

Technical Specifications

CITY OF DENTON, TEXAS, Owner
WAVE POOL
WATERWORKS WATER PARK

August, 2016

TBC# 01.15116.00

The C. T. Brannon Corporation

Consulting Engineers and Urban Planners
Texas Firm Registration No. F-242
P O Box 7487 Tyler Texas 75711

**CITY OF DENTON, TEXAS
WAVE POOL AT WATERWORKS WATER PARK**

**TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS**

DIVISION 00 – PROCUREMENT AND CONTRACTING

00 31 32 Geotechnical Data

DIVISION 01 - GENERAL REQUIREMENTS

01 43 23 Installer Qualifications – Pools
01 50 00 Temporary Facilities and Controls
01 57 23 Temporary Storm Water Pollution Control

DIVISION 02 – EXISTING CONDITIONS

02 41 13.50 Site Preparation, Clearing, Grubbing and Demolition

DIVISION 03 – CONCRETE

03 15 13 Waterstops
03 20 00 Metal Reinforcing
03 30 53 Cast In Place Concrete
03 37 19 Pneumatically Applied Concrete for Swimming Pools (Shotcrete)
03 50 00 Swimming Pool Decks
03 62 13 Non-Shrink Grout

DIVISION 04 – MASONRY

04 20 00 Unit Masonry and Manufactured Stone

DIVISION 06-CARPENTRY AND WOOD WORK

06 10 00 Rough Carpentry

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 16 14 Acrylic Modified (Flexible) Cementitious waterproofing
07 21 00 Batt Insulation
07 41 00 Pre-Formed Metal Standing Seam Roof

DIVISION 08 – DOORS AND WINDOWS

08 11 13 Hollow Metal Doors and Frames
08 56 59 Service Window Units

DIVISION 09 – FINISHES

09 25 13 Pool Plaster (Exposed Aggregate Finish)
09 91 00 Painting

DIVISION 13 – SPECIAL CONSTRUCTION

13 11 00 Swimming Pools
13 11 46 Swimming Pool Piping and Equipment
13 14 16 Wave Generation Equipment

DIVISION 22 – PLUMBING

22 51 19 Water Treatment

DIVISION 26 – ELECTRICAL

26 00 00 Electrical
26 05 26 Grounding and Bonding Pool

DIVISION 31 – EARTHWORK

31 00 00 Earthwork
313116.13 Chemical Treatment for Termite Control
32 31 13 Chain Link Fences and Gates
32 32 23.13 Segmental Concrete Unit Masonry Retaining Wall System
32 92 23 Sodding
33 11 16 Water Main Pipe and Fittings

CITY OF DENTON
WAVE POOL

**SECTION 00 31 32
GEOTECHNICAL DATA**

PART 1 – GENERAL

- 1.1 Scope: An investigation and report was made of the original site subsurface conditions at the project site by a geotechnical testing laboratory prior to the construction of the initial water park. A copy of the soil borings under the existing pool mechanical room are attached. These borings are prior to the introduction of 6 to 10 feet of select fill. Additional investigations have NOT been conducted on the site.

Every attempt should be made by the Contractor to acquaint himself with the site conditions. The report is not a warranty of subsurface conditions nor does it relieve the Contractor of his responsibilities in regard to these conditions. The bidder may make arrangements with the City of Denton for underground exploration if he so desires prior to submitting his bid. Coordinate with Tom Klimko, 940-293-3911.

Contractor shall report any conditions determined by him to be substantially different than those shown on the report and shall delay the work a reasonable time to allow the Engineer to investigate such occurrences. The contractor, by continuing to work, deems the subsurface conditions substantially in agreement with the report and waives any claim for additional compensation due to varied soil conditions.

- 1.2 Work Covered Under Other Sections: Protect previous work of any subcontractor, existing trees, sidewalks, curbs, pavement, buildings, and utilities on or adjacent to the site not included herein for removal or adjustment. Refer to Section 310000 for earthwork.

PART 2 – PRODUCTS

- 2.1 Not Applicable

PART 3 - EXECUTION

- 3.0 GENERAL: Refer to Plans and specifications for sub-surface structures and designs. The geotechnical report is provided for the contractor's use only. Proposed designs generated by the geotechnical report are not necessarily the designs used in the project. Work shall be installed as shown on the plans.
- 3.1 MEASUREMENT AND PAYMENT: Preliminary excavations prior to bidding are at the bidder's sole discretion and expense. Review of the provided geotechnical report for aquatic facilities is considered subsidiary to other bid items included in the forms of proposal. No separate measurement or payment will be made for this work.

END OF SECTION 00 31 32

LOG OF BORING

UNDER EXISTING MECH ROOM. 6-10' FILL AFTER BORING WAS MADE.

PROJECT : Aquatic Center

BORING NO : 8M

CLIENT : Denton I. S. D.

LOCATION : Denton, Texas

JOB NO : 02.012

BORING TYPE : Continuous Flight Auger

DATE : 2/15/02

DRILLER: Coronado

GROUND ELEVATION:

Depth - Feet	Symbol	Sample Type	Penetrometer Reading, TSF	Penetration Test, Blows/6"	Description of Stratum
					<p>Legend:</p> <p>S - Shelby Tube</p> <p>P - STD Penetration Test</p> <p>T - THD Cone Penetration Test</p> <p>B - Bag</p> <p>C - Core</p> <p>X - No Recovery</p> <p>∇ - Water Table</p>
5	S	S	3.25		Brown silty clay, very stiff and moist 2.0'
	S	S	4.5+		Tan and grey shaley clay, hard and moist 10.5'
	S	S	4.5+		
10	S	S	4.5+		
15	ST	ST	4.5+	50/1.00"	Tan weathered marl, soft and moist 14.5'
20	TX	TX		50/0.75"	Grey marl, medium hard and moist
25	TX	TX		50/0.25"	
30					End of Boring 25'
35					
40					

LOG OF BORING

UNDER EXISTING POOL
MECH. BUILDING. 6-10' OF
FILL AFTER BORING WAS
MADE

PROJECT : Aquatic Center

BORING NO : 9M

CLIENT : Denton I. S. D.

LOCATION : Denton, Texas

JOB NO : 02.012

BORING TYPE : Continuous Flight Auger

DATE : 2/15/02

DRILLER: Coronado

GROUND ELEVATION:

Depth - Feet	Symbol	Sample Type	Penetrometer Reading, TSF	Penetration Test, Blows/6"	Legend: <table style="display: inline-table; vertical-align: top; margin-left: 20px;"> <tr> <td>B - Bag</td> </tr> <tr> <td>S - Shelby Tube</td> </tr> <tr> <td>P - STD Penetration Test</td> </tr> <tr> <td>T - THD Cone Penetration Test</td> </tr> </table> <table style="display: inline-table; vertical-align: top; margin-left: 20px;"> <tr> <td>C - Core</td> </tr> <tr> <td>X - No Recovery</td> </tr> <tr> <td>▽ - Water Table</td> </tr> </table>	B - Bag	S - Shelby Tube	P - STD Penetration Test	T - THD Cone Penetration Test	C - Core	X - No Recovery	▽ - Water Table
					B - Bag							
S - Shelby Tube												
P - STD Penetration Test												
T - THD Cone Penetration Test												
C - Core												
X - No Recovery												
▽ - Water Table												
Description of Stratum												
		S	3.75		Brown silty clay, very stiff and moist	2.0'						
		S	3.00		Tan and grey clay, very stiff and moist	4.0'						
5		S	4.5+		Tan and grey shaley clay, hard and moist	9.0'						
10		S	4.5+		Tan and grey marl, medium hard and moist	13.5'						
15		TX		50/1.00"	Grey marl, medium hard and dry							
20		TX		50/0.75"								
25		TX		50/0.25"		End of Boring 25'						
30												
35												
40												

LOG OF BORING

PROJECT : Aquatic Center

BORING NO : 11P

UNDER PAVILION ON
ISLAND, E. OF WAVE
POOL

CLIENT : Denton I. S. D.

LOCATION : Denton, Texas

JOB NO : 02.012

BORING TYPE : Continuous Flight Auger

DATE : 2/14/02

DRILLER: Lawrence

GROUND ELEVATION:

Depth - Feet	Symbol	Sample Type	Penetrometer Readings, TSF	Penetration Test, Blows/6"	Description of Stratum
					Legend: S - Shelby Tube P - STD Penetration Test T - THD Cone Penetration Test B - Bag C - Core X - No Recovery ▽ - Water Table
	[Diagonal Hatching]	S	1.50		Dark grey silty clay, stiff and moist <div style="text-align: right;">2.5'</div>
	[Diagonal Hatching]	S	3.25		
5	[Diagonal Hatching]	S	4.5+		
	[Diagonal Hatching]	S	4.5+		
	[Cross-hatching]	ST	4.5+	34/12.00"	Tan weathered marl, soft and dry <div style="text-align: right;">6.0'</div>
10	[Diagonal Hatching]	TX			Tan and grey shaley clay, hard and moist <div style="text-align: right;">8.0'</div>
15	[Diagonal Hatching]	TX		50/4.00"	
20	[Diagonal Hatching]	S	4.5+		End of Boring 20'
25					
30					
35					
40					

CITY OF DENTON
WAVE POOL

SECTION 01 43 23
INSTALLER QUALIFICATIONS SWIMMING POOL CONTRACTORS & SUBCONTRACTORS

PART 1 - GENERAL

- 1.1 This section shall govern the pre-qualification of swimming pool contractors or subcontractors and the procedures and requirements for such pre-qualification. No prime contractor shall, in his proposal for the contract being bid, consider the bid of, or name, or otherwise award any pool subcontract for the construction of swimming pools, aquatic features or similar work to a corporation, partnership, sole proprietorship not previously approved under this section. The aquatic consultant will issue a certification letter which shall be attached to the pool contractor/subcontractor's bid.

Any swimming pool construction firm desiring to be pre-qualified under the terms herein must submit by mail, electronic mail, express delivery or fax, the application form included at the end of this section to:

Terry Brannon, PE
The C. T. Brannon Corporation
P.O. Box 7487
Tyler, TX 75711
(physical: 1321 S. Broadway, Tyler, TX 75701)
Fax: 903-597-3346

The proposing firm shall be responsible for verifying receipt of the application by the aquatic consultant. Failure of the aquatic consultant to receive a transmitted form will not be just cause for default approval or for any claim against the aquatic consultant.

TO BE CONSIDERED, FORMS OF APPLICATION MUST BE IN THE OFFICE OF THE ABOVE AQUATIC CONSULTANT NOT LESS THAN 72 HOURS BEFORE THE OFFICIAL AND ADVERTISED CLOSING OF THE RECEIPT OF BIDS TO THE OWNER. FORMS RECEIVED AFTER THAT DATE, WILL NOT BE ACCEPTED OR ACTED UPON FOR THIS PROJECT. FIRMS APPROVED FOR THIS PROJECT DO NOT HAVE TO RE-APPLY FOR PRE-QUALIFICATION FOR SUBSEQUENT PROJECTS IF THEY HAVE BID A PROJECT WITH THE AQUATIC CONSULTANT WITHIN THE PRECEDING 12 MONTHS.

- 1.2 Definitions
- A. **Swimming Pool Contractor (SPC):** Swimming pool contractors are contractors acting under a general contract directly between the pool contractor and the owner to build a swimming pool, water park, aquatic features or similar work. A swimming pool contractor for the purposes of this definition has primary responsibility directly to the owner and is not subject to any other contract for construction of other improvements.
- B. **Swimming Pool Subcontractor (SPS):** Swimming pool subcontractors act to complete their work under a general contract between a prime contractor and an owner, which prime contract is for work that includes other work in addition to the construction of swimming pools or water play areas. They are not primarily responsible for completion of the whole contract but rather only a portion of the work involving swimming pool, water park, aquatic features or similar work. Their responsibility is to the prime contractor who shall directly oversee their performance and who shall coordinate with other subcontractors.

INSTALLER QUALIFICATIONS SWIMMING POOL CONTRACTORS & SUBCONTRACTORS

1.3 Quality Assurance

A prime contractor may not, unless himself qualified hereunder, propose to subcontract the various elements of pool facility construction thereby acting in effect as his own pool subcontractor. For purposes of this section, a single contracting or subcontracting entity or person considered the pool contractor or subcontractor (**and therefore subject to the provisions herein**) shall perform the following work or subcontract to another to perform under the direction of the pool contractor/subcontractor.

- A. Excavation of the pool shell
- B. Installation of pool drain lines, supply lines, or feature supply lines or related pool plumbing.
- C. Installation of pool reinforcing steel
- D. Installation of concrete for pool shells, copings or decks.
- E. Installation of pool shell liners, plaster, or paint
- F. Furnishing and installing of pool equipment including gutters, skimmers, drain fittings, filters, pumps, valves, chemical or heating systems, or play features.

1.4 Experience

The pool contractor/subcontractor shall be experienced in the construction of aquatic features and facilities and shall have completed a minimum of three other facilities similar to the project herein under proposal. Similar shall mean in size, dollar value, and features installed in gaining the experience. To be credited, experience shall be gained while performing a contract under the name of the entity herein proposing and/or related experience gained in the employ of another contractor. To be credited, experience gained in the employment of another must be as superintendent, project manager or other position of responsible charge where the final project completion rested significantly on the individual claiming experience. Documentation and references must be submitted to substantiate this claim.

1.5 Bonding

A pool subcontractor shall be required under the terms of his subcontract with the general contractor to provide surety bonds for Performance, Labor and Materials, and Maintenance in the amount of 100 per cent of the subcontract amount, and such bonds shall name the general contractor as obligee of the bonds in the event of default by the pool subcontractor. Bond surety companies shall

- A. be listed on U.S. Treasury Circular 570, most recent release,
- B. be A rated (A- or higher) by Best
- C. be licensed to issue bonds in the state in which project is located
- D. total of obligations shall not exceed the treasury limit imposed on the company as listed in Circular 570.

Evidence of compliance with this section must be provided before any partial payment is made for pool construction items.

1.6 Insurance

A pool subcontractor shall be required under the terms of his subcontract with the general contractor to provide, in his own name, commercial liability insurance, workmen's compensation, and other insurance of the same classes to minimal limits as follows:

Commercial General Liability: \$2,000,000 combined single limit bodily injury/prop damage

INSTALLER QUALIFICATIONS SWIMMING POOL CONTRACTORS & SUBCONTRACTORS

Automobile Commercial Liability: \$500,000/\$500,000 Bodily Injury\$100,000/\$100,000
property damage

Workmen's Compensation: Statutory
Employers Liability: \$500,000 each accident
\$500,000 disease policy limit
\$500,000 disease each employee

Evidence of compliance with this section in the form of a copy of the subcontractors agreement and an insurance certificate must be provided before any partial payment is made for pool construction items. The Owner shall be listed on the certificate as an additional insured and must be notified 30 days prior to any cancellation of any policy listed on the certificate.

1.7 Financial strength

The pool contractor/subcontractors attention is directed to the fact that the pool contractor/subcontractor will be required to pay all expenses incident to the deposit, fabrication, shipping, delivery and unloading of pool filtration or chemical equipment, pumps, or special fountain and play equipment, if any, for this project without an advance of funds from the Owner. No partial payments will be considered for such equipment until it is delivered to the project site AND evidence is provided as to the amount of the PAID invoice from all manufacturer/suppliers.

1.8 Evaluation of Qualifications

The pool consultant, in qualifying bidders, may consider all information in the application or from any other reliable source; client history whether listed or not listed in the application; contractor's history of satisfactory and on time completion of projects; contractor's past record with pool consultant or other design professionals; current work load; current litigation to which the applicant is party; capacity to bond and insure the project.

1.9 Rejection of Application

The application of any prospective contractor/subcontractor may be rejected in the sole opinion of the pool consultant and the contractor/subcontractor shall have no recourse against the consultant for failing to pre-qualify the applicant. In submitting an application, prospective contractor/subcontractors agree that the decision of the pool consultant is final. However, additional information may be supplied in writing should the applicant feel the information will be pertinent to any appeal of the consultant's decision.

1.10 Conditional Approval

The pool consultant reserves all rights and privileges to approve or disapprove an application or to limit approval of a prospective contractor/subcontractor to a specific job or range of project sizes or scope.

PART 2 – EXECUTION

2.1 Form of "APPLICATION FOR PRE-QUALIFICATION OF POOL CONTRACTORS/SUBCONTRACTORS" follows. Contractor to Submit per Part 1 Instructions.

PART 3 – POST CONSTRUCTION

3.1 Qualified bidders will be kept on file at The C.T. Brannon Office. An electronic copy of the existing qualified bidders list will be submitted per request in pdf format.

END OF SECTION 09 30 00

**APPLICATION FOR PRE-QUALIFICATION OF
POOL CONTRACTORS/SUBCONTRACTORS**

Date:

Legal Name of Pool Contractor/Subcontractor:

Address:

Telephone No.:

Fax. No.:

E-mail address:

Federal Taxpayer Identification No. (EIN):

Bonding Company and Name and Address of Resident Surety:

Bond Company Best Rating (must be A- or better):

Contractor's Bonding Capacity (single project limit):

Contractor's Bonding Capacity (aggregate):

Name and address of Commercial General Liability Insurance Company:

No. Years in Business Under This Name?:

Type of Business (corporation, partnership, etc.)

If in business under this name less than 5 years, previous company name:

List Officers (if corporation), Partners (if partnership) or Owners of the company:

Have you ever defaulted within the last ten (10) years on a construction contract?
If yes, please give details and final disposition of contract.

INSTALLER QUALIFICATIONS - POOLS

Pool Construction Experience: (To be qualified for various types and sizes of jobs, list variety of examples adequately expressing your experience.) Attach additional sheets as needed.

Project Name and Description	Owner and Owners Address	Architect/Engineer/Pool Consultant Name & address	Approximate \$ value to nearest \$50K	Year Completed

List your last five (5) pool projects in excess of \$100,000 construction costs:

Project Name and Description	Owner and Owners Address	Architect/Engineer/Pool Consultant Name & address	Approximate \$ value to nearest \$50K	Year Completed

In signing this form I acknowledge that the foregoing is a truthful representation of the qualifications of my company.

Authorized Signature:

Typed or Printed Name:

Date: _____

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1- GENERAL

1.1 SUMMARY

- A. Provide temporary facilities and controls as required to accomplish the work in a safe and orderly manner. Except as specified herein, use materials and products of Contractor's option suitable for accomplishment of intended purpose.

PART 2 - EXECUTION

2.1 TEMPORARY ENCLOSURES

- A. Weather tight enclosures required for all exterior openings as walls and roofs are built. At end of each day's work, enclosures securely closed and exterior doors padlocked for protection against all conditions of weather, such as heat, cold, rain, rapid drying out, etc.

2.2 SANITARY FACILITIES

- A. Provide approved chemical toilets throughout the period of the construction. Keep toilets serviced to prevent undue stench and to assure cleanliness.
- B. Owner's indoor restroom facilities will not be available to the Contractor's personnel.

2.3 HEAT

- A. For indoor construction, provide temporary heat as required to properly protect the work and enhance workmanship. Uniform temperatures, not lower than 60 degrees F shall be maintained at all times, including Saturdays, Sundays, and holidays, in that portion of any building where drywall work, resilient flooring work, and painting is being executed. All temporary heat required shall be provided by the contractor at his expense. When permanent heating system can be operated under temporary heat requirements, all costs of operation, including fuel shall be furnished by the Owner, however the costs for repairing any damage that may be caused to the permanent heating system shall be borne by the Contractor. Propane and butane heating appliances will be approved if adequate protection is provided. No oil-burning equipment will be permitted. Use caution not to place temporary space heaters where they may cause overly rapid drying or other hazards to adjacent materials. As soon as possible, the Contractor shall initiate use of the building heating system.

2.4 WATER

- A. Water is available at the site. Make arrangements with Aquatic Manager to procure water for construction and for drinking. The drinking water shall be clean and from a source approved by local health officer, dispensed either from a bubbler with guarded orifice or from push button dispenser. Use of common drinking cups, dippers, canteens or dipping of water from containers is prohibited.

2.5 POWER

- A. The Contractor shall make all necessary applications, pay all fees and charges to obtain necessary permits, and provide and maintain electrical energy for power and light necessary to construction. The Owner will pay all deposits of fees for permanent service.

Where building distribution system is utilized, the Contractor shall correct or replace any damaged work.

2.6 LIGHTING

- A. Provide adequate flood-lighting for all areas of work during darkness or in areas without daylight. Provide lighting sufficient to assure safety of workmen and good workmanship. During finishing operations, spaces shall be uniformly lit to a light level not less than 20 foot candles, or more, if required, to assure good workmanship.

2.7 JOB-SITE OFFICE

- A. A job-site office is not required for this project. If desired by the General Contractor it shall be his expense provide an office.

2.8 BULLETIN BOARD

- A. The General Contractor shall Install and maintain a bulletin board at a readily accessible location on the construction site for display of the following items:
 - 1. Safety Requirements
 - 2. Official Notices or Announcements
- B. Other items as appropriate to include rules or regulations mandated by City, State, or Federal Law.
- C. All items shall be removed at completion of job.

2.9 DRAINAGE

- A. Keep water accumulations out of excavations where possible. Maintain pumping facilities to keep the item, excavation and structures free of accumulations of water at all times; whether from underground seepage, rainfall, drainage or broken lines.

2.10 GRADES, LINES, LEVELS, AND SURVEYS

- A. All grades, lines, levels, and bench marks shall be established by Contractor from on-site reference controls and benchmarks furnished by the Owner and maintained by the Contractor who shall be responsible for same and shall report any error or inconsistencies before starting work.
- B. The Contractor shall provide and maintain well built batter boards at all corners and shall establish bench marks at not less than two (2) widely separated places.
- C. As work progresses, general contractor shall lay out on forms, rough flooring or ground exact locations of all work, where required, as a guide to all trades.
- D. Each trade shall lay out his work so as to interfere as little as possible with location of work of other trades. Obvious conflicts shall be brought to the attention of the Engineer.

2.11 SHORING, ANCHORING, AND BRACING

- A. The Contractor shall provide temporary shoring, anchoring and bracing required by the nature of the work in order to make all parts absolutely rigid and stable. The Contractor shall be responsible for any damage resulting from failure to provide if either through lack of proper judgment or from any other cause. The Contractor shall strictly adhere to OSHA requirements for shoring, ladders, confined spaces, trench and excavation protection and all other provisions related to job site safety.

2.12 TEMPORARY FENCING

- A. Install enclosed chain link fencing as necessary to secure the site from vandalism or theft and protect the public. Maintain the fencing continuously during the project. The Contractor may use fencing salvaged from the project to comply with this paragraph.

END SECTION 01 50 00

CITY OF DENTON
WAVE POOL

SECTION 01 57 23
TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 DEFINITIONS

- A. BMP – Best Management Practices
- B. CSN –Construction Site Notice- (NOI- CSN for Large sites; CSN for Small sites).
- C. NOI & NOT – Notice of Intent and Notice of Termination for TPDES permits.
- D. SWPPP – Storm Water Pollution Prevention Plan
- E. TCEQ – Texas Commission on Environmental Quality
- F. TPDES – Texas Pollutant Discharge Elimination System
- G. Large Construction Activities – Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than five (5) acres.
- H. Small Construction Activities - Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than one (1) acre and less than five (5) acres of land.

1.2 RELATED DOCUMENTS AND APPLICABLE WORK

- A. The TCEQ TPDES General Permit No. TXR150000, February 19, 2013, and the project SWPPP. This specification requires compliance with all provisions of the TCEQ with regards to the TPDES permit. The TCEQ requirements currently pertain to large construction activities of five (5) acres or more and small construction activities which disturb one (1) to less than five (5) acres.
- B. Information to Respondents, Agreement, General Conditions, Special Conditions, and Special Specifications shall be carefully read for provisions pertaining to this work. In the event of conflict, the better quality or greater quantity shall prevail.
- C. The work described in this section is applicable to any and all sections of the Contract Documents. Any and all work that would disturb the existing site conditions or present the potential for site run-off shall adhere fully to this specification section.
- D. Unless specifically notified to the contrary by the Owner or Engineer, in writing, all aspects of this specification shall apply to this project.

1.3 CONTRACTOR RESPONSIBILITIES

- A. This project requires implementation of storm water “Best Management Practices” (BMP) for control devices and monitoring by the Contractor to comply with all provisions of the Storm Water Pollution Prevention Plan (SWPPP) developed for the project by the licensed civil engineer. The Contractor must fulfill all Texas Pollutant Discharge Elimination System (TPDES) regulatory requirements, including the filing of a NOI and NOT or signing and posting of the Construction Site Notice (CSN).
- B. The Contractor shall provide signatures of a corporate Officer for the NOI, NOI-CSN, CSN and NOT and any other forms or applications as required by the TPDES General Permit TXR150000. The Contractor shall also provide delegated authorization to sign reports per 30 TAC 305.128. Individuals conducting site inspections shall be qualified to the satisfaction of the Owner.
- C. When the Contractor receives the approved SWPPP from the Owner, the Contractor signs the NOI and/or CSN (see Sample form in Part 4 of this section) and forwards it to the Owner. Two separate \$325 application fees (one for the Owner and one for the Contractor) must accompany the NOI. The Owner signs his NOI and sends both NOI's and application fees to TCEQ. The Contractor shall insert a copy of the signed NOI or CSN into the SWPPP booklet to be kept at the jobsite. The \$325 application fees are not required for Small Construction Sites or CSN sites.
- D. The SWPPP booklet kept at the jobsite shall also contain the following:

TEMPORARY STORM WATER POLLUTION CONTROL

1. A letter delegating signature authority to the field personnel for both the Contractor and the Owner.
 2. A copy of TPDES permit when received.
 3. A copy of the Construction Site Notice (Large or Small).
 4. A copy of the Shared SWPPP Acceptance Certification form.
- E. The Contractor shall review SWPPP and verify existing conditions at the site before determining scope of implementation of site controls. Site survey and site plan drawings shall be used for additional reference. The Contractor shall notify the Owner, in advance, of this site review to allow for Owner participation.
- F. The Contractor shall construct a Project SWPPP sign and place it at the main entrance to the project site. This sign shall include the NOI and TPDES permit along with the TCEQ TPDES Large Construction Site Notice (NOI-CSN); or the Construction Site Notice (CSN) for small construction projects. The sign shall be constructed as detailed in the sample SWPPP sign drawing included in Part 4 of this Section.
- G. Contractor shall contact Owner for review of initial site controls in place prior to commencing site-disturbing activities, to ensure that any unusual circumstances or unforeseen site conditions with regard to erosion and sedimentation have been addressed. The Contractor shall complete the SWPPP Project Start-up form (see Sample in Part 4 of this Section) and review it with the Owner before commencing soil disturbing activities. Both parties shall sign this form when the requirements listed in the SWPPP Project Start-up form have been met.
- H. The Contractor shall provide all material, labor, equipment and services required to implement, maintain and monitor all erosion and sedimentation controls in compliance with the Storm Water Pollution Prevention Plan (SWPPP). All controls implemented by the Contractor shall comply with the Texas Pollutant Discharge Elimination System (TPDES) regulations as issued by the Texas Commission on Environmental Quality (TCEQ) on February 19, 2013. These controls shall remain in operation until project completion and reestablishment of the site or longer as directed by the RCM. The work shall include, but not be limited to the following:
- I. All earthwork as required to implement swales, dikes, basins and other excavations for temporary routing of utilities, to protect against erosion or sediment-laden ("polluted") storm water runoff.
- J. All structural controls as shown or specified, including silt fences, sediment traps, stabilized construction entrance, subsurface drains, pipe slope drains, inlet/outlet protection, reinforced soil retention, gabions, rock berms, etc.
- K. All non-structural controls as shown or specified, including temporary or permanent vegetation, mulching, geotextiles, sod stabilization, preservation of vegetative buffer strips, preservation/protection of existing trees and other mature vegetation.
- L. All modifications and revisions to SWPPP necessary to meet changing site conditions and to address new sources of storm water discharges, as the work progresses.
- M. All maintenance and repair of structural and non-structural controls in place shall continue until final stabilization is achieved or as directed by the RCM.
- N. Weekly site inspections, as required by the SWPPP, of pollutant sources, including hazardous sources, structural and non-structural controls, and all monitoring of SWPPP revisions and maintenance of inspection records.
- O. Removal of all structural and non-structural controls as necessary upon completion, and only after final stabilization is achieved.
- P. Filing of Notice of Termination (NOT) with the RCM within 30 days of final stabilization being achieved and is approved by the Owner, or of another Operator assuming control of the unstabilized portions of the site.
- Q. Refer to the SWPPP for additional requirements to ensure compliance with TPDES regulations.

1.4 QUALITY ASSURANCE

- A. In order to minimize the discharge of pollutants to storm water, the Contractor shall implement all permanent and temporary site controls according to Texas Pollutant Discharge Elimination System (TPDES) Guidelines, as set forth by the Texas Commission on Environmental Quality.
- B. Implementation of site controls shall be performed by a qualified contractor experienced in the proper installation of such devices in accordance with manufacturers' specifications, and in keeping with recognized Best Management Practices (BMP's), and in keeping with TPDES regulations. Qualification of installing Contractor shall be reviewed with the Owner prior to entering into a contract with them for services.
- C. The Contractor shall inspect all BMP's at regular intervals as specified in the Storm Water Pollution Prevention Plan for this project. Use standard Owner Inspection forms (see form at the end of this Section) for each inspection. Record all deficiencies of site controls, and take immediate action to correct any deficiencies recorded. Keep records of inspections current and on file, available for review by EPA, TCEQ, MS4 operator and Owner.

1.5 SUBMITTALS

- A. Submittals of products used in structural and non-structural controls shall be made through established procedures for review and approved by the Owner prior to installation on the site. The Contractor shall make available physical samples and product literature on any material used in structural or non-structural controls during the course of the project prior to its implementation in the field.

PART 2 - PRODUCTS

2.1 MATERIALS: Specific site control devices are identified in the SWPPP. Where such devices are indicated, their material composition shall comply with this section. Materials to be used in structural and non-structural site controls shall include, but not be limited to the following:

- A. Silt Fences: implemented to filter, and remove sediment from storm water shall be composed of the following materials:
 - 1. Geotextile fabric – a non-woven, polypropylene, polyethylene, or polyamide fabric with non-raveling edges. It shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture and other weather conditions, and permeable to water while retaining sediment. Fabric shall be 36 inches wide, with a minimum weight of 4.5 oz. /yd.
 - 2. Posts – steel fence posts shall be made of hot rolled steel, galvanized or painted, a minimum of 4 feet long, with a Y-bar or TEE cross-section of sufficient strength to withstand forces implied.
 - 3. Wire Backing – a galvanized, 2"x4", welded wire fencing, 12 gauge minimum. Width shall be sufficient to support geotextile fabric 24 inches above adjacent grades. Chain link fences located along the same lines as silt fences, may be used to support geotextile fabric. In this circumstance, the geotextile fabric shall be firmly attached to fence.
- B. Triangular Filter Dikes: for use on surfaces or in locations where standard silt fence cannot be implemented, shall be composed of the following:
 - 1. Geotextile fabric – a non-woven, polypropylene, polyethylene, or polyamide fabric with non-raveling edges, in a minimum width of 60 inches.
 - 2. Dike Structure - 6 gauge, 6x6 welded wire mesh, 60 inches wide, folded into a triangular form. Each side shall be 18 inches with an overlap of 6 inches.

TEMPORARY STORM WATER POLLUTION CONTROL

3. Ties – metal shoat rings or standard wire/cable ties for attachment of wire mesh to itself, and for attachment of geotextile fabric to wire mesh.
- C. Stabilized Construction Entrance / Exit: A steel grid that allows the safe passage of vehicles while agitating the tires to loosen and remove the soil build up. The grid or structures shall conform to the following:
1. It shall consist of pipes or tubes spaced such that there is a minimum clear distance between the pipes or tubes of 4 ½". It shall be elevated above the ground surface a minimum of 8" to allow water, debris and soil to drain.
 2. Minimum diameter of pipe or tube shall be 3".
 3. It shall be designed to support any and all vehicles entering and leaving the construction site.
 4. It shall be firmly placed in the ground at the exit.
 5. It shall be of sufficient length so that the agitation will remove the soil from the tires or a minimum of 8'-0".
 6. At the "street side" approach of the grid there shall be an impervious surface or it shall consist of 3" to 5" diameter angular crushed stone/rock approximately 5'-0" in length, minimum, and 8" deep, minimum. On the "job site" side of the grid, there shall be 3" to 5" diameter angular crushed stone/rock 15'-0" in length, minimum, 8" deep, minimum. The steel grid will be between the "street side" approach and the job site crushed stone/rock. All crushed stone/rock shall have filter fabric beneath the stone/rock. See diagram on Exhibit F.
 7. Steel grid area shall be used as the tire wash area. When tire wash is in use (rainy or muddy days) the area shall be manned and the tires shall be washed using a high pressure hose/nozzle.
 8. The area beneath the grid shall be sloped such that debris, soil and water shall be diverted back on to the construction site or to a sediment basin. No water, soil or debris shall leave the construction site. The resulting discharge shall be disposed of properly.
- D. Rock Berms: shall be composed of the following materials:
1. Rock – clean open graded rock, with a maximum diameter of 3 inches.
 2. Wire Mesh Support – a galvanized, woven wire sheathing having a maximum opening size of 1 (one) inch, and a minimum wire diameter of 20 gauge.
 3. Ties – metal shoat rings or standard wire/cable ties.
- E. Concrete Truck Washout (self-installed): shall be used for containment of fluids from concrete truck washout wastes.
1. Gravel bags, concrete blocks or open graded rock
 2. 10 mil plastic sheeting
- F. Temporary Storage Tanks: shall be used for temporary storage of fuels on the construction project site.
1. 2 inches of sand on the bottom of the containment area
 2. 6 mil plastic sheeting
 3. 2 inches of sand on top of the plastic sheeting
- G. Erosion Control Matting: shall be used on steep slopes, in drainage swales, and in high traffic pedestrian areas of barren soil. It shall include one or more of the following:
1. Jute Mat – a plain fabric made of jute yarn, woven in a loose and simple manner, with a minimum unit weight of 2.7 pounds per square yard. Width shall be as required for the dimensions of the area to be covered.
 2. Wood Fiber Mat – a mat composed of wood fibers, which are encased in nylon, cotton or other type of netting.

TEMPORARY STORM WATER POLLUTION CONTROL

3. Synthetic Webbing Mat – a mat manufactured from polyvinyl chloride or polypropylene monofilaments, which are bonded together into a three-dimensional web to facilitate erosion control and/or re-vegetation.
- H. Organic Mulches: shall be used for covering bare soil, retaining moisture under existing vegetation being preserved, and for absorbing the energy of compaction caused by foot or vehicular traffic. Mulch shall be one or more of the following:
1. Straw – from broken straw bales that are free of weed and grass seed where the grass from the seed is not desired vegetation for the area to be protected.
 2. Wood Chips – from chipped limbs of cleared trees on site, or delivered in chipped form, in bulk quantities of pine, cedar or cypress. Wood chips of all species shall be partially decomposed to alleviate nitrogen depletion of the soil in areas where existing vegetation is to be preserved and protected.
 3. Shredded Mulches – from pine, cypress or cedar, mechanically shredded, and capable of forming an interlocking mat following placement, and after sufficient wetting and drying has taken place naturally.
- I. Any other materials indicated in SWPPP.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall provide a complete installation of all site control devices and measures (BMPs). Indicated in the SWPPP booklet, including the Site Erosion and Sedimentation Control Drawing and as specified herein. These BMPs must be confirmed as fully operational with the Owner before any work that disturbs the site can begin.
- B. The Contractor shall provide inspection and monitoring of controls in place and shall perform all revisions and updating of SWPPP booklet. An accurate, chronological record of all Contractor inspections revisions and additional controls shall be kept on file at the project site, for review, with a copy of the SWPPP booklet.
- C. The Contractor shall submit their Notice of Termination (NOT) to the Owner after all disturbed areas are re-established (stabilized) with vegetative cover following completion of construction. Following acceptance of stabilized areas, all site controls that are no longer necessary shall be removed.

- 3.2 CONTROL DEVICES: Execution of specific site control devices is described in the following paragraphs. Refer to the SWPPP for applicable devices, extent and location.

A. SILT FENCE

1. Silt fences shall consist of non-woven geotextile fabric, attached to wire fabric backing to support the geotextile. The wire fabric should be galvanized 2" x 4" welded wire, 12-gauge minimum. Attach non-woven geotextile fabric to fence with shoat or standard cable/wire ties, leaving a "toe" of fabric at the bottom of the fence of not less than 6 (six) inches. Steel posts as specified shall be driven to a depth of 1 (one) foot minimum, and spaced not more than 6 (six) feet on center. Tilt posts slightly, in an "uphill" direction for additional strength. Attach fencing to posts with standard cable/wire ties. Dig a 6 (six) inch deep by 6 (six) inch wide trench on the disturbed side of the fence, bury geotextile fabric in trench, backfill and tamp. Abutting ends of geotextile fabric shall be overlapped a minimum of 12 (twelve) inches.
2. Maintain silt fence daily as necessary to repair breaches in geotextile fabric. Maintain steel posts as specified in tilted condition. When siltation has occurred, it shall be removed when it has reached a depth of 6 (six) inches. Silt that has been removed shall be disposed of offsite.

TEMPORARY STORM WATER POLLUTION CONTROL

3. Remove silt fence when the disturbed areas protected by silt fence have been completely stabilized as specified. Minimize site disturbance while removing silt fence and posts.
- B. CURB INLET PROTECTION
1. Cover curb storm inlet with non-woven geotextile fabric covered wire fabric. Wire fabric to be 2"X4" – W1.4XW1.4. Extend fabric 2(two) feet beyond inlet opening at each end and 12" (twelve) in front of opening in the gutter. Remove strip of filter fabric approx. 2 1/2" (two and one half) high for the length of the protection to act as overflow. Extend fabric over the top of opening to allow placement of gravel bags. Anchor fabric with 20 lb. gravel bags placed 3 (three) feet on center.
 2. Maintain inlet protection daily as necessary to repair breaches in geotextile fabric. When siltation has occurred, it shall be removed when it has reached a depth of 2 (two) inches. Silt that has been removed shall be disposed of offsite.
- C. STABILIZED CONSTRUCTION ENTRANCE / EXIT: A steel grid that allows the safe passage of vehicles while agitating the tires to loosen and remove the soil build up. The grid or structures shall conform to the following:
1. It shall consist of pipes or tubes spaced such that there is a minimum clear distance between the pipes or tubes of 4 1/2". It shall be elevated above the ground surface a minimum of 8" to allow water, debris and soil to drain.
 2. Minimum diameter of pipe or tube shall be 3".
 3. It shall be designed to support any and all vehicles entering and leaving the construction site.
 4. It shall be firmly placed in the ground at the exit.
 5. It shall be of sufficient length so that the agitation will remove the soil from the tires or a minimum of 8'-0".
 6. At the "street side" approach of the grid there shall be an impervious surface or it shall consist of 3" to 5" diameter angular crushed stone/rock approximately 5'-0" in length, minimum, and 8" deep, minimum. On the "job site" side of the grid, there shall be 3" to 5" diameter angular crushed stone/rock 15'-0" in length, minimum, 8" deep, minimum. The steel grid will be between the "street side" approach and the job site crushed stone/rock. All crushed stone/rock shall have filter fabric beneath the stone/rock. See diagram on Exhibit F.
 7. Steel grid area shall be used as the tire wash area. When tire wash is in use (rainy or muddy days) the area shall be manned and the tires shall be washed using a high pressure hose/nozzle.
 8. The area beneath the grid shall be sloped such that debris, soil and water shall be diverted back on to the construction site or to a sediment basin. No water, soil or debris shall leave the construction site. The resulting discharge shall be disposed of properly.
- D. ROCK BERM
1. Rock berm shall consist of rip-rap type rock, secured within a wire sheathing as specified, and installed at the toe of slopes, or at the perimeter of developing or disturbed areas. Height of berm shall be a minimum of 18 (eighteen) inches from top of berm to uphill toe of berm. Top width shall be a minimum of 24 (twenty four) inches, with side slopes of 2:1 or flatter. Uphill toe of berm shall be buried a minimum of 4 (four) inches into existing grade. Rock berm shall have a minimum flow-through rate of 60 (sixty) gallons per minute, per square foot of berm face.
 2. Maintain rock berm in a condition that allows the sediment to be removed, when the depth of sediment has reached 1/3 (one third) the height of the berm. Berm shall be reshaped as needed, and silt buildup removed, to maintain specified flow through berm.
 3. Rock berm shall be removed when the disturbed areas served have been stabilized as specified.

TEMPORARY STORM WATER POLLUTION CONTROL

E. CONCRETE TRUCK WASHOUT (SELF INSTALLED)

1. Concrete Truck Washout (self-installed) shall be constructed so that it will be able to accommodate the maximum number of anticipated concrete trucks that will be cleaned on any given day at any given time using 7 gallons of water being used for washout per truck or 50 gallons of water being used to wash out pump trucks. The area utilized to contain the wash water and concrete solids cleaned from the trucks will be a minimum of 10 feet in width. The containment area will be covered with 10 mil plastic sheeting without any holes or tears and the seams shall be sealed according to manufacturer's recommendations. The gravel bags, concrete blocks or open graded rocks shall line the outside perimeter and shall be double wrapped with the 10 mil plastic sheeting to prevent any potential for runoff from the containment area.
2. The concrete truck washout containment area shall be maintained in a condition that will not allow concrete build up within the containment area to exceed 50% of the storage capacity.
3. The concrete truck washout area will be removed when it is no longer necessary to wash out concrete trucks on the site.

F. TEMPORARY STORAGE TANKS

1. Must be located in a bermed containment area. The berm must be a minimum 3 feet in all directions, and the height of the berm must contain the maximum contents of the largest tank plus 8 inches (approximately 110% of the tank capacity). The containment area is constructed by beginning with a 2 inch sand pad, and then covered with 6 mil plastic or rubber sheeting. The sheeting is then covered with another 2 inch layer of sand. The plastic sheeting is secured to the outer berm.
2. Storage tanks are to be placed no closer than 50 feet from a building or property line.
3. If using tanks with a gravity feed type set up, the containment must be of sufficient size to be able to contain the tank if it should fall over
4. There must be a fusible link at the valve that will shut off the flow to the hose in the event of a fire
5. There must be sufficient cover for the tank and the containment area to prevent potential storm water runoff
6. The area within the containment area is to be kept free and clear of spills, if a spill occurs then the sand is to be removed and replace with a fresh layer of sand.
7. The storage tank containment area is to be removed from the site once it has been determined that it will no longer be used on the construction site.

G. DIVERSION DIKE

1. Diversion dikes shall be formed and shaped using compacted fill, and shall not intercept runoff from more than 10 (ten) acres. Dike shall have a minimum top width of 24 (twenty four) inches, and a minimum height of 18 (eighteen) inches. Soil shall have side slopes of 3:1 or flatter, and shall be placed in 8 (eight) inch lifts. Compact soil to 95% standard proctor density. Where protected slopes exceed 2 (two) percent, the uphill side of diversion dike shall be stabilized with crushed stone or erosion control matting – to a distance of not less than 7 (seven) feet from toe of dike. The channel, which is formed by the diversion dike, must have positive drainage for its entire length to a stabilized outlet, such as a rock berm, sandbag berm, or stone outlet structure. Storm water shall not be allowed to overflow the top of diversion dike at any point other than the stabilized outlet.
2. Maintain diversion dike in a condition that allows the storm water runoff to be diverted away from exposed slopes. Repair any failures at top of dike and

TEMPORARY STORM WATER POLLUTION CONTROL

remove sediment as necessary behind dike to allow positive drainage to a stabilized outlet.

3. Remove diversion dike when the expose slopes being protected are stabilized with vegetation or other permanent cover.

H. INTERCEPTOR SWALE

1. Interceptor swale shall be implemented to prevent on or off-site storm water from entering a disturbed area, or prevent sediment-laden runoff from leaving the site or disturbed area. Interceptor swale shall be excavated as required by the SWPPP drawing/s, with side slopes of 3:1 or flatter. This shall include all labor and equipment associated with the installation and maintenance of the swale as shown on the construction documents. Constructed swale may be v-shaped or trapezoidal with a flat bottom, depending on the volume of water being channeled. Sediment laden runoff from swale shall be directed to a stabilized outlet or sediment-trapping device. Flow line of swale shall have a continuous fall for its entire length and shall not be allowed to overflow at any other point/s along its length.
2. Maintain interceptor swale in a condition that allows the storm water runoff to be channeled away from disturbed areas. Remove sediment in swale as necessary to maintain positive drainage to a stabilized outlet.
3. Fill in or remove swale after the disturbed area/s being protected is completely stabilized as specified.

I. EROSION CONTROL MATTING

1. Remove all rocks, debris, dirt clods, roots, and any other obstructions, which would prevent the matting from lying in direct contact with the soil. 6 inch by 6 inch anchor trenches shall be dug along the entire perimeter of the installation. Bury matting in trenches, backfill and compact. Fasten matting to the soil using 10 gauge wire staples, 6 inches in length and 1 inch wide. Use a minimum of one staple per 4 square feet of matting, and at 12 inches on center along all edges. Install parallel to flow of water and overlap joining strips a minimum of 12 inches.
2. Maintain erosion control matting by repairing any bare spots. Missing or loosened matting shall be promptly replaced or re-anchored.
3. Remove matting where protection is no longer required. In areas where permanent vegetation is established along with matting, matting can be left in place permanently.

J. MULCHES

1. Apply specified mulches in areas identified on the SWPPP, to a depth of 3 inches or as otherwise specified on the SWPPP drawing/s.

K. BPM DETAILS

1. Refer to Exhibit's for the following BMP details:
 - Exhibit "A" Area Inlet Detail
 - Exhibit "B" Curb Inlet Detail
 - Exhibit "C" Rock Berm Detail
 - Exhibit "D" Silt Fence Detail
 - Exhibit "E" Triangular Dike Detail
 - Exhibit "F" Stabilized Construction Exit
 - Exhibit "G" Concrete Truck Washout

3.3 INSPECTIONS AND RECORD KEEPING

- A. Contractor shall inspect all BMP's on 7-day intervals. Coordinate inspections with Owner, who is also required by TPDES to regularly inspect the site. Use standard Owner Inspection forms (see form in Part 4 of this Section) for each inspection. Record all deficiencies of site controls, and take appropriate action to correct any deficiencies

TEMPORARY STORM WATER POLLUTION CONTROL

recorded. Exception is rock berms located in a streambed. Any rock berm located in a streambed shall be inspected on a daily basis. Keep records of inspections current and on file, available for review by EPA, TCEQ, MS4 operator Representative and/or Owner's Representative/s.

- B. Contractor shall keep records of all Contractor inspections on file with SWPPP booklet at project site, and make available for review by Owner's Representative/s or EPA, TCEQ or MS4 operator officials requesting review of SWPPP inspection records. One copy of each inspection report shall be delivered to the Owner's office.
- C. Contractor shall keep records of all major grading and stabilization activities on file with the SWPPP booklet at the project site and make available for review by owner's representative(s), EPA, TCEQ, or MS4 operator officials requesting review of the SWPPP.
- D. Contractor shall submit copies of all inspection records and the Major Grading and Stabilization Log and the Major Grading and Stabilization Log along with SWPPP booklet to the Owner at project completion.

3.4 MAINTENANCE

- A. All erosion and sediment control measures and other protective measures identified in the SWPPP must be maintained in effective operating condition. If through inspections the permittee determines that BMP's are not operating effectively, maintenance must be performed before the next anticipated storm event or as necessary to maintain the continued effectiveness of storm water controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable. Erosion and sediment controls that have been intentionally disabled, run-over, removed or otherwise rendered ineffective must be replaced or corrected immediately upon discovery.

PART 4– SAMPLE FORMS

- 4.1 The following forms or sketches are to be used by the Contractor in the execution of the work in this Section, in compliance with TPDES requirements and the SWPPP.
 - A. SWPPP Project Start-up
 - B. Major Grading and Stabilization Log
 - C. SWPPP Posting Sign for Main Construction Entrance for large construction site 5 acres or greater
 - D. SWPPP Posting Sign for Main Construction Entrance for small construction site 1 to less than 5 acres
 - E. TCEQ TPDES Notice of Intent (TCEQ NOI)
 - F. TCEQ TPDES Construction Site Notice (CSN)
 - G. TCEQ TPDES Notice of Termination (TCEQ NOT)
 - H. TCEQ TPDES Large Construction Site Notice (NOI-CSN)
 - I. Shared SWPPP Acceptance Certification form
 - J. SWPPP Inspection form

END SECTION 01 57 23

SWPPP Project Start-Up

Contractors must meet four (4) TPDES requirements before soil-disturbing activities can commence on construction projects. This form provides the Contractor and Owner an acceptance of compliance with initial BMP's and required paperwork for commencement of work on the project site.

The Contractor is to initial items that are certified as complete and then review for concurrence with the Owner's Designated Representative.

- 1. **Best Management Practices (BMP's) applicable to this project have been inspected to ensure correct placement in accordance with the SWPPP and for proper installation according to specifications.**

Initial by Contractor

Initial by Owner

- 2. **The approved Storm Water Pollution Prevention Plan (SWPPP) is approved and on site.**

Initial by Contractor

Initial by Owner

- 3. **The TCEQ NOI Posting Notice forms (and permits if received) or the TCEQ CSN's are complete and posted for all permittees at the main entrance to the project site.**

Initial by Contractor

Initial by Owner

- 4. **Inspector qualifications and letter of delegation of authority are inserted in the SWPPP.**

Initial by Contractor

Initial by Owner

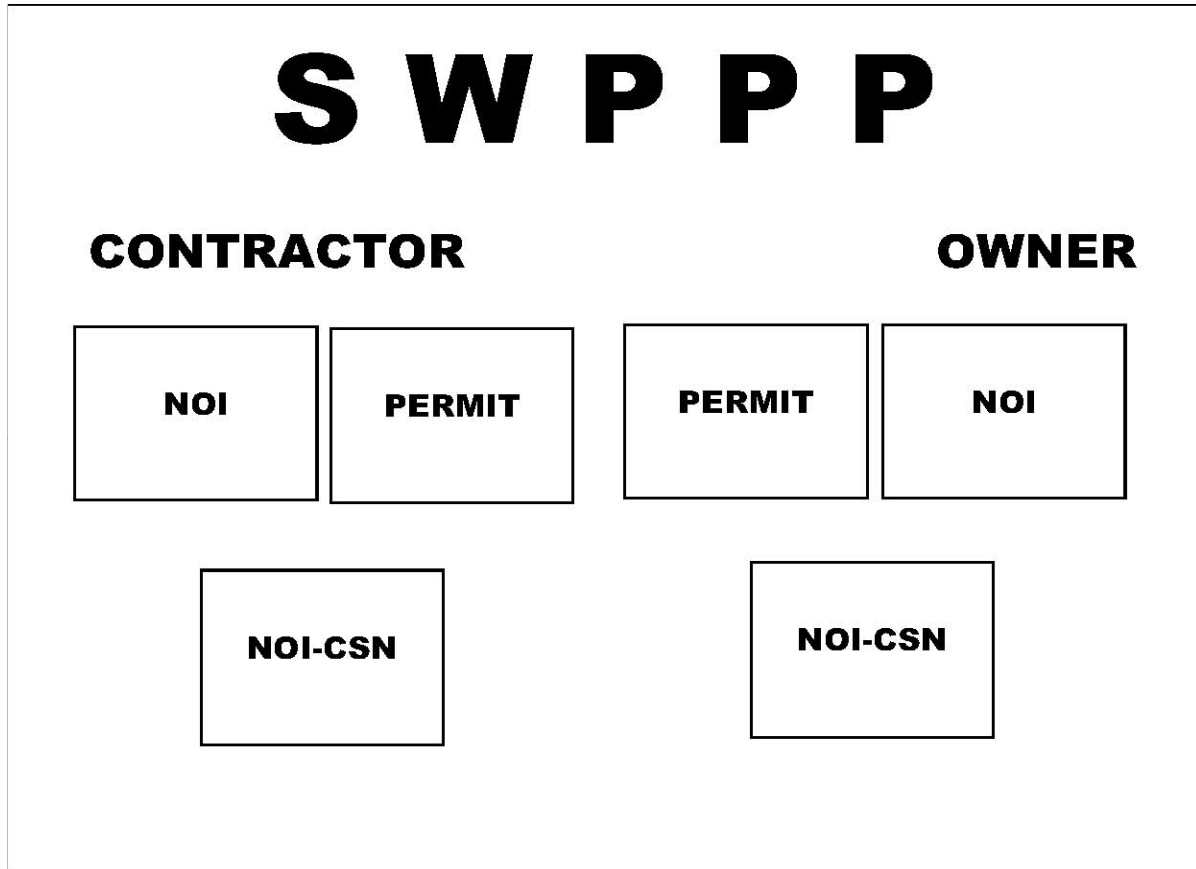
Having met the above requirements and in recognition of prior receipt of Notice to Proceed, the Contractor is authorized to commence work on site.

Contractor

Project # _____

Owner Resident Construction Manager

Date: _____



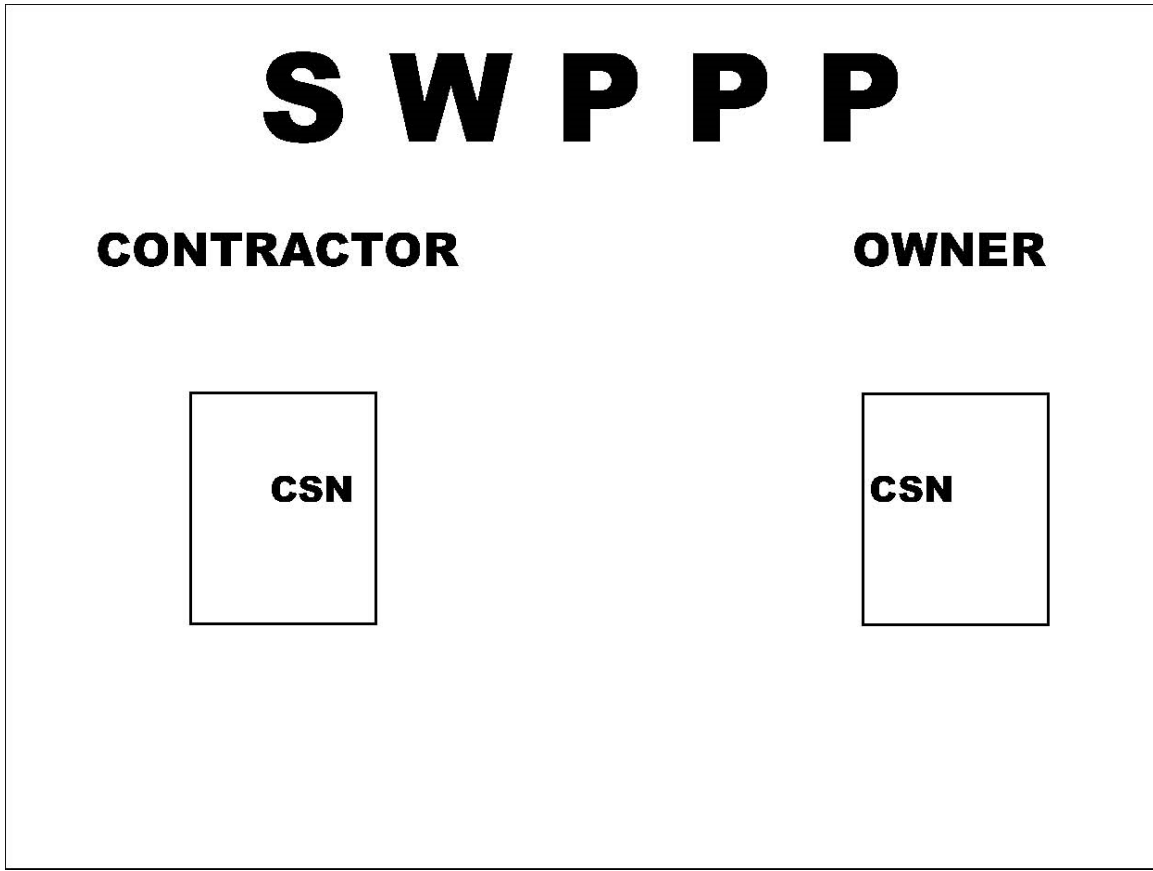
MINIMUM SIGN SPECIFICATIONS: 5 Acre or Greater Sites

SIGN - Exterior grade 3/4" plywood, cut 4' x 4', with red painted letters, Background painted white – **DISPLAY ON CONSTRUCTION FENCE AT MAIN ENTRANCE TO PROJECT SITE.**

S W P P P - 10 inch painted letters, 3 inches from top of sign, centered.

CONTRACTOR OWNER - 3 inch painted letters, 4 inches below SWPPP letters, centered on each half of sign.

NOI, PERMIT, CONTACT - 8-1/2 x 11 TCEQ forms, laminated beyond edges of documents, stapled to plywood.



MINIMUM SIGN SPECIFICATIONS: 1 to Less Than 5 Acre Sites

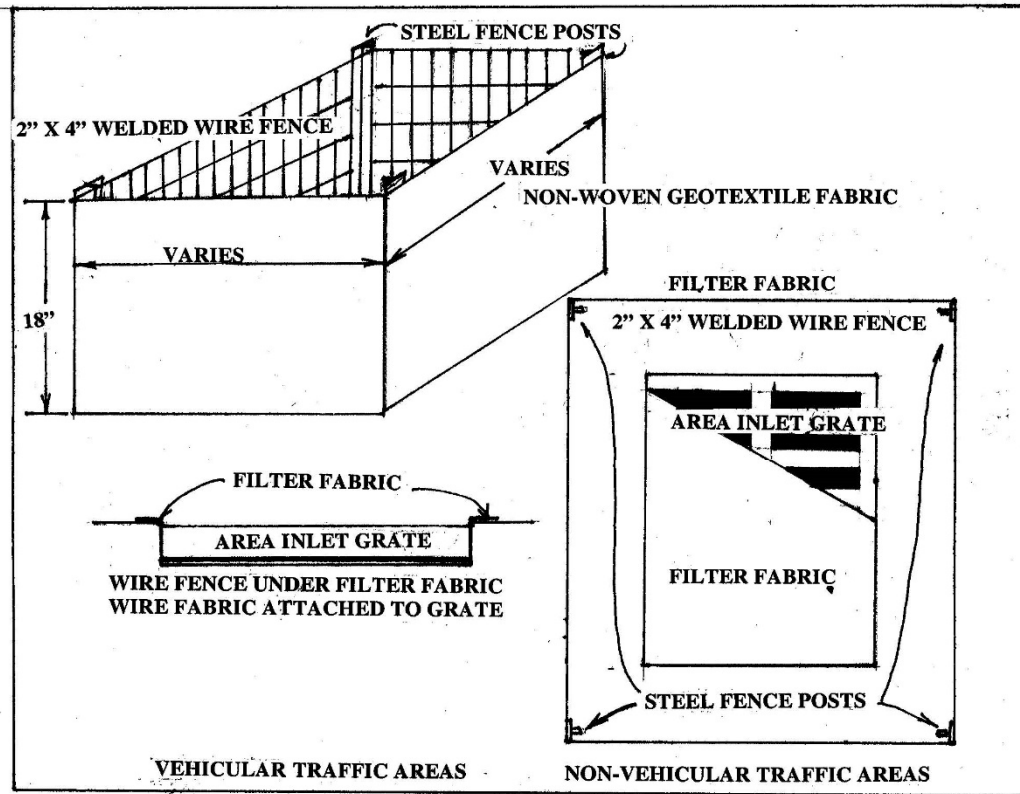
SIGN - Exterior grade 3/4" plywood, cut 4' x 4', with red painted letters, Background painted white – DISPLAY ON CONSTRUCTION FENCE AT MAIN ENTRANCE TO PROJECT SITE.

S W P P P - 10 inch painted letters, 3 inches from top of sign, centered.

CONTRACTOR OWNER - 3 inch painted letters, 4 inches below SWPPP letters, centered on each half of sign.

CONSTRUCTION SITE NOTICE - 8-1/2 x 11 TCEQ forms, laminated beyond edges of documents, stapled to plywood.

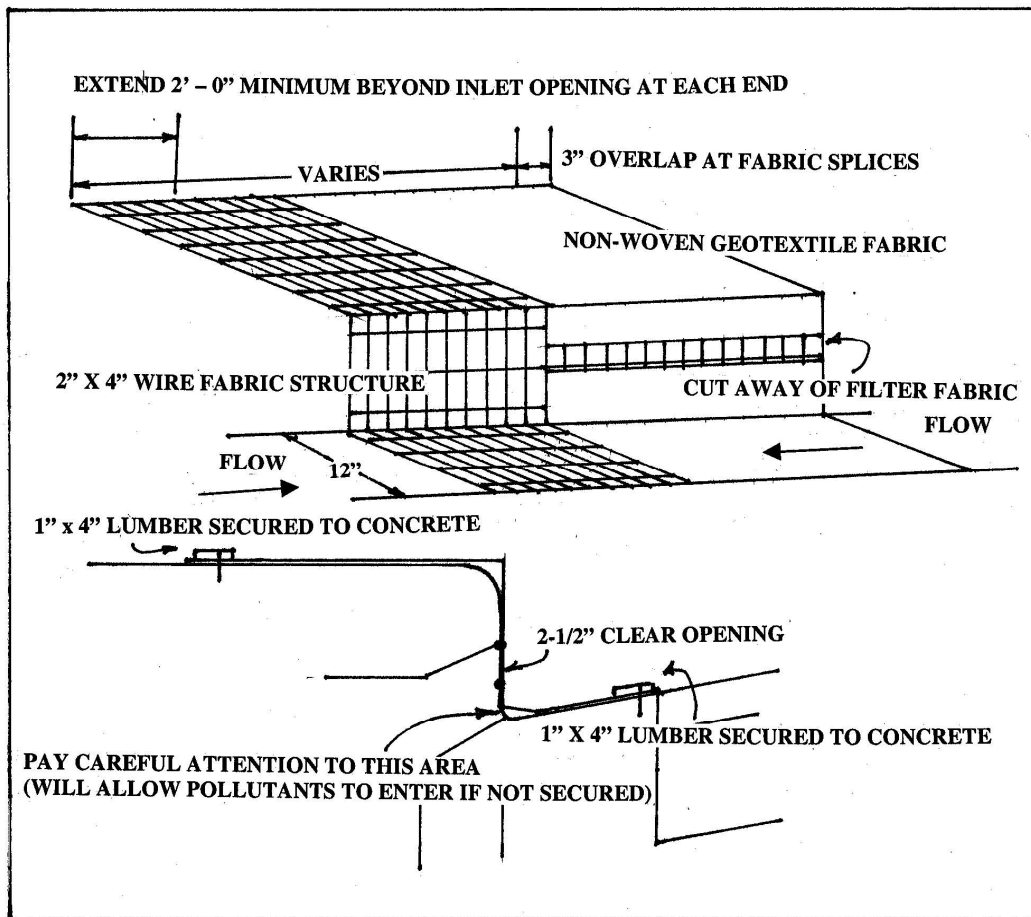
EXHIBIT "A"
Area Inlet Detail



AREA INLET PROTECTION

1. STEEL POSTS THAT SUPPORT THE SILT FENCE SHALL BE INSTALLED AT EACH CORNER AND IN BETWEEN CORNERS IF THE DISTANCE IS GREATER THAN 6' BETWEEN CORNER POSTS.
2. USE SILT FENCE DETAIL FOR INSTALLATION OF THE SILT FENCE AROUND THE AREA INLET.
3. THE METAL AREA INLET GRATE SHALL BE LIFTED AND FILTER FABRIC WRAPPED AROUND THE GRATE AND THE GRATE SHALL BE REPLACED.
4. IN VEHICULAR TRAFFIC AREAS THE METAL GRATE SHALL BE LIFTED OUT AND WIRE FENCE MATERIAL SHALL BE PLACED UNDER IT WITH FILTER FABRIC PLACED BETWEEN THE GRATE AND THE WIRE FENCE. THE WIRE FENCE SHALL THEN BE ATTACHED TO THE GRATE .
5. ACCUMULATED SILT SHALL BE REMOVED WHEN THE FILTER FABRIC OVER THE GRATE COMPLETELY COVERS THE GRATE AREA, AND THE SILT AROUND THE SILT FENCE REACHES A HEIGHT OF 6"
6. AREA INLET PROTECTION SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED.

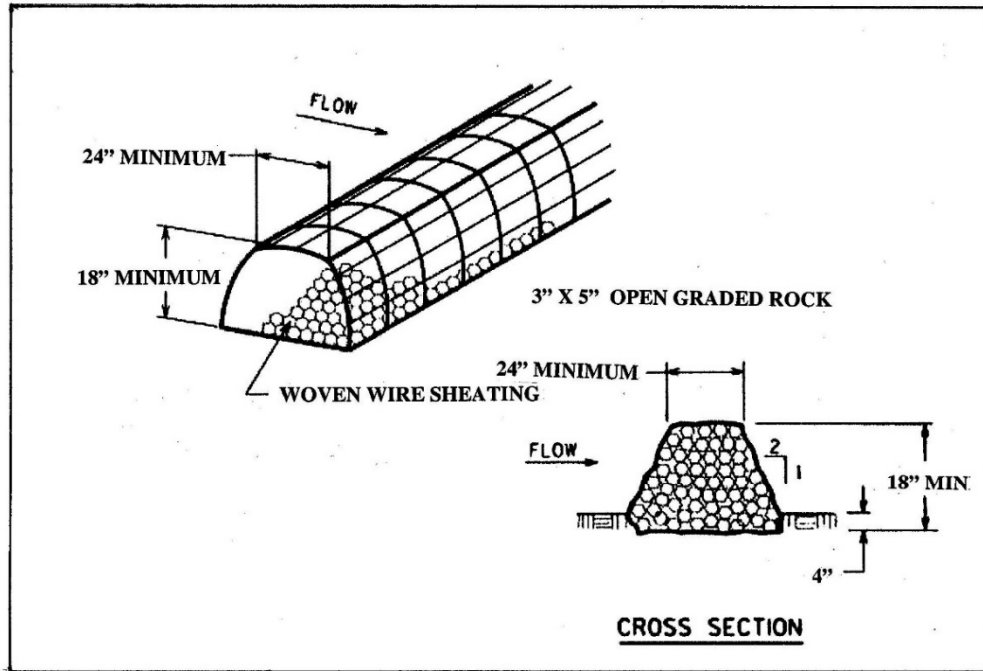
EXHIBIT "B"
Curb Inlet Detail



CURB INLET PROTECTION

1. WHERE MINIMUM CLEARANCES CAUSE TRAFFIC TO DRIVE IN THE GUTTER, USE 1" X 4" LUMBER SECURED WITH CONCRETE NAILS 3' O.C. NAILED INTO THE CONCRETE. IF PEDESTRIAN TRAFFIC ONLY THE USE OF 20# GRAVEL BAGS TO SECURE MATERIAL IS PERMITTED.
2. AS SECTION OF FILTER FABRIC SHALL BE REMOVED AS SHOWN IN THIS DETAIL. FABRIC MUST BE SECURED TO WIRE BACKING WITH CLIPS OR HOG RINGS AT THIS LOCATION.
3. DAILY INSPECTION SHALL BE MADE AND SILT ACCUMULATION MUST BE REMOVED WHEN DEPTH REACHES 2".
4. THE PERFORMANCE OF THE INLET PROTECTION SHALL BE MONITORED DURING EACH RAINFALL EVENT AND PROTECTION SHALL BE IMMEDIATELY REMOVED IF THE STORMWATER BEGINS TO OVERTOP THE CURB.
5. INLET PROTECTION SHALL BE REMOVED AS SOON AS THE SOURCE OF SEDIMENT IS STABILIZED.

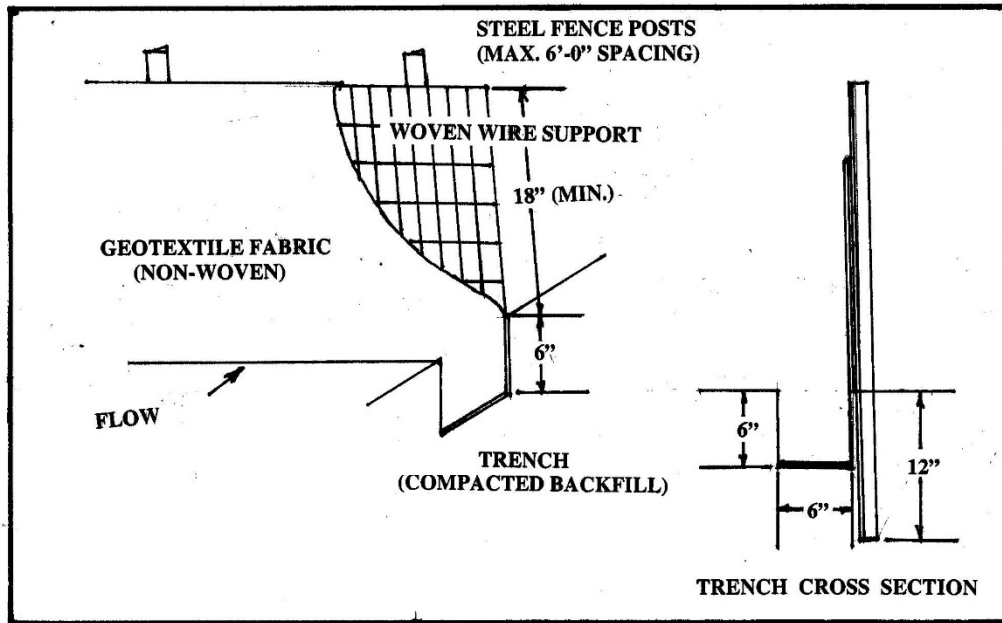
EXHIBIT "C"
Rock Berm Detail



ROCK BERM

1. USE ONLY OPEN GRADED ROCK (4" X 8") FOR STREAM FLOW CONDITIONS. USE OPEN GRADED ROCK (3" X 5") FOR OTHER CONDITIONS
2. THE ROCK BERM SHALL BE SECURED WITH A WOVEN WIRE SHEATHING HAVING A MAXIMUM 1" OPENING AND A MINIMUM WIRE DIAMETER OF 20 GA. ROCK BERMS IN CHANNEL APPLICATIONS SHALL BE ANCHORED FIRMLY INTO THE SUBSTRATE A MINIMUM OF 6" WITH TEE POSTS OR WITH #5 OR #6 REBAR, WITH A MAXIMUM SPACING OF 48" ON CENTER.
3. THE ROCK BERM SHALL BE INSPECTED WEEKLY AND THE STONE AND/OR FABRIC CORE-WOVEN SHEATHING SHALL BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED; DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC, ETC.
4. WHEN SILT REACHES A DEPTH EQUAL TO ONE-THIRD THE HEIGHT OF THE BERM OR 6" WHICHEVER IS LESS, THE SILT SHALL BE REMOVED AND DISPOSED OF ON AN APPROVED SITE AND IN A MANNER THAT WILL NOT CREATE A SILTRATION PROBLEM.
5. DAILY INSPECTION SHALL BE MADE ON SEVERE-SERVICE ROCK BERMS; SILT SHALL BE REMOVED WHEN ACCUMLUATION REACHES 6"
6. WHEN THE SITE IS COMPLETELY STABILIZED, THE ROCK BERM AND ACCUMULATED SILT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.

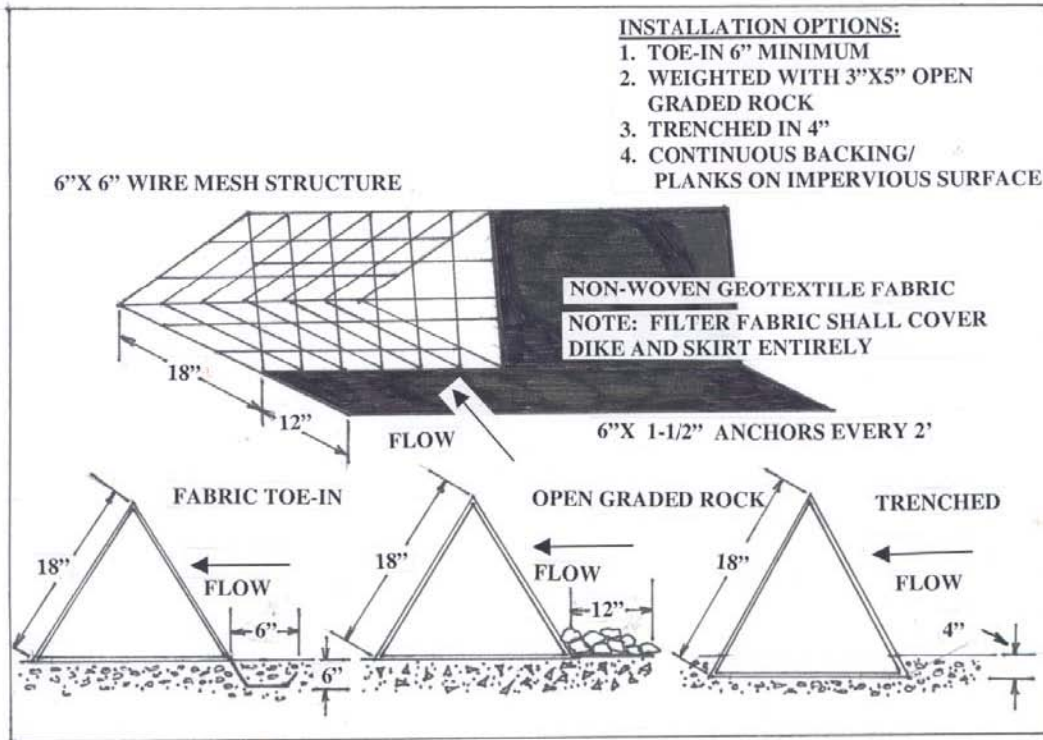
EXHIBIT "D"
Silt Fence Detail



SILT FENCE DETAIL

1. STEEL POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POSTS MUST BE EMBEDDED A MINIMUM OF 12"
2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF THE FLOW. WHERE FENCE CAN NOT BE TRENCHED INTO THE SURFACE (e. g. PAVEMENT) THE FABRIC SHALL BE WEIGHTED DOWN WITH ROCK OR 1" X 4" LUMBER SECURELY FASTENED TO THE SURFACE, ON THE UPSTREAM SIDE TO PREVENT FLOW UNDER THE FENCE.
3. THE TRENCH MUST BE A MINIMUM OF 6" DEEP AND 6" WIDE TO ALLOW FOR THE FILTER FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
4. THE FILTER FABRIC SHALL BE SECURELY FASTENED TO THE WOVEN WIRE BACKING, WHICH IN TURN IS SECURELY FASTENED TO THE STEEL FENCE POST.
5. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF 6". THE SILT SHALL BE DISPOSED OF ON AN APPROVED SITE AND IN SUCH A MANNER THAT WILL NOT CONTRIBUTE TO ADDITIONAL SILTRATION.
6. INSPECTION SHALL BE MADE WEEKLY AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY, IF NEEDED.
7. SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED.

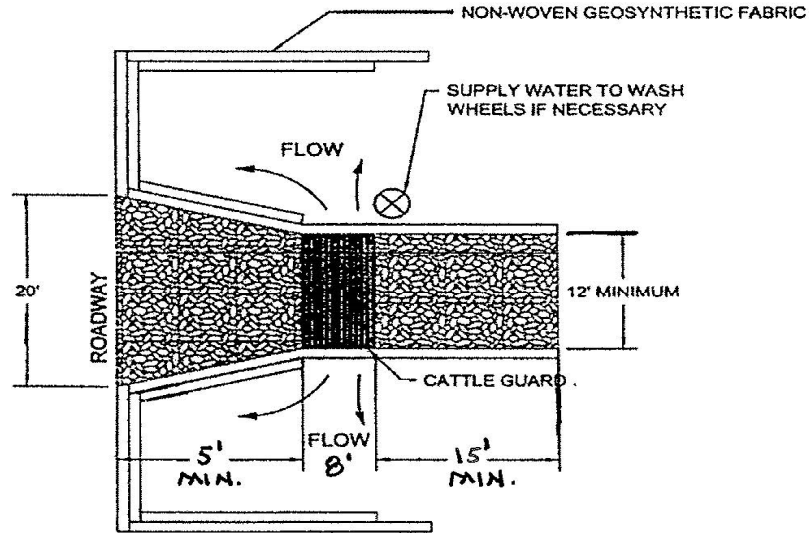
EXHIBIT "E"
Triangular Dike Detail



TRI DIKE FILTER DAM

1. DIKES SHALL BE PLACED IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT DIKE.
2. THE FABRIC COVER AND SKIRT SHALL BE A CONTINUOUS WRAPPING OF NON-WOVEN GEOTEXTILE. THE SKIRT SHALL BE A CONTINUOUS EXTENSION OF THE FABRIC ON THE UPSTREAM FACE.
3. THE SKIRT SHALL BE WEIGHTED WITH A CONTINUOUS LAYER OF 3" X 5" OPEN GRADED ROCK, 1" X 4" LUMBER (SECURELY FASTENED), OR TOED IN 6" WITH MECHANICALLY COMPACTED MATERIAL. OTHERWISE, SHALL BE TRENCHED IN 4" IN DEPTH.
4. DIKES AND SKIRT SHALL BE SECURELY ANCHORED IN PLACE USING 6" WIRE STAPLES ON 2' CENTERS ON BOTH EDGES OF SKIRT, OR STAKE USING 3/8" REBAR WITH TEE ENDS.
5. FILTER MATERIAL SHALL BE LAPPED OVER ENDS 6" TO COVER DIKE TO DIKE JOINTS. JOINTS SHALL BE FASTEN WITH GALVANIZED SHOAT RINGS.
6. THE DIKE STRUCTURE SHALL BE 6 GA. 6"X 6" WIRE MESH, 18" ON A SIDE.
7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF 6" AND DISPOSED OF IN A MANNER WHICH WILL NOT CAUSE ADDITIONAL SILTRATION.
8. INSPECTION SHALL BE MADE WEEKLY AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
9. AFTER THE SITE IS COMPLETELY STABILIZED, THE DIKES AND ANY REMAINING SILT SHALL BE REMOVED.

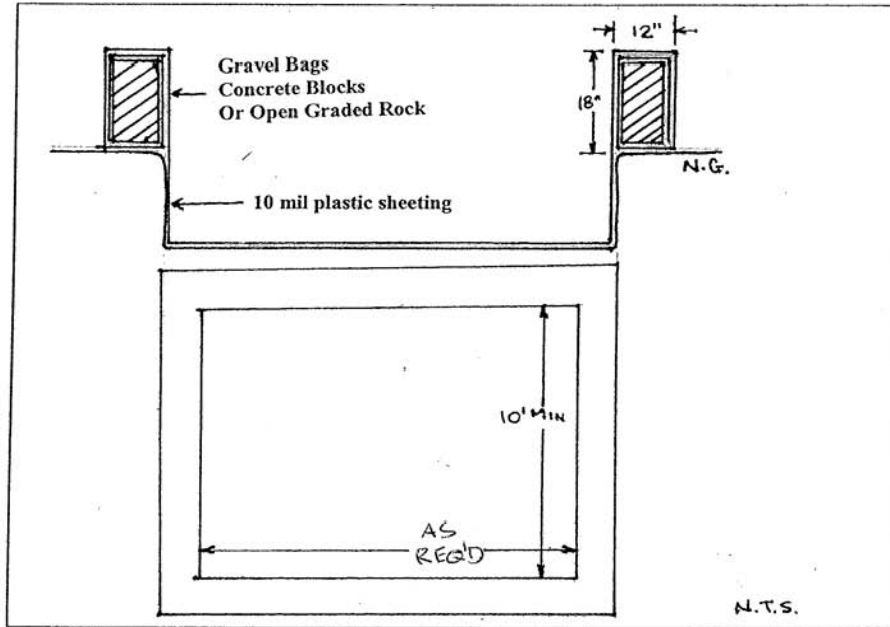
EXHIBIT "F"
Stabilized Construction Exit



A STEEL GRID THAT ALLOWS THE SAFE PASSAGE OF VEHICLES WHILE AGITATING THE TIRES TO LOOSEN AND REMOVE THE SOIL BUILD UP. THE GRID OR STRUCTURES SHALL CONFORM TO THE FOLLOWING:

- A. IT SHALL CONSIST OF PIPES OR TUBES SPACED SUCH THAT THERE IS A MINIMUM CLEAR DISTANCE BETWEEN THE PIPES OR TUBES OF 4 ½". IT SHALL BE ELEVATED ABOVE THE GROUND SURFACE A MINIMUM OF 8" TO ALLOW WATER, DEBRIS AND SOIL TO DRAIN.
- B. MINIMUM DIAMETER OF PIPE OR TUBE SHALL BE 3".
- C. IT SHALL BE DESIGNED TO SUPPORT ANY AND ALL VEHICLES ENTERING AND LEAVING THE CONSTRUCTION SITE.
- D. IT SHALL BE FIRMLY PLACED IN THE GROUND AT THE EXIT.
- E. IT SHALL BE OF SUFFICIENT LENGTH SO THAT THE AGITATION WILL REMOVE THE SOIL FROM THE TIRES OR A MINIMUM OF 8'-0".
- F. AT THE "STREET SIDE" APPROACH OF THE GRID THERE SHALL BE AN IMPERVIOUS SURFACE OR IT SHALL CONSIST OF 3" TO 5" DIAMETER ANGULAR CRUSHED STONE/ROCK APPROXIMATELY 5'-0" IN LENGTH, MINIMUM, AND 8" DEEP, MINIMUM. ON THE "JOB SITE" SIDE OF THE GRID, THERE SHALL BE 3" TO 5" DIAMETER ANGULAR CRUSHED STONE/ROCK 15'-0" IN LENGTH, MINIMUM, 8" DEEP, MINIMUM. THE STEEL GRID WILL BE BETWEEN THE "STREET SIDE" APPROACH AND THE JOB SITE CRUSHED STONE/ROCK. ALL CRUSHED STONE/ROCK SHALL HAVE FILTER FABRIC BENEATH THE STONE/ROCK.
- G. STEEL GRID AREA SHALL BE USED AS THE TIRE WASH AREA. WHEN TIRE WASH IS IN USE (RAINY OR MUDDY DAYS) THE AREA SHALL BE MANNED AND THE TIRES SHALL BE WASHED USING A HIGH PRESSURE HOSE/NOZZLE.
- H. THE AREA BENEATH THE GRID SHALL BE SLOPED SUCH THAT DEBRIS, SOIL AND WATER SHALL BE DIVERTED BACK ON TO THE CONSTRUCTION SITE OR TO A SEDIMENT BASIN. NO WATER, SOIL OR DEBRIS SHALL LEAVE THE CONSTRUCTION SITE. THE RESULTING DISCHARGE SHALL BE DISPOSED OF PROPERLY.

EXHIBIT "G"
Concrete Truck Washout



Alternative Self-installed Construction Site Concrete Truck Washout

1. The excavation for the concrete truck washout shall be a minimum of 10' wide and of sufficient length and depth to accommodate 7 gallons of washout water and concrete per truck per day and/or 50 gallons of washout water and concrete per pump truck per day.
2. In the event that the self-installed concrete truck washout is constructed above ground, it shall be 10' wide and 10' long with the same requirements for containment as described in item 1.
3. The containment area shall be lined with 10 mil plastic sheeting, without holes or tears. Where there are seams, these shall be secured according to manufacturers directions.
4. The plastic sheeting shall be of sufficient size so that it will overlap the top of the containment area and be wrapped around the gravel bags, concrete blocks or open graded rock at least 2 times.
5. The gravel bags or concrete blocks shall be placed abutting each other to form a continuous berm around the outer perimeter of the containment area.
6. The berm consisting of gravel bags, concrete blocks or open graded rock shall be no less than 18" high and no less than 12" wide.
7. The containment area shall not exceed 50% of capacity at any one time.
8. Solids shall be removed from containment area and disposed of properly and any damage to the plastic sheeting shall be repaired or sheeting replaced before next use.

CITY OF DENTON
WAVE POOL

SECTION 02 41 19.50
SITE PREPARATION, CLEARING, GRUBBING AND DEMOLITION

PART 1 - GENERAL

1.1 Scope: The following specification is limited to the clearing and grubbing of trees and shrubs and the demolition of old structures within the project limits. The intention of these specifications is to remove all obstacles, surficial or underground, that would impede the construction of the wave pool, concession building and ancillary construction.

1.2 This item shall include furnishing all labor, equipment, materials, superintendence and other related services necessary to complete the clearing and demolition indicated on the drawings or specified herein and for the lawful disposal of all materials cleared or demolished.

Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical. Before clearing and demolition, the Owner will remove all items to be salvaged and re-used.

Notify the Engineer of discrepancies between existing conditions and Drawings before proceeding with pool demolition work.

1.3 Salvage. Unless otherwise noted on the plans or in these specifications, all salvage belongs to the contractor to be lawfully disposed of by him.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. Description of Work: Refer to other sections for clearing, relocation and demolition of other equipment and structures.

1. Remove chainlink fence and concrete mowing strip where designated.
2. Remove trees and shrubs designated on the plans or otherwise interfering with the project advancement. Do not remove undesignated trees without permission of the Owner.
3. Remove portions of the existing lazy river for addition of steps.
4. Remove portions of the existing lawn irrigation system.
5. Remove landscape borders or curbs within the limits of the project which interfere with construction.
6. Remove and relocate waterline to clear structures.
7. Remove and relocate underground electrical branch circuits between mechanical room and lazy river. [but not the underground primary service which is to be relocated by power company.]
8. Strip sod and other vegetative matter from areas to receive fill.

B. Description of Work By Others:

1. Remove and relocate primary underground service to clear project.

3.2 FENCE REMOVAL: Remove the chainlink fence and the concrete mowing strip along the

fence only to the limits required by earthwork and pool construction. Chain link fence removed is NOT to be re-incorporated into the final project but may be used by the contractor as temporary construction site security fencing at contractor's option. Concrete demolished shall not be incorporated into the fill required for this project but shall be hauled from the site.

3.3 TREE AND SHRUB REMOVAL: Remove trees and shrubs including all roots to a distance of at least 36 inches from any proposed structure in this project. Trees and shrubs may be ground on site but chips may not be incorporated into the required select fill but rather must be spread to the satisfaction of the Owner or hauled from the site.

3.4 CONCRETE REMOVAL: When partial removal of concrete is required on this project, saw joints and neatly remove concrete, exposing reinforcing steel for incorporation into the new work if applicable. Do not jack hammer or cause damage to the rest of the structure. Any damaged concrete resulting from careless demolition shall likewise be removed and replaced at no additional cost to the Owner. Water cutting of the existing concrete is acceptable.

Remove all debris and dust from the existing river.

3.5 IRRIGATION SYSTEM: Remove only those designated areas of the irrigation system which fall within the new project limits and must be extended or relocated. Cut pipe with a saw and cap and mark the termination of old lines so that they can be extended and relocated later in the project. Protect low voltage wires for extension to new locations.

3.6 WATERLINE: Relocate parts of an 8-inch fire loop through the park as noted on the plans.

3.7 ELECTRICAL: Several branch circuits are located under proposed concession building site and must be removed and relocated to clear the footprint of the new building. This item does NOT include removing and relocating the underground primary service. Primary will be relocated by Denton Municipal Electric.

PART 4 - MEASUREMENT AND PAYMENT: Pool clearing, grubbing, utility relocation and demolition for aquatic facilities is considered subsidiary to other bid items included in the forms of proposal. No separate measurement or payment will be made for this work.

END OF SECTION 02 41 19.50

SECT
ION 03 15 13

WATERSTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the placing of waterstops where such are indicated on the Plans.

1.2 MEASUREMENT AND PAYMENT

- A. No separate pay item is provided for waterstop.

PART 2 - PRODUCTS

A. Polyvinyl Plastic Waterstop

1. Waterstops shall be installed in construction joints as required by the Plans. All waterstops shall be continuous throughout their length.
2. The waterstops shall be heavy duty PVC, high tensile neoprene or high tensile styrene butadiene rubber (SBR) waterstop conforming to Corps of Engineers Specifications as manufactured by Williams Products, Inc., Servicesied Products Division of W.R. Grace and Company; Vinylstops by Sonneborn-Contech; W.R. Meadows, Inc.; Vinylex Corporation; Burke or an approved equal of the same type and material and approximately equal in dimensions and weight but not necessarily of exactly the same shape. Waterstops shall be of the size and type designated on the Plans.
3. Construction joint waterstops shall be of ribbed or dumbbell construction without a center bulb, 9" wide. Minimum thickness of waterstops shall be 3/8 inches.
4. Expansion joint waterstops shall be of dumbbell/center bulb design, 9" wide, with a capacity of 1" of movement. Minimum thickness of waterstops shall be 3/8 inches.
5. All water stops shall be installed so that one-half its width will be embedded on one side of the joint and one-half of the other. The Contractor shall employ a method of holding the waterstop in position for the first pour that is satisfactory to the Engineer. The method selected must insure that the waterstop will be held securely in true vertical or horizontal position and in straight alignment in the joint.
6. Care shall be exercised to insure that the waterstop is completely encompassed in good mortar.

- B. Expanding Joint Waterstop-Bentonite. Expanding joint waterstop, where shown on the Plans, shall be a sodium bentonite based strip embedded in concrete which expands in the presence of water to form a watertight seal between concrete and concrete or concrete and steel or PVC. Product shall be applied using manufacturer's recommended adhesive. Products shall be equal to Volclay RX-101 and Volclay WB-Adhesive. (CETCO Building Materials Group, (800)527-9948).

- C. Expanding Joint Waterstop-Non-Bentonite. Expanding joint waterstop, where shown on the Plans, shall be a chemically modified natural rubber (vulcanized) strip product, with a hydrophilic agent chemically bonded to the rubber, embedded in concrete which expands in the presence of water to form a watertight seal between concrete and concrete or concrete and steel or PVC. Product shall be applied using manufacturer's recommended adhesive. Products shall be equal to Adeka Waterstops by OCM, Inc.: Ultraseal KBA-1510FP and P-201 Adhesive or Ultraseal MC-2010MN. (Adeka Corporation, (800)999-3959).

- D. SIKASWELL See Job Specifics.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All waterstops shall be continuous. Joint at all points of contact in the same plane, or at intersections with waterstops in different planes, as to form a complete barrier to the passage of water through any construction, contraction, or expansion joint.
- B. PVC Waterstops: Joints in the waterstops, whether made for the purpose of continuity in a straight strip or for the purpose of securing a watertight junction between strips in different planes, shall be made by adhesive solvent or heat welding. The joints in strips of waterstop shall be such that the entire cross section of the joint shall be dense, homogeneous and free of all porosity. All finished joints shall have a tensile strength of not less than 75 percent of the material of the strip as extruded. Heating of surfaces to be joined shall be done by means of an electric splicing iron designed for the specified purpose and controlled by means of a voltage regulator. In use, the heat of the hot plate shall be so regulated as to prevent too rapid melting and accompanying charring of the waterstop material. The use of makeshift hot plates will not be permitted nor will other means of heating the strips to be joint be allowed except in a case of emergency, as determined by the Engineer. The Contractor shall provide such jigs as will assist in making the joints in a proper and workmanlike manner and in holding the strips so that the alignment of jointed strips is correct and angles are true to those required.
- C. Expanding Joint Waterstop-Bentonite: Install with at least 2-inches concrete coverage. Surfaces shall be clean and dry. Apply 5-mils minimum adhesive (400 lineal feet per gallon) at least 1-inch wide along the joint. Apply waterstop after 15 minutes and within 2 hours of applying adhesive. Butt joint, do not overlap ends. Flow concrete around joint and thoroughly vibrate or rod to remove voids. Do not direct pneumatically-applied concrete at joint. Do not allow expanding joint waterstop to get wet before installation. Discard any material evidencing pre-swelling.
- D. Expanding Joint Waterstop-Non-Bentonite: Install with at least 1-inch concrete coverage for Ultraseal KBA-1510FP and 4-inches concrete coverage for Ultraseal MC-2010MN. Surfaces shall be clean and dry. Apply adhesive according to manufacturer's guidelines Flow concrete around joint and thoroughly vibrate or rod to remove voids. Do not direct pneumatically-applied concrete at joint. Do not allow expanding joint waterstop to get wet before installation. Discard any material evidencing pre-swelling.
- E. Prior to embedment, all joints in the waterstop strips will be inspected by the Engineer and any found defective shall be remedied without delay.

3.2 PRECAUTIONS

- A. The Contractor shall take such steps as are necessary to protect exposed waterstops in the interim period between concrete pours.

END SECTION 03 15 13

CITY OF DENTON
WAVE POOL

**SECTION 03 20 00
METAL REINFORCING FOR SWIMMING POOLS**

PART 1 - GENERAL

- 1.1 This section shall govern the quality and type of metal reinforcement furnished for construction of swimming pools and swimming pool decks only as indicated on the Plans and its placement in the work.
- 1.2 Bar schedules will not be reviewed. Submit mill certification of conformance to ASTM requirements. Submit bar-chair sample or specifications.

PART 2 – PRODUCTS

- 2.1 Reinforcing bars shall conform to the requirements of these Specifications: ASTM A615, Grade 40 or 60 open hearth, basic oxygen, or electric furnace new billet steel or ASTM A617, Grade 40 or 60 axle steel. Epoxy coating is not permitted.
- 2.2 Welded wire fabric or cold-drawn wire for concrete reinforcement shall conform to the requirements of Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement (ASTM A-82 or A-496) or Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A-185 or A-497). Rolled welded wire fabric may not be used in this project. Flat panels of welded wire mesh may be used with permission of the Engineer or where shown on plans.

PART 3 - EXECUTION

- 3.1 Metal reinforcement, at the time concrete is placed, shall be free from rust, scale, or other coating that will destroy or reduce the bond. All bars shall be bent cold. Straightening or rebending shall not be allowed which will injure reinforcement. Bars with kinks or bends not shown on the plans shall not be used.
- 3.2 Metal reinforcement shall be accurately placed and adequately secured in position by nylon or metal chairs and spacers. In no case shall the clear distance between bars be less than 1", nor less than 1-1/3 times the maximum size of the coarse aggregate. Bar chairs shall be nylon or metal commercial re-bar supporting products intended for the purpose and spaced not to exceed 36-inches between supports each direction. All metal chairs, wire and spacers shall be galvanized. Bricks, rock, or broken concrete may not be used.
- 3.3 Splices shall have a length of not less than fifty (50) times the normal size of diameter of the reinforcement, except in the cases of welded splices, and shall be well distributed or else located at points of low tensile stress. No splices other than welded splices will be permitted at points where the section is not sufficient to provide a minimum distance of two inches between the splice and the nearest adjacent bar or the surface of the concrete. The bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer.
- 3.4 The reinforcement of footings and other principal structural members in which the concrete is deposited against the ground shall have not less than 2" of concrete between the steel and the ground contact surface. In walls and floors, if concrete surfaces, after removal of the forms, are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than 2" of concrete over bars more than 5/8" in diameter and 2" over bars 5/8" or less in diameter.

METAL REINFORCING FOR SWIMMING POOLS

CONCRETE PROTECTION FOR REINFORCEMENT SHALL IN ALL CASES BE AT LEAST 2 INCHES.

- 3.5 Bend bars around corners in structural walls and footings. Do not splice bars at right angles in corners but rather lap splice 5 feet or more from corners if dimensions permit.
- 3.6 Reinforcement shall be bent and placed according to the latest A.C.I. requirements and methods. No. 4 or smaller diameter bars may be bent in the field. Larger bars shall be shop bent.
- 3.7 No concrete shall be deposited until the Engineer has inspected the placing of the reinforcement and given permission to place concrete.
- 3.8 Contractor shall, prior to placing concrete, wire brush all bars until they are free of rust, scale or mud. Secure all bars with adequate bar ties and prevent movement of reinforcing during placement of concrete.
- 3.9 Provide safety bar caps for all reinforcing steel temporarily left in a vertical or near vertical position where impaling is a possibility.

PART 4 – PAYMENT

- 4.1 Metal reinforcement will not be measured for payment. Payment for furnishing, bending, fabricating, and placing reinforcing steel, including all labor, tools and incidentals necessary to complete the work, shall be included in the unit price bid for concrete of the class specified. Payment will not be made for unauthorized work.

END OF SECTION 03 20 00

CITY OF DENTON
WAVE POOL

SECTION 03 30 53
CAST IN PLACE CONCRETE - AQUATIC

PART 1 - GENERAL

- 1.1 This section shall govern the furnishing of all labor, materials, tools, plant, performing all operations required to install all cast-in-place concrete and reinforcing steel, and completely finishing the concrete items in strict accordance with the requirements of these specifications and the applicable drawings and subject to all conditions of the contract including but not limited to the following:

- Foundations, spread footings, grade beams
- Slabs on grade, walks, concrete decks, play courts
- Structure Walls, pits, concrete shells
- Exterior Steps and Landings, wheel chair ramps
- Retaining Walls, barrier walls
- Drainage structures
- Concrete floors, girders

- 1.2 Work Covered Under Other Sections:

- A. Refer to Section 033719 of these specifications for "Pneumatically Applied Concrete".
- B. Refer to Section 032000 of these specifications for "Metal Reinforcing for Swimming Pools".

- 1.3 Cracking in concrete structures shall be reported immediately to the Engineer.

1.4 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 2. ACI 301 - Specifications for Structural Concrete
 - 3. ACI 302 - Guide for Concrete Floor and Slab Construction
 - 4. ACI 305R - Hot Weather Concreting
 - 5. ACI 306R - Cold Weather Concreting
 - 6. ACI 308 - Standard Specification for Curing Concrete
 - 7. ACI 309R - Guide for Consolidation of Concrete
 - 8. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 2. ASTM A 706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 - 3. ASTM A 996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 - 4. ASTM C 31 / C 31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 5. ASTM C 33 - Standard Specification for Concrete Aggregates

CAST IN PLACE CONCRETE – AQUATIC

6.	ASTM C 39 / C 39M	-	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
7.	ASTM C 94 / C 94M	-	Standard Specification for Ready-Mixed Concrete
8.	ASTM C 138 / C 138 M	-	Standard Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
9.	ASTM C 143 / C 143 M	-	Standard Test Method for Slump of Hydraulic Cement Concrete
10.	ASTM C 150	-	Standard Specification for Portland Cement
11.	ASTM C 172	-	Standard Practice for Sampling Freshly Mixed Concrete
12.	ASTM C 309	-	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
13.	ASTM C 494 / C 494 M	-	Standard Specification for Chemical Admixtures for Concrete
14.	ASTM C 595	-	Standard Specification for Blended Hydraulic Cements
15.	ASTM C 618	-	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
16.	ASTM C 989	-	Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
17.	ASTM C 1017 / C 1017M	-	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
18.	ASTM C 1064 / C 1064M	-	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
19.	ASTM C 1157	-	Standard Performance Specification for Hydraulic Cement
20.	ASTM C 1240	-	Standard Specification for Silica Fume Used in Cementitious Mixtures
21.	ASTM C 1315	-	Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
22.	ASTM C 1602 / C 1602 M	-	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

PART 2 – PRODUCTS

2.1 GENERAL

- A. **Cement:** The cement shall be Type I or Type III of a standard brand of Portland cement which shall conform to ASTM Specification C-150. The Contractor, if he so elects in order to facilitate his own operations, may use Type III cement. All cement shall be protected against dampness, and no cement will be accepted which has become caked.
- B. **Water:** Water for use in concrete mixtures shall be clean, potable water and shall conform to the provisions of AASHTO Test Method T-26 for quality of water.
- C. **Coarse Aggregate:** The coarse aggregate shall consist of gravel, crushed stone, blast furnace slag or combinations thereof with a wear of not more than forty (40) percent when tested according to AASHTO Method T-96. Aggregate shall conform to the requirements of ASTM C-33.

The maximum size of coarse aggregate shall not be larger than one-fifth (1/5) of the narrowest dimension between forms of the member for which concrete is to be used nor larger than three-fourths (3/4) of the minimum clear spacing between reinforcing bars.

- D. **Fine Aggregate:** The fine aggregate shall consist of sand conforming to ASTM designation C-33. The sand shall not contain more than 1-1/2% clay and shall not show darker than very light amber when tested by the colorimetric method.

The fine aggregate shall conform to the following grading requirements:

Retained on 3/8" screen	0% by weight
Retained on 1/4" screen	0 to 5% by weight
Retained on No. 20 sieve	15 to 50% by weight
Retained on No. 100 sieve	85% to 100% by weight

- E. **Admixtures:** Furnish from one manufacturer.

1. Characteristics: Compatible with each other and free of intentionally-added chlorides.
2. Air-Entraining Admixture: Shall conform to ASTM C 260/C 260M.
Products: MasterAir AE 90, MasterAir VR 10 or MasterAir AE 200 by BASF Corporation.
3. Water-Reducing Admixture: Shall conform to ASTM C 494/C 494M Type A.
Products: MasterPozzolith Series by BASF Corporation.
4. Mid-Range Water-Reducing Admixture: Shall conform to ASTM C 494/C 494M Type A.
Products: MasterPolyheed Series by BASF Corporation.
5. High-Range Water-Reducing Admixture: Shall conform to ASTM C 494/C 494M Type F [or ASTM C 1017/C 1017M Type I].
Products: MasterRheobuild 1000, MasterGlenium Series or PS 1466 by BASF Corporation.
6. Accelerating Admixture: Shall conform to ASTM C 494/C 494M Type C or E.
Products: MasterSet AC 534 or MasterSet FP 20 by BASF Corporation.
7. Retarding Admixture: Shall conform to ASTM C 494/C 494M Type B or D.
Products: MasterPozzolith Series or MasterSet DELVO Series by BASF Corporation.
8. Hydration Control Admixture: Shall conform to ASTM C 494/C 494M Type B or D.
Products: MasterSet DELVO Series by BASF Corporation.
9. Workability-Retaining Admixture: Shall conform to ASTM C 494/C 494M Type S. Shall retain concrete workability without affecting time of setting or early-age strength development.
Products: MasterSure Z 60 by BASF.
10. Corrosion-Inhibiting Admixture: Shall be a nominal 30 percent solution of calcium nitrite or an amine/ester-based organic corrosion-inhibiting admixture.
Products: MasterLife CI 30 or MasterLife CI 222 by BASF Corporation.
11. Shrinkage-Reducing Admixture: Shall conform to ASTM C 494/C 494M Type S.
Products: MasterLife SRA 20 or MasterLife CRA 007 by BASF Corporation.

CAST IN PLACE CONCRETE – AQUATIC

12. Alkali-Silica Reaction Inhibiting Admixture: Shall conform to ASTM C 494/C 494M Type S. Shall contain a nominal lithium nitrate content of 30 percent.
Products: MasterLife ASR 30 by BASF Corporation.
13. Coloring Admixture:
Products: MasterColor by BASF Corporation.
14. Other admixtures with approval from the Engineer.

- E. With Approval from the Engineer only: Supplementary Cementitious Materials (SCM):
1. The substitution of supplementary cementitious materials for cement shall be made on the basis of mass.
 2. Fly Ash: Shall conform to ASTM C 618.
 3. Slag Cement: Shall conform to ASTM C 989/C 989M.
 4. Silica Fume: Shall conform to ASTM C 1240.
Products: MasterLife SF 100 by BASF Corporation.
 5. Metakaolin: Shall conform to ASTM C 618, Class N.
Products: MetaMax by BASF Kaolin, part of BASF Corporation.

- F. With Approval from the Engineer only: Fibers:
1. Microsynthetic Fibers:
 - a. Shall conform to ASTM C 1116/C 1116M.
Products: "MasterFiber F or M" Series by BASF Corporation.
 2. Macrosynthetic Fibers:
 - a. Shall conform to ASTM C 1116/C 1116M.
Products: "MasterFiber MAC" Series by BASF Corporation.
 3. Steel Fibers:
 - a. Shall conform to ASTM A 820/A 820M.
Products: "MasterFiber FF or FS" Series by BASF Corporation.

Dosage of fibers for composite steel deck shall not be less than 4 lb/yd³ for macrosynthetic fibers and 25 lb/yd³ for steel fibers, as recommended in ANSI/SDI C - 2011

- G. Evaporation Reducer:
1. Shall be a monomolecular film-forming liquid for application to fresh concrete to prevent rapid drying of the surface.
 - a. Products:
MasterKure ER 50 by BASF Corporation
 2. Evaporation reducer shall not be used as a finishing aid.

2.2 CONCRETE QUALITY: The concrete shall be composed of Portland cement fine aggregate, coarse aggregate, and water, all as specified herein.

1. All concrete shall have air entrainment based on the maximum size coarse aggregate:

<u>Max. Size Aggregate</u>	<u>Total Air Percent</u>
1-1/2"	5.0% +/-1%

CAST IN PLACE CONCRETE – AQUATIC

3/4"

6.0% +/-1%

The concrete shall be homogenous, readily placeable and uniformly workable. The minimum cement content, maximum allowable water content, and minimum compressive strength of the various classes shall conform to the following:

Class of Concrete	Coarse Grade	Agg.	Maximum ratio	w/c	Min. Compressive Strength psi @ 28 days
A	1-4, 8		0.6		3,000
B	2-7		0.6		2,000
C	1-6		0.45		3,600
S	2-5		0.45		4,000
P	2-3		0.45		4,400
Pn	5-5S		0.48		4,000

The dry loose volume of coarse aggregate shall not exceed 0.82 cubic foot per cubic foot of finished concrete except in cases where the voids in the coarse aggregate as determined by standard test methods exceed 48 percent of the total dry loose volume. Where the voids exceed 48 percent of the total dry loose volume, the dry loose volume of coarse aggregate shall not exceed 0.85 cubic foot per cubic foot of finished concrete.

The net amount of water shall be the amount added at the mixer, plus the free water in the aggregate, and minus the absorption of the aggregate based on a thirty-minute absorption period. No allowance will be made for evaporation of water after batching.

- A. **Class Requirements:** Unless otherwise specified below or elsewhere in the plans or Special Provisions, all concrete is **Class A**. (Except for pneumatically placed concrete.) The following are maximum slumps and the class of concrete required for various types of construction. (Slump test prior to addition of plasticizer.)

<u>Type of Construction</u>	<u>Slump Inches Maximum</u>	<u>Class of Concrete</u>
Foundations	5	A
Slabs on Grade	4	A
Walks, decks	4	A
Wash Concrete / Rip Rap	5	B
Walls and Columns	3	C
Grade Beams, Piers	4	C
Retaining Walls	4	C
Manhole Fillets; Inlet Inverts	5	C
Structural Slabs & Beams	4	S
Concrete Paving	3	P

- B. **Characteristics of Mix:** Concrete shall be of such consistency as to insure the required workability and result in compact masses having dense, uniform surfaces. In cases where the characteristics of the aggregates are such that with the maximum allowable amount of water, the consistency requirements cannot be satisfied, additional aggregates, mineral filler or aggregates of a different character may be furnished to produce the desired results. If these materials are not provided, then the mix design will be modified to insure proper workability by adding additional cement. Concrete temperature shall not be less than 50 degrees F nor more than 90 degrees F.

In general, the consistency of the concrete mixtures shall be such that:

1. The mortar will cling to the coarse aggregate.
2. The aggregates will not segregate in the concrete when it is transported to the place of the deposit.
3. The concrete and mortar will show no free water when removed from the mixer.
4. The surface of the finished concrete will be free from a surface film of "laitance".

Any concrete mix failing to meet the above outlined consistency requirement, although meeting the slump requirements, will be considered unsatisfactory, and the mix shall be changed to correct such unsatisfactory conditions. In cases where the characteristics of the aggregates furnished are such that, with the maximum allowable amount of water, the specified slumps and consistency requirements are not met, aggregates of an improved grading must be furnished and the mix design must be modified to meet the slump and consistency requirements by adding either cement or mineral filler, or both, as may be necessary. In case mineral filler is used, the combined total quantity of mineral filler and fine aggregate passing the 100 mesh sieve shall not exceed twenty (20) percent of the weight of the fine aggregate.

It is the intent of these specifications to secure for every part of the work, and particularly so where the concrete is to be liquid-containing, concrete of homogeneous structure having the required strength and resistance to weathering, which is free of honeycomb, concealed voids or other defects, and which for the various structures and appurtenances shall develop the minimum compressive strengths as indicated in these specifications.

The minimum quantity of cement and mixing water shall be used that will safely produce concrete of the strength required, in order to minimize heat of hydration and shrinkage in the concrete.

PART 3 - EXECUTION

- 3.1 MIXING CONDITIONS: The concrete shall be mixed in quantities required for immediate use, and any concrete which is not in place within thirty (30) minutes after being discharged from the mixer shall not be used. Re-tempering of concrete will not be permitted. Concrete improperly mixed shall not be placed in the structure. Ready-mixed concrete will comply with the following requirements:
- A. Central mixed concrete shall be mixed completely in a stationary mixer and mixed concrete transported to the point of delivery in a truck agitator or in a truck mixer operating at agitator speed.
 - B. Shrink-mixed concrete shall be partially mixed in a stationary mixer, and the mixing completed in a truck mixer.
 - C. Transit-mixed concrete shall be completely mixed in a truck mixer.
 - D. Mixers and agitators shall be operated within the limits of capacity and speed of rotation as designated by the manufacturers.
 - E. When a stationary mixer is used for partial mixing of the concrete, the mixing time in the stationary mixer may be reduced to the minimum required to intermingle the ingredients (about 30 seconds).
 - F. When a truck mixer is used either for complete mixing or to finish partial mixing in a stationary mixer, each batch of concrete shall be mixed not less than 50 nor more than

CAST IN PLACE CONCRETE – AQUATIC

100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment as mixing speed. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed.

- G. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be completed within the time limits shown in the following table, after the introduction of the mixing water to the cement and aggregates, unless otherwise authorized by the Engineer.

TEMPERATURE-TIME REQUIREMENTS

Concrete Temperature (at point of placement)	Maximum Time (No retarding agent) Minutes	Maximum Time ¹ (With retarding agent) Minutes
	Non-Agitated Concrete	
All Temperature	30	45
	Agitated Concrete	
Above 90 degrees F.	45	75 ²
Above 75 degrees F through 90 degrees F	60	90
75 degrees F and below	90	120

¹Normal dosage of retarder

²Slump and concrete temperature can be maintained within longer limits when using retarding admixtures or hydration-control admixtures.

- H. All transit mix delivery tickets shall have the time of departure from the plant as well as water, cement, aggregates and admixture contents.
- I. Hand mixing of concrete will not be permitted.

3.2 FORM WORK: The Contractor shall provide forms that will produce correctly aligned concrete. The centering shall be true and rigid, and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry the dead weight of the concrete as a liquid without deflection, and tight enough to prevent leakage of mortar.

For exposed interior and exterior concrete surfaces of columns and walls, plywood or other approved forms, thoroughly cleaned and tied together with approved corrosion resistant devices shall be used.

Rigid care shall be exercised in seeing that all poured walls and columns are plumb and true and thoroughly cross-braced to keep them so.

Beveled strips shall be provided in form angles and in corners of column and beam boxes for chamfering of corners where shown on drawings or directed by the Engineer.

The inside of the forms shall be coated with an approved oil or thoroughly wetted. Oil shall be applied before reinforcement is placed.

Temporary openings for cleaning and inspection shall be provided at the base of vertical forms and other places where they are necessary.

Forms may be removed at the following minimum times.

CAST IN PLACE CONCRETE – AQUATIC

	*Over 95 degrees F	70-95 Degrees F	60-70 degrees F	50-60 degrees F	Below 50 degrees F
Walls	5 days	1 day	2 days	3 days	Do not remove
Columns	7 days	2 days	3 days	4 days	forms until site
Beam	10 days	4 days	5 days	6 days	cured test cylinder
Structural Slabs Over 5" thick	10 days	5 days	6 days	7 days	develops 50% of required compressive strength

*Where exposed surfaces of concrete can be effectively sealed to prevent loss of water, these times may be reduced to the 70-95 degrees F. time.

- A. **FORMING OF CHANNELS:** Forming for channels or gutters for pools or decks shall be true to plan dimension with parallel sides and ledges. Channel placed without parallel sides shall be removed and replaced per this specification. The use of polystyrene or polyurethane foam channel forms may be required by the Plans or Special Provisions. If so specified, the Contractor does not have the prerogative of substituting other methods. The foam forms shall be secured on grade so they are not dislodged or buoyed by placement of concrete.

3.2 DEPOSITING CONCRETE:

- A. Before placing concrete, thoroughly clean the forms of wood chips, shavings or other debris. Do not deposit concrete in standing water. Before placing new concrete on or against concrete which has acquired its initial set, retighten forms, roughen hardened surfaces, clean off foreign matter and laitance, and saturate with water. Immediately before depositing new concrete, coat the contact surface with neat cement grout.
- B. Concrete shall be deposited, when practicable, in its final position without segregation, rehandling, or flowing. When possible, concreting shall be continuous until the section is complete. Concrete shall be spaded and vibrated with approved mechanical vibrator to maximum subsidence, without segregation, and adjacent to forms and joints. When stoppage of concreting operations occurs for any reason, construction joints shall be placed either horizontally or vertically as needed, provided with keys to resist shear, and dowels to develop bond. Before concreting operations are resumed, the surface of the concrete shall be cut or chipped to remove all laitance and expose the aggregate.
- C. Water accumulating during placing shall be removed. Concrete shall not be deposited in such accumulations. Conveying and chuting of concrete shall be done only with equipment which will insure a continuous flow without segregation. Concrete without super plasticizer admixtures shall not be dropped more than five feet without a tremie or "elephant trunk". Super plasticized concrete may be dropped (free fall) from a height of 15 feet or less.
- D. In threatening weather, which may result in conditions that will adversely affect the quality of the concrete to be placed, the Engineer may order postponement of the work. Where work has been started and changes in weather conditions require protective measures to be used, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or damage due to freezing temperatures. No concrete shall be placed without the approval of the Engineer when air temperature is at or below 40 degrees F. (taken in the shade away from artificial heat) and falling. If authorized by the Engineer, concrete may be placed when the air temperature is at 35 degrees F. and rising.

CAST IN PLACE CONCRETE – AQUATIC

- E. Expansion/isolation joints shall be of the type and size shown on the plans. Saw joints shall be made in floor slabs wherever noted. The saw joints shall be 1/8 inch in width and 3/4" in depth minimum. The saw shall be carefully guided to produce straight lines without overcut beyond limits prescribed. Sawing shall commence immediately upon final set of the concrete when it can be done without raveling the green slab.
- F. Any areas designated on the plans for colored or coated floors shall be so treated in accordance with other Sections of these specifications and in accordance with the manufacturer's specifications as approved by the Engineer.
- G. **FINISH FOR SIDEWALK, DECKS, AND DRIVES:** Sidewalks, decks, and driveways will receive a light broom finish after leveling with a wooden float. Radius all exposed edges of slabs on grade. Unless otherwise shown on Plans, saw one-eighth inch wide by one inch joints on 15-foot centers each way before concrete is 48 hours old.
- H. **FINISH FOR WALLS, COLUMNS OR OTHER STRUCTURES:** If no other specific finish is shown, the contractor shall, immediately upon removal of forms, rub all exposed structural concrete with a grout mixture and stiff wire brush to fill honey combing, tie indentations, form marks or other surface imperfections and render a uniformly textured and colored surface.
- I. Unless they are to receive further treatment such as plaster, tile or paint coatings, walks, decks, floors and vertical surfaces shall be sprayed with an approved curing compound to retard evaporation of water if spraying is not objectionable because of subsequent finish. Curing operations shall begin as soon as the concrete has attained initial set. All materials and facilities for curing concrete shall be on hand and ready for use before concrete is placed. Concrete shall be protected from freezing temperatures for a minimum of five days after placement.
- J. Polyethylene vapor barrier, if shown on the plans, shall be 6 mil thickness, fungi resistant sheets fastened with adhesive backed polyethylene tape. Seal tightly against penetrations. Seal all punctures with tape before placing concrete.
- K. **TEST ON CONCRETE:** One set of three test cylinders shall be made by the Contractor for compressive strength tests performed by an approved independent testing laboratory (all at the expense of the Owner) for each thirty (30) cubic yard lot or a minimum of one set for each days pour. Slump tests shall be made on each batch tested in accordance with ASTM designation C-143. Each of the test cylinders shall be tested at 7 days and 28 days for compressive strength. The Contractor shall coordinate tests with the Owner's designated laboratory. The contractor shall code the cylinders and correlate the samples with specific concrete placements in a written log provided to the Engineer.

If the average strength of the laboratory control cylinders for any portion of the structure falls below compressive strength required for the design, the Engineer shall order further standard ASTM test procedures be performed at Contractor's expense upon concrete sections in question. Should these further tests indicate that any concrete does not meet the requirements of these specifications, the concrete shall be removed and replaced with acceptable concrete by the Contractor and at Contractor's expense.

Copies of reports of all tests shall be furnished to the Engineer and Contractor as soon as available.

Tests on concrete shall conform to the following applicable ASTM designations:

ASTM C-173 or C-231	Air Content of Freshly Mixed Concrete.
ASTM C-172	Standard Method of Sampling Fresh Concrete.
ASTM C-143	Standard Method of Slump Test.

ASTM C-39	Standard Method of Test for Compressive Strength of Molded Concrete Cylinders.
ASTM C-31	Standard Method of Making and Curing Concrete Compression and Flexure Test Specimen in the Field.

PART 4 – POST INSTALLATION

- 4.1 PROTECTION OF THE WORK: Protect the work from freezing, from rainfall, blowing dust or other natural hazards. The Contractor is responsible for protecting from acts of vandalism from the time concrete is placed until the project is completed and accepted by the Owner. Remove any graffiti or other defacing of concrete.
- 4.2 MEASUREMENT: The concrete quantities of the various classifications which constitute the completed and accepted structure will not be measured unless otherwise noted in the proposal, but will be considered as a part of the lump sum payment for the item constructed. If noted on the plans or in the Special Provisions measurement will be by the cubic yard in place or by square footage.
- 4.3 PAYMENT: All concrete shall be considered as a part of the lump sum price bid for the various items of construction. The lump sum price shall include full compensation for furnishing, hauling, and mixing all concrete materials; placing, curing, and finishing all concrete; all grouting and pointing; furnishing and placing all drains, forms, and falsework, labor, tools, equipment, and incidentals necessary to complete the work.

END OF SECTION 03 30 53

CITY OF DENTON
WAVE POOL

SECTION 03 37 19
PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

PART 1 - GENERAL

1.1

- A. Conditions of the Contract: The conditions of the Contract (General, Supplementary and other Conditions) and the General Requirements are hereby made a part of this Section. Protect the work of others before proceeding with shotcrete installation.
- B. Scope: This section shall govern the furnishing and placing of pneumatically placed concrete "gunite" or "shotcrete" for the pool shell. The term "Gunite" is an old trade name for a sand-cement mixture delivered by a compressed air device. The term "shotcrete" will be used herein and shall apply to the wet-process or the dry-process of pneumatically placed concrete.
- C. Processes: Wet process shotcreting, according to ACI 506R 05 shall be deemed to meet the requirements of this section. In some circumstances, conventional formed and placed concrete may be used with permission of the Engineer in writing. In order to acquire this approval, the contractor must provide details to scale for approval of the engineer showing placement of all joints, water stops, and deviations in the plan dimensions necessary to accommodate poured-in-place methods.

- 1.2 Cracking in concrete structures for aquatic structures shall be reported immediately to the Engineer.

PART 2 – PRODUCTS

- A. Materials:
 - 1) Cement: Portland Cement ASTM C 150, Type 1.
 - 2) Water: Potable fresh water shall be used for mixing as well as for curing. ASTM C1602.
 - 3) Normal Weight Aggregate: conforming to ASTM C 33 meeting the following gradation:

Sieve Size	Per Cent by Weight Passing
1/2"	100
3/8"	90-100
No. 4	70-85
No. 8	50-70
No. 16	35-55
No. 30	20-35
No. 50	8-20
No. 100	2-10

- B. Reinforcement: Bar reinforcement shall conform to the requirements of ASTM A615 and to Specification "Metal Reinforcement". Synthetic or glass fiber reinforcement if called for

PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

in Job Specifics or other special provisions to these specifications shall conform to ASTM C1116. If allowed, synthetic fiber shall be as specified in Section 03 30 53.

- C. Bar Chairs: Bar chairs shall be nylon chairs of the prescribed height with a horseshoe shaped clip to grasp the reinforcing steel and a nylon plate to bear on the soil. Steel 'spiders' are permitted if they are furnished with plastic bearing plates to prevent them from being pressed into the soil.
- D. Admixtures:
 - 1) Water reducing admixtures: Conforming to ASTM C1141.
 - 2) Air entraining admixtures: Meeting the requirements of ASTM C 1141.
 - 3) Products shall be as manufactured by BASF Corporation or equal.
- E. Fly ash or pozzolans (by permission of the engineer only): ASTM C618.

3. EXECUTION:

Experience: Crew foreman shall have demonstrated proficiency at all crew positions and a minimum of 3,000 hours as a nozzleman. Pneumatic concrete nozzle operator (gunman) shall have a minimum of 3,000 hours experience in pneumatic concrete installation as a nozzleman.

Conditions: No work shall be done without the permission of the Engineer when the temperature is lower than 40 degrees F. After placement, the concrete shall be protected from freezing or quick drying. ACI 305.1 Hot Weather Concreting and ACI 306.1 Cold Weather Concreting are incorporated into this section by reference. Do not apply shotcrete in standing water or during rain or when rain is forecast before the work can be completed.

Safety: All workmen shall be required to wear appropriate clothing, gloves, boots, eye and head protection on the work site. Protect skin from contact with cement. Contractor shall provide adequate ventilation in confined spaces to remove cement dust or mists.

- A. Proportioning and Mixing: Unless otherwise specified, the pneumatically placed concrete shall be proportioned as follows:
 - 1) Slump - Maximum 3 inches, minimum 1-1/2 inches at the pump.
 - 2) Cement - Seven 90 lb. bags per cubic yard (630 lbs. minimum)
 - 3) Compressive strength at 28 days: 4,000 psi (ASTM C 42).
 - 4) Air entrainment: 7% measured at the pump +/-1-1/2%

No water shall be added to the mix after mixing and before using the gun. Mixed material that has stood for 45 minutes without being used shall be rejected and no remixing or tempering will be permitted.

- B. Equipment:
 - 1) Equipment shall be used that is designed for wet shotcreting.
 - 2) Guns: Either pneumatic feed guns or positive displacement guns are permitted. Modified dry shotcrete equipment shall not be used.
 - 3) Compressor: The compressor shall maintain a supply of clean, oil-free air sufficient for delivering shotcrete at 105 scfm at 100 psi at the air ring for positive displacement blowers or as required by the size of the nozzle employed for pneumatic feed guns. Required capacity of compressor and operating pressures are shown in Table 2 for the various nozzle sizes. Steady pressure must be maintained throughout the placing process.

PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

Table 2 - Compressor Capacities			
Compressor Capacity	Hose Diameter	Maximum Size of Nozzle Tip	Operating Air Pressure Available
cu. ft. per Min.	Inches	Inches	psi
250	1	3/4	40
315	1-1/4	1	45
365	1-1/2	1-1/4	55
500	1-5/8	1-1/2	65
600	1-3/4	1-5/8	75
750	2	1-3/4	85

The values shown in Table 2 are based on a hose length of 150 ft. with the nozzle not more than 25 ft. above the delivery equipment. Operating pressures shall be increased approximately 5 psi for each additional 50 ft. of hose and approximately 5 psi for each 25 ft. the nozzle is raised.

- 4) Mixing equipment: Weight batching methodology shall comply with accuracy specified with ASTM C94. Ready-Mix trucks and on-site batch plants with a capacity of greater than nine cubic yards are permissible. Hand mixing will not be permitted.
- 5) Hoses: Material hoses shall be abrasion resistant, non-collapsible, and flexible designed for the operating pressures expected from the compressor. Hoses shall have safety chains or cables at couplings to prevent hose-end whipping if couplings break loose.
- 6) Nozzles: Nozzles shall be wet-mix nozzle design.
- C. Rebound: Rebound or segregated materials in the pool must be removed and not incorporated into the structure.
- D. Appurtenances: Contractor shall coordinate the installation of light niches, steps, anchors, sleeves, drains, and other appurtenances. These fixtures shall be set in as the concrete is placed or blocked in for later installation. Chipping out after the concrete is set shall not be allowed. The back side of all such appurtenances shall be encased or anchored in shotcrete at least the normal depth of the wall or floor thickness.
- E. Placing and Finishing:
 - 1) Surface preparation: Prepare surfaces to line and grade. Do not apply shotcrete to frozen surfaces. Before the concrete is placed the pool area shall be compacted uniformly and thoroughly and brought to a uniform moist condition.
 - 2) Reinforcement: Reinforcement shall be supported properly throughout placement of concrete using wire chairs or plastic chairs made for this purpose and tied such that displacement does not occur due to workmen walking on the mat or through gun nozzle pressure. Bar chair spacing shall not exceed 36 inches center to center each way.

Bars shall be held off the earth wall at least two inches clear distance.
 - 3) Grade and alignment: Pneumatically placed concrete shall be placed in accordance with the details and to the dimensions shown on the plans. Set taut wire or fine fishing line at the top inside edge of proposed finished wall and intermediate lines as necessary to control vertical faces and meet tolerances. Set taut wire at each grade break and at twenty foot centers each way across floor to insure proper slope and thickness. If wire cannot be used due to shape or changes in slope, set removable depth gage stakes on the floor of the pool for thickness control at no more than 20-foot spacing.

PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

- 4) Gun application: Hold the nozzle between 2-feet and 6-feet from the receiving surface and rotate in a small circular motion, never back and forth. Direct the nozzle as much as possible at an angle perpendicular to the receiving surface but never more than 45-degrees from the perpendicular. Shooting at an angle increases rebound. Proper consistency shall be controlled at the nozzle valve by the operator and a low water-cement ratio must be maintained. The application of concrete through the nozzle shall be in uniform layers free of sand lenses or other inconsistencies. Areas too dry or too sandy shall be scooped from the pool immediately.

The mixture shall be wet enough that it does not cling to the front (gun side) of the reinforcing steel bar but rather clings to the rear of the bar and does not allow voids, shadows or sand pockets behind the bar.

For wall thicknesses greater than 6-inches, begin walls at the bottom, thoroughly encasing the reinforcing steel for the full thickness of the wall and then working up the wall holding the nozzle at 45-degree downward angle or less while maintaining a 45-degree inclined bench. The mix shall be sufficiently dry so that it will not sag or fall from vertical or inclined surfaces or separate in horizontal work.

Shoot corners first to build up shotcrete in the corners and then work away from the corners preventing a buildup of rebound or overspray.

The original surface and each surface which is permitted to harden before applying succeeding layers shall be washed with water and air blast or a stiff hose stream, and loosened material removed. Sand which rebounds and does not fall clear of the work or which collects on horizontal surfaces shall be blown off from time to time to avoid leaving sand pockets. Concrete shall not be applied to a surface containing frost or ice. Where standing or running water is encountered it shall be removed before applying the concrete.

- 5) Shaping: Shaping shall be by removal only with a hand tool. No shovel maneuvering or hand placement to 'build up' shotcrete will be permitted.
- 5) Construction joints: When it is necessary to stop work in one area for an extended period of time (e.g., overnight for a large project), stop the shotcrete edge on a one-to-one slope and do not smooth the surface. Shooting may resume the next day on the sloped edge.
- 6) Waterstops: Where flexible waterstops are required on the plans, secure the edges of the waterstop with wire to the reinforcing steel cage so that the waterstop cannot be deflected over by the force of the shotcrete gun.
- 7) Finishes: The placed concrete shall be struck off with a screed or float to an even line, grade and smooth radius. The surfaces of the pneumatically placed concrete shall be given a coarse brush finish to insure proper plaster bonding before the concrete has obtained its initial set.

The pool is to receive a paint finish. The final surface must be smooth and without voids. After screeding and initial set, shoot a wet 1/4-inch flash coat with sand aggregate and no coarse aggregate applied at low volume from 8-feet to 12-feet away from the surface. Use a rubber float to finish the surface. Form lines, pin or bug holes, tie wires holes and other imperfections shall be rubbed out from the surface.

F. Tolerances:

- 1) Floors: Floors shall be placed to the depths, lines and dimensions shown on the plans plus or minus 1-inch. Floors shown to be planar shall not vary more than (+/-)1/4-inch from a 10-foot straight edge.
- 2) Walls: Tolerances for pool dimensions shall be maintained as follows.

PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

	Course Length	Top 36" below water end walls	Variance between length all lanes
Club Level (Default)	+/-1"	No more than 1/2" from plumb	+/- 1/2"
Competition Level (If noted)	+ 1/2"	No more than 1/4" from plumb	+ 1/4"
Playground or playpools (free form)	Plan: +/- 2" variation from plan dimension in any direction.		
Walls:	Not more than 10° from vertical.		
Accessible Ramps; zero depth entries	Slopes may not exceed 1:12; landings not more than 1/4" per foot slope.		
Steps/stairs	Not more than 1/2" from riser height shown on plans; treads must be level side to side and front to back within 1/4"		
Diving wells	There shall be no incursion into the required diving well envelope at all.		
NOTE: In laying out pool concrete dimensions allow 3/8-inch for plaster thickness on each end if plaster finish is specified.			

- G. Curing: Immediately following the finishing operation, the shell shall be cured by frequent moisture application using misting spray nozzles for a period of not less than 7 days from completion of concrete placement. Maintain an air temperature over the surface of 40 degrees F. or higher during curing. Soaker hoses, wet mats or misters are acceptable for this purpose. Curing compounds which could interfere with the bonding of paint, plaster or other finishes may not be used.
- H. Testing: If required by the Owner; the Contractor shall prepare 24-inch square by 5-1/2-inch deep plywood backed forms in which the concrete placement crews shall "shoot" concrete representative of the mix being placed into the pool shell. Test slabs for pneumatically placed concrete shall be shot with the same air pressure and nozzle tips as the pneumatically placed concrete. One slab shall be cast at the end of the first hour and then one more slab every three (3) hours of shooting thereafter each day of the operation. Concrete slabs shall be allowed to set for 24 hours and then transported to the laboratory. The Contractor shall code mark the individual slabs and correlate in a log the location in the pool which each coded slab represents. This log shall be forwarded to the Engineer following the concrete placement.
The Contractor shall have the slabs picked up by its testing laboratory which, in turn, shall moisture cure the slabs and cut cores from the slabs. Test two cores each for compressive strength at 7, 14, and 28 days (a total of six (6) breaks per test slab) in accordance with ASTM testing procedures. Keep the slab for an additional 60 days after the last set of cylinders are broken.
- I. Acceptable Testing Results: The average of all concrete cores tested from any one test slab shall have a minimum compressive strength of 4,000 psi at 28 days. Should the average of 28-day old core breaks fall more than five (5) percent below the 4,000 psi required at 28 days, the Contractor, at his own expense, shall core that part of the in-place shell represented by the failing cores and identified by the Engineer in accordance with ASTM C42. One core shall be cut and tested for each 500 square foot of pool bottom slab area affected but not less than four (4) cores. The cores shall be taken in locations

PNEUMATICALLY APPLIED CONCRETE FOR SWIMMING POOLS (SHOTCRETE)

including floors and walls directed by the Engineer distributed across the area of the pool. If these field cores break at an average compressive strength of 4,000 psi (even though the cores have aged more than 28 days since placement) they shall be presumed to meet strength requirements herein.

PART 4 – POST CONSTRUCTION

- A. **REMEDICATION:** Pools or portions of the pool including wall, steps, floors and ramps, failing to meet compressive strengths, finishes, or dimensional requirements specified shall be removed to the limits determined by the Engineer and replaced, all at the expense of the Contractor. No additional compensation will be due the Contractor for lost time or other incidental damage to tile, pipe, skimmers, gutters or other appurtenances caused by the tear out and replacement.
- B. **MEASUREMENT:** The concrete quantities of the various classifications which constitute the completed and accepted structure will not be measured unless otherwise noted in the proposal, but will be considered as a part of the lump sum payment for the item constructed. If noted on the plans or in the Special Provisions measurement will be by the cubic yard in place.
- C. **PAYMENT:** All concrete shall be considered as a part of the lump sum price bid for the various items of construction. The lump sum price shall include full compensation for furnishing, hauling, and mixing all concrete materials; placing, curing, and finishing all concrete; all grouting and pointing; furnishing and placing all drains, forms, and falsework, labor, tools, equipment, and incidentals necessary to complete the work.

END OF SECTION 03 37 19

CITY OF DENTON
WAVE POOL

**SECTION 03 50 00
SWIMMING POOL DECKS**

PART 1 - GENERAL

- 1.1 This section shall govern the furnishing of all labor, materials, tools, plant, performing all operations required to install all cast-in-place concrete and reinforcing steel for swimming pool decks as indicated on the Plans and its placement in the work.
- 1.2 Install concrete substrate without the addition of calcium chloride in any form. Air entraining admixtures and water reducing agents are acceptable but no other additives are permitted.
- 1.3 Refer to Section 03 30 53 for additional information.

PART 2 – PRODUCTS

2.0 BACKING RODS

- A. **Oakum and Rope Fiber** - hand-picked, free of oil and grease.
- B. **Foam Plastic** - backer rod similar to Sonneborn's pre-mounded polyurethane "Sonofoam".

2.1 CAULKING SEALANTS

- A. **Primer** - as recommended by caulking compound manufacturer.
- B. **Polysulfide Polymer Sealant** - Thiokol, meeting Fed. Spec. TT-S-00230, liquid, single component (noted "Sealant" on Drawings).
- C. **Butyl Caulking** - "Weatherban" by 3M Co. (noted "caulking" on Drawings).
- D. **Polyurethane Sealant** - Tremco Vulkem 116 for immersion or deck service.

Equal products to those listed above as manufactured by 3M Co., G.E. Thiokol Co., DeWitt, Pecora, Tremco, Sonneborne as acceptable. Submit products in writing for approval before installing. Colors to be selected by Owner

2.2 DRAINS:

- A. **PREFABRICATED EXTRUDED PLASTIC:** Deck drainage, where shown, shall be U-shaped channel with cover, interlocking section with end caps, complete with top heel proof grating with anchoring and locking devices.

Flowmaster 3 Commercial
Stegmeier Corp
1111 West Harris Rd
Arlington, Tx 76001
800.382.5430

Color to be selected by Owner from stock three (3) standard colors. Contractor to submit color charts for the Owner's selection.

- B. **PREFABRICATED FIBER REINFORCED PLASTIC:** Trench drains for the beach entry shall be bolt-together sections of FRP plastic.

Grating for trench drain shall be:

Polymer (GPM) Grating – Style #2 12” gross width
 Natare Corporation
 5905 West 74th Street
 Indianapolis, Indiana 46278
 800.336.8828

Furnish with Lawson Aquatics FRP 12” wide (9” clear span) x 17” deep prefabricated trench gutter. Gel coated interior. Drop out nozzles per plan. Color to be white.

- 2.3a STENCIL FINISH: Not used on this project.
- 2.3b ACRYLIC EMULSION COATING: Not used on this project.
- 2.3c CEMENTITIOUS FLOOR AND DECK COATING: Not used on this project.

PART 3 – EXECUTION

3.0 Deck concrete shall be Class ‘A’ and decks will receive a light broom finish after leveling with a wooden float. Radius all exposed edges of slabs on grade with a ½-inch radius edge tool. Unless otherwise shown on Plans, saw one-eighth inch wide by one inch joints on 15-foot centers each way before concrete is 48 hours old.

3.1 DECK DRAINAGE:

A. PREFABRICATED TRENCH DRAIN: Manufacturer shall furnish drawings and written instructions. Contractor shall abide by written instructions of the manufacturer. Grade is crucial; allow no birdbaths or hollows. Use installation chairs or brackets to brace the channel on line and grade during concrete deck installation. Note that flotation can occur if the channels are not adequately prevented from floating. Finish deck neatly to the edge of the preformed drain and remove excess concrete. The concrete deck shall match perfectly along both sides of the full length of the drain trench. Slope grating to match pool or deck cross slopes.

Run all buried plumbing lines and fittings as per plans. Refer to plans for size and type.

Protect all completed work. Store and protect all equipment in original shipping containers. Seal over drain grating during deck coating and painting operations. Clean cement or paint from completed drains. Clean all debris from drain channel and flush pipes.

B. CAST IN PLACE TRENCH: Not used on this project.

3.2 STENCIL APPLICATION: Not used on this project

3.3 CAULKING

- A. All joints shall be carefully cleaned of all dust, oil, grease, water frost, or other materials which would impair or prevent sealing.
- B. Prime joints using primer recommended by sealant manufacturer.
- C. Sub-caulk back sealant with oakum or yarn (except for fillet joints) for general use. Back control joints, expansion joints and joints requiring sealant with foam plastic.
- D. Weather - Do not caulk during damp or inclement weather. Temperature of air and materials shall be above 40 degrees F.

- E. **FILLER:** Joints and spaces deeper than 3/4" shall be filled with back up material to within 3/4" of surface before caulking.
- F. **BACK-UP:** Back up material shall be compressed to 50% of its original volume at time of installation to provide a positive contact between all surfaces. Thicknesses of back up material shall be adjusted with size of joint.
- G. **APPLICATION:** Apply caulking compound with pressure gun having correct size nozzle to fit into joint. Fill solidly and smooth without voids and thin edges, and in a manner to prevent air entrapment. Finish joint shall show a neat clean bead. Do not overfill or crown joints.
- H. **TIMING:** All caulking shall be done a minimum of 3 weeks in advance of painting.
- I. **WORKMANSHIP:** Use proper size nozzle on caulking gun. Force joint full, and neatly point surface with beading tool and leave smooth and water tight. Remove excess materials and clean adjacent surfaces immediately. Strictly follow printed directions of sealant manufacturer. In general, the depth of sealant joint shall be one-half its width. Carefully control depth with foam plastic and prevent bond with back of joint.
- J. **TYPE OF CAULKING OR SEALANT TO USE:** Use Thiokol or Tremco urethane where joint is exposed directly to water with no or little protection and where "sealant" is noted on the Drawings. Use butyl for general use where joint is well protected from elements or appreciable quantities of moisture.
- K. **FIELD CONTROL:** Cure as recommended by the manufacturer. Protect from foot traffic or rolling equipment.
 - 1. Visually inspect joints after 30 days.
 - 2. Replace joints with evidence of bonding failure, excessive shrinkage, cracking, pitting or improper cutting.
- L. **CLEAN UP:** Upon completion of the work, all caulking and sealing compounds shall be removed from surrounding areas and all joints checked for water tightness and touched up as required.

PART 4 – PAYMENT/CLOSE OUT

- 4.1 **WARRANTY:** The manufacturer shall provide a one year unconditional warranty against all defects in workmanship and materials for a period of one year from shipment in the manufacture of these components. This warranty is in addition to the Contractor's warranty provided under this contract.
- 4.2 **WARRANTY:** The surface shall not delaminate or significantly or unevenly fade or discolor. The finish shall be subject to the project warranty against defects in labor and materials for a period of one (1) year from date of final acceptance of the total project by the owner. Should re-finishing be required within the one year warranty period due to defects in the original installation, the warranty shall be extended for one (1) year from the date of completion of the repair work
- 4.3 **PAYMENT:** Unless specific pay items are provided in the forms of proposal, the installation of concrete deck is to be considered subsidiary to other pay items.

Payment under this section shall include protection of other work, clean up, and protection of the work when completed.

END OF SECTION 03 50 00

CITY OF DENTON
WAVE POOL

**SECTION 03 62 13
NON-SHRINK GROUT**

PART 1 – GENERAL

1.1 Summary

- A. This section shall govern the furnishing of all labor, materials, tools, performing all operations required to install all non-shrink grout as indicated on the plans and its placement in the work. Work includes:
 - 1. Non-shrink grout around wall penetrations.
 - 2. Non-shrink grout under base plates.
 - 3. Grouting swimming pool floor and wall fittings and drain boxes.
- B. The Contractor shall be responsible for the installation and execution of works described in the performance specification

PART 2 – PRODUCTS

2.1 Non-Shrink Grouts

- A. BASF MASTERFLOW 713 PLUS. High-precision nonshrink mineral-aggregate grout

BASF Construction Chemical, LLC-Building Systems
889 Valley Park Drive
Shakopee, MN, 55379
800-243-6739
- B. SikaGrout 212

Sika Corporation
201 Polito Avenue
Lyndhurst, NJ, 07071
201-933-8800
- C. Other Non-Shrink Grouts may be approved by the Project Engineer that meet the following specification.
 - 1. 28 Day compressive strength: 7,500 psi (52 MPa)
 - 2. The grout when tested in accordance to ASTM C- 827 shall not exceed shrinkage of 1%
 - 3. The Non-shrink grout shall conform to ASTM C- 1107

PART 3 – EXECUTION

3.1 Surface Preparation

- A. Steel surfaces must be free of dirt, oil, grease, or other contaminants.
- B. The surface to be grouted must be clean, saturated surface-dry (SSD), strong, and

TBC# 01.15116.00
2016-08-01

roughened to a CSP of 5 – 9 following ICRI Guideline 03732 to permit proper bond. For freshly placed concrete, consider using a bonding agent to achieve the required surface profile.

- C. When dynamic, shear or tensile forces are anticipated, concrete surfaces should be chipped with a “chisel-point” hammer, to a roughness of (plus or minus) 3/8" (10 mm). Verify the absence of bruising following ICRI Guideline 03732.
- D. Concrete surfaces should be saturated (ponded) with clean water for 24 hours just before grouting.
- E. All freestanding water must be removed from the work surface immediately before grouting.
- F. Anchor-bolt holes must be grouted and sufficiently set before the major portion of the grout is placed.

3.2 Forming

- A. Forms should be liquid tight and nonabsorbent. Seal forms with putty, sealant, caulk, or polyurethane foam as necessary.
- B. Moderately sized equipment should utilize a head form sloped at 45 degrees to enhance the grout placement. A moveable head box may provide additional head at minimum cost.
- C. Side and end forms should be a minimum 1" (25 mm) distant horizontally from the object grouted to permit expulsion of air and any remaining saturation water as the grout is placed.
- D. Leave a minimum of 2" (51 mm) between the bearing plate and the form to allow for ease of placement.
- E. Use sufficient bracing to prevent the grout from leaking or the forms from moving.
- F. Eliminate large, non-supported grout areas wherever possible.
- G. Extend forms a minimum of 1" (25 mm) higher than the bottom of the equipment being grouted.

3.3 Temperature

- A. For nonshrink grouting, store and mix grout to produce the desired mixed-grout temperature based upon ambient temperatures and jobsite conditions.

Recommended Temperature Guidelines for Nonshrink Grouting

	MINIMUM °F(°C)	MAXIMUM °F(°C)
Foundation and plates	50 (10)	80 (26)
Mixing water	50 (10)	80 (26)
Grout at mixed and placed temperature	50 (10)	80 (26)

- B. When grouting at minimum temperatures, see that foundation, plate, and grout

temperatures do not fall below 50° F (10° C) until after final set. Protect the grout from freezing (32° F or 0° C) until it has attained a compressive strength of 3,000 psi (20.7MPa) in accordance with ASTM C 109

3.4 Mixing

- A. Place estimated water into the mixer (use potable water only), then slowly add the dry grout.
- B. The water demand will depend on mixing efficiency and material and the ambient temperature. Use the minimum amount of water required to achieve the necessary placement consistency. Recommended flow is 25 – 30 seconds or greater using the ASTM C 939 Flow-Cone Method. Before placing grout at ambient temperatures below 50° F (10° C) and above 80° F (26° C)
- C. Moderate size batches of grout are best mixed in one or more clean mortar mixers.
- D. Mix grout a minimum of 3 minutes after all material and water are in the mixer.
- E. Do not mix more grout than can be placed in approximately 10 minutes or less, depending on ambient temperatures.
- F. Transport by wheelbarrow or buckets or pump to the equipment being grouted. Minimize the transporting distance.
- G. Do not retemper grout by adding water.
- H. For aggregate extension guidelines, refer to Appendix MB-10: Guide to Cementitious Grouting.

3.5 Application

- A. Place Non-Shrink Grout in a continuous pour. Discard grout that becomes unworkable. Make sure that the grout fills the entire space being grouted and remains in contact with the plate throughout the entire grouting process.
- B. Immediately after placement, trim the surfaces with a trowel and cover the exposed grout with clean wet rags. Keep the rags wet for 5 – 6 hours.
- C. The grout should offer stiff resistance to penetration with a pointed mason's trowel before the grout forms are removed or excessive grout is cut back.
- D. To further minimize the potential moisture loss within the grout, cure all exposed grout with an approved membrane curing compound (compliant with ASTM C 309 or preferably ASTM C 1315) immediately after the wet rags are removed.
- E. DO NOT VIBRATE GROUT. Steel straps inserted under the plate may be used to help move the grout.
- F. Do not place lifts more than 6" (152 mm) in depth.

3.6 Safety

- A. Product is alkaline on contact with water and may cause injury to skin or eyes. Ingestion or inhalation of dust may cause irritation.

- B. Avoid contact with skin, eyes and clothing. Prevent inhalation of dust and wash thoroughly after handling. In case of eye contact flush thoroughly with water for at least 15 minutes. In case of skin contact, wash affected areas with soap and water. If any irritation persists, seek medical attention immediately.

PART 4 – PAYMENT/CLOSE OUT

- 4.1 WARRANTY: The contractor shall provide a one year unconditional warranty against all defects in workmanship and materials for a period of one year from shipment in the manufacture of these components. This warranty is in addition to the Contractor's warranty provided under this contract.
- 4.2 WARRANTY: The finish shall be subject to the project warranty against defects in labor and materials for a period of one (1) year from date of final acceptance of the total project by the owner. Should re-finishing be required within the one year warranty period due to defects in the original installation, the warranty shall be extended for one (1) year from the date of completion of the repair work
- 4.3 PAYMENT: Non-Shrink grout is considered subsidiary to other bid items and no separate measurement or payment is to be made.

Payment under this section shall include protection of other work, clean up, and protection of the work when completed.

END OF SECTION 03 62 13

CITY OF DENTON
WAVE POOL

SECTION 04 20 00
CONCRETE MASONRY & MANUFACTURED STONE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete Block.
- B. Manufactured Stone Masonry Units
- C. Mortar and Grout.
- D. Reinforcement and Anchorage.
- E. Flashings.
- F. Lintels and shelf angles.
- G. Accessories.

1.02 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2013.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- H. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.

1.03 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
- B. Samples: Submit four samples of stone units to illustrate color, texture, and extremes of color range.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- D. Confirmation submittal indicating strength of concrete masonry units.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.04 MOCK-UP (Not required)**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS**2.01 CONCRETE MASONRY UNITS - STANDARD UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
 1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
 2. Load-Bearing Units: ASTM C 90, lightweight, minimum compressive strength f'm 1500 psi.
 - a. Hollow block, as indicated.

2.02 MANUFACTURED STONE MASONRY UNITS: PRESSURE FORMED

- A. Product: Eldorado Stone (www.eldoradostone.com) Country Rubble
- B. Color: To be selected. Provide actual samples for color selection
- C. Natural stone substitution: If the contractor desires to use natural stone the Owner may approve a natural stone veneer product as opposed to the manufactured stone. Provide samples of the stone for approval.

2.03 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I.
 1. For Typical Mortar and Masonry Grout: Gray
 2. For Mortar at Face Brick and Pigmented Mortar: White
 3. Hydrated Lime: ASTM C207, Type S.
 4. Grout Aggregate: ASTM C404.
 5. Mortar Aggregate: ASTM C144
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979. C. Water: Clean and potable.
- D. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
 1. Manufacturers:
 - a. Tamms: Product, Hyddralite Plus
 - b. Sonneborn Building Products: Product: Hydrocite Powder
 - c. W.R. Grace: Product: Dry-Block
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
 1. Dur-O-Wal: www.dur-o-wal.com.
 2. Hohmann & Barnard, Inc: www.h-b.com.
 3. Masonry Reinforcing Corp. of America: www.wirebond.com.

4. Substitutions: See Div 00 - General Requirements.
- B. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; galvanized finish.
- C. Single Wythe Joint Reinforcement: Ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
 1. Manufacturers:
 - a. Dur-O-Wal; Product D/A 3100 - Truss: www.dur-o-wal.com.
 - b. Hohmann & Barnard, Inc; Product 120 Truss-Mesh: www.h-b.com.
 - c. Masonry Reinforcing Corporation of America; Product Series 300 -Truss: www.wirebond.com.
 - d. Substitutions: See Div 00 - General Requirements.
- D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 2. Wire ties: Triangular shape, 0.1875 inch thick.
 3. Vertical adjustment: Not less than 3-1/2 inches.
 4. Manufacturers:
 - a. Hohmann & Barnard, Inc; Product DW-10 Vee Wall Tie: www.h-b.com.
 - b. Masonry Reinforcing Corporation of America; Product Type III Anchor: www.wirebond.com.
 - c. Substitutions: See Div 00 - General Requirements.

2.05 FLASHINGS

- A. Flashing: Through-wall and flexible flashing as specified in Section 07 2500 and 07 6200. B. Copper/Glass Fabric Flashing: 3 oz/sq ft copper sheet bonded to fiber reinforced asphalt treated glass fabric. Provide Copper Fabric Flashing by York Manufacturing, Inc., www.yorkmfg.com
- C. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; with cross laminated polyethylene top and bottom surfaces.
 1. Manufacturers:
 - a. Dur-O-Wall; Product Dur-O-Barrier.
 - b. Protecto Wrap, Product: Protecto Flash Building Tape.

2.06 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyurethane;; oversized 50 percent to joint width; self expanding; 1/2 inch wide x by maximum lengths available.
- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Advanced Building Products Inc: www.advancedflashing.com.
 - 2) Mortar Net USA, Ltd: www.mortarnet.com.
 - 3) Substitutions: See Div 00 - General Requirements.
- D. Weeps: Polyester mesh or polypropylene honeycomb 1. Manufacturers:

- a. Mortar Net Solutions; Mortar Net Weep Vents None - N/A: www.mortarnet.com.
 - b. Dur-O-Wall.
 - c. Hoffman & Barnard
- E. Cavity Vents: Polyester mesh or polypropylene honeycomb.
- 1. Manufacturers:
 - a. Dur-O-Wall.
 - b. Hoffman & Barnard.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 CONTROL AND EXPANSION JOINTS

- A. Control Joint Spacing: If location of control joints is not shown, place vertical joints spaced not to exceed 20'-0" for CMU walls and 30'-0" for brick walls. Confirm location(s) with Architect prior to placement. See details for typical location of joints at masonry walls intersections and pilasters.

2.08 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
- 1. Exterior, loadbearing masonry: Type N.
 - 2. Exterior, non-loadbearing masonry: Type N.
 - 3. Masonry below grade and in contact with earth: Type S.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio. Use white cement only with pigments.
- C. Moisture-Resistant Admixture: Add to exterior mortar mix according to manufacturer's instructions. Provide uniform mix.
- D. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.
- F. Mix mortar fresh, in quantities immediately required.
- G. Do not use anti-freeze compounds to lower freezing point of mortar.
- H. Retemper only as required to restore required consistency.
- I. Retempering not allowed after mortar has begun to set.
- J. Use no mortar beyond 2-1/2 hours after mixing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave. D. Brick Units:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally above through-wall flashing. B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

3.09 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar. B. Extend metal flashings to within 1/4 inch of exterior face of masonry.
- C. Extend laminated flashings to within 1/4 inch of exterior face of masonry.
- D. Lap end joints of flashings at least 6 inches and seal watertight with flashing sealant/adhesive.
- E. Where flashing terminates within a wall, create a flashing dam at end of flashing to direct flow of water to exterior face of wall. No water should be able to flow toward the inside of the exterior wall.

3.10 LINTELS AND SHELF ANGLES

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
 - 2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
 - 3. Openings over 78 inches: Reinforce openings as detailed.
 - 4. Do not splice reinforcing bars.
 - 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 - 6. Place and consolidate grout fill without displacing reinforcing.
 - 7. Allow masonry lintels to attain specified strength before removing temporary supports. C. Maintain minimum 8 inch bearing on each side of opening.
- D. Install shelf angles per project documents.
- E. Butt joints of shelf angles shall be kept clean of mortar.

3.11 GROUTED COMPONENTS

- A. Reinforce bond beams with 2, No. 4 bars, 1 inch from bottom web.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.

- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.12 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Size control joints as indicated on drawings; if not shown, 3/4 inch wide and deep.
- D. Expansion joints shall be 1" in brick veneer and CMU and kept clean of mortar and reinforcing.
- E. Control joints shall be 3/8" and kept clean of mortar.

3.13 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.14 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: 1/8 inch in 3 ft.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.15 CUTTING AND FITTING

- A. Cut and fit for pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.
- B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67 requirements, sampling 5 randomly chosen units for each 50,000 installed.
- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.17 CLEANING

- A. Remove excess mortar and mortar droppings.

- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.18 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated.
- B. Work in this section includes rough carpentry for: (a) Wood grounds, nailers and blocking, (b) Wood framing, (c) Wood columns and beams, (d) Sheathing and decking of wood or on wood framing, (e) Subflooring, (f) Underlayment, and (g) Telephone equipment backboards.

PART 2 - PRODUCTS

2.1 PRODUCT HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels so that air circulates within and around stacks and panels.
- B. Trusses for the project shall be shop fabricated pre-engineered wood trusses. Designs shall be furnished with submittals. Designs shall be signed and sealed by licensed professional engineer for the truss manufacturer.

2.2 LUMBER, GENERAL

- A. Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review. UNLESS OTHERWISE SHOWN ON THE PLANS OR IN SPECIAL PROVISIONS:
 - 1. Framing: Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20. Provide dressed lumber, S4S, unless otherwise indicated, Southern Yellow Pine (SYP) or Douglas Fir (DF) No. 1 Grade unless noted otherwise.
 - a. Provide seasoned lumber with 15% maximum moisture content at time of dressing and shipment.
 - b. Provide prefabricated, pre-engineered trusses.
 - c. No. 2 acceptable for studs within walls and for blocking.
 - 2. Sheathing:
 - a. INSULATING SHEATHING: 1" Owens Corning R-5 Formular styrene insulation over the structural sheathing, or approved equal.
 - b. STRUCTURAL SHEATHING: Use full exterior wall, sill plate to top plate. $\frac{3}{4}$ " nominal plywood, CDX-APA, SYP or DF.
 - c. Tyvek Commercial Wrap by Dupont over all wall exteriors and under finishes.
 - 3. Exterior Fascia and Trim: Hardie Trim as shown on drawings.
 - 4. Interior Ceilings: $\frac{5}{8}$ " gypsum drywall. Tape, bed, paint.
 - 5. Interior Siding (non kitchen: closets, surrounding freezer/cooler): $\frac{1}{2}$ " gypsum drywall. Tape, bed and paint.
 - 6. Kitchen interior siding: Marlite standard white textured FRP board over drywall. Seam covers.

ROUGH CARPENTRY

7. Columns, Sign Posts, Roof Nailers, Roof Cants, Wood in Contact With Concrete, Outdoor Benches, Wood Decks and Trellises: 0.40 CCA pressure treated wolmanized pine.
8. Roof Decking: 3/4-inch CDX exterior tongue and groove plywood sheets.
9. Exterior Ceilings, Soffits: Perforated Hardie Soffit.
10. Exterior Siding: Horizontally installed Hardie Plank Select Cedar Mill; textured. Trim with Hardie Trim.
11. Interior cove base: Hardie Trim. 1 x 6 nominal.

2.3 GROUNDS, BLOCKING AND NAILERS

- A. Provide permanent grounds and wood blocking as required for attachment of wood trim, grilles and registers, light fixtures, plumbing fixtures, cabinet work, shelving and other items requiring grounds or nailers to provide a solid means of attachment. Shim as required to form a true line. Fasten securely in place as required by the weight of the item being installed and as required by loads reasonably expected to be superimposed on the item.
- B. Provide truss braces, both diagonal and horizontal. Refer truss manufacturer for locations.

2.4 MISCELLANEOUS ANCHORS

- A. Provide metal wall nailing plugs for nailing wood trim, grounds, etc. to masonry not shown to be bolted or otherwise attached.
- B. Provide all anchors, bolts, screws, nails, expansion bolts, rem-set fasteners, toggle bolts, and other fasteners as detailed or as required to draw members into place and hold them securely.
- C. Provide bolts for attaching wood to wood, wood to masonry, wood to concrete, and wood to steel. Size and spacing, if not otherwise shown, shall be as follows:
 1. Wood to wood: 1/2" machine or carriage bolts, 2'-0" o.c.
 2. Wood to masonry: 1/2" X 8" machine bolts, 2'-8" o.c.
 3. Wood to concrete: 1/2" X 8" machine bolts, 4'-0" o.c.
 4. Wood to steel: 1/2" machine or carriage bolts, 3'-0" o.c.

2.5 WOOD FRAMING

- A. All framing shall be as specified, closely fitted and accurately set in accordance with the best practices in construction, all to the required line and levels.
- B. Bottom plates shall be securely fastened to concrete with Hilti, Red Top or equal galvanized drilled-in expansion anchors on 24 inch centers full perimeter of the building.
- C. Studs shall be nominal 2 x 6 No. 2 SYP or Fir spaced at 16 inch centers unless otherwise shown on the Drawings. Provide blocking and nailers for the installation of work of other trades. Double studs at openings, double and block all corners. Provide one line of horizontal bridging 2" X stud width at approximate mid-height of partitions and walls and at horizontal joints in wall board materials.
- D. Top plates members shall be nominal 2 x 6 No. 2 SYP or Fir or better. Use double plates for load bearing walls and partitions and single plates for non-

ROUGH CARPENTRY

load bearing, unless otherwise shown on the Drawings. Stagger butt joints in double plates.

- E. Joists shall be spaced at 16" centers unless otherwise shown. Provide cross-bridging of 1" X 4" or solid bridging of same size as joists for joist spans greater than 7'-0".

2.6 PLYWOOD

- A. Plan work to minimize cut pieces. In decks and ceilings, stagger joints in 48-inch x 96-inch sheets along the long side by 50%. Support all free edges with 2"x framing or joists. Nail sheets not to exceed 16-inch C-C in each direction.

2.7 DRYWALL CEILINGS AND WALLS

- A. Plan work to minimize cut pieces. Stagger butt joints in adjacent boards by 2'-0" minimum with no discernible pattern.
- B. Tape, bed and paint.

2.8 MATERIALS

- A. Blocking at roof elevation, such as (a) nailers for sheet metal flashing, gravel guards, fascias, and gutter and (b) curbs around roof penetrations, and any other place shown on the Drawings shall be preservative pressure treated.
- B. Studs shall be No. 2 or better SYP, coast region Douglas fir or stud grade pine.
- C. Top and bottom plates shall be No. 2 Southern yellow pine. Bottom plates shall be wolmanized.
- D. Rafters, Girders, Beams, Joists: No. 1 SYP or better.

END SECTION 06 10 00

CITY OF DENTON
WAVE POOL

SECTION 07 16 14
ACRYLIC MODIFIED (FLEXIBLE) CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish all labor, materials, tools and equipment as necessary to perform Acrylic Latex Modified Cement Waterproofing on new and existing structures as shown on drawings and as specified in this section.
- B. Waterproof the interior walls and floor of:
 - a. Surge tanks, balance tanks and equalization tanks.
 - b. Cast in place trenches or sumps.
- B. Related Sections:
 - 1. See Section 03 30 53 - Cast-in-Place Concrete - Aquatic

1.2 SUBMITTALS

- A. General:
Submit manufacturer's certification that proposed materials, details and systems as indicated and specified fully comply with manufacturer's details and specifications. If any portion of Contract Documents does not conform to manufacturer's standard recommendations, submit notification of portions of design that are at variance with manufacturer's specifications.
- B. Product Data: Submit manufacturer's literature and installation instructions for each product.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store in a dry area between 40°F (5°C) and 90°F (32°C). Handle and protect from freezing and direct sun light in accordance with manufacturer's instructions.
- B. Deliver materials in manufacturer's unopened containers, fully identified with brand, type, grade, class and all other qualifying information. Provide Material Safety Data Sheets for each product.
- C. Take necessary precautions to keep products clean, dry and free of damage.

1.4 SYSTEM REQUIREMENTS

- A. Coordinate waterproofing installation with other trades.
- B. Provide materials and accessories in timely manner so as not to delay Work.

1.5 PROJECT CONDITIONS

- A. Maintain surfaces to be waterproofed and surrounding air temperature at not less than 40°F (5°C). Apply only when temperatures are steady or rising. Provide shade to protect from hot sun.
- B. Do not apply materials to frozen or frost-filled surfaces.

ACRYLIC MODIFIED (FLEXIBLE) CEMENTITIOUS WATERPROOFING

- C. Exercise caution when temperatures exceed 90°F (32°C).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers: AQUAFIN, Inc. 505 Blue Ball Road, #160. Elkton, MD, 21921. Phone (866) 278-2346, or (410) 392-2300, Fax (410) 392-2324; e-mail info@aquafin.net.
- B. Requests for substitutions will be considered only if submitted to the architect/engineer in writing and must include substantiation of product performance, 10 days prior to the original bid date.

2.2 MATERIALS

- A. Waterproofing Material - Acrylic Modified Cement Waterproofing: Cementitious, two-component, acrylic emulsion based, highly flexible, crack bridging waterproof membrane barrier against positive water pressure, with the following characteristics:

1. Product: AQUAFIN-2K/M
2. Color: Gray or white
3. Dry Component-A: Precise blend of cementitious material
4. Liquid Component-B: White acrylic emulsion and admixtures
5. Working Time: Approximately 45 minutes
6. Shore A Hardness: (ASTM D-2240) ~ 85
7. VOC: 0 g/L
8. Flammability: (ASTM E-108) Class A – Spread of Flame - Passed
9. Bond/Adhesion: (ASTM C-321) 215 psi (1.5 MPa) @ 28 days
10. Tensile Strength: (ASTM C-412) 600 psi (4.1 MPa) @ 28 days @ 80 mils
11. Elongation: (%) 70 (gray); 40 (white) at 68°F
12. Static crack bridging capacity: 1/16-inch (gray) (1.5 mm)
13. Vapor Permeability: (ASTM E-96) 1.4 perms at 3/32" (2.4 mm) thickness
14. Waterproofing: (CRD C 48-92) Withstands 200 psi = 460 feet (14 bar = 140 m) hydrostatic pressure (positive side) at 3/32" (2.4 mm) thickness.

Note: Approved custom color of AQUAFIN 2K/M shall be provided and based upon a paint sample chip color by Architect.

2.3 ACCESSORY MATERIALS

- A. Patching Compound: Pre-blended, cementitious structural waterproofing and repair mortar recommended or approved by waterproofing manufacturer for patching honeycombs, installing coves, etc.

1. Product: AQUAFIN MORTAR-LN or MORTAR-40
2. Color: Gray
3. Aggregate: Powder
4. Compressive Strength: (ASTM C-109) 6000 psi (41.3 MPa) @ 28 days
5. Flexural Strength: (ASTM C-348) 1160 psi (8.0 MPa) @ 28 days

- B. Crack and static joint sealing tape: Elastomeric, tear resistant, breathable waterproofing tape.

1. Product: AQUAFIN JOINT SEALING TAPE-2000
2. Thickness: approx. 14 mils (0.35 mm)
3. Width: 4.75" (120 mm) or 8" (200 mm)
4. Elongation: 60%

ACRYLIC MODIFIED (FLEXIBLE) CEMENTITIOUS WATERPROOFING

5. Tear Strength: 725 psi (5.0 MPa)
- C. One-component Waterproofing Material for negative side water pressure in combination with two component. Waterproofing Material with the following characteristics:
 1. Product: AQUAFIN-1K
 2. Color: Gray
 3. Aggregate: Powder
 4. Compressive Strength: (ASTM C-109) 4000 psi (27.6 MPa) @ 28 days
 5. Flexural Strength: (ASTM C-348) 440 psi (3 MPa) @ 28 days
 6. Bond/Adhesion: (ASTM C-321) 220 psi (1.5 MPa) @ 28 days
 7. Vapor Permeability: (US Perms) 8 (ASTM E-96) (control = 10)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all construction substrates and conditions under which waterproofing materials are to be installed. Do not proceed with the waterproofing application until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Substrate preparation:
 1. Remove oil, grease, dirt, loose particles, remains of form oils, water repellents, rust or other coatings by high-pressure water blasting (>3000 psi), wet or dry sand blasting, or other mechanical means to produce surface profile ICRI CSP 3 to 5 for application of waterproofing.
 2. Follow manufacturer's instructions to clean and prepare surfaces and seal cracks and joints.
 3. Voids in concrete substrates: 1/4-inch (6 mm) diameter and larger, pre-treat with patching compound. Less than 1/4-inch (6 mm) diameter can be filled with a scratch coat of one component waterproofing material.
- C. Rinse surfaces to be waterproofed (excluding drywall or similar) with clean water to saturated surface dry (SSD) condition, with no standing water on horizontal surfaces.

3.3 INSTALLATION

- A. Mix two-component waterproofing material in proportions recommended by manufacturer.
- B. Cavity fill, honeycombs & form tie holes:
 1. Fill voids at cleaned and prepared faulty construction joints, cracks, formtie holes, etc. with patching compound in mortar consistency flush to surface.
 2. Laminate patching compound in 2 to 3 layers as per manufacturer's instructions for larger spalled or honeycombed areas. (penetration).
- C. Positive Side Waterproofing: Apply two-component waterproofing material in quantities and number of coats as per manufacturer's specifications and recommendations:

ACRYLIC MODIFIED (FLEXIBLE) CEMENTITIOUS WATERPROOFING

1. Apply at 60 mils or 1/16" (1.5 mm) total thickness for all standard applications (i.e. foot traffic, balconies (non-tiled), etc.) and waterproofing up to 13 ft (4.0 m) water head.
 2. Apply at 80 - 90 mils (2.0 - 2.4 mm) total thickness for applications exposed to hydrostatic pressure (>13 ft (>4.0 m) water head), under tiles, plaza decks, etc.
- D. Surface Finish:
1. Surface finish shall be standard (regular) two-component waterproofing material finish.
- E. Negative Side Waterproofing: Follow manufacturer's specifications and instructions for below grade structures (i.e. water and waste water tanks, swimming pools and gutters, basement and retaining walls) where infiltration from ground water is expected:
1. Apply 1st (base) coat one-component waterproofing material at 60 mils (1.6 mm) thickness
 2. After 24 hrs waiting period, apply 2nd (top) coat two-component waterproofing material at 60 mils (1.6 mils) as soon as base coat has reached initial set.
- F. Application considerations:
1. Apply, using stainless steel trowel, tampico brush, short nap roller, or appropriate compressed-air spray equipment.
 2. Apply only when surface and ambient temperatures are 40°F (5°C) and rising. At high temperatures (i.e. 86°F (30°C) and above) protect application from direct sun and wind to prevent premature surface drying and shrinkage cracks. Apply material in two coats minimum.
 3. Application thickness shall not exceed 1/8-inch (120 mils (3 mm)).
 4. If needed, such as in zones posed to movement or cracking, plaza decks, etc., the waterproofing material can be additionally reinforced with a reinforcing mesh (supplied by waterproofing manufacturer), embedded between two waterproofing layers.
 5. Do not bridge cracks greater than 1/16-inch (1.5 mm).
 6. Bridge dynamic cracks or joints with elastomeric joint sealing tape, as supplied by waterproofing manufacturer.
 7. Do not overcoat waterproofing material with solvent-based materials.
 8. Where a uniform color is desired (i.e. balconies, walkways, etc.), application of an elastomeric paint or water based acrylic stain is recommended.
 9. Prime and protect alkali sensitive metals such as copper, aluminum, galvanized or zinc treated metal first with a primer, before over-coating with waterproofing material. Follow manufacturer's recommendations for primer material.

3.4 CURING

- A. Follow manufacturer's general instructions for curing and hardening of waterproofing material. Do not use water for curing. Waterproofing material is self-curing.
- B. Protect surfaces from rain, frost and premature dehydration.

ACRYLIC MODIFIED (FLEXIBLE) CEMENTITIOUS WATERPROOFING

3.5 TESTING OF WATER INCLUDING STRUCTURES

- A. Following application and completion of related work, as required, but well prior to completion of entire project, fill tanks to capacity and allow to stand not less than 3 days. Fill larger structures at a uniform rate not greater than 6.5 feet (2 m) in 24 hours. The temperature of the fill water shall be plus or minus 10 degrees F of the ambient air and/or the tank structure at the time of filling. Extreme caution is urged if the temperature is greater than 10 degree F. Should leakage occur after this period, drain tanks to perform repairs. Notify Owner prior to draining tanks.

3.6 ACCEPTANCE

- A. Remove left over materials and any foreign material resulting from the work from the site.
- B. Clean adjacent surfaces and materials.

END OF SECTION 07 16 14

CITY OF DENTON
WAVE POOL

**SECTION 07 21 00
BATT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Unfaced Batt insulation in all new interior walls.
- B. Batt insulation and vapor retarder above gypsum board ceilings.
- C. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- D. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

- A. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- B. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- C. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. SEE DIV 00 - GENERAL REQUIREMENTS.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.05 SEQUENCING

- A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

- A. Batt Insulation for interior walls: ASTM C 665; preformed glass fiber batt; conforming to the following:
 - 1. Thickness: 3 1/2" or 6" inch.
 - 2. Facing: Unfaced.
 - 3. Manufacturer: Owens-Corning.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACCESSORIES

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in interior and exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- F. Tape seal tears or cuts in vapor retarder.
- G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.03 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

3.04 SCHEDULES

- A. Stud Framed Exterior Wall Insulation: 6 inch fiberglass batts with integral vapor barrier.
- B. Stud Framed Interior Wall Insulation: 3-1/2 or 6 inch fiberglass batts.
- C. Framed Ceiling Insulation Above Gypsum Board: 6 inch fiberglass batts with integral vapor barrier.

END OF SECTION

CITY OF DENTON
WAVE POOL

SECTION 07 41 00
PREFORMED METAL STANDING SEAM ROOFING
(non-structural)

PART 1 - GENERAL 1.01 DESCRIPTION OF WORK

- A. This section covers the pre-fabricated Architectural galvalume standing seam roof system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.
- B. Scope includes roofing over concession building and over pool mechanical.

1.02 SUMMARY

- 1. Section Includes Factory formed Standing Seam metal roof panels.
- 2. Trim, downspouts, and accessories

1.03 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight roofing system. B.

References:

- 1. American Society for Testing and Materials (ASTM)
 - a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
 - b. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
 - c. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
 - d. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
- 2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - a. SMACNA Architectural Sheet Metal Manual, 1993 edition
- 3. American Iron and Steel Institute (AISI)
 - a. AISI Cold Formed Steel Design Manual
- 4. Aluminum Association
 - a. Aluminum Design Manual
- 5. Metal Construction Association
 - a. Preformed metal Wall Guidelines
- 6. Code References
 - a. ASCE, Minimum Loads for Buildings and Other Structures
 - b. BOCA National Building Codes
 - c. UBC Uniform Building Code
 - d. SBC Standard Building Code

1.04 QUALITY ASSURANCE

- A. Petersen Aluminum Corp, Tyler, TX, 800-441-8661 products establish a minimum of quality required.
- B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
- C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.05 SUBSTITUTIONS

- A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.06 SYSTEM DESCRIPTION

A. Material to comply with ASTM A792/A792M Standard Specification for Sheet Steel, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip process

1.07 ROOF SYSTEM PERFORMANCE TESTING

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.
- B. Roof System shall be designed to meet Standard Building Code Wind Load requirements.
- C. Panels to meet:
 - 1. Water Penetration: When tested per ASTM E-283/1680 and ASTM E-331/1646 there shall be no uncontrolled water penetration or air infiltration through the panel joints.
 - 2. Roof System shall be designed to meet a UL Class 90 wind uplift in accordance with UL standard 580 and panel system shall be ASTM 1592 Tested and approved 3. UL 2218 - Impact Resistance rated

1.08 WARRANTIES

- A. Weathertight warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period. Warranty Period: 20 Years from date of Substantial Completion
- B. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace standing seam metal roof panels that show evidence of deterioration of factory-applied finish within specified warranty period.
 - 1. Exposed Panels Finish - deterioration includes the following:
 - a. Color fading more than 5 hunter units when tested according to ASTM D 2244
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
 - c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal. 2. Warranty Period: 20 Years from the date of substantial completion
- C. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition.

1.09 SUBMITTALS

- A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation. B. Provide finish samples of all colors specified.
- C. Shop drawings: Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
- D. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved:
 - 1. Roof panels and attachments
 - 2. Metal trusses, bracings and supports
 - 3. Roof-mounted items including snow guards and items mounted on roof curbs.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.

PREFORMED METAL STANDING SEAM ROOFING

- B. Deliver components, sheets, metal roof panels and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- C. Unload, store and erect metal roof panels in a manner to prevent bending, warping, twisting and surface damage.
- D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.
- E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.11 PROJECT CONDITIONS

- A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.12 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, walls and other adjoining work to provide a leakproof, secure and noncorrosive installation.

PART 2 - PRODUCTS 2.01 PANEL DESIGN

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates and accessories required for a weathertight installation.
- B. Roof panels shall be standing seam Tite-Loc Plus in 18" widths with 2" high seams that are mechanically seamed together @ 180 degrees.
- C. Panels to be produced with Factory supplied hot melt mastic in the seams.
- D. Panels to be produced Smooth - Factory Standard.
- E. Panels to be designed for attachment with concealed fastener clips, spaced as required by the manufacturer to provide for both positive and negative design loads, while allowing for the expansion and contraction of the entire roof system resulting from variations in temperature.
- F. Forming: Use continuous end rolling method. No end laps on panels. No portable rollforming machines will be permitted on this project, no installer-owned or installer-rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.

2.02 ACCEPTABLE MANUFACTURERS

- A. This project is detailed around the roofing product of Petersen Aluminum Corporation Petersen Aluminum Corp, Tyler, TX, 800-441-8661, Tite-Loc Plus.

2.03 MATERIALS AND FINISHES

- A. Preformed roofing panels shall be fabricated of 22 GA Steel
- B. Color shall be *Standard Pac-Clad Finish

PREFORMED METAL STANDING SEAM ROOFING

- C. Finish shall be Galvalume
- D. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
- E. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
- F. Closures: use composition or metal profiled closures at the top of each elevation to close ends of the panels. Metal closures to be made in the same material and finish as face sheet.
- G. Fasteners: Fasteners shall be of Stainless Steel of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.
- H. Substrate shall be Plywood
- I. Roofing Underlayment
 1. On all surfaces to be covered with roofing material, furnish and install a 40 mil "Peel & Stick membrane", required as outlined by metal panel manufacturer. Membrane to be a minimum of 40 mil thickness, smooth, non-granular, by one of the following manufacturers: a. W.R Grace "Ice & water Shield"
 2. Underlayment shall be laid in horizontal layers with joints lapped toward the eaves a minimum of 6", and well secured along laps and at ends as necessary to properly hold the felt in place. All underlayment shall be preserved unbroken and whole.
 3. Ice and Water Shield shall lap all hips and ridges at least 12" to form double thickness and shall be lapped 6" over the metal of any valley or built-in gutters and shall be installed as required by the Standing Seam Panel Manufacturer to attain the desired 20 Year Weathertightness Warranty.
- J. Sealants
 1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
 2. one part polysulfide not containing pitch or phenolic extenders or
 3. Exterior grade silicone sealant recommended by roofing manufacturer or
 4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.04 FABRICATION

- A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.
- B. Fabricate components of the system in factory, ready for field assembly.
- C. Fabricate components and assemble units to comply with fire performance requirements specified.
- D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.

PART 3 - EXECUTION 3.01 INSPECTION

- A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
- B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FASTENERS

- A. Secure units to supports
- B. Place fasteners as indicated in manufacturer's standards.

3.03 INSTALLATION

- A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.
- B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
- C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

3.04 DAMAGED MATERIAL

- A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

CITY OF DENTON
WAVE POOL

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors.
- E. Sound-rated steel doors and frames.
- F. Steel glazing frames.
- G. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

- A. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- G. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2011.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014. (ANSI/BHMA A156.115)
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).
- L. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- M. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2013.
- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2006.
- O. NAAMM HMMA 865 - Guide Specifications for Sound Control Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2013.

- P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.
- R. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- S. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- U. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
 - 2. Ceco Door Products.
 - 3. Republic Doors: www.republicdoor.com.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/us.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Door Top Closures: Flush with top of faces and edges.
 - 3. Door Edge Profile: Beveled on both edges.
 - 4. Glazed Lights: None.
 - 5. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.

HOLLOW METAL DOORS AND FRAMES

6. Galvanizing for all units: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness
 7. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

- A. Exterior Doors:
1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 1 - Full Flush.
 2. Thickness: 1-3/4 inch.
 3. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 4. Texture: Smooth faces.
 5. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363. B. Interior Doors, Non-Fire-Rated:
 1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 1 - Full Flush.
 2. Thickness: 1-3/4 inch. C. Interior Doors, Fire-Rated:
 1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 1 - Full Flush.
 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
 - a. Provide units listed and labeled by UL (Underwriters Laboratories) - UL (BMD).
 - b. Attach fire rating label to each fire rated unit.
 3. Thickness: 1-3/4 inch.
- B. Interior Doors, Sound-Rated:
1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 2 - Seamless.
 2. Acoustic Rating of Assembled Door, Frame, and Seals: STC of 35, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 3. Sound Seals: Integral, concealed in door and/or frame.
 4. Force to Open and Close and Latch: Not more than 5 lbs. F. Panels: Same construction, performance, and finish as doors.

2.04 STEEL FRAMES

- A. General:
1. Comply with the requirements of grade specified for corresponding door.
 2. Finish: Factory primed, for field finishing.
 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
 5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
 6. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- B. Exterior Door Frames: Fully welded.

HOLLOW METAL DOORS AND FRAMES

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvan-nealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 2. Weatherstripping: Separate, see Section 08 71 00.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
1. Terminated Stops: Provide at all interior doors; closed end stop terminated 6 inches above floor at 45 degree angle.

2.05 ACCESSORY MATERIALS

- A. Louvers: None
- B. Glazing: None
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Double Doors:
1. Exterior Doors: Steel, Z-shaped.
- E. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- F. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- G. Hardware:
- a Provide 1-1/2 pair heavy duty ball bearing hinges per door.
 - b Provide brushed stainless steel push pull plates all exterior.
 - c Provide brushed stainless steel keyed/thumblatch Best Lock core dead bolt lock on exterior door.
 - d Provide commercial door closer for exterior door
 - e Provide brushed stainless steel non-locking passage lever type lockset on closet door.
 - f Provide stainless keepers, strikes, and floor mounted door stops,

2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating. Color: As selected by Engineer from manufacturer's standard range.
- C. Finish Coating: Refer to painting sections of these specifications.

PART 3 EXECUTION 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.

HOLLOW METAL DOORS AND FRAMES

- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

- A. Provide nominal 3'-0" wide by 7'-0" high by 1-3/4" commercial hollow metal doors.
- B. Provide frame wrap rabbeted hollow metal door frames.

END OF SECTION

CITY OF DENTON

WAVE POOL

SECTION 08 56 59**SERVICE WINDOW UNITS****PART 1 GENERAL 1.01 SECTION INCLUDES**

- A. Horizontal sliding/automatic closing service window units.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Furnish Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Furnish framing, jambs and headers.
- C. Furnish flashing for watertight installation.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- E. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate work with adjacent materials specified in other sections and as indicated on drawings and approved shop drawings.
- B. Coordinate framing rough in openings.
- C. Provide submittals.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for specified products indicating materials, operation, glazing, finishes, and installation instructions. C. Samples for Selection of Finishes:
- B. Installer qualification data.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience, with ability to provide test reports showing that their standard manufactured products meet the specified requirements.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units in manufacturer's original packaging and unopened containers with identification labels intact.
- B. Store units in area protected from exposure to weather and vandalism.

1.08 WARRANTY

- A. Provide manufacturer's warranty agreeing to repair or replace units and their components that fail in materials or workmanship within two years from Date of Substantial Completion.

PART 2 PRODUCTS 2.01 SERVICE AND TELLER WINDOW UNITS

- A. Service Windows
 - 1. Location: Exterior.
 - 2. Window: Horizontal Sliding/self closing.
 - a. Size: As indicated on drawings.
 - b. Material: Aluminum.
 - c. Finish: Natural anodized.
 - d. Finish Color: As selected from manufacturer's standard colors.
 - 3. Glazing: Insulating, clear.
 - 4. Products:
 - a. Easi-Serv In-Line Side Slider SS Series www.easi-serv.com.
 - b. Manufacturer's installation accessories.
 - c. Model SS-3 47 1/2" unit width, 36" unit height; verify before framing rough openings.

2.02 COMPONENTS

- A. Windows: Factory-fabricated, -finished, and -glazed, extruded aluminum frame and glazing stops; complete with hardware and anchors.
 - 1. Provide window units that are re-glazable.
 - 2. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline, and weatherproof. Fully weld corners.
 - 3. Apply factory finish to all exposed surfaces.
 - 4. Apply bituminous paint to concealed metal surfaces in contact with cementitious or dissimilar materials.
 - 5. Wind Design: Design and size components to withstand dead loads and live loads caused by pressure and negative wind loads acting normal to plane of window as calculated in accordance with applicable code.

2.03 MATERIALS

- A. Aluminum Extrusions: Minimum 1/8 inch thick frame and sash material complying with ASTM B221 and ASTM B221M.
 - 1. Finish: Class I natural anodized.
- B. Monolithic Glass: Fully tempered float glass; minimum 1/4 inch thickness.
 - 1. Low-E coating.
 - 2. Tint: Clear.
- C. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.04 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

- B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

2.05 ACCESSORIES

- 1. Manufacturer's standard installation accessories.

PART 3 EXECUTION 3.01 EXAMINATION

- A. Verify that window openings are ready for installation of windows.
- B. Verify that correct embedded anchors are in place and in proper location; repair or replace anchors as required to achieve satisfactory installation.
- C. Notify Engineer if conditions are not suitable for installation of units; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install units in correct orientation (inside/outside or secure/non-secure).
- C. Anchor units securely in manner so as to achieve performance specified.
- D. Set sill members and sill flashing in continuous bead of sealant.
- E. Separate metal members from concrete and masonry using bituminous paint or with products recommended in writing by the manufacturer for this purpose.

3.03 ADJUSTING

- A. Adjust operating components for smooth operation while also maintaining a secure, weather-tight enclosure and a tight fit at the contact points; lubricate operating hardware.

3.04 CLEANING AND PROTECTION

- A. Remove protective material from factory finished surfaces.
- B. Clean exposed surfaces promptly after installation without damaging finishes.
- C. Remove and replace defective work.
- D. Provide temporary protection to ensure that security windows are without damage upon date of Substantial Completion.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain operable units.
 - 1. Instructor: Manufacturer's training personnel.
 - 2. Location: At project site.
 - 3. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

CITY OF DENTON
WAVE POOL

**SECTION 09 25 13
POOL PLASTER (EXPOSED AGGREGATE FINISH)
ALTERNATE BID**

PART 1 - GENERAL

1.1 SUMMARY

- A. This section governs furnishing and installing all labor, materials, equipment, and superintendence for installing an exposed aggregate plaster top coat to gunite or cast in place concrete pool shell. Prepare surfaces to receive plaster, apply coat(s) and clean up removing all surplus material from the site.
- B. Submittals: Provide submittals for pool plaster, bonding agents and aggregates (if specified) in accordance with the General Provisions and Section 131100 of these specifications.
- C. MEASUREMENT AND PAYMENT: Pool plastering is considered subsidiary to other swimming pool bid items and no separate measurement or payment is to be made.
- D. Scope: Under Alternate Bid, in lieu of painted surfaces, install aggregate plaster finish as follows:
 - a. Entire floor up to the low side of the gutter trench.
 - b. Up the walls and face of caisson to 6 inches below static water line elevation
 - c. Install under this item a glazed water line tile in 6" x 6" frost proof swimming pool waterline tile equal to National or Daltile. The wall waterline tile shall extend from the top of the plaster (6" below static water level) to 6" above static water level. A non-glazed 2" x 2" tile shall extend continuously along the trench gutter and terminate at the water line tile on the adjacent walls to form an edge of the plaster.
 - d. The areas above the water line tile and on the beach shall be coated with AquaBright as specified under the base bid. Recess concrete 3/8" to receive tile to transition to paint in walls and floors.
 - e. Required stripes at depth changes shall be 4" wide made of the 2" x 2" mosaic tiles.

PART 2 - PRODUCTS

- A. Use only commercially manufactured plaster designated by the manufacturer for swimming pool and fountain use. Use only clean sharp sand and aggregates. Acceptable exposed aggregate products are:
 - PebbleFina
Pebble Technology Intl.
15540 North 77th Street
Scottsdale, AZ 85260
800.937.5058
- B. Use only unopened bags of new product.
- C. Use a mechanical mixer designed for mixing plaster and aggregates.
- D. Wind screens as necessary to keep wind-borne debris from marring the fresh plaster surface.
- E. **Color shall be selected by Owner.**

POOL PLASTER (EXPOSED AGGREGATE FINISH)

- F. Bonding agent surface preparation required for all surfaces to receive plaster.
 - Bond Kote
 - Southern Grouts and Mortars, Inc.
 - 1502 2nd Place
 - Pompano Beach, FL 33069-3220
 - 800.641.9247
- G. Tile:
 - a. Waterline tile: National Pool Tile glazed ceramic 6 x 6 nominal tile in Deco series.
 - b. Stripes, targets, gutter trim tile: Daltile or equal 2 x 2 unglazed Keystone series tile.

PART 3 - EXECUTION

- A. Preparation:
 - 1. Allow new concrete to cure for 28 days before applying plaster. The plasterer shall make final inspection of the pool shell prior to plastering and shall notify the pool subcontractor of any visible defects.
 - 2. The pool subcontractor is responsible for providing a sound structural shell.
 - 3. Use SGM Bond-Kote bonding agent or equal over entire concrete shell.
- B. PRECAUTIONS:
 - 1. Contractor shall erect wind screens as necessary to keep wind-borne debris from marring the fresh plaster surface.
 - 2. Do not plaster on windy days when winds exceed, on average 20 mph or gusts exceed 30 mph.
 - 3. Do not plaster when wind-borne debris, smoke, or insects are present regardless of wind conditions.
 - 4. Do not plaster when rain is falling or forecast to fall before the pool can be filled.
 - 5. Do not use wheeled type vacuum heads for at least fourteen (14) days after installation nor automatic vacuums for at least twenty-eight (28) days.
 - 6. Do not plaster while temperatures are at 95 degrees F and above or 35 degrees F or lower. Protect plaster from rapid drying or freezing.
- C. PLASTER MIX: Use only unopened bags of new product as specified under materials. Mix coating materials, to provide consistent color throughout. Do not add admixtures or any other product inconsistent with the plaster materials. Use a mechanical mixer in good operating condition designed for mixing plaster and aggregates.
- D. Apply plaster per manufacturer's instructions.
- E. FILLING: Allow plaster to air dry before filling begins.
- F. "Bathtub" ring stains or water stains may occur if water is turned off even for a brief period of time during the initial filling of the pool or if water is allowed to run over the

POOL PLASTER (EXPOSED AGGREGATE FINISH)

newly plastered surface before the water level has reached that spot. Water shall not be stopped until the pool is full. Water shall not be sprayed on or be allowed to run over newly plastered surfaces.

- G. Plaster shall not be wet down during filling. This could cause washout and water marks. Fill hoses shall be placed in the deep end of the pool and shall have the nozzle end covered with a clean soft cloth.
- H. The pool shall be filled within twenty-four (24) hours or other period of time per the plasterer's recommendations with Engineer's concurrence. DO NOT PLASTER UNTIL THE POOL CAN BE FILLED AND FILTER EQUIPMENT STARTED.
- I. Brush down after filling twice each day for 3 days and once per day for 2 weeks thereafter. This shall be the responsibility of the pool contractor until all turbidity is removed from the pool water.
- J. Thickness:
 - 1. Plaster shall be sufficiently thick to hold water (watertight) and sufficiently thick to hold a smooth, maintainable surface, but not less thickness than 3/8-inch in any location except where feathering to match another surface (tile, etc.) is necessary.
 - 2. The pool shall not leak. Plaster shall be sufficiently thick to hold water (watertight).
 - 3. Plasterer shall be responsible for leaks around all plumbing lines that are in contact with plaster and shall properly pack and seal around all lines, light niches, etc., excluding excessive voids.

PART 4 - POST CONSTRUCTION

- A. PLASTER FINISH:
 - 1. Plaster shall follow the general contour of the concrete shell. Absolute minimum thickness shall be 3/8-inch. Slight variations and waves may occur and will be accentuated if the underlying concrete shell is uneven. The plasterer shall use a trowel that is sufficiently long enough to even out most variations. DO NOT over-trowel or trowel burn the surface by hard troweling a dry surface to achieve finish. Fill all voids in concrete surfaces.
 - 2. Trim tile, tile feature strips, mosaics, plumbing lines, air bars, in-floor cleaners, light niches, etc., shall be set by previous subtrades as evenly and level as possible. The plasterer shall match the plaster to these items in a workmanlike manner. Protect work of previous trades.
 - 3. Plaster shall be finished smooth.
 - 4. Where exposed aggregate finishes are specified, grind or wash the surface smooth to reveal the aggregate faces in accordance with manufacturer's instructions and using recommended equipment.

POOL PLASTER (EXPOSED AGGREGATE FINISH)

B. ETCHING, SURFACE SPALLING, SKINNING OR PEELING:

1. The plasterer shall be responsible for damage due to deficiencies within the plasterer's control. These include problems from within the plaster mix (cement, aggregate, and admixtures not sufficiently mixed; impurities and foreign objects in the mix (i.e., bugs, leaves, dirt, etc.) and application defects (i.e., trowel marks, foot prints, etc.).
2. The integrity of the plaster surface shall remain intact (free from surface spalling, skinning, or peeling).
3. Plaster shall not separate or delaminate from the underlying substrata. Voids or hollow areas that have not cracked open or broken loose are considered a failure and shall be repaired.
4. Plasterer shall repair any shrinkage cracks or pop-off areas that are reported to him during his warranty period.

C. STAINS / DISCOLORATION IN PLASTER:

1. Plaster shall be generally a uniform shade of color, subject to normal cement/plaster mottling and shading. Extreme variations in color due to mix or mixing technique are unacceptable and discolored batches shall be discarded and not applied.
2. Plaster is a hand-troweled, cement product. Slight variations in shading (including shadowing, streaking, and minimal discoloration) are a normal occurrence and are not considered a deficiency. Significant variations, i.e., significant in the opinion of the pool consultant, are not acceptable and may require removal at Owner's option.

D. WARRANTY

1. In addition to any general warranty by the pool subcontractor or general contractor, the plaster installer warrants his work to be free of workmanship in labor or materials for a period of one year from date pool filling commences. Any defects in plaster work detected during this warranty period shall be communicated directly to the general contractor who shall see to the repair or replacement of plaster by his subcontractors at no expense to the Owner. This warranty shall exist regardless of other warranties expressed by manufacturers of plaster products.

END SECTION 09 25 13

CITY OF DENTON
WAVE POOL

SECTION 09 91 00
PAINTING & STAINING

PART 1 - GENERAL

- 1.1 SUMMARY: The work to be performed under this section of the Specifications shall consist of furnishing all labor, materials, scaffolding, ladders, and equipment necessary for painting pumps, exposed pipe, valves and fittings, hangers, supports, electrical conduits, metal work, structural steel, wood siding, wood trim and miscellaneous wood, concrete masonry, concrete pool walls and floors, drywall, doors, etc., as specified herein or noted on the plans.
- A. No painting shall be done below 45 degrees F. or be done in high moisture weather.
 - B. In all cases, paints and coatings shall be applied according to manufacturer's recommendations including coverage in square feet per gallon of paint or stain product.
 - C. Painting found defective shall be removed and the surface repainted as directed by the Engineer. Touch up paint for factory painted equipment.
 - D. Paint for surfaces shall dry opaque and the substrate shall not show through the finish except in the case of semi-transparent or clear stains.
- 1.2 SCOPE: The intent of these specifications is to require painting of all concession building and mechanical room surfaces requiring paint. Refer to plans.
- A. Exterior: Paint new fascia, soffits, trim, siding, downspouts,
 - B. Interior: Seal concrete floors. Paint walls and ceilings all rooms except do not paint FRP board.
 - C. Doors and frames: Paint all steel doors and steel door frames.
 - D. Pool: Refer to Pool specifications on pool paint coatings.

PART 2 - PRODUCTS

- 2.1 Paint, stains and varnishes shall be that shown in the schedule or an equal approved in advance by the engineer. Submit technical formulation data for substitute to engineer for approval prior to use. All materials are to be delivered in new, sealed original labeled containers and stored in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Surfaces to be painted shall be clean before applying paint or surface treatments. Oil, grease, dirt, rust, loose mill scale, old weathered paint, and other foreign substances shall be removed except as hereinafter specified. The removal of oil and grease shall, in general, be accomplished by blast cleaning, minor amounts of grease and oil contaminates will be tolerated on the surface, prior to blast cleaning, provided that abrasive is not reclaimed and reused.
- B. Clean cloths and clean fluids shall be used in solvent cleaning to avoid leaving a thin film of greasy residue. Cleaning and painting shall be so programmed that dust or spray from the cleaning process will not fall on wet, newly painted surfaces. Hardware, electrical fixtures and similar accessories shall be removed or suitably masked during preparation and painting operations, or shall be disconnected and moved to permit cleaning and painting of equipment, and following painting shall be replaced and reconnected. Hangers, brackets and other metallic surfaces which are inaccessible after installation shall be painted, except for final coat, prior to installation. Specific surface preparation requirements are included in Paint Systems.

- C. **Metallic Surfaces:** Preparation of metallic surfaces shall be conducted in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC): SSPC-SP-1 Solvent Clean; SSPC-SP-2 Hand Tool Cleaning; SSPC-SP-3 Power Tool Cleaning; SSPC-SP-5 White Metal Blast Cleaning; SSPC-SP-6 Commercial Blast; SSPC-SP-7 Brush Off Blast Cleaning; SSPC-SP-10 Near White Blast. Unless specified otherwise steel shall be prepared as follows:
1. Above ground steel, normal exposure - SSPC-SP-6.
 2. Submerged, immersed steel or steel exposed to vapor in enclosed tanks - SSPC-SP-10.
 3. All ferrous metals to be painted shall be supplied as primed metal and all subsequent painting performed on-site except as otherwise specified or approved by the Engineer.
- D. **Preparation of Wood Surfaces:** Wood surfaces to be painted shall be cleaned of dirt, oil, or other foreign substances with mineral spirits, scrapers, sandpaper, or wire brush. Finished surfaces exposed to view shall, if necessary, be made smooth by planing or sandpapering. Millwork shall be sandpapered where necessary, and given a coat of the specified exterior primer on all concealed sides before installation. Small, dry seasoned knots shall be surface scraped, sandpapered, and thoroughly cleaned, and shall be given a thin coat of an acceptable knot sealer before application of the priming coat. All beads or streaks of pitch shall be scraped off, or if the pitch is still soft, it shall be removed with mineral spirits or turpentine and the resinous area shall be thinly coated with knot sealer. After priming, all holes and imperfections shall be filled with putty or plastic wood colored to match the finish coat, allowed to dry and sandpapered smooth. Painting of exterior wood surfaces shall proceed insofar as practicable only after masonry work has dried.
- E. **Preparation of Concrete and Masonry Surfaces:** All concrete surfaces which require coating or painting shall be dry and shall be prepared by light sandblasting. Sandblasting shall be sufficient to remove all dirt, dust, efflorescence, oil, and grease stains and other foreign substances and shall provide adequate surface roughening for good adhesion between the concrete and coating or paint. New concrete surfaces which are to receive oil or varnish base coatings shall be allowed to age for at least 60 days except as otherwise specified or directed and, in addition, shall be brush treated with a solution consisting of 2% zinc chloride and 3% phosphoric acid in water, permitted to dry, and the residue removed by light brushing.
- F. **Preparation of Plaster Surfaces:** Unless specifically authorized otherwise, paint shall not be applied to plaster surfaces less than 30 days old or containing more than 14% moisture. Before painting, such surfaces shall be dry, clean and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, properly keyed to existing surfaces and sandpapered smooth. Surfaces to be coated with oil or varnish base paints shall be tested for the presence of alkali. If present, the alkali shall be neutralized as called for under the preparation of concrete surfaces. Moisture will be tested with a Delmhorst Instrument Company moisture detector.
- G. **Preparation of Galvanized Surfaces:** Generally, galvanized surfaces will not require painting. Galvanized surfaces specified or directed to be painted shall be solvent cleaned in accordance with SSPC-SP-1.
- H. **Other Surfaces:** The Plan Paint Schedule or the Interior and Exterior Paint Schedules included at the end of this section shall govern. Where any conflict between the two, the Plan Schedule or any Special Provisions shall prevail over the standardized specifications.

3.2 PRECAUTIONS

- A. ACCESS: Do not remove scaffolding or other rigging necessary for painting until engineer approves coating. If necessary for inspection or testing paint the contractor will re-construct scaffolding or re-set cables, rigging, hoists, or boatswain's chairs.
- B. SAFETY: Observe OSHA requirements (29 CFR 1926) and manufacturer's recommendations for use of paints, solvents, epoxies or other coatings or thinners, cleaners, etc. Do not paint in confined spaces without proper ventilation. Do not use combustibles near possible source of ignition. Display caution signs during spraying advising against open flame.
- C. PROTECTION: Do not paint during high wind. Protect surrounding equipment, fixtures and property from droppings and overspray. Bear all expense for cleaning contaminated or damaged surfaces. Protect fresh paint from damage.

PART 4- POST CONSTRUCTION

4.1 SUMMARY

- A. TESTING: For final inspection the contractor shall furnish a Microtestor or comparable equipment for testing dry thin film thickness. Tests shall be conducted on all painted surfaces having a specified mil thickness. Areas failing shall be repainted to match and retested. Microtesting to be done in the presence of the Engineer.
- B. SPARE MATERIALS: The contractor will furnish new, unopened one gallon containers of paints or coatings of each color and type used on the project labelled as to project use and instructions. In the cast of epoxies or other "component" materials the components shall not be mixed. Instructions for use shall be attached to paint containers.

4.2 WARRANTY: WARRANTY: Warranty paint and coating for one year from date of substantial completion against becoming unserviceable or objectionable in appearance as a result of being defective or nonconforming. Without limiting this warranty scope, the work shall be warranted not to:

- A. Noticeably discolor, yellow, streak, bloom, bleach, or darken.
- B. Change sheet with excessive speed or irregularity.
- C. Peel, blister, crack, or alligator.
- D. Release from substrate or intermediate coats.
- E. Chalk or dust excessively.
- F. Stay tacky or become tacky.
- G. Mildew.

END SECTION 09 91 00

SECTION 09 91 00
PAINTING
JOB SPECIFICS

PROJECT PAINT SCHEDULE

SURFACE	SURFACE PREPARATION	BASE COAT	UNDER COAT(S)	FINAL COAT	FINAL COLOR	TOTAL MIN. DFT
POOL WALLS AND FLOORS	Refer to pool specifications for special pool coating.					
INTERIOR FLOORS	Clean to remove laitance and dust.; patch bug holes; roughen smooth surfaces	Sherwin Williams H & C Clarishield Clear Water Based Epoxy Wet Look	None	Sherwin Williams H & C Clarishield Clear Water Based Epoxy Wet Look with Shark Grip	Clear	
INTERIOR WALLS AND CEILINGS	Clean and dry;	Sherwin-Williams Pro Industrial Water Catalyzed Epoxy	None	Sherwin-Williams Pro Industrial Water Catalyzed Epoxy	TBS by owner	6 mils total of two coats
EXTERIOR WOOD BUILDING TRIM	Clean and dry;	Sherwin Williams Emerald Extr. Latex	None	Sherwin Williams Emerald Extr. Latex Egg Shell	TBS by owner	6 mils total of two coats
H.M. DOORS AND FRAMES; MISC. STEEL SUCH AS LINTELS	Sand or mechanically clean to remove rust and loose paint. Degrease.	Sherwin Williams Pro Industrial Urethane Alkyd Enamel	None	Sherwin Williams Pro Industrial Urethane Alkyd Enamel	TBS by owner	6 mils total of two coats

END OF SECTION 09 91 00 PAINTING JOB SPECIFICS

CITY OF DENTON
WAVE POOL

**SECTION 131100
SWIMMING POOL**

PART 1 - GENERAL

1.1 Scope: This section shall govern constructing the wave pool.

1.2 Work Covered Under Other Sections:

- A. Furnishing and installing piping and accessories are covered under Section 13 11 46 "Swimming Pool and Small Fountain Piping and Equipment".
- B. Refer to mechanical/electrical sections for gas & electrical supply to operate aquatic equipment.
- C. Refer to electrical sections for all power distribution, starters, switches, panel boards, transformers and related electrical wiring. Pools shall be electrically bonded.
- D. Refer to other specification sections for pool finishes, deck and coping stone, for fountain urns and finishes for fountains. Finishes are not specified in this section.
- E. Refer to Section 22 51 19 of these specifications for "Swimming pool Water Treatment Equipment" for sanitization requirements.

1.3 Balancing of Pools:

- A. Pools, fountains and spas shall, upon completion, and upon authorization of the Consultant, be filled with water and the water chemically balanced. Plastered bodies of water must be filled immediately upon completion of plaster installation.
- B. The following parameters shall be considered minimum acceptable criteria before acceptance of the project:
 - 1. Alkalinity: 80 to 150 mg/L
 - 2. Hardness: 150 to 500 mg/L as CaCO₃
 - 3. pH 7.3 to 7.8
 - 4. Free chlorine: 1 to 3 mg/L
 - 5. Combined chlorine: 0.1 to 0.25 mg/L max.
 - 6. Clarity: No discernible cloudiness or turbidity
 - 7. Cyanuric Acid: 30-50 mg/L (outdoor pools only)
 - 8. Salt content: outdoor pools/spas only excluding fountains 4g/L
 - 9. Langelier Saturation Index $-0.5 < LSI < 0.5$

1.4 Submittals: Provide submittals for all equipment specified herein.

1.5 Warranty: In addition to the requirements of any general project warranty set forth in the general provisions of the construction agreement, for one (1) year following date of final acceptance of the project, the pool contractor shall, at his own expense, troubleshoot, repair or replace defective workmanship, equipment or materials including services of factory representatives, contractor's personnel, travel and subsistence, replacement parts or equipment, and other costs of repair or replacement. This warranty includes, but is not limited to, calibration of equipment, repair of leaks, repair or replacement of faulty equipment or materials.

Contractor shall not engage Employer's staff to make corrections, repair or install equipment other than to perform routine operating procedures.

- If a defect is detected or equipment fails to perform, the pool contractor's installation will be presumed at fault and it will NOT be the responsibility of Engineer or Owner to troubleshoot issues or to determine causes. The burden of proof of any cause outside his responsibility under warranty shall remain with the Contractor.
- 1.6 The listing of a material or piece of equipment by name or model designation shall indicate a minimum acceptable standard of product and not be deemed to unreasonably restrict equivalent competitive products from the project. Substitutions, however, may be made only with the approval of the Engineer.
- 1.7 Water & Electrical Scope: Pool contractor shall supply water and electrical site work. However the relocation of primary underground power to the service transformer is by Denton Municipal Electric.
- 1.8 Allowances: Refer to Section 13 14 16 Wave Generating Equipment for the only item purchased under allowance. The Contractor shall include in his bid the allowance without altering the allowance price bid. The Contractor shall provide original invoices or receipts for materials under this section and the allowance shall be used to pay:
- A. Invoice cost less any credits, deductions, or discounts;
 - B. Shipping and handling costs from the manufacturer denoted on the invoice;
 - C. Sales tax (NOT applicable);
 - D. Costs of manufacturer's extended warranty or service options if selected by the Owner.
 - E. Start up services provided by the manufacturer.

The following are costs NOT included in allowances and are to be considered subsidiary to other bid items: Installation labor, equipment, or materials; field painting; services of service personnel or installers; contractor's mark-up, overhead and profit.

SAVINGS BELONG TO OWNER: Any allowance not spent reverts to Owner. Any excess spent over the allowance is the responsibility of the Owner. No Contractor's profit or mark-up will be paid on allowance exceedance.

PART 2 – PRODUCTS

- 2.1 STAINLESS STEEL PRODUCTS: (Not all of these products are required for this project. Refer to schedules on the plans.)
- A. Handrails: Custom bent hand rails shall be constructed of round 1.90-inches x 0.145 inch , 304L low carbon stainless steel and welded using 409 stainless welding rods.
 - B. Handrails shall not be deformed, bent, crimped, dented or otherwise marred. Handrails shall be newly manufactured made of new tubing materials and exhibit no surface oxidation that cannot be removed by sanding. Defective railing shall not be installed and shall be removed from the site.
 - C. Handrail sockets: S R Smith, Paragon, Spectrum or equal bronze wedge anchors for 1.90 inch diameter handrails and ladders.
 - D. Ladders & Grabrails: Furnish and install 1.90-inch (O.D.) diameter x 0.145-inch (min.) wall Type 304L stainless steel cross braces ladder where shown on the plans. Equal to S R Smith, Paragon, or Spectrum

- E. Ladders shall have ABS-UV inhibited steps bolted between ladder rails.
- F. Bronze sockets anchors secure ladders to the deck. The sockets shall be of the bronze wedge type using a tightening hex-nut to securely wedge the railing in the socket.

2.2 FILTERS (GENERAL)

- A. General: Filters shall be of the make, model and manufacture scheduled on the plans or an approved equal. The filters shall be new, of first quality, and designed such that tank, linings, and filter shall be NSF-50 listed and conform to NSF/ANSI 50-1996 latest edition. Operating pressure of 50 or higher psi (0.35 MPa) with a safety factor of at least 3:1.
- B. Filter Valves: The type of filter valve manifold is clearly shown on the plans. Filters shall be furnished with interlocking butterfly valve system to allow operation of filter valves from filter cycle to backwash cycle and back with a single stainless steel lever actuator with stainless steel hardware. Labeling of valves operation for backwash mode and filter mode must be clearly labeled on each filter valve manifold.
- C. Filter Piping External: External face piping shall be Schedule 80 PVC pipe and fittings. Flanges shall be located so as to allow for easy dismantling of face piping. All fittings may be either solvent cemented or full face gasket flanged joints.
 - i. Piping shall be drilled and tapped where necessary to accommodate gauge tubing connectors.
 - ii. All valves 3" and larger shall be PVC body/PVC disc wafer valves. Systems incorporating solenoid, pneumatic or hydraulic valves shall not be acceptable on this project. Refer to Section 13 11 46 for more requirements on valves.
 - iii. Standard accessory items shall include:
 1. Removable and cleanable sight glass rated for 50 psi minimum with polycarbonate glass
 2. Tank mounted gauge panel with two 4-1/2" diameter pressure gauges 0-60 psi scale capacity, 1/4" petcocks, 1/4" poly vent tubing with PVC compressions adapters.
 3. Automatic air release valve, APCO or equal atop the tank.
- D. Filtration/Backwash Control. Manual only; single lever valve actuator.

ACCEPTABLE FIBERGLASS SAND FILTER MANUFACTURERS

- A. The filters shall be new, of first quality, horizontal high rate sand filters and designed to an operating pressure of 50 psi and hydrostatically tested to 75psi. Tank, linings, and filter shall be NSF-50 listed and conform to NSF/ANSI 50-1996 latest edition. Acceptable manufacturers below:

Nemato Corporation
 5405 N. Blackstock Road
 Spartanburg, SC 29303
 800.361.5025

Paragon – Stark Filter
 1351 Route 55
 LaGrangeville, NY 12450
 845.463.7245

Neptune-Benson
 6 Jefferson Drive
 Coventry, RI 02816
 800.832.8002

- B. Filter Media: Filter shall contain recommended sand volume of U. S. Silica Mystic White II #20 hard, uniformity coefficient shall not exceed 1.53. Specific gravity shall not be less than 2.5. pH of media to be 7.0. Furnish sand to the site in original unopened bags.

2.3 PUMPS: (Not all pump types below will be required. Refer to pump schedules on the plans.)

- A. General: Pumps shall be centrifugal pumps with premium efficient motors of the make, model and manufacture scheduled on the plans or an approved equal. The pumps shall be new, of first quality and designed for the operating conditions stated on the plans. Cast iron pump internal volutes shall have a 3M ScotchKote 323 internal factory applied liquid epoxy coating.
- B. Acceptable manufacturers of cast iron pumps are (but refer to schedule on plans for requirements) :
 - 1. Aurora/Pentair
 - 2. Paco Pumps
 - 3. Marlowe Pumps
- C. Submersible pumps: Submersible pumps shall be furnished with cast iron pump quick-connect base; stainless steel lifting cable or chain; lift guide rails; submersible power cable(s); and combination thermal protection/starter /disconnect.
- D. The pump drive motor shall be non-overloading anywhere along the pump curve for the rated impeller. The pump on the pump curve shall fall within 10 percent of the optimum efficiency for the pump. Provide pump curves with submittals.
- E. Composite pumps: Composite body pumps, where specified or permitted, shall be squirrel cage induction motor powered with a fixed impeller diameter for the model specified on the schedule. Pumps shall be furnished with integral composite-bodied strainer chamber and plastic basket. Furnish one extra plastic basket for each strainer shown on the plans. The strainer case shall have a clear plastic lid for viewing the basket contents without removing the lid. The lid shall be O-ring gasketed and twist-locked and unlocked without the use of tools. Pumps scheduled are manufactured by Badu Speck, Hayward Pool Products USA or Pentair Pool Corporation, USA. Refer to plans for schedule of pumps.
- D. Variable speed pumps: Pumps identified on the plans as IntelliFlo are Pentair Corporation variable speed pumps with on-board programmable speed control, RPM, % of power, or GPM/LPS. The Consultant will provide settings based on performance testing in the field. Refer to plans for schedule of pumps.
- E. Gages: Weksler 3 inch (60 mm) diameter glass faced, liquid filled, industrial gage with an accuracy of +/-1% with a 1/4" male threaded bottom stainless steel tap.

Pressure gages on the discharge side of the pump: Equal to Weksler Regal 0-60 psi/0-400 kPa (psi and metric readings); white face; 1/4" t-handled gage cock.

Combination pressure/vacuum gages on the suction side of the pump: Equal to Weksler Regal model, 30" Hg/0/30 psi /100/0/200 kPa (inches of Hg, psi, and kPa scales.)

2.4 LEVEL CONTROL DEVICES

- A. Electronic Actuation: Electronic automated water level controller shall consist of a surge tank mounted probe chamber secured to the tank wall. The probes provide a low voltage signal (12VDC) to the microprocessor monitoring unit in the pool mechanical room which in turn operates a 24 VAC solenoid valve on the make up supply line:

Manufacturer: AquatiControl Technology (www.aquaticontrol.com) or approved equal
 Model: ELC-800r-SS
 Options: High level shut off, low level turn on, very low level pump shut off
 Housing: Watertight NEMA 4X

Menu driven operating system. User interface keypad and alarm reset button. LCD display. FILL ON DELAY (time between sensor not sensing water and fill solenoid opening) shall be adjustable from 15 seconds to 99 seconds. FILL OFF DELAY (time solenoid valve is allowed to stay on after sensor begins sensing water) shall be adjustable from 2 seconds to 99 seconds. MAX FILL TIME (solenoid on time limit) shall be adjustable from 20 to 240 minutes and shall be able to disable for continuous filling. LOW WATER DELAY (time required before alarm is triggered) shall be adjustable from 10 seconds to 99 seconds.

Outputs: The solenoid valve shall be 1 solid state relay output at 24VAC, 1.85A. Auxiliary shall be a mechanical relay output with C, NO, and NC contacts available at a terminal block. This relay is for remote annunciation of an alarm condition, or to interrupt power to the circulation pump during low water condition. Any of the following four conditions will initiate an alarm condition and all of them actuate on the relay output, the red LED and audible alarm.

- a. *Maximum Fill Time Exceeded* (Filled longer than setting), normal functions disabled until reset.
- b. *Low Water Condition* (low water detected) auto or manual restore (select auto or manual during programming).
- c. *Level Sensor Problem* (Sensor not working properly), auto restore.
- d. *Low Water Sensor Problem* (Sensor not working properly), auto restore.

Power: The controller shall be provided with a six foot three wire power cord, 18 AWG; the controller operates on 90 to 130 VAC, 50/60 Hz and is fused at 2 amps with a user protected 5x20mm fuse. The power to the unit is switched on the side of the controller.

B. Float Actuation: Not used on this project.

2.5 POOL FITTINGS/MAIN DRAIN:

A. Plastic Fittings: Return fittings shall be MLD-FI-360 5" x 5" flush floor fittings as manufactured by Lawson Aquatics.

Lawson Aquatics
 4431 Corporate Square
 Naples, Florida 34104
 1.800.897.6160

B. Cup Anchors: Stainless steel T316 with integral cross bar and grounding screw. Welded hooked bars or notches in the gutter wall are not permitted.

KDI Paragon Spec Sheet AA20.70
 1351 Route 55
 LaGrangeville, NY 12540
 888.KDI.SWIM

C. Main Drain: Lawson Aquatics FRP sump and unblockable cover in the size scheduled on the plans. Cast in place sumps will not be considered. VGB certified.

2.6 CONTRACTOR SUPPLIED MAINTENANCE EQUIPMENT (None)

2.7 FLOW METERS

- A. Each aquatic circulation system shall be flow metered whether shown on the plans or not.
- B. Flow meters shall be +GF+ Signet model 3-99001P ProPoint Flow Monitor with analog dial and electronic totalizer or approved equal. 12 to 24V AC/DC wiring required.
- C. The GF Signet Paddlewheel Rotor X model P515 flow sensor shall be installed with a wet tap valve GF Signet 3519 inserted into a PVC full saddle fitting such that the meter probe can be inserted and withdrawn from the line without disrupting flow.
- D. The readout display shall be panel surface mounted in a Signet heavy duty wall bracket 3-0000.596. Low voltage wiring shall be neatly fastened along pool plumbing using nylon wire ties.
- E. Backwash lines shall be equipped with Blue-White Industries, Ltd Pitot Tube Acrylic Flow meters. Model F-300, D-300, or U-300 are all allowable if installed in the correct configuration. Specific model number should be selected based on design flow requirements and manufacturer's recommendations.

2.8 UNDERWATER LIGHTING

- A. CONDUIT: Per electrical sections of these specifications. Conduit shall be watertight Sch 80 PVC from the lighting niche to a point a minimum 9" (300 mm) above the maximum water level of the pool.
- B. TRANSFORMER/CONTROLLER/SWITCH: Furnish each group of four underwater lamps with 120v/12v transformers with adequate wattage to power the fixture count for that pool at 80% of the transformer wattage rating or less. Transformer locations shown on the plans. Transformer shall be UL listed for pool applications equal to Intermatic P100, 300, or 600S with stainless steel enclosure.
- C. LED WITH LIGHT NICHE: Pentair Intellibrite 5G Color LED, 12V AC or Intellibrite White LED 12V Pool & Spa Light Refer to plans. (400W equivalent unless noted on the plans)

Intellibrite devices have an integrated 120VAC to 12VAC transformer option or the unit can be sold as 12VAC and is dependent on an external transformer. The pool contractor may NOT use these internal transformers but shall provide external transformers.

Supply LED light with a stainless steel niche housing designed for the fixture and equipped with conduit connections and bonding lugs.

2.9 POOL HEATING (Not Applicable)

2.10 POOL SHELL SURFACE PRODUCTS

POOL PAINTED COATING SYSTEMS FOR CONCRETE POOL (Base Bid)

- A. The pool shall be prepared for, primed and painted with the Ecofinish AquaBright thermally fused epoxy system.
- B. The system must be applied by a factory authorized installer using manufacturer's specific

equipment and products. All materials are to be delivered in new, sealed original labeled containers and stored in accordance with manufacturer's recommendations.

2.11 SUCTION VACUUM RELEASE SYSTEM (Not used in this project)

2.12 IDENTIFYING SIGNAGE

- A. Provide a laminated sheet with the following data neatly printed on the sheet for insertion into a sheet holder in the mechanical space:

CITY OF DENTON
WAVE POOL

POOL VOLUME:	298,650	U.S. GALLONS
WATER SURFACE AREA:	13,308	S.F.
DESIGN TURNOVER TIME:	2.93	HOURS
REQUIRED TURNOVER:	4.50	HOURS
MINIMUM ALLOWABLE FLOW:	1107	GPM
DESIGN FLOW:	1700	GPM @ 60 FEET T.D.H.
MAX. POOL LOAD:	888	PERSONS

- C. OWNER SHALL provide and install health department required pool signage per state health code. Fasten signs in place with stainless steel hardware.
- D. The Contractor shall furnish and install the following two ply engraved plastic laminate plates:
 - a. "AUTHORIZED PERSONNEL ONLY" 1-1/2" white letters on minimum 3" tall red plate installed on the doors to the filter room, the electrical room and to the blower room. 3 signs.
 - b. "DANGER – HEARING PROTECTION REQUIRED" 1-1/2" white letters on minimum 3" tall red plate installed on the exterior of the door to the blower room.
 - c. Label panels and subpanels in the electrical room with engraved laminate plates. Refer electrical drawings for nomenclature.
 - d. Label WAVE CONTROLLER with engraved laminate plate.
 - e. "DANGER – DO NOT ENTER SURGE TANK WITH PUMPS RUNNING!" in 1-1/2" white letters on minimum 3" tall red plate installed near the top of the surge tank.
 - f. "DANGER-ACID" 1-1/2" white letters on minimum 3" tall red plate installed on the gate to the acid compartment.
 - g. "DANGER-CHLORINE" 1-1/2" white letters on minimum 3" tall red plate installed on the gate to the chlorine equipment compartment
 - h. "DANGER-BLOWERS MAY START AUTOMATICALLY- OBSERVE LOCK OUT PROCEDURES" in 1-1/2" white letters on red foreground laminate plate to be installed on the back of the caisson wall facing the blowers. 2 signs.

2.13 SACRIFICIAL ANODE (Not applicable to this project)

2.14 TRENCH DRAIN

- A. Lawson Aquatics 17" deep x 12" wide with 9" wide FRP trough with 12" wide 9 inch wide continuous Natare or equal composite GPM grating.

Grating shall be:
 Polymer (GPM) Grating – Style#2
 Natare Corporation
 5905 West 74th Street
 Indianapolis, Indiana 46278 800.336.8828

- 2.15 SHADE CANOPY (Base Bid: Owner provided and installed. Alternate Bid: Contractor provides and installs)
- A. Products:
1. Resort Cabanas (www.resortcabanas.com) 12' x 12' nominal pre-engineered to 60 MPH Pacifica Model with optional Firesist flame retardant fabric cover and optional roof-top air vent. Polyester powder coat painted frame from Owner's choice of 11 standard colors. More than one color may be selected.)

Furnish anchor bolts and concrete footings per manufacturer's instructions but not less than 12" diameter x 48" concrete pier per leg or equivalent spread footing.
 2. USA Shade, Dallas (800-966-5005) 20' x 40' hipped roof fire resistant fabric shade structure with minimum 8'-0" side eaves; powder coated steel; with bearing plates, braces, square tubular steel columns and anchors. Install per manufacturer's instructions including footings. Wind rated to 85 mph 3 second gust per ASCE 07-10.

2.16 LIFE LINE RACING LANE MARKERS

- A. Life Line ropes shall be blue and white 3/4-inch diameter twisted strand U.V. stabilized polypropylene secured on each end with chrome plated brass clamp type (screwed together) rope hooks. One end of the rope shall also be furnished with a swivel type snap hook.
- B. Floats for lifelines shall be 5" x 9" linear polyethylene treated with U.V. stabilizers and chlorine inhibitors. Floats shall be self locking or furnished with float keepers. Set floats at 3' -0" c-c. Floats are to be half blue - half white either cylindrical or ellipsoidal.
- C. For pools with racing or lap lanes furnish and install Competitor Racing Lanes plastic wave quelling disks on tensioned 3/16-inch multi-strand stainless "aircraft" cable with standard racing lane configuration using three colors of disks in alternating bands. Furnish super tensioner on one end. Line diameters and lengths are shown on Plans. Colors to be selected by Owner.

KDI Paragon Spec Sheet AA20.75
1351 Route 55
LaGrangeville, NY 12540
888.KDI.SWIM
- D. For pools with racing or lap lanes, furnish one or more stainless steel frame Lane Storage Reel portable lane marker reels storage device with stainless steel castors in sufficient quantity to hold all lane markers and one spare.

KDI Paragon Spec Sheet PA40.0X
1351 Route 55
LaGrangeville, NY 12540
888.KDI.SWIM

PART 3 - EXECUTION

3.0 GENERAL

- A. Follow manufacturer's written instructions explicitly for the installation of swimming pool equipment and products. Where in conflict with the drawings or these specifications, the manufacturer's instructions shall govern.

- B. Coordinate electrical requirements with electrician.
- C. These specifications are intended to provide for complete working systems. If options, accessories, or other parts are not specified but are required for a working system they are to be considered specified.
- D. Deliver to project in original unopened containers labeled for location of installation. Protect from damage on site until project is complete and accepted by Employer.

3.1 FILTERS

- A. Install all filters on minimum 4" (100 mm) thick, level housekeeping pads neatly constructed of non-reinforced concrete with chamfered corners and rectilinear sides. Observe influent and effluent pipe centerline requirements based on pipe elevations given on plans.
- B. Sand filters: Install media carefully taking precaution not to disturb the collector tubes or distributor internals. Install the volume of sand required by the manufacturer for that particular filter. Level the sand before closing the hatchway.
- C. Fill the tank slowly and evacuate all air. Check for leaks at static pressure before starting pumps. Do not fill filter vessel with pool water discharged by the circulation pump. Fill by gravity from the pools above or from potable water supplies.
- D. When placed into service, record the gage pressures on the clean filter and submit to the Consultant.

3.2 ADDITIONAL INFORMATION ON FIBERGLASS SAND FILTER

- A. Ship filter systems to the site; inspect and protect from damage.
- B. Coordinate pool plumbing systems with foundation installation.
- C. Install filter tanks on level foundations.
- D. Connect pool piping per Section 13 11 46.
- E. Test all valve assemblies for proper positioning before attaching to filters.
- F. Once pumps are in position and recirculation system is ready, set the filter to filter mode, open air release assembly and begin filling tank with water. Operate in the filter mode and check for leaks. Close the air release valve when all air has been evacuated.
- G. After the first back wash cycle is complete, open the filter and check the media surface. There should be no evidence of bypassing along the walls of the shell or scouring from the overhead distributor.

3.3 PUMPS

- A. Install pumps on level housekeeping pads neatly constructed of non-reinforced concrete with chamfered corners and rectilinear sides. Observe pump centerline requirements based on pipe elevations given on plans paying close attention to requirements for any pump suction strainers which may actually be taller than the pumps on which they are attached.
- B. Bolt each pump base to the house keeping pad with stainless still expansion bolts.

- D. Bond metallic pumps and pump bases electrically per N.E.C. Provide bonding wire connection at pump location.
- E. Install check valves a minimum of 60" from the pump discharge flange to the valve flange and install the pump butterfly valve at least 60" downstream of the check valve. Valve handles shall be installed for convenient operation but not so that they are dangerous to pedestrians.
- E. Before operating, verify proper rotation of pumps when wired.
- F. Install gages as close to the pump suction and discharge as possible. If the flanges for the pump suction and discharge are tapped, install the gages in the tap holes.
- E. Insure all connections are watertight. Do not run pumps (except to check rotation) without water in the system. Fill the system with water, bleeding off air from pipe lines. Verify all valves are in the correct position. Start the pump to insure proper movement of the water. After the pool circulation has stabilized, record the suction side and discharge side gage readings, record and submit to the Consultant.

3.4 LEVEL CONTROL DEVICES

- A. Pools (Electronic level control):
 1. The remote sensing probe chamber shall be installed in the surge tank in a location approved by the Consultant. Coordinate before installing system.
 2. Install low voltage wiring (#12 AWG or larger) in conduit paralleling pool plumbing pipe back to the mechanical room. Install the control unit where shown on the plans in the pool mechanical room. Controller shall be installed within the new pool mechanical room.
 3. Connect the control unit to the 24VAC 10watt max slow close solenoid valve on the water supply line. The water supply will be brought to the pool mechanical room by the plumbing contractor under this contract.
 4. Controller shall be mounted within 5' of a 120 VAC, 60 Hz grounded wall convenience outlet.
 5. Install 2" static overflow line from the surge tank to storm collection system. Install overflow invert 2" above static operating water surface elevation indicated on plans.

3.5 POOL FITTINGS:

- A. Plastic Fittings: Install fittings with 2-inch branch piping. Install tops of fitting flush with finished concrete surface. Do not remove adjustment plates or screws. Protect fittings during painting operations.
- F. Cup Anchors: Install rope anchors uniformly positioned between 1" above and 2" below waterline in the perimeter at end walls at the 5'-0" depths. Refer to Plans for other possible locations.
- G. Trench drains: Construct with the pool shell a 'vault' into which the fiberglass trench box can be installed, OR, alternatively, cast the fiberglass trench box into the pool floor. Concrete must completely surround the bottom and sides of the trench box. The top grate of the trench must be flush with the finished concrete surface. Anchor trench box against flotation in fresh concrete.

3.6 CONTRACTOR SUPPLIED MAINTENANCE EQUIPMENT (None)

3.7 FLOW METERS

- A. Install +GF+ Signet model 5500 ProPoint Flow Monitor with analog dial and electronic totalizer or approved equal on pool equipment room wall 48"-60" AFF within 48" of the pool chemical monitor/feeder. For multiple meter read-out units, wall-mount units side by side. The readout display shall be panel surface mounted in a Signet heavy duty wall bracket 3-0000.596.
- B. The GF Signet Paddlewheel Rotor X model P515 flow sensor shall be installed with a wet tap valve GF Signet 3519 inserted into a PVC full clamp on saddle fitting on discharge side of each filter/recirculation pump on longest straight run of pipe and following the filter.
- C. Run sensor wires between meters and read-out unit in ½ inch schedule 80 PVC electrical conduit rectilinear with building walls and secured to walls.
- D. Pitot Tube Acrylic Flow meters may be installed by drilling pipe, remove all burrs from drilling inser the pitot tube with gasket in place. Tighten manufacturer supplied stainless steel clamps alternately & insure that flow direction is towards the pitot tube opening.
- E. Pitot tube installed on Schedule 80 PVC will report flow 12% higher than actual flow. Pool contractor shall install valve tag on flowmeter representing "-12% for actual".

3.8 UNDERWATER LIGHTING

- A. Select lamp cord length when ordering underwater fixture to reach from the lighting niche to the 120vac/12vac transformer. Connect the transformers via a gutter to a NEMA 4X stainless steel lighting disconnect switch in the field next to the transformers. Run 120vac circuit to proposed electrical room in the wave pool back of house.
- B. Switch and operation of lighting to be located in the electrical room near the wave pool controller.
- C. Refer to NEC 680 for proper installation of underwater lighting.
- D. Install lighting so the lamp is submerged by 18" minimum of pool water.

3.9 POOL & SPA HEATING (Not in project)

3.10 POOL SHELL SURFACE PRODUCTS

THERMALLY FUSED EPOXY RESIN COATING (AQUABRIGHT)

- A. Safety: Observe OSHA requirements (29 CFR 1926) and manufacturer's recommendations for use of paints, solvents, epoxies or other coatings or thinners, cleaners, etc. Do not paint in confined spaces without proper ventilation. Do not use combustibles near possible source of ignition. Display caution signs during spraying advising against open flame.
- B. SCOPE: The extent of the AquaBright coverage shall be as follows:
 - a. The entire floor of the pool from the face of the caisson to the upper edges of the beach entry where it meets deck.
 - b. The wave pool walls from the floor to the coping.

- c. The coping sides and top and the back of pool wall (where a parapet condition exists) down to the deck.
 - d. The face (pool side) of the caisson but not the top or interiors. Do not coat grating.
- C. SURFACE PREPARATION:
- a. The shotcrete and cast in place surfaces to receive AquaBright shall be rubbed smooth to a float finish prior to coating. Remove surface imperfections caused by forming. Fill bug holes and honeycombing with a white marcite plaster mix. DO NOT USE BONDING AGENTS.
 - b. The system installer shall approve the concrete surface before beginning work. If system installation work commences, the system shall be deemed to have been approved and acceptable to the installer.
 - c. The system will not bridge large cracks. Cracks deemed unacceptable to the Engineer shall be routed and epoxy filled prior to installation of the AquaBright system.
 - d. Remove or mask off all floor return fittings, anchors, trench grates, main drains, caisson grating, and decks not intended for coating.
 - e. Mask off any expansion joints.
 - f. Do not apply primer or coatings when dust or debris is present or when windy conditions exist.
 - g. Acid wash and power wash if required by system installer to meet surface requirements.
- D. APPLICATION:
- a. Roller apply the acetone/epoxy prime coat as required by Ecofinish for their system.
 - b. Spray apply the epoxy powder through the torch/blast gun (supplied by Ecofinish) in a minimum of two coats, each coat being transverse to the previous coat. Apply the color uniformly, thoroughly covering the substrate and fusing the melted epoxy polymer into the surface. Touch up uneven colored areas. Apply the final floor color coat from sufficient distance to give a surface with adequate friction resistance for walking. Slick surfaces on floors are not acceptable.
 - c. Using a contrasting color of AquaBright selected by Owner, stencil all stripes, in-pool depth markers and targets into the pool floor and walls. Refer plans.
- E. Protection: Do not paint during high wind or rainy weather. Protect surrounding equipment, fixtures and property from droppings and overspray. Bear all expense for cleaning contaminated or damaged surfaces. Protect fresh paint from damage.
- F. Access: Do not remove scaffolding or other rigging necessary for painting until engineer approves coating. If necessary for inspection or testing paint the contractor will re-construct scaffolding.
- G. Quality of Work: Painting shall be done using suitable equipment for the materials being applied according to paint manufacturer's written instructions. Coatings shall be applied in evenly distributed passes with sprayers, brush or roller. Each required coat shall be uniform in coverage. Remove any brush or roller marks. Remove sags or runs. Wait the required time between successive coats, allowing additional time for less than optimum ambient conditions if necessary.
- H. Protection of Other Work: Protect work of other trades from overspray. Protect other painted surfaces from overspray. Protect vehicles or property from damage from drifting paint. If necessary, barricade off work zones. Protect floors, even unfinished surfaces, from paint droppings or spray.
- I. Without limiting this warranty scope, the work shall be warranted not to:

1. Noticeably discolor, yellow, streak, bloom, bleach, or darken.
2. Change sheen with excessive speed or irregularity.
3. Peel, blister, crack, or alligator.
4. Release from substrate or intermediate coats.
5. Chalk or dust excessively.
6. Stay tacky or become tacky.
7. Mildew.

3.11 SUCTION VACUUM RELEASE SYSTEM (not used in this project)

3.12 IDENTIFYING SIGNAGE

- A. Fasten in place with stainless steel hardware.

3.13 SACRIFICIAL ANODE (not used in this project)

3.14 TRENCH DRAIN

- A. Grates shall fit snugly in the trench with no projecting edges above or below surrounding surfaces. Grates shall be secured such that they are not removable without tools.

If specified or shown on the Plans, polyurethane or polystyrene form blocks shall be used to form channels. These are available from Grate Technologies or ABT Polydrain and others. Secure form blocks on line and grade and prevent flotation. Provide pool shell waterproof coating over all exposed walls and floors of trenches.

Run all buried plumbing lines and fittings as per plans. Refer to plans for size and type.

Protect all completed work. Store and protect all equipment in original shipping containers. Seal over drain grating during deck coating and painting operations. Clean cement or paint from completed drains. Clean all debris from drain channel and flush pipes.

3.15 SHADE CANOPIES (by Owner)

3.16 LIFE LINE AND RACING LANE MARKERS

- A. Life lines shall be installed as taut as possible given that the line must undulate with the waves. Do not allow lines to submerge under wave action due to tautness but loosen rope anchors until the line floats freely under maximum wave conditions.
- B. Racing lines shall be install taut using super tensioners and springs. Racing lines will not be installed in the pool during wave activities.
- C. Assemble the required racing line reel(s)

3.17 TESTING

- A. Pressure test all circulation and branch lines, including wetted parts and equipment under operating conditions. Repair all failures or leaks. Refer to Section 131146 "Swimming Pool Piping and Equipment" for additional test requirements.
- B. Following Pool Filling: Balance the pool chemically as prescribed herein. Calibrate all testing equipment to match test results from proper titration kit testing.

- C. Check for leaks along the entire pipe line, in the mechanical room and in ceiling spaces around pool and fountain vessels. Repair all leaks.

3.18 MANUALS OF OPERATION AND TRAINING

- A. Pool contractor shall bear all expenses for manufacturer's installers, trainers or trouble-shooters to be on-site to install, calibrate, troubleshoot and train Owner's personnel on operation of the pool and wave equipment. Provide digital video recording of training.
- B. Furnish to the Consultant upon completion of all testing and prior to final acceptance of the project, two (2) three ring binders for the maintenance and operation of the pool clearly identifying by tabbed section the following:
 - B. Equipment manuals of operation.
 - C. Spare parts lists.
 - D. Installation instructions for equipment.
 - E. Contractors' and suppliers' names and contact information.
 - F. Marked 'record' drawings accurately depicting plumbing locations below ground and all equipment within the mechanical room.
 - G. Copies of all warranties for all equipment furnished and installed.
 - H. Provide type-written instructions for backwashing all pumps or cleaning filters.
 - I. Descriptive information detailing proper care, maintenance, and cleaning procedures for equipment listed above shall be provided.
 - J. Proof of product registration submittal by the pool contractor to the manufacturer for all products listed above that are supplied with a product registration card.

END OF SECTION 13 11 00

CITY OF DENTON
WAVE POOL

SECTION 13 11 46
SWIMMING POOL PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section governs furnishing and installing swimming pool, spa and outdoor fountain water filtration and distribution system piping complete with all necessary fittings, pipe penetrations and supports. The lines governed by this section include but may not be limited to:
- Pool main drain
 - Skimmer drains
 - Backwash lines
 - Filtered water return lines
 - Chemical monitoring loop
 - Chemical feed loops
 - Heater, chemical, and bypass lines
 - Pump suction lines
 - Automatic level control static lines
 - Automatic level control make-up water lines
 - Fountain spray heads and nozzles
 - Overflow drain lines
- B. Work covered under other sections: Section 131100 governs equipment used for pool filtration, pumping, water treatment, monitoring and controls, surge control, and level control.
- C. This section does NOT govern pipe installations for storm drainage, sanitary sewer, water distribution, general plumbing (other than pool system plumbing), or irrigation.

1.2 QUALITY ASSURANCE

- A. General: Provide pipe system that is watertight to a pressure of 40 psi (0.276 MPa 2.76 Bar) (refer to testing procedures in this specification).
- B. Contractor to submit a method statement for the execution of each item stating the installation activity, method of repairing and protecting existing work, and the finishing and clean-up process.

1.3 SUBMITTALS

- A. General: Submit information for each item specified in this section according to the general provisions of the construction agreement.
- B. Substitutions: Do not make substitutions of any equipment herein specified without specific written approval of the consultant. Provide proof of equivalency to the consultant for evaluation of the products to be submitted citing all material and significant differences between products specified and products offered for substitution.
- C. Provide all submittals under this section in one complete package; number of copies as required in general provisions governing submittals but no less than two (2) copies.

PART 2 - PRODUCTS

2.1 PIPE

- A. All pipe shall be SCHEDULE 80 PVC, of new manufacture. Salvaged, discolored, misshapen, or brittle pipe shall not be used and shall be removed from the project.
- B. The following table shall set forth the minimum acceptable criteria of PVC pipe by comparison to U.S. ASTM D-1785-2012 Type 1, Grade 1, **Schedule 40** standards. All pipe and fittings shall be provided from the same manufacturer and shall meet the minimum requirements set forth in this table. Provide documentation of compliance:

Minimum Pipe Dimension and Stress Criteria				
Nom. Size in. (mm)	Outside Diameter, in.(mm)	Wall thickness in.(mm)	Sustained pressure rating @ 23°C psi (MPa)*	Burst pressure rating @ 23°C psi (Mpa)*
½" (15)	0.840 (21.34)	0.109 (2.77)	1250 (8.62)	1910 (13.17)
¾" (20)	1.050 (26.67)	0.113 (2.87)	1010 (6.96)	1540 (10.62)
1" (25)	1.315 (33.40)	0.133 (3.38)	950 (6.55)	1440 (9.93)
1-1/2" (40)	1.900 (48.26)	0.145 (3.68)	690 (4.76)	1060 (7.31)
2" (50)	2.375 (60.33)	0.154 (3.91)	580 (4.00)	890 (6.14)
2.5" (65)	2.875 (73.02)	0.203 (5.16)	640 (4.41)	970 (6.69)
3" (80)	3.500 (88.90)	0.216 (5.49)	590 (4.07)	840 (5.79)
4" (100)	4.500 (114.30)	0.226 (5.74)	470 (3.24)	710 (4.90)
6" (150)	6.625 (168.28)	0.280 (7.11)	370 (2.55)	560 (3.86)
8" (200)	8.625 (219.08)	0.322 (8.18)	330 (2.28)	500 (3.45)
10" (250)	10.750 (273.05)	0.365 (9.27)	300 (2.07)	450 (3.10)
12" (300)	12.750 (323.85)	0.406 (10.31)	280 (1.93)	420 (2.90)

1. *Standard ASTM test procedures

SWIMMING POOL PIPING AND EQUIPMENT

- C. The following table shall set forth the minimum acceptable criteria of PVC pipe by comparison to U.S. ASTM D-1785-2012 Type 1, Grade 1, **Schedule 80** standards. All pipe and fittings shall be provided from the same manufacturer and shall meet the minimum requirements set forth in this table. Provide documentation of compliance:

Minimum Pipe Dimension and Stress Criteria				
Nom. Size in. (mm)	Outside Diameter, in.(mm)	Wall thickness in.(mm)	Sustained pressure rating @ 23C psi (MPa)*	Burst pressure rating @ 23C psi (Mpa)*
1/2" (15)	0.840 (21.34)	0.147 (3.73)	1780 (12.27)	2720 (18.76)
3/4" (20)	1.050 (26.67)	0.154 (3.91)	1440 (9.93)	2200 (15.17)
1" (25)	1.315 (33.40)	0.179 (4.55)	1320 (9.10)	2020 (13.93)
1-1/2" (40)	1.900 (48.26)	0.200 (5.08)	990 (6.83)	1510 (10.41)
2" (50)	2.375 (60.33)	0.218 (5.54)	850 (5.86)	1290 (8.89)
2.5" (65)	2.875 (73.02)	0.276 (7.01)	890 (6.14)	1360 (9.38)
3" (80)	3.500 (88.90)	0.300 (7.62)	790 (5.45)	1200 (8.27)
4" (100)	4.500 (114.30)	0.337 (8.56)	680 (4.69)	1040 (7.17)
6" (150)	6.625 (168.27)	0.432 (10.97)	590 (4.07)	890 (6.14)
8" (200)	8.625 (219.08)	0.500 (12.70)	520 (3.59)	790 (5.45)
10" (250)	10.750 (273.05)	0.593 (15.06)	490 (3.38)	750 (5.17)
12" (300)	12.750 (323.85)	0.687 (17.45)	480 (3.31)	730 (5.03)

1. *Standard ASTM test procedures

- D. FITTINGS: Fittings shall be of the same schedule and rating as the pipe in which they are installed.
- E. JOINTS: Solvent weld PVC glue joints for pipe to pipe connection. PVC flanges with stainless steel bolts and hardware for connection to butterfly valves; bulkhead fittings for connection to stainless gutters where shown on plans or for connection to small filters. Larger filters require PVC flange connections. "O" Ring gasketed pipe not permitted.

- F. UV PROTECTION: Any PVC pipe to be installed where it is exposed to sunlight shall be provided with manufacturer's UV inhibitor such as titanium dioxide or equal and shall be painted with two coats of acrylic latex paint to provide long term UV protection.

2.2 PIPE ACCESSORIES

- A. Pipe Penetration Gasket: Pipe penetration gaskets where designated and for all pipe 100 mm (4 inch) diameter or larger passing through existing concrete structure shall be Linkseal, Metraseal or approved equal compression gaskets consisting of rubber links compressed by stainless steel plates and hardware.
- B. Pipe Hangers: Small pipe (3" or 80 mm or smaller) shall be suspended from ceilings or walls by Clic-X nylon serrated locking strap fasteners secured to the ceiling or wall with stainless steel expansion anchors of appropriate size.
- C. Pipe Hangers: Larger pipe (4" or 100 mm or larger) shall be suspended from ceilings with fiber reinforced plastic (FRP) clevis straps with galvanized steel all-thread rods drilled and epoxy anchored into the ceiling. Alternatively, for multiple parallel pipe, the hanger can be fabricated with galvanized Unistrut framing supported by at least two galvanized steel all-thread rods drilled and epoxy anchored into the ceiling.
- D. Pipe Stands: FRP Unistrut; PVC pipe saddle. Pipe stands shall be furnished with floor flanges, stainless steel anchor bolts and a curved cradle supporting a length of one pipe diameter and at least one fourth of the circumference of the pipe. Supports 24" (600 mm) in height or less from centerline of pipe to floor may be constructed of cast-in-place concrete cradled as described above. Rubber isolation pads are required against any concrete cradle for the full length and width of the cradle. Two (2") inch (50 mm) and smaller pipe along walls shall be supported with Clic-X nylon brackets with stainless hardware.
- E. Saddle Tees: PVC glue on or snap on saddles are not permitted. Clamp on saddle x socket single outlet shall be required. Clamp on saddle shall have stainless steel bolts & Viton O-ring seal hardware installed with saddle.
- F. No-Leak Flanges: Any pipe 80 mm (3-inches) or smaller nominal diameter cast into a pool, spa, fountain or stream wall or floor (or other necessarily water tight structure such as a surge tank) shall be fitted with a no-leak flange set mid-depth of the wall or floor. The no leak flange can either be a glued-on fiberglass or PVC flange or a molded PVC fitting to which the pipe is glued or threaded on each side. Larger pipe requires Pipe Penetration Gasket in Paragraph A above.
- G. PVC Pipe Solvent Welding/Joining Materials:
1. PVC pipe cleaner/primer: UV/blacklight detectable primer. Do not use colorless or 'purple' primer. (Primer supplier to provide blacklight 'flashlight' for detection to prove-up primer application.)
 2. PVC pipe solvent welding cement glue: Use materials clearly marked for use in the pipe being joined. Glue to be clear, untinted.
- H. Insulating Spray Foam: CertaSpray Closed Cell foam or equal spray applied insulation and condensation prevention insulating. Install where shown on plans to a minimum thickness of 1" around pipe surface.

Pool contractor to install insulating foam on pool/spa or water feature suction and return lines where piping is installed in an interior finished space. Parking garages are not a finished space.

2.3 VALVES

- A. SMALL VALVES: Valves in PVC lines up to and including three inches (80 mm) in nominal size shall be full port, full union CPVC, PVDF, or PVC ball valves (matching the size and material of the line in which they are installed). Hayward TB Series True Union Ball Valves or equal.
- B. LARGER VALVES: All valves 4" to 12" (100 to 300 mm) nominal diameter, inclusive, shall be PVC body wafer valves installed between pipe flanges, with 316 stainless steel shaft and pin. The disc shall be PVC unless otherwise specified or shown, manually actuated valves shall have 10 position latch lock handles. All bolts and nuts shall be stainless steel with stainless steel washers to be used when secured to PVC flanges. Eight (8") inch (200 mm) and larger valves shall be gear operated. ASAHI/AMERICA POOL-PRO or equal.
- C. CHECK VALVES: Check valves smaller than 3" shall be Spears - True Union 2000 Industrial Ball check valves or equal. Larger check valves sizes may be swing check or double door check valves.
 - 1. Swing Check – Spears or equal PVC body swing check valve with Viton O-ring seals. Valve shall have drain plug for servicing. No counter balance or indicator is required.
 - 2. Check valves 4" and larger shall be APCO CDD-9000T double door check valves with 316 stainless steel body, door, spring, and hinge pin. Seat material shall be EPDM.
- D. VALVE TAGS: Provide each valve with a laser engraved 1-1/2" diameter round brass valve tag with beaded chain (pipemarker.com or equal) stating the function of the valve such as but not limited to:
 - 1. HEATER MODULATION
 - 2. POOL MAIN DRAIN, SPA MAIN DRAIN
 - 3. POOL SKIMMER, SPA SKIMMER
 - 4. HEATER IN and HEATER OUT
 - 5. BACKWASH
 - 6. POTABLE WATER SUPPLY
 - 7. PUMP DISCH
 - 8. NORMALLY CLOSED (Use this tag for any valve such as a pool or tank drain valve which shall be left closed under ordinary circumstances.)

2.4 BACKFLOW PREVENTION

- A. Reduced pressure zone principle backflow preventer equal to Watts Co. Model 909-QT where required on plans and whenever a potable water source is connected directly to the pool plumbing system as in the case of make-up water supplies.

2.5 BACKFILL MATERIAL

- A. Earth materials suitable for backfill of pipe trenches shall meet the following requirements: Gradation – From fine powder to minus 1 inch (25 mm) diameter screen. No large clods, rocks or clumps. Excavated rock must be crushed to be used in backfill.
 - 1. Organic matter – No visible roots or other organic matter.
 - 2. No other construction materials or debris other than earth, sand, gravel or small rock.

- B. Excavated trench spoil may be used for backfill if it conforms to the requirements above.
- C. Reject unsuitable excavated trench spoil and supplement with borrow that meets these requirements.

2.6 PIPE IDENTIFICATION MATERIALS

- A. Seton (www.seton.com) or equal custom printed Opti-Code self-adhesive colored tape pipe markers with contrasting lettering identifying pipe function.

Pipe Function/Wording:	Band Color:	Letter Color:	Seton No.
POTABLE WATER	Dark Blue	White	M4154
MAIN DRAIN	Black	White	M4154
SKIMMER DRAIN	Green	White	M4154
FILTERED WATER	Gray	White	M4154
CHLORINE	Yellow	Black	M4154
ACID	Red	White	M4154
BACKWASH	Brown	White	M4154

Pipe sizes (DN):	¾" to 1¼"	1½" to 2½"	3" to 4"	4½" to 8"	+10"
Seton Size	8SM	8LG	12	24	32

- B. Seton or equal directional self-adhesive 'directional arrows-on-a-roll tape'; 1-inch (25 mm) wide with black arrow.

PART 3 - EXECUTION

3.1 GENERAL

- A. The drawings indicate the general arrangement of the pool plumbing. Details of proposed departures due to actual field conditions or other causes shall be submitted to the Consultant for approval.
- B. The pool contractor shall carefully examine the drawings and shall be responsible for the proper fitting and materials and equipment as indicated without substantial alteration.
- C. No installation shall be made that will provide a cross connection or inter-connection between a distributing supply for drinking purposes and the swimming pool or fountain that will permit a backflow or siphonage of water into the water supply.
- D. Pipe openings shall be closed with caps or plugs during installation. Equipment and pool fittings shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. At the completion of the work, the fittings, materials and equipment shall be thoroughly cleaned and adjusted for proper operation.
- E. Workmanship: All materials to be used in this work shall be installed by workmen thoroughly skilled in their trade and all work shall present a neat and mechanical appearance when complete. The Consultant shall be the sole judge of whether work installed under this contract has met this requirement and the pool contractor, at no additional expense to the Employer, shall replace or correct any work not judged acceptable by the Consultant.

- F. Layout: Exposed pipe in pool mechanical spaces shall be installed such that the pipe is parallel or rectilinear to building walls, Angled, twisted, strained or forced-fit pipe and fittings or use of "flex" pipe is prohibited. Pipe may not be run in direct contact with the building floors, walls or ceilings but shall be held off by the use of the prescribed brackets.
- G. Heating or torching plastic pipe to bend or shape it is strictly prohibited.
- H. Prior to laying any piping, the Pool Contractor shall schedule a "Pre-Plumbing Installation Conference" with the General Contractor for the purpose of determining the final layout of field piping and plumbing and equipment in the pool equipment area after coordinating with all other trades.

3.2 CUTTING PIPE: Shall be done in a neat and workmanlike manner without damage to the pipe. Cutting may be done by means of mechanical cutter or hand saw. Remove all burrs. Ends of pipe shall be square cut and beveled before joining.

3.3 OPEN CUT INSTALLATION: The interior of the pipe shall be thoroughly cleaned of foreign matter and shall be kept clean during laying operation. Pipe shall not be laid in water or when trench or weather conditions are unsuitable for the work. Water shall be kept out of the trench until the pipe is installed. When work is not in progress, open ends of the pipe and fittings shall be securely closed so that no trench water, earthen or other substance will enter the pipes or fittings.

Pipe shall not be installed in direct contact with subgrade rock or buried concrete structures but rather shall have a minimum of 100 mm (4 inches) finely graded backfill material as cushion between the pipe and any rock or structures.

Buried pipe under yard, pavements, walks or deck shall have minimum 2'-0" (600 mm) cover. If invert elevations are shown, cover may be much greater than 2'-0" (600 mm). Invert elevations govern.

Pipe shall be fully supported along its length in the trench as backfilling takes place. Pipe shall not be allowed to span lower trenches or voids without full earth support.

Where possible, use a common trench for pool piping to minimize number of open cuts and possible conflicts with other trades. Pipe within a common trench shall be laid side by side with at least 2 inches (50 mm) between adjacent pipe walls to allow for later servicing. Pipe shall not be laid atop other pool pipes within the common trench.

3.4 BACKFILL: Backfill the pipe with clean earth, free of rocks, clods or vegetative matter. Mechanically tamp backfill with a trench compactor or packer plate in 9-inch (22 cm) loose lifts adding water to achieve maximum density.

3.5 PIPE PENETRATIONS:

- A. Casting in pipe: If permissible by General Contractor in scheduling other work, pipe 3-inch (80 mm) diameter may be cast into walls of pits or pools but must have integral PVC no leak flanges mid-depth of the wall.
- B. Installing pipe through existing walls: Pipe shall be installed in sealed cores. The concrete shall be cored to a diameter as follows and sealed with a compression gasket (Linkseal):

<u>Nominal pipe size:</u>	<u>Core diameter:</u>
Less than or equal to 4" (100 mm)	Pipe OD + 2" (50 mm)
Greater than 4" (100 mm)	Pipe OD + 4" (100 mm)

- C. In lieu of coring, pipe sleeves with a pipe inside diameter (ID) equal to the core diameters above may be cast into pit walls. Compression gaskets (Linkseal) shall then be used to make the installation watertight.
- D. If noted on specific core or sleeve installations on the plans, install expansive grout (grout to which Sika Interplast-N has been added) on the 'wet' side of the gasket and strike off flush with concrete surfaces.

3.6 PIPE SLOPE

- A. Generally unless grades are noted on the plans, direct suction and pressure pipes (pipe connected to pumps and not relying on gravity for flow) are not required to be laid on specific gradient but shall be installed on a reasonably uniform slope that affords full support of the pipe along its centerline.
- B. Gravity gutter drains or gravity skimmer lines shall slope toward surge pit or equalization basin at a minimum slope of 1 percent. Main drains from deep pools shall rise up immediately upon clearing the shell but only enough to flow on gradient to surge pit or equalization basin.

3.7 PIPE SUPPORT

- A. General: No exposed mechanical room pipe four inches (100 mm) in diameter or more shall be unsupported for a span greater than 48 inches of the pipe.
- B. Floor support: Pipe in filter rooms may not be run in contact with the floor. Pipe support pipe stands shall be used in filter galleries or other locations where long runs of horizontal pipe are installed without support of walls or equipment.

FLOOR MOUNTED PIPE SUPPORT			
Pipe Size (Imperial)	Pipe Size (DN)	Height Above Floor	Method of Support
0" - 5"	0 to 125	2" - 8'-0" (50 mm to 2.5 m)	a. Uni-strut (FRP only) b. (1)
6" - 12"	150 to 300	4" - 2'-0" (100 mm to 600 mm)	a. concrete pedestal b. pipe stand with cradle (steel)
6" - 12"	150 to 300	2'-1" - 5'-11" (600 mm to 1.8 m)	a. pipe stand with cradle - bolt to floor
6" - 12"	150 to 300	6'-0" - 10'-0" (1.8 m to 3 m)	a. (1) b. frame x-braced against sway Uni-strut c. other approved structural steel support
(1) Suspending from ceiling or wall mount required when ceiling or walls are available.			

- C. Hanging Pipe Support: Furnish and install any necessary threaded rod/Unistrut cradles and clevis hangers to support pipe from ceilings. Use only stainless steel or FRP rods or fasteners. Galvanized punch straps or wires or other makeshift pipe hangers are not acceptable.

3.8 JOINING PIPE

A. SOLVENT-WELDED JOINTS:

1. Shall be made in accordance with the manufacturer's recommendations. However, the following directions are considered minimum standards. All fittings shall fit easily on the pipe before applying cement. The outer surface area of pipe and inner wall of fitting shall be clean and dry. Primer is to be applied to the outer surface of the pipe and the inner surface of the fittings. Cement is to be applied to the outer surface of the pipe, or on the male section of the fitting only. When the outside surface area of the pipe end is satisfactorily covered with cement, allow ten (10) seconds open time to elapse before inserting pipe into fittings, turn fitting about the pipe end approximately 1/8 to 1/4 of a turn. Wipe off excess cement at the joint in a neat cover bead.
2. All joints shall remain completely undisturbed for a minimum of ten (10) minutes from time of joining the pipe and fitting. If necessary to apply pressure to a newly made joint, limit to ten (10) percent of rated pipe pressure until four (4) hours after joining.
3. Carefully handle all pipe and move as little as possible so that the cement seal shall not be broken before it is completely dry.
4. Full working pressure shall not be applied until the joints have set for a twenty-four hour period.
5. Protect plastic pipe from exposure to aromatic hydrocarbons, halogenated hydrocarbons and most of esters and ketones that attack the material. Protect all pipe from mechanical damage and long exposure to sunlight during storage.

B. THREADED JOINTS

1. Make threaded pipe joints with Teflon tape or approved equal, applied to the male threads only.
2. Do not apply solvent cement to threaded parts

C. FLANGED JOINTS - All connections between PVC and metal pipes 4 inches (100 mm) diameter or larger must be flanged, plastic flange to metal flange. DO NOT use threaded connections between plastic and metal pipe except for 3-inch (80 mm) and smaller pipe and where specifically noted otherwise.

D. O-RING GASKETED PIPE NOT PERMITTED - "O" Ring rubber gasket pipe shall not be used in swimming pool, spa, or fountain applications except for gravity sewer outfall lines, deck or floor drains, or other non-pressure applications approved by the Consultant.

3.9 BACKFLOW PREVENTION

- A. Backwash Piping: Backwash piping shall not be connected directly to sanitary sewer or sanitary sewer manholes but shall be terminated by the Pool Contractor at least two pipe diameters above the receiving pit or manhole overflow elevation.
- B. Potable (Make Up) Water: Make up water lines shall not directly connect to pool plumbing piping without use of a reduced pressure zone principle backflow preventer being installed in line on the potable supply side of the connection. An approved air gap fitting is acceptable if the potable water empties into a tank.

3.10 PIPE INSTALLATION COMPLETION

- A. Color Coding: Exposed piping in pools, fountains and spa vaults or mechanical spaces shall be color decal banded according to the scheme shown in Part 2 - MATERIALS and labeled as to function and direction of flow.
- B. Flushing: All pipe lines leading to or from the pool, fountain, or spa shall be thoroughly flushed clean before the pool is filled and placed in use. All drain boxes, surge tanks or other vessels shall be cleaned of sand, gravel or debris before being placed into service.
- C. Taps: Taps on pipe where required for probes, meters, small pipe connections, or similar equipment shall be made using a clamp-on saddle with appropriately sized NPT outlet. Direct tapping, or glue on saddles of PVC pipe is not permitted.
- D. Cleaning: Remove excess glue, dirt, stains, paint or other similar materials from completed pipe prior to final acceptance of project by Employer.

3.11 QUALITY ASSURANCE AND TESTING

- A. Pressure Testing:
 - 1. Prior to pneumatically applying concrete to pool, spa or fountain shells, camp and test all rough-in pool plumbing by hydrostatic test, purging all air from lines and filling them with water with using a test pump adequate to raise the pressure in the line to the test pressure level. DO NOT AIR TEST PVC PIPE. Pressure test every pool line to 40 psi (0.276 Mpa) and hold for six hours with no drop in pressure and with no additional pumping or air pressure. Provide temporary pressure plugs and valves to allow for isolation and testing of lines. Provide pressure gage on each line being tested. With gages still in place, hold hydrostatic pressure on lines while concrete is placed. Repair all leaks and retest until passing.
 - 2. Prior to placing pool, spa or fountain recirculation system into service, hydrostatically test all lines in accordance with the above procedure, to the same pressure and for the same duration.
 - 3. Testing must be completed and passed before a section of pipe may be covered, enclosed or otherwise made inaccessible.
- B. Trench Backfill Testing:
 - 1. Unless otherwise provided in these specifications, trench compaction testing is not required for pool, spa, or fountain piping.
 - 2. The pool contractor shall excavate and re-compact any trenches he has backfilled which settle due to poor compaction technique or backfill materials

END SECTION 13 11 46

CITY OF DENTON
WAVE POOL

**SECTION 131416
WAVE GENERATION EQUIPMENT**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. This specification section may relate to work described in other sections, specifically Section 13000-Swimming Pool. In the case of discrepancies, this section shall govern as it pertains to the wave generation equipment system described herein.
- B. This item is to be furnished under an ALLOWANCE line item which allowance shall be deemed to cover:
 - a. Wave pool blowers
 - b. Compressor
 - c. Embed caisson slide gate valves.
 - d. Blower ducts
 - e. High temperature shut off switch
 - f. Emergency shut off switch (within the blower room only and not the remote shut off switches shown)
 - g. Wave controller panel
 - h. Shipping from manufacturer to Denton, Texas via ground freight.
 - i. Wave fan check valve
 - j. Plenum discharge fan and hardware
 - k. 1" pneumatic piping
 - l. Plenum access hatch
 - m. Spare parts cabinet
 - n. Audible alarm
 - o. Caisson grates and frames
 - p. Caisson splash guards
 - q. Services of manufacturer's start-up technician at start up.
- C. The following items of work are specifically NOT included in the allowance but required for the complete work:
 - a. Off loading, storing and protection of wave equipment.
 - b. Insurance on equipment after reaching the project site.
 - c. Concrete construction of any kind.
 - d. Installation of wave equipment including mechanical fastening, electrical, connecting, and control system wiring.
 - e. Ventilation and lighting of the blower or electrical rooms.

1.2 DESCRIPTION OF WORK

- A. Manufacturer

1. The Manufacturer below has been selected to furnish a wave generation equipment system for the wave pool as shown on the project drawings and specified herein.

WaveTek,
13 Green Mountain Drive
Cohoes, NY 12047
Phone: 518.783.0038
Fax: 518.783.0474
E-mail: sales@aquaticgroup.com.

2. This wave system is designed to accomplish the periodic generation in accordance with the patterns and wave heights as specified within the corresponding contract documents.

1.3 ALLOWANCE

- A. **A specified allowance for the purchase of wave generation equipment has been provided in the bid form. The amount may not be changed by the Bidder and represents the maximum total funds to be paid for the equipment.**
- B. **The amount paid to the Contractor for the wave equipment will be the actual invoice amount to the contractor from the Manufacturer, the stated allowance notwithstanding.**
- C. **A line item has been provided in the Bid Form for the Bidder to insert additional Contractor costs associated with the handling, insuring, installation and testing of the wave equipment which shall include all profit and overhead for the equipment. The Contractor will be paid the actual invoice amount for the equipment PLUS the line item for handling, insuring, installation and testing.**

1.4 SUBMITTALS

- A. Submittal Drawings- Submittals drawings must include dimensioned plan and elevation views as well as detailed locations of all wave generation equipment components, accessories, and all other required and specified components.
- B. The drawings shall state the predominant materials of construction and their finishes.
- C. Submittals shall also shall clearly delineated limit of supply lines as well as detail any relationship to adjacent work of other trades.

PART 2 – PRODUCTS

2.1 DESIGN & MATERIALS OF CONSTRUCTION

- A. Embedded Items
 1. Embedded items, as required by the specific system design, shall include stainless steel valve block-outs, wave fan block-outs, and a duct access port framed cover.
 2. All embedded items, with the exception of the cover for the pressurized air manifold access port, shall be constructed of 304L stainless steel. The manifold access port shall be constructed of an

inert material structurally sized and suited for the corresponding manifold loads.

3. Each embedded item must be electrically bonded to meet NEC and any other state or local governing codes.

B. Wave Fans

1. Wave fans must meet the design flow and static pressure requirements associated with the wave patterns and heights as specified by the corresponding contract documents.

2. Wave fans shall be low-pressure, high volume, centrifugal fans powered by direct-coupled induction motors. The fan housing shall be of all 304L stainless steel construction. In addition, fan housings shall be sandblasted and epoxy coated for additional corrosion resistance.

3. Wave Fan Motors

- a. Motors must be continuous duty rated and of a premium efficiency design.
- b. Motors shall correspond to the NEMA assigned frame number, as dictated by speed and horsepower, for a general purpose, open drip proof, TC, foot mounted, style frame.
- c. The shaft length and end bearing configurations shall be as dictated by the corresponding TC style NEMA frame provided said shaft length allows for direct coupling with the impeller hub and the bearings will accommodate the corresponding loads at the given speed. Motor shafts shall be drilled and tapped for the installation of an impeller-retaining device.
- d. Motor windings must be triple-dipped for long-term protection.
- e. Space heaters must be installed to operate at any time the motor is turned off to maintain dryness of the windings.
- f. Motors must be precision balanced by the manufacturer.
- g. Motor mounting bases must include a structural mounting frame. Said frame, after being leveled and secured into position must be filled with a concrete mass as specified on the submittal drawings to minimize vibration.

4. Wave Fan Impellers

- a. Wave fan impellers shall utilize backward inclined, airfoil design blades for stable air delivery and non-overloading characteristics.
- b. Construction shall be of a Corten, or equal, material for corrosion resistance, high strength, and fatigue resistance. Impellers shall be additionally coated to a minimum of 1-1/2 mil thickness with a black rust inhibitive primer finish coat with a phenolic modified alkyd vehicle or binder.
- c. Impellers must be factory dynamically balanced.
- d. Impellers must be of all-welded design.
- e. Hubs shall be of the taper-lock design.

5. All fasteners that secure the c-face of the motor to the fan housing must be safety-wired to prevent back out during operation. The

impeller-locking device shall be similarly safety-wired for the same purpose.

6. Vibration analysis of the completed installation shall be less than 0.20 inches/second. If outside this range a qualified balancing shop shall be employed to bring the assembly in to the correct range.
 7. A 304L stainless steel inlet cone shall be precision fitted to the inside diameter of the impeller to maximize efficiency. A stainless steel space cloth shall be installed on the outside of the cone for personnel protection during operation. Dowel pins shall be used when locating the inlet cone to permit correct alignment if removed in the future.
 8. In the case of multiple fans, each fan must be equipped with a check valve at the discharge to prevent backward spinning of fans not concurrently in operation. Each check valve must provide for minimal leakage past the check valve doors. They must be of 304L stainless steel general construction with all non-stainless components of an inert material. In the case of multiple doors, the doors shall be linked together so as to be incapable of independent operation.
 9. All connection hardware shall be of 18-8 stainless steel.
- C. Air Directional Valves (ADV)
1. With the exception of the air cylinders, the ADVs must be of 304L stainless steel general construction with all non-stainless components of an inert material.
 2. All ADVs shall incorporate minimal leakage valve seats that must be capable of withstanding the maximum static pressure developed by the wave fans.
 3. Valves must be designed to provide for multiple wave patterns based on the specific project's programming set-up.
 4. Each ADV shall be equipped with easily replaceable air cylinders that shall exhibit crisp motion from full open to the full closed position during its life cycle. Air cylinder rods shall be fitted with a rod eye which itself shall include a spherical bearing and a grease fitting.
 5. Door hinges shall be fitted with replaceable wear bearings.
 6. The manufacturer shall provide spare parts sufficient to ensure the continuous operation for a one-year period inclusive of pneumatic cylinders, solenoid valves, gasket material, bearing sets, etc.
- D. Splashguards
1. Splashguards shall be of 304L stainless steel construction.
 2. Splashguards shall be of a tested design that eliminates water egress from the caisson into the wave equipment room during maximum wave height operations.
- E. Caisson Grates
1. Each caisson shall have a protective grate at the point of the connection with the wave pool proper.
 2. Grates must be of 304L stainless steel construction. All anchoring and fastening hardware shall be of 18-8 stainless steel. Bond grates to the pool bonding grid.

WAVE GENERATION EQUIPMENT

3. The grate design must employ a rod spacing consistent State and local codes.
 4. Anchor clips shall allow for some tolerance on installation to make up for non-uniformity in the concrete opening.
- F. Ducted Systems (Non-Applicable to Concrete Plenum Air Manifolds)
- G. Pneumatic System
1. The pneumatic sub-system shall include an air compressor and receiver tank of sufficient size to maintain adequate air pressure at each ADV during prolonged wave runs. The receiver tank associated with the compressor shall be provided with an auto-drain valve.
 2. The manufacturer shall provide all the components of the pneumatic system inclusive of the compressor and receiver tank, valves, particulate filters, coalescing filters, regulators, low-air cut-off, high pressure relief valve, air dryers, lubricators, drip legs, piping, wall mount clamps, and fastening hardware.
 3. All equipment within the system shall be of a minimum of 125 PSIG service rating.
- H. Wave Control Panel
1. The panel in question shall be a UL-listed control panel capable of all required motor starting, timing, and sequencing of all wave equipment electrical elements including, but not limited to, wave fan motors, control valves, solenoids, automatic stop station, and optional audio announcement system.
 2. The electrical equipment shall be housed in an enclosure manufactured to NEMA standards and provided with filtered forced-air ventilation. In the case of freestanding control panels the enclosure shall be of a NEMA 12 rating. In the case of wall mounted control panels the enclosure shall be of a NEMA 4 rating.
 3. Motor Control Circuitry
 - a. For wave fan motors of 50 HP and higher, solid-state reduced-voltage starting equipment shall provide smooth step-less acceleration to optimize starting performance and eliminate electrical and mechanical shock. Where solid-state starters are employed the option shall be provided to limit the in-rush surge at time of start-up.
 - b. The following items shall be additionally provided:
 - i) Circuit breakers for each motor.
 - ii) Low-voltage, phase loss, and short circuit protection for three-phase equipment.
 - iii) Thermal overload protection for each motor.
 - iv) Indicating light for a power ON condition.
 - v) Indicating light for proper position of all emergency stops to permit a start of the system.
 - vi) Indicating light for a motor overload tripped condition.
 - vii) Indicating light for an equipment room high temperature condition.

- viii) Indicating light for low air pressure condition.
 - ix) An hour meter for each wave fan.
4. Programmable Logic Controller (PLC) – Multiple Wave Pattern System
- a. A programmable logic controller shall be used to allow for the selection of different wave patterns.
 - b. An operator interface panel shall be provided for selection of both wave cycle run time and rest cycle time.
 - c. The PLC software shall be able to run multiple wave patterns, accept selective switch input for selection of specific wave patterns, allow entry of the sequence of operation of the selected wave patterns, supply the ability to fine tune wave timing to hundredths of a second incremental accuracy to the match dynamics of the pool design, and shall provide an early bell signal to sound before starting waves.
 - d. The software shall include eight selections for use in choosing the particular wave patterns and a procedure to establish the sequence of the selected wave patterns. Each pattern shall sequentially transition to the next pattern automatically.
5. Programmable Logic Controller (PLC) - Diagnostic Light List
- a. LEDs for operating motors.
 - b. LEDs for operating air directional valves.
 - c. LED for the operating bell.
 - d. LED for the start signal.
 - e. Programmable Logic Controller (PLC) - Displays
 - f. Wave cycle time elapsed.
 - g. Rest cycle time elapsed.
6. Key-activated control circuitry with relays and solid-state timers that are totally separate and independent of the programmable controller controls, shall be provided which will allow the operator to run diamond wave patterns when it is desired to over-ride the programmable controller circuitry described herein.
- I. ACCESSORIES
- 1. Remote Stop/Start: The WGE supplier shall provide one remote STOP/START switch and three STOP switches to deactivate the wave generation equipment. The wiring and installation of the equipment at the lifeguard stations shall be the responsibility of the electrical contractor. Said switches shall be provided in NEMA rated enclosures.
 - 2. Audio Alarm: The WGE supplier shall provide one alarm signal to alert swimmers that the wave action is about to begin. The alarm signal shall be a 120 VAC, 1 amp output to be connected to an alarm device supplied by the owner.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING

- A. Shipping, Delivery & Storage
 - 1. The wave generation equipment shall be shipped to the jobsite in components. Coordinate on site delivery to minimize handling and storage
 - 2. The wave generation equipment components shall be unloaded and stored in strict accordance with the manufacturer's operation and maintenance manuals. Failure to do so may void the warranty.
 - 3. The owner/contractor is fully responsible for the safe storage of the wave generation equipment components including damage done by others, weather, vandalism, etc.

3.2 INSTALLATION

- A. Location
 - 1. Refer to the project drawings and manufacturer's submittal drawings for the locations of all wave generation equipment components.
 - 2. The equipment manufacturer's representative will make any necessary final adjustments to the system.
- B. Conflicts
 - 1. The contractor shall promptly notify the Engineer, in writing, of any conflict between any requirements of the general contract documents and the manufacturer's specific written instructions prior to proceeding with installation.

3.3 FACTORY INSTRUCTIONS, START-UP, & TRAINING

- A. Prior to startup and instruction, the manufacturer shall provide the Owner with two complete sets of printed maintenance and operating instructions for the wave generation equipment system.
- B. A manufacturer's representative shall instruct the facility personnel, responsible for the use, care, operation, and maintenance of the equipment, in regards to the complete operation and general maintenance of the equipment components that comprise the system.

PART 4 – POST INSTALLATION

- 4.1 The manufacturer shall warrant, in writing, that the wave generation equipment is to be free from defects in material or workmanship for a period of two years from system acceptance after training. Further it shall be stated in writing that so long as the wave generation equipment is operated and used in conformance with written instructions given and acknowledged by the Owner it will perform in accordance with these specifications.

The warranty shall not cover damage caused by abusive treatment to the wave generation equipment during the construction phase of the project or when the equipment becomes operational.

END OF SECTION 13 14 16

CITY OF DENTON
WAVE POOL

SECTION 22 51 19
SWIMMING POOL WATER TREATMENT EQUIPMENT

PART 1 - GENERAL

- 1.1 Scope: The Pool Contractor shall furnish and install a swimming pool water treatment system complete with all necessary items including the feeding, monitoring, and ph control, including all pipe and valves as hereinafter specified, and all accessories. This includes PVC pipe, unions, check valves, ball valves and fittings; ball type flow indicator.
- 1.2 Equipment to be furnished and installed:
- A. Chemical monitor/controller
 - B. Acid storage tank and peristaltic pump
 - C. Calcium hypochlorinator and pump
 - D. Ultraviolet light disinfection system
 - E. OSHA and NFPA Chemical Hazard Signs
- 1.3 Work Covered Under Other Sections:
- A. Refer to electrical sections Division 26 for all power distribution, starters, switches, panel boards, transformers and related electrical wiring. Pools shall be electrically bonded.
 - B. Refer to other specification sections for pool finishes, deck and coping stone, for fountain urns and finishes for fountains. Finishes are not specified in this section.
 - C. Refer to Section 131100 of these specifications for "Swimming Pools".
 - D. Furnishing and installing piping and accessories are covered under Section 131146 "Swimming Pool, Fountain and Spa Piping".
 - E. Electrical work required but not defined in this section
 - Step down/up transformer if required by conditions on project.
 - Conduit, electrical fitting and conductors. Wiring and connection of equipment supplied by others, under this section.
 - Installation of Aunistrut® supporting devices for starter panel.
 - Electrical lockout of entire chemical feed system when pool circulation pump is not running in addition to system flow switch.

PART 2 – PRODUCTS

- 2.1 Swimming Pool Chemical Monitor/Controller: The pool monitor controller shall be a ProMinent DCM 2 unit with probe chamber, pH and ORP probes, and safety flow switch to disengage feeders when pool circulation is halted.
- A. Provide one extra probe each for pH and ORP.
 - B. Provide electrical power to the unit (120VAC).
 - C. The controller regulates liquid acid feed and liquid chlorine feed rates by switching feeders on and off. These devices plug into the controller.

SWIMMING POOLS WATER TREATMENT EQUIPMENT

- D. Mount the unit on a clear acrylic back board held off the wall between 1/2" and 3/4" with spacers on the masonry anchors.
- E. Neatly tie up all excess wire from probes to controller.
- F. Set the unit approximately 48" to 54" above finished floor in the pool mechanical room.
- G. Install the monitor on a branch loop off of the main pool circulation line. [This loop is also the chemical solution feed line.]Take off water to the probe chamber from the bypass loop before any chemical feed takes place. Return sampling line to the pool circulation line post-heater. Isolate the loop on each end with ball valves.
- H. Provide manufacturer's optional lockable acrylic cover.

2.2 DISINFECTANT FEED:

Calcium Hypochlorite

- A. Provide Pulsar System 500, as specifically shown on the plans. Pulsar is a registered trademark of Arch Chemicals, Inc., Naperville, Illinois.

PULSAR 500 (feed capacity 25-500 lbs. free available chlorine/day)
Pulsar chem. loop booster pump
Venturi injector
300 lb. feeder capacity
Electronic overflow shut off switch; shut off valve
Polyethylene tubing

- B. Calcium hypochlorite tablets with minimum 65% available chlorine by weight; between 4.0 and 8.5 percent water by weight; between 0.4% and 0.6% scale inhibitor; in briquette form weighing between 6.5 and 7.5 grams per briquette.
- C. Furnish upon start-up of the pool two gallons (eight 1-quart bottles) of Pulsar Plus Acid Cleaner 50 in original unopened cartons for removing residue and scale from the chlorinator.

Ultra Violet Light Disinfection System

- A. Equipment shall operate within the electromagnetic spectrum emitting wave lengths in the range of 200 to 400 nanometers to provide constant disinfection and/or inactivation of bacteria, algae, molds, viruses and destruction of chemical mono-, tri-, and di-chloramines.

EngineeringTreatment
Systems, LLC
W9654 Beaverland Parkway
Beaver Dam, WI 53916
877.885.4628

Hanovia
Aquionics Inc.
21 Kenton Lands Road
Erlanger, KY 41018

SWIMMING POOLS WATER TREATMENT EQUIPMENT

859.652.2159

Manufacturers shall have five years in the UV disinfection system market intended for swimming pool applications. Refer to plans for model identification

- B. Furnish with manufacturer's control panel.
- C. Lamps shall be medium pressure/high intensity U.V. lamps designed to provide continuous U.V. wavelengths in the range of 200 nm to 400 nm. Lamps shall be warranted for a period of 4000 hours. Provide one full set of replacement bulbs for each U.V. chamber provided in this project.
- D. UV disinfection has no residual and therefore must be accompanied by a disinfectant that leaves a residual. The UV disinfection is secondary to the primary disinfected method.
- E. Voltage available is 480VAC/3 Ph/ 60 Hz. Voltage transformer may be required refer to product requirements. If required, contractor to furnish and install.
- F. For periodic cleaning of the quartz sleeves and the UV monitor probe, the chamber shall be fitted with an automatic cleaning mechanism. The frequency of the wiper cycle shall be adjustable from 15 to 720 minutes and set for job conditions.
- G. The wetter surfaces shall be chemically passivated and all welds ground to eliminate any potential corrosion mechanisms. Crevices (as found behind a quartz thimble) shall not be permitted under any circumstance.
- H. The unit shall be sized to operate at 100% of the design flow (1700 GPM).
- I. Ultraviolet light reactor tubes shall be installed in the primary filtered return line ahead (upstream) of heaters and chemical injection points with isolation valves on either side of the tube and a valved bypass loop. Furnish and install in-line wire funnel strainer between flanges and downstream of the UV tube to catch any broken glass from the unit.
- J. The unit shall shut down automatically on loss of power to the pool circulating pump.

2.3. PH CONTROL:

Muriatic Acid

- A. Acid feed shall be accomplished using a Stenner, LMI, or ProMinent peristaltic pump 0.5 - 10 gpd delivering muriatic acid to the chemical loop in a silicone tube with Santoprene or equal injection check valve just upstream of the chlorine injection point.
- B. The acid pump shall be connected electrically to the chemical monitor/controller which shall switch the pump on for pH adjustment. The suction tubing penetration from the drum shall be air tight through a stopper or vent. Acid feed shall be halted immediately on the loss of pool circulation. Interlock electrically with the pool circulation pump.
- C. Furnish Stenner Pumps STS Series tank system. Furnish UV resistant gray tank with Viton Grommets and stainless steel hardware.

SWIMMING POOLS WATER TREATMENT EQUIPMENT

- D. Furnish acid carboy with an acid vapor scrubber equal to ProMinent or a non-metallic air admittance vent to prevent release of acid fumes into the mechanical room.
- F. Furnish 15 gal. of muriatic acid upon completion of project.
- G. Furnish and install polyethylene spill pallet with ramp under acid containers in use or spare.

PART 3 - EXECUTION

3.0 GENERAL

- A. Install all equipment in accordance with manufacturer's written instructions.
- B. Install all equipment neatly within the mechanical room, parallel to walls and level to floors.
- C. Furnish all equipment needed for complete and operating systems. Consult with manufacturer to determine any contractor-supplied equipment or tools that may be required.
- D. Retain all manufacturer's warranties, installation instructions, operating instructions, spare parts list and other data that comes with the equipment and furnish in a 3-ring binder to the Owner before final acceptance of the project.
- E. Calibrate or have manufacturer's representatives calibrate and start all equipment. Costs for manufacturer's representatives to come to the project for installation, calibration, trouble shooting or warranty repairs are the responsibility of the contractor until the end of the project (not equipment) warranty period.

3.1 SWIMMING POOL CHEMICAL MONITORING/CONTROLLER

- A. Install an IPS rated PVC chemical monitoring and feed loop as shown on the plans. This loop shall be isolated by Tru-union ball valves from the filtered return portion of the circulation system. The loop shall be branched with one portion of the loop carrying solution water to receive chemicals and the other branch passing through the chemical monitor flow cells. An in-line wye strainer and a safety flow switch is required ahead of the sampling flow cell. The safety flow switch is furnished as part of the monitor and shuts down the feed system in the event of loss of circulation from the chemical booster pump. The two loops shall be reconnected before connection into the filtered return. Chemically injected solution lines shall always be reconnected to the filtered return DOWNSTREAM of heaters, UV disinfection units, and any other equipment which could be damaged by chemicals in concentration.
- B. Project electrician to bring 120VAC/1 phase power to the chemical monitor console. It is a plug in device. Pool contractor or certified manufacturer's representative to install the system per manufacturer's written instructions including wiring between the chemical monitoring and control unit and the chlorinator and acid feed pumps.

SWIMMING POOLS WATER TREATMENT EQUIPMENT

- C. Install chemical monitoring system on mechanical room walls with stainless steel epoxy-set anchors and hardware.
- D. Install wiring to the chlorinator and acid pumps in PVC conduit if more than 6 feet (2m) away from the control unit. Otherwise tie exposed wire neatly to pipe with nylon wire ties.
- E. Observe piping requirements in Section 131146 of these specifications. All piping shall be installed rectilinear with floors, ceilings and walls (except in curved rooms).
- F. Neither concentrated acid or chlorine solution lines shall be run long distances within the mechanical room. Instead, the IPS rated PVC chemical loop shall run from the filtered return line over to the chemical feed area where solution is injected into the chemical loop and returned to the pool return line.

NOTE: Silicone or polyethylene or similar tubing connected to the discharge of peristaltic pumps, diaphragm pumps, or cal-hypo chlorinators shall not exceed 4 feet in length. Tubing shall NOT be strapped to circulation pipe.

Unless the plans show otherwise:

1. Install tubing in excess of 5-feet in length within schedule 40 PVC pipe conduit secured to walls or ceilings or other approved supports. OR
 2. Install PVC hard piping to within 5 feet of the chemical feed pump or chlorinator to serve as a chemical solution line of filtered water into which the chemicals can be injected.
 3. The purpose of this specification is to avoid long and dangerous runs of tubing containing caustics and acids.
 4. This provision will be strictly enforced.
- G. Fill the system slowly and check for watertightness under static conditions before turning on circulating pumps.
 - H. Calibrate the unit per manufacturer's instructions.
 - I. Wire the chemical loop booster pump to the pool circulation pump to shut down the chemical booster on loss of power to the pool circulation pump to avoid overfeeding. [note: it is not sufficient to have a flow switch simply shut off chemical feed peristaltic pumps

3.2 DISINFECTANT FEED

Calcium Hypochlorite

- A. The Pulsar unit has a NEMA double safe junction box with 120VAC power cord which plugs into the chemical ORP controller plug outlet. This is a switched outlet which energizes the on-board solenoid when chlorine is demanded.
- B. Furnish controller wall-mounted housing with lockable clear acrylic slide out door for reach controller

SWIMMING POOLS WATER TREATMENT EQUIPMENT

- C. Adhere to manufacturer's written instructions. If these instructions are in any way in conflict with the drawings bring to the attention of the pool consultant or project Architect.
- D. Install the unit where it will not be damaged or present a hazard to pedestrian traffic.
- E. Coordinate with the electrical subcontractor to provide necessary power to the chlorinator and its recirculation pump.
- F. No more than five feet (5') of any one tubing (suction inlet or discharge to venturi) shall be exposed. Install longer tubing in 1/2-inch PVC conduit with unglued joints and fittings secured to walls or larger pipe.
- G. Install flow switch to shut down chemical injection on loss of flow.
- H. Test the chlorinator without adding chlorine briquettes initially. Test all valves, spray switches, overflow switches, and flow indicators for proper function.
- I. Check for leaks in tubing or chemical injection loop. Check for air bubbles which might indicate a leak.
- J. Verify proper inflow/outflow rates with the system running clean water.
- K. Fill the briquette tank with Pulsar chlorine briquettes and adjust settings. Even though the unit is controlled by the chemical ORP controller, set the built-in timer initially to feed a pool approximately 130% larger than the project pool. This will cause the timer to be a backup in case the controller fails to regulate the flow properly.
- L. DO NOT ADD CHLORINE OF ANY OTHER TYPE THAN THE PULSAR BRIQUETTES TO THIS FEEDER. DO NOT MIX CALCIUM HYPOCHLORITE WITH OTHER FORMS OF CONCENTRATED CHLORINE OR CHEMICALS.
- M. DO NOT USE MURIATIC ACID TO CLEAN THE UNIT. USE THE PULSAR PLUS ACID CLEANER 50 EXCLUSIVELY.

Ultra Violet Light Disinfection System

- A. The UV chamber unit may be installed in either the vertical or horizontal axis as shown on the Plans. UV chamber must be installed on the primary return line with a bypass isolation loop. Butterfly valves shall be installed on both sides of the UV chamber and on the bypass loop.
- B. Floor mount: Install a concrete base under the UV chamber to support its wet weight.
- C. Wall or ceiling mount: Install galvanized unistrut framing to support the UV chamber above the floor. Brace in two orthogonal directions to prevent swaying of the unit. Use galvanized threaded rod when suspending from the ceiling. Brace trapeze systems against sidesway.
- C. Install the factory supplied strainer downstream of the U.V. chamber but before the downstream isolation valve.

SWIMMING POOLS WATER TREATMENT EQUIPMENT

- D. Install on a minimum of 3'-0" either side of the U.V. chamber flanges U.V. resistant UPVC pipe in lieu of standard PVC pipe. Use Schedule 80 PVC in other locations in the U.V. chamber loop.
- E. Mount control panel on uni-strut (galv.) frame on the wall or floor. Use all stainless steel hardware.
- F. Install the Control Panel within 30 linear feet of the UV unit.

3.3 PH CONTROL

Acid Feed

- A. Wiring to the fractional horsepower peristaltic pump is by project electrician but is switched on/off by the chemical monitor/controller.
- B. Furnish and install peristaltic acid feed pump directly to mechanical room walls with stainless steel epoxy-set anchors and hardware.
- C. Silicone tubing from the acid carboy to the peristaltic pump OR from the peristaltic pump to the ejector fitting shall not exceed 5 feet in length on either side of the peristaltic pump unless the tubing is installed inside a ½" (12) mm unglued PVC conduit and fittings to protect the tubing. The conduit shall be secured neatly to the walls of the mechanical room using nylon Clic-X brackets no more than 12" (300 mm) apart.

PART 4 – POST CONSTRUCTION

4.0 TRAINING

- A. The contractor shall provide up to a total of six hours of on-site instruction to Owner's staff for the operation and maintenance of pool equipment. Note: Training may have to occur on separate and possibly on non-consecutive days. No payment will be made for additional trips to the site for the initial six hours of training.
- B. Video tape the training sessions and provide the Owner two sets of DVD's of the training.
- C. Provide owner with (Material Safety Data Sheets) MSDS for chemical products delivered to the project.
- D. Provide Owner four copies of a written Operator's Manual.

4.1 WARRANTIES:

- A. The pool subcontractor shall warranty the total chemical system installation against any defects in workmanship and materials for a period of one year from date of acceptance of the total project including all buildings and site improvements OR from the date the Owner begins to access the pool for public use, whichever occurs first.
- B. The pool subcontractor warranty shall not apply to water chemistry balancing or adjustments to equipment once the pool has been properly balanced and the

SWIMMING POOLS WATER TREATMENT EQUIPMENT

chlorinator has been properly adjusted to maintain proper chlorine levels within the pool.

- C. Manufacturer's Warranty: Buy-back warranty for 100% of purchase price of the equipment (but not chemicals) for 60 days from date of original purchase in accordance with manufacturer's written warranty policy.

In accordance with manufacturer's written warranty policy warrant against defects in workmanship and materials for two years on all equipment except electrical equipment from the date of installation by an authorized dealer representative and registration of the system.

- D. Pool contractor to submit warranty registration card for sanitizing device and controller on behalf of the Owner on date of installation of the equipment.

END SECTION 22 51 19

CITY OF DENTON
WAVE POOL

**SECTION 26 00 00
ELECTRICAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide electrical construction and renovations as set forth in the plans and specifications including electrical distribution, electrical devices, switches, transformers, wiring, pull boxes, junction boxes, luminaires; brackets, bases and poles for luminaires; and support for electrical devices.
- B. Provide demolition of obsolete electrical equipment.
- C. Not all fittings, bends, junction boxes, wall boxes, and ancillary equipment required by code are shown on the plans. Nevertheless, such equipment is deemed specified and required though not shown herein.
- D. Provide bonding and grounding for pool shells and equipment.
- E. Unless otherwise shown Contractor shall provide equipment, new, not used, and install in working order. Any electrical device shown shall require installation of power circuits, switches, outlets and supporting devices even if not shown on the plans.
- F. Refer to other sections for grounding and bonding requirements.
- G. Work includes but is not limited to:
 - 1. Wiring, lighting and power distribution to the new concession building and all equipment.
 - 2. Wiring, lighting and power distribution and control wiring to the wave pool blowers, starters, and compressor and controls.
 - 3. Wiring, lighting and power distribution to the pool circulation equipment and controls and starters.
 - 4. Overhead lighting, poles, bases, and wiring to overhead lighting from the pool mechanical room.
 - 5. Wiring to underwater lighting fixtures including low voltage transformers.
- H. Relocation of secondary wiring and conduit to clear obstructions is included in the required work. Relocation of the underground primary service defined as on the power company side of the step down transformer, shall be by Denton Municipal Electric.

1.2 REFERENCES AND CODES

- A. Work shall conform to the requirements of the National Electrical Code as modified and adopted by the Owner.
- B. Lighting shall conform to the requirements of the Illumination Engineering Society of North America (IESNA)
- C. Electrical work shall conform to the requirements of the Occupational Safety and Health Act, OSHA.

PART 2 – PRODUCTS

- 2.1 Motor Starters: Motor starters are required on any electric motor of one and one half (1-1/2) horsepower or greater but may be capacitor starters mounted on motors of two (2) horsepower or less if furnished by the manufacturer of a pump. Motor starters for larger than 2 horsepower motors shall be combination starter, disconnect, and overload protection NEMA rated starters in stainless steel NEMA 4X enclosures. Motor starters shall be Siemens, Rockwell, Square D, General Electric, Eaton or an equal approved by the Engineer.

NEMA Size	Max. Continuous Amperes	Max. Horsepower at 200 volts AC	Max. Horsepower at 230 volts AC	Max. Horsepower at 480/575 volts AC
00	9	1.5	1.5	2
0	18	3	3	5
1	27	7.5	7.5	10
2	45	10	15	25
3	90	25	35	50
4	135	40	50	100
5	270	75	100	200
6	540	150	200	400

- 2.2 Reduced voltage starters: Where called for on the plans, a reduced voltage motor starter shall be required. Reduced voltage starters by the same manufacturers shall be electro mechanical, part winding, primary impedance or autotransformer/solid state type as required for the type of motor and horsepower being started.
- 2.3 Variable frequency drives: Variable Frequency Drives where called for on the plans shall be Siemens, Eaton, Toshiba, Fuji, General Electric or other brand approved by the Engineer. Variable frequency drives shall be sized for the motor, voltage and phase, for which they will be controlling.
- 2.4 Premium pump motors: Pump motors shall be premium efficient motors.
- 2.5 Luminaires: Luminaires including underwater lamps shall be as scheduled on the plans.
- 2.6 Panelboards: Panelboards shall be as scheduled on the plans. They shall be copper bus type, door in door panels.
- 2.7 Wiring: Unless otherwise shown, wiring for general power distribution within buildings shall be type THWN copper wire rated for up to 600-volts. Wiring for exterior use, around pool equipment, and in shops and mechanical rooms shall be XHHN, XHHN-2, or THHN copper wire rated for up to 600-volts. Wiring for underwater use shall be rated for submergence. Type NM (non metallic sheathed cable (Romex for example) may only be used in residential or other special non-commercial buildings. NM cable may not be used in commercial projects. Services from transformers to meters shall be SEC (service entry cable) type THW or THW-2 copper or aluminum sized per NEC tables.
- 2.8 Conduit: Conduit shall be run in EMT tubing when located within walls or otherwise permitted by local code. Exposed conduit shall be RIGID metallic conduit. Conduit for underground or within concrete shall be PVC schedule 80 conduit. FMT (flexible metallic tubing) shall only be permitted in lengths of 10 feet or less from junction boxes to motors, lights or fans. Service entries shall be installed in rigid non-metallic conduit, corrugated armored conduit or galvanized steel conduit.
- 2.9 Low voltage transformers: Low voltage step-down transformers shall be U.L. listed for swimming pools, fountains, and landscape lighting and shall be installed in NEMA 3R stainless steel enclosures. Transformers shall be equal to 120 VAC primary with 12, 13 or 14 VAC secondary voltages Intermatic PX Series 100, 300 or 600. Lighting load shall not exceed 80% of 100, 300, or 600 watts respectively.

PART 3 - EXECUTION

- 3.1 COORDINATION AND SCOPE OF WORK:

- A. Bonding of the pool shell and deck equipment; grounding systems-refer to other sections of these specifications. Refer to NEC Article 680.26.
- B. Pool Contractor to provide and install underwater niches and lamps. Electrician to provide conduit, junction boxes, or in the case of low voltage lighting, low voltage transformers. Underwater lamps will be furnished with underwater cable long enough to reach a junction box (or transformer) set a minimum of 10 inches above the high water level. From the back of the niche to the junction box or transformer, the submersible cable and the bonding wire shall be installed in water tight PVC conduit. If no other lighting controls are shown, run circuits to the distribution panel and provide a dedicated circuit(s).
- C. Provision and installation of pumps with motors - By Pool Contractor
- D. Starters, power and wiring for motors - By Electrical Contractor.
- E. Power distribution panels, transformers, circuit breakers, circuit wiring, convenience outlets, overhead and task lighting - By Electrical Contractor.
- F. Level Controllers - Level Controller furnished and mounted by Pool Contractor. Some level controllers require 120VAC circuit to be wired by the electrician. Refer equipment schedule to see if the level controller is electrically powered or mechanically operated. Electronic level controller requires 120VAC solenoid valve wiring from the controller to the solenoid valve also by the electrician. Solenoid valve to be furnished by pool contractor.
- G. Heaters – None on this project.
- H. Chemical monitors – 120VAC duplex outlets shall be sufficient for powering these plug-in devices. Requires 120VAC circuits (switched by the monitor) to chemical feed units, either peristaltic pumps, solenoid valves or controlled erodible feeders. The monitor(s), pumps, feeders, and solenoid valves are furnished and installed by the pool contractor and wired by the electrical contractor.
- I. Electrical distribution - All by Electrical Contractor.
- J. Low voltage (4-20 ma) wiring from flow sensors to electronic meters is by Pool Contractor
- K. Ventilation – Furnishing and wiring of ventilation equipment is by Electrical Contractor.
- L. Temporary service – Furnish and install any temporary 'soft service' equipment and make arrangements for power company for service drops, paying all costs incident thereto.
- M. Permanent service – Coordinate with power company for installation of permanent service to the project and make applications necessary for the service. In the event pad mount transformers are needed, provide conduit and service entry cable and meter base as required. Should extension costs be required to bring power to the project in proper phase and voltage, the Owner will pay such costs.
- N. Service disconnect – Provide a service disconnect switch to meet requirements of local code.
- O. Ground fault circuit interrupters – GFCI protected circuits are required:

1. In wet locations such as shower and locker rooms and all restrooms.
 2. In pool equipment locations
 3. On pool decks within 25-feet of any pool vessel.
 4. In kitchens where lavatories, service sinks, or wash sinks are provided.
- P. Duplex Outlets- One or more weatherproof 120VAC duplex outlets shall be installed not less than ten (10) feet or more than twenty five (25) feet from each pool vessel such that every part of the pool(s) is within 100 feet radius of a duplex outlets. Within equipment areas unprotected by roof or walls, all convenience outlets shall be weatherproof.
- Q. Overhead wiring or fixtures – No lighting fixture, fan or other electrical wiring, conduit, or appliance shall be installed over a pool below a level 12 feet above the pool water surface for a distance extending five feet outside the pool wetted perimeter.
- R. Underground wiring – No wiring other than wiring to pool underwater luminaires shall be under a swimming pool, splash pad, or other similar vessel or within five feet horizontally of the wetted perimeter of the pool.
- S. Cover – Underground conduit shall have at least 24-inches cover.

3.2 SCHEDULING:

- A. Pool shells cannot be 'shotcreted' or painted until pool bond wiring has been completed, inspected and approved by building officials.
- B. Deck concrete cannot be placed until deck bond wiring has been completed.
- C. Pool plastering or painting cannot take place until all filter equipment is operational so that the pool can be filled immediately after plastering or painting and filtering can commence.
- D. Pool cannot be opened until all chemical monitoring and feeding systems are on-line and until pool water heating system, if any, is operational.

3.3 LICENSING AND PERMITTING:

- A. Only licensed electricians may install electrical wiring, and connect power and distribution systems.
- B. If a separate electrical permit is required, it shall be obtained by the electrical contractor who shall pay all costs incident thereto.

3.4 TESTING AND START-UP

- A. Complete placard for all distribution panel identifying all circuits and spares.
- B. Test all GFCI breakers and circuits.
- C. Test all duplex outlets for proper voltage and verify grounding.
- D. Verify that all electrically powered devices are functioning including lights, motors, controllers, heaters, monitors, fans, air conditioning, and appliances whether furnished with this project or pre-existing, or furnished by the Owner.

PART 4 – PAYMENT

- 4.1 MEASUREMENT AND PAYMENT: This work is considered subsidiary to other bid items included in the forms of proposal. No separate measurement or payment will be made for this work.

END SECTION 26 00 00

CITY OF DENTON
WAVE POOL

**SECTION 26 05 26
GROUNDING & BONDING POOLS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete grounding system to all non-current carrying conductive components and grounded circuit conductors of the wiring system.
- B. Bond pool shell, metallic equipment, gutters, light niches, diving stands, starting blocks, decks, fountains, rails, etc. as required by NEC 680.26.
- C. All electrical work must be done by qualified, licensed electricians.

PART 2 - PRODUCTS

2.1 GROUND RODS

- A. Shall be 5/8" diameter by 10 feet long copper clad steel. Blackburn 6260, Thomson or equal.
- B. Bonding clamps shall be U.L. listed brass compression clamps.

PART 3 - EXECUTION

3.1 GENERAL

- A. COORDINATION: Coordinate all work with other contractors. Unless otherwise coordinated or specified in these documents, responsibility for grounding and bonding remains with the Electrical Contractor.
- B. GROUNDING:
 - 1. When grounding systems are not shown on the Drawings, as a minimum, ground in accordance with the NEC.
 - 2. When grounding systems are shown on the Drawings, and are more stringent than required by the NEC, the Drawings take precedence.
 - 3. Use a heavy duty exothermic welding process (HD ETP), for all grounding electrode to grounding electrode conductor connections, all grounding connections in contact with earth or concrete, and all grounding connections to structural reinforcing rod.
 - 4. All chain link or steel fencing shall be grounded not more than 100 feet center to center. Ground all ladders, pumps, and other equipment.
- C. EQUIPOTENTIAL BONDING:
 - 1. Tie all required equipment within five feet of the swimming pool vessel using minimum #8AWG bare copper wire. Secure to reinforcing steel grid in a minimum of two locations plus one more for each 1,000 s.f. of pool or deck surface at more or less equal distances from each other and at least 25 feet apart. Secure using U.L. listed brass electrical cable clamps with set screws.
 - 2. The bonding grid shall be the swimming pool belly reinforcing steel.

GROUNDING & BONDING POOL

3. Bond all metal pool pump and circulation equipment such as heaters, pumps, metal pool filters, metal grating, and metal pipe fittings, to the pool grid.
4. Bond all ladders, handrails or grabrails to the grid. If a ladder has metal stairs connecting the rails, then only one anchor need be bonded. If the steps are plastic or if, in the case of grab rails, there is no connection between the two rails, then bonding is required in both anchors.
5. Bond metal doors, windows and metal frames located within five feet of the pool.
6. Bond metal fountain nozzles, metal drains, or other fountain accessories to the grid.
7. Bond metal anchor plates for water play features to the grid.
8. Bond metal gutters to the grid.
9. Bond metal main drain covers.
10. Bond metal diving stands and metal parts of diving boards.
11. Bond metal shade structure anchor plates or poles within five feet of the water.
12. Bond metal slide towers.
13. Bond fixed metal lifeguard stands.
14. Bond metal fencing within five feet of the water.
15. Bonding wires are not tied to the electrical grounding system.
16. Bond metal light niches and metal lamp parts. The lamp parts bond through the power cable back to the junction box or transformer. The niche bonds directly to the belly steel of the pool.
17. Bond deck reinforcing steel to the pool grid.
 - a. If the pool deck is non-reinforced, constructed of stone, gravel, wood, or other non-reinforced surfacing bonding is still required. Install a #8AWG bare copper wire within 24 inches of the pool water continuously around the pool perimeter.
 - b. The wire shall be not less than 4 inches or more than 6 inches below the surface. Clamp this wire to the pool grid at not more than 25-foot intervals
18. Bond any other metal part greater than four inches in greatest dimension or projecting into the pool more than one inch.

PART 4 – PAYMENT

- 4.1 MEASUREMENT AND PAYMENT: This work is considered subsidiary to other bid items included in the forms of proposal. No separate measurement or payment will be made for this work.

END SECTION 26 05 26

CITY OF DENTON
WAVE POOL

**SECTION 310000
EARTHWORK FOR SWIMMING POOLS**

PART 1 - GENERAL

- 1.1 Scope: This item shall include furnishing all labor, equipment, materials, superintendence and other related services necessary to complete the earthwork indicated on the drawings or specified herein including:
- A. General site grading, filling, borrowing and compacting to achieve the final grades shown.
 - B. Excavation and fill for swimming pools.
 - C. Construction of base fill for slabs and decking.
 - D. Backfilling formed structures.
 - E. Over excavation and installation of select fill under pools and decks, if shown.
 - F. Prepare a Storm Water Pollution Prevention Plan and adhere to the requirements of the plan to prevent sediment transport and siltation. Inspect, repair and maintain records as required by law.
- 1.2 Work Covered Under Other Sections:
- A. Protect previous work of any subcontractor, existing trees, sidewalks, curbs, pavement, buildings, and utilities on or adjacent to the site not included herein for removal or adjustment.
 - B. Clearing and grubbing of trees and shrubs.
 - C. Trenching and backfill of trenches.

PART 2 – PRODUCTS

- 2.1 SELECT FILL: Select fill to fill to new subgrades, fill holes, and replace unsuitable sub-grade materials shall be clean sandy clay having a Plasticity Index (P.I.) between 5 and 15 and a Liquid Limit (L.L.) of 35 or less.

PART 3 - EXECUTION

- 3.0 GENERAL
- A. Examination of Site: Prior to commencing work the Contractor shall examine the site and make himself fully aware of the conditions and requirements of the site. He shall make the Engineer aware of any abnormal or questionable soil conditions or the need for additional work not shown on the Drawings or specified herein.
 - B. The Contractor shall use equipment specifically designated for the work to be performed. Do not break out curbs for access. Do not park equipment on parking lots outside designated staging areas. Protect all excavations with guard rails.
 - C. Excavation and Backfill: Excavate to the lines and grade shown on the plans plus sufficient extra to allow for any necessary forming. Do not allow excavations or forms

to stand in water or to become loose and sandy.

1. Where earth forming is used the soil shall be cut true to line and the concrete placed as quickly as possible to prevent drying or caving of the sides. Should sloughing or caving occur, the Contractor shall, at his own expense, back form, brace, parge or otherwise stabilize the sides. If backforming is used, forms and walers must be removed after concrete placed against it has cured a minimum of three days.
 2. Backfill shall be placed immediately after laying pipe or stripping forms and inspection of the final structure by the Engineer or Owner's Site Representative. Remove all debris from the excavation prior to backfilling. Backfill in nine inch lifts, evenly on all sides of the structure if possible, compacting around the structure mechanically to 95 percent of Standard Proctor Density at optimum moisture.
- D. Surplus or unsuitable material shall be hauled away and disposed of by the Contractor.
- G. Subgrade Compaction: The Contractor shall sprinkle and mechanically compact fill under pool, decks, buildings and fill areas to 95% Standard Proctor Density at +/-3% of optimum moisture.
- H. Testing: The Owner shall make arrangements and pay for testing with a qualified independent testing laboratory at his own expense according to the following recommended schedules:
1. Select Fill - Test compaction of each 9 inch lift of 25 foot x 25 foot grid over entire area of fill. Stagger grid for each lift.
 2. Test results shall be furnished to the Contractor and to the Engineer. Areas failing compaction test shall be delineated as half the distance to the closest passing test and reworked until the area passes. No further backfilling, earthfill, or paving may proceed until the previous layer has passed compaction testing. Failing areas shall be retested at the Contractor's expense.
- I. Final Grading: Break up all hard-pan earth or clay surfaces to make them suitable for sodding, seeding, or landscaping. Hand rake all exposed earth surfaces removing all rocks, clods and debris and smoothing the ruts from construction equipment. Leave areas to be sodded 2-inches below adjacent curbs, walks, decks or pavements. Taper gradually all transition to match existing, undisturbed terrain.

PART 4 - PAYMENT

- 4.1 MEASUREMENT AND PAYMENT: Earthwork for aquatic facilities is considered subsidiary to other bid items included in the forms of proposal. No separate measurement or payment will be made for this work. All excavation is considered unclassified.

END OF SECTION 31 00 00

SECTION 31 31 16.13

CHEMICAL TERMITE CONTROL

PART 1 - GENERAL

- 1.1 SUMMARY : This work shall consist of furnishing all labor and materials necessary to treat building slabs and all new construction.
- 1.2. EXPERIENCE: This work shall be performed by a licensed termite company which has been in business for a period of at least two (2) years.

PART 2 - PRODUCTS

- 2.1 Apply to slab areas of the concession building:
 - A. Premise 2 / Premise 75 (Imidichloprid)
 - B. I MaxxPro 2F / I Maxx Pro WP (Imidichloprid)
 - C. Talstar Professional (Bifenthin)
 - D. Bifen Insecticide / Termiticide (Bifenthin)

PART 3 - EXECUTION

- 3.1 METHOD OF TREATMENT
 - A. The termite contractor shall supervise removal of all debris found within foundation walls or area on site. He shall maintain a representative on the job site during the entire backfill operation and shall treat soil as backfill is made along perimeter of building at the rate of 1 gallon to 2-1/2 linear feet.
 - B. Treatment shall not be made when the soil or fill is excessively wet or immediately after heavy rains to avoid surface flow of toxicant from application site. Treated areas shall be immediately covered. After the fill has been compacted, apply an over all treatment under entire area of floor slab, including walkways and entrance platforms. Apply at the rate of one gallon per 10 square feet, except that in areas that fill under slab is gravel or crushed stone, apply at the rate of 1 gallon per 7 square feet.
 - C. Apply to critical areas along both sides of foundation walls at the rate of 1 gallon per 2-1/2 lineal feet per foot of depth.
 - D. Apply a heavy concentration around all pipes, expansion joints, and other areas susceptible to later termite entrance.

PART 4 - POST CONSTRUCTION

- 4.1 GUARANTEE
 - A. A written guarantee shall be furnished to the Owner providing: Protection against future termite damage to structure and contents up to \$25,000.00 for a period of five (5) years, with provisions for treatment in the case of termite infestation, without additional cost to the Owner.

END SECTION 31 31 16.13

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section shall govern the furnishing and installing of various types of chain link fence as shown on the plans. The definition of "height" or "high" or notes to construct a "...6-foot chain link fence" shall be interpreted to mean the height of the chain link fabric itself and not the height of frames, brackets or extensions of barbed wire or similar products.

1.2 GENERAL

- A. Conditions of the Contract
 - 1. The conditions of the Contract (General, Supplementary and other Conditions) and the General Requirements are hereby made a part of this Section.
- B. Scope
 - 1. This section includes all labor, material, equipment and related services necessary to furnish and install fencing materials. This section governs furnishing and installing all fencing fabric, posts, post foundations, rails, connectors, end caps, and necessary appurtenances.

1.3 PAYMENT

- A. Acceptable fencing will be paid for at the lump sum price or unit price set forth in the proposal. Payments shall be full compensation for clearing fence line, furnishing, hauling, and installing materials, excavation for footings, concrete for footings and all labor, equipment, and materials necessary for the work. No payment will be made for unauthorized work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Post Footing: Post footing shall be Portland Cement Concrete.
- B. Wire Fabric: Chain Link Fabric (shall comply with Federal Specifications RR-F-191/1C) shall be steel wire helically wound and interwoven in such a manner as to provide a continuous mesh without knots or ties except in the form of knuckling or of twisting the ends of the wire to form the selvage of the fabric. The woven wires will form a mesh with diamond shaped openings. The base metal of the fabric shall be a commercial quality of 9 gauge steel wire. The zinc coating of the fabric shall be by the hot-dipped process after fabrication in accordance with ASTM A392, Class I. The weight of the zinc coating shall not be less than 1.2 ounces per square foot of actual surface covered. The zinc used for coating shall conform to Grade "E" Federal Specification QQ-Z-351. The mesh size shall be measured between parallel sides.

CHAIN LINK FENCES AND GATES

- C. Vinyl Coated Chainlink Fabric: Where vinyl coated chainlink fabric is called out on the Plans, it shall be coated with fused and bonded PVC 7-12 mils in thickness as per ASTM F-668 Class 2B. Color shall be selected by Owner from manufacturer's standard color chart. Posts and rails and hardware shall receive a similar 10 mil coating but conforming to ASTM F1043, Group 1A or 1C.
- D. Posts: All posts shall be made from standard weight steel pipe. The steel shall conform to ASTM A446 Grade D. The exterior surface shall be given a hot-dipped zinc coating 1.0 (+/- 0.15) oz/ft. (2) followed by a chromate conversion coating of 0.5 (+/- 0.2) mils of clear acrylic. The interior surface shall have a hot-dipped zinc coating of 1.0 (+/- 0.15) oz/ft. (2) followed by a chromate conversion coating. Zinc used shall be Grade "E", Federal Specification QQ-Z-351. Furnish galvanized fence post caps.
1. Line Posts: Line Posts shall be tubular steel of the size specified in the table below, heavily galvanized and spaced not more than ten (10) feet center to center.
 2. Terminal Posts: Corner posts, end posts, and gate posts shall be tubular steel of the size specified in the table below and heavily galvanized.
 3. Rails: Rails shall be tubular steel of the size specified in the table below and heavily galvanized, with sleeve couplings for expansion and contraction. For fences 6'-0" or higher, a bottom rail of the same size as the top rail shall be installed. For fences 10'-0" or higher, a mid-rail is required of the same diameter as the top rail.
 4. Bracing: Brace each way from a corner making a deflection angle of 22.5-degrees or more: from a terminal post; and from either side of a gate. Braces to conform to the table for railing pipe below.
 5. Truss Rods: Required for fences 6'-0" or higher at all corners and gates.
- E. Tension Wire: No. 7 gauge galvanized coiled steel tension wire shall be installed along the base of the fabric if no bottom rail is called for.
- F. Fabric Ties: No. 9 gauge galvanized or aluminum wire spaced not more than 14 inches center to center shall secure the fabric to all posts. No. 9 gauge galvanized or aluminum wire spaced not more than 24" center to center shall secure the fabric to rails, braces, and tension wire.
- G. Barbed Wire: Barbed wire, if called for on the plans, shall be three lines of four-point pattern barb. Each line shall consist of two strands of No. 12 1/2 gauge galvanized wire securely fastened to galvanized extension arms on the fence top.
- H. Extension Arms: Extension arms for barbed wire shall be Hot-Dipped galvanized carrying three wires with the topmost barbed wire extended 12" above the fabric and 12" out from the fence at an angle of 45 except at corners and gates where the arms are to be vertical.
- I. Gates: All gates shall be constructed of 1-5/8 inch diameter galvanized tubular steel frame. Fabric shall be the same as the fence in which the gate is installed. The following accessories shall be furnished for each gate:
1. Corner and tee fittings of malleable iron or pressed steel having means for attaching diagonal bracing members.
 2. Hinges of malleable iron providing for full 180 degree swing with bottom hinges to be ball and socket type.

CHAIN LINK FENCES AND GATES

3. Diagonal braces consisting of 3/8 inch diameter truss rods with turnbuckles, two to each gate frame.
4. Latches for single gates shall have a single fork latch with padlock eye; double leaf gates shall have two fork latches mounted on center plunger rod with padlock eye.
5. Hold backs shall be provided for each leaf of vehicular gates, employing a semi-automatic hold back catch to be anchored at least 12 inches into a 12 inch diameter by 24 inch deep concrete footing.
6. A malleable iron center rest, designed to receive the plunger rod, to be anchored at least 12 inches into a 12 inch diameter by 24 inch deep concrete footing, shall be provided for all double leaf gates.
7. Stretcher bars shall be not less than 3/16 inch by 3/4 inch flat steel and not more than two inches shorter than the fabric height. One stretcher bar shall be provided for each gate and end post. Two stretcher bars shall be provided for each corner and pull post. Stretcher bars shall be attached to terminal posts with 1 inch x 1/8 inch flat steel bands with 3/8 inch carriage bolts at intervals not exceeding 15 inches.

J. Postholes: Holes for concrete footings for all posts shall be dug or drilled to the dimensions listed in the following tables:

Holes for Line and End Posts

Type Post	Fabric Height	Min. Hole Diameter	Min. Hole Depth	Post Embedment
Line	5'	9"	30"	24"
Line	6'	9"	30"	24"
End	5'	12"	36"	30"
End	6'	12"	36"	30"
End & Line	8'	12"	42"	36"

K. Fittings: The bid items shall include all necessary post tops, rail ends, hinges, bracing, fabric bands, and other fittings required to install the fence complete in place. Tops and rail ends shall fit over the outside of the pipe.

TABLE OF MATERIALS Standard Pipe Weights (Schedule 40)	
1 5/8" O.D.	2.27 Lbs/ft
2" O.D.	2.72 Lbs/ft
2 1/2" O.D.	3.65 Lbs/ft
3"	5.79 Lbs/ft

L. Pipe Requirements:

Fabric Height	Fabric Gauge	Line Post	Terminal Post	Rail
4'	9	1-5/8"	2-1/2"	1-5/8"
5'	9	1-5/8"	3"	1-5/8"
6'	9	2"	3"	1-5/8"

CHAIN LINK FENCES AND GATES

8'	9	2-1/2"	3"	1-5/8"
over 8'	. . . Refer to Plans . . .			

- M. Slating: Where slating inserts are required they shall be equal to PDS polyethylene bottom locking tubular slats in color to be selected by Owner. Although tighter chain link mesh may be specified for this project, mesh where slating is shown shall be 1-3/4-inch (1-3/4") mesh.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. All posts shall be set in concrete and spaced not more than ten (10) feet center to center. The posts shall be aligned carefully and set to vertical. The tops of the concrete bases shall be troweled to drain water away from the posts. Excavated materials from footings shall be spread neatly and uniformly to leave the area as slightly as possible.
- B. The fabric shall be installed in a workmanlike manner, generally following the finished contour of the site with the bottom edge of fabric located one inch to three inches above the final grade. The fabric shall be stretched taut, and free of slack edges or warped sections.

END SECTION 32 31 13

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

SECTION 32 32 23.13

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS
(Standard Unit)

PART 1 - GENERAL

1.1 SUMMARY

- A. This section shall consist of furnishing and construction of a KEYSTONE Retaining Wall System or equal in accordance with these specifications and in reasonably close conformity with these specifications and with the lines, grades, design, and dimensions shown on the plans.
- B. Construction drawings and design calculations for the retaining wall system shall be prepared by a registered professional engineer and shall bear his signature and seal. The contractor shall submit the construction drawings and design calculations to the engineer for approval prior to beginning construction.

1.2 CERTIFICATION:

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification.
 - 1. The contractor's submittal package shall include but not limited to actual test results for tension/creep, durability/aging, construction damage, geogrid/facing connection, pullout, and quality control.
- B. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
 - 1. Has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.; and
 - 2. Has been successfully installed on a minimum of 1 million (1,000,000) square feet of retaining walls.
- C. Contractor shall submit a list of previous projects totaling of 500,000 square feet or more where the specific retaining wall system has been used successfully. Contact names and telephone numbers shall be listed for each project.
- D. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with NCMA test method SRWU-1.
- E. Contractor shall submit engineering plans prepared by a professional engineer experienced with Mechanically Stabilized Earth retaining wall systems and registered in the state of the project location. The engineering designs, techniques, and material evaluations shall be in accordance with the KEYSTONE Design Manual, 1994, NCMA Design Guidelines For Segmental Retaining Walls, 1993 or the AASHTO Standard Specifications for Highway Bridges, Section 5.8, 1993 Interim, whichever is applicable.

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

1.3 MEASUREMENT

- A. Retaining walls shall be NOT be separately measured but shall be considered as part and subsidiary to site work provisions of the specifications. The Engineer may authorize other areas for installation at additional cost.

1.4 PAYMENT

- A. All retaining wall work shall be considered as a part of the total price bid for the various items of construction. The lump sum price shall include full compensation for excavating, and grading; furnishing, hauling, and placing modular units; backfilling, furnishing and placing all geotextile fabric, geogrid reinforcement, drains, rock embedment, reinforcing pins; and all labor, tools, equipment, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.1 Definitions

- A. Structural Geogrid: A structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- B. Modular Unit: A concrete retaining wall element machine made from Portland cement, water, and aggregates.
- C. Unit Fill: Drainage aggregate which is placed within and immediately behind the modular concrete units.
- D. Reinforced Backfill: Compacted soil which is placed within the reinforced soil volume as outlined on the plans.

2.2 Modular Concrete Retaining Wall Units: Modular concrete units shall conform to the following architectural requirements.

- A. Face Color: Standard manufacturers' color or custom color as specified by the Owner.
- B. Face Finish: Sculptured rock face in angular multiplaner configuration. Other face finishes will not be allowed without written approval of owner.
- C. Bond Configuration: Running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
- D. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.

2.3 Modular concrete units shall conform to the following material requirements:

- A. Cement: Materials shall conform to the following applicable specifications.
 - 1. Portland Cement: ASTM C 150.

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

2. Modified Portland Cement: Portland cement conforming to ASTM C 150, modified as follows. Limestone - calcium carbonate, with a minimum 85 % content, may be added to the cement, provided these requirements of C 150 as modified are met; (1) limitation on insoluble residue 1.5 %; (2) limitation on air content of mortar - volume percent, 22% maximum; and (3) limitations of loss of ignition - 7 %.
 3. Blended Cements: ASTM C 618.
 4. Pozzolans: ASTM C 618.
 5. Blast Furnace Slag Cement: ASTM C 989.
- B. Aggregates: Aggregates shall conform to the following specifications, as applicable.
1. Normal Weight Aggregates: ASTM C 33.
 2. Lightweight Aggregates: ASTM C 331.
- C. Other Constituents: Air entraining agents, coloring pigments, integral water repellents, finely ground silica, and other constituents shall be previously established as suitable for use in modular concrete retaining wall units and shall conform to applicable ASTM standards or, shall be shown by test or experience to be not detrimental to the durability of the modular concrete units or any material customarily used in retaining wall construction.
- 2.4 Modular concrete units shall conform to the following structural and geometric requirements:
- A. Compressive Strength = 3000 psi minimum;
 - B. Absorption = 8 % maximum (6% in northern states) for standard weight aggregates;
 - C. Unit Depth - 20 inches minimum;
 - D. Unit Width to height ratio = 2.25: 1;
 - E. Unit Weight - 90 lbs/unit minimum for standard weight aggregates ;
 - F. Inter-unit Shear Strength - 1500 plf minimum at 2 psi normal pressure;
 - G. Geogrid/unit Peak Connection Strength -1000 plf minimum at 2 psi normal force;
 - H. Maximum Horizontal Gap between erected units shall be - 1/2 inch.
- 2.5 Modular concrete units shall conform to the following constructability requirements:
- A. Vertical Setback = 1/8"□ per course (near vertical) or 1"□ per course per the design drawings;
 - B. Alignment and Grid Positioning Mechanism - fiberglass pins, two per unit minimum;
- 2.6 Shear Connectors:
- A. Strength of shear connectors between vertical adjacent units shall be applicable over a design temperature of 10 degrees F to +100 degrees F. Shear connectors shall be 1/2 inch diameter thermoset isophthalic polyester

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

resin-pultruded fiberglass reinforcement rods. Connectors shall have a minimum flexural strength of 128,000 psi and short beam shear of 6,400 psi.

- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.7 Base Leveling Pad Material: Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings. The leveling pad shall be a minimum of 6 inches thick. As an option, concrete may be 3 inches thick with a compacted granular base for a total thickness of 6 inches.

2.8 Unit Fill:

- A. Unit fill shall consist of clean 1" minus crushed stone or crushed gravel meeting the gradation listed below.

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
3/4 inch	75-100
No. 4	0 - 10
No. 50	0 - 5

- B. One cubic foot, minimum, of drain fill shall be used for each square foot of wall face. Drain fill shall be placed within cores of, between, and behind units to meet this requirement.

2.9 Reinforced Backfill:

- A. Reinforced backfill shall be free of debris and meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch	100-75
3/4 inch	100-75
No. 4	100-20
No. 40	0-60
No. 200	0-35

Plasticity Index (PI) <10 and liquid limit <40.

- B. The maximum aggregate size shall be limited to 3/4 inch unless field tests have been or will be performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.
- D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.10 Geogrid:

- A. T_a , Allowable Tensile Design Load, shall be determined as follows:

$$T_a = T_{cr} / (FD * FC * FS)$$

T_a shall be evaluated based on a 75 year design life.

- B. T_{cr} , Creep Limited Tensile Load

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

Tcr shall be determined from 10,000 hour creep testing performed in accordance with ASTM D5262.

- C. FD, Factor for Durability/Aging
FD shall be determined from polymer specific durability testing covering the range of expected soil environments.
- D. FC, Factor for Construction Damage
FC shall be determined from product specific construction damage testing performed in accordance with GRI-GG4. Test results shall be provided for each product to be used with project specific or more severe soil type.
- E. FS, Overall Factor of Safety
FS shall be 1.5 unless otherwise noted.
- F. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with NCMA test methods.
- G. Soil Interaction Coefficient, Ci
Ci values shall be determined per GRI:GG5 at a maximum 0.75 inch displacement.
- H. Manufacturing Quality Control: The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing for each 40,000 SF of production, each lot, or each production day. The QC testing shall include:
 - 1. Tensile Modulus
 - 2. Specific Gravity
 - 3. Melt Flow Index (PP&HDPE)
Molecular Weight (PETP)

PART 3 - EXECUTION

3.1 Excavation:

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Architect/Engineer will inspect the excavation and approve prior to placement of leveling material or fill soils.
- B. Over-excavation of deleterious soils and replacement with suitable fill will be paid at unit cost rates.

3.2 Base Leveling Pad:

- A. Leveling pad material(s) shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches.
- B. Soil leveling pad materials shall be compacted to a minimum of 95 % standard or 90 % modified Proctor.
- C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.3 KEYSTONE Unit Installation:

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

- A. First course of units shall be placed on the leveling pad, and alignment and level checked. Pins or molded surfaces of modular concrete units shall be used for alignment control.
- B. Position vertically adjacent modular concrete units as recommended by the Manufacturer.
- C. Maximum stacked vertical height of wall units, prior to wall drain fill and backfill placement and compaction, shall not exceed two courses.
- D. Whole, or cut, units on curves and corners shall be erected with running bond approximately centered on units above and below.
- E. Cap units shall be glued to underlying units with an adhesive recommended by the manufacturer.

3.4 Structural Geogrid Installation:

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid reinforcement shall be placed at the elevations and to the extent shown on the construction drawings or as directed by the Engineer.
- C. The geogrid shall be laid horizontally on compacted backfill. Place the next course of modular concrete units over geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.
- D. Geogrid reinforcements shall be continuous throughout their embedment lengths. Spliced connections between shorter pieces of geogrid is not allowed unless pre-approved by the Architect/Engineer prior to construction.

3.5 Reinforced Backfill Placement:

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid.
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 8 inches where hand compaction is used, or 12 inches where heavy compaction equipment is used.
- C. Reinforced backfill shall be compacted to 95 % of the maximum density as determined by ASTM D695. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be within 2 percentage points dry of optimum.
- D. Only lightweight hand-operated equipment shall be allowed within 3 feet from the tail of the modular concrete unit.
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS (Standard Unit)

- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH. Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

END SECTION 32 32 23.13

SECTION 32 92 23

SODDING

PART 1 - GENERAL

1.1 SUMMARY

- A. "Sodding" shall consist of providing and planting Common Bermuda grass or other acceptable and approved sod adjacent to the proposed construction.
- B. It is the intent of this specification that all exposed earth surfaces remaining after installation of concrete deck and landscape areas shall be sodded per this section whether inside the pool enclosure fence or not.

1.2 PLANTING SEASON

- A. All planting shall be done between April 15 and October 1st except as specifically authorized in writing.
- B. Sod shall not be placed until the irrigation system is repaired and back in service.

1.3 MEASUREMENT AND PAYMENT

- A. "Sodding for Erosion Control" will be paid for at the lump sum price set forth in the proposal. This price shall be full compensation for the cost of materials, transportation, spreading, fertilizing and watering

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The sod shall consist of live, growing Bermuda grass or other acceptable sod secured from sources as approved by the Engineer. Sod shall have a healthy virile root system of dense, thickly matted roots throughout the soil of the sod for a minimum thickness of 1 inch. The Contractor shall not use sod from areas where the grass is thinned out, or where the grass roots have been dried out by exposure to the air and sun. The sod shall be free from noxious weeds or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long-standing stems.

PART 3 - EXECUTION

3.1 MULCH SODDING (not applicable to this project)

3.2 SOLID BLOCK OR STRIP SODDING

- A. Solid Block or Strip Sodding: After the designated areas have been completed to the lines, grades, and cross sections shown on the plans block or strip sodding shall be performed in accordance with the requirements hereinafter described. The area to be planted shall be plowed, disked, and tilled to provide a loose but smooth planting bed. Fertilizer shall be applied uniformly over the area and the sod placed firmly in the loose soil such that the full thickness of the sod comes in contact with soil. On steep slopes (greater than 3:1 slope) the sod shall be staked or pinned.

3.3 FERTILIZER

- A. All fertilizer shall be delivered in bags or containers clearly labeled showing the analysis. The fertilizer shall have an analysis of 13-13-13 or 10-20-10 where such figures represent the percent of nitrogen, phosphoric acid, and potash nutrients respectively as determined by the methods of the Association of Official Agricultural Chemists. Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen (NO₃). The remaining Nitrogen required may be in the form urea Nitrogen (CO (NH₂)₂).
- B. In the event it is necessary to substitute a fertilizer of a different analysis, it shall be a pelleted or granulated fertilizer with a lower concentration, but the total amount of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.
- C. Fertilizer shall be applied uniformly over the area specified to be fertilized and at the rate of 300 pounds per acre.

3.4 WATERING

- A. Water shall be furnished by the Contractor from the Owner's taps or irrigation systems at no charge to the Contractor and shall be clean and free of substances harmful to the growth of grass.
- B. The sod shall be watered thoroughly after installation and watered again each of the next five days in the absence of rainfall during that period and then twice weekly through final completion and acceptance by the Owner of the project. After final completion responsibility for watering is the Owner's.
- C. Sod not surviving and flourishing by June 15 following initial planting in the Spring shall be replaced by the Contractor at no expense to the Owner. The Engineer will designate limits of replacement.

END SECTION 32 92 23

SECTION 33 11 16

WATER MAIN PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Of the following types of pipe, only those pipes shown on the plans or described in the proposal are acceptable.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be new, manufactured in the United States of America and designed in accordance with AWWA Specifications C150 (ANSI A21.50) using 60,000 psi tensile strength, 42,000 psi yield strength and 10 percent elongation unless otherwise designated. The pipe shall be a minimum Class 200 or better designed for at least 200 pounds per square inch water working pressure plus 100 pounds per square inch surge allowance. Ductile iron pipe shall be cement lined in accordance with AWWA Specification C104 (ANSI A21.4). The pressure rating, metal thickness, net weight of the pipe without lining, length of pipe, and name of the manufacturer shall be clearly marked on each joint of pipe. Ductile iron pipe may be mechanical joint, "Fastite", or "Tyton: per AWWA Specification C111 (ANSI A21.11). In cases where plans show excess pipe cover, the thickness class shall conform to the Standard Thickness for Earth Load plus Truck Load, Type 2 Ditch as per AWWA Specification C151 (ANSI A21.51).
- B. Flanged ductile iron pipe where shown shall conform to AWWA C115 minimum thickness Class 53. Furnish full face SBR gaskets 1/8-inch thick. Nuts and bolts shall conform to ANSI B18.2.1 and ASTM A307, 60,000 psi tensile strength Grade B.

2.2 COATING AND LINING

- A. All ductile iron pipe and fittings shall have an inside cement mortar lining conforming with AWWA C104. Buried ductile iron pipe shall have a bituminous outside coating of either coal tar or asphalt base in accordance with AWWA C106 and C151. All newly installed pipe for potable water must conform to ANSI/NSF Standard 61 and must be certified by an organization accredited by ANSI. Above ground pipe shall be painted per Section 09900.

2.3 POLYVINYL CHLORIDE (PVC) WATER PIPE

- A. PVC water pipe shall meet the requirements of AWWA C900, or C905, or ASTM D2241 SDR Class as specified on the plans, in the bid items or in the Special Provisions. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross section rubber ring which meets the requirements of ASTM D-3139 "Joint for Plastic Pressure Pipes using flexible elastomeric seals." Service connections shall be made using a bronze service clamp.
- B. Each joint of PVC pipe shall be marked with the manufacturer's identification, size, material, type and grade of compound, pressure rating and SDR

WATER MAIN PIPE AND FITTINGS

number. In addition, each joint of PVC pipe shall be marked with the letters NSF denoting National Sanitary Foundation approval. Furthermore, all newly installed coatings having contact with potable water must conform to ANSI/NSF Standard 61 and must be certified by an organization accredited by ANSI.

2.4 ASBESTOS CEMENT PIPE

- A. Asbestos cement pipe shall conform to AWWA Specification C400 and ASTM Designation C296, Class 150 and Class 200 for 200 psi internal working pressure for 6 inch or smaller (150 psi for larger than 6") water pipe. Joints shall be elastomeric plastic conforming to ASTM designation D1869 "Rubber Rings for Asbestos Cement Pipe." The Contractor shall use asbestos cement fittings and provide the necessary adapters where required for connections to cast iron or other materials.
- B. Service connections shall be made using heavy wall couplings provided with factory installed brass bushings. Only one bushing shall be allowed per collar. Brass bushings shall conform to ASTM designation B62 and threaded to match the corporation stop. Taps on existing asbestos cement lines are to be made using a bronze service clamp with double strap. Only one tap may be made with each service clamp.

2.5 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement where shown on the plans for the prevention of corrosion shall conform to AWWA C105 and be installed in conformance with ASTM A674, "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water and Other Liquids".

2.6 COPPER PIPE FOR SERVICE CONNECTIONS

- A. Material: Service pipe shall be Type "K" soft copper pipe and shall conform to ASTM Class "A" Specifications, as well as AWWA Specification 7A-CR.
- B. Installation: The service connection shall consist of a tap on the water main, a corporation stop, a curb valve or stop, and a copper line installed without joints or splices from the water main to the point designated and terminated with a curb valve or a meter yoke and angle stop. The copper pipe shall be extended from the water main to the termination point at the same depth as the water main except for new installations in roadways with proposed curbs. For this type of installation the copper water pipe shall be installed at the same depth as the water main to a point twelve (12) inches beyond the back of the proposed curb. At this point or at the termination point for all other installations, the service line shall be raised to a point twelve (12) inches below finished ground elevation.
- C. Water service lines for new developments with curbed streets shall terminate three (3) feet behind the back of the proposed curb and marked the installation of an iron rod one half (1/2) inch diameter by three (3) feet long driven at the end of the service with six (6) inches left exposed. The iron stake shall be painted blue or flagged with blue tap for proper identification.
- D. Water service lines for all other new developments shall terminate at the designated point. The end of the water service shall be marked as noted above.

WATER MAIN PIPE AND FITTINGS

- E. Water service lines installed for replacement of existing service lines shall terminate at the existing water meter, or shall terminate at the new meter if one is specified. These service lines shall be installed in the same manner as described above. The replacement line shall consist of new valves, stops, and pipe from the water main to the inlet side of the existing meter.

2.7 FITTINGS

- A. Ductile iron pipe fittings shall be cement lined cast iron or ductile iron, Class 250, unless otherwise specified on the plans or in the proposal and produced in strict accordance with AWWA Specifications C110 and C111. The fittings shall be cement lined on the inside and bituminous coated (buried pipe) or painted (above ground) on the outside as specified for the cast iron pipe. Fittings shall be mechanical joint or push-on joint. Pipe and fittings above ground will be flanged. Compact fittings per AWWA C153 shall be allowed with consent of the Engineer.
- B. Fittings for PVC lines shall be either PVC or cast iron as set out in the proposal and plans. PVC fittings shall be supplied by the same manufacturer as the pipe and may be either solvent jointed or elastomeric ring jointed to the pipe. The Contractor shall furnish all necessary adapters for connections to cast iron or asbestos cement water lines. Cast iron fittings shall be standard or compact cast or ductile iron fittings per AWWA C153 with transition gaskets or specifically fabricated for use with PVC pressure pipe equal to Tyler Pipe or Trinity Valley.
- C. No fittings for PVC pipe shall be used which are designed for less than 150 psi operating pressure nor less than the design pressure of the pipe in which they are installed.
- D. All newly installed pipe fittings for potable water must conform to ANSI/NSF Standard 61 and must be certified by an organization accredited by ANSI.

PART 3 - EXECUTION

3.1 EXCAVATION OF TRENCH

- A. If clearing is needed the contractor shall clear and grub the entire width of the easement shown on the plans or staked on the ground and remove all cleared debris from the easement and dispose of it properly and legally. Burning is not allowed in the easement. If an easement is not shown, the contractor shall clear and grub only sufficient width to allow pipe installation. Excavation may be done by machine or by hand. The term "excavation" shall include any and all material excavated for whatever purpose, and shall include all subsequent handling and disposal of such material, together with the final preparation of the subgrade. No distinction has been made in the classes of material to be excavated and no extra payments will be made for such. The bidder must make his own investigation of the nature of the material to be excavated. Trenching shall be sufficiently wide to provide ample room for workmen engaged in handling pipe and making joints. In no case shall the width of the trench, inside of sheeting and bracing lines, be less than twelve inches, nor more than twenty-four inches, greater than the external diameter of the pipe from the bottom of the pipe to a depth 12 inches above the top of pipe.

WATER MAIN PIPE AND FITTINGS

- B. Bottoms of trenches shall be accurately graded to provide uniform bearing and support for the pipe on the solid and undisturbed trench bottoms at every point along its entire length between bell holes.
- C. All excavated materials shall be deposited on the sides of the trenches at such distances that no additional load due to surcharge is placed on the trench bank, and in such a manner that the pipe laying crew and public will be inconvenienced as little as possible.
- D. Sheeting shall be used when, in the opinion of the Contractor, it is necessary to prevent caving of banks or injury to adjacent private or public property. The Contractor is in no way relieved from the responsibility of adequate sheeting even though the Engineer's suggestions have been carried out.
- E. Sheeting shall be removed after the trench has been backfilled to a depth sufficient to prevent rupture of the trench banks. Payment will be made for sheeting if it is installed in trenches with depths of 5'-0" or more.

3.2 PIPE BEDDING

- A. All backfill around pipe installed where pavement is to be replaced shall be tamped from the bottom of the pipe to the top. All pipe shall have Class "D" unless otherwise noted in the specifications. No separate pay item is provided for Class "D" bedding it being considered subsidiary to the item for installation of pipe.
- B. Class "D" bedding (AWWA Type 2) shall consist of installing the pipe on a flat bottom trench in such a manner that the barrel of the pipe is uniformly supported along its entire length as previously described, and without the bell of the pipe supporting any load whatsoever. The first backfill shall be selected material from excavation free from rocks and large clumps or clods of earth which shall be placed by hand on alternate sides of the pipe in such a manner to prevent disturbing the position of the pipe. The backfill shall be tamped by hand to the springline of the pipe.
- C. Class "C" (AWWA Type 4 modified) bedding shall consist of installing the pipe on a compacted gravel or sand bed in such a manner that the barrel of pipe is uniformly supported along its entire length as previously described, and without the bell of the pipe supporting any weight whatsoever until the bedding is performed. Sand or gravel backfill shall be placed under and around the barrel and bell of the pipe and to a point just above the springline of the pipe. This material is then vibrated and/or water jetted to obtain maximum density under the pipe and haunches. Select clean native material may then be used if it is free of rocks, clods, roots, or other unsuitable material. The earth shall be moistened slightly if necessary to secure the proper compaction. Mechanical tamping shall be done on alternate sides of the pipe in such a manner that the position of the pipe will not be disturbed. The earth shall be tamped around the pipe and to a depth of twelve inches over the pipe.
- D. In lieu of the tamping of the backfill above the pipe, the Contractor, at his option, may perform Class "C" bedding by continuing the sand or gravel backfill to 12 inches above the pipe, jetting and vibrating until it is completely consolidated. The sand or gravel used for this purpose shall be sharp, clean, free of clay, silt, organic matter, or other material which might act as a binder to prevent proper consolidation during the jetting and vibrating. Free flowing "sugar" sand or pea gravel are unacceptable as Class "C" bedding materials.

WATER MAIN PIPE AND FITTINGS

- E. The type of bedding to be used shall be as specified in the "Proposal" and will depend upon the width of the trench, the size of the pipe, and depth of the cut, and the nature of the backfill material. If the type of bedding is not specifically stated to be otherwise, the contractor may use Class "D" bedding.

3.3 PIPE LAYING AND JOINTING

- A. The interior of the pipe is to be cleaned of all dirt, trash, leaves, and other debris before the pipe is laid. Before the pipe is placed in the trench, the ends of the pipe and the couplings, spigots, and bells shall be thoroughly cleaned. The pipe shall be thoroughly inspected for cracks or any other damage before it is installed.
- B. The method of making joints for all rubber gasketed cast iron pipe and for asbestos-cement pipe shall be as recommended by the manufacturer. Install Class 'B' concrete blocking between valves, bends, tees, or crosses to restrain water line movement. Blocking shall rest against undisturbed trench bank. Concrete for blocking shall not interfere with nuts and bolts on joints or valves. No pay item is provided for blocking. It is considered subsidiary to the other bid items.

3.4 WET CONNECTIONS

- A. A wet connection or tie-in shall be considered to be a connection requiring valving, plugging or otherwise removing a water main from service and tapping or installing tees, valves or other appurtenances with the main not under pressure. Pay item shall include shutting down the main, excavation and pumping the residual line water to make the required connection.

3.5 BACKFILL AND CLEANUP

- A. Where the pipe is laid in paved streets, the pavement shall be scored and removed with straight edges and in uniform pattern per Section 32 01 17 Flexible Paving Repair of these specifications. Where the pipe is laid in oiled, gravel, or dirt streets, or at locations where there is no pavement, the backfill shall be performed as described in this section.
- B. After the pipe has been bedded as previously specified the trench shall be backfilled in carefully compacted 6 inch lifts to approximately the ground level. (Sandy backfill material may be water jetted, with Engineer's approval, or vibrated at the Contractor's option. Arrangement for water must be made by the Contractor with the City. The Contractor must furnish his own pipe, hose, tools, and whatever else is needed to get the water from the nearest fire hydrant or outlet on the new pipe to where the water is needed.)
- C. Any surplus spoil remaining shall be bladed smooth if possible to do so without hindering the surface drainage in the area, or hauled away. After the backfill in the ditches settles, the Contractor shall add more dirt to the ditches and level off the surface again. Maintenance of the ditch surface shall be considered as part of the Contractor's one year warranty and shall be corrected upon notification of the defect. During the time the backfill in the ditches remains soft after flooding, the Contractor shall keep flares burning and barricades erected if necessary to keep the traffic off the ditchline until the backfill has dried and consolidated to the point where the backfill will support the traffic.

WATER MAIN PIPE AND FITTINGS

- D. The contractor shall maintain all backfilled ditches in a condition not hazardous to traffic from the time the ditch is backfilled until the job is accepted as finally complete by the Owner.
- E. The Contractor will be required to replace oiled dirt, gravel, grass, or any surface that he is directed to cut other than pavement, for which no pay is herein provided.
- F. The Contractor shall make his cleanup immediately behind his pipe laying operations. He shall not have more than 300 feet of ditch open per pipe laying crew at any one time.
- G. The Contractor will be required to perform any work necessary to provide access to driveways blocked by his ditching operations. This includes backfilling in front of the driveways as soon as possible, and adding gravel in line with the driveways when the backfill is too wet for the earth to support a car. No pay item is provided for labor, equipment, or materials for this work; it is considered subsidiary to the other bid items.

PART 4- POST CONSTRUCTION

- 4.1 REQUIRED PRESSURE TESTS FOR DUCTILE IRON PIPE: A hydrostatic test in accordance with AWWA C600-93, Installation of Ductile Iron Water Mains, "Section 4-Hydrostatic Testing" shall be performed on all non-PVC water lines installed under this contract. A separate hydrostatic test shall be performed on each valved section of the new water line.

The test procedure called for in AWWA C600-93, Section 4 is paraphrased below for the Contractors reference.

- A. Pressure and Leakage Test
 - 1. Test Restrictions: Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.

Test Pressure shall not exceed pipe or thrust-restraint design pressures.

The hydrostatic test shall be of at least a 2 hour duration.

Test pressure shall not vary by more than \pm 5 psi (34.5 kPa) for the duration of the test.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double disc gate valve. For tests at these pressures, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

Tests shall be made on sections having a valve on each end. The use of test plugs is not permitted.

The test pressure shall not exceed the rated pressure of the valves

WATER MAIN PIPE AND FITTINGS

when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

2. **Pressurization:** After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water, and the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is a good practice to allow the system to stabilize at the test pressure before conducting the leakage test.
3. **Air Removal:** Before applying the specified test pressure, air shall be expelled completely from the section of pipeline under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place as required by the specifications.

No extra payment will be made for the tapping, furnishing, and installing of the corporation cocks.

4. **Examination:** All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
5. **Leakage defined:** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi (34.5 kPa) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
6. **Allowable leakage:** No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$\text{In inch-pounds units, } L = \frac{SD \square P}{133,200}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

$$\text{In metric units, } L_m = \frac{SD \square P}{715,317}$$

Where: L_m = allowable leakage in liters per hour

WATER MAIN PIPE AND FITTINGS

- S = length of pipe tested, in meters
- D = nominal diameter of the pipe, in millimeters
- P = average test pressure during the leakage test, in kPa

These formulas are based on an allowable leakage of 11.65 gpd/mi./in. (1.079L/day/km/mm) of nominal diameter at a pressure of 150 psi (1034kPa).

Allowable leakage at various pressures is shown in the table which follows.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. (1.2 mL/h/mm) of nominal valve size shall be allowed.

When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

7. Acceptance of Installation: Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that allowed by this test procedure, repairs, or replacements shall be accomplished in accordance with the specifications.

All visible leaks are to be repaired regardless of the amount of leakage.

The Contractor shall provide means for measuring the quantity of water pumped during the test.

The Contractor shall provide the Owner and/or Engineer a certificate for each section of line tested showing water loss, allowable loss, and date of test. The Owner's Representative shall be present for all tests.

- 4.2 REQUIRED PRESSURE TESTS FOR POLYVINYL CHLORIDE PIPE: A hydrostatic test in accordance with AWWA M23, PVC Pipe - Design and Installation, "Chapter 8 - Testing and Maintenance" shall be performed on all PVC water lines installed under this contract. A separate hydrostatic test shall be performed on each valved section of the new water line.

The test procedure called for in AWWA M23, Chapter 8 is paraphrased below for the Contractor's reference.

- A. Testing Procedure: The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired, in which case the pressure test should be performed first. The specified test pressure should be applied by means of a pump connected to the pipe. The test pressure should be maintained (by additional pumping if necessary) for the specified time. While the line is under pressure, the system and all exposed pipe, fittings, valves, and hydrants should be carefully examined for leakage. All defective elements should be repaired or replaced and the test repeated until all visible leakage has been stopped and the allowable leakage requirements have been met.

WATER MAIN PIPE AND FITTINGS

- B. Test Method: The installer may perform simultaneous pressure and leakage tests, or he may perform separate pressure and leakage tests on the installed system at test durations and pressures specified in Table 21.
- C. Allowable Leakage: The duration of each leakage test should be 2 hr, unless otherwise specified, and during the test the main should be subjected to the pressure required in Table 22. Leakage should be defined as the quantity of water that must be supplied in to the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi (12.7 k Pa) of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation should be accepted if the leakage is greater than that determined by the following formula:

$$Q = \frac{LD \square P}{148,000}$$

Where: Q = the quantity of makeup water in gallons per hour;
 L = the length of the pipe section being tested in feet;
 D = nominal diameter of the pipe, in.
 P = average test pressure during the hydrostatic test, psig

Leakage values determined by the above formula are to be found in Table 22.

Table 21 System Test Methods		
Procedure	Pressure	Test Duration
Simultaneous pressure and leakage tests	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation.	2 hr
Separate pressure test	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation.	1 hr
Separate leakage test	150% of normal average working pressure of segment tested.	2 hr

Source: Recommended Standard for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe, UNI-Bell Plastic Pipe Association.

Table 22 Allowable Leakage for AWWA PVC Pipe										
Nominal Pipe Size in.	Average Test Pressure in Line, <i>psi</i>									
	50		100		150		200		250	
	Allowable Leakage Per 1000 Ft or 50 Joints, <i>gal/hr (L/hr)</i>									
4	.19	(.72)	.27	(1.02)	.33	(1.25)	.38	(1.44)	.43	(1.63)
6	.29	(1.10)	.41	(1.55)	.50	(1.89)	.57	(2.16)	.64	(2.42)
8	.38	(1.44)	.54	(2.04)	.66	(2.50)	.76	(2.88)	.85	(3.22)
10	.48	(1.82)	.68	(2.57)	.83	(3.14)	.96	(3.63)	1.07	(4.05)
12	.57	(2.16)	.81	(3.07)	.99	(3.75)	1.15	(4.35)	1.28	(4.84)

WATER MAIN PIPE AND FITTINGS

- A. Potable Water lines shall be thoroughly disinfected in accordance with AWWA C-651 and then flushed and sampled before being placed into service. A minimum of one sample for each 1,000 feet of completed main is required for bacteriological analysis. The contractor shall furnish sampling taps and sterile bottles, and shall deliver them to the local Texas Department of Health or county health unit laboratory. No line may be placed into service until negative bacteriological tests results (no bacteria found) are obtained. No hose or fire hydrant shall be used for sampling. Raw water lines shall not be sterilized.

4.4 EXISTING UTILITIES

- A. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed to be the actual location or depth. All existing structures, improvements and utilities shall be protected from damage that may occur due to construction operations and if damaged, they shall be replaced immediately with material equal to or better than the existing material. Such work shall be at the entire expense of the Contractor.

4.5 USE OF EXPLOSIVES

- A. If the use of explosives is necessary for the efficient prosecution of the work, the contractor shall notify the engineer in advance of their use and shall exercise every precaution to prevent damage to adjoining improvements or property by reason of their use. Any damage to existing structures or utilities will be repaired by the contractor at his expense and any damage to private property resulting from the use of explosives shall be the liability of the Contractor. The Contractor will be responsible for obtaining all required approvals and permits from State, County, and Municipal authorities and all blasting must conform to all Federal and State laws and Municipal ordinances.

4.6 FIELD INSPECTION

- A. Field inspection of material and workmanship, all laying, jointing, testing for defects and for leakage under pressure shall be performed in the presence of the inspector and shall be finally approved before being placed into service by the Engineer.

WATER MAIN PIPE AND FITTINGS

ALLOWABLE LEAKAGE PER 1,000 FT. OF NON-PVC PIPELINE* - Gph**
Nominal Pipe Diameter - in.

Avg. Test
Pressure

psi	3	4	6	8	10	12	14	16	18
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14
225	0.34	0.45	0.68	0.90	1.18	1.35	1.58	1.80	2.03
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35

Avg. Test
Pressure

Nominal Pipe Diameter - in.

psi	20	24	30	36	42	48	54	60	64
450	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	1.50	1.80	2.25	2.70	3.16	3.60	4.05	4.50	4.80

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**Calculated on the basis of Eq. 1.