


# Housing Authority of the Cherokee Nation of Oklahoma

## REQUEST FOR BIDS CHEROKEE HEIGHTS SANITARY SEWER LIFT STATION MAYES COUNTY, OKLAHOMA Sections 2 and 11, T20N, R19E

RECEIVED

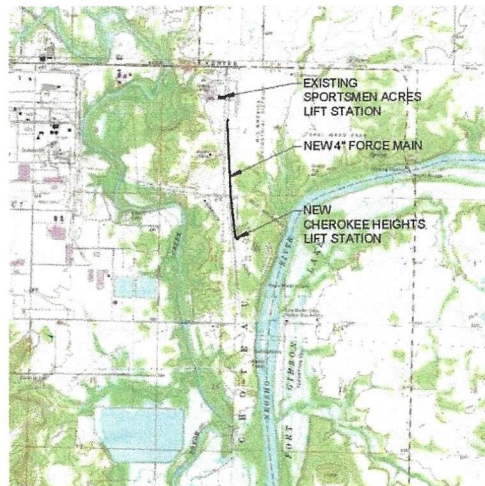
APR 08 2019

WATER QUALITY DIVISION



**SCOTT & ASSOCIATES, INC.**  
*Land Surveyors & Engineers*  
CA. #1041 (PLS, PE) Exp. 6/30/19  
901-B Callahan Street  
Muskogee, OK 74403  
Tel: (918) 682-7577

"Indian Owned Firm"



**MARCH 26TH, 2019**

SL000049190079-R

SPORTSMEN ACRES MA - MAYES CO  
SEWER CONST FILE

SX000049190080-R

SPORTSMEN ACRES MA - MAYES CO  
SEWER CONST FILE

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HOUSING AUTHORITY OF THE CHEROKEE NATION OF OKLAHOMA  
BID REQUEST  
CHEROKEE HEIGHTS  
NEW SANITARY SEWER LIFT STATION  
Sportsmen Acres, Oklahoma

The Housing Authority of the Cherokee Nation of Oklahoma is accepting bids from interested parties for the construction of a New Sanitary Sewer Lift Station to serve Cherokee Heights. The new force main will be constructed to the Town of Sportsmen Acres 8” gravity system along with modifications to the Town’s existing lift station. The Housing Authority of the Cherokee Nation of Oklahoma will be given the option to award to multiple vendors based upon previous assigned projects and time. The scope of work and specifications are included in this bid packet.

Interested parties are to provide a bid to furnish all labor, quality control, materials, supplies and supervision to complete the entire project. Interested bidders must follow all directions outlined in this packet including the utilization of mandatory bid response sheet to be considered fully responsive.

The lowest most responsive, responsible bid will be the determining factor in awarding this bid taking Indian Preference into consideration. The successful bidder will be issued an agreement and a purchase order incorporating the bid response.

**Bids are due** \_\_\_\_\_

**MANATORY SUBMITTAL INFORMATION:** Bid submittal requirements must be followed. Each bid must be submitted on the prescribed, required form with all areas completed. If forward by mail, the envelope containing the bid and all other required completed documents must be received on or before due date listed. Bids may be mailed

To \_\_\_\_\_

Bids may be faxed to the attention of \_\_\_\_\_

or emailed to \_\_\_\_\_. It is the bidder's

responsibility to ensure delivery of bids by \_\_\_\_\_. Any bids received after the designated date and time will be ineligible for award.

**Bid Acceptance:** Bids will be accepted from Indian and Non-Indian bidders Cherokee Nation reserves the right to reject any and all bids. The Housing Authority of the Cherokee Nation of Oklahoma reserves the right to determine if a bid meets stated requirements to award a purchase order for the bid that is in the best interest of the The Housing Authority of the Cherokee Nation of Oklahoma including but not limited to the total cost and capability of the bidder. Bidders are responsible for any and all costs associated with the preparation and submission of bids. To be considered, bids must be received by the specified date and time; any bid received after stipulated date and time will be returned unopened. No bidder may withdraw their bid within 30 days after proposal due date.

TERO Certification: Indian preference will be given only to bidders who provide proof of current certification from the Cherokee Nation Tribal Employments Office (TERO) located in Tahlequah, Oklahoma, telephone number (918) 456-0671. Proof of TERO certification must accompany and be included in bid submittal.

TERO Requirements: Cherokee Nation TERO Office requirements apply to award of agreement; including fee of 1/2 of 1 % of contract award. Successful bidder must complete required TERO paperwork and pay all applicable fees in accordance with Legislative Act 30-12 for this project. Please contact Cherokee Nation Tribal Employment Rights Office (T.E.R.O.) at (918) 453-5000 with any questions. The successful bidder must have fees and all paperwork submitted to TERO for agreement to be considered fully executed.

#### Wage Rate Requirements

All laborers and mechanics employed by contractors and subcontractors shall be paid wages at rates not less than those prevailing on projects of character similar in the locality as determined by the Secretary of Labor in accordance with the Davis-Bacon Act.

#### Laws and Regulations

The bidder's attention is directed to the fact that all applicable State Laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though written out in full,

Qualifications of Bidder: The Housing Authority of the Cherokee Nation of Oklahoma may make such investigations as deemed necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Housing Authority of the Cherokee Nation of Oklahoma all such information and data for this purpose as the Housing Authority of the Cherokee Nation of Oklahoma may request. The Housing Authority of the Cherokee Nation of Oklahoma reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Housing Authority of the Cherokee Nation of Oklahoma such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

Subcontracts: The successful bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this contract must also be acceptable to the Housing Authority of the Cherokee Nation of Oklahoma. Any proposed subcontracts must be approved by the Housing Authority of the Cherokee Nation of Oklahoma, and the TERO office must be consulted prior to subcontractor being on site to ensure all appropriate forms, paperwork, and approvals are in place. Successful bidder will be required to complete the Request for Acceptance of Subcontractor at time of contract signing if subcontractor to be utilized. All sums due to any suppliers or subcontractors must be paid or will be paid within ten (10) days of receipt of any money received from the Housing Authority of the Cherokee Nation of Oklahoma under any executed Agreement.

Method or Award - Lowest Bid That Contains Lowest Most Responsive/Reasonable Offer From Qualified Bidder: After consideration of price and other factors, the purchase order will be awarded to the bidder whose bid is determined to be the lowest most responsive/reasonable offer and in the best interest of the Nation to accept. Award shall be made under unrestricted solicitations to the lowest, most responsive/reasonable bid from a qualified economic enterprise or organization within the maximum total budget price established for the specific project or activity being solicited in accordance with the Housing Authority of the Cherokee Nation of Oklahoma Acquisition Management Policy & Procedures. TERO Preference will be given only to bidders who provide proof of current TERO certification from the Cherokee Nation Tribal Employments Office (TERO). Proof of TERO certification must accompany and be included in sealed bid submittal.

Debarment, Suspension, Proposed Debarment, and Other Responsibility Matters:

The responding party certifies to the best of its knowledge and belief that the person, the firm, or any of its principals are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency or Indian tribe. The bidder will also certify they have not, within a three-year period preceding this Request for Proposal, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, Local or Tribal) contract or subcontract; violation of Federal or State antitrust statutes relating to the submission of offers; or commissions of embezzlement, theft, forgery, bribery, falsifications or destruction of records, making false statements, and are not presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in this provision. The responding party certifies they have not, within a three-year period preceding this Request for Proposal, had one or more contracts terminated for default by a Federal, State, Local or Tribal agency. The responding party shall provide immediate written notice to the Cherokee Nation if, at any time prior to contract award, the person learns its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

General Information: Housing Authority of the Cherokee Nation of Oklahoma reserves the right to waive any informalities or to reject any and all bids. Award will be to the lowest most responsible responsive bidder and will be subject to availability of funds. Indian preference will be given to Contractors certified as an Indian-Owned firm by the Cherokee Nation Tribal Employment Rights Office (T.E.R.O.). Proof of certification must accompany all bids. No bidder may withdraw their bid within thirty (30) days after bid opening date.

A prospective contractor seeking to receive Indian Preference under this contract must be certified as an Indian-owned firm by the Cherokee Nation Tribal Employment Rights Office (TERO) and submit proof of that certification with their bid.

**Mandatory Bid Response Sheet**  
**REQUEST FOR BIDS**  
**CHEROKEE HEIGHTS**  
**NEW SANITARY SEWER LIFT STATION**  
**Sportsmen Acres, Oklahoma**

The General Contractor, as Bidder, agrees to perform all work as shown and called in the scope of work, plans and specifications for the Cherokee Nation, that is shown to be the Base Bid. The work will be completed with the specified number of days from acceptance of this bid, a fully executed contract, and receipt of Notice to Proceed. The Bidder agrees to furnish all labor and materials for the Base Bid for the sum of:

**SCHEDULE OF QUANTITIES**

<b>Item Description No.</b>	<b>Amount</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Total</b>
1    Modification to Existing Lift Station	1	Lump Sum	\$ _____	\$ _____.
2    New Lift Station for Cherokee Heights	1	Lump Sum	\$ _____	\$ _____.
3    4" Force Main Polyethylene Pipe 4703	L.F.		\$ _____	\$ _____.
<b><u>TOTAL SCHEDULE</u></b>			<b>\$ _____</b>	<b>\$ _____.</b>

**BID SUBMITTED ON \_\_\_\_\_, 20 20**

**BY: \_\_\_\_\_**

**COMPANY: \_\_\_\_\_**

IF BIDDER IS:

**AN INDIVIDUAL**

By \_\_\_\_\_ (SEAL)  
(Individual's Name)

doing business as \_\_\_\_\_

\_\_\_\_\_  
Business address:

\_\_\_\_\_

\_\_\_\_\_  
Phone No:

**A PARTNERSHIP**

By \_\_\_\_\_ (SEAL)  
(Individual's Name)

\_\_\_\_\_  
(General Partner)

\_\_\_\_\_  
Business address:

\_\_\_\_\_

\_\_\_\_\_  
Phone No.:

**A CORPORATION**

By \_\_\_\_\_  
(Corporation Name)

\_\_\_\_\_  
(State of Incorporation)

By \_\_\_\_\_  
(Name of Person Authorized to Sign)

\_\_\_\_\_  
(Title)

(Corporate Seal)

Attest \_\_\_\_\_  
(Secretary)

Business Address: \_\_\_\_\_

\_\_\_\_\_

Phone No: \_\_\_\_\_

**A JOINT VENTURE**

By \_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Address)

By \_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Address)

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above.)



**Drug Free Workplace and Tobacco Free Workplace:** Any Contractor performing work for the Housing Authority of the Cherokee Nation of Oklahoma agrees to publish a statement notifying all employees, subcontractors, and other workers that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against violators of such prohibition.

The Housing Authority of the Cherokee Nation of Oklahoma will consider lack of enforcement or lax enforcement of the statement by Contractor a default of the contract.

The Contractor further agrees to provide all persons engaged in performance of the contract with a copy of the statement.

A copy of bidder's Drug Free Workplace statement shall be included with the bid or else the successful bidder will be deemed to accept and agree to use the statement provided by the Housing Authority of the Cherokee Nation of Oklahoma.

**Contractor's Insurance Requirements:** Before performing contractual services on the behalf of or for the Housing Authority of the Cherokee Nation of Oklahoma, compliance with the following insurance requirements must be verified:

**\*\*** Provide an original Certificate of insurance naming the Housing Authority of the Cherokee Nation of Oklahoma as a certificate holder and additional insured with respect to general liability, automobile liability, and builders risk policies, as their interest may appear with respect to the operations defined in this bid packet. The certificate shall reflect that coverage has been placed with an AM Best Rated Carrier of at least A IX and will contain the following information for each required coverage:

- 1) Type of insurance
- 2) Policy number
- 3) Effective date'
- 4) Expiration date
- 5) Limits of Liability (this amount is usually stated in thousands)
- 6) Thirty day notice of cancellation, except ten-day cancellation clause will apply for nonpayment of premium.

• Required Coverages:

- 1) Worker's Compensation and Employer's Liability:
  - Limits of Liability:
    - Bodily Injury by Accident: \$100,000 each accident
    - Bodily Injury by Disease: \$500,000 policy limit
    - Bodily Injury by Disease: \$100,000 each employee
  - Oklahoma Statute requires Worker's Compensation coverage for anyone with one (1) or more employees. Contractor's worker's compensation policy shall include a waiver of subrogation in favor ofHous~ng Authority of the Cherokee Nation of Oklahoma.

- 2) General Liability;  
Coverages:  
Commercial (including products/completed operations) with specific reference made to coverage for lead abatement (as this is usually excluded under standard commercial general liability policies). In addition to the additional insured endorsement, the commercial general liability policy shall also include a waiver of subrogation in favor of Cherokee Nation of Oklahoma.
- Limits of Liability:  
Bodily Injury and Property Damage Combined: \$1,000,000  
(each occurrence)
- 3) Automobile Coverage:  
Vehicles Covered:  
All Autos  
Hired Autos  
Non-owned Autos  
Limits of Liability:  
Bodily Injury and Property Damage Combined: \$300,000
- 4) Builders Risk Insurance:  
Total Contract Value for Each Site;  
Each Site must be referenced on certificates.

NOTE: The Contractor shall either: (1) require each of his subcontractors to procure and to maintain during the life of his subcontract, Subcontractor's Public Liability and Property Damage for the type and in the same amounts as specified above, or (2) insure the activities of this subcontractors in his own policy. Each subcontractor policy must also name Cherokee Nation as all additional insured with respect to general liability and auto liability.

## BONDING REQUIREMENTS

Minimum requirement for bonding and insurance shall be as follows:

- a) A bid bond equal to five percent (5%) of grand total bid amount. A "bid bond" is one executed in connection with a bid offer to guarantee the contractor will enter into a contract if given the award. The only documents accepted will be an actual bid bond or a cashier's check..
- b) A performance bond on the part of the contractor for 100 percent (100%) of the contract price. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.
- c) A payment bond on the part of the contractor for 100 percent (100%) of the contract price. A "payment" bond is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

NOTE: The payment and performance bonds will only be required of the successful Contractor, but must be in full effect before any work is done. The date of the bonds must not be prior to the date of the Contract. If the Contractor is a partnership, all partners must execute the bonds.

Corporate sureties offered for bonds furnished with contracts performed for the Cherokee Nation must appear on the list contained in the Department of the Treasury Circular 570, "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies."

## DIRECTIONS FOR PREPARING AND EXECUTION OF BONDS

Corporate sureties offered for bonds furnished with contracts performed for the Housing Authority of the Cherokee Nation of Oklahoma must appear on the list contained in the Department of the Treasury Circular 570, "Companies Holding Certificated of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies."

The name, including full legal name, and residence of each individual party to the bond shall be inserted in the body thereof, and each such party shall sign the bond with his usual signature on the line opposite scroll seal.

If the principals are partners, their individual names shall appear in the body of the bond, with the recital they are partners composing a firm, naming it, and all members of the firm shall execute the bond as individuals.

The signature of a witness shall appear in the appropriate place, attesting the signature of each individual party to the bond.

In case the surety and if the principal is a corporation; the name of the State in which incorporated shall be inserted in the appropriate place in the body of the bond, and said instrument shall be executed and attested under the corporate seal, the fact shall be stated, in which case a scroll or adhesive seal shall appear following the corporate seal.

The official character and authority of the person or persons executing the bond for the principal, if a corporation, shall be certified by the secretary or assistant secretary, according to the form attached hereto. In lieu of such certificate, there may be attached to the bond copies of so much of the records of the corporation as will show the official character and authority of the officer signing, duly certified by the secretary or assistant secretary, under the corporate seal, to be true copies.

The date of the bond must not be prior to the date of the instrument for which it is given.

## CONTRACTOR'S INSURANCE REQUIREMENTS

Before performing contractual services on the behalf of or for the Housing Authority of the Cherokee Nation of Oklahoma, compliance with the following insurance requirements must be verified:

\*\* Provide an original Certificate of insurance naming the Housing Authority of the Cherokee Nation of Oklahoma as a certificate holder and additional insured with respect to general liability, automobile liability, and builders risk policies, as their interest may appear with respect to the operations defined in this bid packet. The certificate shall reflect that coverage has been placed with an AM Best Rated Carrier of at least A IX and will contain the following information for each required coverage

- 1) Type of insurance
- 2) Policy number
- 3) Effective date
- 4) Expiration date
- 5) Limits of Liability (this amount is usually stated in thousands)
- 6) Thirty day notice of cancellation, except ten-day cancellation clause will apply for nonpayment of premium.

\*\* Required Coverages:

- 1) Worker's Compensation and Employer's Liability:

Limits of Liability:

Bodily Injury by Accident: \$100,000 each accident

Bodily Injury by Disease: \$500,000 policy limit

Bodily Injury by Disease: \$100,000 each employee

Oklahoma Statute requires Worker's Compensation coverage for anyone with one (1) or more employees. Contractor's worker's compensation policy shall include a waiver of subrogation in favor of Cherokee Nation of Oklahoma.

- 2) General Liability:

Coverages:

Commercial (including products/completed operations) with specific reference made to coverage for lead abatement (as this is usually excluded under standard commercial general liability policies). In addition to the additional insured endorsement, the commercial general liability policy shall also include a waiver of subrogation in favor of Cherokee Nation of Oklahoma.

Limits of Liability:

Bodily Injury and Property Damage Combined: \$1,000,000  
(each occurrence)

- 3) Automobile Coverage:

Vehicles Covered:

All Autos

Hired Autos

Non-owned Autos

Limits of Liability:

Bodily Injury and Property Damage Combined: \$300,000

- 4) Builders Risk Insurance:  
Total Contract Value for Each Site;  
Each Site must be referenced on certificates.

NOTE: The Contractor shall either: (1) require each of his subcontractors to procure and to maintain during the life of his subcontract, Subcontractor's Public Liability and Property Damage for the type and **in** the same amounts as specified above, or (2) insure the activities of this subcontractors in his own policy. Each subcontractor policy must also name the Housing Authority of the Cherokee Nation of Oklahoma as an additional insured with respect to general liability and auto liability.

**THE HOUSING AUTHORITY OF THE CHEROKEE NATION OF OKLAHOMA  
INDIAN PREFERENCE POLICY IN CONTRACTING**

The Housing Authority of the Cherokee Nation of Oklahoma shall to the greatest extent feasible give preference in the award of contracts to Indian organizations and Indian-owned economic enterprises. All contracting is required to comply with procedures for selection of Contractors and Sub-contractors as set forth in the Cherokee Nation Tribal Employment Rights Office, Resolution No. 84-50 and Ordinance Section No. 4.8 which provides for preference to Indians in the awarding of contracts, as well as the Housing Authority of the Cherokee Nation of Oklahoma Acquisition Management Policies and Procedures. All work to be performed under any contract is also subject to Section 7(b) of the Indian Self-Determination Act.

Section 7(b) states:

Any contract, subcontract, grant, or subgrant pursuant to this act, the Act of April 16, 1934 (48 Stat. 596) as amended, (the Johnson-O'Malley Act) or any other Act authorizing federal contracts with or grants to Indian organizations or for the benefit of Indians, shall require to the greatest extent feasible;

(1) Preference and opportunities to training and employment in connection with the administration of such contracts or grants shall be given to Indians; and

(2) Preference in the award of subcontracts and sub grants in connection with the administration of such contracts or grants shall be given to Indian organizations and to Indian-owned economic enterprises as defined in Section 3 of the Indian financing Act of 1974 (88 Stat. 77).

A prospective contractor seeking to receive Indian Preference under this contract must be certified as an Indian-owned firm by the Cherokee Nation Tribal Employment Rights Office (TERO) and submit proof of that certification with their bid.

**ATTACHMENT D**

**STATEMENT  
PROVIDING INDIAN PREFERENCE  
IN SUBCONTRACTING**



## **Statement on Providing Indian Preference In Employment and Training Opportunities**

The Housing Authority of the Cherokee Nation of Oklahoma has determined that all bidders this solicitation shall to the greatest extent feasible comply with Indian Preferences in providing training and employment opportunities.

Detail your employment and training opportunities and plans to provide preference to Indians in implementing the contract:

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Provide the number or percentage of Indians anticipated to be employed and trained.

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If less than 100% Indian for new hires explain why: \_\_\_\_\_

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Provide a list of all core crew (permanent full-time employees) members: \_\_\_\_\_

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Describe the methods that will be used to train Indian employees" \_\_\_\_\_

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**Comparable statements from all subcontracts must be submitted.**

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Company Name

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Signature

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Date

ATTACHMENT E

REQUIRED DOCUMENTS LISTING  
SUCCESSFUL BIDDER ONLY

**Required Documents for Successful Bidder Only**

- a. Labor information form (to be provided by the Housing Authority of the Cherokee Nation of Oklahoma)
- b. W-9 form (to be provided by the Housing Authority of the Cherokee Nation of Oklahoma)
- c. New Contractors must complete a Vendor Registration form (provided by Housing Authority of the Cherokee Nation of Oklahoma)
- d. Signed Contract (contract will be drafted and provided by the Housing Authority of the Cherokee Nation of Oklahoma).  
SAMPLE ONLY PROVIDED (Attachment G)
- e. Core Crew Listing
- f. Request for Acceptance of Subcontractors (Attachment H)

ATTACHMENT F  
CHEROKEE NATION CONTRACT  
SAMPLE ONLY

**SAMPLE ONLY**

CHEROKEE NATION  
SERVICE AGREEMENT  
PURCHASE ORDER # \_\_\_\_\_

This Agreement is made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_ by and between the Cherokee Nation, P.O. Box 948, Tahlequah, Oklahoma 74465 (hereinafter referred to as the "NATION"), and \_\_\_\_\_, Federal Identification Number \_\_\_\_\_, (hereinafter referred to as the "CONTRACTOR").

The NATION is a sovereign nation and enjoys the full privileges of a sovereign's immunity from suit, as recognized by Congress and the United States Supreme Court. Execution of this Agreement shall not be construed to be a waiver of sovereign immunity, and neither shall any clause herein be construed to effectuate the consent to suit, as the NATION expressly declines to waive sovereign immunity.

WHEREAS, the NATION wishes to enter into an Agreement with the CONTRACTOR to provide the labor, materials, administration, services, supplies, equipment, transportation, and quality control necessary to \_\_\_\_\_, based on bid solicitation, herein referred to as "ATTACHMENT A" and CONTRACTOR'S bid dated \_\_\_\_\_, herein referred to as "ATTACHMENT B", and

WHEREAS, the CONTRACTOR hereby affirms it is an independent contractor in accordance with the laws of the State of Oklahoma and the Internal Revenue Service, and further maintains it is qualified, willing, and able to perform the services herein described, and

NOW THEREFORE, and in consideration of the mutual covenants, promises, agreements, understandings, and conditions herein contained, the parties hereto mutually promise to the other, agree, and understand as follows, to wit:

TERM: The term of this Agreement shall be from date of last signature through ending date specified in a Notice to Proceed Letter unless canceled or extended in writing by both parties hereto.

NOTICES: All notices required hereunder shall be sent via U.S. Mail, postage paid as follows:

To the NATION: Cherokee Nation  
Acquisition Management Department  
Attention: \_\_\_\_\_  
P.O. Box 948  
Tahlequah, OK 74465

To the CONTRACTOR:

PERFORMANCE REQUIREMENTS OF THE CONTRACTOR:

The CONTRACTOR shall provide all labor, materials, administration, services, supplies, equipment, transportation, and quality control necessary to provide \_\_\_\_\_ based on bid solicitation, herein referred to as "ATTACHMENT A" and CONTRACTOR'S bid dated \_\_\_\_\_, herein referred to as "ATTACHMENT B", and

ASSIGNMENT OR NON-ASSIGNMENT PROVISION:

The NATION and the CONTRACTOR hereby agree the services specified in this Agreement may not be delegated or assigned without the prior written approval of the NATION.

TERMINATION OR CANCELLATION CLAUSE:

In the event the NATION should cancel or terminate the requested work, such cancellation or termination shall be submitted in writing and the NATION shall pay the CONTRACTOR for documented and completed work up to the point of notice of termination or cancellation.

Should the CONTRACTOR be adjudged bankrupt, or make a general assignment for the benefit of its creditors, or should a receiver be appointed because of its insolvency, or should it fail to make reasonable prompt payment to its subcontractors or for materials or labor, disregard laws, ordinances or other governmental regulations, or substantially violate any provisions of this Agreement, the NATION may, upon giving written notice, terminate the CONTRACTOR'S services, and take possession of the premises and all belongings thereon and arrange for the completion of the work. The CONTRACTOR shall be paid only the Agreement's price for work satisfactorily performed prior to the date of termination, and shall not receive such payment until the work is finished. Should the cost of completing the work exceed said unpaid balance, the CONTRACTOR shall pay the NATION the difference, plus any other proper charges or damages resulting from the termination of the CONTRACTOR'S services. The CONTRACTOR, at its cost, shall remove from the site any material designated by the NATION to be removed.

Should the CONTRACTOR wish to terminate or cancel any contracted work, it may do so by informing the NATION of its intent with written notice. The CONTRACTOR agrees to request no further compensation and understands the NATION will make no payment for any work project canceled at the CONTRACTOR'S request.

MODIFICATIONS:

No change or modification of the terms and conditions of this Agreement shall be effective unless approved in writing and executed by both parties hereto. Any changes to the design, specifications, or costs of this Agreement proposed by the CONTRACTOR must be approved in writing prior to implementation, by the NATION'S Acquisition Management Department and the designated Cherokee Nation Inspector.

ASSURANCES:

The CONTRACTOR, its employees, subcontractors, agents, and representatives shall indemnify, defend, and hold harmless the NATION, its employees, agents, and representatives against all suits, actions, losses, damages, expenses, and liabilities for injury or harm to persons, including employees of the CONTRACTOR and its subcontractors, agents, and representatives, for loss of or damage to the NATION'S or CONTRACTOR'S property, resulting from, arising out of, or in any way connected with the performance of this Agreement.

STATUS OF THE PARTIES:

The parties hereto stipulate and agree the CONTRACTOR is an independent contractor, and the NATION is interested only in the results of the CONTRACTOR'S services and shall not

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control the means or methods by which the CONTRACTOR'S services are rendered. The CONTRACTOR is not eligible for federal, Social Security, State Workers' Compensation, or Unemployment Insurance Benefits from the NATION by virtue of payment received and shall be responsible for all federal and state taxes related to payments received from the NATION under the terms of this Agreement.

#### CONSIDERATION OR COMPENSATION:

In consideration for the services provided, the NATION shall compensate the CONTRACTOR in the amount of \_\_\_\_\_ (\$ \_\_\_\_\_). The NATION SHALL process payment within a reasonable time upon receipt of the CONTRACTOR'S properly prepared invoice(s). Any travel incurred under this Agreement shall be included in the CONTRACTOR'S fee and is the responsibility of the CONTRACTOR. The CONTRACTOR shall submit an original invoice, satisfactory release of liens or claims for liens by subcontractors, laborers, and material suppliers for completed work and installed materials, and full compliance with all terms and conditions of this Agreement, to the attention of \_\_\_\_\_, Cherokee Nation \_\_\_\_\_, P.O. Box 948, Tahlequah, OK 74465. The CONTRACTOR'S invoice shall include a description of the services provided, date(s), and amount(s). The NATION shall make full payment for completed work within a reasonable time, upon inspection and certification of the work as satisfactorily completed, approval for payment by an authorized Cherokee Nation Inspector, and receipt and approval of the CONTRACTOR'S properly prepared invoice and attached releases in accordance with payment schedule outlined in bid specifications. The NATION and the designated Cherokee Nation Inspector must approve requests for progress payments for construction, renovation, and remodeling projects. The Contractor certifies all sums due to subcontractors, laborers and material suppliers have been paid or will be paid within ten (10) days of receipt of payment by the NATION. This Agreement shall not exceed \_\_\_\_\_ (\$ \_\_\_\_\_) without the prior written consent of the Principal Chief, Cherokee Nation or his designee.

#### LIENS AND CLAIMS:

The CONTRACTOR shall pay, or cause to be paid when due, all bills for labor, materials, equipment, or services connected with work performed hereunder, and shall not itself assert any lien or permit any lien to be asserted or maintained against the project. The NATION may, as a condition precedent to any payment hereunder, require the CONTRACTOR to submit satisfactory evidence of payment and release of all such claims. If at any time, there should be evidence of any lien or claim for which the NATION or any of its property might be liable or subject to and which originates with the CONTRACTOR, the NATION shall have the right to retain out of any payment then due or thereafter owed to the CONTRACTOR, an amount sufficient to indemnify the NATION completely against such lien or claim until such time as the CONTRACTOR shall deliver to the NATION a complete release satisfactory to the NATION releasing such claim or claims, lien or liens, or receipts in full.

#### DRAWINGS AND SPECIFICATIONS:

Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown and mentioned in both. In case of conflict or inconsistency between specifications and drawings, or in case of discrepancies, omissions, and/or errors, the matter shall be submitted immediately to the NATION for determination and the NATION'S determination shall be final. The CONTRACTOR waives any claim to additional compensation in respect of any such discrepancy, error or omission not so submitted to the NATION, and any work affected by such discrepancy,

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error or omission which is performed by the CONTRACTOR after discovery thereof but prior to the NATION'S determination shall be at the CONTRACTOR'S risk.

#### WORKING CONDITIONS:

All of the CONTRACTOR'S employees engaged in the work hereunder, as well as the CONTRACTOR'S representatives, suppliers, subcontractors, and visitors, shall be subject to the rules and regulations set by the NATION for the safety and orderly and efficient conduct of all operations upon the project site. The CONTRACTOR shall be responsible for all hours worked at premium pay without the NATION'S written authorization.

The CONTRACTOR shall promptly take all precautions which are necessary and adequate against any conditions created during the progress of the CONTRACTOR'S activities hereunder which involve the risk of bodily harm to persons or a risk of damage to any property. The CONTRACTOR shall continuously inspect all work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The CONTRACTOR shall comply with all applicable safety laws, standards, codes, and regulations in the jurisdiction where the work is performed, specifically, but without limiting the generality of the foregoing, and regardless of any exemptions provided by law, with all rules, regulations, and standards adopted pursuant to applicable state and federal safety laws. The CONTRACTOR assumes all liability for its failure to comply with the provisions of this paragraph. The CONTRACTOR shall include this paragraph in its entirety in all subcontracts for any work at the project site.

#### RESPONSIBILITY FOR WORK:

The CONTRACTOR has had the full opportunity to examine the site and data pertaining to this work, determine the scope of work involved, and assumes full responsibility for the performance of the work in a manner adequate to meet the conditions encountered.

The CONTRACTOR shall be responsible for loss of or damage to all materials delivered and work performed until completion and acceptance by the NATION, and upon completion, the work shall be delivered complete and undamaged. Materials furnished by the NATION shall be used by the CONTRACTOR in an economical manner.

The CONTRACTOR shall indemnify, defend, and hold harmless the NATION, its employees, agents, and representatives from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, losses, costs, and expenses of whatsoever kind or nature, whether arising before or after the completion of the work and in any manner directly or indirectly caused, claimed to be caused, by reason of any act, omission, fault or negligence, whether active or passive of the CONTRACTOR, or of anyone acting under its direction or control, or on its behalf, in connection with, or incident to the performance of this Agreement.

#### GUARANTEES:

All materials and labor furnished by the CONTRACTOR pursuant to this Agreement shall conform to the specifications, drawings, performance requirements, operating standards, designs and other descriptions contained in this Agreement or furnished to the CONTRACTOR therefore. All materials furnished and all work are to be new and of the best quality of their respective kinds, to be free from faulty design (to the extent said design is not specified by the NATION), workmanship, or materials and to be of sufficient size and capacity of proper material so as to fulfill in all respects the operating conditions specified. The CONTRACTOR agrees that it will repair or replace, at its expense, all materials, equipment, and construction work furnished or performed by the CONTRACTOR or its subcontractors which fail to conform to the aforesaid

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guarantee in any respect and which are discovered and communicated to the CONTRACTOR during the progress of the work, and for a period of one (1) year following the completion of the work by the CONTRACTOR and its acceptance by the NATION; provided, however, that if the CONTRACTOR'S field forces are unable to promptly perform the required repair or replacement which becomes necessary, the NATION may, at its option, make the necessary repairs and charge the cost thereof to the CONTRACTOR. The NATION shall not be deemed to have waived any rights by allowing or requiring the CONTRACTOR to cure a breach of warranty by repair or replacement of materials and/or workmanship or by itself repairing or replacing materials and/or workmanship.

#### TAXES AND ASSESSMENTS:

Except to the extent otherwise indicated in this Agreement, the CONTRACTOR accepts liability for the payment of sales taxes on materials purchased by CONTRACTOR for project and any and all assessments for unemployment benefits, or other purposes which are in whole or in part measured by and/or based upon the wages, salaries, or other enumerations paid to persons employed by the CONTRACTOR on work performed under this Agreement.

#### LAWS AND REGULATIONS:

The parties' performances under this Agreement shall comply with all applicable laws, ordinances, rules, and regulations of any governmental agency having jurisdiction and shall pay any fine, penalty, loss, damage, or expense resulting from either party's failure to comply therewith. The CONTRACTOR shall provide all licenses and permits required to perform its obligations under this Agreement, including but not limited to, building permits, contractor's licenses, specialty permits required by law to be issued to the CONTRACTOR, and/or transportation permits. The CONTRACTOR and its subcontractors shall, in addition to the above, comply with the NATION'S job site procedures and regulations.

#### CONFIDENTIALITY:

It is understood that any information submitted by the NATION to the CONTRACTOR in respect of the work hereunder embodies certain proprietary information and is loaned to the CONTRACTOR on a confidential basis. Any information acquired at the site or otherwise relating to processes belonging to the NATION incorporated into the project shall be kept confidential. The CONTRACTOR agrees not to use in any unauthorized manner or communicate to others any such confidential items without the prior written consent of the NATION and will undertake such measures as are necessary to require its employees and subcontractors to maintain complete confidentiality.

#### DISPUTES:

In the event of any dispute which may affect this Agreement, the CONTRACTOR agrees this Agreement shall be governed by the laws of the United States and, where applicable, the laws of the Cherokee Nation.

#### MEDICAL FIRST AID FACILITIES:

The CONTRACTOR shall be responsible for the provision of adequate first aid facilities at the project site for all personnel employed or retained by the CONTRACTOR or any of its subcontractors in the performance of the work.

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#### DRUG FREE and TOBACCO FREE WORKPLACE

- a) Any Contractor performing work for the Cherokee Nation agrees to publish a statement notifying all employees, subcontractors, and other workers that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against violators of such prohibition.
- b) The Nation will consider lack of enforcement or lax enforcement of the statement by the Contractor a default of the contract.
- c) The Contractor further agrees to provide all persons engaged in performance of the contract with a copy of the statement.
- d) A copy of the Contractor's Drug Free Workplace statement shall be included with any bid submitted or the Contractor will be deemed to accept and agree to use the statement provided by the Nation.
- e) The Contractor understands and recognizes that all Cherokee Nation buildings, whether leased or owned, and the grounds surrounding those facilities are considered by the Nation to be a tobacco free workplace. The Contractor will ensure all employees, subcontractors, and other workers will abide by this policy.

#### EQUIPMENT, MATERIALS, AND SUPPLIES:

The CONTRACTOR agrees to utilize in the course of its work, only equipment, materials, supplies, and protective equipment to ensure compliance with all applicable federal and state safety laws and established safety requirements of the NATION.

#### INTEGRATION AND WAIVER:

There are no previous or contemporary understandings, representations, or warranties not set forth herein. No subsequent amendment or modification of this Agreement shall be of any force or effect unless in writing and signed by the parties to be bound thereby. No provision of this Agreement shall be considered waived by the NATION unless such waiver is in writing and signed by the NATION. No such waiver shall be a waiver of any past or future default, breach, or modification of any of the provisions of this Agreement unless expressly stipulated in such waiver.

The parties further state to their best of the knowledge, no employee of the NATION who exercises any functions or responsibilities in connection with the performance of the duties under this Agreement has any personal interest, direct or indirect, in this Agreement.

#### INSURANCE:

Unless otherwise specified in this Agreement, the CONTRACTOR shall, at its sole expense, maintain in effect at all times during the performance of the terms of this Agreement, insurance coverage with policies and carriers satisfactory to the NATION. Such policies shall name the NATION as an additional insured, and shall contain an insurer's waiver of subrogation in favor of the NATION. Not less than ten (10) days advance notice will be given in writing to the NATION prior to cancellation, termination, or material alteration of said policies of insurance.

Before beginning the work hereunder and/or within ten (10) days of execution of this Agreement, the CONTRACTOR shall provide an original certificate of insurance naming the NATION as an additional insured. Said certificate of insurance shall demonstrate the CONTRACTOR'S compliance with the provisions of the above paragraph. All subcontractors with written approval from the NATION to perform work under this Agreement must also comply with these requirements.

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The CONTRACTOR shall provide an original certificate of insurance naming the NATION as an additional insured. The certificate should contain the following information:

- 1) Type of insurance;
- 2) Policy number;
- 3) Effective date;
- 4) Expiration date;
- 5) Limits of liability (this amount is usually stated in thousands);
- 6) Ten (10) day cancellation clause.

Required coverage:

- 1) Workers' Compensation and Employer's Liability - Limits of Liability:
  - a) Bodily injury by accident: \$500,000 each accident
  - b) Bodily injury by disease: \$500,000 policy limit
  - c) Bodily injury by disease: \$500,000 each employee
- 2) General Liability:

Coverage:  
Comprehensive (including products/completed operations)  
Limits of Liability:  
Bodily Injury and Property Damage combined \$1,000,000 (each occurrence)
- 3) Automobile Coverage:

Vehicles covered:  
All autos  
Hired autos  
Non-owned autos  
Limits of Liability:  
Bodily Injury and Property Damage combined \$300,000

NOTE: Oklahoma Statute requires Workers' Compensation coverage for anyone with one (1) or more employees.

#### CHEROKEE NATION INDIAN PREFERENCE POLICY

The Cherokee Nation shall to the greatest extent feasible give preference in the award of contracts to Indian organizations and Indian-owned economic enterprises. All contracting is required to comply with procedures for selection of Contractors and Sub-contractors as set forth in Legislative Act 30-12 which provides for preference to Indians in the awarding of contracts, as well as the Cherokee Nation Acquisition Management Policies and Procedures. All work to be performed under any contract is also subject to Section 7(b) of the Indian Self-Determination Act.

#### ADDITIONAL PROVISIONS PER SECTION 7(b):

The work to be performed under this Agreement is on a project subject to Section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450b). Section 7(b) requires to the greatest extent feasible:

Preference and opportunities for training and employment shall be given to Indians; and

Preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned economic enterprises.

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The parties to this Agreement shall comply with the provisions of Section 7(b) of the Indian Self-Determination and Education Assistance Act in the award of any subcontracts. In connection with this Agreement, the CONTRACTOR shall, to the greatest extent feasible, give preference in the award of any subcontracts to Indian organizations and Indian-owned economic enterprises, and preferences and opportunities for training and employment to Indian and Alaska Natives.

The CONTRACTOR shall include this Section 7(b) clause in every subcontract in connection with the project, and shall at the direction of the NATION, take appropriate action pursuant to a finding by the NATION of a violation of Section 7(b) by a contractor or subcontractor.

**CONTRACTOR:**

\_\_\_\_\_  
**Authorized Signature**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Please print name & title**

**CHEROKEE NATION:**

\_\_\_\_\_  
**Executive Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Principal Chief or Designee**

\_\_\_\_\_  
**Date**

\_\_\_\_\_

\_\_\_\_\_

**ATTACHMENT G**  
**REQUEST FOR ACCEPTANCE OF SUBCONTRACTOR**

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# REQUEST FOR ACCEPTANCE OF SUBCONTRACTOR

Date: \_\_\_\_\_

Project: \_\_\_\_\_

In accordance with our proposal to provide all labor, licenses, materials, administration, services supplies, equipment, transportation, and quality control necessary for the \_\_\_\_\_ located in \_\_\_\_\_, Oklahoma; we request acceptance of the following proposed subcontractor to perform work or supply materials as indicated below:

1. \_\_\_\_\_  
(Name)  
\_\_\_\_\_  
(Street address) (City) (State) (Zip code)

2. Scope of work (state kind of work, if for labor, or materials, or both, and give Specification reference):

3. The subcontractor's non-collusive affidavit in the form required by our contract is furnished herewith (original only, attached to the original request).

4. We warrant that the provisions required by our contract to be inserted in each subcontract will be inserted in this subcontract.

5. We certify that this proposed subcontractor is not ineligible to receive awards of contracts from the United States as evidenced by the list or lists of such contractors maintained by the federal government.

6. There will be no assignment of interest in the subcontract except as follow (if none, so state):

Terms of payment:

Price: \$ \_\_\_\_\_

\_\_\_\_\_  
(Signature of Authorized Company Representative)

\_\_\_\_\_  
(Printed Name of Representative)

\_\_\_\_\_  
Title

## APPROVAL OR REJECTION

The proposed subcontractor named above is \_\_\_\_\_.

If accepted, the contracting party giving such acceptance assumes no responsibility in connection with the form of terms of the subcontract, nor the performance of the subcontractor, and this form will not be returned.

If rejected, the reason(s) will be briefly stated herein, and this form will be returned within 10 days after receipt.

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Cherokee Nation - Department)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Cherokee Nation - TERO)

# **TOWN OF SPORTSMEN ACRES**

## **WATER AND SEWER CONSTRUCTION SPECIFICATIONS**

## **DIVISION I**

### **GENERAL SPECIFICATIONS**

#### **PART 101 - SCOPE AND LOCATION**

- 101.1 The location of the project is in the Town of Sportsmen Acres, Oklahoma hereinafter referred to as City. The character and exact location of the project are shown on the Drawings
- 101.2 The site and/or rights-of-way upon which the work is to be performed is shown on the Drawings. The Contractor agrees that the site and/or rights-of-way provided is adequate for the performance of the work. If any additional working area is required, the Contractor shall, at his expense, make arrangements for such working area.

#### **PART 102 - SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND DRAWINGS**

- 102.1 The Specifications and Drawings are intended to supplement, but not necessarily duplicate each other; and together constitute one complete set of Specifications and Drawings, so that any work exhibited in the one and not in the other shall be executed just as if it had been set forth in both, in order that the work shall be completed according to the complete design or designs as decided and determined by the Engineer.
- 102.2 The Drawings are not intended to be scaled for dimensions, and if dimensions not shown on the Drawings are required, the Contractor shall request them from the Engineer. Where existing utility lines or other sub-surface obstructions are shown on the Drawings, the same have been located as nearly as practicable from information furnished by owners of such, and from such surface indications as may exist at the work site. Such obstructions are shown for the purpose of advising the Contractor that they may interfere with the work to be done hereunder, but not for the purpose of indicating that the work can be performed without such interference.
- 102.3 Where soundings are shown on the drawings, the depths are determined by driving a drill rod, using the churn method with water lubrication, to a maximum depth of nine feet or to refusal, whichever is lesser in depth. By showing soundings on the drawings, the City represents only that material of hardness and character which could be penetrated by a drill rod found above the depth of sounding as shown at the point where the drill rod was driven.
- 102.4 Where exploratory drilling is indicated to have been performed on the plans, boring logs will be available for review at the office of the Engineer. The logs will be furnished for information purposes only, and are not to be construed as a true representation of actual subsurface conditions.



- 102.5 Should anything be omitted from the Specifications and Drawings which is necessary to a clear understanding of the work, or should it appear various instructions are in conflict, the Contractor shall request written instructions from the Engineer before proceeding with the construction affected by such omissions or discrepancies.
- 102.6 The Contractor's responsibility for construction covered by conflicting requirements, not provided for by addendums prior to the time of opening bids for the work represented thereby, shall not extend beyond the construction in conformity with the cheaper of the said conflicting requirements. Any increase in cost of work requested to be done in excess of the cheaper of the conflicting requirements will be paid for as Extra Work as provided for herein.

### **PART 103 - LINES AND GRADES**

- 103.1 All work done under this Contract shall be done to the lines, grades, and elevations shown on the Drawings. All lines and grades shall be completed by Licensed Surveyor paid for by the contractor. The Contractor shall provide all batterboards, straight edges, and other materials for lines, levels, and measurements; and shall set all batterboards under direction of the Engineer. The Contractor shall give the Engineer at least forty-eight (48) hours notice as to the location where stakes are required.

### **PART 104 - SATURDAY, SUNDAY, HOLIDAY AND NIGHT WORK**

- 104.1 No work shall be done between the hours of 6:00 p.m. and 8:00 a.m., nor on Saturday, Sunday, or legal holidays without the written approval or permission of the Engineer in each case, except such work as may be necessary for the proper care, maintenance, and protection of work already done, or of equipment, or in the case of an emergency.

### **PART 105 - PROTECTION OF PROPERTY**

- 105.1 The protection of City, State and Government monuments, street signs, and other City property is of prime importance, and if the same be damaged, destroyed or removed, they shall be repaired, replaced or paid for by the Contractor. Disturbance to this property must first be approved by the agency that controls it.
- 105.2 No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor.
- 105.3 At places where the Contractor's operations are adjacent to, or crossing, the path of railway, telegraph, telephone, cable, electric, and gas lines, or water lines, sanitary sewers, and storm sewers, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made. Contractor shall notify the Notification Center of Oklahoma One-Call System, Inc. of any excavation or

Demolition prior to the commencement of such work. Notification shall be made no sooner than ten (10) days, nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays, and legal holidays.

105.4 The Engineer has attempted to locate all storm sewers, culverts, buried telephone of electrical conduits, sanitary sewers, water mains, and gas mains that might interfere with the construction of this project. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted. The revision and crossings of the various types of lines shall be made as follows:

a) Storm sewers and culverts may be removed at the time of crossing of may be adequately braced and held in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, it shall be replaced with pipe of the same type and size as that removed, and it shall be re-joined to the undisturbed line with a joint satisfactory to the Engineer. Backfill over the main, up to and around the storm sewer, shall be thoroughly compacted in order that no settlement will occur. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines, other than those shown on the Drawings, are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary of the construction of the project, the Contractor will be reimbursed for the extra cost of the crossing or revision under the "Extra Work" clause of the Contract.

b) All overhead and buried telephone cable and electrical conduits, and gas mains to be revised or crossed by the construction of this project shall be protected in accordance with the directions of the utility company owning the conduits and/or mains. The Contractor shall notify the companies and obtain their permission before making any crossing or revisions. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines other than those shown on the Drawing are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossings of revisions under the "Extra Work" clause of the contract. Any overhead cables or buried cables or conduits of gas mains damaged by the Contractor shall be repaired at his expense to the satisfaction of the Engineer and the Owner.

c) The Contractor shall not remove any water or sanitary sewer lines except as directed by the Engineer or as required by the Drawings and Specifications, and shall adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damaged by the Contractor's operation will be repaired by the City's maintenance forces. The Contractor shall notify the City immediately after damaging any pipe. The repairs will be made at the Contractor's expense.

105.5 The location of utility service lines serving individual properties may or may not be shown on the Drawings, but the Contractor shall assume that such service lines exist whether or not they are shown on the Drawings, and it shall be the responsibility of the Contractor to make any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other owner thereof, or by an agent or individual contractor approved by such utility company or other owner. Contractor shall pay the cost of all such revisions whether performed by contractor, the utility company, or other owner, or an approved contractor. In the event of interruption of a utility service as a result of accidental breakage, Contractor shall promptly notify the Engineer and the owner of the utility, and shall repair or cause the same to be repaired, in the same manner as necessary changes above provided for, and the Contractor shall do all things necessary to see to the restoration of services as promptly as may be reasonably done. All sanitary sewer service lines damaged shall be replaced with cast iron pipe, regardless of type or kind damaged.

105.6 In the event the Contractor in any way fails to comply with the requirements of protecting, repairing, and restoring of any utility or utility service, the Engineer may, upon forty-eight (48) hours' written notice, proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due the Contractor pursuant to the terms of his contract.

#### **PART 106 - CONNECTIONS**

106.1 All connections to existing water mains shall be made by the Contractor, unless noted otherwise. The Contractor shall perform his work so that these connections may be readily made. All transfer of building service line connections from the existing to the new main shall be made by the Contractor after the main has been backfilled, tested, and chlorinated, but before any sidewalks, driveways, curbs, and/or paved roadways, are replaced.

106.2 The Contractor shall not make any unauthorized connections to a sewer, nor shall he permit any such connections to be made. If the Contractor is properly authorized by the Engineer to make connections by installing tees in the sewer under construction, such installation shall conform to the regulation of the City.

#### **PART 107 - REFERENCES TO OTHER SPECIFICATIONS**

107.1 Where a standard such as American Society for Testing Materials, American Concrete Institute, American Standards Association, American Water Works Association, or other agency designation is specified for a material, that designation shall be the current revision, either tentative or adopted. If a referenced specification is in conflict with these specifications, the specifications shall govern.

**PART 108 - PROTECTION OF MATERIALS**

- 108.1 All materials delivered to the site of the work shall be adequately housed and protected against deterioration according to the standard accepted procedures. The Contractor shall keep his storage yards in good order, pile his materials neatly, and protect them from damage.

**PART 109 - TESTING**

- 109.1 Materials: All materials required to be tested shall be tested by a laboratory approved by City. No material shall be accepted for construction unless it bears the approval of the laboratory. Reports of tests shall be forwarded to the Engineer and City. Before final acceptance of the project, all materials shall be tested and shall be found in good and proper condition, or shall be placed in such condition.
- 109.2 Testing of Manholes: All manholes will be tested using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. The vacuum tester shall be as manufactured by Cherne Industries or equal.

All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole.

A vacuum of 10 inches of mercury (Hg)(5.0 psi) shall be drawn on the manhole and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg)(4.5 psi). The manhole shall pass the test if the time measurement exceeds the values indicated in the following table:

Vacuum Test Timetable  
Manhole Diameter - Inches

Depth-feet	48 Inches	60 Inches	72 Inches	96 Inches	144 Inches
4	10 sec.	13 sec.	16 sec.	19 sec.	21 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.	44 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.	65 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.	88 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.	110 sec.
24	60 sec.	78 sec.	96 sec.	114 sec.	132 sec.
+Each 2'	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5 sec.	+11 sec.

Manhole depth shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 24 feet, add the values listed on the last line of the table for each 2 feet of additional depth.

If the manhole fails the vacuum test, the contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

All repairs and testing are the responsibility of the Contractor and will be performed at no additional cost to the City.

No payment will be made for any manholes which have not passed the vacuum test.

- 109.3 Testing and Chlorinating Water Mains: Testing and chlorinating water mains will be performed by the Contractor. Water mains shall be testing in accordance with the Standard Specifications for "Installation of Ductile Iron Water Mains and Their Appurtenances," AWWA Designation C-600. The pressure test of 150 psi shall be for thirty minutes' duration. If the line passes the test without significant pressure drop, a leakage test shall be made at the normal operating pressures under which the line is to operate for two hours' duration. Before being placed in service, all mains shall be chlorinated in accordance with "AWWA Standard for Disinfecting Water Mains," AWWA Designation C-651. Where temporary plugs' are required for pressure testing, the contractor shall furnish and install the plug and temporary blocking, and remove after testing is complete. The cost shall be included in the unit price bid for pipe. No additional payment will be made.

#### **PART 110 - "OR APPROVED EQUAL" CLAUSE**

- 110.1 When a material is specified or shown on the Drawings by brand or manufacturer's name, any other material that will adequately perform the same function, in the opinion of the City, may be accepted for use.

#### **PART 111 - DeWATERING**

- 111.1 The Contractor shall provide all necessary pumps, drains, dams, well points, and other means for removing water from, or preventing water from entering the trench or other excavation until the project is completed. Sufficient pumps or other works shall be made available at all times to hold the water at a safe level as determined by the Engineer. Water from the excavation shall be properly disposed of so that no damage or interference results to public health, public or private property, completed or uncompleted work, other projects, or streets.

#### **PART 112 - SAFETY**

- 112.1 Excavations: The Contractor shall adequately shore, or sheet, and brace the excavation, or shall slope the sides of the trench in accordance with the State of Oklahoma Department of Labor requirements.
- 112.2 Explosives: In handling explosives used during the construction of the project, the Contractor shall adhere to all Federal and State Laws and City Ordinances regulating the purchase, transportation, storage, handling, and use of such explosives. All blasting shall be done in strict accordance with City Ordinances.

Submittals shall include reference to compliance with AWWA, ASTM, NSF, and other applicable standards.

- 116.4 Copies of all delivery tickets, including factory certification of pipe, manholes, inlets, shall be surrendered to City Inspector.

**SECTION END**

No blasting shall be done without obtaining a "Blasting Permit" or approval from the City and presence of the Inspector. All equipment, tools, and materials used shall be of the correct type and in good conditions for the operation. The Contractor shall take all necessary precautions to avoid damage to property resulting from the transportation, storage, handling and use of explosives. Before blasting, the Contractor shall cover the area to be blasted with steel mesh mat or other suitable material, reinforced with timbers of sufficient weight so that rock and debris will be confined to the excavation. Any blasting within ten feet of a water, sewer, gas, or pipe line shall be done with very light charges, and utmost care should be taken to avoid disturbance to these lines. All locations for blasting shall be subject to approval of the Engineer.

112.3 Danger Signals and Protection: When the Contractor is performing any type of construction or excavation work, or is stockpiling or storing any materials or equipment upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is likely to be subject to pedestrian or vehicular traffic, he shall furnish, erect, and maintain substantial guard rails, safety fencing, lights, and traffic control devices around the project to protect pedestrians, animals, and vehicles from injury or damage. All traffic control shall be in accordance with the Manual of Uniform Traffic Control Devices and Procedures for Street Use and Temporary Traffic Control. Safety and traffic control devices shall be installed and removed only at the direction of the Engineer. The Contractor shall provide sufficient proper signals and flagmen for warning during construction, excavation, and blasting operations.

112.4 Power Lines: No person, materials, or equipment shall come within six feet of any power line carrying more than 440 volts unless the electric power services has been first discontinued.

112.5 Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory fire fighting means at the location of work.

112.6 Interference with Traffic: The Contractor shall construct and maintain adequate and safe bridges or crosswalks over excavations, where required. When a roadway or sidewalk is not closed, the Contractor shall provide a safe substitute route for any portion obstructed by his operations. If a roadway or sidewalk is closed to traffic, the Contractor shall provide and mark detours. As directed by the Engineer, construction across roadways or sidewalks may be done by open excavation.

112.7 Condition of Equipment and Materials: All equipment, tools, appliances, and materials used in connection with the project shall be handled and operated only when they are in safe operating condition and in accordance with a standard safety procedure.

## **PART 113 - REMOVAL OF CONDEMNED MATERIALS AND STRUCTURES**

- 113.1 The Contractor shall remove from the site of the work, without delay, all rejected and condemned materials or structures of any kind brought to or incorporated in the work. Upon his failure to do so, or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice from the Engineer ordering such removal, the condemned material or structure may be removed by the City and the cost of such removal will be taken out of the money that may be due or may become due the Contractor. No such rejected or condemned material shall again be offered for use by the Contractor.

## **PART 114 - CLEAN-UP**

- 114.1 Immediately upon installation of any portion of the work, the Contractor shall restore all fills, topsoil, and utilities to their location and condition prior to construction.
- 114.2 Immediately upon installation of any block in length of the work herein contemplated, the Contractor shall remove all materials, tools, debris, excess excavated material, and equipment; and restore the site in a manner satisfactory to the Engineer.
- 114.3 Clean-up and restoration of service line transfers shall be made immediately following each transfer installation.

## **PART 115 - PLACING WORK IN SERVICE**

- 115.1 If desired by the City, portions of the work may be placed in service when completed and the Contractor shall give prior access to the work for this purpose, but such use and operation shall not constitute an acceptance of the work.

## **PART 116 - SUBMITTALS**

- 116.1 The Contractor shall submit to the Engineer, six (6) copies of material submittals for all material he proposes to use. Construction shall not begin until the Engineer has approved the submittals in writing.
- 116.2 Submittals for pipe shall consist of notarized certifications, from the manufacturer, that the pipe was manufactured and tested in accordance with the applicable specifications. The certifications shall indicate the pipe diameter, the pressure rating, and the batch number from which the pipe was manufactured. For concrete and steel pipelines 16-inches and larger, a detailed laying schedule prepared by the manufacturer shall be submitted, along with the detail design calculations.
- 116.3 Submittals for material other than pipe shall consist of manufacturer's product literature or shop drawings, indicating dimensions and material specifications.



**DIVISION II  
MATERIAL SPECIFICATIONS  
APPROVED FITTINGS MANUFACTURERS**

**Tapping Saddles and Valves**

Mueller (DIP)  
Clow (DIP)  
American (DIP)  
Tyler (DIP)  
PowerSeal (DIP)  
Smith-Blair (DIP)  
Hanson Concrete (Cone)  
Price Bros (Conc)  
TD Williamson (Conc)  
Baker Series 428 (Steel)  
Rockwell 622 (Steel)  
Dresser (DIP)

**Restrained Joint Systems**

American Flex Ring (DIP)  
EBAA Megalug (DIP,PVC)  
Ford Meter Box Uni-Flange (DIP,PVC)  
Star StarGrip (DIP,PVC)  
Price Snap Ring & Harness Joint (Conc)  
Hanson Snap Ring & Harness Joint (Conc)  
Northwest weld (Steel)  
Hanson weld (Steel)  
US Pipe TR Flex (DIP gravity sanitary only)  
Griffin SNAP-LOK (DIP gravity sanitary only)  
McWane THURSTLOCK (DIP gravity sanitary only)

**Resilient Wedged Gate Valves**

American  
Mueller (Aquagrip allowed)  
M&H  
Clow  
Kennedy  
US Pipe  
AVK

**Ball Valves**

Pratt

**Couplings for Out-of-Round CI Pipe**

Viking-Johnson  
Smith-Blair  
Straub

**Check Valves**

M&H  
American Flow Control  
Mueller  
US Pipe  
Clow  
Kennedy  
Watts

**4-Way Fire Hydrants**

American Darling  
Mueller (Aquagrip allowed)

**3-Way Hydrants**

American Darling B84B  
Kennedy Guardian  
Mueller Centurian (Aquagrip allowed)

**Valve Boxes**

(Includes Debris Cap)

Tyler 6850 Series 562-S  
East Jordan 85502737 (562-S)  
SIGMA VB 262-35  
Star VB 562SHD

**4" Reversible Rim & 23 1/4" Lids (Water)**

Neenah 1797-4R-WAT  
Deeter 1155-WAT  
East Jordan 2132R-WAT  
Sigma MH121WV-35

**Uniflanges**

EBAA Series 2100 Megaflange

### **1 ½" & 2" Meter Setters**

Ford B-C 1 0046-011 (1 %"), B-C 1 0046-013(2")  
Mueller 1 %"x15"B2423, 2"x15"B2423  
AYMcDonald 20C615WFFF6654 (1 %")  
AYMcDonald 20C715WGFF7766x22.75 (2")

### **Air Relief Valves**

APCO  
Crispin  
ValMatic

### **Butterfly Valves**

Pratt  
Mueller

### **Manhole Grade Adjustment Rings**

East Jordan V-1901 series (CI only)  
Deeter 1856 (CI only)

### **Chimney Adjustment Rings**

GNC Concrete Products (Concrete)  
Ladtech (HOPE)

### **Fittings**

American  
Griffin  
McWane  
Clow  
Star  
Sigma  
US Pipe  
Tyler  
East Jordan  
Pipeline Components (PCI)

### **4" Reversible Rim & 23 1/4" Lids (Stm)**

(Only McGard system allowed for sealed lids)

Neenah 1797-4R-STM  
Deeter 1155-STM  
East Jordan 2132R-STM  
Sigma MH121TW-35

### **4" Reversible Rim & 23 %" Lids (San)**

(Only McGard system allowed for sealed lids)

Neenah 1797-4R-SAN  
Deeter 1155- SAN  
East Jordan 2132R-SAN  
Sigma MH121N-35

### **8" Non-Reversible Rim & 23 1/4" Lid (San)**

(Only McGard system allowed for sealed lids)

Deeter 1265-SAN  
Neenah 1797-SAN  
East Jordan 2132-SAN  
Sigma MH122N-35

### **4" Reversible Rim & 31 "h" Lid (San)**

(Only McGard system allowed for sealed lids)

Deeter 1296-R-SAN  
East Jordan 2230-R-SAN  
Sigma MH123N-35

### **8" Non-Rev Rim & 23 %" Lid (Stm)**

(Only McGard system allowed for sealed lids)

Deeter 1265- STM  
Neenah 1797-STM  
East Jordan 2132-STM  
Sigma MH122T-35

### **4" Reversible Rim & 31 ½" lid (Stm)**

(Only McGard system allowed for sealed lids)

Deeter 1296-R-STM  
East Jordan 2230-R-STM  
Sigma MH123T-35

### **Cast Iron Curb Inlet - 6" Barrier**

Deeter 2445  
East Jordan 00760065  
Neenah R-3076-6BOK

### **Lampholes (with closed pickhole)**

East Jordan 3312800lid/3342800frame  
Deeter 1828  
Deeter 1828-B (Bolted Ring & Cover)

**Vane Grates-"Orain to River" with "COT"**

Neenah 3076-3000  
East Jordan 00760033

**Type "D" 27 7/8" Circular Grate**

Deeter 1950  
East Jordan 00210032

**Bicycle Safe 17 3/4"x29 3/4" Grate**

Neenah 3076-0015  
EJ 44230231grate/FA1833032GOframe

**Bolted Bicycle Safe Trench Grate**

Neenah 3076-0019  
East Jordan 00697033  
Solid Knobby Frame/ 27 7/8" Circular Lid  
Deeter 1159 Frame 11159 Lid  
Neenah 1682-0001 Frame/R1682 Solid Lid  
East Jordan 00210002

**Vertical Standard Stormwater Grate**

Neenah R5050

**Cast Iron Curb Inlet - 8" Barrier**

Neenah R-3076-8BOK  
East Jordan 00760067

**Cast Iron Curb Inlet - 6" Mountable**

Neenah R-3076-6M  
East Jordan 00760063

**Single Inlet Frame**

Neenah 3076-0001  
East Jordan 00760011

**Center Inlet Frame**

Neenah 3078-0001  
East Jordan 00760017

**Left Inlet Frame**

Neenah 3077-0001  
East Jordan 00760013

**Right Inlet Frame**

Neenah 3077-0002  
East Jordan 00760015

**Water Meter Cans, Rims, Lids (non lockable)**

East Jordan 18 x 18 assembly 32534019  
(3/4" x 518")  
East Jordan 18 x 24 assembly 32535019  
(1 ")  
East Jordan 28 x 36 Assembly 32535539 (1 W)  
East Jordan 36 x 36 Assembly 00842801  
(2")  
Sigma 18 x 18 MB-161TT-35 (3/4" x 518")  
Sigma 18 x 24 MB-163TT-35 (1")  
Sigma 28 x 36 MB-162TT-35 (1-1/2")  
Sigma 36 x 36 MB-147TT-35 (2")

**PART 201 - CONCRETE**

201.1 CEMENT

201.1.1 All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the Standard Specifications for Portland Cement, ANSI/A.S.T.M. Designation C150. Unless otherwise permitted, the Contractor shall use only one brand of cement in the work and under no condition shall he use more than one brand of cement in the same structure. Cement, which for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site.

201.1.2 The acceptance or rejection of cement shall rest with the Engineer. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work, and shall not be offered for inspection again.

Cement kept in storage for several months may be subject to repeated tests, as directed by the Engineer.

201.1.3 The cement shall be delivered in strong cloth or paper bags. No cement shall be used or inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately ninety-four pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

201.1.4 The Contractor shall provide, at the site of the work, a suitable weather tight building, or buildings, having a tight floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to permit keeping on hand a supply of cement in quantity sufficient to prevent delays or interruptions to the work, which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to a height in excess of seven feet. Suitable accurate scales shall be provided by the Contractor for weighing the cement. After it has been delivered to the job, the Contractor will not be permitted to remove or dispose of the cement in any way without the consent of the Engineer.

201.1.5 At the beginning of operations and at all other times while cement is required, the Contractor shall have, at the site of the work, an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

## 201.2 WATER

201.2.1 All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

## 201.3 AGGREGATE

201.3.1 Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of Arkansas River sand or other sand acceptable to the Engineer. It shall be free from injurious amounts of dust, clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than three per cent, by weight, of material, which can be removed by standard decantation tests. If the color of the supernatant liquid is darker than that of the reference standard color solution when subjected to the Standard Test For Organic Impurities in Sands for Concrete ANSI/ASTM C40, the fine aggregate shall be rejected unless it passes the Standard Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar ANSIIASTM C87.

201.3.2 Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust, or other approved fines shall be added:

Per Cent Passing Standard Square Mesh Screens

No. 4	No. 20	No. 50	No. 100
95-100	45-80	10-30	5-10

201.3.3 Coarse aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Engineer. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign materials and must be satisfactory to the Engineer.

201.3.4 Coarse aggregate shall be graded approximately within the limits shown in the following table:

Percent Passing Standard Square Mesh Screens

Aggregate								
Max Size	2%"	2"	1 %"	1"	%"	%"	3/8"	NO.4
2"	100	95-100	60-95	50-83	40-70	20-40		0-5
1 %"		100	95-100		40-70		10-30	0-5
%"				100	95-100		40-75	0-5

201.3.5 Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSIIASTM C33, except as to gradation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

201.3.6 In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Engineer may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

## 201.4 STEEL REINFORCEMENT

201.4.1 All reinforcing steel shall be deformed bars and shall conform to the requirements of the Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ANSIIASTM A615, for grade 40 or grade 60. All steel shall be manufactured in the United States.

201.4.2 The Engineer reserves the right to require a test of three specimens of each size of bar from each carload received. These tests shall be made by a laboratory or testing firm approved by the Engineer and the cost of such testing shall be included in the price bid for steel reinforcement.

#### 201.5 STRENGTH AND PROPORTION

201.5.1 The concrete shall have a compressive strength of not less than 3500 PSI, unless otherwise specified in the plans, as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

201.5.2 The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not less than 6 sacks of cement per cubic yard of finished concrete. With the approval of the Engineer, admixtures may be added in order to increase workability.

#### 201.6 TESTING OF CONCRETE

201.6.1 During the progress of the work, a reasonable number of compression tests shall be made when and if required by the Engineer. Each test shall consist of not less than three test cylinders. At least one test shall be made for each one hundred cubic yards of concrete placed. The test cylinders shall be made and stored in accordance with the Standard Method of Making and Curing Concrete Test Specimens in the Field, ANSIIASTM C31, and shall be tested in accordance with the requirements relating to making compression tests on concrete test specimens as given in the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ANSI/ASTM C39.

201.6.2 All test specimens shall be kept as near to the point of sampling as possible and yet receive the same protection from the elements as is given to the portions of the structure being built. Specimens shall be protected from injury. They shall be sent to a testing laboratory approved by the Engineer not more than seven days prior to the time of the test, and while in the laboratory shall be kept in the ordinary air at a temperature of approximately 70 degrees Fahrenheit until tested.

201.6.3 The Contractor shall furnish the Engineer certified reports on these tests. All failed tests and shall be paid by the contractor.

#### 201.7 RESPONSIBILITY OF CONTRACTOR FOR STRENGTH

201.7.1 It is the intent of these specifications that the Contractor shall guarantee that concrete of the specified compressive strength is incorporated in the structures and that the responsibility for producing the required grades of concrete is assumed by the Contractor.

201.7.2 Should the average strengths shown by test cylinders fall below the strengths required, the Engineer will require any or all of the following changes: amount

of cement, grading of aggregate, or ratio of the water to the cement used. If the tests disclose that the strength of the concrete is insufficient for the structure as built, the Engineer may condemn the part of any structure in which concrete of insufficient strength has been placed and the Contractor, at his cost, shall remove and replace such concrete with concrete meeting these specifications.

## 201.8 EXPERIMENTAL CONCRETE MIXES

201.8.1 The Contractor shall make experimental mixes prior to the placing of the concrete and at any time during the progress of the work when necessary to demonstrate that the concrete will meet these specifications. Materials for making experimental mixes shall be furnished by the Contractor and these materials shall be identical with those intended for use in the work. The cost of the materials, as well as the costs of crushing test specimens made from the experimental mix, shall be borne by the Contractor and shall be included in the price bid for concrete.

## 201.9 MIXING

201.9.1 The concrete shall be mixed in an approved batch machine or mixer. The ingredients shall be accurately measured by weight, unless measurement by volume is permitted by the Engineer, before being placed in the mixer. Measuring boxes or other approved measuring apparatus shall be such that the proportions can be accurately determined. The quantity of water to be added, which will vary with the degree of dryness of the material and with the weather conditions, shall be accurately measured for each batch of concrete. Means shall be provided by which a measured quantity of water can be introduced at any stage of the process. The mixing shall be done in a thorough and satisfactory manner and shall continue until every particle of aggregate is completely covered with mortar. The mixing time for each batch shall not be less than one minute after the materials are in the mixer. The entire contents of the drum shall be discharged before recharging. Retempering of concrete, which has partly hardened, will not be permitted.

## 201.10 CONSISTENCY

201.10.1 All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that: all aggregate will float uniformly throughout the mass without settling or segregation; when dropped directly from the discharge chute of the mixer, it will flatten out at the center of the pile but will stand up at the edges, the pile spreading from internal expansion and not by flowing; it will flow sluggishly when tamped or spaded; it can be readily puddled into corners and angles of forms and around reinforcing steel, it can be readily spaded to the bottom of the pour or to a depth of several feet any time within thirty minutes after placing.

201.10.2 A desirable consistency is one which results in a very slight accumulation of water at the top of a layer several feet in thickness, but not with segregation or accumulation of laitance.

201.10.3 If, through accident, intention, or error in mixing, any concrete shall, in the opinion of the Engineer, vary materially from the consistency specified, such concrete shall not be incorporated in the work but shall be discharged as waste material at a location approved by the Engineer.

## 201.11 PLACING CONCRETE

201.11.1 Before beginning a run of concrete, surfaces of the forms, reinforcing steel, and concrete previously placed, shall be thoroughly cleaned of hardened concrete and foreign materials. Forms shall be thoroughly wetted or oiled.

201.11.2 Concrete shall be placed in the forms immediately after mixing. It shall be deposited so that the aggregates are not separated. Dropping the concrete any considerable distance, generally in excess of five feet, depositing large quantities at any point and running or working it along the forms, or any other practice tending to cause segregation of the ingredients, will not be allowed. It shall be compacted by vibration or continuous tamping, spading, or slicing. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face, and to force the concrete under and around the reinforcement without displacing it. All concrete shall be thoroughly vibrated, except where specifically excepted in the specifications. The concrete shall be deposited in continuous horizontal layers and, whenever practicable, concrete in structures shall be deposited continuously for each monolithic section of the work. Chutes and tremies used for conveying concrete shall be mortar-tight.

201.11.3 Work shall be arranged in order that each part of the work shall be poured as a unit, if this is possible. Where necessary to stop pouring concrete, the work shall be brought up in level courses and against a vertical stop board.

201.11.4 The placing of concrete under water, where permitted, must be done by special approved methods.

## 201.12 PLACING IN COLD WEATHER

201.12.1 No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below thirty-five degrees Fahrenheit.

201.12.2 If concreting in freezing weather is permitted by the Engineer, care shall be taken to prevent the use of any frozen material. In addition to adequate provision for protecting the concrete against chilling or freezing, the Contractor shall be required to heat the water and aggregate in order that when deposited in the forms, the concrete will have a temperature of not less than fifty degrees Fahrenheit, nor more than eighty degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature



for a minimum of seventy-two hours after it has been placed and a temperature above thirty-two degrees Fahrenheit for a period of two additional days. The work shall be done entirely at the Contractor's risk.

201.12.3 No chemicals or other foreign matter shall be added to the concrete for the purpose of preventing freezing.

#### 201.13 READY-MIXED CONCRETE

201.13.1 Ready-mixed concrete may be used on the work, with the approval of the Engineer, when the Contractor can demonstrate that the concrete can be furnished in accordance with the specifications hereinabove and that delivery can be made at such rate as will insure the continuity of any pour. Standard Specifications for Ready-Mix Concrete, ANSI/ASTM C94, when not in conflict with the specifications herein, shall control the furnishing of ready-mix concrete.

201.13.2 All mixer trucks shall be equipped with water meters. Additional water shall be added at the job site only with the specific approval of the Engineer.

#### 201.14 CONSTRUCTION JOINTS

201.14.1 Construction joints shall be located as shown on the drawings and at other points as may be necessary during the construction, provided that the location and nature of additional joints shall be approved by the Engineer. In general, joints shall be located at points of minimum shear, shall be perpendicular to the principal lines of stress, and shall have suitable keys having areas of approximately one-third of the area of the joints.

201.14.2 In resuming work, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance, or other soft material, and shall be roughened. The surface shall then be thoroughly washed with clean water and covered with at least one-half inch of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner in order not to splatter forms and reinforcing steel.

#### 201.15 FINISH OF CONCRETE SURFACES

201.15.1 All surfaces exposed to view shall be free from conspicuous lines, affects, or other irregularities caused by defects in the forms. If for any reason this requirement is not met, or if there are any conspicuous honeycombs, the Engineer may require the correction of the defects by rubbing with carborundum bricks and water until a satisfactory finish is obtained.

201.15.2 Immediately after removing the forms, all wires or other exposed metal shall be cut back of the concrete surface, and the depressions thus made and all honeycombs and other defects shall be pointed with mortar and then rubbed smooth. If the Engineer deems any honeycomb or other defect to require such treatment, the defective concrete shall be cut out to a depth sufficient to

expose the reinforcement and to afford a key for the concrete replacing that cut out.

## 201.16 CURING CONCRETE

201.16.1 Exposed surfaces of concrete shall be protected by approved methods from premature drying for a period of at least seven days. Curing compounds, when approved by the Engineer, shall be applied according to the manufacturer's recommendations. The Engineer may require the frequent wetting of the concrete and/or forms and the use of means to protect it from the direct rays of the sun.

## 201.17 PLACING REINFORCEMENT

201.17.1 All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil or grease, and shall present a clean surface. Bends and splices shall be accurately and neatly done and shall conform to American Concrete Institute Manual of Standard Practice for Detailing Reinforced Concrete Structures.

201.17.2 All reinforcing shall be placed in the exact position shown on the drawings and shall be held firmly in position by means of approved metal spacers and supports, by wiring to the forms, and by wiring the bars together at intersections with approved wire ties in order that the reinforcement will not be displaced during the depositing and compacting of the concrete. The placing and fastening of reinforcement in each section of the work shall be approved by the Engineers before any concrete is deposited in the section. Care shall be taken not to disturb the reinforcement after the concrete has taken its initial set.

## 201.18 FORMS

201.18.1 Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the form for exposed surfaces shall be sized and dressed lumber or metal in which all bolt and rivet heads are countersunk. In either case, a plain, smooth surface of the desired contour must be obtained. Undressed lumber may be used for backing or other unexposed surfaces, except inside faces of conduit.

201.18.2 The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar-tight, and if necessary to close cracks due to shrinkage, shall be thoroughly soaked in water. Forms for re-entrant angles shall be filleted, and for corners shall be chamfered. Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete is placed. The interior surfaces of the forms shall be adequately oiled with a non-staining mineral oil to insure the non-adhesion of mortar.

- 201.18.3 Form lumber, which is to be used a second time, shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete. Any bulging or warping shall be remedied, and all dirt, sawdust, shavings, or other debris within the forms shall be removed. No wood device of any kind used to separate forms will be permitted to remain in the finished work.
- 201.18.4 Temporary openings shall be placed at the bottom of the column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.
- 201.19 REMOVAL OF FORMS
- 201.19.1 Forms shall be removed in such manner as to insure the complete safety of the structure. No forms shall be removed except with the express approval of the Engineer. In general, this approval will be based on the following:
- 201.19.2 Forms on ornamental work, railings, parapets, and vertical surfaces which do not carry loads and which will be exposed in the finished work shall be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions.
- 201.19.3 Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions. No backfill shall be placed against walls, piers, or abutments, unless they are adequately supported or have reached the required strength.
- 201.19.4 Girder, beam, and joist soffit forms shall remain in place with adequate shoring underneath, and no construction load shall be supported upon, nor any shoring removed from any part of the structure under construction until that portion of the structure has attained sufficient strength to support safely its weight and the loads placed thereon.

**PART 202 - QUICK-SETTING FLOWABLE FILL**

202.1 MATERIALS

- 202.1.1 Quick-setting flowable fill shall be a sand-cement slurry consisting of the following materials in a one cubic yard mixture:

Type I Cement	100 pounds
Sand	2,925 pounds
Water	585 pounds
Master Builders Pozzutec 20 (ASTM C494, Type C and E)	80 ounces

- 202.1.2 NOTE: Can change somewhat due to type of sand used.
- 202.1.3 The combination of materials above shall be mixed in a ready-mix truck to produce the sand-cement slurry mixture.
- 202.1.4 Submittals shall be delivered to the City at a date set by the Engineer. Submittals shall include the items outlined in ODOT Specification 701.03.

202.2 CONSTRUCTION METHODS

- 202.2.1 For each cubic yard of quick-setting flowable fill material required, the amount of the mix components in the MATERIALS section shall be used to produce the sand-cement slurry mixture. The slurry mixture shall be mixed between 70 to 100 revolutions of the ready-mix truck.
- 202.2.2 To minimize segregation, all flowable fill material shall be re-mixed at the project site at mixing speed in the ready-mix truck for approximately two minutes immediately prior to discharge of the sand-cement slurry mixture. Re-mixing of the flowable fill slurry shall be done under the direction of the Engineer.

202.3 TESTING

- 202.3.1 Special Provisions, "Flowable Fill Testing Procedures" identifies the Ohio Ready-Mixed Concrete Association (ORMCA) Standards FF1(94), and FF4(94) which shall be used in the performance of field testing.
- 202.3.2 The following are the testing requirements for the quick-setting flowable fill:

Flow	Minimum = 4 ½ " inches
Compressive Strength (28 days)	Minimum = 25 pounds per square inch (psi)
	Maximum = 60 pounds per square inch (psi)

202.4 GENERAL

- 202.4.1 The time required before placing pavement over the cured quick-setting flowable fill is a minimum of six hours and/or whenever a minimum penetration value of 400 pounds per square inch (psi) is achieved. Penetrometer readings shall be taken with a Soiltest Mortar Penetrometer, Model CT -421A, or approved equal. The upper three inches of the area of the cured flowable fill mixture to be tested shall be removed prior to taking the penetrometer readings. The test value of record shall be the average of three tests.

## PART 203 - DUCTILE IRON PIPE, DUCTILE AND CAST IRON FITTINGS, AND VALVES

### 203.1 PIPE AND FITTINGS

203.1.1 Where ductile iron pipe (DIP) three (3) inches in diameter and larger is specified or required, it shall conform to, and be tested in accordance with, the current American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, ANSI/AWWA C151/A21.51.

203.1.2 Length of joints shall be either eighteen or twenty feet. The minimum standard thickness class of each size pipe shall be as follows:

Pipe Size	Thickness Class
4" thru 8"	51
10" and larger	50

203.1.3 For 16-inch and larger Water Ductile Iron Pipe, all bell and spigot joints shall be electrically bonded, using a #4 AWG bare copper wire of adequate length to braze, using a #15 cadweld cartridge, the copper wire to the bare metal at the bell and spigot. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.4 For 16-inch and larger Water Ductile Iron Pipe, junction box test stations shall be furnished and installed, EXCEPT, no magnesium anode banks shall be furnished or installed. Junction box test stations shall be installed in accordance with the stationing shown on the Schedule of Anode Spacing. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.5 Fittings for ductile iron pipe shall be cast or ductile iron. Cast iron and ductile iron fittings shall conform to the American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, ANSI/AWWA C110; or the American National Standard for Ductile-Iron Compact Fittings, 3-inch through 48-inch, ANSI/AWWA C153. The length of all solid sleeves (both AWWA C110 and C153) shall be the longest length listed in the AWWA C110 specification (12-inch length for 3-inch through 12-inch sleeves, 15-inch length for 14-inch through 24-inch sleeves, and 24-inch length for 30-inch through 48-inch sleeves).

203.1.6 Interior of all sanitary sewer 15-in and larger ductile iron pipe shall be lined with 40 mils of ceramic epoxy ("Protecto 401", or equal).

#### 203.1.6.1 Condition of Ductile Iron Prior to Surface Preparation.

All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall

have been applied to the first six inches of the exterior of the spigot ends.

#### 203.1.6.2 Lining Material.

The Standard of Quality is Protecto 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

- A. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
- B. The following test must be run on coupons from factory lined ductile iron pipe:
  - 1. ASTM 8-117 Salt Spray (scribed panel) - Results to equal 9.0 undercutting after two years
  - 2. ASTM G-95 Cathodic Disbondment 1.5 volts @ 7rF. Results to equal no more than 0.5mm undercutting after 30 days.
  - 3. Immersion Testing rated using ASTM 0-714-87.
    - a. 20% Sulfuric Acid - No effect after two years.
    - b. 140°F 25% Sodium Hydroxide - No effect after two years.
    - c. 160°F Distilled Water - No effect after two years.
    - d. 120°F Tap Water (scribed panel) 0.0 undercutting after two years with no effect.
- C. An abrasion resistance of no more than 3 mils (.075mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

#### 203.1.6.3 Application

##### A. Applicator

The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

##### B. Surface Preparation

Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance which can be removed by solvent, shall be solvent cleaned to remove those

substances. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.

#### C. Lining

After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

#### D. Coating of Bell Sockets and Spigot Ends

Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

#### E. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. **To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.**

#### F. Touch-Up & Repair

Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

#### 203.1.6.4 Inspection and certification

##### A. Inspection

1. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
2. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defect found shall be repaired prior to shipment.
3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

##### B. Certification

The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was a specified.

#### 203.1.6.5 Handling

Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

### 203.2 JOINTS

- 203.2.1 Cast iron and ductile iron pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Fittings shall have mechanical joints, unless otherwise specified. Flanged ends shall be used only where specifically noted on the Drawings except that the valve connection end of all tapping sleeves shall be flanged.
- 203.2.2 Mechanical joints and push-on joints shall conform to, and be tested in accordance with, the American National Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings, ANSI/AWWA C 1111 A21 .11 .
- 203.2.3 Flange joints shall conform to the American National Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI 816.1.
- 203.2.4 Where ductile or cast iron pipe is to be tapped, a split case iron or a flexible stainless steel tapping sleeve may be used.



- 203.2.5 Split case iron tapping sleeves shall be of 150 psi working pressure. Sleeve body shall be cast iron conforming to ANSI AWWA C110. Sleeve shall have mechanical joints conforming to AWWA C111 on the run and a flange branch conforming to ANSI 816.1, Class 125. End gaskets shall be natural rubber or neoprene material conforming to ANSI AWWA C111.
- 203.2.6 Flexible stainless steel tapping sleeves shall be rated at 150 psi pressure, with flanges meeting AWWA C207. Assembly shall be NSF or UL rated. Bolts, nuts, and washers shall be stainless steel. Gaskets shall conform to ANSI AWWA C111.
- 203.2.7 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material as specified under ANSI AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI AWWA C207.
- 203.2.8 Where restrained joints are specified or required, they shall be of a mechanical type or push-on type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSI AWWA rated. Set screw type retainer glands will not be permitted.
- 203.3 COATING, LINING AND POLYETHYLENE WRAP
- 203.3.1 Cast iron and ductile iron pipe and fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with American National Standard for Cement Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water, ANSI AWWA C104/A21.4.
- 203.3.2 All ductile iron and cast iron pipe and fittings shall be encased with polyethylene tube in accordance with AWWA C105, American National Standard for Polyethylene Encasement for Ductile Iron Piping for water and other liquids. Polyethylene film shall be manufactured of virgin polyethylene material conforming to ASTM D-1248, Type 1, Class A or C, Grade E. Thickness shall be not less than 8 mils (0.008 in.). Tensile strength shall be 1200 psi, minimum. Elongation shall be 300 percent, minimum. Tube length shall provide at least one (1) foot of overlap at each joint of pipe. Tape shall be a 2" width, plastic backed adhesive tape, Polykan #900, Scotch #50, or equal. Tube width for each pipe diameter shall be as follows:

NOMINAL	PUSH-ON JOINT FLAT	MECHANICAL JOINT FLAT
PIPE SIZES	TUBE WIDTH	TUBE WIDTH
4"	14"	16"
6"	17"	20"
8"	21"	24"
10"	25"	27"
12"	29"	30"
14"	33"	34"
16"	37"	37"
18"	41"	41"
20"	45"	45"
24"	53"	53"
30"	67"	67"
36"	81"	81"

#### 203.4 GATE VALVES

203.4.1 Where gate valves are specified, they shall be resilient-wedged.

203.4.2 Resilient-wedged gate valves shall conform to and be tested in accordance with ANSI/AWWA C509. The valve shall be bubble tight from either direction at the rated design pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber seat bonded or mechanically attached to the disc; non-rising stem with 2-inch AWWA operating nut; counter clockwise opening, "O" ring stem seals, and corrosion resistant interior coating acceptable for potable water use.

203.4.3 Where specified, flanges shall be ANSI B16.1, Class 125, cast iron. Mechanical Joint, push-on, and bell and spigot joints are allowed.

#### 203.5 BALL VALVES

203.5.1 Ball valves shall conform to and be tested in accordance with the AWWA Standard for Ball Valves, ANSI/AWWA C507. Where ball valves are specified or required, they shall be: double-seated with natural or synthetic rubber located in the valve body. Ball seating surfaces shall be stainless steel; designed for 150 psi working pressure; flanged end; "O" ring rotor bearing seals; constructed of high-tensile strength cast iron; counter-clockwise opening; equipped with totally enclosed manual operators, and torque limiting control device. Valves shall be tested by, and shall withstand without leak, a hydrostatic pressure of: (1) 250 psi on the valve body with rotor in the open position; and (2) 150 psi on the side of the valve with the opposite side open to atmosphere. Six (6) copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve.

203.5.2 Valves shall be bubble tight at rated pressure with flow in either direction.

- 203.5.3 Where flanges are specified, they shall be ANSI B16.1, Class 125, cast iron flanges.
- 203.6 BUTIERFL Y VALVES
- 203.6.1 Butterfly valves shall be of the tight-closing, rubber-seat type, shall have a rated pressure of 150 psig, and shall be bubble-tight at this pressure with flow in either direction. Valve opening shall be counter-clockwise. The valves shall conform to and be tested in accordance with the AWWA Standard for Rubber-Seated Butterfly Valves, ANSIIAWWA C504, Class 150B. The valve body shall be of the short-body flange type, constructed of cast iron conforming to either ASTM A126, Class B, or ANSIIASTM A48, Class 40 or ductile iron ANSIIASTM A536, Grade 65-45-12. Flanges shall be ANSI B 16.1, Class 125, cast iron flanges. Valve Discs shall be constructed of alloy cast iron conforming to ANSIIASTM A436, Type 1, or cast iron conforming to ANSIIASTM A48, Class 40, or ductile iron ANSIIASTM A536, Grade 65-45-12. Valve shafts shall be constructed of 18-8, Type 304 or 316 stainless steel, ANSIIASTM A296, Grade CF8, or monel. Valve seats shall be body mounted and shall be of natural or synthetic rubber compound with mating seat surfaces of 18-8, Type 304 or 316 stainless steel, or alloy cast iron conforming to ANSIIASTM A436, Type 1, or bronze Grade A, O, or E. Valve bearings shall be corrosion resistant and self-lubricating.
- 203.6.2 Interior surfaces of the valve, except seating surfaces, shall be epoxy coated in accordance with AWWA Standard for Protective Interior Coatings for Valves and Hydrants, AWWA C550. Exterior surface of the valve shall be painted with two (2) coats of asphalt varnish conforming to Federal Specifications TI-V-51C. For non-buried service, exterior surface shall be coated with two (2) coats of epoxy, not zinc chromate.
- 203.6.3 Performance, hydrostatic and leakage tests shall be conducted in strict accordance with ANSIIAWVVA C 504, except that the leakage tests as outlined in Section 5.3 are to be conducted on both faces of the disc.
- 203.6.4 Six (6) certified copies of the manufacturers detail drawings shall be submitted for approval prior to delivery of the valve.
- 203.6.5 Six (6) certified copies of the test results, signed by a registered professional engineer, are to be furnished to the Engineer.
- 203.7 MANUAL OPERATORS FOR BALL VALVES AND BUTIERFLY VALVES
- 203.7.1 Manual Operators for Ball and Butterfly valves shall be totally enclosed, permanently lubricated, counter-clockwise opening, and designed for buried or submerged service. Manual Operators shall be equipped with a 2" square AWWA operating nut with a removable handwheel complete with spinner and an open-Closed indicator, suitable for one-man operation at 150 psi unbalanced across the valve. Manual Operators shall be either worm gear or

traveling-nut type, and shall conform to AWWA C507 for Ball Valves or AWWA C504 for Butterfly Valves.

- 203.7.2 Manual Operators for Ball and Butterfly Valves 16" and larger shall be equipped with a Torque Limiting Control Device. The device shall be mounted directly on the operating nut for valves in vaults and on top of the extension shaft for buried valves. The device shall be secured to the operating nut with two setscrews. The device shall dedutch at 200 lb-ft of input torque in either direction of rotation. The device shall be designed for permanent buried or submerged service. Declutch and reset shall be automatic. Repeatability shall be within 5 percent of original rating for a minimum of 1000 cycles. Certified proof-of-design test reports shall be furnished for the device.
- 203.8 AIR RELIEF VALVES
- 203.8.1 Where air relief valves are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 150 psi working pressure, tested to 300 psi, size shown on plans. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor.
- 203.9 CHECK VALVES
- 203.9.1 Where check valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Unless otherwise specified, all check valves installed in pump or lift stations shall be equipped with position indicator. Disk shall be coated rubber and body shall be epoxy coated. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, bell and spigot, or flanged).
- 203.10 3-WAY FIRE HYDRANTS
- 203.10.1 Where fire hydrants are specified, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSIIAWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 5 1/4 -inch compression main valve; 6-inch inlet connection; standard bell or mechanical joint hub; four-foot six-inch bury length, or as specified on drawings; two 2 1/2-inch hose nozzles with National Standard threads; one 4-inch pumper nozzle with City Standard threads (refer to attached Standard Detail for Fire Hydrants); "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

2A03.10.2 Where fire hydrant extensions are specified or required, they shall be of proper design to accommodate the make of fire hydrant installed.

203.11 FOUR-WAY FIRE HYDRANT

203.11.1 Where four-way fire hydrants are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 8-inch inlet connection; bell, flange, or mechanical joint inlet; four-foot six-inch bury length; two 2 1/2-inch hose nozzles with National Standard threads; two 4-inch pumper nozzles with Tulsa Standard threads; "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

203.11.2 Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the make of fire hydrant installed.

203.12 BLOW-OFF HYDRANT

203.12.1 Where blow off hydrants are specified or required, they shall be constructed in accordance with Construction Standard Blow-off Hydrant.

## **PART 204 - STEEL PIPE AND FITTINGS**

204.1 GENERAL

204.1.1 Where steel pipe is specified or required, it shall conform to the AWWA Standard for Steel Water Pipe, 6-Inches and Larger, AWWA C200. No steel less than 33,000 psi specified minimum yield strength shall be permitted. All pipe shall be hydrostatically tested in accordance with AWWA C200. Mill Test Reports shall be furnished and the hydrostatic test pressure shown on shop fabrication drawings. AWWA Designation C200 shall govern the testing. Pipe length shall be not less than 35 feet per joint, except for specials, unless otherwise noted. There shall be no more than one longitudinal or girth seam per section. Nominal pipe diameter and steel thickness shall be as specified on the drawings. The diameter shown is the required inside diameter of cement-mortar lining. All pipe shall be manufactured by an established manufacturer who has had at least three (3) years of experience in successfully building this type of pipe. Openings for air valves, main connections, and blow-off connections shall be provided with suitable reinforcements around the opening, welded to the body of the pipe in accordance with AWWA Manual M11. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material listed above as specified under AWWA C200. All bolts shall be carbon steel ANSIIASTM A307, Grade A

only, in accordance with ANSI/AVVVVA C207. For corrosion monitoring of steel pipe, junction box test stations shall be furnished and installed. Magnesium anode banks shall be furnished and installed where specified in the plans. Junction box test stations and anode banks shall be installed in accordance with the stationing as shown on the Schedule of Anode Spacing in the plans.

- 204.1.2 All steel pipe shall be manufactured with ends of true circular shape, free from indentations, projections, or roll marks for a distance of eight inches (8") from the end of the pipe. This shall be done by hydraulic expansion or some other method satisfactory to the Engineer. The outside diameter of the pipe shall be true enough in dimension to permit the passage for a distance of eight inches (8") from the end of the pipe a ring gauge with a bore three-thirty seconds of an inch larger than the outside diameter of the pipe.
- 204.1.3 Where steel fittings or specials are specified or required, they shall conform to all of the steel pipe specification requirements and to the AVVVVA Standard for Dimensions for Steel Water Pipe Fittings AWWA C208. Where fittings and specials are fabricated from mill pipe, they shall be fabricated from pipe hydrostatically tested in accordance with AWWA C200 with mitered joints dye checked for welding flaws. Changes in line and grade shall be made by steel specials or in the joints. Joint deflection shall not exceed that as recommended by the manufacturer. Inside diameter of steel specials and fittings shall be the required inside diameter of cement-mortar lining.
- 204.1.4 Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of six inches each side of the cut and the pipe surface shall be cleaned and brushed to bright metal. After welding, the inside lining shall be replaced in accordance with AWWA C602.
- 204.1.5 Minimum thickness of steel pipe shall be 0.25 inches. The minimum thickness standard in inches for each following size pipe shall be as follows:

Minimum Thickness - Inches for Grade of Steel

Nominal Pipe	A-283 Gr. D	A-53 Gr. B	A-139 Gr. C
Diameter	A-570 Gr. 33	A-135 Gr. B	A-572 Gr. 42
6"- 30"		A-139 Gr. B	
		A-36	
36"	0.313	0.250	0.250
42"	0.313	0.281	0.250
48"	0.375	0.313	0.281
54"	0.438	0.375	0.313
60"	0.500	0.406	0.344
66"	0.500	0.438	0.375
72"	0.563	0.500	0.406

204.1.6 The design criteria for steel pipe thickness is based on 150 psi working pressure plus a 75 psi allowance for water hammer. Maximum depth of cover shall be 12 feet. Depth of cover in excess of 12 feet shall require special design.

## 204.2 JOINTS

204.2.1 Steel Pipe and fittings shall have one of the following type joints: slip joint ends for field lap welding, single beveled ends for field butt welding, double beveled ends for field butt welding, "O" ring bell and spigot joints, or plain ends for mechanically coupled field joints. Flange ends shall be used only when noted on the drawings.

204.2.2 Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water Pipe Joints, AWWA C206. Slip joints for field lap welding shall be sized to provide a tolerance of not less than 0.09 inches and not more than 0.41 inches difference in measurement between the outside circumference of the spigot end and the inside circumference of the bell end.

204.2.3 Mechanically coupled joints shall consist of Dresser Couplings, Style 38, or equal, or as specified on the drawings. The harness lugs, tie bolts, and nuts shall conform to AWWA M11 Steel Pipe Design and Installation, Par. 19.8.

204.2.4 Bell and spigot joints with rubber gasket shall conform to the AWWA Standard for Steel Water Pipe 6-Inches and Larger, AWWA C200 and the AWWA Steel Pipe Manual, Mil. The gasket shall be a continuous "O" ring design of natural rubber or neoprene and shall be of suitable cross-section and size to assure a watertight joint. Acceptable bell and spigot joints for all steel pipe diameters and thicknesses shall be the "O" Ring-Bar Type, or the "O" Ring-Carnegie Section, or rolled groove type joint. Bell and spigot ends shall be properly sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the difference in diameter between outside of spigot and inside of bell at normal engagement is not less than .03" and not more than 0.10" as measured on circumference with a diameter tape. Shop applied interior lining on the bell end of the pipe shall be held back a minimum distance of the spigot engagement + 1-1/8" for the Bar and Carnegie Type Joints. Hold back for the rolled groove joint shall be the spigot engagement + %". Interior lining for the spigot, shall be continuous to the end. Field replacement of the interior joint linings shall be in accordance with Section 203.4. of these specification for cement-mortar linings. All "O" Ring joints shall be electrically bonded using a #4 bare copper wire, 6" length #15 cadweld cartridge brazed to bare metal at the bell and spigot or equal. Shop applied exterior coatings shall be held back in accordance with manufacturer's specifications. Field replacement of exterior coatings at the joints shall be in accordance with the AWWA Standard for Cold-Applied Tape Coatings for Special Sections, Connections, and Fittings, for Steel Water Pipelines, AWWA C209, or AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, or AWWA

C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied.

204.2.5 Where steel pipe is to be tapped, a split tapping saddle of 150 psi working pressure shall be used. The saddle body shall be heavy welded ANSIIASTM A36, or ANSIIASTM A285, Gr. C steel with flange conforming to ANSI/AWWA C207, Class D. The gasket shall be natural rubber or neoprene design in a continuous ring of suitable cross-section, and sized to assure a watertight joint. The interior and exterior surfaces of the saddle body shall be shop coated with a fusion-bonded epoxy. The exterior coating or wrap on steel pipe shall be removed to bare metal beneath the entire area to be covered by the sleeve.

204.2.6 Flanged joints shall conform to the AWWA Standard for Steel Pipe flanges, AWWA C207, Class D.

### 204.3 EXTERIOR COATING

204.3.1 The exterior coating on steel pipe and fittings shall be in accordance with Coal Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, AWWA C203; or Tape Coating Systems for the Exterior of Water Pipelines, AWWA C214 or cement-mortar coatings in accordance with AWWA C205, Cement-Mortar Protective Lining and Coating For Steel Water Pipe, 4" and Larger, Shop Applied. Where tape coatings are used, the total thickness shall be no less than 80 mils. Where cement-mortar coating is used, the thickness shall be not less than 3/4" and reinforced with spiral-wire, wire-fabric, or ribbon mesh reinforcement in accordance with AWWA C205, Sec. 2.1. A" above ground piping shall be cleaned, primed, and painted with an enamel, as shown in the plans. The total dry film thickness shall be 6 mils.

204.3.2 If field welding is used, the pipe joints shall be furnished with the outside coating held back, in accordance with standard joint detailed drawings. The coating and any touch up work shall be done under the direction of the coating manufacturer, and as approved by the Engineer.

### 204.4 INTERIOR LINING

204.4.1 The interior lining shall be installed in the field in accordance with AWWA C602, Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place; or shop applied in accordance with AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied. The lining shall be 3/8" thick for diameters through 36", and 1/2" thick for 42" and larger, whether shop or in place lined. Tolerances shall be in accordance with the applicable AWWA standards. Coal-tar enamel and coal tar epoxy interior linings will not be permitted.

204.4.2 Where in place cement-mortar lining is used, the contractor shall furnish all materials, labor, equipment, prepare the interior surface, and machine place



the mortar lining in the pipe. The lining at valves, specials, and bends may be hand sprayed or troweled, or hand applied as required. The lining shall be maintained in a moist condition while curing. The contractor shall be responsible for any extended curing time until acceptance by the Engineer. No additional payment shall be made for any extended curing period.

204.4.3 Where in-place mortar lining is cracked or delaminated from steel cylinder pipe, contractor shall repair broken or delaminated areas with Hilti 2-part epoxy, or approved equal.

#### 204.5 STRUTTING AND BRACING

204.5.1 Strutting and bracing shall be provided on all specials, fittings, and straight pipe, where shop lined or coated with cement mortar, so as to limit the pipe deflection to 2% maximum of inside diameter. A minimum of three strutting braces shall be installed in each standard pipe joint. For pipe 54" and larger in diameter, the strutting shoes at each bearing point shall be minimum 4 feet long, parallel to the longitudinal pipe axis. The strutting shall remain in place until all compacting and backfilling has been completed. Where In Place cement mortar lining is to be installed, sufficient strutting braces subject to the approval of the engineer, shall be installed at the shop to insure against pipe deformation.

### **PART 205 - REINFORCED CONCRETE PIPE AND FITTINGS**

#### 205.1 REINFORCED CONCRETE PIPE AND FITTINGS FOR WATER AND SANITARY SEWER LINES

205.1.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per AWWA C301, for water or sanitary sewer lines, they shall be designed, manufactured, and tested in accordance with the AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and other Liquids, AWWA C303. All pipe shall be manufactured by an established manufacturer who has had at least three years experience in successfully building this type of pipe. All specials and fittings shall be built to the details furnished by the manufacturer and approved by the Engineer. Each special and each length of straight pipe shall be plainly marked to indicate the head for which the pipe is designed and to indicate where the pipe will be used by reference to the layout drawings. All closure fittings shall be furnished with an 18-inch flanged access manway with an 18-inch steel blind flange. 6-inch screw type hand hole fittings will not be permitted.

205.1.2 Sanitary Sewer Prestressed Concrete Cylinder Pipe (PCCP) or Reinforced Concrete Pipe(RCP) shall have the following interior lining systems or equal:

The lining system shall be a plural component. 100% solids, moisture tolerant, epoxy primer followed with a plural component, 100% solids, polyurethane top coat. The primer shall be a Zebron Low Temperature Epoxy (ZLTE) and the topcoat shall be Zebron #486 polyurethane as manufactured by Zebron Corporation, Anaheim, CA or approved equal. The lining system shall be suitable for application by airless spray. The primer shall be applied to a thickness of 2 to 3 mils and can be top coated when the primer becomes tacky (sticky to the touch) or can be top coated during the next 8 hours. When waiting up to 8 hours to top coat the primer, special care must be taken to assure the surfaces to be top coated are not exposed to moisture, dust, or other contaminants. The topcoat shall be applied to a 50-mil thickness and shall not exhibit running, sagging, or shrinking. The lining system shall be compatible with application to cured or green (one day old) Portland cement concrete or mortar. The applied lining shall formed impermeable, pin-hole-free. Membrane, monolithically applied with tight adherence to the concrete or mortar. The cured lining shall not peel or spall from the concrete or mortar surfaces. The lining system shall be resistant to abrasion during normal pipe handling and installation.

- 205.1.3 All concrete or mortar substrates must be sweep-abrasive grit blasted to create adequate profile then made dust free. All surfaces to be lined must be free of any oil, grease, or other deleterious materials. The surface must be dry to the touch (no standing water), but can have some surface discoloration due to moisture.
- 205.1.4 The two-component epoxy lining for PCCP shall be tested in accordance with National Association of Corrosion Engineers Standard for Discontinuity (Holiday) Testing of Protective Coatings. Results of the Discontinuity Testing shall be furnished to the City. Any defects shall be repaired and retested.
- 205.1.5 RCP and fittings for water lines shall be designed for the following conditions (minimum): Normal operating pressure equal to 150 psi plus 50% for surge pressure plus earth load resulting from actual backfill depth, but not less than 8 feet plus external live load equal to AASHTO HS 20 loading. The thickness of the mortar coating shall provide a minimum cover of 1 inch over the reinforcing steel.
- 205.1.6 Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, ANSIIAWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids, AWWA C 303.
- 205.1.7 Where concrete pressure pipe ANSIIAWWA C301, Steel Cylinder Prestressed Concrete or Pretensioned Concrete Pressure Pipe, AWWA C303 is to be tapped, the tapping saddle shall be fabricated in accordance with the American Water Works Association Manual M-9, and as recommended by manufacturers of Concrete Pressure Pipe. Saddle shall provide grout

gaskets and grout opening to enable filling the wall space between saddle and pipe wall with grout, to assure complete protection of the steel pipe wall. The saddle shall also provide gland assembly, including gasket and flange, to insure a tight seal.

205.1.8 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provisions is made for closing the openings. Blind flanges shall be fabricated from material as specified under AVVWA C200. All bolts shall be carbon steel ASTM A307, Grade A only, in accordance with ANSIIAVVWA C207.

## 205.2 REINFORCED CONCRETE PIPE AND FITTINGS FOR STORMWATER AND SANITARY SEWERS

205.2.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per ASTM C76, for storm and sanitary sewers, except as herein modified, they shall be designed, manufactured, and tested in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain; and Sewer Pipe. Pipe shall be a minimum Class III. Pipe length shall be no less than 6'-0" except for shorts and specials. Pipe sections connected to a manhole or structure shall be no more than 4' - 0" in length, as measured from the inside face of the structure to the point of flexure of the joint. Elliptical reinforcement is not allowed. At least three circumferential reinforcing bars shall be provided in each pipe bell equal in area to an equivalent length of outside cage in the pipe barrel. Concrete shall have a minimum 28-day compressive strength of 6,000 psi, and absorption not to exceed six percent.

205.2.2 Testing shall be observed and reported by an independent testing laboratory approved by the Engineer. One (1) Three-Edge Bearing Test in accordance with ASTM C497 shall be performed on a representative sample of each diameter and class of pipe to be furnished. One (1) absorption test in accordance with ASTM C497 shall be performed for each 300 tons of pipe manufactured, not less than one (1) test per day's production. Four (4) concrete cylinders or core samples shall be tested for compressive strength from each days production, two at 7 days and two at 28 days. An in-plant hydrostatic test in accordance with ASTM C361 shall be performed on each section of pipe and each pipe joint at an internal hydrostatic head of 25 feet. The joints shall be tested for a minimum period of one (1) hour under constant pressure as specified. Each pipe unit that satisfactorily passes all hydrostatic testng shall bear the seal of the testing laboratory. This seal does not constitute acceptance of the pipe installation, which will be subjected to further testing and inspection in the field.

205.2.3 In lieu of the in-plant hydrostatic testing of each joint, the Contractor may substitute the following procedure: (1) Perform one in-plant hydrostatic test per days production, in accordance with the previously specified criteria; and (2) Perform an air test on each joint in the field after assembly, in accordance

with the Oklahoma Department of Environmental Quality Standard Air Test Procedure. The Contractor shall furnish all air test equipment. Testing and test conclusions shall be verified by the Engineer. The Engineer reserves the right to require additional in-plant hydrostatic testing.

- 205.2.4 Reinforced concrete pipe and fittings for storm sewer shall be jointed in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe. Joints shall be concrete bell and spigot, employing a rubber gasket and cement mortar formed by a diaper. Rubber gaskets shall be either a standard o-ring gasket or a Forsheda pre-lubricated gasket, or equal. For the o-ring gasket, the spigot end shall contain a groove to confine and compress the gasket on four surfaces when the joint is in final position. The Forsheda joint shall be designed and installed in accordance with the manufacturer's recommendations.
- 205.2.5 Reinforced concrete pipe and fittings for sanitary sewer shall be jointed in accordance with AWWA C302, Reinforced Concrete Pressure Pipe, Non-cylinder type. Joints shall be Steel End Ring with Spigot Groove and O-ring gasket, and include cement mortar formed by a diaper.

## **PART 206 - VITRIFIED CLAY PIPE AND FITTINGS**

### 206.1 PIPE AND FITTINGS

- 206.1.1 Where vitrified clay pipe (VCP), fittings and in-line tees are specified or required, they shall conform to the Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated ANSIIASTM C700. Testing shall be in accordance with methods of Testing Clay Pipe, ANSIIASTM C301.
- 206.1.2 Where vitrified clay pipe is being installed, in-line tees for future connections to the sanitary sewer shall be manufactured specifically for vitrified clay pipe.

### 206.2 JOINTS

- 206.2.1 Vitrified clay pipe shall be jointed with material conforming to the Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings, ANSIIASTM C425. All jointing materials shall be used in accordance with the manufacturer's instructions and subject to the approval of the Engineer.
- 206.2.2 Where it is necessary to connect vitrified clay pipe to ductile iron pipe a rigid type adapter shall be used. Only the following adapters will be permitted: Dickey OPB- VC x 01, Dresser Style 39, and Rockwell Omni. Flexible couplings will not be permitted.

## **PART 207 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE**

- 207.1 Where polyvinyl chloride (PVC) pipe four (4) inches in diameter through twelve (12) inches in diameter is specified or required, it shall conform to and be tested in accordance with AWWA C900, "AWWA STANDARD for POLYVINYL CHLORIDE (PVC) PRESSURE PIPE, 4 IN. THROUGH 12 IN., FOR WATER", as herein modified. PVC water pipe shall be approved by the Underwriters Laboratory Sanitation Foundation Testing Laboratory for potable water pipe. Polyvinyl chloride water pipe shall be restricted from use adjacent to arterial streets . .
- 207.2 PVC pipe shall conform to pressure Class 200 (equivalent to Dimension Ratio 14) and shall have an outside diameter (OD) equal to the OO of equivalent size ductile iron pipe.
- 207.3 PVC pipe shall have integral wall-thickened bell ends and shall be jointed using one-piece elastomeric gaskets. Solvent cement jointing shall not be permitted.
- 207.4 Fittings for PVC pipe shall be polyethylene wrapped ductile or cast iron conforming to Part 202 of these specifications. The use of PVC fittings shall not be permitted.
- 207.5 Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with AWWA C900, and that it meets the approval of the "NSF".
- 207.6 Where restrained joints are required, they shall be of a mechanical type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSIIAWVA approved. Setscrew type retainer glands will not be permitted.

## **PART 208 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE**

- 208.1 Where polyvinyl Chloride (PVC) pipe eight (8) inches in diameter through fifteen (15) inches in diameter, fittings and in line tees are specified or required for sewer service, it shall conform to and be tested in accordance with ASTM D3034 "Type PSM Polyvinyl Chloride Sewer Pipe and Fittings" for standard dimensional ration (SDR) of 35. Minimum pipe stiffness for all sizes shall be 46 psi.
- 208.2 Where polyvinyl chloride (PVC) pipe 18-inches in diameter through 36 inches in diameter is specified or required for sewer service it shall conform to and . be tested in accordance with ASTM F679, Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings Minimum pipe stiffness shall be 46psi.

- 208.3 The PVC sewer pipe shall be supplied in 12.5 foot, or 20 foot laying lengths as specified.
- 208.4 Where it is necessary to connect PVC sewer pipe to ductile iron pipe and AWWA C110 long body solid sleeve shall be used with a special gasket for the PVC pipe. Flexible couplings will not be permitted.
- 208.5 Where PVC sewer pipe is being installed, the fittings for the service line and the in-line tees for future service connections shall be manufactured and specifically designed for Schedule 40 PVC service lines.
- 208.6 The manufacturer shall maintain quality control through regularly scheduled testing in accordance with all referenced ASTM standards. Testing for flattening and the pipe stiffness shall be performed on one test specimen for each size and class of pipe produced for the project. Certifications shall be furnished that the material was manufactured, sampled, tested, and inspected in accordance with all applicable specifications. The certifications shall indicate the manufacturer's production code from which the plant location, machine, and date of manufacture can be identified.

## **PART 209 - CASTINGS**

- 209.1 Gray iron castings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and applicable sections of Drainage Structure Castings, AASHTO M 306, current edition. All castings, including manhole steps, lamphole covers, water meter lids, manhole frames and lids, adjustment rings and valve boxes shall be Class 35B iron.
- 209.1.1 Iron class shall be determined using only those guidelines outlined in ASTM A48. Tensile specimens shall be obtained using AASHTO M306 Para 9.1.4, Acceptance on the Basis of Test Bars Cut from Portions of Units Supplied to Purchaser. Where samples are too thin and cannot be obtained under ASTM M306 Para 9.1.4, specimens shall be obtained under ASTM M306 Para 9.1.3 Acceptance on the Basis of Cast-on Test Bars. Elapsed time during tensile test shall follow ASTM A48 para 14. Tensile test specimens shall fit the holders of the testing machine in a way such that the load will be axial.
- 209.1.2 Additionally, castings that are rated for traffic loadings within dedicated public rights-of-way or other locations subject to vehicular traffic must pass an AASHTO proof load test that can maintain a 40,000 lb proof load for one (1) minute, applied on a 9"x9" contact area in the center of the casting. The load shall be applied at a constant rate requiring a minimum of 30 seconds to reach the 40,000 lb level. Following this test the casting shall be visually inspected for cracks or permanent deformation which will be cause for rejection. Following this, the casting shall be loaded to failure.

- 209.1.3 Cost for tensile and proof load testing shall be borne by manufacturer, and testing shall be performed at a testing facility acceptable to the Engineer. All tests shall be witnessed by the Engineer.
- 209.2 Casting dimensions shall vary by not more than  $\pm 1/16$  inch per foot.
- 209.3 All bearings surfaces shall be machined to prevent rocking and rattling.
- 209.4 Where sealed manholes are specified, only McGard locking system with 5/8" - 11 thread which is keyed to City standard lock is allowed.
- 209.5 Only those castings which have been approved by the Department will be permitted. Approval for each casting shall consist of approved shop drawings, plus laboratory test reports of the tensile test and load test.
- 209.6 The City reserves the right to randomly select any castings for tensile and proof load testing from the foundry's local representative's yard. Such testing shall be at manufacturer's expense.

**PART 210 - CONDUIT**

- 210.1 Where conduit (also known as tunnel liner or pipe sleeve), 6 inches or larger, is specified or required, it shall be steel pipe, and be in accordance with AWWA C200, 3/8" wall thickness.

Conduit shall be sized according to the following:

Carrier Pipe		Conduit, ID
Water	Sanitary Sewer	
6"	6"	18"
8"	8"	20"
	10"	22"
12"		24"
	12"	26"
	15"	28"
16"		30"
	16"	32"
	18"	32"
24"	24"	42"
30"	30"	48"
36"	36"	54"
42"		60"
	42"	62"
	48"	68"

## **PART 211 - VAULT, PITS AND MANHOLES**

- 211.1.1 Concrete masonry units shall conform to, and be tested in accordance with the specifications for Concrete Masonry, Hollow Load Bearing Concrete Masonry Units, ANSI/ASTM C90, or Concrete Building Brick C55, Grade A.
- 211.1.2 Precast manholes shall conform to, and be tested in accordance with, the specifications for Precast Reinforced Concrete Manhole Sections, ANSIIASTM C478, flat slab top type.
- 211.1.3 Manhole adjusting ring shall be solid cast iron that fits in the standard City of Tulsa Sanitary Sewer manhole frame and the standard manhole lid fits in the adjusting ring.
- 211.1.4 Adjusting rings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and Drainage Structure Castings, AASHTO Designation: M306-89. Castings shall be Class 35-B iron and unpainted.
- 211.1.5 The contact surface between manhole ring and manhole frame and the contact surface between manhole ring and manhole lid shall be machined smooth to prevent rocking and rattling.
- 211.1.6 The two (2) inch manhole adjusting ring where specified shall have a minimum weight of 70 pounds and the three (3) inch manhole adjusting ring where specified shall have a minimum weight of 100 pounds.
- 211.1.7 Markings on all gray iron castings shall conform to AASHTO Designation M306-89. (AASHTO M306-89 states: Each casting shall be identified by the foundry showing): Name of Foundry, Country of manufacturer, ASTM Designation Number, Class by a number followed by a letter indicating the minimum tensile strength and size of test bar. (i.e. Class 35-B), Heat Number and Date. No other wording or marking of any kind other than those stated above or shown on the plan will be permitted on castings.
- 211.1.8 All sanitary sewer manholes and structures 5-foot I.D. or larger shall have an interior epoxy coating
- 211.1.9 **MANHOLE COATING** - This section specifies the insitu-coating of new concrete sanitary sewer manholes to provide protection against corrosion to the manhole interior. This section includes requirements for product and contractor qualifications, work, materials, and equipment required for surface preparation, repairs, and application of a monolithic solvent-free epoxy coating to specified surfaces.



211.1.10 SUBMITTALS - The following items shall be submitted to Engineer for approval:

- A. Technical data sheet and material safety data sheet (MSDS) on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
- B. Contractor Qualifications:
  - 1. Manufacturer certification that Contractor has been trained and approved in the handling, mixing and application of the products to be used.
  - 2. Certification that the plural component spray equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Contractor's personnel have been trained and certified for proper use of the equipment.
  - 3. Three (3) recent references of Contractor projects of similar size and scope indicating successful application of a high-build solvent-free epoxy coating by plural component spray application in underground concrete structures.
  - 4. Proof of any necessary federal, state or local permits or licenses necessary for the project.
  - 5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

#### 211.1.11 DELIVERY, STORAGE, HANDLING AND SITE CONDITIONS

- A. Protective coating materials are to be stored and handled according to their material safety data sheets.
- B. Contractor shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

#### 211.1.12 WARRANTY

Contractor shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work

caused by such defects or the repairing of same, at his own expense and without cost to the City.

211.1.13 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Minimum of 28 days cure time.

211.1.14 MANUFACTURER

- A. Raven Lining Systems, Inc., Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311, or equal.

211.1.15 REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Authority and protective coating Contractor. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.

211.1.16 PROTECTIVE COATING MATERIAL

- A. Raven Lining Systems' Raven 405 epoxy coating system, or equal.

Product type	Amine cured epoxy
Color	Light Blue
Solids Content (vol %)	100
Mix Ratio	3:1
Compressive Strength, psi	18,000
Tensile Strength, psi	7,600
Flexural Modulus, psi	600,000
Hardness, Type D	88
Bond Strength - Concrete	>Tensile Strength of Concrete
Chemical Resistance to:	
Sulfuric Acid, 10%	Immersion Service
Sodium Hydroxide, 20%	Immersion Service
Municipal Wastewater	Successful pass L.A. County
	Sanitation District Coating Evaluation

211.1.17 SURFACE PREPARATION

- A. Contractor shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Contractor shall

notify Engineer of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

- B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
- C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Contractor shall utilize high pressure water cleaning equipment capable of 5,000 psi at 4 gpm.
- E. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified epoxy protective coating.

#### 211.1.18 APPLICATION OF REPAIR MATERIALS

- A. Repair materials shall meet the specifications herein. If using approved cementitious repair materials, such shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar. The repair materials shall be permitted to cure according to manufacturer recommendations.
- B. After leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.

#### 211.1.19 APPLICATION OF PROTECTIVE COATING

- A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

- B. The protective coating material must be spray applied with protective coating manufacturer approved heated plural component spray equipment by a Certified Contractor of the protective coating manufacturer.
- C. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, epoxy protective coating as further described herein. Spray application shall be to a minimum wet film thickness of 80 mils.
- D. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

#### 211.1.20 TESTING AND INSPECTION

- A. All manholes shall be vacuum tested after installation and prior to protective coating preparation and application.
- B. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM 04414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application. A log shall be submitted to Authority by Contractor that includes wet film thickness testing and protective coating material usage per manhole structure. This log is to be kept and certified by Contractor that material usage and WFT indicates proper coverage at a minimum of 80 mils per these specifications.
- C. After the protective coating has set hard to the touch it shall be inspected by Authority with high-voltage holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 8,000 volts (100 volts per 1 mil of film thickness applied) but may be adjusted as necessary to detect the induced holiday (refer to NACE RP0188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. Large areas may require additional surface preparation and spray application to

achieve minimum thickness. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

- D. At the Engineer's option, select structures may be subjected to adhesion testing and destructive testing for measurement of film thickness at no additional cost. Measurement of adhesion of the protective coating to the substrate can be made in accordance with ASTM 04541. Measurement of film thickness can be made from the dollies pulled during adhesion testing. Any areas detected to have inadequate adhesion shall be evaluated by the Engineer. Further tests may be performed to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor in strict accordance with manufacturer's recommendations.
- E. A final visual inspection shall be made by the Authority and Contractor. Any deficiencies in the finished coating shall be marked and repaired by Contractor according to the procedures set forth herein.

#### **PART 212 - SAND FOR CUSHION OR BACKFILL**

- 212.1.1 Sand shall be graded from fine to coarse, free from objectionable material, and contain not more than ten percent (10%) clay or loam by weight. One hundred per cent shall pass a three-quarter inch screen, and ninety-five per cent shall pass a number four screen.

#### **PART 213 - CRUSHED STONE FOR SURFACING, BASE COURSE, AND STABILIZATION**

- 213.1 Crushed stone shall consist of clean, tough, durable fragments, free from an excess of soft or disintegrated particles. Sampling shall be in accordance with the Standard Method of Sampling Aggregates, ANSIIASTM 0 75. Sieve analysis shall be performed in accordance with the method of Sieve Analysis, ANSIIASTM C136. Gradation to be used at each location will be specified by the Engineer. Crushed stone for aggregate base and surface course shall conform to the Oklahoma Department of Transportation Specifications for Highway Construction, and shall conform to the following gradations:

213.2 Percent Passing

Sieve Size	Type A	Type B
3"	-----	100
1-1/2"	100	40-100
3/4"	40-100	30-75
3/8"	30-75	25-60
NO.4	25-60	20-50
No. 10	20-43	15-35
No. 40	8-26	7-22

213.2.1 Crushed stone aggregate for stabilization and bedding shall conform to the following ASTM 0448 and C33 gradations:

213.2.2 Percent Passing

Sieve Size	Size #1	Size #467	Size #57
	3 1/2" to 1 1/2"	1 1/2" to NO.4	1" to NO.4
4"	100	-	-
3 1/2"	50-100	-	-
2 1/2"	25-60	-	-
2"	-	10	-
1 1/2"	0-15	95-100	100
1"	-	-	95-100
3/4"	0-5	35-70	-
1/2"	-	-	25-60
3/8"	-	10-30	-
NO.4	-	0-5	0-10

Sieve Size	Size #67	Size #7
	3/4" to NO.4	1/2" to NO.4
4"	-	-
3 1/2"	-	-
2 1/2"	-	-
2"	-	-
1 1/2"	-	-
1"	100	-
3/4"	90-100	100
1/2"	-	90-100
3/8"	20-55	40-70
NO.4	0-10	0-15

## **PART 214 - RIP RAP**

- 214.1        **QUALITY OF MATERIALS:** All stone for Rip Rap shall be either sandstone, limestone, or other hard stone of good quality that will not materially disintegrate under action of air or water. It shall weigh not less than 140 pounds per cubic foot as determined from the bulk specific gravity (saturated surface dry) of the sample in accordance with procedure in ANSI/ASTM Specifications C127-68, "Test for Specific Gravity and Absorption of Coarse Aggregate". Slabs or slivers shall not be used. Rocks shall be of angular shape. Gypsum, anhydrite, chert, shale, soft or weathered rock shall not be used. All stone material furnished shall be such that will yield hard, massive, heavy, durable stone, and shall be free from cracks, seams and other defects that would tend to unduly increase its destruction by natural causes. The contractor shall furnish for the work, an approved stone of good quality. The successful bidder shall, within fifteen (15) days after receipt of notice to proceed, submit to the contracting officer for approval, three (3) samples weighing not less than 150 pounds each, of the stone he proposes to furnish. The samples shall be fairly representative of the whole quarry. If it is proposed to furnish stone for more than one quarry, samples as stated above shall be furnished from each quarry. The City will notify the contractor of acceptance or rejection of the stone samples within ten (10) days after their submittal for approval. The submission of samples will not be required if the material is to be obtained from a source previously approved by the City from test and service records.
- 214.2        **TYPE "B":** Type "B" rip rap material shall be quarry-run rock free from overburden spoil, and no piece shall weigh more than 500 pounds. At least forty percent (40%) of any shipment shall consist of rocks weighing 100 pounds or more. Rock shall be graded so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids. Rock carrying dirt and fines less than 1/2-inch in maximum cross section, accumulated from interledge layers or from blasting or loading operations, will be accepted if such material does not exceed ten percent (10%) by weight.
- 214.3        **TYPE "C":** Type "C" rip rap material shall be quarry-run rock free from overburden spoil, and no piece shall weigh more than 1,000 pounds. At least forty percent (40%) of any shipment shall consist of rocks weighing 200 pounds or more. Rock shall be graded so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids.

### **SECTION END**

## **DIVISION III**

### **CONSTRUCTION SPECIFICATIONS**

#### **PART 301 - RIGHT-OF-WAY CLEARING AND RESTORING**

- 301.1 Work under this item shall include the removal and reconstruction or replacement of all obstructions affected by the construction of the project, including, but not limited to fences, retaining walls, patios, trash burners, signs, mail boxes, out-buildings, landscaping, etc. Any such obstructions that are not to be reconstructed are so designated on the drawings. Such shall be removed and disposed of by the contractor. All obstructions to be replaced or reconstructed shall be restored to substantially the same condition as existed prior to the construction except as otherwise noted. The Contractor shall remove and dispose of all debris, restore the grade of the surface of the earth as reasonably as may be done to the grade existing prior to construction, and upon completion of the work shall leave the site in as neat, clean and orderly condition as nearly as it was prior to construction as may be reasonably done. Contractor shall document by photographing all concrete and asphalt driveway crossings and marking the location by street address on each photo. Photographs shall be filed with City prior to commencing work. All costs of photography shall be included in Bid Item 301 a, Right-of-way clearing and restoring.
- 301.2 Passable surfaces across or along the construction vicinity shall be maintained at all times with gravel, steel mat or plate, or temporary bituminous surfacing material where a sidewalk, driveway, parking lot, street or alley previously existed. Pavement damaged by the Contractor's equipment shall be replaced to original condition. Gravel surfaces shall be replaced with the same.
- 301.3 If an obstruction is of public ownership, the Contractor shall notify the appropriate agency, and obtain any necessary permit or license forty-eight hours before beginning any operations affecting the obstruction. All work shall conform to the current standards and specifications of that agency, and shall be approved by the agency before completion of the project. At the Contractor's request, the Engineer will furnish information as to what licenses or permits are required.
- 301.4 **PAYMENT:** Payment for this item shall be made at the unit price bid per linear foot. Total footage shall be the total length of pipe, not including bores, fittings, or specials, as included in other items. No additional payment shall be made for alterations of utility mains, service lines, or appurtenances, unless specifically provided for elsewhere in the Contract Documents.

#### **PART 302 - EXCAVATION AND BACKFILL, UNCLASSIFIED**

- 302.1 The work under this item shall include all earth, shale, gravel, loose rock, solid rock, debris, junk and/or other material excavated or otherwise removed in the



preparation of the trench; all work in connection with the excavation, *removal* and subsequent handling and disposal of such material, regardless of its type, character, or condition; subgrade preparation, all sheeting, piling, shoring, bracing, and dewatering of trenches; protection of adjacent property; backfilling; sand cushion; grade base stabilization; all specified backfill consolidation; and other work necessary or required.

- 302.2 The trench shall be excavated so that the pipe can be laid to the alignment and grades shown on the drawings, or as directed by the Inspector. In dense or built-up areas or where unstable soils exist, the trench shall be *excavated* a maximum of one hundred (100) feet in *advance* of pipe laying. In open areas or where soil conditions permit, the trench excavation may be unlimited in *advance* of pipe laying, as approved by the Engineer. Opening of trenches in excess of the maximum requires specific approval of the Engineer. Trenches shall be dry when the trench bottom is prepared. The trench bottom shall be shaped so that *even* bearing is obtained for the barrel of the pipe with the bells unsupported. The standard trench width as shown on the attached Standard Detail, shall not be exceeded at any elevation below a point *twelve* inches *above* the top of the pipe. If for any reason this portion of the trench exceeds the permitted width and if the Inspector shall determine that cradling or encasement then is required, said concrete cradle or encasement shall be installed. Any part of the bottom of the trench *excavated* more than four inches below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Inspector. In the *event* suitable material is not available, sand shall be used. When rock is encountered and concrete cradle is required, it shall be *excavated* four inches below the bottom of the pipe and the trench refilled to grade with sand. When quicksand or other unstable earth is encountered, the Contractor shall *excavate* to sufficient depth to permit backfilling with Class "A" crushed stone in order to provide a stable base for the pipe. Trench safety shall be in accordance with applicable OSHA, State, and local regulations.
- 302.3 Bedding of pipe shall be as shown on the attached Standard Details. Sand shall be placed in the trench simultaneously on both sides of the pipe to an elevation of six inches *above* the top of the pipe, being carefully worked and hand-tamped around the pipe in order to consolidate the sand and assure excellent bedding. Backfill "material shall not be placed in the trench covering the sand cushion without prior approval of the Inspector.
- 302.4 For large diameter (18" and *above*) flexible pipe, bedding shall be in accordance with the Bedding Detail for Large Diameter Flexible Pipe. The pipe shall be bedded in soil-cement, installed *over* a 6-inch sand cushion. The bedding shall be installed to the top of the pipe for the full width of the *excavated* trench. The soil-cement shall consist of a mixture of sand, portland cement, and water. Each cubic yard of soil cement shall contain  $1\frac{1}{2}$  sacks of cement and approximately 70 gallons of water. Precautions shall be taken to prevent flotation. Movable trench supports shall not extend lower than the top of the pipe.
- 302.5 When the type of backfill material is not indicated on the Drawings or specified, the backfill may be made with the *excavated* material, provided that such

material, in the opinion of the Inspector is suitable for backfilling. In the event that excavated material is not suitable, sand or other approved material shall be used. From six inches above the pipe to eighteen inches above the pipe, the trench shall be backfilled by hand or by mechanical methods approved by the Inspector. Special care shall be used in placing this portion of the backfill to avoid damaging or moving the pipe. The remainder of the trench may be backfilled by mechanical methods. Backfilling operation shall be completed within one hundred (100) feet or less of the finished line at all times, as directed by the Inspector.

302.6 Unless otherwise directed by the Engineer, all trenches excavated across any sidewalk, driveway, parking lot or other paved area, across any traveled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be bedded and backfilled with Type A Crushed Stone (1-1/2" crusher run), placed in 8-inch maximum lifts and compacted to 95% Standard Proctor Density, as measured by the Nuclear Density Method. Compaction shall be done by a vibratory hand tamper. Trenches excavated across existing street or alley paving shall be backfilled in accordance with the standard detail for Pavement Removal and Replacement. For excavations where there is more than 6 feet of cover over the top of the pipe and where the trench width is sufficient for use of heavy compaction equipment, an engineered fill using a suitable compactable material may be used in lieu of crusher run, if approved in writing by the City. If the backfilling has been completed and the backfill material does not meet the requirements for compaction, all the material shall be removed and hauled from the job site and the trenches refilled with material as specified above. Failure of backfill shall be corrected immediately, as directed by the Engineer.

302.7 PAYMENTS: Payment for this item shall be made at the unit price bid per cubic yard. Volume will be computed as follows: standard trench width as listed in Standard No. 315; length of line, as the actual horizontal measurement along the centerline of the ditch; depth of excavation as the actual depth of ditch from the original ground surface to the flow line of the pipe as shown in the construction notes. Average end-area method of computing volume will be used. No payment for excavation will be made for material excavated outside the neat lines of the standard trench width. No additional payment will be made for: sand cushion; backfilling; compaction of backfill; crushed stone used for backfill under existing and/or proposed roadways, roadway fills, streets, alleys, driveways, sidewalks, parking lots or as shown on the Drawings; removing and replacing top soils and obstruction, tunneling of trees, storm sewers or other obstructions; blasting; bracing and shoring; dewatering; pumping and draining; grade base stabilization; removal of excess excavated material; or restoration of the site. It is mutually understood that subterranean water, quicksand, or other unstable earth may be encountered and the Contractor has taken such into consideration in making this bid. Where such is encountered, Contractor will be required to excavate to sufficient depth to permit backfilling with crushed stone in order to provide a stable base for the pipe. Extra payment will not be made because of

such additional excavation or because it is necessary to excavate wider than the standard trench width; or for crushed stone.

### **PART 303 - MOBILIZATION**

303.1 This work shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site and for the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work on a substantial phase of the Contract. The Engineer's field office and laboratory is a separate pay item and is not included in this work.

#### **303.2 PAYMENT**

303.2.1 payment shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment, and incidentals necessary to mobilize and subsequently demobilize the construction preparatory operations.

303.2.2 Payment for this item will be made in two installments unless the first estimate submitted is also the final estimate, in which case the total lump sum bid will be paid. The first payment of 50 percent of the lump sum Contract price will be made on the first estimate following partial mobilization and the initiation of construction work.

303.2.3 The second and final payment will be made on the next estimate following the completion of substantial mobilization. The determination of when an estimate is due shall be in accordance with Subsection 109.06 of the Standard Specifications. Mobilization will not be considered in this determination. The completion of the erection of materials processing plants, if any, will not be required as a condition to the release of the final payment.

### **PART 304 - CONTRACTOR CONSTRUCTION STAKING**

304.1 This work shall consist of furnishing, placing, and maintaining construction layout stakes necessary for the proper prosecution and inspection of the work under the contract.

304.1.1 Contractor shall exercise care in the preservation of stakes and benchmarks and have them reset when they are damaged, lost, displaced, or removed. Contractor shall use licensed land surveyor in the State of Oklahoma and suitable equipment for the layout work required.

304.1.2 Contractor shall set all additional stakes needed, such as offset stakes, reference point stakes, slope stakes, pavement, curb line and grade stakes, stakes for bridges, sewers, roadway drainage, pipe underdrains, paved gutter, fence, culverts, or other structures - and any other horizontal or vertical controls necessary to secure a correct layout of the work. Stake centertine/control line of temporary features, such as shoo-fly detours. Contractor shall make stakes for

line and grade adequate to maintain the specified tolerances for the operation being performed and satisfactory to Engineer. Mark the station number and the distance from the centerline of construction on all grade stakes.

304.1.3 Contractor shall furnish platforms and equipment necessary for proper and safe access for checking the staking, and when significant errors occur, resurvey to satisfaction of the Engineer.

304.1.4 Contractor shall notify Engineer immediately of plan errors. Special surveys necessary to determine corrective action shall be responsibility of Engineer.

#### 304.2 PAYMENT

304.2.1 Payment shall be by lump sum for Contractor Construction Staking, and shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified, including profile measurements of connecting features.

304.2.2 Payment for this item of work shall be on the following schedule:

- 25 percent on the first payment estimate
- 25 percent when 10 percent of the contract work is complete
- 25 percent when 50 percent of the contract work is complete
- 20 percent when 75 percent of the contract work is complete
- 5 percent when all construction features have been verified as properly placed and completed

### **PART 305 - PIPE, VITRIFIED CLAY**

305.1 The work under this item shall include furnishing, delivery, and placing and jointing of vitrified clay pipe (VCP) in the trench in specific conformity with the line and levels given.

305.2 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such a manner that there is no shoulder or unevenness of any kind. If Contractor uses batterboards, a top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top line shall be sighted to assure the accuracy of the grade stakes and the batterboards' settings. Any errors, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

- 305.3 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure. Trenches shall be kept water-free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.
- 305.4 Double joints of eight inch pipe may be prepared and laid, provided the double joints are prepared by jointing the pipe in a vertical position using a straight edge inside the pipe to align the joint. Double joints shall not be placed in a horizontal position prior to laying unless suitably supported in racks. Double joints of pipe shall be supported at the middle joint, as well as the ends, when the pipes are lowered into the trench.
- 305.5 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

#### **PART 306 - PIPE, REINFORCED CONCRETE**

- 306.1 The work under this item shall include furnishing, delivery, placing and jointing of reinforced concrete pipe (RCP) in the trench in specific conformity with the lines and levels given.
- 306.2 For water and sewer lines, the American National Standard for Installation of Gray and Ductile Cast-Iron Water Main and Appurtenances, AWWA C-300, shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail. Bedding for pretensioned concrete pipe shall be in accordance with Standard Bedding Detail for Pretensioned Concrete Pressure Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing the proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located by the Contractor before these drawings are prepared. The ends of the pipes to be jointed shall be cleaned immediately prior to jointing and the rubber gasket thoroughly lubricated with vegetable soap before it is placed in position on the spigot end. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining. Any soap remaining on the exposed concrete surfaces inside or outside the pipe shall be completely removed. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail.
- 306.3 For sanitary and storm sewers, the methods of laying pipe, foundation, and grade specified under Pipe, Vitrified Clay, shall apply. All pipe shall be installed with

the mark IC-76" visible on the top of the pipe. The ends of the pipes to be jointed shall be cleaned immediately prior to joining and the rubber gasket. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining.

306.4 For all lines, after the pipe has been jointed, a band at least five-and-one-half inches wide shall be placed around the outside of the pipe at the joint. This band shall serve as a form for placing 1:1 cement mortar grout in the external recess formed by the face of the groove and the shoulder of the tongue. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the spring line before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe, and the grout poured before backfilling. On all pipes, the joint space remaining on the inside of the pipe shall be filled with a stiff mixture of 1:1 cement mortar which shall be troweled in place to produce a continuous, smooth, flush surface across the joint.

306.5 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking or interior coatings.

### **PART 307 - PIPE, DUCTILE IRON**

307.1 The work under this item shall include furnishing, delivery, placing, and jointing of Ductile Iron pipe in the trench in specific conformity with the lines and levels given. All Ductile Iron pipe shall be wrapped with a loose fitting, slip-on polyethylene film. The polyethylene film shall be slipped over the end of the pipe length that has been raised above the ground at the trench side. After the joint on the pipe is made up, the one-foot length shall be slipped over the joint to form an over-or-under lap of the adjacent polyethylene tube at this point. The loosely fitting film shall then be neatly folded over the top of the joint and held in place with tape. The loosely fitting tube extending along the pipe shall be drawn up snugly and folded along the top and held in place by using short pieces of plastic tape at intervals not to exceed four (4) feet. Fittings, valves and corporation stops shall be wrapped with a section of polyethylene material split to form a flat sheet, using plastic tape to hold the material around the appurtenance. For all pipe, the American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions.

307.2 For water lines, all angled fittings or specials included as pipe shall be restrained, or blocked in accordance with the attached Standard Detail, the size to be determined by the Engineer.

307.3            PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, interior coatings, or for concrete blocking.

Payment for any ductile iron pipe designated "restrained Joint" shall include cost of all components necessary to restrain joints of pipe.

### **PART 308 - PIPE, STEEL**

308.1            The work under this item shall include furnishing, delivery, placing, and jointing of steel pipe in the trench in specific conformity with the lines and levels given. For all lines, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-200 shall govern the installation, as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail for Steel Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing his proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located before these drawings are prepared. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions.

308.2            If joints are field-welded, they shall develop the full strength of the pipe. The Contractor shall file with the Engineer a description of the method of welding which he proposes to use, the name of the individual or company who will do the welding, and a statement regarding the previous experience of such individual or company in this particular line of work. Testing shall be in accordance with Section 3.3 of AWWA C206. If requested, coupons shall be cut across the field welds and tested by a testing company approved by the Engineer and at the contractor's expense. The line may be welded continuously with provisions for slack in the line, or in sections to be lowered in the trench and connected by a position weld.

308.3            If joints are to be mechanically coupled, sections up to 240 feet may be coupled and lowered carefully into the ditch. Electrical continuity shall be provided at all joints. Preparation for, protection of, and repair of pipe coating and lining, and coating of mechanical couplings shall conform to the applicable section of these specifications.

308.4            Field replacement of the cement-mortar interior lining shall be in accordance with the AWWA Standard for Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place, AWWA C602.

308.5            PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposai, and placed as shown on the drawings. Total footage shall be the actual horizontal measurement along the

centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.

Payment for any steel pipe designated "restrained joint" shall include cost of all components to restrain joints of pipe.

### **PART 309 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE**

309.1 When PVC pipe is delivered to the jobsite it shall not be exposed to sunlight for more than three (3) weeks. PVC pipe exposed to sunlight for more than three (3) weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the jobsite.

309.2 When a length of PVC pipe is cut, the plain end shall be beveled to the same configuration as the factory beveled end. The end shall be beveled using a pipe beveling tool, portable sander, or abrasive disc. After beveling, stop marks shall be applied to the plain end at a distance from the end corresponding to the original stop marks.

309.3 Both Bell End and Plain End of PVC pipe shall be thoroughly cleaned before connecting pipes.

309.4 Elastomeric Gaskets shall be placed into bell with colored side of the gasket to the outside ..

309.5 Before connecting PVC pipes, the plain end shall be lubricated with an approved lubricant. The bell end of PVC pipe shall not be lubricated.

309.6 When connecting, the plain end pipe shall be inserted into the bell end pipe and then pushed until stop marks on plain end are flush with end of bell.

309.7 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings or specials included as pipe, or for concrete blocking.

Payment for any PVC pipe designated "restrained joint" shall include cost of all components to restrain joints of pipe.

### **PART 310 - LOCATOR WIRE AND DETECTABLE MARKING TAPE**

310.1 A Number 8 bare copper conductor wire for the purpose of locating PVC pipe shall be buried along the top of the pipe, and connected at each end to a fire hydrant by Cadweld Brazing just above the -ground.



- 310.2 Detectable Mylar marking tape for location of PVC water pipe shall be required in areas as designated by the Engineer, more generally in commercial zones and open areas. Detectable Mylar marking tape shall be 2-inches wide, Blue in color with a continuous black lettered imprint stating "Caution: Water Line Below". Tape shall be equal to Lineguard Tape III as manufactured by Lineguard, Inc. of Wheaton, Illinois.
- 310.3 Detectable Mylar Tape shall be buried above PVC water lines at a depth of 10-inches below the surface.
- 310.4 Payment for tape and wire shall be included with unit price payment for PVC pipe.

### **PART 311 - TAPPING OF PVC PIPE FOR SERVICE CONNECTIONS**

- 311 .1 Standard water service connections shall be made by using bronze service clamps as per standard drawings. The couplings shall be provided with factory installed brass bushings which conform to ASTM B62 and AWWA C202 for standard corporation stop threads. Bushings must match the corporation stops. Direct tapping of PVC water pipe will not be allowed.

### **PART 312 - FITTINGS**

- 312.1 The work under this item shall include all of the requirements specified under the item of pipe, in that "pipe" is understood to also mean "bends, tees, crosses, sleeves, outlet assemblies and other specified fittings." Unless otherwise specified, outlet assemblies shall consist of a flanged or mechanized (MJ) outlet constructed into the wall of steel or concrete pipe. If ductile iron pipe is used, the outlet shall consist of a tee with the outlet flanged. If a gate valve is shown on.' the Drawings to be attached to the outlet, the line side end shall be flanged and the opposite end shall be bell or mechanical joint according to the item for valves. All bends, tees, crosses, outlet assemblies, and plugs shall be blocked with concrete as shown on the attached Standard Detail, except where the fittings have flanged, welded, or harnessed joints, the Inspector may, under certain - conditions, delete the blocking. Concrete blocking shall be placed so that joints are accessible for repair.
- 312.2 **PAYMENT:** Payment for this item shall be made at the unit price bid per fitting, of the type specified in the Proposal, and placed as shown on the drawings. Only fittings specifically noted in the Proposal are included in this item. No additional payment shall be made for excavation, backfilling, or concrete blocking.
- Payment for any fittings designated "restrained" shall include cost of all components to restrain joints of fittings ..

## **PART 313 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE**

- 313.1 The work under this item shall include furnishing, delivery, placing, and jointing PVC sewer pipe in the trench in specific conformity with the line and levels given. Installation shall be in accordance with ASTM 02321, Underground Installation of Flexible Thermoplastic Sewer Pipe, except as modified by these specifications.
- 313.2 Pipe shall be protected during unloading and installation against impact shocks and free fall. After unloading and before installation, pipe shall be stored on flat level ground with no rocks or *other* objects under the pipe.
- 313.3 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole, the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such manner that there is no shoulder or unevenness of any kind. The pipe grade shall be obtained by using laser or batterboards and a "top line". A top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top and the batterboards settings. Any error, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.
- 313.4 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure.
- 313.5 At connections to manholes or other concrete structures, where the pipe is to be grouted or cast into the wall, a tight fitting rubber water stop gasket shall be installed around the pipe. The outer sealing surface of the pipe shall be planed smooth. The pipe section with the gasket shall be grouted or cast into the manhole wall. Only pipe with a smooth outer wall or concentric ribs shall be used for cast or grouted in place connections. Where A-Lock type gaskets are used, only smooth outer wall pipe shall be used.
- 313.6 Approximately 30 days after backfilling the contractor shall measure vertical ring deflection for all pipe. The deflection testing shall be performed in the presence of the Engineer or his designated representative. Maximum ring deflection of the installed pipe shall be limited to 5 percent of the base inside diameter. All pipe which exceeds the allowable deflection shall be replaced or corrected by the contractor at no additional cost. The Contractor shall provide all mandrels and necessary equipment to perform the tests. Deflection shall be tested using a Go/No/Go Deflection Test Gauge conforming to the standard detail or as manufactured by Cherne Industries, Inc., or equal in accordance with the manufacturer's instructions.

- 313.7 Any flushing of PVC sewer lines will be performed by the City, but the Contractor will lend assistance as may be required. Any infiltration of flushing water or other leaks into the sewer shall not be acceptable, and the contractor shall immediately correct the cause of the leak in a manner acceptable to the Engineer.
- 313.8 Where air testing of PVC pipe is specified, it shall be air tested in accordance with the ODEQ standard air test procedure. The air testing will be performed by the contractor.
- 313.9 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

#### **PART 314 - MANHOLE**

- 314.1 The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new standard or drop manholes. Construction of manholes shall progress as rapidly as installation of the line permits, and as directed by the Inspector. Brick manholes are not intended for new construction and shall be allowed only as approved by Engineer.
- 314.2 Excavation for manholes shall be made with vertical sides and minimum dimensions permitting construction of the manhole in accordance with the attached Standard Details. Manholes are to be built to an elevation not less than that of the existing ground surface, or as shown on the drawings.
- 314.3 New manholes shall be constructed around existing lines without disturbance to the line. When the manhole is completed, the existing pipe shall be removed from the invert of the manhole. Care shall be taken in removing the pipe to prevent any stoppage. Immediately upon completion of the manhole, all waste mortar and debris shall be removed from the bottom and invert. When the walls are completed, a standard manhole frame and cover shall be set in place. Above the base, manhole inverts shall be carefully constructed of solid concrete to maintain proper velocities. Changes in pipe grade, alignment or size shall be made by transition sections of the invert, determined by the lower half of the inlet and outlet pipes, but not greater than that of the outlet pipe. All inverts shall be plastered, troweled, and brushed to a smooth, clean surface. Inlet and outlet pipes shall not project beyond the interior wall of the manhole and shall be free from all sharp masonry.
- 314.4 During construction, each manhole step shall be set in place on the inside of the manhole, beginning eighteen inches above the bottom and placed not more than fifteen inches apart. No steps shall be placed closer than eighteen inches to the manhole top or farther than 27" to the manhole top. If concrete masonry units are used for the walls, special cut step blocks shall be installed to receive the steps. Steps shall be built firmly into the wall, allowing the steps to project five

inches inside the manhole. If five-inch concrete masonry units are used, the ends of the steps projecting beyond the outside wall shall be cut off flush with the wall, and plastered over. The centerline of the steps shall be as shown on the attached Standard Detail for Manholes. Four-and-one-half-inch steps shall be used for brick manholes and twelve-inch steps for precast manholes.

314.5 The use of concrete masonry units shall not be allowed in connection with pipes larger than eight inches in diameter. If concrete masonry units five inches thick are used, the manhole shall not be located within any dedicated street or alley, or any other location subject to vehicular traffic; and shall not exceed twelve feet in depth. The foregoing restrictions as to location and depth shall not apply if eight-inch concrete masonry units, brick, or precast manholes are used.

314.6 For brick manholes, a single rowlock course shall be turned over each pipe. Every unit shall have a full mortar joint on the bottom and sides, which shall be formed in one operation by placing sufficient mortar on the bed and forcing the unit into it. Horizontal joints shall not exceed three-eighths inch and vertical joints on the inside of the manhole shall not exceed one-quarter inch in thickness. All joints on the inside are to be rubbed full and struck as the manholes are built up. Walls shall be constructed in horizontal courses with vertical joints staggered. When the manhole top is above the proposed graded elevation, the taper shall be drawn in the manhole top to twenty-four inches 1.0. at a point one foot below said proposed elevation and the remainder constructed with brick as a twenty-four inch cylinder. The inside and outside walls of the manholes are to be plastered with one-quarter inch of mortar to give a smooth and regular finish.

314.6.1 Testing of Manholes shall be done in accordance with Part 109.2 of the Specifications.

#### 314.7 PRE-CAST MANHOLES

314.7.1 Pre-cast manholes with cast-in-place base slabs will be permitted for all standard and drop manhole installations.

314.7.2 Pre-cast manholes with integral pre-cast floors will be permitted only for standard manhole installations with depths of 12 feet or less.

314.7.3 Pre-cast manholes with integral pre-cast floors will not be permitted for drop manhole installations. Pre-cast floors shall be placed on a minimum of 18-inches of compacted Class A crushed stone.

314.7.4 Pre-cast manholes shall conform to the specifications for Pre-Cast Reinforced Concrete Manhole Sections, ASTM C478. Joint construction shall be in accordance with the standard specification for Reinforced Concrete Pipe except that no exterior grout band is required. No more than eight (8) inches of concentric rings shall be used to bring the manhole to finished grade. Each concentric ring shall have a full mortar joint, not exceeding three-eighths (3/8) inch in thickness. Inside joints shall be rubbed full and struck.

314.7.5 Cost of sealed manhole rims and lids shall be included in cost of manhole.

314.8 PAYMENT: Payment for this item shall be made at the unit price bid per manhole of the type specified in the Proposal, and placed as shown on the drawings. If the manhole depth, measured from the *invert* to the top of the *cover*, exceeds six feet, the additional depth shall be paid for at the unit price bid per *vertical* foot of manhole depth *over* six feet. No additional payment will be made for *excavation*, backfilling, pipe or concrete bottoms or interior coatings.

## **PART 315 - CONNECTION**

315.1 The work under this item shall include all *excavation*, furnishing all materials required, construction, finishing, and backfilling of connections to existing mains, *valves*, manholes, special connections, service line re-connections, plugs, or in-line tees for future connections, as indicated on the Drawings or as directed by the Inspector.

315.2 The drawing shows details of the *various* connections and they shall be made in accordance with the details or as directed by the Engineer. On water mains, Contractor shall make the pressure and wet connections to existing mains, as shown on the drawing, unless specifically noted otherwise.

315.3 Connections to existing manholes shall be made by cutting into the manhole at the specified grade and inserting the pipe. Pipe installation shall be done in accordance using A-LOK or Z -LOK rubber gasket, or the pipe may be grouted in place with hydrophilic waterstop formed around the pipe and the cold joint. Acceptable hydrophilic compound is ADEKA P-201, or approved equal. Joint shall be watertight. Contractor shall not break into any existing sewer unless the Inspector is present and the work done shall be under the direction of the Inspector. Inlet and outlet pipes at the *invert* shall not project beyond the interior walls of the manholes. The manhole base shall be cut and reconstructed in such a manner that a proper *invert* section is maintained. All waste mortar, debris, and sharp edges shall be *removed* from the joints, bottom, and *invert*. Contractor shall *remove* and replace the manhole steps in the proper location and in accordance with Part 314.4, if they are not properly located after the connection is made. Any and all diversion or pumping of water or sewerage in a wet connection is included in this Item.

315.4 Methods of construction shall be the same for house line reconnections as for main sewers. Ductile iron pipe shall be used for all lines in parking areas, across open or closed storm sewers, across backfilled ditches, or within public rights-of-way. PVC shall be used in all other locations, unless ductile iron pipe is specifically required by the Engineer. All reconnections shall be constructed in conformance with the Plumbing Code of the City, unless modified herein. New pipe used shall be of the same diameter as the existing line.

- 315.5 Plugs shall be constructed of manhole brick and mortar, extending at least one foot into the line plugged from the manhole. The plug shall be watertight and troweled to a smooth finish on the interior of the manhole.
- 315.6 In-line tee fittings shall be installed for future service connections, as shown on the plans, in accordance with the Standard Detail for in-line tees. The tee shall be capped with a screw plug of either bronze, brass or a detectable plastic, marked by a non-magnetic, mylar tape, and stapled to both sides of a nominal 2" x 4" marker, 8' long, 4' buried, and 4' exposed, directly above fitting plug. The mylar tape shall be minimum 2-1/2" width, green in color, marked "Caution, Sanitary Sewer Below," as manufactured by Terra Tape or Line Guard.
- 315.7 After new water mains have been tested and chlorinated, the Contractor shall excavate around the new main for the service transfer. The existing mains and new mains shall remain in service during the transfer of services. The Contractor shall tap the new main and install a new corporation stop, service clamp, bend, copper tubing, and required fittings. The new service shall be connected to the existing meter after the service has been tested for leakage. The excavated area shall be backfilled and restored to original condition. Where galvanized service lines are encountered, they shall be replaced with copper. Where long services are replaced, they shall be bored under existing pavement. Open cutting will not be permitted unless approved by the Engineer. Copper tubing shall be Type K soft annealed conforming to ASTM B 88.
- 315.8 PAYMENT: Payment for this item shall be made at the unit price bid for each type of connection constructed, or in-line tee for future connection, as specified on the Proposal, or as directed by the Engineer. Payment for the first drop connection to a new manhole is included in the Manhole Item. No additional payment will be made for excavation, backfilling, furnishing and placing of concrete, removing and replacing of manhole steps, if necessary, or for the diversion or pumping of water or sewerage necessary to make the connection. Payment for water service transfers shall be made at the unit price bid for pipe and fittings under the appropriate connection bid item and shall include all necessary excavation, backfill, right-of-way clearing and restoring, materials, and labor.

## **PART 316 - LAMPHOLE**

- 316.1 The work under this Item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new lampholes. Lampholes shall be located and constructed as shown on the Drawings, or as directed by the Inspector. When the concrete lamphole frame base is completed, a standard lamphole frame is to be set in place and closed with a lamphole cover.
- 316.2 PAYMENT: Payment for this item shall be made at the unit price bid per lamphole constructed as specified on the Proposal. No additional payment will be made for excavation, backfilling, or pipe.

## **PART 317 - VALVE**

- 317.1 The work under this item shall include furnishing, delivery, and installation of valves at the locations shown on the Drawings, and in accordance with the attached Standard Details. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation, as applicable. If the paint is damaged, the valve shall be cleaned by wire brushing and given two coats of black asphalt paint.
- 317.2 Gate valves shall be set with the stems plumb. Ball valves shall be set with the handwheels horizontal. Air relief valves shall be set so that the square operating nut on the two-inch valve can be operated from the top. Check valves shall be set horizontally. Construction standards for air relief and check valve vaults shall be the same as for manholes.
- 317.3 Fire hydrants shall be set so that the bottom of the steamer nozzle is not less than eighteen (18) inches nor more than twenty-one (21) inches above the finish grade of the ground. Breakable bolts damaged in the installation shall be replaced in kind. If the Mueller hydrant is used, the oil reservoirs shall be filled before the hydrant is set. Concrete blocking shall be placed so that the drain and joints are accessible. Restraining glands may be used in lieu of concrete blocking for fire hydrants. Fire hydrant and stem extensions shall be provided and installed as necessary, in accordance with the manufacturer's recommendations.
- 317.4 **PAYMENT:** Payment for this item shall be made at the unit price bid per valve, of the type specified on the Proposal, and placed as shown on the Drawings. If fire hydrant and stem extension are required, they shall be paid for at the unit price bid for each different length of extension used. The unit price bid for air relief and check valves shall include the valve vault. No additional payment shall be made for: excavation; backfilling; concrete blocking; the pipe length between the line and the fire hydrant, except where the pipe is shown on the Drawings in a separate profile; crushed rock for drains; air relief valve piping vaults; or restraining glands on fire hydrants in lieu of cement blocking.

Payment for any valve designated "restrained joint" shall include cost of restraining glands.

## **PART 318 - VALVE BOX**

- 318.1 The work under this item shall include furnishing, transporting, and installation of valve boxes at the locations shown on the Drawings. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600, shall govern the installation, as applicable.
- 318.2 Valve box shall include SW services' Debris Cap or equal.

- 318.3 PAYMENT: Payment for this item shall be made at the unit bid price per value box and debris cap and placed as shown on plans. Any valve box extension shall be paid under separate bid time. No additional payment shall be made.

#### **PART 319 – ENCASEMENT, CONCRETE**

- 319.1 The work under this item shall include the installation of concrete encasement as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail. Care shall be taken to assure that placing of encasement does not deflect the pipe from the proper grade and alignment.
- 319.2 Sanitary sewers shall be encased when the depth of cut from the original ground elevation to the flow line of the pipe is four feet (4') or less. Concrete encasement necessitated by trench widths more than the maximum as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions shall be placed as directed by the Inspector.
- 319.3 PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as encasement. All concrete encasement required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

#### **PART 320 - CRADLE, CONCRETE**

- 320.1 The work under this item shall include the installation of concrete cradle as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions. Care shall be taken to assure that placing of cradle does not deflect the pipe from the proper grade and alignment.
- 320.2 PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as cradle. All concrete cradle required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

#### **PART 321 - PIERS, REINFORCED CONCRETE**

- 321.1 The work under this item shall include all materials, forming, construction and finishing of reinforced concrete piers, and necessary pipe anchorage. Piers shall be located and constructed as shown on the Drawings. Forms shall be made to conform to the shape of the pier and securely braced. Reinforcing steel shall be bent as detailed and securely tied in place. Bearing area for the pipe shall be



made to fit the outside diameter of the pipe and shall support the pipe at the proper grade. Steel strapping and bolts shall be installed and painted with one heavy coat of coal tar or asphalt paint after bolting in place. Any honeycomb or other unevenness in the concrete shall be patched with cement mortar immediately after form removal.

- 321.2      PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as reinforced concrete piers in accordance with the attached Standard Details, at the location shown on the Drawings, or as directed by the Engineer. No additional payment will be made for excavation, forming, bracing, dewatering, backfilling, or pipe anchorage.

### **PART 322 - CONDUIT, BORED**

- 322.1      The work under this item shall include the installation of railroad, street, or other crossings by boring utilizing steel conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades given. Voids between the outside of the conduit and the surrounding earth shall be filled with cement grout or other material approved by the Engineer. The space between the outside of the carrier pipe and conduit shall be filled with sand and spacers.

- 322.2      PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of steel conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering, sand fill, bulkhead, or bore pits.

### **PART 323 - STRUCTURE, SPECIAL**

- 323.1      The work under this item shall include the furnishing of all materials and performing all work necessary to complete any 'special structures shown on the Drawings.

- 323.2      PAYMENT: Payment for this item shall be made at the unit price bid for each structure as specified in the Proposal, and constructed as shown on the Drawings. Pipe, fittings, valves and other appurtenances will be paid for under other items. No additional payment will be made for excavation, backfill, foundations, or any particular element of construction or interior coatings.

### **PART 324 - MATERIALS FURNISHED BY CONTRACTOR AND INSTALLED BY CITY**

- 324.1      The work under this item shall include furnishing and hauling of materials to the site of work. All necessary clearing, excavation, other site preparation, backfill and restoration, shall be performed by the contractor so that the City may install the materials in place with a minimum amount of delay. The Contractor shall furnish assistance to the City in installing the materials so that they may be

readily installed. The City's responsibility shall be only for the actual installation of the materials. All other work shall be performed by the Contractor.

- 324.2 PAYMENT: Payment for this item shall be made at the unit price bid per material item of the type specified in the Proposal and actually installed per Drawings. Only materials specifically noted in the Proposal are included in this item. All necessary clearing, excavation, other site preparation, backfill and restoration will be paid for under other bid items.

## **PART 325 - SODDING AND SEEDING**

- 325.1 Where the installation of water, sanitary or storm sewer mains traverse developed areas, residential or commercial, the Contractor shall restore all damaged sod turf using same type and variety. The restoration of sod turf shall be by either Sod Replacement or Hydromulch Seeding, as directed by the Engineer. Replacement sod shall match existing sod in type and variety.
- 325.1.1 Only that turf in one residential block may be removed at any time. Where residential blocks are not involved, only that turf in approximately 500 linear feet of trench excavation may be removed at any time. The Contractor shall restore all turf damaged by the construction. Payment for turf restoration will be per linear foot, based on the length of main installed through an area. The Contractor shall consider, when preparing his bid, the width of turf restoration required.
- 325.2 Sod Replacement: Remove the sod turf with approved cutting equipment. Store the turf in an area where construction operations will not damage it and apply sufficient water to preserve the root system. Replace the sod turf after the trench has been backfilled and compacted. As an alternate to this method, the Contractor may furnish and install new solid slab grass sod of the same type as that which was removed. The new sod shall be moist when excavated from the source and kept moist until planted. Sod shall consist of vegetative parts (rhizomes, stolons, and roots) with an appreciable quantity of adhering soil. Sod that becomes dry shall be discarded. Sodded areas shall be thoroughly watered after placement.
- 325.3 Hydromulch Seeding: Remove, store, and replace topsoil. Apply seed, fertilizer, and mulch together in homogeneously mixed slurry. Fertilizer shall be 10-20-10 and shall be applied at a rate of 10 lbs. per 1,000 sq. ft. Mulch shall be wood fiber and applied at a rate of 46 lbs. per 1,000 sq. ft. Grass seed shall be either hulled Bermuda applied at a rate of 2 lbs. per 1,000 sq. ft. or K-31 fescue applied at a rate of 8 lbs. per 1,000 sq. ft. as directed. Mulch shall be kept moist for a minimum of 10 days or until seeds have germinated and rooted. Watering shall be provided as required to maintain the grass.
- 325.4 . The Contractor shall obtain a construction meter from the Connection Control Division and pay all required fees for any watering. The Contractor shall maintain all sodded or seeded areas until acceptance of the contract.

- 325.5      **PAYMENT:** Payment for Sod Replacement or Hydromulch Seeding will be made at the unit price bid per linear foot and shall include all necessary top soil replacement, fertilizing, watering, and maintenance. The linear foot pay quantity will be measured parallel to the pipe through the area being restored. The Contractor shall consider the width of turf restoration required for each area. No additional payment will be made for extra sodding or seeding required due to valve vaults, fire hydrants, tie-ins, service transfers, leak repairs, plugging, manholes, lampholes, or other appurtenances.

#### **PART 326 - STREET WASH DOWN**

- 326.1      The Contractor shall, at the written direction of the engineer, wash down streets to control dust and clean the streets in the area of construction. Contractor shall make arrangements with the City for use and payment of water usage.
- 326.2      **PAYMENT:** Payment for street wash down shall be made at the unit price bid .. per linear foot of street. No payment will be made for street washing without prior written instructions from the Engineer.

#### **PART 327 - TRAFFIC CONTROL DEVICES**

- 327.1      The Contractor shall furnish and install traffic control devices when construction is performed upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is subject to pedestrian or vehicular traffic. Traffic control devices shall include safety fencing, barricades, signs, barrels, warning lights, arrow panels, flagmen, high level devices, etc.
- 327.2      Traffic Control Devices shall conform to the latest edition of the Manual on Uniform Traffic Control Devices.
- 327.3      Safety fence shall be an open mesh type, high-density plastic material, 48-inches in height, and colored International Safety Orange. Fence shall be supported by fence posts spaced at no more than 10 feet.
- 327.4      **PAYMENT:** Payment for safety fence shall be at the unit price bid per linear foot based on the total footage used for the duration of the project. No additional payment will be made for moving the fence as the job site changes. Payment for Type I, II, and III Barricades with flashing light; warning signs with flashing lights, 16 sq. ft. and over, and below 16 sq. ft.; barrels with steady burn light; advance warning arrow panels; and high level warning devices shall be made at the unit price bid per sign day. One sign day is one traffic control device in place for one day. Flagmen shall be paid for at the unit price bid per man-day. One man-day is one man flagging for one full eight (8) hour period. No payment will be made for cones.

**PART 328 - BORE**

- 328.1 Waterline installed under existing concrete or asphalt driveways shall be bored. The diameter of the bore shall be a maximum of 2-inches larger than the outside diameter of the pipe bell. The annular space between the carrier pipe and the surrounding undisturbed earth shall be filled with sand. If the carrier pipe is ductile iron it shall be polyethylene wrapped and taped at one (1) foot intervals through the entire length of the bore. If the Engineer determines that boring is not possible, the driveway shall be open cut and the pavement replaced as directed by the Engineer.
  
- 328.2 PAYMENT: Payment for crossings by boring shall be at the unit price bid per linear foot as measured from edge to edge of the driveway. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering or sand fill, or bore pits.

**PART 329 - PAVEMENT, REMOVAL AND REPLACEMENT**

- 329.1 Work under this item includes removal and replacement of concrete or asphalt for sidewalks, driveways, parking lots, curbs, streets, alleys, and the like. Pavement crossed at right angles shall be saw cut, removed, and replaced as shown on the standard drawings or as directed by the Engineer for the type of pavement indicated on the proposal. Pavement crossed diagonally shall be squared by saw cutting at right angles to the paved area. If a construction joint is within three (3) feet of a proposed saw line, the pavement shall be replaced to the joint as directed by the Engineer. New concrete pavement shall bridge the top of the trench by a minimum of one (1) foot on each side. All paving shall conform to the Oklahoma Dept of Transportation standards and specifications. No street cuts area allowed except as approved by the City.
  
- 329.2 All concrete pavement removal shall be a minimum of 3 feet by 3 feet. Concrete shall be High Early Strength Class P5 as per ODOT Section 701A with a minimum 28 day compressive strength of 5,000 psi, which contains the following:

Cement	705 lbs/Cu. Yd.
Flyash	0
Air	4-6%
W/C Ratio	44lbs./lb.

- 329.3 Concrete shall meet the existing concrete depth with a minimum depth of 8" for streets, 6" for commercial Driveways, 5" for residential driveways, and 4" for sidewalks. Edges of cut shall be sawcut full depth. No traffic shall be allowed on the street replacement for 24 hours after placing of concrete. Twenty-four hours after placing of concrete, all butt joints must be sawed a minimum of 2", cleaned and sealed with joint sealer, ODOT Section 701A.08(e). If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical

existing curb and gutter. When one or more longitudinal construction joints are removed, the joints shall be re-established in accordance with the City of Tulsa standards for concrete pavement. When a pavement section is removed along an existing longitudinal construction joint, the pavement shall be dowelled to the adjacent pavement.

329.4 All asphalt shall be Type B as per ODOT Section 708. The asphalt shall be compacted to a 92% maximum density as determined by AASHTO T-209 method. Spreading and finishing of asphalt shall meet ODOT Section 411.04(g). Edges of cut shall be saw cut full depth. Prior to placement of asphalt in cut, a tack coat shall be uniformly applied. Tack coat shall be an asphalt rubber, meeting the specifications of ASTM 01190. Optional tack coat - SS-IH meeting ODOT 708R Table 26. All surface edge joints of cut/overlay shall be sealed with an asphalt rubber meeting minimum specifications of ASTM 01190. Asphalt rubber shall be squeegeed into edge joints. Optional edge seal - SS-IH shall meet ODOT 708R Table 2C. SS-IH emulsion shall be squeegeed into edge joint and blotted with dry concrete screenings. If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical existing curb and gutter. Macadamized or oiled surfaces shall be replaced with asphalt.

329.5 Materials for asphalt shall meet the following ODOT, Section 708R.04:

3/4"	100
1/2"	90-100
3/8"	70-90
NO.4	45-70
NO. 10	25-50
NO. 40	12-30
NO. 80	7-20
NO. 200	3-9

% AC SOLUBLE IN SOLVENT	4.7-7.5
VISCOSITY GRADE ASPHALT CEMENT	AC-20
DENSITY, % OF MAX. THEO. SP. GR. 1000 ADTORMORE	95-97
LESS THAN 1000 ADT	96-98
HVEEM STABILITY MIN. 5000 ADT OR MORE	40
LESS THAN 5000 ADT	35
V.H.A., MIN. %	15
% RETAINED STRENGTH MIN. FOR 5000 ADTORMORE	75

329.6 **PAYMENT:** Payment for removal and replacement of concrete or asphalt pavement shall be at the unit price bid per square yard. The pay quantity of square yards will be computed using the standard pay width for the type of pavement replaced and the length of the pavement cut along the centerline of the pipe. The pay quantity will include pavement replaced due to the proximity of a construction joint if the specified criteria is met. For diagonal crossings, the pay quantity will include the areas replaced due to squaring. Payment for saw cut shall be at the unit price bid per linear foot. Payment for curb and gutter shall be at the unit price bid per linear foot. Payment for dowells shall be at the unit price bid per each. No payment will be made for disposal of broken pavement, temporary surfaces, excavation, preparation of subgrade, forms, or reinforcing. No payment will be made for removal or replacement of gravel. No payment will be made for the replacement of pavement damaged by the Contractor's equipment movement. No payment will be made for joint sealer, tack coats, or edge sealing.

### **PART 330 - EROSION CONTROL MEASURES**

- 330.1 The contractor is responsible to insure that measures are taken to minimize erosion and sedimentation problems, including but not limited to the following:
- a) Place straw bale dikes in bar ditches at 500 ft. intervals on relatively flat grades and 200 ft. intervals on grades over 5%.
  - b) Place sediment sumps upstream of straw bales. Remove sediment on a regular basis.
  - c) Keep excavation and silt off of streets.
  - d) In areas where water line are being constructed adjacent to improved streets, measures shall be taken which will minimize siltation and excavation accumulating in existing storm sewers. Straw bales should be placed around inlets. Precautions should be taken during heavy rains to assure that a flooding condition is not created.
  - e) Straw mulch can be used as an effective means of erosion control.
  - f) Erosion control measures shall be placed at the toe of slope of all cut and fill areas.
- 330.2 Straw bales shall be standard rectangular size, approximately 18" x 20" x 36", and shall be securely bound with wire. Bales shall be firmly anchored with wood or metal stakes approximately 3 feet long. A sediment sump shall be placed immediately upstream of each bale. Contractor shall clean and maintain sediment sumps throughout the maintenance period.
- 330.3 The contractor shall furnish and install straw mulch as directed. Mulch shall be applied at a rate of 1 ½ tons per acre. Mulch shall be securely anchored in place.

- 330.4 Payment for straw bales including the cost of sediment sumps & anchoring and for straw mulch will be included in the lump sum price.

### **PART 331 - WATER TABLE CRADLE**

- 331.1 The work under this item shall include furnishing and installing Water Table Cradle as shown on the drawings or as directed by the Engineer and in accordance with the Standard Detail for Water Table Cradle.
- 331 .2 The trench excavation shall be completely dewatered to provide a dry and stable trench bottom. The trench shall be excavated to a minimum of 18" below the bottom of the pipe. If additional base stabilization is required crushed stone, 3 1/2" to 1 1/2" (Gradation No.1), shall be installed on the trench bottom, prior to the installation of water table cradle. Minimum trench widths for flexible pipe installations shall be as shown in the Standard Detail No. 367.
- 331 .3 Geotextile filter fabric shall be installed on the trench bottom and walls. Crushed stone shall be installed in the trench directly on the filter fabric to a height of 12 inches above the top of the pipe. The crushed stone bedding material shall be carefully worked and compacted around the pipe. The filter fabric shall be placed over the top of the crushed stone with a minimum 18" lap. All fabric joints shall be lapped a minimum of 18". Water Table Cradle shall be installed for the full excavated width of the trench.
- 331.4 Crushed stone for Water Table Cradle shall be Gradation No. 57, 1" to NO.4. The Geotextile Filter Fabric shall be a nonwoven, needlepunch constructed fabric composed of petrochemical based polymers that are chemically and biologically inert. The fabric unit weight shall be not less than 13 ounces per square yard with a Mullen Burst Strength (ASTM 0-3786) of not less than 600 psi.
- 331.5 PAYMENT
- 331.5.1 Payment for Water Table Cradle will be made at the unit price bid per linear foot for the specified diameter of pipe. The unit price shall include the cost of all labor, equipment, and materials required. No additional payment will be made for dewatering or crushed stone required for additional base stabilization.

### **PART 332 - CONDUIT, OPEN CUT**

- 332.1 The work under this item shall include the installation of railroad, street, or other crossings by open cut utilizing conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades *given*, and shall be installed in accordance with standard bedding detail for semi-rigid pipe.

The conduit shall be installed with spacers, sand fill, and bulkheads as shown in Standard.

332.2 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfill, sand, spacers, or bulkhead.

**SECTION END**



## CHEROKEE HEIGHTS LIST STATION PUMP MATE WITH GENERATOR

The contractor shall furnish and install a factory designed and assembled lift station control and valve station with all necessary electrical controls and accessories as shown on the plans and specified herein.

The PumpMate shall be complete with all required equipment factory installed on a fabricated steel base and enclosed in an insulated fiberglass enclosure. The PumpMate control and valve station shall be as manufactured by USEMCO, Inc., Tomah, Wisconsin as represented by Southwest Fluid Systems, LLC or approved equal.

Proposed equal equipment must be submitted to the engineer at least 14 days prior to bid. Submittals must include data on all equipment included in the station along with a drawing showing the proposed enclosure. Proposed equal equipment not submitted 14 days prior to the bid date will not be considered.

### SCOPE

The principal items of equipment shall include, but not be limited to, the following:

1. Fiberglass Enclosure
2. A fabricated steel base
3. Environmental controls
4. Convenience accessories
5. Dual Fuel Propane/Natural Gas Fueled Generator
6. Automatic Transfer Switch
7. Pump control panel
8. Piping and valves
9. Submersible Sewage Pumps (VORTEX)
10. 4" Magnetic Flow Meter

The principal items of equipment shall include **third party approval and labeled to UL QCZJ standards for package pumping systems**, internal piping, valves, control panel, heater, ventilation, and all internal wiring, all as shown on the plans and specified herein.

The station manufacturer will also provide a certificate of liability insurance of no less than \$10,000,000.00 dollars

To insure total quality control, the complete unit shall be designed, fabricated, assembled and tested in house by the station manufacturer.

All mechanical and electrical components that comprise the pump station shall be **non proprietary** and available for purchase from vendors other than the pump station manufacturer.

### ALTERNATES

The contractor may, if he so chooses, provide an alternate quotation to his base bid. The amount to be added or deducted from the base bid, for a system provided by other system manufacturers, must be indicated with the alternate quotation. This amount shall include all

cost or savings, which will result from the proposed alternate and will include any special expenses incurred by anyone affected by the offered alternate. This shall include, but is not limited to, greater energy cost due to less efficient equipment, required greater installation space, or any other item with which this system is to be interfaced.

In order for an alternate to be considered, it will be necessary for the contractor to provide one set of written information completely describing the alternate fourteen (14) days prior to the bid date. Should the alternate or the information describing it fail to describe its capability in meeting the job requirements or if the contractor fails to furnish complete information, the engineer shall regard the proposal as an inferior alternate and disregard the alternate bid.

## **REQUIRED INFORMATION FOR CONSIDERATION OF ALTERNATE**

This information shall include complete mechanical dimensions, electrical details and specifications of every valve, meter and other instrument to be provided by this section. If a microprocessor or any other similar programmable system is being provided, manufacturer's literature of each of the required two sources shall be provided.

System sketches shall be provided of the hydraulic processes identifying the locations schematically of all process equipment being provided by this contract and the schematic location of the devices being provided in relation to the process equipment.

A written system description of how the control system interacts with the process equipment is to be provided.

A system sketch shall be provided indicating the relationship of telemetry equipment to the system.

A sketch shall be provided of the main control panel, indicating the enclosure size and relative location of the panel mounted equipment.

All panel-mounted equipment is to be identified on this panel sketch so that their existence can be checked and functional relationships determined.

Failure to receive the above information at time of bid will be considered non-responsive and will be caused to reject the alternate. Information submitted with the proposed alternate bid will be used to determine qualifications and quality only of the alternate system supplier and acceptance of the alternate is not to be interpreted as a revision to the requirement of this specification.

## **SUBMERSIBLE SEWAGE PUMPS**

### **SYSTEM DESCRIPTION**

Furnish and install TWO (2) submersible vortex pumps, KSB Model AMAREX NF 100-220/044YLG-150 meeting the following performance requirements. The pump's submersible electric motor shall be capable of operation at 208 Volts, three (3) phases, 60 Hz service. The motor shall be supplied with 30 feet of properly sized electric submersible power cable sized in accordance with NEC standards. Each pump shall be fitted with 30 feet of lifting chain or cable.

**Performance Requirements:**

Design Condition:	100 GPM 26 Ft. TDH
Maximum Motor HP:	5.0
Maximum Motor RPM:	1750

**REFERENCED STANDARDS:**

American Iron & Steel Institute (AISI)  
American Society for Testing and Materials (ASTM)  
Factory Mutual (FM)  
Hydraulic Institute Standards for Centrifugal, Rotary, and Recip. Pumps (HI)  
National Fire Protection Association (NFPA)  
National Electric Code (NEC)  
National Electrical Manufacturers Association (NEMA)  
Anti-Friction Bearing Manufacturers Association (AFBMA)

**WARRANTY**

The pump manufacturer shall warrant the pump and motor to the Owner against defects in workmanship and materials for a period of 7 years from installation. Pump manufacturer warranty shall be in published form and shall to all similar units. A copy of each warranty shall be provided to the Owner at startup.

**PUMP DESIGN**

The pump's design shall allow for removal and reinstallation of the pump without the need for personnel to enter the confined space of the wet well and without the removal of bolts, nuts or other fasteners. The pump shall connect to a permanently mounted discharge connection by simple downward motion, without rotation, guided by at least two non-load bearing Type 316 stainless steel guides. Final connection shall insure zero leakage between the pump and its discharge connection flange by means of an o-ring seal. No part of the pump shall bear directly on the floor of the wet well. The contractor shall also supply stainless steel lifting chain or cable of sufficient length to properly and safely lift the pumps from the wet well.

**PUMP CONSTRUCTION**

Major components (pump casing, impeller, intermediate housing, motor housing) shall be of at minimum ASTM A48 Class 35 cast iron with smooth surfaces devoid of blowholes and other irregularities. All exposed fasteners shall be ASTM A 276 Type 316Ti stainless steel. The cutter/grinder assembly shall be of at minimum a hardened white iron having a minimum Brinell Hardness Rating (BHR) of 750 - 1000.

Mating surfaces between components where watertight integrity is critical shall be machined and fitted with Nitrile Rubber or Viton O-rings. Because these are critical passages and flame paths, no secondary sealing compounds, greases, or other devices shall be used.

**COOLING SYSTEM**

The motor shall be adequately sized and designed so that integrally cast motor cooling fins have sufficient surface area to allow the motor to run continuously in submerged or partially submerged conditions without the need for internal oil circulation systems or cooling jackets which circulate the pumped media up inside the motor shell. Further, the

motor's design shall allow it to be capable of running for extended periods in a dry mode without damage to the motor or seals.

#### **CABLE AND CABLE ENTRY SEAL**

The power cable shall be suitable for the submersible application and sized in accordance with NEC requirements. The cable entry design shall insure that no entry of moisture is possible into the high-voltage motor terminal area even if the cable is damaged or severed below water level to a submerged depth of up to 85 feet.

#### **MOTOR**

The submersible motor shall be squirrel cage, induction in design, housed in a completely watertight and air filled chamber. The motor shall have at minimum a 1.10 service factor and be suitable for use in Class I, Division 1, Group C & D atmospheres as Explosion Proof. The motor stator shall use at minimum Class H insulation rated for 365 Degrees F. The motors shall be designed, rated, and warranted for continuous operation and capable of at minimum twenty (20) starts per hour. Temperature monitors shall be embedded in the motor windings for use in conjunction with and supplemental to external motor overload protection. The pump's control shall shut down the pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Do not provide motors that contain other than ecologically safe paraffin base oil in the seal chamber. Do not provide motors containing di-electric oils used for motor cooling and/or bearing lubrication.

#### **BEARINGS**

Furnish upper and lower bearings as needed to provide a B10 bearing life of at minimum 100,000 hours at anticipated axial and radial loadings. The bearings shall be sealed/shielded permanently lubricated for the life of the pump/bearings.

#### **MECHANICAL SEALS**

Each pump shall be provided with two totally independent shaft seals, installed in tandem. The upper seal shall operate in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. The lower seal shall be of bellows type with both faces of at minimum Silicon Carbide. The seals shall require neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. The seals shall be non-proprietary in design, with replacements available from a source other than the pump manufacturer. Do not provide seals with the following characteristics: conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals with face materials other than those specified.

#### **SHAFT**

Provide a common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. The shaft shall be completely of at minimum ASTM A 276 Type 420 stainless steel. Do not use carbon steel as shaft material without using a stainless steel shaft sleeve.

#### **IMPELLER**

The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, non-clogging design capable of handling soils, fibrous materials, heavy sludge and other matter found in wastewater. The impeller(s) shall have a back shroud only with back pump-out vanes to equalize axial thrust, and curved blades which protrude into the

pump casing for maximum efficiency. The impeller will create a vortex which carries solids through the pump casing without passing through the blades. Impeller(s) shall be capable of passing a minimum 4" diameter solid.

#### **VERIFICATION OF PERFORMANCE**

All pumps shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or over-heating. Any pump that fails to meet any of the contract specifications will be modified, repaired, or replaced by the contractor at no additional cost to the owner.

The manufacturer or his Authorized Representative shall conduct site tests. Tests shall include checking for correct rotation, maximum motor amperage draws within nameplate specifications, balanced voltages on each power leg with the pump operating to within manufacturers tolerances, and demonstrated compatibility of the pump/motor with the controls supplied. Test results shall be in printed form and signed by the manufacturer or his Representative and supplied to the owner.

#### **PACKAGE STATION:**

#### **SYSTEM COORDINATION AND SINGLE SOURCE RESPONSIBILITY**

The equipment provided shall be a completely integrated microprocessor based automatic control and monitoring system consisting of the required controller, power equipment, motor starters, level/flow and alarm monitoring equipment in a factory wired and tested assembly. The automatic control and alarm/monitoring system components shall be standard, catalogued, stocked products of the system supplier to assure one source responsibility, immediately available spare/replacement parts, proper system interconnections and reliable long term operation.

#### **FIELD SUPERVISION**

The services of a factory trained, qualified representative shall be provided to inspect the completed installation, make all adjustments necessary to place the system in trouble free operation and instruct the operating personnel in the proper care and operation of the equipment.

#### **GUARANTEE**

All equipment shall be guaranteed against defects in material and workmanship for a period of one year from date of owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the owner.

#### **EQUIPMENT BASE**

The station's common base shall be fabricated from a minimum 3/8" structural grade steel plate, reinforced with adequate sized steel channels to prevent deflection due to equipment weight and stresses imposed from lifting and setting of equipment.

Bolt on lifting eyes shall be placed about the perimeter of the equipment base to facilitate lifting and handling of the station. The lifting eyes shall be easily removable after the station has been set in place.

The steel plate and structural employed in the base shall meet or exceed the requirement of ASTM-A36.

## **WELDING**

All welding shall be in accordance with standard AWS practices, with proper fillet section and continuity to assure a sound, watertight structure. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight. All welds in contact with soil or water shall be tested with dye penetrant to assure the watertight integrity of the weld system.

## **PAINTING**

All mill scale, rust, weld flux and other foreign matter shall be removed from all steel surfaces by shot blasting to SSPC SP-10 specification for near-white blast cleaning. Surface irregularities shall be removed by grinding.

Interior and exterior surfaces shall receive two coats of hi-build epoxy coating. The coating materials shall show excellent resistance to immersion in seawater as well as to splash or spillage of water, petroleum products or salt solutions. The interior coatings shall be applied to 3 mils dry film thickness each coat and the exterior coatings shall be applied to 4 mils dry film thickness each coat.

A paint touch-up kit shall be provided with the station for coating field weld joints and damaged areas.

## **FIBERGLASS ENCLOSURE**

The fiberglass enclosure will be gel coated inside and out and be of suitable thickness and density formulated to provide durability, abrasion resistance, and color fastness. The coating will also be impervious to sewage, grease, oil, gasoline, and other common chemicals. The exterior finish will consist of 20 to 25 mils of gel coat with an added UV absorber. Fiberglass laminate will then be applied to the backside of the gel coat to an approximate thickness of 1/8". This laminate will be a 25% to 28% chop glass load by weight. The laminate will be rolled out to remove all air and than allowed to cure. Foam insulation board with an R-value of 7.5 and an aluminum laminate vapor barrier will then be applied and bonded into place. A light layer of laminate is chopped on top of the foam sheet and rolled out to remove air and allowed to cure. A cover coat of gel coat with a surfacing agent is then applied on the inside of the part and allowed to cure.

The exterior shall be a tan textured surface. Smooth and/or glossy exteriors will not be acceptable and will not be considered due to their appearance and reflectivity characteristics.

The cover will have access doors on two sides. All access doors shall be equipped with continuous hinges and tamperproof keyed latches. All hardware for the cover shall be tamperproof. The entire cover shall be removable in order to service the equipment in the pump station. Removal shall require no more than two maintenance personnel for removal without the use of lifting equipment.

The cover shall be provided with inlet and discharge louvers and a thermostatically controlled fan.

The equipment chamber shall be provided with a wall mounted commercial grade 1500 Watt electric heater suitable for 120 volt, single phase service. The heater shall be of the fan-forced type, complete with a baked enamel safety grill. The heater shall be hard-wired to the control panel. The heater shall be as manufactured by Berko, Qmark, Dayton or Engineer approved equal. The heater shall be controlled by a digital thermostat separate from the unit heater. If the heater has an integral thermostat, it shall be disabled or turned to the maximum setting. The digital thermostat shall have a PTC 1000 Ohm remote probe with 48" extension. It will have a 120 Volt input and a 16 amp, 250 VAC resistive output to the heater. The display shall be a 3-digit, ½" digits plus Fahrenheit sign and bright red LED.

Removable lifting eyes shall be placed about the perimeter of the equipment base to facilitate lifting and handling of the station.

An aluminum hatch located exterior to the equipment chamber shall be provided for access to the wet well. Steel hatches or access doors will not be acceptable. The aluminum frame shall be ¼" thick extruded aluminum having a continuous concrete anchor as a part of the one-piece extrusion. The access cover shall be of ¼" aluminum diamond plate, reinforced with stiffener bars as required. The cover shall be able to withstand the live load of 300 lbs. per square foot. The cover will have stainless steel hinges and be equipped with a lifting handle and a padlock locking post (padlock by others). The cover shall open to 90 degrees and lock automatically in that position by a stainless steel positive locking arm. The cover will have a full-length ¼" thick aluminum skirt that will be continuous from the frame to the bottom of the base. Hooks will be provided in the access hatch for pump lifting cables or chains.

A jib crane socket shall be provided in the concrete base to facilitate pump removal.

## **PIPING AND VALVES**

The station sewage piping shall be class 53 ductile iron pipe, that will extend down through the common base plate terminating in plain ends exterior to the pump chamber. The pipes shall be sealed where they protrude through the base plate with link seals to form a gas tight seal between the pump chamber and wet well. Each discharge line shall be fitted with a plug valve and check valve as specified herein and sized as shown on the plans. All mill scale, rust, weld flux and other foreign matter shall be removed from all steel surfaces by shot blasting to SSPC SP-10 specification for near-white blast cleaning. Surface irregularities shall be removed by grinding. The piping and control panel bracket surfaces shall receive a minimum of two coats of self-priming, hi-build epoxy coating. The coating material shall show excellent resistance to immersion in seawater as well as to splash or spillage of water, petroleum products or salt solutions. These surfaces shall receive two coats at a minimum of 3 mils per coat to a total of 6 mils dry. A paint touch-up kit shall be provided with the station for coating damaged areas.

Tapping ports will be installed into the piping assembly to allow for air release and accept gauges for pressure readings of the pumps.

Plug valves of the non-lubricated type shall be furnished and sized as shown on the plans. The valve body shall be of high quality cast iron construction with a welded nickel seat. The valves shall be furnished with permanently lubricated, corrosion resistant bearing surfaces in the upper and lower journals to withstand full rated bearing loads and to provide long life in sewage service. Valves shall provide a leak tight seal against full rated pressure in both directions. One handle for valve operation will be provided with the station

Swing check valves, sized as shown on the plans shall be installed in the discharge piping. The valve shall permit flow in one direction only and close tightly without slamming when the discharge pressure exceeds the inlet pressure. The valve shall be provided with an outside lever and spring to accomplish quicker closing and to minimize slamming when rapid flow reversal is encountered. The valve in the full open position shall permit full flow through the valve equal to the nominal pipe diameter. The valve body shall be of high quality cast iron construction and bronze fitted, capable of vertical installation. Wafer check valves will not be permitted.

### **MAGNETIC FLOW METER**

Magnetic flow meter shall be as shown on the drawings and designed for raw sewage service, capable of being submerged indefinitely without damage (including conduits and fittings), sized for flow rates at specific pump station involved, accurate to 0.5% at velocities between 1.3 to 33 fps, compatible with supplied station controls, include remote readout and be the product of one of the following manufacturers:

- × ABB
- × Krohne America

### **EMERGENCY PUMP CONNECTION**

The pump discharge piping shall be provided with a 4" male cam lock emergency pump connection with isolation plug valve and dust cap sized as shown on drawing. Access to the cam lock fitting shall be from outside of PumpMate enclosure.

### **GENERATOR:**

The manufacturer of the generator set shall also provide the automatic transfer switch for single source responsibility. The transfer switch will be mounted in the fiberglass enclosure in order to centralize the pump system controls for the operator. The generator will be supplied in a weatherproof, sound attenuated enclosure on the common PumpMate base. It will be factory mounted and wired.

## **GENERAL**

### **1. QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within OK of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.



- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

## 2. PROJECT CONDITIONS

Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

- A. Ambient Temperature: 0.0 deg C (32.0 deg F) to 40.0 deg C (104.0 deg F).
- B. Relative Humidity: 0 to 95 percent.
- C. Altitude: Sea level

## 3. WARRANTY

Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product and twelve (12) months for Prime/Continuous product from registered commissioning and start-up.

## 4. PRODUCTS

### 1. MANUFACTURERS

Manufacturers: The basis for this specification is Cummins Power Generation equipment, approved equals may be considered if equipment performance is shown to meet the requirements herein.

### 2. ENGINE-GENERATOR SET

Factory-assembled and -tested, engine-generator set.

A. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

- 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

B. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 22.0kW, at 80 percent lagging power factor, 120/208, Parallel Wye, Three phase, 3 -wire, 60 hertz.
2. Alternator shall be capable of accepting maximum 59.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

C. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 1.0 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 35 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 15 percent variation for 35 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: (For engine-generator sets using a PMG-excited alternator) For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.

8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

3. ENGINE

- . Fuel: Liquefied Petroleum Gas (Propane)
- A. Rated Engine Speed: 1800RPM.
- B. Lubrication System: The following items are mounted on engine or skid:
  1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
  2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- C. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
  1. Designed for operation on a single 120 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
  2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
  3. Provided with a 12VDC thermostat, installed at the engine thermostat housing
- E. Governor: Adjustable isochronous, with speed sensing.
- F. Cooling System: Closed loop, liquid cooled
  1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.

2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.

G. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.

H. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

I. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:

- a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
- f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

#### 4. CONTROL AND MONITORING

- Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
  - B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
  - C. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter (3-phase, line to line and line to neutral values).
2. AC ammeter (3-phases).
3. AC frequency meter.
4. AC kVA output (total and for each phase). Display shall indicate power flow direction.
5. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
6. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
7. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
8. DC voltmeter (alternator battery charging).
9. Engine-coolant temperature gage.
10. Engine lubricating-oil pressure gage.
11. Running-time meter.
12. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
13. AC Protective Equipment: The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
14. Status LED indicating lamps to indicate remote start signal present at the control, existing alarm condition, not in auto, and generator set running.
15. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.

16. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
17. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

5. GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- . Comply with NEMA MG 1.
- A. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- B. Electrical Insulation: Class H
- C. Temperature Rise: 125 / Class H environment.
- D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- E. Enclosure: Drip-proof.
- F. Voltage Regulator: SCR type, Separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- G. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- H. Subtransient Reactance: 15 percent maximum, based on the rating of the engine generator set.

6. OUTDOOR GENERATOR-SET ENCLOSURE

. Description: Weather Aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

- A. Construction:
  1. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
  2. Exhaust System:
    - . Muffler Location: Within enclosure.
  3. Hardware: All hardware and hinges shall be stainless steel.

4. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
5. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.

B. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.

C. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 75 dBA measured at any location 7 m from the engine generator in a free field environment.

D. Site Provisions:

1. Lifting: Complete assembly of engine generator, enclosure shall be designed to be lifted into place as a single unit, using spreader bars.

## 7. VIBRATION ISOLATION DEVICES

. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

## 8. FINISHES

. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

## 9. SOURCE QUALITY CONTROL

. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
2. Full load run.



3. Maximum power.
4. Voltage regulation.
5. Steady-state governing.
6. Single-step load pickup.
7. Simulated safety shutdowns.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

## 5. EXECUTION

### 1. INSTALLATION

Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

F. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

### 2. ON-SITE ACCEPTANCE TEST

The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the

option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

- A. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
- B. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
- C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

### 3. FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

### 4. SERVICE AND SUPPORT

The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

A. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within OK of the site.

B. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

### **AUTOMATIC TRANSFER SWITCH**

A. The complete automatic transfer switch shall be designed and manufactured by the manufacturer of the engine generator set. It shall be listed by Underwriters Laboratories, Inc. (STD. 1008). The manufacturer shall furnish schematic and wiring diagram for the automatic transfer switch and a typical interconnection wiring diagram for the entire standby system.

B. The automatic transfer switch shall be rated for continuous operation over an ambient temperature range of  $-25$  to  $+125^{\circ}\text{F}$ . The switch shall be rated for

all classes of load, both inductive and non-inductive, at 600 volts and tungsten lamp loads at 250 volts. The automatic transfer switch shall be designed, built and tested to close on an inrush current up to and including twenty times the continuous rating of the switch, without welding or excessive burning of the contacts. The transfer switch shall be capable of switching loads up to and including its interrupting current capacity. The transfer switch shall be capable of enduring 6000 cycles of operation at rated current, at a rate of 6 cycles per minute, without failure. One cycle shall consist of one complete opening and closing of both sets of contacts on an inrush current ten times the continuous rating of the switch.

- C. The automatic transfer switch shall have terminal lugs for either copper or aluminum wire with cadmium oxide contacts. The transfer switch shall incorporate mechanical and electrical interlocks to prevent simultaneous energizing of both the normal and emergency services. The switch shall be mechanically held on both normal and emergency sides. The switch shall be 3 pole with solid neutral. It shall have 25 Amp rated auxiliary contacts, two on the line side, and three on the emergency side. A contact to provide a loss of power signal to the auto-dialer shall be provided.
- D. The automatic transfer switch shall include the following control logic:
1. Shall signal the engine generator set to start in the event of a power interruption. A solid state time delay start (Adj. from 0 to 6 seconds) shall delay this signal to avoid nuisance start on momentary voltage dips or power outages.
  2. Shall monitor each ungrounded line with an adjustable voltage, solid state under-voltage sensor to sense a decrease of voltage below a set point, or a loss of voltage on any phase of the normal power source. Voltage sensors shall be temperature compensated for 27% maximum deviation over temperature range  $-25$  to  $+175^{\circ}\text{F}$ .
  3. Shall retransfer the load to the line after normal power restoration. A time delay retransfer (adjustable from 0 to 32 minutes) shall delay this transfer to avoid short term normal power restoration.
  4. Shall signal the engine-generator to stop after load re-transfers to normal source. A solid state time delay stop (adjustable from 0 to 8 minutes) shall permit engine to run unloaded to cool down before shut down.
  5. Shall provide a 2 amp S.C.R. voltage regulated current limited, battery float charger, to maintain fully charged cranking batteries.
  6. Shall provide a test switch to simulate an interruption of power from the normal source.
  7. Shall provide an exerciser clock to automatically start the generating set at regular intervals and allow it to run for a preset time period, such as 30 minutes per week.
  8. Shall be provided with a "Load/Without Load" selector switch to select exercise function as follows:
    - a. Without Load – The set runs unloaded.
    - b. With Load – The automatic transfer switch transfers load to the generator set, after a preset delay.

9. Transfer shall have a programmed transition feature. This feature shall provide a sealed adjustable time delay during switching in both directions. During this time the load is isolated from both power sources, to allow residual voltage components of motors or other inductive loads (such as motors, transformers) to decay before completing the switching cycle. This device shall be connected in a manner that shall not cause time delays in switching, where a time delay has already been established by loss of voltage to the load during normal source power interruption.
- E. Indicating lamps shall be front mounted for easy reading without opening doors. Lamps combination shall provide:
    1. Green (normal) and Red (emergency) indicating lamps to indicate which source is supplying power to the load.
  - F. The complete automatic transfer switch shall be mounted in a NEMA 1 enclosure and installed within the envelope of the power module and wired to the engine generator set prior to shipment to the jobsite. The transfer switch shall be the product of the generator manufacturer.

## **ENCLOSURE**

The described equipment shall be housed in a NEMA 1 #304 stainless steel enclosure arranged for mounting where shown on the drawings.

- All seams shall be continuously welded and ground smooth.
- Door and body stiffeners shall be provided for extra rigidity.
- Captivated door screws thread into sealed wells.
- Heavy gauge continuous hinge.
- Removable and reversible print pocket.
- Oil resistant gasket and adhesive.
- Collar studs shall be provided for mounting panel.

All field installed conduits, fittings or connections shall enter the enclosure through the bottom only for any outdoor enclosure.

All major components and sub-assemblies shall be identified as to function with laminated, engraved Bakelite nameplates or similar approved means.

## **POWER SUPPLY AND METERING**

The incoming service shall be 120/208 volts, 3 phase, 4 wire, 60 cycle. All metering shall be done ahead of the main disconnect and control panel. The contractor in accordance with local power company requirements shall install the meter.

## **MAIN CIRCUIT BREAKER**

A 100 amp, 3 pole, molded case circuit breaker shall be provided as the main power disconnecting device for the control panel. The circuit breaker must have a minimum ampere interrupting capacity of (10,000-240 volt - 14,000-480 volt) symmetrical RMS amps.

### **LIGHTNING ARRESTOR**

A lightning arrestor shall be supplied in the control and connected to each line of the main power input terminals. The arrestor shall protect the control against damage due to lightning strikes on the incoming power line.

### **PUMP CIRCUIT BREAKER**

A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each pump motor. The circuit breaker must have a minimum ampere interrupting capacity of (10,000-240 volt - 14,000-480 volt) symmetrical RMS amps. The circuit breaker shall be operable through the operator's door of the enclosure.

The circuit breaker shall be properly sized to protect the control circuit conductors, motor starter and the motor against over current due to short circuit or grounds.

### **MOTOR STARTER**

A NEMA rated full voltage non-reversing motor starter with manual reset, ambient compensated, three phase thermal overload relay shall be provided for each pump listed below. The motor starter pilot circuit voltage shall not exceed a nominal 240 volts. If 120 volts is available, or if a step down transformer is used to supply power from a higher feed line, the pilot circuit voltage shall be 120 volts.

### **LIGHTING PANEL**

A six circuit lighting panel shall be supplied to provide individual circuit protection for the automatic control system and auxiliary station equipment. Breakers shall be provided for the following equipment:

- Control.
- GFI Outlet.
- Heater.
- Fan.
- Generator Tank Heater
- Generator Battery Charger

### **RECEPTACLE**

An operator's door mounted ground fault interrupter (GFI) type convenience receptacle rated at 15 amperes shall be supplied for the operating of trouble lights, drill, etc. It shall be protected by a separate 15-ampere trip rated circuit breaker.

### **SYSTEM OPERATION**

The control panel shall function as a duplex system. Operation of the pumps will be staged in a lead/lag sequence. The control will consist of non-mercury float switches.

## **FLOAT LEVEL CONTROLLER**

A wetwell level-responsive automatic pump controller/alternator and abnormal level alarm module shall be furnished to control two pumps in response to direct-acting liquid level sensors in the wetwell. The controller/alternator shall have a three-position alternator override switch (1-2, auto, 2-1). The controller shall provide independent on, common off operation of 2 pumps with high-level alarm. An internal solid state alternator shall change the pump sequence after each cycle of operation. The controller shall have field adjustable time delay relay to provide staggered start and prevent simultaneous starting of the pump motors after a power failure condition.

Three floats will be provided to control the operation of the duplex pumps. As the liquid level rises in the wetwell the pumps stop float energizes first. As the level increases the lead start float energizes and starts the lead pump. With the lead pump running, the level decreases to the pumps stop float, and turns the pump off. When the pump stops, the alternator shall index so that the other pump starts on the next rise in level. If the level continues to rise with the lead pump running, the lag start float will energize and start the lag pump. Both lead and lag pumps shall operate together until the stop float is deenergized. A fourth float shall be provided to signal the High Level alarm if the level continues to rise with both pumps running. A fifth float shall be provided to signal Low Level Alarm and redundant off if the level continues to decrease below the pumps stop float.

A running time meter measuring hours and tenths of hours of operation up to 99999.9 hours shall be furnished for each pump motor indicated. This shall be a 120 VAC device operating from the control voltage by an auxiliary contact of the motor starter or other run contact.

A heavy-duty, three-position, hand-off-automatic selector switch shall be flush-mounted on the inner door of the control center for the operation of each motor magnetic starter. This selector switch shall operate the starter when it is in either the "hand" position or the "automatic" position and the automatic control system is calling for the operation of the equipment in the manner as herein described.

Heavy-duty oil tight red "High Level" indicating light shall operate from the pump controller.

Heavy-duty oil tight red "Low Level" indicating light shall operate from the pump controller.

A door mounted heavy-duty oil tight type pilot light operated from a respective starter auxiliary contact shall be provided to indicate a "pump running" condition. The pilot light shall have a replaceable screw-base bulb.

A 22 mm oil tight, three-position, "Hand-Off-Automatic" selector switch shall be flush-mounted on the operator's door of the control panel for the operation of each magnetic motor starter. This selector switch shall operate the starter when it is in either the "Hand" position or the "Automatic" position, and the automatic control system is calling for the operation of the

equipment in the manner as herein described.

## **WIRING**

All wiring shall be minimum 600-volt (UL) type MTW or AWM and have a current-carrying capacity of not less than 125% of the full load current.

The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

To ensure the safety of all personnel working with this equipment, as well as providing a simple means of tracing wires when troubleshooting, all wiring shall be color coded in strict accordance with the wiring diagrams furnished by the equipment supplier.

All job connections required for conveniently replacing control components shall be made at approved type terminal blocks with engraved Bakelite marker strips or similar approved means.

## **THIRD PARTY APPROVAL**

The control panel shall be constructed in compliance with Underwriters Laboratories Industrial Control Panels listing and follow-up service. The control panel shall bear a third party approval. It shall be inspected to Underwriters Laboratories 698A standards relating to hazardous locations with intrinsically safe circuit extensions and be suitable for use as service entrance equipment.

## **PUMP SEAL FAIL**

A seal failure relay specifically designed to interface with a contact closure from each of the specified pumps will be included. A Seal Fail light will be included on the control panel operator's door.

## **OVER TEMPERATURE PUMP PROTECTION**

Over temperature protection relays shall be provided in the control panels to operate in conjunction with the over temperature switch in each pump motor. The circuitry shall also include a Overtemp Light and reset push button on the control panel operator's door for manual reset capability.

## **WEATHERPROOF ALARM LIGHT**

A weatherproof alarm light assembly including a high impact resistant lexan red lens shall be included. A solid-state flasher shall be included to strobe the alarm light for any of the specified alarm conditions.

## **ALARM DIALER**

Upon closure of a contact, the dialer will call a pre-determined telephone number called is busy or the dialer is not acknowledged, the dialer will continuously dial up to eight (4) telephone numbers in succession until the dialer is acknowledged.

Alarm conditions monitored are as follows;

- Low Level Alarm
- High Level Alarm
- Pump 1 Seal Failure
- Pump 1 Seal Failure

Features shall include:

- Battery back up
- 120 VAC, 60-hertz input
- Standard RJ-11 modular telephone connection
- Dial up to (8) numbers, up to 32 digits each
- Keypad for local programming and status checks
- Unit can be called from any phone for status
- Programmable security code access

## **SHOP DRAWINGS**

A complete set of drawings shall be supplied to insure successful installation and operation of the control system. The shop drawings shall consist of all of the following:

- Sufficient detail to evaluate compliance with these specifications.
- A detailed component list including manufacturer and catalog number.
- A custom-wiring diagram for this specific application to facilitate and insure accurate field connections to the control panel by electrical installation personnel.
- A description of operation for the control system.
- An enclosure dimension print.



# NEW GENERATOR FOR SPORTSMEN ACRES EXISTING LIFT STATION

## PART 1 GENERAL

### 1.1 Summary

- A This section includes the following items from a single supplier:
  - 1. Engine Generator Set.
  - 2. Enclosure
  - 3. Related Accessories as specified
  
- B Related Requirements
  - 1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  
  - 2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
  
  - 3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
  
  - 4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

### 1.2 Submittals

- A Action Submittals
  - 1. Product Data
    - a The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
  
- B Informational Submittal
  - 1. Certificates
    - a The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
  
- C Closeout Submittal
  - 1. Maintenance Contracts

2. Operation And Maintenance Data
3. Warranty Documentation
4. Record Documentation

### 1.3 Quality Assurance

#### A Regulatory Agency

1. The generator set shall conform to the requirements of the following codes and standards:
  - a CSA C22.2, No. 14-M91 Industrial Control Equipment.
  - b EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
  - c EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - d IEC8528 part 4, Control Systems for Generator Sets.
  - e IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
  - f IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
  - g NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
  - h NFPA 99, Essential Electrical Systems for Health Care Facilities.
  - i NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
2. Qualifications
  - a The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
  - b The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
3. Manufacturers
  - a The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
  - b The generator set described herein is a Kohler model 50REZGC, and it is with the price of this equipment that the contractor of this section shall enter with his proposal at bid time. If the contractor wishes to propose equivalent equipment, it is to be submitted in a separate document at bid time. All additional costs associated with re-engineering and mechanical & electrical modifications to the installation will be at the contractor's expense. The contractor must also supply the details listed below with his equivalent proposal:
    - The associated credit for the equivalent equipment
    - Any deviations from the specifications in a line by line format
    - The weight & outline dimensions

Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification. The certification shall identify,

ENGINE GENERATOR

by serial number(s), the equipment involved. No exceptions to the specifications shall be allowed or included in the certification.

#### 1.4 Warranty or Bond

##### A Manufacturer's Warranty

1. The generator set shall include a standard warranty covering one (1) year or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

### PART 2 PRODUCTS

#### 2.1 Equipment

##### A Equipment

1. The generator set shall be a Kohler model 50REZGC with a 4P7BX alternator. It shall provide 63 kVA and 50 kW when operating at 120/240 volts, 3 Phase, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 105°F and a maximum elevation of 1100 ft above sea level. The standby rating shall be available for the duration of the outage.

##### B Engine

1. The minimum 5.7 liter displacement engine shall deliver a minimum of 105 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
  - a. Electronic isochronous governor capable of 0.5% steady-state frequency regulation
  - b. 12-volt positive-engagement solenoid shift-starting motor
  - c. 70-ampere automatic battery charging alternator with a solid-state voltage regulation
  - d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
  - e. Dry-type replaceable air cleaner elements for normal applications
  - f. The engine shall be turbo charged and fueled by Natural Gas.
  - g. The engine shall have a minimum of 6 cylinders and be liquid-cooled
2. The engine shall be EPA certified from the factory
3. The generator must accept rated load in one-step.

##### C Cooling System

1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

##### D Standard Air Cleaner

1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

##### E Battery

1. Each genset requires a BCI group 31 batteries which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 1630 amps and a minimum reserve capacity of 185 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity.
2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

#### F Housing

1. Weather Enclosure
  - a The generator set enclosure shall be a factory assembled package constructed from a minimum of high strength, low alloy 14-gauge steel. The enclosure shall have a pitched enclosure roof to prevent water accumulation, and a radiator fill panel to provide easy service access to the radiator. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement.
  - b The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat (e-coat) with high-edge protection. Following the e-coat process, the parts shall be finish coated with powder baked paint for superior finish, durability, and appearance with a Power Armor™ industrial finish that provides heavy duty durability in harsh conditions, and is fade-, scratch- and corrosion-resistant.
  - c The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
  - d Enclosures will be finished in the manufacturer's standard color.
  - e The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.
  - f Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.
  - g Doors shall be fitted with hinges, hardware, and the doors shall be removable.
  - h Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.
  - i A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
  - j The complete exhaust system shall be internal to the enclosure.
  - k The critical silencer shall be fitted with a tailpipe and rain cap.

#### G Controller

1. Decision-Maker® 3000 Generator Set Controller
  - a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.

- b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
- 2. Codes and Standards
  - a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
  - b. The controller shall meet NFPA 99 and NEC requirements.
  - c. The controller shall be UL 508 listed.
- 3. Applicability
  - a. The controller shall be a standard offering in the manufacturer's controller product line.
  - b. The controller shall support 12-volt and 24volt starting systems.
  - c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
  - d. The controller shall mount on the generator or remotely within 40 feet with viewable access.
- 4. Controller Buttons, Display and Components
  - a. The generator set controller shall include the following features and functions:
    - 1. Push button Master Control buttons. The buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
      - a. Run Mode: When in the run mode the generator set shall start as directed by the operator.
      - b. Off/Reset Mode: When in the Off/Reset mode the generator set shall stop, the reset shall reset all faults, allowing for the restarting of the generator set after a shutdown.
      - c. Auto Mode: When in Auto the mode the generator set shall be ready to accept a signal from a remote device.
    - 2. Emergency Stop Switch. The remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
    - 3. Push Button/Rotary Selector dial. This dial shall be used for selection of all Menus and sub-menus. Rotating the dial moves you through the menus, pushing the dial selects the menu and function/features in that menu. Pushing the button selects the feature/function and sub-menus.
    - 4. Digital Display. The digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. While the generator set is running, the display shall scroll all-important information across the screen for ease of operator use. The scroll can be stopped by pushing the rotary dial. The display shall fall asleep when the generator set is not running and will wake-up when the generator set starts or the rotary dial is

depressed.

5. Fault Light. The controller shall have an annunciator fault light that glows red for faults and yellow for warnings. These faults and warnings shall be displayed in the digital display. The fault light will also glow yellow when not in AUTO.
  6. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
  7. Alarm Silence/Lamp Test Button. When this button is depressed, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not AUTO.
  8. USB Connection. The controller shall have a USB connection on the face of the controller. This connection shall allow for updating of all software and firmware. This port shall also allow for all servicing of generator set parameters, fault diagnostics and viewing of all controller information via use a laptop computer.
  9. Dedicated user inputs. The controller shall have dedicated inputs for remote emergency stop switch, remote 2-wire star for transfer switch and auxiliary shutdown.
  10. The controller shall have auto resettable circuit protection integral on the circuit board.
5. System Controller Monitoring and Status Features and Functions
- a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
    1. Overview menu
      - a. Active shutdowns and warnings shall be displayed if present and without the need of operator interface
      - b. Engine runtime with total hours
      - c. Average line to line voltage
      - d. Coolant temperature
      - e. Fuel level or pressure
      - f. Oil pressure
      - g. Battery voltage
      - h. Software version
      - i. Frequency
      - j. Average current
    2. Engine metering menu.

- a. Engine speed
  - b. Oil pressure
  - c. Coolant temperature
  - d. Battery voltage
3. Generator metering menu.
    - a. Total power in VA
    - b. Total power in W
    - c. Rated power % used
    - d. Voltage L-L and L-N for all phases
    - e. Current L1, L2, L3
    - f. Frequency
4. Generator set information.
    - a. Generator set model number
    - b. Generator set serial number
    - c. Controller set number
5. Generator set run time.
    - a. Engine run time total hours
    - b. Engine loaded total hours
    - c. Number of engine starts
    - d. Total energy in kW
6. Generator set system
    - a. System voltage
    - b. System frequency 50/60Hz
    - c. System phase, single/three phase
    - d. Power rating kW
    - e. Amperage rating
    - f. Power type standby/prime
    - g. Measurement units, metric/English units adjustable
    - h. Alarm silence, always or auto only
7. Generator set calibration, the following are adjustable at the controller.

- a. Voltage L-L and L-N all phases
    - b. Current L1, L2, L3
    - c. Reset all calibrations
  - 8. Voltage regulation, +/-0.5% regulation, the following is adjustable at the controller.
    - a. Voltage Adjustable +/- 10%
  - 9. Digital and Analog Inputs and outputs
    - a. Displays settings and status
  - 10. Event Log
    - a. Stores event history, up to 1000 events
6. Controller Engine control features and functions
- a. Automatic restart - the controller has automatic restart feature that initiates the start routine and re-crank after a failed start attempt.
  - b. Cyclic cranking - the controller shall have programmable cyclic cranking
  - c. Engine starting aid - the controller shall have the capability of providing control for an optional engine starting aid.
  - d. The control system shall include time delays for engine start and cool down.
  - e. The control system shall interface with the engine ECM and display engine fault codes and warnings. The ECM shall also include sender failure monitoring to help distinguish between failed senders and actual failure conditions.
  - f. The controller shall monitor and display engine governor functions with include steady state and transient frequency monitoring
7. Controller Alternator control features and functions
- a. Integrated hybrid voltage regulator. The system shall have integral microprocessor based voltage regulator system that provides +/- 5% voltage regulation, no-load to full load with three phase sensing. The system is prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 10% adjustable of nominal voltage.
  - b. AC output voltage regulator adjustment. The system shall allow for adjustment of the integral voltage regulator with maximum of +/- 10% adjustment of the system voltage.
  - c. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
  - d. Power metering. The controller digitally displays power metering of kW and kVA.
8. Other control features and functions
- a. Event logging. The controller keeps a record of up to 1000 events, for warning and shutdown faults. This fault information becomes a stored record of systems events and can be reset.
  - b. Historical data logging. The controller total number of generator set successful start shall be recorded and displayed.



- c. Programmable access. The control system shall include a USB port that gives service technicians the ability to provide software and firmware upgrades. The system shall also be capable of allowing setting of all critical parameters using the service software and a laptop computer. All parameters and setting should be capable to being stored on a laptop for future upgrades of printing for analysis.
9. Generator Set Warning, Shutdown Alarm and Status
- a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
    - 1. Engine functions
      - a. Critical high fuel level (alarm)
      - b. ECM communication loss (shutdown)
      - c. ECM diagnostics (alarm & shutdown)
      - d. Engine overspeed (shutdown)
      - e. Engine start aid active
      - f. Engine under speed (shutdown)
      - g. Fuel tank leak (alarm & shutdown)
      - h. High DC battery voltage (alarm)
      - i. High coolant temperature (alarm & shutdown)
      - j. High fuel level (alarm)
      - k. Low DC battery voltage (alarm)
      - l. Low coolant level (shutdown)
      - m. Low coolant temperature (alarm)
      - n. Low cranking voltage (alarm)
      - o. Low engine oil level (alarm & shutdown)
      - p. Low fuel level (alarm & shutdown)
      - q. Low fuel pressure (alarm)
      - r. Low oil pressure (alarm & shutdown)
      - s. No coolant temperature signal (shutdown)
      - t. No oil pressure signal (shutdown)
      - u. Overcrank (shutdown)

- v. Speed sensor fault (alarm)
2. Generator functions
    - a. AC sensing loss over & under current (alarm & shutdown)
    - b. Alternator protection (shutdown)
    - c. Ground fault input (alarm)
    - d. kW overload (shutdown)
    - e. Locked rotor (shutdown)
    - f. Over-frequency (shutdown)
    - g. Over AC voltage (shutdown)
    - h. Under-frequency (shutdown)
    - i. Under AC voltage (shutdown)
    - j. Emergency stop (shutdown)
  3. Other General functions
    - a. Battery charger fault (alarm)
    - b. Common fault (shutdown)
    - c. Common warning (alarm)
    - d. Master switch not in auto (alarm)
    - e. Generator running
    - f. Input/Output fault (alarm)
  4. The generator set controller shall also be capable of meeting all necessary NFPA 110 level 1 requirements that include several of the above along with; EPS supplying load, Master switch “not in auto”, and contacts for local and remote common alarm.
10. Communications
    - a. The controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards
    - b. Kohler proprietary RBUS communication shall be available.
    - c. A RBUS shall be able to monitor and alter parameters, and start or stop a generator.
    - d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) and appropriate application software
    - e. A variety of connections shall be available based on requirements:
      1. A single control connection to a PC via USB
      2. Internet connection via Ethernet
    - f. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication

network.

#### H Generator Overcurrent and Fault Protection

1. The generator shall be provided with a factory installed, 80% rated line circuit breaker rated at 200 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
2. The circuit breaker(s) shall incorporate a thermo-magnetic electronic trip unit.
3. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the other generator-set alarms.
4. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

#### I Alternator

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 180 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

#### J Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

## 2.2 Accessories

1. The generator set shall be supplied with a 6-ampere automatic float/equalize battery charger capable of charging both lead-acid and gel-cell type batteries, with the following features:
  - a. Automatic 3-stage float to equalization charge
  - b. 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
  - c. Indicator LED lamps for charge state indication (bulk charge/absorption/float)

- d. Ambient temperature operating range: -40°C to 70°C
  - e. Potting for durability and waterproofing
  - f. Short-circuit and reverse polarity protection
  - g. UL 1236 listed
  - h. UL 2200 compliant
  - i. CSA certified
  - j. Ring terminals for battery connection.
2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
  3. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
  4. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows and includes the flex exhaust tube and the mounting hardware.
  5. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
  6. Block Heater - The block heater shall be thermostatically controlled, 1500 watt, 110-120 VAC - single phase, with isolating valves, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.

### 2.3 Source Quality Control

#### A. Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
  - a. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
    - i. Maximum power (kW)
    - ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
    - iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
    - iv. Governor speed regulation under steady-state and transient conditions.
    - v. Voltage regulation and generator transient response.
    - vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
    - vii. Three-phase short circuit tests.
    - viii. Alternator cooling air flow.
    - ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
    - x. Endurance testing.

- b. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
- i. Single-step load pickup
  - ii. Safety shutdown device testing
  - iii. Rated Power @ 0.8 PF
  - iv. Maximum power
  - v. Upon request, a witness test, or a certified test record sent prior to shipment.
- c. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
- i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
  - ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
  - iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
  - iv. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
  - v. Load bank testing. The test shall consist of one hour of continuous operation using a portable resistive load bank. Adjust the load bank load to provide fifteen minutes each at zero load, 25 percent, 50 percent, and 75 percent of full load. Furnish the portable load bank, all connecting cables, metering equipment, and other equipment or devices required to perform the on-site testing.

**END OF SECTION**

# **NEW AUTOMATIC TRANSFER SWITCH FOR SPORTSMEN ACRES EXISTING LIFT STATION**

## **PART 1 GENERAL**

### **1.1 Summary**

A This section includes the following items from a single supplier:

1. Automatic transfer switch

B Related Requirements

1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
3. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

### **1.2 Submittals**

A Action Submittals

1. Product Data

- a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

2. Shop Drawings

B Closeout Submittals

1. Operation And Maintenance Data
2. Warranty Documentation

### **1.3 Quality Assurance**

A Regulatory Agency

1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
  - a UL 1008 - Standard for Transfer Switch Equipment
  - b IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - c NFPA 70 - National Electrical Code
  - d NFPA 99 - Essential Electrical Systems for Health Care Facilities
  - e NFPA 110 - Emergency and Standby Power Systems
  - f IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
  - g NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
  - h EN61000-4-4 Fast Transient Immunity Severity Level 4
  - i EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
  - j IEEE 472 (ANSI C37.90A) Ring Wave Test
  - k IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
  - l CSA C22.2 No. 178 certification
  
2. Qualifications
  - a The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
  - b A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.
  
3. Manufacturers
  - a The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
  - b The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - c The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

#### **1.4 Field or Site Conditions**

##### **A Ambient Conditions**

1. Automatic transfer switch shall operate in the following conditions without any damage to the unit or its loads.
  - a Ambient Temperature: -4 to 158 Degrees F
  - b Relative Humidity: 5% to 95% noncondensing

#### **1.5 Warranty or Bond**

##### **A Manufacturer's Warranty**

1. The ATS shall include a standard warranty covering one (1) year to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

## **PART 2 PRODUCTS**

### **2.1 Equipment**

#### **A Equipment**

1. Furnish and install an automatic transfer switches system(s) with 3-Pole / 4-Wire, Solid Neutral, 200 Amps, 240V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

#### **B Manufacturer**

1. Automatic transfer switches shall be Kohler Service Entrance Rated - Programmed Transition KEP-DFTC-0200S-NK. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid date. Alternate bids shall include a line-by-line clarification of the specification marked with "D" for deviation; "E" for exception, and "C" for comply.

#### **C Construction**

1. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
3. The switch shall be positively locked and unaffected by momentarily outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amperes and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
7. For two and three pole switches, where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.



8. For four pole switches with a switching neutral, where neutral conductors must be switched as shown on the plans, the contactor shall be provided with fully rated switched neutral transfer contacts. Overlapping neutral contacts may be used as an alternative.

#### D Enclosure

1. The ATS shall be furnished in a NEMA 3R enclosure.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

## 2.2 Operation

#### A Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
  - a Nominal line voltage and frequency
  - b Single or three phase sensing
  - c Operating parameter protection
  - d Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

#### B Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):
 

a	Parameter	Dropout/Trip	Pickup/Reset
b	Under voltage	75 to 98%	85 to 100%
c	Over voltage	106 to 135%	95 to 100% of trip
d	Under frequency	95 to 99%	80 to 95%
e	Over frequency	01 to 115%	105 to 120%
f	Voltage unbalance	5 to 20%	3 to 18%
2. Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.

6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

#### C Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.
6. All time delays shall be adjustable in 1 second increments.
7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.

#### D Additional Features

1. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.
2. The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.
3. A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
4. Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
5. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

6. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.
7. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
8. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A "not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
10. The programmed transition feature shall control the transfer so that mechanism is placed in a load disconnect position for an adjustable period of time, giving motor and transformer loads and opportunity to decay to acceptable levels. The programmed transition feature shall be specifically designed for and be the product of the ATS manufacturer. The programmed transition setting shall be capable of being enabled or disabled from the user interface, communications interface port or USB. The controller shall include a built-in time delay for programmed transition operation. This time shall be adjustable from the user interface. The default value shall be 1 second and shall be adjustable from 0 to 60 minutes.
11. A time based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre and post transfer delays in either direction of transfer.
12. The controller shall provide 2 inputs for external controls that can be programmed from the following values:
  - a Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)
13. The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
  - a Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase rotation error, Not in automatic mode, Common alarm, In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage, Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load
14. The controller shall be capable of expanding the number of inputs and outputs with additional modules.
15. Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
16. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
  - a Enable or disable the routine
  - b Enable or disable transfer of the load during routine.
  - c Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
  - d Set the duration of the run.

- e At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.
- 17. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
- 18. System Status - The controller shall have a default display the following on:
  - a System status
  - b Date, time and type of the next exercise event
  - c Average voltage of the preferred and standby sources
  - d Scrolling through the displays shall indicate the following:
    - 1) Line to line and line to neutral voltages for both sources
    - 2) Frequency of each source
    - 3) Load current for each phase
    - 4) Single or three phase operation
    - 5) Type of transition
    - 6) Preferred source
    - 7) Commit or no commit modes of operation
    - 8) Source/source mode
    - 9) In phase monitor enable/disable
    - 10) Phase rotation
    - 11) Date and time
- 19. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
- 20. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- 21. Communications Interface - The controller shall be capable of interfacing, through a standard communication with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
- 22. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.
- 23. The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
- 24. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
  - a Event Logging
    - 1) Data, date and time indication of any event
  - b Statistical Data
    - 1) Total number of transfers\*

- 2) Total number of fail to transfers\*
  - 3) Total number of transfers due to preferred source failure\*
  - 4) Total number of minutes of operation\*
  - 5) Total number of minutes in the standby source\*
  - 6) Total number of minutes not in the preferred source\*
  - 7) Normal to emergency transfer time
  - 8) Emergency to normal transfer time
  - 9) System start date
  - 10) Last maintenance date
  - 11) \* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
25. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

### 2.3 Service Entrance Switch

- A. A two position disconnect switch shall be provided to disconnect the normal source and inhibit during maintenance or emergency.
  - i. The controller shall display SERVICE DISCONNECT
  - ii. Further transfer is inhibited after transfer to Emergency
- B. Molded case circuit breakers (MCCB) shall be 80% rated. Molded case switches (MCSW) shall be 100% rated. Insulated case circuit breakers and insulated case switches shall be 100% rated.
- C. The transfer switch mechanism shall provide a simple means of manual operation using only components, which are permanently affixed, in the operating position.
- D. The unit shall permit manual operation of the transfer switch while the system is energized and carrying rated load. Transfer switches, which require all sources of power to be de-energized prior to manual load transferring, shall not be acceptable.
- E. A control circuit isolation plug shall be provided to isolate all control circuitry inside the transfer switch to facilitate maintenance procedures. When isolated, there shall be no voltage present on the control circuitry.
- F. Cable Connections: Provision shall be made to terminate all incoming and outgoing power cables and grounding conductors. Connections shall be via screw type cable lugs.
- G. The Power Switching units shall be fix-mounted, utilize fully enclosed contacts and their withstand/closing rating shall be equal to or exceed the required withstand rating of the complete mechanism.
- H. The service entrance rated automatic transfer switch shall automatically transfer the load to the generator supply in the event of a utility supply failure and return the load to the utility supply upon restoration. The transfer switch shall incorporate an isolating mechanism and over current protection on the utility supply to allow operation with the main services disconnect in accordance with NEC requirements. The transfer switch power switching devices shall be mechanically and electrically interlocked to prevent the utility and generator supplies from being interconnected.
- I. Molded Case Circuit Breaker Service Entrance Rated Transfer Switches
  - i. The normal connection shall be provided with an electronic trip, 80% rated molded case breaker with a 200 amp current rating.

## **2.4 Source Quality Control**

### **A Test and Inspection**

1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

**END OF SECTION**

## **NEW MAGNETIC FLOW METER FOR SPORTSMAN ACRES EX. LIFT STATION**

### **SCOPE OF WORK**

The Contractor shall provide and install all necessary materials for an operable 6" magnetic flow meter mounted on the discharge force main. The Flow Tube shall be 6" flange by flange inside a metering vault and potted in case of submergence. A Signal Converter shall be mount on, or next to, the Lift Station control panel inside a NEMA 4X enclosure with no less than 50' of cabling to Flow Tube.

Flow meter components shall be of the same manufacturer to obtain standardization of performance, operation, spare parts, maintenance and manufacturer's services.

### **DELIVERY, STORAGE, HANDLING**

Equipment shall be delivered to the contractor completely factory assembled. Individual equipment components shall be crated in structurally adequate packing containers to prevent damage during shipping facilitate easy of handling and to provide suitable protection from weather for extended storage at the jobsite prior to installation. Packing containers shall be permanently labeled with appropriate equipment identification, shipping address and return address. Packing list shall be provided with equipment at time of delivery.

Electrical equipment shall be kept thoroughly dry at all times and shall be stored indoors. Equipment storage shall be protected and maintained in accordance with the manufacturer's recommendations. Equipment shall not be stored directly on the ground.

The contractor shall utilize equipment and tools of adequate size suitable for unloading, transporting, storing and supporting the equipment during installation. Caution shall be employed to prevent equipment damage resulting from abrupt contact with other materials or equipment.

### **QUALITY ASSURANCE**

The magnetic meter type flow meters furnished under this contract shall be as manufactured by Siemens or approved equal.

The flow meter Contractor shall submit to the engineer for his review, certified copies of flow test results for each meter. Test results shall be submitted prior to shipment upon Engineer's request and shall show compliance with specified performance requirements.

### **WARRANTY**

The equipment, apparatus, and parts furnished shall be warranted for a period of one (1) year.

Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the Contractor without cost of parts or labor to the Owner.

The Contractor shall provide an application performance guarantee with submittals.

## **PART2 PRODUCTS**

### DESCRIPTION

The 6" electromagnetic flow meter shall consist of a flow sensor based on Faraday's Law of Electromagnetic Induction and microprocessor-based signalconverter.

#### Sensor

Operating principle: Utilizing Faraday's Law of Electromagnetic Induction, the flow of liquid through the sensor induces an electrical voltage that is proportional to the velocity of the flow.

#### Construction

The sensor flow tube and liner material shall be constructed of nitrile, which is a hard rubber composite elastomer, surrounded by two integral coils. Measurement and grounding electrodes shall be 316 stainless steel. Connecting flanges shall be carbon steel. Wetted materials shall be NSF approved for drinking water service.

Operating Temp: -20 to +200 degrees F.

Submergence: The sensor shall be pedestal sealed against accidental submersion to 3 feet for 30 minutes standard, or permanently submerged to 30 feet when the terminal box is backfilled with a non-setting, transparent potting material.

#### Signalconverter:

Enclosure: NEMA 4X enclosure

Display: Background illuminated alphanumeric 3 line, 20 character display to indicate flowrate, totalized values, settings and faults and 6-key keypad.

Power supply: 115/230 VAC or 11-24VDC.

Operating temp: -5 to 120 degrees F.

Output: 0-20mA or 4-20mA into 800 ohms max. 1 relay rated at 42VAC/2A, 24DC/1A.

#### Sensor and converter/transmitter performance

Flow Range: 1.5 fps to 33 fps for accuracies stated below.



Accuracy: 0.50% of actual.

Separation: Maximum distance of 900 feet between converter and sensor without the use of any additional equipment.

Bi-directional flow capabilities shall be standard.

Totalizer:

Two integral eight digit counters programmable for forward, net or reverse flow.

The totalizers may be programmed as non-resettable or resettable.

Insertion type or non-electromagnetic flow meters will not be accepted.

Enclosure: NEMA 4X enclosure

## CALIBRATION

Each flow sensor shall be wet calibrated and all of the calibration information and factory settings matching the sensor shall be stored in an integrally mounted memory unit. At initial commissioning, the flowmeter commences measurement without any initial programming. Any customer specified settings are downloaded to the memory. Should the signal converter need to be replaced, the new signal converter will upload all previous settings and resume measurement without any need for reprogramming or rewiring.

A certificate of calibration shall accompany each flow sensor.

## SIGNAL CONVERTER FUNCTION DETAILS

The following functions shall be provided

All programming shall be accomplished through an integral keypad and all programming shall be protected by a user-defined password.

The signal converter shall be integrally mounted or remotely mounted using a remote-mount kit provided by the manufacturer.

The signal converter shall provide a 4-20 mA DC signal proportional to flow rate into 800 ohms max. Output selectable as unidirectional or bi-directional.

The relay shall be programmable as error indicator, limit alarm or pulsed output.

The signal converter system shall be equipped with an error and status log with 4 groups of information.

Information without a functional error involved.

Warnings which may cause malfunction in the application. Permanent errors, which may cause malfunction in the application.

Fatal error, which is essential for the operation of the flowmeter.

A system error shall be indicated by a flashing icon on the display or activation of the relay when set as an error alarm.

The first nine standing errors shall be stored in the error pending log. A corrected error is

removed from the error pending log. A status log shall be provided to store the last 9 error messages received for 180 days regardless of correction.

### VERIFICATION PARAMETERS

Verification of the Flowmeter shall consist of the following test routines

Insulation test of the entire flowmeter system and cables.

Test of sensor magnetic properties.

Signal converter gain, linearity, and zero point tests.

Digital output test.

Analog output test.

### VERIFICATION CERTIFICATE

A certificate of verification shall be issued if the flowmeter passes all of the tests with-in 1% of the original factory test parameters.

## **PART3 EXECUTION**

Installation:

Equipment and materials utilized or supplied for this project must be approved by the Engineer prior to installation. Approval for installation or incorporation in this project will be made only after submittal of manufacturer's shop and installation drawings, test results or other data as required and as specified herein.

Installation of equipment shall be in full conformance with the manufacturer shop drawings and requirements as approved by the Engineer.

Workmanship:

The contractor shall install equipment and materials furnished under this bid in a workmanlike manner utilizing craftsmen skilled in the particular trade. The finished installation shall portrait a neat, plumb and clean appearance.

Function of Manufacturer:

Operation and Maintenance Materials

The Contractor shall be responsible for supplying written instruction, which shall be sufficiently comprehensive to enable the operator to service and operate the meter and all equipment supplied by the manufacturer.

Operation and maintenance instruction shall be specific to the equipmentsupplied in

accordance with these specifications. Instruction manuals applicable to many different configurations and meters, and which require the operator to selectively read portions of the instructions shall not be acceptable.

All costs for the above functions including travel, lodging, meals, and incidentals shall be included in the Contractor's bid price.

# NEW PUMPS FOR SPORTSMAN ACRES EXISTING LIFT STATION

## DESCRIPTION

The contractor shall furnish and install a submersible sewage VORTEX pumps in an EXISTING concrete wet well with controller. The principal items of equipment shall include control panel, two submersible VORTEX sewage pumps, lift assemblies including base elbow, upper guide rail brackets and 2" SS guide pie, all installed in Existing concrete reinforced wet well and concrete reinforced valve vault as shown on the plans and specified herein.

## SUBMERSIBLE WET PIT SEWAGE PUMPS

### PERFORMANCE REQUIREMENTS

Design Conditions:	325 GPM
	49 Ft. TDH
Maximum Motor HP:	10.0
Maximum Motor RPM:	1750
Power Supplied:	230V, 3 Phase

### QUALITY ASSURANCE - REFERENCED STANDARDS:

- American Iron & Steel Institute (AISI)
- American Society for Testing and Materials (ASTM)
- Factory Mutual (FM)
- Hydraulic Institute Standards for Centrifugal, Rotary, and Reciprocating Pumps (HI)
- National Fire Protection Agency (NFPA)
- National Electric Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- International Standards Organization (ISO) - ISO9001

### GENERAL

Provide pumps capable of handling raw unscreened wastewater. Design pumps to allow for removal and reinstallation without the need to enter the wet well and without removal of bolts, nuts or other fasteners.

Provide a pump which connects to a permanently mounted discharge connection by simple downward motion, without rotation, guided by at least two non-load-bearing guide rails. Final connection shall insure zero leakage between pump and discharge connection flange. Provide a discharge connection/ guide system so that no part of the pump bears directly on the floor of the wet well. Provide Type 316 stainless steel chain of enough length to properly and safely lift pumps from the wet well. All exposed cast iron and ferrous surfaces shall be cleaned of dirt and grease, sandblasted to near white finish, and coated with an anti-corrosion reaction primer.

The pump shall then be coated with two-component thick coat paint, with an epoxy resin base,

having at minimum 83% solids by volume. This coating shall be non-toxic and approved for both wastewater and water applications.

### **MAJOR COMPONENTS**

Furnish major components (pump case, impeller, intermediate housing, motor housing) of cast material as specified with smooth surfaces devoid of blow holes and other irregularities. Pump case design shall incorporate a centerline discharge for stability when mounted on the base elbow.

### **IMPELLER**

The impeller shall be of, free-flow, VORTEX action design, having multiple curved vanes capable of handling coarse solids of at minimum 3-inch size, long fibers, and gas and air inclusions as may be normally found in wastewater. Back vanes shall be provided to minimize axial loads. The impeller shall be a one-piece casting of the material as specified. It shall be smooth, well finished, free from blowholes and imperfections, and be dynamically balanced. The impeller shall be securely fitted to the pump shaft in such a manner that it does not loosen or become detached if the pump is operated in the wrong direction as may happen by reversed flow or reversed motor connections.

### **SHAFT**

Provide common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. Machine the shaft of carbon steel (for maximum strength and motor efficiency) and isolate the shaft from the pumped media with a replaceable Type 420 stainless steel shaft sleeve under the lower mechanical seal. Do not use carbon steel as shaft material without a stainless steel sleeve. If a sleeve is not used, machine the entire pump/motor shaft of ASTM A276 Type 420 stainless steel

### **SHAFT SEAL**

Provide two totally independent mechanical shaft seals, installed in tandem, each with its own independent single spring system acting in a common direction. Install the upper seal in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. Provide seals which are non-proprietary in design, with replacements available from a source other than the pump manufacturer or its distributors. Do not provide seals with the following characteristics: conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals incorporating coolant circulating impellers, seals with face materials other than those specified

### **BEARINGS**

Furnish upper and lower bearings, single row (preferred) or double row as needed to provide a B10 life of, at minimum, 100,000 hours at all anticipated axial and radial loadings. Provide sealed/shielded (permanently lubricated) bearings. If open-type (non-shielded) bearings are

used, provide re-lubrication ports with positive anti-leak plugs for periodic addition of lubrication from external to the pump

## **MOTOR**

The submersible motor shall be squirrel cage, induction in design, housed in a completely watertight and air-filled chamber. The motor shall have at minimum a 1.15 service factor and be suitable for use in Class I, Division 1, Group C & D atmospheres as Explosion Proof. The motor stator shall use at minimum Class H insulation rated for 365 Degrees F. The motors shall be designed, rated, and warranted for continuous operation and capable of at minimum twenty (20) starts per hour. Temperature monitors shall be embedded in the motor windings for use in conjunction with and supplemental to external motor overload protection. The pump's control shall shut down the pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Do not provide motors that contain other than ecologically safe paraffin base oil in the seal chamber. Do not provide motors containing di-electric oils used for motor cooling and/or bearing lubrication.

## **ACCEPTABLE MANUFACTURERS**

Subject to compliance with the Contract Documents, the following are acceptable:  
**KSB KRT/ AMAREX** Model F 80-252/74 XEG or Equal as approved by the engineer by addendum.

## **MATERIALS**

### **SUBMERSIBLE SEWAGE PUMPS**

Pump Case: Cast Iron, ASTM A48, Class 35B

Motor Housing: Cast Iron, ASTM A48, Class 35B

Impeller: Cast Iron, ASTM A48, Class 35B

Intermediate Housing (Backplate): Cast Iron, ASTM A48, Class 35B

Discharge Base Elbow: Cast Iron, ASTM A48, Class 35B

Pump/Motor Shaft: Carbon Steel, ASTM A576, Gr.1045 with replaceable ASTM A276 Type 420 shaft protection sleeve. (NOTE: If sleeve is not supplied, entire shaft is to be ASTM A276 Type 420 stainless steel)

Shaft Sleeve (if used): Stainless Steel, ASTM A276 Type 420

Wear Ring, case: Cast Iron, ASTM A48, minimum 200 Brinell

Wear Ring, impeller (enclosed impellers only): Stainless Steel, AISI329, 350 Brinell

O-Rings: Nitrile Rubber (NBR)

Fasteners (including impeller fastener): Stainless Steel, ASTM A276 Type 316Ti.

Lower Seal Faces: Silicon Carbide/Silicon Carbide

Upper Seal Faces: Silicon Carbide stationary/Carbon rotating

Guide rails/cables and mounting brackets: Stainless Steel, ASTM A276 Type 316 (cables shall be nylon coated)

Lifting Chain or cable: Stainless Steel, ASTM A276 Type 316

Oil-all uses (seal lubrication, etc): Ecologically safe, parifin or mineral base

Power/Control Cable Jacket: Chloroprene with non-wicking fillers

## **POWER CABLE**

Provide 30 ft of power/control cable with each pump, suitable for submersible wastewater application, sized in accordance with NEC requirements. Provide cable terminal box on side of motor housing, with cable entry sealed to ensure that no entry of moisture is possible into the high-voltage motor/ terminal area even if the cable is damaged or severed below water level. Cable seal shall include a compressed rubber grommet to seal the cable exterior and epoxy fill to seal the interior passages. A strain relief device, in direct contact with both the cable and the cast iron entry housing, shall be provided. The cable entry shall be rated by Factory Mutual (or UL) for submerged operating depths to 85 feet.

## **TEMPERATURE PROTECTION**

Furnish temperature monitoring devices in motor windings for use in conjunction with and supplemental to external motor overload protection. Arrange controls to shut down pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Set temperature monitors at levels recommended by pump manufacturer

## **SEAL LEAK DETECTION**

Provide a detector in the motor's stator cavity which allows a control panel mounted relay to indicate leakage into the motor. In addition, on motors 80HP and larger provide a stainless steel float switch in a separate leakage collection chamber to indicate leakage past the inner mechanical seal prior to its entrance into either the motor stator cavity or the lower bearing. Electronic probes which depend on sensing resistance value changes in seal oil will not be acceptable as seal leak indicators.

## **“PumpSafe” MOTOR SENSOR MONITORING RELAY**

The pump supplier shall furnish all relays required for monitoring all motor sensors. The relays shall be installed by others in the motor control panel and properly wired in accordance with pump manufacturer’s instructions. Relays shall mount in standard 12-pin socket bases (provided) and shall operate on available control voltage of 24-240 VAC. If relays require an input voltage that is not available in the motor control panel an adequate transformer (with fused input) shall be provided by the pump supplier. Relays shall have a power consumption of no more than 2.8 watt and shall be UL approved. Relays shall be modular in design, with each relay monitoring no more than two motor sensor functions.

Each relay module shall include a dual color (red/green) LED to indicate the status of each monitored sensor. Green will indicate “status OK”; red will indicate a failure or alarm condition. A self-corrected fault will allow the relay output contacts to reset and cause the LED to change from a steady alarm indication to a flashing signal. The LED shall continue to flash until locally cleared, providing the operator an indication of a potential intermittent fault. Each relay shall also include a power-on LED and both “test” and “reset” pushbuttons.

An independent fail-safe (switch on power loss) form-C output contact shall be included for each monitored sensor to provide a normally-open / normally-closed dry contacts to initiate a remote alarm device or shut down the motor. Contacts shall be rated for 5 amps at 120 volt.

### **WARRANTY**

The pump manufacturer shall warrant the pump, motor and guide system to the Owner against defects in workmanship and materials for a period of seven (7) years under normal use and service. Pump manufacturer warranty shall be in published form and shall apply to all similar units. A copy of each warranty shall be provided to the Owner at startup.

### **CONTROL PANEL**

The electrical control equipment shall be capable of operating (2) 10 HP motors off 230 Volt, 3 Phase power for (4) Float switch operation mounted and wired in a NEMA type 3R painted steel enclosure. The enclosure should be equipped with drip shield and door gasket to prevent liquid or moisture from entering the panel. The hinged outer door shall be securely held closed with provisions for padlocking. All operating controls and indicators shall be mounted through a hinged inner swinging dead front door equipped with screw fittings to hold it securely closed. It shall not be necessary to expose any internal components to perform normal operating procedures.

The Control panel shall include the following standard features:

- overload relays
- circuit breakers
- running lights
- H-O-A switches
- Alternator
- terminal strip
- time delay relay (For lag pump following power failure.)
- SENSAPHONE CELLULAR Dialer

The magnetic across-the-line starters with manual reset shall be provided with the melting alloy type overload relays for each phase to assure positive motor protection.

The sewage pumps shall alternate automatically on the completion of each pumping cycle. One pump shall start as the lead pump and the other pump shall be started if the wet well level continues to rise to the start level of the lag pump. After each operating cycle the lead and lag positions shall alternate. A manual selector switch shall be provided so that the operator can designate either pump to stay continuously in the lead position. Adjustable time relays shall be provided to prevent simultaneous starting of pumps after power failure.

A heavy-duty, three-position, hand-off-automatic selector switch shall be flush-mounted on the inner door of the control center for the operation of each motor magnetic starter. This selector switch shall operate the starter when it is in either the "hand" position or the "automatic" position



and the automatic control system is calling for the operation of the equipment in the manner as herein described.

All control wiring within the control panel shall conform to the National Electrical Code. All wiring shall be neatly installed and run in plastic raceways to prevent interference with any operating devices. All door mounted devices shall be labeled to functions with permanently attached nameplates and all internal wiring, terminal strips, etc. shall be properly identified for field connections and trouble shooting.

The following options shall also be included:

running time meters

motor heat sensor with light

moisture sensor with light

alarm light and horn

Four alarm dry contacts

lightning arrestor

SENSAPHONE CELLULAR Dialer

115 Volt convenience outlet (Mounted on outside of panel)

UL 508 listing

A solid state, phase sequence/failure and under voltage release relay shall be provided when a three phase service is supplied, to ensure additional running protection for the pump motors. The relay shall be complete with an LED to indicate proper phase sequence, all phases in operation and voltage within limits. The relay shall also include an adjustable voltage monitor, be UL and CSA certified and be complete with automatic reset feature.

Heavy-duty oil tight red "High Level" indicating light shall operate from the pump controller.

A door mounted heavy-duty oil tight type pilot light operated from a respective starter auxiliary contact shall be provided to indicate a "pump running" condition. The pilot light shall have a replaceable screw-base bulb.

Over temperature protection shall be provided in the control panels to operate in conjunction with the over temperature switch in each pump motor. The control shall provide pump lockout of operation upon occurrence of high temperature. The circuitry shall also include a red failure indicating light and reset push button on the inner panel for each pump for alarm indication and manual reset capability.

Pump seal failure alarm lights shall be provided to indicate pump seal failure alarm condition of each sewage pump. These lights shall be operated by a contact closure from each pump.

A weather proof, high water alarm light assembly including a high impact resistant lexan red lens shall be included. The alarm light bulb shall be replaceable from inside the control panel without

having to remove the weatherproof red lens from the panel. A solid-state flasher shall be included to strobe the alarm light for any of the specified alarm conditions.

A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each pump motor. The circuit breaker must have a minimum ampere interrupting capacity of (10,000-240 volt - 14,000-480 volt) symmetrical RMS amps. The circuit breakers shall be operable through the operator's door of the enclosure.

The circuit breaker shall be properly sized to protect the control circuit conductors, motor starter and the motor against overcurrent due to short circuit or grounds.

A full voltage non-reversing motor starter with manual reset, ambient compensated, 3 phase thermal overload relay shall be provided for each of the pumps listed below.

A wetwell level-responsive automatic pump controller/alternator and abnormal level alarm module shall be furnished to control two pumps in response to direct-acting liquid level sensors in the wetwell. The controller/alternator shall have float operation LED indicators and terminals for connection of a three-position alternator override switch (1-2, auto, 2-1). The controller shall provide independent on, common off operation of 2 pumps with high-level alarm. An internal solid state alternator shall change the pump sequence after each cycle of operation. Each pump control circuit shall have field adjustable time delay relay to provide staggered start and prevent simultaneous starting of the pump motors after a power failure condition. The controller/alternator/alarm module shall be a standard stocked unit and be UL 913 listed intrinsically safe.

#### CELLULAR DIALER

The automatic dialer shall be a self-contained, solid state device. The dialer shall continuously monitor the presence of main power and the status of four independent alarm input channels, which may be programmed for N.O. or N.C. dry-contact (or logic levels) inputs or for 4-20 ma analog inputs.

Each of the four input channels shall be programmable to alarm on any of the following: OPEN circuit, CLOSED circuit, or analog HIGH and/or LOW alarm set points. Alarms shall be capable of independently being programmatically turned OFF.

On AC power failure (for dialer with backup battery option) and/or on violation of alarm criteria for any of the four alarm inputs, the dialer shall go into alarm status and begin alarm dialing and alarm notification. Dialing shall continue until the alarm(s) is(are) acknowledged.

Unless alarm notification is by pager, notification shall be by playback of high resolution digitally recorded alarm voice messages. Each alarm shall cause the playback of its specific custom message. Analog alarm messages shall include the percent-of-full-scale of the analog inputs.

Alarm acknowledgement shall be accomplished by pressing the 9-button on the telephone touch pad or by using the switch on the dialer front panel. Call-back alarm acknowledgement capability shall be available in the event that alarm notification is by numeric pager.

The dialer shall re-alarm and resume alarm dialing after a programmable period of time has elapsed after an alarm(s) has been acknowledged but the fault(s) causing the alarm(s) not remedied.

The dialer shall respond to inquiry calls from any telephone and shall provide a status report of alarm input point status (OPEN, CLOSED, or analog PERCENT) and main power status. The report shall include alarm status for each point (normal, alarm, and alarm acknowledged but fault not remedied). A warning message shall be provided if no phone numbers have been programmed for alarm notification or if the switch on the dialer front panel is set to DISARMED rather than READY.

### 1.1 Phone Link

The dialer shall be FCC approved. It shall operate on a standard cellular telephone line and shall be capable of calling from one to eight phone numbers, each up to 60 digits in length. Dedicated or lease phone lines shall not be required.

The following telephone interface features shall be included:

- a. 60 digit phone numbers --- for all 8 phone numbers.
- b. Telephone line fault detection --- tests phone line at regular programmed intervals and flashes LED on dialer front panel upon failure.
- c. Automatic selection of pulse versus tone dialing --- tests for capability upon power up without user intervention and maybe overridden for non-standard PBX systems.
- d. Call progress monitoring (CPM) --- detects busy and ringing signals; waits until phone is answer to announce voice alarm; abandons call if line is busy or no answer and quickly tries next number.
- e. Numeric pager support --- allows pause characters and pager system terminator characters such as # or \*.
- f. PBX support -- - ignores non-standard dialing tones and allows pause characters to allow waiting for outside line.

### 1.2 Programming Parameters and Other Features

Dialer shall be programmed using a standard touch tone telephone handset that shall be connected to the dialers through the RJ11 programming port. After programming, the programming telephone shall be disconnected and removed from the dialer. Pre-programmed speech shall provide entry guidance and confirmation of programmable features. Coded programming using function codes shall provide direct access to specific programmable items.

The following parameters/features shall be available. When software based, parameters shall be alterable from their default values through the local programming telephone handset:

- a. Messages --- voice alarm messages for each alarm channel and for dialer station identification shall be digitally recorded at high resolution. Permanently stored factory recorded messages shall

be included as default alarm messages and default station identification so as to allow the dialer to be fully functional even with no user recorded messages. Permanent messages to support user programming shall be provided. b. Alarm Trip Delay --- each alarm channel response time shall be individually programmable from 0.1 to 999.9 seconds. Default shall be 2.0 seconds. Main power loss response time shall be fixed at 5 minutes. c. Delay Between Alarm Dial Outs --- shall be programmable from 0.1 to 99.9 minutes. Default shall be 2.0 minutes. d. Alarm Reset Time --- shall be programmable from 0.1 to 99.9 hours. Default shall be 1.0 hour. e. Incoming Ring Response (dialer answer) Delay --- shall be programmable from 1 to 20 rings. Default shall be 1 ring. f. Alarm Message Repetitions --- shall be fixed at 5 repetitions. g. Station Identification --- see "a. Messages" above. h. Input Alarm Criteria --- each dry-contact alarm input channel shall be independently programmable for non-alarm OPEN or CLOSED circuit. Alarm will occur when dry contacts transition from non-alarm state. i. Built-In Microphone --- shall monitor background sounds at site whenever user is in phone contract with dialer. j. Local Alarm Output --- transistor output for TTL or relay drive (500 MA, 24 VDC max) activated during unacknowledged alarm. k. Arming of System --- front panel shall have an OFF/ARMED/DISARMED switch. l. Phone Dialing Mode --- shall be programmable for automatic, pulse, or touch tone. Default shall be automatic mode. m. Phone Numbers --- up to eight phone number shall be programmable. Each phone number shall be up to 60 characters long. Pauses, \*, and # characters shall be supported for numeric pager communications. n. Metal Enclosure --- shall be NEMA-12 and shall be capable of surface or flush mount. Enclosure shall have LED lights indicating main power failure, DISARMED status, phone line fault, phone off hook, alarm input line status (Normal, Fault with alarm trip delay not timed out, Unacknowledged Alarm, and Acknowledged Alarm).

### 1.3 Power, Operational Backup Battery, and User Program Storage

Main power for the dialer shall be either 10-14 VDC or 105-135 VAC. The latter requires the GAC option.

Backup power to allow dialer operation should main power be lost shall be by an internal 6 V, 4 AH gel cell rechargeable battery and precision voltage controlled charger, option GBB. A trickle charger shall not be supplied. Battery backup shall be 20 hours.

User program storage shall be by an internal lithium battery rated for 10 years from date of shipment. Dialer operating system and default voice messages shall be stored in non-volatile memory.

### **MERCURY FLOAT CONTROL SYSTEM**

To control the operation of the pumps with variations of sewage level in the wet well, UL listed direct acting mercury float switches shall be provided.

The floats shall consist of a chemical resistant polypropylene casing encapsulating a single pole mercury switch which activates when the longitudinal axis of the float is horizontal, and deactivates when the level falls one inch below the actuation elevation.

The float cable shall be of the PVC type STO #18 AWG 41 strand, 600 volt rated conductors. The float switches shall be suspended in the wet well by means of a stainless steel cable and a plastic coated cast iron weight. The floats shall be secured to the cable by stainless steel fasteners to assure drift free mounting and convenient removal for level adjustment.

#### **INITIAL OPERATION**

After the installation is complete, the manufacturer shall provide the services of a factory trained representative for a maximum period of one day to perform initial start-up of the pump station and to instruct the owner's operating personnel in the operation and maintenance of the equipment. Two (2) copies of O and M manuals will be supplied to the owner prior to initial operation.

## Product description

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Pos.no	Name		
	<p><b>Name: KRT F 80-252/74XEG-S</b></p> <p>Centrifugal pump: KRT F 80-252/74XEG-S</p> <p><b>REFERENCE DATA</b></p> <p>Date: .....</p> <p>Project: .....</p> <p>Type of equipment: Waste water pumps</p> <p>Application: .....</p> <p>Item-Nos.: .....</p> <p><b>INPUT</b></p> <p>Nature of system: Single head pump</p> <p>Quantity of pumps: 1 herein 0 standby</p> <p>Required station total flow: 325 US g.p.m.</p> <p>Total dynamic head: 49 ft</p> <p>Static head : 0 ft</p> <p>Temperature of fluid: 68 °F</p> <p>Density of fluid: 62.32 lb/ft<sup>3</sup></p> <p>Viscosity of fluid: 1.082E-5 ft<sup>2</sup>/s</p> <p>Solid size:</p> <p><b>SELECTION</b></p> <p>Manufactured by: KSB</p> <p>Pump type: KRT F 80-252/74XEG-S</p> <p>Nos of poles: 4</p> <p>Impeller type: Open Vortex impeller</p> <p>Impeller diameter: 8.3 inch</p> <p>Free passage: 3 inch</p> <p>Discharge flange: 3 inch to suit CLASS 125 to ASME/ANSI B16.1</p> <p>Type of installation: Stationary wet-well installation for double guide rail system.</p> <p><b>END OF REFERENCE DATA</b></p> <p><b>PERFORMANCE REQUIREMENTS</b></p> <p>Furnished, shall be a total of 1 waste water non-clog submersible motor pump(s) 1 of them operating simultaneously. The nature of system is: Single head pump.</p> <p>The pump shall be designed to successfully operate at a rated duty point of 328 US g.p.m. and 49.9 ft and shall be capable to operate within a range from 20.7 ft to 72.0 ft continuously. The shut-off head shall be at minimum 68.6 ft. The pump's nominal speed shall not exceed 1800 rpm.</p> <p>The pumped media shall have a maximum temperature of 68 °F, a specific gravity of 62.32 lb/ft<sup>3</sup> and a viscosity of 1.082E-5 ft<sup>2</sup>/s. The minimum pump efficiency at the design point shall be not less than 50 %.</p> <p>The pump's submersible dry squirrel cage electric motor shall be capable of operation at , three (3) phase, 60 Hz service. The rated motor power shall not exceed 10 hp.</p> <p><b>MATERIALS</b></p> <p>The submersible pump shall be of at minimum, the following grades of materials:</p> <p>Pump casing: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Discharge cover: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Shaft: Stainless steel EN-1.4021+QT800 (A 276 Type 420)</p> <p>Shaft sleeve: ---Impeller: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Bearing bracket: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Motor casing: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Cable sheath: Waterproof synthetic rubber compound</p> <p>Elastomer components: Nitrile rubber (NBR)</p>		
Project name	Project ID <b>Sportsman Acres LS (Sportsman Acres, OK)</b>	Created by	Created on <b>4/23/2019</b>

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Pos.no	Name		
	<p>Bolts. nuts: Stainless steel A4 (EN-1.4571) (A 276 Type 316)</p> <p><b>PUMP CONSTRUCTION</b> The pump shall be of submersible centrifugal, non-clog, single stage, volute casing, end suction type capable of satisfying the specified performance requirements. The pump shall be designed as "back pull-out" such that the entire rotating assembly can be removed from the casing. The pump shall be suited for continuous operation in a submerged condition driven directly by a fully submersible dry squirrel cage induction motor. The impeller shall be fitted directly to the motor shaft. The head-capacity curve shall have a single flow rate for each pumping head value and have a continuously rising head characteristic from the specified design point to shut-off so as to ensure stability and control in both individual and/or parallel operation. The operating range of the pump, as specified, is defined by the maximum and minimum operating heads against which the pump will be required to operate. At no point on the pump's power demand curve between shut-off and the minimum operating head shall the pump's power demand exceed the rated power of the motor.</p> <p><b>CASING</b> The pump shall have a volute casing with centerline discharge. The single piece pump casing shall be made of suitable thickness to allow for long pump life and to safely withstand the pressure at shut off head. The discharge nozzle shall be provided with integrally cast flange. Critical mating surfaces where watertight sealing is required shall be machined and fitted with O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.</p> <p><b>IMPELLER</b> The impeller shall be of, free-flow, vortex action design, having multiple curved vanes capable of handling coarse solids of at minimum 3 inch size, long fibers, and gas and air inclusions as may be normally found in wastewater. Back vanes shall be provided to minimize axial loads. The impeller shall be a one piece casting of the material as specified. It shall be smooth, well finished, free from blowholes and imperfections, and be dynamically balanced. The impeller shall be securely fitted to the pump shaft in such a manner that it does not loosen or become detached if the pump is operated in the wrong direction as may happen by reversed flow or reversed motor connections.</p> <p><b>PUMP SHAFT</b> The common pump/motor shaft shall be of sufficient size to transmit full driver output with a maximum deflection of 0,05 mm (0.002 inches) measured at the lower mechanical seal. The pump/motor shaft shall be of stainless steel or be completely isolated from the pumped media through the use of a stainless steel shaft sleeve. Do not use carbon steel as a shaft material without using a stainless steel shaft sleeve.</p> <p><b>BEARINGS</b> The shaft shall rotate on at minimum 1 / 1 antifriction bearings. The bearing system shall be adequately designed so as to be capable of handling all axial thrust loads plus any and all radial loads.. The bearings shall be sealed and lubricated for lifetime.</p> <p><b>SHAFT SEAL</b> Each pump shall be provided with two totally independent, mechanical seals, installed in tandem, each with its own independent single spring system acting in a common direction. The sealing shall not depend on the direction of rotation. The primary, impeller-side seal shall operate in a large flooded chamber formed by cast recesses in the impeller and backplate. The impeller-side seal shall be of bellows type mechanical seal. The primary and the secondary seal faces shall operate in a generously proportioned lubricant chamber that hydrodynamically lubricates the seal faces to allow for extended periods of dry-running</p>		
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	<p>operation without the need for external seal lubrication or cooling systems. The lubricant chamber liquid shall be an environmentally friendly and nontoxic. The seal face material of the primary seal shall be of at minimum Silicon Carbide versus Silicon Carbide (SiC/SiC) for excellent hardness and chemical resistance across the entire "pH" range. The secondary seal shall be of Carbon versus Silicon Carbide (Carbon/SiC). The seal faces must be of a solid material capable of being re-lapped. The seals shall require neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. Mechanical seal metal parts shall be of CrNiMo-stainless steel. Seals shall be non-proprietary in design, and shall be available from another vendor in addition to the pump manufacturer. Conventional double mechanical seals with a single or multiple springs acting in opposed direction, cartridge-type mechanical seals; seals with materials other than those specified; shall not be considered as adequate for this critical sealing area.</p> <p><b>BOLTS AND NUTS</b> All nuts or bolts exposed to the pumped media shall be of stainless steel as specified.</p> <p><b>NAMEPLATE</b> Each pump shall be provided with a stainless steel nameplate firmly attached to the pumping unit. It shall be clearly and durable inscribed with the manufacturer's name, year of manufacture, pump-type, serial number, and principal rating data. For easy identification of the submerged pumping unit, a second equal nameplate shall be supplied along with its documentation for attachment outside the wet well.</p> <p><b>PROTECTIVE COATING</b> All exterior metal surfaces of the pump shall be subject to following preparation and coating procedure except name plates, bright parts and stainless steel parts. The preparatory treatment of cast and welded components shall be accomplished in accordance to SSPC near white SP 10. The primer when using Zinc dust or Zinc phosphate base shall have a dry film thickness of not less than 1 1/2 mils (35 microns). An abrasion and shock-resistant, non porous 2 component epoxy resin base coating shall be used. It shall be resistant against many diluted acids and brines as well as grease, oil, solvents and seawater and specially suited for use in hydrous media. The solids content shall be not less than 82%.The shop-applied top coat shall have a dry film thickness of not less than 6 mils (150 microns). The color shall be preferably Ultramarine Blue. Name plates shall be masked or removed prior to surface preparation and coating. Polished parts and surfaces (shafts, couplings) shall not be painted but preserved against corrosion. The coating of stainless steel parts is not required but acceptable.</p> <p>Installation type: S + guide rails . . .</p> <p><b>INSTALLATION</b> The pump shall be furnished with a double guide system to permit easy removal and reinstallation of the pump without the need for personnel to enter the wet well.. The pump shall have a guide claw used to guide the pump into place on the discharge elbow. The claw shall be bolted to the pump and not form an integral part of the same.The discharge elbow of each pump shall be permanently installed in the wet well along with the discharge piping and be designed to receive the pump without the need to remove any bolts and nuts. The discharge elbow shall suit size 3 inch flange connection to ASME/ANSI B16.1, CLASS 125. Perfect sealing between the pump and its discharge elbow shall be accomplished by an O-ring seal. The moment created by the entire weight of the pump unit shall be utilized for sealing. No portion of the weight shall bear directly on the sump floor nor shall any portion of the pump weight be supported by the guides. Simple metal to metal sealings and/ or wedge type connection systems shall not be acceptable.</p>		
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	<p>The guide system utilizing double guides bars shall be suitable for an installation depth of 15 ft (4.5 m) extending from the top of the pump well to the sump floor. Brackets shall be provided with all accessories and bolts forming the upper support of the guides as well as intermediate supports where required for installation shall be provided.</p> <p>The contractor shall supply 2" diameter pipes.</p> <p>Each pump shall be fitted with a stainless steel lifting chain of 8 ft (2,5 m) length with additional lifting loops every 8 ft (2.5 m) to permit raising and lowering the pump from the wet well properly and safely.</p> <p>Materials:</p> <p>Discharge elbow: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Claw: Grey cast iron EN-GJL-250 (A 48 Class 35B)</p> <p>Bracket: Stainless steel EN-1.4571 (A 276 Type 316 Ti)</p> <p>Lifting device: Stainless steel EN-1.4404 (A 276 Type 316L)</p> <p>Motor: 74XEG</p> <p><b>MOTOR</b></p> <p>The motor shall be three-phase, dry squirrel-cage induction type in design. The motor shall be adequately sized and rated for continuous operation to at maximum a fluid temperature of 104 °F (40 °C).</p> <p>The motor housing shall be both air filled and watertight. Motor protection shall be at minimum IP 68. Allowable maximum submergence shall be not less than 100 ft (30 m).</p> <p>The motor shall be rated for supply voltage of 230 V and frequency of 60 Hz and accept voltage fluctuations as per range A of IEC 60034-1 (Supply voltage +/- 5 % supply frequency +/- 2 %). The motor shall be explosionproof to CSA, NEC, FM Class I, Div. 1, Gr. C+D.</p> <p>The motor shall be designed for a maximum of 10 number of starts per hour.</p> <p>The motor stator shall be wound using Class H monomer-free polyester resin insulation resulting in an overall motor rating of 311 °F (155 °C), Class F. The stator windings shall be Current-UV-Dip-Impregnated resulting in a winding fill factor of at least 95 %. The rotor bars and short circuit rings shall be made of cast aluminum.</p> <p>The motor and pump set complete shall be designed and manufactured by the same company.</p> <p><b>ELECTRIC CABLE AND CABLE ENTRY</b></p> <p>All power and control cables shall be suitable for the flexible connection of the submersible pumps, sized in accordance with NEC, FM, IEC requirements and shall be Ozone, UV, weather, oil and water resistant.</p> <p>The conductors shall be made of finely-stranded copper to Class 5 of IEC 60228. Each conductor shall be insulated by ethylen-propylene-rubber (EPR). An inner sheath of rubber shall also be utilized. The cable outer sheath shall be water and oil-resistant and made of Neoprene. Each cable shall be rated for 600/1000 V and a maximum conductor temperature of 194 °F (90 °C).</p> <p>The power and control cables shall be of 33 ft (10 m) length.</p> <p>Each cable entry seal shall be rated for a submerged depth to 100 ft (30 m).</p> <p>A triple sealed cable entry design along with strain relief and a bend protection shall be provided. Firstly, the cable entry seal shall consist of an elastomer grommet compressed by two stainless steel washers, sealing the outside of the cable against the cable entry casing. Secondly, the entire end of the cable shall be sealed inside the cable entry housing through the use of a non-shrink epoxy resin. Thirdly, a monolithic dam formed by either solder on bare stripped section or by an inserted Copper bushing shall seal each individual cable lead making sure that no entry of moisture is possible into the high-voltage motor terminal area even if the cable is damaged or severed below water level.</p> <p>Cable entries providing only simple rubber grommet (external cable jacket) seals will not be accepted. If a triple sealed cable entry as described is not utilized in the pump's design, then the pump shall have installed a separate moisture sensor mounted in the separated terminal area to shut the pump down should moisture approach the high voltage terminal area.</p> <p><b>MOTOR THERMAL PROTECTION</b></p> <p>Temperature monitors shall be embedded in the motor windings for use in conjunction with and</p>		
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	<p>supplemental to external motor overload protection. These temperature sensitive switches shall allow for direct integration with the motor control circuit to shut down the pump if high temperatures are detected. The switches shall be normally closed rated for 250 V AC and a current of not less than 2 A. The temperature monitors shall automatically reset once motor temperature returns to normal.</p> <p><b>MOTOR HOUSING MOISTURE PROTECTION</b> A moisture detector shall be mounted in the motor's stator cavity allowing a control panel mounted relay to de-energize the motor should leakage occur.</p>

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**Data sheet**

**Pump type KRT F 80-252/74XEG-S**

**Operating data**

Flow	328	US g.p.m.	Fluid		
Head	49.9	ft	Density of fluid	62.3	lb/ft <sup>3</sup>
Operating speed	1762	rpm	Viscosity	1.08E-5	ft <sup>2</sup> /s
Shaft power	7.78	hp	Temperature	68	°F
Efficiency	52.6	%			
Required pump NPSH	22.6	ft			
Head H(Q=0)	72.2	ft			
Application range	Head		Flow		
	From	72	ft	4.84	US g.p.m.
	To	20.7	ft	641	US g.p.m.

**Design**

Make	KSB	Impeller type	Vortex impeller
Design	Submersible pump		Open
Series	KRT F	Impeller size	( 210 ) 8 inch
Frame size	80-252		Max. ( 265 ) 10 inch
Stages	1		Min. ( 190 ) 7 inch
Curve number	K43400s/0	Free passage	3 inch
		Weight	lb
Type of bearings	Antifriction		
Nos. of bearings	1 / 1		
Lubrication	Grease lubrication. lubricated for lifetime		
Suction port	Pressure rating	--	
	Flange size	DN0	---
	Flange size	DN1	4"
	Norm		--
Discharge port	Pressure rating		CLASS 125
	Flange size	DN2	3 inch
	Flange size	DN3	4 inch
	Norm		ASME/ANSI B16.1
Suction port: pump (DN1)			Discharge port: discharge elbow (DN3)

**Materials**

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	---
Casing wear ring	
Impeller wear ring	
O-Rings	Nitrile rubber (NBR)

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## Data sheet

### Pump type

KRT F 80-252/74XEG-S

### Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	with elastomer bellows
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

### Monitoring

Thermal winding protection	By temperature sensitive switches
Explosion proof protection	By PTC (Explosion proof models only)
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	---
Bearing temperature monitoring	---

### Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue

### Installation

#### INSTALLATION

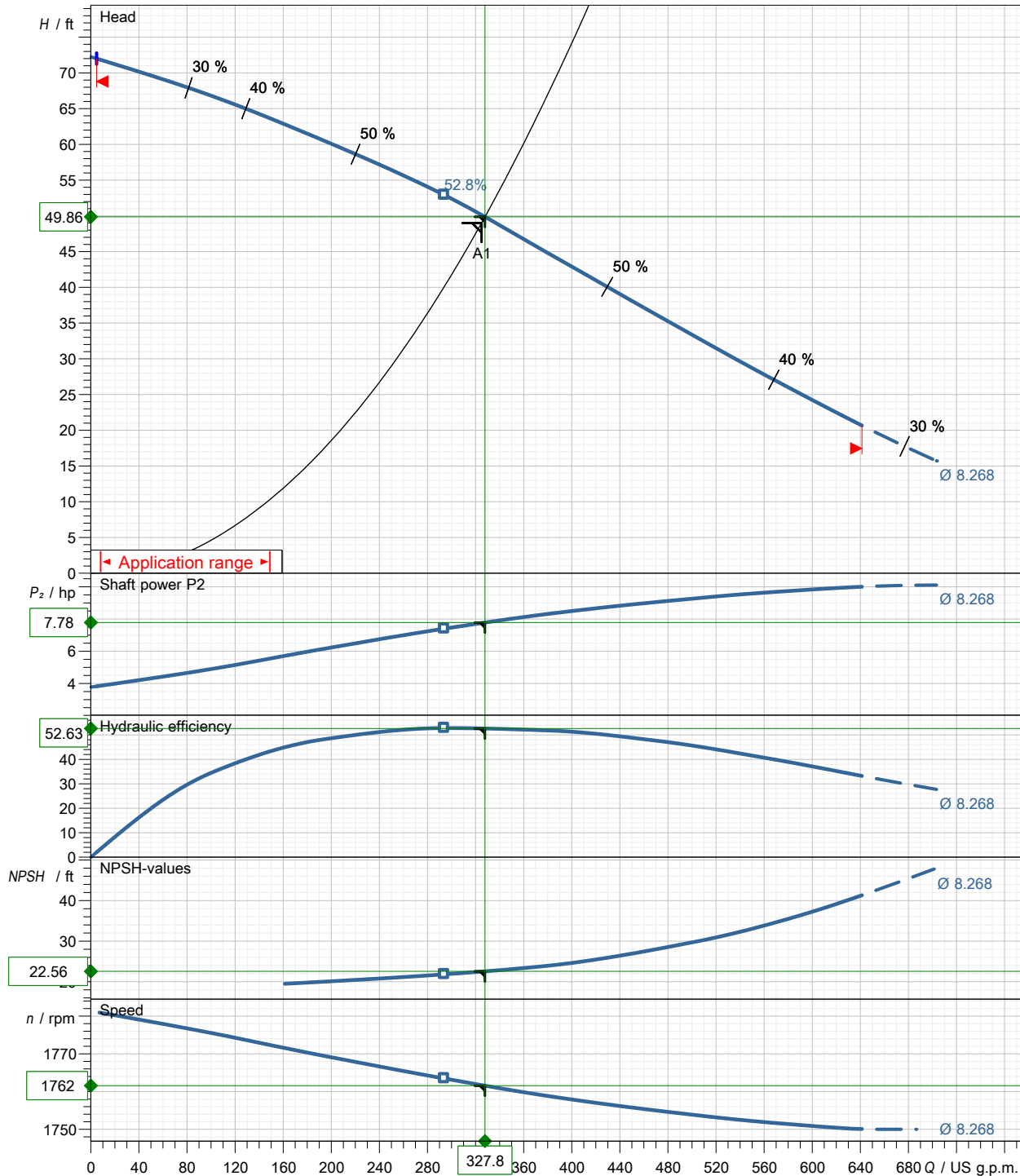
Type of installation:	Wet well installation designed for
automatic connection to a permanently installed discharge elbow	
Discharge elbow size (DN2/DN3):	3 inch / 4 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Guide system:	Double guide bars, by contractor
Guide bar dimension:	2" diameter pipes
Installation depth:	15 ft (4.5 m)
Lifting device:	stainless steel lifting chain
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories:	Discharge elbow, 3 inch / 4 inch
fasteners, claw, bracket, lifting chain, but without guide bars	
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	Stainless steel EN-1.4404 (A 276 Type 316L)

#### INSTALLATION

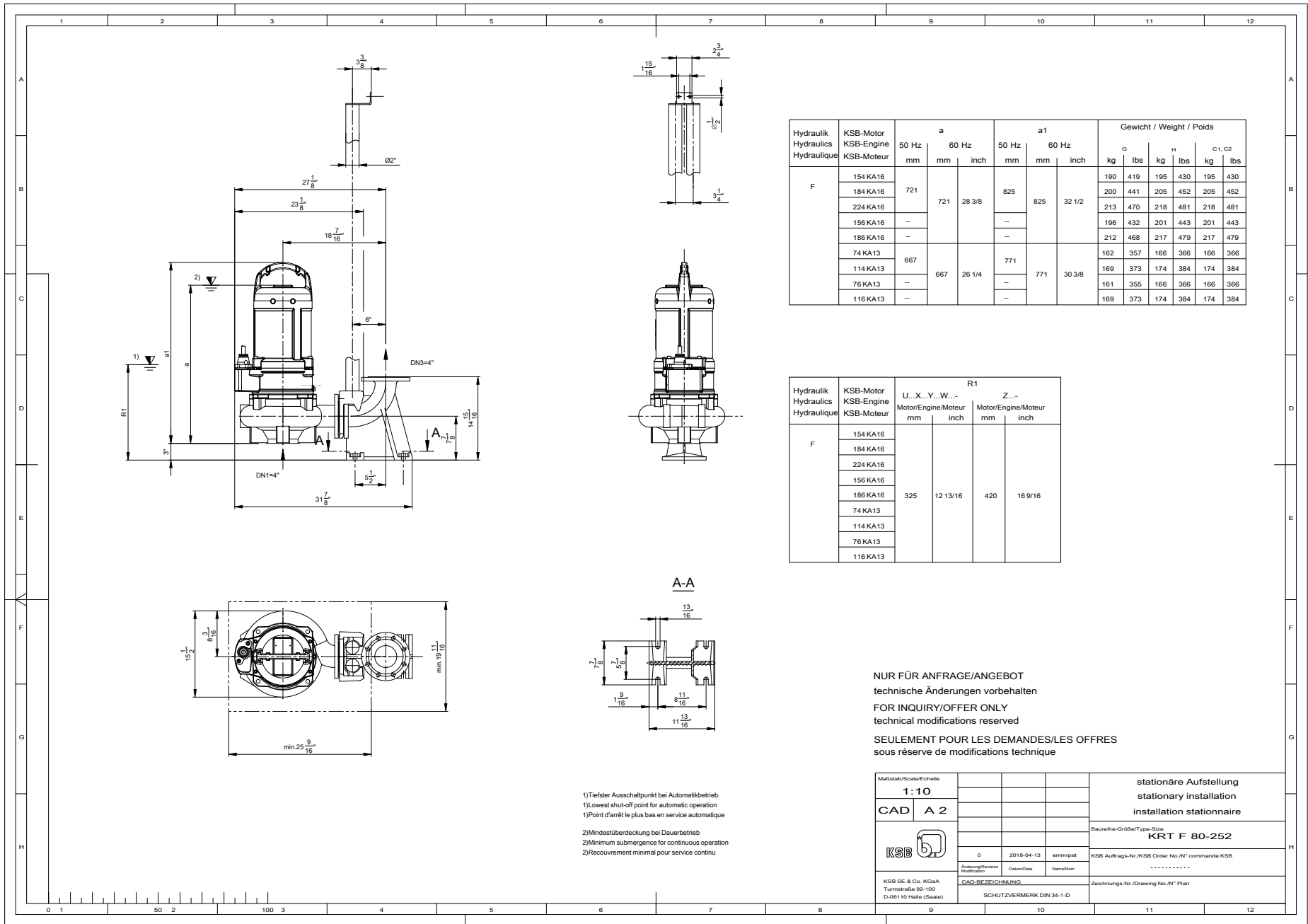
Performance curve

Pump type

**KRT F 80-252/74XEG-S**



Impeller type	Vortex impeller	, Open	Curve number	K43400s/0	
Free passage	3 inch	Density of fluid	62.322 lb/ft <sup>3</sup>	Frequency	60 Hz
Impeller size	8 inch	(210 ) Viscosity	1.082E-5 ft <sup>2</sup> /s	Speed	1762 1/min



Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	a			a1			Gewicht / Weight / Poids						
		50 Hz mm	60 Hz mm	inch	50 Hz mm	60 Hz mm	inch	G		H		C1, C2		
F	154 KA16	721	28 3/8	1 1/8	825	32 1/2	190	419	195	430	195	430		
	184 KA16						200	441	205	452	205	452		
	224 KA16						213	470	218	481	218	481		
	156 KA16	--	--	--	--	--	196	432	201	443	201	443		
	186 KA16	--	--	--	--	--	212	468	217	479	217	479		
	74 KA13	667	--	--	771	--	162	357	166	366	166	366		
	114 KA13	--	26 1/4	--	771	30 3/8	169	373	174	384	174	384		
	76 KA13	--	--	--	--	--	161	355	166	366	166	366		
	116 KA13	--	--	--	--	--	169	373	174	384	174	384		

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	R1			
		U...X...Y...W...- Motor/Engine/Moteur		Z...- Motor/Engine/Moteur	
F	154 KA16				
	184 KA16				
	224 KA16				
	156 KA16				
	186 KA16	325	12 13/16	420	16 9/16
	74 KA13				
	114 KA13				
	76 KA13				
	116 KA13				

- 1) Tiefster Ausschaltpunkt bei Automatikbetrieb  
1) Lowest shut-off point for automatic operation  
1) Point d'arrêt le plus bas en service automatique
- 2) Mindestüberdeckung bei Dauerbetrieb  
2) Minimum submergence for continuous operation  
2) Recouvrement minimal pour service continu

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technical modifications reserved  
SEULEMENT POUR LES DEMANDES/LES OFFRES  
sous réserve de modifications technique

Maßstab/Scale/Echelle <b>1:10</b>				stationäre Aufstellung stationary installation installation stationnaire	
CAD	A 2			Bezeichnung/Größe/Type-Size <b>KRT F 80-252</b>	
KSB				KSB Auftrags-Nr./KSB Order No./N° commande KSB	
Änderung/Revision Modifications		Datum/Date		Name/Name	
KSB SE & Co. KGAA Turmstraße 92-100 D-40811 Hülse (Essen)		CAD-BEZEICHNUNG SCHUTZVERMERK DIN 34-1-D		Zeichnungs-Nr./Drawing No./N° Plan	

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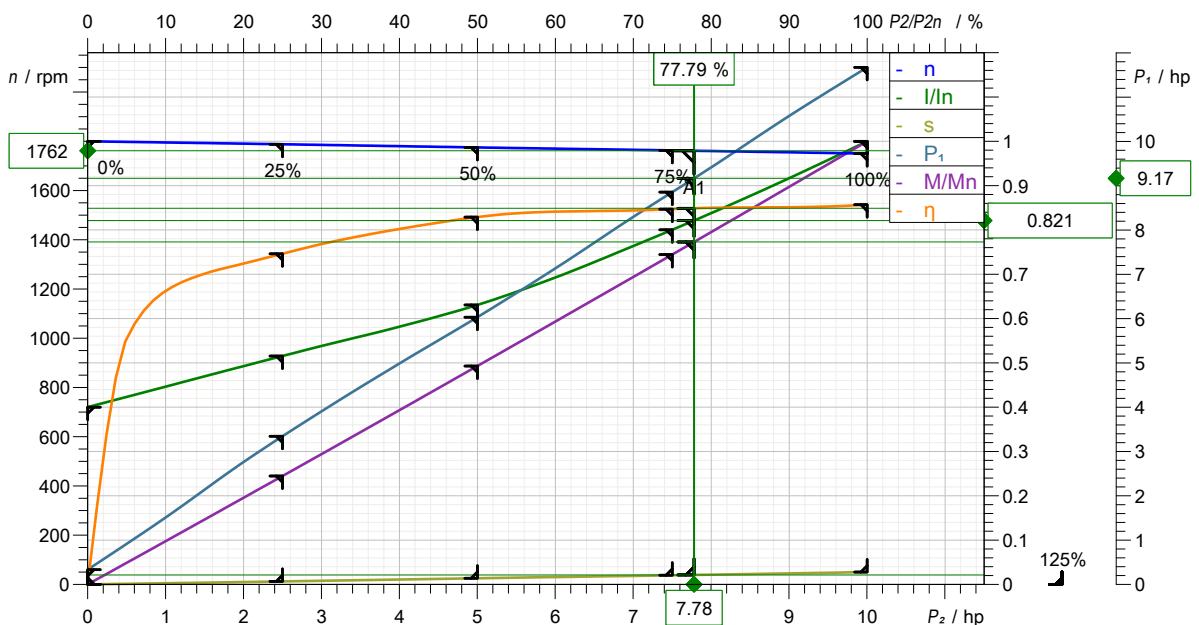
**Data sheet: Motor data**

**Motor type 74XEG**

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	230	V
Design acc. standard	-	Rated frequency	60	Hz
Service factor	1.14	Rated HP (D.O.L) or VFD	10	hp
Degree of protection	IP68	Rated current	26	A
Insulation class		Nominal speed	1750	rpm
Starting mode	Direct starting	NEMA code letter	H	
No. starts / h	10	Starting to rated current	6.8	
Coolant temperature	</= 104 °F (40 °C)	Starting current	176.8	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT F 80-252/74XEG-S			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	8.70	10.0	85.7	0.84	26.0
3/4	6.60	7.5	84.8	0.8	20.8
2/4	4.50	5.0	82.9	0.69	16.4
1/4	2.49	2.5	74.8	0.47	13.4

Main cable 1 x AWG 11-7+15-5 Diameter 92.46 US g.p.m....101.27 US g.p.m.  
 Control cable --- Diameter  
 Cable. outer sheath Waterproof synthetic rubber compound  
 Cable length 33 ft (10 m)



KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961  
 KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

November 27, 2018

Mr. Carl Gales  
KAS Gales Company  
18772 Harmon Road  
Fayetteville, Arkansas 72704-8524

Subject: Report of Subsurface Exploration  
Proposed Cherokee Heights Lift Station  
Sportsmen Acres, Oklahoma  
Building & Earth Project No.: OK180269

Dear Mr. Gales:

Building & Earth Sciences, Inc. completed the authorized subsurface exploration for the proposed Cherokee Heights Lift Station in Sportsmen Acres, Oklahoma. Our services were performed in accordance with our proposal numbered OK19325 (revision #2), dated November 1, 2018. You authorized our services by signing our proposal document on November 1, 2018.

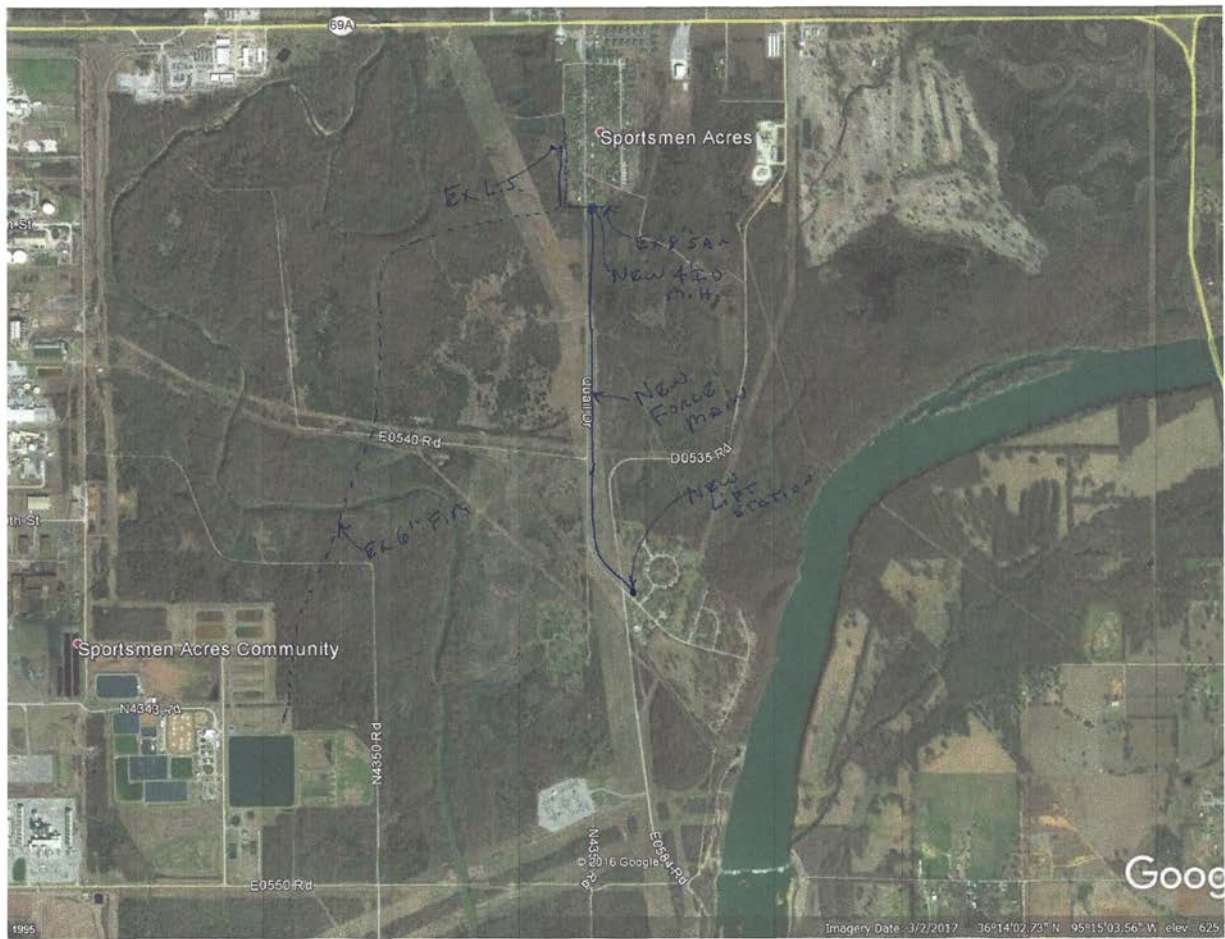
### **GENERAL PROJECT INFORMATION**

We understand the project site is located south of Sportsmen Acres, Oklahoma, adjacent to Quail Drive. The provided Google Earth image indicating the location of existing and proposed sanitary sewer infrastructure is shown in the following figure.

Based on the information provided to our office, we understand proposed construction will consist of a new lift station and force main to serve the Cherokee Heights development south of Sportsmen Acres. **Our scope of work was limited to the proposed lift station location.**

A site grading plan was not available for our review at the time of this proposal. The maximum excavation depth for the lift station will be 15 feet.





**Figure 1: Existing and Proposed Sanitary Sewer Infrastructure**

## **SUMMARY OF SUBSURFACE EXPLORATION**

The authorized subsurface exploration was performed on November 9, 2018. The subsurface exploration consisted of one (1) test boring. The boring location is shown on the Boring Location Plan sheet found in the Appendix of this document. The boring was located in the field by a Building & Earth geologist using a handheld GPS device. As such, the boring location shown should be considered approximate. The ground surface elevation at the boring location was not determined as part of our scope of work.

The boring was drilled using a CME-45 drill rig equipped with hollow stem augers and a manual hammer until auger refusal occurred. The boring was advanced beyond auger refusal depth using a Diedrich D-50 equipped with rock core tooling. A Building & Earth field geologist observed drilling operations and logged the boring in the field.

Further details about Standard Penetration Testing (SPT) and rock coring procedures can be found in the Appendix of this document.

The soil and rock samples retrieved from the boring location were visually examined by our engineer and soil descriptions were provided. The project engineer prepared a Boring Log summarizing the subsurface conditions at the boring location. Laboratory testing was excluded from our scope of work. The following section summarizes the general subsurface conditions encountered in the boring.

### **GENERAL SUBSURFACE CONDITIONS**

Topsoil with thickness of about 6 inches was encountered at the surface. The topsoil was underlain by dark gray-brown residual lean clay that exhibited a medium stiff consistency and that appeared to have low to moderate plasticity characteristics. The clay stratum extended to a depth of about 1.2 feet below the ground surface.

The residuum was underlain by a weathered zone of light gray to gray, limestone that contained clayey shale seams and that was highly jointed. Auger drilling resumed to a depth of about 3.5 feet where auger refusal occurred on harder limestone.

Upon encountering auger refusal, drilling procedures converted to rock coring to further evaluate the condition of the limestone unit beyond auger refusal to depth of about 8.5 feet. The limestone was light gray to gray in color with yellow discolored bedding planes. Multiple clayey shale seams with thickness ranging from about 1.5 to 3 inches were noted throughout the formation to a depth of roughly 7 feet. The limestone was thin bedded with thickness ranging between 0.5 and 4 inches. Below a depth of about 7 feet, the limestone became thicker bedded, ranging in thickness between 6 to 12 inches. The first core run extended from a depth 3.5 feet to 5 feet, which had 94 percent recovery and a Rock Quality Designation (RQD) of 25 percent. Between depths of 5 and 8.5 feet, core recovery of 94 percent and RQD of 71 percent were recorded. In general, rock mass with RQD of 25 to 50 percent is considered to be of poor quality and a rock mass with RQD of 51 to 75 percent is considered to be of fair quality.

Groundwater was not encountered prior to the start of rock coring operations. Groundwater was not measured prior to backfilling due to the introduction of water during rock coring to aid with cooling of the drill bit and flushing of the drill cuttings from the borehole.

## GENERAL EXCAVATION CONSIDERATIONS

Based on the subsurface conditions encountered in our boring, we anticipate that the overburden residuum can be excavated using a backhoe in good working condition to depth of roughly 1 to 1.5 feet. Weathered limestone and a thin bedded limestone with clayey shale seams encountered between depths of about 1.5 and 7 feet likely can be excavated using a large track hoe equipped with rock teeth and a hydraulic hoe ram. It should be noted that auger refusal occurred in limestone at depth of about 3.5 feet. Below depth of 7 feet, the limestone became thicker bedded and no clayey seams were noted within the rock formation to boring termination depth of 8.5 feet.

Our scope of work excluded rock coring to anticipated lift station depth of 15 feet; thus, excavation difficulty considerations below explored depth of 8.5 feet cannot be provided based on subsurface information available at the time of preparing this report.

The contractor will need to anticipate rock excavation techniques, including blasting below a depth of about 7 feet, where thicker bedded limestone was encountered. The ability to excavate hard limestone rock is a function of the material, the equipment used, the skill of the operator, the desired rate of removal and other factors. The contractor should review the borings log and should use his own method to evaluate excavation difficulty.

## CLOSING

We appreciate the opportunity to provide subsurface exploration services for the subject project. If you have any questions regarding the information in this report or need any additional information, please call us.

Respectfully submitted,

**BUILDING & EARTH SCIENCES, INC.**

*Certificate of Authorization #3975, expires 6/30/2020*



Marco V. Vicente Silvestre,  
Regional Vice President  
OK: 21903



Dharmateja Maganti, E.I.  
Project Manager

# Appendix Table of Contents

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## GEOTECHNICAL INVESTIGATION METHODOLOGIES

The subsurface exploration, which is the basis of the recommendations of this report, has been performed in accordance with industry standards. Detailed methodologies employed in the investigation are presented in the following sections.

### *DRILLING PROCEDURES – STANDARD PENETRATION TEST (ASTM D1586)*

Samples were obtained at standard sampling intervals with a split-spoon sampler. The borehole was first advanced to the sample depth by augering and the sampling tools were placed in the open hole. The sampler was then driven 18 inches into the ground with a 140-pound automatic hammer free-falling 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded. The initial increment is considered the “seating” blows, where the sampler penetrates loose or disturbed soil in the bottom of the borehole.

The blows required to penetrate the final two (2) increments are added together and are referred to as the Standard Penetration Test (SPT) N-value. The N-value, when properly evaluated, gives an indication of the soil’s strength and ability to support structural loads. Many factors can affect the SPT N-value, so this result cannot be used exclusively to evaluate soil conditions.

Samples retrieved from the boring location were labeled and stored in plastic bags at the jobsite before being transported to our laboratory for analysis. The project engineer prepared a Boring Log summarizing the subsurface conditions at the boring location.

### *ROCK CORING*

Rock coring was performed in accordance with ASTM Specification D2113. During the coring operations, the rock cores were placed in core boxes at the site and transported to our laboratory for identification and classification. At the laboratory, the rock type was identified and the “recovery” and “rock quality designation” (RQD) was determined. The recovery is the ratio of the length of sample obtained to the length of the run cored, as a percent. The RQD is the percentage of the length of the core run which has rock segments of moderately hard or harder rock four inches or greater in length, compared to the total length of the run. The percent recovery and RQD are related to rock soundness and continuity. Generalized rock descriptions, percent recovery, and RQD values are shown on the boring log.

## BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

### *DEPTH AND ELEVATION*

The depth below the ground surface and the corresponding elevation are shown in the first two columns.

### *SAMPLE TYPE*

The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

### *SAMPLE NUMBER*

Each sample collected is numbered sequentially.

### *BLOWS PER INCREMENT, REC%, RQD%*

When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 5. When rock core is obtained the recovery ratio (REC%) and Rock Quality Designation (RQD%) is recorded.

### *SOIL DATA*

Column 6 is a graphic representation of four different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 6 is summarized below:

- **N-value**- The Standard Penetration Test N-value, obtained by adding the number of blows required to drive the sampler the final 12 inches, is recorded. The graph labels range from 0 to 50.
- **Qu** – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- **Atterberg Limits** – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Remarks column on the far right of the boring log. The Atterberg Limits graph labels range from 0 to 100%.
- **Moisture** – The Natural Moisture Content of the soil sample as determined in our laboratory.

### *SOIL DESCRIPTION*

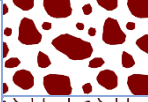




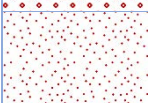
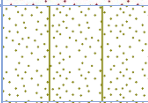
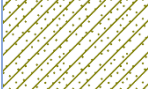

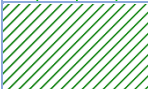
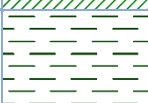



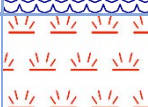
The soil description prepared in accordance with ASTM D2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line and the elevation of the change indicated on the right side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

### *GRAPHIC*

The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

### *REMARKS*

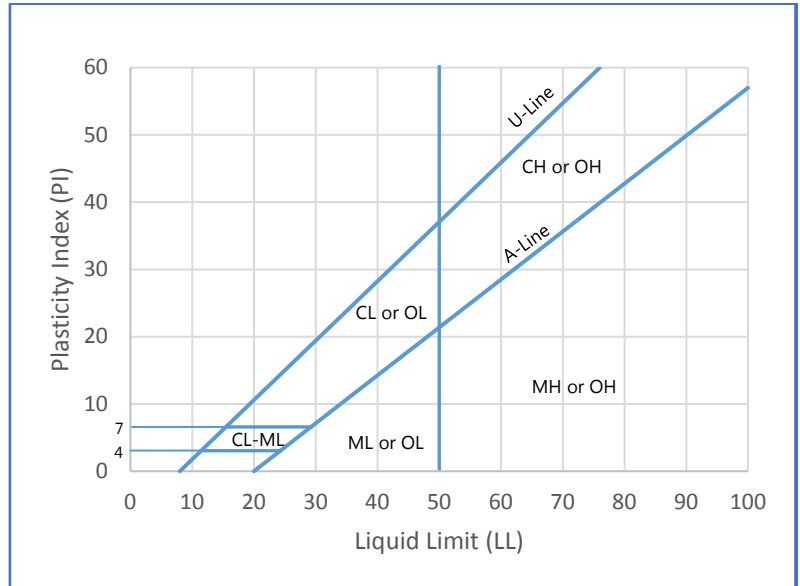
Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.

Major Divisions			Symbols		Group Name & Typical Description	
			Lithology	Group		
<p><b>Coarse Grained Soils</b></p> <p>More than 50% of material is larger than No. 200 sieve size</p>	<p><b>Gravel and Gravelly Soils</b></p> <p>More than 50% of coarse fraction is larger than No. 4 sieve</p>	<p><b>Clean Gravels</b></p> <p>(Less than 5% fines)</p>		<b>GW</b>	Well-graded gravels, gravel – sand mixtures, little or no fines	
				<b>GP</b>	Poorly-graded gravels, gravel – sand mixtures, little or no fines	
		<p><b>Gravels with Fines</b></p> <p>(More than 12% fines)</p>		<b>GM</b>	Silty gravels, gravel – sand – silt mixtures	
				<b>GC</b>	Clayey gravels, gravel – sand – clay mixtures	
	<p><b>Sand and Sandy Soils</b></p> <p>More than 50% of coarse fraction is smaller than No. 4 sieve</p>	<p><b>Clean Sands</b></p> <p>(Less than 5% fines)</p>		<b>SW</b>	Well-graded sands, gravelly sands, little or no fines	
				<b>SP</b>	Poorly-graded sands, gravelly sands, little or no fines	
		<p><b>Sands with Fines</b></p> <p>(More than 12% fines)</p>		<b>SM</b>	Silty sands, sand – silt mixtures	
				<b>SC</b>	Clayey sands, sand – clay mixtures	
	<p><b>Fine Grained Soils</b></p> <p>More than 50% of material is smaller than No. 200 sieve size</p>	<p><b>Silts and Clays</b></p> <p>Liquid Limit less than 50</p>	<p><b>Inorganic</b></p>		<b>ML</b>	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity
					<b>CL</b>	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
<b>Organic</b>				<b>OL</b>	Organic silts and organic silty clays of low plasticity	
<p><b>Silts and Clays</b></p> <p>Liquid Limit greater than 50 sieve</p>		<p><b>Inorganic</b></p>		<b>MH</b>	Inorganic silts, micaceous or diatomaceous fine sand, or silty soils	
				<b>CH</b>	Inorganic clays of high plasticity	
		<b>Organic</b>		<b>OH</b>	Organic clays of medium to high plasticity, organic silts	
<p><b>Highly Organic Soils</b></p>				<b>PT</b>	Peat, humus, swamp soils with high organic contents	

**Table 1: Soil Classification Chart (based on ASTM D2487)**



Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.

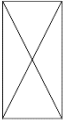



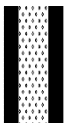





**Figure 1: Plasticity Chart (based on ASTM D2487)**

Non-cohesive: Coarse-Grained Soil		Cohesive: Fine-Grained Soil				
SPT Penetration (blows/foot)		Relative Density	SPT Penetration (blows/foot)		Consistency	Estimated Range of Unconfined Compressive Strength (tsf)
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

**Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)**





\* - Modified based on 80% hammer efficiency

	Standard Penetration Test ASTM D1586 or AASHTO T-206		Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
	Shelby Tube Sampler ASTM D1587		No Sample Recovery
	Rock Core Sample ASTM D2113		Groundwater at Time of Drilling
	Auger Cuttings		Groundwater as Indicated

**Table 1: Symbol Legend**

Soil	Particle Size	U.S. Standard
<b>Boulders</b>	Larger than 300 mm	N.A.
<b>Cobbles</b>	300 mm to 75 mm	N.A.
<b>Gravel</b>	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
<b>Sand</b>	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
<b>Fines</b>	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

**Table 2: Standard Sieve Sizes**

<b>N-Value</b> 	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.	<b>Atterberg Limits</b> 	A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
<b>Qu</b> 	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).	<b>% Moisture</b> 	Percent natural moisture content in general accordance with ASTM D2216.

**Table 3: Soil Data**

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

**Table 4: Soil Drilling Methods**

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

**Table 5: Descriptors**

<b>Manual Hammer</b>	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
<b>Automatic Trip Hammer</b>	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
<b>Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399</b>	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

**Table 6: Sampling Methods**

<b>Non-plastic</b>	A 1/8-inch thread cannot be rolled at any water content.
<b>Low</b>	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
<b>Medium</b>	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
<b>High</b>	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

**Table 7: Plasticity**

<b>Dry</b>	Absence of moisture, dusty, dry to the touch.
<b>Moist</b>	Damp but no visible water.
<b>Wet</b>	Visible free water, usually soil is below water table.

**Table 8: Moisture Condition**

<b>Stratified</b>	Alternating layers of varying material or color with layers at least 1/2 inch thick.
<b>Laminated</b>	Alternating layers of varying material or color with layers less than 1/4 inch thick.
<b>Fissured</b>	Breaks along definite planes of fracture with little resistance to fracturing.
<b>Slickensides</b>	Fracture planes appear polished or glossy, sometimes striated.
<b>Blocky</b>	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
<b>Lensed</b>	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
<b>Homogeneous</b>	Same color and appearance throughout.

**Table 9: Structure**

Hatch	Description	Hatch	Description	Hatch	Description
	<b>GW</b> - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	<b>GP</b> - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	<b>GM</b> - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	<b>GC</b> - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	<b>SW</b> - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	<b>SP</b> - Poorly-graded sands, gravelly sands, little or no fines		<b>CL-ML</b> - Silty Clay		Gravel with Silt
	<b>SM</b> - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	<b>SC</b> - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	<b>ML</b> - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	<b>CL</b> - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	<b>OL</b> - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	<b>MH</b> - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	<b>CH</b> - Inorganic clays of high plasticity		Weathered Rock		Coral
	<b>OH</b> - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	<b>PT</b> - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock

**Table 1: Key to Hatches Used for Boring Logs and Soil Profiles**

**BORING LOCATION PLAN**

**Cherokee Heights - New Lift Station**

**Legend**  
 ● Boring



Google Earth

©2018 Google

**REFERENCE USED  
 TO PRODUCE THIS  
 DRAWING:**

**BORING LOCATION PLAN**

**DATE: 11/26/2018**

Google Earth aerial image  
 dated 10/27/2017

**PROJECT NO.**

**PROJECT NAME / LOCATION:**

**SCALE:**

OK180269

Cherokee Heights Lift Station  
 Sportsmen Acres, Oklahoma

As Shown

**BORING LOG**



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-01

Sheet 1 of 1

1403 S. 70th East Avenue

Tulsa, OK 74112

Office: (918) 439-9005

Fax: (918) 439-9255

[www.BuildingAndEarth.com](http://www.BuildingAndEarth.com)

PROJECT NAME: Cherokee Heights Lift Station  
 PROJECT NUMBER: OK180269  
 DRILLING METHOD: HSA/Rock Core  
 EQUIPMENT USED: CME 45 and Diedrich D-50  
 HAMMER TYPE: Manual  
 BORING LOCATION: Lift Station

LOCATION: Sportsmen Acres, OK  
 DATE DRILLED: 11/9/18  
 WEATHER: Sunny  
 ELEVATION:  
 DRILL CREW: Mohawk Drilling  
 LOGGED BY: Taru Holinsworth

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	N-Value				SOIL DESCRIPTION	GRAPHIC	REMARKS
				10	20	30	40			
				▲ Qu (tsf) ▲						
				Atterberg Limits						
				● % Moisture ●						
				1	2	3	4			
				20	40	60	80			
				20	40	60	80			
0.5								TOPSOIL		
1.2		1	3-50/3"					LEAN CLAY (CL): medium stiff, dark gray-brown, with tree root, low to moderate plasticity, moist		
		2	50/2"					WEATHERED LIMESTONE: hard, light gray to gray, with clayey shale seams, yellow discolored bedding planes, highly jointed		
3.5		3	REC=94 RQD=25					LIMESTONE: hard, light gray to gray, with clayey shale seams (~2-3"), yellow discolored bedding planes (slightly weathered), thin bedded (~0.5-4")		AUGER REFUSAL on limestone, converted to rock coring
4.8								- clayey shale seam (~2.5" thick) at 4.8'		Groundwater not encountered in boring while auger drilling. Boring dry when converting to rock coring procedures
6.3		4	REC=94 RQD=71					- clayey shale seams (~1.5") at 6.3' and 6.7'		
7.0								- no weathering, and thicker bedding of 6" to 12" below 7'		Boring backfilled on 11/9/2018
8.5								Boring terminated at 8.5 ft.		Consistency/ Relative density based on manual hammer

LOG OF BORING 2 OK180269 DRAFT LOG.GPJ 11/26/18

SAMPLE TYPE Split Spoon Rock Core

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT  
 GROUNDWATER LEVEL IN THE BOREHOLE  
**Qu** UNCONFINED COMPRESSIVE STRENGTH FROM POCKET PENETROMETER

**REC** RECOVERY  
**RQD** ROCK QUALITY DESIGNATION  
**UD** UNDISTURBED



## LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

### *DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)*

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

# Important Information about This

# Geotechnical-Engineering Report

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.

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

## A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### **Do Not Redraw the Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### **Give Constructors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

### **Read Responsibility Provisions Closely**

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### **Environmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### **Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance**

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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