12

CONSTRUCTION SPECIFICATIONS

for

CONTRACT FCD 99-42
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN
(Located in the City of Phoenix,
48th Street and Pecos Road Alignment)

PCN 630-01-30

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
25118
JEROME J.
ZOVNE
Date Signed 11/18/99
ARIZONA, U.S.A.

(Engineer's Seal)

Prepared By
HDR Engineering, Inc.
2141 E. Highland Avenue
Phoenix, AZ 85016-4736
for
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Recommended by Edward A. Raleigh **Date:** 11/30/99
Edward A. Raleigh, P.E.
Manager Engineering Division

Issued for Public Bidding by: _____ **Date:** 11/30/99
Michael S. Ellegood, P.E.
Chief Engineer and General Manager

SUPPLEMENTARY TO MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION EDITION OF 1998 AND REVISIONS AND SUPPLEMENTS THERETO.

ATTENTION

ALL PROSPECTIVE BIDDERS

A.R.S. Section 34-201 requires that construction bid proposals be accompanied by a certified check, cashiers check or surety bond for **ten percent (10%)** of the total amount of the bid.

All bonds must be executed solely by a surety company or companies holding a Certificate of Authority to transact surety business in Arizona, issued by the Director of the (State) Department of Insurance.

Bonds (bid, payment and performance) executed by an individual surety or sureties are not in compliance with the Arizona Revised Statutes. Bids received containing bid bonds not in compliance with the Arizona Revised Statutes will be considered as being non-responsive. The use of District-supplied bond forms is required.

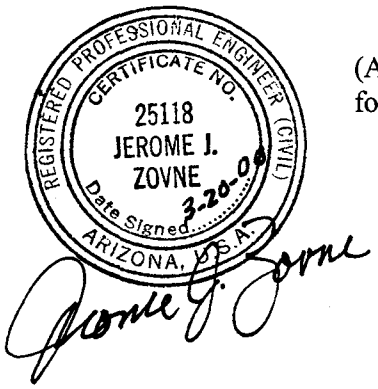
Please submit your bids accordingly.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 99-42
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN
PCN 630-01-30

TABLE OF CONTENTS

		Page
1.	Invitation for Bids	1
2.	Bid Form (Proposal)	4
3.	Bidding Schedule	6
4.	Subcontractor Listing	10
5.	Surety Bond	11
6.	No Collusion Affidavit	12
7.	Certification of License	13
8.	MBE/WBE Assurances Affidavit	14
9.	MBE/WBE Participation Affidavit, Sample	15
10.	D/MBE/WBE Participation Report (Form)	16
11.	Contract Agreement	17
12.	Statutory Payment Bond	20
13.	Statutory Performance Bond	21
14.	Indemnification and Insurance Requirements	22
15.	Certificate of Insurance	26
16.	Supplementary General Conditions (SGC)	(18 pages)
17.	Special Provisions (SP)	(42 pages)
18.	Appendix "A"	(160 pages)
19.	Appendix "B"	(3 pages)
20.	Appendix "C"	(11 pages)
21.	Appendix "D"	(15 pages)
22.	Drawings: (64 Plan Sheets)	(Separate)



(Area to left reserved for Engineer's Seal)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

INVITATION FOR BID

BID OPENING DATE: Tuesday, May 2, 2000

LOCATION: This Project is located within the City of Phoenix, Arizona at the Northeast corner of the intersection of 48th Street and the Pecos Road alignment, near I-10.

PROPOSED WORK: The Project consists of the excavation of a 351 AC-FT detention basin complex, large concrete spillway, construction of two pump stations, piping, manhole and gate structures, and the installation of landscaping, turf and irrigation.

BIDS:

SEALED BIDS for the proposed work will be received by the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona 85009 until 2:00 p.m. (local time) on Tuesday, May 2, 2000, then publicly opened and read at 2801 West Durango Street, Phoenix, Arizona 85009. All bids are to be marked in accordance with Section 102.9 of the MAG Uniform Standard Specifications and addressed to the Chief Engineer and General Manager, Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona 85009, in the Adobe Conference Room.. No bids will be received after the time specified for bid opening. All bids must be submitted on proposal forms furnished by the Flood Control District and included in the Proposal Pamphlet. The Board of Directors reserves the right to reject any and all bids and to waive any informality in any bid received.

ELIGIBILITY OF CONTRACTOR:

The bidder shall be required to certify that it has the appropriate "A" Contractor's license in the State of Arizona to perform the before-mentioned type of work. Certification shall be on the form provided herein.

The bidder may be required to furnish an affidavit as evidence of previous satisfactory performance in the above-mentioned type of work.

PRE-BID CONFERENCE:

A Pre-Bid conference will be held on Thursday, April 13, 2000 at 2:00 p.m. at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona, in the New River Conference Room. All potential contractors and subcontractors are encouraged to attend this pre-bid conference and be prepared at that time to submit in writing and discuss any comments concerning this solicitation.

Questions or items for clarification may be addressed to the Contracts Manager, in writing, at least five (5) days prior to bid opening date. Questions received after this deadline may not be accepted. Responses to all questions submitted will be sent to all planholders by addenda. Verbal interpretations, unless specifically addressed by addendum, shall not be binding nor have any legal effect.

CONTRACT TIME:

All work on this Contract is to be completed within three hundred ninety-five (395) calendar days after date of Notice to Proceed.

MBE/WBE PARTICIPATION:

It is the policy of the Flood Control District of Maricopa County to endeavor to ensure in every way possible that minority and women-owned business enterprises have every opportunity to participate in providing professional services, purchased goods, and contractual services without being discriminated against on the grounds of race, religion, sex, age, disability, or national origin.

The Maricopa County Minority and Women-Owned Business Enterprise Program, effective January 1, 1992, is incorporated herein by reference.

Two Affidavits are included herein. The first form, the "M/WBE Assurances Affidavit", must be completed and submitted with the bid - **Failure to do so may be cause for rejection of the bid.** The first and second low bidders must complete and return the second form, "Actual M/WBE Participation Affidavit", to the Flood Control District by 4:00 p.m. on the seventh calendar day following the bid opening,

For this contract, a goal of ten percent (10%) is established for Minority/Women-Owned Business Enterprises. Complete instructions and additional forms are available from the Flood Control District, Contracts Branch, telephone number 602-506-4433 or 602-506-4876. Bidders unable to meet the established goal, must submit "Good Faith" documentation. Failure to implement "good faith" efforts in accordance with the Maricopa County Minority and Women-Owned Business Enterprise Program to the satisfaction of the District may result in rejection of the bid. Forms for completion of good faith documentation are available from the Flood Control District, Contracts Branch.

PROJECT PLANS, SPECIAL PROVISIONS AND CONTRACT DOCUMENTS:

Plans and Construction Specifications may be obtained from the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona 85009 upon payment of $ 40.00 by check, payable to the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY. This payment will not be refunded. Mail orders for project documents must include an additional $8.00 for first class U.S. postage and handling. The total $48.00 will not be refunded. Regardless of circumstances, we cannot guarantee mail delivery.

Each bid must be accompanied by a Bid Bond executed on the District-supplied bond form, cashier's or certified check or postal money order equal to 10 percent (10%) of the bid, made payable to the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY as a guarantee that if the work is awarded to the bidder, the bidder will within ten (10) days of receipt of the Proposal Acceptance, enter into proper contract and bond condition for the faithful performance of the work, otherwise, said amount may be forfeited to the said BOARD OF DIRECTORS.

****

PRINCIPLE ITEMS AND APPROXIMATE QUANTITIES

QUANTITY	UNIT	DESCRIPTION
827,000	CY	Basin Complex Excavation
2,500	LF	RGRCP Pipe
18	EA	Manhole and Gate Structures
1	EA	Water Quality Pump Station
1	EA	Basin Evacuation Pump Station
37	ACRES	Turf

BID

TO THE BOARD OF DIRECTORS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PHOENIX, ARIZONA

Gentlemen:

The following Bid is made for Southeast Phoenix Regional Drainage Basin Project, Contract FCD 99-42, in the County of Maricopa, State of Arizona.

The following Bid is made on behalf of

_____

and no others. Evidence of authority to submit the bid is herewith furnished. The bid is in all respects fair and is made without collusion on the part of any person, firm, or corporation mentioned above, and no member or employee of the Board of Directors is personally or financially interested, directly or indirectly, in the bid, or in any purchase or sale of any materials or supplies for the work in which it relates, or in any portion of the profits thereof.

The Undersigned certifies that the approved Plans, Supplementary General Conditions, Special Provisions, Forms of Contract, Bonds, and Sureties authorized by the Board of Directors and constituting essential parts of the bid, have been carefully examined and also that the work site has been personally inspected.

The Undersigned declares that the amount and nature of the work to be done is understood and that at no time will misunderstanding of the Plans, Construction Specifications, Special Provisions, Supplementary General Conditions, or conditions to be overcome, be pled. On the basis of the Plans, Construction Specifications, Special Provisions, Supplementary General Conditions, the Forms of Contract, Bonds, and Sureties proposed for use, the Undersigned proposes to furnish all the necessary machinery, equipment, tools, apparatus, and other means of construction, to do all the work and to furnish all the materials in the manner specified and to finish the entire project within the time hereinafter proposed and to accept, as full compensation therefore, the sum of various products obtained by multiplying each unit price, herein bid for the work or materials, by the quantity thereof actually incorporated in the complete project, as determined by the Engineer or Architect.

The Undersigned understands that the quantities mentioned herein are approximate only and are subject to increase or decrease and hereby proposes to perform all quantities of work, as either increased or decreased, in accordance with the provisions of the Specifications, at the unit price bid in the Bidding Schedule.

The Undersigned further proposes to perform all extra work that may be required on the basis provided in the Specifications and to give such work personal attention and to secure economical performance.

The Undersigned further proposes to execute the Contract Agreement and furnish satisfactory Bonds and Sureties within ten (10) days of receipt of Notice of Bid acceptance, **TIME BEING OF THE ESSENCE.** The Undersigned further proposes to begin work as specified in the Contract attached hereto, and to complete the work within **three hundred ninety-five (395) calendar days** from the effective date specified in the Notice to Proceed. The Undersigned agrees to maintain at all times a Payment and Performance Bond, approved by the Board of Directors, each in an amount equal to one hundred percent of the contract amount. This Bond shall serve not only to guarantee the completion of the work on the part of the Undersigned, but also to guarantee the excellence of both workmanship and material and the payment of all obligations incurred, said Bonds and Sureties to be in full force and effect until the work is finally accepted and the provisions of the Plans, Specifications, and Special Provisions fulfilled.

A bid bond in the amount and character named in the Invitation to Bid, and amounting to not less than ten (10) percent of the total bid, is enclosed. The bid bond is submitted as a guaranty of good faith that the Bidder will enter into a written contract to do the work, as provided, if successful in securing the award thereof. It is therefore agreed that if the Undersigned withdraws its bid at any time except as herein provided, or if the bid is accepted and the Undersigned fails to execute the Contract and furnish satisfactory Bonds and Sureties as herein provided, the Flood Control District of Maricopa County shall be entitled and is hereby given the right to retain the said Bid Bond as liquidated damages.

The Undersigned acknowledges receipt of the following addenda, attached these to the bid package, and has included their provisions in the bid:

Addendum No._____ Dated_____

Addendum No._____ Dated_____

Addendum No._____ Dated_____

Addendum No._____ Dated_____

Addendum No._____ Dated_____

The Undersigned has enclosed the required bid security to this Bid.

ENGINEER'S ESTIMATE OF CONSTRUCTION COST

Southeast Phoenix Regional Drainage Basin Project

Contract: FCD 99-42

ITEM NO	DESCRIPTION	UNIT	APPROX QTY	UNIT COST NUMBERS	EXTENDED NUMBERS
105-1	Partnering Allowance	LS	1	$ 15,000.00	$ 15,000.00
107-1	NPDES/SWPPP Permits	LS	1		
107-2	Public Information and Notification Allowance	LS	1	$ 10,000.00	$ 10,000.00
107-3	Project Signs Allowance	LS	1	$ 2,000.00	$ 2,000.00
201-1	Rock Waste Clearing	CY	10,000		
202-1	Mobilization	LS	1		
215-1	Drainage Excavation	CY	827,408		
220-1	Rock Mulch - Gradation No. 2	CY	6,667		
310-1	Aggregate Base	CY	2,233		
321-1	Asphalt Concrete Pavement	SY	12,846		
350-1	Miscellaneous Removals	LS	1		
401-1	Traffic Control	LS	1		
420-1	Chain Link Fence	LF	2100		
425-1	Topsoil	CY	45040		
430-1	Landscaping	LS	1		
430-2	Decomposed Granite	SF	67651		
430-3	Concrete Header	LF	5080		
430-4	Bermuda Grass	AC	36.5		
430-5	Rye Grass	AC	36.5		
430-6	Treatment Cell Landscaping and Planting	LS	1		
440-1	Drip Irrigation System	LS	1		
440-2	Turf Irrigation System	LS	1		
450-1	Perimeter Lighting	Ea.	34		
505-1	Spillway Walls	LF	298		
505-2	Inlet Head Wall w/ Apron (Detail D1)	Ea.	3		
505-3	Inlet Head Wall w/o Apron (Detail D1)	Ea.	2		
505-4	Inlet Head Wall No.6 (Detail D1)	Ea.	1		
505-5	Outlet Head Wall w/Riprap(Detail D2)	Ea.	3		
505-6	Outlet Head Wall without Riprap(Detail D2)	Ea.	1		
505-7	Outlet Head Wall No.5 (Detail D2) w/ Concrete Apron	Ea.	1		
505-8	Gate Structure 100	Ea.	1		

ENGINEER'S ESTIMATE OF CONSTRUCTION COST

Southeast Phoenix Regional Drainage Basin Project

Contract: FCD 99-42

ITEM NO	DESCRIPTION	UNIT	APPROX QTY	UNIT COST NUMBERS	EXTENDED NUMBERS
505-9	Gate Structure 101	Ea.	1		
505-10	Gate Structure 102	Ea.	1		
505-11	Gate Structure 103	Ea.	1		
505-12	Gate Structure 104	Ea.	1		
505-13	Gate Structure 105	Ea.	1		
505-14	Gate Structure 106	Ea.	1		
505-15	Overflow Weir Structure	Ea.	1		
505-16	Concrete Low Flow Channel Lining	LF	1,589		
505-17	Emergency Spillway Cutoff Wall	LF	1,200		
505-18	Concrete Spillway	SY	10,020		
505-19	Access Ramp	SY	575		
510-1	Block Masonry Wall with Gates	LF	485		
520-1	Handrail	LF	818		
520-2	Permanent Safety Posts	Ea.	56		
520-3	Removable Safety Posts	Ea.	6		
610-1	3" Copper Water Line	LF	275		
610-2	4" Ductile Iron Pipe Water Line	LF	1,262		
618-1	Rubber Gasket Reinforced Concrete Pipe (24", Class II)	LF	355		
618-2	Rubber Gasket Reinforced Concrete Pipe (24", Class III)	LF	253		
618-3	Rubber Gasket Reinforced Concrete Pipe (24", Class IV)	LF	1,100		
618-4	Rubber Gasket Reinforced Concrete Pipe (24", Class V)	LF	428		
618-5	Rubber Gasket Reinforced Concrete Pipe (42", Class IV)	LF	396		
618-6	Water Quality Pump Station	LS	1		
618-7	Evacuation Pump Station	LS	1		
618-8	Water Quality Pump Station Electrical	LS	1		
618-9	Evacuation Pump Station Electrical	LS	1		
618-10	Stubout and Plug	Ea.	1		
625-1	Manhole 100	Ea.	1		
625-2	Manhole 101	Ea.	1		
625-3	Manhole 102	Ea.	1		
625-4	Manhole 103	Ea.	1		

ENGINEER'S ESTIMATE OF CONSTRUCTION COST

Southeast Phoenix Regional Drainage Basin Project

Contract: FCD 99-42

ITEM NO	DESCRIPTION	UNIT	APPROX QTY	UNIT COST NUMBERS	EXTENDED NUMBERS
625-5	Manhole 104	Ea.	1		
625-6	Manhole 105	Ea.	1		
625-7	Manhole 106	Ea.	1		
625-8	Manhole 107	Ea.	1		
625-9	Manhole 108	Ea.	1		
625-10	Manhole 108A	Ea.	1		
625-11	Manhole 109	Ea.	1		
TOTAL BID AMOUNT WRITTEN IN NUMBERS					
TOTAL BID AMOUNT WRITTEN IN WORDS					

IF BY AN INDIVIDUAL:

By:_____ _____
(Printed Name - Title) (Address)

_____ _____
(Signature) (Date) (Telephone Number)

IF BY A FIRM, PARTNERSHIP OR L.L.C. (LIMITED LIABILITY COMPANY

_____ _____
(Firm Name) (Firm Address)

By:_____ _____
(Signature - Title) (Date (Telephone Number)

** Name and Address of Each Member, or each Manager of L.L.C. per Operating Agreement

_____ _____
_____ _____
_____ _____
_____ _____

**The name and post office address of each member of the Firm or Partnership must be shown, or of each Manager of an L.L.C., also address of the registered office of the L.L.C.

IF BY A CORPORATION

_____ _____
(Corporate Name) (Corporation Address)

_____ _____
(Printed Name - Title) (Telephone Number)

By:_____
(Signature) (Date)

*Incorporated under the Laws of the State of _____ Names and Addresses of Officers:

_____ _____
(President) (Address)

_____ _____
(Secretary) (Address)

_____ _____
(Treasurer) (Address)

*The name of the State under which the Laws of the Corporation was Chartered and name, title and business address of the President, Secretary, and Treasurer must be shown.

SUBCONTRACTOR LISTING

As required in Section 102.6 of the Supplementary General Conditions, the following is a listing of Subcontractors and material suppliers (including any Minority and Women-owned Business Enterprise participation) that are to be used in the event the undersigned should enter into contract with the Owner. Although this list will not be considered as final commitment on the part of the successful proposer, any Subcontractor changes from those listed must have Owner's written approval prior to commencement of Subcontractor work on site.

_____

_____

_____

_____

_____

_____

(Signature)

SURETY BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, _____, as Principal, (hereinafter called the Principal), and the _____, a corporation duly organized under the laws of the State of _ _____, as Surety, (hereinafter called the Surety), are held and firmly bound unto the Flood Control District of Maricopa County as Obligee, in the sum of **ten percent (10%)** of the total amount of the bid of Principal, submitted by him to the Flood Control District of Maricopa County, for the work described below, for the payment of which sum, well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, and administrators, successors and assigns, jointly and severally, firmly by these presents, and in conformance with the Arizona Revised Statutes.

WHEREAS, the said Principal is herewith submitting its proposal for the Southeast Phoenix Regional Drainage Basin Project, Contract FCD 99-42.

NOW, THEREFORE, if the Flood Control District of Maricopa County shall accept the proposal of the Principal and the Principal shall enter into a contract with the Flood Control District of Maricopa County in accordance with the terms of the proposal and give the Bonds and Certificates of Insurance as specified in the Standard Specifications with good and sufficient Surety for the faithful performance of the contract and for the prompt payment of labor and material furnished in the prosecution of the contract, or in the event of the failure of the Principal to enter into the contract and give such Bond and Certificate of Insurance, if the Principal pays to the Flood Control District of Maricopa County the difference not to exceed the penalty of the bond between the amount specified in the proposal and such larger amount for which the Flood Control District of Maricopa County may in good faith contract with another party to perform the work covered by the proposal then this obligation is void. Otherwise it remains in full force and effect, provided, however, that this bond is executed pursuant to the provisions of Section 34-201, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of the section to the extent as if it were copied at length herein.

Signed and sealed this _____ day of _____, A.D., _____

_____
Agency of Record, State of Arizona

Agency Address and Phone Number:
_____
_____
_____

_____
Principal

By:_____
(Printed Name) (Signature)
Title:_____

_____
Surety Name
By:_____
Title:_____

Bond Number:_____

ATTACH SURETY POWER OF ATTORNEY

AFFIDAVIT BY CONTRACTOR
CERTIFYING THAT THERE WAS NO COLLUSION
IN BIDDING FOR CONTRACT

STATE OF_____)
)§
County of_____)

_____ being first duly sworn, deposes and says:

That he/she is _____ of _____ bidding on Contract FCD 99-42 for Southeast Phoenix Regional Drainage Basin Project, , in the County of Maricopa, State of Arizona.

That, in connection with the above-mentioned project, neither he/she, nor anyone associated with the aforesaid business, has, directly or indirectly, participated in any collusion, entered into any contract, combination, conspiracy or other act in restraint of trade or commerce in violation of the provisions of A.R.S. Section 34-251, Article 4, as amended.

_____
(Signature of Affiant)

Subscribed and sworn to before me this ___ day of _____, _____

_____
(Notary Public)

_____
My Commission Expires

CERTIFICATION OF LICENSE

Pursuant to A.R.S. Section 32-1169, I hereby state that I hold a current contractor's license, duly issued by the office of the Registrar of Contractors for the State of Arizona, said license has not been revoked, that the license number is:_____ that my privilege license number (as required by A.R.S. Section 42-5005) is:_____; and that, if any exemption to the above licensing requirements is claimed;

(1) The basis for the claimed exemption is:_____ and;

(2) The name(s) and license number(s) of any general, mechanical, electrical, or plumbing contractor(s) to be employed on the work are:

_____

_____

_____

IT IS UNDERSTOOD THAT THE FILING OF AN APPLICATION CONTAINING FALSE OR INCORRECT INFORMATION CONCERNING AN APPLICANT'S CONTRACTOR'S LICENSE OR PRIVILEGE LICENSE WITH THE INTENT TO VOID SUCH LICENSING REQUIREMENTS IS UNSWORN FALSIFICATION PUNISHABLE ACCORDING TO A.R.S. SECTION 13-2704.

_____
Signature of Licensee

Date:_____

Company:_____

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
MINORITY/WOMEN-OWNED BUSINESS ENTERPRISE PROGRAM
MBE/WBE ASSURANCES AFFIDAVIT

NOTE: FAILURE TO COMPLETE AND SUBMIT THIS AFFIDAVIT WITH THE BID PROPOSAL MAY BE CAUSE FOR REJECTION OF THE BID.

The undersigned, fully cognizant of the Flood Control District of Maricopa County MBE/WBE Program requirements and of the goal established, hereby certifies that in the preparation of this bid,

_____(the entity submitting the bid)

(CHECK ONE)

___ Will meet the **established** goal for participation by Minority/Women-Owned Business Enterprises.

___ Will provide the necessary documentation to the Flood Control District to establish that a good faith effort was made.

The first and second low bidders will specify their MBE/WBE participation on the Actual Participation affidavit or provide documentation of their good faith efforts not later than 4:00 p.m., the seventh calendar day following the bid opening. If participation is "None", the documentation shall provide bidder's good faith efforts to obtain the participation. The Flood Control District (District) to determine whether in fact a comprehensive "good faith" effort has been implemented will review this documentation. The required affidavit shall be obtained by the apparent first and second low bidders from the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009, Telephone 506-1501 following the bid opening and verbal notification from the Procurement Officer of the Procurement Agency; a SAMPLE affidavit form for reference purposes follows.

_____
Name of Firm

By:_____
Signature

_____
Title

STATE OF_____)
)§
County of _____)

Subscribed and sworn to before me this ___ day of _____, _____ ___

_____
Notary Public

My Commission Expires:_____

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
MINORITY/WOMEN OWNED BUSINESS ENTERPRISE PROGRAM

ACTUAL MBE/WBE PARTICIPATION AFFIDAVIT

(NOTE: COMPLETED AFFIDAVIT MUST BE SUBMITTED WITHIN SEVEN CALENDAR DAYS FOLLOWING THE BID OPENING).

_____
Name of Contractor

Total Amount of Contract $_____
Project/Contract Number 99-42
Contract M/WBE Goal: 10 %

_____
Contact Person

_____
Street No.

_____
City State Zip

M/WBE Owned Firm	Principal	Address	Type of Work	Dollar Amount and Percentage

TOTALS (Dollars and Percentage) _____

The undersigned has entered into a formal agreement with the MBE/WBE subconsultants/subcontractors /suppliers listed above, in the execution of this contract with Maricopa County.

_____
Signature

_____
Title

_____
Date

STATE OF_____ }
}§
County of_____ }

Subscribed and sworn to before me this _____ **day of** _____**by** _____
Notary Public

My commission Expires: _____

MINORITY/WOMEN-OWNED BUSINESS ENTERPRISES PROGRAM

MBE/WBE PARTICIPATION REPORT
(To be attached with Each Request for Pay)

Date: _____

Prime Contractor: _____
Contractor Contact Person: _____
Contractor Address: _____
Telephone Number: _____
Fax Number: _____

Contract Description: _____
Contract Number: _____
Invoice For Pay Period of (indicate dates): _____

M/WBE SubContractor Name: _____
Contact Person: _____
Address: _____
Telephone Number: _____
Type of Firm: _____

Type of Work performed for this contract by this M/WBE firm: _____

Total M/WBE Subcontract Amount: for this SubContractor $ _____

Amount Paid to this M/WBE SubContractor on this invoice payment: $ _____

Total paid to this SubContractor since the contract start date: $ _____

The total M/WBE Goal for this contract is _____%

The total M/WBE Participation on this contract since the contract start date is _____%

Send to: **Flood Control District of Maricopa County**
Dortha Klaahsen, Contracts Branch
Linda Hannan, Accounts Payable Division
2801 West Durango Street
Phoenix, Arizona 85009

CONTRACT AGREEMENT

THIS AGREEMENT, made and entered into this ___ day of _____, _____ by and between the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, hereinafter called the Owner, acting by and through its BOARD OF DIRECTORS, and _____, hereinafter called the Contractor.

WITNESSETH: That the said Contractor, for and in the consideration of the sum of_____ ($) to be paid to him by the Owner, in the manner and at the times hereinafter provided, and of the other covenants and agreements herein contained, hereby agrees for himself, heirs, executors, administrators, successors, and assigns as follows:

ARTICLE I - SCOPE OF WORK: THE Contractor shall construct, and complete in a workmanlike and substantial manner and to the satisfaction of the Chief Engineer and General Manager, a project for the Flood Control District of Maricopa County, designated as Southeast Phoenix Regional Drainage Basin Project, Contract FCD 99-42 and furnish at its own cost and expense all necessary machinery, equipment, tools, apparatus, materials, and labor to complete the work in the most substantial and workmanlike manner according to the Plans and Construction Specifications on file with the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona, and such modifications of the same and other directions that may be made by the Flood Control District of Maricopa County as provided herein.

ARTICLE II - CONTRACT DOCUMENTS: The Construction Specifications, i.e. Invitation to Bid, Plans, Standard Specifications and Details, Supplementary General Conditions, Special Provisions, Addenda, if any, Proposal, Affidavits, Performance Bond, Payment Bond, Certificates of Insurance, and Change Orders, if any, are by this reference made a part of this Contract and shall have the same effect as though all of the same were fully inserted herein.

ARTICLE III - TIME OF COMPLETION: The Contractor further covenants and agrees at its own proper cost and expense, to do all work as aforesaid for the construction of said improvements and to completely construct the same and install the material therein, as called for by this agreement free and clear of all claims, liens, and charges whatsoever, in the manner and under the conditions specified within three hundred ninety-five (395) calendar days following notice to proceed.

ARTICLE IV - PAYMENTS: For and in consideration of the faithful performance of the work herein embraced as set forth in the Contract Documents, which are a part hereof and in accordance with the directions of the Owner, through its Engineer and to its satisfaction, the Owner agrees to pay the said Contractor the amount earned, computed from actual quantities of work performed and accepted or materials furnished at the unit bid price on the Proposal made a part hereof, and to make such payment in accordance with the requirements of A.R.S. Section 34-221, as amended. The Contractor agrees to discharge its obligations and make payments to its subcontractors and suppliers in accordance with A.R.S. Section 34-221.

ARTICLE V - TERMINATION: The Owner hereby gives notice that pursuant to A.R.S. Section 38-511(A) this contract may be canceled without penalty or further obligation within three years after execution if any person significantly involved in initiation, negotiation, securing, drafting or creating a contract on behalf of the Owner is, at any time while the contract or any extension of the contract is in effect, an employee or agent of any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the Chief Engineer and General Manager of the Owner is received by all of the parties to the contract. In addition, the Owner may recoup any fee for commission paid or due to any person significantly involved in initiation, negotiation, securing, drafting or creating the contract on behalf of the Owner from any other party to the contract arising as a result of the contract.

ARTICLE VI - NEGOTIATION CLAUSE: Recovery of damages related to expenses incurred by the Contractor for a delay for which the Owner is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract, shall be negotiated between the Contractor and the Owner. This provision shall be construed so as to give full effect to any provision in the contract which requires notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

ARTICLE VII - COMPLIANCE WITH LAWS: The Contractor is required to comply with all Federal, State and local ordinances and regulation. The Contractor's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform Control Act of 1986 for all personnel that the Contractor and any subcontractors employ to complete this project. It is understood that the Owner shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

ARTICLE VIII - D/MBE/WBE PROGRAM: The Owner will endeavor to ensure in every way possible that minority and women-owned business enterprises shall have every opportunity to participate in providing professional services, purchased goods, and contractual services to the Owner without being discriminated against on the grounds of race, religion, sex, age, disability, or national origin. The City of Phoenix and Maricopa County Minority, Woman and Disadvantaged Business Enterprise Program is incorporated by reference.

ARTICLE IX - ANTI-DISCRIMINATION PROVISION: The Contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, or disability and further agrees not to engage in any unlawful employment practices. The Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

IN WITNESS WHEREOF: Five (5) identical counterparts of this Contract, each of which shall for all purposes be deemed an original thereof, have been duly executed by the parties hereinabove named, on the date and year first above written.

_____
Party of the First Part

By_____
(Printed Name) (Signature)

Title:_____

Date:_____

_____
Tax Identification Number

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PARTY OF THE SECOND PART

RECOMMENDED BY:

_____
Chief Engineer and General Manager Date
Flood Control District of Maricopa County

By:_____
Chairman, Board of Directors Date

ATTEST:

_____
Clerk of the Board Date

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District.

By:_____
District, General Counsel Date

STATUTORY PAYMENT BOND PURSUANT TO TITLE 34
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____ (hereinafter called the Principal), as Principal, and ____ _____ a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, in the County of Maricopa, State of Arizona (hereinafter called the Obligee), in the amount of _____ _____($_____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Flood Control District of Maricopa County, dated the _____ day of _____, _____ for the Southeast Phoenix Regional Drainage Basin Project, Contract FCD 99-42, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal promptly pays all monies due to all persons supplying labor or materials to the Principal or the Principal's Subcontractors in the prosecution of the work provided for in the contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of the Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if they were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as a part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, _____

_____
Agency of Record, State of Arizona

Agency Address and Phone Number:
_____
_____
_____
_____

_____
Principal

By:_____
Printed Name and Signature

Title:_____

_____
Surety Seal

By:_____
Title:_____

ATTACH SURETY POWER OF ATTORNEY

STATUTORY PERFORMANCE BOND PURSUANT TO TITLE 34
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____ hereinafter called the Principal, as Principal, and _____ a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, in the County of Maricopa, State of Arizona, in the amount of _____ ($ _____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Flood Control District of Maricopa County, dated the ____ day of _____, _____, for the Southeast Phoenix Regional Drainage Basin Project, Contract FCD 99-42, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice to the Surety, and during the life of any guaranty required under the contract, and also performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of all duly authorized modifications of the contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, and Article 2, Arizona Revised Statutes, to the same extent as if they were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, _____.

_____
Agency of Record, State of Arizona

Agency Address and Phone Number:
_____
_____
_____
_____

_____
Principal

By:_____
Printed Name and Signature

Title:_____

_____
Surety Seal

By:_____
Title:_____
_____
_____
_____

ATTACH SURETY POWER OF ATTORNEY

INDEMNIFICATION

To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Flood Control District of Maricopa County (District), Maricopa County (County), Maricopa County, the City of Phoenix, Arizona (COP), the Salt River Project (SRP), and the Arizona Department of Transportation (ADOT), their agents, representatives, officers, directors, officials, and employees from and against all claims, damages, losses and expenses, including but not limited to attorney fees, court costs, expert witness fees, and the cost of appellate proceedings, relating to, arising out of, or alleged to have resulted from the acts, errors, omissions or mistakes relating to the performance of this contract. Contractor's duty to defend, indemnify and hold harmless the District, County, COP, SRP, and ADOT, their agents, representatives, officers, directors, officials, and employees shall arise in connection with any claim, damage, loss or expense that is attributable to bodily injury, sickness, disease, death, or injury to, impairment, or destruction of property, including loss of use resulting therefrom, caused by any acts, errors, omissions or mistakes in the performance of this contract including any person for whose acts, errors, omissions or mistakes, the Contractor may be legally liable.

The amount and type of insurance coverage requirements set forth herein will in no way be construed as limiting the scope of the indemnity in this paragraph.

Abrogation of Arizona Revised Statutes Section 34-226:

In the event that A.R.S. § 34-226 shall be repealed or held unconstitutional or otherwise invalid by a court of competent jurisdiction, then to the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the District, County, COP, SRP, and ADOT, their agents, representatives, officers, directors, officials and employees from and against all claims, damages, losses and expenses (including but not limited to attorney fees, court costs, and the cost of appellate proceedings), relating to, arising out of, or resulting from Contractor's work or services. Contractor's duty to defend, indemnify and hold harmless the District, County, COP, SRP, and ADOT, their agents, representatives, officers, directors, officials and employees shall arise in connection with any claim, damage, loss or expense that is attributable to bodily injury, sickness, disease, death, injury to, impairment or destruction of property including loss of use resulting therefrom, caused in whole or in part by any act or omission of the Contractor, anyone Contractor directly or indirectly employes or anyone for whose acts Contractor may be liable, regardless of whether in is caused in part by a party indemnified hereunder, including the District and Maricopa County.

The amount and type of insurance coverage requirements set forth below will in no way be construed as limiting the scope of the indemnity in this paragraph.

The scope of this indemnification does not extend to the sole negligence of the District and Maricopa County.

INSURANCE REQUIREMENTS

Contractor, at Contractor's own expense, shall purchase and maintain the herein stipulated minimum insurance with companies duly licensed, possessing a current A.M. Best Company Rating of at least B++ or a Financial Performance Rating (FPR) of at least 6, or approved unlicensed companies in the State of Arizona with policies and forms satisfactory to the District.

All insurance required herein shall be maintained in full force and effect until all work or service required to be performed under the terms of the contract is satisfactorily completed and formally accepted. Failure to do so may, at the sole discretion of the District, constitute a material breach of this contract.

The Contractor's insurance shall be primary insurance as respects the District, and any insurance or self-insurance maintained by the District shall not contribute to it.

Any failure to comply with the claim reporting provisions of the insurance policies or any breach of an insurance policy warranty shall not affect coverage afforded under the insurance policies to protect the District.

The insurance policies may provide coverage which contains deductibles or self-insured retentions. Such deductible and/or self-insured retentions shall not be applicable with respect to the coverage provided to the District under such policies. The Contractor shall be solely responsible for the deductible and/or self-insured retention and the District, at its option, may require the Contractor to secure payment of such deductibles or self-insured retentions by a surety bond or an irrevocable and unconditional letter of credit.

The District reserves the right to request and to receive, within ten (10) working days, certified copies of any or all of the herein required insurance policies and/or endorsements. The District shall not be obligated, however, to review such policies and/or endorsements or to advise Contractor of any deficiencies in such policies and endorsements, and such receipt shall not relieve Contractor from, or be deemed a waiver of the District's right to insist on strict fulfillment of Contractor's obligations under this contract.

The insurance policies required by this contract, except Workers' Compensation, shall name the District and Maricopa County, their agents, representatives, officers, directors, officials, and employees as Additional Insureds.

The policies required hereunder, except Workers' Compensation, shall contain a waiver of transfer of rights of recovery (subrogation) against the District and Maricopa County, their agents, representatives, officers, directors, officials and employees.

Required Coverage

Commercial General Liability.
Contractor shall maintain Commercial General Liability insurance with a limit of not less than $1,000,000 for each occurrence with a $2,000,000 Products/Completed Operations Aggregate and a $2,000,000 General Aggregate Limit. The policy shall include coverage for bodily injury, broad form property damage, personal injury, products and completed operations and blanket contractual coverage including, but not limited to, the liability assumed under the indemnification provisions of this contract which coverage will be at least as broad as Insurance Service Office, Inc. Policy Form CG 00 01 10 93 or any replacement thereof. The coverage shall include X,C,U.

The policy shall contain a severability of interest provision, and shall not contain a sunset provision or commutation clause, or any provision which would serve to limit third party action over claims.

The Commercial General Liability additional insured endorsement shall be at least as broad as the Insurance Service Office, Inc.'s Additional Insured, CG 20 10 11 85, and shall include coverage for Contractor's operations and products and completed operations.

If the Contractor subcontracts any part of the work, services or operations awarded to the Contractor, he shall purchase and maintain, at all times during prosecution of the work, services or operations under this contract, an Owner's and Contractor's Protective Liability insurance policy for bodily injury and property damage, including death, which may arise in the prosecution of the Contractor's work, service or operations under this contract. Coverage shall be on an occurrence basis with a limit not less than $1,000,000 per occurrence, and the policy shall be issued by the same insurance company that issues the Contractor's Commercial General Liability insurance.

Automobile Liability
Contractor shall maintain Automobile Liability insurance with an individual single limit for bodily injury and property damage of no less than $1,000,000, each occurrence, with respect to Contractor's vehicles (whether owned, hired, non-owned), assigned to or used in the performance of this contract. Coverage will be at least as broad as coverage code 1, "any auto" (Insurance Services Office, Inc. Policy Form CA 00 01 12 93, or any replacements thereof). Such insurance shall include coverage for loading and off-loading and off-loading hazards. If hazardous substances, materials, or wastes are to be transported, MCS 90 endorsement shall be included and $5,000,000 per accident limits for bodily injury and property damage shall apply.

Workers' Compensation:
The Contractor shall carry Workers' Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of Contractor's employees engaged in the performance of the work or services, as well as Employer's Liability insurance of not less than $1,000,000 for each accident, $1,000,000 disease for each employee, and $1,000,000 disease policy limit.

In case any work is subcontracted, the Contractor will require the Subcontractor to provide Workers' Compensation and Employers' Liability insurance to at least the same extent as required of the Contractor.

Builders' Risk (Property) Insurance:
The Contractor shall purchase and maintain, on a replacement cost basis, Builders' Risk insurance in the amount of the initial contract amount, as well as subsequent modifications thereto for the entire work at the site. Such Builders' Risk insurance shall be maintained until final payment has been made or until no person or entity other than the District has an insurable interest in the property required to be covered, whichever is earlier. This insurance shall include interest of the District, the Contractor, and all subcontractors and sub-subcontractors in the work during the life of the contract and course of construction, and shall continue until the work is completed and accepted by the District. For new construction projects, the Contractor agrees to assume full responsibility for loss or damage to the work being performed and to the structures under construction. For renovation construction projects, the Contractor agrees to assume responsibility for loss or damage to the work being performed at least up to the full contract amount, unless otherwise required by the contract documents or amendments thereto.

Builders' Risk insurance shall be on an all-risk policy form and shall also cover false work and temporary buildings and shall insure against risk of direct physical loss or damage from external causes including debris removal, demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for architect's service and expenses required as a result of such insured loss and other "soft costs" as required by the contract.

Builders' Risk insurance must provide coverage from the time any covered property comes under Contractor's control and/or responsibility, and continue without interruption during construction, renovation, or installation, including any time during which the covered property is being transported to the construction installation site, and while on the construction or installation site awaiting installation. The policy will provide coverage while the covered premises or any part thereof are occupied. Builders' Risk insurance shall be primary and not contributory.

Required coverage may be modified by an amendment to the contract documents.

If the contract required testing of equipment or other similar operations, at the option of the District, the Contractor will be responsible for providing property insurance for these exposures under a Boiler Machinery insurance policy.

Certificates of Insurance:
Prior to commencing work or services under this contract, Contractor shall furnish the District with Certificates of Insurance, or formal endorsements as required by the contract, issued by Contractor's insurer(s), as evidence that policies providing the required coverage's, conditions, and limits required by this contract are in full force and effect. Such certificates shall identify this contract number and title.

In the event any insurance policy(ies) required by this contract is(are) written on a "claims made" basis, coverage shall extend for two (2) years past completion and acceptance of the Contractor's work or services and as evidenced by annual Certificates of Insurance.

If a policy does expire during the life of the contract, a renewal certificate must be sent to the District fifteen (15) days prior to the expiration date.

Cancellation and Expiration Notice:
Insurance required herein shall not expire, be cancelled, or materially changed without thirty (30) days prior written notice to the District.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CERTIFICATE OF INSURANCE

CONTRACT FCD 99-42 **PROJECT TITLE: Southeast Phoenix Regional Drainage Basin**

NAME AND ADDRESS OF INSURANCE AGENCY:	*INSURANCE COMPANIES AFFORDING COVERAGES:		
	Company Letter	A	
	Company Letter	B	
	Company Letter	C	
NAME AND ADDRESS OF INSURED:	Company Letter	D	
	Company Letter	E	
	Company Letter	F	

This certificate of insurance certifies that policies of insurance listed below have been issued to the insured named above and are in full force at this time.

*CO. LTR.	TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE (MM/DD/YY)	EXPIRATION DATE (MM/DD/YY)	LIMITS	
	COMMERCIAL GENERAL: ☒: LIABILITY FORM ☒: PREMISES OPERATIONS ☒: CONTRACTURAL ☒: BODILY INJURY ☒: BROAD FORM PROPERTY DAMAGE ☒: PERSONAL INJURY ☒: PRODUCTS AND COMPLETED OPERATIONS HAZARD ☒: EXPLOSION AND COLLAPSE ☒: UNDERGROUND HAZARD ☒: INDEPENDENT CONTRACTORS				GENERAL LIABILITY, EACH OCCURRENCE PRODUCTS/COMPLETED OPERATIONS AGGREGATE GENERAL AGGREGATE	$1,000,000 $2,000,000 $2,000,000
	COMPREHENSIVE AUTO: ☒: LIABILITY AND NON-OWNED				Each Occurrence	$1,000,000
	☐: EXCESS LIABILITY				NECESSARY IF UNDERLYING NOT ABOVE MINIMUM	
	☒: WORKERS' COMPRESATION AND EMPLOYERS' LIABILITY				EMPLOYER'S LIABILITY, each accident DISEASE, each employee DISEASE policy limit	$1,000,000 $1,000,000 $1,000,000
	☒: BUILDERS' RISK ALL-RISK FORM				REPLACEMENT COSTS	
	☒: OTHER:	Except for Professional Liability Insurance and Workers' Compensation Insurance, the Flood Control District of Maricopa County, Maricopa County, the City of Phoenix, Arizona, the Salt River Project, and the Arizona Department of Transportation, their agents, representatives, officers, Directors, Officials, and employees are named as Additional Insured's.				

Except for Professional Liability Insurance and Workers' Compensation Insurance, the Flood Control District of Maricopa County and Maricopa County are added as additional insured's on those types of policies described herein which are required to be furnished by this contract entered into between the insured and the Flood Control District of Maricopa County. To the extent provided in this contract, insured shall hold harmless the Flood Control District of Maricopa County and Maricopa County from liability arising out of any services provided or duty performed by insured as required by statute, law, purchase order or otherwise required, with the exception of liability for loss or damage resulting from the sole negligence of Flood Control District of Maricopa County, its agents, employees, or indemnities. It is agreed that any insurance available to the named insured shall be primary of other sources that may be available. It is further agreed that no policy shall expire, be cancelled, or materially changed to affect the coverage available to the District without thirty (30) days written notice to the District. **THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.**

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY **2801 WEST DURANGO STREET** **PHOENIX, ARIZONA 85009**	**DATE ISSUED:** _____ _____ **AUTHORIZED REPRESENTATIVE**

SUPPLEMENTARY GENERAL CONDITIONS

for

CONTRACT FCD 99-42

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN

CONTRACT NO. FCD 99-42
PCN 630-01-30

SUPPLEMENTARY GENERAL CONDITIONS

SPECIFICATIONS

Except as otherwise amended in these Supplementary General Conditions and the Construction Special Provisions, this project shall be constructed in accordance with all applicable Maricopa Association of Governments (MAG) Uniform Standard Specifications and Uniform Standard Details, dated 1998 including all revisions through 2000, City of Phoenix (COP) Supplement to MAG Specifications and Details (1998 Edition), Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, dated 1996, ADOT Stored Specifications included in this document, ADOT Standard Structure Drawings, dated June 1992, including all revisions and notices through 1999, and ADOT Construction Standard Drawings, dated June 1995, including all revisions and notices through 1999.

PRECEDENCE OF CONTRACT DOCUMENTS

This Contract and its designated documents, whether taken separately or together, are to be interpreted according to full intent, meaning, and spirit, and shall be deemed to mutually explain each other and to be descriptive of any materials to be furnished and the work to be performed under this Contract. In cases of any difference or discrepancy between the Contract documents, the order of precedence shall be a) Addendum to the Invitation for Bids, b) the Contract form, c) Supplementary General Conditions, d) Construction Special Provisions, e) Project Plans, f) MAG Uniform Standard Specifications and Uniform Standard Details, g) COP Supplements 1998 Edition, and h) ADOT Standard Specifications and Standard Details and Drawings.

Subsection 101.2 - Definitions and Terms:

1. Change the definition of the phrase "Board of Supervisors" to being the Board of Directors acting under the authority of the laws of the State of Arizona and in their capacity of the Board of Directors of the Flood Control District of Maricopa County.

2. Change the definition of the phrase "Budget Project" to being a project financed by funds set aside in the annual budget or otherwise approved by the Flood Control District of Maricopa County Board of Directors.

3. Add to the definition of the phrase "Contract Documents," the phrase "Supplementary General Conditions."

4. Change the definition of the term "Engineer" to being the person appointed by the Flood Control District of Maricopa County Board of Directors to the office of Chief Engineer and General Manager of the Flood Control District of Maricopa County acting directly or through its authorized representative, the Chief of the Flood Control District of Maricopa County Planning and Project Management Division.

5. Change the definition for the phrase "Notice of Award" to a letter from the Flood Control District of Maricopa County advising Contractor that it is the successful bidder and the Flood Control District of Maricopa County has accepted its proposal.

6. Change the definition of the term "Owner" to the Flood Control District of Maricopa County, acting through it's legally constituted officials, officers, or employees.

7. Whenever the word "District" is used in these Specifications, it shall mean the Flood Control District of Maricopa County.

8. Add the definition for Maricopa County Minority Business Office (MBO); the office responsible for administering the Maricopa County Minority and Women Owned Business Enterprise Program.

9. Add the definition for the Maricopa County Minority and Women Owned Business Enterprise Program as being the Program adopted by the Board of Supervisors effective January 1, 1992.

Subsection 102.4 - Examination of the Plans, Special Provisions, and Site Work: Add the following:
The soil boring logs (included in Appendix C) and Geotechnical reports including ground water conditions are available for review at the Owner's office, and Contractors are encouraged to do so. Existing moisture conditions shall be no basis for claim for additional money or time extensions. The Contractor shall manipulate the existing soil as required to achieve stable soil conditions and the required densities, as well as safe and stable side slopes during construction activities.

Subsection 102.5 - Preparation of Proposal: Add the following:
Proposals, including the Bidding Schedule, must be legibly written in ink or typed, with all prices given in numerals. In case of a conflict between the unit bid price and the extension, the unit bid price will govern.

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any addenda have been issued by the Flood Control District. This may be accomplished by calling 602-506-1501. Any addendum issued, if not already bound into the Special Provisions, **must be attached and included as part of the Specifications** and any quantities on the Bidding Schedule requiring change shall be adjusted to the new figure by pen and ink. **Bids which do not have appropriate addenda attached and show appropriate changes to the Bidding Schedule, and receipt of addenda acknowledged in the Proposal shall be invalid.**

The bidder's Arizona State Contractor's License number and the classification under which it proposes to perform the work shall be shown on the proposal. An "**A" General Engineering** License is required for this contract. The two lowest bidders may be required to provide certification of prior satisfactory completion for similar construction and to furnish a copy of their license and the renewal certificate.

Subsection 102.6 - Subcontractors' List: Add the following:
A list of subcontractors to be employed on the project shall be submitted with the bid, on the form provided in the Proposal. Following Notice of Award, no change of the subcontractors named therein will be made unless first approved in writing by Owner.

Subsection 102.7 - Irregular Proposals: Add the following:
(F) If the Maricopa County Minority and Women-Owned Business Enterprises Assurances Affidavit is not completed and submitted.
(G) If any addenda are not acknowledged and attached.
(H) If the Owner's bond forms are not utilized.
(I) If the entire specifications document is not returned.
(J) If the statement from bidder's insurance carrier, as required by Subsection 103.6, is not included.

Subsection 103.6 - Contractor's Insurance: Add the following:
A statement from the bidder's insurance carrier shall be included in the proposal certifying that it will furnish the specified kind and amounts of insurance to the bidder if it is awarded the contract, and that it will execute the form of Certificate of Insurance included in the documents. As required by law, the statement will be from an insurance carrier or carriers authorized to do business in the State of Arizona, or countersigned by an agent of the carrier authorized to do business in the State of Arizona. Concurrently with the execution of the contract, Contractor shall furnish a Certificate of Insurance, using the included Certificate, that names the additional insureds as set out in the Certificate. The Certificate shall also name the additional insureds as Certificate Holders. The types of insurance and the limits of liability shall be as indicated on the included form.

Subsection 103.6.1(D) - Contractor's Insurance: Add the following:
Include additional insureds as indicated on the included Certificate of Insurance.

Subsection 104.1 - Work to be Done: Add the following to 104.1.1:
All water for construction purposes, drinking water, lighting, temporary electric power, heat and telephone service shall be arranged and provided for as per requirements of the work by Contractor at his expense.

Add the following to 104.1.2:
The major facilities to be constructed include the primary basin and equalization basin excavation, concrete spillway, pump stations, basin piping and culvert, vegetated and non-vegetated treatment basins, landscaping and irrigation, lighting, and paved access roads.

No utility relocations are anticipated during construction however, all utilities near the site are to be protected in place. All existing irrigation delivery ditches along Pecos Road, and all irrigation tailwater ditches along 48th Street will be maintained in operating condition during construction. The existing COP Sewer Lift Station shall also be protected in place.

104.2.3 - Changes:
The Owner may at any time, by written order, and without notice to the sureties, if any, make changes within the general scope of this contract in any one or more of the following:
A) Drawings, designs, or specifications;
B) Method or manner of performance of the work;
C) Owner-furnished facilities, equipment, materials, services, or site;
D) Directing acceleration in the performance of the work.

Any other written or oral order from the Owner that causes a change shall be treated as a change order under this section provided that the Contractor gives the Owner written notification within two work days after receipt of such direction stating:
A) The date, nature, and circumstances of the conduct regarded as a change;
B) The particular elements of the contract performance for which the Contractor is seeking an equitable adjustment under this section, including any price or schedule adjustments;
C) The Contractor's estimate of the time by which the Owner must respond to the Contractor's notice to minimize cost, delay, or disruption of performance.

The Contractor shall diligently continue performance of this contract to the maximum extent possible in accordance with its provisions. Except as provided in this section, no order, statement, or conduct of the Owner shall be treated as a change or entitle the Contractor to an equitable adjustment. If any change under this section causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, the Owner shall make an equitable adjustment and modify the contract in writing. The equitable adjustment shall not include increased costs or time extensions for delay resulting from the Contractor's failure to provide notice or to diligently continue

performance. No proposal for the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

Subsection 104.2.4 - Cost Estimates or Price Proposals:
The Contractor and any lower-tier subcontractors shall submit itemized cost estimates or price proposals for any owner-directed change order or Contractor-initiated claim.

Cost estimates or pricing proposals shall be itemized to include direct labor by man-hours, individual craft, hourly wage rate and verifiable labor burden. Other direct costs shall include rental and operator rates for rented or owned equipment, material trucking expenses and other costs clearly identified and directly allocable to contract performance. Material costs shall be itemized by item description, quantity for each item, unit price per item, including applicable sales tax markup, and extended total price per item. The Contractor shall provide copies of material supplier quote sheets, invoices or purchase orders, as appropriate.

Lump sum cost estimates or price proposals shall be rejected and returned to the Contractor for itemization as described above. Failure of the Contractor to submit properly itemized cost estimates or price proposals shall not constitute an excusable delay and will result in a change order being unilaterally priced at the Owner's fair estimated price.

Subsection 104.2.6 - Value Engineering:

A) ***General.*** The Contractor is encouraged to voluntarily develop, prepare, and submit value engineering change proposals (VECPs). The Contractor shall share in any instant contract savings realized from accepted VECPs, in accordance with paragraph (f) below. The Owner reserves the right to make alterations to the contract, in accordance with procedures elsewhere within this contract. Such alterations will not be eligible for inclusion in any VECP.

B) ***Definitions.***
Contractor's development and implementation costs means those costs the Contractor incurs on a VECP in developing, testing, preparing, and submitting the VECP as well as those costs incurred by the Contractor to make the changes required by the Owner's acceptance of the VECP.

Owner costs means those owner costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistical support. The term does not include the normal administrative costs of processing the VECP.

Instant contract savings means the estimated reduction in Contract cost of performance resulting from acceptance of the VECP, minus the allowable Contractor's development and implementation costs, minus subcontractors' development and implementation costs (see paragraph (g) below).

Value engineering change proposal (VECP) means a proposal that (1) requires a change to the contract; (2) results in reducing the contract price or estimated cost without impairing essential functions or characteristics; and (3) does not involve a change in deliverable end item quantities, schedule, or a change to the contract type.

C) ***VECP Preparation.*** As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change affects contractually required schedule and cost reporting, it shall be revised to incorporate proposed VECP modifications. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effects of the change on the end item's performance. All design changes must be submitted on 24"x 36" standard drawing sheets along with

supporting calculations. Each drawing sheet and at least the content sheet of the calculations shall be sealed by an Engineer registered in the State of Arizona.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revision.

(3) A separate, detailed cost estimate for the affected portions of the existing contract requirements and the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (G) below.

(4) A description and estimate of costs the Owner may incur implementing the VECP, such as test and evaluation and operating and support costs. This is an estimate based only on the Contractor's understanding of additional efforts to be expended by the Owner, should the VECP be accepted. The final cost will be determined by the Owner.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency, i.e., costs of operation or maintenance.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved and previous Owner actions, if known.

D) ***Submission***. The Contractor shall submit VECPs to the Owner's Engineer.

E) ***Owner Action***.

(1) The Owner shall notify the Contractor of the status of the VECP within 15 calendar days after receipt from the Contractor. If additional time is required, the Owner shall notify the Contractor within the 15-day period and provide the reason for the delay and the expected date of the decision. The Owner will process VECPs expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Owner shall notify the Contractor in writing, explaining the reasons for rejection.

(3) The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Owner.

(4) Any VECP may be accepted, in whole or in part, by the Owner's award of a change order to this contract, citing this subsection. The Owner may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a change order incorporates a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Owner's decision to accept or reject all or any part of any VECP shall be final and not subject to disputes or otherwise subject to litigation.

F) ***Cost Sharing***.

(1) **Rates**. The Owner's share of savings is determined by subtracting the Owner's costs from instant contract savings and multiplying the result by 50 percent. The Contractor's share shall be the remaining 50 percent.

(2) **Payment**. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a change order to this contract to accept the VECP, reduce the contract price or estimated cost by the amount of instant contract savings, and provide the Contractor's share of savings by adding the amount calculated to the contract price.

G) ***Subcontracts***. The Contractor may include an appropriate value engineering clause in any subcontract. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Owner under this contract, but shall exclude any value engineering incentive payments; provided that these payments shall not reduce the Owner's share of the savings resulting from the VECP.

Subsection 105.1 - Authority of Engineer: Add the following:
105.1.1 - Engineer's Evaluation: Engineer will be allowed ten (10) working days within which to evaluate each proposal or submittal made pursuant to subsections 105.3.1 and 106.4. Engineer will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitutes proposed or submitted by Contractor pursuant to subparagraphs 105.3.1 and 106.4(B) and in making changes in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer and Engineer's Consultants for evaluating each such proposed substitute item.

Subsection 105.3 - Conformity with Plans and Specifications: Add the following:
105.3.1 - Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence or procedure of construction is shown or indicated and expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by Engineer will be similar to that provided in subparagraph 106.4(B).

Subsection 105.5 - Cooperation of Contractor: Add the following:
105.5.1 - Partnering
The Owner intends to encourage the foundation of a partnering relationship with the Contractor and its subcontractors. This partnering relationship will be structured to draw on the strength of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance, intended to achieve completion within budget, on schedule, and in accordance with plans and specifications.

This partnering relationship will be bilateral in makeup. Any cost associated with effectuating partnering will be covered by the Bid Item. The initial partnering workshop shall be scheduled after award of the contract, and prior to the Notice to Proceed, and shall be facilitated by a third party competent in the fundamentals of partnering, and mutually acceptable to Contractor and Owner. The Contractor shall be responsible for scheduling, coordinating, and hiring the third party facilitator, and planning all of the partnering meetings in consultation with the Engineer. The Owner will be responsible to notify and coordinate attendance at the partnering meetings by other agencies. To achieve the desired partnering relationships, the Contractor will need to encourage attendance by its major subcontractors on the project. Follow-up workshops will be held periodically throughout the duration of the contract as agreed to by the Contractor and Owner.

An integral aspect of partnering is the resolution of disputes in a timely, professional, and non-adversarial manner. Alternative dispute resolution (ADR) methodologies will be encouraged in place of the more formal dispute resolution procedures. ADR will assist in promoting and maintaining an amicable working relationship to preserve the partnering relationship. ADR in this context is intended to be a voluntary, non-binding procedure available for use by the parties to this contract to resolve any dispute that may arise during performance.

Payment for the Partnering Allowance will be made on the basis of invoices of actual costs, and will be for a total amount not to exceed the amount shown in the bid schedule for the item.
ITEM 105-1 – PARTNERING ALLOWANCE

105.5.2 – Pre-Construction Meeting
After award of the contract, a pre-construction meeting shall be scheduled at a location and time (prior to mobilization and start of construction) to be agreed upon between the Owner and the Contractor. The Contractor shall make all necessary arrangements to have key personnel of his company and of his principal subcontractors present at the meeting. Each representative shall have authority to make commitments and act for his firm. The purpose of the pre-construction meeting is to discuss any specific concerns or potential problems that the Contractor is aware of, to provide general information appropriate to the contract, to identify responsible individuals for various functions within each organization, and to develop tentative dates for the start of construction. There are submittals identified within the contract documents which are required to be prepared for the pre-construction meeting.

The Contractor shall be responsible to take minutes of the pre-construction meeting and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at the pre-construction meeting, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

105.5.3 –Construction Progress Meetings
Construction progress meetings shall be scheduled weekly, or as considered necessary by the Owner. The Contractor shall make all arrangements to have key personnel of his company and of his principal subcontractors present at all progress meetings; representatives shall have authority to make commitments and act for their firms. The Contractor shall assume full responsibility to act for and commit any subcontractor employed by the Contractor, whether or not such subcontractor is represented at the meeting.

During the construction progress meeting the Owner's representative will act as chairman and will advise the Contractor of any administrative matters connected with the contract. The Contractor shall submit for review his two-week rolling schedule. The Contractor's representative at these meetings shall be prepared to discuss and resolve construction problems and concerns, material delivery and vendor data submittals status, construction progress as measured against the Contractor's approved construction schedule and the Contractor's short range construction activities as provided on his two-week rolling schedule. The Contractor shall not be relieved of his responsibility to fulfill all of the terms of the contract as a result of any inferences drawn or suggestions made available at these meetings.

The Contractor shall be responsible to take minutes of the construction progress meetings and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at meetings, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

Subsection 105.6 - Cooperation with Utilities: Add the following:
An attempt has been made to determine the location of all underground utilities, drainage pipes, and structures; however, it shall be the Contractor's responsibility to cooperate with the pertinent utility

companies so that any obstructing utility installation(s) may be adjusted. The location of the underground and overhead utilities as shown on the plans is based on the best available information. The Contractor shall not assume that this represents an exact location of the line. No guarantee is made to the accuracy of the location shown on the plans. The Contractor shall determine for himself the exact location of all utilities. Should Contractor's operations result in damage to any utility the location of which has been brought to its attention, he shall assume full responsibility for such damage. There also exists the strong likelihood that other abandoned older and undocumented underground utility and irrigation lines exist within the project area. Contractor shall contact Arizona Blue Stake (telephone number 263-1100) a minimum of two (2) working days before beginning any underground work. In addition, Blue Stake notification(s) shall be maintained on a current basis.

The following phone numbers should put the Contractor in contact with the proper personnel:

Arizona Public Service Company (APS) 230KV OHE
Mr. Steve Goodman, Project Design Leader (602) 371-6965

El Paso Natural Gas (EPNG) 20" line
Mr. Bill Ward, Phoenix District Superintendent (602) 438-4224
Mr. John McNeely, Principal Engineer (915) 496-5562

City of Phoenix (COP) 12" and 24" Water lines, 24" Force Mains, 18" Sewer line
Mr. Jerry Arakaki, Senior Engineer (602) 261-8229

Salt River Project Irrigation (SRP) Pecos Drain, 48th Street Drain, etc.
Mr. Gerry Bastian, Senior Engineer (602) 236-4609

Salt River Project Power Distribution (SRPPD) 12KV OHE
Mr. Dan Hawkins, Project Leader (602) 236-8603
Mr. Greg Wilson (602) 236-8643

Salt River Project Power Transmission (SRPPT) 500KV OHE
Mr. Bill Phillips, Senior Engineer (602) 236-8092

Kinder Morgan Energy Partners, L.P. (KMEP) 6" Fuel Pipeline
Mr. Dan Tarango (602) 278-2320

US West (USW) 4" Telecommunication Line
Mr. John Aker (602) 831-4700

It shall be the responsibility of the Contractor to verify the location of all utilities prior to any construction activities in a particular area where such facilities may exist. All existing overhead and underground utilities shall be Protected-in-Place (P.I.P.) unless noted otherwise on the plans, these Supplementary General Conditions, and the Special Provisions.

APS and SRPPT:

Both APS and SRP maintain high voltage (230kV and 500kV) overhead electric transmission lines in the vicinity of the project. The lines are within the construction limits of the project and shall be protected in place. The Contractor shall use caution in the adjacent area.

At all times during construction, the Contractor shall comply with all laws, ordinances, rules, regulations, and safety requirements, including but not limited to the National Electric Safety Code, and the Occupational Safety and Health Standards for General Industry and specific requirements of both SRP and APS when working in the vicinity of these high voltage lines.

City of Phoenix Water Line, Sanitary Sewer, and Force Mains:
An existing COP 24" water pipeline along Pecos Road parallels the southern construction limit boundary. The pipeline is in close proximity to the construction, but is not in direct conflict with the construction. This water pipeline shall be protected in place.

An existing COP 24" water line and a 12" water line parallels 48th Street. These water lines shall be protected in place throughout construction.

A portion of the existing COP 18" sewer line parallels 48th Street along the western construction limit boundary. The sewer line shall remain and be protected-in-place throughout project construction.

Two 24" COP Sanitary Sewer force mains parallel Pecos Road in the Utility Corridor. These lines are to be protected in place throughout construction.

A 36" Concrete Sanitary Sewer is abandoned in place in the Utility Corridor. This line shall remain in place unless otherwise indicated.

A 4" PVC US West Telecommunications line parallels the two 24" Sanitary Force Mains and services the COP Lift Station at the intersection of Pecos Road and 48th Street. This line shall be protected in place.

The Contractor shall protect in place the existing COP Sanitary Sewer Lift Station, and access to the lift station shall be maintained at all times during construction.

NOTE: The Contractor shall exercise extreme caution when near sanitary sewer lines to avoid spills or off-site discharges. Any spills or off-site discharges caused by the Contractor's actions will be the responsibility of the Contractor to correct solely at his cost and to the satisfaction of the COP.

El Paso Natural Gas (EPNG)
EPNG has a 20" high pressure gas main south of the project which is not affected by construction. However, crossing of this line may be required if the contractor establishes an excavation waste disposal site on the Gila River Indian Community land. Contractor is to maintain five feet of cover wherever the 20" pipeline is crossed. The Contractor shall contact EPNG at least 14 days prior to any construction activities near this line. EPNG may have a representative on site as they deem necessary.

Salt River Project Irrigation (SRPI):
Salt River Valley Water Users Association has several facilities that are impacted by the project. The unlined ditch along the Pecos Road alignment is a regional drain and flows must remain uninterrupted throughout the construction period. An unlined irrigation tailwater ditch along the west side of 48th Street shall also remain uninterrupted and protected-in-place.

The unlined ditch along Pecos Road must also be maintained at full capacity at all times or the Contractor must have an approved Temporary Outage Agreement (See Appendix "B"). If ditch diversions are required for construction of the basin outlet piping or utilities, it is the Contractor's responsibility to obtain all necessary permits and approvals from SRP along with the Engineers approval. The Contractor must reconstruct the ditch according to SRP requirements including the installation of new lining as shown in the plans. All operation and maintenance roads must be maintained during construction.

Prior to any construction activities relating to any diversion of the existing Pecos Road unlined ditch the Contractor shall contact SRP to schedule a pre-construction meeting. The meeting will be used to identify what role SRP will have during construction including the possible use of SRP surveyors for layout of project control. The Contractor shall be prepared to discuss proposed construction, survey and irrigation outage schedules, along with executing a TEMPORARY OUTAGE AGREEMENT and obtaining the necessary construction clearance using the instruction sheet included in Appendix B.

Construction on the SRP facilities shall not commence until the Contractor attends the SRP Pre-Construction Conference.

NOTE: The Contractor shall exercise caution and care when working around these facilities. The costs for the repair of any damage to neighboring property, and any loss of water conveyance or revenue by the SRP that is in any way caused by the Contractor's actions shall be the sole responsibility of the Contractor, and shall be corrected to the satisfaction of the SRP solely at the Contractor's expense and at no cost to the project. The Contractor is cautioned that the ditch along Pecos Road currently intercepts a significant amount of off-site storm water that must be conveyed to the Gila Drain. The Contractor must make provisions to maintain the existing capacity at all times during construction.

Salt River Project Power Distribution (SRPPD)

Salt River Project has overhead and underground electric distribution facilities along Pecos Road and 48th Street that are in close proximity to the project. These are to be protected in place and the Contractor shall use caution in the adjacent areas.

Prior to any construction activities affecting the installation of SRP electrical service to the irrigation booster station or to the two pump stations the Contractor shall contact SRP to schedule a pre-construction meeting. Contact SRP at 602-236-0676. This meeting is necessary to establish installation schedules, coordination responsibilities, etc.

At all times during construction, the Contractor shall comply with all laws, ordinances, rules, regulations, and safety requirements, including but not limited to the National Electric Safety Code, and the Occupational Safety and Health Standards for General Industry when working in the vicinity of electrical lines.

NOTE: The cost for the repair of any damage to these facilities, and any loss of revenue by SRP due to the loss of service of the overhead or underground electric cables that is in any way caused by the Contractor's actions shall be the sole responsibility of the Contractor at no cost to the project.

Kinder Morgan Energy Partners (KMEP)

KMEP has a 6" fuel line parallel to the southern boundary of the project outside of construction limits which may be crossed if the Contractor establishes a waste excavation disposal site on the Gila River Indian Community land. No equipment shall cross this lane unless there is a minimum of five feet of fill over the pipeline.

Contractor shall notify KMEP 14 days in advance of any construction activities near this line. KMEP will have a representative on site as it deems necessary.

Subsection 105.7 – Cooperation Between Contractors:

Add the following:

ADOT may begin construction of the Pecos Road Connector project consisting of interchange ramps located along the north and east side of the basin complex. The anticipated start date for this ADOT work, at the time of preparation of these Supplementary General Conditions (SGC's), is December 2000. The ADOT Contractor would be working in close proximity to the north and east side of the basin complex. The Contractor shall be aware of this possible ADOT construction activity and shall work cooperatively with the ADOT Contractor to minimize impacts to both projects.

As part of the ADOT construction a concrete box culvert will be constructed that will discharge into the northwest corner of the Equalization Basin. Contractor coordination may be required for this construction

activity, though at the time of preparation of these SGC's, it was anticipated that the culvert construction would occur after construction of the Equalization Basin.

Construction access along 48th Street to the basin project site will be closed soon after the ADOT construction project is underway. The ADOT Contractor will provide at least 30 calendar days notice to the basin project Contractor prior to the closure of 48th Street. Alternate access will be provided from the intersection of Chandler Blvd. and 40th Street, south along 40th Street to the Pecos Road alignment, and then east along the Pecos Road alignment to the basin project site. This route will also be utilized by the City of Phoenix for operation and maintenance access to the sewer lift station at 48th Street and Pecos Road. The ADOT Contractor will provide graded access along this alternate route where necessary. The basin project Contractor will need to obtain a no cost permit from the ADOT Maintenance District for use of the alternate access route which will at that time be partially within ADOT controlled rights-of-way.

The COP may have under construction at the time of this project roadway and drainage improvements along Chandler Blvd, at 48th Street. This construction activity may affect project site access from the 48th Street and Chandler Blvd. intersection.

The Salt River Project (SRP) will be piping the unlined Pecos Drain ditch along the south side of the Pecos Road alignment sometime during the basin construction contract. SRP will provide a manhole for connection of the basin Evacuation Pump Station 16" discharge pipe. If SRP has completed piping the ditch before installation of the discharge pipe, then the pipe will be connected to the manhole and the ditch lining as shown on the plans will not be required. And, the power connection to the station would be placed below the 36" pipe. The Contractor shall coordinate his work accordingly with SRP.

Subsection 105.8 - Construction Stakes, Lines, and Grades: Add the following:

A) The Engineer will furnish a Benchmark which the Contractor will use to set line and grade for all construction. All other surveying required for the project shall be the Contractor's responsibility. The Engineer will not set any construction stakes.

B) Before any construction work is started, the Contractor shall perform all base surveys and cross sections of existing conditions that may be required as a basis for quantity determination.

C) The Contractor shall submit original construction surveyor's notes duly signed by a Registered Land Surveyor to the Engineer at the end of the project. Copies of the survey notes shall be submitted to the Engineer during construction as and when requested.

D) As-built plans sealed by an Engineer registered in the State of Arizona shall be provided by the Contractor to the Engineer prior to project close out.

Subsection 106.1 - Source of Materials and Quality: Add the following:

Select Material, Aggregate Base, Mineral Aggregate, concrete, steel products and pipe shall be obtained from commercial sources. Contractor shall pay all royalties, or any other charges or expenses, incurred in connection with the securing and hauling of the material. Contractor will be required to furnish Engineer with a list of its proposed commercial sources prior to use, and shall present certificates stating that the material produced from any commercial sources is in accordance with the Uniform Standard Specifications and these Supplementary General Conditions.

Subsection 106.4 - Trade Names and Substitutions: Replace with the following:

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quantity required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is

permitted, other items of material or equipment of other Suppliers may be accepted by Engineer under the following circumstances:

A) "Or-Equal": If in the Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

B) Substitute Items: If in Engineer's sole discretion an item does not qualify as an "or-equal" item under subparagraph 106.4 (A), it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by Engineer will include the following and may be supplemented in the Special Provisions and as Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall first make written application to Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other Contractors affected by the resulting change, all of which will be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.

C) Contractor's Expense: All data to be provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's expense.

D) If the final placement of a product will remain the property of the municipality or utility and/or owned by the municipality or utility, that entity is responsible for issuing written approval for any equivalent or "or-equal" products. The Contractor or Supplier will submit to that entity the request and documentation for written approval of a product substitution. The Contractor will provide the entity's written approval to the Engineer at the Pre-Construction Meeting.

Subsection 106.5 - Contractors Marshaling Yards: Add the following:
The Contractor shall obtain approval of the Engineer when using vacant property to park and service equipment and store materials for use. The Contractor will obtain prior written approval of the property owner for such use and submit a copy of the approval to the Engineer prior to use of the property.

The Contractor shall grade all construction yards, easements and limits of construction which are disturbed by construction or construction related activities to the lines and grades shown on the plans; or as a minimum, where no line or grade is shown, to a condition similar to or better than the pre-existing condition.

The Contractor shall not cross onto Gila River Indian Community land south of the community boundary line along the Pecos Road alignment without specific written authorization to do so from the community.

Subsection 107.2 - Permits: Replace with the following:
Contractor shall obtain all permits and licenses, including those required by the City of Phoenix and Maricopa County and shall pay all charges, fees, taxes, and provide all notices necessary and incidental to the due and lawful prosecution of the work.

The Gila River Indian Community (Community) may allow the Contractor to stockpile waste excavation on Community property. Contractor must obtain a permit to enter the Community and use any disposal site that is granted by the Community. The Contractor must comply with all tribal environmental regulations and the tribe may charge a fee for disposal. In addition, the height of the stockpile shall not exceed 10 feet and side slopes shall not be steeper than 4:1 without written permission from the Community. Contact Fred Ringlero, Director of Land Use Planning at (520) 562–3301.

The City of Phoenix Parks, Recreation and Library Department (PRLD) may allow the Contractor to stockpile waste excavation on property West of 48th Street. The height of the stockpile shall not exceed 18 inches and side slopes shall not be steeper than 4:1 without written permission from the PRLD. Contact T.J. Newman at (602) 261–8799.

Subsection 107.2.1 - NPDES Permit Requirements: Add the following:

A. This project is subject to the National Pollutant Discharge Elimination System (NPDES) storm water requirements for construction sites under the Environmental Protection Agency (EPA) General Permit for Arizona. Under provisions of that permit, the Contractor shall be designated as permittee, and shall take all necessary measures to assure compliance with the NPDES General Permit for Arizona as well as all other applicable Federal, State and local laws, ordinances, statutes, rules and regulations pertaining to Storm water discharge. As the permittee, the Contractor is responsible for preparing, in a manner acceptable to the EPA, all documents required by this regulation, including but not necessarily limited to:

    1. Storm water Pollution Prevention Plan (SWPPP) for the project, including certification of compliance form. Contractor shall be required to develop, implement, update and revise the SWPPP, as necessary, in order to assure compliance with the EPA permit requirements. The SWPPP shall be retained on the project site at all times during construction.

    2. Notice of Intent (NOI) to assure compliance with the NPDES General Permit for Arizona, including certification of signatures.

    3. Notice of Termination (NOT) of coverage under NPDES General Permit for Arizona.

B. Preliminary copies of the NOI and the SWPPP shall be submitted to Owner during the pre-construction meeting and shall be subject to review by Owner prior to implementation.

C. Contractor shall submit the completed and duly signed NOI forms no later than forty-eight (48) hours prior to the initial start of construction on the project to the following agencies:

    EPA Storm Water Notice of Intent
    P.O. Box 1215
    Newington, VA 22122

A copy of the completed NOI form shall be submitted to the following:

Storm Water Coordinator
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600

Gary W. Boesch, PE
Stormwater Management Engineer
200 West Washington Street, 5th Floor
Phoenix, AZ 85003
(602) 495-5326

Failure by the Contractor (or Subcontractors of any tier) to submit NOI's within the mandated time frame shall result in delay of the construction start date, and no claim for extension of time will be granted for such delay. A copy of the completed NOI shall be posted at the construction site.

D. Inspections of all Storm water pollution control devices on the project shall be performed by Contractor on a monthly basis and following each rainfall of 0.50 inches or more in a 24-hour period at the project site as required under provisions of the NPDES General Permit for Arizona. Contractor shall prepare reports on such inspections and retain the reports for a period of three years following the completion of the project. Inspection reports shall be submitted monthly to Owner along with progress payment requests. Additionally, Contractor shall maintain all Storm water pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

E. Contractor warrants that its employees and Subcontractors of any tier and their employees shall at all times comply with all applicable laws, ordinances, statutes, rules and regulations set forth by all federal, state and local governments and the Environmental Protection Agency in connection with NPDES Permitting requirements and laws and regulations pertaining to air, groundwater and surface water quality.

Fines and penalties imposed by the EPA against Owner or the Contractor for Contractor's failure to comply with any of the requirements of NPDES General Permit of Arizona shall be borne by the Contractor.

F. Upon project completion, acceptance and demobilization, Contractor shall submit its completed, duly executed NOT form to the EPA, with a copy to the Arizona Department of Environmental Quality at the address listed in Section (C) above, thereby terminating all NPDES permit coverage for the project. Contractor shall then surrender to Owner copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance of the NPDES General Permit. Contractor shall retain the originals of such documents for a period of three (3) years following the completion of the project.

G. The Lump Sum price for the SWPPP shall include all material, labor, and all other costs relating to the preparation, installation and maintenance of the SWPPP during project construction, including assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The Lump Sum price for the SWPPP shall be inclusive of all costs, and no additional claims shall be made by Contractor under any other specification provision of these documents, including Changed Conditions. Payment for this bid item shall be upon final completion and acceptance of the project, as per Section 109.1.

H. Copies of all required forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control." The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009.

Payment for NPDES/SWPPP permit requirements shall be made on the basis of lump sum for all work described in Subsection 107.2 .1 for:
ITEM 107-1 - NPDES/SWPPP PERMITS

Subsection 107.4 - Archeological Reports: Add the following:
Any cultural and/or paleontological resource (historic or prehistoric site or object) discovered by the Contractor, or any person working on his behalf, shall be immediately reported to the Engineer. The Contractor shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Engineer. An evaluation of the discovery will be made by authorized personnel and the Engineer to determine appropriate actions to prevent the loss of significant cultural or scientific resources.

Subsection 107.5: Add the following:
The entire construction site shall be considered a "Hard Hat Area" and all personnel in the area will be required to wear a hard hat.

Subsection 107.5.2 - Compliance with the Arizona Communication Standard: Add the following:
Owner will provide Contractor with Material Safety Data Sheets (MSDS) for any products known to exist on the site that are deemed health hazards. Contractor will provide a copy of Owner-provided MSDS to all Subcontractors.

Contractor will provide Owner and all Subcontractors with MSDS for any products that have or are deemed health hazards that will be brought onto the site or created on the site either by Contractor or by any Subcontractors.

Contractor will provide Owner with a statement certifying that all personnel (Contractor and Subcontractor) employed by Contractor or by a Subcontractor on the job site have received the required Hazard Communication Standard training.

Subsection 107.6.3 - Public Information and Notification: Add the following:
The Contractor shall employ a specialty public information service as a subcontractor to provide the community relations program for the project as described herein. The name and address of the public information subcontractor shall be submitted with the bid as specified in subsection 102.6 of the Supplementary General Conditions. Contractor shall work closely with his subcontractor in developing and carrying out the community relations program, but shall not expect to actually perform the work of providing the public information services. Contractor shall submit a history of the subcontractor's qualifications and experience in public information services at the pre-construction conference for acceptance by the Engineer. The community relations program shall be designed to run the full length of calendar days in the contract for this project. The program will include but not be limited to:

1. Distributing a pre-construction information letter to all residents, business, etc. within an area bounded by I-10 on the east, Pecos Road on the south, to one quarter mile west of 48th Street on the west, and one quarter mile north of Frye Road on the north.
2. Printing and distribution of public notices and/or newsletters.

The Contractor will use these or other means to inform the local citizens of necessary operations which create high noise levels, street closures, limited access, detour locations, haul route and material delivery routes, hours of construction and disruption of bus, trash, school bus and other delivery/pick-up routes.

The Contractor will be required to furnish a private line telephone to be used solely for receiving incoming calls from local citizens with questions or complaints concerning construction operations or procedures. The Contractor shall publish this phone number and maintain a 24-hour answering service. The answering service shall be operated by Contractor personnel during all hours that work is being performed on the job site. The Contractor shall maintain a log of incoming calls, responses, and action taken which shall be submitted to the Engineer weekly and/or upon request.

Prior to the start of work, the Contractor shall notify, by letter, all affected businesses and residents of construction plans and schedules within the geographic area identified above. In addition, all schools and emergency services which serve the geographic area will also be notified even though they may be located outside the geographic area described above. The letter shall contain, as a minimum, the following information:

1. Name of Contractor
2. 24-hour telephone complaint number
3. Brief description of the project
4. Name of Contractor project Superintendent
5. Name of Engineer
6. Name of area supervisor
7. Construction schedule including anticipated work hours
8. Traffic regulations including lane restrictions
9. City of Phoenix Street Transportation 24-hour phone number

The Contractor shall submit a Public Information and Notification Plan to the Engineer at the pre-construction meeting. No payments shall be made for this item until the Engineer approves the plan.

The plan and work which is eligible for reimbursement shall include: meetings with impacted businesses, schools, emergency services, residents, etc.; scheduling; preparation and distribution of newsletter at least monthly; and maintaining a 24-hour telephone hot line for complaints.

The Contractor shall submit a final report/evaluation of the Public Information and Notification process performed for this project. This report shall be submitted before the Contractor receives final payment.

Payment will be based on invoices, and will be for a total amount not to exceed the amount shown in the bid schedule for the item, PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE, for work performed in notifying and coordinating with the local population impacted by this project. To cover the cost for administration and supervision, the General Contractor may add an amount equal to not more than 5 percent of the accumulated total invoiced billing for actual public information services provided by a Subcontractor. This cost for administration and supervision will be considered included in the PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE.

ITEM 107-2 - PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE

Subsection 107.6.4 - Project Signs:

Contractor shall provide and install two project information signs, at locations to be determined by the Engineer , before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate travel routes. Project signs shall include the names of all agencies participating in the project. The signs shall also include the 24-hour hot line complaint telephone number. Signs shall be constructed in accordance with the Project Sign Information drawing to be provided to the Contractor at the pre-construction meeting. The signs shall be installed at the location(s) approved by the Engineer. The Contractor shall maintain the signs as necessary, and update the information as requested by the Engineer. Payment shall be made according to the allowance in the Bidding Schedule in installments of 50% upon installation, and the remaining 50% upon final payment for the work.

ITEM 107-3 - PROJECT SIGNS ALLOWANCE

Subsection 107.9 - Protection and Restoration of Property: Add the following:
The Contractor shall protect-in-place all existing structures and other features as identified on the plans, including but not limited to irrigation facilities, roadways, fencing, signs, and other structures and features near construction activities, including but not limited to along the Pecos Road and 48th Street alignments.

The Contractor shall limit all construction activities to the right-of-way limits shown on the plans including dedicated street right-of-way, and shall not disturb any areas other than as required for construction as shown on the plans.

The Contractor will grade all Temporary Construction and Permanent Easement areas, and project areas which are disturbed during construction to the lines and grades shown on the plans, or as a minimum, where no lines and grades are shown, to a condition similar to or better than the pre-existing condition.

The Contractor shall not cross onto Gila River Indian Community land south of the community boundary line along the Pecos Road alignment without specific written authorization to do so from the community.

Subsection 107.10 - Contractor's Responsibility for Work: Add the following:

A) Contractor is advised that the work area will be subject to flows of water of varying amounts. Owner assumes no responsibility for notifying Contractor of any anticipated flows, nor for any damages incurred by Contractor to its equipment or to any of the Contractor's work as a result of any flows of water.

B) No payment will be made for providing excavation protective works for such things as dewatering. The cost thereof shall be included in the bid price for the construction or installation of the items to which said excavation protective works are incidental or appurtenant.

C) The Contractor shall take all necessary action to protect the public from the construction work area.

Subsection 108.1 - Notice to Proceed: Delete Paragraph (A) and replace with the following:

(A) Contractor shall commence work within seven (7) calendar days after the date of the Notice to Proceed and complete all work within **three hundred ninety five** (395) calendar days beginning the day following the effective date specified in the Notice to Proceed.

Subsection 108.2 - Subletting of Contract: Add the following:
For this project, Contractor shall perform, with its own organization, work amounting to 50 percent or more of the total contract cost.

Subsection 108.4 - Contractor's Construction Schedule: Delete in its entirety and replace with the following:
Contractor shall submit a proposed work schedule to Engineer for review before starting work using the Primavera or other similar software program that is acceptable to the Engineer. Weekly updates shall be submitted to Owner's Inspector at the weekly coordination meeting.

Subsection 108.4.1 - Contractor's Billing Schedule: The Contractor shall furnish the Engineer an Estimated Billing Schedule which shall include the estimated amount of each billing for the total project at the pre-construction conference, and thereafter at monthly intervals as agreed to between the Contractor and Engineer.

Subsection 108.5 - Limitation of Operations: Add the following:
The normal workweek shall be 40 hours, Monday through Friday, and the work hours will be determined at the pre-construction meeting. This does not imply that this contract can be completed on time utilizing normal working hours. The Contractor shall furnish sufficient forces and shall work such hours including

night shifts and overtime operations as necessary to ensure the completion of the work within the time required. To work other than normal working hours, for other than emergency situations, the Contractor shall give the Engineer at least 24 hours advance written notification and receive written approval before working. The notification shall include: the working hours, the type of work to be performed, and the name of and a phone number for the person in charge. Should the Contractor elect to perform any work after regular working hours, on weekends, or legal holidays, any charges incurred by the Owner for inspection of the work, surveys or tests of materials will be deducted from monies due or to become due to the Contractor.

Subsection 108.9 - Failure to Complete on Time: Add the following:
The actual cost per calendar day incurred by the District for Administrative and Inspection Services on this project will be added to the daily charges as indicated by TABLE 108, LIQUIDATED DAMAGES, and will be deducted from money due or to become due to the Contractor for each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer. Nothing contained in this provision shall prohibit the Owner from deducting from money due or to become due to the Contractor for any other costs incurred by the Owner directly attributable to the delay in completing this contract.

Subsection 109.2 - Scope of Payment: Add the following:
In addition to the contained provisions, the work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work operations that must be performed and costs incurred prior to beginning work on the various items on the project site.

Subsection 109.7 - Payment for Bond Issue and Budget Projects:

(A) To third paragraph, add:
Payment or release of retained funds shall be made to the Contractor within thirty (30) days following final payment to the Contractor [reference (B) following], and Contractor furnishing to Engineer satisfactory receipts for all labor and material billed and waivers of liens from any and all persons and Subcontractors holding claims against the work. Additionally, Contractor shall furnish a completed Certificate of Performance to Engineer evidencing it has satisfactorily discharged all its duties in connection with the work to be performed under this Contract. The form of Certificate of Performance shall be provided to Contractor by the Engineer.

(B) Add the following:
The final payment will be made to Contractor by Owner within thirty (30) days following receipt of Engineer's final estimate and receipt by Owner of Consent of Contractor's Surety to said final payment. If payment will be longer than thirty (30) days as aforesaid, Owner will provide Contractor specific written findings for reasons justifying the delay in payment.

(C) Contractor's pay estimates will be initially processed by Owner's Construction Branch on the week prior to the last day of the month.

Subsection 110 – Notification of Changed Conditions and Dispute Resolution:
Delete in its entirety and replace with the following:
The Contractor and Owner will follow the established rules of the Maricopa County Procurement Code.

SPECIAL PROVISIONS

for

CONTRACT FCD 99-42

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN

CONTRACT NO. FCD 99-42
PCN 630-01-30

SPECIAL PROVISIONS

SECTION 201 - CLEARING AND GRUBBING

Clearing and grubbing shall conform to Section 201 of the MAG Uniform Standard Specifications, except as modified herein.

Subsection 201.1 – Description

Add the following:

Approximately 10,000 cubic yards of rock waste has been stockpiled on the project site. The Contractor shall remove this material and dispose of it off site.

Subsection 201.5 - Payment

Except for the Rock Waste Clearing, no payment will be made for clearing and grubbing as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which said clearing and grubbing are incidental or appurtenant. Payment for the Rock Waste Clearing including hauling to an approved landfill or other approved disposal site shall be made on the basis of price bid per cubic yard. Price shall include disposal fees and all associated costs.

ITEM 201-1 – ROCK WASTE CLEARING

SECTION 202 - MOBILIZATION

Subsection 202.1 - Description

The work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of all offices, buildings and other facilities necessary for work on the project, permits and licenses, and for all other work and operations that must be performed and costs incurred prior to beginning work on various items on the project site.

Field Office:

This work shall consist of providing and maintaining a furnished Field Office for the exclusive use of and occupancy by the Engineer and the Engineer's staff.

The office shall be a building or mobile trailer erected at a location convenient to the project. The Contractor's and the Engineer's offices shall not be in the same building or mobile trailer although the offices shall be located next to each other or within reasonable walking distance.

The Contractor may furnish equivalent facilities in an existing building provided such facilities and building are located to provide convenient service.

The field office shall be an approved and weatherproof building or mobile trailer providing a minimum of 500 square feet of clear floor space, not including the toilet area. The structure shall have a minimum ceiling height of seven (7) feet and shall be provided with weatherproof doors

equipped with adequate locking devices. Windows shall also be provided with adequate locking devices. The Contractor shall also provide the following:

a. Lighting - Electric light, non-glare type luminaries to provide a minimum illumination level at desk height level.

b. Heating & Cooling - Adequate electrically powered equipment to maintain an ambient air temperature of 72 degrees F plus or minus 8 degrees.

c. Telephone answering machine, paper FAX machine, and copying machine - Two (2) telephones with two (2) outside lines for the exclusive use of the Engineer. The Contractor will pay for the cost of the line and local calling charges. Long distance charges made on one telephone line will be paid for by the District.

d. Toilet - A commode and wash sink in a separately enclosed room within the building or mobile trailer, properly ventilated and complying with applicable sanitary codes. Contractor shall provide water and sewer service.

e. Maintenance - The Contractor shall maintain all facilities and furnished equipment in good working condition and the office shall be cleaned weekly.

f. Fire Extinguisher - Two non-toxic, dry chemical, fire extinguishers meeting Underwriters Laboratories, Inc. approval for Class A, Class B, and Class C fires with a minimum rating of 2A: 20B: 10C.

g. Electricity - Contractor shall provide electric power and pay for all electric services.

h. Furnishings - Three office desks with drawers, five office chairs (padded, swivel type), one drafting table (adjustable height 3 feet by 6 feet), one eight foot (8') conference table, twelve folding chairs, and one draftsman's stool. All furnishing shall be in good working order.

i. First Aid Kit

j. Potable water supply or service

The office shall be fully equipped and made available for the Engineer's use and occupancy prior to the start of any Contract work and not later than 10 days after the date of notice to proceed. The Engineer will notify the Contractor, in writing, of the acceptability of the Field Office provided. The Contractor shall maintain the field office in operating condition until seven (7) days after acceptance of the Contract work.

All facilities shall be maintained in good operating condition and appearance by the Contractor for the designated period, after which all portable buildings or trailers, fencing, surfacing, and utilities shall be removed from the site, the areas cleaned and seeded if required and left in a neat and acceptable condition.

Subsection 202.1 - Payment

Payment shall be made on the basis of the lump sum price bid and shall be full compensation for supplying and furnishing all materials, facilities, and services and performing all work involved as specified herein. The lump sum price bid shall not exceed three (3%) percent of the total project

bid amount exclusive of mobilization and permits and licenses. No additional payment will be made for occupancy and services during periods of contract extension of time due to engineering changes or shutdowns.

ITEM 202-1 - MOBILIZATION

SECTION 206 - STRUCTURE EXCAVATION AND BACKFILL

Structure excavation and backfill shall conform to Section 206 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 206.1 - Description

Add the following:

Work specified in this item includes excavation and backfill required to construct manholes, gate structures, concrete slabs, headwalls, wingwalls, spillway walls, cutoff walls, channel linings, the Water Quality Pump Station and the Basin Evacuation Pump Station as shown on the plans.

Subsection 206.2 - Foundation Material Treatment

Add the following:

Foundation bearing surfaces shall be free of debris and water softened materials prior to placing concrete and reinforcing steel. All foundation excavations shall be inspected and approved by the Engineer prior to placing the reinforcing steel and all trench excavations shall be inspected prior to placing bedding material. Any loose or disturbed zones should be removed and replaced with compacted fill or Class C concrete as directed by the Engineer.

Below culvert/pipeline bottom the moisture content of existing site soils should be maintained between optimum and optimum plus 3 percent (ASTM D698) during and subsequent to site grading to reduce expansive potentials. At these conditions, some pumping may be experienced under dynamic loading if the compaction is done by very heavy equipment (i.e., loaded scrapers, water-pulls, etc.) Some pumping is not considered detrimental in areas below the culvert/pipeline bottom (i.e., static loading conditions) provided specified densities are obtained. Lighter compaction equipment and/or drying of wet soils may be used to reduce pumping if this condition becomes severe.

The Geotechnical Reports are available from the District and may be used by the Contractor in developing plans for temporary construction slopes.

Subsection 206.4 - Structure Backfill

Add the following:

Compaction of structure backfill soils against embedded footings or walls shall be accomplished to a minimum 95 percent of the maximum ASTM D698 density.

Compaction operations shall be accomplished by mechanical methods. Water settling or jetting shall not be permitted. Compaction against or within 3 feet of the structure walls or lining shall be accomplished using manual compaction equipment only.

Backfill behind subsurface walls designed to support utilities, pavement, channels, or other facilities should be compacted to density criteria from Section 211 of these Special Provisions. Backfills should consist of granular soils, free of vegetation, debris, organic contaminants, and fragments larger than 3 inches in size, which exhibit low expansive potentials and a PI less than 5. High plasticity on-site soils with PI > 25 may not be used in structure fills or backfills.

Imported soil used for fills below box culverts or backfills around box culverts or under pavements, or channels should be granular soils conforming to the following requirements:

Maximum Particle size:	3 inch*
Maximum percent expansion:	1.5**

* Maximum size may be reduced at the Engineer's direction to satisfy trenching and landscape requirements, etc.

**Performed on sample remolded to 95 percent of the maximum ASTM D698 density and 2 percent below optimum moisture under a 0.695 psi surcharge pressure.

See plans for pump station wet well structure backfill gradations.

Subsection 206.5 - Payment
No payment will be made for structure excavation or backfill as such; the cost thereof shall be included in the bid price for the construction or installation of the items for which said excavation is incidental or appurtenant.

SECTION 211 – FILL CONSTRUCTION

Fill construction shall conform to Section 211 of the MAG Uniform Standard Specifications except where modified herein.

Subsection 211.1 – Description
Add the following:
The work in this section consists of basin berm construction including area preparation, and the placing and compacting of approved material.

Subsection 211.2 - Placing
Add the following:
Highly plastic soils, PI >25, removed from the excavation shall not be used in any required fills.

Subsection 211.3 - Compacting
Add the following:
Compaction of exposed site soil, backfill, fill, and base course materials shall be accomplished to the following density criteria:

Material	Minimum Percent Compaction (ASTM D698)
Subgrade Soil:	
Below structural elements	95
Below Pavement	95
Backfill:	
Below channel lining	95
Channel berms	95

Aggregate base course:	
Below channel lining	95
Below pavement	100

Compaction of on site soils in scarified zones or in new fills more than 3 feet below final grade should be accomplished at a moisture content between optimum and optimum plus 3 percent. Compaction of granular imported soil below the channel lining should be accomplished at a moisture content between optimum minus 3 percent and optimum plus 3 percent. Compaction of exposed soil and fill material within 3 feet of asphalt pavement should be accomplished at a moisture content 2 percent below optimum or lower.

On site undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced by materials compacted as specified above.

Subsection 211.6 – Payment
Delete section and add the following:
No payment will be made for fill construction as such; the cost thereof shall be included in the bid price for the construction or installation of the items for which said fill is incidental or appurtenant.

SECTION 215 - EARTHWORK FOR OPEN CHANNELS

Earthwork for open channels shall conform to Section 215 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 215.1 - Description
Add the following:
The work in this section consists of excavation, over-excavation, fill, grading, and disposal of excavated and removed material for the construction of the basin complex, including but not limited to, the Primary Basin, the Lower Basin, the Equalization/Sedimentation basin, the Treatment Cells, Low Flow Channel, Spillway, O&M road and haul road.

The Gila River Indian Community (Community) may allow the Contractor to stockpile waste excavation on Community property. Contractor must obtain a permit to enter the Community and use any disposal site that is granted by the Community. The Contractor must comply with all tribal environmental regulations and the tribe may charge a fee for disposal. In addition, the height of the soil shall not exceed 10 feet and side slopes shall not be steeper than 4:1 without written permission from the Community. Contact Fred Ringlero, Director of Land Use Planning at (520) 562–3301.

The City of Phoenix Parks, Recreation and Library Department (PRLD) may allow the Contractor to stockpile waste excavation on property West of 48th Street. The height of the stockpile shall not exceed 18 inches and side slopes shall not be steeper than 4:1 without written permission from the PRLD. Contact T.J. Newman at (602) 261–8799.

Subsection 215.2 - Stripping
Add the following:
For the stripping and stockpiling of topsoil see Section 425.

Subsection 215 - Grading
Add the following:
The Primary Basin and the Lower Basin shall be overexcavated by 8" on side slopes and bottom and wherever specified in Sections 425 and 430 to allow for backfilling of topsoil per the landscaping specifications. The Equalization Basin, Treatment Cells, Spillway, Low Flow

Channel, and areas of riprap and concrete aprons, as well as the O & M Road shall not be overexcavated.

Subsection 215.7 - Measurement
Add the following:
Measurement for excavation will be made according to the quantity of material excavated from natural ground to the finished sub-grades shown on the plans, including the overexcavation in the Primary Basin and Lower Basin. The Engineer will verify the quantities of excavation by a method which in his opinion is best suited to obtain an accurate determination.

Subsection 215.8 - Payment
Payment for excavation for the basin complex, shall be made on the basis of the price bid per cubic yard, and shall include disposal of excess material.
ITEM 215-1 - DRAINAGE EXCAVATION

SECTION 220 - RIPRAP CONSTRUCTION
Riprap construction shall conform to Section 220 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 220.1 - Description
Add the following:
The construction of plain riprap (no grout) at pipe outlet structures, and the installation of rock mulch in the vegetated cells shall consist of furnishing and placing stone as shown on the plans and these specifications. Sacked concrete riprap shall not be allowed. There is no grouted riprap in the project.

Subsection 220.2 - Materials:
Add the following:
Plain riprap Gradation No.1 stones shall be angular or rounded in shape and conform to the requirements set forth in Section 703. A geotextile fabric underlay shall be provided for all areas using riprap Gradation No.1.

The geotextile fabric shall be non-woven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed into stable network such that the filaments retain their position to each other. The fabric shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversly affect or alter its physical properties. The requirements for the high survivability fabric shall meet the following minimum average roll values:

Property	Requirements	Test Method
Grab Tensile Strength, lbs., at break or 100% elongation, whichever occurs first	200	ASTM D4632-86
Grab Elongation at Break, %	45 min., 115 max.	ASTM D4632-86
Puncture Strength, psi	80	ASTM D3787
Burst Strength,lbs	320	ASTM D3786
Trapezoidal Tear, lbs.	50	ASTM D4533-85
Permittivity, sec^{-1}	0.1	ASTM D4491-85
Apparent Opening Size, US Standard Sieve Size	30 – 100	ASTM D4751-87
Ultraviolet Stability, %	70	ASTM D4355-84

Minimum average roll values represent the average test results for a lot in the weaker direction when sampled according to ASTM D4354 and tested according to the test methods specified above.

Geotextile information must be supplied to the Engineer including but not limited to, product information sheets, installation procedures and recommendations, recommended use and project references from the supplier or manufacturer for product approval. Additionally, each shipment or lot of geotextile fabric must be approved by the Engineer prior to installation.

The identification, packaging, handling, and storage of the geotextile fabric shall be in accordance with ASTM D4873. Fabric rolls shall be furnished with suitable wrapping for protection against moisture, abrasion, extreme heat and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quality, lot number, roll number, date of manufacture, shipping date, and the project number and name to which it is assigned. Rolls will be stored on site in manner which protects them from the elements. They shall be elevated and protected with a waterproof, light colored, opaque cover. At no time shall the fabric be exposed to sunlight for a period exceeding 14 days.

The rock mulch Gradation No.2 shall consist of river rock as specified in Section 703 and be used in both the vegetated and non-vegetated treatment cells. Prior to placement of the rock mulch, the surfaces shall be fine graded and compacted to 90 percent of maximum density as determined in accordance with the requirements of Arizona Test Methods 225, 226, 227, 230 or 231 and 232 and the impervious liner shall be installed. All deleterious material shall be removed and disposed of by the Contractor.

The treatment cells shall be grubbed and cleared of any weeds prior to placement and shall continue to be weeded at a minimum of once per month thereafter until final acceptance. The control of weeds shall be accomplish by manual methods. An impervious liner shall be installed before placement of the rock mulch. The purpose of the impervious liner installation will be to restrict water infiltration from the vegetated treatment cells to the underlying soils.

The impervious liner shall consist of an impervious sheet of single-layered construction, with all seams continuously jointed together by fusion welding to form an impervious layer. The impervious liner shall be inert to chemicals and hydrocarbons and shall be resistant to mildew, rot, ultra violet exposure, insects and rodents. It shall also conform to the minimum average roll values for properties listed in the following table:

Property	Requirements	Test Method
Width, ft.	9	N.A.
Thickness, mils	20	ASTM D1777
Grab Tensile Strength, lbs., at break or 100% elongation, whichever occurs first	170	ASTM D4632
Grab Elongation at Break, %	20	ASTM D4632
Puncture Strength, lbs	70	ASTM D4833
Burst Strength, psi	250	ASTM D3786
Trapezoidal Tear, lbs.	40	ASTM D4533
Permittivity grains/ft^2/hr	0.027	ASTM D96

Minimum average roll values represent the average test results for a lot in the weaker direction when sampled according to ASTM D4354 and tested according to the test method specified above.

Samples of the impervious liner shall be submitted for testing. No samples shall be taken within 5 feet of either end of a roll. Samples shall be a minimum of 3 feet long by the full roll width. A minimum of one sample shall be taken per lot. More samples may be required as determined by the Engineer.

The contractor may use the geotextile fabric approved for Riprap Gradation No.1 as an overlay for the impervious liner to meet the grab and puncture test qualifications.

The Contractor shall submit a sample of the proposed impervious liner, selected on the basis of material property requirements previously listed, prior to use. If the sample fails, the Contractor may submit another sample of impervious liner product for testing and preapproval. A maximum of three impervious liner products can be submitted for evaluation and testing. Each submittal shall include product information sheets, installation procedures and recommendations, recommended use, project references provided by the supplier or manufacturer. Product shall be furnished in protective covers capable of protecting the materials from harmful environmental conditions such as ultra violet rays, abrasion, extreme heat, and water. Storage of the materials will be in a manner to prevent damage, contamination, or deterioration of materials.

The impervious liner shall be installed in accordance with the plans, these special provisions, and the manufacturer's installation procedures and recommendations. Bonded seams shall be tested for impermeability by non-destructive testing, such as vacuum testing. If voids or pinholes are detected, repairs shall be made and the section retested. Bonded impervious liner with fabric on only one side shall not be placed when weather conditions, in the opinion of the Engineer, are not suitable to allow placement or installation. This will normally be at times of wet or snowy conditions, heavy rainfall, extreme cold or frost conditions, or extreme heat.

Mechanical or manual laydown equipment for the installation of the impervious liner shall be capable of handling full rolls of fabric, and laying the fabric smoothly, without wrinkles and folds, in the position specified. The equipment shall be in accordance with the manufacturer's recommendations or as approved by the Engineer.

Impervious liner shall then be placed over the horizontal subgrade surface to the extent shown on the plans details. All wrinkles and folds shall be removed and overlaps shall be a minimum 24 inches wide. Any impervious liner which extends onto the subgrade from a vertical trench shall also be overlapped a minimum of 24 inches. Bonded impervious liner with fabric on only one side shall be placed with the fabric side upward. Sewn seams will not be permitted unless it can be demonstrated that they are watertight factory seams.

Rock mulch Gradation No. 2 shall be placed by back dumping the rock mulch in a manner that does not damage the impervious liner. The rock mulch shall be placed in an even application to provide complete coverage of the area shown on the project plans so that liner will not be visible between rocks. The rock mulch shall be spread in a minimum thickness of 8 inches onto the impervious liner in a constant forward direction until the thickness as specified on the plans is reached. Traffic or construction equipment shall not be permitted directly on the impervious liner unless approved by the Engineer for emergency purposes. Pins or piles of rock mulch can be used to hold the impervious liner in place while being covered. Any regrading that is necessary after placement of the rock mulch shall be at the Contractor's expense. Care shall be taken in the

placement of the rock mulch so as not to disturb or damage any plant material, adjacent surfaces, irrigation equipment or the impervious liner.

Overstressing the subgrade soil shall be avoided by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. If ruts of 2 inches or greater occur in the rock mulch, the Contractor shall use lighter equipment which transmit less ground pressure. Any ruts that develop during the spreading or compacting of the rock mulch shall be filled with additional rock mulch rather than bladed from adjacent areas so that the final design aggregate thickness is maintained. Construction equipment shall not be allowed to turn or stop suddenly on the rock mulch placed over the impervious liner. Rock mulch shall not be mixed or processed on the impervious liner.

Any damage to the impervious liner occurring during placement of the rock mulch shall be repaired immediately. The rock mulch shall be removed from the damaged area to allow placement of a impervious liner patch extending 3 feet on all sides beyond the damaged area, followed by replacement of the rock mulch Gradation No. 2.

Subsection 220.8 - Payment
No payment for plain riprap construction will be made, the cost thereof shall be included in the bid price for the construction of the items for which said riprap is incidental or appurtenant including, preparation of ground surfaces, furnishing and placing of geotextile fabric, riprap, and cleanup.

Payment for rock mulch installation shall be made on the basis of the price bid per cubic yard to the neat lines shown on the plans, and shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the rock mulch structures complete in place as specified on the plans, and in these Special Provisions. This includes, but is not limited to, preparation of ground surfaces, furnishing and placing of geotextile fabric and impervious liner, rock mulch, and cleanup. No measurement or payment will be made for impervious liner that has been damaged.
ITEM 220-1 – ROCK MULCH - GRADATION NO. 2

SECTION 225 - WATERING
Watering shall conform to Section 225 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 225.1 - Description
Add the following:
Material to be excavated between the existing ground surface and the finished grade shall be pre-wet immediately prior to its removal. The Contractor shall rip or scarify the upper 1.5 feet of soil in the excavation area concurrently with the application of water. Dust shall be kept to a minimum. The moisture shall be kept at a content sufficient to insure that dust will be kept at a minimum for the excavation, hauling, and disposal or placement of soil.

Subsection 225.5 - Payment
No payment will be made for watering as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which watering is incidental or appurtenant.

SECTION 301- SUBGRADE PREPARATION
Subgrade preparation shall conform the Section 301 of the MAG Uniform Standard Specifications except where modified herein.

Subsection 301.1 - Description
This section shall include the preparation of the operation and maintenance (O&M) road and access ramp prior to the placement of aggregate base and appropriate pavement or concrete, and the haul road along the north side of the basin complex.

Subsection 301.5 – Payment
No payment will be made for subgrade preparation as such; the cost thereof shall be included in the bid price for the construction of the items to which it is incidental or appurtenant.

SECTION 310 - UNTREATED BASE
Untreated base shall conform to Section 310 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 310.1 - Description
Add the following:
This work includes the placement of aggregate base course for the O&M road, paved areas within pump station enclosures and access ramp.

The aggregate base course for the O&M roads and access ramp shall conform to:

Percent Passing Sieve								
Class of Aggregate	3 inch	1 1/2 inch	1 1/8 inch	No. 4	No. 8	No. 30	No. 200	PI, Max
2	--	100	90-100	--	--	35-55	0-8.0	3

Notes:
1) The percentage, by weight, passing each sieve will be determined in accordance with the requirements of Arizona Test Method 201.

2) The PI (Plasticity Index) will be determined in accordance with the requirements of AASHTO T90.

3) For Class 1 through Class 4 aggregate, the amount of fractured particles shall be at least 30 percent, when tested in accordance with the requirements of Arizona Test Method 212.

4) Resistance to abrasion for Class 1 through Class 4 aggregate will be determined in accordance with the requirements of AASHTO T 96 and shall meet the following requirements:

Maximum loss of 9 percent at 100 revolutions
Maximum loss of 40 percent at 500 revolutions

Subsection 310.4 - Payment
Payment for untreated base shall be made on the basis of the price bid per cubic yard.
ITEM 310-1 - AGGREGATE BASE

SECTION 321 – ASPHALT CONCRETE PAVEMENT

Asphalt concrete pavement shall conform to Section 321 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 321.1 - Description

Add the following:

This section applies to the placement of asphalt concrete for the O&M road and the pump station paved areas including leveling the aggregate base conforming to the plans and these specifications.

Subsection 321.2 – Materials and Manufacture

Add the following:

Material shall be D1/2 mix and conform to Section 710 of the MAG Uniform Standard Specifications.

Subsection 321.8 – Measurement

The asphalt concrete pavement shall be measured by the square yard.

Subsection 321.9 – Payment

Payment for the asphalt concrete pavement shall be made on the basis of the price bid per square yard complete and in place and include all equipment, materials, labor and incidentals necessary to construct the O&M road and the pump station paved areas.

ITEM 321-1 – ASPHALT CONCRETE PAVEMENT

SECTION 350 - REMOVAL OF EXISTING IMPROVEMENTS

Removal of existing improvements shall conform to Section 350 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 350.1 - Description

Add the following:

The work includes the removal and disposal of existing structures, pavement, and any other obstacles to construction. Holes, cavities and trenches resulting from the removal of structures shall be backfilled in accordance with Sections 206 and 211.

The disposal of all waste material removed under this item shall be the responsibility of the Contractor. The disposal site shall be approved by the Engineer.

If a Maricopa County landfill is selected for disposition of waste materials and/or debris, a Maricopa County Landfill Use Permit will be required. Application for permit can be made at the Maricopa County Landfill Office, located at 2801 West Durango Street, Phoenix, Arizona 85009 (telephone (602) 269-2661). Charges will be levied on a volume basis for each load delivered to the landfill in accordance with the current fee schedule.

The project construction limits shall be cleared of all trash and construction debris. Such material as collected shall be disposed of at an approved landfill site and shall be subject to landfill fees so assessed, which will be included in the unit price bid for this item.

Weigh tickets from all landfill disposal must be furnished to the Engineer.

Subsection 350.4 - Payment

Payment for all miscellaneous removals required for construction of the project shall be made on the basis of the lump sum price bid, and including but not limited to, removal and disposal of

headwalls, irrigation ditches and boxes, riprap, curb and gutter, fencing, miscellaneous utilities and remnants abandoned within the area of construction, and other items as required.
ITEM 350-1 - MISCELLANEOUS REMOVALS

SECTION 401 – TRAFFIC CONTROL
Traffic control shall conform to Section 401 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 401.1 – Description
Add the following:
Traffic shall be maintained at all times along 48th Street and the Pecos Road alignments bordering the project site. Access to the COP sanitary sewer lift station at the northeast corner of 48th Street and Pecos Road shall be maintained at all times.

Traffic along 48th Street may be reduced to a single graded lane for the purposes of installation of the water service connections to the existing City of Phoenix 12" water line along 48th Street. One lane shall remain open at all times for maintenance vehicles along the Pecos Road alignment between 40th Street and I-10.

ADOT may begin construction of the Pecos Road Connector project consisting of interchange ramps located along the north and east side of the basin complex. The anticipated start date for this ADOT work, at the time of preparation of these Special Provisions (SP's) is December 2000.

Construction access along 48th Street to the basin project site will be closed soon after the ADOT construction project is underway. The ADOT Contractor will provide at least 30 calendar days notice to the basin project Contractor prior to the closure of 48th Street. Alternate access will be provided from the intersection of Chandler Blvd. and 40th Street, south along 40th Street to the Pecos Road alignment, and then east along the Pecos Road alignment to the basin project site. This route will also be utilized by the City of Phoenix for operation and maintenance access to the sewer lift station at 48th Street and Pecos Road. The ADOT Contractor will provide graded access along this alternate route where necessary. The basin project Contractor will need to obtain a no cost permit from the ADOT Maintenance District for use of the alternate access route which will at that time be partially within ADOT controlled rights-of-way.

The COP may have under construction at the time of this project roadway and drainage improvements along Chandler Blvd, at 48th Street. This construction activity may affect project site access from the 48th Street and Chandler Blvd. intersection.

Subsection 401.7 – Payment
Payment for traffic control shall be made on the basis of the lump sum price bid for all construction or installation of items required to maintain traffic as described in this Section 401.
ITEM 401-1 – TRAFFIC CONTROL

SECTION 420 - CHAIN LINK FENCE
Chain Link Fence shall conform to Section 420 of the MAG Uniform Standard Specifications.

Subsection 420.1 – Description
Add the following:
Chain link fence and gates without barbed wire shall be placed around the Equalization Basin and the access road around the basin as shown on the plans. The fence and gates shall conform to MAG Detail 160.

Subsection 420.5 - Payment
Payment for the chain link fence shall be made on the basis of the price bid per linear foot, complete in place. Gates shall be considered incidental to the price of the fence.
ITEM 420-1 - CHAIN LINK FENCE

SECTION 425 – TOPSOILS
Topsoil shall conform to Section 425 of the MAG Uniform Standard Specifications except as modified herein and in Section 430.3.1.

Subsection 425.1 – Description
Add the following:
Topsoil within the top 12 inches of soil within the basin site, after clearing and grubbing to remove vegetation and other unacceptable material, shall be stripped from the basin site and stockpiled either on site or within the stockpile site identified on the plans. In addition, any topsoil or other soil stockpiled on the stockpile site shall be cleared and the stockpile site restored to original contours.

The CONTRACTOR shall stake the area(s) from which the topsoil will be removed. This area is to be approved by the Engineer and the COP Parks, Recreation and Library Department (PRLD) prior to soil excavation. Previously excavated areas and rock rubble areas located on site shall not be used for topsoil excavation areas.

The topsoil shall be placed to a compacted 8" thickness in the overexcavated areas of the Primary Basin and Lower Basin as indicated on the plans. Compaction shall be achieved by wheel loading to 85%.

Subsection 425.5 – Payment
Payment for the stripping, stockpiling, placing and compacting of topsoil shall be made on the basis of the price bid per cubic yard complete in place and including the restoration of the stockpile area.
ITEM 425-1 – TOPSOIL

SECTION 430 – LANDSCAPING AND PLANTING Landscaping and planting shall conform to Section 430 of the MAG Uniform Standard Specifications and COP Supplement except as modified herein.

430.1 - Description:
Add the following:
This section shall govern the preparation and planting of landscape areas required in the Plans and Specifications. Materials shall be in accordance with MAG Section 795.

Existing utilities and improvements not designated for removal shall be protected in place. Any damages will be repaired by the Contractor at no additional cost to the Owner.

Unless otherwise provided, concrete header, turf, tree and shrub plantings, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

The work under this section shall consist of furnishing all labor, materials and equipment to install Bermuda and rye grass seed, decomposed granite, concrete header, and installation of trees and shrubs.

430.2 - General:
Add the following:
The prospective Contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

Furnish all labor, materials, equipment and incidental needs to install the landscape to the lines and details shown in the plans.

All materials and products shall conform to the requirements of the City Supplement to MAG Specifications Section 795.

Applicable publications listed below form a part of this specification to the extent referenced:

> Arizona Nursery Association Growers Committee Recommended Tree Specification (latest edition)

Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State and local authorities in furnishing, transporting and installing materials as shown or for completing the work identified herein.

Water costs are the Contractor's responsibility, until Final Acceptance or end of Plant Establishment, Guarantee, and Maintenance Period which ever is longer and the water meters are transferred to the COP.

All planting areas shall be left free of construction debris and/or toxic material and sub-graded to a level to permit landscape and irrigation construction. Trenches, foundation backfill or other filled excavations shall be compacted prior to the site being turned over to the landscape Contractor. No soil preparation or planting shall begin before the site has been cleared and cleaned of debris. Commencement of work indicates acceptance of job site conditions.

Cooperate and coordinate with other Contractors and trades working in and adjacent to landscape areas.

Determine location of underground utilities and perform work in a manner, which will avoid possible damages. The Contractor at no additional cost to the Owner will repair any damages. Hand excavates, as required. Maintain stakes by others until removal is mutually agreed upon by parties concerned. The Contractor must meet all requirements of the MAG Uniform Standard Specifications and Blue Stake.

Ship materials with Certificate Of Inspection required by governing authorities.

If specified material is not obtainable, submit proof of non-availability, together with proposal for use of equivalent material, similar in appearance, ultimate height, shape, habit of growth and general soil requirements. The Contractor may make substitution of a larger size of the same species with approval by the Engineer and City of Phoenix Parks, Recreation and Library

Department (PRLD). However, any additional cost for these substitutions will be borne by the Contractor.

Before delivery, Certificates Of Compliance shall be submitted, certifying that materials meet the requirements specified. Certified copies of the reports for the following materials shall be submitted:

1. Transporting of Cacti and Landscape Plant Materials (from the Arizona Department of Agriculture).
2. Soil Amendments and Conditioners
3. Seed Mix

Certification shall indicate; suppliers name, address, telephone number, date of purchase, name and technical description of item purchased, and quantity of each item purchased.

The Engineer reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected materials shall be immediately removed from the site at the Contractor's expense. The Contractor shall pay cost of removing materials not meeting specifications.

All herbicide / pesticide applicators shall be properly licensed for application of non-restricted use chemicals with an A-20 license or an A-21 license with Pesticide Endorsement from the State Registrar of Contractors and Structural Pest Control Commission. All Landscape Contractors are required to furnish a copy of their application from the Registrar of Contractors, which shall list the names of those employees, approved as applicators by the Registrar of Contractors. Application of non-restricted use pesticides shall not take place until the Engineer receives a copy of the application.

All non-paved areas, as directed by the Engineer, shall be treated with a chemical control, such as Round up or Equal, to control and kill weeds. After weed kill has been established to the satisfaction of the Engineer, these areas shall be cleared and grubbed.

Finish grade for landscape areas shall not vary more than 1 inch from specified grade and cross section and shall be a smooth, uniform surface, free of abrupt grade changes or depressions. Finished soil grade, adjacent paving, curbs or headers shall be adjusted for surface materials.

Unless otherwise specified, seeded lawn areas shall be 1-1/2 inches below adjacent concrete header. Granite areas shall be 1 inch below adjacent pavement.

During Landscape Work, keep pavements clean and work areas in orderly conditions. Sweep, scrub or hose affected areas as directed by the owners representative to maintain a clean and neat work area.

Protect Landscape Work and Materials from damage due to landscape installation, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat repair or replace Contractor-damaged work as directed by the owner's representative. Remove all debris, trash and excess materials generated by the landscape installation.

Do not treat any area with a pre-emergence control that is to receive bermuda or rye grass or native seed mix.

430.3.1 - Preparation of In-Place Soil:
Add the following:
Eight inches of topsoil shall be placed in all overexcavated areas of the Primary Basin and Lower Basin as designated for turf and conforming to Section 215 and Section 425.

Apply soil amendments as follows:

Two ounces of Iron Chelate per 1,000 SF
10 LBS of Sulfur per 1,000 SF
2 LBS of Phosphate per 1,000 SF

Till soil and amendments to homogenous fine mixture, free of lump clots, stones roots and other extraneous matter to a depth of not less than 4 inches.

Fine grade lawn areas to a smooth, even surface with a loose uniformly fine texture. Roll, rake and drag lawn areas, remove ridges. Apply fertilizer, reference City Supplement to MAG Section 795, at the rate recommended by the manufacturer (approximately 6-lbs/1000 sf) for initial seeding operations.

Moisten prepared lawn areas if soil is dry.

430.3.4 - Seed Mix
Winter rye shall be planted in all areas designated for turf as described on the project plans between September and April.

Bermuda grass shall be planted in all areas designated for turf as described on the project plans between May and August.

430.3.5 - Seedbed Preparation
Prior to placing any seed, the Contractor is to verify that rough and final grading is complete and has been accepted by Engineer.

Mix soil amendments and fertilizers with topsoil at rates specified in Subsection 430.3.1. Apply soil amendments on surface of topsoil and incorporate thoroughly into the top 4-inches before planting, using approved equipment.

Fine grade the turf area to a smooth, even surface with loose, uniformly fine texture. Lightly roll, rake, and remove ridges and fill depressions to meet finish grades. The Contractor shall achieve 85% compaction for the topsoil. Remove trash, debris, stones larger than 1-inch in any dimension, and other objects, which may interfere with planting or the maintenance operation of the turf area.

Lightly moisten prepared turf area before planting if soil is very dry, or to achieve desired compaction. Allow surface to dry off and loosen top 1-inch before planting the bermuda grass seed. Do not create muddy soil conditions.

Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to seeding.

Site preparation shall not disturb or destroy existing irrigation pipe, plants or other improvements. The Contractor shall be responsible to replace or repair any damage that occurs to the satisfaction of the Engineer.

430.3.6 - Application of Seed Mix
The bermuda grass and rye seed shall be installed per MAG City of Phoenix Supplements, Revised July 1, 1994, Subsections 430.11.4 and 430.11.5. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

The bermuda grass and rye seed shall be applied using a spreader or seeding machine at a rate of 4 lbs/1,000 sf. Do not seed when wind velocity exceeds five miles per hour. Distribute seed evenly over the entire area by sowing equal quantities in two directions at right angles to each other. The seeding rate is specified in pure live seed (pls). Any change to the specie of bermuda grass or the rate of application will be approved by the Engineer.

The bermuda grass seed shall be planted after night time temperatures reach or exceed 65 degrees. Use hulled seed for greater than 65 degree planting.

430.3.7 - Acceptance:
At the end of a 120-day guarantee and maintenance period, the Engineer will make an inspection to determine acceptability of the Bermuda grass seed. Bermuda grass area will be acceptable provided requirements, including maintenance, have been complied with, and a vigorous, healthy, well rooted lawn is established, free of weeds, bare areas greater than 2-inches in diameter, and surface irregularities.

430.4 Decomposed Granite Area:
Delete the entire section and replace with the following:

The areas on which the decomposed granite is to be placed shall be graded according to the drawings, prior to the placement of any decomposed granite. The ground shall be reasonably smooth and rocks larger than 1" in diameter, within the top 1" of soil, removed and disposed of off-site.

The Contractor shall stake out all areas to receive decomposed granite. These areas shall be treated with a pre-emergent control, such as Surflan, prior to and after placement of the cover material.

Decomposed Granite shall be evenly distributed on the designated areas to a depth as indicated on the plans and details. If a depth is not indicated the minimum depth shall be two inches.

After placing and grading the granite, the Contractor shall water settle the granite with a light spray to remove fine materials from the surface. Immediately after watering, the Contractor shall roll the granite with an appropriate device to an extent satisfactory to the owner's representative.

430.5.6 - Shrub and Tree Pits:
Delete the entire section and replace with the following:
Plant trees after final grades are established and prior to planting lawns, unless otherwise acceptable. If planting of trees occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from tree planting operations.

Layout individual trees and shrubs for the COP representative to approve. Make minor adjustments as might be requested.

Deliver trees just prior to planting. If planting is delayed more than 6 hours after delivery, set trees in shade, protect from weather and mechanical damage. Keep roots moist. Water as often as necessary.

Prior to delivery of any species to the project site, the Contractor shall make the necessary arrangements with the Engineer for an inspection of the plant material. The Contractor will pay for travel to non-local Nurseries, out of the metropolitan Phoenix area, when requested by the Contractor. Any plants found to be unsuitable in growth or condition, or plants, which are not true to the specification, shall be removed and replaced with acceptable plants.

The Contractor shall notify the Engineer at least 48 hours in advance for inspection of the plant material at the offsite location. Prior to notification of the Engineer, the Contractor shall physically verify that the plant material meet the size specified.

Prior to planting, a percolation test shall be performed on all tree-planting pits to determine adequate drainage. Fill pit half-full with water. Allow 24 hours to drain. If pit has not substantially drained, a caisson shall be installed. Each caisson shall have a four-foot (4') by 8-inch (8") diameter hole filled with 1-1/2 inch diameter crushed stone. Fill to bottom of pit. Adjust depth of caissons if ground water, caliche, or rock is encountered.

Do not prune prior to delivery unless otherwise approved by owner's representative. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide adequate protection for root systems. Protect root balls from drying wind and sun.

Prepared backfill mix shall be delivered in unopened 5 pound bags as specified in COP Supplement to MAG Section 795.3 and individually mixed into the backfill as described below for each planting pit.

Plant Size	Amount of Fertilizer
1 gallon	1 pound (one fifth of a bag)
5 gallon	2.5 pounds (one half bag)
15 gallon	5 pounds (one bag)
24" box	10 pounds (two bags)
36" box	15 pounds (three bags)

Submit certification of contents, quantity and source to the Engineer for approval.

Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored on site.

Setting and Backfilling for Plants: Set plant material on layer of compacted backfill mixture, plumb and in center of pit or trench with top of ball at an elevation necessary to accomplish finished grade. Remove pallets or containers before backfilling. Do not handle container plants by foliage, branches or trunks. After removing plant from container, scarify side of root ball to eliminate root bound condition. Do not plant stock if root ball is cracked or broken. When set, place additional backfill mix around plant, brace and place fertilizer tablets, if specified on the drawings. Work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Fertilizer tablets when specified shall be added approximately 6" below grade at the following rate:

For one-gallon container.....1 tablet
For five-gallon container..... ...2 tablets
For fifteen-gallon container.....4 tablets
For twenty-four inch box.....6 tablets
For thirty-six inch box or larger.....3 tablets per

Provide plant saucers as detailed, or directed by the Engineer.

Stake all trees per plans. Set stakes vertically and spaced to avoid penetrating balls or root masses. Place tree ties for maximum support with top tie above scaffold branches and second ties midway to the ground level. Avoid "rigid" restraint of tree and allow for some trunk movement. Stakes to be set into native soil.

Surface drainage of planting areas: Provide proper surface drainage of planted areas. Any discrepancy in the Plans or Specifications, obstructions on the site, or prior work done by another party which Contractor feels precludes establishing proper drainage, shall be brought to the attention of the Engineer in writing for correction and relief.

430.6 Header Installation:
Delete the entire section and replace with the following:
Concrete headers shall be installed at the location and grade as shown on the plans. The Engineer shall approve all formwork prior to pouring of concrete.

430.8 - Plant Guarantee and Maintenance:
Add the following paragraphs:
Unless otherwise authorized, the Contractor shall maintain all landscape areas on a continuous basis as they are completed during the course of work and until final Plant Establishment Guarantee and Maintenance Acceptance. The Contractor shall provide adequate personnel to accomplish maintenance. Maintenance shall include keeping the landscape areas free of debris on a weekly basis, chemical control of weeds and fertilization as needed, cultivating the planting areas, and mowing of turf where lawns are part of the project. Make replacements within seven days of notification from the Engineer. Remove dead, damaged or vandalized plants within seven days of notification. Replacements shall be of the same kind and size as originally specified and shall be installed as described in the contract documents.

Plants shall be kept in a healthy, growing condition by watering, pruning, spraying, weeding and any other necessary operation of maintenance. Plant saucers and beds shall be kept free of weeds, grass and other undesirable vegetation. Plants shall be inspected at least once per week and appropriate maintenance performed. Pruning and restaking is to include removal of any growth conflicting with vehicular or pedestrian movement.

Turf from seed shall be considered established when no bare ground exists within a reasonable area (approximately 2 inches in diameter) as determined by the Engineer. Disturbed areas or any areas greater than 2 inches in diameter which fail to show a good stand of grass shall be reworked and replanted until an acceptable stand is established.

The Contractor shall maintain the irrigation system and make any necessary repairs regardless of cause to assure a complete and operational system as originally designed and constructed. Repairs shall be made within 48 hours of detection.

Chemical mixing and method of application for weed control shall be done in the presence of the Engineer. Chemical application for weed control shall not apply to areas that are hydroseeded when hydroseeding is part of the project.

The Contractor shall request an inspection by the Engineer whenever completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of work, the Engineer will issue a written field notification to the Contractor setting the effective date for beginning of the Plant Establishment Guarantee and Maintenance Period. This Period shall last for 120 days or as specified, unless extended by the Engineer. If the landscape areas are improperly maintained; if appreciable plant replacement is required (for whatever reason); if corrective work is required for the operation of the irrigation system; if turf areas or hydroseeded areas need reseeding or are not established; or if other corrective work is necessary; the Plant Establishment Guarantee and Maintenance Period shall be extended and the Contractor shall continue to maintain the entire site until accepted at no increased cost to the Owner.

The Plant Establishment Guarantee and Maintenance Periods will not be required for the planting of the rye grass.

At the end of the Plant Establishment Guarantee and Maintenance Period a final inspection will be performed. If, after inspection, the Engineer is of the opinion that all planting areas are weeds free, plant materials and turf are in satisfactory growing condition, and he will give the Contractor written Notice of Acceptance of the landscape installation. Any plants, which need to be replaced, regardless of the cause, shall be replaced prior to final acceptance.

There shall be no separate measurement and payment for the Plant Establishment and Maintenance Period. This cost shall be included in landscape bid items for: plant materials, irrigation, and inert materials such as decomposed granite. Ten percent of the landscaping and bermuda grass bid item amounts will be withheld until the completion and acceptance of the Plant Establishment and Maintenance Period, at which time payment of these remaining monies will be made to the Contractor.

430.12 - Measurement and Payment

Payment shall be considered full compensation for all labor, materials, equipment, and all other items necessary and incidental to the installation of landscaping, complete in place including but not limited to trees, soil preparation according to the plans, and the 120-day establishment and maintenance period. Payment for landscaping shall be made on the basis of the lump sum price bid.

ITEM 430-1 – LANDSCAPING

Payment for decomposed granite shall be made on the basis of the price bid per square yard. Price bid shall include all labor, material, and equipment necessary to place decomposed granite in accordance with the plans.

ITEM 430-2 - DECOMPOSED GRANITE

Payment for the concrete header shall be made on the basis of the price bid linear foot. Price bid shall include all labor, material, and equipment necessary to place the concrete header in accordance with the plans.

ITEM 430-3 - CONCRETE HEADER

Payment shall be considered full compensation for all labor, materials, equipment, soil preparation, and all other items necessary and incidental to the application of the bermuda grass seed in the

bottom and on the side slopes of the Primary Basin, and the 120-day establishment and maintenance period. Payment for the bermuda grass seed shall be made on the basis of the price bid per acre.

ITEM 430-4 - BERMUDA GRASS

NOTE: ITEM 430-5 – RYE GRASS will not be subject to Value Engineering. At the discretion of the Engineer and the City of Phoenix PRLD, and at no cost to the Owner, this bid item may be deleted from the contract if the seasonal timing requirements of these Special Provisions can be met in the construction schedule for the planting of the bermuda grass, and not requiring the planting of the rye grass.

Payment shall be considered full compensation for all labor, materials, equipment, soil preparation, and all other items necessary and incidental to the application of the rye grass seed in the bottom and on the side slopes of the Primary Basin. Payment for the rye grass seed shall be made on the basis of the price bid per acre.

ITEM 430-5 – RYE GRASS

The work under ITEM 430-6 – Treatment Cell Landscaping and Planting shall consist of furnishing and planting all plants for the vegetated treatment cell as designated on the project plans. The work shall also include the preparation of the rock mulch for planting, storage and protection of all planted and unplanted stock and other materials; amendments, all watering, staking, guying, pruning and wrapping; the cleanup of the area, disposal of unwanted and deleterious materials, and the care and maintenance all in accordance with the details shown on the plans and the requirements of these specifications. Materials shall be in accordance to Section 795 of these specifications.

Prior to any planting the area shall be cleared and grubbed, the impervious liner installed and the rock mulch placed in accordance with Section 220.

Prior to delivery to the project site the Contractor shall make arrangements with the Engineer for inspection of the plant material. Any plants which are found to be unsuitable in growth or condition or which are not true to name shall be removed and replaced with acceptable plants at the Contractor's expense.

Prior to shipping, all plants shall be dug, handled, prepared and packed for shipment with care and skill, in accordance with recognized standard practices for the kind of plants involved. Plants shall be transported to the site only when the vegetated treatment cell is ready for planting and water can be delivered to the cell. Any weed species shall be removed prior to transporting. Protect plants during transporting and prior to planting to prevent damage to shoots and roots. Plants shall be kept moist during transport, temporary storage and planting.

Plants delivered, inspected and found acceptable for planting shall normally be planted within 24 hours after delivery to the project site. Any plants not able to be planted within 24 hours shall be temporary stored as specified and protected from damage. Any stock, that in the opinion of the Engineer, has deteriorated due to exposure, storage or transport will be removed and replaced at the Contractor's expense.

At planting the large clumps shall be broken in to smaller clumps or individuals plants. Plants should be a minimum of 12 inches long with green shoots of at least 4 inches long.

Individual hand dug holes, dug at the time of or just prior to planting shall be used. The rock mulch shall be saturated at the time of planting. Roots shall be placed into gravel to a depth of 4 inches with the green shoot above the bed surface. Bed material shall be replaced around the plants.

The two recommended plants (See Section 795) shall be placed upright in the cell in an alternating pattern. Planting shall begin at the influent end of the cell. Set plants into prepared rock mulch with 3 feet between each plant and 3 feet between alternating rows as shown on plans.

During planting nighttime air temperature shall be no less then 32° F. Do not plant when air temperature is below freezing. Planting shall commence and be completed during the months of late September to the end of November.

Upon completion of planting, the vegetated cell shall be maintained with a water depth of at least one inch but no more than 3 inches above the rock mulch surface for 60 days, thereafter the water level shall be kept 1 to 3 inches below the rock mulch surface. Under no circumstances shall the water level be allowed to rise above the tops of the exposed plant shoots or drop below the root zone.

The Contractor shall document planting activities, including dates of planting, number of each plant placed into cell and the condition of the plants. In addition, the Contractor is required to document the source of all plants.

All requests for substitutions must be submitted in writing to the Engineer prior to commencement of work on the project. The Contractor shall not take any further action concerning his request until a written approval or denial is received from the Engineer. Plants of kinds other than indicated on the plant list will be considered by the Engineer only upon submission of proof of specified plant is not reasonably procurable in the local region. Substitutions will resemble the specified plant in regards to appearance, ultimate height, shape, habit of growth and soil requirement.

Substitution of a larger size of the same specie may be made by the Contractor without written approval. However, the Owner will not be responsible for any additional costs incurred by the Contractor, either for additional cost of the plants or for any additional planting costs.

This work shall consist of the care of all stock in accordance with accepted horticultural practices; keeping all areas free of weeds, grasses and construction related debris; applying irrigation water; repairing weather damage; taking all precautions necessary to prevent damage from cold, frost, sunburn or other hazards; pruning as required by the Engineer; as shown on the plans and specified in these special provisions. Materials necessary for the establishment of planted stock shall be furnished by the Contractor and shall conform to these specifications.

The Contractor shall remove and replace, at his expense, all dead, damaged or vandalized plants and all plants that show signs of failure to grow or which are injured or damaged as so to render them unsuitable for the purpose intended, as determined by the Engineer. The Contractor may, with the approval of the Engineer, delay replacement of plants killed by frost until such time that frost is not imminent. A minimum plant survival of 95% is required for acceptance.

Contractor shall maintain a perimeter fence at all times to prevent animals from damaging plants.

The Contractor shall request an inspection by the Engineer whenever completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of work, the Engineer will issue a written field notification to the Contractor setting the effective

date for beginning of the Plant Establishment Guarantee and Maintenance Period. This Period shall last for 120 days or as specified, unless extended by the Engineer. If the planted areas are improperly maintained; if appreciable plant replacement is required (for whatever reason); if corrective work is required for the operation of the water system; or if other corrective work is necessary; the Plant Establishment Guarantee and Maintenance Period shall be extended and the Contractor shall continue to maintain the entire site until accepted at no increased cost to the Owner.

At the end of the Plant Establishment Guarantee and Maintenance Period a final inspection will be performed. If, after inspection, the Engineer is of the opinion that all planting areas are weeds free, plant materials are in satisfactory growing condition, and he will give the Contractor written Notice of Acceptance of the landscape installation.

A special inspection shall be performed at anytime during the landscaping establishment period when, in the opinion of the Engineer, conditions justify such action.

The Contractor will not be required to keep planted areas cleared of trash and debris unless such trash and debris is a result of his operations. If, in the opinion of the Engineer, trash and debris has been deposited within the planted areas, not as a result of the Contractor's operation, and such trash and debris is detrimental to the health and proper development of the plant material the Engineer may require the Contractor to clear the areas of this material.

The Contractor's responsibility for the work during landscaping establishment shall be in accordance with the requirements of Subsection 107.2.1. All unacceptable planted stock and/or other work discussed at the monthly inspection shall be removed, replaced and/or repaired, as directed by the Engineer, at the Contractor's expense within 21 calendar days from the date of the inspection. The Contractor shall notify the Engineer when the replacement work has been performed.

All erosion which occurs within the landscaped area shall be immediately repaired by the Contractor to maintain the final grade in reasonably close conformity with the lines and grades shown on the plans or as established by the Engineer. Erosion repair work shall be completed before the next monthly inspection and at the Contractor's expense.

All electrical power or water used for planting, maintenance and establishment shall be paid for by the Contractor.

All dead, damaged, vandalized or unhealthy plant stock shall be removed and replaced, as directed, at the Contractor's expense, within 21 calendar days from the date of the inspection and the Contractor shall notify the Engineer in writing when the replacement work has been performed. Stock furnished for replacement shall be of the same size and species as originally specified.

After the final inspection and when all dead, damaged, vandalized or unhealthy stock has been removed and, if directed, replaced, the Contractor will then no longer be responsible for the replacement of plant stock.

In case of certain plant stock found to be dead, damaged, vandalized or unhealthy at the inspections specified above, the Contractor may be ordered to remove certain dead, damaged, vandalized or unhealthy plant stock and may be ordered not to replace such plant stock when the nonreplacement would not adversely affect planting design. The initial furnishing and planting, and the subsequent removal of such plant stock ordered removed and not replaced shall be at the Contractor's expense.

There shall be no separate measurement and payment for the Plant Establishment and Maintenance Period. This cost shall be included in landscape bid items for: plant materials, watering, and inert materials, such as decomposed granite. Ten percent of each landscape bid item amount in addition to retention will be held for distribution during the maintenance period. Equal monthly payments will be authorized, based on inspection and subject to extensions, where the Contractor fails to comply with previously stated requirements. Payment may or may not be supplemental to final project payment.

Payment shall be made on the basis of the lump sum bid and shall be full compensation for furnishing all labor, materials, tools, water, equipment and all other items necessary and incidental to complete the planting in accordance with the plans and the 120-day establishment and maintenance period of the vegetated treatment cell.

ITEM 430-6 – TREATMENT CELL LANDSCAPING AND PLANTING

SECTION 440 - SPRINKLER IRRIGATION SYSTEM INSTALLATION

Sprinkler irrigation system installation shall conform to Section 440 of the MAG Uniform Standard Specifications and COP Supplement except as modified herein.

Subsection 440.1 - Description

The work shall consist of the installation of an irrigation system for all plantings, and an irrigation system for the bermuda grass.

The Contractor shall install all irrigation systems, lines, sprinkler heads, irrigation booster pump station (see Appendix D), electrical service connection and other irrigation equipment as shown on the plans. The irrigation system lines and spray headers will be adjusted as required to accommodate the newly graded area contours. All new materials and hardware for irrigation lines, valves, heads, etc. shall satisfy the requirements of Section 440 and Section 757.

An irrigation controller will be installed to support the irrigation system for the basin. This work includes the installation of one (1) – 6" water service line and one (1) - 6" water meter and vault off the existing 12" water line located in 48th Street as shown on the plans. The Contractor shall provide and install all pipes, tapping sleeve, backflow preventors, meter vaults, valves, valve boxes, fittings, booster pump station electrical service and any incidental items to complete the installation of the irrigation system. The one (1) - 6" water meter will be provided and installed by the City Water Services Department (WSD) at no cost to the Contractor. The WSD will also complete the line tap to the 12" main after the Contractor has installed the tapping sleeve. The Contractor shall coordinate with the City of Phoenix Water Services Department for the connection to the 12" main. The city's WSD representative, Gerald Arakaki (602) 261-8229 or the Corona Yard (602) 262-1847 shall be contacted a minimum of 30 calendar days in advance for the installation of the tap and meter.

The irrigation pump station shall be provided as described in Appendix D and as shown on the plans.

Electrical power for the irrigation controller and irrigation booster pump station is by a service connection to the existing SRP transformer located within the adjacent Sewage Lift Station enclosure. Contractor is responsible for the underground service connection from the SRP transformer to the irrigation booster pump station as shown on the plans. Contractor shall coordinate with SRP to schedule SRP's work that includes installation of the meter and conductor wire from the transformer to the meter.

Due to the scale of the drawings, it is not possible to indicate all offsets fittings and sleeves which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such offsets, fittings and sleeves as may be required to meet such conditions. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

440.2 References:
Conform to the requirements of reference information listed below except where more stringent requirements are shown or specified in the Contract Documents.

A. American Society of Testing Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.
B. Underwriters Laboratories (UL) - UL Wires and Cables.

440.3 Quality Assurances:
Work involving plumbing for installation of copper piping, backflow preventer(s), and related work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.

Tolerances: Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, recompaction, and repair of finish grade treatment.

Coordinate work with other trades.

For period of one year from Final Acceptance, guarantee/warranty irrigation materials, equipment, and workmanship against defects. The Contractor shall replace any pavement damage resulting from the installation of the irrigation system and repair damage to grading, soil preparation, seeding, sodding, or planting at no additional cost to the owner. Make repairs within 3 days following notification by the Owner or the City of Phoenix PRLD.

440.4 Submittals:

440.4.1 Shop drawings and product information: Prepare and make submittals in accordance with conditions of the Contract, and as follows: A minimum of ten days prior to beginning work on the irrigation system the Contractor shall submit six (6) copies of manufacturers literature including name and numbers covering materials listed below and any other items requested by the Engineer. Do not order materials until the Engineer approves products.

Items to be submitted:

Pipe	Automatic Controls
Fittings and Solvents	Wire and Connectors
Gate Valves	Air Relief Valves
Valve Boxes	Pressure Regulating Valves
Sprinklers	Quick Coupling Valves
Automatic Valves	Emitters

All items shall be those specified and approved by the Engineer. Substitutions will not be allowed without approval.

440.4.2 Record Drawings: The Contractor shall maintain an accurate set of as-built plans on site. At the end of each day work accomplished shall be updated on the as-built plans. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following:

A. Connection to existing water lines
B. Connection to existing electrical power
C. Gate valves
D. Routing of Sprinkler pressure lines (dimension at a minimum of 100 feet along routing)
E. Sprinkler control valves
F. Routing of control wiring
G. Quick-coupling valves
H. Other related equipment as directed by the Engineer

The above mentioned equipment and stock shall be turned over to the Owner at the conclusion of the project. Before final inspection evidence that the Owner has received this material must be shown to the Engineer.

The Contractor shall also indicate any non-pressure pipe routing changes on the as-built drawings.

Before the final inspection, the Contractor shall deliver to the Engineer one copy of the as-built plans to review. Delivery of this set of plans does not relieve the Contractor of the responsibility of furnishing required information that may be requested by the Engineer. The Contractor shall make corrections noted and submit final as-built plans to the Engineer for approval and acceptance. The Engineer will not certify payment requests or make final payment if as-built plans are not current or complete.

440.4.3 Controller Charts: The Engineer shall approve As-Built drawings before controller charts are prepared. The chart shall show the area controlled by the automatic controller and shall be the maximum size, which will fit inside the controller door, and still be legible. Identify the area of coverage of each remote control valve, using a distinctively different color, drawing over the entire area of coverage. Following review of the charts by the Engineer, they shall be hermetically sealed between two layers of 20-mm thick plastic sheets. These charts shall be completed and approved prior to final inspection of the irrigation system.

440.4.4 Operation and Maintenance Manuals: Submit 4 operation and maintenance manuals to the Engineer for review prior to final acceptance. The manuals should include the complete technical description of materials and products used, guarantee statement, complete operating and maintenance instructions on all major equipment. Contractor to provide a demonstration to maintenance personnel, with owners representative present, of how to adjust and maintain all sprinkler head types, controller functions, and recommended controller programs, as established by the Contractor. Contractor also to review recommended watering rates for new plant materials.

440.4.5 Equipment to be furnished: All materials to be new and bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source replacement will be furnished to the Engineer.

Equipment to be furnished:

A. Two sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied to the project.
B. Two five foot valve keys for operation of gate valves. Four quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
C. Three valve box keys or wrenches.

Extra Stock to be furnished:

A. 2 sprinkler heads of each type.
B. 2 nozzles for each type used.
C. 2 emitters of each type used.

440.5 Permits:
All permits for installation or construction of the work included under this section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.6 Execution:
Examine areas and conditions under which work of this section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

440.6.1 Staking: Mark with powdered lime, routing of pressure supplies line and stake locations of various components, sprinkler heads and emitters. Unless otherwise specified, the automatic sprinkler system layout shall be considered schematic. Sprinkler head spacing shall not exceed the maximum shown on the drawings or recommendations by the Manufacturer. Preliminary adjustments to conform to actual site conditions shall be accomplished during staking. Should changes be required the Contractor shall obtain approval of the Engineer prior to actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned.

440.6.2 Trench Excavation: Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

A. Electrical conduit - 18 inches
B. Waterlines continuously pressurized - 18 inches
C. Lateral sprinkler lines - 12 inches
D. Plastic lines under pavement - 24 inches

The bottom of the trenches shall be true to grade and free of protruding stones, roots or other matter, which would prevent proper bedding of pipe or other facilities. Where ledge rock, hard pan, or boulders are encountered, the trench bottom shall undercut and filled with sand or fine grained material approved by the Engineer.

Clearances:

A. Piping 3" and larger, minimum trench width of 12 inches.

B. Piping smaller than 3", minimum trench width of 7 inches.

C. Provide not less than 6 inches of clearance between each line, and not less than 12 inches of clearance between lines of other trades, to permit service or replacement without disturbing the other line.

Grading and Stockpiling of trenched materials shall comply with Section 601.2.8.

440.6.3 Sleeving: Piping located under asphalt, concrete, or other pavements shall be sleeved, size and schedule as noted on the plan. If not noted, sleeves shall be Schedule 40, sized to easily accommodate piping. Use separate sleeve for wiring.

Boring will be permitted only where pipe must pass under obstructions, which can not be removed, or when approved by the Engineer. When any cutting or removal of asphalt and or concrete work is necessary, it shall be saw cut in accordance with Section 601. Permission to cut asphalt or concrete shall be obtained from the Engineer. When piping on the drawings is shown in paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

440.6.4 Piping: Provide pipes, schedule and size as shown on the drawings and per Section 757.

PVC Pipe: Snake pipe in trench as much as possible to allow for expansion and contraction. Provide a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. Pipe shall be installed in accordance with ASAE Standard: ASAE 376. Pipe shall be clean prior to installation and shall be maintained in that condition during installation. When pipe lying is not in progress, the open ends of the pipe shall be closed by approved means.

Sand bedding or fine-grained material shall be provided where ledge rock, hard pan, or boulders are encountered. Compact bedding material to provide a minimum depth of bed between pipe and rock of 4 inches.

Solvent welded joints shall be made in accordance with ASTM D-2855, and the type of solvent and primer recommended by the pipe manufacturer shall be used. Primer and solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly. The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

Schedule 80 pipe shall be used for threaded joints. Field threading shall be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Solvent will not be used on threaded pipe. Threaded joints shall be hand tightened with final tightening as necessary to prevent leaks with a strap wrench.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches will be used. Any plastic pipe, which has been nicked, scarred, or otherwise damaged, shall be removed and replaced. Care shall be exercised so that stress on a previously made joint is avoided.

When PVC to metal pipe connectors are required, these connections shall be accomplished first. A plastic adapter with external pipe threads should be used, screwing it into the metal internal pipe threads. Use a non-hardening pipe dope, such as Permatex #2, or equal, on all plastic to metal

threaded joints. The joint shall be hand-tightened. Utilize a light wrench, as necessary, to prevent leaks.

When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

440.6.5 Wiring: All service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified. A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum service wire shall be No. 12 AWG copper 600 volt type, TWH or larger, as required by the contract documents or controller manufacturer. Wire splices shall be located only in specified pull boxes and shall be made with a packaged kit approved for underground use. Pull boxes shall be plastic with locking covers set to proper elevation on a 6 inch layer of crushed rock or washed gravel.

Low Voltage Control Wiring issuing from the controller shall be direct burial, type UF, No.12 AWG copper, unless otherwise required and installed in main or lateral waterline trenches wherever practical. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted. Install two (2) control wires along the entire length of the mainline. The wiring shall be bundled and secured to the lower quadrant of the irrigation pipeline at 10-foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring to provide for expansion and contraction. When control wiring cannot be installed in the pipe trench it shall be installed a minimum of 18 inches below finish grade. Attach wire markers to the ends of the control wires and label valve stations at controller locations.

All pilot or "hot" wires are to be of a different color and all common wires are to be of another color. If multiple controllers are being utilized, and wire paths of different controllers cross both common and control wires, from each controller, shall be of different colors.

Splices in control wire shall be made in accordance with the requirements for Service Wire. Sufficient slack shall be left at each splice and point of connection in pull boxes so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wire. No splices shall be permitted under pavements.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment. All controllers shall be grounded independent of any other controller as recommended by the controller manufacturer and all valves shall be connected to the ground wire of their controller. A separate hot wire to its controller shall connect each valve.

Two spare #12 AGW wire shall be installed from the controller pedestal of terminal along entirety of pressure lines to last electric control valve on each and every leg of mainline. Color of spare wire to be green in all controllers. Loop spare wire inside all valve boxes.

440.6.6 Valves, Valve Boxes, and Special Equipment: Backflow Preventor Assembly: The Backflow Prevention assembly shall be installed per the details shown on the drawings and associated governing code requirements. Provide pipe supports and the accessories to properly secure the assembly. The irrigation system shall not be operated until the assembly has been tested and certified to meet the requirements of the Water and Wastewater Department - Water Quality Section.

After the backflow assemblies have been properly installed by the Contractor and approved by Development Services Department - Building Safety Branch, the Contractor shall pay for testing and be responsible for having the assembl(ies) tested by a certified backflow prevention assembly tester, approved by the City. The tester shall prepare test report(s), showing the condition of the assemblies and confirming that the assemblies are properly functioning. It is the Contractors responsibility to submit the forms to the Engineer and to Water Quality Division, Backflow Prevention Unit. Final acceptance will not be given until the Engineer approves the reports.

Valves, Pressure Regulators, and Related Accessories shall be installed as shown on the plans, or as specified. They shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. The equipment shall be set at a sufficient depth to provide clearance between the valve box cover and the valve handle, cap, or key for operation of the system.

Gate Valves and Isolation Valves shall be installed below ground and shall be housed in a concrete or plastic pipe, with bolt down locking cover that will permit access for servicing. The pipe shall be centered on the valve stem. Isolation valves shall not be located within range of the sprinklers they control without approval of the Engineer.

Drain Valves shall be installed at all low points in pressure supply line as detailed. Provide drainage sump for each drain valve based on the table below:

CUBIC FEET OF GRAVEL PER DRAIN VALVE
DISTANCE OF PIPING TO BE DRAINED

PIPE				
SIZE	0-250 LF	251-500 LF	501-750 LF	751-1000 LF
1"	.75	1.50	2.25	3.00
1-1/4"	.75	1.50	2.25	3.00
1-1/2"	1.50	3.00	4.50	6.00
2"	2.50	5.00	7.50	10.00
2-1/2"	4.00	8.00	12.00	16.00
3"	6.00	12.00	18.00	24.00
4"	11.00	22.00	33.00	44.00
6"	25.00	50.00	50.00	50.00

Quick Couplers and Hose Bibcocks shall be installed as shown on the plans, or as specified. Their location shall be a minimum of 3 feet from curbs, pavements and walks, unless approved otherwise by the Engineer. Quick-couplers shall be installed on a swing joint riser assembly and set at a sufficient depth below ground to provide clearance for the valve box cover in the closed position. Hose bibcocks shall be set 12 inches above finish grade and installed on a galvanized riser or as detailed.

Valve Boxes: Install one valve box for each type of valve installed as shown on the plans, or specified unless directed otherwise by the Engineer. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted.

Set valve boxes to the finish grade specified, or as follows:

A. In non-irrigated areas set box 1/2 inch above finish grade.
B. In areas irrigated by flood bubblers set boxes adjacent to curbs, sidewalks, or pavements at or just above water level.
C. In irrigated turf areas set box 1/2 inch above finish grade.

The valve boxes shall be branded with the controller letter and station number of the contained valve. The letter and number size shall be no smaller than 1 inch and no greater in size than 1-1/2 inches. Depth of branding shall not be more than 1/8 inch into the valve box lid. All labeling shall be neat and legible.

440.6.7 Sprinkler Heads: Install sprinkler heads where indicated on the drawings, staked and approved. Set to finish grade as detailed; spacing of the heads shall not exceed maximum recommended by the manufacturer without approval of the Engineer. They shall be installed with at least 4 inches clearance from vertical elements projecting above grade such as walls, planter boxes, curbs, and fences. All sprinkler heads shall be perpendicular to finish grade unless otherwise designated on the plans or details.

440.6.8 Emitters: Install emitters where indicated on the drawings, staked and approved. Emitter heads shall be installed as detailed.

440.6.9 Riser Assemblies: Sprinkler heads, and Quick Couplers shall have double swing joint assemblies, as shown on the plans. The assembly shall consist of: horizontal nipple threaded into a single outlet ell or tee installed schedule 80 fittings, minimum 12" long threaded nipple. The Contractor may submit a pre-manufactured swing joint assembly, such as that manufactured by Lasco Inc., or approved equal.

440.6.10 Controller System: The Controller and accessories shall be installed at the locations designated and per the details shown on the contract documents. Submit shop drawing showing wall elevation with equipment, and sleeving for approval by the Engineer.

All distribution wire shall be as specified in section 440.6.5. Provide slack and tape controller wire in neat bundles. The foundation for the controller, unless wall mounted, shall be Class B concrete of the size shown on the plan or as recommended by the manufacturer. Stub out all conduits for control wiring 2 feet beyond concrete slab or walls and provide bushings for all conduits. All RGS conduit in contact with earth shall be taped with scotchwrap, or equal, #50 minimum thickness 40 mils.

440.6.11 Bedding, Backfilling and Compaction: Pipe shall be bedded in at least 4 inches of finely graded native soil or sand to provide a firm, uniform bearing. After laying, the pipe shall be surrounded with additional finely grained native soil or sand to at least 4 inches over the top of the pipe.

Bedding sand shall be required when site conditions dictate and clean backfill meeting the specifications is not available. It shall also be required under asphalt and concrete pavements such as roadways, parking surfaces and plazas.

Thrust blocking shall be formed against a solid trench wall that has been hand excavated. The size and type of the thrust blocking shall be as per the drawings. Control wire shall not be concealed within the thrust blocking.

Trench backfill, sufficient to anchor the pipes, may be deposited before pipeline pressure testing, except that joints shall remain exposed until satisfactory completion of testing.

Trenches and excavations shall be backfilled with clean material from excavations. Remove organic material as well as rocks larger than 1 inch in diameter. Place acceptable backfill material in lifts, the height of which shall not exceed that which can be effectively compacted, depending on the type of equipment and methods used. Trenches and excavations shall be backfilled so that the specified thickness of topsoil is restored to the upper part of the trench. Compaction shall be in accordance with Section 301. Water settling of the trenches will not be permitted unless approved by the Engineer.

440.6.12 Cleaning: Maintain continuous cleaning operations throughout the duration of the work. Dispose of, off-site at no additional cost to the Owner, all trash or debris generated by installation of the irrigation system.

440.7 Flushing and Testing:
After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. The Contractor shall furnish all equipment, materials, and labor necessary to perform the tests and all tests shall be conducted in the presence of the Engineer.

Pipeline Pressure Test: A water test shall be performed on all pressure mains. Pressure mains shall be tested with all control valves installed and in the closed position. The constant test pressure and duration of the test shall be for 6 hours at 125 psi. Any leaks, which occur during the test period, will be repaired immediately following the test. The pressure mains will then be retested until accepted by the Engineer.

Sprinkler Coverage Test: The coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or zone in the irrigation system is balanced to provide uniform and adequate coverage of the areas serviced. The Contractor shall correct any deficiencies in the system.

Operational Tests: The Contractor shall adjust or replace any type of irrigation heads or equipment to ensure proper distribution of water throughout the course of the Plant Establishment Guarantee and Maintenance Period.

440.8 Preliminary, Substantial and Final Walk-Through Inspections:
Arrange for a preliminary walk-through with the Engineer, when the entire system is operational. Operate each zone in its entirety, additionally, open all valve boxes and expose items covered, if directed. Generate a list of items to be corrected and make adjustments, "fine tuning" the entire system by regulating valves, adjusting patterns and break-up devices, and setting pressure regulators at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Adjustments may include, at no additional cost to the City, changes in nozzle sizes, and degree of arcs.

Arrange for a Substantial Completion walk-through when all items generated from the preliminary walk-through have been corrected. Items deemed not acceptable by the Engineer shall be reworked to complete satisfaction. The maintenance period will not begin unless authorized by the Engineer.

All accessories, charts, record drawings and equipment, as required, will be provided before scheduling the Final walk-through.

Following the Landscape Maintenance Period a Final walk-through inspection will be scheduled to review the system and make adjustments to the watering schedules.

Subsection 440.9 - Measurement and Payment
Payment for the irrigation system for all plantings, and including the irrigation controller shall be made on the basis of the lump sum price bid. Price bid shall include all labor, materials, tools, and equipment to complete the irrigation system for all plantings and for the complete installation of the irrigation controller including the electrical connection, and backflow preventor enclosure according to the project plans.
ITEM 440-1 - DRIP IRRIGATION SYSTEM

Payment for the turf grass irrigation system shall be made on the basis of the lump sum price bid. Price bid shall include all labor, materials, tools, and equipment to complete the sprinkler irrigation system for the turf grass, including all items related to the installation and operation of the irrigation booster pump station, water service connection, piping, electrical service, sun screen shade structure, and all other items necessary for the operation of the turf irrigation system, complete in place.
ITEM 440-2 - TURF IRRIGATION SYSTEM

SECTION 450 – PERIMETER LIGHTING
Add the following section:

Subsection 450.1 – Description
Perimeter Lighting consists of installing luminaires and luminaire assemblies along with associated wiring, conduits, luminaire foundations and handholes as shown on plans.

Subsection 450.2 – Measurement
Perimeter lighting shall be measured as an each item including all luminaires, luminaire assemblies, associated wiring, conduits, foundations and handholes installed complete and in place as shown on the plans.

Subsection 450.3 – Payment
Payment for perimeter lighting shall be made on the basis of the price bid per each for constructing and installing all luminaires, luminaire assemblies, associated wiring, conduits, foundations and handholes, and including full compensation for furnishing all labor, materials, tools, equipment and any incidentals needed to complete the luminaires as shown on the plans.
ITEM 450-1 – PERIMETER LIGHTING

SECTION 505 - CONCRETE STRUCTURES
Concrete structures shall conform to Section 505 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 505.1 - Description
Add the following:
The work under this section shall consist of furnishing all labor, materials and equipment for the construction of all cast-in-place and other concrete, including:

Inlet and Outlet Pipe Headwalls,

Gate Structures,
Overflow Structure,
Spillway Walls,
Concrete Spillway and Spillway Apron,
Concrete Low Flow Channel Lining,
Access Ramp,
Emergency Spillway Cutoff Wall.

Concrete structures required for the Water Quality Pump Station and the Evacuation Pump Station shall conform to Section 618 and Appendix A of these specifications.

Concrete shall conform to the requirements of Section 725 of the MAG Standard Specifications, and mix designs shall additionally meet the requirements of Chapter 5, Section 5.3 of ACI STANDARD 318-89. The Contractor shall submit mix designs and certifications of conformance with the above requirements for the written approval of the Engineer.

Class "A" Concrete, f'c = 3000 psi, shall be used for all concrete structures, including the spillway and spillway walls, low flow channel lining, inlet and outlet headwalls and aprons, spillway apron, wet wells, gate structures, access ramp, emergency spillway cutoff wall, and overflow weir structure.

The use of Class F fly ash will be permitted in all concrete mixes, subject to approval of mix design by Engineer.

Transit Concrete mixers used on the project must carry current certification from ADOT or Arizona Rock Products Association.

The reinforcing steel shall conform to Section 727, Grade 60, of the MAG Standard Specifications.

Wire mesh reinforcement shall be furnished in flat sheets (not rolled), and may be used in the spillway, low flow channel lining, emergency spillway cutoff wall, and access ramp.

A 42" concrete pipe plug shall be installed in the outlet pipe as specified in Section 618.

The water stop shall be installed between the spillway walls and the overflow spillway as indicated on the plans. Adeka Ultra Seal MC-201OM or approved equal shall be used. The water stop shall be included in the price bid for ITEM 505-1 – SPILLWAY WALLS.

Trash racks and grates shall be installed according to the plans and conform to the specifications and the plans. No payment will be made for trash racks or grates as such; the cost thereof shall be included in the bid price for the construction of the items to which they are incidental or appurtenant.

Riprap to be installed at outlet headwalls (Detail D2) shall conform to Section 220 and be installed as shown on the plans. The cost of the riprap shall be included in the bid price for the construction of the items to which the riprap is incidental or appurtenant.

All sluice gates shall be the product of one of the following or approved equal:

- Rodney Hunt
- Waterman

Sluice gate, stem lifts, and other appurtenances of site, type, material and construction shall be supplied as shown on the plans and as specified. Gates shall meet requirements of AWWA specification C-501. Maximum clearance between seating surfaces with slide gate closed is 0.004 inches.

Sluice gate shall have manual handwheel operator with centerline of handwheel approximately 36 inches above operating floor unless otherwise shown. Lift shall be provided in accordance with AWWA C-501. All lifts shall be provided with clear butyrate plastic stem cover with Mylar open-close indicator.

Sluice gate frame, glides, slide, pedestal, gear housing, thimble, and yoke shall be constructed of cast iron, ASTM A126 Class B. Resilient seals for flush bottom gates shall be of neoprene. Wedges shall be of bronze, ASTM B584, CA872. Stems, stem couplings, anchor bolts, assembly bolts and nuts shall be bronze ASTM B98.

Sluice gate operators with counter clockwise opening as viewed from the top shall be provided as shown on drawings or as specified. A handwheel shall be provided with the direction of opening and the word OPEN shall be cast into the handwheel. Size handwheel for valves in accordance with AWWA C500. Size actuator to produce required torque with a maximum pull of 80 LB and to withstand without damage a pull of 200 LB. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.

505.6.1 - Joints
Add the following:
Construction joints shall be located at the end of a day's pour or when concrete placement stops for more than 45 minutes. Reinforcing steel shall be continuous through lining construction joints for a minimum of 2 feet beyond the end of pour unless noted otherwise on the plans. The end of the pour shall be a roughened surface.

Subsection 505.8 - Curing
Add the following:
All concrete to receive any coloration shall be water cured, utilizing the wet burlap method, unless otherwise permitted by the Engineer, and shall be kept continuously wet for 10 days.

No vehicular loads will be permitted on the box culvert structures before the period of twenty-one (21) days from the date of the last pour of concrete unless approval is obtained in writing from the Engineer. In no case shall traffic be allowed on the structure until the specified concrete strength has been attained. The Contractor shall take special precautions to keep the area properly barricaded, lighted, and marked to prevent automotive traffic from crossing the new box culvert structures prior to the Engineer's approval.

Subsection 505.9 - Finishing Concrete
Add the following:
The use of wood trowels will not be permitted in any finishing operations for concrete slabs.

The concrete spillway and spillway apron shall be finished using a heavy raked finish oriented perpendicular to the spillway slope.

Concrete Low Flow Channel lining shall be finished to heavy broomed texture.

All exposed concrete surfaces of the equalization basin spillway, the spillway walls, spillway apron, the low flow channel lining, and the inlet and outlet headwalls and aprons located within the Primary and the Lower Basins shall be colored using a "Light Brown" color admixture conforming to LANSCO #6100, as manufactured by Landers-Segal Color Co., Inc., or approved equal. The admixture shall be added at the rate of 2 pounds per 94 pound sack of cement.

The color shall conform to the color requirements with respect to hue, value, and chroma. A 5'x5' test panel shall be made for the concrete color, and the color shall be approved by the Engineer prior to use.

The concrete color test panel will be considered incidental to the cost of the concrete.

A form liner shall be used on all exposed vertical concrete surfaces of the equalization basin spillway walls.

The form liner shall be VA D.O.T. Fractured Rib design, No. 367, uni-cast and/or multi-cast sheets as manufactured by Greenstreak, or approved equal. Form liners shall be prepared, placed and stripped per the manufacture's requirements, recommendations, and specifications. The form liner shall be installed as required in the plans. A 5'x5' test panel of the form liners shall be made and approved by the Engineer, and shall remain on the project site until project completion. The cost of the form liner is incidental to the concrete structure.

Subsection 505.10 - Payment
Payment for the spillway walls shall be made on the basis of the price bid per linear foot including all concrete, reinforcing steel, and other materials, all structure excavation and backfill, color admixture and formliner, water stop, and all labor, equipment and appurtenances necessary for construction complete in place.
ITEM 505-1 - SPILLWAY WALLS

Payment for all gate structures, the overflow weir structure, and the inlet and outlet headwall structures, aprons and lining shall be made on the basis of the price bid per each complete in place and including all materials, concrete, reinforcing steel, trash racks, access barriers, aluminum grates, concrete aprons, sluice gate and crank stand assemblies, structure excavation and backfill, riprap and color admixture where required, and all labor, equipment, and other materials and appurtenances required complete in place.
ITEM 505-2 - INLET HEAD WALL W/APRON (DETAIL D1)
ITEM 505-3 - INLET HEAD WALL W/O APRON (DETAIL D1)
ITEM 505-4 - INLET HEAD WALL NO. 6 (DETAIL D1)
ITEM 505-5 - OUTLET HEAD WALL W/RIPRAP (DETAIL D2)
ITEM 505-6 - OUTLET HEAD WALL WITHOUT RIPRAP (DETAIL D2)
ITEM 505-7 - OUTLET HEAD WALL NO. 5 (DETAIL D2) W/CONCRETE APRON
ITEM 505-8 - GATE STRUCTURE 100
ITEM 505-9 - GATE STRUCTURE 101
ITEM 505-10 - GATE STRUCTURE 102
ITEM 505-11 - GATE STRUCTURE 103
ITEM 505-12 - GATE STRUCTURE 104
ITEM 505-13 - GATE STRUCTURE 105
ITEM 505-14 - GATE STRUCTURE 106
ITEM 505-15 - OVERFLOW WEIR STRUCTURE

Payment for the concrete emergency spillway cutoff wall, the concrete low flow channel lining, including the spillway apron transition and outlet apron shall be measured to neat lines and shall be made on the basis of the price bid per linear foot, and shall include full compensation for all labor, material, equipment, and appurtenances necessary for the construction of the channel lining and cutoff wall complete in place including all concrete, color admixture as required, reinforcing steel, and structure excavation and backfill.

ITEM 505-16 - CONCRETE LOW FLOW CHANNEL LINING
ITEM 505-17 - EMERGENCY SPILLWAY CUTOFF WALL

Payment for the equalization basin concrete access ramp, and the concrete spillway and spillway apron shall be measured to neat lines and made on the basis of the price bid per square yard, and shall include full compensation for all labor, material, equipment, and appurtenances necessary for construction of the spillway, apron, and ramp including all concrete, reinforcing steel, and color admixture as required complete in place.

ITEM 505-18 - CONCRETE SPILLWAY
ITEM 505-19 - ACCESS RAMP

SECTION 510 – CONCRETE BLOCK MASONRY

Concrete Block Masonry shall conform to Section 510 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 510.1 – Description

Add the following:

The water quality pump station, the evacuation pump station and the irrigation booster pump station shall be enclosed using concrete block masonry in accordance with the plans. Access gates will also be provided, the cost of which shall be incidental to the masonry enclosure. The gate shall be a steel double swing gate with traditional pickets, outside locking mechanism and latch pins.

The concrete block fence shall consist of ribbed and standard bond beam block as shown on the plans. The concrete block shall be painted using Davis Color "Canyon" from the Subtle color group to match the existing sanitary sewer lift station wall color. Painting shall be considered incidental to the concrete block masonry wall construction.

Subsection 510.6 – Payment

Payment for Concrete Block Masonry shall be paid for by the linear foot including painting, and including the specified access gates as shown on the plans and described in these Special Provisions.

ITEM 510-1 – BLOCK MASONRY WALL WITH GATES

SECTION 520 – STEEL AND ALUMINUM HANDRAILS

Steel handrails shall conform to Section 520 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 520.1 – Description

Add the following:

Steel handrail shall be installed along the top of spillway walls, inlet and outlet headwalls in the primary and lower basins, and the overflow weir structure as shown on the plans. The 5" diameter removable safety posts shall be installed at the end of AC pavement and the 6" diameter permanent safety posts shall be installed around gate structures as indicated on the plans and shall conform to MAG Standard Detail 140 and the Removable Safety Post detail presented in the plans. The safety posts and handrail shall be galvanized in accordance with MAG 771.

Subsection 520.5 – Payment
Payment for the galvanized steel handrail shall be made on the basis of the price bid per linear foot including full compensation for furnishing labor, materials, tools, and equipment to construct the railing complete in place as shown on the plans, and including galvanizing.
ITEM 520 – 1 - HANDRAIL

Payment for safety posts shall be made on the basis of the price bid per each complete in place and including concrete, excavation and backfill, galvanized steel post and all labor, equipment, and other materials and appurtenances required.
ITEM 520 – 2 - PERMANENT SAFETY POSTS
ITEM 520 – 3 – REMOVABLE SAFETY POSTS

SECTION 525 - PNEUMATICALLY PLACED MORTAR
Pneumatically placed mortar shall conform to Section 525 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 525.1 - Description
Add the following:
Pneumatically placed mortar may be used for channel lining at the pipe outlet into Pecos Drain. Portland Cement Concrete used shall be Class A concrete and conform to MAG Standard Specifications Section 725.

Subsection 525.9 - Finishing
Add the following:
Pneumatically placed mortar used for the channel linings shall be finished to a heavy broomed texture.

Subsection 525.12 - Payment
Payment for pneumatically placed concrete channel lining at the pipe outlet into Pecos Drain shall be considered incidental to ITEM 618-7, and shall include full compensation for all labor, material, equipment, and appurtenances including all concrete for construction of the pipe outlet installed complete and in place.

SECTION 610 - WATER LINE CONSTRUCTION
Water line construction shall conform to Section 610 of the MAG Uniform Standard Specifications and COP Supplement except as modified herein.

Subsection 610.1 - Description
Add the following:
A 4" water service line to the water quality pump station, with tapping sleeve, meter vault and backflow preventor shall be installed for the treatment cell water supply. A 3" branch water line will supply each of the Treatment Cells. The 4" water line will be tapped into an existing City of Phoenix 12" water line located in the 48th Street alignment as shown on the plans. The City of Phoenix Water Services Department will provide and install the 4" water meter and perform the line tap at no cost to the contractor. The 3" propeller meters shall be supplied and installed by the contractor.

The 6" water service line with meter, 8" backflow preventor, 12" x 6" tap and 6" gate valve used for the landscape and turf sprinkler irrigation system shall conform to the plans and Section 440 of these specifications and be included in bid ITEM 440-2.

The Contractor is responsible for coordinating with the city and installing all other items included in the plans and these specifications for all 3", 4" and the 6" water lines. The existing 12" water line shall remain and be protected-in-place. Any temporary shutdown or relocation of the 12" water line required for these installations shall be accomplished with the approval of and the coordination with the COP WSD. Contact Gerald Arakaki at (602) 261-8229 or the Corona Yard (602) 262-1847 at least 30 days in advance for installation of the meter and tap. All testing and disinfecting of the water line shall be in accordance with MAG Section 610. Tapping of the line, sleeves, meters and meter vaults, valves and valve boxes shall conform to Section 630 of the MAG Standard Specifications.

The 3" water lines shall be copper and conform to MAG Uniform Specifications Section 754 and these Special Provisions. The 4" line shall be DIP with mechanical joints or flanged as indicated and conform to MAG Uniform Specifications Section 750 and Appendix A of these Special Provisions.

Subsection 610.18 - Measurement and Payment
Payment for the installation of the 3" and 4" water lines for the treatment cells water supply, including all piping, fittings, tapping sleeve, backflow preventors, tees, elbows, propeller meters, gate valves, vaults, labor and equipment necessary for the water line installations complete in place, and including any protection of the 12" water line shall be made on the basis of the price bid per linear foot.
ITEM 610-1 – 3" COPPER WATER LINE
ITEM 610-2 – 4" DUCTILE IRON PIPE WATER LINE

SECTION 618 - STORM DRAIN CONSTRUCTION
Storm drain construction shall conform to Section 618 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 618.1 - Description
Add the following:
The work includes the installation of the 24" and 42" basin and outlet piping, and 42" pipe plug. The work also includes the Water Quality Pump Station and the Evacuation Pump Station as shown on the plans.

The Water Quality Pump Station and the Evacuation Pump Station work includes submersible electric pumps, variable frequency drives, wet wells, influent and discharge piping, valves, mechanical and electrical control systems, lighting and all other items shown within the pay limits and tabulated quantities on the pump station plans (PS sheets) and the electrical plans (E sheets).

Subsection 618.2 - Materials
Add the following:
Materials and installation for the Water Quality Pump Station and the Evacuation Pump Station shall be in accordance with Appendix A.

Rubber gasket reinforced concrete pipe shall be used for both the 24" and 42" diameter pipe. Material for pipe, gaskets, joints, specials and testing shall conform to MAG Uniform Standards Section 735.

4", 8", 12", 16"and 24" ductile iron pipe with mechanical joints shall be used for inlet and outlet pipe to the Water Quality Pump Station and the Evacuation Pump Station as shown on the project

plans. Pipe shall conform to the MAG Uniform Specification Section 750 and specifications in Appendix A. No payment will be made for 4", 8", 12", 16" or 24" DIP as such; the cost thereof shall be included in the bid price for the construction of either the Water Quality Pump Station and the Evacuation Pump Station.

A 42" pipe plug conforming to MAG Standard Detail 427 shall be install as indicated on the project plans and including the 10' stubout.

Subsection 618.6 - Payment

Payment for the basin and outlet piping shall be made on the basis of the price bid per linear foot, and shall be full compensation for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, saw-cutting, removal, disposal, replacement of AC pavement, pipe collars, pipe markers, removal of obstructions, furnishing and compacting granular bedding, backfilling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

ITEM 618-1 – RUBBER GASKET REINFORCED CONCRETE PIPE (24", Class II)
ITEM 618-2 – RUBBER GASKET REINFORCED CONCRETE PIPE (24", Class III)
ITEM 618-3 – RUBBER GASKET REINFORCED CONCRETE PIPE (24", Class IV)
ITEM 618-4 – RUBBER GASKET REINFORCED CONCRETE PIPE (24", Class V)
ITEM 618-5 – RUBBER GASKET REINFORCED CONCRETE PIPE (42", Class IV)

Payment for the Water Quality Pump Station and the Evacuation Pump Station, will be made on the basis of the lump sum price bid, and shall be full compensation for each pump station built and completed in place including, but not limited to, all DIP piping, vaults, wet wells, mechanical and piping installations, Pecos Drain lining, stilling wells and 2" copper pipe, as indicated in the plans by the pay limits and approximate quantity tabulations, these specifications and Appendix A.
NOTE: The Contractor will provide to the Engineer at the Pre-Construction meeting a cost breakdown of the major elements that make up each of these lump sum bid items.

ITEM 618-6 – WATER QUALITY PUMP STATION
ITEM 618-7 – EVACUATION PUMP STATION

Payment for Water Quality Pump Station electrical service installation will be made on the basis of the lump sum price bid, and shall be full compensation for all electrical service required for the pump station including cabinets, wiring, conduit, transformers, pads, labor, materials, tools, permits, equipment and any incidentals needed to install all electrical facilities within the enclosure and to the stilling wells as shown on the plans complete and in place.

ITEM 618-8 – WATER QUALITY PUMP STATION ELECTRICAL

Payment for Evacuation Pump Station electrical service installation will be made on the basis of the lump sum price bid, and shall be full compensation for all electrical service required for the pump station including service connection to SRP OHE, electrical connection to the Water Quality Pump Station, cabinets, wiring, conduit, transformers, pads, labor, materials, tools, permits, equipment and any incidentals needed to install all electrical facilities shown on the plans complete and in place.

ITEM 618-9 – EVACUATION PUMP STATION ELECTRICAL

Payment for the installation of the 42" pipe stub out and plug per MAG Detail 427 shall be made on the basis of the price bid per each.

ITEM 618-10 – STUBOUT AND PLUG

SECTION 625 - MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

Manhole construction shall conform to Section 625 of the MAG Uniform Standard Specifications.

Subsection 625.1 – Description

Add the following:

The work includes the construction of 48" and 72" manholes for the 24" basin piping and the 42" outlet piping respectively, conforming to MAG Detail 522. Manhole 108A - Monitoring & Sampling manhole shall have equipment provided by others at a later date.

Subsection 625.4 - Measurement

Add the following:

Manhole measurement will be per each complete in place.

Subsection 625.5 Payment

Payment for the 24" basin piping manholes and the 42" outlet pipe manholes shall be made on the basis of the price bid per each, and shall include full compensation for all labor, materials, equipment, and appurtenances necessary for construction in place including all concrete and reinforcing steel, precast manhole sections, and all other steel and other embedments, and manhole covers, including frames.

ITEM 625-1 - MANHOLE 100
ITEM 625-2 - MANHOLE 101
ITEM 625-3 - MANHOLE 102
ITEM 625-4 – MANHOLE 103
ITEM 625–5 – MANHOLE 104
ITEM 625–6 – MANHOLE 105
ITEM 625–7 - MANHOLE 106
ITEM 625–8 – MANHOLE 107
ITEM 625–9 – MANHOLE 108
ITEM 625–10 – MANHOLE 108A
ITEM 625–11 – MANHOLE 109

SECTION 703 - RIPRAP

Riprap shall conform to Section 703 of the MAG Uniform Standard Specifications except as modified herein.

Subsection 703.1 - Stone

Add the following:

In addition to the requirements of Section 703.1, stone for riprap shall have a minimum apparent specific gravity of 2.4 per ASTM C-127.

Waste concrete shall not be used for riprap.

In order to maintain slope stability where the plain riprap is constructed, stone used shall be hard, durable, resistant to weathering and to water action, free from overburden, spoil, shale, and organic material, and shall meet the gradation requirements for the type specified.

Riprap Gradation No.1 shall be angular or rounded in shape.

Rock mulch Gradation No.2 shall be used in both vegetated and non-vegetated treatment cells as indicated on the plans and shall be river rock. It shall be round washed rock obtained from natural deposits. Crushed rock or angular rock will not be accepted.

Subsection 703-2 - Size of Stone
Add the following:
Subsection 703-2 of the MAG Standard Specifications is replaced with the following requirements:

RIPRAP GRADATION NO. 1

D_{MIN}	D_{50}	D_{MAX}
3 inch	8 inch	12 inch

ROCK MULCH GRADATION NO. 2

D_{MIN}	D_{50}	D_{MAX}
1 inch	2 inch	3 inch

SECTION 795 – LANDSCAPE MATERIAL
Landscape material shall conform to Section 795 of the MAG Uniform Specifications except as modified herein.

Subsection 795.5 – Chemical Soil Conditioner:
Add the following:
No chemical conditioners or herbicides shall be used in or around the vegetated treatment cell area.

Subsection 795.7 – Plants, Trees and Shrubs
Add the following:
The following types of plants shall be used for the Vegetated Treatment Cell landscaping and installed as per plan and these specifications:

Bulrush – Scripus olneyi
– Scripus validus

Plant Materials and information may be obtained from:

Western Sods Arid Adapted Revegetation
P.O. Box 10610
Casa Grande, AZ 85230
Mobile Phone: (602) 320-1232
Phoenix Phone: (602) 268-8811 or 1-800-832-8873
Fax : (602) 836-2146

Aquatic and Wetland Nurseries
9999 Weld County Road 25
Fort Lupton, CO 80621
Phone: (303) 857-6157
Fax: (303) 857-2455
-OR-
P.O. Box 82
Avondale, AZ 85323

APPENDIX A

WATER QUALITY PUMP STATION
&
EVACUATION PUMP STATION
SPECIFICATIONS

APPENDIX A

TABLE OF CONTENTS

SECTION	DESCRIPTION
01010	SUMMARY OF WORK
01340	SHOP DRAWINGS, PRODUCT DATA & SAMPLES; OPERATION & MAINTENANCE MANUALS; AND MISCELLANEOUS SUBMITTALS
01600	PRODUCT DELIVERY, STORAGE, AND HANDLING
01640	PRODUCT SUBSTITUTIONS
01650	FACILITY STARTUP
09906	PAINTING AND PROTECTIVE COATINGS
11005	EQUIPMENT: BASIC REQUIREMENTS
11060	PUMPING EQUIPMENT: BASIC REQUIREMENTS
11076	PUMPING EQUIPMENT: SUBMERSIBLE NON-CLOG
13440	INSTRUMENTATION FOR PROCESS CONTROL: BASIC
13442	PRIMARY ELEMENTS AND TRANSMITTERS
15060	PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS
15062	PIPE: DUCTILE
15063	PIPE: COPPER
15090	PIPE SUPPORT SYSTEMS
15102	PLUG VALVES
16010	ELECTRICAL: BASIC REQUIREMENTS
16111	CONDUIT, CONDUIT FITTINGS AND CONDUIT SUPPORTS, WIREWAY
16120	WIRE AND CABLE - 600 VOLT AND BELOW
16140	WIRING DEVICES
16150	PANELBOARDS
16190	DRY-TYPE TRANSFORMERS
16265	VARIABLE FREQUENCY DRIVES – LOW VOLTAGE
16450	GROUNDING
16474	CONTROL EQUIPMENT AND SEPARATELY MOUNTED DEVICES
16530	SITE LIGHTING

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:
   1. Furnish all labor, materials, tools, equipment and services as indicated in accord with provisions of Contract Documents.
   2. Although such Work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation

1.02 WORK COVERED BY CONTRACT

A. The Work of this Contract for the Water Quality Pump Station and the Evacuation Pump Station under the Base Bid generally includes the following:
   1. Furnish and install all pumps, piping and electrical systems and all associated instrumentation and controls as specified herein.
   2. Furnish all supervision, labor, material, equipment, tools, power, light, fuel, water, supplies, services and other means of construction necessary or proper for performing and completing the Work.
   3. Maintain the Work area and site in a clean and acceptable manner.
   4. Maintain existing utilities and facilities in service at all times.
   5. Protect finished and unfinished Work.
   6. Repair and/or restore all Work damaged during construction.

1.03 WORK BY OTHERS

A. Electric and communications utilities will be responsible for work associated with their respective facilities. The Contractor shall coordinate the construction with these utilities and shall provide adequate notice to the utilities of any work required in advance or requiring presence of their personnel.
   1. Salt River Project (SRP) will furnish and install the primary feed and transformer on the 15 kv overhead power line as indicated on the SRP plan. The Contractor shall furnish and install electrical conduit and equipment pads in accordance with SRP plan and the pump station electrical plans.

1.04 WORK SEQUENCE

A. Contractor shall organize and plan the construction activities to assure the safety and reliability of and to minimize the interruption to the electric system and all other utilities.

1.05 OUTAGES

A. Contractor shall organize and plan the construction activities so that the number and length of any required outages shall be minimized.

B. An outage to any customer shall require specific approval of the Owner. The Owner reserves the right to reject any request for an outage.

C. Contractor shall provide the Owner at least 48 hours notice in advance of any requested outage so that the Owner may advise and coordinate the outage with the customer(s).

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA & SAMPLES; OPERATION & MAINTENANCE MANUALS; AND MISCELLANEOUS SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY

A. General:
   1. Section Addresses:
      a. Mechanics and administration of the submittal process for shop drawings, operation and maintenance manuals, and miscellaneous submittal items.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Sections in Divisions 2 through 16 identifying required submittals.

1.02 DEFINITIONS

A. Shop Drawings:
   1. See General Conditions.
   2. Product data and samples are Shop Drawing information.

B. Miscellaneous Submittals:
   1. Submittals other than Shop Drawings:
   2. Representative types of miscellaneous submittal items include but are not limited to:
      a. Construction schedule.
      b. Installed equipment and systems performance test reports.
      c. Manufacturer's installation certification letters.
      d. Instrumentation and control commissioning reports.
      e. Warranties.
      f. Service agreements.
      g. Construction photographs.
      h. Survey data.
      i. Cost breakdown (Schedule of Values).

1.03 TRANSMITTALS

A. Shop Drawings and Operation and Maintenance Manuals:

1. Transmit all submittals to:
   HDR Engineering, Inc.
   2141 East Highland Avenue, Suite 250
   Phoenix, Arizona 85016
   Attn: Mr. Jerry Zovne, P.E.
2. Utilize two copies of attached Exhibit "A" to transmit all shop drawings, product data and samples.
3. Utilize two copies of attached Exhibit "B" to transmit all Operation and Maintenance Manuals.
4. All transmittals must be from Contractor and bear his approval stamp. Transmittals will not be received from or returned to subcontractors.
   a. Shop drawing transmittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval.
   b. Operation and Maintenance Manual transmittal stamp may be Contractor's standard approval stamp.
5. Provide submittal information defining specific equipment or materials utilized on the project. Generalized product information not clearly defining specific equipment or materials to be provided will be rejected.
6. Calculations required in individual specification sections will be received for information purposes only and will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
7. Submittal schedule:
   a. Schedule of shop drawings:
      1) Submitted and approved within 20 days of receipt of Notice to Proceed.
      2) Account for multiple transmittals under any specification section where partial submittals will be transmitted.
   b. Shop drawings:
      1) Submittal and approval prior to 50 percent completion.
   c. Operation and Maintenance Manuals and Equipment Record Sheets:
      1) Initial submittal within 60 days after date shop drawings are approved.

B. Miscellaneous Submittals:

1. Transmit under Contractor's standard letter of transmittal or letterhead.

2. Submit in triplicate or as specified in individual specification section.
3. Transmit to:
   HDR Engineering, Inc.
   2141 East Highland Avenue, Suite 250
   Phoenix, Arizona 85016
   Attn: Mr. Jerry Zovne, P.E.

1.04 PREPARATION OF SUBMITTALS

A. Shop Drawings:
   1. Scope of any letter of transmittal:
      a. Limited to one Specification Section.
      b. Do not submit under any Specification Section entitled (in part) "Basic Requirements".
   2. Numbering letter of transmittal:
      a. Include as prefix the specification section number followed by "-xx" beginning with "01".
      b. If more than one submittal under any specification section, number transmittals consecutively.
   3. Describing transmittal contents:
      a. Provide listing of each component or item in submittal capable of receiving an independent review action.
      b. Identify for each item:
         1) Manufacturer and Manufacturer's drawing or data number.
         2) Contract Document tag number(s).
   4. Resubmittals:
      a. Number with original root number and a suffix letter starting with "A" on a (new) duplicate transmittal form.
      b. Do not increase the scope of any prior transmittal.
      c. Account for all components of prior transmittal.
         1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
            a) Do not include submittal information for items with prior "A" or "B" Action in transmittal.
         2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
            a) Obtain Engineer's prior approval to exclude items.
   5. For 8-1/2 x 11 IN size sheets, provide four copies of each page for Engineer plus the number required by the Contractor. The number

of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed 10.

6. For items not covered in paragraph 1.04-A.6 submit one reproducible transparency and one print of each drawing until approval is obtained. Utilize mailing tube; do not fold. The Engineer will mark and return the reproducible to the Contractor for his reproduction and distribution.
7. Provide clear space (3 IN SQ) for Engineer stamping of each component defined in 1.04-A.4.
8. Contractor shall not use red color for marks on transmittals. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible. Outline Contractor marks on reproducible transparencies with a rectangular box.
9. Transmittal contents:
    a. Coordinate and identify shop drawing contents so that all items can be easily verified by the Engineer.
    b. Identify equipment or material use, tag number, drawing detail reference, weight, and other project specific information.
    c. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
    d. Submit items like equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8-1/2 x 11 IN pages. Indicate exact item or model and all options proposed.
    e. Include legible scale details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout drawings, parts catalogs, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data. Arrange data and performance information in format similar to that provided in Contract Documents. Provide, at minimum, the detail provided in the Contract Documents.
    f. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet.

B. Samples:
1. Identification:
    a. Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Standard Specification section or drawing detail reference, color, range, texture, finish and other pertinent data.

b. If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.

2. Include application specific brochures, and installation instructions.
3. Provide Contractor's stamp of approval on samples or transmittal form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
4. Resubmit samples of rejected items.

C. Operation and Maintenance Manuals:

1. Number transmittals for Operation and Maintenance Manual with original root number of the approved shop drawing for the item.
2. Submit two copies until approval is received.
3. Identify resubmittals with the original number plus a suffix letter starting with "A."
4. Submit Operation and Maintenance Manuals printed on 8-1/2 x 11 IN size heavy first quality paper with standard three-hole punching and bound in stiff metal hinged binder constructed as a three-ring style. Provide binders with titles on front and on spine of binder. Tab each section of manuals for easy reference with plastic-coated dividers. Provide index for each manual. Provide plastic sheet lifters prior to first page and following last page.
5. Reduce drawings or diagrams bound in manuals to an 8-1/2 x 11 IN or 11 x 17 IN size. However, where reduction is not practical to ensure readability, fold larger drawings separately and place in vinyl envelopes which are bound into the binder. Identify vinyl envelopes with drawing numbers.
6. Transmittal Content:
   a. Submission of Operation and Maintenance Manuals is applicable but not necessarily limited to:
      1) Major equipment.
      2) Equipment used with electrical motor loads of 1/6 HP nameplate or greater.
      3) Specialized equipment including valves and instrumentation and control system components for process systems such as meters, recorders, and transmitters.
      4) Valves greater than 12 IN DIA.
      5) Water control gates.
   b. Operation and maintenance manuals shall include, but not necessarily be limited to, the following detailed information, as applicable:
      1) Equipment function, normal operating characteristics, limiting operations.

2) Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
3) Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
4) Lubrication and maintenance instructions.
5) Guide to "troubleshooting."
6) Parts list and predicted life of parts subject to wear.
7) Outline, cross-section, and assembly drawings; engineering data; and electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, word description of wiring diagrams and interconnection diagrams.
8) Test data and performance curves.
9) A list of recommended spare parts with a price list and a list of spare parts provided under these specifications.
10) Copies of installation instructions, parts lists or other documents packed with equipment when delivered.
11) Instrumentation or tag numbers relating the equipment back to the Contract Documents.
12) Include a filled-out copy of the Equipment Record Sheet, Exhibits C1 and C2 as the first page(s) of each Operation and Maintenance Manual. Complete maintenance requirements in detail. Simple reference to the Manual is not acceptable.
13) For equipment items involving components or subunits, an Equipment Record Sheet for each operating component or subunit is required.

1.05 ENGINEER'S REVIEW ACTION

A. Shop Drawings and Samples:

1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
   a. A - FURNISH AS SUBMITTED.
   b. B - FURNISH AS NOTED (BY ENGINEER).
   c. C - REVISE AND RESUBMIT.
   d. D - REJECTED.
   e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Transmittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp. Drawings not stamped by the Contractor or stamped with a stamp containing language other than that specified in Paragraph 1.03-A.4.a., will not be reviewed for technical content and will be returned without any action.

3. Transmittals returned with Action "A" or "B" are considered ready for fabrication and installation. If for any reason a transmittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
4. Transmittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
   a. The portion of the transmittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference). One copy or the one transparency of the "C" or "D" drawings will be marked up and returned to the Contractor. Correct and resubmit items so marked.
   b. Items marked "A" or "B" will be fully distributed.
   c. If a portion of the items or system proposed are acceptable, however, the major part of the individual drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action. This is at the sole discretion of the Engineer. In this case, some drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package." Distribution to the Owner and field will not be made (unless previously agreed to otherwise).
5. Failure to include any specific information specified under the submittal paragraphs of the specifications will result in the transmittal being returned to the Contractor with "C" or "D" Action.
6. In addition to calculations stamped and returned "E. Engineer's Review Not Required," other transmittals such as submittals which the Engineer considers as "Not Required," submittal information which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" Action in a prior transmittal, will be returned with Action "E. Engineer's Review Not Required."
7. Samples may be retained for comparison purposes. Remove samples when directed. Include in bid all costs of furnishing and removing samples.
8. Approved samples submitted or constructed, constitute criteria for judging completed work. Finished work or items not equal to samples will be rejected.

B. Operation and Maintenance Manuals:
   1. Engineer will review and indicate one of the following review actions:

a. ACCEPTABLE.
b. FURNISH AS NOTED.
c. REVISE AND RESUBMIT.
d. REJECTED.

2. Acceptable submittals will be retained with the transmittal form returned with a request for two (2) additional copies.
3. Deficient submittals will be returned along with the transmittal form which will be marked to indicate deficient areas.

END OF SECTION

HDR

EXHIBIT A

Shop Drawing Transmittal No. _____-_____

(Spec Section) (Series)

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	HDR Engineering, Inc.	Log Page:
Address	Address:	HDR No.
		Spec Section:
		Drawing/Detail No.
Attn:	Attn:	1sr Sub. ☐ ReSub. ☐
Date Transmitted:	Previous Transmittal Date:	

Item No.	No. Copies	Description	Manufacturer	Mfr/Vendor Dwg or Data No.	Action Taken *

Remarks:

* The Action Designated Above is in Accordance with the Following Legend:

A - Furnish as Submitted

B - Furnish as Noted

C - Revise and Submit
1. Not enough information for review.
2. No reproducibles submitted.
3. Copies illegible.
4. Not enough copies submitted.
5. Wrong sequence number.
6. Wrong resubmittal number.
7. Wrong spec section.
8. Wrong form used.
9. See Comments.

D - Rejected

E - Engineer's review not required.
1. Submittal not required.
2. Supplemental information. Submittal refined for informational purposes only.
3. Information reviewed and approved on prior submittal.
4. See Comments.

Comments:

By _____ Date _____

Distribution: Contractor ☐ File ☐ Field ☐ Owner ☐ Other ☐

Copyright 1991 HDR Engineering, Inc.

HDR

EXHIBIT B

O&M Manual Transmittal No. _____-_____

(Spec Section) (Series)

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	Owner:	Log Page:
Address:	Address:	HDR No.:
Attn:	Attn:	1st. Sub. ☐ ReSub. ☐

Date Transmitted:	Previous Transmittal Date:

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:

To:

From:

HDR Engineering, Inc.

Date:

* The Action Designated Above is in Accordance with the Following Legend:

A - Acceptable, Provide five additional Copies

B - Furnish as Noted

C - Revise and Resubmit
This Operation and Maintenance Manual Submittal is deficient in the following area:
1. Equipment record sheets.
2. Functional description.
3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions.
4. Operating instructions.
5. Lubrication & maintenance instructions.
6. Troubleshooting guide.
7. Parts list and ordering instructions.
8. Organization (index and tabbing).
9. Wiring diagrams & schematics specific to installation.
10. Outline, cross section & assembly diagrams.
11. Test data & performance curves.
12. Tag or equipment identification numbers.
13. Other - see comments.

D - Rejected

Comments:

By

Date

Distribution: Contractor ☐ File ☐ Field ☐ Owner ☐ Other ☐

Copyright 1991 HDR Engineering, Inc.

SECTION 01600

PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Scheduling of product delivery.
   2. Packaging of products for delivery.
   3. Protection of products against damage from:
      a. Handling.
      b. Exposure to elements or harsh environments.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.

C. Payment:
   1. Owner is not required to pay for stored materials.
   2. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved shop drawings.
      a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

1.02 DELIVERY

A. Scheduling:
   1. Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

B. Packaging:
   1. Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

C. Identification:
   1. Clearly and fully mark and identify as to manufacturer, item, and installation location.

D. Protection and Handling:
   1. Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PROTECTION, STORAGE AND HANDLING

A. Manufacturer's Instruction:
   1. Protect all products or equipment in accordance with manufacturer's written directions.
      a. Store products or equipment in location to avoid physical damage to items while in storage.
      b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
   2. Protect equipment from exposure to elements and keep thoroughly dry.
   3. Store pumps, motors, electrical equipment, and other equipment having antifriction or sleeve bearings in weathertight warehouses which are maintained at a temperature of at least 50 degF.
   4. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

3.02 FIELD QUALITY CONTROL

A. Inspect Deliveries:
   1. Inspect all products or equipment delivered to the site prior to unloading. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Area:
   1. Monitor storage area to ensure suitable temperature and moisture conditions are maintained.

END OF SECTION

SECTION 01640

PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. The procedure for requesting substitution approval for a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
      a. Name of manufacturer.
      b. Name of vendor.
      c. Trade name.
      d. Catalog number.
   2. This Section does not address substitutions for major equipment. See "Instructions to Bidders."

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of The Contract.
   2. Supplementary General Conditions.

C. Requests for Substitution - General:
   1. Base all bids on materials, equipment, and procedures specified.
   2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are capable of accomplishing the same tasks as the products specifically indicated.
   3. Other types of equipment and kinds of material may be acceptable.

1.02 QUALITY ASSURANCE

A. In making request for substitution or in using an approved product, Contractor represents:
   1. He has investigated proposed product, and has determined that it is adequate or superior in all respects to that specified, and that it will perform function for which it is intended.
   2. He will provide same guarantee for substitute item as for product specified.

3. He will coordinate installation of accepted substitution into work, to include building modifications if necessary, making such changes as may be required for work to be complete in all respects.
4. He waives all claims for additional costs related to substitution which subsequently arise.

1.03 DEFINITIONS

A. Product: Manufactured material or equipment.

1.04 PROCEDURE FOR REQUESTING SUBSTITUTION

A. Considered after award of Contract.

B. Written requests through Contractor only.

C. Transmittal Mechanics:
1. Follow the transmittal mechanics prescribed for shop drawings in Section 01340. Product substitution will be treated in a manner similar to "deviations," as described in paragraph 1.04-A.9.f of Section 01340. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading "DESCRIPTION." Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in paragraph D below.

D. Transmittal Contents:
1. Product identification:
   a. Manufacturer's name.
   b. Telephone number and representative contact name.
   c. Specification section or drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
   a. Size.
   b. Composition or materials of construction.
   c. Weight.
   d. Electrical or mechanical requirements.
4. Product experience:
   a. Location of past projects utilizing product.
   b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.

c. Available field data and reports associated with proposed product.

5. Data relating to changes in construction schedule.
6. Data relating to changes in cost.
7. Samples:
   a. At request of Engineer.
   b. Full size if requested by Engineer.
   c. Held until substantial completion.
   d. Engineer not responsible for loss or damage to samples.

1.05 APPROVAL OR REJECTION

A. Written approval or rejection of substitution given by the Engineer.

B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.

C. In event substitution results in a change of Contract price or time, provisions in General Conditions will be applied for adjustment.

D. Substitutions will be rejected if:
   1. Submittal is not through the Contractor with his stamp of approval.
   2. Requests are not made in accordance with this Section.
   3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
   4. In the Engineer's opinion, substitution is not equal to original product specified or will not perform adequately the function for which it was intended.

END OF SECTION

SECTION 01650

FACILITY STARTUP

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Procedures and actions, required of the Contractor, which are necessary to achieve and demonstrate Substantial Completion (Beneficial Use).
   2. Requirements for Substantial Completion Submittals.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 13440 - Instrumentation for Process Control: General Requirements.

1.02 DEFINITIONS

A. Project Classified System (PCS): A defined part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system.

B. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
   1. Finishing type construction work to ensure the each PCS has reached a state of Substantial Completion (Beneficial Use).
   2. Equipment startup.
   3. Personnel training.

C. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control

interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion (Beneficial Use).

1.03 SUBMITTALS

A. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration Period.

1. Master operation and maintenance training schedule:
   a. Submit 60 days (minimum) prior to first training session for Owner's personnel.
   b. Schedule to include:
      1) Target date and time for Owner witnessing of each system initial startup.
      2) Target date and time for Operation and Maintenance training for each system, both field and classroom.
      3) Target date for initiation of Demonstration Period.
   c. Submit for review and approval by Owner.
   d. Include holidays observed by Owner.
   e. Attend a schedule planning and coordination meeting 90 calendar days prior to first anticipated training session.
      1) Provide a status report and schedule-to-complete for requirements prerequisite to manufacturer's training.
      2) Identify initial target dates for individual manufacturer's training sessions.
   f. Owner reserves the right to insist on a minimum 7 days' notice of rescheduled training session not conducted on master schedule target date for any reason.
   g. Schedule to be resubmitted until approved.
2. Substantial Completion Submittal:
   a. File Contractor's Notice of Substantial Completion and Request for Inspection.
   b. Approved Operation and Maintenance manuals received by Engineer minimum 1 week prior to scheduled training.
   c. Written request for Owner to witness each system pre-demonstration startup. Request to be received by Owner minimum 1 week before scheduled training of Owner's personnel on that system.
   d. Equipment installation and pre-demonstration startup certifications.
   e. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.

1.04 COST OF STARTUP

A. Contractor to pay all costs associated with Facility startup.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL

A. Facility Startup Divided into Two Periods:
   1. Pre-Demonstration Period including:
      a. Completion of construction work to bring Project to a state of Substantial Completion.
      b. Startup of Equipment.
      c. Training of Personnel.
      d. Completion of the filing of all required submittals.
      e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.
   2. Demonstration Period including:
      a. Demonstration of functional integrity of facility or PCS.

3.02 PRE-DEMONSTRATION PERIOD

A. Completion of Construction Work:
   1. Complete the work to bring the Project to a state of substantial completion (Beneficial Use).

B. Equipment Startup:
   1. Requirements for individual items of equipment are included in Divisions 2 through 16 of these Specifications.
   2. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
   3. Perform Process Equipment Startup to extent possible without introducing product flow.
   4. Introduce product flow to complete Equipment Startup for the following equipment:
      a. Submersible non-clog pumps.
   5. Procedures include but are not necessary limited to the following:
      a. Test or check and correct deficiencies of:
         1) Power, control, and monitoring circuits for continuity prior to connection to power source.
         2) Voltage of all circuits.
         3) Phase sequence.
         4) Cleanliness of connecting piping systems.

5) Alignment of connected machinery.
6) Vacuum and pressure of all closed systems.
7) Lubrication.
8) Valve orientation and position status for manual operating mode.
9) Tankage for integrity using product flow.
10) Pumping equipment using product flow.
11) Instrumentation and control signal generation, transmission, reception, and response. See Section 13440.
12) Tagging and identification systems.
13) All equipment: Proper connections, alignment, calibration and adjustment.

b. Calibrate all safety equipment.

c. Manually rotate or move moving parts to assure freedom of movement.

d. "Bump" start electric motors to verify proper rotation.

e. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.

f. Documentation:

1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Startup. Provide a place for the Contractor to record date and person accomplishing required work. Submit completed document before requesting inspection for Substantial Completion certification.

6. Obtain certifications, without restrictions or qualifications, and deliver to Owner:

a. Manufacturer's equipment installation check "Certificate of Installation Services" for each piece of equipment.

b. Instrumentation Supplier's Instrumentation Installation Certificate.

C. Personnel Training:

1. See individual equipment specification sections.

2. Conduct all personnel training after completion of Equipment Startup for the equipment for which training is being conducted.

a. Personnel training on individual equipment or systems will not be considered completed unless:

1) All pretraining deliverables are received and approved before commencement of training on the individual equipment or system.

2) No system malfunctions occur during training.

3) All provisions of field and classroom training specifications are met.

b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.

3. Field and classroom training requirements:
   a. Hold classroom training on-site.
   b. Notify each manufacturer specified for on-site training that the Owner reserves the right to video record any or all training sessions. Organize each training session in a format compatible with video recording.
   c. Training instructor: Factory trained and familiar with giving both classroom and "hands-on" instructions.
   d. Training instructors: Be at classes on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
   e. Organize training sessions into maintenance verses operation topics and identify on schedule.
   f. Plan for minimum class attendance of 2 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
   g. Instructors to have a typed agenda and well prepared instructional material. The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs. Deliver agendas to the Owner a minimum of 7 days prior to the classroom training. Provide equipment required for presentation of films, slides, and other visual aids.
   h. In the on-site training sessions, cover the information required in the Operation and Maintenance manuals submitted according to Section 01340 and the following areas as applicable to PCS's.
      1) Operation of equipment.
      2) Lubrication of equipment.
      3) Maintenance and repair of equipment.
      4) Troubleshooting of equipment.
      5) Preventive maintenance procedures.
      6) Adjustments to equipment.
      7) Inventory of spare parts.
      8) Optimizing equipment performance.
      9) Capabilities.
      10) Operational safety.
      11) Emergency situation response.
      12) Takedown procedures (disassembly and assembly).

i. Address above paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address above paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.

j. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.

k. Obtain certifications without restrictions or qualifications and deliver to Engineer:

1) "Certificate of Instructional Services" for each piece of equipment.

D. Complete the filing of all required submittals:

1. Shop drawings.
2. Operation and Maintenance Manuals.
3. Training material.

E. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of Facility:

1. File the notice when the following have been completed:
   a. Construction work (brought to state of Substantial Completion).
   b. Equipment Startup.
   c. Personnel Training.
   d. Submittal of required documents.
2. Owner will review required submittals for completeness within 5 calendar days of Contractor's notice. If complete, Owner will complete inspection of the Work, within 10 calendar days of Contractor's notice.
3. Owner will inform Contractor in writing of the status of the Work reviewed, within 14 calendar days of Contractor's notice.
   a. Work determined not meeting state of Substantial Completion:
      1) Contractor: Correct deficiencies noted or submit plan of action for correction within 5 days of Owner's determination.
      2) Owner: Reinspect work within 5 days of Contractor's notice of correction of deficiencies.
   b. Work determined to be in state of tentative Substantial Completion: Owner to prepare tentative "Owner's Certificate of Substantial Completion."
   c. Owner's Certificate of Substantial Completion:
      1) Certificate tentatively issued subject to successful Demonstration of functional integrity.
      2) Issued for Project as a whole or for one or more PCS.
      3) Issued subject to completion or correction of items cited in the certificate (punch list).

4) Issued with responsibilities of Owner and Contractor cited.
5) Accepted by Owner.
6) Accepted by Contractor.

d. Upon successful completion of Demonstration Period, Owner will endorse certificate attesting to the successful demonstration, and citing the hour and date of ending the successful Demonstration Period of functional integrity as the effective date of Substantial Completion (Beneficial Use).

3.03 DEMONSTRATION PERIOD

A. General:

1. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.
2. Duration of Demonstration Period: 100 consecutive hours.
3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
4. Conduct the demonstration of functional integrity under full operational conditions.
5. Owner will provide operational personnel to provide process decisions affecting Facility performance. Owner's assistance will be available only for process decisions. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.
6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.
7. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor and Owner in advance of initiating Demonstration Period.
8. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems and to respond to any system problems or failures which may occur.

9. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.
10. Provide "Certificate of Post Start-Up Services" for each piece of equipment.

END OF SECTION

CERTIFICATE OF INSTALLATION SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify that the named equipment has been inspected by the Manufacturer's Representative and further certifies:

1. That the equipment is properly installed an is in accordance with the Contract Documents.
2. That nothing in the installation shall void warranty.
3. That equipment, as installed, is ready to be operated by others.

MANUFACTURER'S REPRESENTATIVE

Signature_____ Date_____

Name (print)_____

Title_____

CONTRACTOR

Signature_____ Date_____

Name (print)_____

Title_____

Complete and submit three copies of this form with the detailed report to Engineer 24 hours prior to training of Owner's personnel as required by Specification Section 01650, subparagraph 3.02 B.7.a.

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify that the Manufacturer's Representative has instructed Owner's personnel in start-up operation and maintenance of this equipment as required in Contract Documents.

MANUFACTURER'S REPRESENTATIVE

Signature_____ Date_____

Name (print)_____

Title_____

Representing_____

CONTRACTOR

Signature_____ Date_____

Name (print)_____

Title_____

ENGINEER

Signature_____ Date_____

Name (print)_____

Title_____

COMMENTS:

Complete and submit three copies of this form with the detailed report to Engineer 24 upon completion of training as required by Specification Section 01650, subparagraph 302 C.3.K.

CERTIFICATE OF POST START-UP SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify that the Manufacturer's Representative has inspected this equipment, made adjustments and calibrations, and that it is operating in conformance with the design, specifications and manufacturer's requirements. Notation of improper operation shall be detailed and recommendations made and attached to this form.

MANUFACTURER'S REPRESENTATIVE

Signature_____ Date_____

Name (print)_____

Title_____

Representing_____

CONTRACTOR

Signature_____ Date_____

Name (print)_____

Title_____

ENGINEER

Signature_____ Date_____

Name (print)_____

Title_____

COMMENTS:

Complete and submit three copies of this form to Owner upon completion of 6 to 11 months reinspection as required by Specification Section 01650, subparagraph 303 A.10.

SECTION 09906

PAINTING AND PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Painting and protective coatings.
   2. Minimum surface preparation requirements.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 11005 - Equipment: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. Z535.1, Safety Color Code.
   2. American Society for Testing and Materials (ASTM):
      a. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   3. National Bureau of Standards (NBS):
      a. Certified Coating Thickness Calibration Standards.
   4. National Fire Protection Association (NFPA):
      a. 101, Life Safety Code.
   5. Steel Structures Painting Council (SSPC):
      a. PA-2, Measurement of Dry Paint Thickness with Magnetic Gages.
      b. SP-1, Solvent Cleaning.
      c. SP-2, Hand Tool Cleaning.
      d. SP-3, Power Tool Cleaning.
      e. SP-5, White Metal Blast Cleaning.
      f. SP-6, Commercial Blast Cleaning.
      g. SP-7, Brush-off Blast Cleaning.
      h. SP-10, Near-White Blast Cleaning.

B. Qualifications:
   1. Coating manufacturer's authorized representative shall provide written statement attesting that Applicator has been instructed on

proper preparation, mixing and application procedures for coatings specified.

C. Miscellaneous:
   1. Furnish paint through one manufacturer unless noted otherwise.

D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.

E. Material may not be thinned unless approved in writing by paint manufacturer's authorized representative.

1.03 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the section where the product is specified or in Section 11005.

C. Corrosive Environment: Immersion in, or not more than 6 IN above, or subject to frequent condensation spillage or splash of a corrosive material such as water, wastewater, or chemical solution; or chronic exposure to corrosive, caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions with pH range of 5 - 9.

D. Highly Corrosive Environment: Immersion in, or not more than 6 IN above, or subject to frequent condensation spillage or splash of a corrosive material such as water, wastewater, or chemical solution; or chronic exposure to corrosive, caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions with pH range below 5 or above 9.

E. Holiday: A void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating. May also be identified as a pinhole or a discontinuity.

F. Exposed Exterior Surface: Surface which is exposed to weather but not necessarily exposed to view as well as surface exposed to view.

G. Paint includes fillers, primers, sealers, emulsions, oils, alkyds, latex, enamels, thinners, stains, epoxies, vinyls, chlorinated rubbers, urethanes, shellacs, varnishes, and any other applied coating specified within this Section.

H. Surface Hidden from View: Surfaces such as those within pipe chases, and between top side of ceilings (including drop-in tile ceilings) and underside of floor or roof structure above.

I. VOC: Volatile Organic Compounds.

J. Water level for purposes of painting is: See Drawings.

1.04 SUBMITTALS

A. Manufacturer's statement regarding Applicator instruction on product use.

B. Applicator experience qualifications.

C. Manufacturer's recommendation for universal barrier coat.

D. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's application instructions.
      c. Manufacturer's surface preparation instructions.
      d. If products being used are manufactured by Company other than listed in Article 2.01, provide complete individual cut sheet comparison of proposed products with specified products including application procedure, coverage rates, and verification that product is designed for intended use.
      e. Coating manufacturer's recommendation on abrasive blasting.

E. Samples:
   1. Manufacturer's full line of colors for Engineer's color selection.
   2. After initial color selection by Engineer provide two 3 x 5 IN samples of each color selected.

F. Miscellaneous Submittals:
   1. See Section 01340.
   2. Approval of application equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver in original containers, labeled as follows:
   1. Name or type number of material.
   2. Manufacturer's name and item stock number.
   3. Contents, by volume, of major constituents.

4. Warning labels.
5. VOC content.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, only the following manufacturers are acceptable:
1. Tnemec.
2. Ameron Protective Coatings Div.
3. Valspar Corp.
4. Carboline Protective Coatings.
5. Sherwin Williams.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. All materials used must contain not more than 2.8 LBS/GAL VOC as applied (in thinned state) unless noted otherwise.

B. For unspecified materials such as thinner, provide manufacturer's recommended products.

C. Paint Systems - General:
1. P=prime coat. F1, F2 . . . Fn = first finish coat, second finish coat . . . . nth finish coat, color as selected by Engineer.
2. If two finish coats of same material are required, Contractor may, at his option and by written approval from paint manufacturer, apply one coat equal to mil thickness of two coats specified.

D. Products specified are manufactured by Tnemec.

E. Paint Systems:
1. System #1 - Modified Polyamidoamine Epoxy Primer with Modified Polyamidoamine Epoxy or Acrylic Polyurethane Enamel Top Coats.

P1=Series 135 Chembuild VOC=1.90
(Modified Polyamidoamine Epoxy)
1 coat, 5 mils
*F1=Series
135 Chembuild

(Modified Polyamidoamine Epoxy)
1 coat, 5 mils
*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 3 mils
*Replace F1 with F1E for exterior environment.

2. System #2 – Cycloaliphatic Amine Epoxy Primer with Cycloaliphatic Amine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=Series 104 H.S. VOC=1.90
(Cycloaliphatic Amine Epoxy)
1 coat, 8 mils
*F1=series 104 H.S.
(Cycloaliphatic Amine Epoxy)
1 coat, 8 mils
*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 3 mils
*Replace F1 with F1E for exterior environment.

3. System #3 - Modified Polyamidoamine Epoxy Primer with Modified Polyamidoamine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=Series 135 Chembuild VOC=1.90
(M1 coat, 3 mils)
*F1=Series 135 Chembuild
(Modified Polyamidoamine Epoxy)
1 coat, 3 mils
*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 2.5 mils
*Replace F1 with F1E for exterior environment.

4. System #4 - Zinc Rich Urethane Primer with Cycloaliphatic Amine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=90-97 VOC=3.10
(Zinc Rich Urethane)
1 coat, 2.5 mils
F1=Series 104 H.S. VOC=1.90
(Cycloaliphatic Amine Epoxy)
1 coat, 4 mils

*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 2.5 mils
*Replace F1 with F1E for exterior environment.

5. System #5 - Modified Polyamidoamine Epoxy Primer with Modified Polyamidoamine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=Series 135 Chembuild VOC=1.90
(Modified Polyamidoamine Epoxy)
1 coat, 2.5 mils
*F1=Series 135 Chembuild
(Modified Polyamidoamine Epoxy)
1 coat, 2.5 mils
*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 2.5 mils
*Replace F1 with F1E for exterior environment.

6. System #6 - NOT USED.

7. System #7 - Modified Polyamidoamine Epoxy Primer with Modified Polyamidoamine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=Series 135 Chembuild VOC=1.90
(Modified Polyamidoamine Epoxy)
1 coat, 4 mils
*F1=Series 135 Chembuild
(Modified Polyamidoamine Epoxy)
1 coat, 4 mils
*F1E=Series 75 Endura-Shield VOC=2.53
(Aliphatic Acrylic Polyurethane Enamel)
1 coat, 2.5 mils
*Replace F1 with F1E for exterior environments.

8. System #8 – Silicone Copolymer Primer with Silicone Copolymer Top Coat.

P1=Dempney Thurmaloz 260 Series VOC=3.90
(Silicone Copolymer)
1 coat, 2.5 mils
F1=Dampney Thurmalox 260 series VOC=3.90
(Silicone Copolymer)
1 coat, 2.5 mils

9. System #9 - Modified Polyamidoamine Epoxy Primer.

P1=Series 135 Chembuild VOC=1.90
(Modified Polyamidoamine Epoxy)
1 coat, 4 mils

10. System #10 - Modified Polyamidoamine Epoxy Primer with Modified Polyamidoamine Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coat.

P1=Series 135 Chembuild VOC=1.90
(Modified Polyamidoamine Epoxy)
1 coat, 3 mils
F1=Series 135 Chembuild
(Modified Polyamidoamine Epoxy)
1 coat, 3 mils VOC=2.5
1 coat, 2.5 mils
*Add F2 for exterior environment.

11. System #11 - Zinc-Rich Urethane Primer.

P1=90-97 Tneme-Zinc VOC=3.10
(Zinc-Rich Urethane)
1 coat, 3 mils

12. System #12 – NOT USED.

13. System #13 - Modified-Acrylate Elastomer Primer and Top Coat.

P1=Series 156 Enviro-Crete VOC=0.98
(Modified-Acrylate Elastomer)
1 coat, 6 mils
F1=Series 156 Enviro-Crete
(Modified-Acrylate Elastomer)
1 coat, 6 mils

14. System #14 - NOT USED.

15. System #15 – NOT USED.

16. System #16 - Waterborne Cementitious Acrylic Primer with Cycloaliphatic Epoxy Top Coats.

P1=Series 130 Envirofill VOC=0.6
(Waterborne Cementitious Acrylic)
80-100 SF/GAL
F1=Series 104 H.S. VOC=1.90
(Cycloaliphatic Amine Epoxy)
1 coat, 4 mils
F2=Series 104 H.S.
(CycloaliphaticAmine Epoxy)
1 coat, 4 mils

17. System #17 – Acrylic Emulsion Primer with Acrylic Emulsion Top Coats.
P1=Series 7 Tneme-Cryl VOC=2.09
(Acrylic Emulsion)
1 coat, 2.5 mils
F1=Series 7 Tneme-Cryl
(Acrylic Emulsion)
1 coat, 2.5 mils
F2=Series 7 Tneme-Cryl
(Acrylic Emulsion)
1 coat, 2.5 mils

18. System #18 - NOT USED.

19. System #19 - NOT USED.

20. System #20 - NOT USED.

21. System #21 - NOT USED.

22. System #22 – Polyamidoamine Epoxy Potable Water Approved Primer with Modified Polyurethane Potable Water Approved Top Coats.

P1=Series 140-WHO2 Pota-Pox Plus VOC=2.75
(Polyamidoamine Epoxy Potable Water System)
1 coat, 6 mils
F1=Series 264 Elasto-Shield VOC=.77
(Modified Polyurethane)
1 coat, 2.5 mils
F2=Series 264 Elasto-Shield VOC=.77
(Modified Polyurethane)
1 coat, 2.5 mils

23. System #23 – Polyamidoamine Epoxy Potable Water Approved Primer and Top Coats.

P1=Series 140-1255 Pota-Pox Plus VOC=2.75
(Polyamidoamine Epoxy Potable Water System)
1 coat, 5 mils
F1=Series 20-WH02 Pota-Pox Plus
(Polyamidoamine Epoxy Potable Water System)
1 coat, 6 mils

24. System #24 - NOT USED.

25. System #25 - NOT USED.

26. System #26 – NOT USED.

27. System #27 through #30 – NOT USED.

28. System #31 - Waterborne Epoxy-Amine Adduct Primer and Top Coat.

P1=Series 287 Enviro-Tread VOC=1.78
(Waterborne Epoxy-Amine Adduct)
1 coat, 4 mils
F1=Series 287 Enviro-Tread VOC=1.78
(Waterborne Epoxy-Amine Adduct)
1 coat, 4 mils

29. System #31A – Waterborne Epoxy-Amine Adduct Skid Resistant Primer and Waterborne Epoxy-Amine Adduct and Top Coat.

P1=Series 287 Enviro-Tread VOC=1.78
(Waterborne Epoxy-Amine Adduct)
P1 Additive=287-300c Skid Resistant Sand
(10 lbs per gallon of mixed material)
1 coat, 4 mils
F1=Series 287 Enviro-Tread VOC=1.78
(Waterborne Epoxy-Amine Adduct)
1 coat, 4 mils

PART 3 - EXECUTION

3.01 ITEMS TO BE PAINTED

A. Exposed Exterior Surfaces including:
   1. Piping, valves, fittings and hydrants, and supports, except when covered by pipe jacketing.
   2. Conduit, device boxes, junction boxes and covers, pull boxes and covers.
   3. Exterior and interior surfaces of ferrous metal tankage.
   4. Miscellaneous ferrous metal surfaces.
   5. Pipe bollards.
   6. Galvanized metal surfaces.
   7. Copper and brass surfaces.

B. Surfaces in Areas Not Considered Finished:
   1. Paint following surfaces in areas not considered as finished area:
      a. Pipe insulation, wrapping, and jacketing.
      b. Galvanized metal surfaces.
      c. Copper and brass surfaces.

C. New Equipment:
   1. Paint new equipment, except:
      a. Where noted in Article 3.02.
      b. Where specified elsewhere in the Contract Documents.

3.02 ITEMS NOT TO BE PAINTED

A. General: Do not paint items listed in Article 3.02 unless specifically noted in the Contract Documents to be painted.

B. Items with Approved Factory Finish:

C. Electrical Equipment:
   1. Do not field paint certain items of electrical equipment as listed in Section 11005; except where painting is specifically stated elsewhere in these Contract Documents, or where the equipment is subject to a corrosive environment. The list of equipment includes specific types of equipment with Approved Factory Finishes.

D. Surfaces Hidden from View, except when in a corrosive or highly corrosive area, including:
   1. Piping.
   2. Conduit.
   3. Ducts.
   4. Insulation.
   5. Note: (Manufacturer's standard coatings, if any, may remain).

E. Other Items:

1. Stainless steel surfaces except:
   a. Piping.
   b. Banding as required to identify piping.
2. Aluminum surfaces except:
   a. Where specifically shown in the Contract Documents.
   b. Where imbedded in concrete.
   c. Where in contact with dissimilar metals.
3. Fiberglass surfaces except:
   a. Fiberglass piping.
   b. Piping supports.
4. Interior of pipe, ductwork, and conduits.
5. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
6. Code labels and equipment identification and rating plates.
7. Exterior concrete or precast concrete surfaces.
8. Structural steel or steel deck required to be fireproofed.
9. Pipe jacketing.
10. Steel deck.
11. Contact surfaces of friction-type connections.
12. Galvanized steel grating.

3.03 SCHEDULE OF ITEMS TO BE PAINTED AND PAINTING SYSTEMS

		PAINTING SYSTEM NUMBER
A.	Miscellaneous Ferrous Metals (non-corrosive dry environment):	1
	1. May include bare steel handrails, guardrails, piping, exterior of tankage, tank or equipment bridges, pumps, and similar items.	
B.	Galvanized Metals:	
	1. Field cut edge where top coat is required.	4
	a. Prime paint only the cut edge.	
	2. Assembled galvanized steel items.	3
	3. Field touch-up of galvanized surfaces not requiring a finish top coat.	11
	a. Paint only damaged areas.	
C.	Steel equipment with existing paint coating or factory-applied prime or finish coating including:	5
	1. Equipment specifically indicated in the Contract Documents to be painted. Factory-applied coats to remain.	
D.	Plastic Surfaces:	
	1. PVC, FRP, and CPVC surfaces including tankage.	3
E.	Electrical Conduit	
F.	Pipe, Valves, and Fittings:	
	1. Steel cast-iron, and uncoated ductile iron.	1
	2. Stainless.	1
	3. Brass and bronze.	3
	4. PVC, FRP, and CPVC.	3
G.	Bituminous Coated Ductile Iron Pipe and Material.	10
H.	Interior of steel potable water storage tank and all ferrous metal items subject to contact with potable water requiring NSF approval. Includes all ferrous metal surfaces subject to splash, spillage, vapor, condensation, or other chronic potable water exposure. Also includes ferrous metal surfaces within concrete tankage painted with System #22.	23

3.04 PREPARATION

A. General:

1. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and this Section.
2. Remove all dust, grease, oil, compounds, dirt, and other foreign matter which would prevent bonding of coating to surface.

B. Protection:
1. Protect surrounding surfaces not to be coated.
2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.

C. Prepare and Paint Before Assembly: Where component is subject to corrosive or highly corrosive environment, prepare and paint, before assembly, all surfaces which may be subject to environment which are inaccessible after assembly.

D. Ferrous Metal:
1. Complete fabrication, welding, or burning before beginning surface preparation.
   a. Chip or grind off flux, spatter, slag, or other laminations left from welding.
   b. Remove mill scale.
   c. Grind smooth rough welds and other sharp projections.
2. Solvent clean in accordance with SSPC SP-1 all surfaces scheduled to receive additional SSPC surface preparation.
3. Surfaces subject to corrosive or highly corrosive environment and all surfaces subject to immersion service:
   a. Near-white blast clean in accordance with SSPC SP-10.
4. Interior and exterior surfaces not subject to corrosive or highly corrosive environment (including structural steel surfaces):
   a. Commercial blast clean in accordance with SSPC SP-6.
5. Surfaces subject to high temperatures:
   a. Heat in excess of 600 DegF: SSPC SP10.
   b. Heat in excess of 200 DegF but less than 600 DegF: SSPC SP6.
6. Surfaces of steel joists:
   a. Power tool or hand clean in accordance with SSPC SP-2 or SP-3.
7. Steel surfaces scheduled to receive paint system No. 24:
   a. White metal blast in accordance with SSPC SP-5.
8. Restore surface of field welds and adjacent areas to original surface preparation.
9. All concealed surfaces of steel lintels used in wall construction shall be completely painted with both prime and finish coats prior to placing in wall.

E. Hollow Metal:

1. Solvent clean in accordance with SSPC SP-1.

F. Galvanized Metal:
   1. Solvent clean in accordance with SSPC SP-1 followed by brush blast in accordance with SSPC SP-7 to provide 1 mil profile.

G. Abrasive blast clean the following equipment or surfaces regardless of previous finish, if any.
   1. Bituminous coated ductile iron pipe where exposed, SSPC SP-6.

H. Preparation by Abrasive Blasting:
   1. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of paint coatings.
      a. Inspection shall be performed to determine profile depth of blasted surfaces and cleanliness and to certify that surface has been prepared in accordance with these Specifications.
   2. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before painting.
   3. Perform additional blasting and cleaning as required to achieve surface preparation required. Prior to painting, reblast surfaces allowed to set overnight or surfaces that show rust bloom.
      a. Surfaces allowed to set overnight or surfaces which show rust bloom prior to painting shall be reinspected prior to paint application.
   4. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils, unless required otherwise by coating manufacturer.
   5. Provide compressed air for blasting that is free of water and oil. Provide accessible separators and traps.
   6. Confine blast abrasives to area being blasted.
      a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
      b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
   7. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
   8. Reblast surfaces not meeting requirements of these Specifications.
   9. Abrasive blasting media may be recovered, cleaned, and reused, providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
   10. Properly dispose of blasting material contaminated with debris from blasting operation not scheduled to be reused.

I. All plastic surfaces and non-furrous surfaces except galvanized steel:
   1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.05 APPLICATION

A. General:

1. Thin, mix, and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
   a. Application equipment must be inspected and approved in writing by coating manufacturer.
2. Temperature and weather conditions:
   a. Do not paint surfaces when surface temperature is below 50 DegF, unless product has been formulated specifically for low temperature application or approved in writing by Engineer and paint manufacturer's authorized representative.
   b. Avoid painting surfaces exposed to hot sun.
   c. Do not paint on damp surfaces.
3. Immediately after surface has been inspected, apply structural steel, miscellaneous steel, and steel joist prime coat in the factory.
   a. Finish coats shall be applied in the field.
   b. Prime coat referred to here is prime coat as indicated in this Specification. Structural, miscellaneous steel, and steel joist prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
4. Provide complete coverage to mil thickness specified.
   a. Thickness specified is dry mil thickness.
   b. All paint systems are "to cover." In situations of discrepancy between manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern.
   c. When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
6. Apply materials under adequate illumination.
7. Evenly spread to provide full, smooth coverage.
8. Work each application of material into corners, crevices, joints, and other difficult to work areas.
9. Avoid degradation and contamination of blasted surfaces and avoid intercoat contamination.
   a. Clean contaminated surfaces before applying next coat.
10. Smooth out runs or sags immediately, or remove and recoat entire surface.
11. Allow preceding coats to dry before recoating.
    a. Recoat within time limits specified by coating manufacturer.

b. If recoat time limits have expired, reprepare surface in accordance with coating manufacturer's printed recommendations.

12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
13. Coat all aluminum in contact with dissimilar materials.
14. When coating fluted, ribbed, or other rough face masonry surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses.
15. When applying coatings over acoustical concrete block units, do not spray apply. Apply by roller.
16. Backroll concrete and masonry surfaces with a roller if paint coatings are spray applied.

B. Prime Coat Application:

1. Prime all surfaces indicated to be painted. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Section.
2. Ensure field-applied coatings are compatible with factory-applied coatings.
   a. Employ services of coating manufacturer's qualified technical representative.
      1) Certify thru material data sheets.
      2) Perform test patch.
   b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation, and method of application.
   c. At Contractor's option, coatings may be removed, surface reprepared, and new coating applied using appropriate paint system listed in paragraph 2.02-E.
      1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
3. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
4. Back prime all wood scheduled to be painted, prior to installation.
5. Apply zinc-rich primers while under continuous agitation.
6. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
7. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
8. Fill all pores of concrete block completely using block filler specified.

9. Touch up damaged primer coats prior to applying finish coats. Restore primed surface equal to surface before damage.
10. Paint all edges of doors same as face of door.

C. Finish Coat Application:
1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Section.
2. Touch up damaged finish coats using same application method and same material specified for finish coat. Prepare damaged area in accordance with Article 3.04.

3.07 FIELD QUALITY CONTROL

A. Measure wet paint with wet film thickness gages.

B. Measure paint dry film thickness in accordance with SSPC PA-2 using Mikrotest gage calibrated against National Bureau of Standards "Certified Coating Thickness Calibration Standards."
1. Engineer may measure paint thickness at any time during project to assure conformance with specifications.

C. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.

D. Measure substrate humidity with humidity gage specifically designed for such.

E. Provide wet paint signs.

3.08 CLEANING

A. Clean paint spattered surfaces. Use care not to damage finished surfaces.

B. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.

C. Remove surplus materials, scaffolding, and debris. Leave areas broom clean.

3.09 SCHEDULE

A. The Owner and Engineer will provide color selections. Color selections will be based upon manufacturer's color charts.

END OF SECTION

SECTION 11005

EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Requirements of this Section apply to all equipment provided on the Project including that found in Divisions 11, 12, 13, 14, 15, and 16, even if not specifically referenced in individual "Equipment" articles of those Specifications.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 16010 - Electrical: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. American Society for Testing and Materials (ASTM):
      a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. Institute of Electrical and Electronics Engineers (IEEE):
      a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment.
      b. ICS 6, Enclosures for Industrial Control and System.
      c. MG 1, Motors and Generators.
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

B. Miscellaneous:
   1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project even though:
      a. More than one manufacturer is listed for a given "product" in Specifications.
      b. No manufacturer is listed.

2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall FULLY comply with specific NEC requirements related to area classification and to NEMA 250 and ICS-6 designations and defined in Section 16010.
3. Utilize only year 2000 compliant equipment and software.

1.03 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
1. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within specifications.

D. Year 2000 Compliant Equipment and Software: Equipment and software for which neither performance or functionality is affected by dates prior to, during, or after the year 2000.

E. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
1. Installer or applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:
1. General for all equipment:
a. See Section 01340.
b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
c. Manufacturer's delivery, storage, handling, and installation instructions.
d. Equipment identification utilizing numbering system and name utilized in Drawings.
e. Equipment installation details:
1) Location of anchorage.
2) Type, size, and materials of construction of anchorage.
3) Anchorage setting templates.
4) Manufacturer's installation instructions.
f. Equipment area classification rating.

g. Shipping and operating weight.
h. Equipment physical characteristics:
1) Dimensions (both horizontal and vertical).
2) Materials of construction and construction details.
i. Equipment factory primer and paint data.
j. Manufacturer's recommended spare parts list.
k. Equipment lining and coatings.
l. Equipment utility requirements include air, natural gas, electricity, and water.

2. Electrical and control equipment:
a. Control panels:
1) Panel construction.
2) Point-to-point wiring diagrams.
3) Scaled panel face and subpanel layout.
4) Technical product data on panel components.
5) Panel and subpanel dimensions and weights.
6) Panel access openings.
7) Nameplate text.
8) Panel anchorage.

B. Operation and Maintenance Manuals:
1. See Section 01340.

C. Miscellaneous Submittals:
1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
4. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

a. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Motors:
a. Siemens.
b. Westinghouse.
c. General Electric.
d. U.S. Motors.

e. Reliance Electric.
f. Baldor.

2.02 YEAR 2000 COMPLIANT EQUIPMENT AND SOFTWARE

A. All equipment which utilizes microprocessors, computers, embedded chips, integrated circuits, operating systems, or PLCs shall be demonstrated to be year 2000 compliant.

B. All software shall be demonstrated to be year 2000 compliant.

C. Compliance Requirements:

1. General Integrity:
   a. Value for the current date shall not interrupt operation.
   b. System shall return the correct date accurate to century in response to a request for current date, and software shall be unaffected by any value returned.
2. Date Integrity: Correct results shall be returned in the operation of all legal arithmetic, logical, and calendar operations of dates that span century marks within the range of the software.
3. Explicit Century. Software's internal date storage format shall explicitly include the century and reporting formats, allowing date representation in the full century format.
4. Implicit Century. On encountering data that does not include the century, either from transaction input or from an external data source, the century value is unambiguously inferred by the software.

2.03 MANUFACTURED UNITS

A. Electric Motors:

1. Provide motors designed and applied in compliance with NEMA, IEEE, and the NEC for specific duty imposed by driven equipment.
2. Where used in conjunction with adjustable speed AC drives, provide motors that are fully compatible with the speed controllers.
3. When used on variable frequency type adjustable speed drive applications, provide motors in compliance with NEMA MG-1, Part 31.
4. Derate NEMA design A and B squirrel cage induction motors which will be operated from variable speed AC drive controllers in accordance with NEMA MG-1, Part 31.
5. Design for frequent starting duty equivalent to duty service required by driven equipment.
6. Rate for continuous duty at 40 DegC ambient. Design in accordance with the NEMA Standards for Class F insulation with Class B temperature rise above 40 DegC ambient on continuous operation or intermittent duty at nameplate horsepower.
7. Design for full voltage starting.
8. Design bearing life based upon actual operating load conditions imposed by driven equipment.
9. Size for altitude of Project.

10. Size motors so that, under maximum continuous load imposed by driven equipment, motor nameplate horsepower for continuous operation is minimum of 15 percent more than driven load or provide motor with 1.15 service factor in which case maximum continuous load imposed shall not exceed nameplate horsepower rating of motor.
11. Provide encapsulated windings in areas designated as wet and for outdoor applications.
    a. Provide encapsulation using a silicone or epoxy seal after the windings have been dried to less than 1 percent moisture.
12. Furnish with clamp-type grounding terminals inside motor conduit box.
13. Furnish with oversized external conduit boxes.
14. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.
15. Electrical motors greater than 10 HP.
    a. 230/460 V, 60 HZ, 3 PH supply voltage.
    b. Totally enclosed fan cooled (TEFC).
    c. Oil or grease lubricated antifriction bearings conforming to ABMA Standards. Design bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
    d. Thermal protection.
        1) Provide resistance type winding temperature protection included in each phase winding to detect "hot spots."
        2) Remote mount controller in VFD. Energize controller from VFD control power circuit. Rate controller interrupting contacts at 120/240 V AC.
    e. For vertical motors, provide 15-year average life thrust bearings conforming to ABMA Standards.
16. Motors 15 HP and above having a locked rotor inrush KVA greater than 6.3 times motor horsepower are not acceptable.
17. Provide high efficiency rated motors. Where high efficiency motors are not available because of motor size or application, clearly document within the shop drawing submittal process.
18. Measure efficiencies by IEEE 112 - Method B. Vertical motors may eliminate thrust bearing losses for efficiency measurements.

2.04 ACCESSORIES

A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Construct from 16 GA stainless steel or aluminum.
3. Construct to preclude entrance of rain, snow, or moisture.
4. Roll to conform to shaft or coupling surface.

5. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:

1. Cast-in-place anchorage:
   a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
   b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
   c. Provide two nuts for each bolt.
2. Drilled anchorage:
   a. Epoxy grout.
   b. Threaded rods same as cast-in-place.
3. Data Plate:
   a. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
   b. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

C. Lifting Eye Bolts or Lugs:

1. Provide on all equipment 50 LBS or greater.
2. Provide on other equipment or products as specified in the narrow specifications.

2.05 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:

1. The standard factory-applied paint coating system(s) of the approved manufacturers of the following equipment are acceptable:
   a. Panel boards.
   b. Electrical panels.
   c. Safety switches.
   d. Motor starter equipment.
   e. Raceways and cable trays.

2.06 SOURCE QUALITY CONTROL

A. Motor Tests:

1. Test motors in accordance with NEMA and IEEE procedures. Include the following:
   a. Routine test:
      1) Running no-load amperes.
      2) Locked rotor amperes.
      3) Winding resistance, DC.
      4) High-potential test.
      5) Vibration check.
2. The Owner reserves the right to, at any time, select and have tested any motor included within the Project. If motor passes testing requirements, Owner will be responsible for any shipping and

testing costs incurred. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test. If motor fails test, Contractor shall be responsible for all costs incurred. If two successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer. The Owner also reserves the right to witness any routine or complete tests at Owner's expense.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. DO NOT construct foundations until major equipment supports are approved.

D. Couplings:
   1. Align in the annular and parallel positions.
   2. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
   3. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
   4. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
   5. Check surfaces for runout before attempting to trim or align units.

E. Grouting:
   1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Extend dam or formwork at least 1/2 IN above the top of leveling shims and blocks.
   2. Saturate top of roughened concrete subbase with water before grouting. Add grout until entire space under machine base is filled to the top of the base underside. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
   3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface. Cover

exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

3.02 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation. In each case, representative(s) shall be present during placement and startup of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:

1. Has been properly installed and lubricated.
2. Is in accurate alignment.
3. Is free from any undue stress imposed by connecting piping or anchor bolts.
4. Has been operated under full load conditions and that it operated satisfactorily. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks. All or any time expended during installation check does not qualify as O&M training or instruction time when specified.

3.03 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Section 10400.

3.02 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Terminate motor circuit conductors with copper lugs bolted to motor leads.

C. Tape stripped ends of conductors and associated connectors with electrical tape. Wrapping thickness shall be 150 percent of the conductor insulation thickness.

D. Connections to carry full ampacity of conductors without temperature rise.

E. Terminate spare conductors with electrical tape.

3.03 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.

B. Inspect wire and connections for physical damage and proper connection.

C. Check rotation of motor before connection to driven equipment, before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated.

3.04 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01650.

END OF SECTION

SECTION 11060

PUMPING EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pumping equipment.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 09906 - Painting and Protective Coatings.
   4. Section 11005 - Equipment: Basic Requirements.
   5. Section 11076 - Pumping Equipment: Submersible Non-Clog.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. Hydraulic Institute (HI):
      a. Standards for centrifugal, rotary and reciprocating pumps.

B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

C. Qualifications:

1.03 DEFINITIONS

A. The abbreviations are defined as follows:
   1. IPS: Iron Pipe Size.
   2. NPSHR: Net Positive Suction Head Required.
   3. TDH: Total Differential Head.

1.04 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005.
   2. Product technical data including:

a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.
b. Pump accessory data.
c. Bearing supports, shafting details and lubrication provisions.
d. Solids passage information.

3. Certifications:
a. Certified pump performance curves as described in Article 2.04.

4. Test reports:
a. Factory hydrostatic test.

B. Operation and Maintenance Manuals:
1. See Section 01340.

C. Miscellaneous:
1. Certifications:
a. Statement relative to installation and start-up per paragraph 3.02-A.4.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pumps:
a. See individual pump specification sections.
2. Mechanical seals:
a. Chesterton.
b. Garlock.

2.02 CENTRIFUGAL PUMP DESIGN

A. Provide units with increasing head characteristics from the end run out portion of the curve to shutoff condition.

2.03 ACCESSORIES

A. See Section 11005.

B. Each Unit:
1. Lifting eye bolts or lugs.

C. Packing Seal:

2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
3. Hold interface in contact by its own spring system.

E. Bearings:
1. Support shaft on upper and lower permanently lubricated bearings with a minimum L-10 life of 50,000 HRS.

F. Motors:
1. Provide pump with FM or UL listed motor designed for area classification shown on Drawings.
2. Provide motor of totally submersible design, constructed with epoxy or poly-seal encapsulated windings, air-filled or dielectric oil filled, with Class F insulation and rated for continuous duty operation.
3. Motor shall be 3 phase, 60 cycle, 460 V.
4. Assure motor is capable of running dry for extended periods without damage to motor or seal.

G. Power and Control Cables:
1. Provide power cable and control cable to pump suitable for submersible applications in wastewater and indicate same by a code or legend permanently embossed on cables.
2. Size cables in accordance with applicable NEC specifications.
3. Provide 40 FT power cable and control cable.
4. Provide each cable with a strain relief, cord grip, and explosionproof seal installed in accordance with NEC Article 500.

H. Temperature Monitor:
1. Furnish each phase of the motor with a temperature monitor embedded in the motor windings.
2. Arrange controls so as to shut the pump down and active alarm light should any one of the monitors detect high temperature and automatically reset once the stator temperature returns to normal.
3. Set temperature of the temperature monitors at not higher than 90 percent of insulation temperature rating.

I. Coatings:
1. For wet pit applications, apply polyamidoamine epoxy system to the exterior of the pump casing and motor housing that is equal to or better than that specified in Specification Section 09906.
2. Protect all metallic surfaces coming into contact with stormwater except stainless steel and bronze by a corrosion-resistant coating.

J. Wet Pit Applications:
1. Provide sliding guide bracket integral to pump unit which properly aligns the pump discharge with the discharge connection elbow for watertight seal during pumping.

2. Guide the entire weight of the pumping unit by guide rail(s).
3. The guide rail(s) shall not support any portion of the weight of the pump.
4. Provide chains or cable of sufficient strength to lift pumps from sump.
5. Furnish guiding rail assembly and the discharge flange assembly of nonsparking components.
6. Design pump to allow for removal without entering the wet well and without removal of bolts, nuts or other fastenings.
7. Provide pump unit connecting to discharge connection with a simple downward motion without rotation.
8. Provide necessary sliding guide bracket and discharge connection which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
9. No portion of the pump shall bear directly on the floor or the wet well.

2.05 ACCESSORIES

A. See Section 11060.

B. Controls:
1. Provide sealed float-type mercury switches to control pumps and provide alarm signal.
2. Seal mercury tube switches in a solid polypropylene float.
3. Provide float with large radius top at electrical cable connection to assure trouble-free operation.
4. Suspend floats on their own cable.
5. Provide floats to operate at elevations shown on Drawings.
6. Design floats to be field-adjustable.
7. Floats switches to control pumps:

   Water Quality Pump Nos. 1, 2, and 3: One float switch for low water cutoff the elevation of which will need to be determined by the pump manufacturer. Additional float switches provide the signal for high water level cutoff in the stilling wells at the pump discharge outlet headwalls as indicated on the plans.

   Evacuation Pump Station Pump Nos. 1 and 2: One float switch for low water cutoff the elevation of which will need to be determined by the pump manufacturer. An additional float switch provides the signal for high water level cutoff in the stilling well at the pump discharge pipe outlet as indicated on the plans.
8. Provide a intrinsically safe relay for each level control circuit to reduce the energy in the circuit to the point that no spark is created by switching.

C. Control Panel:
1. Furnish and install locally mounted automatic control panels at locations shown on Drawings and rated for area classification.

2. Include combination circuit breaker type controller with short circuit, overload, and three overload relays, interior-mounted motor starter(s), and transformer with disconnect and overload protection for control circuit of 24 V.
3. Include a terminal board for connection of level sensors.
4. Provide the following features:
   a. NEMA 3 weatherproof enclosure with locking mechanism complete with padlock.
   b. NEMA 4 stainless steel watertight enclosure with continuous hinge, neoprene gasket in cover and continuous seam weld. Include locking mechanism complete with padlock.
   c. Hand-Off-Automatic selector switches.
   d. Automatic alternator.
   e. High level alarm with alarm light.
   f. Low level alarm with alarm light.
   g. Pump running lights.
   h. Elapsed time meters.
   i. Overload reset button to reset overload relays.
   j. Pump sequence selector switch which overrides automatic alternator.
   k. Lightning protection.
   l. Condensation heater.
   m. Moisture detector alarm light and pump shutdown.
   n. 100 watt utility light outlet.
   o. Float switch test pushbuttons.
   p. Auxiliary contacts wired to terminal blocks.
   q. Power ON control relay.
   r. Power OFF control relay.
   s. Remote telemetering contact.
   t. 12 V DC alarm system: A safety device which will actuate when faced with an incoming power failure.
   u. Normal emergency power transfer switch.
   v. Inner door in cabinet-mounted on a continuous vertical steel hinge; size to completely cover wiring and components mounted on the back panel; provide for mounting of controls and instruments on inner door.
   w. Pedestal mounting.
   x. Pole mounting bracket.

D. Access Doors and Frames:
1. Furnish and install double hinged door constructed of stainless steel.
2. Furnish size shown on Drawings.
3. Equip with nonsparking upper guide rail support, float bracket, and flush locking mechanism.
4. Door shall be able to remain in open position while work is being performed.
5. Securely place frame above pump(s).

6. Provide doors of skidproof design.
7. Provide doors with snap locks and removable handle.
8. Provide door hardware including latching mechanism and hinges of stainless steel materials.

E. Winch:
1. Secure a manually operated, cable-type winch capable of lifting the pumps.
2. Provide winch with a fabricated steel support frame and with a minimum capacity of 1.5 times pump weight.
3. Fit cable end with a grab hook to properly link up with the lifting chain.

2.06 SOURCE QUALITY CONTROL

A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
1. Check impeller, motor rating and electrical connections for compliance with Specification.
2. Test motor and cable insulation for moisture content or insulation defects.
3. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.
4. Run pump for 30 minutes submerged, a minimum of 6 FT under water.
5. After operational test #4, perform insulation test (#2) again.

B. Factory test of head (FT) versus flow (gpm) for one pump of each service category as specified in Section 11060.

PART 3 - EXECUTION

3.01 INSTALLATION

A. See Section 11060.

B. For wet pit pumps, permanently install discharge connection elbow in wet well along with discharge piping.

C. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

3.02 FIELD QUALITY CONTROL

A. See Section 11060.

END OF SECTION

SECTION 13440

INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Basic requirements for complete instrumentation system for process control.

B. Related Sections include but are not necessarily limited to:
   1. Supplementary General Conditions.
   2. Section 16010 - Electrical: Basic Requirements.
   3. Section 16120 - Wire and Cable - 600 Volt and Below.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Society for Measurement and Control (ISA):
      a. S5.1, Instrumentation Symbols and Identification.
      b. S5.2, Binary Logic Diagrams for Process Operations.
      c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
      d. S5.4, Standard Instrument Loop Diagrams.
      e. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
      f. RP7.1-56, Pneumatic Control Circuit Pressure Test.
   2. National Institute of Standards and Technology (NIST).

B. Miscellaneous:
   1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

C. Qualifications:
   1. Instrumentation subcontractor:
      a. Experience.
         1) Have satisfactorily provided a control system for a minimum of five projects of similar magnitude and function.

1.03 DEFINITIONS

A. Instrument Air Header: The segment of air supply piping and tubing which transports air from the compressed instrument air source through the branch isolation valve of any takeoff (branch) line.

B. Branch Line: The segment of air supply piping and tubing which transports air from the outlet of the air header branch isolation valve through an air user's isolation valve.

1. Provide packing unless mechanical seal specified in narrow-scope pump sections.
2. Minimum of five rings graphite impregnated synthetic packing.

2.04 FABRICATION

A. Pump Support:
1. Design base to support weight of drive, shafting and pump.
2. Comply with HI vibration limitations.
3. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.05 SOURCE QUALITY CONTROL

A. Statically and dynamically balance each pump per HI standards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. See Section 11005.

B. Submersible Units:
1. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
2. Field paint units as defined in Section 09906.
3. Provide pressure gage on discharge of all pumps and on suction of all non-submersible units.

3.02 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial startup of equipment and perform operational checks.
4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 11076

PUMPING EQUIPMENT: SUBMERSIBLE NON-CLOG

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Submersible non-clog pumps - wet pit application.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 11060 - Pumping Equipment: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
   2. American National Standard Institute (ANSI).
   3. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
   4. Factory Mutual (FM).
   5. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps (HI).
   6. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Controls.
   7. National Fire Protection Agency (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc.(UL).

1.03 SYSTEM DESCRIPTION

A. Influent stormwater pumps utilizing manually controlled VFDs pumping from wet well to vegetated treatment cells or Pecos Drain.

B. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
   1. Pumps.
   2. Motors.
   3. VFDs.
   4. Soft Starters.
   5. Winch.

1.04 SUBMITTALS

A. Shop Drawings:
   1. Requirements in Section 11060.
   2. Source quality control test reports.
   3. For soft start and variable speed applications, submit:
      a. Critical speed and half critical speed data for each pump model.
      b. Certification that the pump manufacturer is bearing coordination responsibility for the pump(s) and VFD(s) and soft starter(s) for their specific application to avoid overheating and harmonic vibrations caused by rotational speed and carrier-frequency-induced rotational "cogging".
      c. Certified statement signed by a registered professional engineer that the L_{10} bearing lives meet or exceed the specified requirements.
   4. VFD and Soft Starter submittal information in compliance with Section 16474.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Submersible non-clog pumps - wet pit applications:
      a. Flygt.
      b. Gorman Rupp.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. Wet Pit Applications:
   1. Pump case: Cast iron, ASTM A48, Class 30.
   2. Motor housing: Cast iron, ASTM A48, Class 25 or Class 30.
   3. Impeller: Cast iron, ASTM A48, Class 30.
   4. Shaft: Stainless steel, ANSI, Series 300 or 400. Carbon steel C1035 is acceptable if not contacting pumped fluid.
   5. Wear rings: Corrosion and wear resistant materials.
   6. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
   7. Fasteners: Stainless steel.
   8. Guide rails: Stainless steel.
   9. Lifting chains and cables: Stainless steel.
   10. Lower ring seal: Tungsten-carbide both faces.

11. Upper ring seal: Tungsten-carbide both faces or carbon and ceramic or carbon and Ni-resist.
12. Seal metal parts: Stainless steel.

2.03 EQUIPMENT

A. Performance and Configuration Requirements:
1. Water Quality Pump Station – Pump Nos. 1 and 2:
a. Design condition: 1000 gpm at 18.0 FT TDH with minimum pump efficiency of 65 percent.
b. Secondary condition: 1580 gpm at 6.0 FT TDH
c. Minimum Shutoff condition: 0 gpm at 30 FT.
d. Pump configuration:
1) Submersible wet pit.
2) Clockwise rotation when viewed from the driver end.
e. Maximum pump speed: 1800 rpm.
f. Minimum Nameplate driver horsepower: 7.5 .
g. Drive type: Variable speed.
h. Minimum solids passage: 3 IN.
i. Discharge: 8 IN DIA.
j. Motor Requirements:
1) Service Factor: 1.15 .
k. Ambient conditions:
1) Storm water maximum temperature 86 DegF.
2) Air maximum temperature 122 DegF.

2. Water Quality Pump Station – Pump No. 3:
a. Design condition: 500 gpm at 31.1 FT TDH with minimum pump efficiency of 74 percent.
b. Maximum Shutoff condition: 0 gpm at 60 FT.
c. Minimum Shutoff condition: 0 gpm at 40 FT.
d. Pump configuration:
1) Submersible wet pit.
2) Clockwise rotation when viewed from the driver end.
e. Maximum pump speed: 1800 rpm.
f. Minimum Nameplate driver horsepower: 7.5 .
g. Drive type: Variable speed.
h. Minimum solids passage: 3 IN.
i. Discharge: 4 IN DIA.
j. Motor Requirements:
1) Service Factor: 1.15 .
k. Ambient conditions:
1) Storm water maximum temperature 86 DegF.
2) Air maximum temperature 122 DegF.

3. Evacuation Pump Station – Pump Nos. 1 and 2:

a. Design condition: 4,488 gpm at 11.4 FT TDH with minimum pump efficiency of 70 percent.
b. Secondary condition: 3,124 gpm at 20 FT TDH with minimum pump efficiency of 75 percent.
c. Maximum Shutoff condition: 0 gpm at 40 FT.
d. Minimum Shutoff condition: 0 gpm at 28 FT.
e. Pump configuration:
   1) Submersible wet pit.
   2) Clockwise rotation when viewed from the driver end.
f. Maximum pump speed: 1800 rpm.
g. Minimum Nameplate driver horsepower: 30.
h. Drive type: Variable speed.
i. Minimum solids passage: 4 IN.
j. Discharge: 12 IN DIA.
k. Motor Requirements:
   1) Service Factor: 1.15 .
l. Ambient conditions:
   1) Storm water maximum temperature 86 DegF.
   2) Air maximum temperature 122 DegF.

2.04 COMPONENTS

A. General:
1. Provide pumps capable of handling storm water.
2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.

B. Impeller:
1. Provide nonclog-type dynamically balanced impeller in accordance with HI Standards.
2. Provide impeller and volute wear rings as necessary to assure efficient sealing between volute and impeller.

C. Shaft:
1. Design pump shaft of sufficient size to transmit full driver output.
2.. Use shaft which is accurately machined and constructed with sufficient materials.
3. Design shaft for a maximum deflection of 0.002 IN measured at the stuffing box.

D. Shaft Seal:
1. Seal shaft with double mechanical seal running in an oil filled chamber.

C. Calibrate: To standardize a device so that it provides a specified response to known inputs.

1.04 SYSTEM DESCRIPTION

A. Control System Requirements:
   1. This Specification Section 13440 provides the general requirements for the instrument and control system.
   2. The instrument and control system consists of all primary elements, transmitters, switches, controllers, computers, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.

B. Unless otherwise required for instrument compatibility, electric control signals shall be 4 to 20 mA, 24 V DC and pneumatic signals shall be 3 to 15 psi.

C. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.

D. Single Instrumentation Subcontractor:
   1. Furnish and coordinate instrumentation system through a single instrumentation subcontractor. The instrumentation subcontractor shall be responsible for functional operations of all systems, performance of control system engineering, supervision of installation, final connections, calibrations, preparation of drawings and operation and maintenance manuals, startup, training, demonstration of substantial completion and all other aspects of the control system.
   2. Ensure coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

1.05 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Submittals shall be original printed material or clear unblemished photocopies of original printed material. Facsimile information is not acceptable.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Equipment catalog cut sheets.
      c. Instrument data sheets:
         1) ISA S20 or approved equal.
         2) Separate data sheet for each instrument.
      d. Materials of construction.
      e. Minimum and maximum flow ranges.

f. Pressure loss curves.
g. Physical limits of components including temperature and pressure limits.
h. Size and weight.
i. Electrical power requirements and wiring diagrams.
j. NEMA rating of housings.
k. Submittals shall be marked with arrows to show exact features to be provided.

4. Loop diagrams per ISA S5.4.
   a. Each loop diagram on a separate sheet.
   b. Each sheet shall contain the following minimum information.
      1) All loop devices clearly identified.
      2) Identification of the loop and each loop component, including connections to such things as recorders and computers. Numbering and tagging must agree with the P&ID.
      3) All interconnections with identifying numbers for:
         (a) Electrical cables.
         (b) Conductor pairs.
         (c) Pneumatic or hydraulic tubing.
      4) Identification of connections including:
         (a) Junction boxes.
         (b) Terminals.
         (c) Bulkheads.
         (d) Ports.
         (e) Computer input/output connections.
         (f) Grounding systems.
      5) Signal levels and ranges.
      6) Device location.
      7) Energy sources designating voltage, pressure, and other applicable requirements.
      8) Enough process lines and equipment to clearly show the process side of the loop and provide clarity of control action. This includes:
         (a) What is being measured.
         (b) What is being controlled.
         (c) Other information required to complete the process loop.
      9) Reference to supplementary records and drawings to show inter-relation to other control loops.
      10) Controller action.
      11) Control valve action upon electronic, hydraulic, or pneumatic failure.

5. Process connected instrument installation details containing the following minimum information:

a. Bill of materials providing as a minimum the following information:
   1) Tube material and size.
   2) Connection size.
   3) Fitting size, material, and rating.
   4) Valve type and material.
   5) Instrument description.
   6) Pipe stand size and material.
b. Tube slope requirements.
c. Required elevations and dimensions.

6. Comprehensive set of point-to-point wiring diagrams showing all interconnections between packaged systems or equipment control panels, motor control centers, instrumentation and all other electrical equipment as required to depict a complete and functional plant-wide electrical control system. Instrumentation wiring already shown on loop diagrams need not be included on point-to-point wiring diagrams.
   a. Diagrams shall provide the following minimum information:
      1) Terminal block identification (includes terminals on remote equipment furnished by Others).
      2) Wire size.
      3) Wire type.
      4) Wire color.
      5) Wire shielding and insulation type.
      6) Conductor quantities and associated conduit size.
      7) Ground points.
      8) Interconnection requirements to existing systems or equipment furnished by Others.
   b. Diagrams shall be provided on Drawings of sufficient size so as to minimize the number of drawings.
      1) Maximum drawing size 24 x 36 IN.
      2) Minimum drawing size: 11 x 17 IN.
7. Electrical schematic control diagrams. Diagrams shall include:
   a. Terminal identification.
   b. Unique identification of all control devices and contacts.
      1) Utilize Owner's device identification numbers where applicable.
   c. Wire identification.
   d. Equipment identification.
   e. Indication of remote and local devices and wiring.
   f. Overcurrent protection indication.
   g. Voltage.
   h. All control logic.
8. Panel fabrication drawings.
9. Scaled floor plan layouts of control room.
10. PLC/DCS equipment drawings.
11. Graphic layouts.

12. Graphic component construction.
13. Nameplate layout drawings.
14. Drawings, systems, and other elements are represented schematically in accordance with ISA S5.1 and S5.3. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.
15. Certifications:
    a. Documentation verifying that calibration equipment is certified with NIST traceability.
    b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.
16. Testing reports:
    a. Source quality control reports.

B. Operation and Maintenance Manuals:
1. See Section 01340.
2. Warranties: Provide copies of warranties and list of factory authorized service agents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

PART 2 - PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. System Operating Criteria:
1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two cycles per minute or a magnitude of movement of 0.5 percent full travel.
2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.

6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

2.02 ACCESSORIES

A. Provide instruments with manufacturer's identification nameplate showing:
   1. Manufacturer's model number.
   2. Manufacturer's serial number.
   3. Range.
      a. Utilize the same units of measurement as are utilized in the Contract Documents.
   4. Power supply requirement.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Use bottom entry for all conduit entry to instruments and junction boxes.

B. Install electrical components per Division 16.

C. Panel-Mounted Instruments:
   1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
   2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

D. See Section 16120.

3.02 FIELD QUALITY CONTROL

A. See Section 01650.

B. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.
   1. Documentation requirements include the utilization of the forms located at the end of this section.
      a. Loop Checkout Sheet.
      b. Instrument Certification Sheet.
      c. Final Control Element Certification Sheet.

C. In the event that instrument air is not available during calibration and testing, supply either filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality air. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system or pneumatic control system.

D. Pneumatic Signal Tubing Testing:
   1. Before the leak test is begun, blow clean with dry air.
   2. Test signal tubing per ISA RP7.1, except for tubing runs of less than 10 FT where simple soap bubble testing will suffice.
   3. If a leak is detected, repair the leak and repeat the leak test.

4. After completion of the leak test, check each signal line for obstructions. If any are indicated, remove and retest.

E. Instrumentation Calibration:

1. Verify that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
2. Calibrate all field-mounted instruments, other than local pressure and temperature gages, after the device is mounted in place to assure proper installed operation.
3. Calibrate in accordance with the manufacturer's specifications.
4. Bench calibrate pressure and temperature gages. Field mount gage within 1 day of calibration.
5. Check the calibration of each transmitter and gage across its specified range at 0, 25, 50, 75, and 100 percent. Check for both increasing and decreasing input signals to detect hysteresis.
6. Replace any instrument which cannot be properly adjusted.
7. Stroke control valves with clean dry air to verify control action, positioner settings, and solenoid functions.
8. Mark range, date, setpoint and calibrator's initials on each instrument by means of blue or black ink on a waterproof tag affixed to the instrument.
9. Calibration equipment shall be certified by an independent agency with traceability to NIST. Certification shall be up-to-date. Use of equipment with expired certifications shall not be permitted.
10. Calibration equipment shall be at least three times more accurate as the device being calibrated.

F. Loop checkout requirements are as follows:

1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections. Use actual signals where available. Closely observe controllers, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components. Make corrections as required. Following any corrections, retest the loop as before.
2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
3. Check all interlocks to the maximum extent possible.
4. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

G. Provide verification of system assembly, power, ground, and I/O tests.

H. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

END OF SECTION

SECTION 13442

PRIMARY ELEMENTS AND TRANSMITTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Flow components.
   2. Pressure components.
   3. Level components.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 13440 - Instrumentation for Process Control: General Requirements.
   4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Gas Association (AGA):
      a. Gas Measurement Committee Report #3.
   2. American Iron and Steel Institute (AISI).
   3. American National Standards Institute (ANSI):
      a. B16.5, Pipe Flanges and Flanged Fittings.
      b. PTC 19.3, Instruments and Apparatus, Part 3 Temperature Measurement.
      c. MC96.1, Temperature Measurement Thermocouples.
   4. American Society of Mechanical Engineers (ASME):
      a. Fluid Meters, Sixth Edition.
   5. American Society for Testing and Materials (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. A182, Standard Specification for Forged or Rolled Alloy - Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service.
      c. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
      d. B61, Standard Specification for Steam or Valve Bronze Castings.
   6. National Electrical Manufacturers Association (NEMA):
      a. ICS 6, Enclosures for Industrial Controls and Systems.

1.03 SYSTEM DESCRIPTION

A. The instruments specified in this Section are the primary element components for the control loops shown on the "E" series Drawings. These instruments are integrated with other control system components specified under the 13440 specification series to produce the functional control defined in the Contract Documents.

1.04 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 13440.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the Manufacturers listed in the articles describing the elements are acceptable.

B. Submit requests for substitutions in accordance with Specification Section 01640.

2.02 FLOW COMPONENTS

A. Doppler type ultrasonic flow meters:
   1. Acceptance manufacturers:
      a. Polysonics.
      b. Dynasonics, Inc.
   2. Material:
      a. Transducer housing: Epoxy encapsulated aluminum or equal.
   3. Design and fabrication:
      a. Flow transducers mounted to outside of pipe:
         1) Single head transducer.
         2) Installed and removed without interrupting flow in pipe.
      b. Solid state sensing element circuitry.
      c. Ambient temperature: 0 to 140 DegF.
      d. Power supply: 120 V AC at 60 HZ.
      e. Transmitter adjustments:
         1) Range calibration.
         2) Span.
         3) Zero.
         4) Output signal damping.
      f. Transmitter output:
         1) 4-20 mA isolated into 600 ohms.
         2) Proportional to flow.

4. Schedule:

TAG NUMBER	SERVICE	PIPE SIZE (IN)	THICKNESS (IN)	RANGE
WQPS1	Stormwater	12	0.28	0-4000 gpm
EPS1	Stormwater	16	0.34	0-20 cfs

B. Propeller Meters:

1. Acceptable manufacturers:
   a. Sensus Technologies, Inc.
   b. Sparling.
   c. Brooks.
   d. Hersey Measurement Co.
   e. Water Specialties.
2. Materials:
   a. Body: Fabricated steel tube meter with 125 lb flanged ends.
   b. Propeller support shaft: Stainless steel.
   c. Propeller: Polypropylene, nylafil, injection molded thermoplastic or polystyrene.
   d. Meter head: Cast iron or fabricated steel.
   e. Gear housing: Bronze or stainless steel.
   f. O-Ring:
      1) Up to 105 DegF: Buna-N.
3. Design and fabrication:
   a. Fabricate with four straightening vanes, radially spaced 90 degrees apart.
   b. Meter tube: Nominal inside diameter throughout its length.
   c. Provide flanged end connections:
      1) Per ANSI B16.5.
      2) Rated for piping system operating and test conditions.
   d. Connect meter head to tube by means of a flanged connection designed for easy removal.
   e. Use O-ring, compression type seal to seal the meter head to the tube.
   f. Isolate register drive from water pressure by a sealed housing.
   g. Provide propeller magnetically coupled to the register drive.
   h. Protect register by an O-ring sealed register box located under the hinged lid. Provide hinged lid complete with locking hasp.
   i. Accuracy: ± 2 percent of rate within 10:1 turndown.
   j. Provide a 4 IN minimum dial indicator calibrated to read instantaneous flow rate directly in units indicated with a range as specified.
   k. Equip with a six-digit totalizer calibrated in thousands of gallons. Provide test hand.
4. Schedule:

TAG NUMBER	SERVICE	PIPE ID (IN)	PIPE OD (IN)	PIPE MATERIAL	FLOW RANGE (GPM)	OUTPUT SIGNAL
WM1 & WM2	Water	3	3.96	DIP	0-330	none

2.03 PRESSURE COMPONENTS

A. Pressure Gage:
1. Acceptable manufacturers:
   a. Ashcroft.
   b. Ametek.
2. Materials:
   a. Bourdon tube, socket, connecting tube: 316 stainless steel.
   b. Case: Phenolic.
   c. Diaphragm seal housing: 316 stainless steel.
   d. Pressure snubber:
      1) Filter disc: 316 stainless steel.
      2) Housing: 316 stainless steel.
3. Accessories:
   a. Provide valve at point of connection to equipment and at panel if panel mounted.
   b. Provide pressure snubbers designed to match application in accordance with the following:

POROSITY DESIGNATION	PORE OPENING, INCHES MEAN	MAX	MILITARY DESIGNATION TYPE	SERVICE FLUID	VISCOSITY RANGE
C			I	Highly Viscous Fluids	Over 500 SSU
D	0.0025	0.005	I	Heavy Oils	225 - 500 SSU
E	0.0013	0.0025	II	Water & Light Oils	30 - 225 SSU
F			II	Vapors & Low Viscosity	Under 30 SSU
G	0.0004	0.0009	III	Air, Steam & Gases	
HX	0.0002	0.0006		Violent Pneumatic Pulse	

   c. In-line isolating sleeve (Annular Seal):
      1) Acceptable manufacturers:

a) Red Valve.
b) Or equal.

2) Provide full 360 degree circumferential reading of line fluid with flexible in-line rubber sleeve.

3) Mounting: In-line mounting between standard ANSI pipe flanges.

d. System fill application:

1) Utilize halocarbon fill for process applications involving strong oxidizing agents. Agents include but are not limited to: Cl2, KMNO4, FeCl, NaOH, and NaOCl.

2) Utilize manufacturer's standard fill for other applications. Ensure fill is suitable for application temperatures.

e. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water and steam applications.

4. Design and fabrication:

a. All components suitable for service at:

1) 250 DegF.

2) The maximum process temperature to which the gage is to be exposed.

b. Provide viewer protection from element rupture.

c. Calibrate gages at jobsite for pressure and temperature in accordance with manufacturer's instructions.

d. Unless otherwise required by codes, provide stem mounted or flush mounted, as required, with dial diameter as follows:

PIPE SIZE	DIAL SIZE	GAGE CONNECTION
1-1/2 IN or less	2-1/2 IN	1/4 IN
Larger than 1-1/2 IN	4-1/2 IN	1/2 IN

e. Equip with white faces, black numerals and black pointers.

f. Gage tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment. Gage to be readable from an accessible standing position.

g. Gage accuracy: 1 percent of full range.

h. Select gage range so that:

1) The normal operating value is in the middle third of the dial.

2) Maximum operating pressure does not exceed 75 percent of the full scale range.

B. Float-Tilt Type Level Switches:

1. Acceptable manufacturers:

a. Anchor Scientific Inc.

b. Consolidated Electric.

2. Materials:

a. Float material: Polypropylene or teflon coated type 316 stainless steel.
b. Cable jacket: PVC, neoprene or equal.
c. Cable clamp: Polypropylene or 316 stainless steel.
d. Design and fabrication:
    1) Sealed mercury switch in float.
    2) Provide switch complete with flexible electrical cables.
    3) DPST contact rated at 4.5 A at 120 V AC.
    4) Direct acting float switch:
        a) Switch actuates on rising level.
        b) Switch deactuates when liquid falls 1 IN below actuation level.
    5) Terminate cables in junction box.
    6) Process temperature: 40°-90°F.
    7) Install floats per Drawing details.

2.04 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
    1. Materials, unless otherwise specified, shall be as follows:
        a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
        b. Mounting brackets:
            1) Standard: 316 stainless steel.
            2) Highly corrosive areas: aluminum.
        c. Mounting plates, angles:
            1) Standard: carbon steel.
            2) Corrosive areas: aluminum.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Process piping systems.
2. Utility piping systems.

B. Related Sections include but are not necessarily limited to:
1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Supplementary General Conditions.
3. Section 09906 - Painting and Protective Coatings.
4. Section 11005 - Equipment: Basic Requirements.
5. Section 13442 - Primary Elements and Transmitters.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M36, Corrugated Steel Culverts and Underdrains.
   b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
2. American National Standards Institute (ANSI):
   a. B16.3, Malleable Iron Threaded Fittings.
   b. B16.5, Pipe Flanges and Flanged Fittings.
   c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
   d. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element.
3. American National Standards Institute (ANSI)/American Water Works Association (AWWA):
   a. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
   b. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
   c. C151, Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand-Lined Molds for Water or Other Liquids.
   d. ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 IN Through 16 IN, for Water and Other Liquids.
   e. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
4. American Society for Testing and Materials (ASTM):

a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
b. A536, Standard Specification for Ductile Iron Castings.
c. B88, Seamless Copper Water Tube (ANSI H23.1).
d. D1785, Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
e. D2466, Socket Type (PVC) Plastic Pipe Fittings, Schedule 40.
f. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

5. American Water Works Association (AWWA):
   a. B300, Standard for Hypochlorites.
   b. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
   c. C651, Standard for Disinfecting Water Mains.

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.03 SUBMITTALS

A. Shop Drawings:
1. See Section 01340.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
3. Qualifications:
   a. Qualifications of lab performing disinfection analysis on water systems.
4. Test reports:
   a. Copies of pressure test results on all piping systems.
   b. Disinfection test report.
   c. Notification of time and date of piping pressure tests.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Insulating unions:
      a. "Dielectric" by Epco.
   2. Dirt strainers (Y type):
      a. Mueller (#351).
      b. Sarco.
      c. Armstrong.
   3. Chemical strainers (Y type):
      a. Chemtrol.
      b. Asahi.
   4. Dielectric flange kit:
      a. PSI.
      b. Maloney.
      c. Central Plastics.
   5. Pipe saddles (for gage installation):
      a. Dresser Style 91 (steel and ductile iron systems).
      b. Dresser Style 194 (non-metallic systems).

2.02 COMPONENTS AND ACCESSORIES

A. Insulating Components:
   1. Dielectric flange kits:
      a. Flat faced.
      b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
      c. Suitable for 175 psi, 210 DegF.
      d. 1/32 IN wall thickness bolt sleeves.
      e. 1/8 IN thick phenolic insulating washers.
   2. Dielectric unions:
      a. Screwed end connections.
      b. Rated at 175 psi, 210 DegF.
      c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Dirt Strainers:
   1. Y-type.
   2. Composition bronze.
   3. Rated for test pressure and temperature of system in which they are installed.
   4. 20 mesh monel screen.
   5. Threaded bronze plug in the blowoff outlet.
   6. Ball valve with hose thread nipple in the blowoff outlet.

7. Threaded NPT end connections.

C. Strainers for Chemical Applications:
1. Y-type.
2. Strainers of same material, test pressure, and temperature rating as system in which strainer is placed.

D. Reducers:
1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

E. Protective Coating and Lining:
1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items are specified.
2. Field paint pipe in accordance with Section 09905.

PART 3 - EXECUTION

3.01 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 3 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Laying Pipe In Trench:
1. Excavate and backfill trench in accordance with M.A.G. specifications.
2. Clean each pipe length thoroughly and inspect for compliance to Specifications.
3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
6. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except where approved by Engineer.
7. Seal open end of line with watertight plug if pipe laying stopped.
8. Remove water in trench before removal of plug.

C. Lining Up Push-On Joint Piping:
1. Lay piping on route lines shown on Drawings.
2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.

3. Observe maximum deflection values stated in manufacturer's written literature.
4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

D. Anchorage and Blocking:
1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall. Concrete blocks shall not cover pipe joints.
3. Provide bearing area of concrete in accordance with M.A.G. Standard Detail 380.

E. Install insulating components where dissimilar metals are joined together.

3.02 EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown. However, install according to Drawing intent and with clearance and allowance for:
1. Expansion and contraction.
2. Operation and access to equipment.
3. Headroom and walking space for working areas.
4. System drainage and air removal.

C. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

D. Pipe Support:
1. Use methods of piping support as shown on Drawings.

E. Use reducing fittings throughout piping systems. Bushings will not be allowed unless specifically approved.

F. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

G. Install expansion devices as necessary to allow expansion/contraction movement.

H. Provide full face gaskets on all systems.

I. Anchorage and Blocking:
   1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

J. Provide insulating components where dissimilar metals are joined together.

3.03 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in the M.A.G. specifications.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.04 FIELD QUALITY CONTROL

A. Pipe Testing - General:
   1. Test piping systems as follows:
      a. Test exposed, non-insulated piping systems upon completion of system.
      b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
      c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
   2. Isolate equipment which may be damaged by the specified pressure test conditions.

3. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
   a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
   b. Notify the Engineer 24 HRS prior to each test.
4. Completely assemble and test new piping systems prior to connection to existing pipe systems.
5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
6. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

3.05 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
1. Clean interior of piping systems thoroughly before installing.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.

B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
5. Drain flushing water to sanitary sewer. Do not drain flushing water to receiving stream.
6. Use continuous feed method of application. Tag system during disinfection procedure to prevent use.
7. After required contact period, flush system to remove traces of heavily chlorinated water.

8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality. Repeat entire disinfection procedures until satisfactory results are obtained.

3.06 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as buildings, existing structure lines, and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

3.07 SCHEDULES

A. POTABLE AND NONPOTABLE WATER PIPING SPECIFICATION SCHEDULE – SYSTEM

1. General:
   a. Potable and Nonpotable water piping service:
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: Per M.A.G. Specifications.
      3) Duration: Per M.A.G. Specifications.
   c. Gaskets and O-rings:
      1) O-rings: Neoprene or rubber.
      2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA C111.
      3) Flanged joints (steel): Rubber, ANSI C207.
      4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
2. System components:
   a. Pipe size: To 1 IN.
      1) Exposed service:
         a) Materials: Stainless steel tubing, TP-304L.
         b) Reference: ASTM A269.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: Stainless steel 304L compression type tube fittings.
         f) Joints: Compression type couplings, unions at equipment and valves.

g) Minimum wall thickness:
(1) 1/16 IN OD: 0.010 IN.
(2) 1/8 to 1/4 IN OD: 0.028 IN.
(3) 5/16 to 1/2 IN OD: 0.049 IN.
(4) 5/8 to 1 IN OD: 0.065 IN.

b. Pipe size: 1 to 3 IN.
1) Exposed service:
a) Materials: Steel, Grade B, black. Schedule 40 if threaded. If grooved type joint, use pipe thickness per AWWA C606.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Malleable iron or steel meeting ANSI B16.3 and ASTM A234.
f) Joints: Threaded or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.
2) Buried service:
a) Materials: Steel, Schedule 40, Grade B.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Bituminous.
e) Fittings: Malleable iron meeting ANSI B16.3.
f) Joints: Threaded.

c. Pipe size: 3 IN through 24 IN.
1) Exposed service:
a) Materials: Ductile iron, Class 350 if flanged. If grooved type mechanical joint system, use pipe thickness per AWWA C606.
b) Reference: ANSI C115.
c) Lining: Cement.
d) Coating: Paint.
e) Fittings: Either ANSI C110 ductile or gray iron.
f) Joints: Flanged or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide screwed-on flanges at valves, equipment and structure penetration.
2) Buried service:
a) Materials: Ductile iron, Class 350.
b) Reference: ANSI C115.
c) Lining: Cement.

d) Coating: Bituminous with polyethylene encasement.

e) Fittings: Either ANSI C110 ductile or gray iron. Optional ANSI C153 ductile iron compact fittings for sizes 3 to 16 IN.

f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.

END OF SECTION

SECTION 15062

PIPE: DUCTILE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Ductile iron piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.02 SUBMITTALS

A. Shop Drawings:
   1. See Section 15060.
   2. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which will be utilized to meet system requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All ductile iron pipe shall meet the requirements of MAG Specification Section 750.

2.02 FABRICATION

A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled to be painted.

B. Furnish cast parts with lacquer finish compatible with finish coat.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Joining Method - Push-On Mechanical (Gland-Type) Joints:
   1. Install in accordance with AWWA C111.

2. Assemble mechanical joints carefully according to manufacturer's recommendations.
3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
4. Do not overstress bolts.
5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.

B. Joining Method - Push-On Joints:
1. Install in accordance with AWWA C151.
2. Assemble push-on joints in accordance with manufacturer's directions.
3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket. Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
4. Assure the gasket groove is thoroughly clean.
5. For cold weather installation, warm gasket prior to placement in bell.
6. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.

C. Joining Method - Flanged Joints:
1. Install in accordance with AWWA C115.
2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
3. Make flange faces flat and perpendicular to pipe centerline.
4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
5. Allow one flange free movement in any direction while bolts are being tightened.
6. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
7. Gradually tighten flange bolts uniformly to permit even gasket compression.

D. Joining Method - Mechanical Coupling Joint:
1. Arrange piping so that pipe ends are in full contact.
2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
3. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

E. Flange Adapters 12 IN and Less:
1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.

2. Drill holes not more than 1/8 IN larger than diameter of stud projection.

F. Cutting:
1. Do not damage interior lining material during cutting.
2. Use abrasive wheel cutters or saws.
3. Make square cuts.
4. Bevel and free cut ends of sharp edges after cutting.

G. Joint Restraint: All ductile iron pipe horizontal and vertical bends and deflections shall be restrained per MAG Standard Details 303-1 and 303-2. In no instances shall concrete thrust blocks be allowed.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060.

END OF SECTION

SECTION 15063

PIPE: COPPER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Copper piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Supplementary General Conditions.
   2. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.
   3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
   4. Section 15090 - Pipe Support Systems.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B16.18, Cast Bronze Solder - Joint Pressure Fittings.
      b. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      c. B16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.
      d. B16.24, Bronze Flanges and Flanged Fittings, 150 and 300 LBS.
      e. B16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.
   2. American Society for Testing and Materials (ASTM):
      a. B32, Solder Metal.
      b. B42, Seamless Copper Pipe, Standard Sizes.
      c. B88, Seamless Copper Water Tube (ANSI H23.1).
      d. B306, Copper Drainage Tube (DWV) (ANSI H23.6).
   3. American Welding Society (AWS):
      a. A5.8, Brazing Filler Material.

1.03 SUBMITTALS

A. See Section 15060.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Copper Tubing:

1. Pressure non-buried: ASTM B88, Type L hard.
2. Pressure buried: ASTM B88, Type K.
3. Non-pressure: ASTM B306.

B. Copper Pipe: ASTM B42, regular strength.

C. Fittings:
1. Pressure non-buried: ANSI B16.22.
2. Pressure buried: ANSI B16.22 or B16.26.
3. Non-pressure: ANSI B16.23

D. Soldering and Brazing:
1. Non-buried:
a. ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180 DegF water temperature.
b. At 180 DegF and above, use brazing alloy with melting temperature above 1000 DegF and suitable flux.
2. Buried: Silver solder per AWS 5.8.

E. See Piping Schedules in Section 15060.

F. Unions:
1. Pipe sizes 2 IN and smaller:
a. Copper, ground joint.
2. Pipe sizes 2-1/2 IN and larger:
a. Brass flanged unions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with Section 15060.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060.

B. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.

C. Support exposed piping in accordance with Sections 15060 and 15090.

D. Install buried piping in accordance with Sections 15060.

END OF SECTION

SECTION 15090

PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pipe support and anchor systems.

B. Related Sections include but are not necessarily limited to:
   1. Supplementary General Conditions.
   2. Section 09906 - Painting and Protective Coatings.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B31.1, Power Piping.
      b. B31.3, Chemical Plant and Petroleum Refinery Piping.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      c. A576, Standard Specification for Steel Bars, Hot-Wrought, Special Quality.
   3. American Welding Society (AWS):
      a. D1.1, Structural Welding Code Steel.
   4. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
      a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP-69, Pipe Hangers and Supports - Selection and Application.

1.03 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.

d. Scale drawings showing guides, hangers, supports, anchors, structural members and appurtenances to describe the pipe support system.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Hanger Rods:
1. Material:
   a. ASTM A36.
   b. ASTM A510, Grade 1020.
   c. ASTM A575, Grade M1020.
   d. ASTM A576, Grade 1020.
   e. Minimum allowable tensile stress of 12,000 psi at 650 DegF per MSS-SP-58.
2. Continuously threaded.
3. Electro-galvanized or cadmium plated after threads are cut.
4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

B. Hangers:
1. Hangers for use directly on copper pipe: Copper or cadmium plated.
2. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER SIZE
All except noted	4 IN & less	ITT Grinnell Figure 108 with Figure 114
All except noted	Over 4 IN	ITT Grinnell Figure 590
Steam, condensate and hot water	All	ITT Grinnell Figure 181, Figure 82 or equal

C. Concrete Inserts for Hanger Rods:
   1. Continuous slots: Unistrut #P1000.
   2. Individual inserts: ITT Grinnell Figure 281.
   3. Self-drilling expansion anchors: Phillips flush-end or snap-off end type.

D. Beam Clamps for Hanger Rods:
   1. Heavy duty.
   2. ITT Grinnell Figure 134.

E. Trapeze Hangers for Suspended Piping:
   1. Material: Steel.
   2. Galvanized.
   3. Angles, channels, or other structural shapes.
   4. Curved roller surfaces at support point corresponding with type of hanger required.

F. Vertical Pipe Supports:
   1. At base of riser:
   2. Lateral movement:
      a. Clamps or brackets:
         1) ITT Grinnell.

G. Expanding Pipe Supports:
   1. Spring hanger type.
   2. MSS SP-58.

H. Pipe Support Saddle:
   1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
   2. ITT Grinnell Figure 264.

I. Pipe Support Risers:
   1. Schedule 40 pipe.
   2. 304 L Stainless Steel for exterior installations.
   3. Galvanized.
   4. As recommended by saddle manufacturer.

J. Pipe Support Base Plate:
   1. 4 IN larger than support.
   2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
   3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
   4. Collar welded to floor plate.
   5. Edges ground smooth.
   6. Assembly hot dipped galvanized after fabrication.

K. Pipe Covering Protection Saddle:
   1. For insulated pipe at point of support.
   2. ITT Grinnell Figure 167, Type B.

L. Wall Brackets:
   1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
   2. ITT Grinnell Figure 199.

M. Pipe Anchors:
   1. For locations shown on the Drawings.
   2. 1/4 IN steel plate construction.
   3. Hot dipped galvanized after fabrication.
   4. Designed to prevent movement of pipe at point of attachment.

N. Pipe Guides:
   1. For locations on both sides on each expansion joint or loop.
   2. To ensure proper alignment of expanding or contracting pipe.
   3. ITT Grinnell Figure 256.

O. Substitutions:
   1. Submit requests for substitutions in accordance with Specification Section 01640.

2.02 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.
   1. Provide 5 to 1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
   1. ANSI B31.3.
   2. MSS SP-58 and SP-69.
   3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
   1. ANSI B31.1.
   2. MSS SP-58 and SP-69.

F. Check all physical clearances between piping, support system and structure.
   1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.

H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.
   1. Insulated piping 1-1/2 IN and less:
      a. Provide a 9 IN length of 9 LB density fiberglass insulation at saddle.
   2. Insulated piping over 1-1/2 IN:
      a. Provide a 12 IN length of 9 LB density fiberglass insulation on saddle.

I. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.

J. Pipe Support Spacing:
   1. General:
      a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
      b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
      c. Provide at least one support for each length of pipe at each change of direction and at each valve.
   2. Steel, stainless steel, cast-iron pipe support schedule:

PIPE SIZES – IN	MAXIMUM SPAN – FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

   3. Copper pipe support schedule:

PIPE SIZES – IN	MAXIMUM SPAN – FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC pipe support schedule:

PIPE SIZES – IN	MAXIMUM SPAN – FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 Degf.

5. Support each length and every fitting:
   a. Bell and spigot piping:
      1) At least one hanger.
      2) Applied at bell.
   b. Mechanical coupling joints:
      1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
7. Provide continuous support for nylon tubing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
   1. Included in this requirement are movements from:
      a. Trap discharge.
      b. Water hammer.
      c. Similar internal forces.

B. Weld Supports:
   1. AWS D1.1.
   2. Weld anchors to pipe in accordance with ANSI B31.3.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect hangers for:
   1. Design offset.
   2. Adequacy of clearance for piping and supports in the hot and cold positions.
   3. Guides to permit movement without binding.
   4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
   1. Install concrete inserts as concrete forms are installed.

G. Welding:
   1. Welding rods: ASTM and AWS standards.
   2. Integral attachments:
      a. Include welded-on ears, shoes, plates and angle clips.
      b. Ensure material for integral attachments is of good weldable quality.
   3. Preheating, welding and postheat treating: ANSI B31.3, Chapter V.

H. Field Painting:
   1. Comply with Section 09906.

END OF SECTION

SECTION 15102

PLUG VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Plug valves.

B. Related Sections include but are not necessarily limited to:
   1. Supplementary General Conditions.
   2. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A21.11, Rubber - Gasket Joints for Ductile - Iron and Gray - Iron Pressure Pipe and Fittings.
      b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
   2. American Society for Testing and Materials (ASTM):
      a. A126, Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      b. A536, Standard Specification for Ductile Iron Castings.
   3. American Water Works Association (AWWA):
      a. C606, Grooved and Shouldered Joints.

1.03 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. No like, equivalent or "or-equal" item or substitution is permitted.

2.02 NON-LUBRICATED ECCENTRIC PLUG VALVES SLUDGE, DECANT

A. Acceptable Manufacturer:
   1. DeZurik Series 100.
   2. Millikin Series 600.

B. Materials:
   1. Body: Cast-iron ASTM A126, Class B.
   2. Plug: One piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM 126 Class B.
   3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.
   4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
   5. Valve seats: Welded-in overlay of 90 percent nickel, minimum Brinell hardness of 200, (minimum 1/8 IN thick).
   6. Stem seal: Nitrile butadiene packing or Buna-N dual U-cups per Sec. 3.7 AWWA C504.

2.03 ACCESSORIES

A. Furnish handwheel actuator integral with valve.

2.04 DESIGN REQUIREMENTS

A. Non-Lubricated Eccentric Plug Valves:
   1. Port area:
      a. Valves 4 IN through 20 IN: Equal to or exceed 80 percent of full pipe area.
      b. Valves greater than 20 IN: 100 percent equivalent full pipe area.
   2. Valve body:
      a. Fitted with bolted bonnet.
   3. End connections: See Section 15100.
   4. Stem seal:
      a. Adjustable and replaceable without disassembling valve or bonnet.
   5. Designed for seating drip tight in any flow direction.
   6. Rating:
      a. 1/2 through 12 IN, 175 psi working pressure.
      b. 14 through 36 IN, 150 psi working pressure.
      c. Three-way valves, 125 psi working pressure.
   7. Actuator:
      a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
      b. Positive identification on actuator indicating valve position.

c. Adjustable stop to set closing torque.
d. Stem seal adjustment accessible without removing actuator from valve.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

B. Install valve with actuator above pipe or plug centerline.

END OF SECTION

SECTION 16010

ELECTRICAL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical work and requirements for underground distribution.

B. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe for energization.

C. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 11005 - Equipment: Basic Requirements.

D. Drawings Use and Interpretation:
   1. Drawings indicate the location and arrangement of electrical equipment and the approximate location of other equipment requiring electrical work.
      a. For exact locations refer to dimensioned civil drawings.
      b. Field measurements take precedence over dimensioned drawings.

E. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.

F. Dimensions indicated for electrical equipment and dimensions indicated for the installation of electrical equipment shall be complied with.

1.02 AREA CLASSIFICATIONS

A. Classification of an area will determine the NEMA rating of the electrical equipment enclosures to be used in that area. Selection of electrical equipment enclosures shall be based on the following criteria:
   1. All locations are classified as Wet and all electrical equipment enclosures shall be NEMA 4 rated.

1.03 DEFINITIONS

A. Shop Fabricated:
   1. Manufactured or assembled equipment for which a UL test procedure has not been established.

1.04 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual - Stainless and Heat Resisting Steel..
   2. American Association of State Highway & Transportation Officials (AASHTO).
   3. American National Standards Institute (ANSI):
      a. C2, National Electrical Safety Code.
   4. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      d. A536, Standard Specification for Ductile Iron Castings.
   5. ETL Testing Laboratories, Inc (ETL).
   6. Factory Mutual System (FM):
      a. A Guide to Equipment, Materials and Services.
   7. Institute of Electrical and Electronics Engineers (IEEE):
      a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
      b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   7. National Electrical Manufacturers Association (NEMA):
      a. ICS 6, Enclosures for Industrial Controls and Systems.
   8. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   9. Underwriters Laboratories, Inc (UL):
      a. 508, Safety Industrial Control Equipment.
      b. 698, Industrial Control Equipment for Use in Hazardous Locations.
      c. 1449, Safety Transient Voltage Surge Suppressors.

B. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, drawings and specifications, or within either document itself, the more stringent condition shall govern.

C. Miscellaneous:
   1. Drawings indicate the intended location of handholes; and routing of direct buried conduit. Field conditions may affect actual routing.

1.05 SYSTEM DESCRIPTION

A. Provide functioning systems in compliance with manufacturer's instructions, performance requirements specified or shown on the Drawings, and modifications resulting from reviewed shop drawings and field coordinated drawings.

1.06 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 11005.
   2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division 16 sections for specific requirements.
   3. Prior to submittals of shop drawings, coordinate electrical equipment, particularly motor control equipment, control panels, and instrumentation, with all applicable equipment and systems interfacing with that equipment..
   4. For each product, clearly identify manufacturer by name.
   5. Provide manufacturer's technical information on products to be used, including:
      a. Product descriptive bulletin.
      b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications and Drawings.
      c. Equipment dimensions, where applicable.
      d. Evidence that the products submitted meet the requirements of the standards referenced.
   6. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.
   7. Ensure that all submittals clearly indicate the equipment is UL or ETL listed or is constructed utilizing UL or ETL listed or UL recognized components. Where a UL standard has not been established clearly identify that no UL standard exists for that equipment.
   8. For all equipment, provide manufacturer's installation instructions.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01600.

B. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage-either inside or on top of enclosures.

C. Protect nameplates on electrical equipment to prevent defacing.

D. Repair, restore or replace damaged, corroded and rejected items at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

B. Refer to related Division 16 sections.
   1. All equipment of a similar type shall be by one manufacturer unless otherwise noted in the Specifications.

C. Warning Tape:
   1. W H Brady Company.
   2. Seton Nameplate Company.

D. Nameplates:
   1. W H Brady Company.
   2. Seton Nameplate Company.

E. Conduit:
   1. See Section 16111.

F. Precast manholes and handholes:
   1. Quazite Composolite.
   2. Dalworth Quickset.
   3. Utility Vault Co.

G. Manhole and handhole covers:
   1. Neenah.
   2. Utility Vault Co.

H. Cable pulling irons and duct terminators:
   1. Condux International, Inc.

2.02 MATERIALS

A. Trade names and catalog numbers may be used in the Drawings or Specifications to establish quality standards and basics of design.

1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.
2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Listed:
1. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

C. Structural Steel Supports:
1. Galvanized steel: ASTM A36.
   a. PVC coated in Class I and in corrosive areas.
2. Stainless steel: AISI Type 316.

D. Warning Tape:
1. Material: Polyethylene.
2. Thickness: 3.5 mils.
3. Tensile strength: 1750 psi.
4. Size: 6 IN wide (minimum).
5. Legend: Preprinted and permanently imbedded:
   a. Message continuously printed.

E. Equipment Enclosure and Component Nameplates:
1. Phenolic or thermoplastic laminate 1/16 IN thick with holes for screw mounting.
2. 3/16 IN high lettering, unless otherwise indicated.
3. Engrave letters through top surface into contrasting color core:
   a. Colors: Black top surface, white core, unless otherwise indicated.
4. Stainless steel self-tapping screws.
5. Size as required for the legend.

F. Warning Signs:
1. Plastic laminate 1/16 IN thick with holes for screw mounting.
2. ¾ IN high letters for the words "WARNING," "DANGER," and "CAUTION"; all other lettering 3/16 IN high unless otherwise indicated.
3. Engrave letters through top surface into contrasting color core:
   a. Colors: Red for "DANGER", orange for "WARNING", yellow for "CAUTION", and green for "Safety Instructional" signs.
4. Stainless steel self-tapping screws.
5. Size as required for the legend.

G. Precast Manholes and Handholes:

1. Fiberglass reinforced polymer concrete and steel reinforced cement concrete structures:
2. Shall have an AASHTO live load rating of H-20.
3. Mating edges shall be tongue and groove type.

H. Manhole and Handhole Covers:
1. Cast ductile iron:
a. ASTM A536.
2. AASHTO live load rating: H-20.
3. Cast the legend "ELECTRICAL" into manhole and handhole covers.

I. Cable Pulling Irons:
1. 7/8 IN DIA hot-dipped galvanized steel.
2. 6000 LB minimum pulling load.

J. Duct Terminators:
1. ABS plastic.
2. Provide for conduit entrance.
3. Designed for installation into handhole walls for a watertight seal.

2.03 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:
1. See Section 11005.
2. Interiors of other painted equipment shall be either white or light gray.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with the requirements of the NEC.

B. Enclosures for Use with Electrical Equipment:
1. NEMA 4: Use in wet locations.
2. Exceptions:
a. As modified in other Division 16 sections.
b. As otherwise indicated on the Drawings.
3. Standards:

a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.
b. UL 508, Safety Industrial Control Equipment.
c. UL 698, Industrial Control Equipment for Use in Hazardous Locations.

C. Verify that equipment will fit support layouts indicated.

D. Equipment Dimensions and Clearances:
1. Do not use equipment that exceeds the indicated dimensions.
   a. Except as approved in writing by the Engineer.
2. Electrical equipment shall be installed a minimum of 6 IN from process, gas, air and water piping and equipment:
   a. Electrical equipment does include conduit and pull and junction boxes.
3. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

E. Install equipment in accordance with the manufacturer's instructions.

F. Equipment Access:
1. Install equipment so it is readily accessible for operation and maintenance.
2. Equipment shall not be blocked or concealed.
3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

G. Equipment shall be installed plumbed and square and shall be securely fastened.

H. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

I. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

J. Provide all necessary anchoring devices and supports.
1. Use supports as detailed on the Drawings and as specified.
   a. Where not detailed on the Drawings or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.
2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.

3. Hardware shall be malleable type, corrosion resistant and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.
4. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

K. Provide concrete foundations or pads required for electrical equipment as indicated or specified.

L. Underground Conduits:
1. Direct-buried:
   a. Provide conduit directly buried in earth.
   b. For circuits 600 V and below, install so that top of conduit, at any point, is not less than the minimum depths established by the NEC (Table 300-5 and exceptions).
      1) RGS conduit: 6 IN.
      2) Rigid PVC conduit: 18 IN.
      3) Under areas subject to vehicular traffic:
         a) All applications: 24 IN.
      4) Unless otherwise detailed on the Drawings.
2. All underground conduits shall comply with the following:
   a. Minimum grade shall be 4 IN per 100 FT or as detailed on the Drawings.
   b. During construction and after conduit installation is complete, plug the ends of all conduits.
   c. Make conduit joints watertight and in accordance with manufacturer's recommendations.
      1) Make plastic conduit joints by uniformly brushing a plastic solvent cement on inside of plastic coupling fitting and outside of conduit ends. Slip conduit and fitting together with a quick one-quarter turn twist to set joint tightly.
   d. Accomplish changes in direction of runs exceeding a total of 5 degrees by long sweep bends having a minimum radius of 25 FT.
      1) Sweep bends shall be made with RGS conduit and may be made up of one or more curved or straight sections or combinations thereof.
   e. Transition from PVC to RGS conduit a minimum of 5 FT prior to entering a structure or going above ground.
      1) Unless otherwise indicated on the Drawings.
      2) PVC conduit may be extended directly to pull, junction and transformer boxes and handholes.
   f. After the conduit run has been completed, pull a standard flexible mandrel having a length of not less than 12 IN and a

diameter approximately 1/4 IN less than the inside diameter of the conduit through each conduit. Then pull a brush with stiff bristles through each conduit to remove any foreign material left in conduit.

3. Warning tape:
   a. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable.
      1) 6 IN below finished grade where conduit or ductbank is 12 IN or more below finished grade.
      2) 3 IN below finished grade where conduit or ductbank is less than 12 IN below finished grade.
   b. Provide warning tape as follows:
      1) Electrical trenches and ductbanks or directly buried conduit:
         a) Legend: CAUTION CAUTION CAUTION (1st line), BURIED ELECTRIC LINE (2nd line).
         b) Letters: 1-1/4 IN minimum.
         c) Interval: Continuous.
         d) Color: Tape shall be red with black letters.
4. Handholes:
   a. Construct approximately where shown on the Drawings. Determine the exact locations after careful consideration has been given to location of other utilities, grading, and paving.
      1) Locations are to be approved by the Engineer prior to excavation and construction.
   b. Shall be sized for the number of conduits entering unless other dimensions are detailed on the Drawings or specified.
      1) Minimum floor dimensions shall be 2 x 2 FT and minimum depth shall be 2 FT .
   c. Shall be installed in accordance with the manufacturer's instructions for "subject to occasional heavy vehicles."
      1) Do not use precast handholes in roadways.
   d. Provide minimum 8 IN of crushed rock or gravel prior to setting manhole and handhole bases.
   e. Grout or seal all joints in accordance with the manufacturers instructions.
   f. Set frames and covers:
      1) Paint with two coats asphaltic paint before setting.
      2) In paved areas, set top of handhole covers flush with finished surface of paving.
      3) In unpaved areas, set top of handhole covers approximately 1/2 IN above finished grade.
         a) Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block

between top of handhole and frame to temporarily elevate cover to existing grade level.

g. In each handhole, drive 3/4 IN x 10 FT long copper clad ground rod into the earth and extend ground rod approximately 6 IN above finished floor. Drill openings in floor for ground rod.

1) Connect all metallic conduits, racks, and other metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.

h. After installation is complete, backfill and compact soil around handholes.

M. Equipment to be tagged:

1. Enclosures for electrical, mechanical, and I&C equipment, e.g., power distribution equipment including circuit breakers, panelboards, VFD's and lighting contactors.

a. Legend: Name and number of equipment enclosure or component as indicated on the drawings.

N. Schedule of hazard and safety signs:

TYPE & SIZE	LEGEND	LOCATION
D 7 x 10	DANGER HIGH VOLTAGE (define voltage, ex. 480 V AC KEEP OUT AUTHORIZED PERSONNEL ONLY	All locations where voltages above 120 V AC or 50 V DC exist
D 10 x 14	CAUTION THIS EQUIPMENT STARTS BY REMOTE CONTROL	Near equipment capable of being remotely or automatically started

1. Elsewhere as indicated on Drawings

O. Device Mounting Schedule:
1. Dimensions are to center of item unless otherwise indicated.
a. Mounting heights as indicated below:
1) Light switch: 48 IN.
2) Receptacle: 48 IN.
3) VFD: 54 IN
4) Panelboard (to top): 72 IN.

3.02 FIELD QUALITY CONTROL

A. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the record drawings, from visible and permanent building features.

B. After installation, all equipment shall be tested as recommended by the manufacturer.

C. Verify all components are operational.

D. Test Equipment Interface:
1. Verify systems coordination and operation.

E. Verify all system and equipment ground continuity.

F. Adjust installed equipment for proper operation of all electrical and mechanical components.

G. Replace equipment and systems found inoperative or defective and re-test.
1. If equipment or system fails re-test, replace it with products which conform with Contract Documents.
2. Continue remedial measures and re-tests until satisfactory results are obtained.
3. Remedial measures and re-tests will be done at no cost to the Owner.

H. At Completion of Installation:
1. Test to ensure all equipment is free of short circuits and improper grounds.
2. Test to ensure all equipment is operational.

3.03 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.04 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01650.

END OF SECTION

SECTION 16111

CONDUIT, CONDUIT FITTINGS AND CONDUIT SUPPORTS, WIREWAY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Conduits, conduit fittings, conduit supports, and wireway.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 16010 - Electrical: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C80.1, Rigid Steel Conduit - Zinc-Coated.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      d. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      e. A569, A569, Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
      f. A570, Hot-Rolled Sheet and Strip, Structural Quality.
      g. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      h. A635, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled.
      i. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      j. D2564, Solvent Cements for (PVC) Plastic Pipe, Tubing, and Fittings.

k. (ANSI/ASTM) F512, Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.

3. ETL Testing Laboratories, Inc (ETL).
4. Joint Industry Council (JIC):
   a. EGP-111/EMP-1, Electrical Standards.
5. National Electric Manufacturers Association (NEMA):
   a. TC-2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
   b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
6. National Fire Protection Association (NFPA):
   a. 70, National Electric Code (NEC).
7. Underwriters Laboratories Inc (UL):
   a. 6, Rigid Metal Conduit.
   b. 360, Liquid-Tight Flexible Steel Conduit.
   c. 467, Grounding and Bonding Equipment.
   d. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
   e. 651, Schedule 40 and 80 Rigid PVC Conduit.
   f. 870, Wireways, Auxiliary Gutters, and Associated Fittings.

1.03 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Rigid, Non-Metallic Conduit and Fittings:
   1. Shall not be stored exposed to sunlight or other UV rays.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable.

2.02 GALVANIZED RIGID STEEL CONDUIT (RGS)

A. Acceptable Manufacturers:
   1. Allied Tube and Conduit Corporation.
   2. Triangle PWC Inc.
   3. Western Tube and Conduit Corporation.

4. Wheatland Tube Company.
5. LTV Steel Company.

B. Mild steel with continuous welded seam.

C. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
1. Threads: Galvanized after cutting.

D. Internal Coating:
1. Baked lacquer, varnish or enamel for a smooth surface.

E. Standard:
1. ANSI C80.1.
2. UL 6.

2.03 RIGID NON-METALLIC CONDUIT

A. Acceptable Manufacturers:
1. Poly-vinyl chloride (PVC) conduit:
a. Carlon.
b. Certainteed Corporation.
c. Western Plastics Corporation.

B. Schedules 40 and 80:
1. Polyvinyl-chloride (PVC) plastic compound which meets, as a minimum, ASTM D1784 cell classification PVC 12233-A, B, or C.
2. Rated for direct sunlight exposure.
3. Fire retardant and low smoke emission.
4. Shall be suitable for use with 90 DegC wire and shall be marked "maximum 90 DegC".
5. Standards:
a. ASTM D1784.
b. NEMA TC-2.
c. UL 651.

2.04 PVC-COATED FLEXIBLE GALVANIZED STEEL (LIQUID-TIGHT) CONDUIT (FLEX-LT)

A. Acceptable Manufacturers:
1. Anamet, Inc.
2. Electri-Flex Company.
3. International Metal Hose Company.

B. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.

C. Extruded PVC outer jacket positively locked to the steel core.

D. Liquid and vaportight.

E. Standard:
   1. UL 360.

2.05 WIREWAY

A. Acceptable Manufacturers:
   1. Crouse-Hinds.
   2. E.M.Wiegmann and Company, Inc.
   3. Hoffman Engineering Company.
   4. Square D.

B. Enclosure:
   1. Minimum wall thickness of 0.040 IN.
   2. Furnished without knockouts.
   3. Designed for continuous grounding.
   4. Suitable for lay-in conductors.
   5. Covers:
      a. Accessible, solid, hinged.

C. Watertight (NEMA 4) Wireway:
   1. Enclosure: Type 304 stainless steel.
   2. Cover: Fully gasketed and provided with captive external screw type clamps.
   3. Standards:
      a. JIC EGP-111/EMP-1.
      b. UL 870.

2.05 CONDUIT FITTINGS AND ACCESSORIES

A. Acceptable Manufacturers:
   1. Adalet.
   2. Appleton.
   3. Carlon.
   4. Certainteed.
   5. Crouse-Hinds.
   6. Killark.
   7. Occidental Coating Company.
   8. OZ Gedney Company.
   9. Perma-Cote.
   10. RACO.
   11. Rob-Roy Ind.
   12. Steel City.
   13. Thomas and Betts.
   14. Western Plastics Company.

B. Fittings for Use with RGS:

1. Materials: The following are minimum requirements unless otherwise noted.
   a. Body: Malleable iron, zinc- or cadmium-plated; steel, hot-dipped galvanized; or steel zinc plated with aluminum lacquer or aluminum enamel finish.
   b. Covers: Malleable iron, zinc plated.
   c. Gaskets: Neoprene or PVC, integrally fused to or recessed into the body.
   d. Insulators-phenolic, thermosetting:
      1) Minimum 105 DegC UL rating.
   e. Grounding saddles tin-plated copper or bronze suitable for use with copper and aluminum conductors.
   f. Bonding jumpers: Tinned copper flexible braid.
   g. Locknuts: Malleable iron, zinc plated.
   h. Pulling elbows and tees:
      1). Raintight.
      2) Cover - steel, zinc-plated.
   i. Mogul pulling elbows:
      1) Die cast copper free aluminum.
2. All fittings: Threaded unless otherwise noted.
3. All covers: Gasketed.
4. Standards:
   a. UL 6.
   b. UL 467.
   c. UL 514.
   d. UL 1242.
5. Hubs shall be raintight.
6. Straight couplings: Same material and finish as the conduit with which they are used.

C. Fittings for Use with Rigid Non-Metallic Conduit:

1. Fittings shall be of the same material, thickness, and construction as the conduits with which they are used.
   a. Standards:
      1) UL 651.
      2) NEMA TC-2-1978.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
   a. Shall not be more than 1 year past date of manufacture.
   b. Standard: ASTM D2564.

D. Fittings for Use with FLEX-LT:

1. Fittings shall meet the following minimum requirements unless otherwise noted:
   a. Body: Malleable iron, zinc-plated.

b. Ferrule: Steel, zinc-plated.
c. Locknuts and compression nuts: Malleable iron, zinc-plated.
d. Sealing ring: Neoprene.

2. Standard: UL 514.

2.06 ALL CONDUIT FITTINGS AND WIREWAY

A. Mark Products:
1. UL or ETL listed.
2. Identify the nominal trade size on the product.
3. Stamp with the name or trademark of the manufacturer.

B. Substitution: Submit requests for substitution in accordance with Specification Section 01640.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Shall be in accordance with the requirements of NFPA 70.

B. Size of Raceways and Conduits:
1. Raceway sizes are normally shown on the Drawings. If a size is not shown on the Drawings, or if a minimum size is not stated in the Specifications, then size in accordance with the NEC.
2. Conduits shall not be smaller than 3/4 IN trade size, unless otherwise shown on the Drawings.

C. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

D. Total of Bends in a Conduit Run:
1. Less than 360 degrees.
2. Provide pull boxes, condulets, pulling elbows or tees as needed.

E. Raceway runs, where shown, indicate the preferred location. Site conditions may affect actual routing. Coordinate routing and measurement with other trades and with equipment suppliers to avoid interference with equipment, piping, ductwork, etc.

F. Type of conduit which shall be installed in specified areas is defined in the following tabulations:

TABLE 1. WET AREAS

TYPE	EXPOSED
Rigid	RGS
Flexible	FLEX-LT

TABLE 2. UNDERGROUND AREAS

DIRECT BURIED POWER AND CONTROL	BENDS AT END OF RUNS DIRECT BURIED	LONG SWEEP BENDS DIRECT BURIED
PVC-80	RGS	RGS

G. FLEX-LT:
   1. Install as the final conduit to motors, electrically operated valves, primary elements (instrumentation), and electrical equipment that is liable to vibrate.
   2. Shall not be used as a conduit run:
      a. Maximum length shall not exceed:
         1) 36 IN to motors.
         2) 24 IN to all other equipment.

H. Wireways:
   1. Shall be installed only where indicated in the Drawings.

I. Conduit Support Systems:
   1. Compatible with the material and finish of the conduit supported.
      a. Hot-dipped galvanized steel for use with RGS.

J. Field Bending and Cutting of Conduits:
   1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
   2. Do not reduce the internal diameter of the conduit when making conduit bends.
   3. Prepare tools and equipment to prevent damage to the PVC coating.
   4. Degrease threads after threading and apply a zinc rich paint.
   5. Debur interior and exterior after cutting.

K. Conduit Installation:
   1. Install conduit and fittings, as required (including offsets and crossovers), for a complete system that has a neat appearance and is in compliance with all applicable codes.
   2. Conduit support systems:

a. Maximum spacing between conduit supports:
   1) RGS: 10 ft.
   2) Rigid nonmetallic conduit:
      a) 1/2 to 2 IN: 3 FT.
      b) 2-1/2 to 6 IN: 6 FT.
b. Support all conduits within 3 FT of the conduit termination.
c. Support all conduits at 90-degree bends and at vertical drops.
d. Provide substantial vertical support for all conduit drops for stability and to minimize vibration.

3. Underground conduit:
   a. See Section 16010.
4. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
5. Threaded connections shall be made wrench-tight.
6. Conduit joints shall be watertight.
   a. Where exposed to possible submersion.
   b. In areas classified as wet.
   c. Underground.
7. Conduits shall be installed to eliminate moisture pockets. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
8. Rigid non-metallic conduit and fittings shall be joined utilizing solvent cement.
   a. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
9. Terminate conduits:
   a. In NEMA 4 type enclosures:
      1) Into a threaded hub.
      2) With an insulating bushing, unless the hub provides equivalent protection to the conductors.

L. The protective coating integrity of conduits, fittings, and accessories shall be maintained.
   1. Repair RGS utilizing a zinc rich paint.
   2. Repair surfaces which will be inaccessible after installation prior to installation.

M. Remove moisture and debris from conduit before wire is pulled into place.
   1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
   2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
   3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

N. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

END OF SECTION

SECTION 16120

WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building wire and cable (600 V and below), splices, taps, electrical tape and pulling lubricant.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 16010 - Electrical: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
      a. S-66-524/WC 7, Cross-Linked Thermosetting- Polyethylene-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc (UL):
      a. 44, Rubber Insulated Wires and Cables.
      b. 486A, Wire Connectors and Soldering Lugs for use with Copper Conductors.
      c. 510, Insulating Tape.

1.03 DEFINITIONS

A. Instrumentation Cable: Multiple conductors, insulated, twisted with outer sheath, intended for transmission and distribution of low current (4-20mA DC) or low voltage (0-10 V DC) analog signals.

1.04 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Building wire, power and control cable:
   1. All conductors shall be copper.
   2. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
      a. American Insulated Wire Corporation.
      b. Cablec Corporation.
      c. Carol Cable Company, Inc.
      d. Rome Cable Corporation.
      e. Southwire Company.
   3. Conform to ICEA/NEMA S-66-524/WC 7 and UL 44 for type XHHW insulation.

B. Building wire, power cable, control cable and instrumentation cable:
   1. UL listed or UL recognized.
   2. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.

C. Splices and Taps:
   1. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
      a. Burndy Corporation.
      b. Ideal.
      c. Minnesota Mining and Manufacturing Co.
      d. Penn Union.
      e. Thomas and Betts.
   2. UL listed.
   3. Conform to UL 486A.

D. Electrical Tape:
   1. Pressure sensitive vinyl.
   2. Premium grade.
   3. Heat, cold, moisture, and sunlight resistant.
   4. UL listed.
   5. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
   6. For cold weather or outdoor location, tape must also be all-weather.
   7. Comply with UL 510.

E. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

F. Submit requests for substitutions in accordance with Specification Section 01640.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Usage of Insulation Types:
   1. Type XHHW insulated conductors shall be used for all wire, power and control cable applications.

B. Conductor size limitations:
   1. Power conductors shall not be smaller than No.~u 12 AWG unless otherwise indicated on the drawings.
   2. Control conductors shall not be smaller than No.~u 14 AWG unless otherwise indicated on the drawings.

C. Color code all wiring as follows:
   1. Lighting and power wiring:

	208Y/120 V	480Y/277 V
Phase 1	Black	Brown
Phase 2	Red	Orange
Phase 3	Blue	Yellow
Neutrals	White	White
Ground	Green	Green

   2. Color code ends of feeder phase conductors only.

D. Install all wiring in raceway unless otherwise indicated on the drawings.

E. Make splices and taps only at pull or junction boxes.
   1. Crimp or indenter-type connectors: Installation shall be made using a ratchet type compression tool.
   2. Insulated conical spring type connectors may be used for wire smaller than #6 AWG.
   3. Solderless lugs and screw type connectors may be used for #6 AWG and larger wire.

F. Electrical Tape Usage:
   1. For insulating connections of #8 AWG wire and smaller: 7 mil vinyl tape.
   2. For insulating splices and taps of #6 AWG wire or larger: 10 mil vinyl tape.
   3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

G. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.

1. Contractor shall supply terminal boards as required.
2. Do not field wire directly to devices.
3. Ground both ends of spare wires.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:

1. Light switches, receptacles, covers and outlet boxes.

B. Related Sections include but are not necessarily limited to:

1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Section 16010 - Electrical: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Refer to Section 16010.

1.03 SUBMITTALS

A. Shop Drawings:

1. Refer to Sections 01340 and 16010.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Light switches and receptacles:
   a. Hubbell.
   b. Slater.
   c. P&S.
   d. Arrow Hart.
   e. General Electric.
   f. Leviton.
2. Raintight and watertight boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. Light Switches:
   1. Presswitch type, quiet action, Standard Specification grade, with grounding terminal.
   2. Back and side wired.
   3. Solid silver cadmium oxide contacts.
   4. One-piece switch arm.
   5. Rated 20 A, 120/277 V AC.
   6. UL listed.
   7. Color: Ivory.
   8. Wall plate: Gray weatherproof presswitch type.
   9. SPST unless otherwise indicated on the Drawings.

B. Receptacles:
   1. Straight blade, GFCI type, Standard Specification grade.
   2. Rated 20 A, 125 V AC.
   3. UL listed.
   4. Test and reset pushbuttons.
   5. Color: Ivory.
   6. Wall plate: Weatherproof, phenolic, UL listed, WDL open and closed.
   7. Duplex unless otherwise indicated on the Drawings.

C. Outlet Boxes:
   1. Use: Installation of wiring devices.
   2. Boxes::
      a. Cadmium plated, cast, ferrous metal, with threaded hubs.
      b. Raintight and watertight.
      c. Type FS or FD.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount devices where indicated on the Drawings and as scheduled in Section 16010.

C. Set switches and receptacles plumb and vertical to the floor.

END OF SECTION

SECTION 16150

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Lighting panelboards and distribution panelboards.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16450 - Grounding.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. PB 1, Panelboards.
   2. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).
   3. Underwriters Laboratories, Inc (UL):
      a. 67, Panelboards.
      b. 50, Cabinets and Boxes.
      c. 489, Molded Case Circuit Breakers.

1.03 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.
   2. Panel layout with alphanumeric designation, branch circuit breaker sizes and types, as indicated in the panel schedules.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Panelboards and circuit breakers:
      a. General Electric.

b. Square D.
c. Cutler-Hammer/Westinghouse.
d. Siemens.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MANUFACTURED UNITS

A. Panelboards:
1. UL 67 listed.
2. Designed in accordance with NEC Article 384.
3. Dead-front type.
4. Fronts:
a. Steel reinforced.
b. Concealed or semi-concealed hinges.
c. Trim adjusting screws.
d. Directory card mounted inside front door.
e. Padlockable.
f. Surface mounting.
5. Bus bars:
a. Sequenced phased.
b. Fully insulated.
c. Drilled and tapped on circuit pole centers.
6. Main lugs:
a. Solderless type.
b. Approved for copper and aluminum UL listed wire.
7. Solid neutral bar with solderless mechanical type connectors.
8. Non-insulated grounding strip including:
a. Main ground lug.
b. Individual grounding terminals for each circuit breaker and circuit breaker space.
9. See Drawings for additional requirements.

B. Panel Boxes and Cabinets:
1. UL 50 listed.
2. Gutter space per NEC and UL requirements.
3. Code gage galvanized steel.
4. Furnish with hubs.
5. NEMA 4 enclosure.

C. Circuit Breakers:
1. Current rating as indicated on the Drawings.
2. Thermal-magnetic type, UL listed:
a. Over-center, toggle handle operated.
b. Quick-make, quick-break action.

1) Independent of toggle handle operation.

c. Common tripping of all poles.

d. Molded-in ON and OFF markings on breaker cover.

e. Bolt-on type.

f. Three-position handles indicating ON, OFF and TRIPPED.

g. Removable from front of panelboard without disturbing adjacent circuit breakers.

h. One-, two- or three-pole as indicated on the Drawings.

i. Rated 10,000 AIC, minimum, unless a higher interrupting rating is noted on the Drawings.

j. Tandem or half-size circuit breakers shall not be used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install per manufacturer's instructions.

B. Install in accordance with the NEC.

C. Provide each panelboard with a typed "as installed" directory.

END OF SECTION

SECTION 16190

DRY-TYPE TRANSFORMERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:
1. Dry-type transformers.

B. Related Sections include but are not necessarily limited to:
1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Supplementary General Conditions.
3. Section 16010 – Electrical Basic Requirements.
4. Section 16450 – Grounding.
5. Section 16474 – Control Equipment and Separately Mounted Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American National Standards Institute (ANSI):
a. C89.2, Dry-Type Transformers for General Applications.
2. National Electrical Manufacturers Association (NEMA):
a. ST-20, Dry-Type Transformers for General Applications.
3. Underwriters Laboratories Inc. (UL):
a. 506, Specialty Transformers.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Sections 01340 and 16010.
2. UL nameplate data.

B. Operation and Maintenance Manuals:
1. See Section 01340.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Dry-type transformers:
   a. Cutler-Hammer.
   b. General Electric.
   c. Siemens.
   d. Square D.

B. Submit requests for substitution in accordance with Section 01640.

2.2 MANUFACTURED UNITS

A. Dry-type transformers:
   1. UL 506 listed.
   2. Air cooled, two winding type.
   3. Coils: continuous wound construction, impregnated with non-hygroscopic thermosetting varnish.
   4. Mount core-and-coil assemblies of transformers on rubber isolation pads.
   5. Furnish taps for transformers as follows:
      a. 3 PH, 15 KVA and below: Two 2-1/2 percent FCAN and two 2-1/2 percent FCBN.
      b. 3 PH, 30 KVA and above: Two 2-1/2 percent FCAN and four 2-1/2 percent FCBN.
   6. Transformers shall meet or exceed ANSI C89.2 and NEMA ST-20 requirements.
   7. Insulating material shall be in accordance with NEMA ST-20 standard for a 220 DegC component recognized insulation system.
   8. Voltage, KVA rating, and phase as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Ground in accordance with Section 16450.

END OF SECTION

SECTION 16265

VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Variable frequency drives (VFDs) for operation of 460 VAC, 3 PH, 60 HZ, Inverter Duty Rated induction motors.

B. Related Sections include but are not necessarily limited to:
1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Section 11005 - Equipment: Basic Requirements.
3. Section 11076 - Pumping Equipment: Submersible Non-Clog.
4. Section 16010 - Electrical: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
1. American National Standards Institute (ANSI):
   a. C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits.
   b. C62.45, Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.
2. Canadian Standards Association (CSA).
3. ETL Testing Laboratories (ETL).
4. Institute of Electrical and Electronic Engineers (IEEE):
   a. 519, Recommended Practices and Requirements for b. Harmonic Control in Electrical Power Systems.
5. National Electrical Manufacturer's Association (NEMA):
   a. ICS 6, Enclosures for Industrial Controls and Systems.
   b. MG-1, Motors and Generators.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code.
7. Underwriter's Laboratory (UL):
   a. Standard 508, Electrical Industrial Control Equipment.1.03

B. Qualifications:

1. Provide drives that have the standard factory configuration of the variable speed drive listed and labeled by Underwriter's Laboratories, Inc. (UL), Canadian Standards Association (CSA), ETL Testing Laboratories (ETL), or that shall be capable of field inspection and subsequent field labeling by a UL-recognized field inspector. Where drives and controlling equipment are mounted in a custom enclosure, UL listed components shall be furnished.
2. VFD Supplier shall maintain an authorized service organization within 100 miles of the project site.

C. Coordination:
1. VFD manufacturer shall verify with the driven equipment manufacturer that the VFD and the drive motor are compatible and that the VFD will operate the driven equipment motor over its required operating range and will do so without exceeding the motor or VFD safety factors.

D. VFD shall be supplied complete with all required control components.

E. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range. These may include, but are not limited to, analog and digital interface modules, communication interface modules, feeder circuit power output filters or chokes which may be required due to VFD to motor feeder length., switches, lights and other devices.

F. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
1. Equipment which exceed the allotted maximum dimensions may not be acceptable.
2. Equipment which reduces clear space below the minimums established by the NEC will not be acceptable.

G. Contractor shall coordinate submittal with submittals from the motor manufacturer and the equipment manufacturer to provide concurrent submittals.

H. VFD manufacturer shall clearly identify conditions that will limit the operation of, or cause damage to, the VFD. These shall include, but are not limited to:
1. Line side overvoltage.
2. Line side voltage imbalance.
3. Line side surge magnitude and duration.
4. Location of VFD enclosure with respect to external cooling air flow.

1.03 SUBMITTALS

A. Shop Drawings:
1. See Section 16010.
2. Provide the following information:

a. Rated VFD input kVA and current, and output kVA and current.
b. Percent efficiency and power factor at 50, 75, and 100 percent speed.
c. Maximum BTU heat release data and verification of the drive cooling requirements.
d. Panel interior, and front and side exterior views, with details showing maximum overall dimensions of VFD and isolation transformer (if provided).
e. Locations and sizes of electrical connections, ground terminations, and shielded wire usage.
f. Harmonic calculations by the VFD manufacturer with detailed drawings and/or information showing how protection is applied to comply with harmonic limits.
g. Identification and location of closest authorized service organization.

B. Certifications:

1. Submit with Shop Drawings:
   a. Manufacturer's experience.
   b. Compliance with IEEE 519.
   c. Compliance with "Factory Tests".
   d. That the VFD can withstand the same level of fault current as that imposed on the equipment feeding the VFD.
2. Submit prior to shipment:
   a. From the VFD manufacturer and each VFD driven equipment manufacturer that the specific application has been reviewed and that the combination will satisfy the drive duties required with the actual motor furnished.
   b. That the testing described under "Factory Tests" in Part 2 has been successfully completed.
3. Submit after installation:
   a. That the critical frequency of the drive system has been identified and the VFD has been set to lockout these frequencies.
   b. Installation test reports that show:
   c. Each VFD is operational.
   d. Each VFD and its driven equipment motor is compatible.
   e. Each VFD responds correctly to the input control signals.
   f. That by on-site field measurements the VFD is not introducing harmonics to the power distribution system in excess of those recommended by IEEE 519.

C. Operations and Maintenance Manuals:

1. See Section 16010.
2. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.

3. Connection data to permit removal and installation of recommended smallest field-replaceable parts.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. ASEA-Brown Bovari (ABB).
   2. Halmar-Robicon
   3. Toshiba

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 TYPE OF DRIVE

A. Pulse Width Modulated (PWM) type.

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

A. The VFD's shall be of sufficient capacity and shall provide a quality output waveform for stepless motor control from 10 to 100 percent of base speed for NEMA Design B squirrel cage inverter duty rated induction motors complying with NEMA MG-1, Part 31 and for special purpose submersible pump squirrel cage induction motors as appropriate for the application.

2.04 APPLICATION:

A. The estimated feeder length from the VFD(s) to the motor(s) is 50 FT.
B. The drives shall be suitable for Variable Torque (VT) applications.
C. VFDs shall be designed to operate successfully under the following conditions:
   1. Ambient:
      a. Temperature: 0-50 DegC.
      b. 95 percent non-condensing relative humidity.
   2. Elevation: Less than 3300 above MSL.
   3. Input power to VFD:
      1. 480V AC (±10 percent).
      2. 3 PH, 60 HZ (±3 percent).
      3. Line voltage imbalance ±5 percent of rated voltage.
D. Performance:
   1. The VFD shall have the following capabilities:
      a. Voltage rating:
         1) 480VAC, 3 PH, 60 HZ.
      b. Continuous current rating:

1) 100 percent rated VFD current shall be equal to or greater than the motor full load nameplate rating including motor service factor.

c. Current overload capacity:
   1) VT: 110 percent for 1 MIN.

d. Efficiency:
   1) 97 percent at full speed and full load.
   2) 93 percent at 1/2 speed and full load.
   3) Efficiency shall be determined excluding isolation transformer and input and output reactor losses.

e. Power Factor:
   1) 94 percent at full speed and load.

f. Frequency drift:
   1) $\pm$ 0.5 percent of set frequency.

g. Speed regulation (motor dependent):
   1) 3 percent.

h. Speed range:
   1) 10:1.

i. Critical frequency lockout:
   1) Minimum of three.

j. Continued operation with momentary voltage dips of 25 percent of rated voltage for a 4 second duration.

k. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
   1) When operating under voltage boost.
   2) At frequencies over 60 HZ.

l. Automatic restart with one restrike following a power outage.

E. The VFD shall be supplied with line side and load side reactors:
   1. Minimum impedance:
      a. 5 percent.
   2. Current overload:
      a. 150 percent for 1 MIN.
   3. Insulation temperature rating:
      a. 180 DegC.
   4. Copper windings.
   5. Saturation current rating:
      a. 3.5 to 5 times rated current.
   6. Hi-potential rating:
      a. 2500 VAC line to ground and line to line, for 1 MIN.
   7. Noise reducing:
   8. Epoxy over cast coil.
   9. Extra dips and bakes of varnish over continuous wound coil.

E. The VFD shall be provided with the following adjustments:
   1. Independent maximum and minimum speed.
   2. Independent linear acceleration and deceleration time.

3. Volts/Hertz ratio.
4. Voltage boost.
5. Process follower gain, offset and bias.
6. Torque limit.
7. Overcurrent trip point.

F. The VFD shall have the power circuit designed such that the power circuit components are protected:

1. Input protection:
   a. Line side disconnect molded case circuit breaker:
   b. Fault current interrupting rating equal to or greater than the withstand or interrupting rating of the equipment feeding the VFD.
   c. Incoming circuit breakers padlockable in the OFF position.
      1) .Frame sizes 150 A and below shall be thermal-magnetic non-adjustable and non-interchangeable trip type.
      2) Frame sizes 225 to 400 A shall be thermal-magnetic adjustable and interchangeable trip type.
      3) Frame sizes 600 A and above shall be solid-state trip type.
         a) Interchangeable rating plug.
         b) Adjustable long time pick-up and delay, minimum range 70-100 percent of rating plug.
         c) Adjustable instantaneous pick-up, minimum range of 3 to 8 times current setting.
   d. Input line high speed fuses, 200 KAIC.
   e. Undervoltage trip:
      1) Auto restart.
   f. Ride through a momentary power dip, magnitude and duration as previously specified.
   g. Ride through a one cycle loss of power.
   h. Incoming line transient suppression.
   i. Loss of phase trip:
      1) Manual restart.
   j. Reverse phase trip:
      1) Manual restart.
   k. Overvoltage trip:
      1) Auto restart.
      2) Relay installed in the VFD.
   l. Internal protection:
      1) Surge suppression and power device snubbers.
      2) Power devices rated at 2.5 times line voltage.
      3) Instantaneous overcurrent trip with manual reset.
      4) DC bus overvoltage trip with manual reset.

5) Power device overtemperature trip with manual reset.

6) Control logic circuit malfunction trip with manual reset.

m. Output protection:

1) Inverse-time overload trip:

a) Manual restart.

2) Overvoltage trip:

a) Auto restart.

3) Overfrequency trip:

a) Auto restart.

4) Short circuit trip:

a) Line to line and line to ground.

(1) Manual restart.

5) Ground fault trip:

a) Manual restart.

6) Drive shutdown on motor winding overtemperature:

a) Manual reset.

b. Motor winding overtemperature switch to initiate VFD shutdown. Wire to terminal board in the VFD.

G. OPERATOR AND REMOTE CONTROL INTERFACE

1. Control circuits shall be 115 VAC supplied by CPT in the VFD.

a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.

b. CPT shall have two fuses on the primary side and one fuse on the secondary side.

c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.

2. Operator interface:

a. Door mounted sealed keypad, membrane type with LED or LCD display.

1) Messages shall be in English and engineering units.

2) Drive operating parameters shall be programmable.

3) Menu driven.

4) Password security.

5) Display fault and diagnostic data.

6) Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.

7) Gold plated plug-in contacts.

b. Hand-Off-Auto control and speed reference selector switch.

c. Manual speed adjustment.

d. Manual start and stop control.

e. Indicating lights:

1) POWER ON.
2) VFD RUN.
3) VFD FAULT.

f. Speed indication:
1) Calibrated in percent.
2) Open-loop, function of VFD frequency.

g. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure. On occurrence of more than one condition each shall be recorded or indicated by the diagnostics.

h. Wet Well Level Indication on each VFD.
1) From remote 4-20 ma DC level transmitters.

2.05 HARMONIC PROTECTION REQUIREMENTS

A. Each VFD shall be designed and provided with all necessary equipment to protect the VFD and the power system ahead of the VFD from voltage and current distortion. The VFD manufacturer shall provide harmonic filters as required.

1. In accordance with and as defined by IEEE 519:
2. Each VFD shall be designed to operate from a power bus that may contain up to 5 percent voltage distortion.
3. Each single or multiple set of VFDs powered from the same bus shall be designed to limit percent distortion factor to a maximum total of 5 percent voltage distortion.
4. Current distortion limits shall not exceed the values listed in Table 10.3 of IEEE 519.
5. Line-to-line notching at the input to the drive shall have a maximum notch depth of 20 percent and a maximum notch area of 22,800 volt-microseconds reflected back to the power source.
6. The PCC for all harmonic calculations and field measurements for both the voltage and current distortion shall be defined as the primary (line side) connection of each VFD.

2.06 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:

1. Each VFD system shall be shop assembled in an enclosure for surface mounting outdoors, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible. Shop assembly shall be performed by the VFD manufacturer or his authorized agent. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or his authorized agent will not be acceptable.

B. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.

C. Cooling fans shall be provided to run when drive is running.

D. Enclosures for VFD's:
NEMA Type 4 for installation outdoors.

E. Wiring:

1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base. Bases with a self-sticking back will not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Terminal blocks shall be complete with marking strip, covers and pressure connectors. They shall be nonbrittle, interlocking, track-mounted type. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable. Not less than 25 percent spare terminals shall be provided. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
4. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
5. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coordinated. Markings or color coordination shall comply with the manufacturer's drawings.
6. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

F. Nameplates:

1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Section 16010. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate. All other devices shall have an engraved, laminated plate. All lettering shall be a minimum of 3/16 IN high and shall be white or silver on a black background.
2. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
3. Use stainless steel screws to attach nameplates.

G. Painting:

1. Equipment, after being phosphate washed, shall be thoroughly cleaned and given at least one coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.07 SOURCE QUALITY CONTROL

A. Factory Tests:
   1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.
   2. Prior to final assembly:
      a. Inspect incoming components.
      b. Test and inspect power devices. .
      c. Circuit cards:
         1) Component and functional tests:
         2) Burn-in chamber or temperature cycling test.
      d.. System test after burn-in, or temperature cycling.
   3. After final assembly:
      a. Continuity and insulation test of 480 V AC circuits.
         1) Test voltage shall be 2500 V DC.
      b. Continuity and insulation test of 120 V AC circuits.
         1) Test voltage shall be 500 V DC.

B. Drive tests:
   1. Burn-in complete drive at full load for 24 HRS.
   2. Verify all auxiliary circuits operation.
   3. Monitor output variables.

C. Systems test:
   1. Provide inputs to field connections and simulate on-site operation.
   2. Test all auxiliary equipment.

PART 3 EXECUTION

301 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.

C. Provide services of manufacturer's representative to perform start-up services.

3.02 START UP

A. Pre-startup services:
   1. Shall be completed a minimum of 30 days prior to the startup and demonstration period described in Section 01650.
   2. Shall consist of:
      a. Physical and electrical installation check.
      b. Final adjustments and calibration of drive parameters.

c. VFD operation from simulated input signals.
d. Shall be complete when VFD(s) are fully operational.

B. Startup and demonstration services:
1. Supervise startup of all units including recheck of settings made during the pre-startup tests.
2. Perform all work in the presence of the Owner's designated representatives.
3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
4. Ensure compatibility of VFD with associated control and instrumentation signals.
5. Simulate VFD failures and demonstrate troubleshooting aids.
6. Instruct Owner's designated personnel:
   a. Minimum of 8 hours at the jobsite.
   b. Include both field and classroom instruction.
   c. Instructions shall include proper operation and maintenance procedures including, but not limited to:
      1) Troubleshooting.
      2) Repair and replacement.
      3) Parts inventory.
      4) Maintenance records.
7. Perform onsite field measurement of harmonics at the PCC.
   a. For each individual VFD.
   b. For the maximum number of VFDs that will be operational at the same time.
8. Perform onsite field measurement of the maximum voltage peak, measured line-to-line, at the terminals of each motor fed from a VFD.
   a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
   b. Time shall be measured in microseconds.
   c. Tests shall be performed at full voltage and speed.
   d. Peak voltage shall not exceed 1200 V line-to-line.
   e. Peak voltage in excess of 1200 V line-to-line:
9. Contractor shall coordinate with the VFD manufacturer to solve any problem and at no cost to the Owner.
10. VFD manufacturer shall increase the impedance of the output line reactor, or provide an output filter, to limit the motor terminal voltage peak to 1200 V or less, line-to-line.
11. Contractor shall perform a complete retest of all affected drives.
12. Record all data necessary for the preparation of required test reports.

3.03 SPARE PARTS

A. Provide manufacturer's recommended spare parts.

1. When not included in the recommended spare parts provide for each type and rating of drive:
   a. Complete set of all plug-in drive components.
   b. One set of 3 of each type power fuse.
   c. One set of 12 of each type control fuse.
   d. One main control board.
   e. One inverter module.
   f. One inverter snubber module.
   g. One inverter base drive module.
   h. One set of other field replaceable components.

B. Spare parts shall be labeled and packed in containers suitable for storage.

C. Spare parts utilized during pre-startup or startup and demonstration testing shall be immediately restocked, at no cost to the Owner.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Service, distribution and equipment grounding.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16111 - Conduit, Conduit Fittings, and Conduit Supports, Wireway.
   5. Section 16120 - Wire and Cable - 600 Volt and Below.

1.02 QUALITY ASSURANCE

A. Assure ground continuity is continuous throughout the entire Project.

B. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 467, Electrical Grounding and Bonding Equipment.

1.03 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.
   2. Grounding system details for:
      a. Service entrance grounding.
      b. Equipment grounding.
   3. Data sheets for all materials and components.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Wire and cable:
      a. As specified in Section 16120 except as modified in the following.
   2. Conduit:
      a. As specified in Section 16111.
   3. Ground rods:
      a. Thompson.
      b. Joslyn.
      c. Heary Brothers.
   4. Grounding clamps and connectors:
      a. Thompson.
      b. Burndy.
      c. Heary Brothers.
      d. Joslyn.
   5. Exothermic weld connections:
      a. Erico Products Inc., Cadweld.
   6. Fall-of-potential test device:
      a. "Ground Megger" device:
         1) James G.Biddle Co.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 COMPONENTS

A. Wire and Cable:
   1. As specified in Section 16120 except as modified by the following.
   2. Grounding electrode conductor:
      a. Bare copper ground cable:
         1) Soft drawn stranded bare copper cable.
         2) ASTM B8.
      b. Sized as required by Table 250-94 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
         1) Minimum conductor allowed: 4/0.
   3. Grounding conductor:
      a. Bare copper ground cable:
         1) Soft drawn stranded bare copper cable.
         2) ASTM B8.
      b. 2/0 unless otherwise shown on Contract Drawings.
   4. Equipment grounding conductor:

a. Green copper conductor: Identical insulation to phase conductors.
b. Sized as required by Table 250-95 of the NEC, except where a larger size conductor is shown on the Contract Drawings.

B. Conduit: As specified in Section 16111.

C. Grounding Clamps:
1. High copper alloy content: Compression type.
2. UL 467 listed.
3. Noncorrosive.

D. Ground Rods:
1. 3/4 IN x 10 FT, except as otherwise indicated on the Contract Drawings.
2. Copperclad:
a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
b. Corrosion resistant bond between the copper and steel.
3. Hard drawn for a scar-resistant surface.
4. UL listed.

E. Exothermic Weld Connections:
1. Copper oxide reduction by aluminum process.
2. Molds properly sized for each application.

F. Connections:
1. Below grade connection of wire to wire or wire to ground rod may be by exothermic welding or compression ground clamp.
2. Molds and cartridges for thermic welds:
a. Size recommended by manufacturer for size and rods installed.
3. Connections to equipment lugs or busses:
a. Burndy Type YGHA, 2-hole compression terminal.
4. Cable to water pipe:
a. Cast bronze, O-Z Gedney "Universal Ground Clamp System" or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. Install products in accordance with manufacturer's instructions.
2. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.

3. Where ground conductors pass through floor slabs or building walls, sleeves of intermediate metal conduit of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.

B. Ground Grid:
1. Locate ground rods at approximate locations shown on Drawings.
2. Install rods in firm soil outside of excavated areas.
3. Place perimeter rods a minimum of 10 FT from the building foundation.
4. Drive top of rod to minimum depth of 2 FT-6 IN below grade or structure unless otherwise noted on Contract Drawings.
5. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
6. Interconnect all ground rods with ground electrode conductor:
   a. Sized per the NEC unless a larger size is shown on the Drawings.
7. Do not splice grounding electrode conductor.
8. Provide excavation required for installation of ground conductors buried in earth.
9. Allow sufficient slack to prevent conductor breakage during backfill or due to ground movement.
10. Leave taps, junctions, and splices uncovered until inspected by Owners Representative.
11. Backfill around ground grid completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
12. Bond underground metal piping to the ground grid in accordance with NEC 250. Grounding clamps may be utilized on piping if exothermic welds may damage structural integrity.
13. Complete grid system:
   a. Resistance of 5 ohms or less.
   b. Refer to Engineer for test results greater than 5 ohms.

C. Raceway Grounding-Conduit:
1. All metallic conduit shall be electrically continuous.
2. Provide grounding-type insulating bushings:
   a. For all equipment not supplied with a conduit hub.
   b. On ends of metallic ductbank conduit.
3. Bond all conduit, at entrance and exit of equipment, to equipment ground bus or ground lug.
4. Use double locknuts at all panels.
5. Provide bonding jumpers if conduit are installed in concentric knockouts.
6. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at

ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

7. Provide bonding jumper from equipment ground lug to RGS conduit, if flexible conduit is utilized for equipment connections.
8. Provide bonding jumpers identical in conductor size to the largest ground conductor run within the conduit.

D. Equipment Grounding:

1. Ground all equipment to the distribution equipment ground bus. Provide an equipment grounding conductor connected to the ground bus and equipment ground lug.
2. Ground all equipment fed from lighting panels through the lighting panel ground bus. Provide ground conductors for all connections.
3. Consider control devices (switches, indicating lights, meters, starters, relays, etc.) mounted in MCCs, switchgear, control panels, or other metal enclosures to be adequately grounded, if the enclosure ground lug or ground bus is properly grounded.
4. Do not splice grounding conductors.
5. Run all equipment grounding conductors in conduit.
6. Ground cranes and hoists in accordance with NEC 610.G.
7. Size all grounding conductors in accordance with the NEC unless larger size is shown on the Drawings.
8. Provide surge arresters for:
   a. All instrumentation cables
9. Run all exposed grounding conductors in Schedule 40 PVC conduit.

3.02 FIELD QUALITY CONTROL

A. Test resistance of installed ground systems after backfilling and before connection to any other grounded system including underground piping, utility services or other building ground systems.

1. Test ground grid resistance by fall-of-potential method.

END OF SECTION

SECTION 16474

CONTROL EQUIPMENT AND SEPARATELY MOUNTED DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Separately mounted circuit breakers and control equipment.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16150 - Panelboards.
   5. Section 16190 - Dry-Type Transformers.
   6. Section 16450 - Grounding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits.
   2. Canadian Standards Association (CSA).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturers Association (NEMA):
      a. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
      b. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc (UL):
      a. 1449, Safety Transient Voltage Surge Suppressors.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.
   2. Typical wiring diagrams for all control equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mechanical timers:
      a. Tork.
   2. Enclosures:
      a. Hoffman.
   3. Separately mounted circuit breakers:
      a. General Electric.
      b. Siemens.
      c. Square D.
      d. Cutler Hammer/Westinghouse.
   4. Transient voltage surge suppressors (TVSS):
      a. Innovative Technology, Inc (IT).
      b. LEA International.
      c. Liebert.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 COMPONENTS

A. Main and Feeder Circuit Breakers Separately Mounted:
   1. Molded case thermal magnetic or solid state trip type, with minimum interrupting rating equal to the main bus fault current rating:
   2. Circuit breaker frame sizes 150 A and less:
      a. Non-interchangeable, non-adjustable thermal magnetic trip units.
   3. Circuit breaker frame sizes 225 A and higher:
      a. Interchangeable and adjustable thermal magnetic trip units.
   4. Circuit breaker frame sizes 600 A and greater:
      a. Solid state trip units, unless otherwise noted on the Drawings.
      b. Current sensor or rating plug.
      c. Adjustable current setting: Minimum range 70 to 100 percent of current sensor or rating plug.
      d. Adjustable instantaneous pickup: Minimum range 3 to 8 times.
   5. Provide main circuit breaker with service entrance label.
   6. All circuit breakers to be provided with padlocking provision in the OFF position for up to three padlocks.
   7. Thermal capability:
      a. Frame size 800 amp continuous and below:
         Shall be provided for use at 80 percent of their continuous rating unless otherwise indicated on the Drawings.

B. Provide ambient compensated devices.

C. Selector Switches, Indicating Lights, and Pushbuttons:
   1. Heavy-duty oiltight/watertight for unclassified or wet areas.
   2. NEMA 4 for outdoor applications or panels specified WP.
   3. NEMA 4X for corrosive areas.
   4. NEMA 7 and 9 for Class I, Division I Groups C and D; and Class II, Division I, Groups E, F, and G hazardous locations.

5. Selector switches shall have standard gloved operator.
6. Pushbuttons shall have standard flush operator.
7. Provide switch positions and contacts:
   a. As specified on Contract Drawings or as necessary for proper control.
8. Switch contacts shall be NEMA A600 rated.
9. Full voltage indicating lights, unless specified otherwise.
10. Provide 100 percent replacement lamps for indicating lights.
11. Provide 10 percent replacement caps for indicating lights.

D. Terminal Strips:
   1. 600 V.
   2. Full size.
   3. Rated for 10 A continuous current.

E. Electromechanical Timers:
   1. Time switches:
      a. Duty cycle type.
      b. Capable of programming at 15-minute intervals of the day.
      c. Schedule tabs provided:
         1) Easily set by hand without tools to obtain or change the desired schedule.
   2. The unit:
      a. Powered by a self-starting, enclosed, 120 V, 60 HZ, synchronous motor capable of continuous and accurate operation.
   3. The switch mechanism:
      a. Self-contained unit rated at not less than 20 A, 120 V, single pole, double throw.
      b. Readily replaceable in the field.
   4. An omitting device:
      a. Furnished as an integral part of the time switch:
         1) To enable the switching operation to be skipped for any preselected day or days of the week.
   5. Verify that the timer is compatible with all associated control relays, and furnish schematics showing all connections.
   6. Provide detailed instructions:
      a. Setting and changing the timing intervals.
      b. As part of the operation and maintenance manuals.
   7. The electromechanical timer and associated relay configuration may be replaced by a programmable controller.

F. Enclosures and Control Panels:
   1. NEMA 12 for unclassified areas.
   2. NEMA 4 for outdoor or wet areas.
      a. Except MCC's which shall be NEMA 3R non-walk-in type.
   3. NEMA 4X for corrosive areas.
   4. NEMA 7 for Class I hazardous locations.
   5. See Section 13448.

G. Transient Voltage Surge Suppressors:

1. For use in motor control centers, switchboards, low voltage switchgear and panelboards.
   a. Shall be designed for parallel operation.
   b. Shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category B and C3 (high exposure level) environments, as tested by ANSI/IEEE C62.11, C62.45.
2. Units shall be UL Listed and labeled under UL 1449 Standard for Transient Voltage Surge Suppression (TVSS) and the surge ratings shall be permanently affixed to the TVSS.
3. The TVSS maximum continuous operating voltage shall be equal to or greater than 115% of the nominal system operating voltage.
4. The operating frequency range of the system shall be at least 47 - 63 Hertz.
5. The response time shall not exceed 1 ns.
6. Unit shall be internally fused and rated to allow maximum specified surge current capacity.
   a. Shall not require external fusing to meet UL1449 requirements.
   b. Overcurrent protection shall not limit specified surge currents.
7. The TVSS shall provide L-N or L-L, L-G and N-G (where applicable) protection.
8. The UL 1449 listed surge ratings for the specified protection modes shall comply with the following:
   a. For use on 277Y/480 volt, 3 phase, 4 wire systems:
      1) Let through shall not exceed 800 volts.
      2) 100,000 amps minimum repetitive surge current capability per phase.
      3) 50,000 amps minimum surge current capability per mode.
   b. For use on 208Y/120 volt, 3 phase, 4 wire and 120/240 volt, 1 phase, 3 wire systems:
      1) Let through shall not exceed 400 volts.
      2) 100,000 amps minimum repetitive surge current capability per phase.
      3) 50,000 amps minimum surge current capability per mode.
9. Environmental Requirements:
   a. Operating Temperature: -40 to +60 C (-40 to 140 F).
   b. Relative Humidity: 0 to 95% non-condensing.
   c. Operating Altitude: 0 to 18,000 feet above sea level..
10. Five year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions.
11. Enclosure shall be NEMA 12.
12. Terminal boards shall be provided for external connections.
13. Shall include the following features:
    a. Indicating light(s) to indicate surge suppression capability.
       1) Fully rated surge suppression capability may be indicated by light(s) ON or by light color.

H. Form C, NO/NC dry contacts for remote monitoring of status. Float-Tilt Type Level Switches:
   1. Acceptable manufacturers:

a. Anchor Scientific Inc.
b. Consolidated Electric.

2. Materials:
   a. Float material: Polypropylene or teflon coated type 316 stainless steel.
   b. Cable jacket: PVC, neoprene or equal.
   c. Cable clamp: Polypropylene or 316 stainless steel.
   d. Design and fabrication:
      1) Sealed mercury switch in float.
      2) Provide switch complete with flexible electrical cables.
      3) SPDT contact rated at 4.5 A at 120 V AC.
      4) Direct acting float switch:
         a) Switch actuates on rising level.
         b) Switch deactuates when liquid falls 1 IN below actuation level.
      5) Terminate cables in junction box.
      6) Install floats per Drawing details.
3. Schedule:

TAB NUMBER	SERVICE	CONTACT NO/NC	MOUNTING ELEVATION

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Mount equipment as scheduled in Section 16010.

C. TVSS Installation:
   1. Install the TVSS in the equipment it is intended to protect.
   2. Lead length shall not exceed 6 IN.
      a. If installation restrictions require lead length in excess of 6 IN, submit data to show the impact of the additional length on the surge limiting characteristics of the TVSS.
   3. Twist leads together.

3.2 FIELD QUALITY CONTROL

A. Field test and verify operation of the equipment.

END OF SECTION

SECTION 16530
SITE LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site lighting.

B. Related Sections include but are not necessarily limited to:
   1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Supplementary General Conditions
   3. Section 16010 - Electrical: Basic Requirements.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Pole wind loading capability.
   3. Lighting calculations verifying average illuminaion, at the paved surfaces (in footcandles),
      average to minimum footcandle ratio, and pole spacing.
   4. Pole moment of inertia.
   5. Ballast electrical data.
   6. Fuseholder and fuse data.
   7. Lamp data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Luminaires:
   1. As indicated on Contract Drawings.

B. Poles:
   1. As indicated on Contract Drawings

C. Pole Foundations: Per detail on Contract Drawings.

D. Underground Wiring: Type XLP/USE installed Sch. 80 PVC conduit.
   1. Provide all wiring runs with separate green equipment grounding conductor, and ground all pole bases.

E. Pole Wiring from Base to Ballast: #12 Type XHHW, each phase protected by a 30 A, 600 V, Type Tron waterproof fuseholder, Bussman "Limitron" type fuse, size rating 3-times load current.

F. Lamps:
   1. Acceptable manufacturers:
      a. General Electric.

b. Osram.
c. Phillips.

2. High pressure sodium.
3. Bulb finish: Clear.

G. Luminaire Ballasts:
1. UL listed.
2. Minimum 90 percent power factor at rated voltage and current.
3. Minimum current shall not exceed operating current.
4. Operating current shall not exceeen 0.55 Amps at 480V AC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conduit and wire to poles as shown on Drawings.

B. Mount poles to foundations in accordance with manufacturer's installation instructions.

C. Construct pole foundations in accordance with drawing details and coordinates.

D. Provide branch wiring from pole base to luminaire.
1. Wire: No. 12 AWG
2. Insulation type: XHHW
3. Protect each phase by Bussman Limitron 1.5A, 600V fuse installed in Bussman Tron 30A, 600 V waterproof fuseholder.

E. Install ground rod at each pole in accordance with Drawings. Connect to ground lug in pole shaft.

F. Install lamps in all luminaires.

G. At completion of the project and prior to turning the lighting system over to the Owner, replace all failed lamps and all lamps exhibiting "end of life" cycling.

END OF SECTION

APPENDIX B

SALT RIVER PROJECT (SRP)
TEMPORARY OUTAGE AGREEMENT

TEMPORARY IRRIGATION OUTAGE AGREEMENT INSTRUCTIONS

Whenever an SRP irrigation outage is needed for construction, an Outage Agreement must be completed by the SRP Watermaster and signed by the Contractor before SRP will allow construction to begin.

To initiate the process, Contractor shall contact the SRP Watermaster and request a pre-construction meeting.

At the pre-construction meeting, or subsequent meetings, if all conditions have been met to the satisfaction of SRP, the SRP Watermaster will fill out an Outage Agreement form. Outage Agreement form must be signed by SRP Watermaster and by Contractor. SRP Watermaster will provide Contractor with a copy of signed Outage Agreement.

After the Outage Agreement form has been completed and signed, Contractor may proceed with the agreed upon work during the time period specified.

Delivering More Than Power™

SRP File or License # _____

TEMPORARY IRRIGATION OUTAGE AGREEMENT

This TEMPORARY IRRIGATION OUTAGE AGREEMENT ("OUTAGE AGREEMENT") is made by and between _____ ("CONTRACTOR") and the SALT RIVER PROJECT AGRICULTURAL IMPROVEMENT AND POWER DISTRICT ("SRP"), an agricultural improvement and power district organized and existing under the laws of the State of Arizona.

During the period from _____ 19___ at ____:00 ____.M. through _____ 19___ at ____:00 ____.M. ("OUTAGE PERIOD"), SRP agrees to cease irrigation deliveries through the SRP irrigation facilities at the following location(s):

_____

_____

_____

_____

_____

The CONTRACTOR, having read both sides of this OUTAGE AGREEMENT, understands and agrees to all the terms and conditions contained herein. CONTRACTOR further acknowledges that CONTRACTOR (1) has been informed that the workplace may contain OSHA Permit-Required Confined Spaces, (2) agrees that CONTRACTOR will conduct any Permit-Required Confined Space entry under a permit space program that complies with applicable OSHA requirements, and (3) has received and reviewed SRP's Association Permit-Required Confined Space Program.

_____

Authorized CONTRACTOR Representative Date

Office Phone No.: _____ Emergency Phone No.: _____

_____

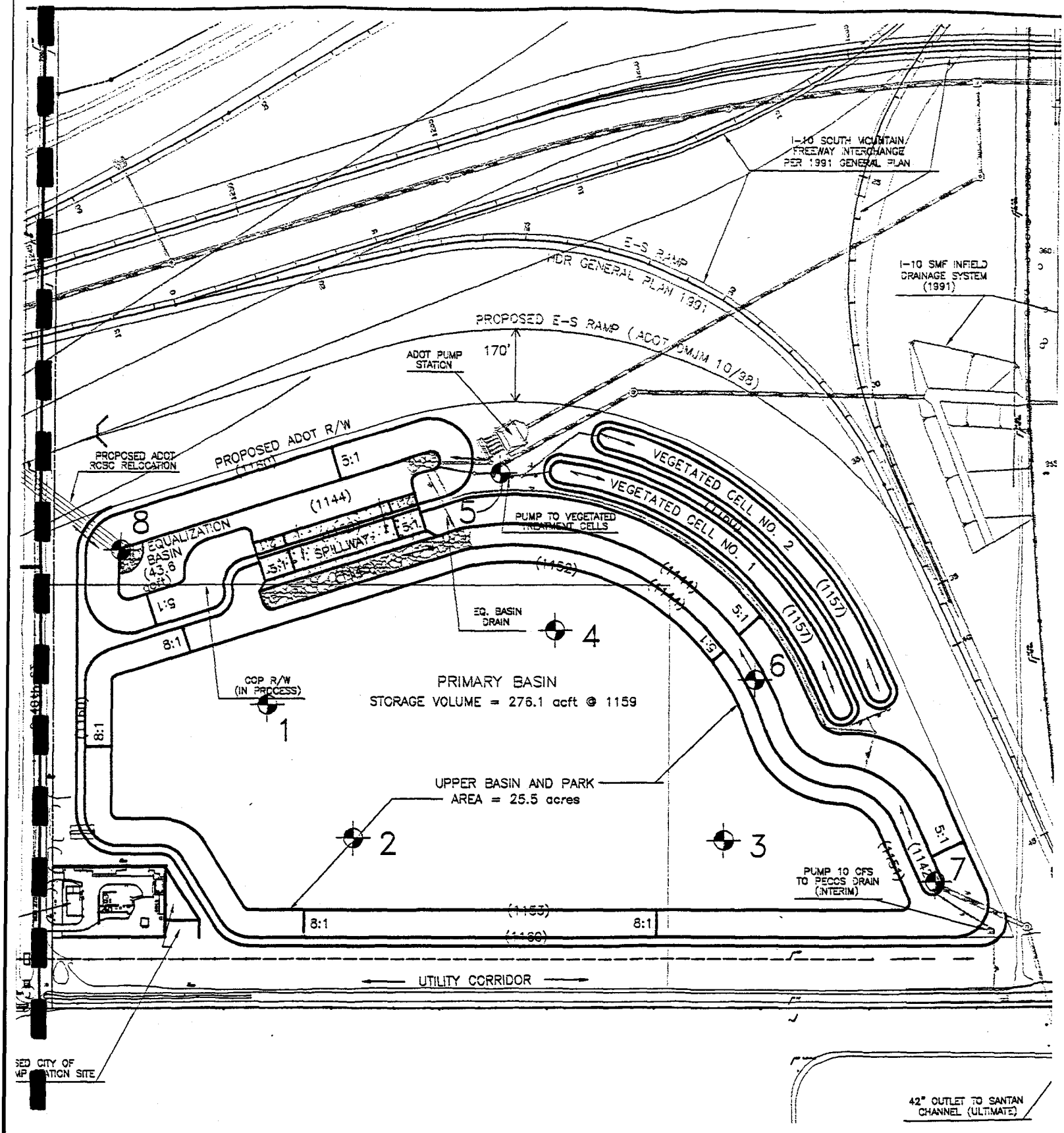
SRP Date

SRP emergency phone number: 236-5296

COPIES: WHITE - INSPECTOR CANARY - WATERMASTER PINK - CONTRACTOR

APPENDIX C

SOIL BORING LOGS



REFERENCE: HDR ENGINEERING, INC., 48th STREET DETENTION BASIN SITE PLAN, FOR CITY OF PHOENIX, ARIZONA, HDR PROJECT NO. 00167-293-044, SHEET NO. 1 OF 6, DECEMBER 1998.

AGRA
Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
Tel: (602)272-6848
Fax: (602)272-7239

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 1

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-3-6			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained sand, subrounded to subangular, low plasticity, brown
5			X	S	9-13-16			SC	slightly moist firm	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, light brown
10			X	S	2-4-5			CL	slightly moist moderately firm	**SILTY TO SANDY CLAY**, low to medium plasticity, light brown
15			X	S	13-17-21			SC/CL	slightly moist very firm	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, light brown
20										Stopped Auger at 15' Stopped Sampler at 16'6"
25										
30										
35										
40										
45										
50										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

GEOTECH_BR 9117001014.GPJ AGRA_ALB.GDT 2/18/99

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 2

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-4-8			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low plasticity, brown
								CL	slightly moist moderately firm	**SANDY CLAY**, weakly lime cemented, low to medium plasticity, light brown
5			X	S	8-12-15		9			
10			X	S	6-5-5		11	SC-SM	slightly moist firm to hard	**CLAYEY SAND**, some to considerable silt, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown
15				U	40					Stopped Auger at 15' Stopped Sampler at 16'
20										
25										
30										
35										
40										
45										
50										

GEOTECH_BH 9117014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 3

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-5-7			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist firm	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
5			X	S	6-7-9					
								CL	slightly moist firm to hard	**SANDY CLAY**, predominantly fine to medium grained, subrounded to subangular, weakly to moderately lime cemented, medium plasticity, brown
10				U	34		11			
15			X	S	10-22-50					
20										Stopped Auger at 15' Stopped Sampler at 16'6"
25										
30										
35										
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 4

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-3-4			SC/CL	slightly moist soft	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist firm	**CLAYEY SAND**, poorly graded, subrounded to subangular, low to medium plasticity, brown
5			X	S	12-12-12					
								SC	slightly moist hard to firm	**CLAYEY SAND**, some fine grained gravel, poorly graded, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown note: some sand (SP) lenses
10				U	52	107	5			
15			X	S	13-13-15		9			
										Stopped Auger at 15' Stopped Sampler at 16'6"
20										
25										
30										
35										
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

GEOTECH_BH 9117014.GPJ AGRA_ALB.GDT 2/16/99

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 5

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth In Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-5-6			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SAND CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist very firm to moderately firm	**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown
5			X	S	9-13-18					
10			X	S	7-7-8					
								SC/SM	slightly moist firm	**CLAYEY SAND**, some silt & fine grained gravel, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
15			X	S	7-8-12					
20			X	S	14-16-50		13			
								SC	slightly moist hard	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, light brown
25			X	S	18-50/4"					
30				U	100/7"					
35			X	S	30-45-25					
										Stopped Auger at 35' Stopped Sampler at 36'6"
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 6

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-5-7			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained sand, subrounded to subangular, low to medium plasticity, brown
5			X	S	9-12-12			SC	slightly moist firm to hard	**CLAYEY SAND**, poorly graded, subrounded to subangular, low to medium plasticity, brown
10			X	S	4-6-11					
15				U	78	113	10			
20				S	50/3"			GP/GC	slightly moist hard	**CLAYEY GRAVEL**, poorly graded, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown
25				S	50/0"			SC	slightly moist hard	**CLAYEY SAND & GRAVEL**, predominantly medium to fine grained sand, predominantly fine grained gravel, subrounded to subangular, low to medium plasticity, brown
30										Stopped Auger at 25' Sampler refused at 25'
35										
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

GEOTECH_BH 9117001014.GPJ AGRA_ALB.GDT 2/16/99

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 7

JOB NO. 9-117-001014 DATE 2/3/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth In Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-4-8			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist firm to very firm	**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
5			X	S	9-9-8					
10			X	S	6-14-18					
15			X	S	22-30-38		12	SM/GM	slightly moist hard	**SILTY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, angular to subangular, low plasticity, brown
								SC/SM	slightly moist hard	**CLAYEY SAND**, some silt, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, light brown
20			X	S	14-50/5 1/2"					
25			X	S	11-15-50/5"		13			
30				S	50/2"					Auger refused at 29' Sampler refused at 29'2"
35										
40										
45										
50										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 7A

JOB NO. 9-117-001014 DATE 2/4/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								SC/CL	slightly moist	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist	**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
5										
10										
15								SM/GM	slightly moist	**SILTY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, low plasticity, brown
20				A				SC/SM	slightly moist	**CLAYEY SAND**, some fine grained gravel, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown note: considerable moderately to strongly lime cemented nodules in lenses
25										
				A						
30										
35										
40										Stopped Auger at 40'
45										
50										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 8

JOB NO. 9-117-001014 DATE 2/4/99

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-2-4			SC/CL	slightly moist soft	**CLAYEY SAND TO SANDY CLAY**, poorly graded, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist very firm to hard	**CLAYEY SAND**, some fine grained gravel, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown to light brown
5				U	58	104	8			
10			X	S	13-18-21					
15			X	S	16-18-22					
20			X	S	16-20-26					
								SC	slightly moist hard	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown
25			X	S	50/5"					
30			X	S	28-50/5"					
								SM	slightly moist to moist very firm	**SILTY SAND**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity; brown note: thin layers of moderately to strongly lime cemented nodules
35			X	S	8-16-24		26			
40			X	S	8-10-20					
										Stopped Auger at 40' Stopped Sampler at 41'6"
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
ENGINEERING GLOBAL SOLUTIONS

APPENDIX D

IRRIGATION PREFABRICATED PACKAGE
BOOSTER PUMP STATION SPECIFICATION

APPENDIX D

IRRIGATION PREFABRICATED PACKAGE
BOOSTER PUMP STATION SPECIFICATION

PART 1 - GENERAL

1.00 GENERAL.

To provide a single source responsibility for the manufacture, warranty, service and operation of a prefabricated, skid mounted, fully automatic variable speed pumping system (systems) for turf irrigation. The pumping system shall automatically maintain a constant discharge pressure regardless of varying flow demands within the station rating. This specification covers the minimum requirements, however, it should not be construed as all inclusive. It is the successful vendor's responsibility to include all necessary appurtenances to provide for a complete, automatic, smooth operating, and reliable pumping system. The manufacturer shall supply a complete set of general arrangement drawings, electrical power schematics, and control schematics in the operations & service manual.

1.10 MANUFACTURER.

The pumping system shall be of the type manufactured by FLOWTRONEX PSI Inc., Dallas, Texas, U.S.A., or approved equal. For consideration of a proposed equal system, the contractor shall refer to Supplementary General Conditions Subsection 106.4 and furnish the following data to the engineer:

- A general arrangement drawing showing overall dimensions and all piping layouts.
- Complete submittal data for all major equipment (pumps, motors, filter, variable frequency drive (VFD), programmable controllers (PLC), valves, and motor starters).
- An electrical schematic showing power wiring.

PART 2 - MECHANICAL

2.10 SCOPE.

Pump station shall be a completely skid mounted horizontal centrifugal VFD pump station. All equipment including but not limited to pumps, motors, valves, instrumentation and controls shall be mounted on a common structural steel base to form a complete operating pumping station.

2.15 STATION BASE.

The pump station base shall be designed and fabricated to provide proper structural support for all attached equipment. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation. Main structural members shall be constructed from heavy weight channel

or I-beam steel. Provisions shall be made in the station base for off-loading and handling the station at the site of installation. Base shall include 1/4" checkered deck plate and 1" steel plate mounted under pump and motor. All 1/4" deck plate and 1" steel plate shall be 100% seal welded to main structural members. Skip welding is not acceptable. Critical frequency of complete pump station shall be above operating frequencies.

2.20 DISCHARGE PIPING.

All piping shall be constructed from ASTM A105 schedule 40 pipe or heavier as required to maintain a 3 to 1 pressure safety factor (including 1/16" corrosion allowance). All piping shall be hydrostatically tested to 150% of maximum shutoff pressure.

2.30 PAINT.

Structural steel, attached piping, and supports shall be grit-blasted with #50 steel grit per SSPC-10 to a near white metal condition. The cleaned steel surfaces shall immediately thereafter be primed with an industrial grade primer to a thickness of 2 1/2 to 3 mils epoxy primer. The finish coat shall be acrylic enamel to a thickness of no less than 3 mils.

The control panel shall be dip cleaned, acid etched and neutralized, iron phosphate coated and painted with a finish coat of 1 1/2 to 2 mils of polyurethane.

2.40 PUMPS.

The main irrigation pumps shall be of the horizontal centrifugal type. There will be two irrigation pumps required each having to pump 400 gpm from a base suction pressure of 45 psi to a discharge pressure of 80 psi constant.

The horizontal pumps shall be manufactured according to the standards of the Hydraulic Institute and to ANSI specification No. B58.1. The pump casing shall be ASTM 48, class 30, cast-iron capable of hydrostatic test @ 150% of maximum discharge pressure and have both suction and hub replaceable wear ring. All mating parts shall have a register fit to ensure alignment.

The impeller shall be an enclosed, single piece bronze or cast-iron casting completely machined on all outside surfaces and statically balanced at time of pump assembly. The impeller shall be keyed to the shaft and securely fastened with a vibration resistant lock screw and washer.

The packing box shall contain a **mechanical seal** for the specific application.

The impeller shall not contact the suction or hub wear ring under any operating load condition.

The pump and motor shall be connected by an ASTM 48, class 30, cast-iron bracket incorporating a full isolating shield with dual slinger rings to prevent moisture from

entering the front motor bearing. The main irrigation pump shall be as manufactured by Ingersoll-Dresser Pump Company, or Cornell, or Berkeley, or approved equal.

A pressure maintenance pump shall be provided to maintain system pressure during non irrigation periods. The pump end shall be of the vertical multi-stage design with the motor mounted directly to the top of the pump.

The pump suction/discharge chamber, motor stool and pump shaft coupling shall be constructed of cast iron. The impellers, pump shaft, diffuser chambers, outer discharge sleeve and impeller seal rings or seal ring retainers shall be constructed of stainless steel. The impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement. Intermediate and lower shaft bearings shall be Tungsten Carbide and Ceramic or Tungsten Carbide and Bronze. Pumps shall be equipped with a high temperature mechanical seal assembly with Tungsten Carbide/Carbon or Tungsten Carbide/Tungsten Carbide seal faces. Pump shall be as manufactured by Grundfos, or approved equal.

2.45 MOTORS.

Motor(s) for the irrigation pumps shall be of United States manufacture, close-coupled type with rodent screens on all ventilating passages and be open-drip proof, 1.15 service factor, and class F insulation. Motors shall be wound for the starting configuration as called out in the technical data sheet. Design pump brake horsepower shall not exceed 98% of motor horsepower exclusive of service factor. Maximum pump run out horsepower shall not be greater than 8% higher than motor rating exclusive of service factor. The motor bearings shall be selected to withstand thrust loads and have a minimum life of 5 years continuous operation. The motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. Motors shall be as manufactured by U.S. Electric, or Baldor or Reliance, or approved equal.

Motor for pressure maintenance pump shall be sized to ensure the pump is non-overloading when operating on the specified pump curve. The motors shall be 15 horsepower, 460 volt, 3 phase and 60 HZ.

Motor design shall be of the open drip proof, with a NEMA C face design operating at a nominal 3450 RPM with a minimum service factor of 1.15. Lower motor bearings shall be adequately sized to ensure long motor life. Motor for pressure maintenance motor shall be as manufactured by Baldor, or approved equal.

2.50 PUMP CHECK VALVE.

Pump check valves shall be provided on the discharge of each pump and sized per the technical data sheet. They shall be of the silent operating type that begin to close as forward velocity diminishes and be fully closed at zero velocity preventing flow reversal. Valve bodies shall be cast from grade 35 cast-iron or better and shall be free from blow holes, sand holes, and other impurities. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Internals shall be machined bronze

disc, seat, and stem guide. Seat shall be Buna-N to provide resilient sealing. Dual disc style check valves is not acceptable. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI. Check valve shall be as manufactured by Valmatic, Cla-Val, or Bermad.

2.55 PUMP ISOLATION VALVES: DISCHARGE.

Pump isolation valves shall be of the butterfly type with grooved ends to provide for expansion and vibration dampening and a lever operator. Lug style isolation valves are not acceptable. They shall be sized as shown in the technical data sheet. Valve body shall be constructed of ductile iron with a polyphenylene sulfide coating. Valve disc is rubber coated ductile iron. Valve shall be rated to 300 PSI. Isolation valve shall be as manufactured by Victaulic Company of America, or approved equal.

2.60 PUMP ISOLATION VALVES: SUCTION.

Pump isolation valves shall be installed on the inlet of the pump to completely isolate the individual pumps. Valve shall be of the lug style butterfly type. Valve shall have one piece body cast from ASTM A126 cast iron. Stem shall be 416 stainless steel. Disc shall be nickel plated ductile iron. Stem bushings shall be Acetyl to prevent stem seizure to body during prolonged periods of non-use. Seat shall be Buna-N elastomer, one piece construction, and shall also form the flange sealing gaskets. Valves 8" and smaller shall have a lever operator. Valves 10" and larger shall have a gear operator with hand wheel. Valve shall be rated at 200 PSI bubble shutoff. Pump suction isolation valve shall be as manufactured by Watts, or approved equal.

2.65 PRESSURE RELIEF VALVE.

A pilot operated modulating pressure relief valve shall be included and sized per the technical data sheet. The valve shall be set 7 to 10 PSI above operating pressure and will relieve when inlet pressure exceeds spring setting on pilot. Valve shall be quick opening and slow closing to minimize surging. Valve body shall be cast iron with 125 lb. inlet and outlet flanges, and shall be rated for 200 PSI. A wye strainer shall be installed in the inlet side of the valve body to provide clean water to the CRL pilot. A wafer style butterfly valve shall be installed on the inlet and outlet of the relief valve. Specifications for this isolation valve will be the same as for the station isolation valve found later in the specification. Relief valve shall be as manufactured by Cla-Val, or approved equal.

2.70 PRESSURE GAUGE.

A pressure gauge shall be mounted on the suction and discharge header with an isolation ball valve. All gauges shall be silicon filled to reduce wear due to vibration. Accuracy shall be within 2%. Gauge diameter shall be 3 1/2" minimum. Range shall be at least 30% higher than the highest pressure attainable from the pumps at shutoff head conditions. Stainless steel back & bronze internal. Pressure gauge shall be as manufactured by Ashcroft.

2.75 STATION ISOLATION VALVE.

Station isolation valve shall be installed on the discharge of the pump station to completely isolate the pumping system from the irrigation system. Valve shall be of the lug style butterfly type. Valve shall have one piece body cast from ASTM A126 cast iron. Stem shall be 416 stainless steel. Disc shall be nickel plated ductile iron. Stem bushings shall be Acetyl to prevent stem seizure to body during prolonged periods of non-use. Seat shall be Buna-N elastomer, one piece construction, and shall also form the flange sealing gaskets. Valves 8" and smaller shall have a lever operator. Valves 10" and larger shall have a gear operator with hand wheel. Valve shall be rated at 200 PSI bubble shutoff. Station isolation valve shall be as manufactured by Watts, or approved equal.

PART 3 - ELECTRICAL

3.00 SCOPE.

To provide complete instrumentation and controls to automatically start, stop and modulate pump speed(s) to smoothly, efficiently and reliably pump variable flow rates at a constant discharge pressure. Full alarms and safety features needed to protect the equipment and irrigation piping system.

3.10 CONTROL ENCLOSURE.

Controls shall be housed in a NEMA 4 enclosure with integral latches. The control enclosure should be constructed of 12 gauge steel and the back plate assembly shall be constructed of 12 gauge steel. The enclosure shall be painted as specified in the paint specification listed under Section 2.0 Mechanical. All indicating lights, reset buttons, speed potentiometer, selector switches and the operator interface device shall be mounted on enclosure door and also be rated NEMA 4. All internal components shall be mounted and secured to the removable back plate assembly. A closed type cooling system shall be included to cool the enclosure and reject heat from the VFD. Open type cooling systems allowing outside ambient air to enter the panel are not acceptable. No water line connections shall be permitted inside of the control enclosure.

The VFD LCD display shall be viewable through a water tight plexiglass window built into the control panel door.

3.15 LIGHTNING AND SURGE ARRESTER.

All electrical equipment shall be protected by a U.L. approved Category C and Category B surge arrester to suppress voltage surges on incoming power. The devise under IEEE C62.41 Category C will withstand a impulse of 10Kv/10Ka and Category B to withstand a ringwave of 6Kv/500a and a impulse of 6Kv/3Ka. Pass voltage for a 480v devise to the end equipment shall not exceed 1500V-1800V when subjected to a 8ms * 20ms waveshape resulting in the following performance statistics: 3720 joules minimum with a power dissipation of 82,500,000VA at 1800V maximum pass voltage to the protected equipment. Response time shall be less that 5 nanoseconds.

3.20 MAIN DISCONNECT.

A non-fusible main disconnect shall be provided to completely isolate all controls and motor starting equipment from incoming power. Main disconnect shall have a through the door operator, and shall be sized as shown in the technical data sheet. Disconnect shall be as manufactured by ABB.

3.25 CONTROL POWER.

Power for the controls shall be provided by a control power transformer which will provide 120 volt, single phase power for the pumping system control operation. Control power transformer shall not be used for any other external load. The control power transformer shall be protected on the primary side by control limiting fuses of adequate size and voltage rating. All control components will be protected by time delay circuit breakers of adequate size. Control power transformer shall be as manufactured by Acme, or approved equal.

3.30 MOTOR STARTING EQUIPMENT.

All motor starters for the pumping station shall be mounted on a single back panel in a single NEMA 4 enclosure as specified in section 3.10. Motor starters shall meet I.E.C. standards and shall be rated for a minimum of 1,250,000 operations. Each main irrigation motor shall have dual contactors which are both electrically and mechanically interlocked to allow the VFD to operate on any of the motors as called out in the technical data sheet. Motor overload relays shall be I.E.C. rated class 10 ambient compensated. Fuses shall supply short circuit protection to each motor and shall be rated for a minimum 200,000 amp interrupting capacity. Motor starters shall be as manufactured by Allen Bradley.

3.35 VARIABLE FREQUENCY DRIVE.

The variable speed drive shall be a digital, pulse width modulation (PWM) variable frequency drive (VFD) with IGBT transistors. The VFD shall have a minimum wire to wire efficiency of 98.5%, and shall be rated up to 550 volt operation in order to eliminate nuisance tripping at marginally high voltage conditions. Front end shall be protected by fast acting semiconductor fuses. Any VFD error messages shall be displayed on a 40 character LCD readout in English or any one of 8 other languages. The following fault protection circuits shall be included: Overcurrent (200%), Overvoltage (130%), Undervoltage (60%), Overtemperature (70 Deg. C), Ground fault, and Motor overload. The VFD shall be capable of starting into a rotating load and accelerate or decelerate to setpoint without safety tripping. The VFD shall have an automatic extended power loss ride through circuit which will utilize the inertia of the pump to keep the drive powered. Minimum power loss ride-through shall be one cycle based on full load and no inertia. The VFD shall be optimized for a 3 kHz carrier frequency to reduce motor noise. The VFD shall employ three current limit circuits to provide "tripless" operation. The following operating information shall be displayed on the VFD LCD: KWH, elapsed time, output frequency (Hz), motor speed (RPM), motor current (amps), and voltage.

Line reactor will be installed on input of VFD to protect against voltage transients. The VFD LCD display shall continuously scroll through all operating information and shutdown faults while the drive is running and while stopped. This information shall be viewable through a water tight plexiglass window on the control panel door as specified in Section 3.10. VFD shall be as manufactured by ABB, or approved equal.

3.40 PRESSURE TRANSDUCER.

Pressure transducer shall be utilized for providing all pressure signals for the control logic. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 0.20% and constructed of 316L stainless steel. Transducer shall be rated for station discharge pressure as shown on technical data sheet, and shall provide gauge pressure output, rather than an absolute. Pressure transducer constructed of plastic is not acceptable. Pressure transducer shall be as manufactured by Druck, or approved equal.

3.45 FLOW METER.

The pump station shall have a flow sensor installed which will provide the pump station flow rate and total flow through the operator interface device (OID) as specified in Section 3.55. The flow sensor shall be a six bladed design which provides a low impedance signal proportional to the flow. The accuracy shall be plus/minus 2% of actual flow rate between flow velocities of 1-30 ft./sec. A flow meter run shall be included with a minimum of 5 pipe diameters straight run upstream and 2 pipe diameters downstream for proper meter accuracy. Meter run shall be sized as shown in technical data sheet. Flow sensor shall be as manufactured by Data Industrial.

3.50 CONTROLS.

All control logic shall be handled by an industrial grade programmable logic controller (PLC) with a 40 character LED industrial operator interface providing data entry and read-out capabilities. PLC shall have LED indicators for input, output, and six diagnostic read-outs showing PC Run, CPU Fault, and two communications, (battery and force). An LED visual status light is provided for each I/O to indicate on/off status. PLC shall be provided with a built in EEPROM, capacitor, and battery for memory backup. All logic for system control, timing, and control of VFD speed shall be handled by the PLC. A separate set point controller is not acceptable. PLC shall have a built in clock calendar. The PLC shall be as manufactured by Allen Bradley, or approved equal.

Control software shall be parameter driven, fully documented, and allow user to easily change all operational parameters. Standard control features and equipment which need to be included as a minimum are as follows:

A. Alarms and shutdowns:

- Low discharge pressure
- High discharge pressure (Attempt restart)*
- Low suction pressure or Loss of Prime (Attempt restart)*

- Phase loss (Attempts restart)*
- Low voltage (Attempts restart)*
- Phase unbalance (Attempts restart)*
- Phase reversal
- Individual motor overload/phase loss (indicates which individual motor was shut down)
- VFD fault (shutdown VFD pump only and attempts restart)*

* Three unsuccessful restarts in 15 minute period will give hard shutdown.

All alarms will be indicated by a red general alarm light. Specific alarm conditions along with procedures for correction will be displayed in English on the operator interface display (OID).

Individual motor phase failure and low voltage safety circuitry shall retire any pump that experiences low voltage, phase failure or phase unbalance as monitored at the load-side of each pump motor contactor. Each pump motor shall have its individual protective device and time delay to allow for transient low voltage during motor starting to allow maximum motor protection. Separate main phase failure and low voltage safety circuit shall also be provided to retire the pumping system if it experiences low voltage, phase failure or phase reversal as monitored at line-side of control enclosure. Phase monitor shall have a time delay to allow for transient low voltage during motor starting and to allow maximum motor protection. Operator interface device (OID), mounted in enclosure door, shall signal phase failure for any affected pump. The individual pumps or pumping system shall not operate until the voltage problem has been corrected and safety has been manually reset. Single incoming phase monitor safety circuit is not acceptable.

B. Panel face switches and lights:

- Individual pump run lights
- Individual pump on/off switches
- System Hand/Off/Automatic switch
- Mode Select switch -- allows automatic bypass mode of operation which can be used if VFD should fail
- VFD selector switch -- in manual mode, allows user to select which pump will be run of the VFD
- Reset -- Acknowledges pump station alarms
- Speed potentiometer -- in manual mode allows user to adjust VFD pump speed
- Low discharge pressure override switch -- disables low discharge pressure alarm

C. PLC bypass switch mounted inside panel allows user to manually operate pumps should PLC fail.

D. Four distinct set point pressures (normal, lockouts 1 & 2, and high elevation). The lockout feature gives the user the flexibility to lower the set point pressure automatically at days and times, and "locking out" the operation of one or more of main pumps if local power authority imposes penalties for operating these pumps during such times. It also allows user to set a maximum RPM for the VFD pump during these lockout times so that user can limit amperage draw during penalty periods. The high elevation set point can be tied into a computerized irrigation system, or directly linked to high elevation satellites. When high elevation satellites are operating, control software will automatically and gradually elevate the pressure to the new desired set point. When finished, the high set point will be lowered back to normal. The high elevation set point will only be used if called out on the technical data sheet.

E. Software will be included to automatically and gradually ramp up irrigation system pressure to the desired operating pressure (i.e., 1 PSI every 4 seconds) without overshooting design pressure. This feature operates whenever pressure drops below set point pressure. This ramp up time is fully adjustable by the operator. This control feature is based on an increase in pressure over a pre-defined time period. The acceleration control on the VFD is NOT an acceptable means of adjusting pressure ramp up speed.

F. Software will be included for optionally maintaining a lower irrigation system pressure when not irrigating. Reduced pressure values will be shown in the technical data sheet. Controls will cycle the PM pump at these reduced pressures during non irrigation times and pressure will gradually increase to design pressure when the irrigation periods begin.

G. Neither flow meter nor VFD output frequency shall be used for shutting down last VFD driven pump. Controls and software shall incorporate a method to eliminate excessive cycling of VFD pump at very low flow conditions, yet not run the pump excessively at no flow conditions.

H. Automatic alternation of VFD driven pumps. This shall be accomplished by incorporating dual mechanically and electrically interlocked contactors allowing alternation of the VFD between pumps.

I. Real time clock calendar allows PLC to internally provide all date and time functions used above.

J. Two separately adjustable PID control loops for both low flow and high flow pressure stability.

K. User shall be able to field select either of two modes of VFD operation. Auto switch VFD option allows VFD to sequentially start each pump. The standard mode of operation starts the first main pump on the VFD and the remaining pumps start across the line as required.

L. Shutoff algorithm for fixed speed pumps to minimize pump cycling while also remaining responsive to sudden flow reductions. Minimum run timers alone for minimizing fixed speed pump cycling is not acceptable. Discharging through relief valve during pump transitions is not acceptable.

M. Full manual operation capability with panel face mounted speed potentiometer for manually adjusting VFD speed.

N. System can be immediately and directly switched from manual to automatic mode of operation. This allows for manual pressurization and immediate switching capability to automatic.

O. Light test sequence: Pressing the reset button for 5 seconds illuminates all lights.

P. Rate of pressure change algorithm to rapidly determine if there is an irrigation demand and immediately cycle on the VFD pump, instead of waiting for pressure to drop to a predetermined start pressure.

Q. All pump station shutdowns shall be of the controlled type that sequentially phase pumps off at user selectable intervals to reduce water hammer within the irrigation system.

R. The pump station software program shall be user friendly enough to enable the setpoint pressure from being raised or lowered by the end user at the pump station or through the remote monitoring software package if provided. The pump station software latter logic shall be written in such a way that no other value would require changing if the setpoint pressure had to be adjusted. Pressure maintenance pump and main irrigation pump start pressures, the pressure maintenance pump stop pressure, low discharge shutdown and high discharge shutdown shall not be a specific value but a differential pressure off of setpoint (i.e. pressure maintenance pump (PMP) to start 5 psi below setpoint and stop 5 psi above setpoint).

3.55 OPERATOR INTERFACE DEVICE (OID).

The pump station shall include a NEMA 4, 40 character LED display and keypad mounted on the control panel door. This device will allow the operator to view and selectively modify all registers in the PLC. The unit shall store its messages in non-volatile memory. The operator interface device shall incorporate password protection for protecting data integrity. The device will allow for display and modification of all timers, set points, lockout times, etc. The device shall communicate with the PLC through the programming port, and shall include an RS232 communications port allowing a printer to be attached for real time station status logging.

In addition to normal data entry keys, the device shall include a minimum of the following function keys labeled:

A. Events. Displays the last 254 sequential pump station events with date and time of occurrence. Events shall include but not be limited to: all alarms, starting of individual pumps, stopping of individual pumps and changing of selector switches.

B. Pumplog #1. Operator can scroll through the historical pump station flows and pressures for up to the last 7 days. Sampling time periods can be changed by the operator (from 10 seconds to 60 minutes). Averages are taken over the sample period and the average recorded with date and time stamp.

C. Pumplog #2. Station flow and pressure are shown every second for the previous 60 seconds and every minute for the previous 30 minutes. If a shutdown occurs, the flow and pressure tables are locked in so that the operator may view how the pump station was performing immediately before the shutdown occurred.

D. Status. Will display the current operating status. When the station is running, the display will show the setpoint pressure, actual pressure, flow, and pump RPM.

E. Alarm Inf. Last nine alarms recorded in memory and are displayed with related detailed information on the alarm, time of occurrence, date, pumps operating at time of alarm and how to correct the alarm condition.

F. Daily Log/Total. It will display the following: Last time of log reset, individual pump run times, run times since last reset, pump starts, pump starts since last reset, total flow, and total flow since last reset.

G. Scroll Key. Used to scroll up and down through data.

The OID shall be an information system only and not required for pump station operation. No switches, reset buttons, general alarm light, run lights or speed potentiometers are included within this unit. The pump station will be fully functional in the event the OID unit should fail.

3.60 CODES.

The control panel with controls shall be built in accordance N.E.C., and U.L. standards All equipment and wiring shall be mounted within the enclosure and labeled for proper identification. All adjustments and maintenance shall be able to be done from the front of the control enclosure. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided. Main disconnect shall be interlocked with door.

3.65 OPERATION.

During non irrigation times, the pressure maintenance pump (PM) will cycle on and off as required to maintain irrigation system pressure. The start and stop pressure shall be a

differential off of setpoint. The cycling pressures can be user selected and can be set substantially below normal set point pressure, if desired. If the PM pump cannot maintain the desired pressure, then the VFD will start the first pump and will gradually ramp the pressure up to desired irrigation pressure. The start pressure of the VFD pump shall be a **differential** below the setpoint. The pump speed will be modulated to hold a constant discharge pressure regardless of flow. As the flow rate increases and the VFD pump can no longer maintain pressure while at maximum speed, the next sequential pump will be started and the VFD driven pump will accordingly reduce its speed and modulate. An algorithm shall be included for accurately reducing the VFD pump speed as the next sequential pump is started so that no pressure surges are generated during the transition (even with across the line starting). If the user prefers to switch the VFD from pump to pump for sequential starting, he can select this option with the OID. As the flow continues to increase, pumps will sequentially be started until all pumps are running. As the flow begins to decrease, pumps will be sequentially turned off until only a single VFD driven pump is operating. When a no flow condition occurs, the VFD pump shall be turned off.

PART 4 - INSTALLATION

4.10 GENERAL.

Others shall be responsible for providing all materials, equipment, and labor necessary to install all items associated with the pump station.

4.15 UNLOADING AND SETTING SUPERVISION.

Setting of the pump station is the responsibility of the Contractor and not the manufacturer.

4.20 START UP.

When discharge piping, electrical connections, and electrical inspection have been completed, the pump station manufacturer shall be contacted for start up. A minimum one week notice shall be given to manufacturer prior to scheduled start up date. During start up, the complete pumping system shall be given a running test of normal start and stop, and fully loaded operating conditions. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating and shall demonstrate its general fitness for service. All defects shall be corrected and adjustments made at the expense of the pump station manufacturer. Test shall be repeated until satisfactory results are obtained. Start up assistance will be provided but will be limited to one 8 hour day unless otherwise specified.

After the station startup has been completed, but before leaving the job site, a training session will be given. The training session will be given to the owner or the owner's representative to familiarize them with the pumping system operation, maintenance and adjustments.

PART 5 - ADDITIONAL FEATURES

5.10 MOTOR SPACE HEATER.

The pump station manufacturer shall provide on each pump motor a 120 volt, single phase space heater of ample size to prevent condensation from occurring within the motor during non operating periods. The space heater shall be de-energized when the motor is running.

5.20 REMOTE PUMP STATION CONTROL AND MONITORING.

Remote PC compatible pump station monitoring software shall be provided which allows user to remotely view all specified items in section 3.55 -- Operator Interface Device. Pump station monitoring software shall be included that is 100% compatible with Microsoft Windows 3.1, 3.11 or Windows 95. Software shall be graphic with full mouse (point and click) control. The monitoring system shall be capable of communicating at baud rates from 300 Baud to 19,200 Baud. User shall be able to view and/or change any and all station operating parameters (i.e. set point pressure, lockout times, ramp up speed, et), and also acknowledge and reset fault conditions. The pump station software shall be field configurable for direct hardware connect, phone modem, radio modem, or cellular modem. The software shall be capable of simultaneous or individual communication with up to 32 pump systems so equipped. Complete historical reporting capabilities shall be included. All required PLC interface card(s), modem and hardware required (other than computer, monitor screen, and direct burial cable) shall be supplied by pump station manufacturer.

A. Manufacturer shall provide the capability to monitor and control the pump system from a remote location. Monitoring program shall require an IBM compatible PC (minimum 386-33) with VGA monitor, 4 MB ram minimum, 10 MB free hard disk, Windows 3.1, 3.11, or Windows 95, available communication port capable of 2400 Baud communication, Mouse compatible with Windows, Printer capable of graphics, Hayes modem 2400 Baud rate. **The above equipment to be supplied by City of Phoenix.**

B. The monitoring software shall provide the ability for auto-datalog-download. This feature shall allow the timed retrieval of pump station historical data in order for complete station history storage and recall. Display of historical information shall be in a logical, graphical format. The data shall also be available as tabular information, either for screen viewing or for ASC11 export to external programs. The file format shall be non-proprietary and a description supplied with the software.

C. The monitoring system shall store up to 4 channels of data for analysis and system performance verification. These 4 channels shall be easily user selectable at any time through the graphic interface in the Windows environment. These 4 channels shall be capable of recording any of the following information:

a) Irrigation system pressure as well as set-point pressure
b) System flow rate
c) Auxiliary system pressure (as equipped)
d) Auxiliary system flow rate (as equipped)
e) VFD motor speed (as equipped)
f) Any auxiliary analog equipment such as level and temperature sensors

D. The system shall also store all station events for retrieval and graphical display. The events which are recorded shall be as follows:

a) Pump start XL (across the line)
b) Pump start VFD (variable speed drive)
c) Pump stop
d) All pump switch setting changes
e) Controller power loss
f) System switch setting changes
g) Faults - system and individual pump
h) Automatic and manual fault reset

E. The pump monitoring system shall graphically display the following real time information:

a) Pump run status
b) Pump RPM
c) Motor/pump hours
d) Pump system fault
e) Individual pump faults
f) Pump control panel switch status
g) System flow rate
h) System total flow
i) All pump control system monitoring pressures

F. Manufacturer shall provide the following monitor and control items:

1. Software - to be developed "in-house" and be fully documented and serviceable.
2. Hardware - limited to pump system and communication support, including PLC interface card (Hardware support for software is by user -- i.e., Computer, Monitor, Mouse, Phone Modem, Printer, Printer Cable etc.).

- Graphical display of datalog values will be included with user selectable ranges of 15 minutes, 1/2 hour, 1 hour, 12 hour, and 24 hours per screen.
- Monitoring software shall be user configurable. Communications shall be selected between two basic modes as detailed in technical specifications:

a) Direct connection - communicate via buried cable shall be Paige Electric #P7171D for a 2 pair (4 wires) #18 AWG shielded buried cable or #P7171D-A for a 2 pair (4 wire) #18 AWG shielded buried signal cable.

b) Modem - communicate via phone (RJ-11) dial-in @ 9600 Baud.

Communications port shall be selected by user (i.e., COM1:, COM2:, etc).

G. Password security shall be provided to guard against unauthorized system changes.