces shall be water cured for 7 days after the concrete is placed.

After 48 hours of water cure, and with the acceptance of the Engineer, the curing of concrete surfaces may be completed by the curing compound method. Curing compounds shall be applied in strict conformance with the manufacturer's instructions. If the compound is applied to a surface which is later to be painted, the Contractor shall thoroughly sandblast the surface to remove all vestiges of the compound prior to concrete finishing. Curing compound shall not be used on any surfaces against which additional concrete or other finishing materials are to be bonded.

- B. In all concrete structures, Class A concrete made with normal Portland cement shall be prevented from drying for at least the first seven (7) days after placing. Whenever the temperature of the surrounding air is between 40 deg. and 60 deg. F., adequate provision shall be made for maintaining the temperature of concrete above 60 deg. F. or the moist curing period shall be extended to insure a compressive strength corresponding to that which would be secured under provisions of the previous part of this paragraph.
- C. Whenever the temperature of surrounding air is less than 40 deg. F., all Class A concrete shall be maintained at not less than 50 deg. F. for at least 72 hours or as much more time as is necessary to insure the required strength of the concrete. The housing, covering or other protection in connection with curing shall remain in place for at least 24 hours after the artificial heating has been discontinued. Other chlorides shall be used for protection.
- D. Protection from the Sun Concrete shall be adequately protected from injurious action of the sun or other source of heat to the satisfaction of the Engineer.
- E. Temperature At the conclusion of the specified curing period, the temperature of the concrete shall be maintained to insure that the temperature of the air adjacent to the concrete does not fall below 40 deg. F. for more than 1 hour nor more than 30 deg. F. in any one day.

C10.8. CONCRETE PLACEMENT OTHER: When the atmospheric temperature is below 40 deg. F at the time concrete is delivered to the placement, or at any time during the curing period, the following provisions also shall apply:

The temperature of the concrete at the time of placing shall not be less than 50 deg. F nor more than 90 deg. F. The temperature of the aggregates nor mixing water shall be more than 100 deg. F prior to mixing with the cement.

When the daily minimum temperature is less than 40 deg. F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50 deg. F nor more than 90 deg. F for the duration of the curing period.

- C. Methods of insulating, housing, and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting," ACI Standard 306.
- D. When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40% shall be provided unless the concrete has been coated with curing compound or is covered tightly with an approved impervious material.

C10.9. CONCRETING IN HOT WEATHER: When climatic conditions are such that the temperature of the concrete may reach or is expected to exceed 90 deg. F at the time of delivery at the work, or during placement, or during the first 24 hours after placement, the following provisions also shall apply:

- A. The Contractor shall maintain the temperature of the concrete below 90 deg. F during mixing and placing. Methods of protection used shall conform to "Recommended Practice for Hot Weather Concreting," ACI Standard 308.
- B. The concrete shall be placed immediately after mixing. Truck mixing shall be used if the concrete remains to be placed for more than 90 minutes.
- C. Exposed surfaces that tend to dry or set too rapidly shall be covered with plastic sheeting or other means of fog sprays or otherwise protected during the time between placement and curing.
- D. Other exposed surfaces shall be started as soon as placement of the concrete allows and shall be completed as soon as possible.

Surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 48 hours of the curing period, or for the entire curing period unless curing compound is applied as specified.

Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during, and after form removal) or until curing compound is applied as specified.

C.10.10. INSERTS AND EMBEDDING:

- A. Inserts: Where pipes, castings or conduits are to pass through the walls, the Contractor shall place such pipes or castings in the forms before pouring the concrete, or in special cases, with the express consent of the Engineer or as specified, he shall build accepted boxes in the forms to make openings for subsequent insertion of such pipes, castings or conduits as required by the Engineer. To withstand water pressure and to insure watertightness and the openings so formed, the boxes shall be provided with continuous keyways and waterstops all the way around the opening with a slight flare to facilitate grouting and the edges shall be finished during grouting. Before placing the grout, the interior surfaces and the surfaces of the insert shall be coated with a bonding compound. Mixing and placement of the grout shall be in accordance with the manufacturer's directions.

Additional reinforcement shall be provided for large openings, as shown on the drawings for pipes or conduits as specified shall be grouted in grout under a head of at least 4 inches. The grout shall be poured or rammed or joggled into the space between pipes, castings or conduits and the openings so as to obtain the same as the wall itself. The grouted castings shall be finished as specified herein. The grouting material shall be finished when the forms are removed and shall be exposed to the wall if such wall be exposed to the exterior.

The Contractor shall set accurately and hold in exact position all forms until the concrete is poured and set, all gate lugs, ladders, special castings, channels or other metal items to be embedded in the concrete; and he shall set and hold in place all inserts and anchor or other bolts necessary for the attachment of piping, valves, metal sash and equipment. All nailing, blocking, plugs, strips and the like, necessary for the attachment of form, finish and similar work shall be furnished and placed by the Contractor.

Blockouts may be used for embedded items, with the prior written consent of the Engineer. Where blockouts are allowed, non-shrink cement based grout shall be used to set the embedded items.

In lieu of embedding anchor bolts and other items to be anchored in the concrete, the Contractor will be permitted with prior written

acceptance of the Engineer, to drill holes in hardened concrete and install the anchor bolts and other items with non-shrink epoxy based grout. Drilling or coring holes shall be done by rotary drill with diamond boring or coring bits. Bonding mortar or grout shall be epoxy bonding adhesive grout or epoxy bonding adhesive mortar. Holes shall be blown clean and dry before installation of embedded items. Before insertion, both the hole and the item to be embedded shall be coated with bonding compound. Rods of equal size and length may be substituted for anchor bolts if fasteners are used. When accepted by the Engineer, the bonded expansion shields may be used for anchorage of miscellaneous metal.

C10.11. DRYPACK MORTAR: Where surfaces are to be finished with mortar, such surfaces shall be thoroughly cleaned, and coated with bonding compound before the application of the required mortar. Mortar shall be applied immediately following the application of bonding compound and in bands or strips to form a compact dense surface of uniform thickness and shall be free from lumps and voids. Joints in the mortar shall be sloped to thin edge. When work is resumed, the joint shall be thoroughly cleaned and coated with bonding compound. Mortar shall be used for built-up surfaces, setting miscellaneous metal, and correcting minor repairs and imperfections.

No mortar shall be placed in freezing weather unless adequate protection is provided.

The curing compound shall be as specified for concrete.

C10.12. FORMWORKING CONCRETE: Where the work indicated requires modification of existing concrete structures or where concrete is to be removed or modified, the concrete shall be cut accurately to the lines required under the drawings of the Engineer. Concrete faces exposed to view shall be cut with a concrete saw. The cutting shall be accomplished in a manner that shall be free from cracks or other injuries, those parts of the existing concrete that are to remain. Where the cut surface is to be left exposed, it shall be cleaned and faced with non-shrink grout and finished to match adjacent surface. Where new concrete or mortar is to be placed against existing concrete surfaces or surfaces that have been cut, such surfaces shall be thoroughly cleaned by sandblasting, if required by the Engineer, and coated with the bonding compound just prior to the placement of the new concrete. Bonding compounds shall be as specified herein. Depth of saw cut should be $\frac{3}{4}$ " minimum. Unless otherwise indicated on the drawings or specified, continuity of reinforcing steel shall be obtained by

either exposing bars to provide sufficient laps with new bars or by welding existing bars with new bars as specified. Where indicated, existing bars shall be exposed and fully developed by; embedding in new concrete.

- C10.13. PROTECTION AND REPAIR OF CONCRETE CONSTRUCTION:** All surfaces shall be protected against injury. During the first 72 hours after placing the concrete, any wheeling, working or walking on the concrete shall not be permitted. All slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as the concrete has set. Sisalcraft paper or other similar tough waterproof paper shall be used, provided all joints between adjacent strips of paper shall be lapped. This does not alter the requirements for proper curing.
- No concrete slabs or top surfaces or walls shall be exposed to weather, unless acceptable protective shelter is provided. When exposed to weather, all concrete placed within the preceding 72 hours shall be covered with waterproof canvas or other suitable material and kept ready at hand.
- Immediately after the removal of forms, all concrete shall be inspected, and all pour joints, rough surfaces and other defects containing loose materials such size and quantity as may be necessary for cement mortar fill. Before the mortar is placed, the existing concrete shall be coated with epoxy. All form tie holes and small imperfections shall be filled with a concrete repair mortar. All imperfections and form ties shall consist of one part cement well mixed with three parts sand by volume and just enough water so that the mortar can be molded into a ball by slight pressure. The mortar shall be thoroughly compacted into place. When the defective concrete is large, it may be removed to a depth of 4 inches and filling the opening with concrete. The filling shall be reinforced and doweled securely to match the surface and texture of the existing concrete. All patches shall be cured as accepted by the

TECHNICAL SPECIFICATIONS

SECTION C11 - STEEL REINFORCEMENT

C11.1. MATERIAL: Steel reinforcement shall conform to the "Specification for Deformed Billet Steel Bars for Concrete Reinforcement", ASTM A-615, Grade 40.

Wire fabric reinforcement shall conform to the "Specification for Welded Steel Wire Fabric for Concrete Reinforcement", ASTM A-185, or "Specifications for Welded Deformed Steel Reinforcement", ASTM A-497.

C11.2. STORAGE: Reinforcement shall be stored on a flat surface upon skids, platforms or other supports to prevent damage from mechanical injury and surface corrosion due to the weather.

C11.3. SPLICES: No splices of reinforcement on the Plans, will be permitted without the approval of the Engineer. Bars shall be rigidly clamped or wired at splices and approved by the Engineer. Welding may not be used without specific approval of the Engineer. Welding shall conform to the American Welding Society Practices for Welding Reinforcing Steel, Manual for Welding in Reinforced Concrete Construction. Welded wire fabric shall be lap spliced a minimum of 6 bar spacing. Splices in reinforcing bars shall conform to the requirements of the ACI Code, except ring splices, which should be a minimum of 40 bar spacing and should be staggered where possible or increased by 50%.

C11.4. FABRICATION: Furnish Shop Detail and Field Placing Drawings for all reinforcing steel for approval of the Engineer. Shop Drawings shall include reinforcing, placing plans and details indicating location, arrangement, splice locations, bending diagrams, placing sequence, etc. Placing Drawings shall be insufficient detail to allow field personnel to accurately place reinforcing. Shop and Placing Drawings shall be prepared in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315-65, current edition.

Reinforcement bars shall be bent cold to the shapes indicated on the Plans. Fabrication tolerances, fabrication, and detailing of steel

reinforcement shall conform to the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI-315).

Steel reinforcement shall be of the type and size, cut to lengths and bent to shapes as indicated on the Plans. Unless otherwise indicate, hooks, laps, splices, embedment lengths, and other details of reinforcement shall be provided as set forth in the

ACI Building Code (ACI-318) to develop the full tensile strength of the bar.

C11.5. PLACING REINFORCEMENT: Metal reinforcement to be placed shall be free from mud, oil, paint, excess mill scale or any other coating that would destroy the bond with the concrete.

Metal reinforcement shall be accurately placed and held in accordance with the Plans and Specifications. Wire mesh shall be tightly secured against displacement by wire, or suitable clips at intersections. Mesh shall be supported and held securely against displacement on clear of the forms as indicated on the Plans and Specifications and conform to ACI-318.

Nails shall not be driven through reinforcement nor shall any other device be used to come in contact with the form on the waterside of the structure. Metal devices used to provide the required clearances from reinforcing steel to waterside of concrete shall be approved, or shall be as approved by the Engineer.

For slabs in contact with the ground shall be supported in position, as indicated on the Plans, by means of approved blocks, of approved dimensions, resting on the ground. When precast blocks shall be made of mortar composed of 1 part cement to 2 parts sand. Blocks shall be spaced at the intervals indicated on the Plans to maintain the reinforcement in its required position in the slab during the placing of the concrete. The slab reinforcement shall not be used to support planking or runways used in placing concrete.

Removal of bars embedded in hardened concrete will not be permitted except when specifically approved by the Engineer for the field condition encountered.

In the case of floor slabs, galleries, deck slabs, and beams, metal chairs, spacers and other metal accessories necessary to provide the required clear distances and proper alignment and spacing between bars shall be

galvanized or shall have plastic protective covering over portions in contact with forms.

C11.6. CONCRETE PROTECTION FOR REINFORCEMENT: Steel reinforcement shall be placed and held in position so that the concrete cover, as measured from the surface of the bar shall be the following, except as otherwise shown, specified, or directed:

Slabs:

1½ inches, in general, top and bottom.

1½ inches at surfaces troweled as floor finish, w

2 inches on bottom for slabs over water and weather.

Footings:

2 inches at top of footings.

3 inches at bottom, sides, and

Walls:

2 inches on surface

1 inch on interior

2 inches on interior surfaces in contact with water.

Beams and Columns in Contact with Water:

2 in

2 inches minimum to longitudinal steel.

2 inches minimum to main vertical reinforcement.

2 inches minimum to main reinforcement on surfaces in contact with water.

Beams and Girders:

2 inches minimum to stirrup steel.

2 inches minimum to longitudinal Steel.

TECHNICAL SPECIFICATIONS

SECTION C12 - CONCRETE FORMWORK

C12.1. **SCOPE:** Work in this section includes all labor, plant and material necessary to furnish and install all concrete formwork required by the project. Concrete formwork shall conform to all requirements of ACI 301 "Specifications for Structural Concrete for Buildings" and "Building Code Requirements for Reinforced Concrete" and "Recommended Practice for Concrete Formwork" as referenced herein.

C12.2. **MATERIALS:**

A. Forms shall be of wood, metal, plywood, or other material approved by the Engineer. Sections greater than 18" thick shall be constructed in two or more sections. Surfaces shall be smooth and free from protrusions, holes, or other defects when used for permanent forms. Pins and rods used for internal ties shall be removed from the forms after the forms are removed, and all metal will be removed from any concrete surface. Where concrete surface will be exposed, the coloration will be uniform. Forms shall have approved form liners of the type specified. Forms shall be constructed of smooth surfaced

B. Chamfer forms shall be 1/2 inch thick and shall have 1/2 inch chamfers or as otherwise specified on all outside corners that are to be exposed in the structure. Chamfer forms shall be molded plastic or wood with a minimum radius of chamfer strips. Use one style of form throughout the project.

C. Sealing and Score Line Strips shall be a non-absorbent material such as extruded polyvinyl chloride, plastic, fiberglass or metal or they may be milled from good quality lumber and well sealed to prevent moisture absorption, wood strips may not have protruding splinters which may become embedded in the concrete. Sealing wood shall be accomplished by immersion or brushing on two coats of form coating.

D. Form ties for concrete shall have an approved waterstop barrier to prevent seepage of moisture along the ties. The ends of the tie

metal after breaking off shall be minimum of 1½ inches from the finished wall face. Submit samples to the Engineer for review.

C12.3. EXECUTION: Forms shall be built true to line and grade, and be mortartight and sufficiently rigid to prevent displacement or sagging between supports. All formwork and shoring shall be designed for the construction loads to be placed on them, and the design and construction of said forms shall be in accordance with ACI Standard "Recommended Practice for Concrete Formwork (ACI 347)". The structural integrity of the formwork shall rest with the Contractor. All forms shall be constructed that they can be removed without harming the concrete against the concrete. Forms shall not be removed until approved by the Engineer. Forms shall not be removed before the concrete has attained the strength specified below, or longer if job control tests indicate a lower strength specified below, except when specified otherwise by the Engineer.

Beams and Slabs 3 days

Walls up to 12" Thick and Vertical Surfaces 3 days

Columns 5 days

Walls over 12" Thick 7 days

In general, all supported slabs and beams shall not be removed until the concrete has acquired 70% of its design strength, other than the dead weight of the concrete and the weight of the forms. Forms shall not be removed until 24 hours after the concrete has attained 70% of its design strength. Forms shall be removed after expiration of the lapsed time specified above or as directed by the Engineer, where concrete is to receive a rubbed

TECHNICAL SPECIFICATIONS

SECTION C13 - CONSTRUCTION JOINTS AND WATERSTOPS

C13.1. GENERAL: This section covers construction joints, expansion joints, and the placing of waterstops where such are indicated on the Plans.

C13.2. POLYVINYL PLASTIC WATERSTOP: Waterstops shall be installed at all construction joints with water or other liquid on one side of the concrete and at other locations as required by the Plans. All waterstops shall be continuous throughout their length.

The waterstops shall be heavy duty polyvinyl plastic conforming to Corps of Engineers Specification C-13.1. Waterstops shall be manufactured by Serviced Products, Inc.; Vinylstops by Sonnet Windows, Inc.; Vinylex Corporation; or an equivalent type and material and approximately equal in strength but not necessarily of exactly the same shape. Waterstops shall be "Type A" with a center bulb, 4" wide, capable of withstanding a pressure load of 65 feet of water, unless otherwise specified.

"Expansion joints" shall be of ribbed construction, 6" wide, with a capacity to expand and contract 1/2 inch.

All waterstops shall be installed so that one-half its width will be embedded in the concrete on one side of the joint and one-half on the other. The method of holding the waterstop in position for placement shall be satisfactory to the Engineer. The method selected shall ensure the waterstop will be held securely in true vertical or horizontal position and in straight alignment in the joint.

The Engineer shall exercise to insure that the waterstop is completely embedded in good mortar.

C13.3. JOINTS IN WATERSTOPS: All waterstops shall be continuous and so installed at all points of contact in the same plane, or at intersections with waterstops in different planes, as to form a complete barrier to the passage of water through any construction, contraction, or expansion joint.

Joints in the waterstops, whether made for the purpose of continuity in a straight strip or for the purpose of securing a watertight junction between

strips in different planes, shall be made by heat welding as hereinafter specified.

Joints in PVC waterstops shall be made by heating the two surfaces to be jointed until the material has softened to the point where it is just short of being fluid and then bringing the two softened surfaces together with a slight rubbing motion followed by firmly pressing them together so that a solid and tight bond is made.

The joints in strips of waterstop made in the above manner shall be such that the entire cross section of the joint shall be dense and free of all porosity. All finished joints shall have a strength of not less than 75 percent of the material of the strip.

The heating of the surfaces to be joined shall be done with an electric splicing iron designed for the purpose and controlled by means of a voltage regulator.

In use, the heat of the hot plate shall be controlled to prevent too rapid melting and accompanying degradation of the waterstop material.

The use of makeshift heating devices is prohibited nor will other means of heating the strips be permitted except in a case of emergency, as directed by the Engineer.

The Contractor shall assist in making the joints in a proper manner and in holding the strips so that the alignment, length and angles are true to those required.

Each joint in the waterstop strips will be inspected by the Engineer and defective shall be remedied without delay.

C13.4 WATERSTOP BETWEEN POURS: The Contractor shall take steps as are necessary to protect exposed waterstops in concrete between concrete pours.

C13.5 EXPANSION JOINTS: Expansion joints of the size and type shown on the Plans or specified herein, shall be placed in concrete pavement or structure as shown on the Plans.

A. Preformed Asphalt Fiber Joint Material: Asphalt fiber sheet filler shall consist of preformed strips of inert material impregnated with asphalt. It shall be of the thickness shown on the Plans or indicated in these Specifications.

The sheet filler shall conform to the requirements of AASHTO Specification M-59 with the following additional provisions.

The sheet filler shall be of such character that it will not be deformed by ordinary handling during hot weather nor become hard and brittle in cold weather. It shall be of a tough, resilient, durable material not affected by weathering.

- B. Hot Poured Rubberized Tar Joint Sealer: Hot poured rubberized mastic sealer shall consist of a mixture of durable rubber, coal tar pitch, and other materials which will form a strong adhesive compound capable of effectively sealing concrete surfaces against repeated expansion and contraction. The sealer shall be installed in accordance with the following provisions.

C13.6. CONSTRUCTION JOINTS: Location of construction joints shall be approved by the Engineer. Maximum length of construction joints shall be 40 ft. Maximum height of wall pours shall be 10 ft. Construction joints or as shown on the plans. Footings for concrete structures that will be cast monolithically without cold joints or other construction joints. Radial control joints consisting of grooves shall be required at 60 degree angles. Such joints shall be caulked with epoxy sealant after concrete is cured and prior to placement of concrete. Cracks greater than 0.05" wide not located in the waterstop shall be sealed by cutting a bevel groove on the waterstop 1/2" wide and caulked with epoxy sealant. The sealant shall be measured at the concrete surface.

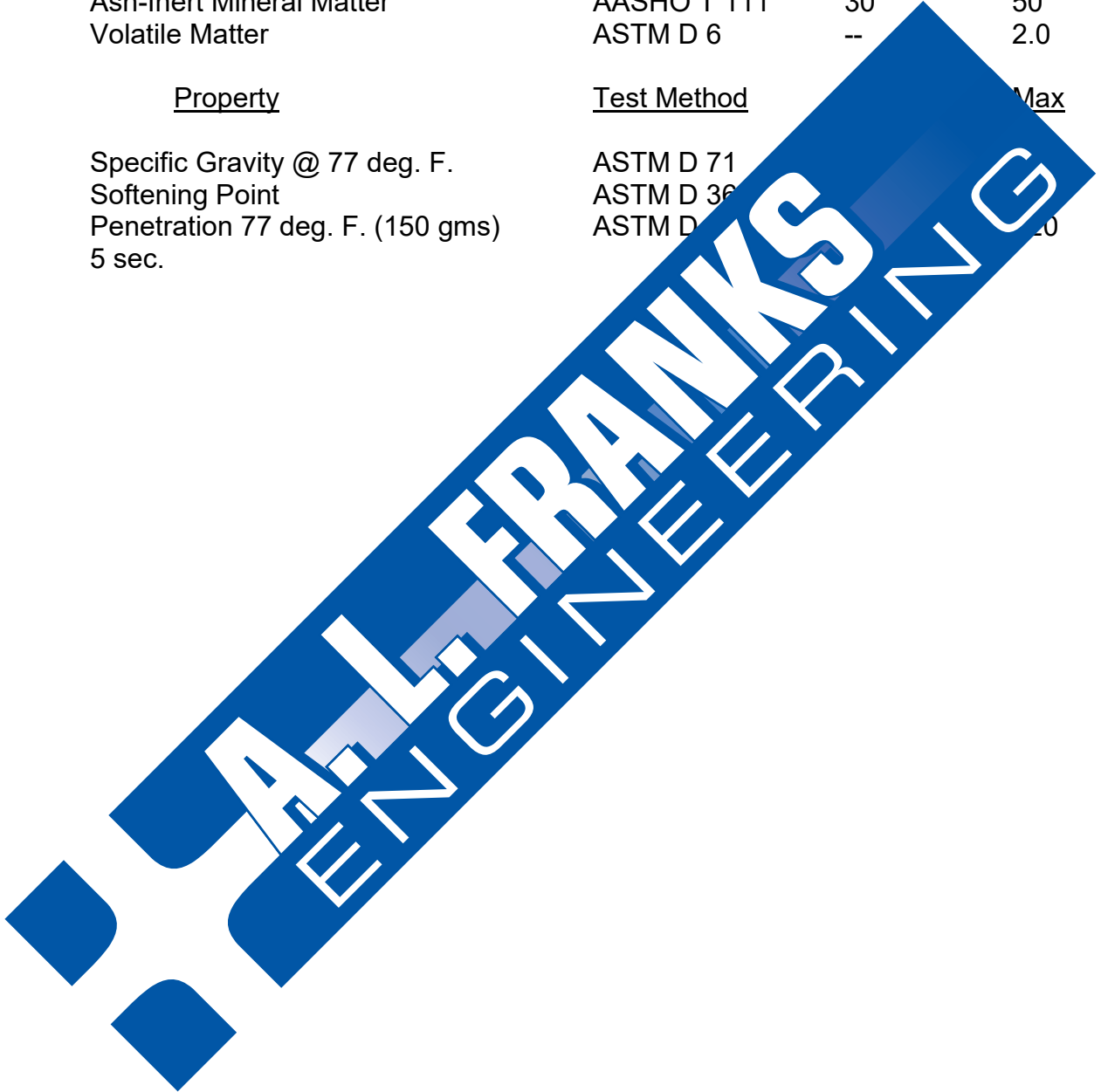
C13.7. A. Preformed plastic waterstop shall meet or exceed Federal Specification SS-S-00210 Type I or II. The waterstop shall be equal to SYNKO-FLEX as manufactured by SYNKO-FLEX Products, Inc. Houston, TX or approved equivalent. The waterstop shall meet the following requirements.

The waterstop shall be produced from blends of refined carbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The plastic waterstop shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded form of suitable cross-section and of a size to seal the joint areas of concrete sections. The plastic waterstop shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that 1/2 may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound. The flexible

plastic waterstop shall also meet the requirements as stated in the following table:

<u>Composition</u>	<u>Test Method</u>	<u>Min</u>	<u>Max</u>
Bitumen (petroleum plastic content)	ASTM D 4	50	70
Ash-Inert Mineral Matter	AASHTO T 111	30	50
Volatile Matter	ASTM D 6	--	2.0

<u>Property</u>	<u>Test Method</u>	<u>Max</u>
Specific Gravity @ 77 deg. F.	ASTM D 71	
Softening Point	ASTM D 36	
Penetration 77 deg. F. (150 gms) 5 sec.	ASTM D 5	20



TECHNICAL SPECIFICATIONS

SECTION C14 – CONCRETE TREATMENT PLANT INSTALLATION

C14.1. SCOPE:

This Contractor shall be responsible for working with the manufacturer or supplier of the plant and equipment and shall perform all excavation, backfill, concrete base, slabs, dewatering, access roads, service roads, crane equipment and electrical service, and all wiring. This Contractor shall also furnish and install all structures and buildings as noted on the plans as well as all grading noted.

C14.2. GENERAL:

The excavation for all structures shall be in accordance with lines and grades as shown on the plans. The excavation shall be properly sloped or shoring and bracing shall be provided in accordance with appropriate safety standards. Sufficient space shall be provided for setting of concrete structures while in place for installation.

Information shall be taken from the test boring or drawings. In case unforeseen soft, unstable or unsatisfactory conditions are encountered at the elevation required, the contractor shall call the attention of the Architect/Engineer immediately. The excavation shall extend down to stable ground or as required by the Architect/Engineer. When unforeseen rock is encountered, it shall be removed and bedded with sand or screenings.

The Contractor shall provide and operate all pumping equipment including dewatering equipment necessary to keep the excavation free of water and shall remove water in a manner satisfactory to the Architect/Engineer.

C14.3. PRECAST UNITS

Machine excavation shall be carried 1" to 4" below bottom of the precast unit and filled with a bed of sand or screenings to permit leveling of bottoms to correct final grades. Furthermore, should the Contractor excavate below the grade set by the Engineers or disturb the soil by the use of power shovels or other heavy suitable material and compacted at the Contractor's expense.

C14.4 BACKFILL

Backfill material shall be deposited in layers and compacted against the structure for the full length of the excavation. The backfill shall be thoroughly compacted until the backfill is at least 6 inches below the finish grade.

Use only clean sand, screenings or similar material in soil only for the upper-most foot. Contractor shall carry to surface in traffic areas.

Slope finish grade to provide drainage away from plant. Surplus material shall be removed from the site and disposed of by the Contractor. The Contractor shall consult the Engineer in regard before disposing of excess material.

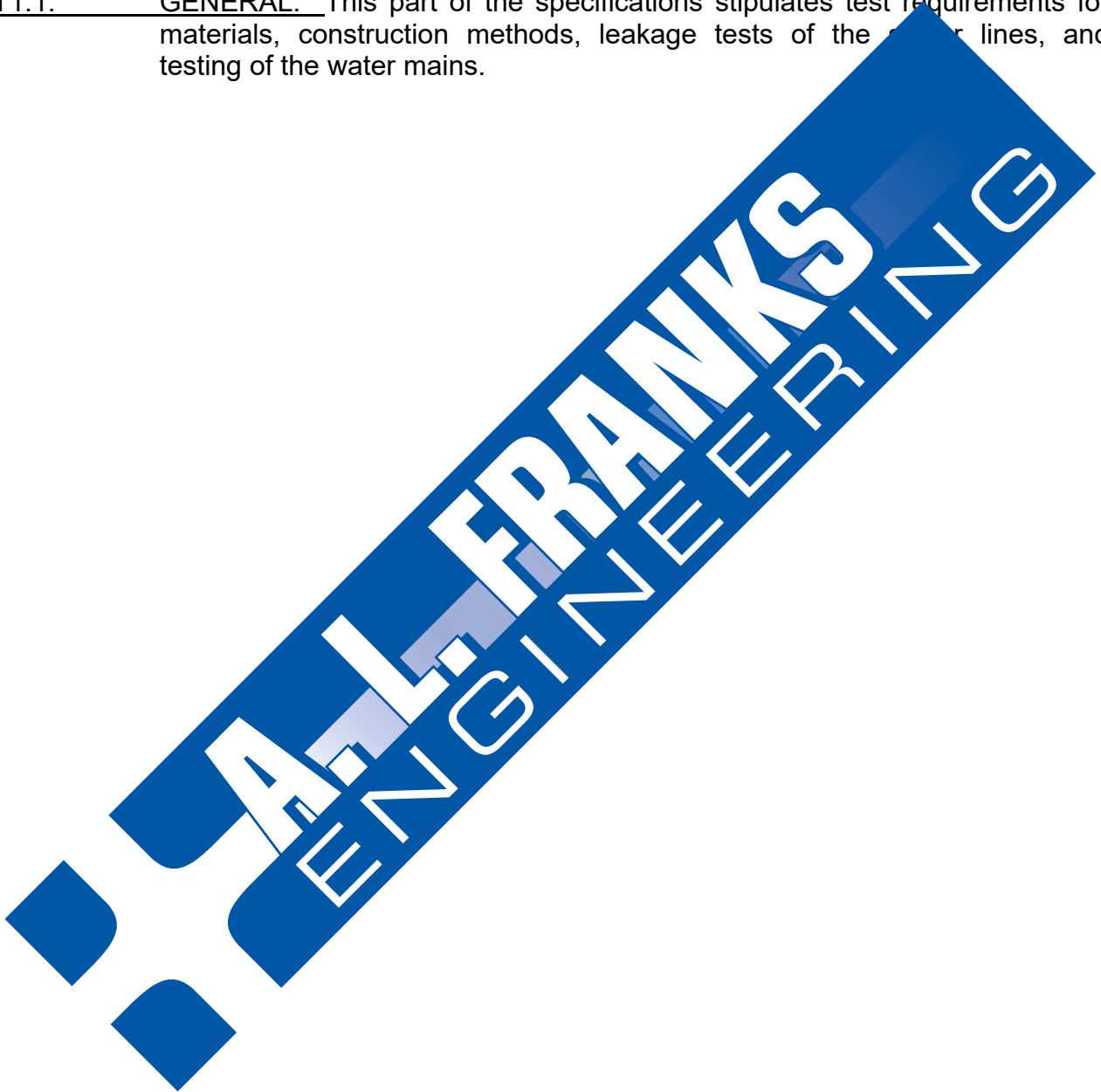
C14.5 CRANE

The Contractor shall furnish a crane of adequate size to safely lift and place sections at any angle of boom. The Contractor shall determine the maximum weight with manufacturer prior to placement. The crane shall be used to unload and set precast concrete sections as well as heavy mechanical equipment. A concrete pumper shall be furnished by the Contractor to assist in the placement of grout and concrete as required to seal all joints and pour all concrete fillets.

TECHNICAL SPECIFICATIONS

SECTION T1 - DESCRIPTION

T1.1. **GENERAL:** This part of the specifications stipulates test requirements for materials, construction methods, leakage tests of the water lines, and testing of the water mains.



TECHNICAL SPECIFICATIONS

SECTION T2 - SEWER LINE TESTING

T2.1. DESCRIPTION: This section covers the testing of pipe materials, joints, or other materials incorporated into the sanitary sewer line and leakage tests to determine watertightness.

T2.2. SANITARY SEWER PIPE: All pipe and pipe materials shall be based on the manufacturer's certificate that the pipe meets all applicable code requirements and has been tested in accordance with ASTM D3034 standard procedure for testing pipe, pipe joints, and fittings. Unless specific tests are requested by the Engineer, all pipe materials shall be subject to permeability and hydrostatic testing.

T2.3. LEAKAGE TESTS OF SEWER PIPE: All sewer pipe shall pass leakage tests as specified herein. Tests shall be performed in the presence of a representative of the City. If a contractor is requested to provide 24 hours notice for testing procedures. Tests shall be completed in accordance with the following procedure:

GRAVITY SEWER

- A. Infiltration: The pipeline shall not leak under external pressure in excess of 50 gallons per inch of pipe diameter per mile of pipeline per 24 hours. If, in the presence of the Engineer, the ground water table at the time of testing produces dependable results, exfiltration tests shall be performed. The allowable limits of exfiltration shall be 50 gallons per inch of pipe diameter per mile of pipeline per 24 hours. Tests shall be performed in the following manner:

The lower end of the section to be tested shall be plugged with a watertight plug. The manhole at the upper end of the section shall be filled with water to an average depth of four (4) feet above the lower end, taking steps to ensure that all air has been removed from the line at the lower end. Depth measurements shall then be taken by the Engineer to establish the variance in the water level. An allowance of an additional ten (10) percent of gallonage lost shall be permitted for each additional two feet of head over a basic two (2) feet minimum internal head.

SEWER FORCE MAINS

- B. The test shall be the same as listed for water mains in Section T3 and shall consist of raising and holding the hydrostatic pressure in the test section to 150 psi. Such pressure shall be maintained for a period of not less than four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a satisfactory manner.

Water Mains shall be Hydrostatic Tested per AWWA C900 13 leak test for PVC. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$Q = \frac{LD \sqrt{P}}{148000}$$

in which Q is allowable leakage, in gallons per hour; L is the length of pipe tested in feet; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the test in pounds per square inch gage. In the event the tested pipe fails to meet the above specified requirements, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer. The Contractor, including retesting. It shall be the responsibility of the Contractor to provide the necessary outlet for the test water.

$$Q = LD \sqrt{P} / 148000$$

Where Q = leakage in gallons per hour
L = length of section being tested, in feet
D = diameter of the pipe, in inches
P = test pressure during the hydraulic test in PSI (gauge pressure)

Testing: N/A

T2.4. VACUUM LEAKAGE TESTS: Refer to leakage testing for sewer mains.

T2.5. LEAKS ENCOUNTERED IN FINAL INSPECTION: In addition to passing the above described leakage tests, all obvious running leaks which may be observed in the final inspection shall be satisfactorily repaired.

T2.6. DEFLECTION TESTING: Deflection testing shall be performed on the total footage of the project. The deflection test shall occur after a thirty day consolidation of the backfill in the trench section. A maximum of five

percent deflection is allowable. A contractor shall use a mandrell deflection testing as follows:

- A. Completely flush the line making sure the pipe is clean of any mud or trash that would hinder the passage of the mandrell.
- B. During the final flushing of the line, attach a floating block or ball to the end of the mandrell. Pull rope and float the mandrell through the line.
- C. After the rope is threaded through the line, attach the rope to the mandrell and place the mandrell in the line.
- D. Connect a second rope to the back of the mandrell. This will enable you to retrieve the mandrell if it becomes stuck.
- E. Remove all the slack in the rope by pulling the rope at the far manhole. After the rope is taut, place a tape marker on the rope close to the mandrell. If the mandrell encounters a restriction, the tape marker will provide a means of measuring the distance to the restriction so that the restricted area can be located.
- F. Draw the rope back to the manhole.
- G. An increase in rope pull is an indication of excessive deflection. Measure beginning marker on rope the distance to the restriction and replace bedding or pipe if necessary to prevent damage.

Excessive pull may be caused by not properly flushing or not cleaning the line prior to testing. Actions to take prior to digging are as follows:

Remove mandrell and reflush with water, or

- (2) Preferably remove mandrell and pull a rubber sewer cleaning ball through the line with water to clear any mud or debris that did not flush during initial cleaning.

The mandrell O.D. shall be equal to the minimum pipe I.D. less the allowance for the maximum five percent deflection.

The test equipment used shall be certified as satisfactory by the Engineer at the beginning of the project. The Engineer or his representative may at any time require a calibration check of the instrumentation used.

T2.7. **CLEANING UP:** As the construction work progresses, the Contractor shall backfill the trenches, remove excess excavated materials and other debris and do sufficient clean-up and blading of the trench surface to make the streets and alleys suitable for safe use of traffic.

After the construction work is completed and before acceptance by the Owner, the Contractor shall remove all materials, including excess materials from excavations and other areas, and all trench surfaces shall be backfilled and compacted. Adjacent road ditches and slopes which are affected by this construction shall be restored to original condition. The cost of clean-up shall be included in the unit price for each unit of work.

TECHNICAL SPECIFICATIONS

SECTION T3 - TESTING AND STERILIZATION

T3.1 DESCRIPTION OF WORK: The work to be performed under this section of the specifications shall consist of furnishing labor, materials, and equipment necessary to test and sterilize water main as specified herein.

T3.2 HYDROSTATIC TEST: After the pipe has been installed (7) days, the line shall be tested in such manner as directed by the Engineer. The Contractor shall furnish labor, materials, and equipment required to bulkhead and fill the line with water, raise the filled line to test pressure, and maintain it at that pressure and leakage over the test period.

The entire length of the installed water main shall be tested for water tightness in the following manner:

The section of the line to be tested shall be bulkheaded with water and allowed to stand for a minimum of 24 hours for the cement lining of the pipe to absorb water and for escape of all air from the line. During this time, the Contractor shall be exercised to see that all joints, bulkheads, valves, manholes, connections, and fittings on the line undergoing test shall be carefully examined for leaks. Any leaks shall be stopped, regardless of the size. If permanent air vents are not located at all points, the Contractor shall install corporation cocks at such points to expel air as the line is filled with water. After all air is expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the owner.

The test shall consist of raising and holding the hydrostatic pressure in the test section to 150 psi. Such pressure shall be maintained for a period of not less than four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a satisfactory manner.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD \sqrt{P}}{7400}$$

in which L is allowable leakage, in gallons per hour; S is the length of the pipe tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

In the event any section of the line tested fails to meet the specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer, at the expense of the Contractor.

T3.3 STERILIZATION: Prior to sterilizing, each new water pipeline shall be pressure tested and flushed from the existing system to remove all apparatus, sediment and fine debris which may have entered the line during construction and testing.

Chlorine shall be used to sterilize the water line by the following method: The amount of chlorine shall be calculated to provide a dosage of not less than fifty (50) mg per liter. Chlorinating material shall be introduced to the water distribution system in a manner approved by the Engineer. The water shall be in contact with the chlorine for a contact time of not less than twenty-four (24) hours. The water shall be flushed with clean water until the residual chlorine is greater than 0.2 parts per million. All valves and hydrants shall be opened and closed several times during the flushing process.

Water samples shall be collected and submitted for analysis to the Board of Health for each segment of water line. The water line shall be placed into service until satisfactory approval has been received.

Unless otherwise provided for in the Bid Schedule and Proposal, the Contractor shall be responsible for furnishing the chlorine, labor, tools, equipment, and test of the water. The content and bacteriological tests shall be at the expense of the Contractor.

TECHNICAL SPECIFICATIONS

SECTION MP - MEASUREMENT AND PAYMENT

MP.1. GENERAL:

The contractor shall review the scope of work and site conditions to become familiar with all aspects of construction necessary to complete the proposed scope of work. The payment for work items shall be made as follows: paid in accordance with the units or items of measured as defined for each item.

Where items are referred to as being paid by the unit, the contractor will be allowed to request a progress payment reflecting the work completed as agreed to by the Engineer and Contractor.



SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General requirements applicable to all Electrical Work.
2. General requirements for electrical submittals.
3. Interfaces to equipment, instruments, and other components.
4. The Drawings, Specifications, and overall design shall be coordinated with information furnished by various equipment manufacturers. The manufacturer's information shall be used to supply from the manufacturers. This information shall be used to, but not limited to, instruments, control devices, electrical equipment, and control systems, and control equipment provided with mechanical and electrical connections.
5. Provide all material and labor necessary for the complete, functional installation based on the manufacturer's wiring requirements, and include all costs to add any additional material, or other electrical hardware to the Work, which is necessary for a complete, functional installation based on the manufacturer's wiring requirements.
 - a. Make all changes to the manufacturer's wiring requirements.
 - b. Submit all changes to the Engineer for acceptance.
6. Review the manufacturer's specifications in order to ensure that all items related to control systems are completely accounted for. Include all items in the Drawings or in the Specifications from the manufacturer's work:
 - 1) When a conflict between the Drawings and Specifications is discovered, refer conflict to the Engineer for resolution.
 - 2) Electrical information required in the preparation of loop drawings but not limited to:
 - 1) Conduit numbers and associated signal(s) contained within each conduit.
 - 2) Wire numbers.
 - 3) Equipment terminal numbers.
 - 4) Junction boxes and signal(s) contained within each junction box.
 - 5) Equipment power sources, and associated circuit numbers.
 - 6) As-built drawings detailing wiring.

B. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections.
2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.
3. Owner is not responsible for any additional costs due to the failure of Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

C. Contract Documents:

1. General:

- a. The Drawings and Specifications are combined together in order to fully describe the Work.

2. Specifications:

- a. The General and Supplemental Specifications documents govern the Work.
- b. These requirements are minimum requirements.

3. Contract Drawings:

- a. The Electrical Drawings show locations, arrangements, and components of the Electrical Work as shown by the Engineer.
- b. Locations of instruments, boxes, panels, etc. are approved by the Engineer. Use good judgment in executing the Work to ensure proper fit and function.
- c. Dimensions indicated on the Drawings are minimum dimensions. Use the Drawings to determine the proper layout, foundation, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and fit within the defined space. Make changes required to accommodate differences in dimensions.

The Contractor has the freedom to select any of the named manufacturers specified in the individual specification sections; however, the Engineer has approved the spatial equipment layout based upon a single manufacturer and has confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.

Installation details:

- 1) The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.
- 2) Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.

4. Schematic diagrams:

- a. All controls are shown de-energized.
- b. Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
- c. Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.
- d. Mount all devices shown on motor controller schematic diagram in the controller compartment enclosure, unless otherwise noted or indicated.
- e. Schematic diagrams are to be used in conjunction with the sequencing and timing sequences in the Contract Documents. Combine all information to create a coordinated and fully functional control system.

1.2 REFERENCES

A. Code compliance:

1. As specified in the section for Regulatory Requirements. The publications are referred to in the Contract Documents by the Authority Having Jurisdiction. The latest edition accepted by the Authority Having Jurisdiction shall govern. Publications in effect at the time of the bid govern.
2. The standards listed are hereby incorporated by reference:
 - a. American National Standards Institute (ANSI).
 - b. American Society of Mechanical Engineers (ASME).
 - c. ASCE 7 - Minimum Design Loads and Other Structures.
 - d. ASTM International (ASTM).
 - e. International Building Code (IBC).
 - f. Institute of Electrical and Electronics Engineers (IEEE).
 - g. International Electrotechnical Commission (IEC).
 - h. International Association of Bridge and Structural Engineers (IABSE).
 - i. International Council (ICC):
 1. International Building Code (IBC).
 2. International Council Evaluation Service (ICC-ES).
 3. International Code Council (ICC) - International Code Council Evaluation Service (ICC-ES) - Acceptance Criteria for Seismic Certification by Shake Table Testing of Structural Components (ICC-ES AC 156).
 - j. International Society of Automation (ISA).
 - k. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - l. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - m. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - n. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - o. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - p. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - q. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - r. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - s. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - t. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - u. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - v. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - w. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - x. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - y. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).
 - z. International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA) - International Society of Automation (ISA).

1.3 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth by:

1. IEEE.
2. NETA.
3. IES.
4. ISA.
5. NEC.
6. NEMA.
7. NFPA.
8. NIST.
9. Specific definitions:
10. FAT: Factory acceptance test.
11. LCS: Local Control Station
12. ICSC: Instrumentation and controls substation
13. LCP: Local control panel: Operator interface panel with HMI, pilot type control devices, operator interface, etc. does not contain a PLC or RIO.
14. PCM: Process control module: One of the following devices: PLC, RTU, or RIO.
15. PCIS: Process control interface station
16. RTU: Remote terminal unit: Consisting of a PLC, and a means for remote communication. Communications devices typically are radios, modems, etc.
17. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device. Equipment, i.e., provide all standoffs, bus, and
18. Panel: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device with no load connections to be made.
19. Control panel: Control panels that are furnished with particular equipment other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
20. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, etc., or other equipment.

1.4 SYNOPSIS DESCRIPTION

A. General requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:
 - a. The Electrical Drawings are schematic in nature; use the Structural, Architectural, Mechanical, and Civil Drawings for all dimensions and scaling purposes.

2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.
 3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work.
 4. Coordinate all aspects of the Work with the electrical subcontractors and other subcontractors before bidding in order to ensure that all costs for complete installation are included. The Owner is not responsible for delays or orders due to lack of coordination of the Work between the Contractor, the electrical subcontractor, the other subcontractors or suppliers.
 5. Portions of this Project involve installation in existing facilities. Existing circuits, power systems, controls, and equipment shall be:
 - a. Perform and document comprehensive investigation of existing conditions (circuits, power systems, controls, etc.) before starting any Work. Determine all existing conditions, interface with, modify, upgrade, or replace existing systems, controls, and equipment.
 - b. Provide and document all necessary upgrades, or replacement of existing circuits, power systems, controls, and equipment.
 - c. Provide all trenching, backfilling, hard surface removal and replacement for the Electrical Work and installation:
 - 1) As shown on the Drawings.
- B. Operating facilities
1. The portions of this facility must remain fully functional throughout the construction period. In consideration of this requirement, comply with the following:
 - a. Construction shall be of minimal duration and fully coordinated and agreed to by the Owner. Construction schedule to meet the requirements of the Owner. All delays and any needs to reschedule are included in the Work.
 - b. Construction shall be coordinated with the Owner's water demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.
 - c. The Contractor shall coordinate the construction and power renovation, bear all costs, so that all existing facilities can continue operation throughout construction.
 - d. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.
 - e. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.

1.5 SUBMITTALS

A. General:

- b. Name and telephone number of individual who reviewed submittal before delivery to Engineer.
- c. Name and telephone number of individual who is primarily responsible for the development of the submittal.
- d. Place for Contractor's review stamp and comments.

2. Next pages:

- a. Provide confirmation of specification compliance:
 - 1) Specification section: Include with each submittal a copy of the relevant specification section.
 - 2) Indicate in the left margin, next to each pertinent item, compliance with a check (✓) or deviation with a check (✗).
 - 3) Provide a list of all numbered deviations with a description of the deviation for the deviation.
- b. Include a response in writing to each of the comments and questions for submittal packages which are re-submitted.
 - 1) In the order that the comments and questions appear throughout the submittal.
 - 2) Referenced by index number to the comment or question in the comment or question.
- c. Acceptable responses to comments and questions are:
 - 1) Engineer's comments and questions are answered and appropriate changes are made.
 - 2) Explanation of why comment or requested change is not made.
 - 3) Alternative solution is provided and approved by Engineer.
- d. Submittal packages must contain responses to the Engineer's previous comments and questions for Revision and Re-submittal.

Engineer will be performed until a response for previous submittal is received.

3. Submittal data:

Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is intended to be used.

D. Submittal requirements:

- 1. Furnish submittals that are fully indexed with a tabbed divider for every component.
- 2. Sequentially number pages within the tabbed sections. Submittals and operation and maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- 3. Edit all submittals and operation and maintenance manuals so that the submittal specifically applies to only the equipment furnished.

4. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.
5. Submit copies of shop drawings, and product data:
 - a. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.
6. Where submittals are required, provide a separate submittal for each specification section. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
 - a. The only exception to this requirement is when 1 specification section contains requirements for a component of equipment specified in more than 1 specification section. For example, circuit breakers are a component of switchgear. The submittal must also contain data for the associated circuit breakers, even if the circuit breakers are covered in a different specification section.
7. Exceptions to Specifications and Drawings:
 - a. Include a list of proposed exceptions to the specifications and drawings along with a detailed explanation of each.
 - b. If there is insufficient explanation, the submittal will be returned requiring revision.
 - c. Acceptance of any exceptions is at the discretion of the Engineer.
 - d. Provide all items (including performance, etc.) required by the Contract Documents for the exceptions.
 - e. Replace all references to the Contract Documents, which would be exceptions, even if the submittals contained information that met the requirements.
8. Specifications and Drawings:
 - a. Provide information to evaluate the suitability of the proposed equipment for the intended use, and for compliance with these requirements:
 - i. Drawings requirements:
 - a. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
 - b. Locations of conduit entrances and access plates.
 - c. Component layout and identification.
 - d. Schematic and wiring diagrams with wire numbers and terminal identification.
 - e. Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.
 - f. Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.
 - g. Weight.

1. Provide Record Documents of all Electrical Drawings.
2. Record Drawing requirements:
 - a. Update Record Drawings weekly.
 - b. Record Drawings must be fully updated as a condition of the monthly progress payments.
 - c. Submit Record Drawings upon completion of the Work for final review.
 - d. Clearly and neatly show all changes including the following:
 - 1) All existing pipe, conduit, wire, instruments or other structures encountered or uncovered during construction.
3. Shop drawings:
 - a. Upon completion of the Work, update all shop drawings to reflect the final configuration of the systems:
 - b. Provide as-built shop drawings for all electrical systems on 11x17 inch paper.
 - c. Size all drawings to be readable and legible.
 - d. Provide electronic copies of the drawings on CD or DVD disks in PDF format.
4. Review and corrections:
 - a. Correct any record drawings that are found to be incomplete, not accurate, of poor quality, or otherwise deficient.
 - b. Promptly correct any deficiencies. Drawings returned for correction.
- J. Test reports:
 1. Include the following information:
 - a. A description of the test.
 - b. A description of the equipment used in conducting the test.
 - c. A description of the test results.
 - d. A description of the test location.
 - e. A description of the test date.
 - f. A description of the test results.
 - g. A description of the test results.
 - h. A description of the test results.
 - i. A description of the test results.
 - j. A description of the test results.
 - k. A description of the test results.
 - l. A description of the test results.
 - m. A description of the test results.
 - n. A description of the test results.
 - o. A description of the test results.
 - p. A description of the test results.
 - q. A description of the test results.
 - r. A description of the test results.
 - s. A description of the test results.
 - t. A description of the test results.
 - u. A description of the test results.
 - v. A description of the test results.
 - w. A description of the test results.
 - x. A description of the test results.
 - y. A description of the test results.
 - z. A description of the test results.
- K. Calculations:
 - a. Where required by specific Electrical Specifications:
 - a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

1.6 QUALITY ASSURANCE

- A. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the section for Product Requirements.
- B. Shipping precautions:
 - 1. After completion of shop assembly and successful factory testing, pack all equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
 - 2. Place dehumidifiers, when required, inside the polyethylene covering.
 - 3. Skid-mount the equipment for final transport.
 - 4. Provide lifting rings for moving without removing protective covering.
 - 5. Display boxed weight on shipping tags together with instructions for loading, unloading, transporting, storing, and handling at the job site.
- C. Delivery and inspection:
 - 1. Deliver products in undamaged condition, in manufacturer's original packaging with identifying labels intact and legible. Verify weight and dimensions on label.
- D. Special instructions:
 - 1. Securely attach special instructions for storage, handling, and installation to each piece of equipment before shipping.

1.8 PROJECT OR SITE CONDITIONS

- A. Site conditions:
 - 1. Provide an electrical system, including all equipment, raceways, and associated wiring, for a complete installation that meets the environmental conditions specified in the General Requirements and below.
 - 2. Seismic:
 - a. Design and construct with construction and anchorage to supporting structure to resist site seismic loads as specified in Specifications.
 - 3. Design and construct equipment with construction and anchorage to supporting structure to resist site wind loads as specified in Specifications.
 - 3. Temperature and humidity:
 - a. Design and construct in accordance with Specifications.
 - b. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.
 - c. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:
 - d. Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.
 - 5. Outdoor installations:

- a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
 - b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:
 - c. Provide all wiring necessary to power these devices.
 - d. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:
 - 1) NEMA Type 1: Intended for indoor use, primarily for protection from accidental contact with energized parts.
 - 2) NEMA Type 4: Intended for indoor or outdoor use, primarily for protection of equipment from exposure to windblown dust and rain, ice formation and freezing.
 - 3) NEMA Type 4X: Made from corrosion-resistant materials, intended for indoor or outdoor use, primarily for protection from exposure to windblown dust and rain, salt corrosion, ice formation and freezing, and corrosion. Details shall be specified or indicated on the Drawings.
 - 4) NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from the entry of liquids, including corrosive liquids.
 - 5) NEMA Type 7: Intended for use in locations where explosive or combustible atmospheres may be present (Class I Division 1 or Class I Division 2 locations as defined in NFPA 70) as outlined in the section for Hazardous Locations.
6. Plant area enclosures shall conform with the following table, unless otherwise specified on the Drawings:

PLANT AREA	ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Spill Areas	NEMA 1	Galvanized rigid steel	C	Stainless steel
Above ceilings	NEMA 1	EMT	C	Stainless steel
Indoor Non-Conditioned Spaces	NEMA 1	Galvanized rigid steel	C	Stainless steel
Below Grade/Vault	NEMA 3R	Galvanized rigid steel	X	Stainless steel
Outdoor	NEMA 3R	Galvanized rigid steel	W	Stainless steel

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Classified Areas	NEMA Type 7	Galvanized rigid steel	H	Stainless steel

Modify exposed conduit runs as specified in the section for Conduits.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING

A. General:

- Testing requirements are specified in the section for Tests and other sections.

B. Pre-submittal conference:

- Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, modules, and submittal requirements.
- Contractor, electrical subcontractor, and equipment manufacturers furnishing equipment shall attend.

C. Factory acceptance testing:

- Where FAT is required by these Specifications, notify the Engineer in writing when equipment is completed and ready for factory inspection and testing.
- Indicate the location of the equipment and testing.
- Submit the FAT procedures submittal:
 - Submit the FAT procedures including all forms at least 21 days before any testing.
 - Submit the FAT procedures including all forms at least 15 days before the date of testing.

1.11

Electrical Work as specified in General Conditions:

Warranty as specified in the individual Electrical Specifications.

1.12 SYSTEM T-UP

- Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:
- Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

- A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.
- B. Furnish all spare parts as required by other sections of the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide similar items of same manufacturer throughout the electrical portion of the Project.
- B. Allowable manufacturers are specified in individual Electrical

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

- A. Furnish all materials under this Contract that are standard products produced by manufacturers recognized in the industry of these products and that bear all approvals and labels.
- B. Provide materials complying with materials as specified in General Conditions.
- C. Stainless steel:
 - 1. Where stainless steel is required for a portion of the Electrical Work, provide a non-magnetic stainless steel, minimum 1/8" thick, type 316, satin finish.
 - 2. Provide extra for waste.
 - 3. Provide smooth surfaces or sharp edges.
 - 4. Use stainless steel when chemically compatible, in all areas that are or will be in contact with chemicals.
 - 5. Use stainless steel when chemically compatible, in all chemical areas or where 4X construction.
 - 6. Use stainless steel in any area containing chlorine, gas or solution, chlorine dioxide, or hydrogen fluoride.

2.4 ACCESSORIES (NOT USED)

2.5 FINISHES (NOT USED)

2.6 COATINGS (NOT USED)

2.7 ACCESSORIES (NOT USED)

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The electrical subcontractor is encouraged to visit the site to examine the premises completely before bidding.
- B. **Review the site conditions and examine all shop drawings for the location of equipment in order to determine exact routing and final terminations of conduits and cables.**
- C. It is the electrical subcontractor's responsibility to be fully familiar with all applicable codes and local requirements and regulations.
- D. Comply with pre-bid conference requirements as specified.

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. Equipment locations shown on Electrical Drawings shall be installed with variations in equipment size or minor changes made by other trades.
 - B. Verify all dimensions indicated on drawings.
 - 1. Actual field conditions, including obstructions, distances, and levels.
 - C. Review all Contract Documents and shop drawings and coordinate Work as necessary to adjust to such changes.
 - D. Make minor changes to rough in, as directed by the Owner or Engineer.
 - E. Provide and install all components and interfaces as may be necessary to provide a complete electrical system.
 - 1. Install components in accordance with the accepted installation instructions and meet the seismic and wind load requirements at the Project site.
- Complete all cutting, patching, channeling, core drilling, and fitting required for the work, except as otherwise directed:
- Obtain the permission of the Engineer before performing any operation likely to affect the length of a structural member such as drilling, cutting or piercing:
- Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:
- a. Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.
 - b. Use tone-locate system or X-ray to ensure that area is clear of obstructions.
 - c. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.

4. Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:
- 3M: CP 25WB+: Caulk.
 - 3M: Fire Barrier: Putty.
5. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear:
- Install all conduits and equipment in accordance with working drawings and requirements in accordance with the NEC.
 - This includes any panel, disconnect switch or other equipment that will be energized while open exposing live parts regardless of whether the equipment is under examination or has serviceable parts.
 - Where the Drawings do not show dimensions, locate equipment in the approximate locations indicated on the Drawings.
 - Adjust equipment locations as necessary to avoid obstructions and clearances.
 - Where an obstruction interferes with the installation, access, relocate the equipment.
 - Where the Drawings do not show a method of support or supporting method to be used, use material and methods of support as indicated on the Drawings.
- G. Earthwork and concrete:
- Install all trenching, grading and resurfacing associated with the Electrical Work.
 - Requirements as indicated on the Drawings.
- H. Roof penetration:
- Seal all roof penetrations in accordance with roofing manufacturer's instructions.
- I. Termination:
- Install all conductors required to interconnect power, controls, and all other equipment.
- Requirements:
- Reference between electrical equipment indicated on the Drawings and the Engineer's Office, notify the Engineer as specified in General Conditions.
- Manholes and pullboxes indicated on the Drawings are approximate. Determine the exact location of manholes and pullboxes with Mechanical and Civil Work.
- Provide additional manholes or pullboxes to those shown where they are required to make a workable installation.
4. Circuits of different service voltage:
- Voltage and service levels:
 - Medium voltage: greater than 1.0 kV.
 - Low voltage: 120 V to 480 V.
 - Instrumentation: Less than 50 VDC.

- e. Install different service voltage circuits in separate raceways, and junction boxes.
- 5. In manholes, install all cables operating at less than 50 VDC in PVC coated flexible metallic conduit, with corrosion resistant fittings.
- 6. Labeling:
- K. Equipment tie-downs:
 - 1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing criteria, which apply to the Site.
 - 2. **ALL CONTROL PANELS MUST BE PERMANENTLY MOUNTED AND TIED DOWN TO STRUCTURES IN ACCORDANCE WITH THE PROJECT SEISMIC CRITERIA.**
- 3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)
- 3.5 REPAIR/RESTORATION (NOT USED)
- 3.6 RE-INSTALLATION (NOT USED)
- 3.7 FIELD QUALITY CONTROL
 - A. Inspection:
 - 1. Provide any assistance necessary.
 - 2. Engineer inspections may include the following:
 - 3. Inspect equipment and materials.
 - 4. Inspect installation for compliance with Plans and Specifications.
 - 5. Inspect installation for proper clearances around equipment.
 - 6. Inspect equipment for proper labeling, alignment, anchorage, and assembly.
 - 7. Inspect installation for compliance with design requirements.
 - 8. Inspect installation for workmanship and adequate support.
 - 9. Inspect installation for proper labeling.
 - 10. Inspect installation for proper labeling.
 - 11. If inspection results during construction do not satisfy inspection or testing requirements, the Contractor shall rework the section for Field Electrical Acceptance Tests.
 - B. Functional Testing:
 - 1. Conduct functional testing when the Electrical Work is ready for field acceptance testing.
 - 2. Conduct acceptance tests as specified in the section for Field Electrical Acceptance Tests.
 - 3. Submit results of the required tests along with the date of test:
 - 4. Mark conduit identification numbers to indicate portion of circuit tested.
 - C. Workmanship:
 - 1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
 - 2. Neatly coil and label spare wiring lengths.
 - 3. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the Engineer.

3.8 ADJUSTING (NOT USED)

3.9 CLEANING

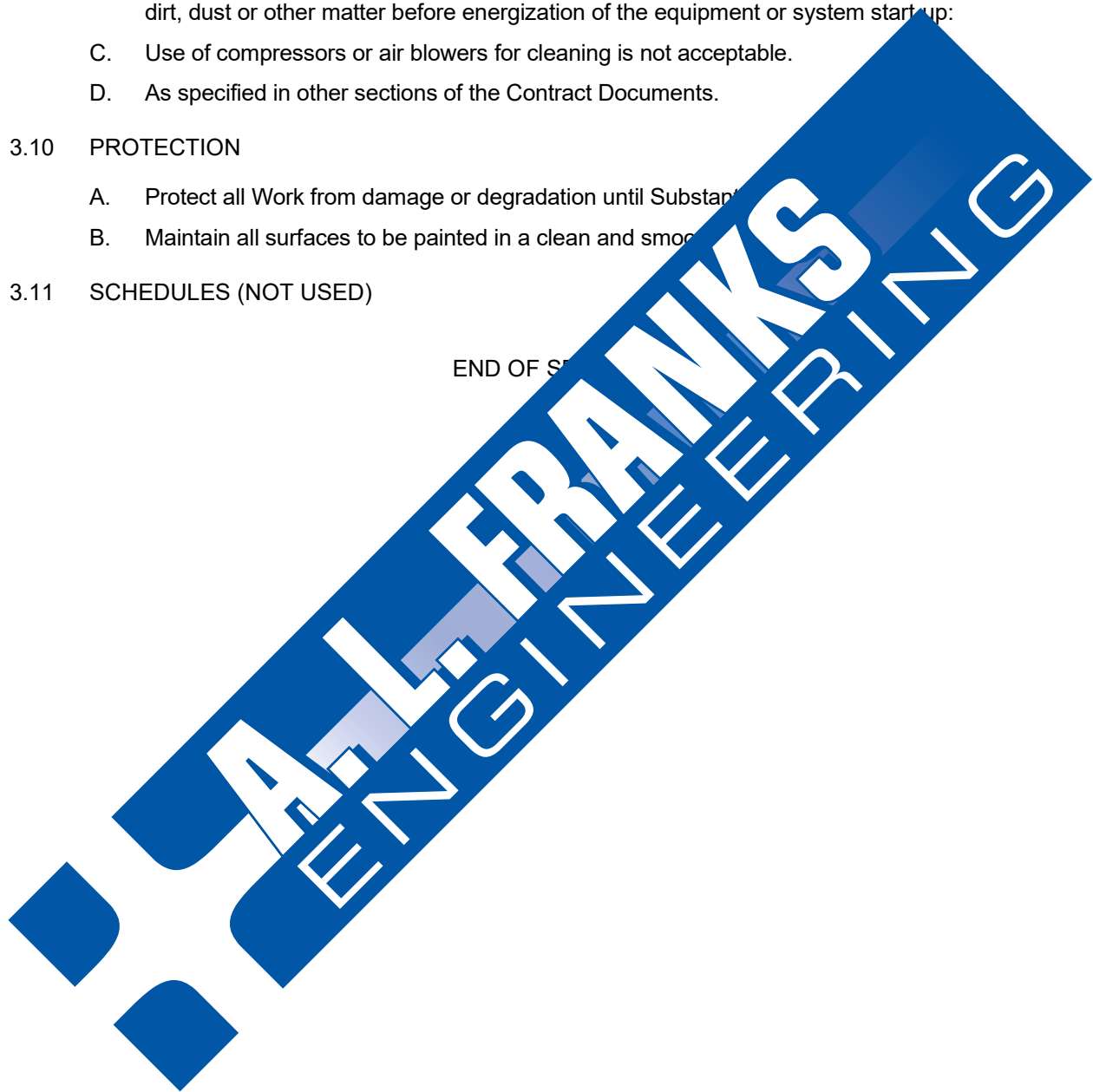
- A. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.
- B. Clean and vacuum all enclosures to remove all metal filings, surplus insulation and any visible dirt, dust or other matter before energization of the equipment or system start up:
- C. Use of compressors or air blowers for cleaning is not acceptable.
- D. As specified in other sections of the Contract Documents.

3.10 PROTECTION

- A. Protect all Work from damage or degradation until Substantial Completion.
- B. Maintain all surfaces to be painted in a clean and smooth condition.

3.11 SCHEDULES (NOT USED)

END OF SECTION



QUALIFICATION OF ELECTRICAL CONTRACTOR

1.01 SUMMARY

- A. Section includes:
1. Prequalification as an electrical contractor.
 2. Firms interested in submitting bids as the electrical contractor shall be described herein and in Section 16050 - Common Work Requirements. Firms shall submit a prequalification submittal as specified in the Instructions to Bidders.
 3. Only those firms who, based on their prequalification submittal and related investigations, meet the minimum requirements shall be eligible to bid. Firms who are approved by the Owner and Engineer shall be required to execute an Addendum to the Contract Documents, shall be required to execute a Performance and Payment Bond for this Project.
- B. REFERENCES
- C. National Fire Protection Association (NFPA):
1. 70 - National Electrical Code
 2. 70E - Standard for Electrical Safety in the Workplace®
 3. 101 - Life Safety Code
- D. Occupational Safety and Health Administration (OSHA):
1. 300 - General Requirements for Safety and Health.
 2. 302 - Specific Requirements for Safety and Health.

A. _____ - Common Work Results for Electrical.

_____ and below.

_____,400 volts to 69,000 volts.

_____ 115,000 volts and above.

1.04 CAPITALS

- A. General:
1. Any submittal failing to present clearly all the requested information or failing to be the requested format may be considered unresponsive and rejected.
 2. Information contained in the qualification submittal will be considered confidential, and reasonable precautions will be taken to ensure the security of the documents.
 3. All submittals will become and remain the property of the Owner.

4. The Owner reserves the right to request an applicant clarify any part of his submittal. Response to such requests shall be made in writing and will become part of the submittal.
5. If it is discovered at any time that any significant information in a prequalification submittal is incorrect, substantially misleading, or fraudulent, the submitting firm shall be subject to immediate disqualification from participation in the Project.

B. Format and information to be provided:

1. Qualification submittal shall include the following information organized in the order outlined below:
 - a. General information on the company:
 - 1) Document that the electrical contractor company is currently involved in the water and wastewater business and has adequate facilities, organization structure, and technical and managerial expertise to perform the work in conformance with these Specifications.
 - b. Document that the electrical contractor has the capability:
 - 1) Document in-house resource of personnel trained in the installation of the systems and equipment.
 - 2) Document the existence of field personnel, including qualified instructors, to provide proper installation, operation, and maintenance of equipment in accordance with the Specifications.
 - c. Similar project experience:
 - 1) Provide a list of completed projects for a water and/or wastewater treatment plant of similar size and complexity in which the proposed firm has been involved. The list must have performed, for use on the proposed project, the same as those intended for use on the proposed project. The list must have performed, for each listed project, the following information for each project:
 - a) Name of the owner, contact name, and current address.
 - b) Design engineer's name, address, and telephone number.
 - c) Failure to provide current contact information for the listed project being disqualified for use in the project.
 - d) Minimum requirements for prequalification.
 - e) Description of the system.
 - f) Estimated cost of the system, including change orders for the completed projects.
 - g) Duration of the project and date of completion.
 - 2) Information on the proposed project team members:
 - a) Provide the name and resume of the individual persons who will be responsible for each of the following:
 - a) Office engineering and management of this Project.
 - b) Individual who will be responsible for the installation crew.
 - c) Individual who will be responsible for field-testing, calibration, and start-up.
 - b) All of these individuals must be permanent employees of the proposing firm.

1.05 QUALITY ASSURANCE

A. Responsibilities:

1. The electrical contractor shall perform the following Work with its own employees, as a minimum:
 - a. Perform all Work specified in the Electrical Specifications and Work shown on the Electrical Drawings, except where the Work is clearly indicated to be provided under the Specifications of another Division of the Contract Documents.
 - b. Prepare hardware submittals for the components and power system.
 - c. Procure all electrical system hardware.
 - d. Prepare technical manuals.
 - e. Prepare Record Drawings.

B. Qualification minimum requirements:

1. To be qualified to bid on the project as an electrical contractor, a proposing company must submit all required information and documentation to meet the minimum requirements set forth in the following sections. All information must be submitted. For joint ventures, both firms must meet the minimum requirements.
2. Firm has been in business at least 5 years.
3. Firm and officers do not have any pending legal actions, records, such as criminal convictions, default judgments, or other legal actions.
4. Firm does not have a pending litigation, default judgments, such as repeated claims, litigation, default judgments, or other legal actions.
5. Firm demonstrate experience in the design and construction of (water or wastewater) projects in the past 5 years. The project must include:
 - a. Project size must be at least 10% of the Project's estimated cost.
 - b. Water or wastewater treatment plant.
 - c. "Complete" project has been installed and is in service.
6. Provide detailed experience and credentials, including:
 - a. List of similar projects completed in similar roles on at least 1 comparable project in the past 5 years.
 - b. List of similar projects completed in similar roles on at least 1 comparable project in the past 5 years.
 - c. List of similar projects completed in similar roles on at least 1 comparable project in the past 5 years.

The Owner and Engineer reserve the right to reject any or all qualification submissions and to waive any irregularities in any submittal.

The Owner reserves the right to relax the minimum requirements, in any way determined to be in the best interest of the Owner, if, in the Owner's opinion, an insufficient number of firms can qualify under the criteria specified above.

The Owner's decision shall be final as to the acceptability of the proposing electrical contractor.

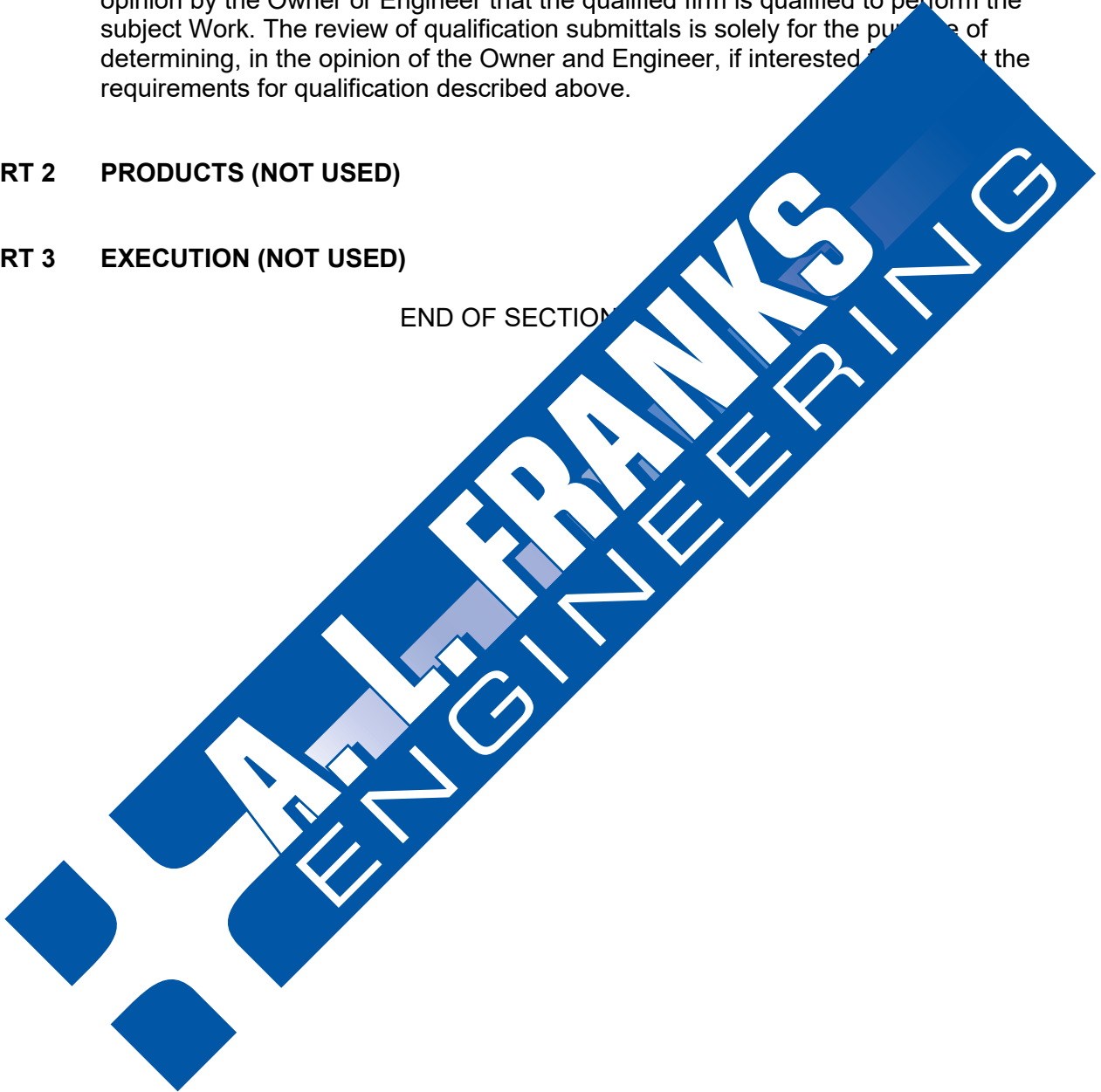
- a. The Owner shall decide acceptability or unacceptability, and not offer or be required to provide any supporting statements or documentation concerning the decision.
- b. The decision of "Not Qualified" for a proposing contractor has no implied connotations and only states simply that the proposing contractor has failed to meet the submission or minimum requirements for this particular project.

- D. The Project team members identified in the qualification submittal shall perform the roles described in the submittal, and not be substituted without the written permission of the Owner. Substitute personnel shall be subject to the review and approval of the Engineer, even in cases where the individuals named in the qualification submittal are no longer employed by the proposing company at the time of contract award.
- E. Qualification of a firm as an electrical contractor shall not be construed as an opinion by the Owner or Engineer that the qualified firm is qualified to perform the subject Work. The review of qualification submittals is solely for the purpose of determining, in the opinion of the Owner and Engineer, if interested firms meet the requirements for qualification described above.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION



SECTION 260520

HAZARDOUS CLASSIFIED AREA CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Executing and completing Work in hazardous and/or classified areas as specified by the NEC Articles 500 through 516, NFPA 820, and as indicated on the Drawings and specified in the Specifications.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. Specific definitions:

1. For the purposes of these Specifications, the terms "Hazardous" and "Classified" will be considered synonymous.

1.4 SYSTEM DESCRIPTION (NOT USED)

1.5 SUBMITTALS

A. Furnish submittals as specified in the Submittal Procedures and Common Work Results for Electrical section.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. Regular inspection:

1. Work in hazardous or classified locations shall comply with all applicable articles of the NEC Articles 500 through 516.

2. In addition to the NEC Articles 500 through 516, all other applicable rules contained in the NEC shall apply to the installation of electrical equipment and wiring installed in hazardous and/or classified locations. In Class I Division 1 or Division 2 areas must have visible manufacturer nameplates specifically stating the Class, Division, and Group for which the device is approved.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. The following areas are classified:

1. Refer to classification area drawing.

1.9 SEQUENCING

- A. Conduit seals shall be filled during start-up and commissioning after verification of field wiring. Conduit seals shall be filled prior to the introduction of process or gas to the equipment/area.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS (NOT USED)

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS (NOT USED)

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS

- A. Conduit and sealing fittings:

- 1. As specified in the

- B. Conduit boxes and

- 1. As specified

- C. Wiring devices

- 1. As specified in this section.

2.7 ACCESSORIES

2.8 MATERIALS

2.9

2.10

2.11 SOURCE OF MATERIALS CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Conduit installation:
1. As specified in the Conduits section.
 2. Wrench tighten all conduit joints to minimize sparking when fault current flows through the conduit system.
 3. Make all conduit connections so that there are a minimum of 5 threads fully engaged in the connection.
 4. Flexible conduit:
 - a. Class I Division 1 hazardous areas:
 - 1) Approved and marked suitable for Class I Division 1.
 - 2) Listed for compatibility with the group type atmosphere.
 - b. Class I Division 2 areas:
 - 1) Liquidtight metal conduit with approved fittings.
 - c. Maximum length as specified in the Conduits section.
- C. Sealing fittings:
1. Provide an approved seal, no more than 12 inches in length, for all conduits entering an enclosure containing switches, circuit breakers, or any other apparatus which may produce arcs, sparks, or heat.
 - a. Only explosion proof unions, couplings, and conduit bodies similar to "L", "T", and "X" may be used for sealing fitting and the enclosure.
 2. Provide entire assemblies approved for use in the area where sealing or factory sealed assemblies where the equipment is subject to sparks, or high temperatures is located in a compartment. Provide a seal between compartments containing splices or taps, and an integral seal is provided between the compartments.
 - a. Seals are required between the compartment containing splices and the compartment containing the equipment. The seal must be within 18 inches of the equipment.
 3. Install a conduit seal at the secondary in each conduit run entering or leaving a classified location. No fitting is allowed in the conduit between the sealing fitting and the equipment. The conduit leaves the classified location.
 4. For underground conduits leaving a classified location or between Class I Division 1 and Class I Division 2 areas:
 - a. Provide a seal at all points where the conduit emerges from the ground: within 18 inches of finished grade.
 - b. No fitting, box, or fitting is allowed in the conduit system between the seal and the equipment. The seal must be at the point at which the conduit enters the ground.
 - c. Seal the conduit within the conduit system and seal using an approved packing dam between the sealing compound and to maintain the separation between the wires: separate each conductor from the cable and seal individually.
 - d. Provide drains in all electrical control stations, low points of conduit or any place where moisture may condense and accumulate.
 7. Seal the sealing compound with a minimum thickness of 5/8 inch or the trade size of the conduit, whichever is greater.
- D. Boxes and fittings:
1. Class I Division 1 areas:
 - a. Utilize threaded connections for all metallic boxes, fittings, and joints to the conduit system.
 2. Class I Division 2 areas:
 - a. Provide approved grounding bushings on conduits entering and exiting metallic boxes to bond the conduits together.

- E. Outlet boxes and bodies:
1. Provide conduit bodies and boxes suitable for the conduit system as specified in the Conduits section.
 2. Class I Division 2 areas:
 - a. Boxes not containing arcing parts:
 - 1) Material and NEMA ratings as specified in Section 16050 - Common Work Results for Electrical.
 - 2) Pressed metal boxes are not allowed.
 - b. Provide heavy duty cast construction type conduit fittings and joints:
 - 1) Explosion proof rated fittings and joints are not necessary.
 - c. Any enclosure containing arcing parts, etc. shall have all construction associated with the enclosure, conduit system, etc. conforming to Class I Division 2.

- F. Motor connections:
1. Conduit installation in Class I Division 1 and Class I Division 2 areas containing arcing parts, shall proceed as follows:
 - a. First - Conduit.
 - b. Second - Explosion proof flexible coupling.
 - c. Third - Sealing fitting.
 - d. Fourth - Explosion proof union.
 - e. Fifth - Connection to the motor terminal box.
 2. Wiring connections to motor leads shall be made in accordance with Section 16050 - Low Voltage Wire Connections.
 3. Bond the non-current-carrying metal parts of motor enclosures and other enclosures as required by the NEC to ensure proper grounding.

3.4 ERECTION, INSTALLATION, APPLICATION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Electrical section.

B. Obtain approval from the Engineer before and after each seal is poured.

3.9 AS-BUILT

3.10

3.11 (NOT USED)

3.12 SCHEDULE (NOT USED)

END OF SECTION

SECTION 260600
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Grounding materials and requirements.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical.
- B. ASTM International (ASTM):
1. B3 - Standard Specification for Soft or Annealed Copper Wire, Hard, Medium-Hard, or Soft.
 2. B8 - Standard Specification for Concentric Stranded Copper Wires, Hard, Medium-Hard, or Soft.
- C. Institute of Electrical and Electronics Engineers (IEEE):
1. 81 - IEEE Guide for Measuring Ground Resistance, and Earth Surface Potentials of a Grounding System
- D. Underwriters Laboratories, Inc. (UL):
1. 467 - Ground and Bonding

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.

1.4 SUBMITTALS

- A. Furnishings and materials shall be submitted for review in accordance with the Submittal Procedures section and the Common Work Results for Electrical section.
- B. As specified in the Common Work Results for Electrical section.

1.5

- A. As specified in the Common Work Results for Electrical section.
- L. Grounding components and materials shall be UL listed and labeled.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.7 PROJECT/SITE CONDITIONS (NOT USED)

1.8 SEQUENCING (NOT USED)

1.9 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in the Common Work Results for Electrical.

1.11 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Exothermic connectors: One of the following:

1. Erico.
2. Harger.
3. Burndy.
4. Thomas & Betts.

B. Ground rods: One of the following:

1. Erico.
2. Harger.
3. Neha.
4. Thomas & Betts.

C. Grounding boxes or equal:

Grounding boxes: One of the following or equal:
Concrete Products, 3-RT Valve Box.
Concrete Products, G12 Valve Box.

2.2 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:

1. Grounding electrodes.
2. Bonding jumpers.
3. Ground connections.

- C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.
- D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 16950 - Field Electrical Acceptance Tests, shall be:
 - 1. 5 ohms or less for industrial systems.

2.3 EXISTING PRODUCTS (NOT USED)

2.4 MATERIALS

- A. Ground rod:
 - 1. Minimum: 3/4-inch diameter, 10 feet long.
 - 2. Uniform 10 mil covering of electrolytic copper metallization.
 - a. The copper-to-steel bond shall be corrosion resistant.
 - 3. In accordance with UL 467.
 - 4. Sectional type joined by threaded copper alloy.
 - 5. Fit the top of the rod with a threaded coupling nut.
- B. Ground cable:
 - 1. Requirements:
 - a. Soft drawn (annealed).
 - b. Concentric lay, coarse strand, minimum 1/8 inch diameter, minimum B8.
 - 2. Size is as indicated on the schedule required by the NEC.
- C. Exothermic welds:
 - 1. Current carrying capacity shall be equal to the conductor.
 - 2. Permanent molten metal bond that will not corrode over time.
 - 3. Will not deteriorate under any conditions.
 - 4. Use low energy welding process.
- D. Equipment conductors:
 - 1. Conductors and insulation as the load circuit conductors:
 - a. Equipment grounding conductors for medium voltage shall be in accordance with the NEC.
- E. Equipment bonding jumpers:
 - 1. Equipment bonding jumpers shall be in accordance with the NEC.

2.5 EXISTING UNITS (NOT USED)

2.6 EQUIPMENT (NOT USED)

2.7 COMPONENTS (NOT USED)

2.8 ACCESSORIES

- A. Precast ground well boxes:
 - 1. Minimum 10-inch interior diameter.
 - 2. Traffic-rated cast iron cover.

3. Permanent "GROUND" marking on cover.

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for
- B. Provide a separate, green insulated, ground conductor, independent of raceway material:
 1. Multi-conductor power and ground raceway shall include an integral green insulated grounding conductor.
 2. Provide a separate ground conductor in a separate raceway for parallel feeders.
- C. Provide a separate ground conductor for motor and connect at motor terminal box. Do not use bolts secured with lock washers for grounding connectors:
 1. When ground conductors for variable frequency drives (VFD) comply with the requirements of the manufacturer.
- D. Provide a separate ground conductor for connection of grounding conductor for conductors in the secondary switchgear, switchboard, or panelboard:
 1. Provide a separate ground conductor to the ground bus in the equipment.
- E. Provide ground bushings with lugs for connection of grounding conductor at both ends. Bond ground bushings to the grounding system.
- F. Provide a separate ground conductor from the ground screw to a box grounding conductor for terminal type devices, to equipment grounding conductor.
- G. Provide a separate ground conductor from the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at the entrance point or after a transformer.
- H. Duct bank ground system:
 1. Provide a bare copper grounding conductor the entire length of each duct bank.
 2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.
- I. Grounding at service (600 V or Less):
 1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

- J. Ground connections:
1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using exothermic welds as indicated on the Drawings, UL listed, and labeled for the application.
 2. Make ground connections in accordance with the manufacturer's instructions.

K. Grounding electrode system:

1. Ground ring:
 - a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.
 - b. Ground ring conductor shall be in direct contact with the electrode system.
 - c. Minimum burial depth 36 inches or as indicated on the Drawings.
 - d. Re-compact disturbed soils to original density in 6-inch increments.
2. Ground rods:
 - a. Locations as indicated on the Drawings.
 - b. Length of rods forming an individual ground electrode shall be as indicated on the Drawings.
 - c. Drive ground rods and install grounding conductors in concrete slabs and duct banks.
3. Metal underground water pipe:
 - a. Bond metal underground domestic water pipe to the electrode system.
4. Metal frame of building or structure:
 - a. Bond metal frame of building or structure to the electrode system.
5. Extend grounding conductors to all equipment and electrical enclosures for grounding.
6. Where grounding conductors are direct buried, install in Schedule 40 PVC conduit.
7. Install grounding system for all gear, motor control centers, switchboards, panelboards, and other electrical equipment are installed.

L. Shield grounding:

1. Analog signal cables shall be grounded at a single point in the loop. Unless otherwise specified, the single point shall be at the control panel.
2. For control cable shields and drain wires should be grounded at the control panel.
3. Install a drain wire for each signal cable with heat-shrink tubing at the control panel.
4. Connect shield to a dedicated grounding terminal block.

M. In all buildings, install ground rods in precast ground wells.

3.4. [REDACTED], APPLICATION, CONSTRUCTION (NOT USED)

3.5. [REDACTED] (NOT USED)

3.6. [REDACTED] (NOT USED)

3.7. COMMON WIRING (NOT USED)

3.8. FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

B. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.9 ADJUSTING

- A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
 - 1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

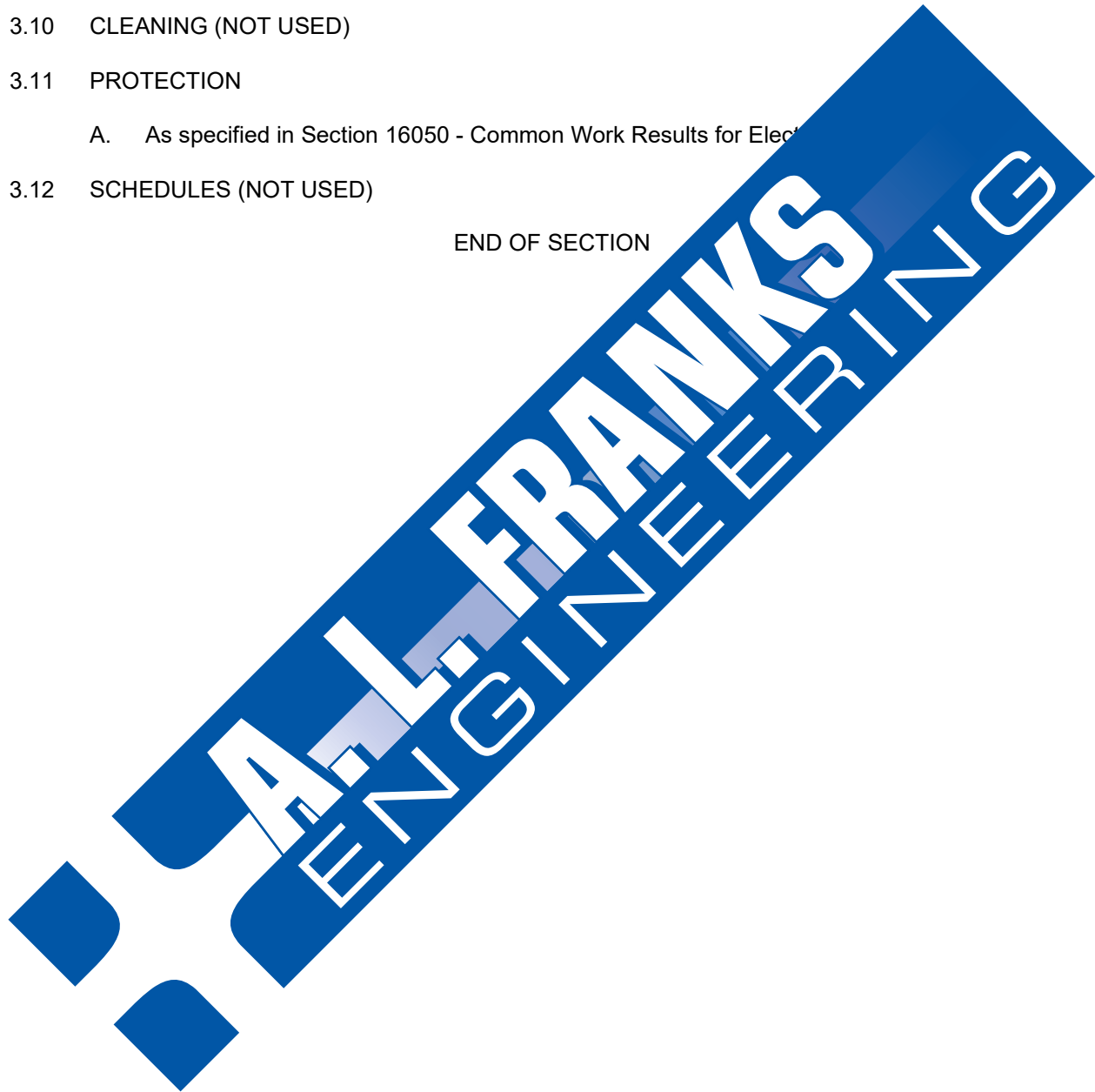
3.10 CLEANING (NOT USED)

3.11 PROTECTION

- A. As specified in Section 16050 - Common Work Results for Electrical

3.12 SCHEDULES (NOT USED)

END OF SECTION



SECTION 260700

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Mounting and supporting electrical equipment and components

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. ASTM International (ASTM):

1. A123 - Standard Specification for Zinc (Hot-Dip) Coated Iron and Steel Products.
2. A153 - Standard Specification for Zinc Coated (Electrolytically Applied) Steel Hardware.
3. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

1.4 SYSTEM DESCRIPTION

A. Design requirements:

1. Demonstrate that the design meets the following accepted engineering methods:
 - a. The design is adequate to resist the loads generated in the Building Code and equipment requirements.
 - b. The capacity of the anchors can be fully developed in the concrete in which they are attached.
 - c. The design meets the following requirements:
 - 1. The design meets the Building Code unless otherwise specified.
 - 2. The design meets the following requirements:
 - a. Hanging, suspended, or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in the Common Work Results for Electrical section.
 - b. Wind loading requirements:
 - 1. All exterior equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in the Common Work Results for Electrical section.
 - d. Minimum safety factor against overturning: 1.5.
 - e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:

1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Submittal Procedures section and the Common Work Results for Electrical section.
- B. Product data:
 - 1. Supports:
 - a. Materials.
 - b. Geometry.
 - c. Manufacturer.
 - 2. Hardware:
 - a. Materials.
 - b. Manufacturer.
- C. Shop drawings:
 - 1. Complete dimensioned and scalable shop drawings for all structures, including but not limited to, trapezes, wall supports, etc.
 - 2. Complete anchoring details for equipment, line supports, and wall supports for all equipment, including but not limited to, trapezes, and wall supports for all equipment.
 - a. For free standing supports and wall supports, weight in excess of 200 pounds:
 - 1) Stamped by a professional engineer where the Project is being constructed.
 - b. Said submittals, by virtue of the stamp of a registered engineer, will be reviewed for compliance with the requirements specified in the Contract Documents, including but not limited to, accuracy, or method of calculation.
 - 3. Include data on attachment and connection methods that will satisfy the design loading and other requirements.
- D. Installation instructions:
 - 1. Furnish installation instructions based on the seismic and wind conditions.
 - a. Said instructions shall be prepared by a professional engineer licensed in the state where the Project is located.

1.6 QUALITY ASSURANCE

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

1.7 MATERIALS AND HANDLING

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

1.8 SPECIAL CONDITIONS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM STARTUP

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. One of the following or equal:
 - 1. Preformed channel:
 - a. Thomas & Betts.
 - b. Power-Strut.
 - c. Unistrut.
 - d. Cooper B-Line.
 - e. Robroy.
 - f. Tyco.
- B. Nonmetallic cable rack:
 - 1. Underground Devices Inc.
 - 2. Hubbell.
 - 3. Unistrut.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

- A. Use materials specified in the Common Work Results for Electrical section.
- B. Prefabricated cable rack:
 - 1. Fabricated with ASTM A240, type 316 material.
 - 2. Fabricated with type 316 material.
 - 3. Cable rack:
 - a. Fabricated of stanchions and cable support arms.
 - b. Fabrications:
 - 1. 50 percent glass reinforced nylon or other non-metallic material.
 - 2. Capable of supporting multiple arms.
 - 3. Recessed bolt mounting holes.
 - 4. Length as required.
 - 3. Arms:
 - a. 50 percent glass reinforced nylon or other non-metallic material.
 - b. Size the arms based on the length and weight of the cable to be supported.
 - 4. Stainless steel mounting hardware.

2.4 MANUFACTURED UNITS (NOT USED)

- 2.5 EQUIPMENT (NOT USED)
- 2.6 COMPONENTS (NOT USED)
- 2.7 ACCESSORIES (NOT USED)
- 2.8 MIXES (NOT USED)
- 2.9 FABRICATION (NOT USED)
- 2.10 FINISHES (NOT USED)
- 2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 - EXECUTION

- 3.1 EXAMINATION (NOT USED)
- 3.2 PREPARATION (NOT USED)
- 3.3 INSTALLATION

A. As specified in the Common Work

B. Preformed Channel:

1. Mount all raceways, equipment, components, and devices on Contractor-fabricated racks using the following methods:
 - a. Provide the necessary bracing to keep trapeze type structures from swaying under loading.
2. Brace and anchor all supports using methods that provide structural integrity under all loads and wind loads:
 - a. Anchor supports not to exceed support height divided by 240.
3. Provide pedestals for wall mounted panels that weigh more than 100 pounds.
 - a. If the support is made of welded angle, tube sections, or preformed channel, the support must be designed to match the supported equipment. If the equipment is a panel or cabinet, match the supported equipment height, width, and depth.
4. Provide secondary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
5. Mount equipment, cabinets, boxes, instruments, and devices in damp or wet areas using a minimum of 7/8-inch preformed mounting channel.
 - a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.
6. Corrosion protection:
 - a. Isolate dissimilar metals, except where required for electrical continuity.
 - 1) Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.
7. Raceway:
 - a. Furnish all racks and trapeze structures needed to support the raceway from the structure.
 - 1) Group raceway and position on racks to minimize crossovers.
 - 2) Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.
7. Anchoring methods:

- a. Solid concrete: Anchor bolts, anchor rods or post-installed anchors.
- b. Metal surfaces: Machine screws or bolts.
- c. Hollow masonry units: Post-installed anchors.
8. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.
9. Recoat or seal all drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

C. Non-metallic cable rack:

1. Install the non-metallic cable rack in accordance with the manufacturer's recommendations.
2. Provide at least 2 stanchions and 2 arms at each installation.
3. Mount the cable rack so that the supported cable does not obstruct any manhole or handhole and so that the supported cable does not sag.
4. Do not exceed the cable manufacturer's minimum bend radius.
5. Use nylon cable ties to secure the cable to the support.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

- A. As specified in the Commissioning section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

- A. As specified in the Protection section.

3.12 SPECIAL

END OF SECTION

SECTION 260750

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Identification of electrical equipment, devices and components
 - 2. Material, manufacturing and installation requirements for

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical
- B. Occupational Safety and Health Administration

1.3 DEFINITIONS

- A. As specified in the Common Work Results

1.4 SYSTEM DESCRIPTION

- A. Nameplates:
 - 1. Provide a nameplate for all electrical equipment and devices, control panel and control panel components.
 - 2. Provide all nameplates, and material throughout the facility.
 - 3. Device nameplates shall:
 - a. Be clearly legible, and identified on the Process and Instrumentation Diagrams (P&ID).
- B. Wire numbering:
 - 1. Develop a wire numbering system with all vendors of equipment so that every wire has a unique number associated with it for the entire system:
 - a. Field wires shall correspond to the wire numbers on the control drawings or the circuit numbers for receptacles and lighting.
 - b. Control panel wires shall correspond to the terminal block number to which they are connected in the control panel.
 - c. Control panel wires on a common terminal shall have the same wire number.
 - 2. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:
 - 1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers in the Conduits section.
 - 3. Provide the following wiring numbering schemes throughout the project for field wires between process control module, (PCM), vendor control panels, (VCP), motor control centers, (MCC), field starters, field instruments, etc.

(ORIGIN LOC.)–(ORIGIN TERM.)/(DEST. LOC.)–(DEST. TERM.)

(ORIGIN LOC.)–(ORIGIN TERM.)
(DEST. LOC.)–(DEST. TERM.)

OR

a. Where:

- 1) ORIGIN LOC.= Designation for originating equipment
- 2) ORIGIN TERM. = Terminal designation
- 3) DEST. LOC. = Designation for destination equipment
- 4) DEST. TERM. = Terminal designation for PLC or PLC I/O address at destination panel
- 5) I/O address at destination panel

- a) Identify equipment and terminal designations
- b) PCMs are always identified by a unique tag and loop number
- c) Location is the panel designation for a PCM. For connections to a PCM, the tag and loop number. Location is the panel designation for motor starters, field instruments, and the panel designation or tag and loop number for the panel designation or tag and loop number
- d) Terminal number is the number on the terminal block where the conductor connects to the equipment or services and vendor control panels. Terminal numbers shall be shown,

For motor leads shall be the motor terminal designation (e.g. T1, T2, T3, etc.). For connections at PCMs where the field conductor connects to a PLC input or output shall be the PLC address. The PLC I/O numbering scheme is typical for Allen-Bradley PLC I/O numbering scheme should be modified to match that of the PLC manufacturer used for the project):

Discrete Point: W:X:Y/Z.

W:X:Y.Z.

W= I for input, O for output

X= PLC number (1, 2, 3...)

Y= Slot number (01, 02, 03...)

- 4) Z= Terminal number (00, 01, 02...) for a discrete point or a word number for an analog point (1, 2, 3...)

b. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (e.g. C0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with "A" (e.g. C0010A).

4. Case 1: Vendor control panel (VCP) to process control module (PCM):
 - a. Field wire number/label: A-B/C-D
 - b. A = Vendor control panel number without hyphen (VCP#)
 - c. B = Terminal number within VCP (manufacturer's or vendor's standard terminal number)
 - d. C = Process control module number without hyphen (PCM#)
 - e. D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
 - f. Examples:
 - 1) VCP#-10/PCM#-I: 1:01/01
 - 2) VCP#-10/PCM#-O: 1:10/07
 - 3) VCP#-10/PCM#-C0100
5. Case 2: Field instrument to process control module (PCM):
 - a. Field wire number/label: E-F/C-D
 - b. C = Process control module number without hyphen (PCM#)
 - c. D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
 - d. E = Field mounted instrument tag number without hyphen (EDV#)
 - e. F = Manufacturer's standard terminal number for analog input. Use both terminal numbers for analog input.
 - f. Examples:
 - 1) TIT#-2,3/PCM#-I: 1:01/01
 - 2) TSH#-1/PCM#-O: 1:10/07
6. Case 3: Motor control center (MCC) to process control module (PCM):
 - a. Field wire number/label: G-B/A-B
 - b. B = Terminal number within motor control center or vendor control panel (manufacturer's or vendor's standard terminal number)
 - c. A = Actual starter designation in the motor control center without hyphen (MMS#)
 - d. D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
 - e. Examples:
 - 1) MMS#-X2/PCM#-I: 1:01/01
 - 2) MMS#-X2/PCM#-O: 1:10/07
 - 3) MMS#-X2/PCM#-C0100
7. Case 4: Motor control center (MCC) to vendor control panel (VCP):
 - a. Field wire number/label: G-B/A-B
 - b. B = Terminal number within motor control center or vendor control panel (manufacturer's or vendors standard terminal number)
 - c. A = Actual starter designation in the motor control center without hyphen (MMS#)
 - d. Example: MMS#-X2/VCP#-10
8. Case 5: Motor leads to a motor control center (MCC):
 - a. Field wire number/label: H-I/G-B
 - b. B = Terminal number within motor control center (manufacturer's standard terminal number)
 - c. G = Actual starter designation in the motor control center without hyphen (MMS#)
 - d. H = Equipment tag and loop number without hyphen (PMP#)
 - e. I = Motor manufacturer's standard motor lead identification (e.g. T1, T2, T3, etc.)
 - f. Example: PMP#-T3/MMS#-T3

9. Identify all spare conductors as required for other field wires with an "S" prefix:
 - a. Example: S MMS#-10/PCM#-C011

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Submittal Procedures section and the Common Work Results for Electrical section.
- B. Product data:
 1. Nameplates:
 - a. Color.
 - b. Size:
 - 1) Outside dimensions.
 - 2) Lettering.
 - c. Material.
 - d. Mounting means.
 2. Nameplate schedule:
 - a. Show exact wording for each nameplate.
 - b. Include nameplate and letter sizes.
 3. Wire numbers:
 - a. Manufacturer's catalog data for each wire number including
- C. Record documents:
 1. Update the conduit schedule with wire numbers including spares and destination notes.

1.6 QUALITY ASSURANCE (NOT USED)

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT SCHEDULE

1.9 SEQUENCE OF WORK

1.10 SCHEDULE

1.11

Common Work Results for Electrical section.

1.12

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Nameplates and signs:
 - 1. One of the following or equal:
 - a. Brady.
 - b. Seton.
- B. Conductor and cable markers:
 - 1. Heat-shrinkable tubing:
 - a. One of the following or equal:
 - 1) Raychem.
 - 2) Brady.
 - 3) Thomas & Betts.
 - 4) Kroy.
 - 2. Non heat-shrinkable tubing:
 - a. One of the following or equal:
 - 1) Brady.
 - 2) Seton.
 - 3. Pre-printed slip-on sleeve markers:
 - a. The following or equal: Engineer knows
 - 1) Grafoplast.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

- A. Nameplates:
 - 1. Colors:
 - a. Warning nameplates.
 - b. Other nameplates.
 - 2. Laminated plastic:
 - a. 3/32-inch thick.
 - b. 2-ply.
 - c. With reflective surface.
 - 3. Block letters: Adequate size to be read easily from a distance of 6 feet. Minimum 1/8-inch in height.
- B. Signs:
 - 1. High voltage signs:
 - a. For use.
 - b. With OSHA regulations.
 - 2. Cable markers:
 - a. Pre-printed black characters on white tubing.
 - b. Minimum 1/8-inch in height.

2.4 MISCELLANEOUS UNITS (NOT USED)

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES (NOT USED)

2.8 MIXES (NOT USED)

2.11 SOURCE QUALITY CONTROL

a. Same material and same color and appearance as the device that the applicant states, in order to achieve an aesthetically consistent and coordinated appearance.

3.3 INSTALLATION

a. Misaligned or damaged components shall be remounted, or provide new components as required by the Engineer.

Start within 1/32 inch of the end of the stripped insulation point.

- a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.

4. Place warning signs on equipment that has 120 VAC control voltage sources used for interlocking.
 - a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

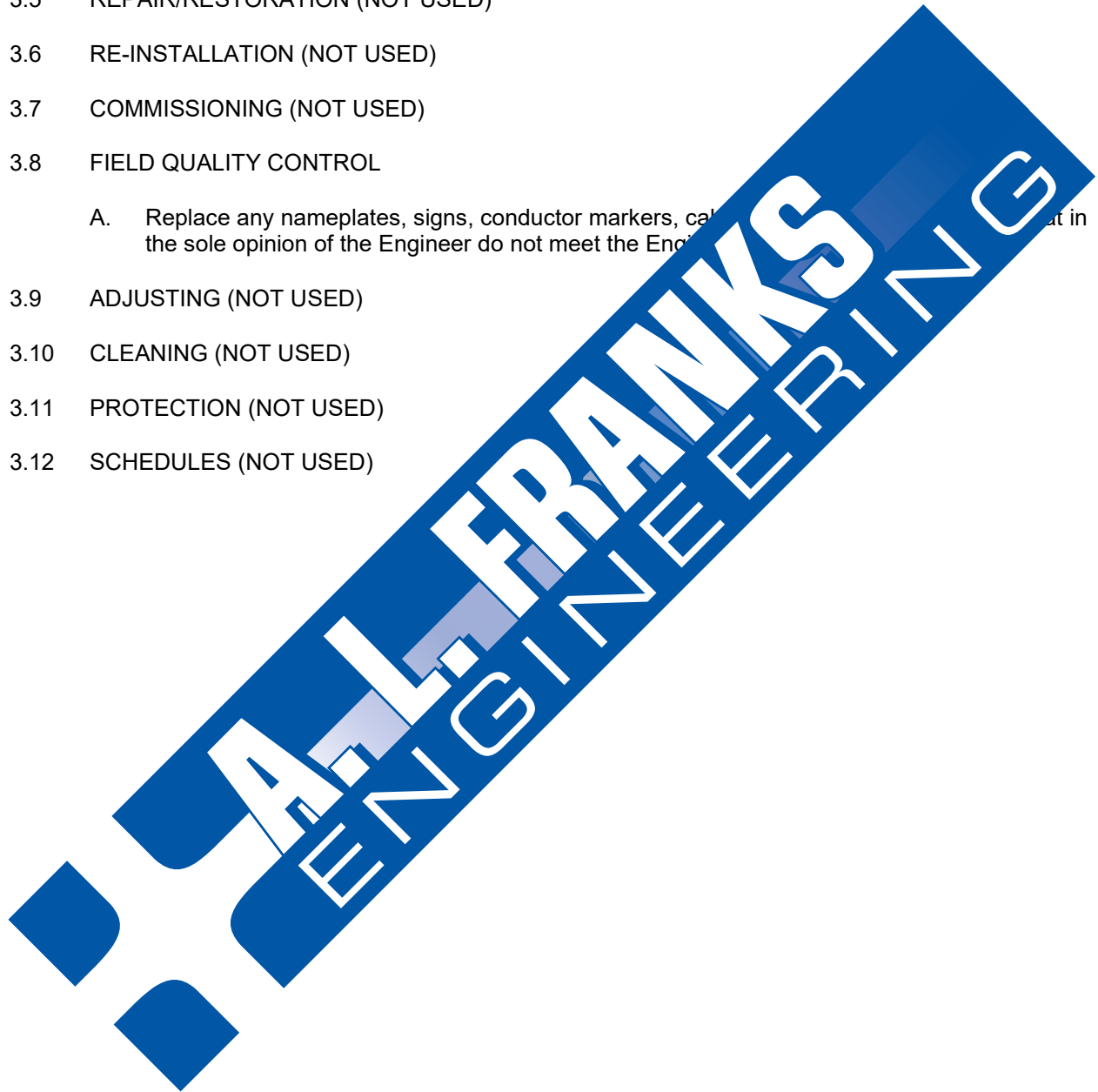
- A. Replace any nameplates, signs, conductor markers, callouts, etc. that in the sole opinion of the Engineer do not meet the Engineer's requirements.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)



SECTION 261230

600-VOLT OR LESS WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. 600 volt class or less wire and cable.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. ASTM International (ASTM):
1. B3 - Standard Specification for Soft or Annealed Copper Wire, Hard, Medium-Hard, or Soft.
 2. B8 - Standard Specification for Concentric Stranded Copper Wires, Hard, Medium-Hard, or Soft.
- C. CSA International (CSA).
- D. Insulated Cable Engineers Association (ICEA):
1. NEMA WC 70/ICEA S-95 - Standard for Cables Rated 2000 Volts or Less for the Distribution of Electric Power.
 2. NEMA WC 57/ICEA S-96 - Standard for Thermocouple Extension, and Instrumentation Cables.
- E. National Fire Protection Association (NFPA):
1. 72 - National Electrical Code.
 2. 101 - Life Safety Code.
- F. Telecommunications Industry Association (TIA)/Electronics Industry Association (EIA):
1. TIA/EIA-568 - Telecommunication Cabling and Components.
 2. TIA/EIA-569 - Cabling Standards for Telecommunications Pathways and Enclosures.
- G. Underwriters Laboratories Inc., (UL):
1. UL 84 - Standard for Flame-Resistant Wires and Cables.
 2. UL 157 - Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 3. UL 1666 - Standard for Cables for Power-Limited Fire-Alarm Circuits.
 4. UL 19 - Standard for Metal-Clad Cables.
 5. UL 196 - Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
 6. UL 2225 - Standard for Cables and Cable-Fittings for Use in Hazardous (Classified) Locations.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.

- B. Specific definitions and abbreviations:
1. AWG: American wire gauge.
 2. BCCS: Bare copper-covered steel.
 3. CPE: Chlorinated polyethylene.
 4. FEP: Fluorinated ethylene propylene.
 5. FHDPE: Foam high-density polyethylene.
 6. FPE: Foam polyethylene.
 7. OD: Outside diameter.
 8. PVC: Polyvinyl chloride.
 9. XHHW: Cross-linked high heat water resistant insulated wire.

- C. Definitions of terms and other electrical considerations as set forth:
1. ASTM.
 2. ICEA.

1.4 SYSTEM DESCRIPTION

- A. Furnish and install the complete wire and cable system.

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

- B. Product data:

1. Manufacturer of wire and cable.
2. Insulation:
 - a. Type.
 - b. Voltage class.
3. AWG size.
4. Conductor material.
5. Pulling capacity.

- C. Shop drawings:

1. Shop drawings shall include calculations and justification provide written justification describing why the

- D. Provide meg-ohm tests.

Provide pulling calculations to the Engineer for review and comment for all cables installed using mechanical pulling equipment. Show that the maximum tension and sidewall pressure will not exceed manufacturer recommended

Provide a table showing the manufacturer's recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.

- b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

1.6 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.

B. All wires and cables shall be UL listed and labeled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS (NOT USED)

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following:

1. 600 volt cables:

a. CommScope.

b. General Cable.

c. Selden.

2. 600 volt cables and cable:

a. CommScope Surprenant Cable Corp.

b. General Cable.

c. Selden.

d. CommScope.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

A. Conductors:

1. Copper in accordance with ASTM B3.

2.4 MANUFACTURED UNITS

A. General:

1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
2. Permanently mark each wire and cable with the following at 24-inch intervals:
 - a. AWG size.
 - b. Voltage rating.
 - c. Insulation type.
 - d. UL symbol.
 - e. Month and year of manufacture.
 - f. Manufacturer's name.
3. Identify and mark wire and cable as specified in the Identification Systems section:
 - a. Use integral color insulation for #2 AWG and larger.
 - b. Wrap colored tape around cable larger than #2 AWG.

B. 600 volt class wire and cable:

1. Provide AWG or kcmil sizes as indicated:
 - a. When not indicated on the Drawings:
 - 1) In accordance with the following:
 - a) Use 75 degree Celsius.
 - b) Ampacity rating shall be equal to or greater than rating of the overcurrent device.
 - 2) Provide #12 AWG for control circuits.
 - 3) Provide #10 AWG for conductors.
2. Provide Class B insulation for conductors in accordance with NEMA B8:
 - a. Provide Class B insulation where fire resistance is required.
3. Insulation:
 - a. XHHW-2.
 - b. EPR.
4. Marking:
 - a. Mark conductors as indicated on the Drawings.
 - b. Mark insulation in accordance with XHHW-2 insulation.

5. Control wire in accordance with ICEA Method 1, E-2 in accordance with NEMA WC 57/ICEA S-73-532.
6. Conductor: Insulated, green: Insulated in accordance with NEC.

C. 600 volt class cable:

1. Suitable for use in wet locations.
2. Voltage rating: 600 volts.
4. Temperature rating:
 - a. 90 degree Celsius rating in dry locations.
 - b. 75 degree Celsius rating in wet locations.
5. Conductors:
 - a. Insulation:
 - 1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.

- b. #16 AWG stranded and tinned.
 - c. Color code: ICEA Method 1:
 - 1) Pair: Black and white.
 - 2) Triad: Black, white and red.
 - 3) Multiple pairs or triads:
 - a) Color-coded and numbered.
 - 6. Drain wire:
 - a. #18 AWG.
 - b. Stranded, tinned.
 - 7. Jacket:
 - a. Flame retardant, moisture and sunlight resistant PVC.
 - b. Ripcord laid longitudinally under jacket to facilitate removal.
 - 8. Shielding:
 - a. Individual pair/triad:
 - 1) Minimum 1.35-mil double-faced aluminum tape applied to provide 100 percent coverage.
 - b. Multiple pair or triad shielding:
 - 1) Group shield: Minimum 1.35-mil double-faced aluminum tape overlapped to provide 100 percent coverage.
 - 2) Completely isolate group from other groups.
 - 3) Cable shield: 2.35 mils double-faced aluminum tape overlapped to provide 100 percent coverage.
 - c. All shielding to be in contact with jacket.
- D. Network cables:
 - 1. Category 5e:
 - a. General:
 - 1) Performance standards set by TIA/EIA-568-C.2 and ANSI/TIA-646-D.
 - b. Construction:
 - 1) Twisted pair copper.
 - c. Shielding:
 - 1) Shielded pair cables formed into a cable core.
 - 2. Category 6:
 - a. General:
 - 1) Performance standards set by TIA/EIA-568-C.2 and ANSI/TIA-646-D.
 - b. Construction:
 - 1) Twisted pair copper.
 - c. Shielding:
 - 1) Shielded pair cables formed into a cable core.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

A. Wire ties:

1. One of the following or equal:
 - a. T&B, "Ty-Rap" cable ties.
 - b. Panduit, cable ties.
- B. Wire markers:
 1. As specified in the Identification for Electrical Systems section.
- 2.8 MIXES (NOT USED)
- 2.9 FABRICATION (NOT USED)
- 2.10 FINISHES (NOT USED)
- 2.11 SOURCE QUALITY CONTROL
 - A. Assembly and testing of cable shall comply with the American Wire Gauge, 195-658-1999.
 - B. Test Type XHHW-2 in accordance with the requirements of the American Wire Gauge, 195-658-1999.

PART 3 EXECUTION

- 3.1 EXAMINATION (NOT USED)
- 3.2 PREPARATION (NOT USED)
- 3.3 INSTALLATION
 - A. As specified in the Identification for Electrical Systems section.
 - B. Color-coding:
 1. Color-coding shall be used throughout the facility.
 2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Equipment ground: Green.
 3. The following color code shall be followed for all 480/277 volt systems:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Equipment ground: Green.
 4. The following color code shall be followed for all 120 VAC control wiring:
 - a. Power: Red.
 - b. Neutral: White.
 5. The following color code shall be followed for all general purpose DC control circuits:
 - a. Grounded conductors: White with blue stripe.

- b. Ungrounded conductors: Blue.
 - 6. Switch legs shall be violet. 3-way switch runners shall be pink.
 - 7. Wires in intrinsically safe circuits shall be light blue.
 - 8. Wire colors shall be implemented in the following methods:
 - a. Wires manufactured of the desired color.
 - b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
 - 1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.
- C. Install conductors only after the conduit installation is complete, and all conduits have been vacuumed clean, and the affected conduits have been swabbed:
 - 1. Install wires only in approved raceways.
 - 2. Do not install wire:
 - a. In incomplete conduit runs.
 - b. Until after the concrete work and plastering is complete.
- D. Properly coat wires and cables with pulling compound:
 - 1. For all #4 AWG and larger, use an approved pulling compound if the cable is being installed in conduit:
 - a. Ideal Products.
 - b. Polywater Products.
 - c. 3M Products.
 - d. Greenlee Products.
 - e. Or equal as recommended by the manufacturer.
 - f. Do not use oil, grease, or any other lubricant.
- E. Cable pulling:
 - 1. Prevent mechanical damage during installation.
 - 2. For cables with diameters less than 1/2 inch, pull by hand.
 - 3. For cables with diameters greater than 1/2 inch, pulling winches may be used if they have cable pulling capacity and are used in accordance with the manufacturer's instructions.
 - 4. Prevent excessive cable pulling tension. Cable pulling tension was no more than 75 percent of the minimum breaking strength of the cable, or the recommended level as published by the cable manufacturer. If the cable is damaged, at his discretion, require replacement of the cable.
 - 5. The installer shall have all calculations and cable pulling limitations while pulling cable.
- F. Cable pulling:
 - 1. Use a junction box or pullbox where required to prevent cable pulling tension from exceeding 75 percent of manufacturer's recommended level for the specified cable size:
 - 2. Use a minimum of 12 inches of slack in manholes or pull boxes only.
 - 3. Use a minimum of 12 inches of slack to make proper connections.
- G. Install and terminate all wire in accordance with manufacturer's recommendations.
- H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
 - 1. Do not lace wires in gutter or panel channel.
 - 2. Install all wire ties with a flush cutting wire tie installation tool:
 - a. Use a tool with an adjustable tension setting.
 - 3. Do not leave sharp edges on wire ties.

- I. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
1. Use ring type lugs if box lugs are not available on the equipment.
- J. Lighting circuits:
1. Each circuit shall have a dedicated neutral.
- K. Splices:
1. Provide continuous circuits from origin to termination whenever possible:
 - a. Obtain Engineer's approval prior to making any splices.
 2. Lighting and receptacle circuit conductors may be spliced with the approval of the Engineer.
 3. Where splices are necessary because of extremely long runs that exceed standard manufactured lengths:
 - a. Splice box NEMA rating requirements as specified in the Specifications for Electrical section.
 - b. Make splices in labeled junction boxes for power circuits.
 - c. Make splices for control and instrument circuits:
 - 1) Provide terminal boards with screw terminals for wiring with spade or ring lug connectors.
 4. Power and control conductors routed in the same raceway shall be spliced in common junction boxes.
 5. Clearly label junction and termination boxes with the word "SPICE LOCATED WITHIN".
 6. Leave sufficient slack at junction and termination boxes to make proper splices and connections. Do not use pull boxes for splicing.
 7. Install splices with heat-shrink sleeves and insulate using a heat-shrink sleeve:
 - a. In NEMA rated boxes, provide heat-shrink sleeves that are listed for the application.
 8. Splices shall be made in a dry box subject to flooding, and in wet areas shall be made in a box listed for submersible applications.
 - a. Use a splice kit.
- L. Cable:
1. Install cable at each end after being installed in the conduit and before termination.
 2. Do not mix instrumentation class cables in separate raceway systems from power cables:
 - a. Do not install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
 - b. Do not install cable without splices between instruments or between field devices and instrument enclosures or panels.
 - c. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.
 3. Shield grounding requirements as specified in the Grounding and Bonding section.
- N. Copper Ethernet cables:
1. Comply with TIA/EIA-568-C.2.
 2. Pathways:

- a. For initial installation, the maximum fill capacity for pathways (i.e. conduit, raceways, trays, baskets) is 40 percent. The maximum fill capacity of 60 percent is allowed to accommodate future additions after initial installation.
- b. Conduit should be run in the most direct route possible with no more than two 90 degree bends between pull boxes and serve no more than 3 outlet boxes.
3. Cable bend radius:
 - a. Proper cable bend radius control must be maintained throughout the pathways. The bend radius needs to be at a minimum 10 times the cable diameter.
4. Cable pulling:
 - a. Provide cable pulling swivel system to prevent winding and twisting of rope and cables during pull.
 - b. The maximum pulling tension is not to exceed manufacturer's ratings. Cable installation should not in any way deform the cable.
 - c. Do not install bruised, kinked, scored, deformed cable between termination, tap, or junction points. Replace any cable damaged during installation and replace it with new cable.
5. Cable management:
 - a. Organize and manage cables for quick changes.
6. Testing:
 - a. All cables and termination hardware shall be tested for defects in installation and to verify cabling meets the installed conditions according to the requirements of TIA/EIA-568-C.2.
 - 1) All pairs of each installed cable shall be tested to system acceptance.
 - 2) Any defect in the cable, connector, or panel, but not limited to cable, connector, or panel, shall be replaced to ensure 100 percent useable conductors.
 - b. All twisted pair cables shall be tested for compliance to the requirements of the appropriate Category of cabling installed.
 - c. All cables shall be labeled with the contract documents, TIA/EIA standards, and the manufacturer's name.
 - d. Test the requirements of TIA/EIA-568-C. The test results shall be used to verify Category 6 cabling. Inspect all materials for NRTL certification markings. Inspect all communications equipment rooms for compliance with designations, and inspect cabling connections for compliance with designations.
 - e. Inspect cable placement, cable termination, grounding and bonding, and labeling of all components.
 - f. Test copper cabling for DC loop resistance, shorts, opens, intermittent connections, and polarity between conductors.
 - g. Test operation of shorting bars in connection blocks.
 - h. Test cables after termination but not cross-connection.
 - a) Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2.
 - (1) Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex.
 - (2) Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
7. Separation from EMI sources:

- a. Comply with TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - 1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches
 - c. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - 1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - d. Separation between communications cables in ungrounded metallic raceways and unshielded power lines and electrical equipment located in the same enclosure shall be as follows:
 - 1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 3 inches.
 - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - e. Separation between Communications cables and motors and Transformers, 5 kVA or HP or less: A minimum of 12 inches.
- O. Multi-conductor cable:
- 1. Where cable is not routed in a raceway and conductor, use 1 conductor in the cable for each circuit and conductor, use:
 - a) Use an internal ground conductor smaller than as indicated on the Drawings for equipment ground
 - b) When the internal ground conductor in each cable is not acceptable as a ground conductor, use 4-conductor cable with 3 conductors serving as ground.
- P. Armored cable:
- 1. Where cable is not routed in a raceway and the internal ground conductor in each cable is not acceptable as a ground conductor, use 4-conductor cable, with 3 conductors serving as ground.
 - 2. Where cable terminates at a device, switchboard, panel, etc., use armored cable connector.
 - 3. Where cable run continues in conduit, strip jacket and armor for portions in conduit and terminate cable and jacket with an armored cable connector threaded into conduit or conduit box.
- Q. Fire alarm cable:
- 1. Install telephone cables in dedicated metallic raceways, including raceways in duct banks, manholes, and pull boxes.
- R. Fire alarm cable:
- 1. Install fire alarm cable in dedicated metallic raceways as indicated on the Drawings.
- S. Signal cable:

1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.
- T. Submersible cable in wet wells:
1. Provide Kellem's grip or stainless steel wire mesh to support cable weight and avoid stress on insulation.
- U. Wiring allowances:
1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, outlets, fixtures, communication outlets, instruments, and devices within the scope of locations indicated on the Drawings.
 2. Locations for pull boxes, manholes, and duct banks may vary from the drawings. Include an allowance for necessary conductors and terminations to provide conductors to all pull boxes, manholes and duct banks within the scope of locations indicated on the Drawings.
- 3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION
- 3.5 REPAIR/RESTORATION (NOT USED)
- 3.6 RE-INSTALLATION (NOT USED)
- 3.7 COMMISSIONING
- 3.8 FIELD QUALITY CONTROL
- A. As specified in the Commissioning section.
- B. Grounding:
1. As specified in the Grounding section.
- 3.9 ADJUSTING (NOT USED)
- 3.10 CLEANING
- 3.11 PROTECTION
- A. As specified in the Protection section.
- 3.12
- END OF SECTION

SECTION 261300

CONDUITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Metallic conduits.
 - 2. Nonmetallic conduits.
 - 3. Conduit bodies.
 - 4. Conduit fittings and accessories.
 - 5. Conduit installation.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. American National Standards Institute (ANSI)
 - 1. C80.1 - Electrical Rigid Steel Conduit.
 - 2. C80.3 - Steel Electrical Metallic Tubing.
 - 3. C80.5 - Electrical Rigid Aluminum Conduit.
 - 4. C80.6 - Electrical Intermediate Metal Conduit.
- C. National Electrical Manufacturers Association (NEMA)
 - 1. RN-1 - Polyvinyl Chloride (PVC) Conduit, Galvanized Rigid Steel Conduit, and Intermediate Metal Conduit.
 - 2. TC2 - Electrical Rigid Metal Conduit - Steel.
 - 3. TC3 - Polyethylene Conduit, Use with Rigid PVC Conduit and Tubing.
 - 4. TC7 - Standard for Polyethylene Conduit.
 - 5. TC12 - Standard for Rigid PVC Conduit and Tubing.
 - 6. TC13 - Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- D. Underwriters Laboratories (UL)
 - 1. Standard for Rigid Metal Conduit - Steel.
 - 2. Standard for Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
 - 3. Standard for Liquidtight Flexible Steel Conduit.
 - 4. Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
 - 5. Standard for Continuous Length HDPE Conduit.
 - 6. Standard for Electrical Metallic Tubing - Steel.
 - 7. Standard for Electrical Intermediate Metal Conduit - Steel.
 - 8. Standard for Electrical Nonmetallic Tubing.
 - 9. Standard for Liquidtight Flexible Nonmetallic Conduit.
 - 10. Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.
- B. Specific definitions and abbreviations:

1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, Shapes C, E, LB, T, X, etc.
2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.
3. GRC: Galvanized rigid steel conduit.
4. PCS: Polyvinyl chloride (PVC) coated rigid steel conduit.
5. EMT: Electrical metallic tubing.
6. PVC: Polyvinyl chloride rigid nonmetallic conduit.
7. SLT: Sealtight-liquidtight flexible conduit.
8. EFLX: Explosion proof flexible conduit.
9. RAC: Rigid aluminum conduit.
10. NPT: National pipe thread.

1.4 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.
- B. Product data:
 1. Furnish complete manufacturer's catalog of conduit, fitting, conduit body, and accessories.
 2. Furnish complete manufacturer's recommendations for use and installation if required.
- C. Certifications:
 1. Furnish PVC-coated conduit certification for each installer.
- D. Record Documents:
 1. Incorporate all conduit and fitting details from electrical plan drawings.
 2. Dimension underground conduits from building lines.
 3. Furnish hand-drawn details of conduit and fitting locations.

1.5 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.
- B. Conduit fittings shall be UL listed and labeled.
- C. Rigid and flexible metallic conduit shall be certified by the manufacturer for use in wet or corrosive locations.

1.6 STORAGE AND HANDLING

- A. As specified in the Common Work Results for Electrical section.
- B. Do not expose non-metallic conduit to direct sunlight.
- C. Do not store conduit in direct contact with the ground.
- D. Do not store aluminum conduit in contact with concrete.

1.7 PROJECT OR SITE CONDITIONS

- A. As specified in the Common Work Results for Electrical section.

1.8 SEQUENCING

- A. Before installing any conduit or locating any device box:
 - 1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.
 - 2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

1.9 SCHEDULING (NOT USED)

1.10 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.11 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Galvanized rigid steel:
 - 1. One of the following:
 - a. Western Pipe and Foundry.
 - b. Alliance Pipe and Foundry.
 - c. Waco Pipe and Foundry.
- B. PVC-conduit:
 - 1. One of the following:
 - a. BlackGuard.
 - b. Flex-Conduit flexible conduit:
 - 1. One of the following or equal:
 - a. Southwire.
 - b. AFC Cable Systems.
 - c. Electri-Flex Co.
 - d. Anaconda.
- D. Explosion proof flexible conduit:
 - 1. One of the following or equal:
 - a. Appleton.
 - b. Crouse-Hinds.
 - c. Hubbell Killark.

- E. Conduit bodies:

1. One of the following or equal:
- Crouse-Hinds.
 - Appleton.
 - O-Z/Gedney.
 - Ocal, Inc.
 - Robroy Ind.
 - Calbond.
 - Carlson.
- F. Joint compound:
- The following or equal:
 - Thomas and Betts.
- G. Galvanized rigid steel conduit expansion fittings:
- One of the following or equal:
 - Crouse-Hinds.
 - Appleton.
 - O-Z/Gedney.
- H. PVC-coated rigid steel conduit expansion fittings:
- One of the following or equal:
 - Ocal, Inc.
 - Robroy Ind.
 - NEC, Inc. BlackGuard.
- I. Conduit sleeve:
- One of the following or equal:
 - Crouse-Hinds.
 - Appleton.
 - O-Z/Gedney.
- J. Conduit seals:
- One of the following or equal:
 - O-Z/Gedney.
- K. Conduit hangers and Supports section.
- L. Conduit floor seals:
- One of the following or equal:
 - O-Z/Gedney.
 - Type "WSK."
 - Type "CSM."
- 2.2 SYSTEM DESCRIPTION
- A. Provide conduits, conduit bodies, fittings, junction boxes, and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

- 2.3 EXISTING PRODUCTS (NOT USED)
- 2.4 MATERIALS (NOT USED)
- 2.5 MANUFACTURED UNITS (NOT USED)
- 2.6 EQUIPMENT (NOT USED)
- 2.7 COMPONENTS

A. GRC:

1. All threads: NPT standard conduit threads with a 3/4-inch tap
 - a. Running conduit threads are not acceptable.
2. Hot-dip galvanized inside and out:
 - a. Ensures complete coverage and heats the zinc
 - b. Ensures the zinc alloys with the steel over the
 - c. Electro-galvanizing is not acceptable.
3. Manufactured in accordance with:
 - a. UL-6.
 - b. ANSI C80.1.

B. PCS:

1. The steel conduit, before PVC coating, shall be hot-dip galvanized material, conforming to the requirements of the standard.
2. Coated conduit NEMA Standard 250-1.
 - a. The galvanized coating shall be uniform in thickness during the cleaning and processing.
3. Factory-bonded PVC coating.
 - a. The exterior coating shall be coated with primer before PVC coating to ensure adhesion of the primer and the PVC coating.
 - b. Nominal thickness of the coating shall be 0.040 inch except where the project dictates otherwise.
 - c. The coating shall be uniform in thickness and shall be free of holes and holidays. The thickness of the coating shall be greater than the tensile strength of the coating.
 - d. The coating shall be certified test results.
 - e. The coating shall be uniformly and consistently applied to the interior of all conduits.
 - f. The coating shall be free of holes and holidays.
 - g. The coating shall be free of holes and holidays.
 - h. The coating shall be free of holes and holidays.
 - i. The coating shall be free of holes and holidays.
 - j. The coating shall be free of holes and holidays.
 - k. The coating shall be free of holes and holidays.
 - l. The coating shall be free of holes and holidays.
 - m. The coating shall be free of holes and holidays.
 - n. The coating shall be free of holes and holidays.
 - o. The coating shall be free of holes and holidays.
 - p. The coating shall be free of holes and holidays.
 - q. The coating shall be free of holes and holidays.
 - r. The coating shall be free of holes and holidays.
 - s. The coating shall be free of holes and holidays.
 - t. The coating shall be free of holes and holidays.
 - u. The coating shall be free of holes and holidays.
 - v. The coating shall be free of holes and holidays.
 - w. The coating shall be free of holes and holidays.
 - x. The coating shall be free of holes and holidays.
 - y. The coating shall be free of holes and holidays.
 - z. The coating shall be free of holes and holidays.

- g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.
 - 1) The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.
 - 2) The sleeve shall provide a vapor- and moisture resistant seal at every connection.

C. SLT:

1. Temperature rated for use in the ambient temperature at the installation location but not less than the following:
 - a. General purpose:
 - 1) Temperature range: -20 degrees Celsius to +80 degrees Celsius.
 - b. Oil-resistant:
 - 1) Temperature range: -20 degrees Celsius to +80 degrees Celsius.
2. Sunlight-resistant, weatherproof, and watertight.
3. Manufactured from single strip steel, hot-dip galvanized steel, or aluminum alloy fabrication.
4. Strip steel spiral wound resulting in an interior diameter that allows easy wire pulling.
5. Overall PVC jacket.
6. With integral copper ground wire, built-in ground wire, or ground wire 1/2 inch through 1-1/4 inch.

D. EFLX:

1. Suitable for the hazardous location as specified in the NEC.
- a. As specified in the NEC for the hazardous location.
2. Metallic braid shall provide a continuous path to ground.
3. Stainless steel construction.
4. Provide fittings and connections for installation.

E. PVC:

1. Extruded PVC.
- a. As specified.
- b. As specified where specified.
2. For use with conductors or cable.
3. As specified.

F.

1. Conduit type:
 - a. Bodies and covers when used with Type GRC.
 - b. Bodies and covers when used with Type RAC.
 - c. Bodies and covers when used with Type PVC.
 - d. Bodies and covers when used with Type PCS.
 - e. Bodies to conform to Form 8, Mark 9, or Mogul design.
 - f. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire-bending space.
2. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.8 ACCESSORIES

A. Connectors and fittings:

1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:

1. Construction:
 - a. Malleable iron or zinc-plated steel when used with steel conduit.
 - b. Aluminum when used with aluminum conduit.
 - c. Positive metallic conduit end stop.
 - d. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
 - e. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.
- C. Insulated grounding bushings:
 1. Construction:
 - a. Malleable iron or steel, zinc-plated, with a positive metallic contact.
 - b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
 - c. Tin-plated copper grounding saddle for use with steel conduit.
- D. Electrical unions (Erickson Couplings):
 1. Construction:
 - a. Malleable iron for use with steel conduit.
 - b. Aluminum for use with aluminum conduit.
 - c. Concrete tight, 3-piece construction.
 - d. Rated for Class I Division 1 Conditions.
- E. SLT fittings:
 1. Construction:
 - a. Malleable iron.
 - b. Furnished with liquidtight seal.
 - c. Liquidtight, rated for use in wet locations.
 - d. Insulated throat.
 - e. Furnish 90-degree elbows.
 - f. Design shall include:
 - 1) A plastic raceway jacket to the plastic gasket seal.
 - g. Fittings shall provide ground continuity irrespective of the grounding device, if inserted into raceway and factors, shall have rolled-over edges for sizes under 5 inches.
 2. Installation:

a. A threadless opening using a threaded hub fitting, a gasket, and a resistant/oil-resistant synthetic rubber gasket shall be provided in the side of the box or enclosure and the fitting shoulder. Gasket shall be protected by and permanently bonded to a metallic retainer.

b. Indoor and outdoor SLT fittings:

1) Indoor: PVC-coated liquidtight fittings with a bonded 0.040-inch thick PVC coating on the metal connector to form a seal around the SLT conduit.

2) Outdoor: Insulated throat and an integral sealing ring.
- F. Threaded attachment of steel conduit to sheet metal enclosures:
 1. Construction:
 - a. Insulated throat.
 - b. PVC-coated when used in corrosive areas.
 - c. Bonding locknut.
 - d. Recessed neoprene o-ring to ensure watertight and dusttight connector.
 - e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
 - f. 1-1/2-inch through 6-inch malleable iron zinc plated.
 - g. Aluminum with aluminum conduit.
 2. Usage:

f. PVC-coated when used with Type PCS.

L. Conduit markers:

1. As specified in the Identification for Electrical Systems section.

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. General:

1. Conduit routing:

a. The electrician shall follow the following conditions:

1) Install conduits at locations indicated on the schematic representation indicated on the drawings.

2) Install conduits at locations that are consistent with the design conditions, as accepted by the Engineer: a) To avoid obstructions, or routing to bypass obstructions. b) To avoid conduit routing due to the relocation of equipment. c) To avoid conduit routing due to the relocation of equipment. d) To avoid conduit routing due to the relocation of equipment. e) To avoid conduit routing due to the relocation of equipment. f) To avoid conduit routing due to the relocation of equipment. g) To avoid conduit routing due to the relocation of equipment. h) To avoid conduit routing due to the relocation of equipment. i) To avoid conduit routing due to the relocation of equipment. j) To avoid conduit routing due to the relocation of equipment. k) To avoid conduit routing due to the relocation of equipment. l) To avoid conduit routing due to the relocation of equipment. m) To avoid conduit routing due to the relocation of equipment. n) To avoid conduit routing due to the relocation of equipment. o) To avoid conduit routing due to the relocation of equipment. p) To avoid conduit routing due to the relocation of equipment. q) To avoid conduit routing due to the relocation of equipment. r) To avoid conduit routing due to the relocation of equipment. s) To avoid conduit routing due to the relocation of equipment. t) To avoid conduit routing due to the relocation of equipment. u) To avoid conduit routing due to the relocation of equipment. v) To avoid conduit routing due to the relocation of equipment. w) To avoid conduit routing due to the relocation of equipment. x) To avoid conduit routing due to the relocation of equipment. y) To avoid conduit routing due to the relocation of equipment. z) To avoid conduit routing due to the relocation of equipment.

3) Install junction boxes and pull boxes to facilitate wire pulling as indicated on the drawings.

4) To meet cable manufacturer's pulling tension requirements.

5) To limit total conduit bends between pull locations.

6) Install junction boxes and pull boxes at locations acceptable to the Engineer.

7) The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:

1) The Engineer is the sole source in determining whether the change is constituted as a deviation:

2) Perform any changes resulting in additional conduits, or extra work from such deviations.

3) Incorporate any deviations on the Record Documents.

2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.

3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:
- Clearance of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.
 - Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
 - Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
 - Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8-inch on wall on an accepted preformed channel:
- Do not run conduits within water-bearing walls unless specified on the Drawings.
5. Do not install 1-inch or larger conduits in or through slabs unless approved by the Engineer.
6. Run conduits exposed to view parallel with or at right angles to floors, walls, or lines of the building:
- Install straight and true conduit runs with no offsets, and bends.
 - Make changes in direction with listed conduit elbows.
7. Install conduits with total conduit bend angle less than or equal to 270 degrees.
8. Route all exposed conduits to provide clearance and work space, and to prevent tripping hazards:
- Install conduit runs to provide proper and safe operation of equipment and do not obstruct access or egress, including equipment-repair access.
 - Route conduits to avoid utility lines. Where conflicts occur, relocate utility lines.
9. When installing conduits through slabs or walls, make provisions for locating any possible conduit penetration. Use tone signal or X-ray method. Penetrations will be made into the existing concrete containing cables, etc.
10. Provide access to boxes, manholes, handholes, and other openings until installation is complete.
11. Provide door and floor seals where indicated on the Drawings.
12. For 1-inch and larger conduit runs, snake conduits with a conduit mandrel of a cylindrical mandrel of a diameter not less than 85 percent of the conduit:
- Replace conduits through which mandrel will not pass.
 - Provide sleeves and openings required for the passage of electrical raceways or conduits when these openings or sleeves are not specifically indicated on the Drawings.
13. Complete conduit systems before conductors are installed.
14. Seal metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.
16. Underground conduits:
- Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:
 - As specified in the Duct Banks section.
 - Make underground conduit size transitions at handholes and manholes.
 - Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and handholes.

d. Seal around conduit penetrations of below grade walls with a mechanical seal.

C. Lighting and receptacle conduits:

1. Provide conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:
2. Install conduits in accordance with the requirements of this Section unless otherwise indicated.
3. Minimum conduit size:
 - a. 3/4-inch for exposed conduits.
 - b. 1-inch for underground or in-slab conduits.
4. Provide conduit materials for the installed location as specified in the Common Work Results for Electrical section.

D. Hazardous areas:

1. As specified in the Common Work Results for Electrical and specific Class and Division.
2. As specified in the Hazardous Classified Area Classification and its area conduit installation requirements.

E. Conduit usage:

1. Exposed conduits:
 - a. Rigid conduit:
 - 1) Install the rigid conduit in accordance with the Common Work Results for Electrical.
 - 2) Minimum size: 3/4-inch.
 - b. Flexible conduit:
 - 1) Use flexible conduit between rigid conduit and motors, vibrating equipment, or where required for equipment.
 - a) Use flexible conduit.
 - b) Use flexible conduit in Division 1 locations.
 - 2) Use flexible conduit for connection to instruments.

	Flexible Conduit Length (inch)
	18
	18
	18
	18
	36
2-1/2	36
3	36
3-1/2	38
4	40

b) Removable instruments or hinged equipment:

- (1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
 - a. Straight runs and bends less than 45 degrees:
 - 1) Type PVC Schedule 40.
 - b. Bends with total deflection greater than 45 degrees;
 - 1) PCS,
 - c. Entering and exiting duct bank, underground or embedded conduit runs a minimum 12 inches above and below grade, finished floor, or entering equipment:
 - 1) PCS.
 - d. Minimum size:
 - 1) 2-inch in duct banks.
 - 2) 1-inch for in-slab conduits.
 - 3) Provide conduit fittings to enlarge the conduit from minimum to the conduit schedule as required.
 3. PVC-coated rigid metallic conduit:
 - a. Use specifically manufactured or machined three-piece fittings and couplings to specifications to accommodate the PVC jacket.
 4. GRC:
 - a. Conduit shall be cut square and reamed.
- F. Conduit joints and bends:
1. General:
 - a. Where conduit is underground, it shall be protected from the weather, or in NEMA Type 4 or NEMA 7 environments, it shall be watertight.
 - b. Keep bends and offsets to a minimum.
 - c. All bends shall be symmetrical.
 - d. The following conditions apply to sweep elbows:
 - 1) Underground.
 - 2) Conduits 1/2-inch and larger.
 - e. Provide large enough bends for 1-1/4-inch trade size or larger.
 - f. Make field bends tighter than the requirements found in the NEC:
 - 1) The minimum bend radius of the cable must be less than the radius of the bend.
 2. Bending:
 - a. Use power bending equipment or manual benders for the purpose:
 - 1) To ensure that the conduit is not damaged and the internal diameter is not effectively reduced.
 - 2) To avoid creating sharp bends that could damage the conduit.
 - b. When bending conduits, make bends to meet their requirements. Do not create flattened, or kinked conduit.
 - c. Cut rigid metallic conduit with a standard conduit-cutting die that creates a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
 - d. Thoroughly ream conduit after threads have been cut to remove burrs.
 - e. Use bushings or conduit fittings at conduit terminations.
 - f. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing "Galvabar™," or CRC "Zinc It."
 - g. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
 - 1) Apply to the male threads and tighten joints securely.
 - 2) Clean excess sealant from exposed threads after assembly.
 - h. Securely tighten all threaded connections.

- g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.
3. PVC:
- Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.
 - Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at all bends:
 - Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.
- G. Conduit sealing and drainage:
- Conduit drainage and sealing other than required for hazardous areas:
 - Provide sealing and drainage in vertical drops of long runs. For exterior, above-grade conduit runs at the points at which they enter buildings, switchgear, control panels, lighting panels, and other enclosures.
 - Provide seal fittings with drains in vertical drops of long runs. For exterior and above-grade conduit runs that are exposed to weather, provide seal fittings with drains in vertical drops of long runs.
 - Provide conduit seals with drains in areas subject to changing temperatures:
 - Where portions of an interior run are exposed to ceilings, or floors that separate adjacent areas with different temperatures.
 - Provide conduit seals similar to those used for all conduits between corrosive and non-corrosive areas.
 - Seal one end only of a run at the first point with O-Z/Gedney sealing (non-hazardous).
 - Install seals with drains in areas where moisture may condense or accumulate, but is not limited to, the following locations: control panels, switchgear, or low points of the conduit.
- H. Conduit supports:
- General:
 - Provide supports, fasteners, and seismic restraints to suit the conditions and the type of conduit being installed. Refer to the Fasteners and Supports section.
 - Use materials consistent with the type of conduit being installed. Refer to the Common Work Results for Electrical section.
 - Supports must be installed at the intervals required by the NEC.
 - Wire ties and plumbers tape are not acceptable for conduit supports.
 - For concrete or masonry:
 - Use malleable iron straps with metallic or plastic expansion anchors and support from preset inserts.
 - Use preset inserts in concrete when possible.
 - Use pipe spacers (clamp backs) in wet locations.
 - For steel conduit:
 - Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.
 - For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2-feet long, provide rigid sway bracing.
 - Supports at structural steel members:
 - Use beam clamps.
 - Drilling or welding may be used only as specified or with approval of the Engineer.
 - PVC-coated rigid metal systems:

- a. Provide right-angle beam clamps and "U" bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC-encapsulated nuts that cover the exposed portions of the threads.
- b. Securely fasten exposed conduits with Type 316 stainless steel clamps or straps.

I. Expansion or expansion/deflection fittings:

1. General:
 - a. Align expansion coupling with the conduit run to prevent binding.
 - b. Follow manufacturer's instructions to set the piston opening.
 - c. Install expansion fittings across concrete expansion joints and other locations where necessary to compensate for thermal or mechanical expansion and contraction.
 - d. Furnish fittings of the same material as the conduit system.
2. For metallic conduit, provide expansion or expansion/deflection fittings, where appropriate, where:
 - a. Install expansion fittings a minimum of every 50 feet.

J. Empty conduits:

1. Provide a polyethylene rope rated at 250 lb. for every 100 feet of empty conduit more than 10 feet in length.
2. Seal ends of all conduits with approved caps, or plugs immediately after installation:
 - a. Keep ends sealed until immediately before use.

K. Miscellaneous:

1. Seal roof penetrations for conduits that penetrate the roof in accordance with roofing requirements and as indicated on the Drawings.
2. Provide electrical tape or other approved sealant on open ends of rigid conduit systems that cannot otherwise be sealed:
 - a. Running conduits are not allowed.
3. Replace any conduits or fittings that the Engineer determines do not meet the requirements of this section.

3.4 ERECTION, INSTALLATION, AND MAINTENANCE OF CONDUITS, CONSTRUCTION (NOT USED)

3.5 REPAIR/REPLACEMENT OF CONDUITS

3.6 REPAIR/REPLACEMENT OF

3.7 (b) (3)

2. (b) (3)

the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

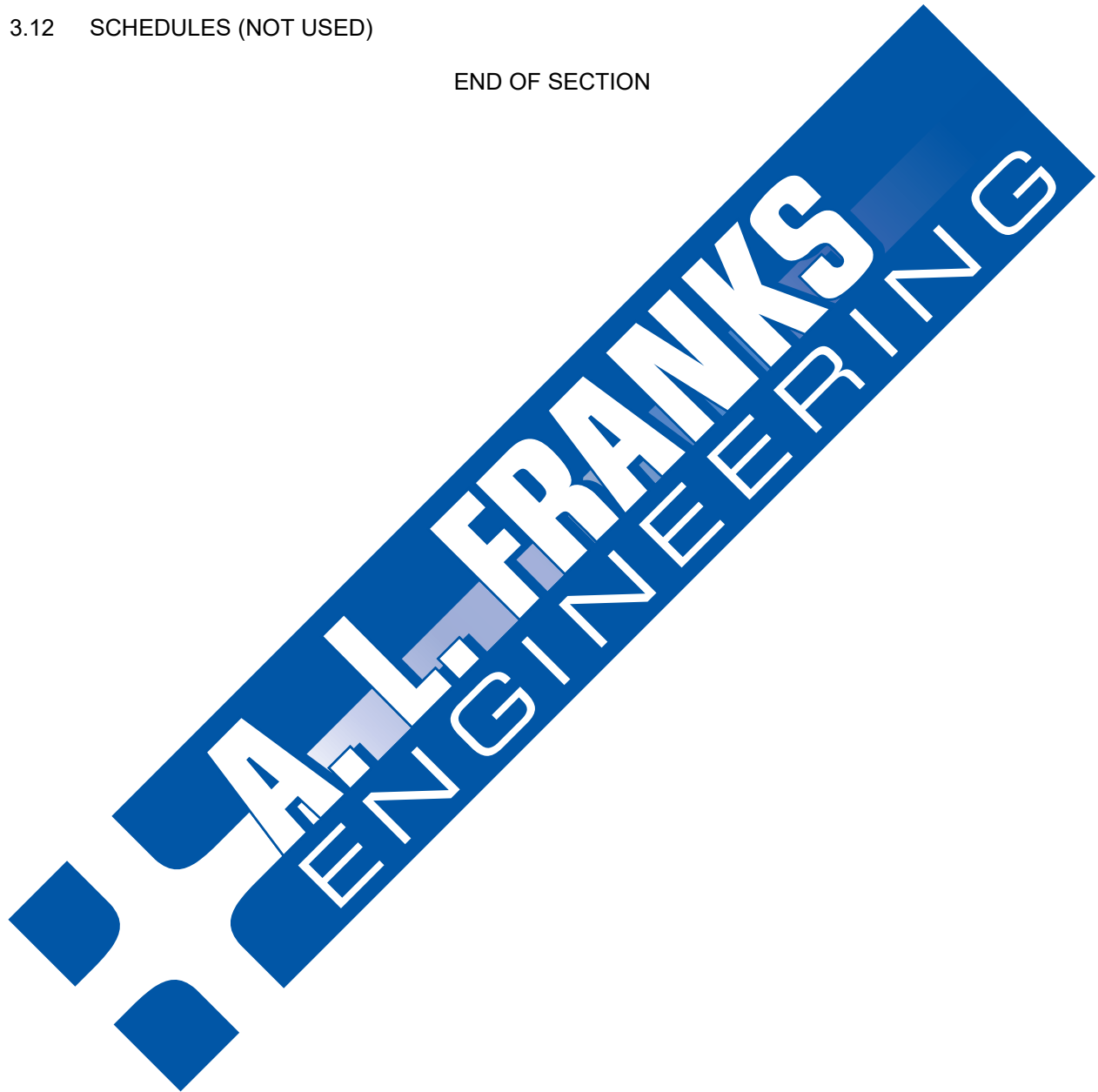
3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION



SECTION 261330

DUCT BANKS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Electrical underground duct banks.
 - 2. Duct bank installation requirements.

1.02 REFERENCES

- A. As specified in the Common Work Results for Electrical

1.03 DEFINITIONS

- A. As specified in the Common Work Results for

1.04 SYSTEM DESCRIPTION

- A. Provide trenching, forming, spacing, and compaction necessary for the complete installation of the duct banks.
- B. Provide concrete duct bank enclosures, on grade, on the site, below structures, or in contact with structures, as indicated on the Drawings.

1.05 SUBMITTALS

- A. Furnish submittals in accordance with the General Procedures section and the Common Work Results for Electrical section.
- B. Product data for:
 - 1. Marking tape.

Submit drawings of duct banks including underground profiles indicating all utilities.

Submit drawings of duct bank routings crossing under building footers or foundations alternative to the routings indicated on the Drawings:

Submit shop drawings detailing the new building footer crossing locations and plan drawings labeling all equipment to be installed on top of the new routing for approval by the project Structural Engineer.

1.06 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.09 SEQUENCING

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Conduit spacers:

1. One of the following:

- a. Carlon Snap
- b. Cantex.
- c. Osburn

B. Detectable

1. One

C.

or equal:

Associates, Inc.

following or equal:

OZ Gedney type DUX.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Provide conduit as specified in the Conduits section:

1. Use duct suitable for use with 194 degree Fahrenheit rated conductors.

2.04 MANUFACTURED UNITS

- A. Conduit spacers:
 - 1. Provide conduit spacers recommended by the conduit manufacturer or specified above.
 - 2. Saddle type.
 - 3. Non-metallic, non-corrosive, non-conductive.
 - 4. Interlocking type:
 - a. Vertical interlocking.
 - b. Horizontal interlocking.
 - 5. Suitable for concrete encasement.
 - 6. Molded-in rebar holder.
 - 7. Accommodates 2-inch through 6-inch conduit sizes.
 - 8. Relieves the conduit from both horizontal and vertical stress.
- B. Pull line:
 - 1. Minimum 1/4-inch wide, flat design.
 - 2. Polyester.
 - 3. Minimum pulling strength 1,200 pounds.
- C. Detectable marking tape:
 - 1. Provide a detectable tape, located 12 inches from above the undisturbed grade.
 - 2. Aluminum core laminated between two layers of polyester.
 - 3. 6-inch wide red tape imprinted with the words "CAUTION - BURIED ELECTRIC LINE BELOW".
- D. Duct seal:
 - 1. Non-hardening.
 - 2. Flexible, can be removed.
 - 3. UL Listed for use with electrical conduit.

- 2.05 EQUIPMENT (NOT USED)
- 2.06 COMPONENTS (NOT USED)
- 2.07 ACCESSORIES (NOT USED)
- 2.08 ' (NOT USED)
- 2.09 ' (NOT USED)
- 2.10 ' (NOT USED)
- 2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

- 3.01 EXAMINATION (NOT USED)
- 3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Duct banks:
1. Install duct banks encased in concrete at least 24 inches below finish grade, unless otherwise indicated on the Drawings.
 2. Damage minimization:
 - a. Conduit should not be left exposed in an open trench longer than necessary.
 - b. Protect all underground duct banks against damage during placement of concrete or backfilling.
 3. All plastic conduit fittings to be joined should be exposed to the weather under these conditions for a reasonable length of time before assembly.
 4. Provide No. 4/0 American Wire Gauge bare copper grounders to be installed in each duct bank and bond to the grounding system at each manhole.
 5. Install underground ducts to be self-draining:
 - a. Slope duct banks away from buildings to manholes.
 - b. Slope duct banks uniformly from manholes, handholes, or pullboxes or both ways to manholes, handholes, or pullboxes.
 - c. Slope a minimum of 1/4 inch per foot.
 6. Where new duct banks join to existing duct banks at pullboxes, make the proper fittings and fabricate the transitions to be smooth and durable.
 7. Install pull line in spare conduit:
 - a. Provide adequate lubrication to facilitate conductor pulling.
 - b. Cap above ground end with screw-on conduit caps.
- C. Trenching:
1. Trench must be bottom, rock free and covered with select material.
 2. When trench is to be encased in concrete:
 - a. Soil is not self-supporting.
 3. A trench must be able to support conduits, cables, and other utilities.
- D. Duct banks:
- Manufactured plastic spacers using a minimum space between adjacent conduits of 2 inches, unless otherwise indicated on the Drawings.
- For medium voltage ducts a minimum of 7.5 inches on center.
- To maintain uniform spacing of duct assembly a minimum of 4 inches on center.
- Bottom of the trench during concrete pour. Install spacers on 8-foot intervals:
- Due to some distortion of conduit from heat, and other means, it may be necessary to install extra spacers within the duct bank:
- 1) Install the intermediate set of spacers within normal required spacing to maintain the proper horizontal clearance:
 - a) Clearance is required to allow the proper amount of concrete to infiltrate vertically among the duct to ensure proper protection.
 3. Spacers shall not be located at the center of a bend:
 - a. Locate spacer in the tangent, free of the coupling on fabricated bends.
 - b. Locate spacers midway between the tangent and the center bend on trench formed sweeps.

- E. Terminating:
1. Use bell ends in duct at entrances into cable vaults.
 2. Make conduit entrances into cable vaults tangential to walls of cable vault.
 3. Form trapezoidal transitions between duct bank and cable vaults as needed in order to ensure adequate cable bending radius for the duct bank-to-vault transition.
 4. Install duct seal in all conduits including spare conduits, at entrance to manholes/handholes, and building/equipment stub-ups. Form by hand to conduit and around cables to develop moisture barrier.
 5. New manhole or handhole applications, provide a single opening or "window" per duct bank, sized to accommodate the duct bank envelope.
- F. Concrete:
1. Provide nonferrous tie wires to prevent displacement of the concrete from the center of concrete:
 - a. Tie wire shall not act as a substitute for spacers.
 2. Install minimum 3-inch cover around conduit and manhole/handhole.
 3. Consolidation of encasement concrete around conduits and manhole/handhole, with no mechanical vibration.
 4. Conduit is subject to temperature rise. As temperature rises, conduit tends to expand by pouring the concrete from the center.
- G. Marking tape:
1. Install a detectable marking tape along the entire length of the duct bank.

3.04 ERECTION, INSTALLATION, APPLICATION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTMENT

3.10

Remove old material and debris by use of an appropriately sized steel mandrel no less than the inside diameter of the conduit.

3.11

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide shoring and pumping to protect the excavation and safety of workers.

C. Protect excavations with barricades as required by applicable safety regulations.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 261340

BOXES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Device boxes.
 - 2. Raceway system boxes.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. American Association of State Highway and Transportation Builders (AASHTO):
 - 1. Standard Specifications for Highway Bridges, 17th Edition, 2002.
- C. ASTM International (ASTM):
 - 1. A47 - Standard Specification for Steel Wire Rods and Bars.
 - 2. D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Room Temperature and Power Frequencies.
 - 3. D495 - Standard Test Method for Determining the Dry Arc Resistance of Solid Electrical Insulating Materials.
 - 4. D570 - Standard Test Method for Water Absorption of Plastics.
 - 5. D648 - Standard Test Method for Determining the Temperature of Plastics Under Flexural Load in the Elongation Region.
 - 6. D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 7. D792 - Standard Test Method for Determining the Density and Specific Gravity (Relative Density) of Plastics.
- D. Joint Industry Project (JIP).
- E. Underwriters Laboratories (UL):
 - 1. UL 94 - Standard for Flammability of Plastic Materials for Parts in Devices and Appliances.

Refer to the Common Work Results for Electrical section.

Definitions:

Switching parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.

Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.4 SYSTEM DESCRIPTION

- A. Provide outlet boxes for devices such as switches, receptacles, telephone and computer jacks, security systems, junction, and pullboxes for use in the raceway systems, etc.

- B. Provide boxes as indicated on the Drawings or as needed to complete the raceway installation.

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

- B. Product data:

1. Manufacturer.
2. Materials.
3. Dimensions:
 - a. Height.
 - b. Width.
 - c. Depth.
 - d. Weight.
 - e. NEMA rating.
4. Conduit entry locations.
5. Catalog cut sheets.
6. Installation instructions.

- C. Shop drawings:

1. Include identification and sizes of pullboxes.

1.6 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.

- B. Regulatory requirements:

1. Outlet boxes shall comply with the following:
 - a. JIC.
 - b. NEC.
 - c. NEMA.
 - d. UL.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT CLOSEOUT

- A. As specified in the Common Work Results for Electrical section.

1.9 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.10 SCHEDULE (NOT USED)

1.11 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. One of the following or equal:
 - 1. Cast device boxes:
 - a. Appleton.
 - b. Crouse - Hinds.
 - c. OZ/Gedney.
 - 2. Stainless steel enclosures:
 - a. Hoffman.
 - b. Stahlin.
 - c. Rittal.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS

- A. Cast device boxes:
 - 1. Construction:
 - a. With internal green paint.
 - b. Furnished with mounting lugs.
 - c. With integral mounting lugs.
 - d. Conduit size 1/2 inch to 1 inch.
 - e. Tapered top for mounting.
 - 2. Malleable iron boxes:
 - a. Cast in accordance with ASTM A510.
- B. Plastic enclosures:
 - 1. Construction:
 - a. With internal green paint and screw.
 - b. With integral mounting lugs.
 - c. With integral mounting lugs when surface mounted.
 - d. Mounting lugs from 3/4 inch to 1 inch.
 - e. With a nominal 0.002-inch (2 mil) urethane on both the interior and exterior.
 - f. With application of PVC coating.
 - g. With a minimum 0.040-inch (40 mil) PVC coating bonded to exterior.
 - h. With a pressure sealing sleeve to protect the connection with conduit.
- C. Class I, Division 1 areas:
 - a. Provide boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
 - a. The approval ratings must be permanently marked on each item.
- D. Class I, Division 2 areas:
 - 1. For boxes not containing arcing parts:
 - a. As specified in the Common Work Results for Electrical section.
 - b. Pressed metal boxes are not allowed.
 - 2. For boxes containing arcing parts provide:
 - a. Boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
 - 1) The approval ratings must be permanently marked on each item.

3. Cast iron Cast copper - free aluminum box and cover.
4. Precision machined flame path between box and cover with neoprene o-ring.
5. For applications requiring hinged cover, provide flexible hinge mounting either left or right side.
6. External flange.
7. Provisions for mounting pan.
8. Ground lug.
9. Stainless steel:
 - a. NEMA Type 4X:
 - 1) Boxes in locations subject to flooding or temporary submersion.
 - a) NEMA Type 6.
 - b. Fabricated from 14-gauge Type 316 stainless steel.
 - c. All seams continuously welded.
 - d. Door:
 - 1) Rolled lip around 3 sides.
 - 2) Attached to enclosure by means of a continuous pin.
 - e. Neoprene door gasket to provide a watertight seal.
 - 1) Attached with an adhesive.
 - 2) Retained by a retaining strip.
 - f. Fabricate all external removable hardware from heavy gauge stainless steel enclosure body from heavy gauge stainless steel.
 - 1) With a hasp and staple for panel.
 - g. Provide large enclosures with door for rigidity.
 - h. No holes or knockouts.
 - i. Finish:
 - 1) Brushed.
 - j. Stainless steel external mounting.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

A. Fasteners:

1. Ele boxes with wiring devices.
2. Sealed fasteners:

B. Hinges where appropriate.

panels where required for mounting of terminal strips or other

steel shoulder studs.

white polyester powder finish.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. General:

1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in the Common Work Results for Electrical section.
2. Provide outlet box materials to match the conduit system:
 - a. GRC - Cast ferrous boxes.
 - b. PCS - PVC coated cast ferrous boxes.
 - c. PVC - PVC boxes.
3. Solid type gang boxes:
 - a. For more than 2 devices.
 - b. For barriered outlets.
4. Support all wall mounted NEMA Type 1, 3R, 4, 4X, 5, 6, 12, 13, 16, 17, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

D. Pullboxes and junction boxes:

1. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.

2. Install pullboxes such that access to them is not restricted.

E. For boxes not indicated:

1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in the Common Work Results for Electrical section.
2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
 - a. One-piece, galvanized, pressed steel.
3. Ceiling boxes for flush mounting in concrete:
 - a. Deep, galvanized, pressed steel.
4. Outlet, switch, and junction boxes where surface mounted in exposed locations:
 - a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating.
5. Outlet, control station, and junction boxes for installation in corrosive locations:
 - a. Fiberglass reinforced polyester, stainless steel, or plastic compatible with the conduit system.
 - b. Furnished with mounting lugs.

F. Hazardous locations:

1. All metallic boxes, fittings, and joints shall utilize the same conduit system.
2. All threaded connections shall be wrench tight and all threads shall be fully engaged.
3. Conduits entering and exiting metallic boxes shall utilize the same conduit system and approved grounding bushings to bond the boxes to the conduit system.
4. Provide the following types of conduit:
 - a. Malleable iron bodies and fittings for wet or dry locations.
 - b. PVC coated conduit bodies and fittings for dry locations.

3.4 ERECTION, INSTALLATION, APPLICATION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 REINSTALLATION (NOT USED)

3.7 COMMISSIONING

A. As specified

3.8 FIELD QUALITY

A. As specified in the Common Work Results for Electrical section.

3.9 AS-BUILT

3.10

A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 261360

WIREWAY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Wireway systems as indicated on the Drawings.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. ICS-6 - Industrial Control and Systems: Enclosures
- C. Underwriter's Laboratories (UL):
 - 1. Article 870 - Wireways, Auxiliary Gutters, and Raceways

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.

1.4 SYSTEM DESCRIPTION

- A. System includes hardware, components, runs of wireway, fittings, covers, splices, barriers, and related accessories.
 - 1. Connections

1.5 SUBMITTALS

- A. Fabrication and installation of wireway systems as specified in the Common Work Results for Electrical section.
- B. Shop drawings:
 - 1. Show details of construction and materials.
 - 2. Show dimensions for construction and materials.
 - 3. Show dimensions for loading and span.
 - 4. Show enclosure type.
 - 5. Show dimensions:
 - a. Width.
 - b. Depth.
 - 6. Show weight of wireway sections and fittings.
 - 7. Complete bill of materials.
 - 8. Manufacturer's installation instructions.
- C. Shop drawings:
 - 1. Provide complete details and scaled drawings for the layout of the installed wireway system showing all components and proposed mounting details.
- D. Calculations:

1. Provide cross sectional area and fill calculations.
 - a. Cross sectional area and fill shall be in accordance with the NEC.
2. Provide structural calculations to ensure that the installed system meets all structural, seismic as specified in the Common Work Results for Electrical section, wind as specified in the Common Work Results for Electrical Requirements section at the Project Site with respect to support and mounting:
 - a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.6 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.
- B. Manufacturer qualifications:
 1. Member of NEMA for the manufacturer of wireway systems and capacities required.
- C. Wireway shall be UL listed and labeled.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

- A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING

- A. The Drawings indicating the wireway systems. Data presented on those drawings are as shown and planning can determine until final equipment selection.
- B. Specific distance and guidance but exact routing, locations, distance by actual field conditions. Make field surveys as part of the project.

1.10 SCOPE

1.11

- A. As specified in the Common Work Results for Electrical section.

1.12

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metallic wireway:
 - 1. One of the following or equal:
 - a. B-Line.
 - b. Hoffman.
 - c. Hammond.
 - d. Rittal Electromate.
- B. Non-metallic wireway:
 - 1. One of the following or equal:
 - a. Hoffman.
 - b. Carlon.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS (NOT USED)

2.5 EQUIPMENT

- A. Provide wireways as indicated on drawings:
 - 1. Type (lay-in or feed-through).
 - 2. Dimensions.
 - 3. NEMA enclosure type.
 - 4. Wireway material.

2.6 COMPONENTS

- A. Fittings:
 - 1. Elbow fittings. Construct as the straight runs.
 - 2. Tee fittings. Construct as the straight runs.

- B. Wireway material:
 - 1. Material specified in the Common Work Results for Electrical section.

2.8 MIXED (NOT USED)

2.9 FABRICATIONS (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. Manufactured in accordance with NEMA ICS-6.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions and route before ordering wireway:
 - 1. Make all necessary field measurements.
 - 2. Coordinate with all subcontractors and suppliers to determine structural dimensions and equipment dimensions to avoid all potential conflicts with other systems.

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Install the wireway per the manufacturer's guidelines and as required to meet the seismic and wind requirements at the project location.
- C. General:
 - 1. Install in straight runs as much as possible.
 - 2. Expansion fittings:
 - a. Install as recommended by the manufacturer to allow for thermal expansion.
 - b. Install where wireway crosses walls, floors, or ceilings.
 - 3. Fittings:
 - a. Not all fittings are required.
 - 1) Provide all fittings as required by the manufacturer.
 - 4. Wireway supports:
 - a. Support wireway per the manufacturer's instructions and as required by the seismic code.
 - b. Support wireway at the requirements of the wireway manufacturer.
 - c. Do not install wireway channels under the entire width of wireway.
 - d. Do not install wireway with manufacturer-approved fittings.
 - 5. Doors:
 - a. Doors to be opened minimum 90 degrees.
 - b. Provide access to doors for maintenance and future installations.
- D. Do not install wireway until after the NEC.
- E. Do not install wireway until after the complete raceway system is installed.
- F. Do not install wireway surfaces and accessories are smooth, free from burrs or sharp edges.
- G. Do not install wiring that is UL listed for wireway use.
- H. Penetrations:
 - a. Do not terminate wireway on both sides of penetration, and penetrate wall via conduits:
 - 1) Seal all open spaces inside and around conduits where they penetrate building exterior walls or fire-rated walls.
 - 2) Fill spare conduits with sealing compound.
 - 3) Provide sealing material in accordance with all applicable codes and regulations.

3.4 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 PRE-INSTALLATION (NOT USED)

3.7 COMMISSIONING

A. As specified in the Commissioning section.

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

B. Inspect entire wireway system for the following:

1. Secure anchoring.
2. Proper supports.
3. Burrs or sharp edges.
4. Sufficient clearance from ducts and piping, especially for fire protection.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

SECTION 262720

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Enclosed dry-type transformers:
 - a. Rated 1 to 1,000 kilovolt-amperes, single and 3-phase.
 - b. Primary voltage 600 volts and below.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. 389 - IEEE Recommended Practice for Testing and Rating of Inductors.
 - 2. C57.12.01 - IEEE Standard General Requirements for Liquid-Immersed and Power Transformers Including Those with Solid Dielectric and Windings.
 - 3. C57.96 - IEEE Guide for Loading Dry-Type Transformers.
- C. National Electrical Manufacturers Association (NEMA)
 - 1. 250 - Enclosures for Electric Equipment.
- D. Underwriters Laboratory (UL)
 - 1. 1561 - Standard for Power Transformers.
- E. U.S. Department of Energy (DOE)
 - 1. 10 CFR Part 431 - Energy Conservation for Certain Commercial and Industrial Equipment.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.
- B. In accordance with NEMA 250.
- C. In accordance with NEMA 250.

1.4

- A. For 1-phase, 60 hertz dry-type with voltage ratings, kilovolt-ampere capacities, and connections as indicated on the Drawings:
 - 1. Transformers shall provide full capacity at the Project elevation and environmental conditions specified in the Common Work Results for Electrical section after all derating factors have been applied.
 - 2. Suitable for continuous operation at full rating with normal life expectancy in accordance with IEEE C57.96.

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

- B. Product data:
 1. Catalog cut sheets.
 2. Nameplate data.
 3. Dimensions:
 - a. Height.
 - b. Width.
 - c. Depth.
 4. Inrush current.
 5. Insulation system and temperature constraints.
 6. Number and rating of taps.
 7. Sound levels.
 8. Connection diagrams:
 - a. Primary.
 - b. Secondary.
 9. BIL rating.
 10. Required clearances.
 11. Percent impedance.
 12. Efficiency.
 13. Certification of full capacity capability at the Project location.
 14. For equipment installed in structures designated seismic design category A, E, or F submit the following as specified in the Common Work Results for Electrical section:
 - a. Manufacturer's statement of seismic capacity and test data.
 - b. Manufacturer's special seismic certification and test data.
- C. Installation instructions:
 1. Detail the complete installation of equipment, including moving, and setting into place.
 2. For equipment installed in structures designated seismic design category A or B:
 - a. Provide manufacturer's recommended anchoring details for connecting equipment to support structure.
 3. For equipment installed in structures designated seismic design category C, D, E, or F:
 - a. Provide proposed anchoring details and anchoring details based on support conditions and seismic and wind loads as specified in the Common Work Results for Electrical section.
 - b. Submit supporting calculations.
 - c. Drawings shall be stamped by a professional engineer registered in the State of Arkansas.

1.6 QUALITY CONTROL

- A. As specified in the Common Work Results for Electrical section.

1.7 MATERIALS AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROTECTION OF EXISTING CONDITIONS

- A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. One of the following or equal:

1. General Electric.
2. Jefferson.
3. Schneider Electric.
4. Eaton.
5. ABB.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

- A. Cores:

1. Non-aging, grain-oriented silicon steel.
2. Magnetic flux densities below 1.8 Tesla.

- B. Windings:

1. High-grade magnet wire.
2. Impregnated assembly with no-setting varnish:
 - a. Cured to meet moisture resistance.
3. Material electrical resistance:
 - a. Copper.

2.4 MANUFACTURE

2.5 EQUIPMENT

- A. 15 kilovolt class windings.
Compliance with IEEE 389 test conditions, not to exceed:

Amperes Range	Audible Sound Level (db)
1-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1000	64

3. Taps:

- a. 15 kilovolt-amperes and less:
 - 1) Two 5 percent full capacity primary taps below rated voltage.

- b. 25 kilovolt-amperes and larger:
 - 1) Four 2.5 percent full capacity primary taps below rated voltage.
 - 2) Two 2.5 percent full capacity primary taps above rated voltage.
- c. Operated by a tap changer handle or tap jumpers accessible through a panel.
- 4. Terminals:
 - a. UL listed for either copper or aluminum conductors.
 - b. Rated for 75 degrees Celsius.
- 5. Daily overload capacities, at rated voltage and without reduction in life, in accordance with IEEE C57.96.

- B. Transformers less than 15 kilovolt-amperes:
 - 1. Insulation class: 185 degrees Celsius.
 - 2. Temperature rise: 115 degrees Celsius.

- C. Energy efficient transformers 15 kilovolt-amperes and larger:
 - 1. Insulation class: 220 degrees Celsius.
 - 2. Temperature rise: 80/115/150 degrees Celsius, except as follows:
 - a. 150-degree Celsius rise for dry-type transformers.
 - 3. Efficiency:
 - a. In accordance with DOE 10 CFR Part 431.

- D. Enclosures:
 - 1. Heavy gauge steel:
 - a. Outdoor: Moisture and water resistant in all openings and in a weather-protected enclosure.
 - b. Indoor: NEMA Type 2.
 - 2. Louvers to limit coil temperature, and case temperature rise to 50 degrees Celsius.
 - 3. Built-in vibration dampers from the enclosure:
 - a. Neoprene vibration dampers.

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

- A. Nameplates:
 - 1. Non-metallic:
 - a. Marked with the following information:
 - (1) Rated voltage.
 - (2) Rated power.
 - (3) Temperature rise.
 - (4) Insulation class.
 - (5) UL rating.
 - (6) Connection diagram.
 - (7) Weight.
 - (8) Manufacturer.
 - (9) The identification "transformer".
 - (10) Classes of cooling.
 - (11) Tap voltage(s).
 - (12) Vector diagram.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES

- A. Finish to consist of de-greasing, phosphate cleaning, and an electrodeposited manufacturer's standard gray enamel rust-inhibiting paint.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Install the equipment in accordance with the accepted industry practices and storage details to meet the seismic and wind load requirements at the project location.
- C. General:
 - 1. Floor, wall, platform, motor control center, and other equipment to be mounted, as indicated on the Drawings.
 - 2. Install where not in direct contact with the ground.
 - 3. Install on single layer vibration isolation pads on a smooth, level surface.
 - a. Manufacturers: The following are acceptable:
 - 1) Korfund.
 - 4. Make any necessary connections using liquidtight flexible conduit having neoprene gaskets and approved by the manufacturer.
 - 5. Ground the enclosure.
 - a. To an equipment grounding conductor.
 - b. To the frame of the enclosure.
 - 6. Floor mounted equipment:
 - a. Install on leveling pads.
 - b. Provide clearance space from walls or other enclosures for proper ventilation in accordance with the manufacturer's recommendations.

3.4 ERECTION, COMMISSIONING, CONSTRUCTION (NOT USED)

3.5 REPAIRS (NOT USED)

3.6 MAINTENANCE (NOT USED)

3.7 TESTING

- A. Refer to the Commissioning section.
- B. Factory tests:
 - 1. Applied voltage test to each winding and from each winding to the core:
 - a. 600-volt class winding 4.5 kilovolt.
 - 2. Induced voltage test at 2 times normal voltage and 400 hertz for 1,080 cycles.
 - 3. Voltage ratio and polarity.
 - 4. Sound level, performed in a test room with ambient sound level not exceeding 24 db.
 - 5. Perform all tests in accordance with UL 1561.

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING

A. Set the transformer taps as required to obtain nominal output voltage on the secondary terminals.

3.10 CLEANING

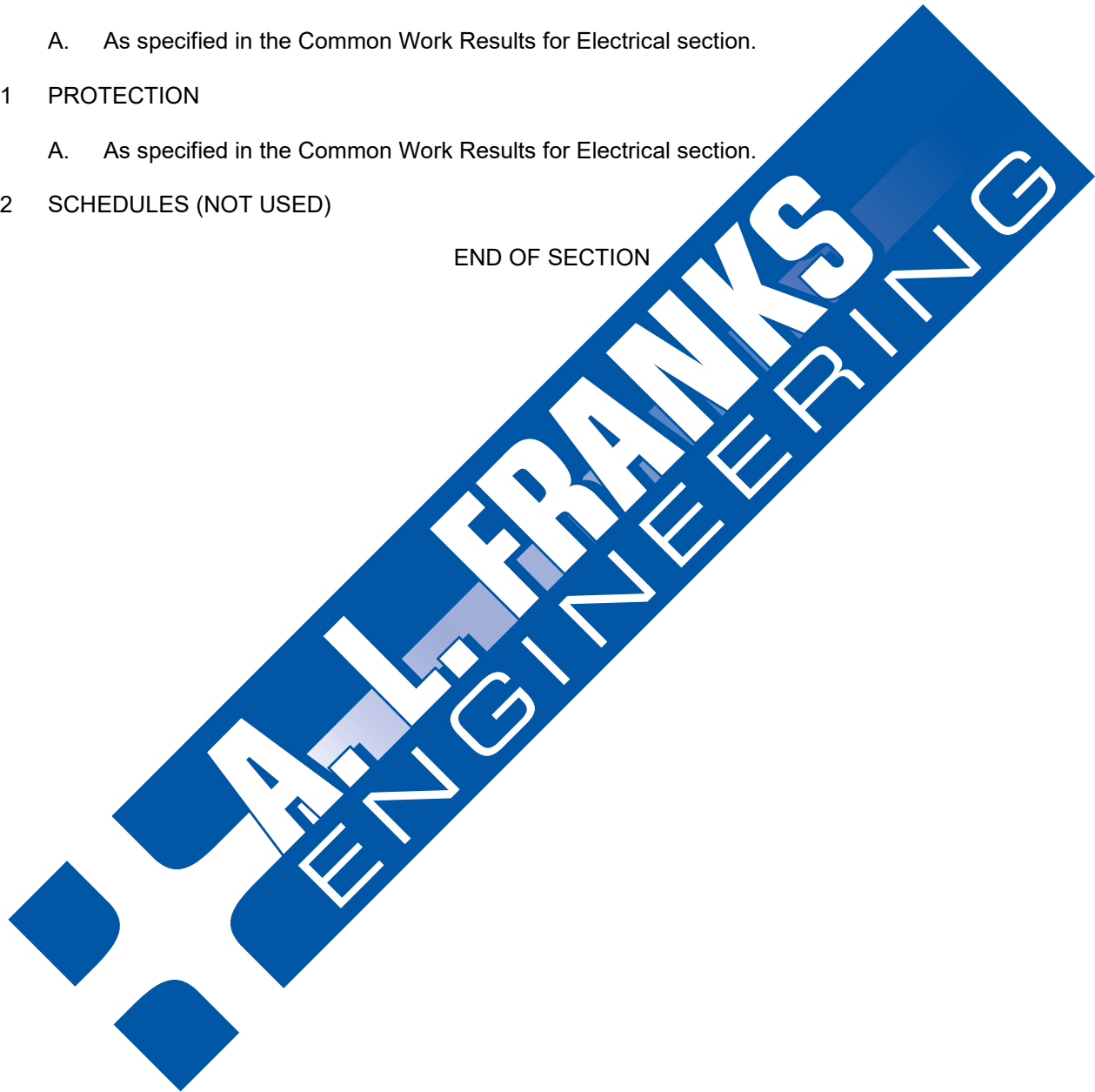
A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION



SECTION 262850

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. High-energy surge protective devices.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. Institute of Electrical and Electronics Engineers (IEEE):
1. C62.41.1 - Guide on the Surge Environment in Low-Voltage AC Power Circuits.
 2. C62.41.2 - Recommended Practice on Coordination of Low-Voltage (1000 V and Less) AC Power Circuits.
 3. C62.45 - Recommended Practice on Coordination of Low-Voltage (1000 V and Less) AC Power Circuits Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
 4. C62.62- Standard Test Specifications for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Entrance (100 V and less) AC Power Circuits.
- C. National Electrical Manufacturers Association (NEMA):
1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- D. Underwriters Laboratories (UL):
1. 1449, 489 - Surge Protective Devices.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.
- B. As specified in the Common Work Results for Electrical section:
1. Surge protective device.
 2. Surge protective device.
 3. Surge protective device.
 4. Surge protective device.

- C. Definitions:
1. Surge protective device.
 2. Surge protective device.
 3. Surge protective device.
 4. MCOV: Maximum continuous operating voltage.
 5. I_n : Nominal discharge current.
 6. VPR: Voltage protection rating.
 7. SCCR: Short circuit current rating.

1.4 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:

1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
2. Manufacturer's catalog cut sheets indicating:
 - a. Manufacturer and model numbers.
 - b. Ratings of each SPD including but not limited to:
 - 1) Short circuit current rating.
 - 2) Nominal discharge current.
 - 3) Maximum continuous operating voltage.
 - 4) Voltage protection rating.
 - 5) System voltage.
 - 6) System frequency.
 - 7) Surge current capacity.
3. Submit independent test data from a nationally recognized testing agency for the following:
 - a. Overcurrent protection.
 - b. UL 1449.

C. Shop drawings:

1. Provide electrical and mechanical drawings, including but not limited to:
 - a. Unit dimensions.
 - b. Weights.
 - c. Components.
 - d. Field connection location.
 - e. Mounting provisions.
 - f. Connection details.
 - g. Wiring diagram.

D. Operation and maintenance:

1. Provide the manufacturer's operation, start-up, spare parts lists, and operating instructions.

1.5 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. Equipment shall be designed, manufactured, tested and installed in compliance with the following standards:

IEEE Standard for Institute of Electrical and Electronics Engineers (IEEE C62.41.1, C62.41.2, C62.45,

IEEE Standard for Fiberoptic Interconnection Processing Standards Publication 94 (FIBS PUB 94).

International Electrotechnical Commission (IEC 60364).

National Fire Protection Association (NFPA 20, 75 and 780).

National Electric Code (NFPA 70).

Underwriters Laboratories (UL 1449 4th Edition and UL 1283).

International Electrotechnical Commission (IEC 801).

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.7 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.8 SEQUENCING

- A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.9 SCHEDULING (NOT USED)

1.10 WARRANTY

- A. As specified in the Common Work Results for Electrical section.
- B. Extended warranty:
 - 1. Furnish a manufacturer's full 5-year parts and labor warranty against any part failure when installed in compliance with instructions, UL listing requirements, and any applicable electrical codes.
 - 2. Warranty shall include:
 - a. Direct, factory trained employees must be available for assessment of the problem.
 - b. A 24-hour toll-free 800-number for voice and fax.

1.11 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. One of the following:
 - 1.
 - 2.
 - 3.

2.2

- A. Provide SPD units as an integral component of the electrical equipment or externally mounted on the Drawings.

2.3 CONNECTIONS (NOT USED)

2.4 MATERIALS (NOT USED)

2.5 MANUFACTURED UNITS

- A. Provide Type 1 or Type 2 SPD units as required for the locations indicated on the Drawings.
- B. Electrical requirements:
 - 1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
 - 2. MCOV:

- a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
3. Operating frequency:
 - a. 47 to 63 hertz.
4. SCCR:
 - a. 65 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.
 - b. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.
5. Nominal discharge current I_n :
 - a. 20 kA.
6. Maximum VPR:

Modes	<u>240/120</u>	<u>208Y/120</u>	
L-N, L-G, N-G	900	900	
L-L	1,200	1,200	

7. Peak surge current:
 - a. Service entrance locations:
 - 1) 240 kA per phase minimum
 - 2) 120 kA per mode minimum
 - b. Branch locations:
 - 1) 120 kA per phase
 - 2) 60 kA per mode
 - C. Protection modes:
 1. Provide SPD protection:
 - a. Line to Neutral
 - b. Line to Ground
 - c. Neutral to Ground
 - D. Environment:
 1. Storage temperature:
 - a. -40 to 140 degrees Fahrenheit.
 2. Operating temperature:
 - a. -40 to 140 degrees Fahrenheit.
 3. Humidity:
 - a. 5 to 95 percent.
 4. Sound:
 - a. 120 dBA at 5 feet (1.5 m).
 5. Altitude:
 - a. Up to 2,000 feet above sea level.
- protective devices that are suitable for application in IEEE C62.41.1, C62.41.2, B and C3 environments, as tested to IEEE C62.45.

2.6 EQUIPMENT (NOT USED)

2.7 COMPONENTS

- A. Enclosure:
 1. Located in electrical equipment as indicated on the Drawings.
 2. External mounting:
 - a. NEMA Type 4X enclosure:
 - 1) No ventilation openings.

- b. Hinged cover requiring a tool for internal access.
 - c. Internal drawing pocket.
 - d. All monitoring indications must be visible without opening the door.
 - B. Internal connections:
 - 1. Provide low impedance copper plates for intra-unit connections:
 - a. Attach surge modules using bolted connections to the plates for low impedance connections.
 - 2. Size all connections, conductors, and terminals for the specified surge current capacity.
 - C. Surge diversion modules:
 - 1. MOV:
 - a. Where multiple MOVs are used in parallel, utilize components with a maximum voltage within 1 volt variance and tested for manufacturing consistency.
 - D. Overcurrent protection:
 - 1. Individually fuse all components, including surge modules and surge diverters, and components:
 - a. Rated to allow maximum specified surge current.
 - b. Overcurrent protection that limits fault current to a level acceptable.
 - E. Connections:
 - 1. Provide terminals to accommodate surge current.
- 2.8 ACCESSORIES
- A. Unit status indicators:
 - 1. Provide red and green LEDs and printed labels, on the front cover to redundantly indicate status:
 - a. The absence of the red light indicate that a surge event has occurred and a surge module is needed to restore full operation.
 - b. Indicate status for each mode or phase.
 - B. Dry contacts:
 - 1. Provide dry contacts (1 A/125 VAC) for remote monitoring of SPD status, such as under voltage, phase and/or power loss.
 - C. Alarm:
 - 1. Alarm shall activate under any fault condition.
 - 2. Provide a manual switch to silence the alarm.
 - 3. Provide a status indicator to confirm whether alarm is On or Disabled.
 - 4. Provide visual and audible alarm on the unit's front cover.
 - D. Disconnect switch:
 - 1. Provide a manual disconnect switch located in-line with the SPD enclosure:
 - a. Switch shall be operable by a manual operator.
 - b. Switch shall disconnect all ungrounded circuit conductors from the SPD.
 - c. Integral disconnect switch shall be capable of withstanding, without failure, the maximum published surge current magnitude and short circuit current without failure or damage to the switch.
 - E. Interconnection cable:
 - 1. Interconnect the SPD to the power system using a manufacturer furnished assembly of low impedance coaxial cables installed in flexible conduit.
 - 2. Cable designed to transmit transients with minimal voltage drop.
 - 3. UL listed.

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL

- A. Permanently affix surge rating to the SPD.
- B. Perform manufacturer's standard factory test:
 - 1. Perform testing in accordance with UL 1449.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Follow the manufacturer's recommended installation with all applicable codes.
- C. Special techniques:
 - 1. Install the SPD with as short as possible grounding conductor as practically possible:
 - a. Twist the input and output conductor inductance.
 - 2. Interconnect the SPD with manufacturer supplied interconnection for coaxial cables installed in a flexible conduit.
 - 3. Do not subject SPD to testing.

3.4 ERECTION, INSTALLATION, AND COMMISSIONING INSTRUCTION (NOT USED)

3.5 REPAIR/REINSTATEMENT (NOT USED)

3.6 RE-INSTATEMENT (NOT USED)

3.7 COMMISSIONING

3.8 SOURCE QUALITY CONTROL

3.9 ACCEPTANCE TESTING (NOT USED)

3.10 CLEANUP (NOT USED)

3.11 PROTECTION

- A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26412

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Low voltage molded case circuit breakers.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. AB 3. - Molded Case Circuit Breakers and Thermal-Magnetic Switches.
- C. Underwriter's Laboratories (UL):
 - 1. 489 - Molded-Case Circuit Breakers, Molded Case Switches, and Combination Unit-Breaker Enclosures.
 - 2. 943 - Ground Fault Circuit Interrupters.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.
- B. In accordance with UL 489.

1.4 SYSTEM DESCRIPTION

- A. Molded case circuit breakers shall be air circuit breaker type circuit breakers as indicated on the Drawings and as specified in the completed system.

1.5 SUBMITTALS

- A. As specified in the Common Work Results for Electrical section.
- B. Time-current curves for all molded case circuit breakers furnished.

1.6 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.7 DELIVERY, STORAGE AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:

1. Eaton.
2. General Electric Co.
3. Schneider Electric.
4. ABB.

2.2 EXISTING PRODUCTS

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURERS

A.

1. Trip mechanism:
 - a. Quick-break, non-welding silver alloy contacts.
 - b. Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
 - c. Mechanically trip free from the handle.
 - d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped. Lockable in the "OFF" position.
2. Arc extinction:
 - a. In arc chutes.
3. Voltage and current ratings:
 - a. Minimum ratings as indicated on the Drawings.
 - b. Minimum frame size 100A.
4. Interrupting ratings:
 - a. Minimum ratings as indicated on the Drawings.
 - b. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).

- B. Motor circuit protectors:
 - 1. Instantaneous only circuit breaker as part of a listed combination motor controller.
 - 2. Each pole continuously adjustable in a linear scale with 'LO' and 'HI' settings factory calibrated.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS

- A. Terminals:
 - 1. Line and load terminals suitable for the conductor type, size, and application and conductors in accordance with UL 489.
- B. Case:
 - 1. Molded polyester glass reinforced.
 - 2. Ratings clearly marked.
- C. Trip units:
 - 1. Provide thermal magnetic or solid-state trip units in accordance with the Drawings.
 - 2. Thermal magnetic:
 - a. Instantaneous short circuit protection.
 - b. Inverse time delay overload.
 - c. Ambient or enclosure compensation element.
 - 3. Solid state:
 - a. With the following settings:
 - 1) Adjustable load.
 - 2) Adjustable short circuit.
 - 3) Adjustable overload.
 - 4) Adjustable ambient.
 - 5) Adjustable enclosure.
 - 6) Adjustable ambient and enclosure.
 - 7) Adjustable ambient and enclosure.
- D. Molded case circuit breakers:
 - 1. Not acceptable.
 - 2. Indicated on the Drawings.

2.7

2.8

2.9 EQUIPMENT (NOT USED)

2.10 EQUIPMENT (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. Test breakers in accordance with:
 - 1. UL 489.
 - 2. Manufacturer's standard testing procedures.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. Install breakers to correspond to the accepted shop drawings.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results.

3.9 ADJUSTING

A. Adjust trip settings in accordance with the Load Calculation Study as accepted by the Engineer and in accordance with the manufacturer's recommendations.

B. Adjust motor circuit protection in accordance with the manufacturer's recommendation based on the nameplate data of the installed motor.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULING

END OF SECTION

SECTION 264450

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Panelboards serving feeder circuits and branch circuits.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. Underwriter's Laboratories, Inc. (UL):
 - 1. 67 - Standard for Panelboards.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.

1.4 SYSTEM DESCRIPTION

- A. Circuit breaker panelboards, including schedules, one-lines, and where indicated on the Drawings:
 - 1. Service voltage and panel schedules.

1.5 SUBMITTALS

- A. Furnish submittals as specified in the Common Work Results for Electrical section.
- B. Product data:
 - 1. Manufacturer's name.
 - 2. Manufacturer's name.
 - 3. Manufacturer's name.
 - 4. Manufacturer's name.
 - 5. Manufacturer's name.
 - 6. Manufacturer's name.
 - 7. Manufacturer's name.
 - 8. Manufacturer's name.
 - 9. Manufacturer's name.
 - 10. Manufacturer's name.
 - 11. Manufacturer's name.
 - 12. Manufacturer's name.
 - 13. Manufacturer's name.
 - 14. Manufacturer's name.
 - 15. Manufacturer's name.
 - 16. Manufacturer's name.
 - 17. Manufacturer's name.
 - 18. Manufacturer's name.
 - 19. Manufacturer's name.
 - 20. Manufacturer's name.
 - 21. Manufacturer's name.
 - 22. Manufacturer's name.
 - 23. Manufacturer's name.
 - 24. Manufacturer's name.
 - 25. Manufacturer's name.
 - 26. Manufacturer's name.
 - 27. Manufacturer's name.
 - 28. Manufacturer's name.
 - 29. Manufacturer's name.
 - 30. Manufacturer's name.
 - 31. Manufacturer's name.
 - 32. Manufacturer's name.
 - 33. Manufacturer's name.
 - 34. Manufacturer's name.
 - 35. Manufacturer's name.
 - 36. Manufacturer's name.
 - 37. Manufacturer's name.
 - 38. Manufacturer's name.
 - 39. Manufacturer's name.
 - 40. Manufacturer's name.
 - 41. Manufacturer's name.
 - 42. Manufacturer's name.
 - 43. Manufacturer's name.
 - 44. Manufacturer's name.
 - 45. Manufacturer's name.
 - 46. Manufacturer's name.
 - 47. Manufacturer's name.
 - 48. Manufacturer's name.
 - 49. Manufacturer's name.
 - 50. Manufacturer's name.
 - 51. Manufacturer's name.
 - 52. Manufacturer's name.
 - 53. Manufacturer's name.
 - 54. Manufacturer's name.
 - 55. Manufacturer's name.
 - 56. Manufacturer's name.
 - 57. Manufacturer's name.
 - 58. Manufacturer's name.
 - 59. Manufacturer's name.
 - 60. Manufacturer's name.
 - 61. Manufacturer's name.
 - 62. Manufacturer's name.
 - 63. Manufacturer's name.
 - 64. Manufacturer's name.
 - 65. Manufacturer's name.
 - 66. Manufacturer's name.
 - 67. Manufacturer's name.
 - 68. Manufacturer's name.
 - 69. Manufacturer's name.
 - 70. Manufacturer's name.
 - 71. Manufacturer's name.
 - 72. Manufacturer's name.
 - 73. Manufacturer's name.
 - 74. Manufacturer's name.
 - 75. Manufacturer's name.
 - 76. Manufacturer's name.
 - 77. Manufacturer's name.
 - 78. Manufacturer's name.
 - 79. Manufacturer's name.
 - 80. Manufacturer's name.
 - 81. Manufacturer's name.
 - 82. Manufacturer's name.
 - 83. Manufacturer's name.
 - 84. Manufacturer's name.
 - 85. Manufacturer's name.
 - 86. Manufacturer's name.
 - 87. Manufacturer's name.
 - 88. Manufacturer's name.
 - 89. Manufacturer's name.
 - 90. Manufacturer's name.
 - 91. Manufacturer's name.
 - 92. Manufacturer's name.
 - 93. Manufacturer's name.
 - 94. Manufacturer's name.
 - 95. Manufacturer's name.
 - 96. Manufacturer's name.
 - 97. Manufacturer's name.
 - 98. Manufacturer's name.
 - 99. Manufacturer's name.
 - 100. Manufacturer's name.
- C. Shop drawings:
 - 1. Drawings to contain:
 - a. Overall panelboard dimensions, interior panel dimensions, and wiring gutter dimensions:
 - 1) Height.
 - 2) Length.

- 3) Width.
- b. Weight.
- c. Anchoring locations.
- d. Breaker layout drawing with dimensions:
 - 1) Location of the main, branches, solid neutral, and ground.
- e. Conduit entry/exit locations:
 - 1) Identify all conduit entry/exit locations and restrictions.
- f. Individual panel schedules identifying breaker locations, ratings, and nameplate designations within the panelboard, for every panelboard.

D. Installation instructions:

1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
2. For equipment installed in structures designated as seismic categories A or B:
 - a. Provide manufacturer's installation instructions for connecting equipment to supports and structures.
3. For equipment installed in structures designated as seismic categories C, D, E, or F:
 - a. Provide project-specific installation instructions based on support conditions and requirements as specified in the Common Work Results for Electrical section.
 - b. Submit anchoring drawings with calculations.
 - c. Drawings and calculations shall be reviewed by a professional engineer registered in the state where the project is located.

E. Operations and maintenance:

1. Provide a complete maintenance schedule for the panelboard, including circuit breakers, disconnects, and other components.
 - a. Including but not limited to:
 - 1) Insulation resistance testing.
 - 2) Load testing.
 - 3) Visual inspections.

F. Calculation:

1. Provide calculations to verify that the actual physical testing performed on the panelboard is suitable for the seismic requirements at the project location.

1.6

C. As specified in the Common Work Results for Electrical section.

D. All equipment shall be UL listed and labeled.

E. When designated as service entrance equipment, panelboards shall be UL labeled and listed as "Suitable for Service Entrance."

1.7

F. STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8

PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9

SEQUENCING (NOT USED)

1.10

SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. One of the following or equal:

1. Eaton.
2. General Electric Co.
3. Schneider Electric.

- B. Circuit breakers:

1. Same manufacturer as the panel.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS

2.5 EQUIPMENT

- A. Provide:

1. Circuit breakers with trip ratings as shown on the panel schedules.
2. Circuit breakers in panels as shown on the panel schedules.

3. Panelboards with short-circuit ratings as indicated on the Drawings:
 - a. In accordance with UL 67.

4. Panelboards with its maximum short circuit rating at the supply voltage.
 - a. Panelboards shall be fully rated.

5. Enclosure:

NEMA enclosure type as indicated on the Drawings.

- a. Where not indicated on the Drawings, as specified in the Common Work Results for Electrical section for the installed location.
2. Minimum width: 20 inches.
3. Gutter space in accordance with the NEC:
 - a. Minimum of 4 inches of gutter space.
4. Dead-front, no live parts when the panelboard is in service.
5. Enclose entire panelboard bus assembly in a corrosion resistant galvanized steel cabinet.

6. 4-piece front to provide ease of wiring access.
7. Lockable, hinged door over the protective devices with a flush, cylinder tumbler-type lock with catch and door pull.
 - a. Minimum 2 keys per panelboard.
 - b. Key all panelboard locks alike.
8. Circuit directory frame and card on the inside of the door.
9. Interior design such that replacement of circuit breakers does not require disturbing adjacent units or removal of the main bus connectors.
10. Outdoor locations: Provide NEMA Type 3R enclosures with a NEMA Type 3R outer enclosure (with a hinged door) and a NEMA Type 1 interior panelboard, unless otherwise indicated.

B. Bus:

1. General:
 - a. Tin-plated copper.
2. Phase bus:
 - a. Full size and height without reduction.
 - b. Dimensions and temperature rise in accordance with the following:
 - 1) Limit current density to less than 1.5 amperes per square centimeter.
 - c. Insulate all current carrying parts from ground with a high dielectric strength insulator.
3. Ground bus:
 - a. Copper, solidly bonded.
4. Neutral bus:
 - a. Provide where indicated.
 - b. 100 percent rated.
 - c. Provide lugs for neutral connection.
5. Provide insulation between the live bus and the dead front shield to provide increased safety.

C. Lugs:

1. UL listed:
 - a. Provide for all terminations.
 - b. Provide for all main lug terminations as required for the incoming conductors.

D. Circuit Breakers: Provide Low Voltage Molded Case Circuit Breakers section and

1. Provide circuit breakers with bolt-on connections:
 - a. Circuit breakers are not allowed.

2. Surge protective devices:

1. Provide surge protective devices on panelboards with surge protective devices as indicated on the Drawings. Specify in the Surge Protective Devices section.

3. Nameplates:

1. As specified in the Identification for Electrical Systems section.
2. Install on outside of door.
3. Indicating:
 - a. Panel designation.
 - b. Voltage.
 - c. Number of phases and configuration.

C. Circuit identification labels:

1. Provide index cards behind heavy clear plastic in cardholders on the inside of the doors.
 2. Type all information on the cards using designations in the panel schedules.
 3. Laminated on both sides.
- D. Pad locking mechanism:
1. Provide a pad locking attachment to allow circuit breakers to be locked in the off position.
 2. At a minimum, provide 1 mechanism per panelboard:
 - a. Provide multiple mechanisms if required to accommodate all circuit breaker frame sizes in the panelboard.
- 2.8 MIXES (NOT USED)
- 2.9 FABRICATION (NOT USED)
- 2.10 FINISHES
- A. Finish stand-alone panelboards with a primer, rust-inhibiting primer, and 2 coats of oven-baked enamel with manufacturer's recommended finish.
- B. Finish panelboards mounted in motor control center with motor control center finish and color.
- 2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

- 3.1 EXAMINATION (NOT USED)
- 3.2 PREPARATION (NOT USED)
- 3.3 INSTALLATION
- A. As specified in the results for Electrical section.
- B. Install in accordance with the accepted installation instructions and the seismic and wind load requirements at the Project site.
- 3.3.1 Mount MCC mounted as indicated on the Drawings.
- 3.3.2 Mount to structural members with exposed surfaces plumb and level to within 1/8 inch.
- 3.3.3 Install in accordance with the manufacturer's instructions and shop drawings.
- 3.3.4 Provide all brackets, hangers, supports, and hardware for mounting as required.
- 3.3.5 At all NEMA Type 4 and NEMA Type 4X locations, mount panelboards on 7/8-inch deep stainless steel preformed channel, with channel running vertically from top to bottom of panelboard:
- a. Use only stainless steel mounting hardware.
6. Mount panelboard so that top operating handle is not more than 6 feet-7 inches above the operating floor.
- 3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)
- 3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING

- A. Factory testing:
 - 1. Perform standard factory tests on the panelboards:
 - 2. Test in accordance with the latest version of NEMA and UL standards.

3.8 FIELD QUALITY CONTROL

- A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING

- A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

- A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES

- A. Circuiting within the panelboard shall be as indicated on the Drawings.
- B. Provide typewritten schedules.

SECTION 264720

PACKAGED POWER SUPPLY CENTER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Packaged power supply centers, a single integrated unit comprising:
 - a. Primary main breaker.
 - b. Dry-type transformer.
 - c. Branch circuit panelboard with main breaker.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. Underwriter's Laboratories, Inc. (UL):
 - 1. 50 - Standard for Enclosures for Electrical Equipment.
 - 2. 67 - Standards for Panelboards.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.

1.4 SYSTEM DESCRIPTIONS

- A. Packaged power supply center is a unit that provides a means for:
 - 1. Transforming voltage to the utilization voltage level.
 - 2. Primary distribution of power from the transformer.
 - 3. Distribution of power to the utilization voltage level.

1.5 SUBMITTALS

- A. As specified in the Common Work Results for Electrical section.

- B. Submittals including:
 - 1. Manufacturer's literature.
 - 2. Manufacturer's nameplate.
 - 3. Continuous current.
 - 4. Short circuit interrupting rating.
 - 5. Transformer kVA rating.
 - 6. NEMA enclosure type.
 - 7. Catalog sheets for circuit breakers contained within the panelboard.
 - 8. Cable terminal sizes based upon actual feeder and branch circuit conductors used.
 - 9. Furnish circuit breaker submittals as specified in the Low Voltage Molded Case Circuit Breakers section.
 - 10. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in the Common Work Results for Electrical section:

- a. Manufacturer's statement of seismic qualification with substantiating test data.
 - b. Manufacturer's special seismic certification with substantiating test data.
 - C. Shop drawings:
 1. Including but not limited to:
 - a. Overall dimensions, interior panel dimensions, and wiring gutter dimensions:
 - 1) Height.
 - 2) Length.
 - 3) Width.
 - b. Weight.
 - c. Anchoring locations.
 - d. Breaker layout drawing with dimensions:
 - 1) Location of the main, branches, solid neutral, and ground bus.
 - e. Conduit entry/exit locations.
 - f. Individual panel schedules identifying breaker location and designations within the panelboard, for each panel.
 - D. Operations and maintenance manual:
 1. Provide a complete manual for the operation and maintenance of the panelboard, circuit breakers, devices, and accessories:
 - a. Instruction narratives and bulletins.
 - b. Renewal parts lists.
 - E. Calculations:
 1. Detailed calculations or designations shall be performed on the packaged power supply centers to meet seismic requirements at the Project Site as specified in the Common Work Results for Electrical section.
 - F. Installation instructions:
 1. Detail the construction and installation including rigging, moving, and setting into place.
 2. For equipment designated as seismic design category A or B:
 - a. Provide installation instructions and anchoring details for equipment and structures.
 3. For equipment designated as seismic design category C, D, E, provide installation instructions and anchoring details based on seismic design requirements to resist seismic and wind loads as specified in the Common Work Results for Electrical section.
- 1.6. All calculations shall be stamped by a professional engineer in the state where the Project is being constructed.
- 1.6.1. A. As specified in the Common Work Results for Electrical section.
- 1.6.1. B. Packaged power supply centers shall be UL listed and labeled.
1. Where indicated as service entrance equipment, packaged power supply centers shall be UL labeled and listed "Suitable for Service Entrance."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:

1. Eaton.
2. Schneider Electric.
3. General Electric.

2.2 EXISTING PRODUCTS

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURERS

2.5 EQUIPMENT

1. Including panelboard bus assembly, main breakers, and galvanneal or galvanized steel cabinet:
 - a. NEMA Type 3R, suitable for outdoor use.
 - b. 1/2 inch thick steel gauge in accordance with UL 50.
 - c. 1/2 inch gutter space in accordance with UL 67.
 - d. Access door:
 - 1) Maintained in open position when desired.
 - 2) With padlock provisions to prevent unauthorized entry.
3. Dead-front panelboard construction.

B. Panelboard:

1. Bus:
 - a. General:
 - 1) Tin-plated copper.
 - b. Phase bus:
 - 1) Fully rated for the associated transformer.

- 2) Full size without reduction.
- c. Neutral bus:
 - 1) Ampere rating to match phase bus.
 - 2) Provide with suitable lugs for the maximum number of circuits that can be connected to the panel.
- d. Ground bus:
 - 1) Provide suitable lug space to provide a lug for each circuit including spaces.
2. Label panelboards with UL short circuit current rating.

2.6 COMPONENTS

- A. Primary and secondary main breakers:
 1. Sized to protect the transformer.
 2. Integrally mounted and wired.
 3. Provide as specified in the Low Voltage Molded Case Breakers section.
 4. Minimum interrupting rating as indicated on the Drawings.
 - a. Primary main breaker: 480 VAC, 65,000 AIC.
 - b. Secondary main breaker: As shown on the Drawings.
- B. Branch circuit breakers:
 1. As specified in the Low Voltage Molded Case Breakers section.
 2. Match circuit breaker arrangement as indicated on the Drawings.
 3. Circuit breakers shall not be installed in a row due to their physical size.
 4. Install circuit breakers so that they do not disturb adjacent units.
 - a. Provide wire connections as indicated on the Drawings.
- C. Transformer:
 1. General:
 - a. Minimum primary taps below normal.
 - b. Insulation class: 180-degree Celsius UL component recognized
 - c. Maximum temperature rise above 40 degrees Celsius maximum
 - d. Enclosure: Cast in place, as indicated on the Drawings.
 - e. Protection: As indicated on the Drawings.
 - f. Voltage: 480 VAC.
 - g. Secondary voltage: As indicated on the Drawings.

2.7

- A. Nameplates as specified in the Identification for Electrical Systems section.
- B. Circuit identification labels:
 1. Index cards behind heavy clear plastic in card holders on inside of doors:
 - a. Type all information on cards.
 2. Laminated on both sides.
 3. Circuit identification to follow panel schedules as indicated on the Drawings.
- C. Device locking mechanisms:

1. Provide a handle lock-off device for each circuit breaker that acts as an equipment or control panel disconnect.
2. Provide a handle lock-on device for each circuit breaker that acts as critical power systems breakers.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

- A. As specified in the Common Work Results for Electrical section.
- B. Install the equipment in accordance with the manufacturer's instructions and anchorage details to meet the requirements of the Project site.
- C. Provide any and all necessary supports, and hardware for mounting in the location as indicated.
- D. In all wet and dry locations, install on 7/8-inch deep stainless steel preformed mounting channels.
 1. The channels shall run from top to bottom of unit.

3.4 ERECTION, COMMISSIONING, AND CONSTRUCTION (NOT USED)

3.5 REPAIRS (NOT USED)

3.6 PROTECTION (NOT USED)

3.7 TESTING AND COMMISSIONING
 A. As specified in the Commissioning section.

3.8 INSTRUMENTATION AND CONTROL

- A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING

- A. Set transformer taps as required.

3.10 CLEANING

- A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION



SECTION 265100

LIGHTING: LED LUMINAIRES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: LED luminaires, drivers, poles, and accessories.

1.2 REFERENCES

- A. As specified in the Common Work Results for Electrical section.
- B. Illuminating Engineering Society of North America (IESNA) Methods of Measuring the Light Output of Solid-State Lighting Products.
1. LM-79 - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 2. LM-80 - IES Approved Method: Measuring the Light Output of LED Light Sources.
 3. TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources.
- C. Institute of Electrical and Electronics Engineers (IEEE) Recommended Practice for Low-Voltage AC Power Circuits.
1. C62.41 - IEEE Recommended Practice for Low-Voltage AC Power Circuits.
- D. National Electrical Manufacturers Association (NEMA) Performance Test for Switching Devices with Electronic Drivers and Discharge Lamps.
1. 410 - Performance Test for Switching Devices with Electronic Drivers and Discharge Lamps.
- E. Underwriters Laboratories (UL) Listing for Use In Lighting Products.
1. 1598 - Luminaires.
 2. 8750 - LED Lighting Products.

1.3 DEFINITIONS

- A. As specified in the Common Work Results for Electrical section.
- B. Definitions:
1. Color temperature - Scientific scale to describe how "warm" or how "cool" the light is, measured in Kelvin. The lower the Kelvin temperature, the warmer the light appears.
 2. Color Rendering Index - A quantitative measure of the ability of a light source to render colors of various objects faithfully in comparison with an ideal or natural light source.
 3. LED driver - Device that manages power and controls the current flow from AC to DC for LED lighting product.
 4. Efficacy - Lumen output of a light source per unit of power supplied to that source (lumens per watt).
 5. EMI: Electromagnetic Interference - Electrical interference (noise) generated by electrical and electronic devices.
 6. FC: Foot Candles - Measure of light level on a surface being illuminated.
 7. L70 - The extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from initial values.
 8. LED: Light emitting diode - A solid-state semiconductor device that produces light when electrical current flows through it.

c. Luminaire substitutions:

- 1) Provide complete literature for each luminaire substitution:
- 2) Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:
 - a) Photometric data:
 - (1) IES file in standard IES format.
 - (2) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
 - (3) Candlepower distribution curves.
 - (4) Average luminaire brightness.
 - (5) Lumen output charts.
 - (6) Power requirements in watts and volt-amps.
 - b) Calculations:
 - (1) Provide software generated calculations for footcandle and power levels in footcandles and power for each of the areas in which substituted.
 - (a) Use surface reflectance factors approved by the Engineer for calculations.
 - c) Specification sheets:
 - (1) If lacking sufficient data with contract documents, substitutions will not be accepted. This includes luminaire type designation, manufacturer, voltage, LED type, CCT, CRI, system efficacy, L70 life rating, and necessary to meet the requirements of the applicable building and energy codes.
- 3) Substitutions shall be evaluated upon quality of construction, use, appearance, and maintenance.
- 4) Substitutions shall comply with applicable building and energy codes.

2. Driver: Provide

- a. Catalog
- b. Technical
- c. Data
- d. Submittal

temperature range.

output range in ambient temperatures of 30 to 55 degrees Celsius.

depression data.

Comments:

Update the Luminaire Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

1.5 QUALITY ASSURANCE

- A. As specified in the Common Work Results for Electrical section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. As specified in the Common Work Results for Electrical section.

1.7 PROJECT OR SITE CONDITIONS

- A. As specified in the Common Work Results for Electrical section.

1.8 SEQUENCING (NOT USED)

1.9 SCHEDULING

- A. Exterior and outdoor lighting system operation shall be demonstrated during the hours of darkness.
- B. Lighting demonstration shall occur within 2 weeks before substantial completion.

1.10 WARRANTY

- A. As specified in the Common Work Results for Electrical section.
- B. LED luminaire:
 - 1. 5 year warranty from the date of installation for the luminaire, including the ballast, photometrics, driver, and LED modules.

1.11 SYSTEM START-UP

- A. As specified in the Common Work Results for Electrical section.

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE

- A. Furnish 1 complete maintenance manual for each type of luminaire used.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. As specified in the Luminaire Schedule.

allowing or equal:
Advance.
Thomas Research.
LidoLED.

- C. Substitutions:

- 1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and photometric requirements of the original design.

2.2 SYSTEM DESCRIPTION

- A. Provide luminaires, and accessories for all lighting systems, complete and operable, in accordance with the requirements of the Contract Documents.
- B. Individual luminaire types are indicated on the Drawings and on the Luminaire_Schedule.

2.3 EXISTING PRODUCTS (NOT USED)

2.4 MATERIALS (NOT USED)

2.5 MANUFACTURED UNITS (NOT USED)

2.6 EQUIPMENT

A. LED Luminaires:

1. General:
 - a. Pre-wired with leads of 18-AWG, minimum, for connection to circuits.
 - b. Provide the luminaires furnished per the following Drawings:
 - 1) The Specifications noted in the Contract Documents, Supplement to the Luminaire Schedule.
 - c. Individual LEDs connected so that the failure of 1 LED will not result in the loss of the luminaire.
 2. Minimum ambient temperature: 40 degrees Celsius.
 3. Minimum rated life:
 - a. Office Areas: 70,000 hours at 40 degrees Celsius.
 - b. Process Areas: 50,000 hours at 40 degrees Celsius.
 - c. Hazardous Areas: 50,000 hours at 40 degrees Celsius.
 4. Minimum efficacy:
 - a. Hazardous Areas: 100 lumens per watt.
 5. Minimum CRI: 90.
 6. Tested to meet UL 1598.
 7. Luminaire performance in accordance with IESNA TM-21.
 8. Recessed luminaires shall be designed for use in hazardous locations.
 9. Recessed luminaires shall be designed for use in hazardous locations.
 10. Locations as indicated on the Drawings or on the Luminaire Schedule.
- Luminaires shall be listed to UL 1598 listed.
- LED assembly. Retrofit LED lamps in luminaires not designed for LED lamps shall not be used.
- Luminaires:
- Luminaires in combination with their mounting pole and bracket shall be capable of standing:
- Wind levels at the project site without damage.
 - Seismic levels at the project site.
 - Corrosion-resistant hardware and hinged doors or lens retainer.
- Luminaires furnished with integral photoelectrical control shall be of the luminaire manufacturer's standard design.

B. Drivers:

1. Dimmable, with dimming signal protocol of 0-10 VDC or DALI.
2. Input power source:
 - a. As indicated on the Drawings.
3. Drive current:
 - a. As indicated in the Luminaire Schedule.
4. Power factor: greater than 0.90.

5. Efficiency: greater than 80 percent.
6. Total harmonic distortion (THD) of the input current less than 20 percent.
7. Rated life of 60,000 hours in an LED luminaire operated at an ambient temperature of 40 degrees Celsius.
8. Minimum operating temperature of 0 degrees Celsius.
9. Sound rating: Class A+ or quieter.
10. UL listed Class 2 Outdoor in accordance with UL 8750.
11. In accordance with IEEE C62.41 Category A for transient protection.
12. Driver must limit inrush current:
 - a. Meet or exceed NEMA 410 driver inrush standard:
 - 1) 230 Amps per 10 Amp load with a maximum of 106 Amps for 1/100 seconds at 120V.
 - 2) 430 Amps per 10 Amp load with a maximum of 106 Amps for 1/100 seconds at 277V.

2.7 COMPONENTS

2.8 ACCESSORIES (NOT USED)

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION

3.3 INSTALLATION

A. Verify all work Results for Electrical section.

B. Verify manufacturer's guidelines and submitted installation calculations to meet requirements at the project site.

1. Support luminaires from structural elements capable of carrying the total weight.
2. Install luminaires plumb and square with building and wall intersections:
 - a. Suspend pendant-mounted luminaires that are mounted from sloping ceilings with ball hangers, unless otherwise indicated on the Drawings.
 - b. Install luminaires in machinery rooms after machines have been installed, so as to ensure no conflict with machinery, piping, or ductwork.
3. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:
 - a. Locate bottom of luminaire approximately at the bottom of ductwork, unless otherwise specified or indicated on the Drawings.
4. Support luminaires weighing more than 25 pounds independently of the outlet box and the conduit.

5. Provide ceiling or pendent mounted luminaires with a safety chain connecting the lens, driver, and other components to the building structure.
6. Provide recessed luminaires with auxiliary safety supports attached directly to the building structure:
 - a. The safety supports shall consist of number 12 AWG soft drawn galvanized wires.
7. Install luminaires in accordance with the architectural reflected ceiling Drawings:
 - a. Center luminaires on ceiling tiles unless otherwise indicated.
8. Support luminaires installed in suspended grid ceilings, independently of the grid:
 - a. Provide seismic restraint clips for all luminaires installed in suspended grid ceilings.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

- A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING

- A. Aim and verify all exterior luminaires, during dark evening hours, as directed by Owner or the Architect.

3.10 CLEANING

- A. As specified in the Common Work Results for Electrical section.
- B. Clean all luminaires and support brackets, where finish has been damaged.
- C. Repair and replace damaged and support brackets, where finish has been damaged.
- D. Remove and replace (new and old), used during construction for construction lighting, as specified in the Common Work Results for Electrical section.

3.11 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.12 REPAIR/RESTORATION (NOT USED)

- A. As specified in the Luminaire Schedule in the Drawings.

END OF SECTION



GE

ETTL | Engineers & Consultants

GEOTECHNICAL * MATERIALS * ENVIRONMENTAL * DRILLING * LANDFILLS

September 4, 2025

Caleb Mudford
A.L. Franks Engineering
118 East Broad Street
Texarkana, Arkansas 71854

SUBJECT: North Texarkana WWTP
Texarkana, Arkansas
Geotechnical Investigation
ETTL Job No. G6576-256

Dear Caleb:

Submitted herein is the report summarizing the results of the investigation conducted at the site of the above-referenced project.

If you have any questions concerning this report or need assistance during construction, please contact us. We are available to provide materials testing and inspection services that you may require. Thank you for the opportunity of service.

Sincerely,
ETTL Engineers & Consultants



Reid Banta, EIT
Project Manager



Evan Felker, P.E.
Project Engineer



09/04/2025

Distribution: (PDF) A.L. Franks Engineering

Main Office

3527 Star Road, Whitehouse, TX 75791

Phone: 903-595-4421

Fax: 903-595-6613

Arlington, TX

*

Austin, TX

*

Texarkana, AR

W W W . E T T L I N C . C O M

Geotechnical Investigation

North Texarkana WWTP

Texarkana, Arkansas

Submitted to

A.I. C.

Prepared by

ETTL Engineers & Consultants Inc.
Tyler, Texas

September 2025

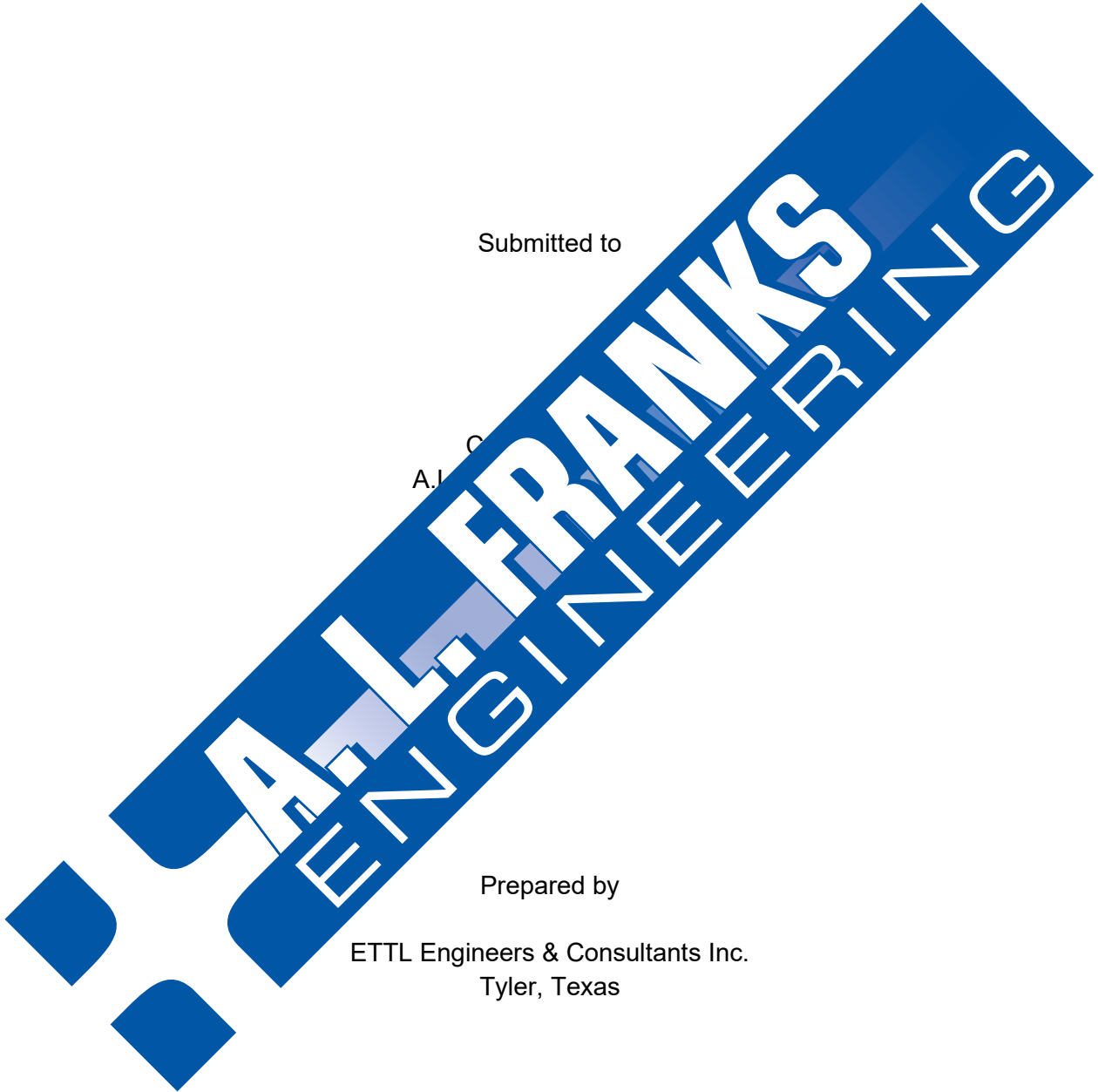


TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 PROJECT DESCRIPTION	1
3.0 SITE DESCRIPTION.....	2
4.0 FIELD OPERATIONS	2
4.1 Groundwater Observations.....	3
4.2 Control of Groundwater	3
5.0 LABORATORY TESTING	4
5.1 Unconsolidated/Undrained Triaxial Compression	5
5.2 One Dimensional Swell	5
5.3 One-Dimensional Consolidation	6
6.0 FOUNDATION SOIL STRATIGRAPHY AND PROPERTIES.....	6
6.1 Site Geology.....	6
6.2 Site Stratigraphy.....	6
6.2.1 Predicted Soil Properties	6
6.3 The Behavior of Expansive Soils	7
6.3.1 Vertical Heave Predictions.....	7
6.3.2 Heave Reduction Remediation.....	8
6.3.3 Expansive Soil Assessment.....	9
6.4 Seismic Site Classification.....	10
7.0 FOUNDATION DESIGN RECOMMENDATIONS.....	10
7.2 Shallow Spread Footings.....	11
7.2.1 Bearing Capacity.....	12
7.2.2 Predicted Settlement.....	12
7.2.3 Eccentricity.....	12
7.2.4 Sliding.....	13
7.3 Mat Foundations.....	14
7.3.1 Bearing Capacity.....	14
7.4 Grouped Pier Foundations.....	15
7.5 Aggregate Piers.....	15
8.0 FOUNDATION CONSTRUCTION.....	16
8.1 Construction.....	16
8.2 Subgrade Reaction.....	16
9.0 GEOTECHNICAL DESIGN.....	17
9.1 Permeability Moisture Barrier	17
9.2 External Mat Work.....	18
9.3 Site Design.....	19
10.0 EXCAVATION AND SITE WORK.....	20
10.1 Mat Footings	20
10.2 Subgrade Preparation for Slabs on Grade.....	20
10.3 Select Fill.....	21

10.4 General Fill.....	21
10.5 Excavation Safety.....	22
11.0 LIMITATIONS	22

APPENDIX A

Plate I: Plan of Borings

Log of Borings with Laboratory Test Data

Geology Map

APPENDIX B

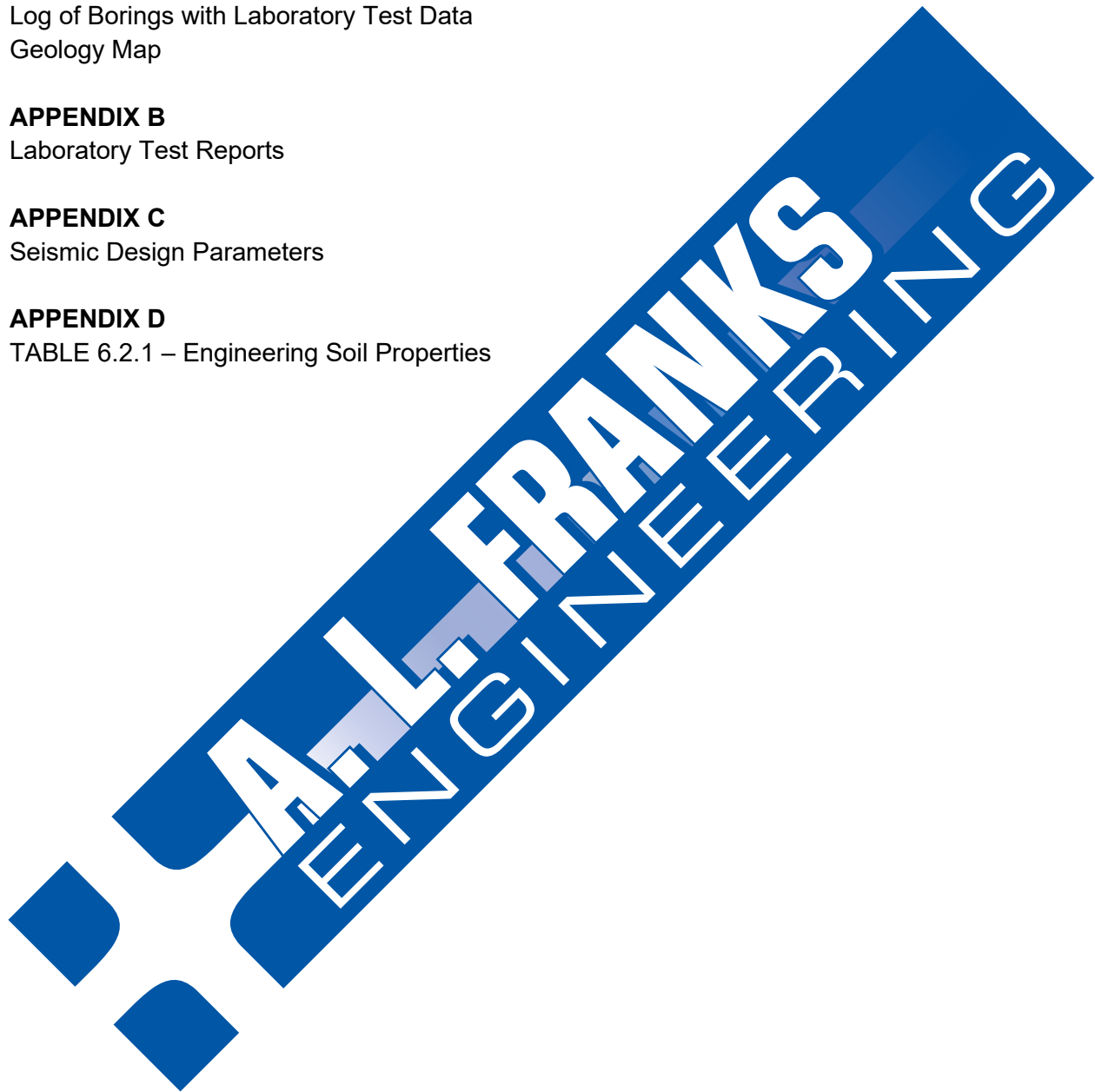
Laboratory Test Reports

APPENDIX C

Seismic Design Parameters

APPENDIX D

TABLE 6.2.1 – Engineering Soil Properties



1.0 INTRODUCTION

This study was performed at the request and authorization to proceed granted by Caleb Mudford with A.L. Franks Engineering, in accordance with our proposal signed June 25, 2025. Field operations were conducted on July 8, 2025.

The purpose of this investigation was to define and evaluate the general subsurface conditions of the proposed site in Texarkana, AR. A site map depicting the location is included in **APPENDIX A**.

Specifically, the study was planned to determine the following:

- Subsurface stratigraphy within the limits of exploratory borings
- Classification, strength, expansive properties, and compaction of the foundation soils.
- Suitable foundation types, predicted settlement values
- Construction-related problems that may be anticipated

This investigation was conducted in three phases: 1) field investigation, sampling, and testing; 2) laboratory testing; and 3) engineering evaluation. The details of which are outlined in the following sections.

A variety of tests were performed to provide the data used to form the basis for the conclusions and recommendations of this study. The conclusions and recommendations that follow are based on the data obtained from the investigation regarding site grading. Using a handheld GPS unit, ETTL surveyed the ground based on a site plan provided by the client. ETTL surveyed the locations indicated on the Plan of Borings. This information was used for design. Should any portion of it prove incorrect, this firm reserves the right to assess the need for revisions to this report.

2.0 PROJECT

The project consists of:

- Foundation size)
 - Approximately 1,250,000 gallons
 - Finished grade approximately 3' below existing grade
 - Soil bearing was not provided, assumed to be 1.25 ksf (equal to equivalent fluid height of 15%)
- Clarifier
 - 67' diameter
 - Will hold approximately 450,000 gallons
 - Finished grade approximately 3' below existing grade

- Loading was not provided, assumed to be 1.15 ksf (equal to equivalent fluid height + 15%)

3.0 SITE DESCRIPTION

The proposed project area is located west of Sanderson Lane at the existing North Texarkana Wastewater Treatment Plant. The site is currently a grass-covered field with an existing aeration basin directly north and two clarifiers directly west. Grading plans were not provided. Based on Google Earth data and on-site observations, the site is relatively flat.

4.0 FIELD OPERATIONS

Subsurface conditions were defined by two (2) sample core borings located 10 feet below existing grade. The field boring logs were prepared and reviewed and approved. The plan of borings, final logs, and boring reference key were provided. Descriptive terms and symbols used on the logs are in accordance with the Unified Classification System (ASTM D 2487).

A track-mounted drill rig utilized a combination of standard and modified drilling procedures to advance the borings. Soils were sampled using a 24-inch-long split-spoon sampler driven into the bottom of the borehole using standard procedures. In conjunction with this sampling technique, the Standard Penetration Test (SPT) was conducted by recording the N-value, which is the number of blows required to drive a split-spoon sampler 1 foot into the soil. The number of blows is limited to a maximum of 50 blows with the sampler. If possible, the sampler is "seated" six inches before the N-value is recorded. The N-value obtained from the Standard Penetration Test provides an approximate relative density that correlates with the shear strength of the soil. The N-value was multiplied by 1.25 to conservatively convert the N values from the SPT to a standard N_{60} value for use in correlations to predict engineering properties. Disturbed samples were removed from the sampler, logged, and transported to the laboratory for further identification and classification.

Soils were sampled using a 3-inch O.D. by 24-inch-long thick-walled Shelby Tube sampler. Under hydraulic pressure, the sampler was pushed smoothly into the bottom of the borehole. The consistency of these samples was measured in the field by a calibrated pocket penetrometer. Penetration values, recorded in tons per square foot, are shown on the boring logs. Such samples were collected in the field, logged, sealed to maintain *in situ* conditions, and packaged for transport to the laboratory.

All boreholes were backfilled with soil cuttings after collecting final groundwater readings. Samples obtained during our field studies and not consumed by laboratory testing procedures will be retained in our Tyler office free of charge for 30 days. To arrange storage beyond this point in time, please contact the Tyler office.

TABLE 4.0 – Boring Identification				
Boring	Structure	Boring Depth (ft.)	Boring Elevation (ft.)	¹ Estimated Groundwater Depth (ft.)
B-1	Clarifier Pond	40	NG	5.0
B-2	Aeration Basin	40	NG	

Table Notes:

- 1) Observed groundwater depth measured at the time of drilling operations only.
- 2) NG = not given

4.1 Groundwater Observations

Upon completion of the drilling activities, groundwater was observed in both borings. The phreatic surface is estimated to be 5 feet below existing ground surface.

Data regarding the groundwater level was obtained from the two borings. At best this provides only an approximation of the phreatic surface during drilling. *The phreatic surface that should be considered for the design is the one that is most significantly different from that which was observed in the borings due to the effects of the drilling process.*

- The characteristics of the soil and the water level in the boring may change from rising to the phreatic surface to the level of observation.
- A given boring may encounter multiple aquifers (i.e., the groundwater is perched or travels through multiple layers that are not continuous over the entire site).
- Groundwater may be present above local aquicludes, but the distribution of borings is not sufficient to confirm this with a high level of certainty.
- Groundwater may be present and with rainfall.
- Rotary drilling may introduce fluid into the boring that often makes it impossible to measure the water level and drilling fluid.
- The soil may cave-in above the observed seepage elevation thereby preventing readings from being measured after completion.

If the level of groundwater could significantly impact the project, then E TTL is recommended to develop a plan for piezometer installation and monitoring to more accurately measure groundwater levels at the site.

4.2 Control of Groundwater

Excavations more than 5 feet below grade may encounter groundwater and, if so, will experience infiltration that will need to be dealt with during construction. This will likely require some temporary and/or permanent dewatering measures.

Measures that will need to be taken will probably be as simple as excavating a trench to collect the seepage and pumping water from sumps adjacent to the excavation. In isolated areas, the saturated soils can be over-excavated and replaced with compacted select fill. Construction traffic should be excluded from the excavation virgin base area when it is wet as this traffic may seriously damage the bearing soils. What measures are appropriate to deal with excess water both during construction and permanently depends on the nature and extent of the groundwater and the permeability of the strata through which it flows. Such a characterization was outside the scope of this study.

Where the groundwater is "perched" or is a relatively minor flow through the presence of a relatively shallow impervious stratum (called an "aquiclude"), and the flow is intercepted at the perimeter of the worksite or a system of ditches routing flow to a sump, it is possible to intercept some or all of the flow, provided interception is made in an area where the aquifer is sufficiently and are not bypassed by local areas of artesian flow. It may occur in secondary features of the soil profile such as joints or fractures. Such flow may be managed by the collection of the flow in a sump. Intercepted flow may be pumped to a sump or trench or allowed to drain by gravity.

When the flow is not perched, a system of dewatering may be the most effective way of dewatering excavations. A system of dewatering is designed to provide sufficient drawdown of the groundwater below the excavation. However, the design of such a system necessitates knowledge of the quantity of groundwater flow and the permeability and extent of the aquifer. This information was beyond the scope of this investigation.

Groundwater that is artesian (i.e., maintained at a head level below foundations), will exert buoyant forces on foundations, possibly resulting in heaving.

5.0 LABORATORY TESTING
The geotechnical engineer visually examined all samples and multiple samples for representative identification of the substrata. By determining the Atterberg limits (ASTM D 4318) and percentage of fines passing the No. 200 sieve (ASTM D 422), field classification of the various strata was verified. Also conducted were natural moisture content tests (ASTM D 2216). These results are presented on the individual log of boring provided in **APPENDIX A**.

TABLE 5.0 – Soil Laboratory Testing Procedures		
Laboratory Test	Test Method	Number of Tests
Dry Sieve Analysis (% Passing No. 4)	ASTM D 6913	8
Dry Sieve Analysis (% Passing No. 40)	ASTM D 6913	8
Washed Sieve Analysis (% Passing No. 200)	ASTM D 1140	8
Atterberg Limits (Liquid & Plastic Limits)	ASTM D 4318	8
Moisture Content by Dry Weight	ASTM D 2216	8
U.U. Triaxial Compression Test	ASTM D 2850	8
One-Dimensional Consolidation	ASTM D 2435/D 4546	8
One-Dimensional Swell	ASTM D 4546	8

The above laboratory tests were performed in general accordance with ASTM, U.S. Army Corps of Engineers procedures, and/or general engineering practice. It should be noted that reference to ASTM or other standard procedures does not mean that all cross-referenced procedures in ASTM or other standards have been followed. Only those procedures or other procedures used have been followed exactly. Only those procedures and/or portions of procedures, which, in the professional judgment of the engineer of record for this report, are applicable, appropriate, and necessary for the project, have been used or followed. Details regarding these tests are provided in **APPENDIX A** and in the Laboratory Test Reports in **APPENDIX B**.

5.1 Unconsolidated/Undisturbed Triaxial Tests

The strength and deformation characteristics of cohesive strata were evaluated by conducting unconsolidated, undisturbed triaxial tests (ASTM D 2850) on selected field samples obtained with the **undisturbed** type of compression test, confining pressures were chosen that are representative of the in-situ stresses at the sample depth below existing ground, and specimens were tested at their natural moisture content. The specimens were axially loaded until failure. The shear strength (or cohesion) is equal to one-half of the peak compressive stress. It is very difficult to obtain specimens while maintaining the integrity of the clay mass. This phenomenon is considered when evaluating test results. Moisture content (ASTM D 2216) and dry density (ASTM D 2437) are also reported for this test.

5.2 One-Dimensional Swell

Pressure-swell testing (ASTM D 4546 Methods A & B (mod)) was performed by adding moisture to a specimen and observing the amount of pressure necessary to restrain swelling. In some cases, the specimen is dried from its natural moisture to evaluate the potential swell under relatively dry conditions (see reports). After the pressure has stabilized, the restraining pressure is removed, and the specimen is allowed to swell, and the total primary free-swell is recorded following a period of up to 96 hours.

5.3 One-Dimensional Consolidation

Successive load increments are added to a saturated, 0.78" thick specimen trimmed from a Shelby tube sample to determine properties of consolidation due to load over time. Parameters derived from this test are used to predict the settlement of foundations including how much settlement will occur in a given time. We also develop constrained, drained moduli as they vary with confining pressure for use in predicting settlement.

6.0 FOUNDATION SOIL STRATIGRAPHY AND PROPERTIES

6.1 Site Geology

According to the USGS, the project site is located in alluvium deposits.

Alluvium deposits (Qal) are characterized as soil or sediment deposited by flowing water. Alluvium is typically made up of a variety of materials, including silt and clay and larger particles of sand and gravel.

<https://www.geology.arkansas.gov/>

6.2 Site Stratigraphy

A soil profile comprised of the strata listed below was used for engineering property purposes to conservatively represent the soil characteristic of the site. The classifications are based on weathering, texture, mineralogy, color change, lithology, and structure. Detailed descriptions of the soil types and depths of the various soil strata are provided in **APPENDIX A**. The boundaries between various soil types, but in reality, the boundaries are generally gradual.

- **Stratum 1 -**
 - Heavy Clay with Sand (CH)
- **Stratum 2 -** Lean Clay with Sand (CL)
- **Stratum 3 -** Sand/Sand with Silt (SM)/(SP-SM)

6.3 Soil Properties

Due to the heterogeneous nature of the soil and the necessarily limited data, the issue of assigning design parameters for the various characteristics of a soil mass is a matter of interpretation. Assessing shear strength along a failure surface that passes through a large mass, it is reasonable to expect that strength variations will be encountered along any potential surface. Where data are sufficient, we believe that it is overly conservative to take the lowest data values as representative of the characteristics of a soil mass. On the other hand, using average values could be unconservative. How we recommend selecting appropriate values to use is explained below.

There is insufficient data (i.e., less than 30 data points for a given parameter for a given soil layer) to warrant a rigorous statistical analysis. Experience has also shown that the average (i.e., best fit to the scattered data) can be unconservative for soils that are not homogeneous (e.g., randomly variable degrees of sand content). We have adopted what we call a P25/P75 approach (as originally promulgated by George Sowers) as an appropriate means for dealing with random variation in soil masses. The average of all applicable test results averaged with the lowest value is termed the “P25” value. The average of all applicable test results with the highest applicable value is termed the “P75” value. Rather than use the worst-case situation when sufficient data are available, we have used either the P25 value (when a low result would be conservative) or the P75 value (when a high result would be conservative) to predict parameters used to quantify the behavior of the soil mass. This procedure is only used when the data is anticipated to be spatially random. If there is a discernible pattern in the data (e.g., shear strength tends to be softer in low areas) then the data is analyzed with the pattern prior to applying the method stated above (i.e., data is divided into groups).

Listed in **TABLE 6.2.1 in APPENDIX D** are the soil strength and the P75 (as appropriate) engineering properties selected to be used for this project. Note that properties in isolated situations may be adjusted considering the specifics of the situation (contact ETTL for further information). Engineering properties are derived from our testing of the soils as well as correlations with data in question together with published correlations.

6.3 The Behavior of Expansive Soils

Expansive soils can be any of the following: Clay (CL), Fat Clay (CH), and Clayey Sand (SC) which exhibit significant volume changes (shrink or swell) with the addition or subtraction of moisture. These soils are found at various depths throughout the soil profile swell when they are wet and shrink as they dry. Structures placed on these soils move up and down with the moisture content of the soil. When expansive soils are covered by an impermeable layer such as a foundation or pavement, seasonal moisture fluctuation at the interior of the soil is reduced or eliminated due to the lack of exposure to natural variations (i.e., wind, rain, sun, vegetative, etc.). At the perimeter of the structure, moisture can enter the foundation soils from surface drainage could lead to localized swelling (if the soils were dry at the start of construction) resulting in tilt or distortion of the structure. If the soils immediately adjacent to the structure are paved both the risk of swelling and shrinkage due to moisture absorption and shrinkage due to moisture loss are reduced significantly.

6.3.1 Vertical Heave Predictions

The amount of potential heave to which a structure may be subject depends on the thickness of the expansive soil beneath the footprint and the variation of the Plasticity Index (PI) in that thickness. In any given area of the project, borings indicate significant variability in the degree of expansion potential, depending on the finished grade as well as the moisture content at the time of construction. Consequently, we provide herein a prediction of potential heave based on the

The assessment of the impact of expansive soils given below is predicated on soil moisture change that is a result of normal climatological fluctuation only. Factors such as poor drainage and consequent ponding water, plumbing leakage, excavation details (e.g., permeable backfill in trenches or beneath structures), and vegetation (trees and shrubs) can result in moisture changes (and consequent swelling or shrinkage) outside the ranges predicted herein. The predicted heave is also the predicted differential movement that could be experienced by a finished slab and/or foundation placed on native grade.

One method for quantifying the potential for subgrade movement is to calculate the Potential Vertical Rise (PVR) (Tex 124 E Mod). This considers the inter-relationship between depth, Plasticity Index (PI), and moisture. The maximum potential shrink/swell of the existing PVR, based on fluctuations in soil moisture content, is predicted to be **2.6 inches**. These calculations are based on assumed dry conditions and an estimated fluctuation zone of approximately 10 feet. Foundations bearing on the existing grade are predicted to be subject to a PVR of 1.0" or less.

Another method for predicting the potential for moisture-induced swelling (PVH) of the subgrade soils is the USACE Hand (manual) Method for Predicting Swelling in Expansive Soils (TM 5-818-7, 1983) section 5-4.1. This method is based on the LEVEL OF RISK FOR STRUCTURAL MOVEMENT USING EXPANSIVE SOILS (TM 5-818-7, 1983) section 5-4.1. This method is based on test results determined from a consolidometer from laboratory testing of specimens trimmed in-situ moisture, the predicted free swell at the existing grade. These calculations are based on moisture of sampling and an estimated moisture fluctuation zone of approximately 1.0" or less. This method is based on test results determined from a consolidometer from laboratory testing of specimens trimmed in-situ moisture, the predicted free swell at the existing grade. These calculations are based on moisture of sampling and an estimated moisture fluctuation zone of approximately 1.0" or less.

The movement varies with the design and other requirements, but methods are not available to limit slab movements to about 1.0 inch or less. Reductions in anticipated movement can be achieved by using methods developed in this area to reduce on-grade slab movements. The more commonly used method entails the removal and replacement with compacted select fill. The use of this method will reduce, but not eliminate the risk of unacceptable movements. These methods of subgrade preparation are presented as options for the owner's consideration. The options may or may not be practical or economically feasible, depending on the expected performance of the proposed structure(s). The owner should be aware that these methods will not prevent the movement of soil-supported foundation elements and are only designed to reduce the magnitude of the predicted movement. Placement of the floor slab on

grade represents a compromise between construction cost and risk of floor (and related element) distress. These risks are discussed elsewhere herein. **Section 10.2** provides more details on the implementation of these methods.

6.3.2.1 Replacement of the Expansive Clay with Select Fill

This option is only recommended for structures founded near existing grade and should incorporate site design options to limit the risk of the bathtub effect as explained below.

Based on the conditions encountered at the site excavating 3.0 feet below existing grade and replacing it with 3.0 feet of select fill will reduce the PVR/PVH to 1.0 inch.

6.3.3 Expansive Soil Assessment

Risk and cost are inversely related, and a decision must be made as to the best approach when weighing the risk of detrimental foundation movements against the cost of a foundation and floor system that either isolates the structure from the soil or reduces the effect of such movements to a tolerable level. While it is not possible to quantify the risk at a given site, the risk of soil movements detrimental to the structure can be mitigated. A system utilizing a structural slab suspended over deep foundations supported on deep foundations can virtually eliminate the risk of heave. Conversely, a floor slab placed on a prepared subgrade would likely be more susceptible to damage from foundation movements. The optimum approach is rarely immediately apparent, we provide this assessment as an aid in dealing with the risk aspect of various approaches.

Many factors must be considered in assessing shrink/swell behavior including:

1. Soil characteristics (clay/silt)
2. The thickness of the soil layer below the ground surface
3. The soil moisture content at the time of construction relative to moisture content at the time of maximum attainable during swelling.
4. Foundation and/or foundation stiffness and loads on heaving.
5. Changes in soil moisture content include:

- a. Soil characteristics immediately adjacent to the structure
- b. Effects of sun, wind, and vegetation (such as trees and shrubs)
- c. Seasonal depth of moisture penetration and exfiltration
- d. Exposure to, or isolation from, drying or wetting effects both during construction and after completion
- e. Landscaping and irrigation
- f. Utility trench construction
- g. Plumbing leaks

When we speak of foundation movements, we consider them as “potential” movements that may, in fact, only partially, or even never occur. The measures recommended in this report are intended

to reduce the risk of exceedance of the predicted potential movements. It is the usual case that if these measures are properly implemented, structure performance is satisfactory. However, sometimes conditions outside the scope of this study (some of which are noted elsewhere herein) can result in excessive movement and structure distress.

Actual vertical change in soil thickness (i.e., heave or shrinkage) is directly related to the change in soil moisture content so if the moisture content change can be limited, the heave potential is reduced proportionally. However, moisture change is the hardest variable to control and control. The perimeter areas of structures are typically the most susceptible to moisture change. The factors related to natural climate variations as well as the other factors listed in the report are the main risk of moisture fluctuation for interior areas, however, is mainly due to construction (5g, and 5h (post-construction)).

The performance of floor slabs placed on the native ground is a function of the undercut and replacement with select fill or moisture-conditioned soil. The accuracy of the shrink/swell predictions and our understanding of the factors involved in the prediction methods cannot precisely account for all the factors involved. The on-grade option carries with it a greater degree of risk of movement than the floor option. The recommendations provided in this report will not eliminate it.

6.4 Seismic Site Classification

ASCE 7-16 requires density/shear wave velocity testing to a depth of 100 feet for seismic site classification. The client provided the required 100-foot soil profile data. An onsite geophysical survey was performed to determine the shear wave velocities of the formation was beyond the scope of this investigation. It is likely that geophysical testing will provide an increase in the shear wave velocity and cohesion values obtain during our field investigation we are confident in the soil mass definition as Class D “very stiff soil.” We have utilized an online tool from the California’s Office of Statewide Health Planning and Development (<https://www.dhs.ca.gov/ohp/cehps/cehps.html>) to determine the seismic design parameters for the site. The site is classified as Category IV. A printout of this report is provided in

APPENDIX A to verify the accuracy of this report and it is presented to the client.

7.0 DESIGN RECOMMENDATIONS

Two independent design criteria must be satisfied in the selection of the type of foundation to support the proposed structure. First, the ultimate bearing capacity, reduced by a recommended minimum factor of safety of 3, must not be exceeded by the bearing pressure transferred to the foundation soils. Second, total and differential vertical movements due to consolidation and/or expansion of the underlying soils during the operating life of the structure(s) must be within tolerable limits. For most structures 1 inch or less of predicted total settlement or heave is widely considered an acceptable target for design. It is our understanding that the elevated tank superstructure proposed can tolerate movements of approximately 1.0 inch (total) and the ground

storage tanks can withstand greater total settlements, but need to be less than 1 inch of differential settlement.

7.1 General Foundation Considerations

Some conditions that may affect foundation and slab or flat work performance (e.g. plumbing leaks, poor drainage conditions, deep-seated heave, etc.) are difficult to account for in standard slab and foundation design procedures and are not considered in this report. Such sources of moisture change could cause significant shrink/swell movements of the expansive clay that will remain beneath the structures (beyond what is normally considered in the design process) and result in significant distress. It is very important to detail the facility to provide for surface drainage to the expansive soils that will remain beneath the structures in order to virtually eliminate the risk of damage from vertical movement due to shrink/swell. Incorporating deep foundations with a suspended cap or slab could be considered. A deep foundation system for the proposed structures penetrating below the zone of seasonal moisture fluctuation will reduce the susceptibility to shrink/swell movements substantially and represents the least risk.

Shrink/swell movements of the clay that remain beneath the foundation and/or floor subsequent to subgrade preparation as recommended should they occur, are predicted to be within the normal target of 1 inch (depending on the option for site preparation chosen) and, thus, resulting distress is expected to cause cosmetic damage only. Alternatively, a structural slab or foundation system could be considered if the risk described herein is not tolerable. Please contact the engineer for more information regarding deep foundations.

Where expansive clays are present, it is considered essential that measures be taken to help assure subgrade preparation and drainage to enhance the chances of satisfactory structure performance. Please account for the possibility of some differential movement between structures, sidewalks, and other associated appurtenant structures. Proper drainage (prevents water from soaking into the subgrade soils around the structures, provides for rapid runoff away from them) is critical to reduce shrink/swell movement caused by saturation of foundation soils and should help reduce differential movement between exterior soil-supported elements and the structures.

In areas where expansive clay soils are found in the upper 10' of the finished soil profile, footings, floor slabs, or other appurtenances supported on grade will potentially be subject to vertical movement due to normal seasonal moisture variation of the expansive clay soils.

7.2 Shallow Spread Footings

A shallow foundation system with an isolated or monolithic flat or ribbed slab placed on subgrade prepared as specified in **Section 10.2** can be considered (provided the above-noted risk is tolerable). Shrink/swell movements due to normal climate moisture fluctuations of the clay that remains beneath the structures, should they occur, are predicted to be within the normal target of 1 inch and, thus, the resulting distress is expected to cause cosmetic damage only. Alternatively,

a system of shallow footings incorporated in a stiffened slab (conventional or post-tensioned) placed directly on prepared subgrade can also be considered.

7.2.1 Bearing Capacity (Shallow Footings)

Footings should be designed to bear in properly compacted select fill at a minimum depth of 2.0 feet below the finished subgrade or adjacent exterior grade (whichever is deeper). Isolated footings should have a minimum width of 2 feet and strip footings should be at least 12 inches wide. Footings should be proportioned for allowable gross bearing pressure of 1,500 psf for individual (isolated) and 2,000 psf for continuous (strip) shallow footings. Allowable pressures incorporate a safety factor relative to shear failure of the soil. Allowable pressures may be increased up to 33% for intermittent loads such as wind.

7.2.2 Predicted Settlement of Shallow Footings

The total settlement due to *dead load plus sustained live load* (not more than 2,500 psf) for footing widths less than 6 feet is limited to a maximum of 0.5 inch (differential). Detailed testing for the prediction of long-term settlement for shallow footings is beyond the scope of this investigation. Settlement is not anticipated to be significantly more than the immediate settlement.

7.2.3 Eccentrically Loaded Footings

Allowable loading for eccentrically loaded footings is reduced based on the degree of eccentricity and is lower than for a concentrically loaded footing. Allowable vertical uniform pressure (i.e., ignoring the effects of overburden) for an eccentrically loaded footing may be computed in accordance with the following:

Where:

q_a = allowable gross bearing pressure for a concentrically loaded footing as given above.

R_{ex} = reduction coefficient for eccentricity about the x axis

R_{ex} = 1.0 for cohesive soils (CL & CH)

R_{ex} = $(1 - e_x/B_x)$ for cohesionless soils (SM, SC, ML)

R_{ey} = reduction coefficient for eccentricity about the y axis

R_{ey} = 1.0 for cohesive soils (CL & CH)

R_{ey} = $(1 - e_y/B_y)^{0.5}$ for cohesionless soils (SM, SC, ML)

e_x = eccentricity in the x and y direction, respectively

B_x = footing dimension in the x and y direction, respectively

Use the predominant soil type in the zone that is one footing width beneath the footing to calculate the reduction coefficient. If no one type is predominant, then use a weighted average based on the relative thicknesses in this zone. Total allowable vertical load with eccentricities e_x and e_y may be found by multiplying the gross area of the eccentrically loaded footing by q_{ae} as determined above.

7.2.4 Sliding Resistance for Footings on Grade

The ultimate (nominal) sliding resistance (R_T) should be checked for both drained and undrained loading conditions using the parameters listed in the **Predicted Soil Engineering Properties TABLE 6.2.1 in APPENDIX D**, for the appropriate bearing stratum and the following formulae for nominal (un-factored) resistance:

For drained loading:

$$R_T = V * \tan \delta$$

- V = total un-factored vertical force on the footing base for the loading condition
- $\tan \delta = \tan \phi$ (ϕ = drained friction angle of the soil for the loading condition) against the soil. Use $\tan \delta = 0.8 * \tan \phi$ for precast concrete footings.

For undrained loading:

$$R_T = c; \text{ or the lesser of: } R_T = c \text{ vs. } R_T = 0.5 * V$$

- c = undrained shear strength (cohesion)
- Nominal resistance should be factored by 0.5 for footings on soft clay.
- 6" (min) of compacted, well-graded sand or gravel placed beneath the footing (where suitable) use

Ultimate (nominal) passive resistance (P_p) for a footing block face should be computed by the following formula for drained and undrained conditions and selecting the most critical condition:

$$P_p (\text{drained}) = \frac{1}{2} \gamma H^2 K_a \tan^2(45 + \phi'/2) + 2cH \tan(45 + \phi'/2) \quad (\text{second term often neglected})$$

$$P_p (\text{undrained}) = \frac{1}{2} \gamma H^2 K_a \quad (\text{usually reduces to: } \gamma z + 2c)$$

- γ = unit weight of soil
- K_a = active earth pressure coefficient = $(\tan(45 + \phi'/2))^2$ (equals 1 for undrained $\phi=0$)
- ϕ' = drained internal friction angle
- ϕ = undrained internal friction, generally = 0
- c = undrained cohesion
- H = height of soil above footing base where pressure is determined

The appropriate parameters to be used in the above equation are to be selected from **TABLE 6.2.1 in APPENDIX D**, for the appropriate loading condition that controls (i.e., long-term(draind) or short-term (undraind)) for the soil against the face of the footing. A significant amount of lateral movement is required to fully mobilize ultimate passive pressure (as much as 6% of the depth to the base of the loaded face). To limit the lateral movement to about 1% (of the depth to the base of the loaded face) a factor of about 0.5 is typically recommended to reduce the above-computed

resistance to the available mobilized nominal (un-factored) passive resistance given lateral displacement restrictions.

Passive resistance as computed above assumes that the footing excavation can be constructed in such a manner as to provide solid contact of the side of the concrete with the undisturbed sides of the excavation (which may be impractical in some situations). *Caution:* Lateral resistance against a vertical face should only be assumed where construction can be controlled to assure that the footing is cast against undisturbed earth or backfill between the excavation face and the footing edge is placed under density-controlled conditions (backfill should be compacted to 100% ASTM D698). It should be noted that such heavy compaction against the excavation face may result in earth pressures exceeding the usually assumed active or at-rest pressures. *Excavation face needs to be nearly vertical and extended to the bottom of the footing. The portion of the sides of the excavation for the footing that is subjected to wetting or drying action and that is within 5' of the finished grade should be neglected with respect to computing passive resistance to account for the effect of the moisture change of the zone.*

7.3 Mat Foundation

We understand that the proposed foundation for the WWTP tanks will be a cast-in-place concrete mat placed on native soil at or near the existing finish grade. Size will be as described in **Section 2.0**. Since the allowable bearing values are dependent on the size and depth that the mat is placed, we have assumed an average design (loaded) contact pressures for the mat foundation. **TABLE 7.3.1. Deviations from this assumption will directly affect the bearing capacity.** Once design loads have been established, E TTL should be consulted for recommendations provided herein. Pertinent design parameters and the recommended design(s) are presented below.

7.3.1 Bearing Capacity

The following assumptions are made: the finished grade is near existing, as described elsewhere in the project. There are no other existing or proposed footings within one width dimension of the mat. If this is not the case, please contact this office for further recommendations.

For the purpose of developing a model for predicting settlement (see below) and determining bearing capacity, the bearing capacity is dependent on footing plan dimension, for the mat foundation we have assumed a single footing. For the mat foundation, see **TABLE 7.3.1** for mat footing sizes, bearing on prepared subgrade per **Section 2.0**. The loaded area will act as a single flexible footing. We recommend that the bearing level for the mat foundation is at least 3 feet below the finished grade. Listed in the table below are the recommended gross allowable bearing pressures for the various types of subgrade modifications and soil bearing stratum. These allowable pressures incorporate a safety factor relative to shear failure of the soil of at least 3 and may be increased up to 33% for intermittent loads such as wind. Significant variations from the above-assumed characteristics may necessitate reevaluation as allowable bearing pressure is a function of footing width and depth.

Recommended allowable bearing pressures incorporate adjustments for loading conditions within the limits noted above and require no further reduction except, possibly, to limit settlement or eccentricity. An increase in footing depth (for depths below the minimum depth assumed above) will generally result in an increase in recommended allowable bearing pressure. Wider footing widths tend to decrease the recommended allowable load.

TABLE 7.3.1 - Bearing Capacity of Mat Foundation FS = 3

Bearing Material or Stratum	Mat Footing Size (ft x ft)	Bearing Capacity (psf)	¹ Estimated Loading (ksf)	Predicted Settlement (in)
Prepared Subgrade, See Section 10.2	107' x 70'	2,000	1.2	
Prepared Subgrade, See Section 10.2	67' Diameter	2,000		Differential

Notes:

1. If the anticipated loaded pressure is anticipated to be less than the base contact ETTL.

It should be noted that, whereas the contact pressure beneath a mat foundation is generally quite uniform, the contact pressure beneath a pile foundation varies from a maximum at the edge to a minimum at the center. The bearing recommendations herein, we have assumed that the mat will be designed to maintain uniform contact pressure. Determining whether this is the case requires complex analysis outside the scope of this report.

7.4 Ground Improvement

Due to the magnitude of the loads, the mat foundation may not meet the assumed settlement criteria listed herein, shallow spread footings in undisturbed native ground or compacted select fill may not be allowable because of the predicted excessive size of the footings. However, this may be reduced by some form of ground improvement. The two most common options are 1) undercut the loose soils and recompact them at the base of the footing, or 2) install a system of Rammed/Vibratory Aggregate Piers to support the structure. The engineer and site design should consider the expansive soils and moisture content to determine the risk of deep-seated heave.

7.4.1 Rammed/Vibratory Aggregate Piers

The design of a ground improvement system is typically performance-based and proprietary, requiring a specialty design-build contractor such as Geopier or Keller North America. These systems can be a cost-effective foundation solution to support settlement sensitive structures while providing increased allowable bearing. The process increases the lateral stress in the surrounding soil; thereby further stiffening the composite soil mass, increasing the bearing capacity, and reducing settlements. For the soil profile encountered at the site, we anticipate that aggregate piers can be provided to achieve the necessary bearing capacities while maintaining predicted settlements of less than 1.0 inch. If this is an option the designer would like to consider, we recommend contacting the engineers at Geopier and/or Keller North America for further

information. If aggregate piers are utilized the compaction requirement for the placement of select fill can be reduced to 95% D698. E TTL can assist in making the introduction upon request.

8.0 FLOOR SYSTEMS AND FLATWORK

Floor systems placed on native subgrade will potentially be subject to differential movements as noted in **Section 6.3** and which may result in unacceptable distress to the floor and elements supported thereon. Managing and/or mitigating this risk can be addressed in a number of ways including (in order of decreasing risk and increasing cost):

1. Removal and replacement of a portion of expansive soils from the subgrade to reduce the degree of potential movement, generally to within a range of 1 to 2 percent moisture content.
 - a. To reduce the predicted potential shrink/swell movements, the subgrade at the structure's subgrade be prepared as set forth in the following table:
2. Isolation of the floor/structure from subgrade movements by transferring it on deep foundations above a void or crawl space.

Option 1 is discussed in more detail below. If the predicted vertical differential movements as noted in **Section 6.3** and as noted in **Section 10.2** of this report is not considered tolerable, a structural element (option 2) can be used to reduce the risk of movement. Assume that an evaluation by others of risk vs. cost as discussed in the appropriate design approach.

8.1 Slab on Grade

Floor slabs (and exterior footings) can be placed on a subgrade prepared as described in **Section 9.2** can be placed on a subgrade prepared as described in **Section 9.2**. The construction should only be considered if the risk of slab movement (and potential damage) as noted throughout this report can be tolerated. The risk varies with the design and other requirements, but methods of construction can be used to achieve the goal of limiting predicted slab movements to about 1.0 inch or less. Predicted movements can be achieved by using subgrade modification for that purpose. The more commonly used method in this area consists of compacting the expansive soils. The use of this method will reduce, but not eliminate, acceptable movements.

8.2

8.2.1 Modulus of Subgrade Reaction

Design on Firm Ground, ACI 360R provides a methodology for the thickness design of floors subjected to concentrated wheel and post loads as well as area rack loads. That procedure requires a characterization of the subgrade support in the form of the modulus of subgrade reaction (MSR), k . This value represents the pressure applied to the subgrade surface on a 30" diameter plate that results in a deflection of 1" and is in units of psi/in (or PCI). Actual plate load testing of the finished subgrade to determine an appropriate value is not generally practical, so predictions are made based on published correlations of the modulus with soil properties (ACI 330R). Based on those correlations, the predicted MSR (k) at the top of the native subgrade for

the various native soil layers as well as for select fill is provided in **TABLE 6.2.1 in APPENDIX D**. The use of a well-graded crushed stone base material on top of the soil can be used to increase the modulus.

9.0 GENERAL SITE DESIGN

Planting beds adjacent to the structure should be contained in leak-proof boxes or a horizontal moisture barrier sealed to the grade beam should be used in conjunction with them in order to isolate the building subgrade from water infiltration sources such as springs. Backfill adjacent to the structure is discussed in **Section 9.3** to help limit surface erosion. If plantings are desired near the perimeter of the building, we do not recommend trees because as trees mature, they tend to send roots beneath the building foundation causing them to shrink and the floor to settle.

Vehicle or pedestrian ramps leading up to the building should be constructed to avoid abrupt differential movement between the building slab and the ramp. Where such elements are supported on the untreated native subgrade, the ramp should be supported on deep foundations and/or where a portion of the native subgrade has been replaced with non-expansive fill and/or moisture treated clay. Expansion joints are required at the points where ramps connect with paving and the building slab. In addition, ramp slabs should be constructed so that slopes away from the building. Surface drainage of surface water are still provided should the potential differential movement elsewhere herein occur.

Where the predicted potential differential movement (as defined in **Section 6.3**) between elements supported on native subgrade and an element supported on deep foundations is considered significant, the building slab should be connected into the structure grade beam to allow for some rotation but not to span over a void below to native grade at some distance from the building. The slab should be able to rotate about its joint with the grade beam without significant damage. Expansion joints also help to prevent moisture fluctuation in the perimeter zone. An effective seal is maintained at the joint of the exterior slab with the building slab. The exterior slabs should be sloped sufficiently to prevent an eventual slope away from the building. The void below these slabs should be drained to prevent accumulation of surface drainage.

9.1 Moisture Barrier

To reduce the risk of the native clay, which will remain beneath the building footprint, will experience significant fluctuation in moisture content, a moisture barrier that extends to a distance of at least 10 feet beyond the perimeter of the building can be placed. This barrier can be in the form of concrete (floor slab, sidewalk, or paving) abutting the building and with all joints sealed and maintained, or a synthetic sheet vapor barrier such as STEGO® WRAP VAPOR BARRIER (20-MIL), or equivalent that is sealed to the foundation edge and is buried sufficiently to prevent damage. Where 10 feet of extension beyond the building perimeter is not available, the vapor barrier can be turned into a trench the depth of which is equal to the remaining length of the barrier

sheet, and which is backfilled with flowable fill. Moisture barriers are typically not necessary for suspended slabs.

Where building pads that are prepared but construction of the slab may be delayed more than two weeks, place a moisture barrier on the prepared subgrade and cover with 2 feet of general fill. Contact ETTL for more specific details regarding this situation.

9.2 Exterior Flat Work

Flatwork placed on grade will be subject to movement due to subgrade swell/shrinkage, the amount of which depends on the preparation of the subgrade (see **Section 6.3**). The movement is usually most pronounced in the immediate vicinity of exterior slabs and is generally much less in the interior areas, provided that the joints and cracks are sealed. Conditions at the edges of slabs on grade should provide for rapid drainage of surface water away from the edge. Shrinkage cracks in the vicinity of pavement edges are often causes of excessive settlement leading to the distress of adjacent flatwork.

Consideration can be given to extending the subgrade preparation to include entrances, sidewalks, porticos, flatwork, etc., to reduce the potential for movement and where the predicted potential movement is significant.

To reduce abrupt differential movement, flatwork areas that are placed on prepared subgrade and those that are placed on natural ground where potential movements are significant, consideration should be given to the depth of treatment or over-excavation is tapered from the edge of the flatwork to the ground surface at a slope of 1:1 or flatter.

Although movement may be expected, it may be more economical to maintain and repair the flatwork than to remove or treat potentially expansive soil. Determining the extent of the problem and the scope of this investigation.

Irrigated lands and areas with high water table may be subject to heave of exterior flatwork areas. Moisture fluctuations in the soil beneath narrow flatwork areas can subject the soils underlying the flatwork to shrinkage. To reduce the risk of moisture fluctuations in the upper soil beneath the slab, consideration can be given to a vertical moisture barrier beneath the flatwork.

Flatwork should be placed in a manner that could impound water adjacent to the structure should it be subject to heave (predictions of the degree of potential heave are discussed in **Section 6.3**) at some time in the future. Articulating joints in the flatwork can serve to lessen the extent of distress due to shrink/swell movements of the soil upon which it is placed. Such joints will require regular maintenance to maintain a sealed condition. The better the drainage and joint and crack maintenance, the lower the risk potential for distress.

9.3 Site Design

The following recommendations are derived from years of experience with structures founded on moderately expansive soils and are considered essential to satisfactory structure performance, especially where the floor slab is to be placed on grade:

- Sidewalks should be sloped away from buildings and should not be tied to the structures (with the exception of entrance walkways). The joint between the sidewalk or pavement and the foundation should be sealed and maintained. Sidewalks should not impound water adjacent to the structure. The potential heave of native ground (see Section 9.2) adjacent to the structure needs to be taken into consideration when constructing sidewalks to avoid a sidewalk that impounds water adjacent to the structure.
- Any unpaved ground surface around the building or foundation should be sloped away from the building on all sides. A minimum slope of 2% is recommended for areas as 10 feet wide immediately adjacent to the structure. Water should be conveyed by an appropriate means for a distance of at least 10 feet before it is allowed to drain into the subgrade. Water should not be directed toward the building after the floor system has been placed.
- Trees should not be closer than 10 feet to the structure and landscape beds should not be placed adjacent to the structure. Planting beds can be contained in watertight planter boxes and irrigated to prevent water from seeping into the subgrade around the building. A root barrier around the structure is an alternative to planter boxes provided it is properly installed and maintained (i.e., joints sealed, and punctures repaired). Planting beds should be protected from ground water. A root barrier around the entire structure perimeter is recommended to provide assurance against desiccation of the soil due to roots and to prevent water from seeping into the subgrade. Periodic root pruning may be required to limit the drying of the soil due to vegetation. *Over irrigation adjacent to the structure can result in subsurface moisture contents that could lead to*

Water infiltration beneath the structure, backfill in the area above the foundation (minimum 5 feet wide adjacent to the structure) should be native lean clay or compacted to a minimum density of 95% of ASTM D 698 (Standard Proctor) maximum dry unit weight at optimum moisture content of optimum% or greater. This zone should be at least 2 feet thick. This is not necessary where pavement abuts the structure, and the joint is sealed and maintained. A vertical moisture barrier sealed to the side of the foundation and extending to a depth of about 8' will provide added protection against moisture fluctuation beneath the building footprint.

- Backfill for utility line ditches should be carefully controlled and should consist of a relatively impermeable material (clayey sand or lean clay), especially in the area beneath and immediately outside of the structure. Old utility lines should be removed from beneath

the structure. Fill in new or old utility trenches should be placed to the same specifications as select fill. The top 6 inches under the paving should be compacted to a density equal to that specified for the pavement subgrade.

- Utility connections to the building should be flexible to allow for anticipated soil movements (see predictions elsewhere in this report) that will be different than the anticipated movement of the structure to which they are connected (e.g., where attached to, or passing through a foundation element supported on piers). Drain lines should be placed so that potential movements beneath or adjacent to the building do not affect the functionality of the line.

Any significant differential movement potential between structures and the native subgrade needs to be addressed in the design (e.g., for predicted soil movements to assess whether or not the potential movement is deemed excessive and in need of mitigation). Common approaches include conduits supported on deep foundations and/or utility corridors. In either case, there will need to be a transition zone where the conduits taper from full depth to none at a 1:1 slope or flatter (verify that the conduits can tolerate this differential slope and still be functional). Utility corridors should be twice the width of the corridor at its base and surface at a 1:1 slope in all directions (i.e., perpendicular to the long axis).

10.0 EXCAVATION AND SUBGRADE PREPARATION

To validate the design assumptions regarding allowable foundation loads, and, in order to provide a serviceable subgrade (within the limitations stated above), the subgrade of the building must be prepared. The following procedures are recommended as a minimum:

10.1 Mat Foundation

All footing excavations should be inspected by qualified personnel to ensure that the subgrade is compacted to the required density and is composed of non-expansive soil or properly compacted select fill as recommended in the design. Material in footing excavations should be removed before the final subgrade preparation and placement of concrete.

10.2 Subgrade Preparation for Slabs on Grade

The following minimum over-excavation is recommended for each specific situation listed. Limits of the base of the over-excavation should extend beyond building and/or footing lines a distance of 5' and should taper up to the finished grade at a 1:1 slope. See **Section 9.2** to incorporate subgrade preparation at flatwork and entrances.

- Over-excavate below existing subgrade elevation to a minimum depth of 3 feet and replace with non-expansive select fill to reduce the PVR to 1 inch.

- Maintain specified moisture content until the subgrade is covered with fill or slab.
- Perimeter moisture barriers are recommended where structural elements are not supported by deep foundations.

10.3 Select Fill

Select fill shall consist of homogeneous soils (i.e., not sand with clay lumps) classifying as SC or CL, free of organic matter and rocks larger than 3 inches in diameter and passing the Atterberg plasticity index (PI) of 5 to 20, with a liquid limit of 45 or less and a percent passing No. 20 sieve between 30 and 75. Permeability should not exceed 1×10^{-5} cm/sec (field testing to confirm is recommended). These characteristics are chosen to help limit the potential for surface water infiltration that would become trapped in the expansive clay, leading to an increased potential for moisture damage.

In-lieu of select fill, crushed stone, or concrete base may be used in accordance with TxDOT 2014 Standard Specifications Item 247, Grade 3 or better. The Plasticity Index (PI) should be greater than 5, qualified as select.

Atterberg limits testing of the fill at a rate of one test per 3,000 square feet of fill placed (minimum 1 test per fill area per lift and as visual check) to verify that fill specifications are met. The material should be placed in lifts.

- Prepare the subgrade in accordance with recommendations discussed elsewhere herein. Sites that shall be benched with 8-foot-wide benches prior to placing fill.
- Place subgrade in lifts, loose layers not exceeding 9 inches in thickness to the subgrade. Compact to a minimum of 98% of the maximum density defined by the Modified Proctor (Modified ASTM D1557 for base). Maintain moisture content within optimum $\pm 4\%$ (-3% to $+3\%$ for ASTM D1557).

Density tests at a rate of one test per 3,000 square feet of lift area (minimum of 2 tests per lift). *Density testing is essential to ensure that the structure is properly placed.*

- Prevent excessive loss of moisture during construction (periodic sprinkling may be required).

10.4 General Fill

Common fill may consist of any of the following soil classifications: SC, CL, CH, and may be used as fill to bring the site to grade in areas where other specific preparation is not desired and where differential soil movement is not critical for both the current and future development. Proper processing, placement, and testing of this material are essential. Sandy soils that classify as silty

sand (SM) or poorly graded sand (SP) or well-graded sand (SW) should not be used as fill as they will likely become reservoirs for water in the future. Listed below are several factors that must be considered if fat clay (CH) is to be used for fill:

- The material must be relatively uniform (homogeneous). It cannot be blocky or shaley or a mixture of various types of soils or even various types of clays.
- The clay must be processed to assure uniform moisture distribution (a rule of thumb for gradation is 1" or less). Discing the clay may not be adequate for this process. Sometimes the use of a pulvermixer is necessary. Processing the clay in place prior to picking it up and moving it is typically more effective. More time for the water to penetrate the soil "clods." Some shales may not be processed.

Place processed soil in loose lifts not exceeding 9" in thickness. The soil must be 95% to 98% of ASTM D698 (Standard Proctor) and maintain a moisture content of 95% or greater. The fill must not be allowed to dry prior to the placement.

10.5 Excavation Safety

The Federal Register, Volume 54, No. 2, contains the United States Department of Labor, Occupational Safety and Health (OSHA) standards for excavations. The "Construction Standards for Excavations, 29 CFR 1926.1000" states that the contractor is solely responsible for designing and constructing shoring and bracing in accordance with these standards and should shore, slope, or brace excavations as required to maintain the stability of both the excavation sides and bottom. The "responsible person," as defined in CFR Part 1926, should evaluate the excavation as part of the contractor's safety procedure. In no case should the excavation, including utility trench excavation, be deeper than the maximum allowable excavation depth, including utility trench excavation, as specified in local, state, and federal safety regulations. Testing to evaluate the soil conditions during excavations at this site was beyond the scope of this report.

11. The site is characterized by the presence of a calculated risk that soil and groundwater conditions may not have been fully revealed by the exploratory borings. This risk derives from the practical necessity of basing interpretations and design conclusions on a limited sampling of soil stratigraphy at the project site. The number of borings and spacing is chosen in such a manner as to decrease the possibility of undiscovered anomalies while considering the nature of loading, size, and cost of the project. The recommendations given in this report are based upon the conditions that existed at the boring locations at the time they were drilled. The term "existing groundline" or "existing subgrade" refers to the ground elevations and soil conditions at the time of our field operations.

It is conceivable that soil conditions throughout the site may vary from those observed in the exploratory borings. If such discontinuities do exist, they may not become evident until construction begins or possibly much later. Consequently, careful observations by the geotechnical engineer must be made of the construction as it progresses to help detect significant and obvious deviations of actual conditions throughout the project area from those inferred from the exploratory boreholes. Should any conditions at variance with those noted in this report be encountered during construction, this office should be notified immediately so that further investigations and supplemental recommendations can be made.

Construction plans and specifications should be submitted to E TTL for review and assistance for construction to help verify that the recommendations of this report are properly understood and implemented.

This company is not responsible for the conclusions, opinions, or recommendations made by others based on the contents of this report. The recommendations of this report are applicable only to the proposed scope of work described in the **PROJECT DESCRIPTION** and may not be used for any other purpose without the written consent of E TTL Engineers. The purpose of this study is only to assist in determining the presence of a landfill. Our professional services are limited to our findings obtained, and our recommendations prepared in accordance with accepted geotechnical engineering principles and practices. No warranty is made or implied.

Important Information about This

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Provided for this Report

Geotechnical-engineering services typically include collection, interpretation, and analysis of exploratory widely spaced borings and/or test pits. Field testing with results from laboratory tests of soil samples obtained from field exploration (if applicable) may include geotechnical reconnaissance, and historical information may be used to determine the expected subsurface conditions. The design of the site structure and alterations of the site structure may be based on the proposed construction and the geotechnical data. Geotechnical engineers apply their knowledge and experience to adapt the requirements of the design to the subsurface conditions. The design model(s) is/are developed based on the subsurface conditions that are expected. The design model(s) is/are used to predict the expected performance of the structure under the anticipated loading and/or other conditions.

The culmination of the geotechnical-engineering services is typically a geotechnical-engineering report. Following the data obtained, a discussion of the subsurface conditions, an interpretation of the geotechnical-engineering assessments and analyses, and a summary of the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a geotechnical engineer or even a different civil engineer. Because of the nature of the engineering study is unique, each geotechnical engineering study is prepared *solely* for the client.

[illegible]

 Technical engineer prepared it:

may or may not include all or a portion of the following events occurred at the site or adjacent to it; events like construction or environmental impacts; or natural events like floods, droughts, earthquakes, and water fluctuations.

The reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed surface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual site-wide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical engineering reports has resulted in costly problems. To avoid that, by having your geotechnical engineer serve as a consultant on the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design documents; and
- be available whenever geotechnical engineering is needed.

You should also confront the risk of misinterpretation in this report. Do so by retaining your geotechnical engineer to serve on the prebid and preconstruction team through construction-phase observation.

Give Constructors Informed Guidance

Some owners believe they can shift the risk of misinterpretation to constructors by limiting the information provided in the report. To help prevent the costly, construction-phase problems that misinterpretation has caused, include the complete geotechnical report, along with any attachments or appendices, with the report to the constructors, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be helpful in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is a distinct engineering discipline. The materials and conditions encountered on project sites are typically more complex than those encountered with well-defined engineering disciplines. That complexity, coupled with a lack of understanding of geotechnical engineering, can result in disputes. To confront that risk, your geotechnical engineer may include explanatory language in the report, such as “limitations,” “assumptions,” or “disclaimers.” Your client representatives should recognize their own responsibility to read these provisions closely. Ask questions. Discuss them fully and frankly.

Geotechnical Engineering Techniques Are Not Covered

Geotechnical engineering techniques used to perform an environmental study are significantly different from those used to perform a geotechnical engineering study. For that reason, a geotechnical-engineering consultant may not be able to provide environmental findings, conclusions, or recommendations, e.g., about the likelihood of encountering underground water or regulated contaminants. *Unanticipated subsurface conditions have led to project failures.* If you have not obtained your own environmental information about the project site, you should retain your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration* by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*



**GEOPROFESSIONAL
BUSINESS
ASSOCIATION**

Telephone: 301/565-2733

e-mail: info@geoprofessional.org www.geoprofessional.org



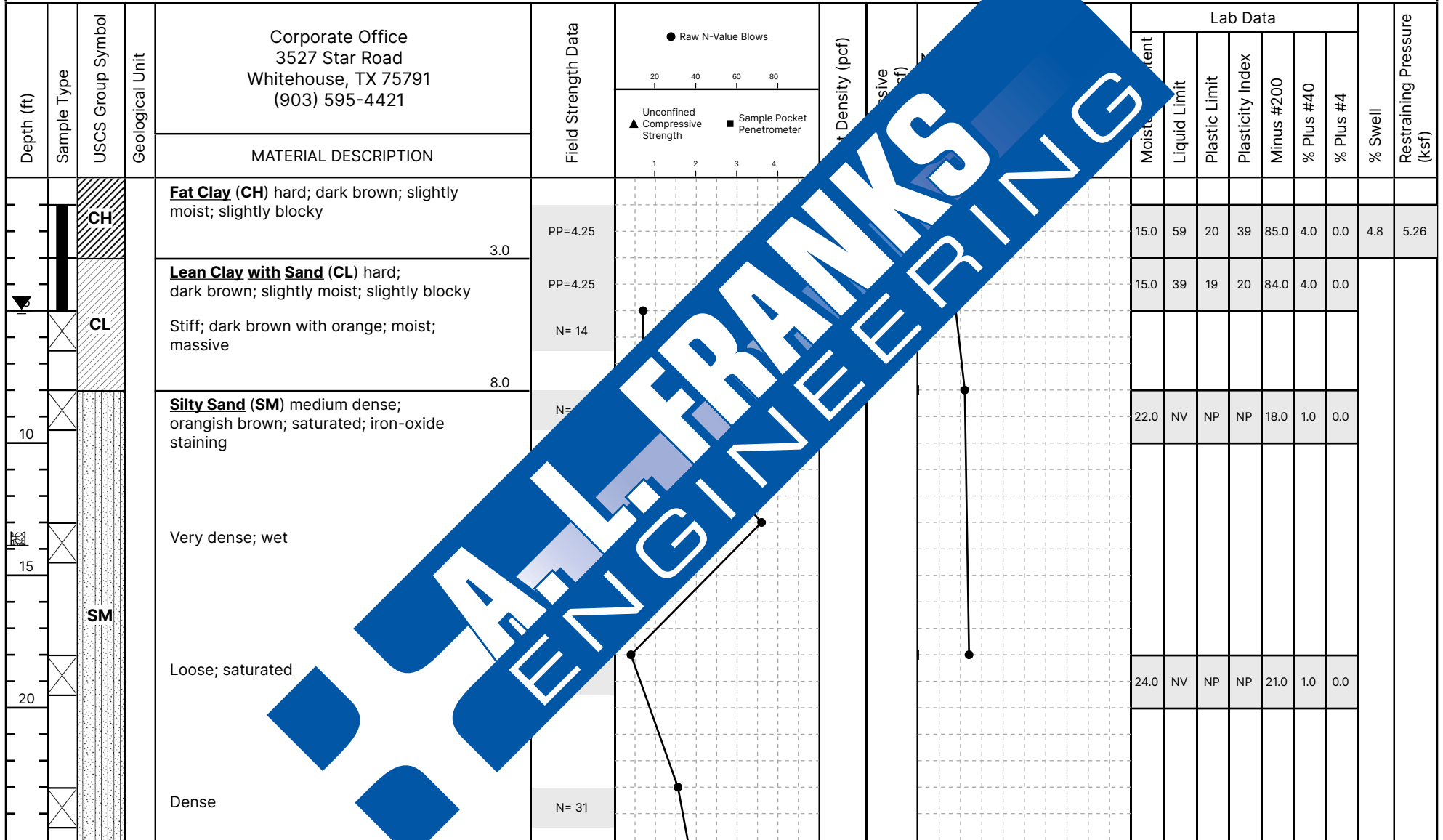
AF



SOIL BORING NO. B-1

Project: North Texarkana
 Texarkana, Arkansas
Project No.: G6576-25

Method: Auger
Drill Rig: CME-55



Date Drilled: 07/08/2025	Driller: Juwuan Martin	Logger: Hunter Franks	Latitude / longitude: 33.502446, -94.017965	Notes: GW @ 5' and caved to 14' upon completion.
------------------------------------	----------------------------------	---------------------------------	---	--

SOIL BORING NO. B-1

Project: North Texarkana
Texarkana, Arkansas
Project No.: G6576-25

Method: Auger
Drill Rig: CME-55

Depth (ft)	Sample Type	USCS Group Symbol	Geological Unit	Corporate Office 3527 Star Road Whitehouse, TX 75791 (903) 595-4421	Field Strength Data	● Raw N-Value Blows 20406080 ▲ Unconfined Compressive Strength ■ Sample Pocket Penetrometer	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Minus #200 (%)	% Plus #40	% Plus #4	% Swell	Restraining Pressure (ksf)	
				MATERIAL DESCRIPTION												
30	⊠	SM		Silty Sand (SM) medium dense; orangish brown; saturated; iron-oxide staining	N= 43	12										
35	⊠			Wet	N=											
40	⊠			Saturated												
45																

Date Drilled:
07/08/2025

Driller:
Juwuan Martin

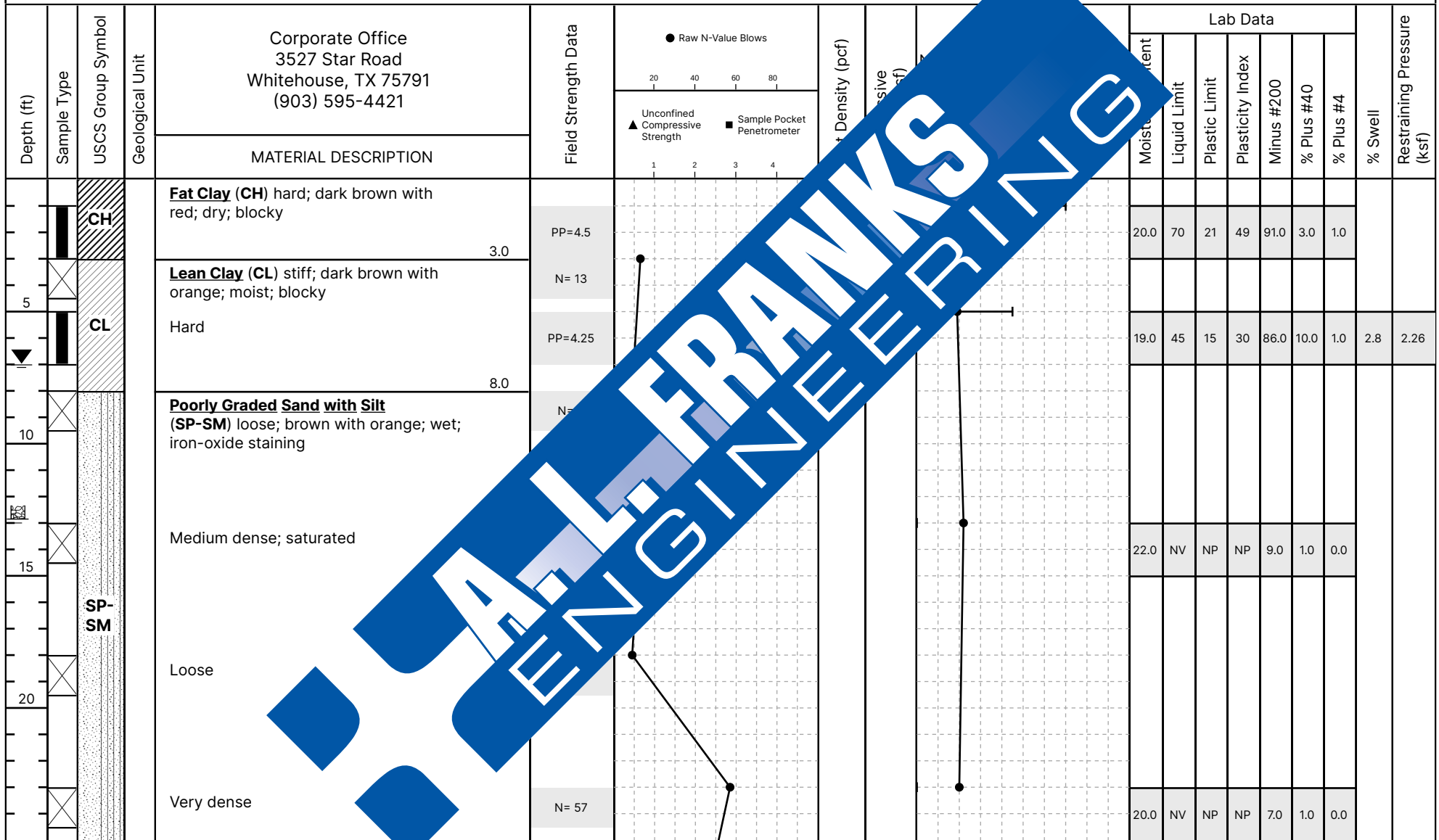
Logger:
Hunter Franks

Latitude / longitude:
33.502446, -94.017965

Notes: GW @ 5' and caved to 14' upon completion.

Project: North Texarkana
 Texarkana, Arkansas
Project No.: G6576-25

Method: Auger
Drill Rig: CME-55



Date Drilled: 07/08/2025	Driller: Juwuan Martin	Logger: Hunter Franks	Latitude / longitude: 33.502654, -94.017530	Notes: GW @ 7' and caved to 13' upon completion.
------------------------------------	----------------------------------	---------------------------------	---	--

Project: North Texarkana
Texarkana, Arkansas
Project No.: G6576-25

Method: Auger
Drill Rig: CME-55

Depth (ft)	Sample Type	USCS Group Symbol	Geological Unit	MATERIAL DESCRIPTION	Field Strength Data	● Raw N-Value Blows ▲ Unconfined Compressive Strength ■ Sample Pocket Penetrometer	Unit Weight (pcf)	Moisture Content (%)	Lab Data						% Swell	Restraining Pressure (ksf)
									Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Minus #200	% Plus #40	% Plus #4	
30	×	SP-SM		Poorly Graded Sand with Silt (SP-SM) loose; brown with orange; wet; iron-oxide staining Dense	N= 43											
35	×															
40	×															
45				Very dense												

Date Drilled:
07/08/2025

Driller:
Juwuan Martin

Logger:
Hunter Franks

Latitude / longitude:
33.502654, -94.017530

Notes: GW @ 7' and caved to 13' upon completion.

Boring Log Descriptive Terminology

Key to Soil Symbols and Terms

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	Well-graded gravels, gravel sand mixtures, little or no fines.
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	Silty gravels, gravel-sand-silt mixtures.
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		GC	Clayey gravels, gravel-sand-clay mixtures.
		CLEAN SANDS (LITTLE OR NO FINES)		SW	Well-graded sands, gravelly sands, little or no fines.
		Poorly graded sands, gravelly sands, little or no fines.		SP	
FINE GRAINED SOILS	SILTS AND CLAYS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	Silty sands, sand-silt mixtures.
		CLAYEY SANDS, sand-clay mixtures.		SC	
	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sand, flour, silty or clayey fine sand, clayey silts with silt.
		LIQUID LIMIT LESS THAN 50		CL	Inorganic clays, silty clays, plasticity clays.
		LIQUID LIMIT GREATER THAN 50		OL	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE SOILS THAT ARE BOTH INORGANIC AND ORGANIC.

Order of Descriptors

- Group Name
- Consistency or Relative Density
- Moisture Condition
- Color
- Particle size descriptor(s) (coarse grained soils only)
- Angularity of coarse grained soils
- Other relevant notes

Criteria for Descriptors	
Consistency	N-Value (uncorrected)
Very Soft	< 2
Soft	2 - 4
Medium	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	> 30

Moisture Condition

Very moist, moist, damp, dry to the touch, very dry, no visible water, no visible free water.

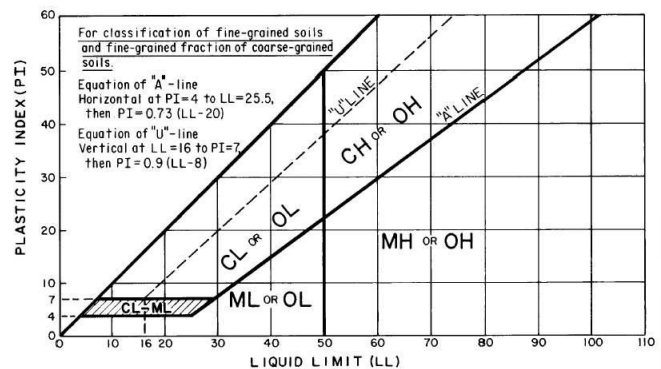
Definition of Particle Size Ranges

Component	Size Range
Boulder	> 12 in (300 mm)
Cobble	3 in (75 mm) - 12 in (300 mm)
Gravel	No. 4 Sieve (4.75 mm) to 3 in (75 mm)
Sand	No. 200 (0.075 mm) to No. 4 Sieves (4.75 mm)
Silt	< No. 200 Sieve (0.075 mm)*
Clay	< No. 200 Sieve (0.075 mm)*

*Use Atterberg limits and chart below to differentiate between silt and clay.

SPT (Standard Penetration Test):
The number of blows required to drive a 60 lb (27 kg) hammer falling freely from a height of 30 in (762 mm) into a 1.5 ft (0.45 m) of soil.
Written as: 12-24-50 (0.09 m) - third 0.5 ft (0.15 m) of penetration.
Note: If the number of blows exceeds 50 before 0.5 ft (0.15 m) of penetration is achieved, the actual penetration follows the number of blows in parentheses (ex: 12-24-50 (0.09 m), 34-50 (0.4 ft), or 100 (0.3 ft)).
WR denotes a zero blow count with the weight of the rods only.
WH denotes a zero blow count with the weight of the rods plus the weight of the hammer.

Soil Classifications are Based on the Unified Soil Classification System, ASTM D2487 and D2488. Also included are the AASHTO group classifications (M145). Descriptions are based on visual observation, except where they have been modified to reflect results of laboratory tests as deemed appropriate.



Angularity of Coarse-Grained Particles

- Angular** - Particles have sharp edges and relative plane sides with unpolished surfaces.
- Subangular** - Particles are similar to angular description, but have rounded edges.
- Subrounded** - Particles have nearly plane sides, but have no edges.
- Rounded** - Particles have smoothly curved sides and well-rounded corners and edges.



LABORATORY TEST DATA SUMMARY SHEET

PROJECT: North Texarkana WWTP

ETTL JOB NUMBER: G6576-25

PROJECT LOCATION: Texarkana, AR

CLIENT: A.L. Franks

PROJECT MANAGER.: Reid Banta

START DATE: 7/17/2025

FINISH DATE: 7/18/2025

TECHNICIAN(S): JC

DATE SAMPLED: 7/8/2025

[illegible]

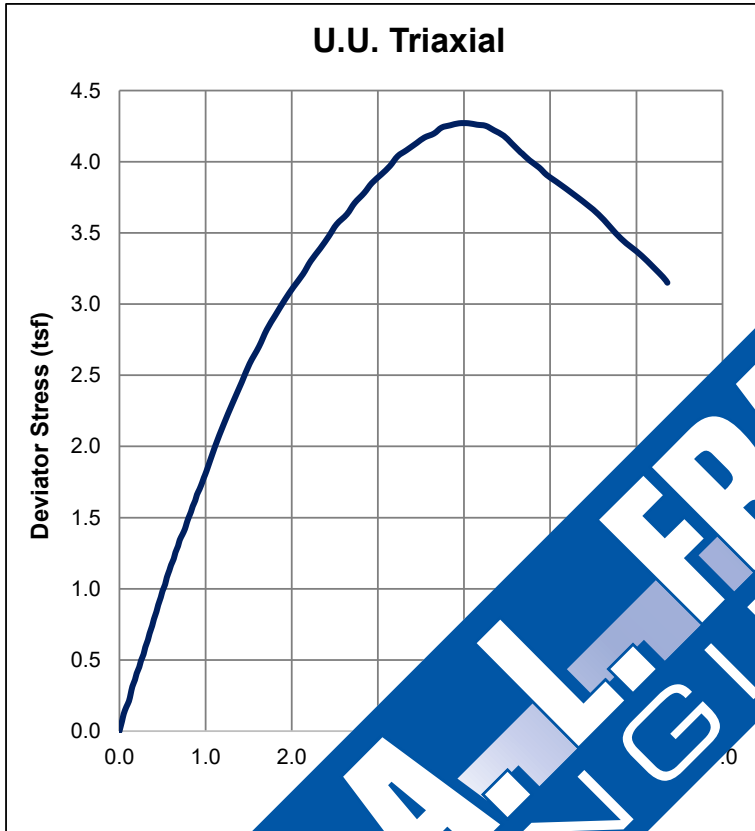
NT = Not Tested, Visual Classification

NP = Non Plastic, LL Attempted

ASTM D 2850 Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

Project: North Texarkana WWTP
 Client: A.L. Franks
 Location: Texarkana, AR
 Material: Dark Brown Fat Clay (CH)

ETTL Project No.: G6576-25
 Boring No.: B-1
 Depth (ft.): 1.0' - 3.0'
 Sample: _____



At Test Properties

Height	3.9	inches
Inside Diameter	2.8	inches
Moisture Content	22.2	(trimmings)
Unit Weight	122.2	lbs./ft ³
Specific Gravity	2.67	(assumed)
Void Ratio	0.589	
Skempton's B	74.8	%
Preconsolidation Pressure	4.25	tsf
Unconfined Compressive Strength	N/T	tsf
Rate of Strain	1.0	%/min
Peak Stress ($\sigma_1 - \sigma_3$)	4.26	tsf
Confining Pressure σ_3	1.60	psi
Strain At Failure	4.05	%
Modulus at 1/2 Peak Stress	357	ksf
Strain at 50% Max Stress (e_{50})	0.012	in/in
Atterbergs LL / PI	59	39
Passing No. 200 Sieve	85.0	%
Sampling Method	2.8 in. Shelby Tube	
Type of Specimen	Undisturbed	
Date Sampled	7/8/285	
Specimen Trimming ID	E	(whole)

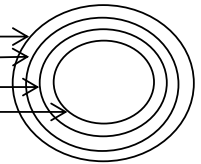
Testing Remarks:

Applied to Deviator Stress (psi) = 0.24

Technician: _____

Test Date: 7/17/2025 Report Date: 8/5/2025

E=2.8"
 A=2.5"
 B=2.0"
 C=1.4"



Measured Angle of Fracture from Horizontal: N/A

Sketch of Fracture:



Crumbled

ASTM D 4546 One-Dimensional Swell or Settlement of Cohesive Soils, Method A/B Modified

Project Information

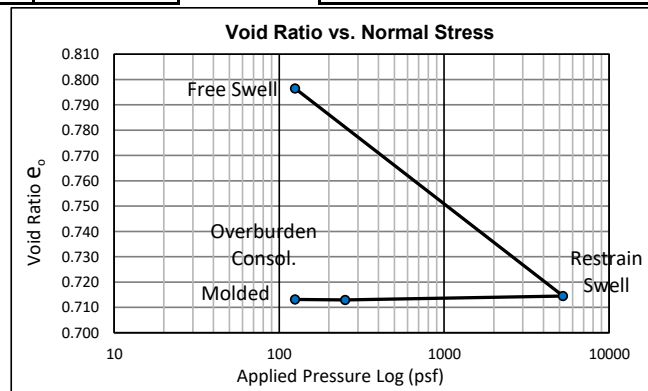
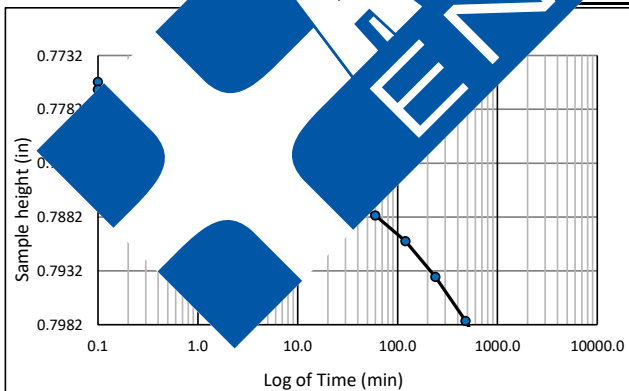
Project: North Texarkana WWTP
 Client/Arch./Engr: A.L. Franks
 Project Location: Texarkana, AR
 Ettl Job No: G6576-25

Sample Information

Location / Boring No: B-1
 Sample No: _____ Depth: 1.0' -3.0' ft.
 Material Origin: Geotechnical Boring
 Sampling Info. provided By: Ettl Engineers & Consultants, Inc.
 Material Description: Dark Brown Fat Clay (CH)
 Sample Type: Undisturbed Shelby Tube Trimmed at In-situ M.C.
 Sampled By: Ettl Drilling Date Sampled: _____
 Technician: Hunter Franks Test Date: _____

Test Data

	Sample Data			Liquid Limit	
	Molded	Overburden Consol.	Restrained Swell	L.L.	P.L.
Wt. of mold + Wet Wt.:	187.12	187.12	187.12	59	20
Wt. of mold:	66	66	66	P.L.	-200%
Wet Wt. of sample:	121.12	121.12	121.12	39	85
Dry Wt. of sample:	97.21	97.21	97.21	*N/T = Not Tested	
Height of sample:	0.7758	0.7758	0.7758	Pocket Penetrometer (tsf)	
Diameter of sample:	2.500	2.500	2.500	Before Test	After Test
Area of sample:	4.909	4.909	4.909	4.25	1.00
Volume of sample:	3.808	3.808	3.808	USACE Swelling Index - Cs	
Degree of Saturation:	92.1%	92.1%	92.1%	0.051	
Void Ratio e:	0.717	0.796	0.796	Percent Moisture Absorption	
Applied Pressure:		125	125	3.7%	
Assumed Specific Gravity:		2.67	2.67	Percent Free Swell	
Wet Unit Weight:		119.0	119.0	4.8%	
Dry Unit Weight:		92.7	92.7	Restrained Pressure (psf)	
Moisture Content:	24.6%	28.3%	28.3%	5262	



ASTM D 4546 One-Dimensional Swell or Settlement of Cohesive Soils, Method A/B Modified

Project Information

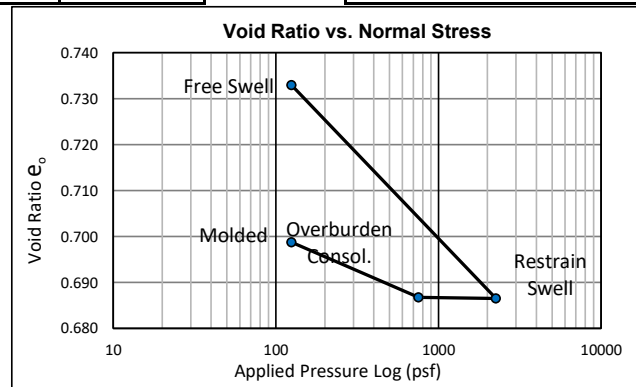
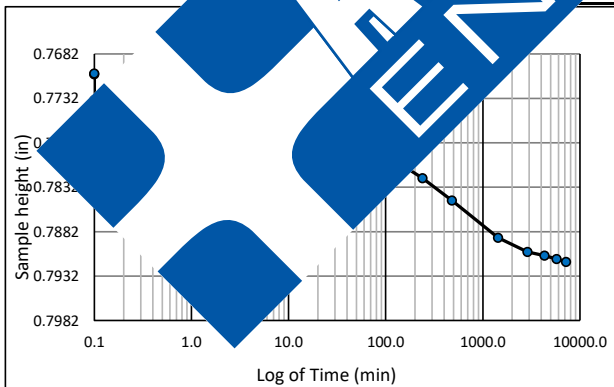
Project: North Texarkana WWTP
 Client/Arch./Engr: A.L. Franks
 Project Location: Texarkana, AR
 ETTTL Job No: G6576-25

Sample Information

Location / Boring No: B-2
 Sample No: _____ Depth: 5.0' -7.0' ft.
 Material Origin: Geotechnical Boring
 Sampling Info. provided By: ETTTL Engineers & Consultants, Inc.
 Material Description: Orange Brown w/ Dark Brown Lean Clay (CL)
 Sample Type: Undisturbed Shelby Tube Trimmed at In-situ M.C.
 Sampled By: ETTTL Drilling Date Sampled: _____
 Technician: Hunter Franks Test Date: _____

Test Data

	Sample Data			Liquid Limit and Plasticity Limits	
	Molded	Overburden Consol.	Restrained Swell	L.L.	P.L.
Wt. of mold + Wet Wt.:	183.73	183.73	183.73	45	15
Wt. of mold:	66.19	66.19	66.19	P.I.	-200%
Wet Wt. of sample:	117.54	117.54	117.54	30	86
Dry Wt. of sample:	98.07	98.07	98.07	*N/T = Not Tested	
Height of sample:	0.7760	0.7705	0.7705	Pocket Penetrometer (tsf)	
Diameter of sample:	2.500	2.500	2.500	Before Test	After Test
Area of sample:	4.909	4.909	4.909	4.25	1.00
Volume of sample:	3.809	3.809	3.809	USACE Swelling Index - Cs	
Degree of Saturation:	75.9%	75.9%	75.9%	0.037	
Void Ratio e_0 :	0.695	0.695	0.733	Percent Moisture Absorption	
Applied Pressure:			125	3.5%	
Assumed Specific Gravity:			2.67	Percent Free Swell	
Wet Unit Weight:			118.6	2.8%	
Dry Unit Weight:			96.1	Restrained Pressure (psf)	
Moisture Content:	19.9%	23.4%	23.4%	2258	

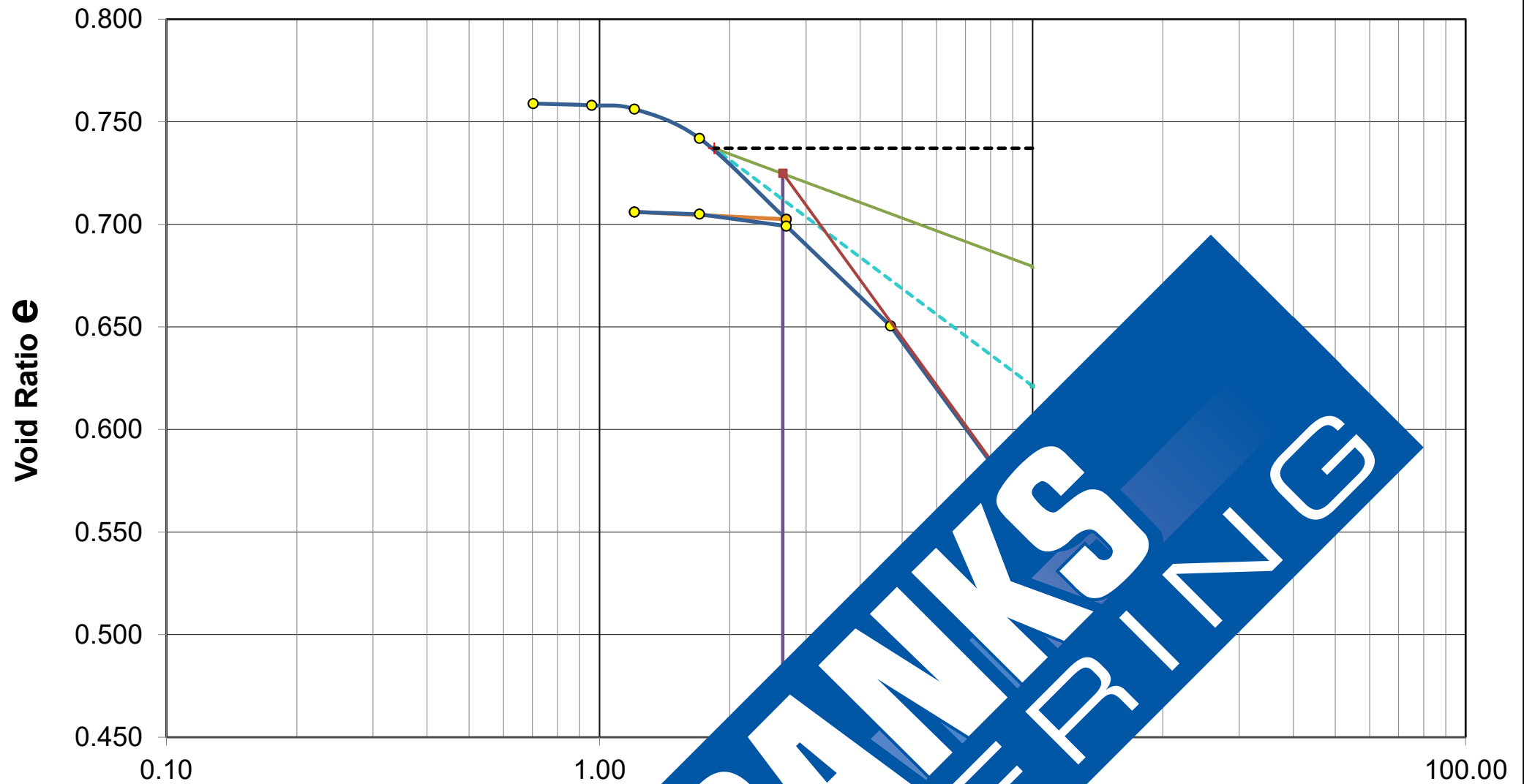




ETTL Engineers & Consultants Inc.

GEOTECHNICAL ★ MATERIALS ★ ENVIRONMENTAL ★ DRILLING ★ LANDFILLS

ASTM D 2435 - One-Dimensional Consolidation



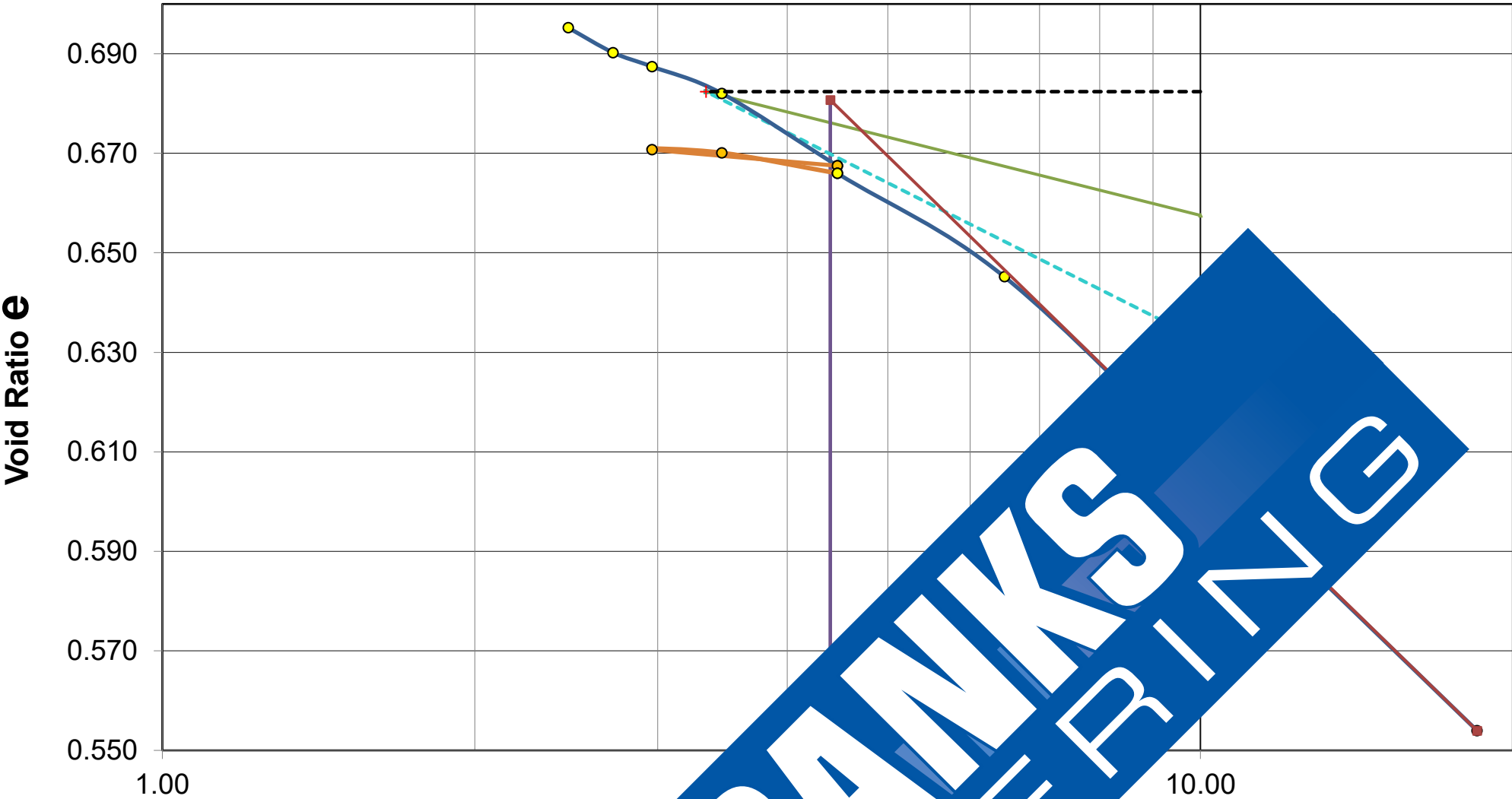
C_c	Initial e_o	Restraining Swell Stress (tsf)	Restraining Swell e_s	Preconsolidation Pressure (tsf)	Estimated OCR
0.218	0.757	0.70	0.757	2.65	9.7
Effective Stress (tsf)	(%) Strain @ 24 Hrs.	Void Ratio e @ 24 Hrs.	C_v (Log of Time Method)	Cv - Log of Time Method	
0.00	-	0.757			
0.70	0.000	0.757			
0.96	0.051	0.757			
1.20	0.153	0.757			
1.70	0.967	0.757			
2.70	3.207	0.757			
1.20	3.000	0.757			
1.70	?	0.757			
2.70		0.757			
4.70		0.757			
8.70		0.757			
16.68		0.757			
Est. Insitu Effective Stress (tsf)					
54.9					
Project Information					
Project: North Texarkana WWTP					
Location: Texarkana, AR					
ETTL Job No.: G6576-25					
Client: A.L. Franks					
Technician: Hunter Franks					
Report Date: 9/4/2025					
Project Information					
Project: North Texarkana WWTP					
Location: Texarkana, AR					
ETTL Job No.: G6576-25					
Client: A.L. Franks					
Technician: Hunter Franks					
Report Date: 9/4/2025					
Project Information					
Project: North Texarkana WWTP					
Location: Texarkana, AR					
ETTL Job No.: G6576-25					
Client: A.L. Franks					
Technician: Hunter Franks					
Report Date: 9/4/2025					



ETTL Engineers & Consultants Inc.

GEOTECHNICAL * MATERIALS * ENVIRONMENTAL * DRILLING * LANDFILLS

ASTM D 2435 - One-Dimensional Consolidation



C _c	Initial e _o	Restraining Swell Stress (tsf)	Restraining Swell e _s	Preconsolidation Pressure (tsf)	Estimated OCR
0.202	0.690	2.46	0.690	4.40	10.5
Effective Stress (tsf)	(%) Strain @ 24 Hrs.	Void Ratio e @ 24 Hrs.	Cv (10 ⁻⁴)	Cv - Log of Time Method	
0.00	-	0.690			
2.46	0.000	0.690			
2.72	0.294	0.685			
2.96	0.460	0.680			
3.46	0.780	0.675			
4.47	1.636	0.670			
2.96	1.44	0.675			
3.46	1.1	0.680			
4.47	0.780	0.685			
6.47	0.460	0.690			
10.48	0.294	0.695			
18.47	0.118	0.700			
Est. Insitu Eff. Stress (tsf)					
835					
Test Data				Project Information	
Boring: B-2		Depth / Spl#: 5.0 - 7.0		Project: North Texarkana WWTP	
Material Description: Brown w/ Dark Brown Lean Clay (CL)				Location: Texarkana, AR	
LL	PL	PI	-200%	ETTL Job No.: G6576-25	
45	15	30	86	Client: A.L. Franks	
Initial MC	Final MC	Initial Dry Unit Weight (pcf):		Technician: Hunter Franks	
21.2%	20.7%	Final Dry Unit Weight (pcf):		Report Date: 9/4/2025	
Initial Sat. %	Final Sat. %	Test method:			
82.0%	100.0%	Test Condition:			
Initial e	Final e	Testing Consolidometer			
0.690	0.554	Soil Test			
		262			

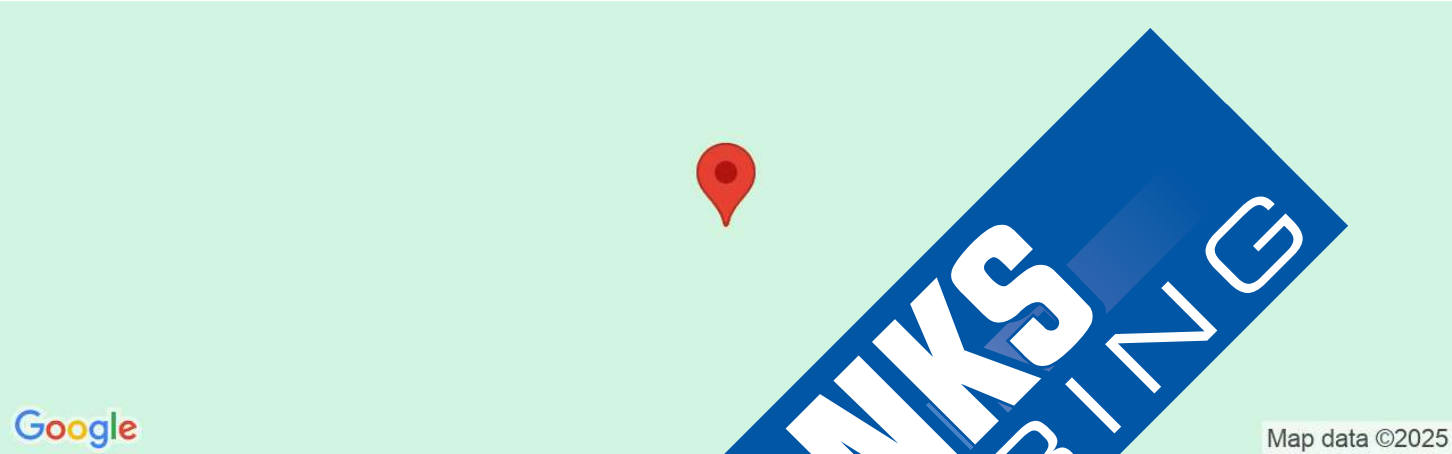


Se
A
ters

Announcement
ASCE 7-22 is now available.



Latitude, Longitude: 33.50257280, -94.01759496



Date
Design Code Reference Document
Risk Category
Site Class

Type	Value	Description
S _S	0.13	MCE _R ground motion
S ₁	0.079	MCE _R ground motion
S _{MS}	0.208	Site-modified
S _{M1}	0.189	Site-modified
S _{DS}	0.139	Maximum considered earthquake spectral acceleration
S _{D1}	0.126	Maximum considered earthquake spectral acceleration

Type	Value	Description
SDC	C	Seismic design category
F _a	1	Seismicity factor at short periods
F _v	1	Seismicity factor at 0.2 second
PGA	0.099	Peak ground acceleration
F _{PGA}	1.6	Factor at PGA
PGA _M	0.099	Peak ground acceleration
T _L	12	Long period transition period in seconds
SsRT	0.13	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.141	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.079	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.09	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA _{UH}	0.062	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C _{RS}	0.921	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.878	Mapped value of the risk coefficient at a period of 1 s
C_V	0.7	Vertical coefficient



DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC / OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.



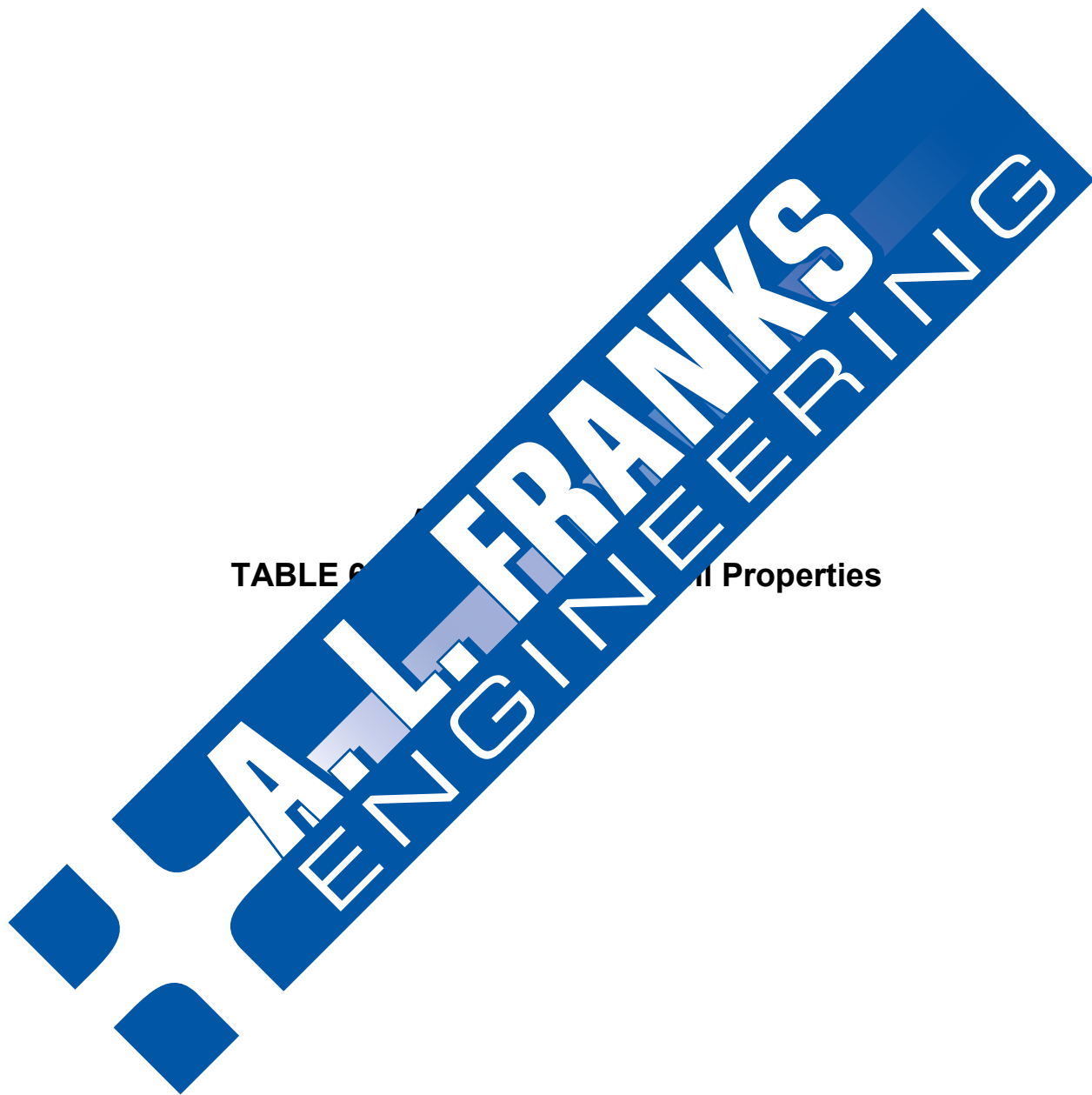


TABLE C-10. General Properties

TABLE 6.2.1 - Predicted Soil Engineering Properties

Stratum	1	2	3	Compacted TxDOT Base	Select Fill Compacted 98% D698
Depth from Existing Grade (ft)	0 - 3'	3 - 8'	8 - 40'	-	-
Moist Weight (pcf) ¹	115	120	125	135	120
Soil Classification - USCS	CH	CL	SM / SP	GW	Sandy CL / SC
Peak Shear Strength Parameters ³					
Estimated Drained Friction Angle ϕ' ²	22	20	30	-	20
Unconsolidated / Undrained Cohesion c (psf) ³	2000	1000	-	-	1000
Lateral Loading Parameters					
Rankine – Kp (passive)	2.20	2.04	-	-	3.00
Rankine – Ka (active)	0.45	0.49	-	-	0.33
Rankine – Ko (at rest)	0.63	0.63	-	-	0.50
ϵ 50 ⁴	0.012	-	-	-	-
Soil Type (For L-Pile Analysis) ⁴	Stiff Clay w/ Free Water	-	-	-	Stiff Clay w/o Free Water
Consolidation Parameters					
Initial Void Ratio – eo	-	-	-	-	0.4
Preconsolidation Pressure- Pc (tsf)	-	-	-	-	2
Compression Index – Cc	-	-	-	-	0.060
Recompression Index – Ce	-	-	-	-	0.005
Coefficient of Consolidation – Cv (in ² /min)	-	0.003	-	-	3.000
Poisson's Ratio – ν	-	0.4	0.3	0.35	0.4
Modulus of Elasticity – E (ksf)	93	28	97	269	88
Modulus of Elasticity – E _u (ksf)	93	62	215	595	194
Confined Tangent Modulus – M _t (ksf)	120	80	300	800	250

Notes:

- 1) Use buoyant unit weight where applicable
- 2) Estimated drained friction angle (ϕ' = degrees) and cohesion (c' = psf), measured by CU triaxial and CD direct shear, or correlated values
- 3) Predicted Undrained Unconfined (UU) compressive strength based on testing or estimated from SPT blow counts.
- 4) Use default L-Pile values for K and ϵ 50, as applicable where values not otherwise indicated
- 5) Pre-consolidation pressure (tsf) was measured at the sample depth. Value varies with overburden.
- 6) M_t = Confined (1D) Tangent Modulus (ksf) estimated from consolidation testing or UU tests

TEXARKANA, ARKANSAS

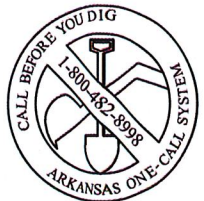
NORTH WWTP - EXPANSION

TX-01-24

INDEX TO SHEETS

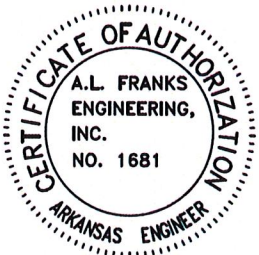
SHEET	DESCRIPTION
1.	COVER SHEET
2.	GENERAL NOTES
3.	SITE OVERVIEW
4.	EXISTING FLOW SCHEMATIC
5.	PROPOSED FLOW SCHEMATIC
6.	HYDRAULIC PROFILE
7.	DEMOLITION PLAN
8.	SITE & GRADING PLAN
9.	YARD PIPING
10.	EROSION & SEDIMENT CONTROL PLAN
11.	INFLUENT PUMP STATION
11A.	SAMPLING MANHOLE
12.	HEADWORKS DEMOLITION PLAN
13.	HEADWORKS PLAN
14.	HEADWORKS DETAILS
15.	MECHANICAL BAR SCREEN
16.	GRIT CLEANSE
17.	AERATION BASIN PLAN
18.	AERATION BASIN DETAILS
19.	AERATION BASIN DETAILS
20.	AERATION BASIN STRUCTURAL DETAILS
21.	CLARIFIER #3 PLAN
22.	CLARIFIER #3 DETAILS
23.	CLARIFIER #3 DETAILS
24.	CLARIFIER #3 DETAILS
25.	RAS PUMP PLAN
26.	UV DISINFECTION
27.	AIR BLOWER PLAN
28.	MISCELLANEOUS DETAILS
29.	MISCELLANEOUS DETAILS
30.	MISCELLANEOUS DETAILS
31.	EROSION & SEDIMENT CONTROL DETAILS
S1.	GRIT CHAMBER PLAN AND NOTES
S2.	GRIT CHAMBER SECTION
S3.	GRIT CHAMBER SECTIONS
E1.	LEGEND AND ABBREVIATIONS
E2.	SITE OVERVIEW
E3.	SITE-OVERVIEW-CLASSIFICATION PLAN
E4.	INFLUENT PUMP STATION
E5.	HEADWORKS PLAN
E6.	AERATION BASIN PLAN
E7.	CLARIFIER #3 PLAN
E8.	RAS PUMP STATION
E9.	WAS PUMP STATION
E10.	UV DISINFECTION
E11.	BLOW BUILDING PLAN
E12.	DETAILS I
E13.	DETAILS II
E14.	ONE-LINE DIAGRAM
E15.	ONE-LINE DIAGRAM
E16.	SCHEDULES I
E17.	SCHEDULES II

TEXARKANA WATER UTILITIES
801 WOOD STREET
TEXARKANA, TX 75501
PH: 903-798-3800



BEFORE CONSTRUCTION BEGINS
GIVE 48 HOURS NOTICE
FOR UNDERGROUND UTILITY LOCATIONS
CALL: THE ARKANSAS ONE-CALL SYSTEM 1-800-482-8998

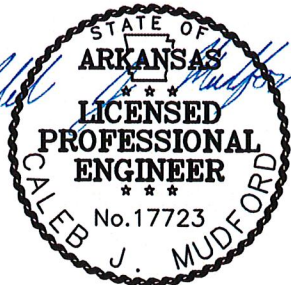
SUBMITTED BY:



118 E. Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

101 West Main, Ste. 413
El Dorado, Arkansas 71730
Phone (870) 444-5160
Fax (870) 444-5161

REVISION 1.0
REVISION 2.0



9-2-26

Caleb J. Mudford
CALEB J. MUDFORD, P.E. PROJECT ENGINEER DATE 9-2-26

Anthony L. Franks
ANTHONY L. FRANKS, P.E. PROJECT REVIEWER DATE 9/02/2026

ARKANSAS HEALTH DEPARTMENT NOTES

1. THIS PROJECT SHALL CONFORM TO THE FOLLOWING:
- A) "RECOMMENDED STANDARDS FOR WASTEWATER FACILITIES" (TEN STATES STANDARDS).
- B) ARKANSAS STATE LICENSING LAW FOR COMMERCIAL CONTRACTORS ACT 150 OF 1965 AND ACT 162 OF 1987 (AS AMENDED) REQUIRES THE INSTALLATION CONTRACTOR TO HAVE A CONTRACTORS LICENSES CLASSIFICATION OF MUNICIPAL AND UTILITY CONSTRUCTION.
- C) ARKANSAS BOARD OF HEALTH "RULES AND REGULATIONS PERTAINING TO PUBLIC WATER SYSTEMS"
- D) ALL APPLICABLE AWWA (AMERICAN WATER WORKS ASSOCIATION) SPECIFICATIONS INCLUDING:
- 1) AWWA C600-23 STANDARDS FOR INSTALLATION OF DUCTILE WATER MAIN AND THEIR APPURTENANCES.
- 2) AWWA C605-21 STANDARD FOR UNDERGROUND INSTALLATION OF POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS FOR WATER.
- 3) AWWA C651-23 STANDARDS FOR DISINFECTING WATER MAINS.
- 4) AWWA C900-22 & C907-23 STANDARD FOR PVC PRESSURE PIPE FOR WATER DISTRIBUTION.
- 5) AWWA C651-23 STANDARDS FOR DISINFECTING WATER MAINS REQUIRE BACTI SAMPLING ON DISTRIBUTION SYSTEM EVERY 1200 FEET. HOWEVER, THE ARKANSAS DEPT. OF HEALTH, DIVISION OF ENGINEERING WILL ALLOW BACTI SAMPLING EVERY 2600 FEET ON MAINS AND BRANCH LINES AT THE END OF EVERY BRANCH LINE.
2. AWWA C651-23, APPENDIX C (CHLORINE NEUTRALIZATION) WILL BE COMPLIED WITH. " DRAINAGE OF MAINS AND DISPOSAL OF CHLORINATED WATER SHALL BE IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL LAWS, ORDINANCES AND REGULATIONS. MAINS SHALL BE DRAINED TO SANITARY SEWERS, WHERE AVAILABLE. DRAINAGE DIRECTLY TO SURFACE WATERS (CREEKS, RIVERS, STREAMS, LAKES, PONDS, ECT.) WILL NOT BE ALLOWED. DRAINAGE BRANCHES, BLOW-OFF'S, AIR VENTS AND APPURTENANCES SHALL BE PROVIDED WITH VALVES AND SHALL BE LOCATED AND INSTALLED AS SHOWN ON THE PLANS AND STANDARD DETAILS. DRAINAGE OF MAINS WILL BE ACCOMPLISHED IN SUCH A MANNER AS TO MINIMIZE EROSION AND SILTATION TO ADJOINING PROPERTIES. WATER VELOCITY FROM DRAINAGE AND OR BLOW-OFF WILL BE DISSIPATED AS NECESSARY TO PREVENT EROSION. DRAINAGE BRANCHES OR BLOW-OFFS SHALL BE NOT BE CONNECTED TO ANY SEWER, SUBMERGED IN ANY STREAMS, OR INSTALLED IN ANY OTHER MANNER THAT WILL PERMIT BACK SIPHONAGE INTO THE DISTRIBUTION SYSTEM.
3. THE OPERATING ROUTINE SHALL INCLUDE NECESSARY PROTECTIVE MEASURES TO DETECT AND REMOVE OR DESTROY ANY CONTAMINANT OF CONCERN OR REGULATION THAT MIGHT ENTER THE DISTRIBUTION SYSTEM. EVERY PRECAUTION MUST BE TAKEN AGAINST THE POSSIBILITY OF SEWAGE CONTAMINATION OF THE WATER IN THE DISTRIBUTION SYSTEM.WATER MAINS AND SANITARY SEWERS SHALL BE CONSTRUCTED AS FAR APART AS PRACTICABLE, AND SHALL BE SEPARATED BY UNDISTURBED AND COM EARTH. A MINIMUM HORIZONTAL DISTANCE OF TEN FEET SHOULD BE MAINTAINED BETWEEN WATER LINES AND SEWER LINES OR OTHER LINES OF CONTAMINATION. WATER LINES AND SEWERS SHALL NOT BE PLACED IN THE SAME TRENCH EXCEPT ON THE WRITTEN APPROVAL OF THE ARKANSAS DEPARTMENT OF HEALTH. WATER MAINS NECESSARILY IN CLOSE PROXIMITY TO SEWERS MUST BE PLACED SO THAT THE BOTTOM OF THE WATER MAIN WILL BE AT LEAST 18 INCHES ABOVE THE TOP OF THE SEWER LINE AT

HIGHEST POINT. IF THIS DISTANCE MUST BE UNAVOIDABLY BE REDUCED, THE WATER LINE OR THE SEWER LINE MUST BE ENCASED IN WATERTIGHT PIPE WITH THE SEALED ENDS EXTENDING AT LEAST TEN FEET EITHER SIDE OF THE CROSSING. ANY JOINT IN THE ENCASEMENT PIPE IS TO BE MECHANICALLY RESTRAINED. THE ENCASEMENT PIPE MAY BE VENTED TO THE SURFACE IF CARRYING WATER OR SEWER UNDER PRESSURE. WHERE A WATER LINE MUST UNAVOIDABLY PASS BENEATH THE SEWER LINE, AT LEAST 18 INCHES OF SEPARATION MUST MAINTAINED BETWEEN THE OF THE TWO PIPES IN ADDITION TO THE PRECEDING ENCASEMENT REQUIREMENT. EXCEPTIONS TO THIS MUST BE APPROVED IN WRITING BY THE ARKANSAS DEPARTMENT OF HEALTH. A MINIMUM HORIZONTAL DISTANCE OF THREE FEET SHALL BE MAINTAINED BETWEEN WATER LINES AND OTHER UNDERGROUND UTILITIES OF A NONSANITARY NATURE (GAS, ELECTRIC, ETC.). EXCEPTIONS TO THIS MUST BE APPROVED IN WRITING BY THE ARKANSAS DEPARTMENT OH HEALTH

GENERAL NOTES

1. A 3'-0" MIN. BURY SHALL BE MAINTAINED ON WATER MAIN.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO EXISTING UTILITIES, PIPING, CONDUIT, ETC. RESULTING FROM CONSTRUCTION WORK SHOWN ON THESE DRAWINGS OR NOT.
3. CONTRACTOR SHALL PERFORM FINISH GRADING, TOP SOIL, AND ESTABLISHMENT OF GRASS COVER IN ALL DISTURBED AREAS. SPECIAL SPECIFICATIONS, OR AS DIRECTED BY THE ENGINEER.
4. ALL WATER MAINS TO BE TESTED PER PLANS.
5. CONTRACTOR SHALL HAVE UTILITIES LOCATED PRIOR TO CONSTRUCTION FOR DAMAGE TO ALL UTILITIES ARISING FROM CONSTRUCTION REGARDLESS OF BEING SHOWN OR OMITTED. ALL UTILITIES ARE INDICATED IN APPROXIMATE LOCATIONS.
6. ALL DEBRIS SHALL BE DISPOSED OF BY THE ENGINEER.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM REQUIRED 10 FEET HORIZONTAL SEPARATION BETWEEN WATER MAINS AND SEWER MAINS.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR PREVENTING SOILS AND CONTAMINATION REPAIRS.
9. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM STREET/HWY R.O.W. ACCESS PERMITS SHALL BE OBTAINED BY THE CONTRACTOR. PROPERTY SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
10. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
11. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
12. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
13. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
14. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
15. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
16. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
17. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
18. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
19. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
20. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
21. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
22. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
23. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
24. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
25. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
26. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
27. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
28. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
29. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
30. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
31. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
32. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
33. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO
34. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING A MINIMUM CO

- OWNER AND IT'S REPRESENTATIVES WILL PROVIDE GENERAL LOCATION OF EXISTING WATER MAINS. CONTRACTOR IS RESPONSIBLE FOR DAMAGE AND SUBSEQUENT REPAIRS OF EXISTING MAINS, SERVICE LINES AND APPURTENANCES.
15. ALL BENDS, FITTINGS, VALVES & FIRE HYDRANTS SHALL BE BLOCKED PER DETAILS.
16. M.J. BENDS SHALL BE UTILIZED WHERE ALLOWABLE DEFLECTION WOULD BE EXCEED
17. MAIN VALVES TO BE INSTALLED w/ ADJ. VALVE BOXES & UTILIZATION PADS.
18. VALVES TO BE LOCATED ON PROPERTY CORNERS PLUMB & AT THE ENGINEER.
19. VALVES TO MEET DEFLECTION REQUIREMENTS AND SHALL BE INCLUDED IN BID.
20. VALVES TO BE DELIVERED TO THE CITY.
21. PROPOSED MAINS TO EXISTING MAINS THE CONTRACTOR SHALL TEMPORARILY BLOCK, PRESSURE TEST AND BAC-TI TEST PER AWWA AND ADH SPECIFICATIONS.
22. MAIN INSTALLATION DETAILS ON SHEET 17 & 18.
23. ABANDONING EXISTING WATER MAINS SHALL BE ACCOMPLISHED UPON ACCEPTANCE TESTING COMPLETION. ABANDONING EXISTING WATER MAINS IS SUBSIDIARY TO THE PROJECT.
24. MAINS WITH ASPHALT OR CONCRETE PAVEMENT SHALL BE CROSSED BY THE CONTRACTOR. GRAVEL DRIVEWAYS SHALL BE TRENCHED AND REPAIR IS SUBSIDIARY TO WATER MAIN INSTALLATION.
25. CONTRACTOR SHALL VERIFY LOCATION OF EXISTING WATER METERS PRIOR TO SERVICE INSTALLATION.
26. EXISTING HYDRANTS TO BE ABANDONED SHALL BE REMOVED AND DELIVERED TO THE CITY.
27. DISINFECTION AND TESTING OF WATER MAINS SHALL BE ACCOMPLISHED AS WORK IS COMPLETED AND WILL BE PAID SEPARATELY. FLUSHING OF WATER MAINS SHALL BE ACCOMPLISHED AT FIRE HYDRANTS OR FLUSH HYDRANTS AT THE EXTREMITY OF NEWLY INSTALLED MAINS.
28. DIRECTIONAL BORES UNDER DITCHES AND CREEKS SHALL BE CERTA-LOK C-900 PVC PIPE
29. REMOVE EXISTING FIRE HYDRANTS IS NOT A PAY ITEM AND SHALL BE INCIDENTAL TO NEW FIRE HYDRANT INSTALLATION.
30. INSTALL 1" TAP WITH SERVICE TERMINATING WITH CORP STOP IN METER BOX FOR BACTI SAMPLING AT LOCATIONS DESIGNATED BY THE ENGINEER. COST SHALL BE INCIDENTAL TO TESTING & STERILIZATION.
31. CONTRACTOR SHALL VERIFY DEPTHS OF EXISTING SEWER MAINS PRIOR TO CROSSING AND/OR DIRECTIONAL BORING PROPOSED WATER MAINS. IN THE EVENT THAT 2-FT VERTICAL SEPARATION CANNOT BE ACHIEVED THE WATER MAIN SHALL BE CASED WITH A 20-FT JOINT OF C900 PVC PIPE BEING CENTERED OVER THE SEWER MAIN. EACH END OF THE CASING SHALL BE SEALED.
32. SOME PROPOSED LINES ARE SHOWN OUTSIDE THE STREET R.O.W. FOR CLARITY. ALL CONSTRUCTION SHALL BE WITHIN STREET AND HIGHWAY R.O.W.
33. ABANDONED MAINS SHALL BE PLUGGED WITH A PROPERLY SIZED MJ PLUG AT THE TIME TIE-INS ARE MADE. PRE-BID SITE VERIFICATION : 34. FIELD VERIFY ALL EXIST CONDITIONS. PRIOR TO BIDDING & CONSTRUCTION REPORT ANY DISCREPANCIES TO ENGINEER IN WRITING PRIOR TO BIDDING. NO EXTRA PAYMENTS WILL BE MADE TO CONTRACTOR AFTER BIDDING TO ACCOMMODATE SITE DISCREPANCIES NOT REPORTED PRIOR TO BIDDING.
34. IT IS RECOMMENDED THAT THE CONTRACTOR VISIT THE SITE, PRIOR TO BIDDING.

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

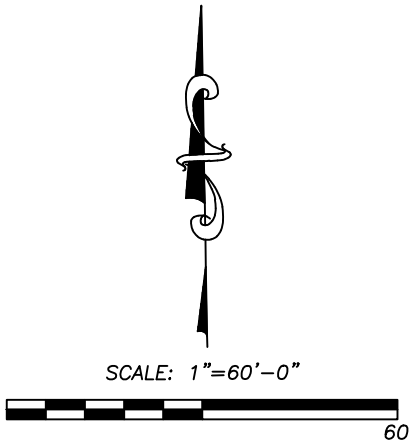
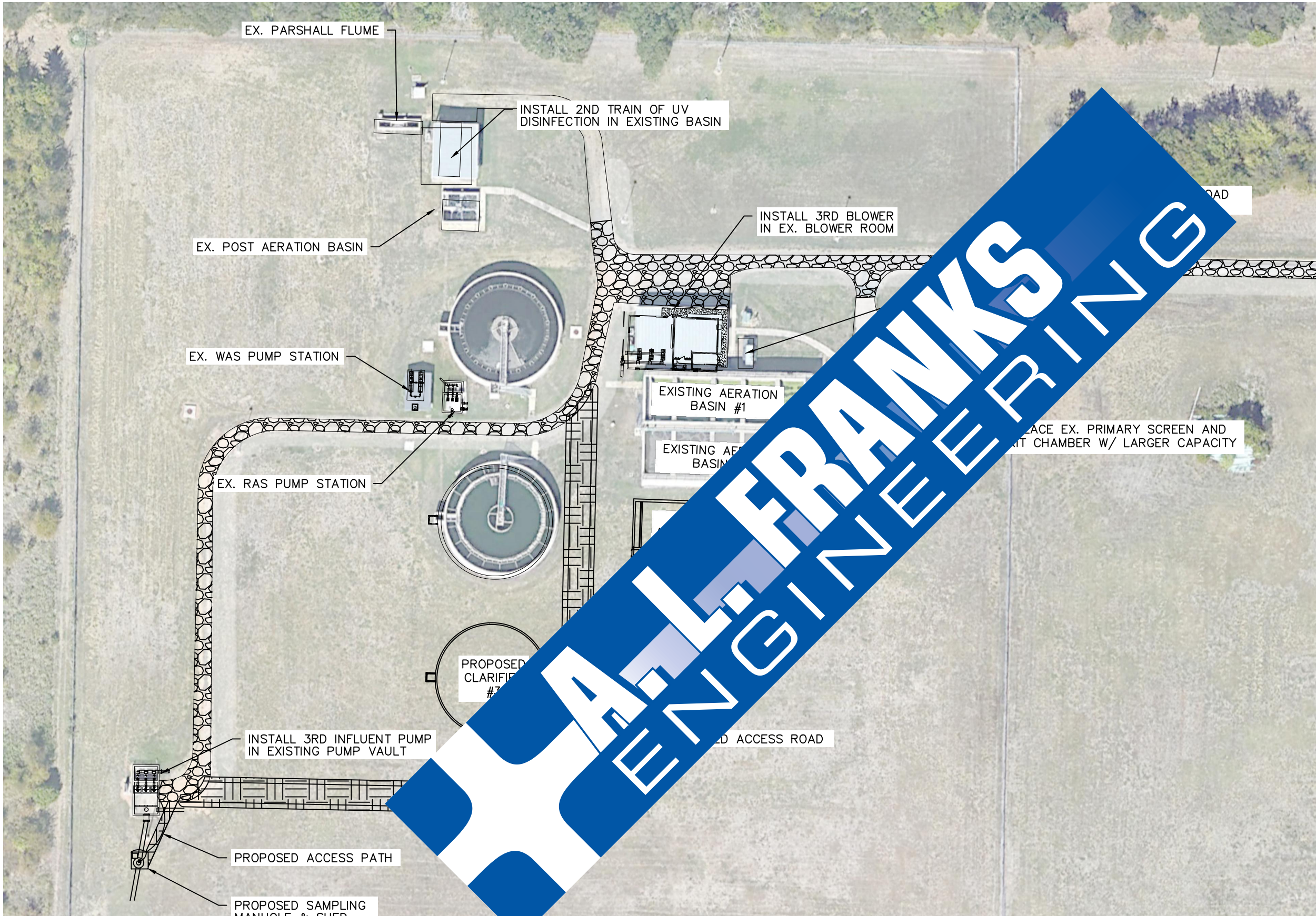
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

GENERAL NOTES

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 2



C:\Users\cmudford\A - L Franks Engineering\Company Files - Files\A.L. Franks Engineering Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design_01.dwg



NOTES
NO WORK IS ASSOCIATED WITHIN THE PROJECT SCOPE FOR THE EXISTING WAS PUMP STATION, POST AERATION BASIN AND PARSHALL FLUME AND AS SUCH THOSE EXISTING COMPONENTS ARE NOT INCLUDED WITHIN THIS PLAN SET. CONTRACTOR MAY REQUEST ASBUILT PLANS FOR THESE COMPONENTS AS NEEDED.

8-17-26	1-PROPOSED SAMPLING MANHOLE & PATH	CJM
8-26-26	2-EXISTING ACCESS ROAD IMPROVEMENTS	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

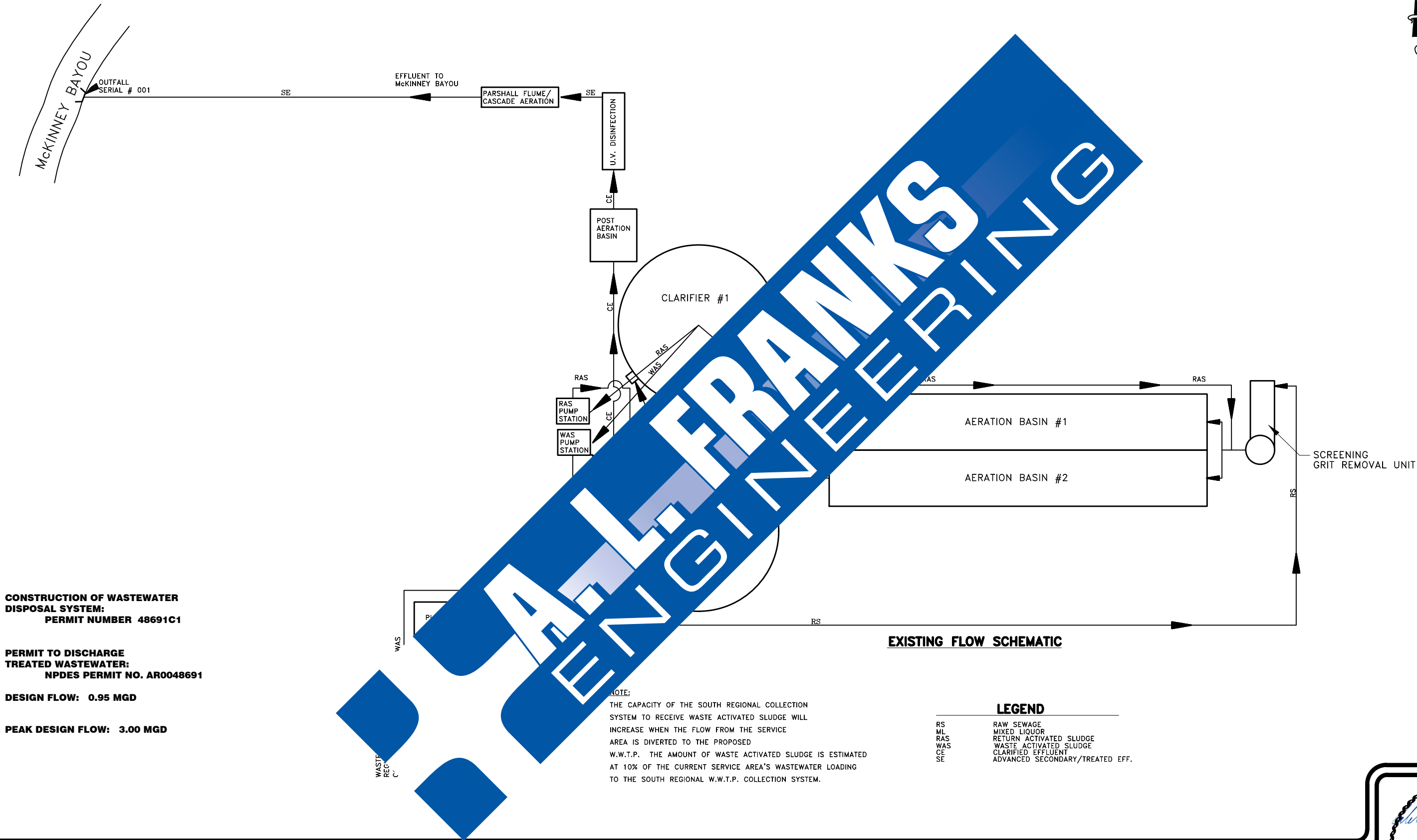
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

SITE OVERVIEW

Job No. TWU-02-23
Scale: 1"=60'
Date: 9/2026
Sheet 3



C:\Users\mudford\A_L Franks Engineering\Company Files - Files\A.L. Franks Engineering Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design_01.dwg



CONSTRUCTION OF WASTEWATER DISPOSAL SYSTEM:
PERMIT NUMBER 48691C1

PERMIT TO DISCHARGE TREATED WASTEWATER:
NPDES PERMIT NO. AR0048691

DESIGN FLOW: 0.95 MGD

PEAK DESIGN FLOW: 3.00 MGD

NOTE:
THE CAPACITY OF THE SOUTH REGIONAL COLLECTION SYSTEM TO RECEIVE WASTE ACTIVATED SLUDGE WILL INCREASE WHEN THE FLOW FROM THE SERVICE AREA IS DIVERTED TO THE PROPOSED W.W.T.P. THE AMOUNT OF WASTE ACTIVATED SLUDGE IS ESTIMATED AT 10% OF THE CURRENT SERVICE AREA'S WASTEWATER LOADING TO THE SOUTH REGIONAL W.W.T.P. COLLECTION SYSTEM.

LEGEND	
RS	RAW SEWAGE
ML	MIXED LIQUOR
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
CE	CLARIFIED EFFLUENT
SE	ADVANCED SECONDARY/TREATED EFF.

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

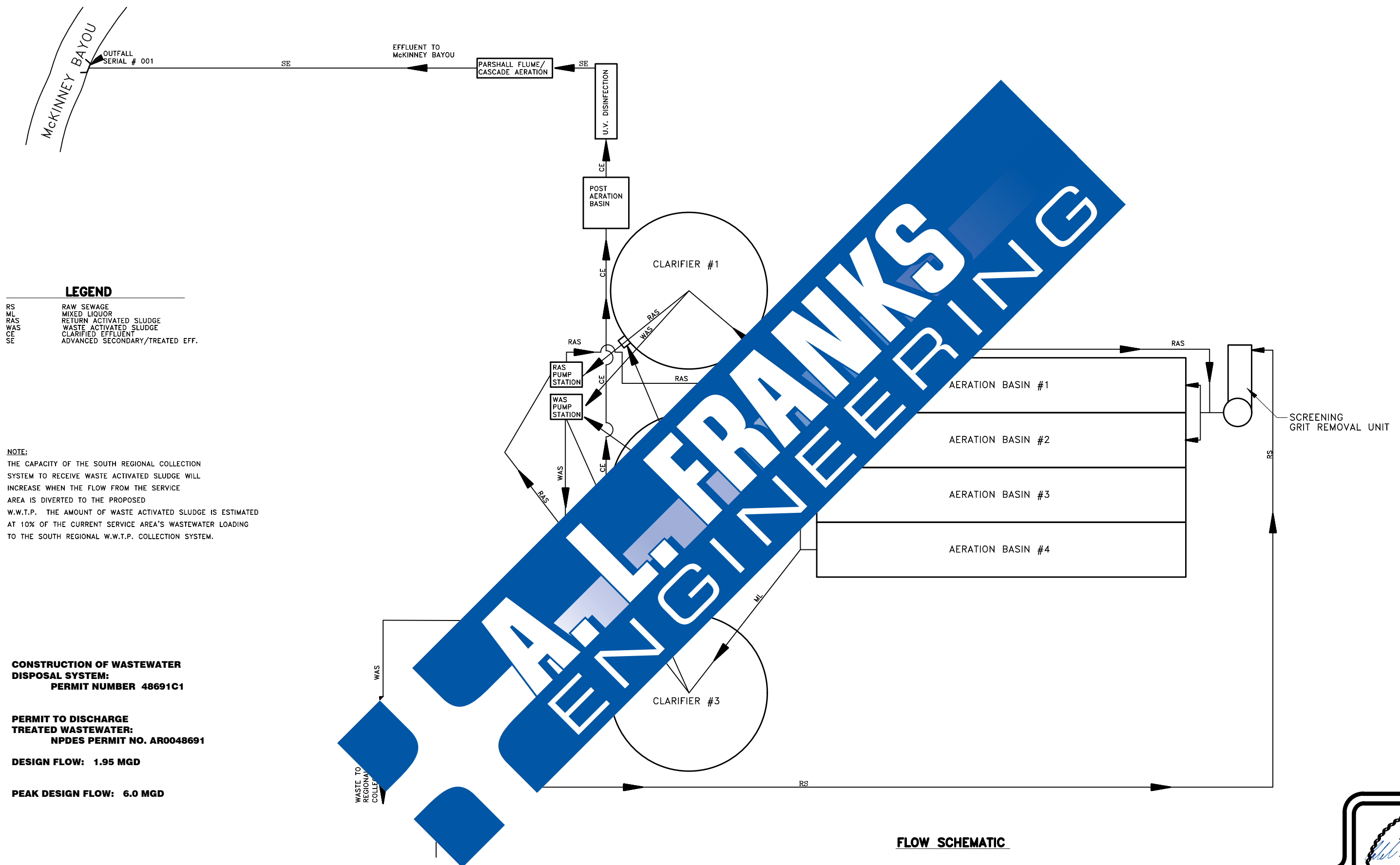
EXISTING FLOW SCHEMATIC

Job No.	TWU-02-23
Scale:	N.T.S.
Date:	5/2026
Sheet	4



5-18-26

C:\Users\mudford\A. L. Franks Engineering\Company Files - Files\A.L. Franks Engineering Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design_01.dwg



LEGEND

RS RAW SEWAGE
ML MIXED LIQUOR
RAS RETURN ACTIVATED SLUDGE
WAS WASTE ACTIVATED SLUDGE
CE CLARIFIED EFFLUENT
SE ADVANCED SECONDARY/TREATED EFF.

NOTE:
THE CAPACITY OF THE SOUTH REGIONAL COLLECTION SYSTEM TO RECEIVE WASTE ACTIVATED SLUDGE WILL INCREASE WHEN THE FLOW FROM THE SERVICE AREA IS DIVERTED TO THE PROPOSED W.W.T.P. THE AMOUNT OF WASTE ACTIVATED SLUDGE IS ESTIMATED AT 10% OF THE CURRENT SERVICE AREA'S WASTEWATER LOADING TO THE SOUTH REGIONAL W.W.T.P. COLLECTION SYSTEM.

CONSTRUCTION OF WASTEWATER DISPOSAL SYSTEM:
PERMIT NUMBER 48691C1

PERMIT TO DISCHARGE TREATED WASTEWATER:
NPDES PERMIT NO. AR0048691

DESIGN FLOW: 1.95 MGD

PEAK DESIGN FLOW: 6.0 MGD

FLOW SCHEMATIC

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

PROPOSED FLOW SCHEMATIC

Job No. TWU-02-23

Scale: N.T.S.

Date: 5/2026

Sheet 5



C:\Users\cmuford\OneDrive\Documents\A.L. Franks Engineering\Company Files - Files\A.L. Franks Engineering\Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design_01.dwg



EXISTING CLARIFIER #1 TO REMAIN IN PLACE. SLUDGE REMOVAL, CLEANING AND REPAIRS BY OTHERS. WORK BY OTHERS TO BE SCHEDULED BY OWNER TO AVOID CONFLICT WITH PROPOSED WWTP IMPROVEMENTS ASSOCIATED WITH THIS PLAN SET.

AFTER CLARIFIER #3 IS IN OPERATION, TAKE DOWN CLARIFIER #2 TO BE CLEANED AND REPLACE EXO-SKELETON, GREASE RING, SCUM HEADER AND CENTER WELD AS SHOWN IN CLARIFIER PLAN.

REMOVE AND DISPOSE OF EXISTING SPIRAL SCREEN, GRIT CHAMBER, AND GRIT CLASSIFIER, SEE HEADWORKS DEMOLITION PLAN FOR ADDITIONAL DETAIL

AFTER AERATION BASINS #3 AND #4 ARE IN OPERATION, TAKE DOWN AERATION BASINS #1 AND #2 ONE AT A TIME TO BE CLEANED.
-REMOVE ALL DEBRIS/SLUDGE
-POWER WASH ALL WALLS AND EQUIPMENT AND PREPARE FOR ENGINEER INSPECTION

REMOVE 890 SY OF TOPSOIL/VEGETATION TO A DEPTH OF 6-8"



SCALE: 1"=60'-0"



NOTES
APPROXIMATELY 20 CY OF SLUDGE TO BE REMOVED AND DISPOSED OF FROM CLARIFIER #2 AND AERATION BASINS 1 & 2.
SLUDGE SHALL BE DISPOSED OF IN AN OFFSITE LANDFILL CERTIFIED TO ACCEPT WASTE FROM A WASTEWATER TREATMENT PLANT AND DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE ADH AND ADEQ REQUIREMENTS.

8-26-26	2-MODIFIED WORK FOR CLARIFIER/BASINS	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

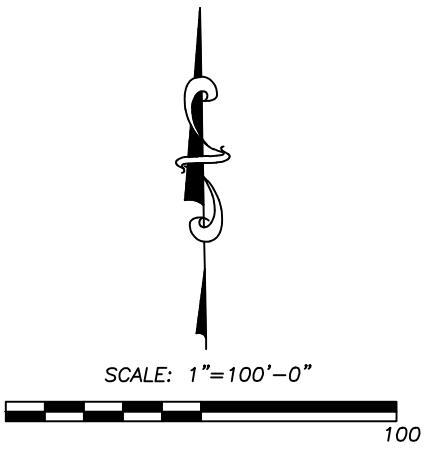
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

DEMOLITION PLAN

Job No.	17WU-02-23
Scale:	1"=60'
Date:	9/2026
Sheet	7



- NOTES:
1. GRAVEL DRIVE IMPROVEMENTS SHALL BE PERFORMED NEAR PROJECT COMPLETION TO ENSURE ACCESS ROAD CONDITIONS ARE NOT NEGATIVELY IMPACTED FROM CONSTRUCTION TRAFFIC.
 2. ACCESS ROAD IMPROVEMENTS INCLUDE HATCHED AREAS SHOWN AND CONTINUE EAST TO SANDERSON LANE. CURVE & TURNOUT RADII SHALL MATCH EXISTING
 3. ACCESS ROAD SHALL BE MAINTAINED THROUGHOUT PROJECT FOR OWNER ACCESS. MAINTAINING ACCESS AND ASSOCIATED REPAIRS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.



C:\Users\lford\OneDrive\Documents\Projects\TXU\02-23 North WWTP\Design_01.dwg

8-26-26	2-EXISTING INFLUENT MANHOLE LOCATION	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

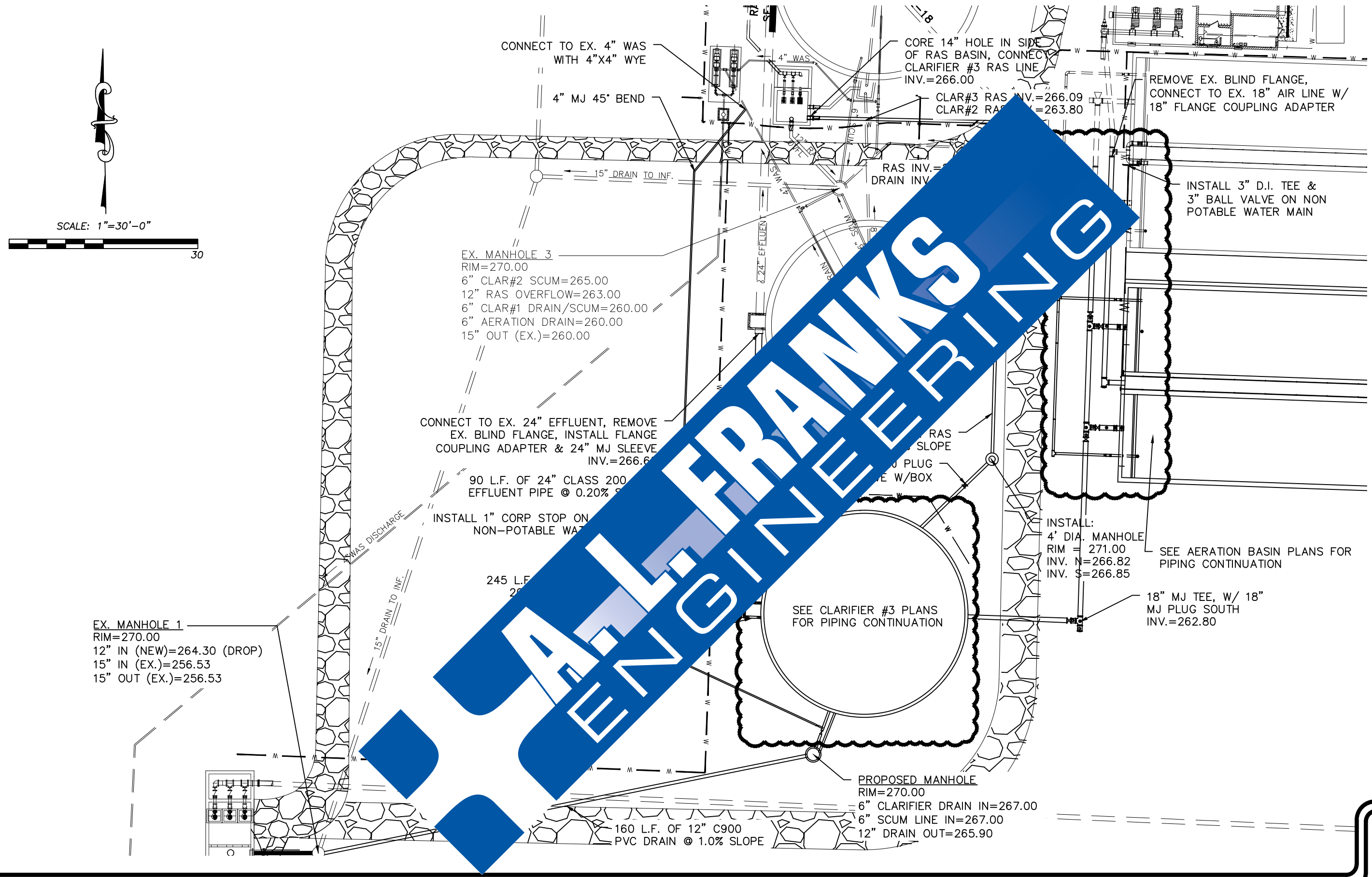
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

SITE & GRADING PLAN

Job No. TWU-02-23
Scale: 1"=100'
Date: 9/2026
Sheet 8



C:\Users\lfrank\OneDrive\Documents\Projects\2023\North WWTP\Design_01.dwg



8-26-26	2-CLARIFIER 3 RAS PIPING MODIFIED	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

YARD PIPING

Job No.: TWU-02-23
Scale: 1"=30'
Date: 9/2026
Sheet 9

9-2-26

- EROSION CONTROL NOTES
- THE PROPOSED PROJECT AS SHOWN WILL DISTURB APPROX. 1.2 ACRES AND IS THEREFORE CLASSIFIED AS A SMALL SITE THAT RECEIVES AUTOMATIC COVERAGE UNDER ADEQ GENERAL PERMIT. CONTRACTOR IS TO MAINTAIN BMP'S AND SWPPP ONSITE THROUGHOUT CONSTRUCTION AND POST ALL REQUIRED NOTICES AS REQUIRED BY ADEQ AND THE CITY OF TEXARKANA, AR.
1. THE CONTRACTOR SHALL UTILIZE BEST MANAGEMENT PRACTICES TO MINIMIZE THE IMPACTS OF SEDIMENTATION AND TURBIDITY IN DRAINAGE WAYS. THE CONTROLS SHOWN ARE CONSIDERED THE MINIMUM AND ADDITIONAL CONTROLS SHALL BE ADDED BY THE CONTRACTOR AS NECESSARY TO CONTROL SEDIMENT RUNOFF FROM THE SITE.
 2. BMP'S SHOWN ARE TO BE INSTALLED PRIOR TO DEMOLITION OR EARTHWORK OPERATIONS.
 3. THE CONTRACTOR SHALL MAINTAIN ALL BMP'S THROUGHOUT THE PROJECT UNTIL PERMANENT COVER & VEGETATION IS ESTABLISHED.
 4. DIRT ON ROADWAYS FROM SITE OFF-TRACKING SHALL BE REMOVED DAILY.
 5. ALL SITE NOTICES REQUIRED BY ADEQ AND THE CITY OF TEXARKANA SHALL BE POSTED FOLLOWING ALL STATE AND LOCAL GUIDELINES. NOTICES SHALL BE PROVIDED TO THE MS4 OPERATOR AS NECESSARY.
 6. EROSION CONTROL WORKFLOW SHALL PRIMARILY CONSIST OF THE PLACEMENT OF PERIMETER CONTROLS, CONSTRUCTION OF PERMANENT SITE FEATURES, SITE STABILIZATION INCLUDING VEGETATION OF AREAS ONCE FINAL GRADES ARE MET AND SITE CLEANUP ONCE CONSTRUCTION IS COMPLETE.

CONTRACTOR SHALL PROVIDE SANITARY FACILITIES FOR THE DURATION OF THE CONSTRUCTION PERIOD

CONTRACTOR SHALL PROVIDE DUMPSTER

CONCRETE WASH OUT STATION

EXISTING B

IN #3

PROPOSED
ION BASIN #4

TOPSOIL WASTE AREA

CONSTRUCTION LAYDOWN AND STAGING AREA

INSTALL APPROX. 800 LF OF SILT FENCE, SEE DETAILS



SCALE: 1"=40'-0"



Job No.: TWU-02-23
Scale: 1"=40'
Date: 5/2026
Sheet 10

EROSION & SEDIMENT CONTROL PLAN

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

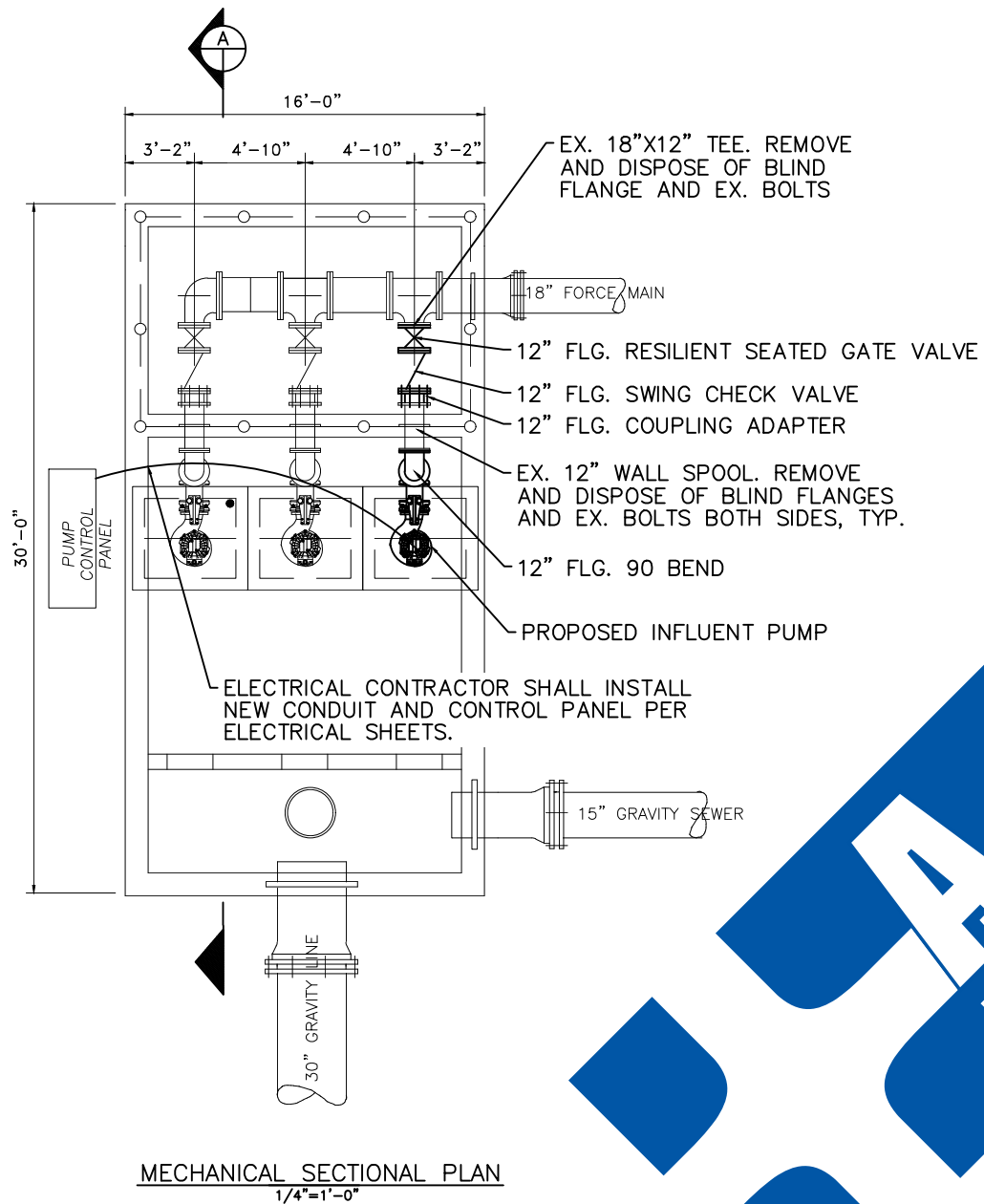
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907



Designed: CJM
Checked: KSB
Drawn: CJM
Approved: KSB

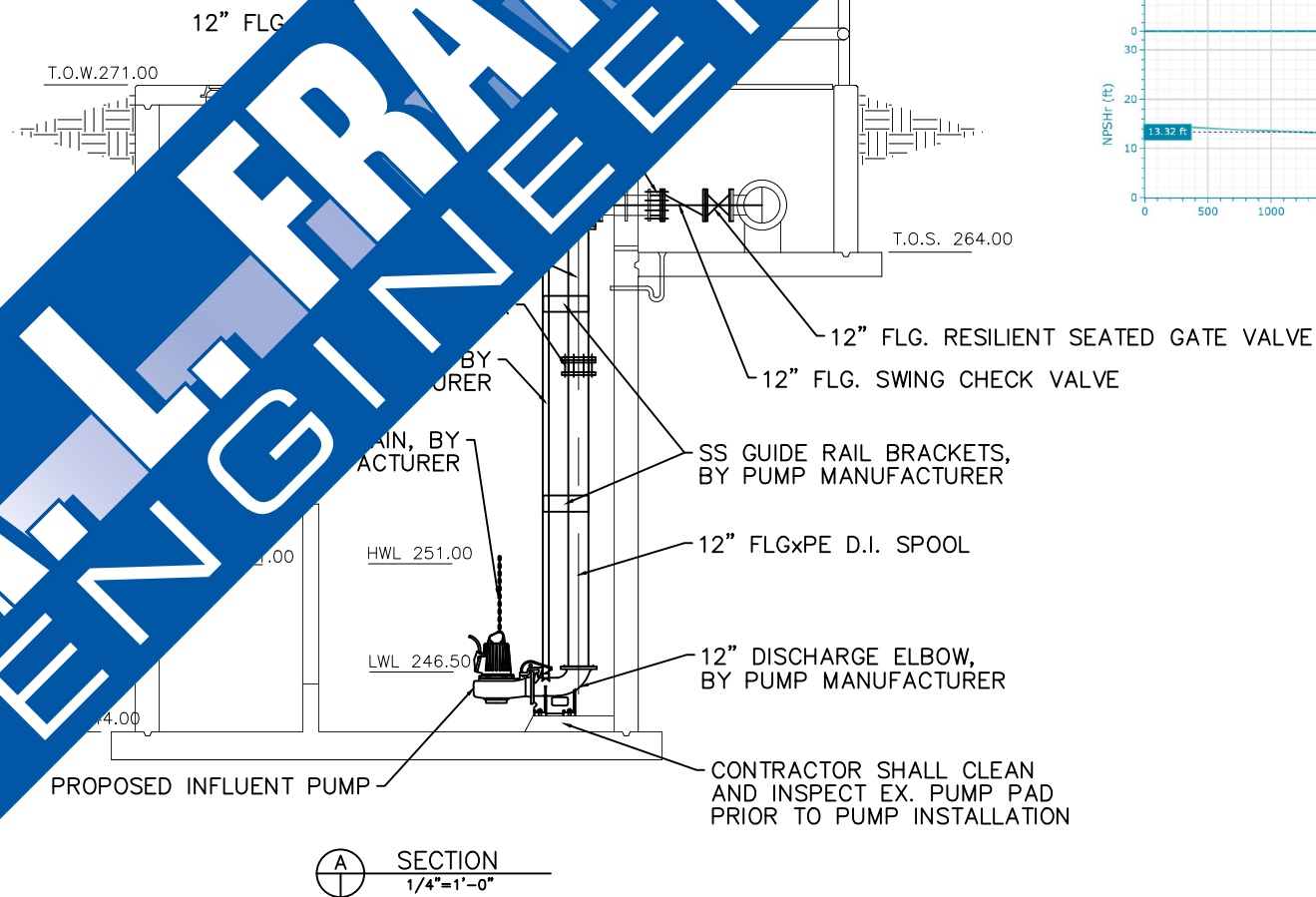
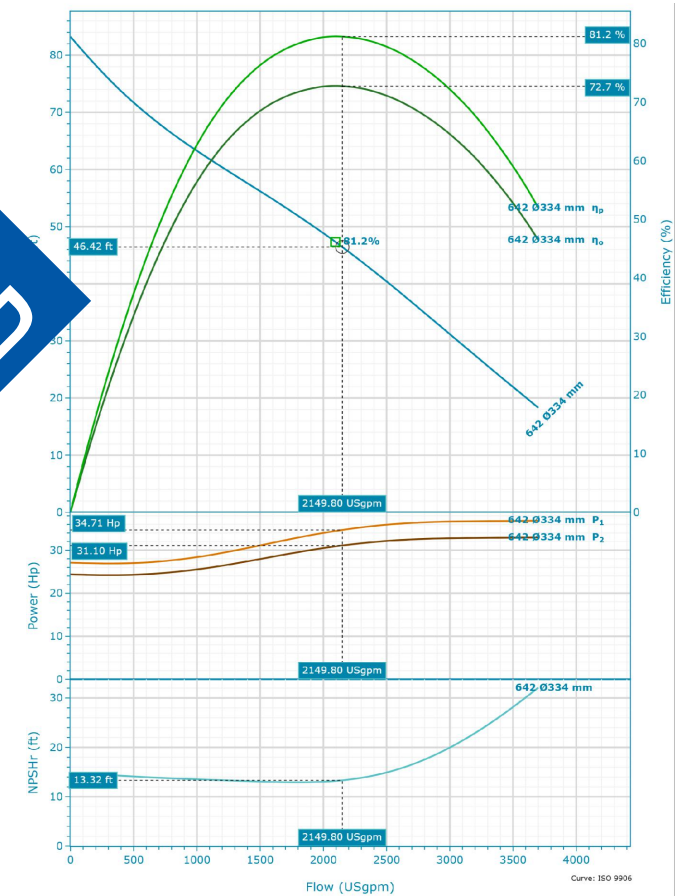
Date	Revision	By

C:\Users\mudford\OneDrive\Documents\Projects\Arkansas Water Utilities\North WWTP\Design - 01.dwg



LIFT STATION DATA	
TOP ELEVATION	271.00
BOTTOM ELEVATION	244.00
30" INFLUENT PIPE FL. EL.	251.00
PUMP CAPACITY (GPM)	2149
PUMP DESIGN TDH (FT)	46
MOTOR BHP	35
MINIMUM EFFICIENCY	75%
FLYGT#NP 3202 MT 3-642 OR E	

NOTE: MOTOR SHALL BE SIZED FOR FULL RANGE OF PUMP OPERATION



Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

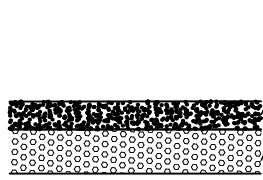
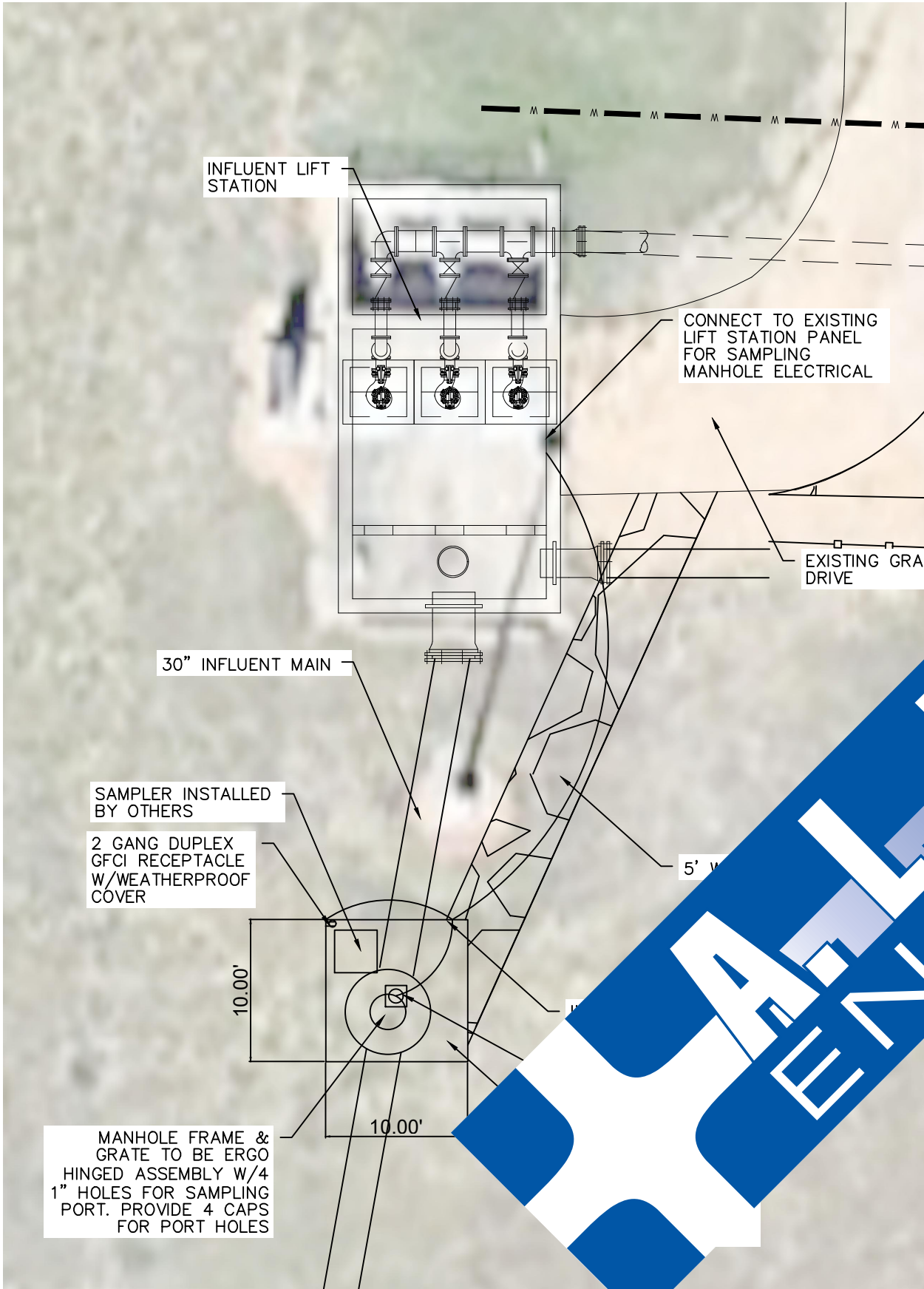
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

INFLUENT PUMP STATION

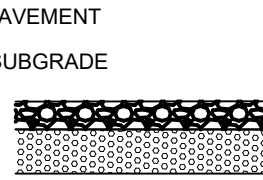
Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 11



C:\Users\mudford\OneDrive\Documents\Projects\Arkansas Water Utilities\TWU-02-23 North WWTP\Design_01.dwg



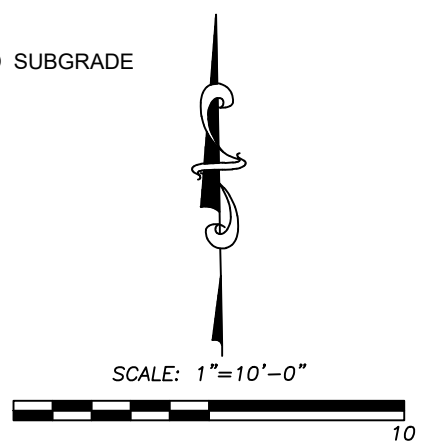
CONCRETE SLAB
N.T.S.



GRAVEL PATH
N.T.S.

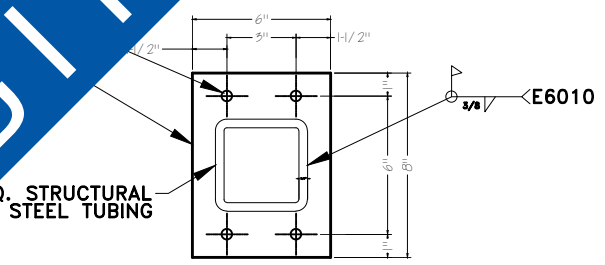
NOTE:

1. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH W/4.5-6% ENTP
2. SUBGRADE SHALL BE CO... RD PROCTOR +/-3%.
3. REINFORCEMENT S... C-C

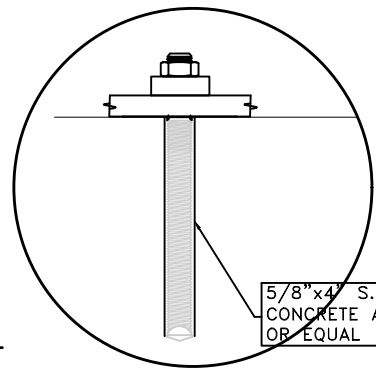


EAST ELEVATION

EAST AND WEST ELEVATION
N.T.S.



DETAIL A
N.T.S.



DETAIL B
N.T.S.

8-17-26	1-PROPOSED SAMPLING MANHOLE & PATH	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB

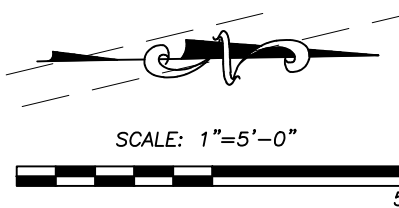
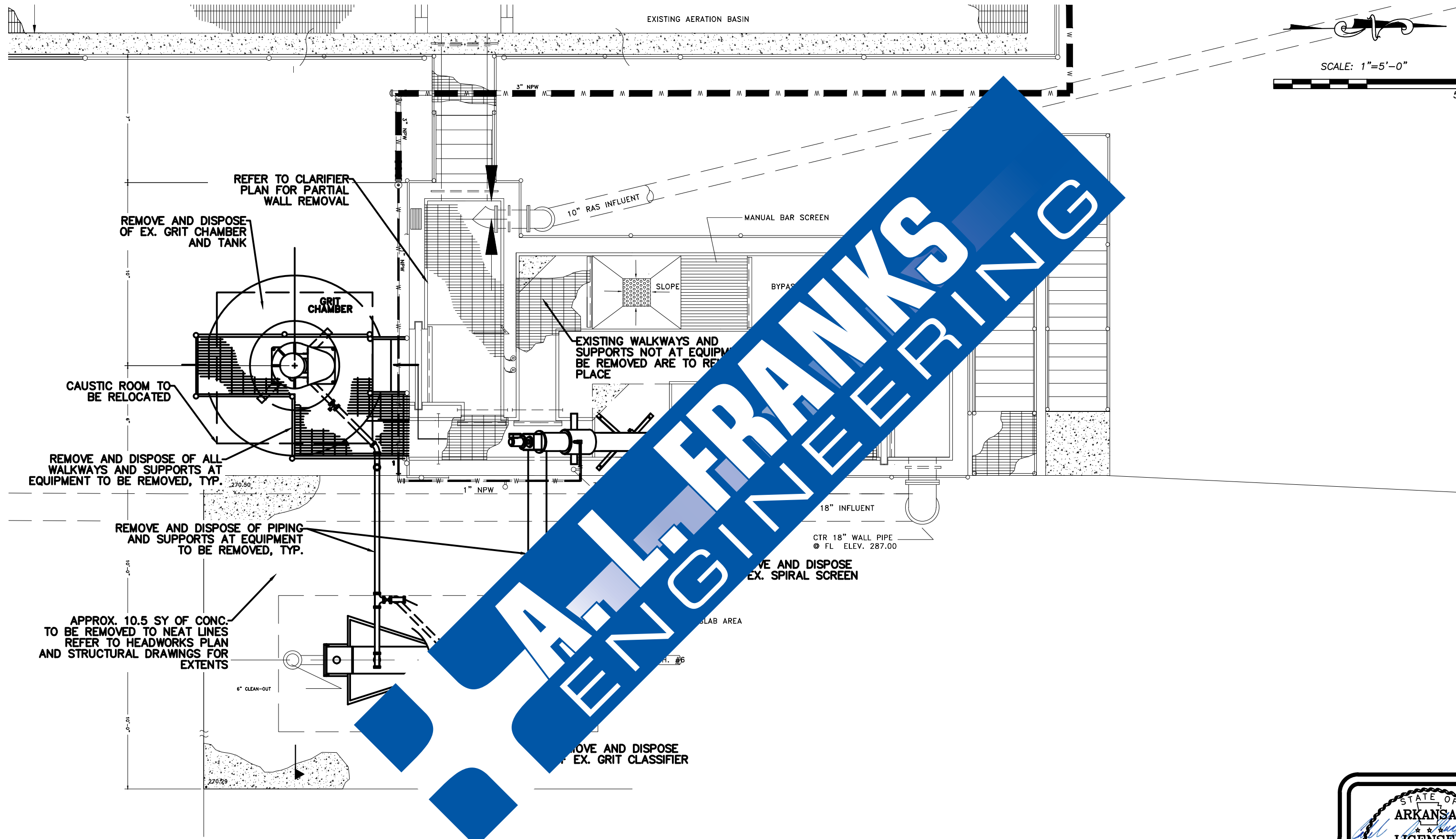
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

INFLUENT SAMPLING MANHOLE

Job No.: TWU-02-23
Scale: N/A
Date: 8/2026
Sheet 11A

8-17-26



8-26-26	2-CONCRETE REMOVAL	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

HEADWORKS DEMOLITION PLAN

Job No.	TWU-02-23
Scale:	1"=5'
Date:	5/2026
Sheet	12

STATE OF
ARKANSAS

LICENSED
ENGINEER

No. 17723
J. MUDFORD

9-2-26

C:\Users\mudford\A. L. Franks Engineering\Company Files - Files\A. L. Franks Engineering Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design - 01.dwg

CONCRETE ENCASE 18" INFLUENT PIPE A MIN. OF 2.0' BEYOND OUTSIDE EDGES OF GRIT CHAMBER FOOTING. EXPOSE INFLUENT LINE AND REPORT ELEV. TO ENGINEER BEFORE GRIT CHAMBER CONSTRUCTION

GRIT PUMP PER HYDRO INTERNATIONAL HEADCELL & GRIT CLEANSE SYSTEM REQUIREMENTS

RELOCATED CAUSTIC ROOM
EXTEND ELECTRICAL THROUGH UNDERGROUND CONDUIT

CAUSTIC ROOM

GRIT CHAMBER

12" RAS INFLUENT

MANUAL BAR SCREEN

SLOPE

BYPASS CHANNEL

INSTALL:
DUPERON MECHANICALLY CLEAN
BAR SCREEN OR APPROVED

LOCATE & CONNECT
TO 1" NPW
W/1"x1" TEE &
VALVE W/BOX

INSTALL
16" TEE

WALL PIPE
ELEV. 287.00

1" NPW TO EXTEND
AND CONNECT TO
GRIT CLEANSE AND
RELOCATED CAUSTIC
ROOM EYE WASH
STATION

HEADWORKS PLAN
SCALE: 1/2" = 1'-0"

PIPING SCHEDULE

- 1 4" 22.5° BEND FLxFL
- 2 4" SPOOL FLxFL
- 3 4" TEE FLxFL
- 4 6"x6"x4" WYE MxMJ
- 5 4" SPOOL MxMJ
- 6 4" 45° BEND FLxFL
- 7 4" BLIND FLANGE

NOTE:
1. ALL EXPOSED PIPING SHALL BE INSULATED
PER SPECIFICATIONS.

VALVE SCHEDULE

V201	4" PLUG VALVE WITH OPERATING NUT POINTED DOWN
------	---

SCALE: 1"=5'-0"

5

8-26-26	2-GRIT CHAMBER AND WASHER MODIFIED	CJM
Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

HEADWORKS PLAN

Job No. TWU-02-23
Scale: 1"=5'
Date: 5/2026
Sheet 13



REFER TO STRUCTURAL
DRAWINGS FOR GRIT
CHAMBER DETAILS

T\FLR. 286.00

SCALE: 3/8" = 1'-0"

NOTE: DIELECTRIC UNIONS OR AN MOULATION SECTION SHALL BE INSTALLED WHEREVER PIPES OF DISSIMILAR METALS ARE CONNECTED PER SPECIFICATIONS.

3/4" WATER SUPPLY LINE

FL. 287.00

16" PIPE CHUTE

GALV. PIPE

**FLEXIBLE
DISCHARGE
CHUTE**

T/S 270.50

6" FL. 266.50

18" F 264.50

10" FL. 284.00

F/G 270.00

1st

GRIT CHAMBER
SCALE: 3/8" = 1'-0"

Designed CJM
Checked KSB
Drawn CJM
Approved KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

HEADWORKS DETAILS

Job No. TWU-02-23

Scale: N/A

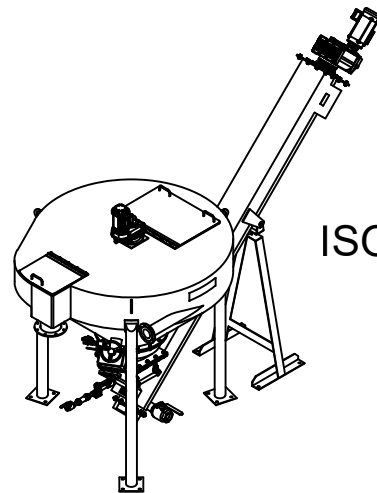
Date: 9/2026

Sheet 14

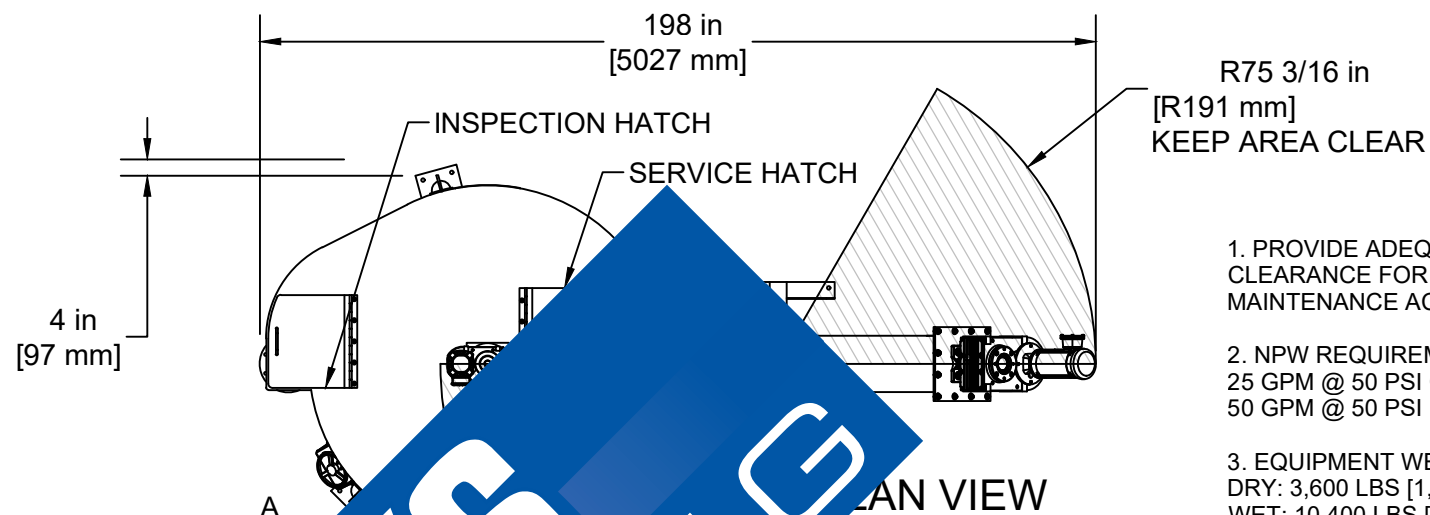


9-2-26

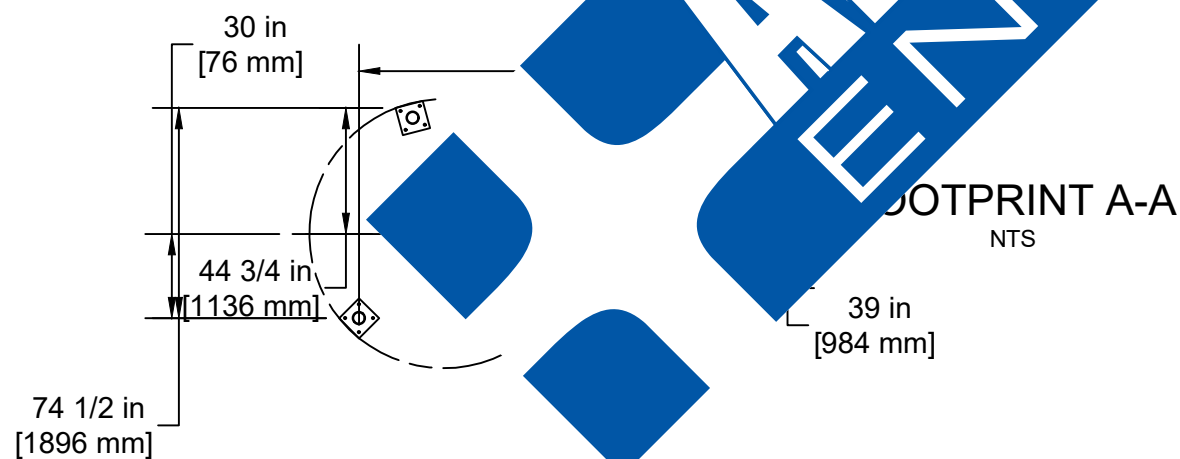
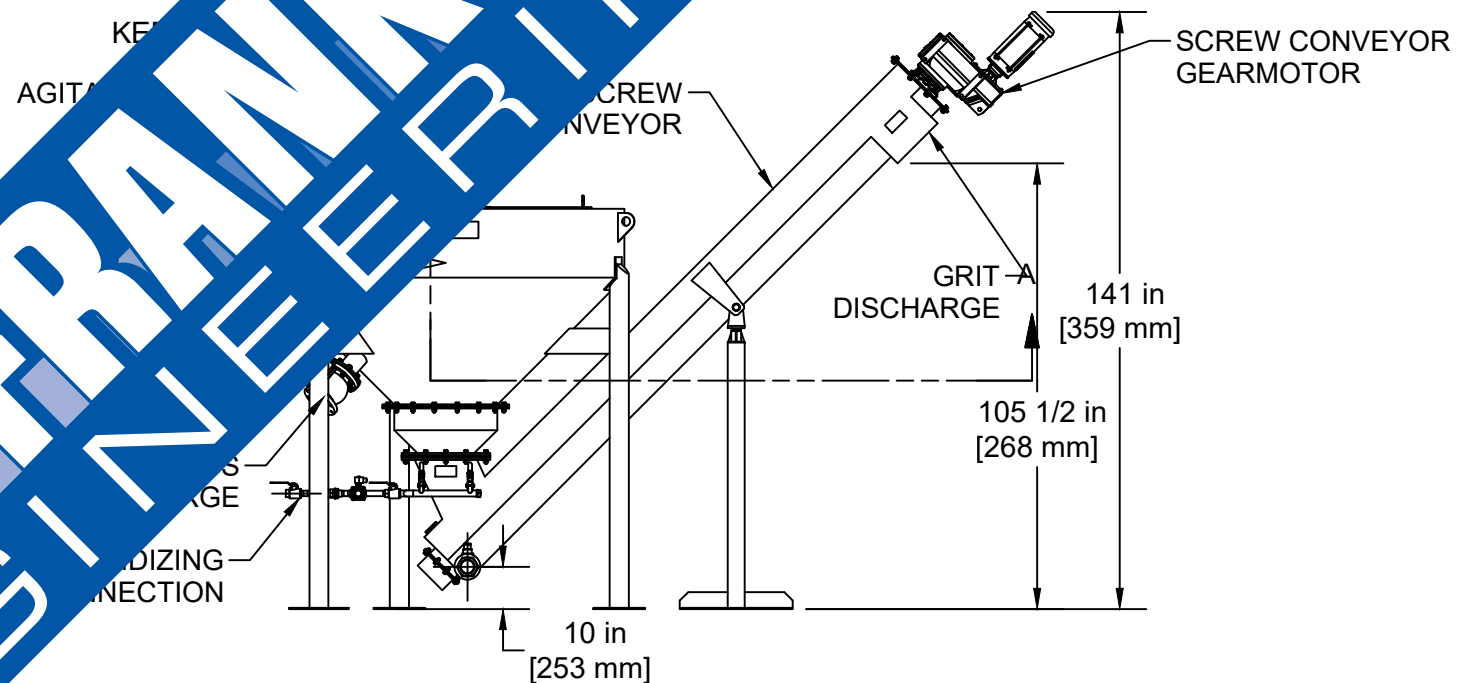
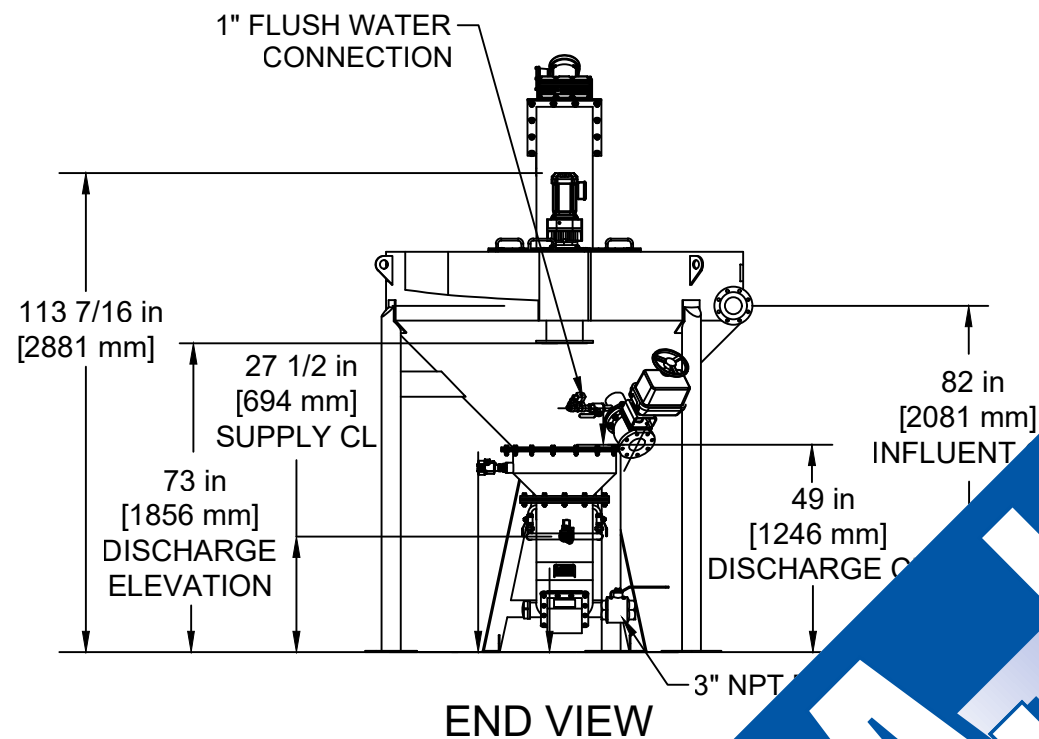




ISOMETRIC VIEW
NTS



1. PROVIDE ADEQUATE CLEARANCE FOR SERVICE AND MAINTENANCE ACCESS
2. NPW REQUIREMENTS:
25 GPM @ 50 PSI CONTINUOUS
50 GPM @ 50 PSI INTERMITTENT
3. EQUIPMENT WEIGHTS:
DRY: 3,600 LBS [1,630 KG]
WET: 10,400 LBS [4,700 KG] (MAX)



GRIT WASHER TO BE PROVIDED BY
HYDRO INTERNATIONAL



Job No.: TWU-02-23
Scale: N/A
Date: 9/2026
Sheet 16

GRIT CLEANSE

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

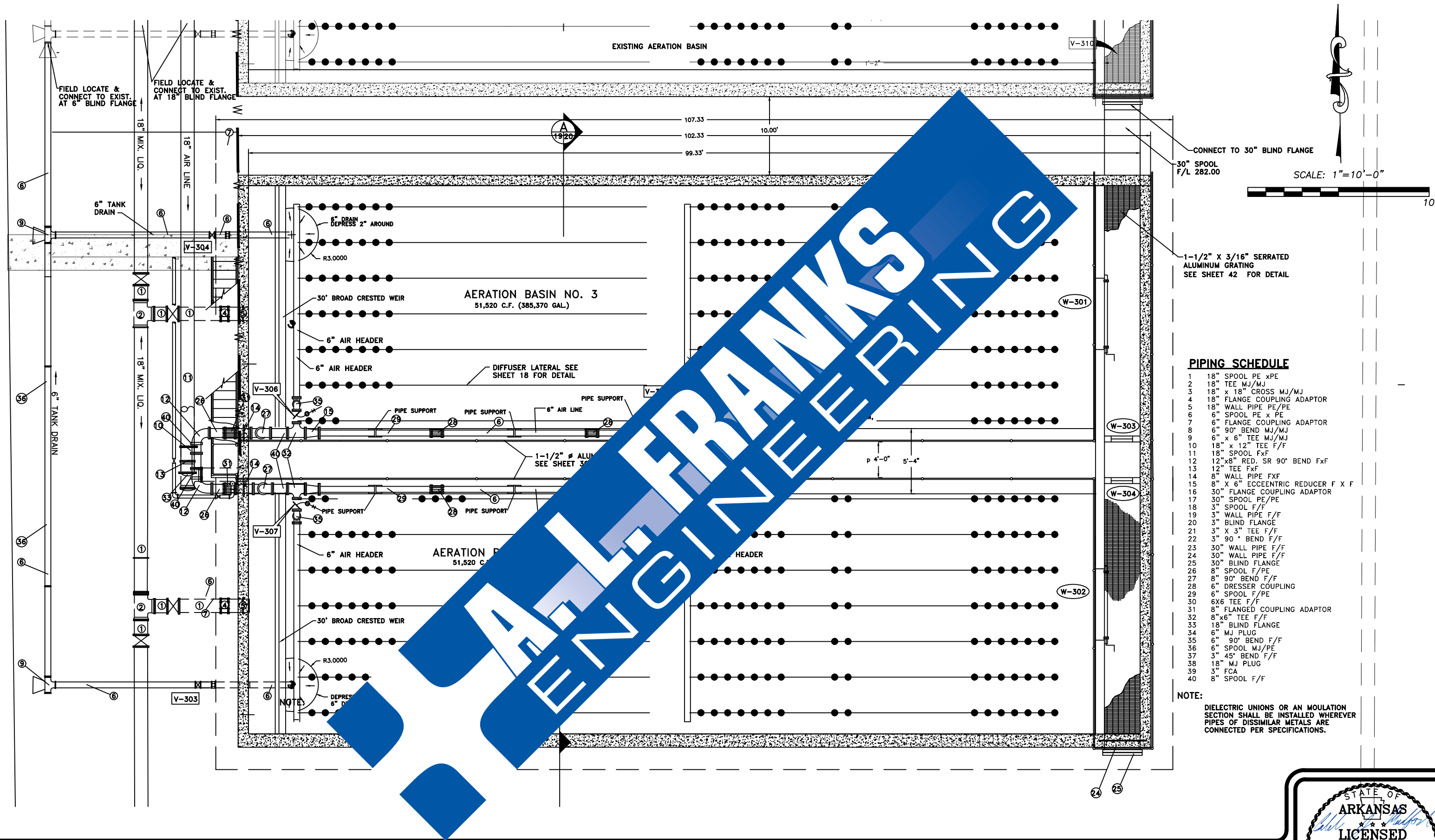


FRONT VIEW
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

Designed: CJM
Checked: KSB
Drawn: CJM
Approved: KSB

8-26-26	2-GRIT WASHER TYPE MODIFIED	CJM
Date	Revision	By

C:\Users\mudford\OneDrive\Documents\Projects\Arkansas Water Utilities\North WWTP\Design_01.dwg
C:\Users\mudford\OneDrive\Documents\Projects\Arkansas Water Utilities\North WWTP\Design_01.dwg
C:\Users\mudford\OneDrive\Documents\Projects\Arkansas Water Utilities\North WWTP\Design_01.dwg



PIPING SCHEDULE	
1	18" SPOOL PE xPE
2	18" TEE MJ/MJ
3	18" x 18" CROSS MJ/MJ
4	18" FLANGE COUPLING ADAPTOR
5	18" WALL PIPE PE/PE
6	6" SPOOL PE x PE
7	6" FLANGE COUPLING ADAPTOR
8	6" 90° BEND MJ/MJ
9	6" x 6" TEE MJ/MJ
10	18" x 12" TEE F/F
11	18" SPOOL Fx F
12	12"x8" RED. SR 90° BEND Fx F
13	12" TEE Fx F
14	8" WALL PIPE Fx F
15	8" x 6" ECCENTRIC REDUCER F x F
16	30" FLANGE COUPLING ADAPTOR
17	30" SPOOL PE/PE
18	3" SPOOL F/F
19	3" WALL PIPE F/F
20	3" BLIND FLANGE
21	3" x 3" TEE F/F
22	3" 90° BEND F/F
23	30" WALL PIPE F/F
24	30" WALL PIPE F/F
25	30" BLIND FLANGE
26	8" SPOOL F/PE
27	8" 90° BEND F/F
28	6" DRESSER COUPLING
29	6" SPOOL F/PE
30	6X6 TEE F/F
31	8" FLANGED COUPLING ADAPTOR
32	8"x6" TEE F/F
33	18" BLIND FLANGE
34	6" MJ PLUG
35	6" 90° BEND F/F
36	6" SPOOL MJ/PE
37	3" 45° BEND F/F
38	18" MJ PLUG
39	3" FCA
40	8" SPOOL F/F

NOTE:
DIELECTRIC UNIONS OR AN MOULATION SECTION SHALL BE INSTALLED WHEREVER PIPES OF DISSIMILAR METALS ARE CONNECTED PER SPECIFICATIONS.

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN PLAN

Job No. TWU-02-23
Scale: 1"=10'
Date: 5/2026
Sheet 17

7-20-26



C:\Users\mudford\OneDrive\Documents\A. L. Franks Engineering\Company Files - Files\A. L. Franks Engineering\Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design - 01.dwg

NOTE:

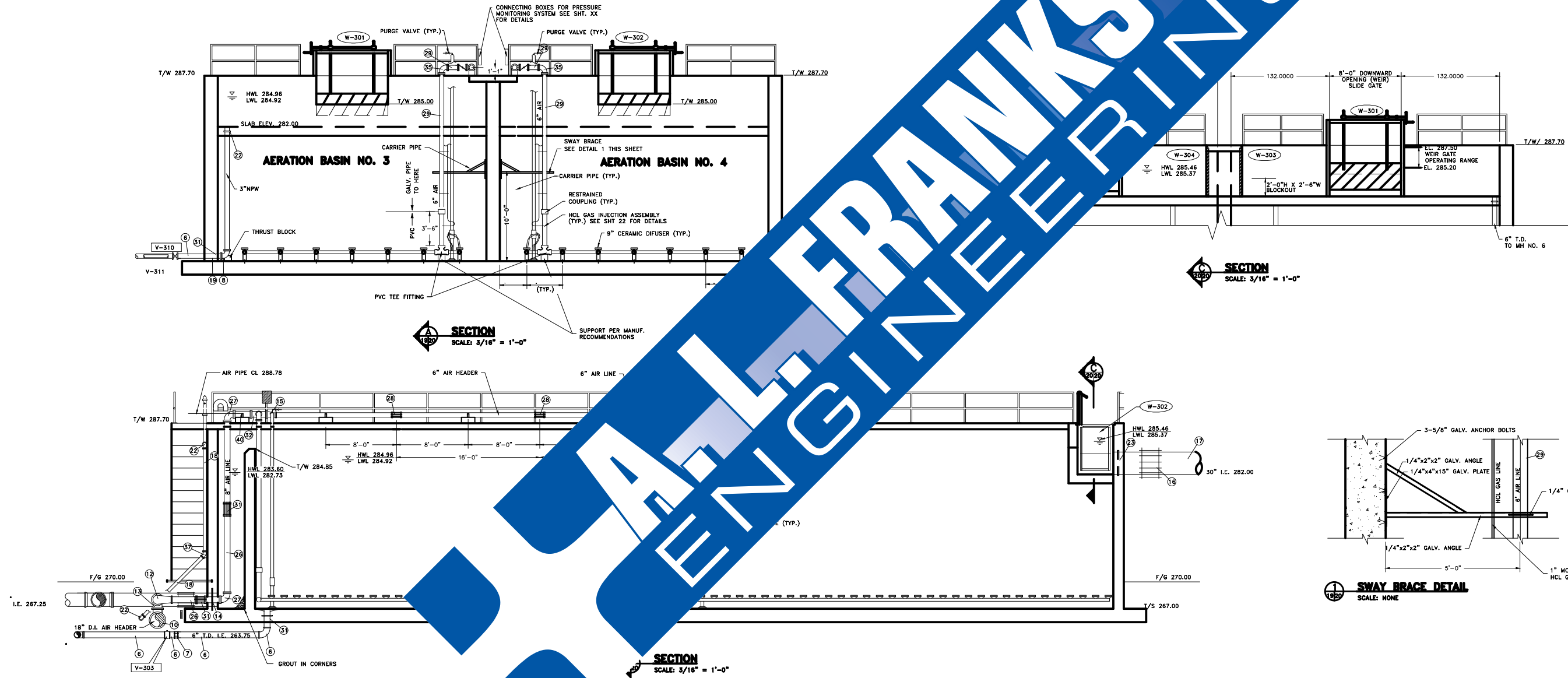
FOUNDATION SHALL BE OVER EXCAVATED TO A MINIMUM DEPTH OF 3.0' AND REPLACED WITH SELECT FILL. CONTRACTOR SHALL FOLLOW GUIDANCE IN GEOTECHNICAL REPORT PERFORMED BY ETL ENGINEERS & CONSULTANTS DATED SEPTEMBER 4, 2025 FOR ALL FOUNDATION AND SITE PREPARATION REQUIREMENTS.

VALVE SCHEDULE

V-301	18" MJ PLUG VALVE WITH BOX	V-306	6" BUTTERFLY VALVE - WAFER
V-302	18" MJ PLUG VALVE WITH BOX	V-307	6" BUTTERFLY VALVE - WAFER
V-303	6" MJ PLUG VALVE WITH BOX		6" BUTTERFLY VALVE - WAFER
V-304	6" MJ PLUG VALVE WITH BOX		BUTTERFLY VALVE - WAFER
V-305	18" MJ PLUG VALVE WITH BOX		PLUG VALVE WITH BOX
			PLUG VALVE WITH BOX

WEIR GATE SCHEDULE

W-301	8' x 36" DOWNWARD OPENING WEIR GATE W/ TANDEM ACTIVATOR
W-302	8' x 36" DOWNWARD OPENING WEIR GATE W/ TANDEM ACTIVATOR
W-303	30" ALUMINUM STOP GATE
W-304	30" ALUMINUM STOP GATE



Date	Revision	By

Designed - CJM
Checked - KSB
Drawn - CJM
Approved - KSB



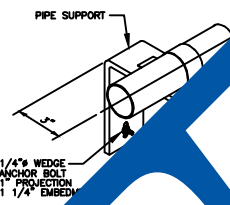
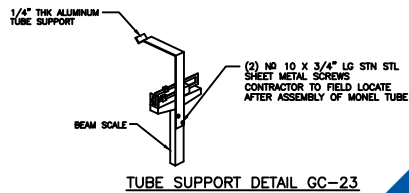
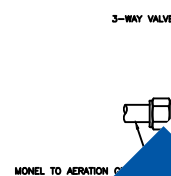
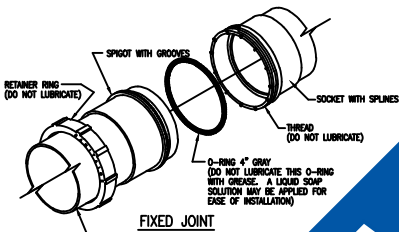
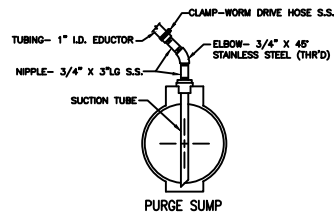
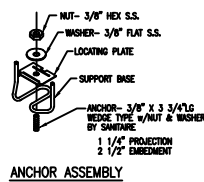
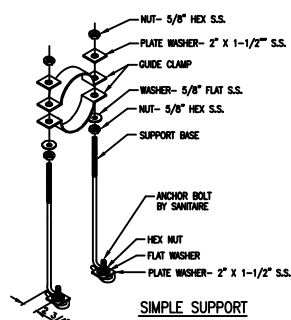
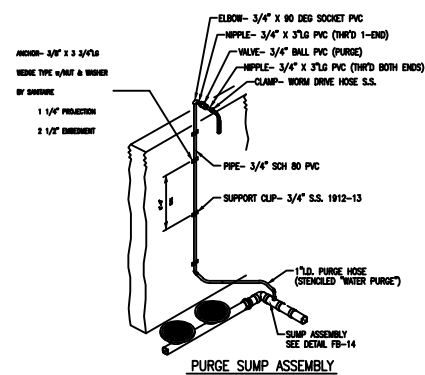
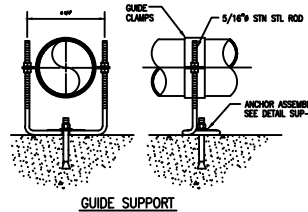
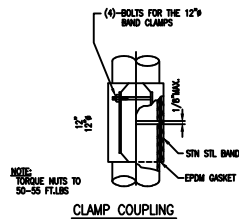
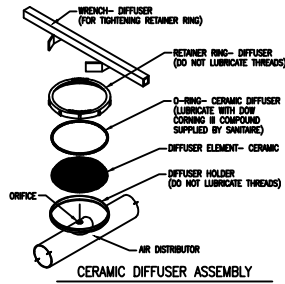
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

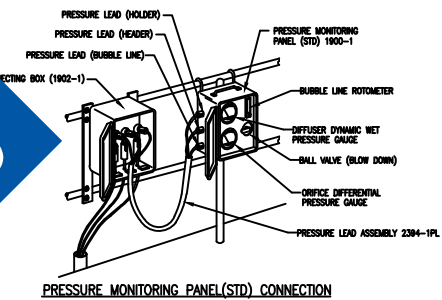
AERATION BASIN DETAILS

Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 18



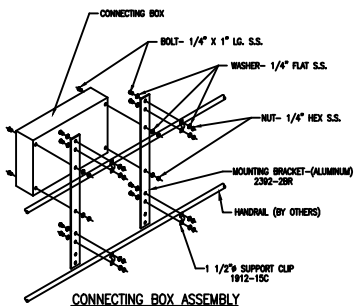


CONNECTING BOX PART NO. 1902-1 FOR ASSEMBLY OF MONEL SEE DETAIL PM-34

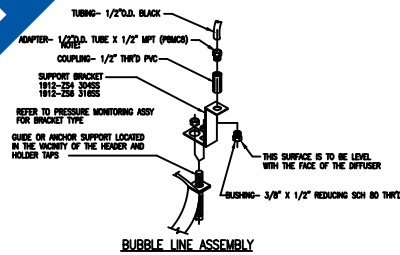
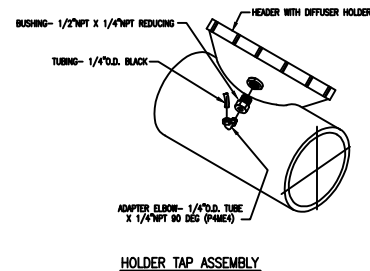
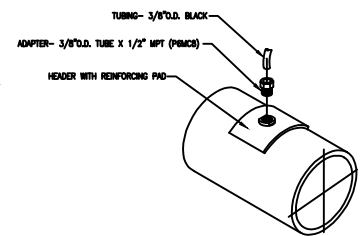


CONNECTING BOX (1902-1) FOR ASSEMBLY OF MONEL SEE DETAIL PM-34

MONITORING ASSEMBLY



HEADER TAP ASSEMBLY



NOTE:

ALL SUBMERGED BOLTS, NUTS, WASHERS, CONNECTORS, ETC. SHALL BE STAINLESS STEEL.

Date	Revision	By

Designed - CJM
Checked - KSB
Drawn - CJM
Approved - KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

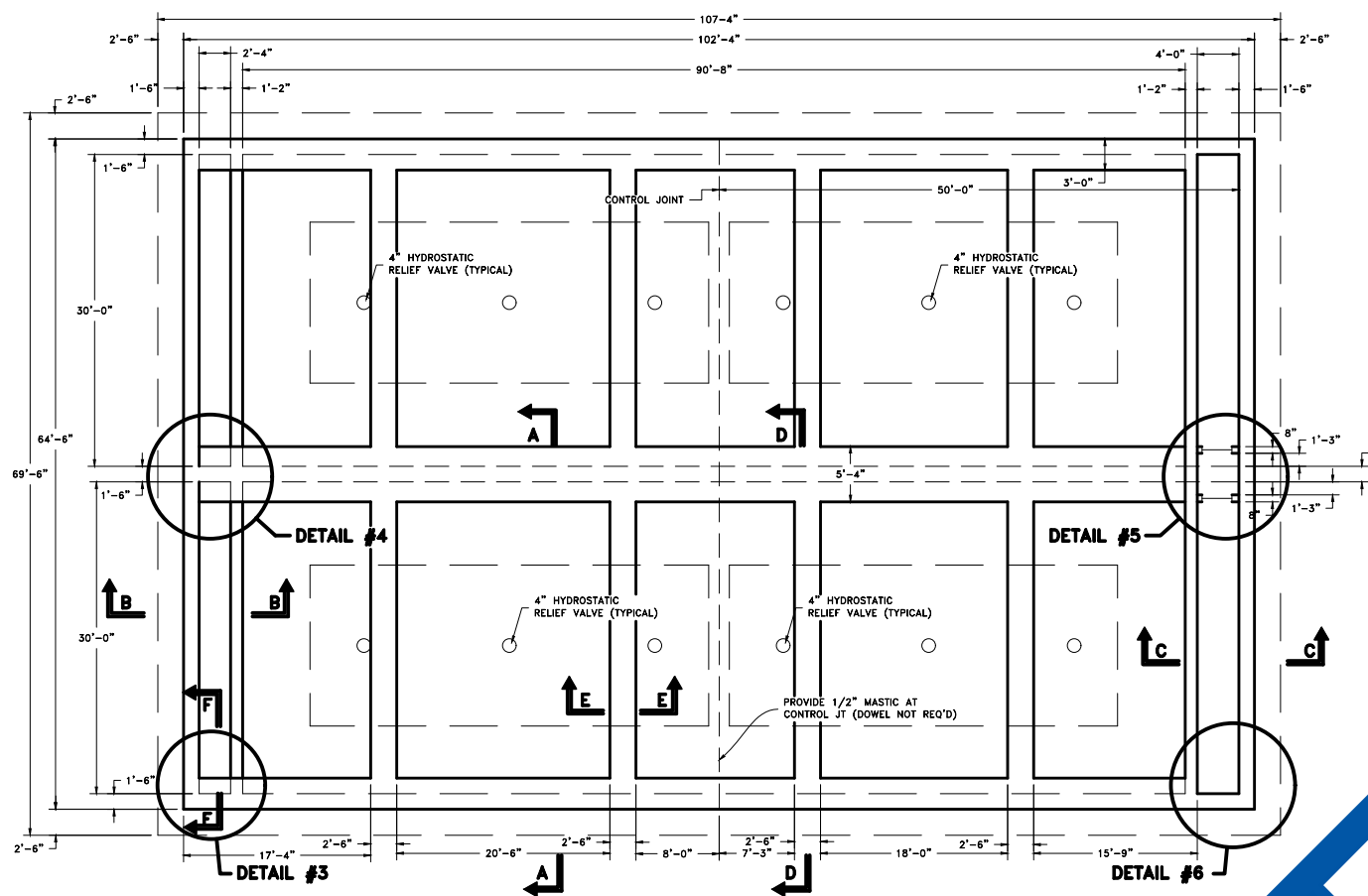
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN DETAILS

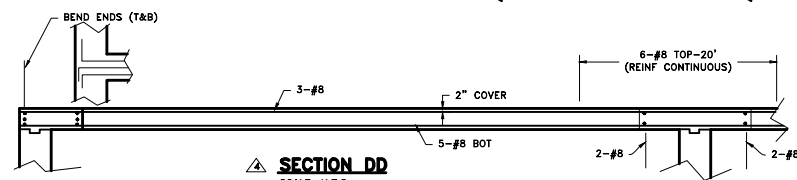
Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 19



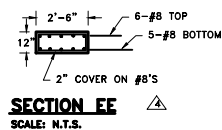
C:\Users\mduford\OneDrive\Documents\A.L. Franks Engineering\Company Files - Files\A.L. Franks Engineering\Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design - 01.dwg



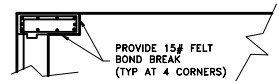
AERATION BASIN PLAN
SCALE: N.T.S.



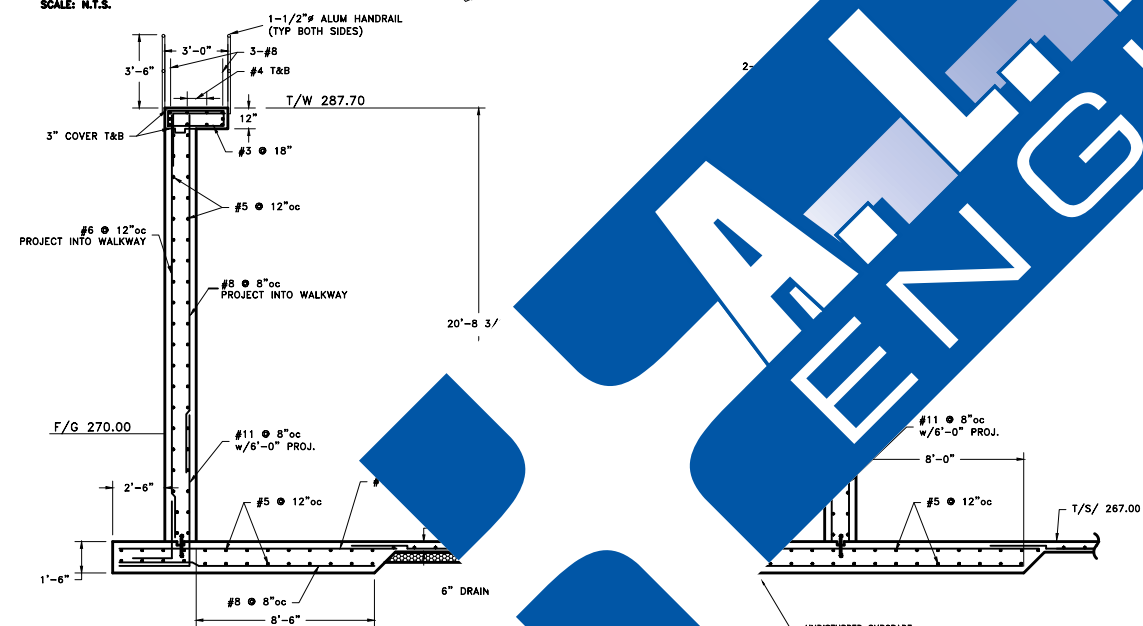
SECTION DD
SCALE: N.T.S.



SECTION EE
SCALE: N.T.S.

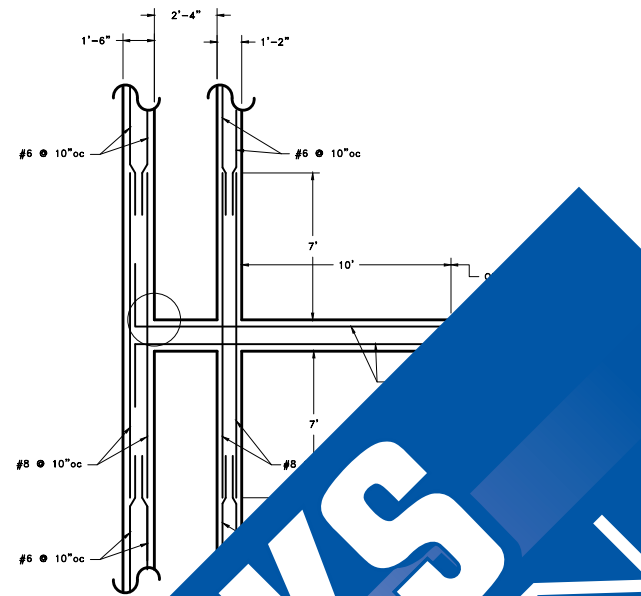


SECTION FF
SCALE: N.T.S.

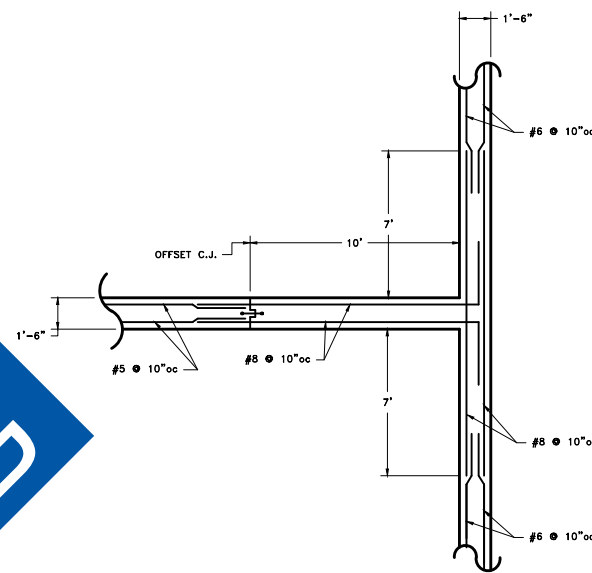


SECTION BB
SCALE: N.T.S.

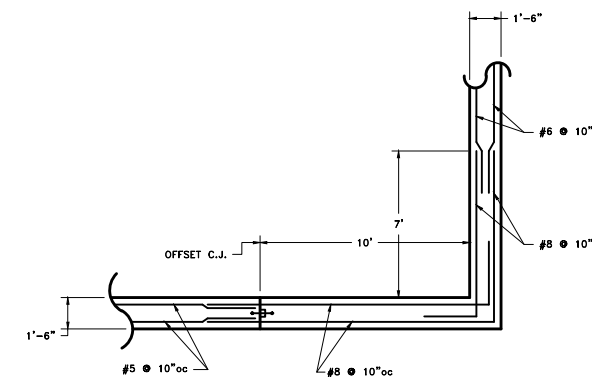
UNDISTURBED SUBGRADE—
IF OVEREXCAVATION IS PERFORMED THE
CONTRACTOR SHALL PLACE GRAVEL FILL
TO THE GRADE REQ'D.



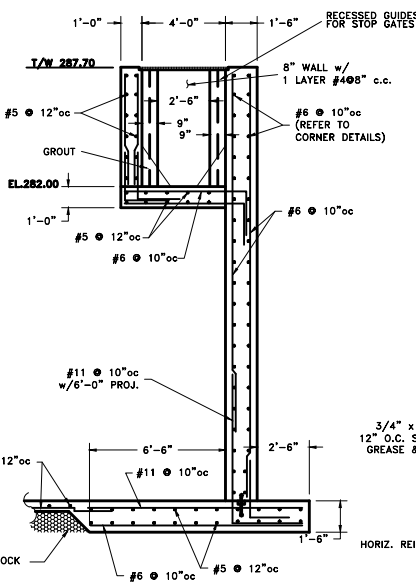
DETAIL #3
SCALE: N.T.S.



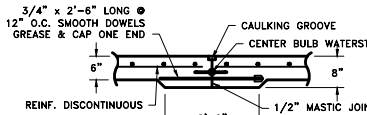
DETAIL #5
SCALE: N.T.S.



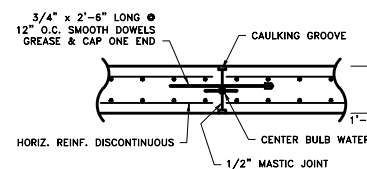
DETAIL #6
SCALE: N.T.S.



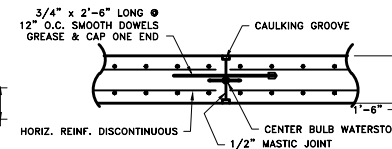
SECTION CC
SCALE: N.T.S.



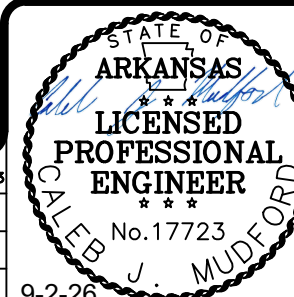
SLAB CONTROL JOINT
SCALE: N.T.S.



WALL CONTROL JT.
SCALE: N.T.S.



FOOTING CONTROL JT.
SCALE: N.T.S.



8-26-26	2-DIMENSIONS PROVIDED, SCALE REMOVED	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



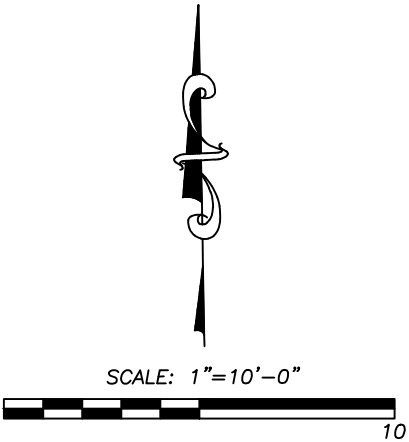
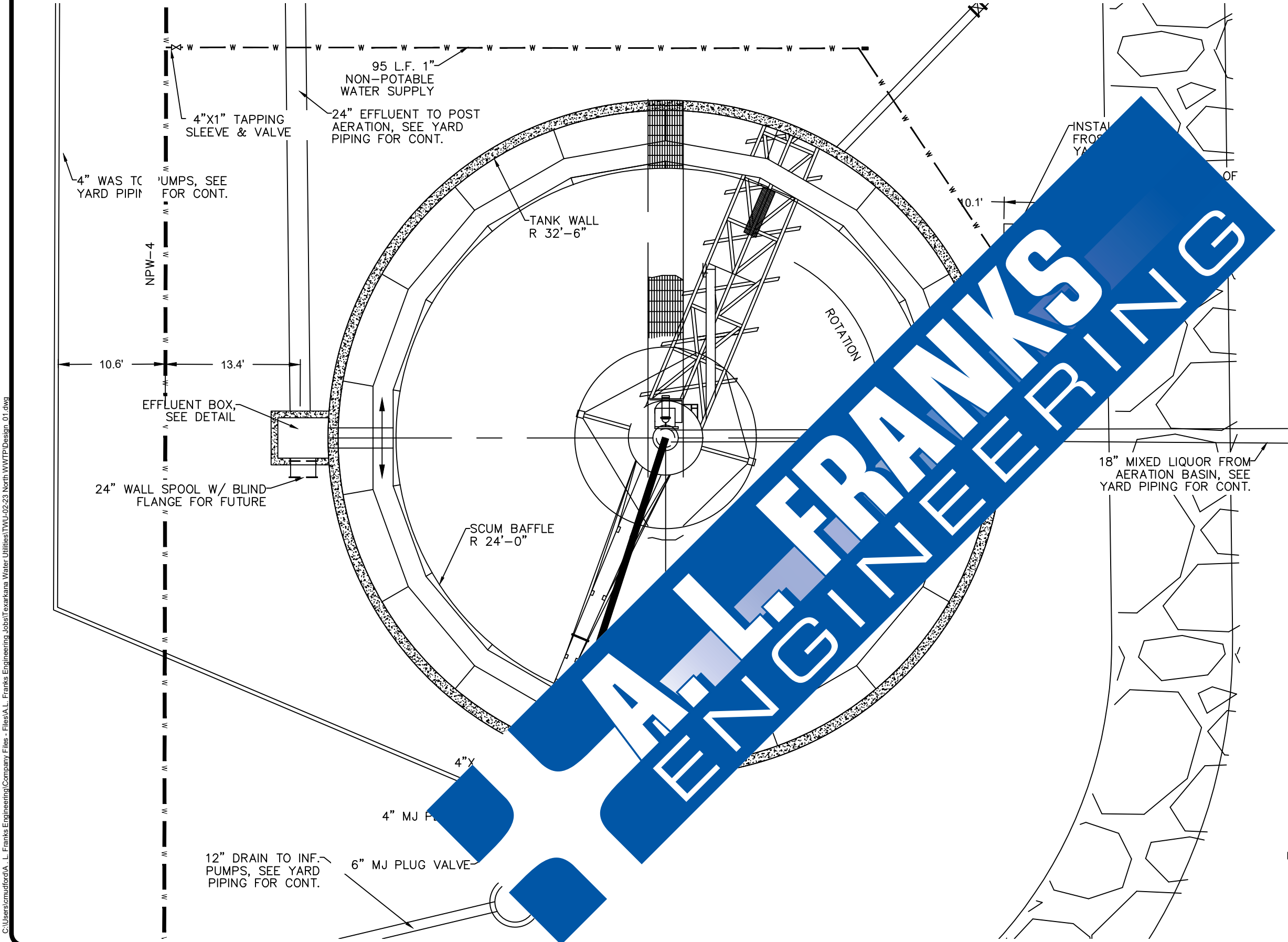
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN
STRUCTURAL DETAILS

Job No. TWU-02-23
Scale: N/A
Date: 9/2026
Sheet 20

C:\Users\mudford\OneDrive\Documents\Projects\Texarkana Water Utilities\North WWTP\Design_01.dwg



NOTE: DIMENSIONS, SIZES, AND LOCATIONS OF WEIR, BAFFLE, WALKWAY, SCUM TROUGH, AND ANCHOR BOLTS, ETC. ARE SHOWN FOR REFERENCE ONLY AND MAY VARY AMONG EQUIPMENT MANUFACTURERS. ONCE EQUIPMENT SELECTION IS FINALIZED DIMENSIONS, ELEVATIONS, AND SIZES SHALL BE ADJUSTED ACCORDINGLY.

NOTE: FOUNDATION SHALL BE OVER EXCAVATED TO A MINIMUM DEPTH OF 3.0' AND REPLACED WITH SELECT FILL. CONTRACTOR SHALL FOLLOW GUIDANCE IN GEOTECHNICAL REPORT PERFORMED BY ETL ENGINEERS & CONSULTANTS DATED SEPTEMBER 4, 2025 FOR ALL FOUNDATION AND SITE PREPARATION REQUIREMENTS.



8-26-26	2-CLARIFIER PLAN MODIFIED	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB

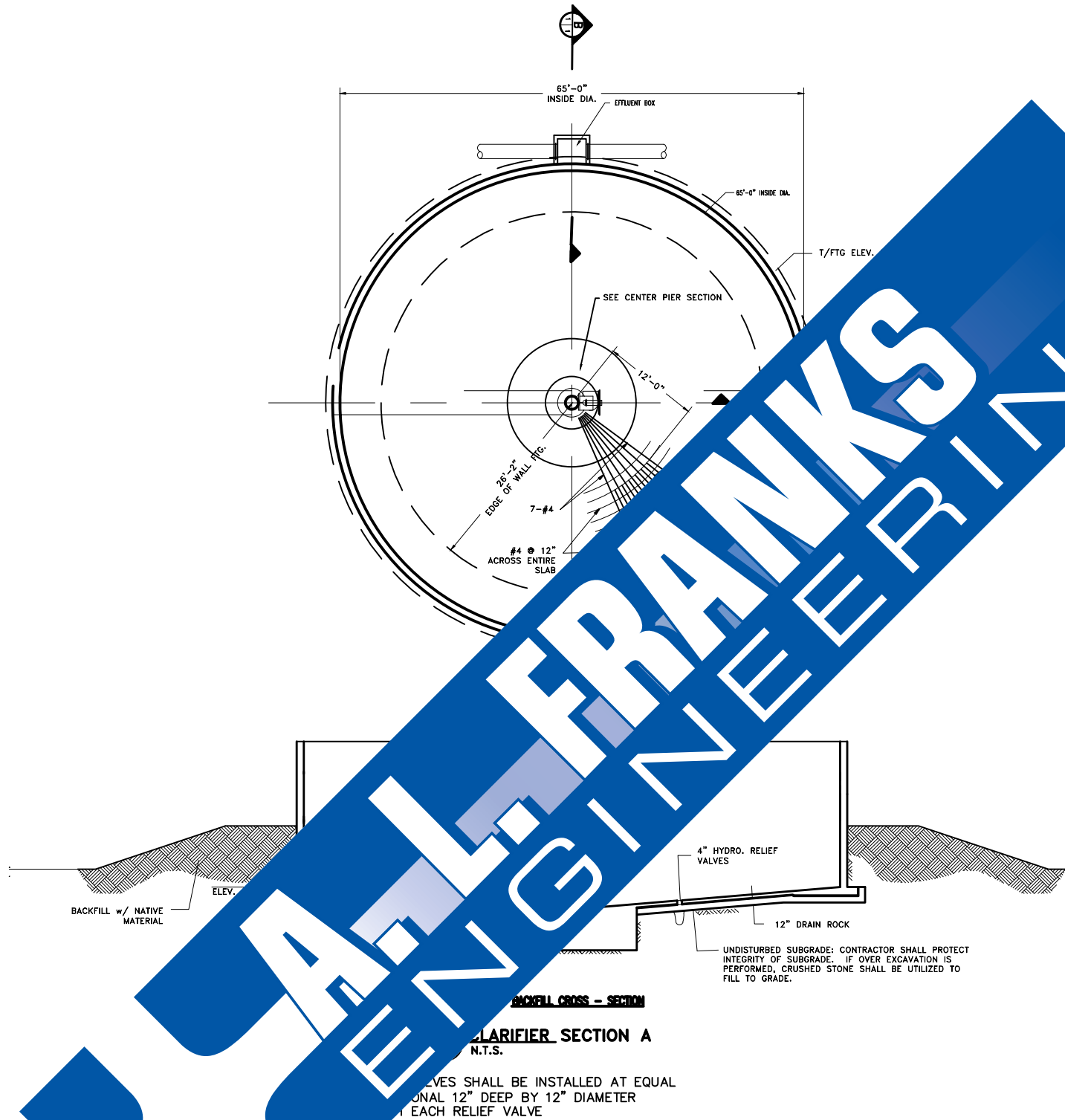


118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

CLARIFIER #3 PLAN

Job No. TWU-02-23
Scale: 1"=10'
Date: 9/2026
Sheet 21



8-17-26	1-RAS BLIND FLANGE	CJM
8-26-26	2-RAS COLLECTION BOX REMOVED	CJM
Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

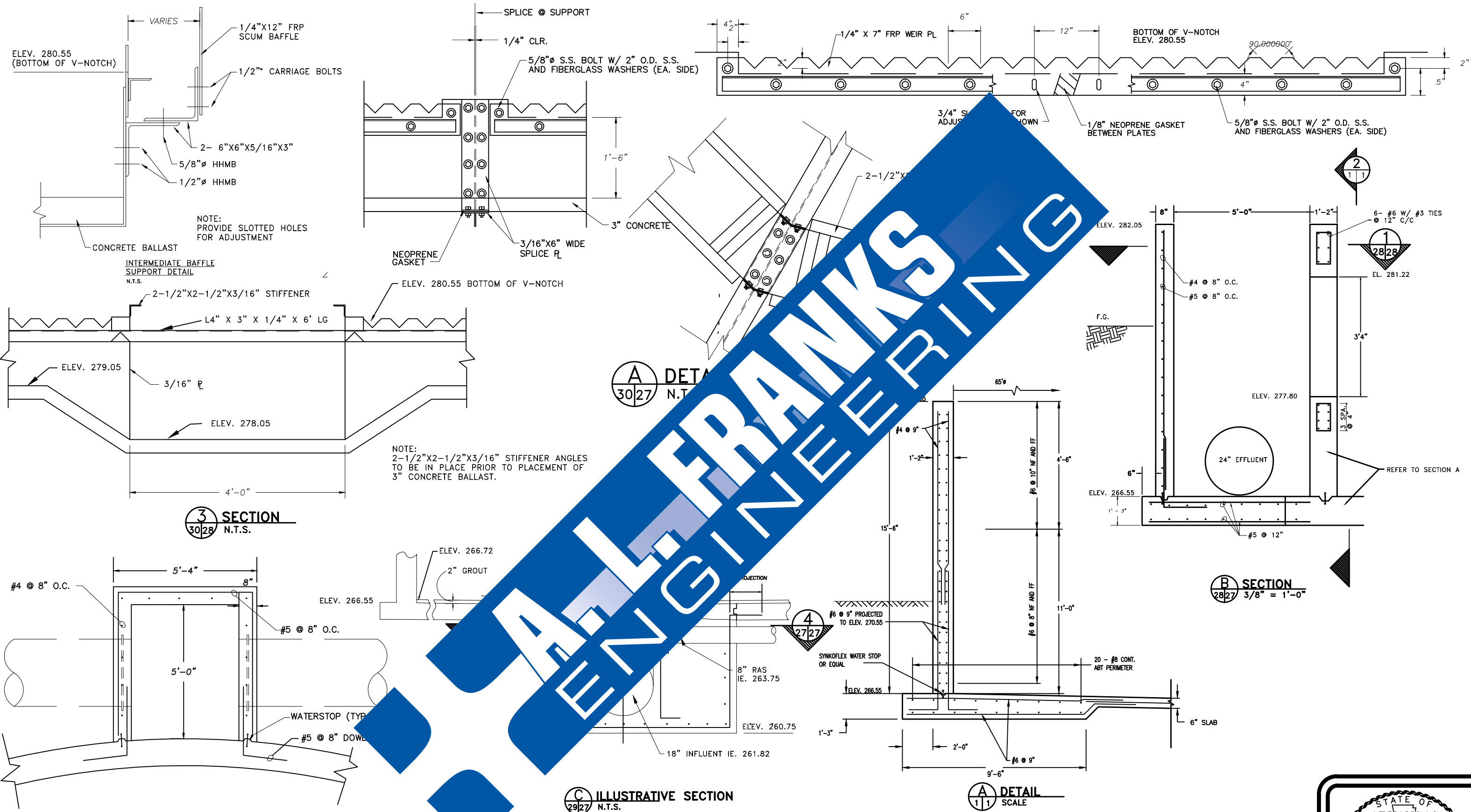
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

CLARIFIER #3 DETAILS

Job No.	TWU-02-23
Scale:	N/A
Date:	8/2026
Sheet	22



C:\Users\mduford\OneDrive\Documents\A.L. Franks Engineering\Jobs\Texarkana Water Utilities\TWU-02-23 North WWTP\Design - 01.dwg



Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



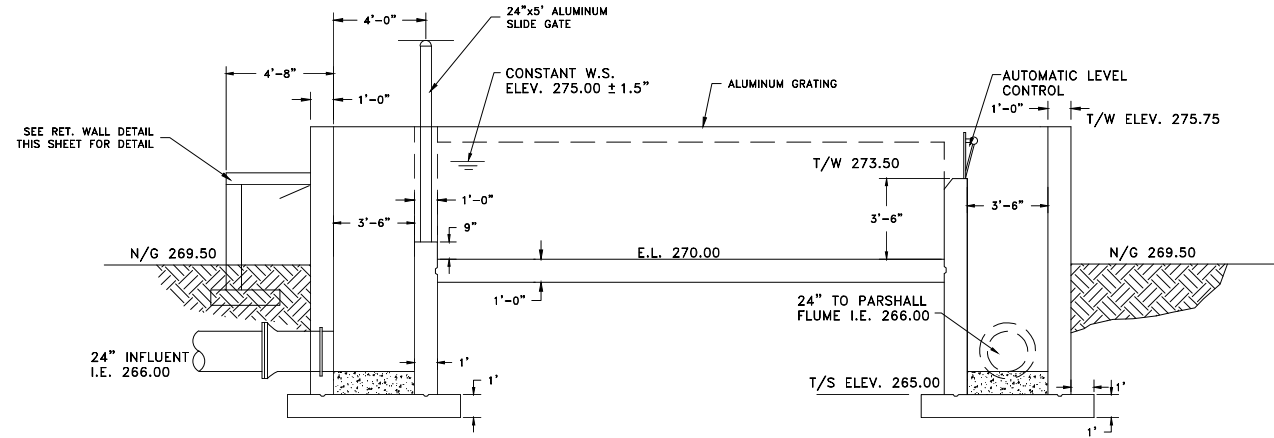
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

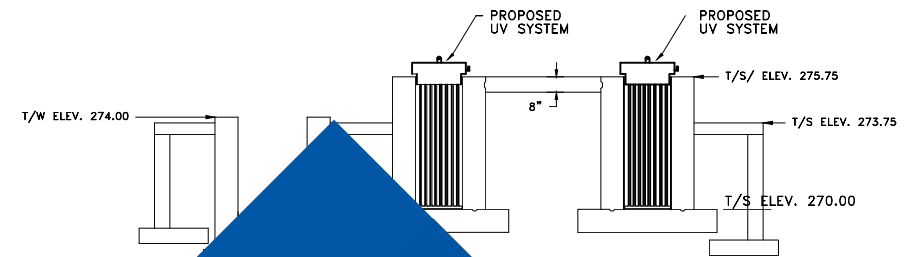
CLARIFIER #3 DETAILS

Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 23

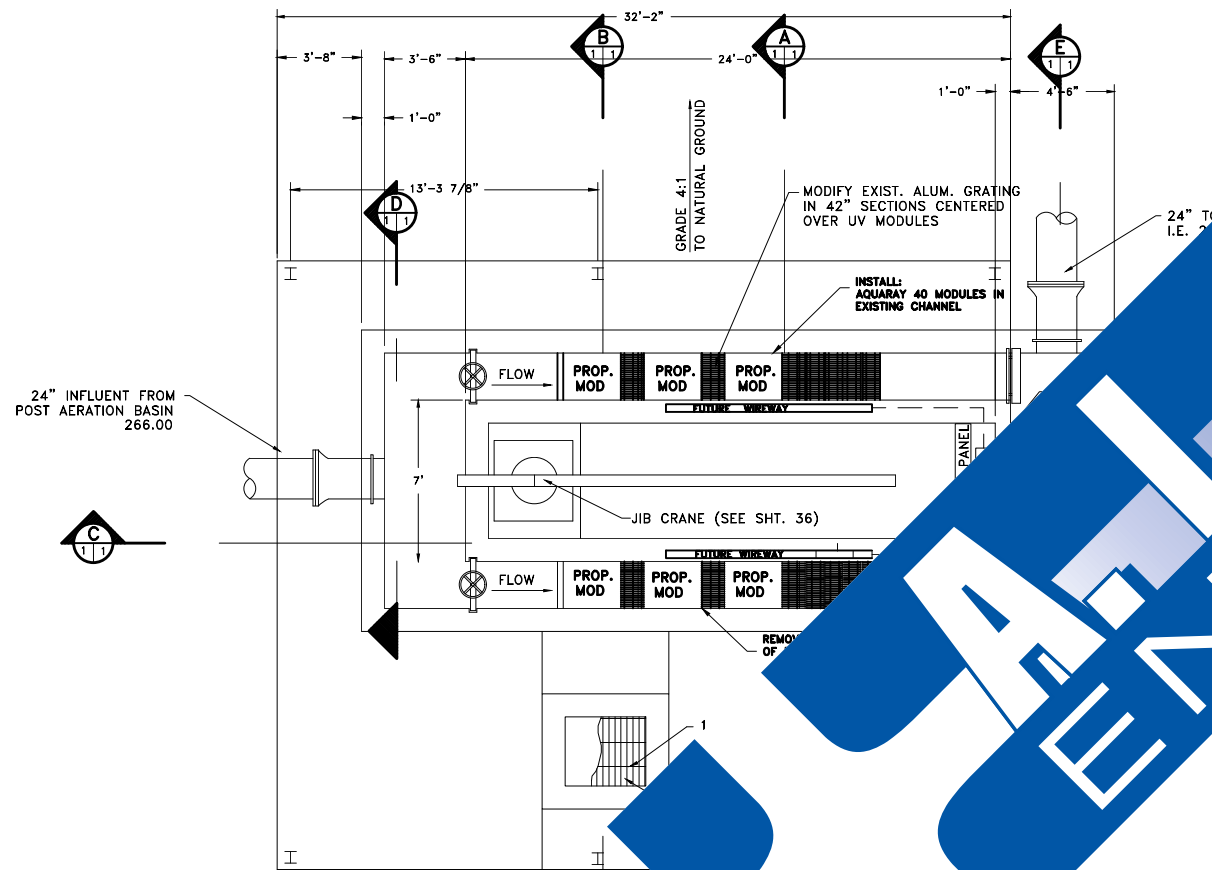




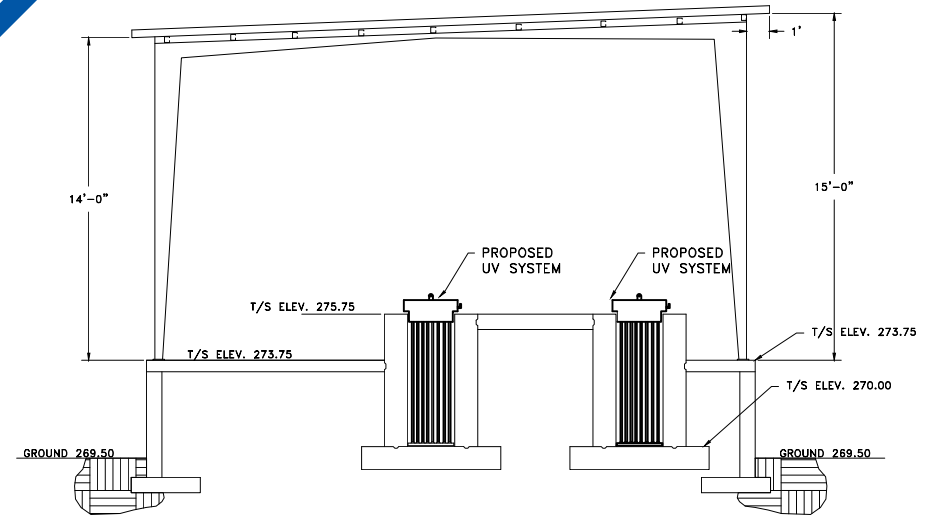
SECTION C
1/4" = 1'-0"



DETAIL
SCALE



PLAN VIEW
SCALE: 1/4" = 1'-0"



SECTION A
1/4" = 1'-0"

AL FRANKS ENGINEERING

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



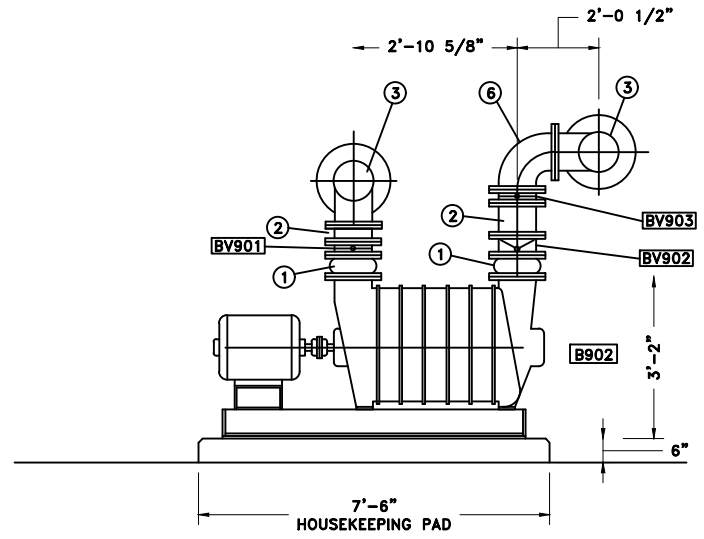
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

UV DISINFECTION

Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 26





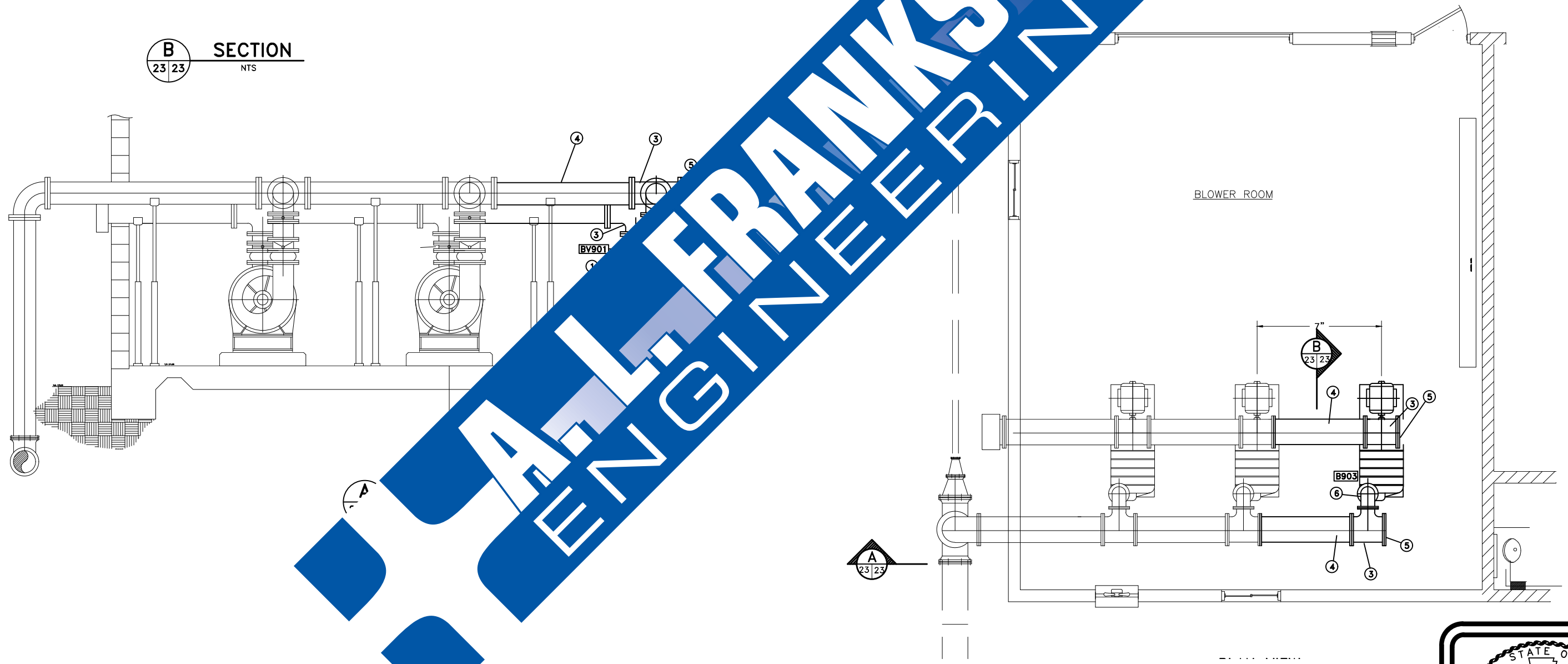
B
23 23
SECTION
NTS

VALVE SCHEDULE				
VALVE NO.	SIZE	CONNECTION	TYPE	COMMENTS
BV901	8"	F	BUTTERFLY VALVE	LOCKING HANDLE
BV902	8"	F	CHECK VALVE	DOUBLE DISC
BV903	8"	F	BUTTERFLY VALVE	LOCKING HANDLE

BLOWER SCHEDULE			
BLOWER NO.	TYPE	HP	DESCRIPTION
B901	CENTRIFUGAL BLOWER	75	8" DISCHARGE

NOTE
BLOWER TO BE CONTINENTAL MODEL 51.08 RATED
FOR 1270 CFM AT 8.2 PSIG OR APPROVED EQUAL

PIPING SCHEDULE	
1	8" EXPANSION JOINT, F/F
2	8" D.I. SPOOL, F/F
3	18" X 18" X 8" D.I. TEE, F/F
4	18" D.I. SPOOL, F/F
5	18" D.I. BLIND FLANGE
6	8" D.I. 90° S/R BEND, F/F



Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AIR BLOWER PLAN

Job No.	TWU-02-23
Scale:	N/A
Date:	5/2026
Sheet	27

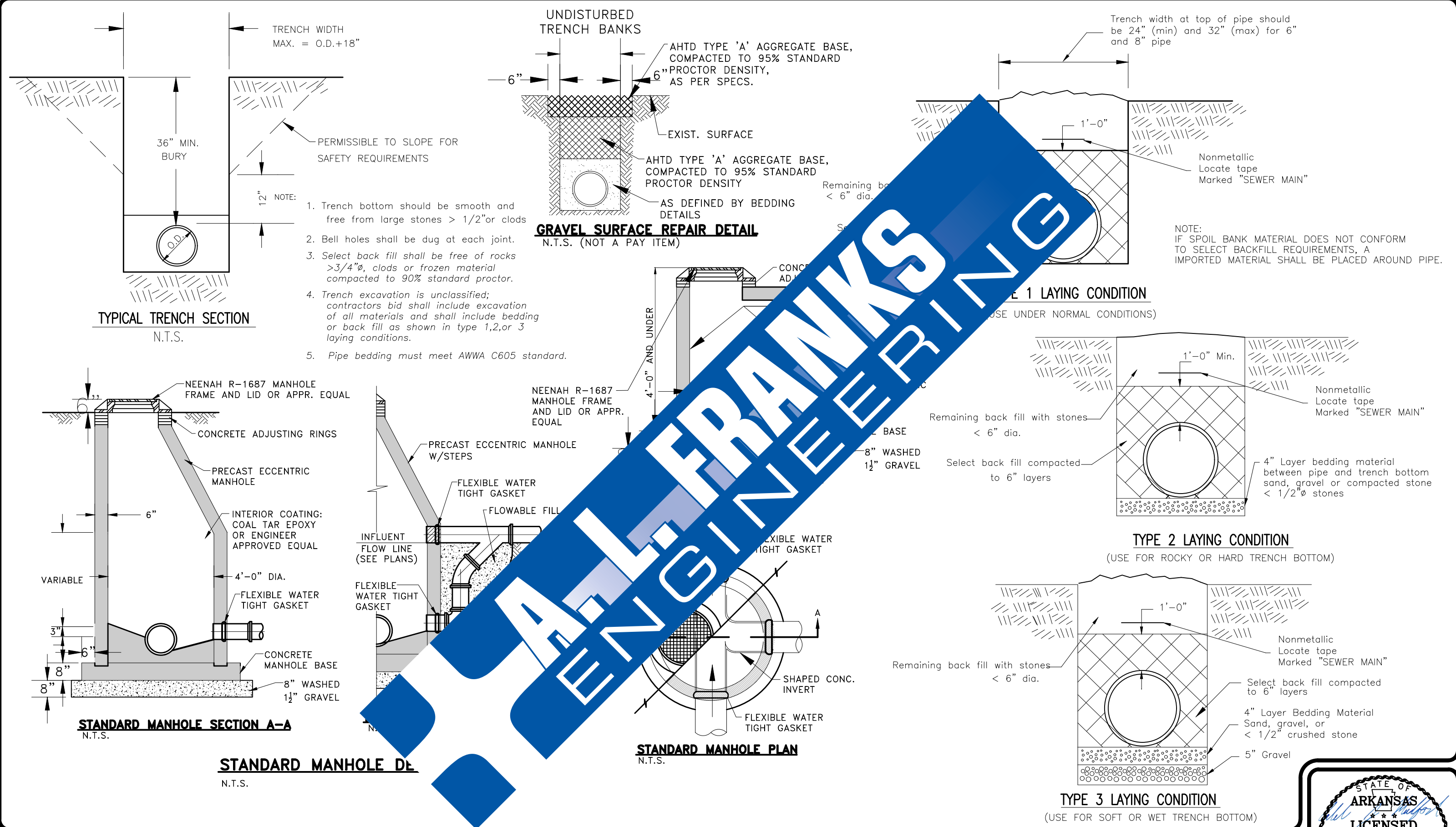
STATE OF
ARKANSAS

LICENSED
PROFESSIONAL
ENGINEER

No. 17723
J. MUDFORD

5-18-26

C:\Users\lfrank\OneDrive\Documents\Projects\Texarkana Water Utilities\TWU-02-23 North WWTP\Design - 01.dwg



Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB

118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

MISCELLANEOUS DETAILS

Job No.: TWU-02-23

Scale: N/A

Date: 5/2026

Sheet 28

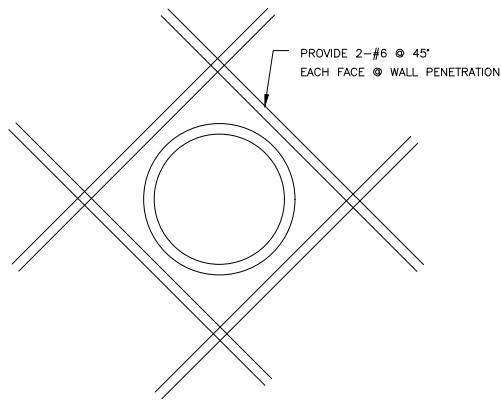
STATE OF ARKANSAS

LICENSED PROFESSIONAL ENGINEER

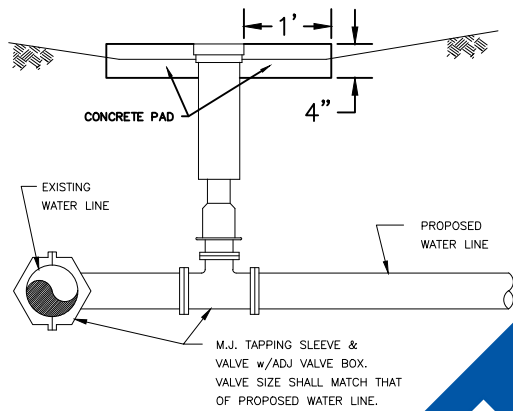
No. 17723

CALEB J. MUDFORD

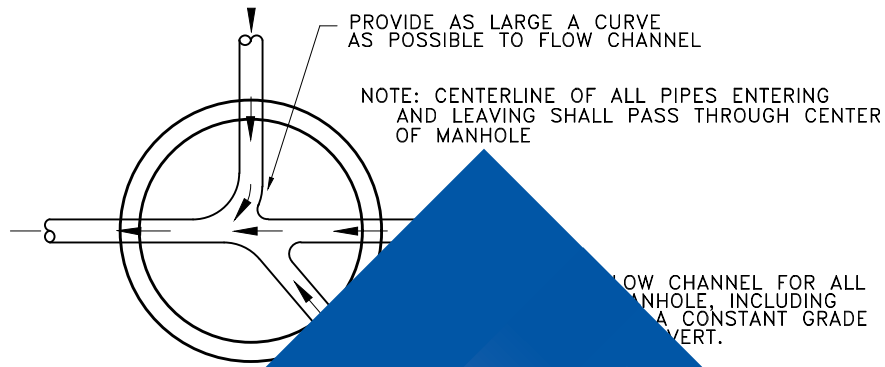
5-18-26



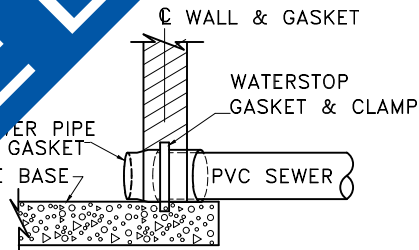
TYPICAL PIPE PENETRATION
N.T.S.



PROPOSED TIE-IN & INSTALLATION OF
N.T.S.



MANHOLE
N.T.S.



PVC SEWER PIPE MANHOLE CONNECTION DETAIL
N.T.S.

PUSH-ON JOINT
MAJOR FLEXIBLE
COUPLING



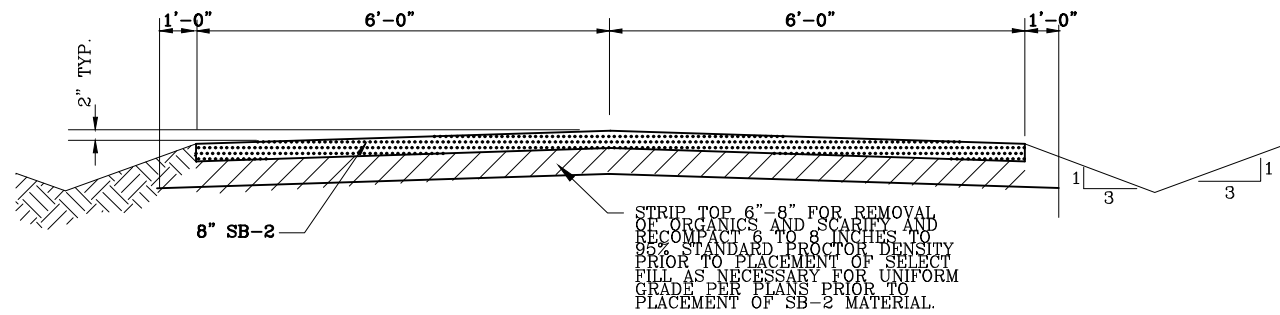
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

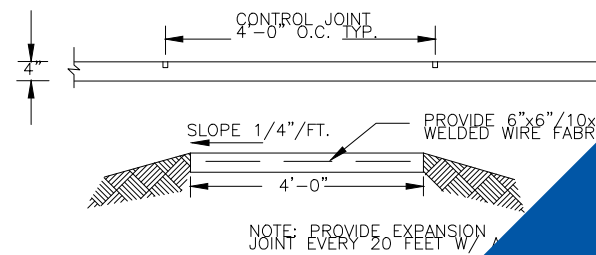
MISCELLANEOUS DETAILS

Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 29

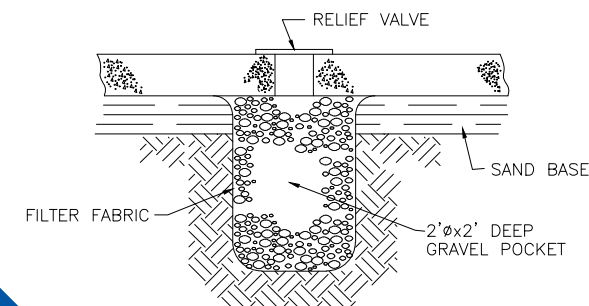




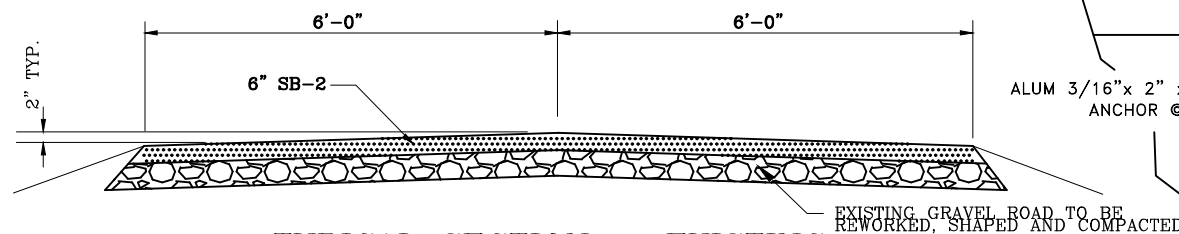
TYPICAL SECTION - OPEN DITCH ACCESS ROAD
N.T.S.



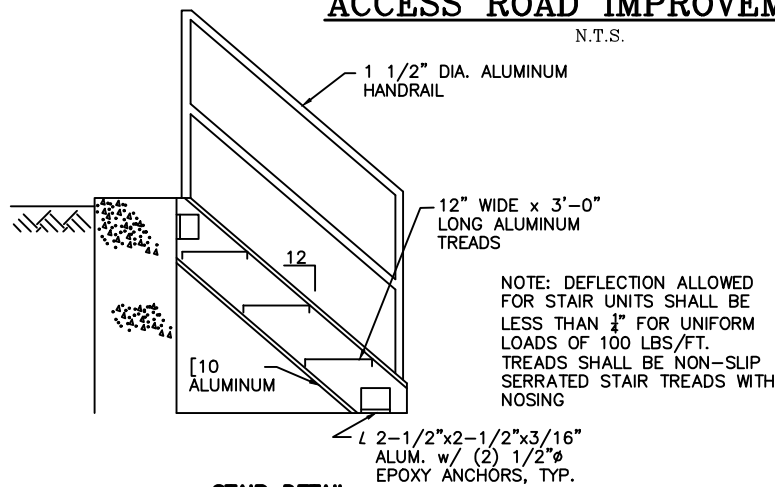
TYPICAL SIDEWALK
N.T.S.



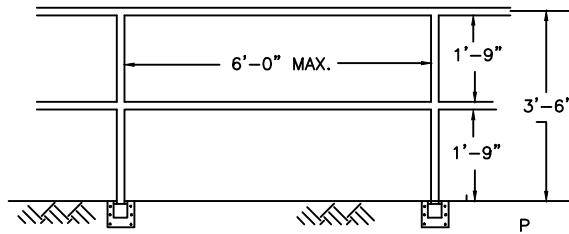
TYPICAL RELIEF VALVE DETAIL
N.T.S.



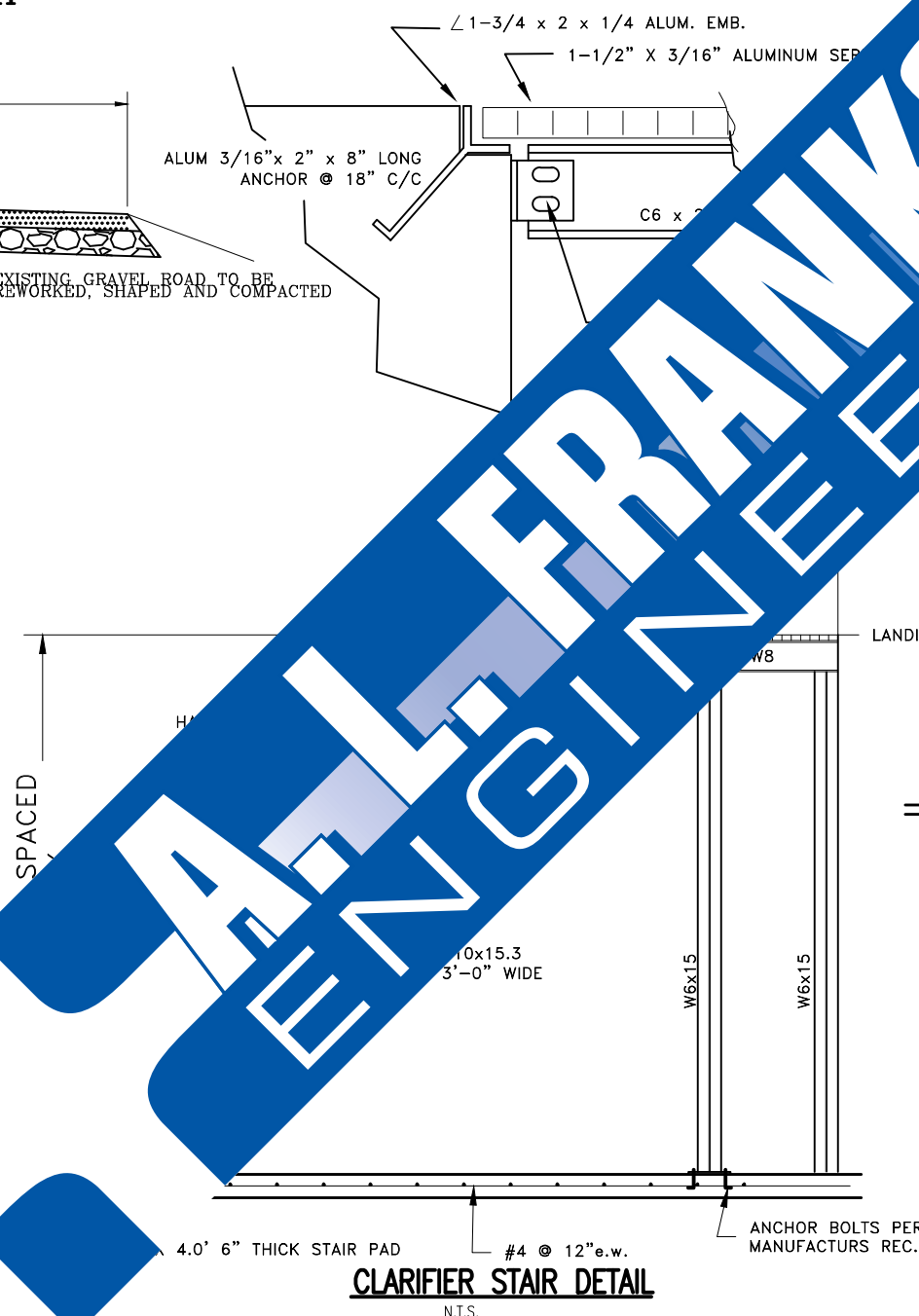
TYPICAL SECTION - EXISTING ACCESS ROAD IMPROVEMENTS
N.T.S.



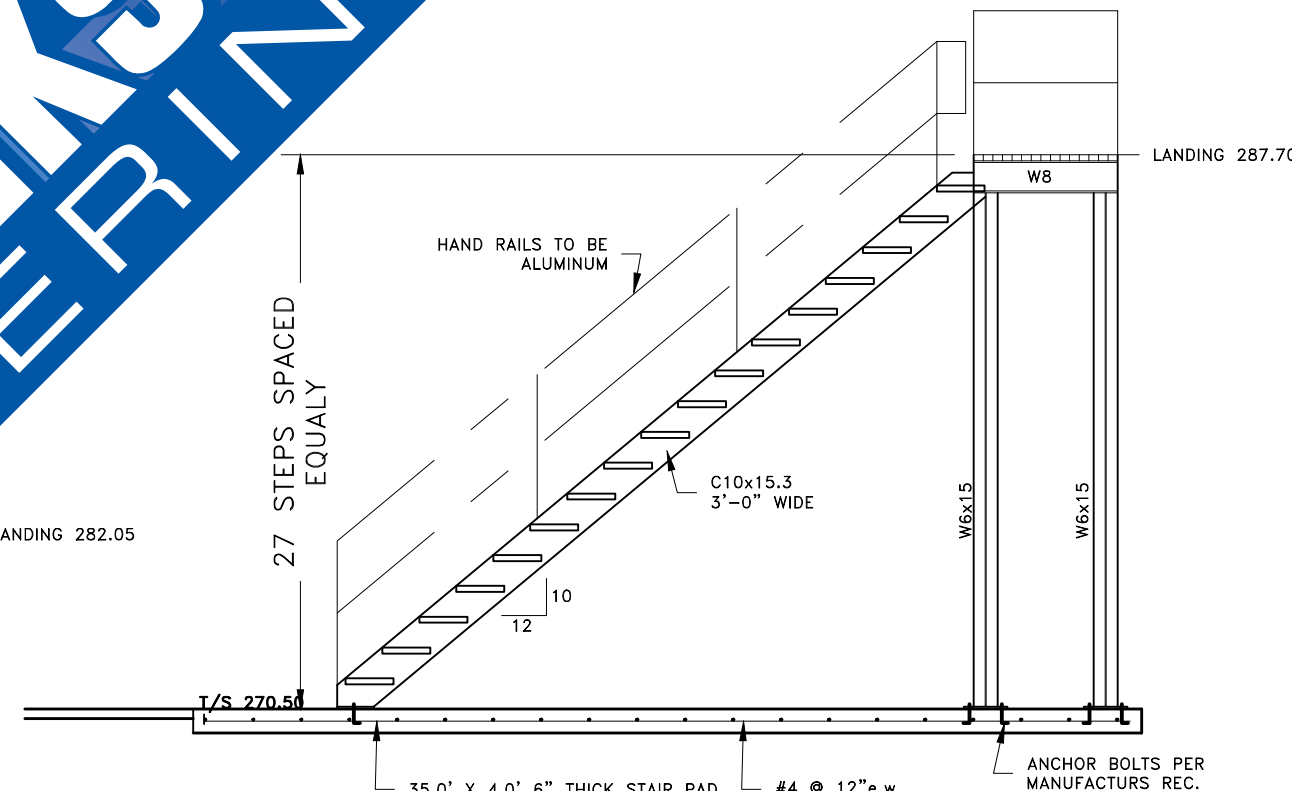
STAIR DETAIL
N.T.S.



TYPICAL HANDRAIL DETAIL
N.T.S.



CLARIFIER STAIR DETAIL
N.T.S.



AERATION BASIN STAIR DETAIL
N.T.S.



Job No. TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 30

MISCELLANEOUS DETAILS

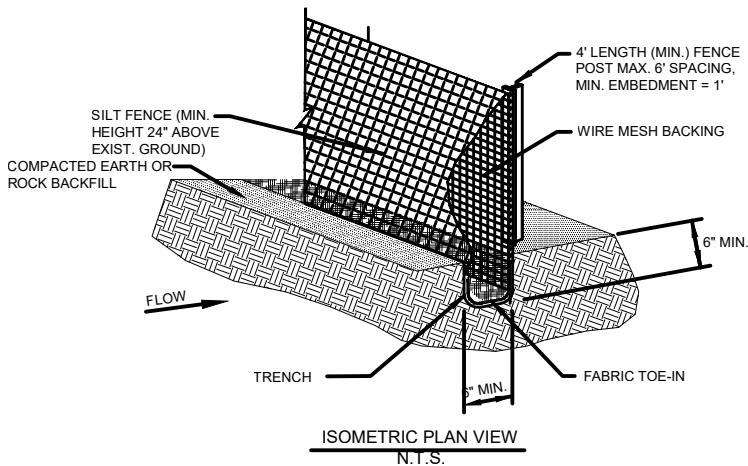
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

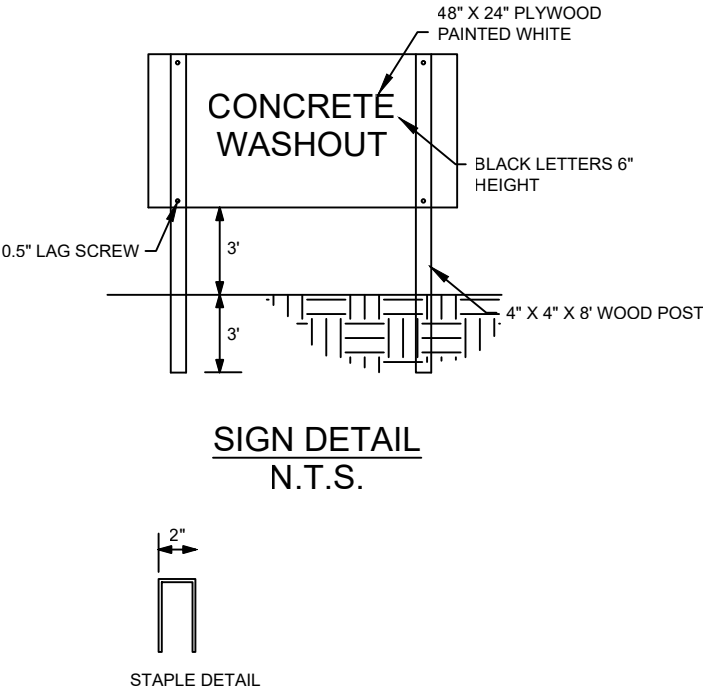
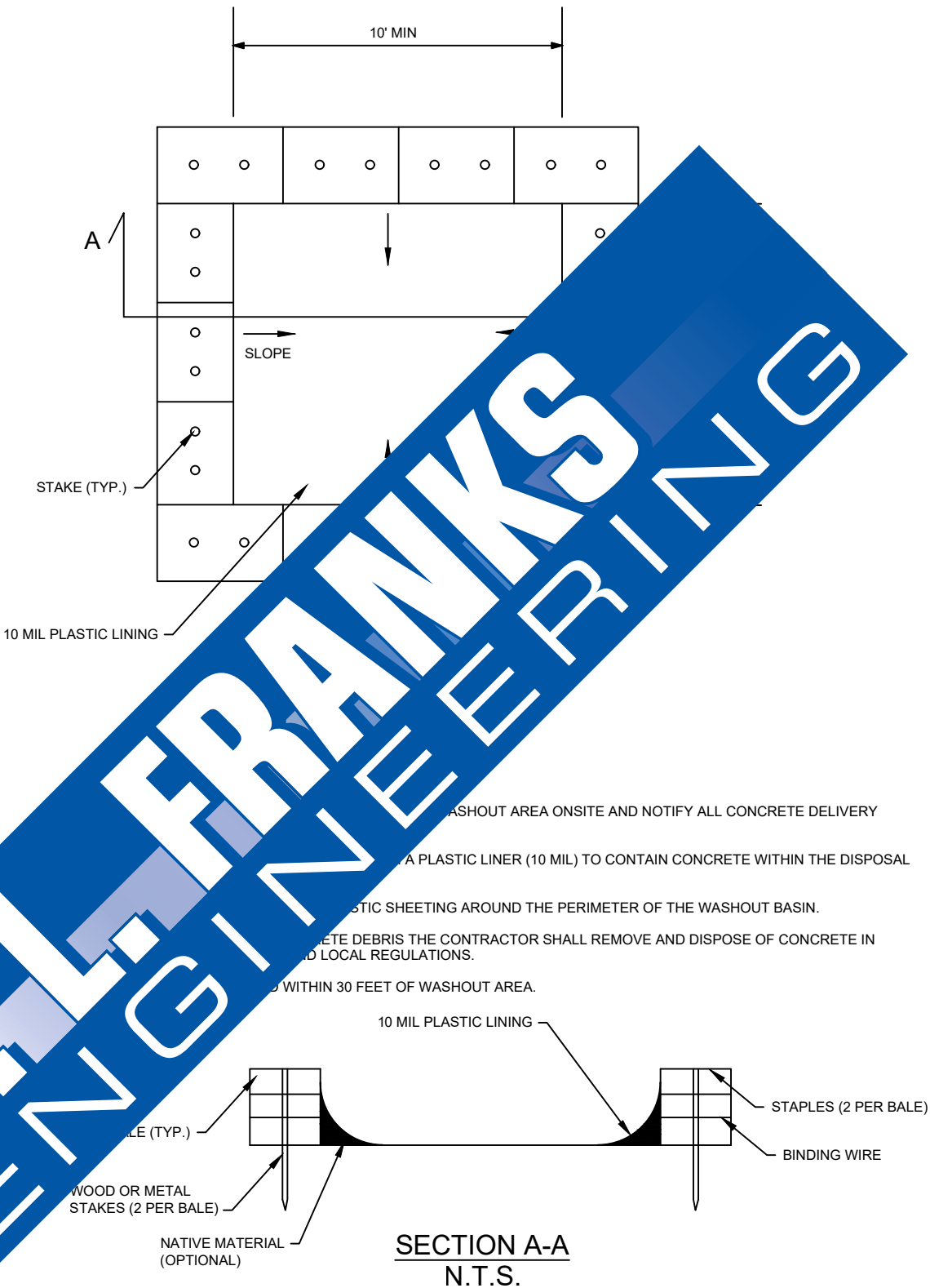
Designed: CJM
Checked: KSB
Drawn: CJM
Approved: KSB

8-17-26	1-STAIR BASE DIMENSIONS ADDED	CJM
8-28-26	2-GRAVEL ROAD SECTION MODIFIED	CJM
Date	Revision	By



SILT FENCE GENERAL NOTES:

1. POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF ONE FOOT.
2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (e.g. PAVEMENT), WEIGHT FABRIC FLAP WITH ROCK ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE
3. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH STEEL SUPPORT POST OR TOWIRE BACKING. A TURN IS ATTACHED TO THE STEEL FENCE POST. THERE SHALL BE A 3 FOOT OVERLAP, SECURELY FASTENED AT ENDS OF FABRIC MEET.
5. INSPECTION SHALL BE MADE EVERY TWO WEEKS AND AFTER EACH 1/2\"/>
6. SILT FENCE SHALL BE REMOVED WHEN FINAL STABILIZATION IS ACHIEVED OR ANOTHER EROSION CONTROL DEVICE IS EMPLOYED.
7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF HALF THE FENCE HEIGHT. SILT SHALL BE DISPOSED OF AT AN APPROVED SITE AND IN SUCH A MANNER AS TO PREVENT FURTHER SILTATION.



CONCRETE WASHOUT
N.T.S.

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

EROSION & SEDIMENT
CONTROL DETAILS

Job No.	TWU-02-23
Scale:	N/A
Date:	5/2026
Sheet	31



POWER, LIGHTING & SYSTEM LEGEND

	UNDER CABINET LIGHT FIXTURE		NON-FUSED DISCONNECT SWITCH, SIZE AS NOTED
	1x4 FLUORESCENT LIGHT		COMBINATION DISCONNECT AND MOTOR STARTER, SIZE AS NOTED. FUSED TYPE SHOWN.
	2x4 FLUORESCENT LIGHT		FUSED DISCONNECT SWITCH, SIZE AS NOTED
	FLUORESCENT LIGHT WITH EMERGENCY LIGHT (EL) BATTERY 1400 LUMENS MINIMUM FOR 2 LAMPS		PUSHBUTTON STATION, NEMA 4X
	2x2 FLUORESCENT LIGHT		ELECTRICAL PANEL, SURFACE MOUNTED, 5'-6" TO TOP OF ENCLOSURE
	RECESSED LIGHT, UNLESS OTHERWISE SHOWN		ELECTRICAL PANEL, RECESSED MOUNTED, 5'-6" TO TOP OF ENCLOSURE
	WALL MOUNTED LIGHT-MOUNTING HEIGHT AS INDICATED		EQUIPMENT CABINET SIZE AS NOTED, RECESSED MOUNTED, 5'-6" TO TOP OF ENCLOSURE
	LED EXIT LIGHT, CEILING MOUNTED OR AS INDICATED, DARKENED AREA INDICATES FACE, ARROWS INDICATE DIRECTION OF EGRESS		EQUIPMENT CABINET SIZE AS NOTED, SURFACE MOUNTED, 5'-6" TO TOP OF ENCLOSURE
	EMERGENCY EXIT LIGHT, WALL MOUNT 7'-6" A.F.F. OR AS NOTED		HOME RUN TO PANEL, RECEPTACLES AND EQUIPMENT SHALL HAVE GREEN GROUND WIRE. NUMBER OF ARROWS INDICATES NUMBER OF PHASE CONDUCTORS, OR AS SHOWN ON SCHEDULE
	4 FT. STRIP FLUORESCENT LIGHT		BRANCH CIRCUIT WITH PHASE, NEUTRAL, SWITCHED PHASE AND EQUIPMENT GROUNDING CONDUCTORS
	LIGHT SWITCH, MTD. 4'-0" A.F.F.		TELEPHONE OR DATA OUTLET, SINGLE GANG BOX MTD. 18" A.F.F. WITH 3/4"C STUB TO ABOVE LAY-IN CEILING. "W" INDICATES 4'-6" MTD. HEIGHT FOR WALL PHONE.
	LIGHT SWITCH, 2 POLE, MTD 4'-0" A.F.F.		3/4" PLYWOOD TELEPHONE BACKBOARD, SIZE AS NOTED, MTD. 5'-6" TO TOP
	LIGHT SWITCH, 3-WAY, MTD. 4'-0" A.F.F.		JUNCTION BOX 42 CUBIC INCH MINIMUM CAPACITY
	LIGHT SWITCH, 4-WAY, MTD. 4'-0" A.F.F.		FLOOR TELEPHONE OUTLET, CAST JUNCTION-BOX
	LIGHT SWITCH WITH PILOT LIGHT, MTD. 4'-0" A.F.F.		WALL TELEPHONE/DATA OUTLET
	20 AMP DUPLEX RECEPTACLE MTD. HORIZ. 6" ABOVE COUNTER TOP UNLESS OTHERWISE SHOWN		DOOR SWITCH MOUNTED IN DOOR JAMB
	20 AMP DUPLEX RECEPTACLE MTD. 18" A.F.F., WITH #12 GROUND WIRE, GFCI INDICATES GROUND FAULT CIRCUIT INTERRUPTER, WP INDICATES WEATHERPROOF WHILE IN USE ENCLOSURE AND COVER		DOOR BUTTON WEATHER PROOF, 50" A.F.F.
	SINGLE RECEPTACLE, RATINGS AS NOTED		DOOR BUZZER MTD 7'-0" A.F.F.
	HP RATED TOGGLE SWITCH, 1 OR 2 POLES AS REQUIRED W/OVERLOADS		

ABBREVIATIONS:

P-LSI(G)	PROGRAMMABLE BREAKER MICROLOGIC OR EQUAL WITH ADJUSTMENTS LISTED: L = LONG-TIME S = SHORT TIME I = INSTANTANEOUS G = GROUND FAULT P = POWER METERING WITH ETHERNET CONNECTIVITY
MM	ENERGY REDUCING MAINTENANCE SWITCHING WITH LOCAL STATUS TO COMPLY WITH NEC 240.87
AVT	ABSENCE OF VOLTAGE TESTER (PANDUIT VERISAFE VS-AVT-C08-L10 OR APPROVED EQUAL)

LINE TYPES

	FURNISH + INSTALL NEW
	EXISTING
	DEMOLISH
	AREA/PACKAGE BOUNDARY

ABBREVIATIONS

A	AMP	SHT	SHEET
ACU	AIR CONDITIONING UNIT	SN	SOLID NEUTRAL
AFF	ABOVE FINISHED FLOOR	SS	STAINLESS STEEL
AHU	AIR HANDLER UNIT	STA	STATION
AIC	AMPS INTERRUPTING CAPACITY	SW	SWITCH
AM	AMP-METER	TC	TIME CLOCK
ANN	ANNUNCIATOR	TEL	TELEPHONE
AP	AERIAL PRIMARY	TD	TIME DELAY
AS	AERIAL SECONDARY	TDD	TIME DELAY ON DE-ENERGIZATION
ATS	AUTOMATIC TRANSFER SWITCH	TDE	TIME DELAY ON ENERGIZATION
AUX	AUXILIARY	TYP	TYPICAL
BFI	BLOWN FUSE INDICATOR	TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
BKR	BREAKER	UG	UNDER GROUND
C	CONDUIT	UH	UNIT HEATER
CGRS	PVC CONDUIT RIGID GALVANIZED RIGID STEEL	UP	UNDERGROUND PRIMARY
CKT	CIRCUIT	US	UNDERGROUND SECONDARY
COM	COMMON	VA	VOLT-AMP
CONT	CONTROLLER	VFD	VARIABLE FREQUENCY DRIVE
CP	CIRCUIT PROTECTOR	VM	VOLT-METER
CPT	CIRCUIT PROTECTOR	W	WATT OR WIRE
CR	CIRCUIT RATING	WH	WEATHER HEAD
CS	CIRCUIT SIZE	WM	WATT METER
CU	COPPER	WP	WEATHERPROOF
G	GROUND	W/	WITH
VAR	VARIABLE	XMFR	TRANSFORMER
kw	KILOWATT		
L	LINE (PHASE)		
LA	LIGHTNING ARRESTOR		
L.O.	LUGS ONLY		
LSI	LONG-TIME, SHORT-TIME, INSTANTANEOUS TRIP UNIT		
LV	LOW VOLTAGE		
MCB	MAIN CIRCUIT BREAKER		
MCC	MOTOR CONTROL CENTER		
MCP	MOTOR CIRCUIT PROTECTOR		
MFR	MANUFACTURER		
MIN	MINIMUM		
MLO	MAIN LUGS ONLY		
MM	MAINTENANCE MODE (ENERGY-REDUCING MAINTENANCE SWITCHING WITH LOCAL STATUS)		
MS	MOUNTED		
MTD	MANUAL TRANSFER SWITCH		
MTS	NEUTRAL		
N	NON-FUSED DISCONNECT SWITCH		
NFDS	NOT TO SCALE		
NTS	ON CENTER		
OC	OVERHEAD		
OH	OVERLOAD		
OL	OFFICE PRINCIPAL GROUND POINT		
OPGP	PUSH BUTTON		
PB	POWER DISTRIBUTION SERVICES CABINET		
PDSC	PHOTO ELECTRIC CELL		
PEC	POWER FACTOR		
PF	POWER FAIL RELAY		
PFR	PILOT LIGHT		
PL	PHASE MONITOR RELAY		
PMR	PANEL		
PNL	PUSH-TO-TEST		
PTT	SCHEDULE 40 POLYVINYL CONDUIT		
PVC	RECEPTACLE		
RECPT	ROOM		
RM	REDUCED VOLTAGE AUTO-TRANSFORMER STARTER		
RVAT	SECOND		
S	SURGE ARRESTER		
SA	SOFT DRAWN BARE COPPER		
SDBC	SERVICE ENTRANCE		
SE			

CONTROL SCHEMATIC LEGEND

	WIRING WITHIN PANEL
	WIRING TO FIELD DEVICE
	PUSHBUTTON SWITCH, NORMALLY OPEN
	PUSHBUTTON SWITCH, NORMALLY CLOSED
	SELECTOR SWITCH, NUMBER OF POSITIONS AND CONTACTS AS SHOWN
	RELAY CONTACT, NORMALLY OPEN
	RELAY CONTACT, NORMALLY CLOSED
	TIME DELAY CONTACT, CLOSE ON ENERGIZATION
	TIME DELAY CONTACT, OPEN ON ENERGIZATION
	TIME DELAY CONTACT, OPEN ON DE-ENERGIZATION
	TIME DELAY CONTACT, CLOSE ON DE-ENERGIZATION
	LEVEL SWITCH
	PRESSURE SWITCH
	LIMIT SWITCH CONTACT, NORMALLY OPEN
	LIMIT SWITCH CONTACT, NORMALLY CLOSED
	LIMIT SWITCH CONTACT, HELD OPEN
	LIMIT SWITCH CONTACT, HELD CLOSED
	RELAY COIL, "TR" INDICATES "TIMING RELAY"
	PILOT LIGHT; "A" INDICATES "AMBER LENS" "G" INDICATES "GREEN LENS" "R" INDICATES "RED LENS"
	SOLENOID
	ELAPSED TIME METER
	TERMINAL BLOCK
	ELECTRICAL CONNECTION
	FUSE, AMPERE RATING AS SHOWN OR REQUIRED "BFI" INDICATES "BLOWN FUSE INDICATOR" TYPE
	GROUND CONNECTION TO ENCLOSURE GROUND BAR

Arkansas One Call



Know what's below.
Call before you dig.



Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
LEGEND AND ABBREVIATIONS

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E1

MANUFACTURER-DESIGNED EQUIPMENT SYSTEM NOTES:

- 1. THIS PROJECT INCLUDES THE CONSTRUCTION OF MANUFACTURER-DESIGNED EQUIPMENT SYSTEMS.
- 2. POWER, SIGNAL AND CONTROL CIRCUITS ARE SHOWN ON THESE DRAWINGS BASED ON SIMILAR MANUFACTURER-DESIGNED EQUIPMENT SYSTEMS.
- 3. THE FINAL POWER, SIGNAL AND CONTROL CIRCUIT REQUIREMENTS SHALL BE DETERMINED BY THE APPROVED MANUFACTURER.
- 4. DRAWINGS, SPECIFICATIONS, INSTALLATION MANUALS, AND OTHER REQUIRED DOCUMENTATION SHALL BE PROVIDED BY THE APPROVED MANUFACTURERS AND MAY INCLUDE ADDITIONAL AND/OR ALTERED REQUIREMENTS THAN SHOWN ON THESE DRAWINGS.
- 5. THE CONTRACTOR SHALL COORDINATE WITH THOSE APPROVED SUBMITTAL DRAWINGS AND PROVIDE ALL REQUIRED LABOR AND MATERIALS NECESSARY FOR A COMPLETE AND ACCEPTED SYSTEM AT NO ADDITIONAL COST TO THE OWNER.

GENERAL NOTES:

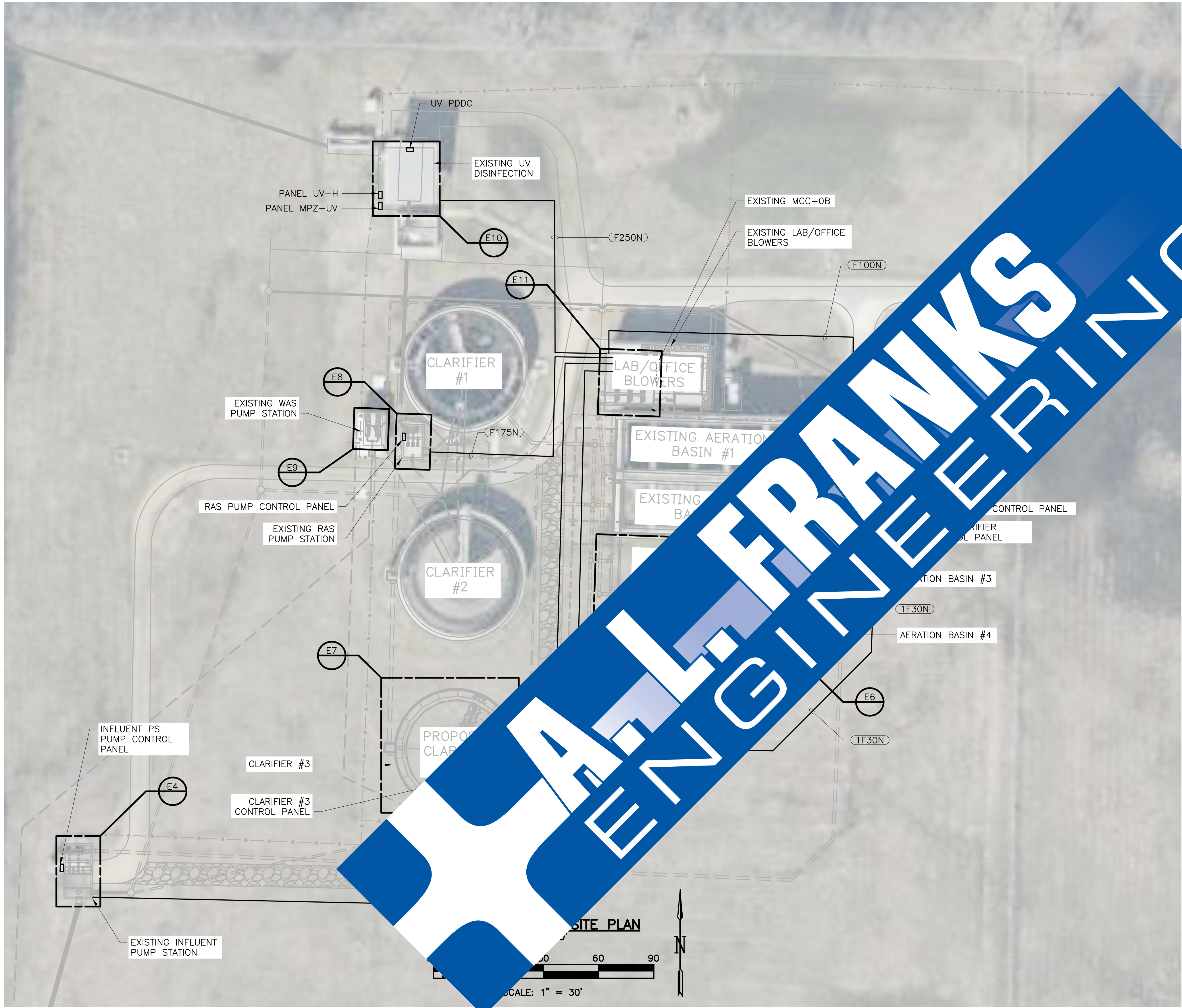
- 1. CONTRACTOR SHALL FAMILIARIZE HIMSELF WITH ALL SITE CONDITIONS AND POTENTIAL HAZARDS INCLUDING BUT NOT LIMITED TO OVERHEAD ELECTRICAL LINES.
- 2. CONTRACTOR SHALL COORDINATE ALL CONDUIT AND ELECTRICAL WORK WITH PRESENT AND EVOLVING SITE CONDITIONS. CONDUIT ROUTING IS SCHEMATIC IN NATURE.
- 3. CONTRACTOR SHALL ROUTE CONDUIT IN SHARED TRENCH WHERE DETERMINED POSSIBLE.

CABLE LEGEND

CONDUIT:	1	= 1"C
	2	= 2"C
	3	= 3"C
	4	= 4"C
CONTROL TYPE:	D	= DISCRETE (#14 AWG CONDUCTORS)
	A	= ANALOG (1 INDIVIDUALLY SHIELDED PAIR, 16 AWG, [1ISP16])
	E	= ETHERNET
	F	= FIBER
QUANTITY:	*****	INDIVIDUAL #14 AWG (DISCRETE CONTROL "D")
		INDIVIDUAL [1ISP16] CABLES (ANALOG CONTROL "A")
		INDIVIDUAL FIBER STRANDS (FIBER CONTROL)
		CAT5e CABLES (ETHERNET CONTROL)

EXAMPLE CALLOUTS

(1D036)	(1A001)	(1F012)
(2D140)	(2A007)	(1E001)
(3D309)	(3A016)	
(4D531)	(4A027)	



Arkansas One Call



Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

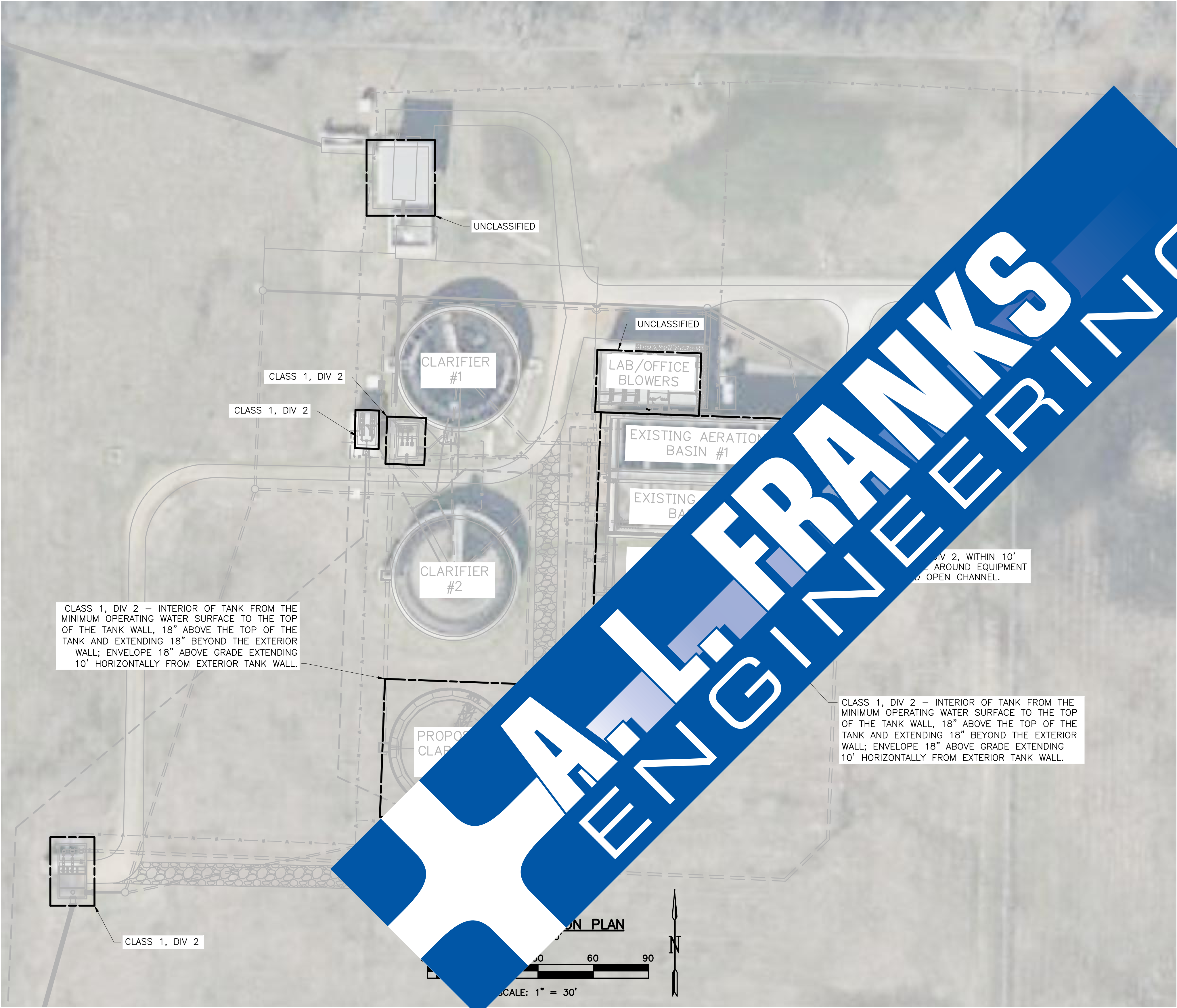
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
SITE OVERVIEW

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E2

HAZARDOUS LOCATION NOTES:

1. THIS PROJECT INCLUDES THE INSTALLATION OF ELECTRICAL SYSTEMS IN LOCATIONS DEFINED BY THE NATIONAL FIRE PROTECTION AGENCY (NFPA) AS HAZARDOUS (CLASSIFIED) LOCATIONS. WASTEWATER COLLECTION SYSTEMS AND WASTEWATER TREATMENT PROCESSES ARE FIRE AND EXPLOSION HAZARDS DUE TO THE POSSIBLE IGNITION OF FLAMMABLE GASSES AND FLOATING FLAMMABLE LIQUIDS.
2. WIRING MATERIALS AND METHODS IN HAZARDOUS (CLASSIFIED) LOCATIONS SHALL MEET THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE (NEC), ARTICLE 500, HAZARDOUS (CLASSIFIED) LOCATIONS. INSTALLATION SHALL BE DONE BY PERSONS TRAINED AND EXPERIENCED IN HAZARDOUS (CLASSIFIED) LOCATION WORK.
3. CONDUIT SEAL FITTINGS SHALL BE FURNISHED AND INSTALLED AT BOUNDARIES OF HAZARDOUS (CLASSIFIED) LOCATIONS. BOUNDARIES OF HAZARDOUS (CLASSIFIED) LOCATIONS ARE BETWEEN CLASS I AND UNCLASSIFIED LOCATIONS, CLASS I AND CLASS II LOCATIONS, CLASS II AND UNCLASSIFIED LOCATIONS. CONDUIT SEAL FITTINGS SHALL BE LOCATED AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.
4. RIGID CONDUIT IN HAZARDOUS (CLASSIFIED) LOCATIONS SHALL BE RIGID METAL CONDUIT (RMC) OR CONCRETE-ENCASED PVC. FLEXIBLE CONDUIT IN HAZARDOUS (CLASSIFIED) LOCATIONS SHALL BE RATED FOR THE HAZARD CLASSIFICATION IN WHICH IT IS INSTALLED.
5. WASTEWATER LIFT STATION WET WELLS ARE CLASS I, DIVISION I HAZARDOUS LOCATIONS.
6. WASTEWATER LIFT STATION METER VAULTS ARE CLASS I, DIVISION II HAZARDOUS LOCATIONS.



Arkansas One Call



Know what's below.
Call before you dig.

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWT
TEXARKANA, ARKANSAS 71854

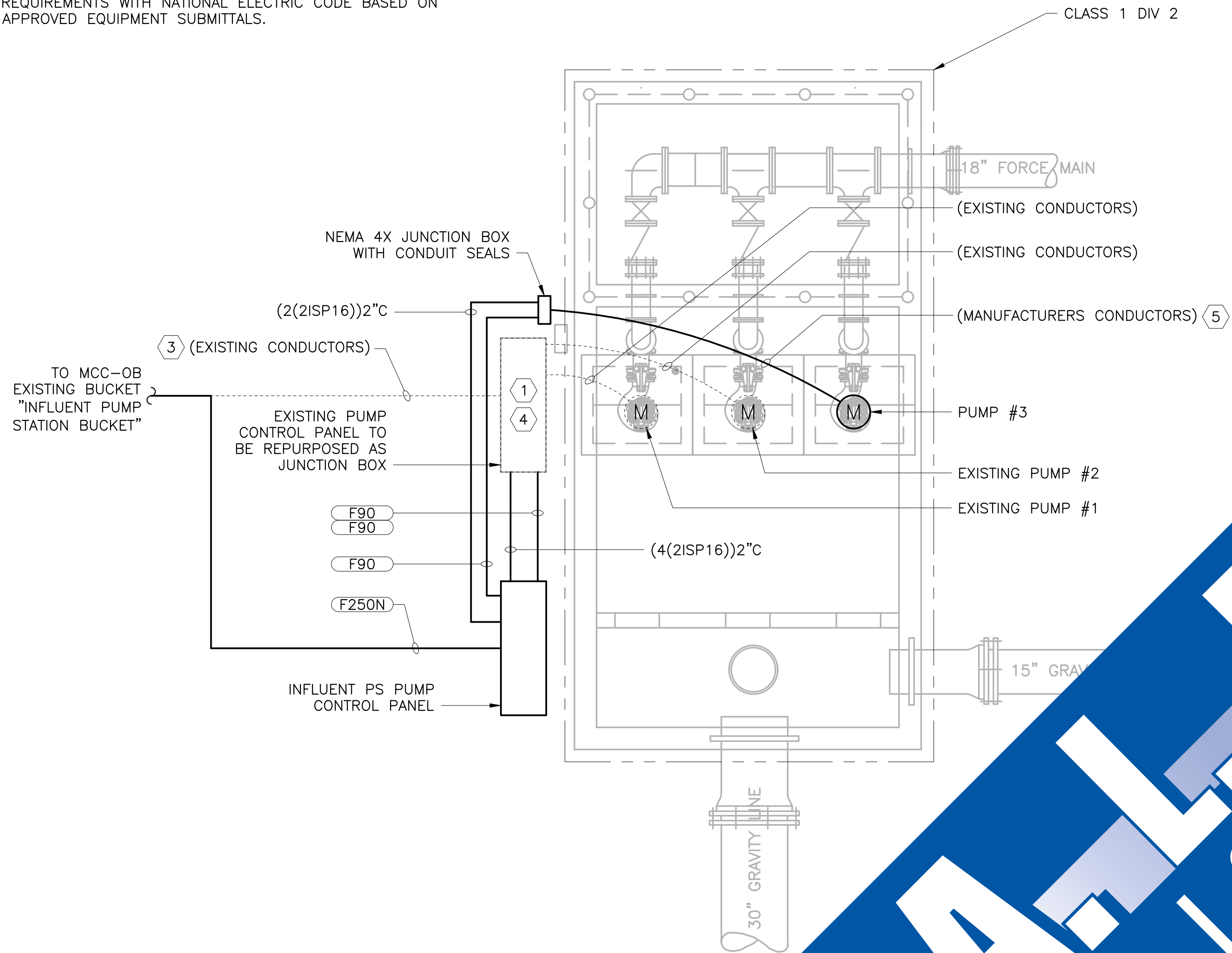
TEXARKANA WATER UTILITIES
ELECTRICAL
SITE-OVERVIEW – CLASSIFICATION PLAN

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E3



KEYED NOTES:

1. CONTRACTOR SHALL WATERTIGHT SPLICE EXISTING PUMP POWER AND CONTROL CONDUCTORS AND ROUTE AS SHOWN.
2. NOT USED.
3. CONTRACTOR SHALL DEMOLISH EXISTING CONDUCTORS AND CONDUIT BELOW GRADE BACK TO MCC-OB.
4. CONTRACTOR SHALL REMOVE INTERNAL CONTENTS AND RETURN TO OWNER.
5. CONTRACTOR SHALL COORDINATE CONDUIT SIZING REQUIREMENTS WITH NATIONAL ELECTRIC CODE BASED ON APPROVED EQUIPMENT SUBMITTALS.



2 MCC-OB EXISTING BUCKET
SCALE: NONE

1 INFLUENT
SCALE: NONE

Arkansas One Call



Know what's below.
Call before you dig.

Designed AE
Checked BB
Drawn CD
Approved BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

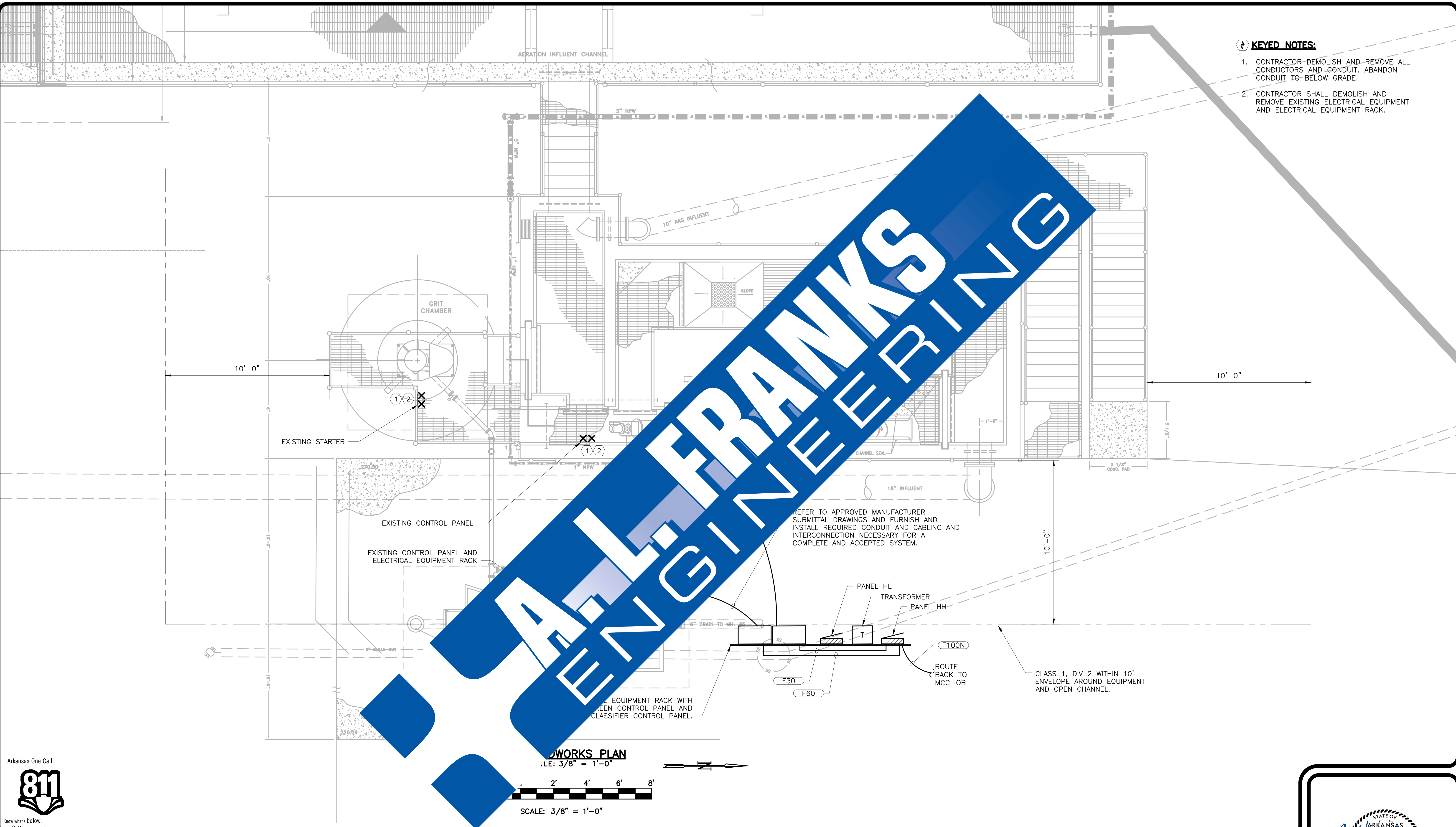
TEXARKANA WATER UTILITIES
ELECTRICAL
INFLUENT PUMP STATION

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E4



KEYED NOTES:

1. CONTRACTOR DEMOLISH AND REMOVE ALL CONDUCTORS AND CONDUIT. ABANDON CONDUIT TO BELOW GRADE.
2. CONTRACTOR SHALL DEMOLISH AND REMOVE EXISTING ELECTRICAL EQUIPMENT AND ELECTRICAL EQUIPMENT RACK.



Arkansas One Call

811

Know what's below.
Call before you dig.

Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



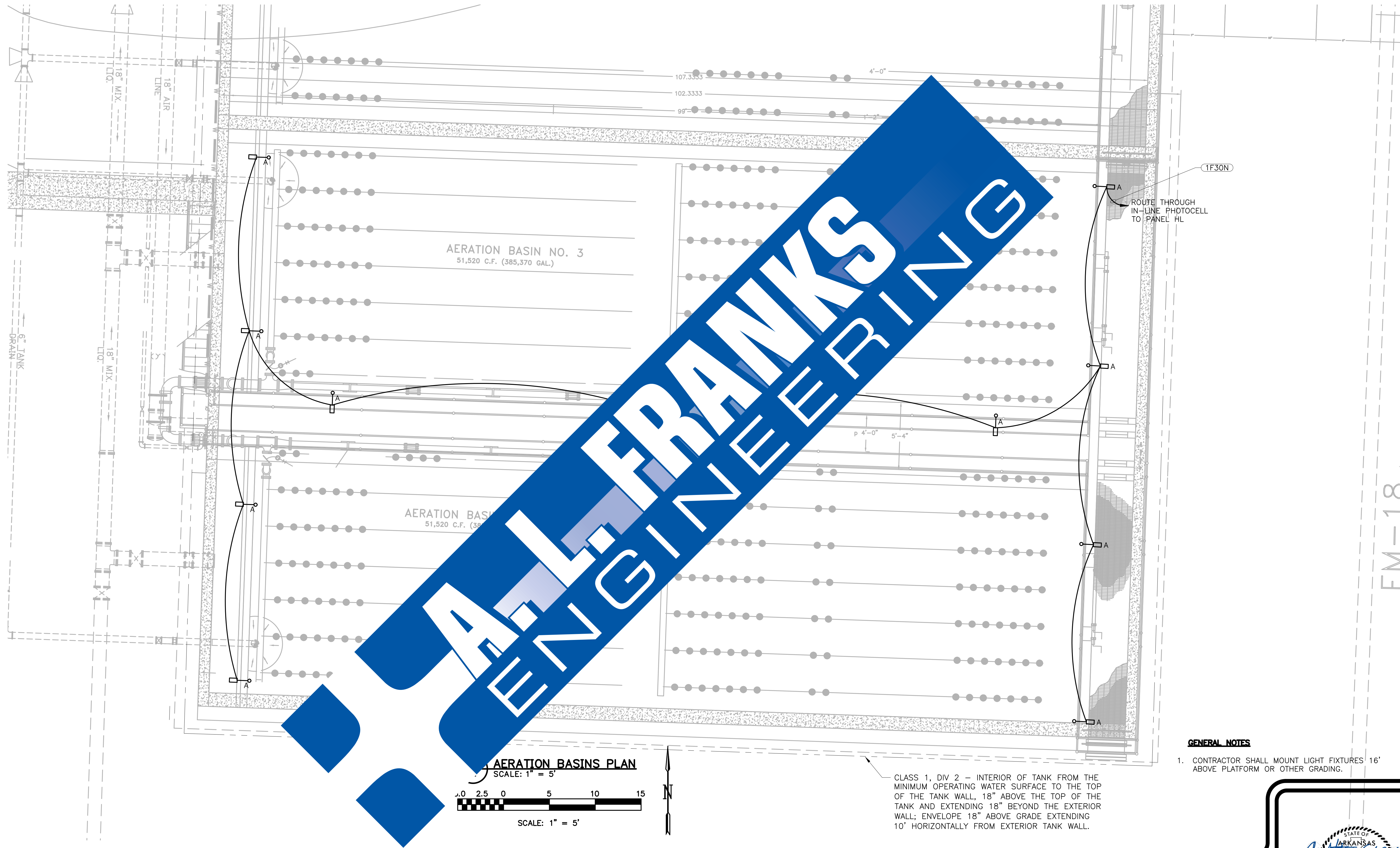
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
HEADWORKS PLAN

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E5





Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
AERATION BASIN PLAN

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E6



FM-18



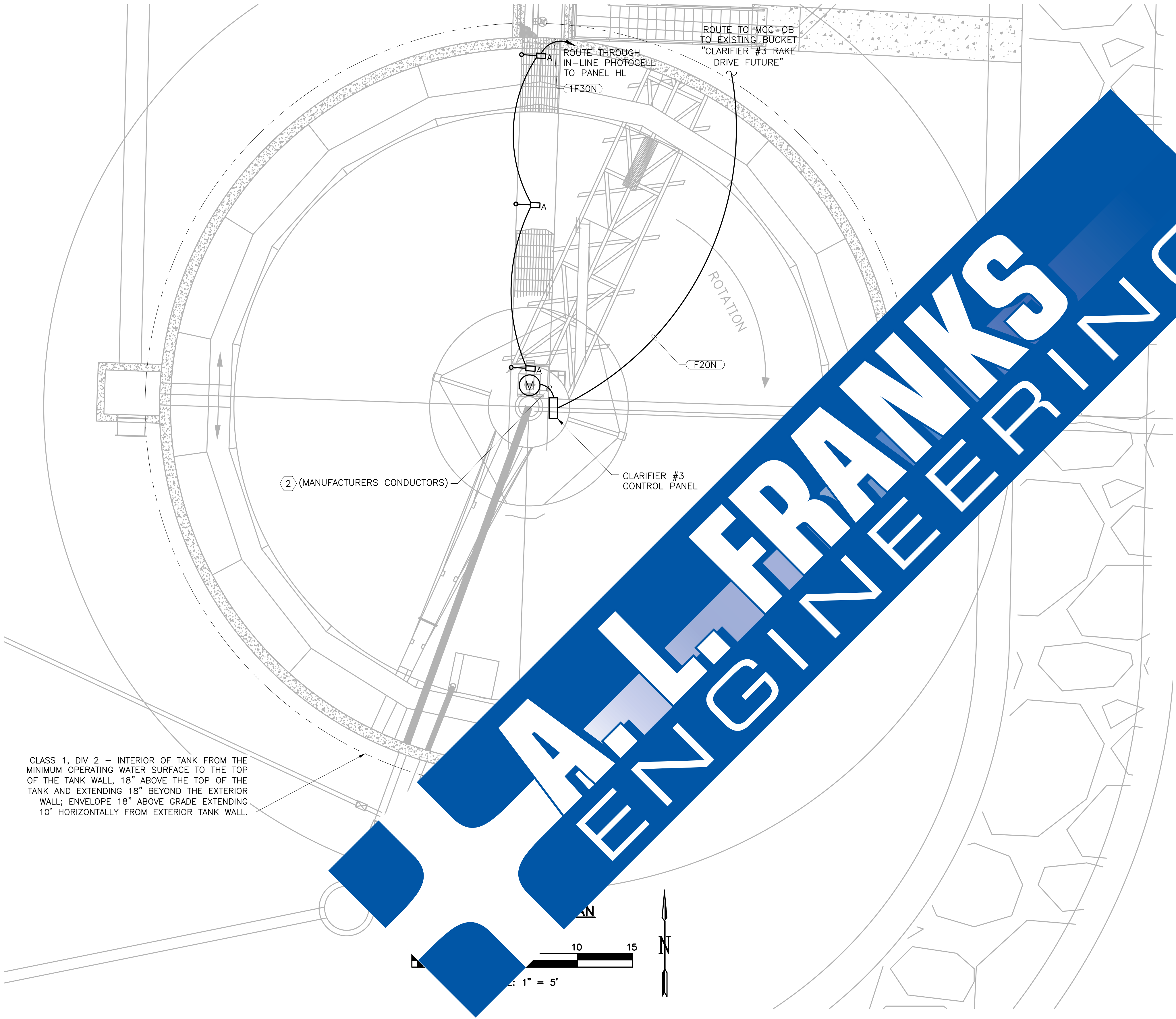
2 MCC-OB EXISTING BUCKET
SCALE: NONE

KEYED NOTES

1. CONTRACTOR SHALL REPLACE NAMEPLATE IN-KIND TO REFLECT "CLARIFIER #3 RAKE DRIVE"
2. CONTRACTOR SHALL COORDINATE CONDUIT SIZING REQUIREMENTS WITH NATIONAL ELECTRIC CODE BASED ON APPROVED EQUIPMENT SUBMITTALS.

GENERAL NOTES

1. CONTRACTOR SHALL MOUNT LIGHT FIXTURES 16' ABOVE PLATFORM OR OTHER GRADING.



CLASS 1, DIV 2 - INTERIOR OF TANK FROM THE MINIMUM OPERATING WATER SURFACE TO THE TOP OF THE TANK WALL, 18" ABOVE THE TOP OF THE TANK AND EXTENDING 18" BEYOND THE EXTERIOR WALL; ENVELOPE 18" ABOVE GRADE EXTENDING 10' HORIZONTALLY FROM EXTERIOR TANK WALL.

Arkansas One Call



Know what's below.
Call before you dig.

Date	Revision	By

Designed AE
Checked BB
Drawn CD
Approved BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

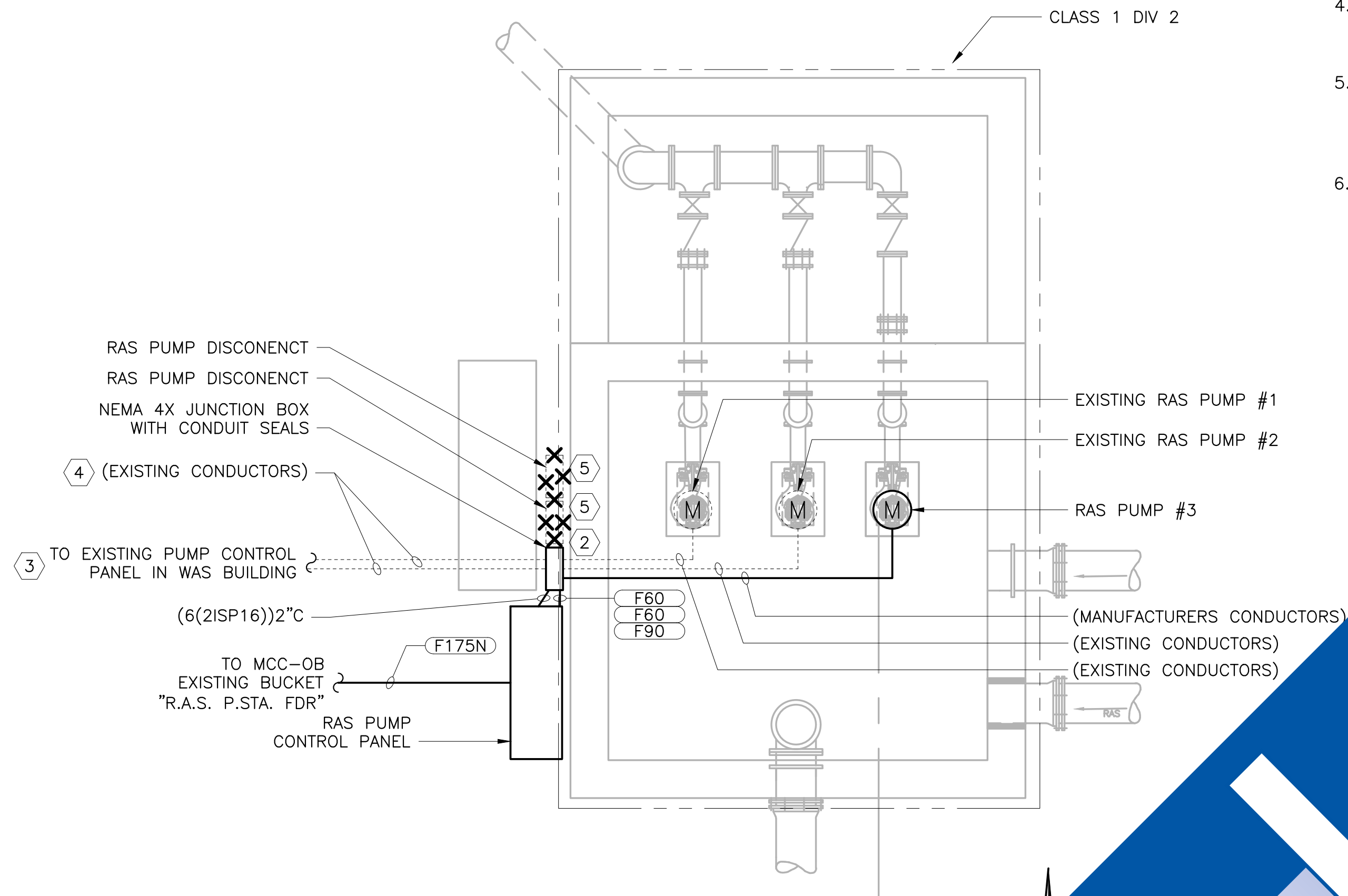
TEXARKANA WATER UTILITIES
ELECTRICAL
CLARIFIER #3 PLAN

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E7



KEYED NOTES:

1. NOT USED.
2. CONTRACTOR SHALL INTERCEPT EXISTING RAS PUMP 1 AND 2 CONDUCTORS TO EXISTING PUMP CONTROL PANEL IN NEW JUNCTION BOX AS SHOWN.
3. CONTRACTOR SHALL DEMOLISH EXISTING CONDUCTORS AND CONDUIT BELOW GRADE. CONTRACTOR SHALL ABANDON IN PLACE EXISTING RAS PUMP CONTROL PANEL.
4. CONTRACTOR SHALL DEMOLISH EXISTING CONDUCTORS AND CONDUIT BELOW GRADE FROM EXISTING RAS PUMP CONTROL PANEL TO MCC-OB.
5. CONTRACTOR SHALL CAREFULLY PROTECT AND PRESERVE CONDUCTORS WHILE DEMOLISHING AND REMOVE DISCONNECTS FOR EXISTING RAS PUMP #1 AND PUMP #2.
6. CONTRACTOR SHALL COORDINATE CONDUIT SIZE REQUIREMENTS WITH NATIONAL ELECTRIC CODE ON APPROVED EQUIPMENT SUBMITTALS.



1 RAS PUMP STATION PLAN
SCALE: NONE



2 MCC-OB EXISTING BUCKET
SCALE: NONE

Arkansas One Call



Date	Revision	By

Designed AE
Checked BB
Drawn CD
Approved BB



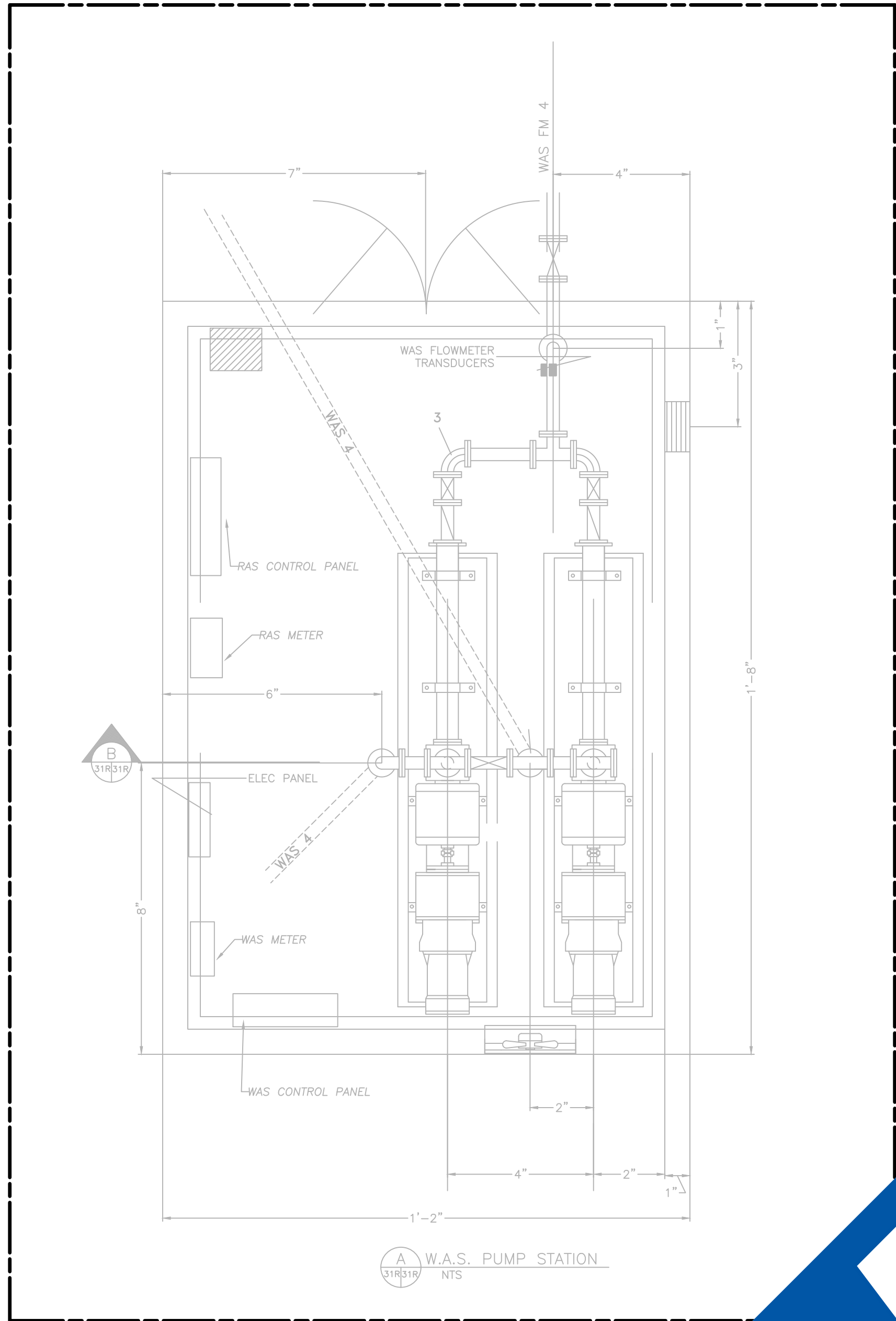
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
RAS PUMP STATION

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E8





CLASS 1, DIV 2

NO ELECTRICAL
WORK THIS AREA

A. L. FRANKS
ENGINEERING

Arkansas One Call



Know what's below.
Call before you dig.



Date	Revision	By

Designed AE
Checked BB
Drawn CD
Approved BB

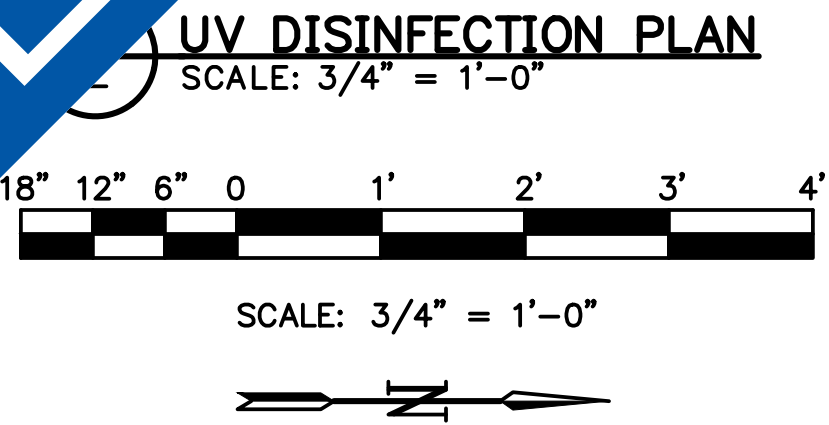
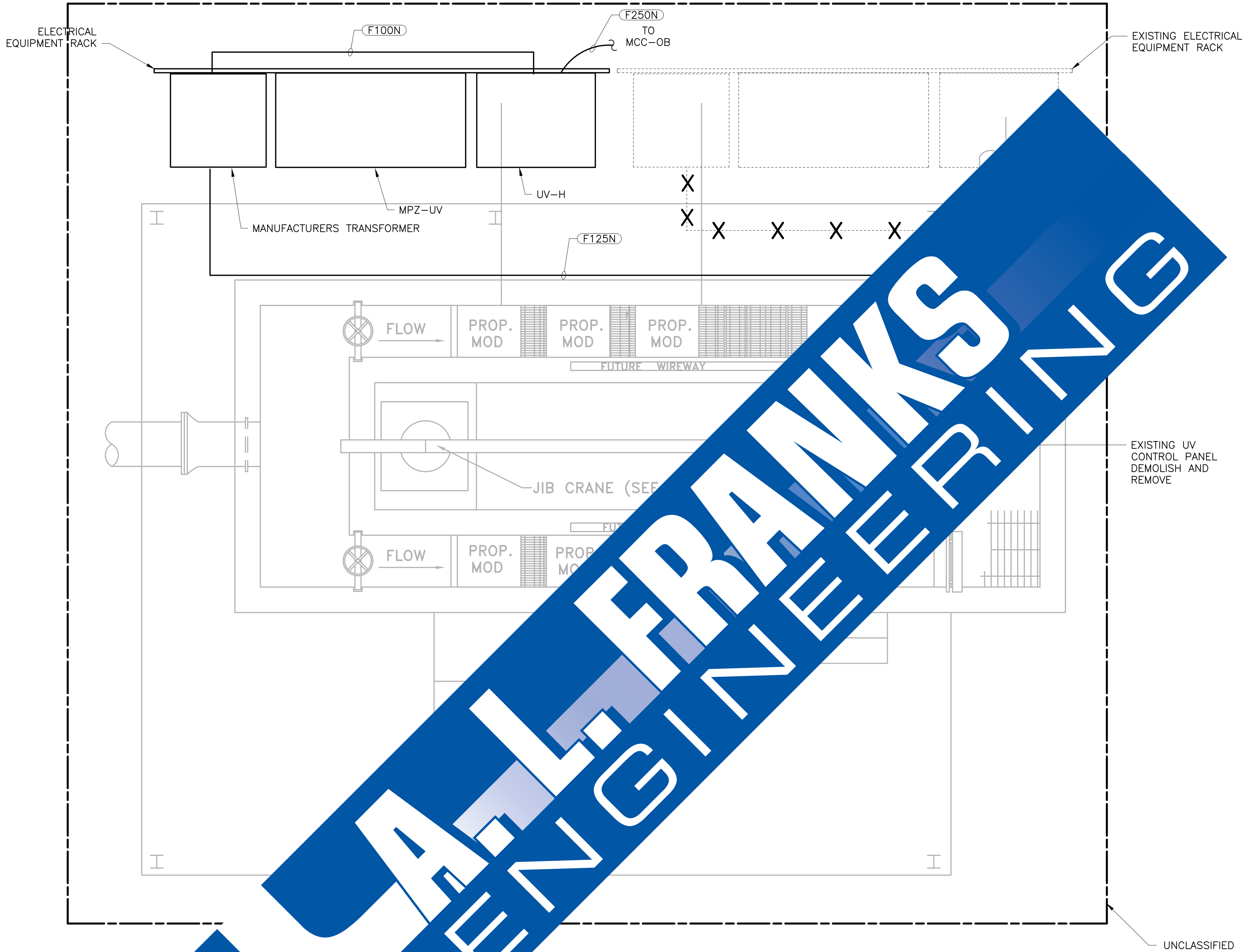


118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
WAS PUMP STATION

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E9



Arkansas One Call



Know what's below.
Call before you dig.

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



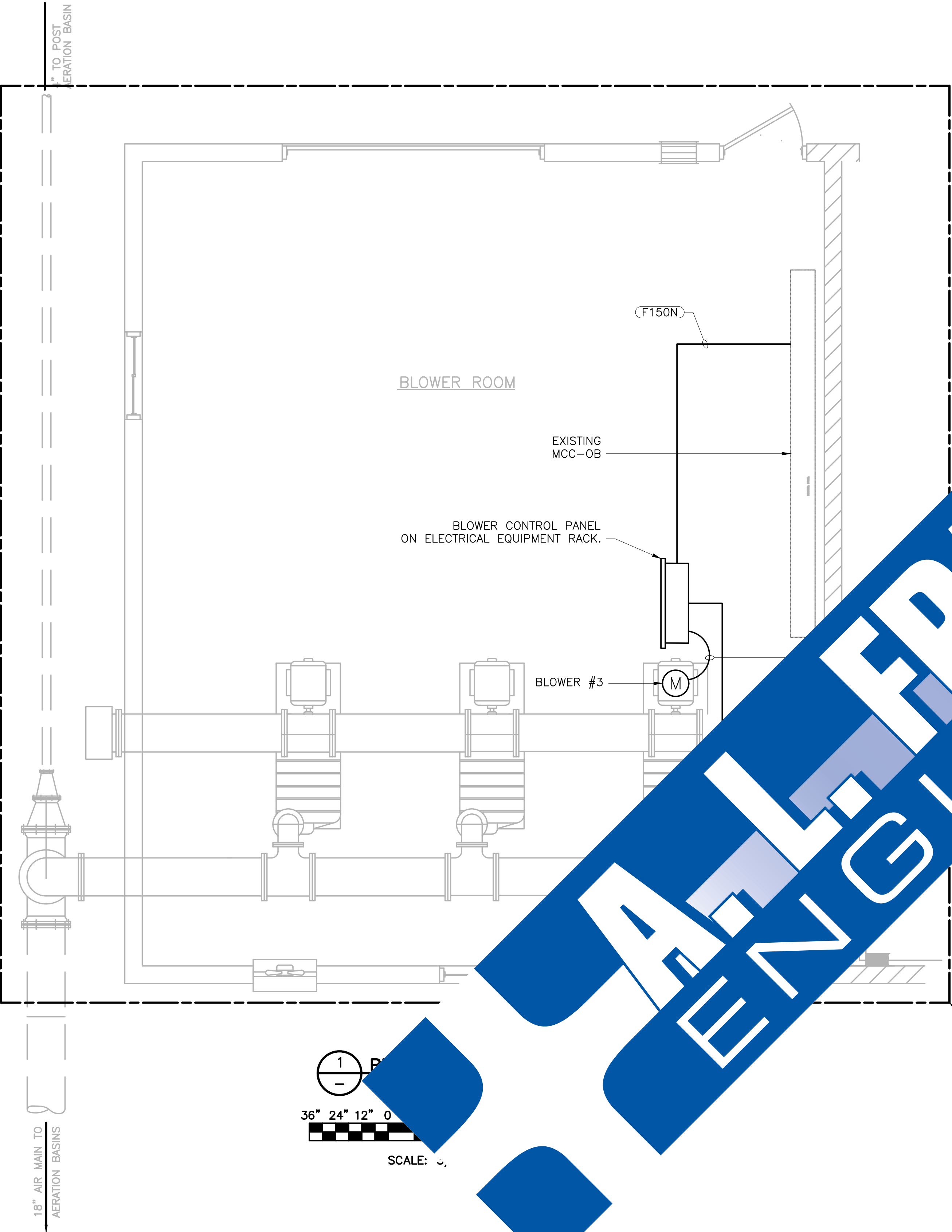
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
UV DISINFECTION

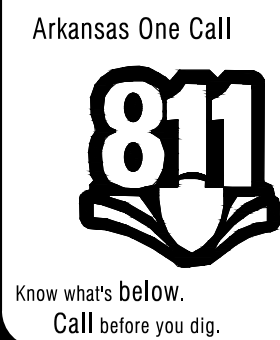
Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E10





KEYED NOTES:

1. CONTRACTOR SHALL COORDINATE CONDUIT SIZING REQUIREMENTS WITH NATIONAL ELECTRIC CODE AND APPROVED EQUIPMENT SUBMITTALS.



Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



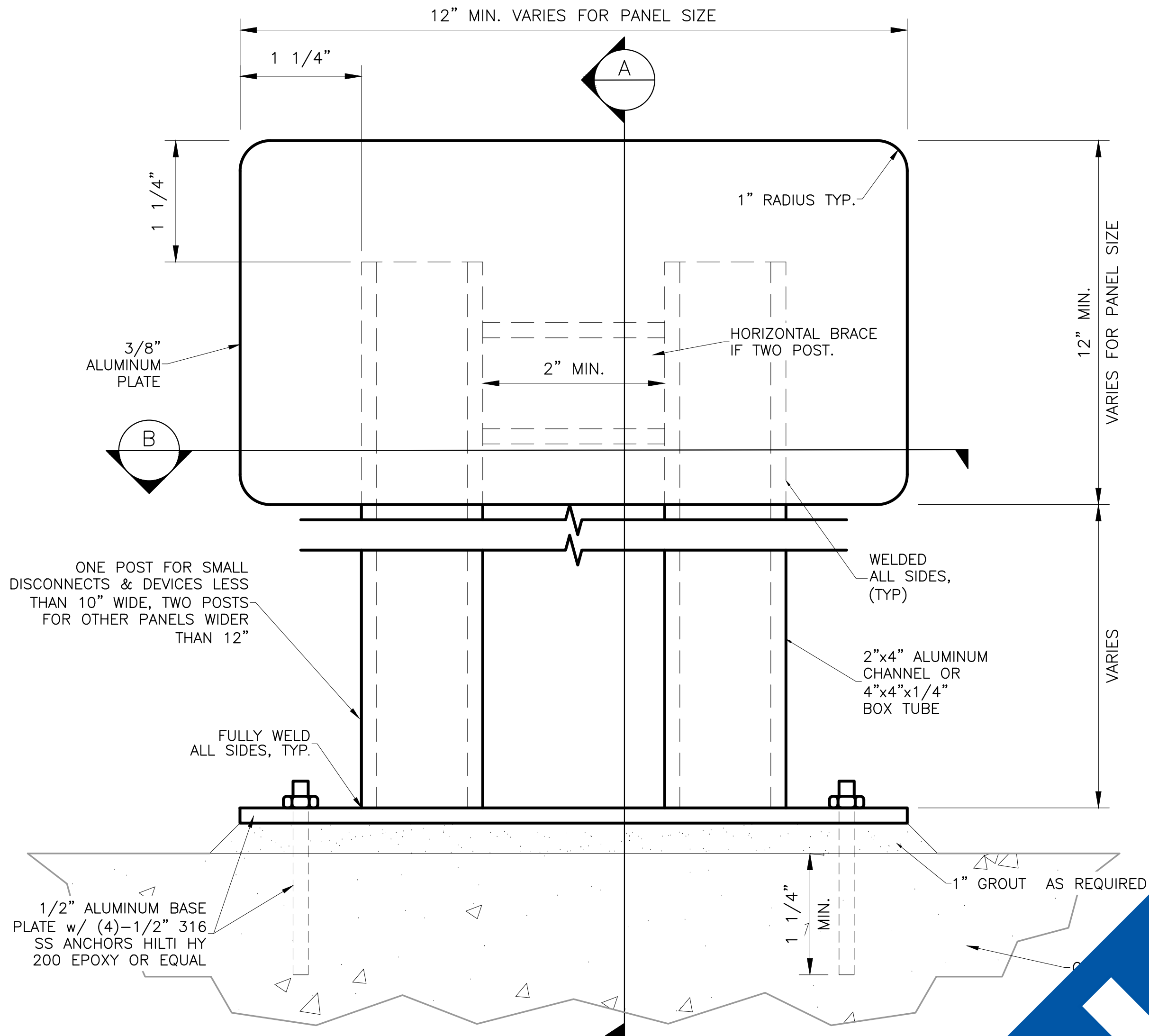
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
BLOWER BUILDING PLAN

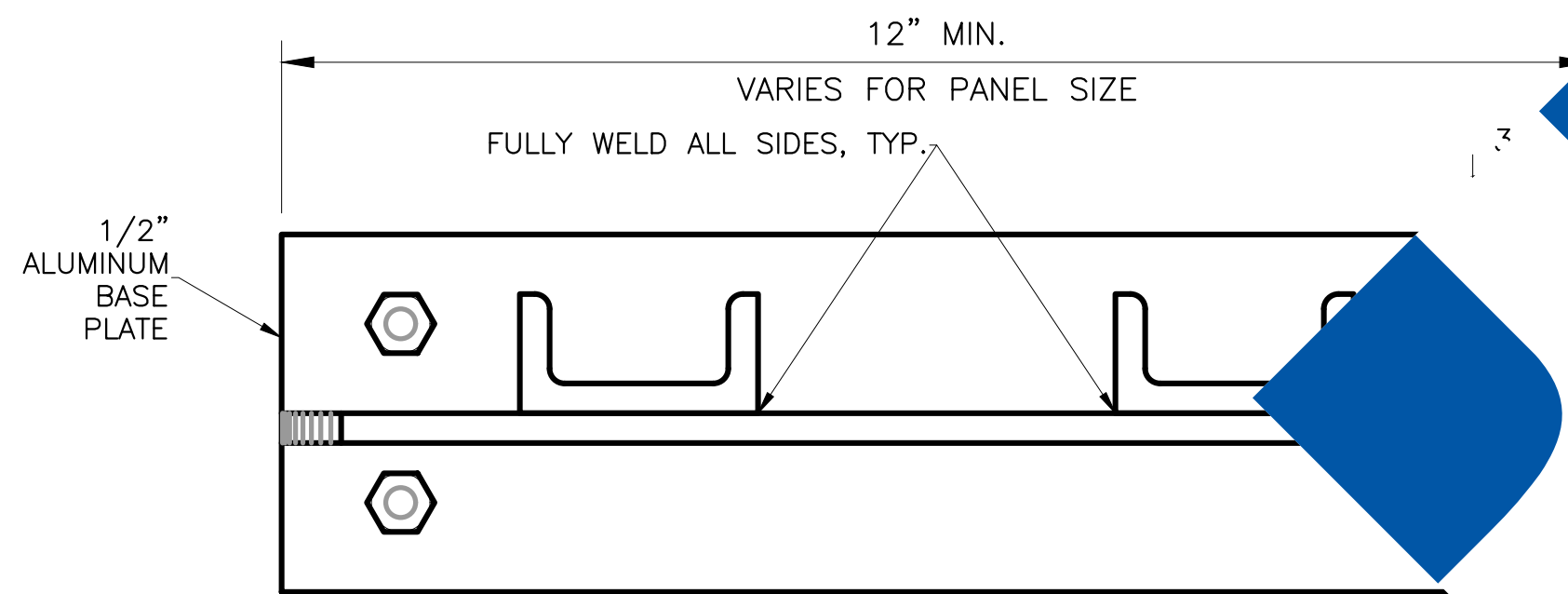
Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E11



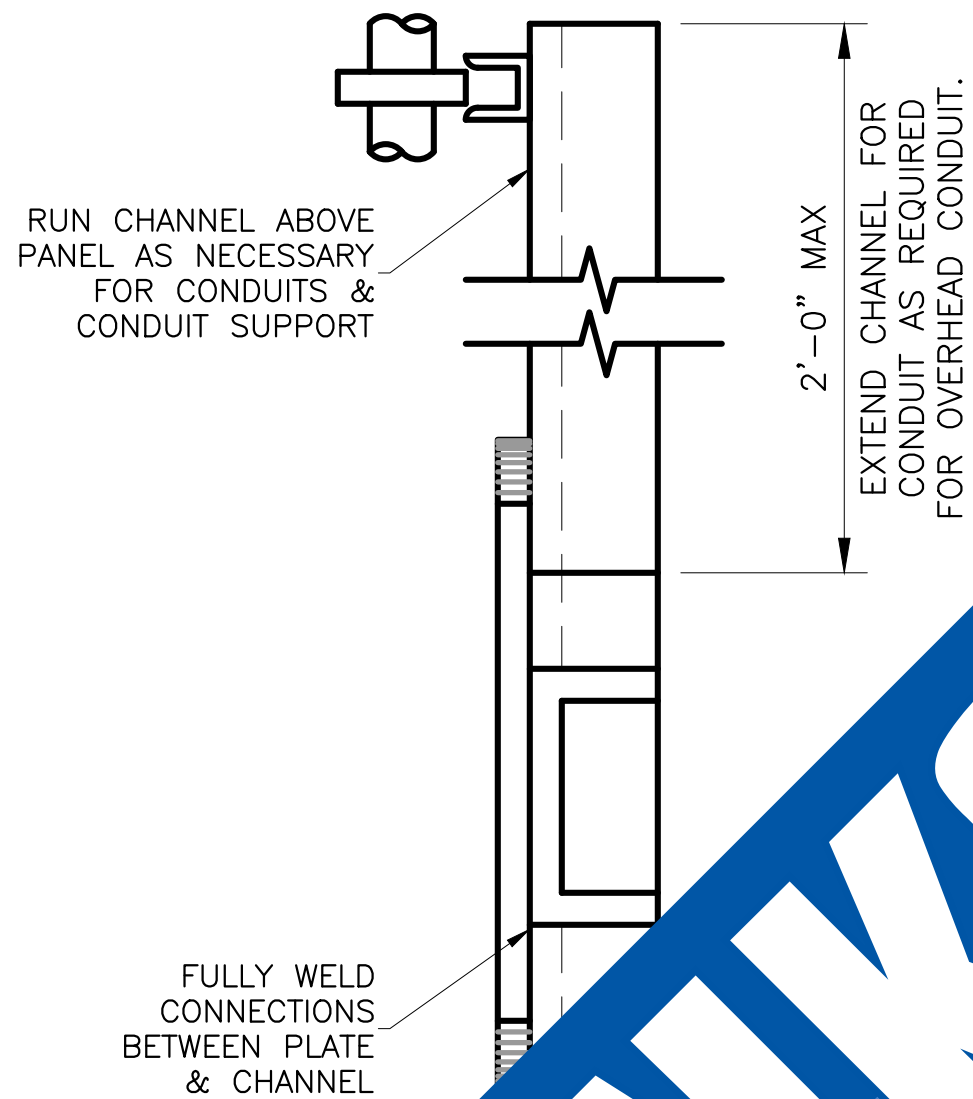


1 CUSTOM ALUMINUM PANEL SUPPORT
SCALE: NONE

DETAIL NOTE:
SUBMIT DRAWING FOR APPLICATION FOR APPROVAL. PANEL(S) NOT SHOWN FOR CLARITY.



B PANEL SUPPORT BASE PLATE DETAIL
SCALE: NONE



2 PANEL SUPPORT SECTION
SCALE: NONE

GENERAL NOTES:

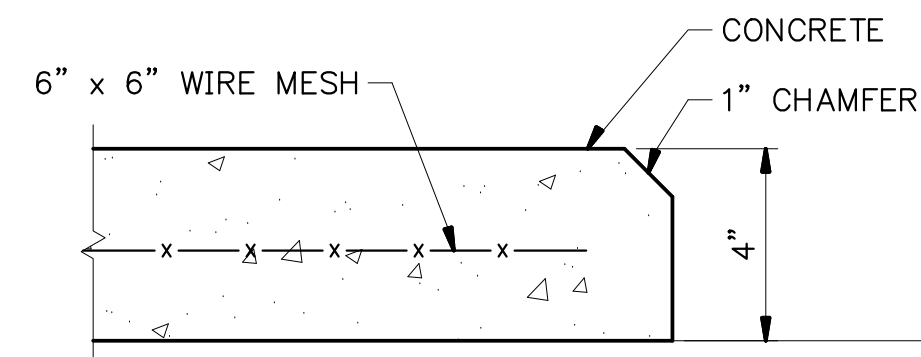
- POWER MARKING TAPES SHALL BE DETECTABLE TYPE CONSTRUCTION WITH RED BACKGROUND AND BLACK LETTERING.
- COMMUNICATION MARKING TAPES SHALL BE DETECTABLE TYPE CONSTRUCTION WITH ORANGE BACKGROUND AND BLACK LETTERING, "TELEPHONE LINE" OR "FIBER OPTIC LINE" RESPECTIVELY.
- TAPE SHALL BE DETECTABLE, DURABLE, HIGHLY VISIBLE, RESISTANT TO ELEMENTS, MEETING AND/OR EXCEEDING ALL INDUSTRY STANDARDS.

2 UNDERGROUND DETECTABLE WARNING TAPE
SCALE: NONE

FEEDER SCHEDULE					
FEEDER DESIGNATION	AMPERE RATING	CONDUCTOR SIZE (AWG OF KCMIL)		CONDUIT	
		PH	GND	NO. RUNS	SIZE
F20	20	12	12	1	1"
	30	10	10	1	1"
	40	8	10	1	1-1/4"
	50	6	10	1	1-1/4"
	60	6	10	1	1-1/4"
	70	4	8	1	1-1/2"
	80	4	8	1	1-1/2"
	90	2	8	1	2"
	100	2	8	1	2"
	110	2	8	1	2"
F250	250	250	4	1	4"
	300	350	4	1	4"
	350	500	2	1	4"
	400	500	1/0	1	4"
	450	450	4/0	2	3"
	500	250	2	2	4"
	600	350	1/0	2	4"
	700	500	1/0	2	4"
	800	500	1/0	2	4"
	1000	500	2/0	3	4"
F1200	1200	350	3/0	4	4"
	1600	500	4/0	5	4"
	2000	500	250	6	4"
	2500	500	350	7	4"
	3000	500	500	8	4"
	4000	500	500	11	4"

FEEDER SCHEDULE NOTES:

- "H" SUFFIX INDICATES THAT FEEDER IS TO BE USED ON A 480 VOLT CIRCUIT.
- "L" SUFFIX INDICATES THAT FEEDER IS TO BE USED ON 208/240 VOLT CIRCUIT.
- "N" SUFFIX INDICATES THAT FEEDER CONTAINS A FULL SIZE NEUTRAL CONDUCTOR. OTHERWISE PROVIDE ONLY PHASE AND GROUND CONDUCTORS.
- "1" PREFIX INDICATES A SINGLE PHASE FEEDER (LINE-TO-LINE). OTHERWISE ASSUME 3-PHASE FEEDER.
- "S" PREFIX INDICATES A SERVICE FEEDER CONSISTING OF PHASE CONDUCTORS PLUS A FULL SIZE GROUNDED SERVICE CONDUCTOR (NEUTRAL).
- "CO" MEANS PROVIDE CONDUIT ONLY FOR THAT FEEDER SIZE.



3 HOUSEKEEPING PAD (TYPICAL)
SCALE: NTS

Arkansas One Call



Know what's below.
Call before you dig.

Designed AE
Checked BB
Drawn CD
Approved BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

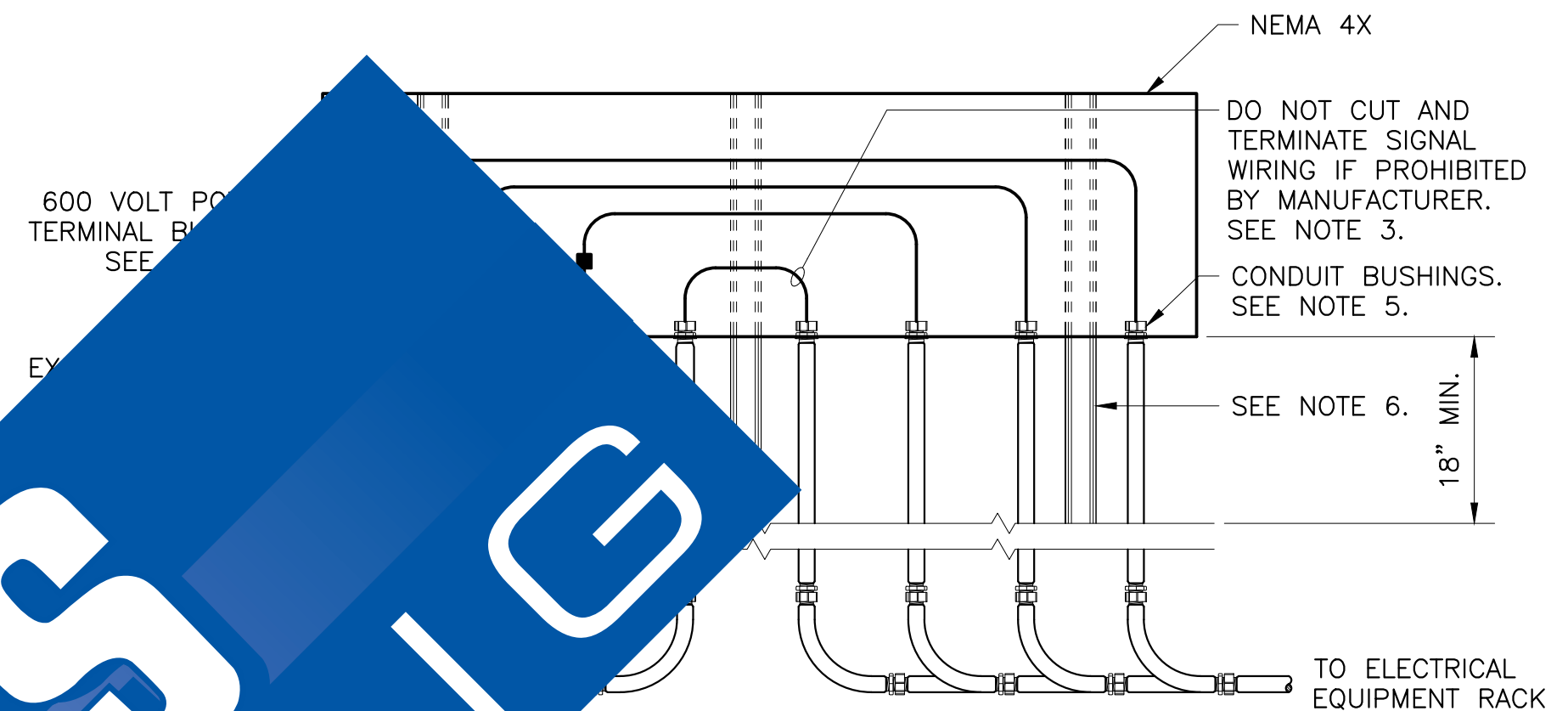
TEXARKANA WATER UTILITIES
ELECTRICAL
DETAILS I

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E12



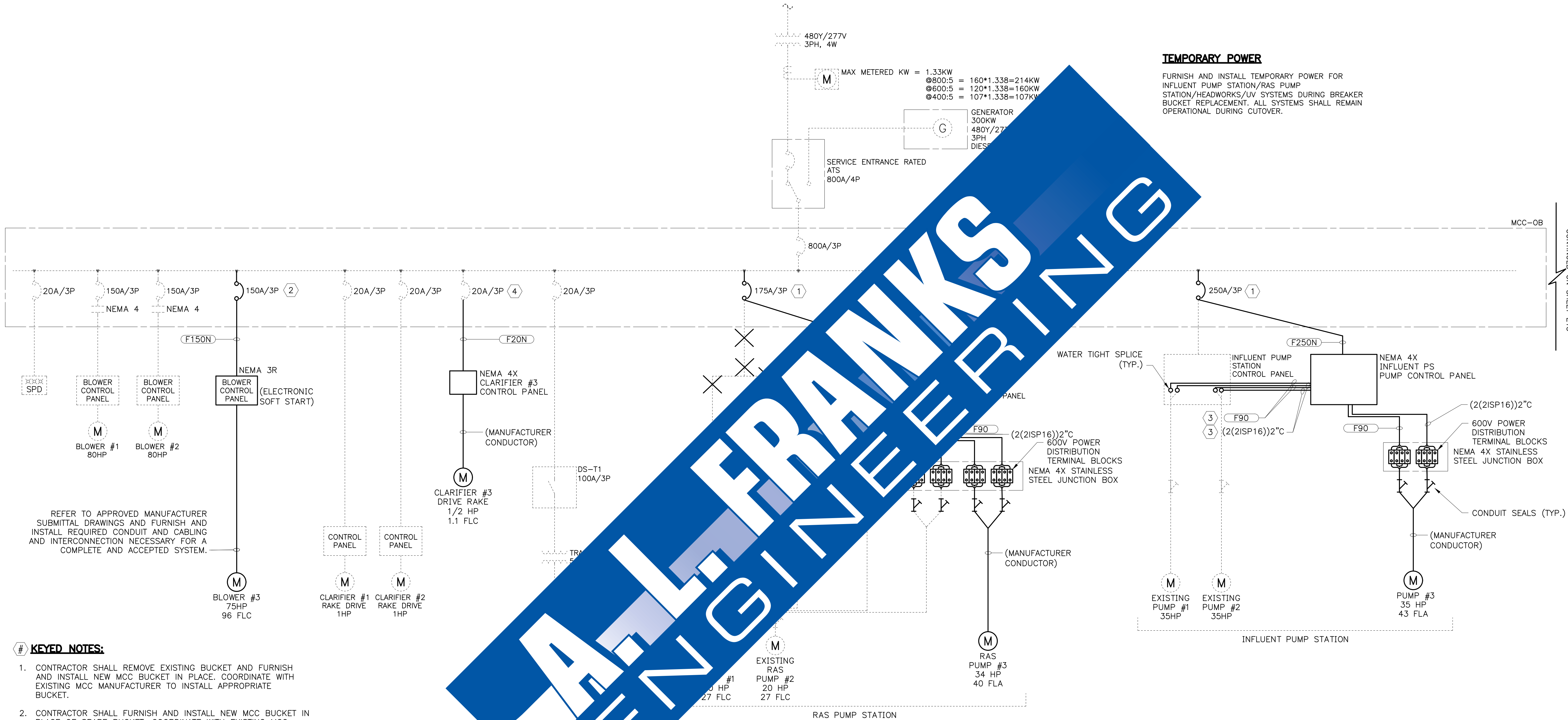


1. CONTRACTOR SHALL STAKE THE DUCT INSTALLATION IN PLAN AND ELEVATION FOR NEW ELECTRICAL DUCTS TO AVOID EXISTING UTILITIES.
2. CONTRACTOR SHALL ADJUST THE DEPTH OF THE ELECTRICAL DUCTS AS REQUIRED TO MAINTAIN THE MINIMUM COVER REQUIREMENT INDICATED AND AVOID EXISTING UTILITIES.
3. SIMILAR CONSTRUCTION FOR OTHER DUCT SIZES. SEE DUCT BANK SCHEDULE FOR QUANTITY AND SIZES.
4. INSTALL DUCT CONDUIT SUPPORTS AT 5'-0" O.C. MAXIMUM SPACING (TYPICAL ALL DUCTS).
5. OFFSETS AND BENDS OVER 10 DEGREES AND ELBOWS IN PVC CONDUIT RUNS SHALL BE PVC COATED GALVANIZED RIGID STEEL CONDUIT.
6. NO PVC SHALL EMERGE FROM THE GROUND OR CONCRETE SLAB OR ENCASEMENT, PVC SHALL CONVERT TO PVC COATED GALVANIZED RIGID STEEL CONDUIT PRIOR TO ITS EMERGENCE.
7. INSTALL GROUND RODS AT ENDS OF ELECTRICAL DUCT OR CONNECT TO GROUND RING.
8. INSTALL CONDUCTORS AND CABLES AS NOTED ON DRAWING. INSTALL PULLWIRE IN ALL SPARE DUCTS.
9. MINIMUM COVER REQUIREMENT FOR DUCT BANKS UNDER ROADS, DRIVEWAYS AND PARKING LOTS SHALL BE 24".
10. MINIMUM COVER REQUIREMENTS FOR ELECTRICAL SECONDARY SERVICE DUCT BANKS SHALL BE 30".
11. MINIMUM COVER REQUIREMENTS FOR ELECTRICAL PRIMARY SERVICE DUCT BANKS SHALL BE 36".



BOX NOTES:

3. ALL WIRING SHALL BE TERMINATED ON 600 VOLT TERMINAL BLOCKS IN TERMINAL BOX EXCEPT FOR SIGNAL CABLES, SUCH AS ULTRASONIC LEVEL TRANSDUCERS, THAT ARE REQUIRED NOT TO BE CUT BY THE EQUIPMENT MANUFACTURER.
4. INSTALL EXPLOSION PROOF CONDUIT SEALS BETWEEN ALL HAZARDOUS LOCATIONS AND THE TERMINAL BOX.
5. INSTALL CONDUIT BUSHINGS ON ALL CONDUIT ENTERING TERMINAL BOX.
6. SUPPORT TERMINAL BOX WITH STAINLESS STEEL STRUT CHANNEL SUPPORTS WITH CONCRETE BASE.



TEMPORARY POWER
FURNISH AND INSTALL TEMPORARY POWER FOR
INFLUENT PUMP STATION/RAS PUMP
STATION/HEADWORKS/UV SYSTEMS DURING BREAKER
BUCKET REPLACEMENT. ALL SYSTEMS SHALL REMAIN
OPERATIONAL DURING CUTOVER.

- # **KEYED NOTES:**
1. CONTRACTOR SHALL REMOVE EXISTING BUCKET AND FURNISH AND INSTALL NEW MCC BUCKET IN PLACE. COORDINATE WITH EXISTING MCC MANUFACTURER TO INSTALL APPROPRIATE BUCKET.
 2. CONTRACTOR SHALL FURNISH AND INSTALL NEW MCC BUCKET IN PLACE OF SPARE BUCKET. COORDINATE WITH EXISTING MCC MANUFACTURER TO INSTALL APPROPRIATE BUCKET.
 3. BID AS SHOWN. MATCH EXISTING CONDUCTORS.
 4. CONTRACTOR SHALL VERIFY BREAKER EXISTS IN "CLARIFIER #3 RAKE DRIVE FUTURE." FURNISH AND INSTALL BUCKET WITH BREAKS IF NOT PRESENT.

1
— **ONE-LINE DIAGRAM**
SCALE: NTS

SCHEDULE							
ID	TYPE	MANUFACTURER		LAMP TYPE	VOLTAGE	WATTS	NOTE
A	AREA LIGHT	RIG-A-LITE	3-L1-X	LED	240V	97	LED FIXTURE WITH TYPE 1 DISTRIBUTION. MOUNT FIXTURE ON RIGID PIPE.



Designed — AE
Checked — BB
Drawn — CD
Approved — BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

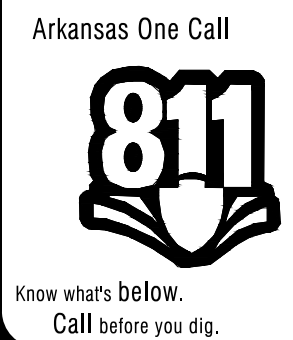
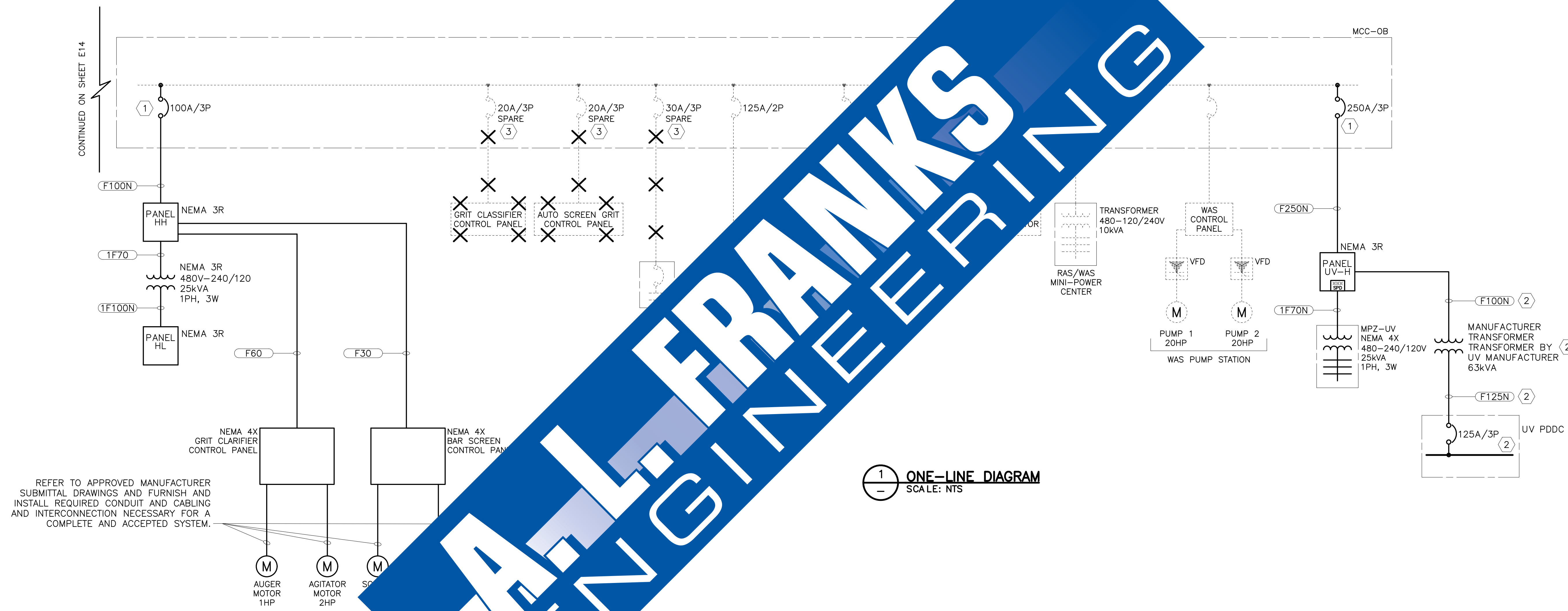
TEXARKANA WATER UTILITIES
ELECTRICAL
ONE-LINE DIAGRAM

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E14



KEYED NOTES:

1. CONTRACTOR SHALL REMOVE EXISTING SPARE BUCKET AND FURNISH AND INSTALL NEW MCC BUCKET IN PLACE. COORDINATE WITH EXISTING MCC MANUFACTURER TO INSTALL APPROPRIATE BUCKET.
2. CONTRACTOR SHALL COORDINATE FINAL REQUIREMENTS WITH APPROVED UV SYSTEM SUBMITTED AND NATIONAL ELECTRIC CODE.
3. LABEL AS SPARE.



Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB

118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
ONE-LINE DIAGRAM

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E15

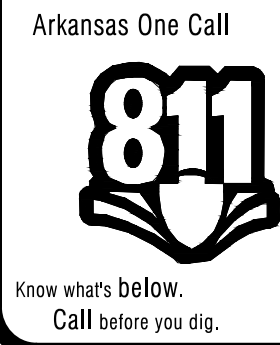


POWER PANEL "UV-H"								
480 Y / 277 VOLTS, 3 PHASE 4 WIRE				250 AMP MAIN CIRCUIT BREAKER 65,000 AIC				
CKT.	DESCRIPTION	LOAD				OVERCURRENT		
		KVA	AMPS	HP	STARTER	TRIP	POLES	FRAME
1	SURGE PROTECTIVE DEVICE	0.00	0.00			60	3	
2	MPZ-UV	0.00	0.00			70	2	
3	UV PDCC	63.00	75.78			100	3	
4	SPARE	0.00	0.00			20	3	
5	SPARE	0.00	0.00			20	3	
6	SPARE	0.00	0.00			20	3	
7	SPARE	0.00	0.00			30	3	
8	SPARE	0.00	0.00			30	2	
9	SPARE	0.00	0.00			30	3	
10	SPARE	0.00	0.00			30	3	
11	SPARE	0.00	0.00			150	3	
12	SPARE	0.00	0.00			200	3	
13	SPARE	0.00	0.00			250	3	
14	SPARE	0.00	0.00			50	3	
15	SPARE	0.00	0.00			50	3	
16		0.00	0.00					
17		0.00	0.00					
18		0.00	0.00					
19		0.00	0.00					
20		0.00	0.00					
CONNECTED LOAD		63.000	KVA					
DESIGN FACTOR		1.2500						
DESIGN LOAD		78.750	KVA					
DESIGN CURRENT		94.72	AMPS					

POWER PANEL "HH"								
480 Y / 277 VOLTS, 3 PHASE 4 WIRE				100 AMP MAIN CIRCUIT BREAKER 65,000 AIC				
CKT.	DESCRIPTION	LOAD				OVERCURRENT		
		KVA	AMPS	HP	STARTER	TRIP	POLES	FRAME
1	SURGE PROTECTIVE DEVICE	0.00	0.00			60	3	
2	SCREEN CONTROL PANEL	12.03				30	3	
3	GRIT CONTROL PANEL	0.06				60	3	
4	PANEL HL					70	2	
5	SPARE					20	3	
6	SPARE					20	3	
7	SPARE					50	3	
8	SPARE					100	3	
9								
10								
11								
12								
13								
14								
15								
		0.00						
		0.00						
		0.00						
		0.00						
CONNECTED LOAD		12.400	KVA					
DESIGN FACTOR		1.2500						
DESIGN LOAD		39.250	KVA					
DESIGN CURRENT		47.21	AMPS					

PANELBOARD SCHEDULE																	
PANEL: MPZ-UV			VOLTS: 240/120 1PH, 3W				MAIN: 125A MCB				10,000 AIC						
DESCRIPTION	BKR	NO.	A	B	A	B	NO.	BKR	DESCRIPTION								
SURGE PROTECTIVE DEVICE	60A/2P	1	0.000		0.000		2	20A/2P	SPARE								
SURGE PROTECTIVE DEVICE	-	3		0.000		0.000	4	-	SPARE								
SPARE	30A/2P	5	0.000		0.000		6	20A/2P	SPARE								
SPARE	-	7		0.000		0.000	8	-	SPARE								
SPARE	30A/2P	9	0.000		0.000		10	30A/2P	SPARE								
SPARE	-	11		0.000		0.000	12	-	SPARE								
SPARE	20A/2P	13	0.000		0.000		14	30A/2P	SPARE								
SPARE	20A/1P	15		0.000		0.000	16	-	SPARE								
SPARE	20A/2P	17	0.000		0.000		18	20A/2P	SPARE								
SPARE	20A/1P	19		0.000		0.000	20	30A/2P	SPARE								
SPARE	20A/2P	21	0.000		0.000		22	20A/2P	SPARE								
SPARE	20A/1P	23		0.000		0.000	24	20A/2P	SPARE								
SPARE	20A/1P	25	0.000		0.000												
SPARE	20A/1P	27		0.000		0.000											
SPARE	20A/1P	29	0.000		0.000												
	20A/1P	31		0.000		0.000											
	20A/1P	33	0.000		0.000												
	20A/1P	35		0.000													
	20A/1P	37	0.000		0.000												
	20A/1P	39		0.000													
	20A/1P	41	0.000														
			0.000	0.000													
			0.000	0.000													
			0.000														
			0.000														
			0														

PANELBOARD SCHEDULE																	
PANEL: MPZ-UV			VOLTS: 240/120 1PH, 3W				MAIN: 100A MCB				10,000 AIC						
DESCRIPTION	BKR	NO.	A	B	A	B	NO.	BKR	DESCRIPTION								
SURGE PROTECTIVE DEVICE	60A/2P	1	0.000		0.000		2	20A/1P	SPARE								
SURGE PROTECTIVE DEVICE	-	3		0.000		0.000	4	20A/1P	SPARE								
SPARE	20A/2P	5	0.500		0.000		6	20A/1P	SPARE								
SPARE	-	7		0.500		0.000	8	20A/1P	SPARE								
SPARE	20A/2P	9	0.200		0.000		10	20A/1P	SPARE								
SPARE	-	11		0.200		0.000	12	20A/1P	SPARE								
SPARE	20A/2P	13	0.000		0.000		14	20A/2P	SPARE								
SPARE	-	15		0.000		0.000	16	-	SPARE								
SPARE	20A/2P	17	0.000		0.000		18	20A/2P	SPARE								
SPARE	-	19		0.000		0.000	20	-	SPARE								
SPARE	20A/2P	21	0.000		0.000		22	20A/2P	SPARE								
SPARE	-	23		0.000		0.000	24	-	SPARE								
SPARE	20A/1P	25	0.000		0.000		26	20A/1P	SPARE								
SPARE	20A/1P	27		0.000		0.000	28	20A/1P	SPARE								
SPARE	20A/1P	29	0.000		0.000		30	20A/1P	SPARE								
SPARE	20A/1P	31		0.000		0.000	32	20A/1P	SPARE								
SPARE	20A/1P	33	0.000		0.000		34	20A/1P	SPARE								
SPARE	20A/1P	35		0.000		0.000	36	20A/1P	SPARE								
SPARE	20A/1P	37	0.000		0.000		38	20A/1P	SPARE								
SPARE	20A/1P	39		0.000		0.000	40	20A/1P	SPARE								
SPARE	20A/1P	41	0.000		0.000		42	20A/1P	SPARE								
			0.700	0.700	0.000	0.000											
			0.700	0.700													
			1.400														
			1.750														
			7														



Date	Revision	By

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
SCHEDULES I

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E16



POWER PANEL "MCC—OB"					800 AMP MAIN CIRCUIT BREAKER			
480 Y / 277 VOLTS, 3 PHASE 4 WIRE					65,000 AIC			
CKT.	DESCRIPTION	LOAD			OVERCURRENT			
		KVA	AMPS	HP	STARTER	TRIP	POLES	FRAME
1	TVSS	0.00	0.00					
2	MAIN BREAKER	0.00	0.00					
3	BLOWER #1	80.00	96.23			150	3	
4	BAR SCREEN	1.00	1.20			20	3	
5	INFLUENT PUMP STATION	30.00	36.09			200	3	
6	BLOWER #2	0.00	0.00			150	3	
7	50 KVA XFMR	25.00	30.07			125	3	
8	CLARIFIER 3 (FUTURE)	0.00	0.00				3	
9	75 KVA XFMR	30.00	36.09				3	
10	CLARIFIER #1	1.00	1.20				3	
11	CLARIFIER #2	1.00	1.20				3	
12	RAS PUMP STATION	20.00	24.06			150	3	
13	UV XFMR 1	0.00	0.00				3	
14	GRIT CLASSIFIER	1.00	1.20			20	3	
15	GRIT PUMP	5.00	6.01				3	
16	SPARE	0.00	0.00					
17	CAUSTIC ROOM	0.00	0.00			60	3	
18	LIGHTING CONTACTOR	10.00	12.03			20	3	
19	RAS/WAS MPZ	10.00	20.83				2	
20	WAS CONTROL PANEL	20.00	24.06				3	
21	SPARE	0.00	0.00					
	CONNECTED LOAD	234.000	KVA	* LABEL AS SPARE				
	DESIGN FACTOR	1.2500						
	DESIGN LOAD	292.500	KVA					
	DESIGN CURRENT	351.83	AMPS					

POWER PANEL "MCC-OB"				800 AMP MAIN CIRCUIT BREAKER				
480 Y / 277 VOLTS, 3 PHASE 4 WIRE				65,000 AIC				
CKT.	DESCRIPTION	LOAD			OVERCURRENT			
		KVA	AMPS	HP	STARTER	TRIP	POLES	FRAME
1	TVSS		0.00					
2	MAIN BREAKER		0.00					
3	BLOWER #1					150	3	
4	BAR SCREEN					20	3	*
5	INFLUENT PUMP					250	3	△
6	BLOWER #2					150	3	
7	50 KVA					125	3	
8	CLARIFIER					20	3	△
9							3	
10							3	
							3	
						175	3	△
			0.00				3	
			0.00			20	3	*
			0.00				3	*
			0.00	393.73		250		△
			0.00	0.00		60	3	
			10.00	12.03		20	3	
			10.00	20.83			2	
			20.00	24.06			3	
			31.40	37.77		100	3	△
			80.00	96.23	ESS	200	3	△
		511.400	KVA					
		1.2500						
		639.250	KVA					
DESIGN CURRENT		768.92	AMPS					
				* LABEL AS SPARE				
				△ NEW FEEDER AND MCC BUCKET				

Arkansas One Call



Know what's below.
Call before you dig.

Designed	AE
Checked	BB
Drawn	CD
Approved	BB



118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

TEXARKANA WATER UTILITIES
ELECTRICAL
SCHEDULES II

Job No.:
Scale: AS SHOWN
Date: AUG. 2026
Sheet E17

