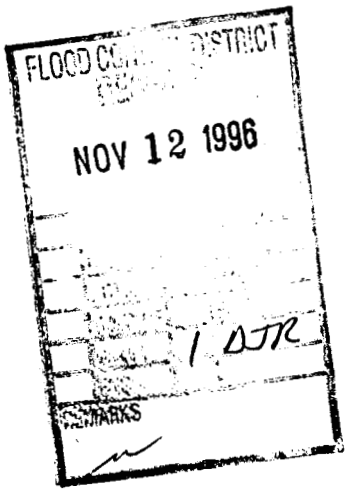

CITY OF TEMPE, ARIZONA
PUBLIC WORKS DEPARTMENT
DIVISION OF ENGINEERING

Contract Documents

for

RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A

PROJECT NO. 946523A

CITY COUNCIL MEMBERS

Mayor - Neil Giuliano

Linda Spears

Dennis Cahill

P. Ben Arredondo

Joseph P. Spracale

Joseph Lewis

Carol E. Smith

1996

SPECIAL NOTICE

BIDS SHALL BE SUBMITTED IN A SEALED ENVELOPE. THE OUTSIDE LOWER RIGHT HAND CORNER SHALL BE MARKED:

BID OF _____, CONTRACTOR,

FOR: **RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A**

PROJECT NO. 946523A

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CITY OF TEMPE, ARIZONA
PUBLIC WORKS DEPARTMENT
DIVISION OF ENGINEERING

NOTICE TO CONTRACTORS

RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A

PROJECT NO. 946523A

SEALED BIDS will be received by the City of Tempe, Arizona, Public Works Administration, City Hall West Garden Level, 31 East 5th Street, Tempe, Arizona 85281, until 9:00 a.m. November 5, 1996. At that time, bids will be opened and publicly read aloud in the Public Works Conference Room. Bids received after the time specified will be returned unopened.

The proposed work will consist of installation of **A STORM WATER DIVERSION SYSTEM CONSISTING OF APPROXIMATELY 3,500 LF OF 30" TO 108" DIAMETER REINFORCED CONCRETE PIPE, A SOURCE WATER SYSTEM CONSISTING OF 400 LF OF 48" DIAMETER REINFORCED CONCRETE PIPE, A RECOVERY WELL AND PIPING SYSTEM CONSISTING OF APPROXIMATELY 4,700 LF OF 14" TO 30" DIP, AND 10-4.5 MGD RECOVERY WELLS, AND MISCELLANEOUS STRUCTURES** together with associated work and shall be accomplished in accordance with the "Maricopa Association of Governments Uniform Standard Specifications and Standard Details for Public Works Construction", and "The City of Tempe Supplements thereto" except as otherwise set forth in the Contract Documents.

A bid guarantee acceptable to the City of Tempe in the amount of 10% of the proposal shall be submitted with the proposal. Personal or individual surety bonds are not acceptable. The City requires all bonding companies and liability and excess insurance carriers to have a rating of "A-" or better as listed in the most recent "Best Key Rating Guide (Property and Casualty)" published by A.M. Best Company.

A set of plans, specifications and other contract documents may be purchased from the City Engineering Division (350-8200) upon payment of fifty dollars ($50.00) or checked out for a ten (10) day review period upon deposit of fifty dollars ($50.00).

Work shall not start until after the date of issuance of Notice to Proceed and shall be completed within four-hundred twenty (420) calendar days thereafter. See Construction sequencing schedule in the Special Provisions.

The City of Tempe reserves the right to reject any and all bids and to waive any informality in the bids received. Award will be made or bids rejected within thirty (30) days after bid opening.

"NOTICE: THIS CONTRACT CONTAINS AN EXCLUSIVE AND MANDATORY PARTNERING AND AN ALTERNATIVE DISPUTE RESOLUTION PROCESS FOR THE EFFICIENT AND EXPEDITIOUS RESOLUTION OF ALL CLAIMS WHICH MAY ARISE FROM THIS CONTRACT AND OTHER CONTRACTS CONTAINING THESE PROVISIONS FOR THE PROJECT."

_____

Judith Greenberg
Public Works Director

GENERAL PROVISIONS

SPECIFICATIONS

All work done under this contract shall be accomplished in accordance with the Maricopa Association of Governments Uniform Standard Specifications and Standard Details for Public Works Construction and the City of Tempe Supplement thereto except as modified in these Special Provisions.

In the event of any conflict between these Project Specifications and the requirements of the above referenced specifications, codes and regulations, these Project Specifications shall prevail. All bids to receive considerations shall be made in accordance with the General Conditions of the Standard Specifications as set forth hereinafter.

SECURING DOCUMENTS

Copies of specifications, special provisions, and other proposed contract documents are on file in the office of the City Engineer, City Hall, 31 East Fifth Street, Tempe, Arizona, and are open for public inspection. A set of such documents may be obtained from the City Engineer, upon payment of fifty dollars ($50.00), which payment will not be returned. In addition, a set is available to be checked out for a period of ten (10) days upon deposit of fifty dollars ($50.00). If the plans and specifications are returned in the original condition (without marks or alterations) and are returned within the specified ten (10) day period, the deposit will be returned. If either of these conditions are not met, the deposit will not be returned but will instead be kept as payment.

INTERPRETATIONS OF DRAWING AND DOCUMENTS

If any person submitting a bid for the proposed contract is in doubt as to the true meaning of part of the specifications or other contract documents, or finds discrepancies in, or omissions from the specifications, he may submit to the Tempe City Engineer a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretations or corrections of the proposed documents will be made by Addendum duly issued, and a copy of each addendum will be mailed or delivered to each person receiving a set of such documents. The City of Tempe will not be responsible for any other explanation or interpretations of the documents.

ADDENDA

Addenda issued during the time of bidding shall be attached to and made a part of the contract documents.

BID SECURITY

Each proposal shall be accompanied by a certified check, cashier's check, or bid bond acceptable to the City in an amount equal to at least ten per cent (10%) of the proposal, payable without condition to the City as a guarantee that the bidder, if awarded the contract, will promptly execute such a contract in accordance with the proposal and in manner and form required by the Contract Documents. Each bid bond shall be executed by a surety company or companies duly authorized to do business in the state and all bond documents shall be executed pursuant to the requirements of Arizona Revised Statutes. The bid security of the two lowest bidders will be retained until the contract is executed or other disposition is made thereof. The bid security of all bidders except the two lowest will be returned promptly after the award of contract.

PROPOSAL

Bids shall be properly executed upon the proposal form attached to and made a part of the contract documents, with items properly filled out. The signature of all persons signing shall be in longhand. The completed forms shall be without interlineations, alterations, or erasures. In case of an error in the extension of unit prices and the totals, the unit price shall govern.

Bids shall not contain any recapitulations of the work to be done. Alternative proposals will not be considered except as called for. No oral, telegraphic, or telephonic proposals or modifications will be considered.

IRREGULAR BIDS

Proposals may be considered irregular and may be rejected if any of the unit prices quoted in the bidding schedule are unbalanced, either above or below the amount of a reasonable bid price, to the potential detriment of the City.

AWARD OF CONTRACT

A contract will be awarded or bids rejected within 30 days after bid opening.

INSURANCE AND BOND RATING REQUIREMENTS

Personal or individual bonds are not acceptable.

Bonding companies and Liability and Excess insurance carriers shall be "Best Rated A-" or better as currently listed in the most recent "Best's Key Rating Guide (Property/Casualty)" published by the A.M. Best Company. This requirement does not apply to the Workmen's Compensation/Employers Liability portion on the Certificate of Insurance.

Each such bond SHALL be executed by a surety company or companies duly licensed to do business in the State of Arizona. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official.

INSURANCE REQUIREMENTS

The Contractor's attention is directed to Section 103.6 of the Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction and all such required insurance policies shall additionally provide full coverage of indemnity to the City as set forth below including an increase in the minimum limits to $5,000,000.00 combined single limit coverage. The proof of insurance shall be submitted to the City Engineer prior to execution of contract. Builders Risk Insurance shall be provided as applicable, in accordance with Section 103.6C.

BONDS REQUIRED

Bonds in the following amounts will be required at the time of executing the formal contract and must meet the requirements of Arizona Revised Statutes Title 34, Chapter 2:

1. Performance bond, one hundred percent (100%) of the contract price.
2. Payment bond, one hundred percent (100%) of the contract price.

EXECUTION OF CONTRACT AND BONDS

The form of the contract, which the successful bidder, as Contractor, will be required to execute and the form of bonds which he will be required to furnish, are included in the contract documents and should be carefully examined by the bidder. The successful bidder will be required to execute the bonds and the standard form of contract in three (3) original counterparts within ten (10) days after formal notice of award of contract. Failure to execute a contract and file satisfactory contract bonds as provided herein within 10 calendar days after the date of Notice of Award, shall be just cause for the cancellation of the award and the forfeiture of the bid security which shall become the property of the City of Tempe, not as penalty, but in liquidation of damages sustained. Award may then be made to the next lower responsible bidder or the work may be re-advertised as the City of Tempe may decide.

LICENSES

The Contractor must carry the appropriate State of Arizona contractor's license for the proposed work at the time of the bid. If the low bidder does not have the appropriate license, the City reserves the right to reject their bid and award it to the lowest bidder who has the appropriate license.

Prior to execution of the contract documents, the low bidder must possess a valid City of Tempe Transaction Privilege License and shall provide the Permit Number of such for validation.

EXAMINATION OF PREMISES

The Contractor shall visit the site of the project and shall fully acquaint himself with the conditions as they exist, so that he may fully understand the facility, difficulties and restrictions attending the execution of the work.

Bidders shall also thoroughly examine and be familiar with the specifications and other contract documents. The failure of the Contractor to obtain, receive or examine any addenda to the proposed contract documents, or to visit the site and acquaint himself with the conditions there existing, shall in no way relieve him from any obligation with respect to his proposal.

By submitting a proposal, the Contractor agrees that he has examined the site, specifications and other contract documents and accepts, without recourse, all site conditions and the proposed contract documents.

HAUL PERMIT

In any operation where more than one-tenth of an acre of surface area is disturbed and/or when unpaved onsite haul roads are used, the Contractor will obtain a Maricopa County Earth Moving Permit as required under Rule 200 of the Maricopa County Division of Air Pollution Control Requirements. This permit will require that a Control Plan to mitigate dust and tracking problems be submitted to the County for approval prior to issuance of the Earth Moving Permit. The Control Plan should be submitted to the City of Tempe for review prior to County submittal to ensure that all elements of the planned operation are covered. Please contact the Maricopa County Division of Air Pollution Control at 506-6700 for additional details.

In addition, all Contractors hauling fill or excavation materials where the haul exceeds 5000 cubic yards or when the duration of the haul is more than 10 working days are required to obtain a hauling permit before the hauling operation begins. Prior to receiving a hauling permit, the Contractor must submit the required certificate of insurance, a plan showing the proposed haul routes and a complete schedule of his hauling operation to the City of Tempe Transportation Division. Prior to submittal, the Contractor should contact Engineering Services for complete details.

INDEMNITY

To the fullest extent permitted by laws and regulation, the Contractor shall indemnify and hold harmless the City, its engineer, architect, their employees and agents, from and against all losses and expenses, direct, indirect or consequential, and all claims, demands, payments, suits, actions, recoveries, and judgments of every nature and description brought or recovered against them by any reason of any act, omission, negligence or claimed negligence of the City, its engineer, architect, their employees and agents, other than for loss or damage resulting from the sole negligence of the City, its engineer, architect, their employees and agents, arising from the work, completed work, or product under this contract.

In any and all claims against the City or any of its agents, or employees by any employee of contractor, subcontractor, or any person or organization directly or indirectly employed by any of them to perform or furnish any of the work under the contract or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the City or any person or organization under workers' or workman's compensation acts, disability benefit acts or other employee benefit acts.

PLANS TO THE SUCCESSFUL BIDDER

The successful bidder may obtain (7) sets of Specifications for this project from the office of the City Engineer, at no cost.

If he desires more than seven (7) sets, he shall be required to pay the reproduction cost of fifty dollars ($50.00) each.

START AND COMPLETION OF WORK

Work shall start as soon as practical after the starting date specified in the Notice to Proceed and shall be completed within four-hundred twenty (420) calendar days thereafter.

CONTRACTOR'S CONSTRUCTION SCHEDULE

Within ten (10) days after execution of the contract, the Contractor shall furnish the City Engineer a proposed Construction Progress Schedule, in the form of a Ghant Chart or Critical Path Method (CPM) diagram, indicating dates of commencement and completion of all major activities required in the contract. During construction, the Contractor shall maintain and revise the construction schedule to reflect changes or conditions encountered in the construction work.

CONTRACTOR'S REPRESENTATIVE

The Contractor shall at all times be present at the work in person or represented by a foreman or other properly designated agent. Instructions and information given by the Engineer to the Contractor's foreman or agent on the work shall be considered as having been given to the Contractor.

NON-DISCRIMINATION

In connection with the performance of work under this Contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

The Contractor agrees to post hereinafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the Contracting officer setting forth the provisions of the Non-Discrimination clause.

RELOCATION OF UTILITIES

Except as otherwise provided in the plans or project specifications, all utilities in conflict with the new work will be relocated by the owner thereof.

MISCELLANEOUS REMOVAL AND RELOCATIONS

Miscellaneous removals and relocations shall be construed to mean the removal of all unsuitable materials whether designated or implied by the plans and specifications, and shall include but not be limited to the removal of such items as pipes, concrete, asphalt, block, brick, rock, metal, etc. of every nature and description, unless such items are specifically designated in a separate bid item. Also, certain items require temporary removal and reinstallation such as mail box stands, sign posts, survey monument frames and covers, etc., and are included in this category.

EXCESS MATERIALS

Excess or unsuitable material, broken asphaltic concrete and broken portland cement concrete shall be disposed of by the Contractor. The Contractor shall, prior to commencement of the work, submit a letter to the City Engineer stating the location of disposal site(s) for all excess material and certifying that he has obtained the property owner's permission for the disposal of all surplus material.

ENVIRONMENTAL REQUIREMENTS

The Contractor shall comply with all Federal, State, and Municipal regulations, laws, and policies relating to air, ground water quality, and water conservation. In addition, the following requirements are applicable for City construction projects.

1. Non-pick up sweepers will not be allowed except as required to make joints during chip sealing operations.

2. Water flooding of trenches with potable water will not be permitted.

3. All paints applied by sprayers shall be of a water-based type.

4. Provisions shall be made to prevent the discharge of construction silt, mud, and debris into City storm drains or streets.

5. Spills of oil, gas, chemical, or any other hazardous materials must be reported and removed by approved procedures. Mitigation measures shall be taken to prevent contamination of construction storage sites.

6. Concrete waste must be disposed of in an approved location and at least 25 feet from established landscaping.

7. City of Tempe refuse roll-off containers shall be used on City projects.

8. Hazardous wastes shall not be discharged into the City's sanitary sewers or storm drainage system. All waste products shall be disposed of in accordance with applicable regulations.

9. The discovery of archeological ruins or artifacts must be reported immediately, and excavation shall not resume in the identified area until approved by the Engineer.

10. The Contractor shall take whatever steps, procedures, or means to prevent abnormal, material spillage, or tracking conditions due to his construction operations in connection with the Contract. The dust control measures shall be maintained at all times during construction of the project, to the satisfaction of the City Engineer, in accordance with Rule 200 of the "Maricopa County Health Department Air Pollution Control Regulations", which require that an Earth Moving Permit be issued and a Control Plan be approved prior to commencement of work. Contact the County at 506-6700 for details.

11. The Contractor shall comply with all applicable Federal Regulations concerning NPDES permits for storm discharges from construction sites.

No additional payment will be made for compliance with the above items.

In addition to the above, the use of new products made with reclaimed material and that meet project specifications, are encouraged.

CLEAN-UP

The Contractor shall, upon completion of the work, remove all temporary construction facilities, debris, and unused materials provided for in the work, and put the work site of the work and public right-of-way in a neat and clean condition. No special payment will be made for this item.

APPROXIMATE QUANTITIES

It is expressly understood and agreed by the parties hereto that the quantities of the various classes of work to be done and material to be furnished under this Contract, which have been estimated, as stated in the Proposal, are only approximate and are to be used solely for the purpose of comparing, on a consistent basis, the proposals offered for the work under this Contract; and the Contractor further agrees that the City of Tempe will not be held responsible if any claim for damages or for loss of profits because of a difference between the quantities of the various classes of work as estimated and the work actually done. If any error, omission, or misstatement is found to occur in the estimated quantities, the same shall not invalidate this Contract or release the Contractor from the execution and completion of the

whole or any part of the work in accordance with the specifications and the plans herein mentioned, and for the prices herein agreed upon and fixed therefore, or excuse him from any of the obligations or liabilities hereunder, or entitle him to any damages or compensation except as may be provided for in this Contract.

MISCELLANEOUS WORK AND ALLOWANCES

The following items will be included in the work with no direct payment allowed. Payment shall be included in the payment for other items for which direct payment is made.

1. Contractor's expenses for but not limited to mobilization, job site office, storage facilities, traffic control and public safety devices, sanitary facilities, utilities and telephone.
2. Cleanup including day to day cleanup.
3. Notification to residents adjacent to this project prior to start of construction which would affect them.
4. Water required for compaction or dust control.
5. Miscellaneous removals and relocations not otherwise specified in the Technical Provisions.
6. Power pole bracing.
7. Removal of trees twelve inches (12") or less in diameter.
8. Removal, relocation and/or modification of existing walls and fences.
9. Trimming of trees and bushes.
10. Replacement of plant material and repair of irrigation equipment to meet or exceed conditions existing prior to Contractor beginning work.

SUPERVISION BY CONTRACTOR

The Contractor will supervise and direct the work. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to the supervisor shall be as binding as if given to the Contractor. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the work.

PROTECTION OF FINISHED OR PARTIALLY FINISHED WORK

The Contractor shall properly guard and protect all finished or partially finished work, and shall be responsible for the same until that phase is completed and accepted by the City Engineer. Estimate or partial payment of work so completed shall not release the Contractor from such responsibility but he shall turn over the entire work in full accordance with these specifications before final payment can be made.

SURVEY CONTROL POINTS

Existing survey markers (brass caps, hand holes or iron pipes) shall be protected by the Contractor or removed and replaced under the direct supervision of the City Surveyor or his authorized representatives. Lot corners shall not be disturbed without knowledge and consent of the property owner and only after such corner has been properly referenced for replacement.

CONSTRUCTION STAKING

Construction staking will be provided by the City of Tempe or their designated representative in accordance with Section 105.8 of the MAG Specifications unless otherwise provided for in whole or in part in the Special Provisions.

Replacement of construction stakes that have been knocked out due to Contractor's work or lack of work, weather condition, traffic, or vandalism will be at the Contractor's expense.

AUTHORITY OF THE CITY ENGINEER APPOINTED REPRESENTATIVE

The Engineer shall act as the City Engineer's designated representative during the construction period. He shall advise on questions concerning coordination with the City of Tempe, public safety, and quality and acceptability of materials and work performed. The Engineer or his assigned inspector shall interpret the intent of the Contract Plans, Specifications, and Technical Provisions in an unbiased manner. The Engineer or his assigned inspector shall be present on the site at times during construction to monitor the work and to maintain records for contract management. The Engineer shall promptly make decisions relative to the interpretation of the contract document so as to minimize delays in construction. The Engineer will not be responsible for directing construction, control, techniques, sequence, or procedures, or for directing job safety.

SHOP DRAWINGS, SCHEDULES & SAMPLES

In time for each to serve its proper purpose and function, the Contractor shall submit to the Engineer such schedules, reports, drawings, lists, literature samples, instruction, directions, and guarantees as are specified or reasonably required for construction, operation, and maintenance of the facilities to be built and/or furnished under this Contract.

Shop drawings and data shall be submitted to the Engineer in such number of copies as will allow him to retain four (4) copies of each submittal. The submittal shall clearly indicate the specific area of the Contract Documents for which the submittal is made. The additional copies received by him will be returned to the Contractor's representative at the job site. The Engineer's notations of the action which he has taken will be noted on one (1) of these returned copies.

The above drawings, lists, prints, samples, and other data shall become a part of the Contract and a copy of the same shall be kept with the jobsite Contract Documents, and the fabrications furnished shall be in conformance with the same. However, the Engineer's review of the above drawings, lists, prints, specifications, samples, or other data shall in no way release the Contractor from his responsibility for the proper fulfillment of the requirements of this Contract nor for fulfilling the purpose of the installation nor from his liability to replace the same, should it prove defective or fail to meet the specified requirements.

BLUE STAKE

The Contractor is required to notify Blue Stake (263-1100) prior to the excavation of any material in accordance with ARS 40-360.22. The Contractor shall directly contact the City for marking of electrical for traffic signals, sprinkler and irrigation facilities.

SALT RIVER PROJECT CONSTRUCTION CLEARANCE AGREEMENT

Salt River Project requires all contractors who will be working on their facilities to sign a standard form "Construction Clearance Agreement" prior to issuance of a license. This agreement sets forth the requirements to complete the proposed work in an allotted time frame or to pay full costs for others to complete. It also obligates the contractor to comply with all applicable federal, state, and local laws, rules, regulations, and ordinances including, but not limited to, the new OSHA Permit Required Confined Space rules. The contractor is responsible for executing a "Construction Clearance Agreement" with Salt River Project, if required, and furnishing a copy to the City of Tempe prior to proceeding with any construction on Salt River Project facilities.

QUALITY CONTROL

All material shall be new and of the specified quality and equal to the accepted samples, if samples have been submitted. All work shall be done and completed in a thorough, workmanlike manner, notwithstanding any omission from these Contract Documents; and it shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instruction before proceeding with the work. The Engineer may, by appropriate instruction, correct errors and supply omissions, which instructions shall be as binding upon the Contractor as though contained in the original contract documents.

At the option of the Engineer, materials to be supplied under this Contract will be tested and/or inspected either at their place of origin or at the site of the work. The Contractor shall give the Engineer written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the material nor shall it preclude retesting or reinspection at the site of the work.

CHANGE ORDERS

In the event that significant changes in the scope of the work, and/or changes in the quantities due to contingencies of construction becomes necessary, such changes shall be made in accordance with Section 104 of General Conditions in the MAG 1979 Uniform Standard Specifications.

INSPECTION

The Contractor is responsible for complying with the specifications and is hereby forewarned that final approval of any work will not be given until the entire project is completed and accepted.

NOTIFICATION OF PROPERTY OWNERS

All property owners that may be affected by the proposed construction activities shall be notified of scope and duration of the construction activities by the Contractor prior to start of construction.

ACCESS

Access shall be maintained to adjacent businesses at all times during construction. Where property has more than one point of access, no more than one access shall be restricted or closed at any one time. Access to adjacent private driveways shall be maintained during all non-working hours.

PROTECTION OF EXISTING FACILITIES

The Contractor is to protect all existing facilities during construction. Utility poles that may be affected by the construction activities shall be protected and/or braced by the Contractor. The Contractor shall notify the appropriate Utility Company or agency of any construction that may affect their facilities and state the course of action which will be taken to protect same.

UNDERGROUND UTILITIES

Underground utilities indicated on the plans are in accordance with maps furnished by the City of Tempe and by each utility company. The locations are only approximate and require verification prior to construction as per Tempe requirements for underground street crossings and potholing.

HINDRANCES AND DELAYS

A. Except as provided in paragraph B, no charge shall be made by the Contractor for hindrances or delays from any cause during the progress of any portion of the work embraced in this contract; but such delays, if due to no fault or neglect of the Contractor, shall entitle the Contractor to a time extension sufficient to compensate for the delays. The amount of the delay shall be determined by the Engineer provided the Contractor gives the Engineer immediate notice in writing of the cause of such delay.

B. The parties agree to negotiate for the recovery of damages related to expenses incurred by the Contractor for a delay under the following circumstances:

   1. If the City is solely responsible for the delay which is unreasonable under the circumstances, and

   2. Which delay was not within the contemplation of the parties to the contract at the time the contract was entered into, and

   3. The Contractor can show the impact of the delay on the critical path of the construction activity as indicated in an approved CPM schedule.

The maximum compensation for an unreasonable or unforeseen delay shall not exceed the daily amount specified for liquidated damages as based on the original contract amount.

This section shall not be construed to void any provisions of this contract which require notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

SUBSIDIARY WORK

All work called for in the specifications and/or shown on the drawings shall be performed by the Contractor and unless a specific bid item is provided for the work, then such portion of the work will be considered subsidiary to other work for which payment is provided.

AS-BUILT DRAWINGS

The Contractor shall provide accurate data and field notes as construction progresses, for preparation of the "As-built" drawings by the Engineer. Final payment for the project will not be given until all such information is submitted.

SPECIAL PROVISIONS

A. Add the following sections to the General Provisions:

DEFINITION OF OWNER AND ENGINEER

The term OWNER used in the construction documents refers to the City of Tempe.

The term DESIGN ENGINEER used in the construction documents refers to CH2M HILL.

The term ENGINEER and RESIDENT ENGINEER used in the construction documents refers to PARSONS BRINCKERHOFF CONSTRUCTION SERVICES.

STAGING AREAS

CONTRACTOR shall be responsible for repair or replacement at its own expense of any equipment or materials damaged or destroyed due to flood events or other occurrences within the river, or the staging areas as shown on Drawing A-G-6.

PERMITS

OWNER will obtain and pay only for the following construction permits and licenses:

US COE Section 404 Permit
US EPA National Pollution Discharge Elimination System Permit
Arizona Department of Environmental Quality Water Quality Certification
Arizona Department of Water Resources Dam Safety
Arizona Department of Water Resources Recovery Well Permit
Arizona Department of Transportation Permit
Flood Control District of Maricopa County
City of Tempe Building Permit
Union Pacific Railroad Company
Arizona Public Service
Salt River Project

A copy of each permit is attached in the Appendix. CONTRACTOR shall examine the permits and shall conform to the requirements contained therein, including the purchase of additional Bonds or insurance as specified therein, and such requirements are hereby made a part of these Contract Documents as fully and completely as though the same were set forth herein. Failure to examine the permits will not relieve CONTRACTOR from compliance with the requirements stated therein.

The successful bidder will be required to obtain all other necessary permits and comply with all provisions of said permits. There will be no charge to CONTRACTOR for the necessary City of Tempe permits and inspections.

REPORTS

In preparation of the Drawings and Specifications, DESIGN ENGINEER has prepared the following reports of explorations and tests of subsurface conditions:

1. Report dated December 1994 prepared by CH2M HILL entitled "Geotechnical/ Hydrogeological Data Report for the Rio Salado Town Lake Project."
2. Report dated January 1996 prepared by CH2M HILL entitled "Addendum No. 1 to Geotechnical/Hydrogeological Data Report for the Rio Salado Town Lake Project."
3. Report dated February 1996 prepared by CH2M HILL entitled "Geotechnical/ Hydrogeological Design Report - Rio Salado Town Lake Project."

A copy of these reports are available for review at the office of City of Tempe Engineering during regular business hours.

These reports and drawings are not part of the Contract Documents. CONTRACTOR is not entitled to rely upon other information and data utilized by DESIGN ENGINEER in the preparation of Drawings and Specifications.

OTHER WORK

Other work anticipated to be performed at the site by others prior to, during, and in sequence with the scheduled performance of the Work under these Contract Documents as described in Section 01040, COORDINATION.

Should CONTRACTOR cause damage to the work or property of any separate contractor at the site, or should any claim arising out of or resulting from CONTRACTOR's performance of the Work at the site be made by any separate contractor against CONTRACTOR, OWNER, DESIGN ENGINEER, or RESIDENT ENGINEER or any other person, CONTRACTOR shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by mediation, arbitration, or at law.

CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold OWNER, DESIGN ENGINEER, and RESIDENT ENGINEER and the officers, directors, employees, agents, and other consultants of each and any of them harmless from and against all claims, costs, losses and damages, (including, but not limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising directly, indirectly or consequentially out of or resulting from any action, legal or equitable, brought by a separate contractor against OWNER, DESIGN ENGINEER, or RESIDENT ENGINEER or the officers, directors, employees, agents, or other consultants of each and any of them to the extent based on a claim caused by, arising out of, or resulting from CONTRACTOR's performance of the Work.

and expenses incurred by the OWNER in conjunction with the failure of the CONTRACTOR to complete the Contract Work on time.

OWNER may withhold from CONTRACTOR the amount of $1,500 per day that the Contract is not completed on schedule (change orders issued will extend original scheduled deadline), as presumptive damages for delay by CONTRACTOR. OWNER shall promptly pay to CONTRACTOR all presumptive damages which exceed actual damages which have been finally determined through the partnering process or the Alternate Dispute Resolution process set forth in this Contract together with 10 percent per annum interest thereon from the date withheld.

Actual damages include, but are not limited to the following items:

1. Damages awarded to other Rio Salado construction contractors resulting from Contract interference or delay caused by the failure of this Contract to be completed on time.

2. Engineering cost associated with delayed contract completion including, but not limited to, inspection, survey layout, materials testing, and contract administration.

3. Loss of anticipated revenues for use of the lake and lake facilities.

4. Other costs that are identified as being directly related to the impact of failure to complete this Contract within the specified Contract time.

5. Cost of financing the Project.

PARTNERING

The foundation and development of a partnering relationship with the CONTRACTOR is a goal of the OWNER. The partnering relationship is to be structured to draw on the strength of each organization and to identify and achieve reciprocal goals. Partnering objectives include efficient and effective contract performance, completion of contract work within budget, on schedule, and in accordance with the Drawings and Specifications.

The partnering relationship shall be bilateral in makeup. An initial formal partnering workshop shall be scheduled after the award of the contract, but prior to the Notice to Proceed. The workshop shall be facilitated by a third party competent in the fundamentals of partnering, who is mutually acceptable to the CONTRACTOR and OWNER. In order to effectively develop the desired partnering relationships, the CONTRACTOR shall encourage attendance by any and all of its project subcontractors. Joint informal partnering meetings, scheduled on 3-month (quarterly) intervals, shall be undertaken throughout the term of the construction contract to strengthen and maintain the initial partnering concepts. The quarterly partnering meetings shall be scheduled to immediately follow the weekly construction progress meeting and shall be at 3-month intervals beginning the third month following the month in which the construction Notice to Proceed is issued. The agenda of the joint quarterly meetings shall be structured to include review of potential conflicts or upcoming claims, as wall as to review, discuss, and solidify personal relationships between the various

emergency circumstances.

6. Award: The Arbitration Panel shall, within 10 days from the conclusion of any hearing, issue its award. The award shall include an allocation of fees and costs pursuant to the Binding Arbitration Procedure paragraph herein. Any award providing for deferred payment shall include interest at the rate of 10 percent per annum. The award is to be rendered in accordance with the Contract and the law of the State of Arizona.

7. Scope of Award: The Arbitration Panel shall be without authority to award punitive damages, and any such punitive damage award shall be void. The Arbitration Panel shall also be without authority to issue an award against any individual party in excess of $2,000,000, exclusive of interest, arbitration fees, costs, and attorney's fees. If an award is made against any individual party in excess of $100,000, exclusive of interest, arbitration fees, costs, and attorneys' fees, it must be supported by written findings of fact, conclusions of law and statement as to how damages were calculated.

8. Jurisdiction: The Arbitration Panel shall not be bound for jurisdictional purposes by the amount asserted in any party's claim, but shall conduct a preliminary hearing into the question of jurisdiction upon application of any party at the earliest convenient time, but not later than the commencement of the arbitration hearing.

9. Entry of Judgment: Any party can make application to the Maricopa County Superior Court for confirmation of any award and for entry of judgment on it.

10. Severance and Joinder: To reduce the possibility of inconsistent adjudications, the Neutral Evaluator or the Arbitration Panel, may at the request of any party, join and/or sever parties, and/or claims arising under other contracts containing this ADR provision, and the Neutral Evaluator, (Chairman) may, on his own authority, join or sever parties and/or claims subject to this ADR process as they deem necessary for a just resolution of the dispute, consistent with the parties' goal of the prompt and efficient resolution of disputes. Nothing herein shall create the right by any party to assert claims against another party not recognized under the substantive law applicable to the dispute. Neither the Neutral Evaluator or the Arbitration Panel are authorized to join to the proceeding parties not in privity with the OWNER.

11. Appeal: Any party may appeal errors of law by the Arbitration Panel if, but only if, the errors arise in an award in excess of $100,000; the exercise by the Chairman or Arbitration Panel of any powers contrary to or inconsistent with the Contract; or any of the grounds provided in A.R.S. 12-1512. Appeals shall be to the Maricopa County Superior Court within 15 days of entry of the award. The standard of review in such cases shall be that applicable to the consideration of a motion for

sought in a previously adjudicated claim for an alleged cost, loss, breach, error, or omission

LANDFILL EXCAVATION AND BACKFILL

This section applies when landfill materials are encountered within the limits of the required excavation. Landfills that extend beyond the excavation limits described in the Technical Specifications are not to be disturbed, removed, or added to unless directed by the City. The general area of the former landfill is shown on the Drawings. At test pit and test boring locations, the landfill materials appeared to be typical construction waste and included reusable mixtures of wood, paper, plastic, glass, lawn and tree trimmings, construction rubble, and other debris. It varied from greater than 25 feet below the ground surface test pit and test boring locations.

Because the disposal activities at the landfill are not well documented, there is a risk of encountering hazardous waste during excavation. For this reason, the CONTRACTOR shall furnish for approval by the City of Tempe, at the preconstruction meeting, a Landfill Excavation Monitoring Plan proposed to implement during excavation of the landfill materials. If the CONTRACTOR fails to submit an acceptable plan, the City may refuse to allow construction to start in the landfill and withhold funds from progress payment until an acceptable plan is submitted.

The purpose of the Landfill Excavation Monitoring Plan is to provide procedures for monitoring during excavation and removal of landfall materials and also to ensure the health and safety of all personnel during field operation at the site. If unanticipated site-specific problems arise during fieldwork, they will be addressed by the CONTRACTOR's Environment Consultant. This monitoring plan will apply to any and all areas of the project in which landfill is identified or encountered during construction. The plan shall be prepared by an Environmental Consultant who will be responsible to the CONTRACTOR during implementation of the plan. The Landfill Excavation Monitoring Plan shall include as a minimum the following:

A. Introduction

1. Scope of Work.
2. Purpose of Landfill Excavation Monitoring Plan.

B. Site Information

1. Location.
2. Description.

C. Contractor Information

1. Corporate Overview.
2. Qualification of Key Personnel.
3. Duties and Responsibilities of Key Personnel.

4. CONTRACTOR Certification Statement of Landfill Removal and Conference.

D. Landfill Excavation Procedures

1. General.
2. Contingency Health and Safety Plan.
3. Work-Right-to-Know Training.
4. Monitoring Procedures.
5. Reporting Procedures.
6. Site Control.
7. Traffic Control.

E. Hazardous Waste Material Management Procedures

1. General.
2. Analytical Laboratory Information.
3. Qualification Assurance.
4. Hazardous Waste Material Handling Information.

F. Identification of the CONTRACTOR's Environmental Consultant of the Plan

G. Identification of the CONTRACTOR's Hazardous Waste Material Transportation Subcontractors

The CONTRACTOR shall remove and dispose of all landfill encountered within the limits of excavation during this Contract. Landfill disposal shall be accomplished in accordance with all applicable regulations and an approved disposal facility. Should drums, containers, liquids, stained soils/materials, unusual odors or other evidence of potentially hazardous materials be identified during excavation of landfill materials, the CONTRACTOR will stop further excavation activities in the immediate area, notify the City and the CONTRACTOR's Environmental Consultant for a monitoring and evaluation of the material.

Acceptance of the CONTRACTOR's Plan is required prior to the start of landfill excavation. The City reserves the right to require the CONTRACTOR to make changes in his Landfill Excavation Monitoring Plan and operations as necessary to obtain the monitoring specified.

After acceptance of the Landfill Excavation Monitoring Plan, the CONTRACTOR shall notify the City of Tempe, in writing, of any proposed change. Proposed changes are subject to acceptance by the City of Tempe.

Landfill excavation and backfill shall conform to the provision of Section 02205, EXCAVATION, and Section 02220, FILL AND BACKFILL.

All unsuitable material and obstructions shall be disposed of legally by the CONTRACTOR and the CONTRACTOR shall be responsible for importing additional material to complete the Work.

SHOP DRAWINGS, SCHEDULES, AND SAMPLES

Delete the second paragraph of this section in the General Provisions and refer to Section 01300, SUBMITTALS.

QUALITY CONTROL

Add the following to this section within the General Provisions:

Tests required by Contract Documents to be performed by CONTRACTOR and that require test certificates be submitted to OWNER or RESIDENT ENGINEER for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

1. "Recommended Requirements for Independent Laboratory Qualification" published by the American Council of Independent Laboratories.

2. Basic requirements of ASTM E329, "Standard of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable.

3. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

FINAL ACCEPTANCE & GUARANTEE

Add the following:

Prior to requesting a certificate of final acceptance, and allowing occupancy of the facilities, CONTRACTOR shall provide an inspection by a state industrial representative or a federal or state (OSHA) representative qualified in the construction type being inspected, to determine that the facilities provided are in compliance with the state and federal safety requirements. Signed copies of the inspection reports shall be submitted to RESIDENT ENGINEER for OWNER's files. Violations or deficiencies noted therein shall be resolved by CONTRACTOR prior to occupancy of the facilities and before final payment will be made.

CITY OF TEMPE

TEMPE, ARIZONA

TECHNICAL SPECIFICATIONS

for the construction of the

RIO SALADO TOWN LAKE

PROJECT NO. 946523-A

SCHEDULE A - PIPE AND WELL SYSTEMS

****

****

CH2M HILL

Tempe, Arizona

November 1996

Project No. 111253.09

Copy No._____

END OF SECTION

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.1 RIO SALADO TOWN LAKE PROJECT

A. The City of Tempe, Arizona's, Rio Salado Town Lake Project is an urban redevelopment project focused on the construction of a 200-acre recreational lake in the normally dry Salt River bed. Water flows in the river channel in response to flood events. Water may also occur in the river due to localized storm events or incidental releases into the storm drain system.

B. The 2-mile long lake will be formed by impounding water using air-inflatable rubber dams. The depth of the lake will vary from 6 feet at the upstream end to 19 feet at the downstream end. During seasonal flooding, the dams will be lowered to allow flood waters to pass downstream. When flooding stops, the dams will be raised to impound water for the lake once again. When fully deflated, the dams must pass the 100-year peak flood flows of 215,000 cfs and must also pass the peak sediment volume of 230,000 tons per day during the 100-year event. It is expected that the dam will be fully deflated during about 10 percent of the flood events.

C. The downstream dam will consist of a 16-foot high rubber dam on a 3-foot high sill and will control the water level in the lake. A smaller 6-foot high dam at the upstream end will capture local river discharges, creating a wetlands-type riparian enhancement zone while reducing the flow of pollutants into the lake.

D. Infiltration from the lake will be controlled by a combination of cutoff walls and controlled extraction/recovery. Infiltration from the downstream (western) portion of the lake will be controlled using cutoff walls along the lake boundary. Approximately 10 recovery wells will be used along the upstream (eastern) portion to collect and pump back to the lake an estimated 40 million gallons per day of infiltrated water.

E. A reliable source of water is required as makeup water for losses due to evaporation. Facilities provided include new connections to the Salt River Project canal system for delivery to the lake. Water for the initial filling of the lake and for monitoring the lake water level will be conveyed through a new 48-inch pipeline. This pipeline provides a connection between the existing SRP Lateral 2-4.6 and the existing 66-inch storm drain which empties into the lake.

F. A stormwater management system will be constructed to increase the water quality in the lake by reducing potential pollutants and contaminants. Stormwater diversions will capture and bypass the "first flush" from several major stormwater discharges to a point either upstream or downstream of the lake. In addition, detention areas will be provided to reduce the potential for spills from the Red Mountain Freeway entering the lake.

G. The Rio Salado Town Lake Project is divided into the following four schedules:

1. Schedule A: Pipe and Well Systems.
2. Schedule B: Dam Facilities.
3. Schedule C: Shoreline Improvements.
4. Schedule D: Cutoff Wall Construction.

1.2 WORK COVERED BY THESE CONTRACT DOCUMENTS (SCHEDULE A):

A. The completed Work covered by these Contract Documents will provide OWNER:

1. A stormwater diversion system for the purpose of diverting stormwater from various outfalls away from the Town Lake,including:
   a. South Bank Interceptor: 67 linear feet of 54-inch diameter pipe. 550 linear feet of 84-inch diameter pipe and 1,470 feet of 108-inch diameter pipe and several diversion structures to divert stormwater flow downstream of the lake.
   b. Dorsey Diversion and Karsten Storm Drain Extension consisting of 2,450 feet of 78-inch diameter pipe and diversion structures to divert stormwater flow upstream of the lake.
   c. Miller Weir and Indian Bend Wash Drop Structure Modifications consisting of structural modifications to detain low flows of stormwater from entering the lake.
   d. College Avenue and Curry Road Storm Drain Modifications consisting of concrete structures and earthwork to detain low flows of stormwater from entering the lake.
2. The wells and piping required for the infiltration management system, including:
   a. Recovery Well and Piping System consisting of 10 recovery wells each having a capacity of 4.5 mgd, 3,350 linear feet of 18-inch diameter pipe and 1,582 linear feet of 14-inch diameter pipe and appurtenances.
3. The piping and structures required for the source water system, including:
   a. 400 feet of 48-inch diameter pipe to connect SRP Lateral 2-4.6 to existing storm drain.

B. Alternatives specified in the Contract Documents are as follows:

1. Deductive Alternate No. A1—Well No. 5 and Related Piping: This deductive alternate includes the drilling of Well No. 5, furnishing and installing of the pump and related discharge piping, and making all electrical connections and controls.
2. Deductive Alternate No. A2—Recovery Well Manifold Piping: This deductive alternate includes the furnishing and installing of piping and appurtenances between Well Nos. 2, 3, and 4, and between Well Nos. 6, 7, and 8. The valves located at the tees and/or crosses are to be included in the base bid.

1.3 WORK NOT COVERED BY THESE CONTRACT DOCUMENTS

A. Schedule B: Dam Facilities.

B. Schedule C: Shoreline Improvements.

C. Schedule D: Cutoff Wall Construction.

1.4 PROVISIONS FOR FUTURE WORK

A. Provisions for future construction are as shown.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 ADMINISTRATIVE SUBMITTALS

A. Schedule of Values: Submit schedule on CONTRACTOR's standard form.

B. Application for Payment.

C. Final Application for Payment.

1.2 SCHEDULE OF VALUES

A. Prepare a separate schedule of values for each schedule of Work under the Agreement.

B. Lump Sum Work:

1. Reflect schedule of values format included in conformed Bid Form, specified allowances, alternates, and equipment selected by OWNER, as applicable.
2. List Bonds and insurance premiums, mobilization, demobilization, facility startup, and contract closeout separately.
3. Break down by Division 2 through 16 with appropriate subdivision of each Specification for each of the Project facilities.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Each pay item reflecting a schedule of values shall be subject to a review and approval of RESIDENT ENGINEER. An unbalanced or front-end loaded schedule will not be acceptable.

E. Summation of the complete schedule of values representing all Work shall equal the Contract Price.

F. Submit schedule of values on 3.5-inch, 1.44mb diskettes, in a spreadsheet format compatible with the latest version of Excel.

1.3 APPLICATION FOR PAYMENT

A. RESIDENT ENGINEER shall prepare both monthly and final contract progress payments and submit to OWNER for approval. Payment shall be based on data received from CONTRACTOR, subject to evaluation and concurrence of RESIDENT ENGINEER.

B. CONTRACTOR shall transmit application for payment to RESIDENT ENGINEER on a draft Application for Payment Form provided by OWNER.

C. Attach one Schedule of Value form with each draft application for payment for each lump sum item of Work and include a request for payment of materials and equipment on hand as applicable. Execute certification by authorized officer of CONTRACTOR.

D. Preparation:

1. Round values to nearest dollar.
2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form for each schedule as applicable.
3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by RESIDENT ENGINEER.

1.4 MEASUREMENT – GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, the material shall be weighed on scales furnished by CONTRACTOR and certified accurate by the state agency responsible. A weight or load slip shall be obtained from the weigher and delivered to RESIDENT ENGINEER at the point of delivery of the material.

C. If material is shipped by rail, the car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by RESIDENT ENGINEER. Each vehicle shall bear a plainly legible identification mark.

E. Quantities Based on Profile Elevations: Existing ground profiles shown on Drawings were taken from a topographic map drawn with contour intervals of 1 foot with supplementary spot elevations to the nearest half foot.

F. Quantities will be based on ground profiles shown. Field surveys may be made by OWNER to confirm accuracy of elevations shown.

G. Units of measure shown on the Bid Form shall be as follows unless specified otherwise.

Item	Method of Measurement
CY	Cubic Yard–Field Measure by RESIDENT ENGINEER within the limits specified or shown
EA	Each–Field Count by RESIDENT ENGINEER
HR	Hour
LF	Linear Foot–Field Measure by RESIDENT ENGINEER
LS	Lump Sum–Unit is one; no measurement will be made
SF	Square Foot
SY	Square Yard

1.5 PAYMENT

A. General: Progress payments will be made monthly on the date established at the preconstruction meeting.

B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specifications, or as described as follows:

1. Item No. 1, Mobilization/Demobilization for Pipeline Work Demolition, and Diversion and Care of Water: CONTRACTOR shall be compensated for one-time mobilization/demobilization of CONTRACTOR's personnel, equipment, supplies, incidentals, establishment of offices, building and other facilities required for the performance of the Work under this contract. Also included in this item is all Work required for the diversion and care of water and demolition of existing facilities, and all Work for the Project with the exception of those items specifically listed as either lump sum or unit price items. Payment for mobilization/demobilization will be made at the contract lump sum price shown in the Bid Schedule for Bid Item 1, Mobilization/Demobilization. Payment shall be made in equal one-third portions. The first one-third shall be paid with CONTRACTOR's first monthly progress payment. The second one-third shall be paid when the total payment to CONTRACTOR for the bid items under this contract, exclusive of payment for mobilization/demobilization, equals one-half of the total bid amount. The remaining one-third shall be paid as part of the final contract payment due CONTRACTOR. If CONTRACTOR performs a second mobilization/demobilization of personnel, material, and/or equipment at the ENGINEER's expressed written request, CONTRACTOR shall be compensated for such expense at CONTRACTOR's actual cost. CONTRACTOR shall provide all documentation requested by ENGINEER in support of said cost.
2. Item No. 49, Connection to Existing Karsten Storm Drain: Includes all site preparation, excavation, removal, and reinstallation of existing flap gate, headwall, and one joint of 30-inch diameter RCP, concrete collar, furnishing and placing of riprap bank protection and backfill.

3. Item No. 50, Pressure Manhole: Includes all site preparation, excavation, furnishing and placing of steel pipe elbows, reducing couplings, access port, PVC drain, concrete, reinforcing steel, watertight manhole frame and cover, backfill, and all other miscellaneous items required to complete the pressure manhole as shown on the Drawings.
4. Item No. 51, Farmer Diversion Structure: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, watertight manhole frame and cover, ladder, removal of existing 72-inch diameter storm drain, backfill, and all other miscellaneous items required to complete the Farmer Diversion Structure as shown on the Drawings.
5. Item No. 52, Rural Road Diversion Structure: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, aluminum grating, ladder, sluice gate and floor stand installation, 12-inch vent pipe, removal of existing 60-inch diameter storm drain, backfill, and all other miscellaneous items required to complete the Rural Road Diversion Structure as shown on the Drawings.
6. Item No. 53, Dorsey Diversion Structure: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, watertight manhole frame and cover, ladder, 12-inch vent pipe, backfill, and all other miscellaneous items required to complete the Dorsey Diversion Structure as shown on the Drawings.
7. Item No. 54, Karsten Diversion Structure: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, watertight manhole frame and cover, ladder, 12-inch vent pipe, backfill, and all other miscellaneous items required to complete the Karsten Diversion Structure as shown on the Drawings.
8. Item No. 55, Miller Weir: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, grouted riprap, backfill, and all other miscellaneous items required to complete the Miller Weir as shown on the Drawings.
9. Item No. 56, Indian Bend Wash Drop Structure Modifications: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, 30-inch sluice gate, 18-inch RCPP, backfill, and all other miscellaneous items required to complete the Indian Bend Wash Drop Structure Modifications as shown on the Drawings.
10. Item No. 57, College Underground Detention Basin: Includes all site preparation, excavation, furnishing and placing concrete, reinforcing steel, 24-inch RCP, 24-inch perforated PVC pipe, reducing couplings, removal of existing 48-inch RCP storm drains, backfill, and all other miscellaneous items required to complete the College Underground Detention Basin as shown on the Drawings.
11. Item No. 58, Curry Detention Area: Includes all site preparation, excavation and backfill, and all other miscellaneous items required to complete the Curry Detention Area as shown on the Drawings.
12. Item No. 59, Existing Storm Drain Outfall Modifications: Includes all labor, equipment, and materials required to complete the existing storm drain modifications, including salvaging, refurbishing, and/or replacing existing flap gates, pressure grouting of backfill around

outfalls, installing concrete plugs, and filling outlet structure with concrete and sandblasting and cleaning up existing pipe surface.

13. Item No. 60, Mobilization/Demobilization, Cleanup, and Temporary Construction Pad for 10 Wells: Includes the mobilization to the Project site, all equipment set up, take down, and clean up at each of 10 wells and, if necessary, all earthwork required for both the construction and removal of temporary construction pads at the wells.
14. Item No. 61, Permanent Well Pullout Pads for 10 Wells: Includes all labor, equipment, and materials required for the site preparation furnishing and placement of embankment material, transformer pads, and electrical equipment pads used for the permanent well pullout pads at the 10 recovery wells as shown on the Drawings.
15. Item Nos. 77, 78, Abandonment of Type I and Type II Wells: Includes all labor, equipment, and material required to complete the abandonment of six Type I wells and six Type II wells as described in Section 02595, WELL ABANDONMENT, and as shown on the Drawings.
16. Item No. 79, Relocation of Bike Path and Light Pole: Includes all labor, equipment, and material required to relocate the bike path and light pole adjacent to Well No. 4.
17. Item No. 76, Aeration Diffuser: Includes all labor, equipment, and materials required for excavation, providing all perforated PVC pipe and fittings, riprap, and all other miscellaneous items required to complete the nine aeration diffusers.
18. Item No. 84, Concrete Cap for Manholes: Includes all labor, equipment, and material required for excavation, furnishing, and placing concrete, reinforcing steel, backfill, and all other miscellaneous items required to complete the concrete caps for two sanitary sewer manholes in the river channel west of Rural Road.
19. Item No. 95, Electrical/Instrumentation and Control: Includes all labor, equipment, and materials required to complete the electrical and I&C not covered by Items 85 through 95, including trench excavation, conduit, raceways, conductors, switchboards, grounding, motor control, telemetry, backfill, and testing.

C. Payment for unit price items covers all Work necessary to furnish and install the following items:

1. Items Nos. 2 through 23 and 27 through 45, PVC, RCPP, BSP, and DIP: Includes all site preparation, excavation, processing of onsite material or importation of material required for placement of pipe bedding, pipe zone, and backfill, providing pipe, polyethylene wrap of DIP, fittings, thrust protection, removal and replacement of gabions, replacement of pavement, curb and gutter, surfacing, testing, and all associated Work. Payment will be made at the contract unit price bid per linear foot for the completed installation of pipe.
2. Item Nos. 24, 25, 26, Butterfly Valve, Valve Box, and Cover: Payment will be made at the contract unit price bid for each of the completed valves, valve boxes, and covers.
3. Items Nos. 46, 47, 48, Flap Gate: Payment will be made at the contract unit price bid for each of the completed flap gates.
4. Item No. 62, 63, Drilling of the Well Borehole: Includes all labor, material, and equipment required for drilling and soil sampling as

described in Section 02581, DRILLING METHODS, and Section 02582, SOIL SAMPLING. Also includes temporary piping and appurtenances, and maintaining borehole logs. Payment will be made at the contract unit price bid per linear foot for the completed drilling.

5. Item No. 64, 65, Well Casing Pipe. Includes casing pipe above and below the well screen, end cap, and casing centralizers. Payment will be made at the contract unit price bid per linear foot for the completed installation of casing.
6. Item No. 66, Well Screen: Payment will be made at the contract unit price bid per linear foot for the completed installation of well screen.
7. Item No. 67, Recovery Well Annular Materials: Includes cement grout, gravel pack, granular bentonite. Payment will be made at the contract unit price bid per linear foot for the completed installation of annular materials.
8. Item No. 68, Recovery Well Pump Column Pipe: Payment will be made at the contract unit price bid per linear foot for the completed installation of pump column pipe and submersible cable.
9. Items Nos. 69, 70, Recovery Well Submersible Pumps and Motors: As described in Section 11305, SUBMERSIBLE PUMPS. Payment will be made at the contract unit price bid for each type of completed installation of pump and motor.
10. Item No. 71, Spare Submersible Pump and Motor: As described in Section 11305, SUBMERSIBLE PUMPS. Payment will be made at the contract unit price for furnishing one pump and 150-hp motor.
11. Item No. 72, Development of 10 Wells: Includes all labor, equipment, and materials required to complete the development of 10 wells as described in Section 02670, WATER WELLS. Payment will be made at the contact unit price bid per hour of well development.
12. Item No. 73, Well Pumping Test and Disinfection: As described in Sections 02672, WELL PUMPING TEST, and 02682, DISINFECTION. Payment will be made at the contract unit price bid for the completed testing and disinfection of each well.
13. Item No. 74, Well Vault: Includes surface plate, access pipes, steel gravel tube, elbow, all piping and appurtenances within 3 feet of vault, electrically actuated butterfly valve, combination air release valve, pressure switch, pressure gauge, electromagnetic flow element, site preparation, pipe supports, drain pipe, concrete vault and cover, ladder, excavation, and backfill. Payment will be at the unit price bid for the completed installation of each well vault.
14. Item No. 75, Aeration Blower Vault: Includes concrete vault, site preparation, excavation and backfill, aluminum grating, checkered plate cover, check valve, and all miscellaneous piping within vault. Payment will be at the unit price bid for the completed installation of each aeration vault.
15. Item No. 80, Rock Excavation: Includes all labor and equipment required for removal of rock excavation as defined in Section 02205, EXCAVATION. Payment will be made at the contract unit price bid per cubic yard of rock excavated.
16. Item No. 81, Trench Stabilization Material: Includes furnishing and placement of all trench stabilization material as defined in Section 02225, TRENCH BACKFILL. Payment will be made at the contract unit price bid per cubic yard of trench stabilization material placed. Measurement for backfill with trench stabilization material

will be made from the bottom of the excavation to the top of the placed trench stabilization material.

17. Item No. 82, Removal of Landfill Materials: In the event landfill material is encountered during the Project, it shall be removed and disposed of offsite. Includes the additional excavation, disposal, grading, benching, borrow material, backfill, and compaction as required to dispose of the landfill material and construct an engineered fill from the bottom of the excavation to the design grade with trench stabilization material. Measurement for this Work shall be made on a volumetric basis by the end area cross-section method. Measurement for excavation will be made from the top of the landfill material encountered to the bottom of the excavation.
18. Item No. 83, Removal of Unsuitable Materials Other than Landfill Material: In the event unsuitable material is encountered during the Project, it shall be removed and disposed of offsite. Includes the additional excavation, disposal, grading, benching, borrow material, backfill, and compaction as required to dispose of the unsuitable material and construct an engineered fill from the bottom of the excavation to the design grade with trench stabilization material. Measurement for this Work shall be made on a volumetric basis by the end area cross-section method. Measurement for excavation will be made from the top of the unsuitable material encountered to the bottom of the excavation.
19. Items Nos. 85 through 88, Electrical Conduit for Primary Service: Includes all labor equipment and materials for site preparation, excavation, processing of onsite material or importation of material required for placement of pipe bedding, pipe zone, and backfill, providing conduit for primary service, fittings, spacers, concrete encasement, removal and replacement of gabions, surfacing, and all associated Work. Payment will be made at the contract unit price bid per linear foot for the completed installation of electrical conduit. All other conduit is included in Item No. 95.
20. Item No. 89, Installation of Communications Conduits Furnished by Others: Includes all labor, equipment, and materials required for placement of conduit furnished by Cox Cable.
21. Item No. 90, Installation of Communications Pullboxes Furnished by Others: Includes all labor, equipment, and materials required for placement of pullboxes furnished by Cox Cable.
22. Item No. 91, Transformer Pads: Includes all labor, equipment, and materials for site preparation, excavation, furnishing and placement of concrete, reinforcement, and all associated Work required to complete each transformer pad. Payment will be made at the contract unit price bid for completed installation of each transformer pad.
23. Item No. 92, Control Cabinets and Pads: Includes all labor, equipment, and materials required for site preparation, excavation, furnishing and placement of concrete, reinforcement, control cabinets, and all associated Work required to furnish and install complete each control cabinet and pad. Payment will be made at the contract unit price bid for completed installation of each control cabinet and pad.
24. Item No. 93, Installation of APS Furnished Pullboxes: Includes all labor, equipment, and materials for site preparation, excavation, backfill, and all associated Work required to complete each pullbox.

Payment will be made at the contract unit price bid for the completed installation of each electrical pullbox.

25. Item No. 94, Installation of APS Furnished Electrical Equipment Pad/Box Pad: Includes all labor, equipment, and materials for site preparation, excavation, and all associated Work required to complete each electrical box pad. Payment will be made at the contract unit price bid for completed installation of each electrical box pad for the switching cabinets and capacitor cabinets.

1.6 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. *Defective* Work not accepted by OWNER.
6. Material remaining on hand after completion of Work.

1.7 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to RESIDENT ENGINEER.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to CONTRACTOR unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01040
COORDINATION

PART 1 GENERAL

1.1 SUBMITTALS

A. Photographs and other records of examination.

1.2 PARTNERING

A. OWNER and CONTRACTOR will have a partnering relationship as described in the Special Provisions. In addition, other utilities, agencies, and contractors will be included in the partnering process.

1.3 OTHER WORK

A. Coordination of OWNER's Work by Others: Reference the General Provisions for coordination of OWNER's work by others, if any, and coordinate CONTRACTOR's Work with OWNER or OWNER's designated coordinator.

B. Other work is anticipated to be performed at site by others prior to, during, and in sequence with scheduled performance of Work under these Contract Documents as follows:

C. Public Utilities and Agencies:

1. Water:
   a. Salt River Project: Tom Sands, telephone number: 602/236-2371.
   b. Work to be performed by SRP:
      1) Provide flowmeter at existing turnout structure on southside of Lake to provide makeup water and filling water to Town Lake.
      2) Provide new turnout and flowmeter on north side of lake to connect SRP lateral 2-4.6 with new 48-inch pipe to provide makeup water and filling water to Town Lake.
   c. Work to be Performed by CONTRACTOR: Coordinate CONTRACTOR's Work with SRP.
   d. OWNER will be responsible for payment of any direct charges of SRP.
2. Power:
   a. Agency and Contact Person: Arizona Public Service, Vicki Reynolds, telephone number: 602/493-4433.
   b. Work to be performed by APS:
      1) Incoming underground power cables, materials, installation, termination, and connections to all facilities.
      2) Transformers supplying main electric service to the facility.

3) Primary switching cabinets.
4) Primary capacitor cabinet.
5) Metering facilities, except as indicated.

c. Work to be performed by CONTRACTOR:
1) Coordinate CONTRACTOR's Work with APS.
2) Incoming power trench, and backfill, and duct system.
3) Transformer site preparation and pad(s).
4) Installation of utility-furnished pullboxes and box pads.
5) As indicated.
6) Perform Work in accordance with APS requirements and codes.

d. OWNER will be responsible for payment of direct charges of APS.

3. Cable TV:
a. Agency and Contact Person: Cox Cable, Randy Rollard, telephone number: 602/866-0072, Ext. 582.
b. Work to be Performed by Cox Cable: Furnish conduits and pullboxes to be installed.
c. Work to be Performed by CONTRACTOR: Installation of utility-furnished conduit and pullboxes.

D. Flood Control District of Marciopa County (FCDMC):

1. OWNER will obtain a license from the FCDMC prior to any work which impacts the levees or other flood control features.
2. OWNER will notify the FCDMC at least 48 hours prior to any construction activities which require disturbing the levee CSA or gabions. This will allow the FCDMC inspector to be onsite for inspection purposes.
3. OWNER will not backfill over any levee gabions that may be disturbed as part of construction without first having the gabions inspected by the FCDMC. Any damage to the gabions shall be repaired by CONTRACTOR to the satisfaction of the FCDMC.
4. OWNER will not place backfill or concrete against the levee CSA without first having the CSA inspected by the FCDMC. Any damage to the CSA shall be repaired by CONTRACTOR to the satisfaction of the FCDMC.
5. CONTRACTOR shall allow inspection by FCDMC representatives for the activities specified above.

E. Other Contractors:

1. Schedule B: Dam Facilities (contractor unknown).
a. Upstream and downstream dam.
b. Upstream and downstream dam control buildings.
2. Schedule C: Shoreline Improvements (contractor unknown).
a. Northshore shoreline improvements.
b. Southshore shoreline improvements.
3. Schedule D: Cutoff Wall Construction (contractor unknown).
a. Northshore cutoff wall.
b. Southshore cutoff wall.
c. Downstream dam cutoff wall.

4. North Bank Bike Path (contractor unknown).
   a. Bike path between SPTC railroad bridge and Canal Road on northshore.
5. Schedule A Pipe and Well Systems, Schedule C Shoreline Improvements, and Schedule D Cutoff Wall Construction will receive the same Notice to Proceed dates. Schedule B Dam Facilities will receive a Notice to Proceed date approximately 5 months later.
6. Work to be performed by CONTRACTOR:
   a. Coordinate CONTRACTOR's Work with work of other contractor, particularly at the following locations:
      1) Outfall of southbank interceptor is in immediate proximity to the downstream dam.
      2) Outfall of Dorsey Diversion and Recovery Wells No. 5 and No. 6 are in immediate proximity to the upstream dam.
      3) Recovery wells, discharge piping, and recovery piping is in immediate proximity to both the northshore and southshore shoreline improvements.
      4) Well No. 5 is in immediate proximity to upstream dam control building.
      5) Well No. 1 is in immediate proximity to north bank bike path.

1.4 UTILITIES

A. Coordinate Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.

1. Salt River Project Electricity Company:
   a. Contact Person: Jim Frescholtz.
   b. Telephone: 602/236-8476.
2. U.S. West Telephone Company:
   a. Contact Person: Bruce Bartlett.
   b. Telephone: 602/831-4753.
3. City of Tempe Water Department:
   a. Contact Person: Don Hawkes.
   b. Telephone: 602/350-2660.
4. City of Tempe Public Works Department:
   a. Contact Person: Howard Hargis.
   b. Telephone: 602/350-8200.
5. Telephone Company: AT&T.
   a. Contact Person: Blue Stake.
   b. Telephone: 602/263-1100, or
   c. Contact Person: Cable Hazard Center.
   d. Telephone: 1-800-252-1133.
6. Telephone Company: MCI
   a. Contact Person: Blue Stake.
   b. Telephone: 602/263-1100, or
   c. Contact Person: Fiber Security Department.
   d. Telephone: 1-800-782-5348.
7. Gas Company: Southwest Gas.
   a. Contact Person: Howard Warren.
   b. Telephone: 602/484-5235 or 602/271-4277.

8. Water Department: City of Phoenix Water Department:
   a. Contact Person: 24-hour Emergency.
   b. Telephone: 602/261-8000.
9. Nitrogen Company: Air Products.
   a. Contact Person: Paul Sansoucy.
   b. Telephone: 602/899-7700.
10. Electricity Company: Arizona Public Service.
   a. Contact Person: Vicki Reynolds.
   b. Telephone: 602/493-4433.
11. Flood Control: Flood Control District of Maricopa County.
   a. Contact Person: Fred Fuller.
   b. Telephone: 602/506-1501 or 602/506-4728.
12. Cable TV Company: Cox Cable
   a. Contact Person: Shawn Hawkins.
   b. Telephone: 602/352-5860, Extension 159.

B. Railroad(s) serving the area at or near site:

1. Railroad: Union Pacific Railroad, Denver, CO.

1.5 PROJECT MEETINGS

A. General:

1. RESIDENT ENGINEER: Schedule physical arrangements for meetings throughout progress of Work, prepare meeting agenda with OWNER and CONTRACTOR input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.
2. Representatives of OWNER, CONTRACTOR, and Subcontractors shall attend meetings, as needed.

B. Preconstruction Conference:

1. CONTRACTOR shall be prepared to discuss the following subjects, as a minimum:
   a. Required schedules.
   b. Status of Bonds and insurance.
   c. Sequencing of critical path work items.
   d. Project changes and clarification procedures.
   e. Use of site, access, office and storage areas, security and temporary facilities.
   f. Major product delivery and priorities.
   g. CONTRACTOR's safety plan and representative.
2. Attendees may include but not be limited to:
   a. OWNER's representatives.
   b. CONTRACTOR's office representative.
   c. CONTRACTOR's resident superintendent.
   d. CONTRACTOR's quality control representative.
   e. Subcontractors' representatives whom CONTRACTOR may desire or RESIDENT ENGINEER may request to attend.

f. RESIDENT ENGINEER's representatives.
g. Others as appropriate.
h. Progress payment procedures.

C. Preliminary Schedules Acceptability Review Meeting: As set forth in the General Conditions.

D. Progress Meetings:

1. RESIDENT ENGINEER will schedule regular progress meetings at site, conducted weekly to review Work progress, progress schedule, Shop Drawing and Sample submissions schedule, Application for Payment, contract modifications, and other matters needing discussion and resolution.
2. Attendees will include:
   a. OWNER's representative(s), as appropriate.
   b. CONTRACTOR, Subcontractors, and Suppliers, as appropriate.
   c. RESIDENT ENGINEER's representative(s).
   d. Flood Control District's representative(s).
   e. Others as appropriate.

E. Quality Control and Coordination Meeting(s):

1. Scheduled by RESIDENT ENGINEER on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.
2. Attendees will include CONTRACTOR, CONTRACTOR's designated quality control representative, selected Subcontractors and Suppliers, contractors responsible for other construction schedules, and RESIDENT ENGINEER's representatives.

F. Preinstallation Meetings:

1. When required in individual Specification sections, convene at site prior to commencing Work of that section.
2. Require attendance of entities directly affecting, or affected by, Work of that section.
3. Notify RESIDENT ENGINEER 4 days in advance of meeting date.
4. Provide suggested agenda to RESIDENT ENGINEER to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

G. Other Meetings: In accordance with Contract Documents and as may be required by OWNER and RESIDENT ENGINEER.

1.6 SEQUENCE OF WORK

A. Certain work, sequence, order, and direction is specified in Section 01310, PROGRESS SCHEDULES, Article SCHEDULE RESPONSIBILITIES. Compliance with this section is required to integrate the multiple construction activities scheduled to occur in this area. CONTRACTOR's construction schedule must conform to the requirements set forth in

Section 01310, PROGRESS SCHEDULES, Article SCHEDULE RESPONSIBILITIES and the master Rio Salado Town Lake schedule shown in Exhibit A to Section 01310.

B. Construct Work in stages to allow for OWNER's uninterrupted operation during construction. Coordinate construction schedule and operation with OWNER.

C. Be responsible for bypass facilities and temporary connections required to maintain OWNER's operations. Sequences other than those specified will be considered by RESIDENT ENGINEER, provided they afford equivalent continuity of operations.

D. Power outages will be considered upon 48 hours written request to OWNER and RESIDENT ENGINEER. Describe the reason, anticipated length of time, and areas affected by the outage in its written request. Provide temporary provisions for continuous power supply to critical existing facility components if requested by OWNER and RESIDENT ENGINEER.

E. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of OWNER's operations.

F. Coordinate proposed Work with the RESIDENT ENGINEER and facility operations personnel before effecting unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process, in which case, remain onsite until necessary repairs are complete.

G. Do not close lines, open valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after approval of OWNER and RESIDENT ENGINEER. Such actions will be considered by OWNER and RESIDENT ENGINEER upon 48 hours written notice to RESIDENT ENGINEER.

1.7 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at site is started, CONTRACTOR, RESIDENT ENGINEER, and affected property owners and utility owners shall make thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which might be damaged by construction operations. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
2. Record observations for signature of RESIDENT ENGINEER and CONTRACTOR.

B. Documentation:

1. Submit two copies of photographs or other records documenting examination for RESIDENT ENGINEER's signature. RESIDENT ENGINEER will review, sign, and return one record copy of every observation document and photograph to CONTRACTOR to be kept on file in CONTRACTOR's field office as site records.
2. These observations and photographs are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of CONTRACTOR's operations, and are for protection of adjacent property owners, CONTRACTOR, and OWNER.

1.8 OWNER FACILITIES

A. Operation and Shutdown of Existing Facilities:

1. Continuous operation of OWNER's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
2. Conduct Work outside regular working hours on prior written consent of OWNER to meet Project schedule and avoid undesirable conditions.
3. Do not proceed with Work affecting a facility's operation without obtaining OWNER's advance approval of the need for and duration of such Work.
4. Provide 7 days advance request for approval to OWNER of need to shut down a process or facility.

B. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by RESIDENT ENGINEER.

1.9 PHYSICAL CONDITIONS

A. Exercise reasonable care to verify locations of existing subsurface structures and Underground Facilities.

B. Thoroughly check immediate and adjacent areas subject to excavation by visual examination (and by electronic metal and pipe detection equipment, as necessary) for indications of subsurface structures and Underground Facilities.

C. Make exploratory excavations where existing Underground Facilities or structures may potentially conflict with proposed Underground Facilities or structures. Conduct exploratory excavations in presence of RESIDENT ENGINEER and sufficiently ahead of construction to avoid possible delays to CONTRACTOR's Work.

1.10 REFERENCE POINTS AND SURVEYS

A. Dimensions for lines and elevations for grades of structures, appurtenances, and utilities are indicated on Drawings, together with other pertinent information required for laying out Work. If conditions vary from those indicated, notify RESIDENT ENGINEER immediately, who will make minor adjustments required.

B. Any existing survey points or other control markers destroyed without proper authorization will be replaced by owner of the survey points or control markers at the CONTRACTOR's expense.

C. CONTRACTOR's Responsibilities:

1. Locate and protect reference points prior to starting site preparation.
2. Notify RESIDENT ENGINEER at least 3 working days in advance of time when grade and line to be provided by others will be needed.
3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
4. In event of discrepancy in data or staking provided by RESIDENT ENGINEER, request clarification before proceeding with Work.
5. Preserve and leave undisturbed control staking until RESIDENT ENGINEER has completed checks it deems necessary.
6. Re-establish reference points resulting from destruction by CONTRACTOR's operations.
7. Provide competent employee(s), tools, stakes, and other equipment and materials as RESIDENT ENGINEER may require to:
   a. Check layout, survey, and measurement Work performed by others.
   b. Measure quantities for payment purposes.
8. Cooperate with RESIDENT ENGINEER so that checking and measuring may be accomplished with least interference to CONTRACTOR's operations.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Obtain prior written authorization of RESIDENT ENGINEER before commencing Work to cut or otherwise alter:

1. Structural or reinforcing steel, structural columns or beams, elevated slabs, trusses, or any other structural member.
2. Weather- or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Work of others.

C. Refinish surfaces to provide an even finish.

1. Refinish continuous surfaces to nearest intersection.
2. Refinish entire assemblies.
3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and Work is evident in finished surfaces.

D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown.

E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use best recommended practice of manufacturer or appropriate trade association.

F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

G. Remove specimens of installed Work for testing when requested by RESIDENT ENGINEER.

END OF SECTION

SECTION 01092
ABBREVIATIONS

PART 1 GENERAL

1.1 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided herein and in the individual Specification sections.

B. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet the requirements or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed the additional prescriptive or performance requirements included within the Contract Documents to establish a higher or more stringent standard of quality than that required by the referenced standard.

D. Where two or more standards are specified to establish quality, the product and workmanship shall meet or exceed the requirements of the most stringent.

E. Where both a standard and a brand name are specified for a product in the Contract Documents, the proprietary product named shall meet or exceed the requirements of the specified reference standard.

F. Copies of standards and specifications of technical societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.
2. Where copies of standards are needed by the CONTRACTOR, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the site as Work site records, available to the CONTRACTOR's personnel, Subcontractors, OWNER, and RESIDENT ENGINEER.

1.2 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association

4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ACI	American Concrete Institute
6.	AFBMA	Anti-Friction Bearing Manufacturers' Association
7.	AGA	American Gas Association
8.	AGMA	American Gear Manufacturers' Association
9.	AI	Asphalt Institute
10.	AISC	American Institute of Steel Construction
11.	AISI	American Iron and Steel Institute
12.	AITC	American Institute of Timber Construction
13.	ALS	American Lumber Standards
14.	AMA	Acoustical Materials Association
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	American Plywood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AREA	American Railway Engineering Association
21.	ARI	Air Conditioning and Refrigeration Institute
22.	ASA	American Standards Association
23.	ASAE	American Society of Agricultural Engineers
24.	ASCE	American Society of Civil Engineers
25.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
26.	ASNT	American Society for Nondestructive Testing
27.	ASME	American Society of Mechanical Engineers
28.	ASTM	American Society for Testing and Materials
29.	AWI	Architectural WoodWork Institute
30.	AWPA	American Wood Preservers' Association
31.	AWPB	American Wood Preservers Bureau
32.	AWPI	American Wood Preservers' Institute
33.	AWS	American Welding Society
34.	AWWA	American Water Works Association
35.	BHMA	Builders Hardware Manufacturers' Association
36.	CBMA	Certified Ballast Manufacturers' Association
37.	CDA	Copper Development Association
38.	CGA	Compressed Gas Association
39.	CIPRI	Cast Iron Pipe Research Institute
40.	CISPI	Cast Iron Soil Pipe Institute
41.	CMAA	Crane Manufacturers' Association of America
42.	CRSI	Concrete Reinforcing Steel Institute
43.	CS	Commercial Standard
44.	CSA	Canadian Standards Association
45.	CSI	Construction Specifications Institute
46.	CTSS	Caltrans Standard Specification
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Engineering Test Laboratories
49.	FCC	Federal Communications Commission
50.	FEMA	Federal Emergency Management Agency
51.	FGMA	Flat Glass Marketing Association
52.	FM	Factory Mutual
53.	Fed. Spec.	Federal Specifications
54.	FS	Federal Specification

55.	GA	Gypsum Association
56.	HI	Hydraulic Institute
57.	HMI	Hoist Manufacturers' Institute
58.	ICBO	International Conference of Building Officials
59.	ICEA	Insulated Cable Engineers' Association
60.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
61.	IES	Illuminating Engineering Society
62.	IFI	Industrial Fasteners Institute
63.	ISA	Instrument Society of America
64.	ISO	Insurance Service Office
65.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
66.	MAG	Maricopa Association of Governments, Uniform Standard Specifications and Details for Public Works Construction
67.	MIA	Marble Institute of America
68.	Mil. Sp. or MIL	Military Specification
69.	MS	Military Specifications
70.	MMA	Monorail Manufacturers' Association
71.	NAAMM	National Association of Architectural Metal Manufacturers
72.	NACE	National Association of Corrosion Engineers
73.	NBHA	National Builders' Hardware Association
74.	NEC	National Electrical Code
75.	NECA	National Electrical Contractor's Association
76.	NEMA	National Electrical Manufacturers' Association
77.	NESC	National Electric Safety Code
78.	NFPA	National Fire Protection Association
79.	NHLA	National Hardwood Lumber Association
80.	NHPMA	Northern Hardwood and Pine Manufacturer's Association
81.	NLMA	National Lumber Manufacturers' Association
82.	NRCA	National Roofing Contractors Association
83.	NSF	National Sanitation Foundation Testing Laboratory
84.	NSPE	National Society of Professional Engineers
85.	NTMA	National Terrazzo and Mosaic Association
86.	NWWDA	National Wood Window and Door Association
87.	OECI	Overhead Electrical Crane Institute
88.	OSHA	Occupational Safety and Health Act (both Federal and State)
89.	PCI	Prestressed Concrete Institute
90.	PEI	Porcelain Enamel Institute
91.	PPI	Plastic Pipe Institute
92.	PS	Product Standards Section—U.S. Department of Commerce
93.	RMA	Rubber Manufacturers' Association
94.	SAE	Society of Automotive Engineers
95.	SCPRF	Structural Clay Products Research Foundation
96.	SDI	Steel Deck Institute
97.	SDI	Steel Door Institute
98.	SIGMA	Sealed Insulating Glass Manufacturing Association
99.	SJI	Steel Joist Institute

100.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
101.	SPI	Society of the Plastics Industry
102.	SSPC	Steel Structures Painting Council
103.	SWI	Steel Window Institute
104.	TEMA	Tubular Exchanger Manufacturers' Association
105.	TCA	Tile Council of America
106.	UBC	Uniform Building Code
107.	UFC	Uniform Fire Code
108.	UL	Underwriters Laboratories Inc.
109.	UMC	Uniform Mechanical Code
110.	US	U.S. Bureau of Standards
111.	USBR	Bureau of Reclamation
112.	WCLIB	West Coast Lumber Inspection Bureau
113.	WWPA	Western Wood Products Association

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.1 GENERAL

A. Inquiries: Direct to RESIDENT ENGINEER regarding procedure, purpose, or extent of Submittal.

B. Timeliness: Schedule and make submissions in accordance with requirements of individual Specification sections and in such sequence as to cause no delay in Work or in work of other contractors.

C. Identification of Submittals:

1. Complete, sign, and transmit with each Submittal package, one Transmittal of CONTRACTOR's Submittal Form.
2. Identify each Submittal with the following numbering and tracking system:
   a. Sequentially number each Submittal.
   b. Resubmission of a Submittal will have original number with sequential alphabetic suffix.
3. Format: Orderly, indexed with labeled tab dividers.
4. Show date of submission.
5. Show Project title and OWNER's contract identification and contract number.
6. Show names of CONTRACTOR, Subcontractor or Supplier, and manufacturer as appropriate.
7. Identify, as applicable, Contract Document section and paragraph to which Submittal applies.
8. Identify Submittal type; submit only one type in each Submittal package.
9. Identify and indicate each deviation or variation from Contract Documents.

D. Resubmissions: Clearly identify each correction or change made.

E. Incomplete Submittal Submissions:

1. RESIDENT ENGINEER will return the entire Submittal for CONTRACTOR's revision/correction and resubmission.
2. Submittals which do not clearly bear CONTRACTOR's specific written indication of CONTRACTOR review and approval of Submittal or which are transmitted with an unsigned or uncertified submission form or as may otherwise be required will be returned to CONTRACTOR unreviewed.

F. Nonspecified Submissions: Submissions not required under these Contract Documents and not shown on submissions will not be reviewed and will be returned to CONTRACTOR.

G. RESIDENT ENGINEER's Review: RESIDENT ENGINEER will act upon CONTRACTOR's Submittal and transmit response to CONTRACTOR not later than 30 days after receipt, unless otherwise specified. Resubmittals will be subject to the same review time.

H. Schedule Delays:

1. No adjustment of Contract Times or Price will be allowed due to RESIDENT ENGINEER's review of Submittals, unless all of the following criteria are met:
   a. CONTRACTOR has notified RESIDENT ENGINEER in writing that timely review of Submittal in question is critical to progress of Work, and has received RESIDENT ENGINEER's written acceptance to reflect such on current accepted submissions and progress schedule. Written agreement by RESIDENT ENGINEER to reduce Submittal review time will be made only for unusual and CONTRACTOR-justified reasons. Acceptance of a progress schedule containing Submittal review times less than specified or less than agreed to in writing by RESIDENT ENGINEER will not constitute RESIDENT ENGINEER's acceptance of the review times.
   b. RESIDENT ENGINEER has failed to review and return first submission of a Submittal within agreed time indicated on current accepted schedule of submissions or, if no time is indicated thereon, within 30 days after receipt.
   c. CONTRACTOR demonstrates that delay in progress of Work is directly attributable to RESIDENT ENGINEER's failure to return Submittal within time indicated and accepted by RESIDENT ENGINEER.
2. No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmission of Submittals, including multiple resubmissions.

1.2 SHOP DRAWINGS AND SAMPLES

A. Copies:

1. Shop Drawings and Product Data: Seven.
2. Samples: Three, unless otherwise specified in individual Specification sections.

B. General: Submit to RESIDENT ENGINEER as required by individual Specification sections. RESIDENT ENGINEER will distribute to DESIGN ENGINEER for review.

C. Identify and Indicate:

1. Pertinent Drawing sheet(s) and detail number(s), products, units and assemblies, and system or equipment identification or tag numbers.
2. Critical field dimensions and relationships to other critical features of Work.
3. Samples: Source, location, date taken, and by whom.
4. Each deviation or variation from Contract Documents.

D. Design Data: When specified, provide Project-specific information as required and as necessary to clearly show calculations, dimensions, logic and assumptions, and referenced standards and codes upon which design is based.

E. Foreign Manufacturers: When proposed, include following additional information:

1. Names and addresses of at least two companies closest to Project that maintain technical service representatives.
2. Complete inventory of spare parts and accessories for each piece of equipment.

F. Preparation:

1. Format: Whenever possible, schedule for and combine Shop Drawings and Samples required for submission in each Specification section or division into a single Submittal package. Also combine product data for like items into a single Submittal package.
2. Present in a clear and thorough manner and of sufficient detail to show kind, size, arrangement, and function of components, materials, and devices and compliance with Contract Documents. Identify details by reference to sheet and detail, and schedule or room numbers shown on Drawings.
3. Reproducible Copy:
   a. Preferred Minimum Sheet Size: 8-1/2- by 11-inch and 11- by 17-inch pages, suitable for photocopying.
   b. Larger than 11- by 17-Inch Sheets: 22-inch by 34-inch preferred, mylar or sepias suitable for copying in a blueprint machine.
4. Piping Systems: Drawn to scale.
5. Product Data: Clearly mark each copy to identify pertinent products or models and show performance characteristics and capacities, dimensions and clearances required, wiring or piping diagrams and controls, and external connections, anchorages, and supports required.
6. Equipment and Component Titles: Identical to title shown on Drawings.
7. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to Work.
   b. Supplement standard information to provide information specifically applicable to Work.

G. Shop Drawing Disposition: DESIGN ENGINEER will review, mark, and stamp as appropriate and submit copies to RESIDENT ENGINEER. RESIDENT ENGINEER will distribute marked-up copies as noted:

1. Approved as Submitted (for incorporation in Work):
   a. One copy furnished OWNER.
   b. One copy retained in DESIGN ENGINEER's file.
   c. One copy retained in RESIDENT ENGINEER's file.
   d. Remaining copies returned to CONTRACTOR appropriately annotated.

e. CONTRACTOR may begin to implement activities to incorporate specific product(s) or Work covered by Submittal.

2. Approved as Noted (for incorporation in Work):
   a. One copy furnished OWNER.
   b. One copy retained in DESIGN ENGINEER's file.
   c. One copy retained in RESIDENT ENGINEER's file.
   d. Remaining copies returned to CONTRACTOR appropriately annotated.
   e. CONTRACTOR may begin to implement activities to incorporate product(s) or Work covered by Submittal, in accordance with ENGINEER's notations.
3. Disapproved:
   a. One copy furnished OWNER.
   b. One copy retained in DESIGN ENGINEER's file.
   c. One copy retained in RESIDENT ENGINEER's file.
   d. Remaining copies returned to CONTRACTOR appropriately annotated.
   e. CONTRACTOR shall make corrections or develop replacement and resubmit (in same manner and quantity as specified for original submission).
   f. Submittal is not approved.
4. Incomplete:
   a. One copy furnished OWNER.
   b. One copy retained in DESIGN ENGINEER's file.
   c. One copy retained in RESIDENT ENGINEER's file.
   d. Remaining copies returned to CONTRACTOR appropriately annotated.
   e. CONTRACTOR shall complete and resubmit or submit missing portions.
   f. Submittal is not approved.

H. Sample Disposition: Same as Shop Drawing disposition; samples will not be returned.

1.3 ADMINISTRATIVE SUBMITTALS

A. Copies: Submit six.

B. Description: Submittals that are not Shop Drawings or Samples, or that do not reflect quality of product or method of construction. May include, but not limited to those Submittals identified below.

C. Applications for Payment: Meet requirements of Section 01025, MEASUREMENT AND PAYMENT.

D. Progress Reports and Quantity Charts: As may be required in Section 01310, PROGRESS SCHEDULES.

E. Schedules:

1. Progress Schedule(s): Meet the requirements of Section 01310, PROGRESS SCHEDULES.

2. Schedule of Values: Meet requirements of Section 01025, MEASUREMENT AND PAYMENT.
3. Schedule of Submittal Submissions:
   a. Prepare and submit, preliminary list of submissions grouped by Contract Document article/paragraph number or Specification section number, with identification, numbering and tracking system as specified under Paragraph Identification of Submittals and as approved by RESIDENT ENGINEER.
   b. Include only the following required submissions:
      1) Shop Drawings and Samples.
      2) Training plans.
      3) Test procedures.
      4) Operation and maintenance manuals.
      5) Record documents.
      6) Specifically required certificates, warranties, and service agreements.
   c. Coordinate with progress schedule and prepare submissions to show for each Submittal, at a minimum, the following:
      1) Estimated submission date to RESIDENT ENGINEER.
      2) Specifically requested and clearly identified RESIDENT ENGINEER review time if shorter than that set forth herein, with justification for such request and critical dates Submittals will be needed from RESIDENT ENGINEER.
      3) For first 6-month period from the date the Contract Times commence or following any update or adjustment of the submissions, the estimated submission date shall be week, month, and year; for submissions beyond 6-month time period, show closest month and year.
   d. Submit to RESIDENT ENGINEER monthly (i) updated list if changes have occurred, otherwise submit a written communication confirming existing list, and (ii) adjusted submissions reflecting submission activity planned for forthcoming 6-month time period and beyond. Coordinate with progress schedule updates.

F. Training Materials: Meet the requirements of Section 01640, MANUFACTURERS' SERVICES.

G. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to RESIDENT ENGINEER for OWNER's records one copy of correspondence and transmittals (to include enclosures and attachments) between CONTRACTOR and governing agency.

H. Disposition: RESIDENT ENGINEER will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:

1. Accepted:
   a. Schedules: Acceptance will indicate that schedules provide for the orderly progression of the Work to completion within any

specified milestones and the Contract Times, but such acceptance will neither impose on RESIDENT ENGINEER responsibility for the sequencing, scheduling, or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor.

b. Acceptance of other Administrative Submittals will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
c. CONTRACTOR may proceed to perform Submittal related Work.
d. One copy furnished OWNER.
e. One copy retained in RESIDENT ENGINEER's file.
f. Remaining copies returned to CONTRACTOR appropriately annotated.

2. Rejected as Noted:
   a. One copy retained in RESIDENT ENGINEER's file.
   b. Remaining copies returned to CONTRACTOR appropriately annotated.
   c. CONTRACTOR shall revise/correct or develop replacement and resubmit.

1.4 QUALITY CONTROL SUBMITTALS

A. Copies: Submit seven.

B. Certificates:

1. Manufacturer's Certificate of Compliance:
   a. When specified in individual Specification sections or where products are specified to a recognized standard or code, submit prior to shipment of product or material to the site.
   b. DESIGN ENGINEER may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
   c. Signed by product manufacturer certifying that materials, manufacture, and product specified conforms to or exceeds specified requirements and intent for which product will be used. Submit supporting reference data, affidavits, and certifications as appropriate.
   d. May reflect recent or previous test results on material or product, but must be acceptable to DESIGN ENGINEER.
2. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in the individual Specification sections.
3. Manufacturer's Certificate of Proper Installation: As required in Section 01640, MANUFACTURERS' SERVICES. Coordinate with Section 01650, FACILITY STARTUP.

C. Operation and Maintenance Manual: As required in Section 01430, OPERATION AND MAINTENANCE DATA.

D. Statements of Qualification: Evidence of qualification, certification, or registration. As required in these Contract Documents to verify

qualifications of professional land surveyors, engineers, materials testing laboratories, specialty Subcontractors, trades, specialists, consultants, installers, and other professionals.

E. Field Samples: Provide as required by individual Specifications and as may be required by RESIDENT ENGINEER during progress of Work.

F. Written Test Reports of Each Test and Inspection: As a minimum, include the following:

1. Date of test and date issued, Project title and number, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
2. Date and time of sampling or inspection and record of temperature and weather conditions.
3. Identification of product and Specification section, location of Sample, test or inspection in the Project, type of inspection or test with referenced standard or code, certified results of test.
4. Compliance with Contract Documents, and identifying corrective action necessary to bring materials and equipment into compliance.
5. Provide an interpretation of test results, when requested by RESIDENT ENGINEER.

G. Disposition: DESIGN ENGINEER will review, mark, and stamp as appropriate and submit copies to RESIDENT ENGINEER. RESIDENT ENGINEER will distribute marked-up copies as noted:

1. Accepted:
   a. Acceptance will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
   b. CONTRACTOR may proceed to perform Submittal related Work.
   c. One copy furnished OWNER.
   d. One copy retained in DESIGN ENGINEER's file.
   e. One copy retained in RESIDENT ENGINEER's file.
   f. Remaining copies returned to CONTRACTOR appropriately annotated.
2. Rejected as Noted:
   a. One copy retained in DESIGN ENGINEER's file.
   b. One copy retained in RESIDENT ENGINEER's file.
   c. Remaining copies returned to CONTRACTOR appropriately annotated.
   d. CONTRACTOR shall revise/correct or develop replacement and resubmit.

1.5 CONTRACT CLOSEOUT SUBMITTALS

A. General: In accordance with Section 01700, CONTRACT CLOSEOUT.

B. Disposition: RESIDENT ENGINEER will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:

1. Accepted:
   a. Acceptance will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
   b. CONTRACTOR may proceed to perform Submittal related Work.
   c. One copy furnished OWNER.
   d. One copy retained in RESIDENT ENGINEER's file.
   e. Remaining copies returned to CONTRACTOR appropriately annotated.
2. Rejected as Noted:
   a. One copy retained in RESIDENT ENGINEER's file.
   b. Remaining copies returned to CONTRACTOR appropriately annotated.
   c. CONTRACTOR shall revise/correct or develop replacement and resubmit.

1.6 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION", are part of this Specification.

1. Forms: Transmittal of CONTRACTOR's Submittal

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

CH2M HILL **TRANSMITTAL OF CONTRACTOR'S SUBMITTAL**
(ATTACH TO EACH SUBMITTAL) DATE:_____

TO:_____ Submittal No.:_____

_____ ☐ New Submittal ☐ Resubmittal

_____ Previous Submittal No.:_____

_____ Project:_____

_____ Project No.:_____

Specification Section No.:_____

FROM:_____ **(Cover only one section with each transmittal)**

Contractor Schedule Date of Submittal:

_____ _____

_____

_____

SUBMITTAL TYPE: ☐ Shop Drawing ☐ Administrative ☐ Sample

☐ Quality Control ☐ Contract Closeout ☐ "Or-Equal"/Substitute

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

CONTRACTOR hereby certifies that (i) CONTRACTOR has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By:_____
CONTRACTOR (Authorized Signature)

SECTION 01310
PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUBMITTALS

A. Submit with Each Progress Schedule Submission:

1. CONTRACTOR's certification that progress schedule submission is the actual schedule being utilized for execution of the Work and certification by all Subcontractors with 5 percent or more of Work that they concur with CONTRACTOR's progress schedule submission.
2. Four Legible Copies of the Progress Schedule: For each computer generated schedule submission.
3. Disk file compatible with Primavera Project Planner (P3).

B. Preliminary Progress Schedule: Submit within 10 days of award. No progress payment shall be made to CONTRACTOR until the schedules are submitted and acceptable to RESIDENT ENGINEER. Schedule shall comply with the requirements of MAG paragraph 108.4.

C. Progress Schedule: Submit adjusted schedule or confirm validity of current schedule with each monthly Application for Payment, and at such other times as necessary to reflect: (i) progress of Work to within 5 working days prior to submission; (ii) changes in Work scope and activities modified since submission; (iii) delays in Submittals or resubmittals, deliveries, or Work; (iv) adjusted or modified sequences of Work; (v) other identifiable changes; and (vi) revised projections of progress and completion. Schedule shall comply with the requirements of MAG paragraph 108.4.

D. Narrative Progress Report: Submit with each monthly submission of progress schedule.

E. Precedent to final payment, provide four copies of any Critical Path Method (CPM) type schedule utilized with certification that said schedule represents correctly the way the Work was performed.

F. Progress quantity chart(s).

1.2 SCHEDULE RESPONSIBILITIES

A. Project is divided into several prime contracts with each contract awarded separately. OWNER's Construction Manager will be responsible for developing and maintaining a master progress schedule utilizing individual progress schedules prepared by each contractor as submitted to RESIDENT ENGINEER under this section.

B. CONTRACTOR's construction schedule must conform to the prescribed work in the sequence shown on the Rio Salado Town Lake Coordination

Schedule (Exhibit A), and specified notes therein. Certain work and progress direction is specified.

C. Upon review and acceptance, RESIDENT ENGINEER will transmit one hard copy and one diskette copy, Primavera Project Planner (P3), each for all contractors' schedules to OWNER's Construction Manager. Within 5 days of receipt, OWNER's Construction Manager shall prepare and transmit to RESIDENT ENGINEER one hard copy of master progress schedule for each designated contractor and one hard copy for RESIDENT ENGINEER.

D. Where CONTRACTOR is referred to in the singular, it shall refer to each of separate contractors as applicable.

1.3 PROGRESS OF THE WORK

A. If CONTRACTOR fails to complete activity by its latest scheduled completion date and this failure may extend Contract Times (or Milestones), CONTRACTOR shall, within 7 days of such failure, submit a written statement as to how CONTRACTOR intends to correct nonperformance and return to the acceptable current progress schedule. Actions by CONTRACTOR to complete Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

B. OWNER may order CONTRACTOR to increase plant, equipment, labor force or working hours if CONTRACTOR fails to: (i) complete a critical scheduled activity by its latest Milestone completion date, or (ii) satisfactorily execute Work as necessary to prevent delay to the overall completion of the Project.

1.4 PRELIMINARY PROGRESS SCHEDULE

A. As a minimum, submit two bar charts or preliminary network analysis diagrams as follows:

1. 90-Day Plan: Show major initial activities including, but not limited to, mobilization, permits, submittals for early product procurement and long lead time items, initial site work, and other activities anticipated in the first 90-day period of the Contract Time.
2. Project Overview Plan: Show major components of the Work and the sequence relations between major components and subdivisions of major components. The chart shall indicate the relationship and time frames in which the various facilities will be made substantially complete and placed into service in accordance with the Project Milestones. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as:
   a. Excavation.
   b. Foundation subgrade preparation.
   c. Foundation concrete.
   d. Completion of all structural concrete.
   e. Major mechanical Work.
   f. Major electrical Work.

g. Instrumentation and control Work.
h. Other important work for each major facility within the overall Work scope.

B. Planned durations and start dates shall be indicated for each Work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 11 inches by 17 inches in size. Not more than four sheets shall be employed to represent this overview information.

C. The preliminary progress schedule, when accepted by the RESIDENT ENGINEER, will be the initially acceptable schedule.

1.5 PROGRESS SCHEDULE

A. General:

1. Schedule(s) shall reflect Work logic sequences, restraints, delivery windows, review times, Contract Times, and Milestones set forth in the Agreement and Section 01040, COORDINATION, and shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. The schedule requirement herein is the minimum required. CONTRACTOR may prepare a more sophisticated schedule if such will aid CONTRACTOR in execution and timely completion of Work.
3. Base schedule on standard 5-day Work week.
4. When bar chart or network analysis schedules are specified, use Primavera Project Planner (P3) latest version or a compatible and approved software.
5. Adjust or confirm schedules on a monthly basis.
6. Float time is a Project resource available to both parties to meet contract Milestones and Contract Times.
7. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of OWNER and CONTRACTOR.
8. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond contract completion date.
9. If CONTRACTOR provides an accepted schedule with an early completion date, OWNER reserves the right to reduce Contract Times to match the early completion date by issuing a deductive Change Order at no change in Contract Price.

B. Format:

1. Comprehensive computer generated Network Analysis Diagram schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) publication "The Use of CPM in Construction–A Manual for General Contractors and the Construction

Industry," latest edition, prepared on reproducible paper, not larger than 30 inches by 42 inches.

a. Submit within 45 days after the Contract Times start to run.
b. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work, identifying Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
c. Include at a Minimum: Subcontract Work; major and other equipment and critical product design, fabrication, testing, delivery and installation times including required lead time for OWNER-furnished products, move-in and other preliminary activities, Project closeout and cleanup, Substantial Completion dates, Submittals that may impact critical path, and system/ subsystem/component testing, facility startup, and training activities that may impact critical path.
d. Develop subschedules to further define critical portions of the Work, i.e., Process Instrumentation and Control System/ Subsystems.
e. Indicate dates for early- and late-start, early- and late-finish, float and duration.
f. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day nor more than 15 working days, unless otherwise approved by RESIDENT ENGINEER.
g. Activity duration for Submittals review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from RESIDENT ENGINEER.
h. Monthly Schedule Submissions: Include overall percent complete, projected and actual; and percent completion progress for each listed activity.
i. The estimated cost to perform each Work activity shall be noted for each activity in the network on a tabular listing. The sum of the costs assigned to all activities shall equal the Contract Price. No activity costs shall be assigned to Submittals or Submittal reviews. An unbalanced or front-end loaded schedule will not be acceptable. The accepted cost loaded progress schedule shall constitute the schedule of values specified in Section 01025, MEASUREMENT AND PAYMENT.

1.6 NARRATIVE PROGRESS REPORT

A. Include, as a minimum:

1. Summary of Work completed during the past period between Narrative Progress Reports.
2. Work planned during the next period.
3. Explanation of differences between summary of Work completed and Work planned in previously submitted Narrative Progress Report.
4. Current and anticipated delaying factors and their estimated impact on other activities and completion Milestones.
5. Corrective action taken or proposed.

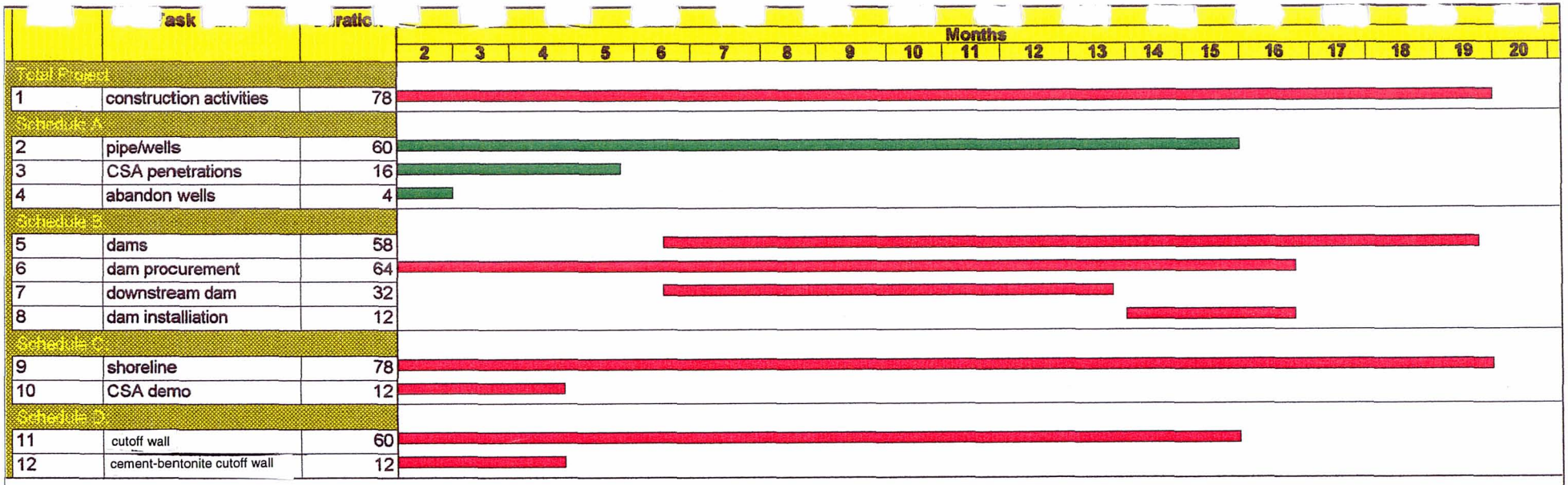
1.7 CLAIMS FOR ADJUSTMENT OF CONTRACT TIMES

A. Where RESIDENT ENGINEER has not yet rendered formal decision on CONTRACTOR's claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in progress schedule, CONTRACTOR shall reflect that amount of time adjustment in progress schedule as RESIDENT ENGINEER may accept as appropriate for the interim. It is understood and agreed that such interim acceptance by RESIDENT ENGINEER will not be binding and will be made only for purpose of continuing to schedule Work, until such time as formal decision as to an adjustment, if any, of the Contract Times acceptable to the RESIDENT ENGINEER has been rendered. CONTRACTOR shall revise progress schedule prepared thereafter in accordance with RESIDENT ENGINEER's formal decision.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION



1. General construction schedule is shown for coordination and reference.

2. All durations and end points shown are critical in order to coordinate work to occur in adjacent areas. Failure to complete specified work within the time allocated will subject contract to damages, due to consequential conflict with other scheduled activities, according to the specification for liquidated damage. (See specification index).

3. Other schedule "A" work may be done concurrent with items 3 & 4.

4. Well construction should proceed from east to west.

5. Levee may be inaccessible during recovery pipe installation.

Project Start	30DEC96
Project Finish	22JUN98
Data Date	30DEC96
Plot Date	06SEP96

Early Bar
Progress Bar
Critical Activity

RSTL

Sheet 1 of 1

Parsons Brinckerhoff C. S.

Rio Salado Town Lake

Construction Coordination Schedule A

SECTION 01430
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 DEFINITIONS

A. Maintenance Operation: As used in the Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

B. System and Subsystem: Refer to Section 01650, FACILITY STARTUP.

1.2 QUALITY ASSURANCE

A. Manuals for equipment and systems shall be prepared by equipment manufacturer or system Supplier.

1.3 SEQUENCING AND SCHEDULING

A. Manual Outline: Submit detailed outline of each manual prior to preparation of Preliminary Manuals.

B. Manuals for Equipment and Systems:

1. Preliminary Manuals: Submit prior to shipment date for equipment, system, subsystem, or component. Include copy of warranties, Bonds, and service agreements if specified.
2. Final Manuals: Submit not less than 30 days prior to equipment or system field testing or startup.

1.4 GENERAL

A. Furnish for each item of equipment or system as specified in the individual Specification sections.

B. Prepare data for use by OWNER's personnel in the form of an instructional manual and on electronic media.

C. Manual Format:

1. Size: 8-1/2 inches by 11 inches.
2. Paper: 20-pound minimum, white for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten.
4. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
5. Provide fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component

parts of equipment and provide with heavy section dividers with numbered plastic index tabs.

6. Provide each manual with title page, and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.
7. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE MANUAL, VOLUME NO. __ OF __", if applicable, and list:
   a. Project title.
   b. Designate the system or equipment for which it is intended.
   c. Identity of separate structure as applicable.
   d. Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
8. Assemble and bind material in same order as specified, as much as possible.
9. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.
10. Binders:
    a. Preliminary Manuals: Heavy paper covers.
    b. Final Manuals: Commercial quality, substantial, permanent, three-ring binders with durable, cleanable, plastic binders.
11. Table of contents neatly typewritten, arranged in a systematic order:
    a. CONTRACTOR, name of responsible principal, address, and telephone number.
    b. List of each product required to be included, indexed to content of each volume.
    c. List with Each Product: Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
       1) Identify area of responsibility of each.
       2) Provide local source of supply for parts and replacement.
    d. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
12. Product Data:
    a. Include only those sheets that are pertinent to specific product.
    b. Clearly annotate each sheet to:
       1) Identify specific product or part installed.
       2) Identify data applicable to installation.
       3) Delete references to inapplicable information.
13. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
    a. Relations of component parts of equipment and systems.
    b. Control and flow diagrams.
    c. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
    d. Do not use Project record documents as maintenance manual drawings.
    e. Provide reinforced punched binder tab, bind in with text.
    f. Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.

g. Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
h. Identify Specification section and product on Drawings and envelopes.

14. Instructions and Procedures: Within text, as required to supplement product data.
    a. Handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shutdown in emergency, troubleshooting, maintenance, interface, and as may otherwise be required.
    b. Organize in a consistent format under separate heading for each different procedure.
    c. Provide a logical sequence of instructions for each procedure.
    d. Provide information sheet for OWNER's personnel, including:
        1) Proper procedures in the event of failure.
        2) Instances that might affect the validity of warranties or Bonds.
15. Warranties, Bonds, and Service Agreements: In accordance with Section 01700, CONTRACT CLOSEOUT.

D. Electronic Format: Microsoft Word, most current version.

1.5 SUBMITTAL PROCEDURE

A. Preliminary Manuals:

1. Submit seven copies.
2. Disposition: In accordance with Section 01300, SUBMITTALS, Article SHOP DRAWINGS AND SAMPLES.
3. If Accepted:
    a. One copy will be returned to CONTRACTOR.
    b. Four copies will be forwarded to OWNER.
    c. One copy will be retained in DESIGN ENGINEER's file.
    d. One copy will be retained in RESIDENT ENGINEER's file.
4. If Rejected:
    a. One copy will be returned to CONTRACTOR with DESIGN ENGINEER's comments for revision.
    b. One copy will be retained in DESIGN ENGINEER's file.
    c. One copy will be retained in RESIDENT ENGINEER's file.
    d. Resubmit seven revised Preliminary copies for ENGINEER's review.

B. Final Manuals:

1. If different than accepted Preliminary Manuals, submit:
    a. Seven copies of any necessary supplemental material, including revised table of contents.
    b. Instructions for insertion of supplemental material in unreturned sets.
2. If Final Manuals are acceptable, CONTRACTOR will be so notified.
3. If rejected, and at DESIGN ENGINEER's option:
    a. All copies will be returned to CONTRACTOR for revision, or;

b. All copies will be retained and the necessary revision data will be requested from CONTRACTOR.

1.6 MANUALS FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Description of unit and component parts, including controls, accessories, and appurtenances:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
2. Operating Procedures:
   a. Startup, break-in, routine, and normal operating instructions.
   b. Test procedures and results of factory tests where required.
   c. Regulation, control, stopping, and emergency instructions.
   d. Description of operation sequence by control manufacturer.
   e. Shutdown instructions for both short and extended durations.
   f. Summer and winter operating instructions, as applicable.
   g. Safety precautions.
   h. Special operating instructions.
   i. Installation instructions.
3. Maintenance and Overhaul Procedures:
   a. Routine operations.
   b. Guide to troubleshooting.
   c. Disassembly, removal, repair, reinstallation, and reassembly.
4. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
5. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
6. Spare parts ordering instructions.
7. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
8. Manufacturer's printed operating and maintenance instructions.
9. As-installed, color-coded piping diagrams.
10. Charts of valve tag numbers, with the location and function of each valve.

B. Maintenance Summary:

1. Compile an individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or subunits.
2. Format:
   a. Use Maintenance Summary Form bound with this section, or an electronic facsimile of such.
   b. Each Maintenance Summary may take as many pages as required.

c. Use only 8-1/2-inch by 11-inch size paper.
d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
   a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
   b. "Unit" is the unit of measure for ordering the part.
   c. "Quantity" is the number of units recommended.
   d. "Unit Cost" is the current purchase price.

C. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including all control and lighting systems.
2. Circuit Directories of Panelboards:
   a. Electrical service.
   b. Controls.
   c. Communications.
3. List of electrical relay settings, and control and alarm contact settings.
4. Electrical interconnection wiring diagram, including control and lighting systems.
5. As-installed control diagrams by control manufacturer.
6. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Sequences required.
   c. Safety precautions.
   d. Special operating instructions.
7. Maintenance Procedures:
   a. Routine operations.
   b. Guide to troubleshooting.
   c. Adjustment and checking.
   d. List of relay settings, control and alarm contact settings.
8. Manufacturer's printed operating and maintenance instructions.
9. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

1.7 MANUALS FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.

c. Information required for reordering special-manufactured products.

2. Instructions for Care and Maintenance:
   a. Manufacturer's recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
2. Instructions for inspections, maintenance, and repair.

1.8 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION", are part of this Specification.

1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE

   a. Name _____ Telephone No. _____

   b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant list required.

8. LUBRICANT LIST

Reference Symbol	Shell	Standard Oil	Gulf	Arco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SUBMITTALS

A. Administrative Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.

B. Shop Drawings:

1. Temporary Utility Submittals:
   a. Electric power supply and distribution plans.
   b. Water supply and distribution plans.
   c. Drainage plans.
2. Temporary Construction Submittals:
   a. Access Roads: Routes, cross-sections, and drainage facilities.
   b. Parking area plans.
   c. Storage yard and storage building plans, including gravel surfaced area.
   d. Fencing and protective barrier locations and details.
   e. Staging area location plan.
   f. Traffic Routing Plans: As specified herein, and proposed revisions thereto.
   g. Plan for maintenance of existing plant operations.
3. Temporary Control Submittals:
   a. Noise control plan.
   b. Plan for disposal of waste materials and intended haul routes.

1.2 MOBILIZATION

A. Mobilization shall include, but not be limited to, these principal items:

1. Obtaining required permits.
2. Moving CONTRACTOR's plant and equipment required for first month operations onto site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite communication facilities, including telephones, fax machine, and mailing address.
5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of CONTRACTOR's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having the CONTRACTOR's superintendent at the site full time.

9. Maintain complete field file of Shop Drawings, posted Contract Documents, and other files of field operations including provisions for maintaining "As recorded Drawings."
10. Removing field office from site upon acceptance of the entire work by OWNER.

B. Use area designated for CONTRACTOR's temporary facilities as shown as the staging area on Drawings.

1.3 CONTRACTOR'S USE OF PREMISES

A. Lands furnished by OWNER upon which CONTRACTOR shall perform the Work are as shown in the Drawings.

B. Rights-of-way and easements for access to such lands furnished by OWNER have been acquired. One copy of each easement will be furnished to CONTRACTOR.

1. The Flood Control District of Maricopa County (FCDMC) maintains flood control maintenance easements within the river channel. The typical northern limit of the easement is 15 feet from the leading edge of the existing north channel levee and the typical southern limit is 15 feet from the leading edge of the existing south channel levee.
2. CONTRACTOR is responsible for confining its construction equipment within the limits of the FCDMC easement except where specifically shown on the Drawings.

1.4 PERMITS

A. Permits, Licenses, or Approvals: Obtain in accordance with the General Provisions and as otherwise may be provided in the Special Provisions and retain onsite.

1.5 PROTECTION OF WORK AND PROPERTY

A. Safety Representative: CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

B. Comply with OWNER's safety rules.

C. Keep OWNER informed of serious accidents on the site and related claims.

D. Use of Explosives: No blasting or use of explosives will be allowed on the site.

E. During the performance of the Work, CONTRACTOR is responsible for adapting its means, methods, techniques, sequences and procedures of construction to allow OWNER to maintain operation at the existing level of facility production and consistent with applicable permit requirements, and Laws and Regulations. In performing such Work and in cooperating with

the OWNER to maintain operations, it may be necessary for the CONTRACTOR to plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items which will be included within the Contract Price.

1.6 VEHICULAR TRAFFIC

A. Traffic Routing Plan: Show sequences of construction affecting the use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians and vehicles.

PART 2 PRODUCTS

2.1 RESIDENT ENGINEER'S FIELD OFFICES

A. To be provided by OWNER.

2.2 PROJECT SIGN

A. Provide and maintain an 8-foot wide by 4-foot high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear the name of Project, OWNER, CONTRACTOR, DESIGN ENGINEER, RESIDENT ENGINEER, and other participating agencies. Lettering shall be blue applied on a white background by an experienced sign painter. Paint shall be exterior type enamel. The information to be included will be provided by the OWNER.

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

A. Power:

1. Electric power will be available at or near the site. Determine the type and amount available and make arrangements for obtaining temporary electric power service, metering equipment, and pay all costs for the electric power used during the contract period, except for portions of the Work designated in writing by the RESIDENT ENGINEER as substantially complete.
2. Cost of electric power used in performance and acceptance testing will be borne by CONTRACTOR.

B. Lighting: Provide temporary lighting at least to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions

for the installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity.

2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. No construction or potable water is available at the site. CONTRACTOR shall make arrangements for and bear all costs of providing water required for construction and potable purposes during construction.
2. Hydrant Water:
   a. Water may be available from hydrants in the Project vicinity. Secure written permission for connection and use from the water department and meet requirements for use. Notify fire department before obtaining water from fire hydrants.
   b. Use only special hydrant-operating wrenches to open hydrants. Make certain that hydrant valve is open full, since cracking the valve causes damage to the hydrant. Repair damaged hydrants and notify the appropriate agency as quickly as possible. Hydrants shall be completely accessible to the fire department at all times.
   c. Include costs to connect and transport water to construction areas in the Contract Price.

E. Sanitary and Personnel Facilities: Provide and maintain facilities for CONTRACTOR's employees, Subcontractors, and all other onsite employer's employees. Service, clean, and maintain facilities and enclosures.

F. Telephone Service: Arrange and provide onsite telephone service for CONTRACTOR's use during construction. Pay all costs of installation and monthly bills.

G. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

3.2 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within rights-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. Maintain in continuous service all existing gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along the line of work, unless other arrangements satisfactory to owners of said utilities have been made.
3. Where completion of Work requires temporary or permanent removal and/or relocation of an existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
4. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
5. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
6. In areas where the CONTRACTOR's operations are adjacent to or near a utility such as gas, telephone, television, electric power, water, sewer, or irrigation system and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection thereof have been made by the CONTRACTOR.
7. Notify property owners and utility offices which may be affected by the construction operation at least 2 days in advance.
   a. Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to the CONTRACTOR's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
8. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures. Maintain original site drainage wherever possible.

B. Excavations Near Existing Gaslines:

1. Prior to any excavations, CONTRACTOR shall call Blue Stake at 263-1100 so the existing gas pipes may be accurately located. CONTRACTOR shall hand dig carefully at these marked locations until the gas pipe has been found and exposed. Use care to avoid damaging or breaking a small electrical tracer wire (which is used for locating purposes) that may be buried with the pipe.
2. Once mechanical trenching is in progress, CONTRACTOR shall not attempt to trench within 2 feet of a gas pipe. Trenching within 2 feet of a gas pipe shall be done by hand in order to prevent any damage to the gas pipe. If CONTRACTOR "hooks" or otherwise strains a gas pipe while excavating, a call shall be placed to 271-GASS (271-4277).

If a steel facility is exposed and the pipe coating is found to be in need of repair, CONTRACTOR shall contact the utility.

3. When the excavations are complete, CONTRACTOR shall protect all exposed gas pipes. If the trench is more than 3 feet wide, the pipe must be supported in a manner where the supporting material does not damage the pipe or its protective wrapping. CONTRACTOR shall call Southwest Gas at 484-5306 to review and approve all proposed pipe support designs.
4. Before backfilling the natural gas facilities, CONTRACTOR shall provide both 6 inches of bedding and 6 inches of shading with sand or material free of rocks and able to pass through a 3/8-inch screen in order to provide firm support under the facility and to prevent damage to the pipe or pipe coating from the backfilling operation. When backfilling, CONTRACTOR shall not drop backfill directly on the exposed gas pipe. When compacting backfill, CONTRACTOR shall use extra care when directly over the gas pipe in order to avoid any damage.

C. Barricades and Lights:

1. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of CONTRACTOR's employees, other employer's employees, and others who may be affected by the Work.
2. Provide to protect existing facilities and adjacent properties from potential damage.
3. Locate to enable access by facility operators and property owners.
4. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
5. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section.

D. Signs and Equipment:

1. Conform to requirements of the manual published by the Arizona Department of Transportation and the City of Tempe Traffic Control and Barricade Manual.
2. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Tree and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside the limits of the Work and within the limits of the Work which are designated on the Drawings to remain undisturbed.
   a. Where practical, tunnel beneath trees when on or near the line of trench.
   b. Employ hand excavation as necessary to prevent tree injury.

c. Do not stockpile materials or permit traffic within drip lines of trees.
d. Provide and maintain temporary barricades around trees.
e. Water vegetation as necessary to maintain health.
f. Cover temporarily exposed roots with wet burlap, and keep the burlap moist until soil is replaced around the roots.
g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of the RESIDENT ENGINEER.
h. Dispose of removed trees in a legal manner off the site.

2. The balling and burlapping of trees indicated for replacement shall conform to the recommended specifications set forth in the American Standards for Nursery Stock, published by American Association of Nurserymen. All balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by the ball and not by the top.
3. In the event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
4. Replace each plant that dies as a result of construction activities.

F. Existing Structures: Where CONTRACTOR contemplates removal of small structures such as signposts, and culverts that interfere with CONTRACTOR's operations, obtain approval of property owner and RESIDENT ENGINEER. Replace those removed in a condition equal to or better than original.

G. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

H. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain the foundations and parts of the Work free from water.

3.3 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations in accordance with the General Provisions.
2. Burning: Of waste materials, rubbish, or other debris will not be permitted on or adjacent to the site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in the construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as the need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Plans: Proposed plan to mitigate construction noise impacts and to comply with noise control ordinances including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to an existing waterway.
2. Prior to commencing excavation and construction, obtain OWNER's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.
3. Comply with procedures outlined in U.S. Environmental Protection Agency manuals entitled, "Guidelines for Erosion and Sedimentation Control Planning" and "Implementation, Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity," and "Erosion and Sediment Control–Surface Mining in Eastern United States."
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.
5. CONTRACTOR shall comply with the requirements of the Arizona Department of Environmental Quality State Water Quality Certification provided in the Appendix.

D. Damage to New Work:

1. CONTRACTOR shall protect all new Work and Work in progress from stormwater inflow into Salt River Channel from any and all underground storm drain pipes which outfall into the river at or upstream of the worksite location - worksite location being defined as the limits of the lake area. CONTRACTOR shall construct provide, maintain, and operate any and all temporary facilities necessary to control erosion and sediment associated with the stormwater flow in and throughout the aforementioned storm drain systems.

2. CONTRACTOR shall also be responsible for protecting or insuring against damage to new Work and Work in progress for stormwater flows in Salt River Channel and in Indian Bend Wash due to storm runoff or upstream water releases. CONTRACTOR shall be responsible for any and all loss or damage to new Work or Work in progress caused by flows originating upstream in the Salt River Channel or in Indian Bend Wash.
3. CONTRACTOR shall be required to obtain and maintain Builder Risk and Business Interruption insurance for the full term of the construction contract. Required insurance coverage shall include cost of replacing falsework, re-excavating worksite, and other actual damages to Work associated with this contract and shall also include home office or field office expenses and other expenses related to extended general conditions incurred by CONTRACTOR in conjunction with construction downtime due to unavailability of worksite resulting from sustained flows in the river channel.

3.4 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01600, MATERIAL AND EQUIPMENT.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels, etc.) in a well-ventilated and remote building meeting safety standards.

3.5 ACCESS ROADS

A. Access to the construction areas is possible using the river bed and the existing access roads that parallel both lake shores and are located at the top of the cement stabilized alluvium (CSA) and at the top of the levee. There are several existing ramps located on both sides of the lake that connect each of the access roads with the river bed. During flood releases, the river bed may not be available as an access route. In addition, construction activities as a result of the work by other contractors (Schedules B, C, and D) may result in one or more of the access roads being unavailable for extended (up to 3 months) period of time. CONTRACTOR is responsible for constructing any other required access roads within the easements, rights-of-way, or Project limits, as shown. Alignments for new routes must be approved by RESIDENT ENGINEER.

B. The existing bike paths shall be closed to bike traffic throughout the construction period except the bike path on the north side of the river between Scottsdale Road and the Indian Bend Wash drop structure shall

remain open unless constructions operations make a temporary closure necessary. Closures shall be reviewed and approved by the City prior to implementation. CONTRACTOR shall not use the existing bike paths as access roads or operate any heavy equipment on the bike paths. CONTRACTOR shall not stockpile on top of any existing bike path. CONTRACTOR shall be responsible for protection of all bike paths in the event of any damage. CONTRACTOR shall repair the bike path in accordance with COT standards.

C. CONTRACTOR shall provide haul plan in accordance with the General Provisions.

D. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.

E. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

F. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

G. Coordinate with RESIDENT ENGINEER detours and other operations affecting traffic and access. Provide at least 72 hours' notice to RESIDENT ENGINEER of operations that will alter access to the site.

H. Upon completion of construction, restore ground surface disturbed by access road construction to original grade. Replace damaged or broken culverts with new culvert pipe of same diameter and material.

3.6 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, OWNER's operations, or construction operations.

B. Provide parking facilities for personnel working on the Project.

3.7 VEHICULAR TRAFFIC

A. All traffic control shall be in accordance with the City of Tempe Traffic Control and Barricade Manual, latest edition. All traffic control plans shall be reviewed by the City Transportation Division.

B. Comply with Laws and Regulations regarding closing or restricting the use of public streets or highways. No public or private road shall be closed, except by written permission of the proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.

C. Conduct Work to interfere as little as possible with public travel, whether vehicular, bicycle, or pedestrian.

D. Whenever it is necessary to cross, close, or obstruct roads, driveways, bike paths, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

E. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen the shoulder on the opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.

F. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

G. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

H. Notify the fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from the fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish CONTRACTOR's night emergency telephone numbers to the police department. All street closures must be approved by the City of Tempe Transportation Division.

I. Temporary Bridges:

1. Construct temporary bridges at all points where maintenance of traffic across pipeline construction is necessary.
2. Make bridges over bike paths, public streets, roads, and highways acceptable to the authority having jurisdiction thereover.
3. Bridges erected over private roads and driveways shall be adequate for the service to which they will be subjected.
4. Provide substantial guardrails and suitably protected approaches.
5. Provide bicycle and foot bridges not less than 6 feet wide with handrails and uprights of dressed lumber.
6. Maintain bridges in place as long as the conditions of the Work require their use for safety of the public, except that when necessary for the proper prosecution of the Work in the immediate vicinity of a bridge, the bridge may be relocated or temporarily removed for such period as the RESIDENT ENGINEER may permit.

J. Coordination: Coordinate traffic routing with that of others working in the same or adjacent areas.

3.8 CLEANING DURING CONSTRUCTION

A. In accordance with the General Provisions, as may be specified in Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep all floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up all debris and dispose.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep the entry drive and roadways, and all other streets and walkways affected by Work and where adjacent to Work.

END OF SECTION

SECTION 01505
MOBILIZATION AND CLEANUP (WELL DRILLING)

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the Work necessary to move in and move out personnel and equipment, set up and remove drill rigs and temporary facilities, and clean up site, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all materials and equipment required to accomplish the work as specified.

PART 3 EXECUTION

3.1 GENERAL

A. Set up well drilling equipment within the temporary construction pad area constructed by the CONTRACTOR as specified in Section 02100, SITE PREPARATION, and Section 02220, FILL AND BACKFILL. Accomplish all required Work in accordance with applicable portions of these Specifications.

B. Some obstructions may not be shown. Bidders are advised to carefully inspect the existing facilities before preparing their proposals. The removal and replacement of minor obstructions such as electrical conduits, water, waste piping, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned.

3.2 SECURITY FENCE

A. CONTRACTOR's security fence may be constructed for the protection of materials, tools, and equipment of the CONTRACTOR and subcontractors. At completion of the Work, remove fence from the site and restore the area.

3.3 CONTAMINATION PRECAUTIONS

A. Avoid contamination of the Project area. Do not dump waste oil, rubbish, or other similar materials on the ground.

3.4 CLEANUP OF CONSTRUCTION AREAS

A. Upon completion and acceptance of each well, remove from the site the drill rig and equipment, complete, and all debris, unused materials,

temporary construction buildings, and other miscellaneous items resulting from or used in the operations. Replace or repair any facility which has been damaged during the construction work. Restore the site as nearly as possible to its original condition.

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by CONTRACTOR or OWNER for the Project, or taken from previously purchased stock and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change the meaning of such other terms used in the Contract Documents as those terms are self-explanatory and have well recognized meanings in the construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.2 DESIGN REQUIREMENTS

A. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the latest edition of Uniform Building Code (UBC).

1. Wind: 80 mph, with Exposure C condition and an importance factor of 1.0.
2. Seismic: Zone 2B, importance factor of 1.0, unless specified otherwise.

1.3 SUBMITTALS

A. Administrative Submittals:

1. List of all proposed substitute or "or-equal" items/methods.
2. Schedule of factory tests required by Contract Documents. Identify tests for which RESIDENT ENGINEER's presence has been specified.

B. Quality Control Submittals:

1. Factory Tests: As specified in the individual Specifications.
   a. Procedures: Preliminary outlines.
      1) Final Accepted Procedures: Prior to start of factory testing.
   b. Test Documentation: Results of successful testing, including certification of procedures and results.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 1,175 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 10 degrees F to 130 degrees F.

1.5 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Matchmark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with a strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and CONTRACTOR, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Spare Parts, Special Tools, Test Equipment, Expendables, and Maintenance Materials:

1. Furnish as required by the Specifications prior to (i) starting functional testing as set forth in Section 01650, FACILITY STARTUP, or (ii) operation of the equipment by the OWNER, or (iii) 75 percent Project completion, whichever occurs first.
2. Properly package to avoid damage, in original cartons insofar as possible. Replace parts damaged or otherwise inoperable.
3. Firmly fix to, and prominently display on, each package.
   a. Minimum 3-inch by 6-inch manila shipping tag with the following information printed clearly:
      1) Manufacturer's part description and number.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.
      5) Applicable Specification section.
      6) Name of CONTRACTOR.
      7) Project name.
4. Deliver materials to site.
5. Notify RESIDENT ENGINEER.

D. Protect equipment from exposure to the elements and keep thoroughly dry and dustfree at all times. Protect painted surfaces against impact, abrasion, discoloration, or other damage. Grease or oil all bearings and similar items.

E. Request a minimum 7-day advance notice of shipment from manufacturers. Upon receipt of manufacturer's advance notice of shipment, promptly notify

RESIDENT ENGINEER of anticipated date and place of the arrival of recovery well pumps and motors.

F. Factory Test Results: Reviewed and accepted by RESIDENT ENGINEER before product shipment as required in individual Specification sections.

1.6 DELIVERY AND INSPECTION

A. Deliver products in accordance with the accepted current progress schedule and coordinate to avoid conflict with Work and conditions at the site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label date of manufacture and shelf life, where applicable. Include UL labels on products so specified.

C. Unload products in accordance with manufacturer's instructions for unloading, or as specified. Record the receipt of products at the site. Inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from the site and expedite delivery of identical new undamaged products and remedy incomplete or lost products to provide that specified, so as not to delay the progress of the Work.

1.7 HANDLING, STORAGE, AND PROTECTION

A. Handle products in accordance with the manufacturer's written instructions, and in a manner to prevent damage. Store products, upon delivery, in accordance with manufacturer's instructions, with labels intact and legible, in approved storage yards or sheds provided in accordance with Section 01500, CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by OWNER.

B. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered but not installed in the Work.

C. Store electrical, instrumentation, and control products, and equipment with bearings in weathertight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage. Connect and operate continuously all space heaters furnished in electrical equipment.

D. Store fabricated products aboveground, on blocking or skids, and prevent soiling or staining. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter. Cover products that

are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

E. Store finished products that are ready for installation in dry and well ventilated areas. Do not subject to extreme changes in temperature or humidity.

F. Hazardous Materials: Prevent contamination of personnel, the storage building, and the site. Meet the requirements of the product specifications, codes, and manufacturer's instructions.

1.8 SUBSTITUTE AND "OR-EQUAL" PRODUCTS

A. Meet the requirements of the Specification sections, and as set forth herein.

B. Listing of proposed substitute or "or-equal" items or methods.

1. With consideration of the additional evaluation time necessary for DESIGN ENGINEER and RESIDENT ENGINEER's review of such items, indicate for each item the review status (either substitute or "or-equal") and estimated submission date.
2. CONTRACTOR, in indicating the review status of the proposed item, acknowledges that the time shown for review on the current accepted schedule is sufficient only to accomplish review for the status indicated and not sufficient to perform both a review for "or-equal" status and a subsequent review for substitute status on the same product.
3. RESIDENT ENGINEER may return unreviewed those submissions (i) not shown on the current accepted schedule, (ii) for which the review status differs from that indicated on the accepted list unless previously approved in writing by RESIDENT ENGINEER, (iii) not as specified herein, (iv) which are incomplete, or (v) which are uncertified, in which case CONTRACTOR shall provide the specified product.

C. Submit seven copies of proposed substitute or "or-equal" item/method, to include all supporting data to allow review. Complete, sign, and transmit with each proposed substitute or "or-equal" item/method submission.

D. Disposition of "Or-Equal" Item: In accordance with Article SHOP DRAWINGS in Section 01300, SUBMITTALS, Article SHOP DRAWINGS AND SAMPLES, or in accordance with following paragraph.

E. Disposition of Substitute Item/Method:

1. Accepted: RESIDENT ENGINEER will evidence such acceptance by recommendation of a Change Order for CONTRACTOR and OWNER execution. Such Change Order will accompany DESIGN ENGINEER's evaluation and acceptance of CONTRACTOR's proposed substitute.
2. Rejected:
   a. One copy retained by DESIGN ENGINEER.
   b. One copy retained by RESIDENT ENGINEER.

c. One copy returned to CONTRACTOR with a commentary by DESIGN ENGINEER.
d. Remaining copies will be destroyed.
e. CONTRACTOR shall provide item specified in Contract Documents.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, and manufacturer's services and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

H. Provide materials and equipment listed by UL wherever standards have been established by that agency.

I. Equipment Finish:

1. Provide manufacturer's standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

J. Special Tools and Accessories: Furnish to OWNER, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

K. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by OWNER.

2.2 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible. Oil drains with bronze or stainless steel valves and fill plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.3 SOURCE QUALITY CONTROL

A. Calibration Instruments: Bear the seal of a reputable laboratory certifying that instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

B. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage which necessitates procurement of new products will be considered delays within CONTRACTOR's control.

3.2 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions and as may be specified. Retain a copy of manufacturers' instruction at site, available for review at all times.

F. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.3 FIELD FINISHING

A. In accordance with Section 09900, PAINTING.

3.4 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.5 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by OWNER.

END OF SECTION

SECTION 01640
MANUFACTURERS' SERVICES

PART 1 GENERAL

1.1 DEFINITIONS

A. Reference Section 01650, FACILITY STARTUP.

B. Person-Day: One person for 8 hours within regular CONTRACTOR working hours.

1.2 SUBMITTALS

A. Training Schedule: Submit not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.

B. Preliminary Training Plan: Submit within 60 days after Notice to Proceed.

C. Final Training Plan: Submit after training coordination meeting.

D. Training Materials:

1. Submit written outlines of proposed training sessions not less than 21 days prior to scheduled training.
2. Furnish complete training materials, to include operation and maintenance data as required in this section to be retained by each trainee.

E. Quality Control Submittals: When specified in the individual Specifications, submit:

1. Qualifications of Manufacturer's Representative performing specified services.
2. Manufacturer's Certificate of Proper Installation: On form appended to this section.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. Additional qualifications may be specified elsewhere.

B. Representative subject to acceptance by OWNER. No substitute representatives will be allowed unless prior written approval by OWNER has been given.

1.4 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Where manufacturers' services are specified, furnish manufacturer's qualified representative. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, additional time required to perform the specified services shall be considered incidental work.

B. Schedule manufacturer's services to avoid conflicting with other onsite testing or other manufacturer's onsite services. Determine that all conditions necessary to allow successful testing have been met before scheduling services.

C. Only those days of service approved by RESIDENT ENGINEER will be credited to fulfill the specified minimum services.

D. If specified, manufacturer's onsite services shall include as a minimum:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of CONTRACTOR's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish written approval of installation.
3. Revisiting the site as required to correct problems and until installation and operation are acceptable to RESIDENT ENGINEER.
4. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
5. Assistance during functional and performance testing and startup demonstration, and until product acceptance by the OWNER.
6. Training of OWNER's personnel in the operation and maintenance of respective product as required.
7. Completion of Manufacturer's Certificate of Proper Installation (form enclosed at end of this section) with applicable certificates for proper installation and initial, interim, and final test or service.
8. Additional requirements may be specified elsewhere.

1.5 TRAINING SCHEDULE

A. List specified equipment and systems with respective manufacturers that require training services of manufacturers' representatives and show:

1. Estimated dates for installation completion.
2. Estimated training date. This training session shall be videotaped by CONTRACTOR for use by OWNER in conducting future training sessions.

B. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by OWNER, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.

C. Coordinate with Section 01310, PROGRESS SCHEDULES and Section 01650, FACILITY STARTUP.

1.6 TRAINING OWNER'S PERSONNEL

A. Furnish trained, articulate personnel to coordinate, expedite, and videotape training, to be present during training coordination meetings with OWNER, and familiar with operation and maintenance manual information specified in Section 01430, OPERATION AND MAINTENANCE DATA.

B. Furnish manufacturers' representatives for detailed classroom and hands-on training to OWNER's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.

1. Manufacturer's Representative: Familiar with facility operation and maintenance requirements as well as with specified equipment.

C. Prestartup Training:

1. Coordinate training sessions with OWNER's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01430, OPERATION AND MAINTENANCE DATA.
2. Complete at least 14 days prior to actual startup.

D. Post-Startup Training: If required in Specifications, furnish and coordinate training of OWNER's operating personnel by respective manufacturer's representatives.

1.7 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION", are part of this Specification.

1. Forms: Manufacturer's Certificate of Proper Installation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01650
FACILITY STARTUP

PART 1 GENERAL

1.1 DEFINITIONS

A. Reference Section 01640, MANUFACTURERS' SERVICES.

B. Facility Startup: Includes putting Project in operating order, cleaning, adjusting and balancing equipment, initial operation (startup) of equipment item, operating equipment, starting systems, operation of systems, testing of equipment and systems, and demonstration and verification of the completed facility as a unit.

C. Functional Test: A test or tests in the presence of the DESIGN ENGINEER, RESIDENT ENGINEER, and OWNER to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.

D. Performance Test: A test performed in the presence of the DESIGN ENGINEER, RESIDENT ENGINEER, and OWNER and after any required functional test specified, to demonstrate and confirm that the equipment and/or system meets the specified performance requirements.

E. Significant Interruption: May include any of the following events:

1. Failure of CONTRACTOR to maintain qualified onsite startup personnel as scheduled
2. Failure to meet specified performance for more than 2 consecutive hours.
3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
4. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
5. As may be determined by DESIGN ENGINEER.

F. Startup Test Period:

1. Startup of the entire facility or any portion thereof includes coordinated operation of the facilities by the CONTRACTOR, Subcontractors, OWNER operating personnel, and manufacturer's representatives for equipment items and systems after all required functional tests have been completed and those performance tests deemed necessary for the safe operation of the entire facility have been completed.
2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of DESIGN ENGINEER, the facility

or designated portion has operated in the manner intended for 5 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

G. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Project are as follows:

1. Recovery wells.
2. Instrumentation and control system(s).

1.2 SUBMITTALS

A. Administrative Submittals:

1. Functional and performance test schedules and plan for equipment, units, and systems at least 14 days prior to start of related testing. Include test plan, procedures, and log format.
2. Schedule and plan of facility startup activities at least 21 days prior to commencement.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Proper Installation as required.
2. Test Reports: Functional and performance testing, in format acceptable to DESIGN ENGINEER and certification of functional and performance test for each piece of equipment or system specified.
3. Certifications of Calibration: Testing equipment.

1.3 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Perform Work for tests specified.
2. Demonstrate proper installation, adjustment, function, performance, and operation of equipment, systems, control devices, and required interfaces individually and in conjunction with process instrumentation and control system.

1.4 OWNER/DESIGN ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review CONTRACTOR's test plan and schedule.
2. Witness each functional or performance test.
3. Coordinate other plant operations, if necessary, to facilitate CONTRACTOR's tests.
4. Provide water, power, chemicals, and other items as required for testing, unless otherwise indicated.

B. Startup Test Period:

1. Operate process units and devices, with support of CONTRACTOR.
2. Provide sampling, labor, and materials as required and provide laboratory analyses.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 TESTING PREPARATION

A. General:

1. Complete Work associated with the unit and related processes before testing, including related manufacturer's representative services.
2. Furnish qualified manufacturer's representatives when required to assist in testing.
3. Utilize the Manufacturer's Certificate of Proper Installation Form from Section 01640, MANUFACTURERS' SERVICES, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
4. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, DESIGN ENGINEER and OWNER involvement.
5. Designate and furnish one or more persons to be responsible for coordinating and expediting CONTRACTOR's facility startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the facility startup period.
6. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

B. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
6. Check power supply to electric-powered equipment for correct voltage.
7. Adjust clearances and torques.
8. Test piping for leaks.
9. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Furnish typed report documenting results of balancing.
10. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation in accordance with Section 01640, MANUFACTURERS' SERVICES.

C. Ready-to-test determination will be by DESIGN ENGINEER based at least on the following:

1. Notification by CONTRACTOR of equipment and system readiness for testing.
2. Acceptable testing plan.
3. Acceptable Operation and Maintenance Manuals.
4. Receipt of Manufacturer's Certificate of Proper Installation, if specified.
5. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
6. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
7. Equipment and electrical tagging complete.
8. All spare parts and special tools delivered to OWNER.

3.2 FUNCTIONAL TESTING

A. General:

1. Begin testing at a time mutually agreed upon by the OWNER, DESIGN ENGINEER, manufacturer's representative(s), and CONTRACTOR.
2. Notify in writing OWNER, DESIGN ENGINEER, and manufacturer's representative at least 10 days prior to scheduled date of functional tests.
3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to DESIGN ENGINEER.
4. Conduct functional test until each individual component item or system has achieved 1 continuous hour of satisfactory operation. Demonstrate all operational features and controls function during this period while in automatic modes.
5. If, in DESIGN ENGINEER's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase, if required. If, in DESIGN ENGINEER's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
6. Performance testing shall not commence until the equipment or system meets functional tests specified.

3.3 PERFORMANCE TESTING

A. General:

1. Begin testing at time mutually agreed upon by the OWNER, DESIGN ENGINEER, manufacturers' representative(s), and CONTRACTOR, as appropriate.
   a. DESIGN ENGINEER will be present during test.
   b. Notify DESIGN ENGINEER and OWNER at least 14 days prior to scheduled date of test.

2. Follow approved testing plan and detailed procedures specified.
3. Source and type of fluid, gas, or solid for testing shall be as specified.
4. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
5. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

3.4 STARTUP TEST PERIOD

A. Test Reports: As applicable to the equipment furnished, certify in writing that:

1. Necessary hydraulic structures, piping systems, and valves have been successfully tested,
2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational,
3. Systems and subsystems are capable of performing their intended functions,
4. Facilities are ready for intended operation.

B. Attend planning meetings and arrange for attendants by key major equipment manufacturer representatives as required by the Contract Documents.

C. Designate and furnish one or more persons to be responsible for coordinating and expediting CONTRACTOR's facility startup duties.

D. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup. Support the facility startup activities with adequate staff to prevent delays and process upsets. This staff shall include, but not be limited to, major equipment and system manufacturers' representatives, Subcontractors, electricians, instrumentation personnel, millwrights, pipefitters and plumbers.

E. Supply and coordinate specified manufacturer's facility startup services.

F. Make adjustments, repairs, and corrections necessary to complete facility startup.

G. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.

3.5 PARTIAL UTILIZATION

A. After successful performance testing of a particular equipment type or system, OWNER may elect to start up a portion of the equipment or system for continuous operation. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to startup that portion operated in combination with the rest of the facility when testing is completed.

3.6 CONTINUOUS OPERATIONS

A. OWNER will accept equipment and systems as substantially complete and ready for continuous operation only after successful facility startup is completed and documented, and reports submitted, and manufacturers' services completed for training of OWNER's personnel.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SUBMITTALS

A. Quality Control Submittals: Written procedures for maintaining and markup of record documents.

B. Contract Closeout Submittals: Submit prior to application for final payment.

1. Record Documents.
2. Approved Shop Drawings and Samples.
3. Special Bonds, Special Warranties, and Service Agreements.
4. Consent of Surety to Final Payment.
5. Releases or Waivers of Liens and Claims.
6. Releases from Agreements.
7. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01025, MEASUREMENT AND PAYMENT.
8. Spare Parts and Special Tools: As required by individual specification sections.

1.2 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each page of Specifications and each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in Work has occurred.
4. Prior to submitting each request for progress payment, request RESIDENT ENGINEER's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a referral by RESIDENT ENGINEER to recommend the whole or any part of the CONTRACTOR's Application for Payment, either partial or final.

1.3 RELEASES FROM AGREEMENTS

A. Furnish OWNER written releases from property owners or public agencies where side agreements or special easements have been made, or where CONTRACTOR's operations have not been kept within the OWNER's construction right-of-way.

B. In the event CONTRACTOR is unable to secure written releases, inform the OWNER of the reasons:

1. OWNER or its representatives will examine the site, and OWNER will direct CONTRACTOR to complete Work that may be necessary to satisfy terms of the easement.
2. Should CONTRACTOR refuse to perform this Work, OWNER reserves the right to have it done by separate contract and deduct the cost of same from the Contract Price, or require the CONTRACTOR to furnish a satisfactory Bond in a sum to cover legal claims for damages.
3. When OWNER is satisfied that Work has been completed in agreement with the Contract Documents and terms of easements, the right is reserved to waive the requirement for written release if: (i) CONTRACTOR's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that CONTRACTOR has failed to fulfill the terms of the easement, or (ii) CONTRACTOR is unable to contact or has had undue hardship in contacting the grantor.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from RESIDENT ENGINEER at no cost to CONTRACTOR, one complete set of Contract Documents. Drawings will be full size.
2. Delete RESIDENT ENGINEER title block and seal from all documents.
3. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
4. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by RESIDENT ENGINEER.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda Change Order, Written Amendment, and RESIDENT ENGINEER's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.
   b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
   c. Make identification so descriptive that it may be related reliably to Specifications.
6. Specifications: Legibly mark and record for each product the description of actual product installed if differs from that specified, including:
   a. Manufacturer, trade name, and catalog model number of each product and item of equipment actually installed.

3.2 FINAL CLEANING

A. Immediately prior to CONTRACTOR's notice of completion, clean entire site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to OWNER and RESIDENT ENGINEER.

2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Broom clean exterior paved driveways and parking areas.
5. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
6. Rake clean all other surfaces.
7. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 02050
DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Portions of structures and other areas scheduled for selective demolition, partial demolition, salvage, and remodeling work are as shown.

B. Equipment and material scheduled for salvage by CONTRACTOR.

Existing Location	Quantity	Name of Equipment
Ash SD Outfall	1	54" Flap Gate
Mill South SD Outfall	1	24" Flap Gate
Karsten SD Outfall	1	30" Flap Gate
Karsten GC SD Outfall	1	30" Flap Gate

C. Equipment and materials scheduled to be removed for reuse by CONTRACTOR prior to commencement of demolition, and located in structures to be demolished, are as follows:

Existing Location	Quantity	Name of Equipment	New Location
Farmer SD Outfall	1	72" Flap Gate	SPTC SD Outfall

1.2 SUBMITTALS

A. Quality Control Submittals:

1. Schedule of demolition, as part of and consistent with the progress schedule specified in Section 01310, PROGRESS SCHEDULES.
2. Methods of demolition and equipment proposed to demolish each structure and cement stabilized alluvium (CSA).
3. Copies of any authorizations and permits required to perform Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

A. Utilities:

1. Notify OWNER or appropriate utilities to turn off affected services before starting demolition

2. Plug storm sewerlines at locations shown or at limits of excavation if not shown with concrete length of plug, 5 feet minimum.

B. Removal and Storage of Equipment for Salvage and/or Reuse:

1. All equipment designated for salvage shall be the property of the OWNER and shall be removed, transported, unloaded, and stored at a location in Tempe identified by the OWNER.
2. Do not remove equipment and materials without approval of RESIDENT ENGINEER.
3. Properly store and maintain equipment and materials in same condition as when removed.
4. RESIDENT ENGINEER will determine condition of equipment and materials prior to removal.

C. Removal of existing gabion mattresses shall be as specified in Section 02272, GABION MATTRESS CONSTRUCTION.

D. Well abandonment shall be as specified in Section 02595, WELL ABANDONMENT.

3.2 DEMOLITION

A. Drawings define minimum portion of pipes, structures, chain link fence, and cement stabilized alluvium (CSA) to be removed. Unless otherwise shown, rough cuts or breaks may be made exceeding limits of demolition shown.

B. Exposed surface of CSA cut with jackhammers, saw, etc., shall be uniform and straight. Sawcut a minimum of 4-inch depth perpendicular to CSA surface. Rough cut chipping may be used below sawcut depth.

C. Remove damaged CSA to satisfaction of Resident Engineer and protect remaining CSA. Replace damaged CSA with concrete.

D. Remove piping from areas to be backfilled. Pipe, valves, and fittings adjacent to those to be removed may also be removed as salvage.

E. Remove all materials associated with existing equipment that is to be removed or relocated.

F. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.

3.3 DISPOSAL

A. Dispose of cement stabilized alluvium, debris, and other nonsalvaged materials offsite in licensed landfills. Disposal of demolition material in the river channel is prohibited.

3.4 BACKFILLING

A. Demolished Areas: Backfill to existing ground level or foundation level of new construction.

B. Backfill Material and Compaction:

1. Conform to Section 02220, FILL AND BACKFILL.
2. Do not use demolition debris as backfill material.

3.5 SALVAGE

A. Equipment and materials designated for salvage will become the property of the OWNER.

B. Other equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of CONTRACTOR.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.1 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 12 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.2 SCHEDULING AND SEQUENCING

A. Prepare site only after adequate erosion and sediment controls are in place.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.2 LIMITS

A. As follows:

1. Excavation: 5 feet beyond top of cut slopes.
2. Fill:
   a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
   b. Stripping: 2 feet beyond toe of permanent fill.
3. Waste Disposal:
   a. Clearing: 5 feet beyond perimeter.

b. Scalping and Stripping: Not required.
c. Grubbing: Around perimeter as necessary for neat finished appearance.

4. Structures: 15 feet outside of new structures.
5. Roadways: Clearing and grubbing 30 feet from roadway shoulders.
6. Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.3 DISPOSAL

A. Clearing and Grubbing Debris: Dispose of debris offsite.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Stockpile topsoil in sufficient quantity to meet Project needs.
2. Stockpile levee slope protection material from recovery well pullouts in sufficiant quantity to meed Project needs.
3. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil in waste disposal areas shown or approved by RESIDENT ENGINEER.

END OF SECTION

SECTION 02140
DIVERSION AND CARE OF WATER

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the Work necessary for removal of water from Work areas, diversion of river flow, and handling and removal of all other water during the entire construction period, complete.

1.2 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of this section.

B. Weather Monitoring and Flood Warning Plan: Flood warning and weather advisory services are available through the Salt River Project, Flood Control District of Maricopa County, Arizona Department of Water Resources, and the National Weather Services. CONTRACTOR shall be responsible for coordinating with these and other appropriate agencies on a regular and timely basis to obtain available flood warning information for the Salt River and Indian Bend Wash. CONTRACTOR shall prepare a weather monitoring and flood warning plan for approval by the City prior to initiating activities within the Salt River floodplain.

C. Diversion Plan: A water diversion and control plan shall be prepared which addresses the diversion of water in and under the Salt River around construction areas. Design of the diversion plan is the sole responsibility of CONTRACTOR. Prior to beginning any Work, and within 45 days after award of contract, CONTRACTOR shall submit a Certificate of Design for the Diversion Plan with the seal of CONTRACTOR's Engineer. This plan shall show proposed method for the diversion and care of water during construction. The diversion plan shall be designed, stamped, signed, and certified by an independent professional consulting engineer, registered in the State of Arizona. CONTRACTOR's Engineer shall certify on a monthly basis that the diversion is constructed, operated, and maintained substantially in accordance with the design. System monthly certification shall be submitted on the 5th of each month.

D. Handling and Removal Plan: A water handling and the removal plan shall be prepared which addresses the handling and removal of water from all sources that may impact construction. The Plan shall include descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this section. Drawings shall show locations, dimensions, and relationships of elements of each system. Design calculations shall be provided demonstrating adequacy of proposed dewatering systems and components. If the system is modified

during installation or operation, revise or amend and resubmit Water Control Plan. Design of the water handling and removal plan is the sole responsibility of CONTRACTOR. Water shall be removed so Work can be performed in the dry as specified.

E. Prior to beginning any Work on handling and removal of water from excavations and foundations, CONTRACTOR shall submit a Certificate of Design for the Handling and Removal Plan with the seal of CONTRACTOR's Engineer. The plan shall show proposed method for removal and disposal of water from excavations and foundations. The handling and removal plan shall be designed, stamped, signed, and certified by an independent professional consulting engineer registered in the State of Arizona. CONTRACTOR's Engineer shall certify on a monthly basis that the handling and removal of water is constructed, operated, and maintained substantially in accordance with the design. Monthly certification shall be submitted by the 5th of each month.

F. Administrative Submittals:

1. Well permits.
2. Water discharge permits if required.

G. Quality Control Submittals:

1. Water Level Elevations Observed in Observation Wells: Submit same day measured.
2. Settlement Benchmark Elevations: Submit weekly record.

1.3 CODES, ORDINANCES, AND STATUTES: A contractor shall familiarize themselves with, and comply with, all applicable, codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance. CONTRACTOR shall allow 6 weeks to have the diversion plan reviewed by the RESIDENT ENGINEER and State and local agencies, and shall include the time for this review in his construction schedule.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 MANAGEMENT OF RIVER FLOWS

A. CONTRACTOR shall construct and maintain all specified and necessary cutoffs, cofferdams, channels, flumes, drains, sumps, pumps, and/or other temporary diversion and protection works necessary for diversion and care of all water to properly accomplish Work.

B. CONTRACTOR shall conform to the regulations of the local and state agencies pertaining to passing the natural flow of the Salt River through the construction site and for measures required to do Work on the existing levees.

C. Gap in the Facilities: If CONTRACTOR creates a gap in the facilities for the purpose of diversion of the river, the gap shall be constructed and filled as specified.

3.2 PASSING WATER OVER COMPLETED FACILITIES

A. Temporarily passing water over completed portions of the facilities will be permitted, provided that completed Work is protected from erosion with riprap, and further protected from erosion and contamination in a manner approved by CONTRACTOR's Engineer. Facilities over which flow has temporarily passed shall be cleaned up, contaminated material removed and placed and facilities repaired and suitably prepared to receive the phase of Work.

3.3 DEWATERING SYSTEMS

A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry, and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, until backfilled to final grade.

B. Design and Operate Dewatering Systems:

1. To prevent settlement of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. To relieve artesian pressures and resultant uplift of excavation bottom.

C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

D. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

E. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.4 CLEANUP

A. After having served their purpose, all materials placed for temporary diversion and protection shall remain the property of CONTRACTOR and shall be removed from the site. Remove all cofferdams or other temporary diversion and protective so as not to interfere in any way with the operation or usefulness of the river channel. Remove, level, and grade all cofferdams or other temporary diversion and protective works constructed and not a part of the permanent facilities to the extent necessary to prevent obstruction in any degree whatever the flow of water in conformance with the Plans.

3.5 SETTLEMENT

A. Monitoring Dewatering-Induced Settlement: Establish monuments for monitoring settlement at locations selected by RESIDENT ENGINEER. Monitor vertical movement of each settlement monument, relative to remote benchmark selected by RESIDENT ENGINEER, at frequency stated in CONTRACTOR's Dewatering Plan.

3.6 DISPOSAL OF WATER

A. Obtain discharge permit for water disposal from authorities having jurisdiction.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.7 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems including but not limited to reinjection wells, and infiltration trenches and cutoff walls necessary to prevent damage to existing facilities, completed Work, and adjacent property.

B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.8 RESPONSIBILITY OF CONTRACTOR

A. CONTRACTOR shall be responsible for and shall repair at his expense any damage to the foundations, structures, or any other part of the work caused by natural floods, water, or failure of any part of the diversion or protective works. In the event the construction area is flooded, clean up and repair the damage and dry out or remove material in embankments deemed too wet or contaminated for proper fill material by RESIDENT ENGINEER, all at CONTRACTOR's expense. CONTRACTOR shall be responsible for, and shall repair at his expense, any damage to areas downstream of the construction site caused by failure of any part of the diversion or protective work. CONTRACTOR shall inspect, monitor, and repair diversion works to maintain them in safe condition.

3.9 HANDLING AND REMOVAL OF WATER

A. CONTRACTOR shall furnish, install, maintain, and operate all necessary sumps, drains, ditches, pumps, equipment, and other facilities for removal of water from the various parts of the Work and maintain excavations and embankments free from water as necessary for constructing each part of the Work in the dry.

B. Removal of Water from Excavations and Fill Areas:

1. Drain or otherwise positively dewater borrow areas, embankment areas, structural excavations, trenches, foundation excavation, and other areas as necessary to permit satisfactory construction at all times. Where an excavation extends below the water table, dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, will maintain stability of the excavated slopes and bottom of the excavation, and will result in all construction operations being performed in the dry. The use of sufficient number of properly screened sumps, wells, or other equivalent methods will be necessary for dewatering. CONTRACTOR will also be required to control seepage along the bottom of the excavation, which may require pipe drains leading to sumps from which the water shall be pumped. Such pipe drains shall be of uniform diameter for each run, shall be provided with grout connections and returns at 50-foot intervals, and shall be embedded in reasonably well-graded gravel.
2. During the placing and compacting of the fill material, the water level at every point in the excavation shall be maintained below the bottom of the excavation until the compacted material in the foundation excavation has reached a depth of 10 feet, after which the water level shall be maintained at least 10 feet below the top of the compacted embankment. When the fill has been constructed to an elevation above the stabilized water level without pumping, the pipe drains and sumps, including surrounding gravel, shall be completely filled with grout composed of water, cement, and 5 percent bentonite. The grout mix shall be acceptable to RESIDENT ENGINEER. In no case shall a water cement ratio greater than 0.75 be used.

END OF SECTION

SECTION 02205
EXCAVATION

PART 1 GENERAL

1.1 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock or landfill excavation.

B. Rock Excavation:

1. General: Removal of solid material which by actual demonstration cannot, in RESIDENT ENGINEER's opinion, be reasonably loosened or ripped by single-tooth, hydraulically operated ripper mounted on crawler tractor in good condition and rated at minimum 410 flywheel horsepower; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
2. Trench: Removal of solid material which by actual demonstration cannot, in RESIDENT ENGINEER's opinion, be reasonably excavated with minimum 195 hp backhoe in good condition and equipped with manufacturer's standard boom, two rippers, and rock points or similar approved equipment; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
3. Term "rock excavation" indicates removal of solid material, as specified above, and does not necessarily correspond to "rock" as implied by names of geologic formations.
4. Removal of boulders larger than 1/2 cubic yard will be classified as rock excavation, if breaking them apart with power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means is both necessary and actually used for their removal.
5. Removal of cement stabilized alluvium is included is Section 02050, DEMOLITION.
6. For excavation of cement stabilized alluvium, see Section 02050, DEMOLITION.

C. Landfill Excavation: Removal of material containing a significant portion of solid waste material including constrauction debris, landscape trimmings, and household solid waste. Removal of landfill material is included in the Special Provisions.

D. Influence Area: As defined in Section 02220, FILL AND BACKFILL.

E. Standard Specifications: As defined in Section 02220, FILL AND BACKFILL.

1.2 SUBMITTALS

A. Shop Drawings:

1. Excavation Plan, Detailing:
   a. Proposed locations of stockpiled excavated material.
   b. Proposed onsite and offsite spoil disposal sites.
   c. Reclamation of onsite spoil disposal areas.

1.3 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.4 WEATHER LIMITATIONS

A. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.5 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable Work specified in Section 02050, DEMOLITION, prior to excavating.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 02100, SITE PREPARATION, prior to excavating.

C. Dewatering: Conform to applicable requirements of Section 02140, DIVERSION AND CARE OF WATER, prior to initiating excavation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not overexcavate without written authorization of RESIDENT ENGINEER.

C. Remove or protect obstructions as shown and as specified in Section 01500, CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS, Article PROTECTION OF WORK AND PROPERTY.

3.2 CLASSIFIED EXCAVATION

A. Excavation is classified; see Article DEFINITIONS for classifications. Notify RESIDENT ENGINEER whenever rock or landfill material is encountered.

B. Before beginning rock excavation, comply with following requirements:

1. Remove overlying material as common excavation and expose rock surface for examination by RESIDENT ENGINEER.
2. Demonstrate that removal of remaining material classifies as rock excavation unless waived by RESIDENT ENGINEER.
3. Assist RESIDENT ENGINEER with measurement and documentation of rock excavation.

C. Landfill excavation shall comply with the requirements in the Special Provisions.

1. Landfill material shall be removed from the influence area of all foundations, embankments, and pipelines.

3.3 TRENCH WIDTH

A. Minimum Width of Trenches: As described below, unless otherwise shown or specified.

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
   a. 6-inch Outside Diameter or Width and Less: 24 inches.
   b. Greater than 6-inch Outside Diameter or Width: Outside diameter of pipes, conduits, direct-buried cables, or duct banks plus 36 inches.
2. Multiple Pipes, Conduits, Direct-Buried Cables, and Duct Banks in Single Trench: Aggregate width of pipes, conduits, direct-buried cables, or duct banks, plus 4 inches between, plus 20 inches.
3. Increase trench widths by thickness of shoring.

B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

3.4 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3 inch in diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.

3.5 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.

D. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.6 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are not needed for fill or backfill, in designated fill disposal areas. Material greater than 6 inches in diameter shall be disposed in designated cobble disposal area. Material placed in fill or cobble disposal area shall be placed and compacted in accordance with Section 211 of the Standard Specifications.

B. Dispose of debris resulting from removal of underground facilities as specified in Section 02050, DEMOLITION, for demolition debris.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in the Special Provisions.

END OF SECTION

SECTION 02215
SUBGRADE PREPARATION

PART 1 GENERAL

1.1 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 02220, FILL AND BACKFILL.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 02220, FILL AND BACKFILL.

D. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

E. Influence Area: As defined in Section 02220, FILL AND BACKFILL.

F. Unsuitable Material: Subgrade material within the influence area of structures and pipelines determined by the RESIDENT ENGINEER to require overexcavation and replacement.

1.2 QUALITY ASSURANCE

A. Notify RESIDENT ENGINEER when subgrade is ready for compaction or whenever compaction is resumed after a period of extended inactivity.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. Prepare site in accordance with Section 02100, SITE PREPARATION, prior to beginning Work. Remove loose soft soils to firm foundation.

B. Keep subgrade free of water, debris, and foreign matter during compaction.

C. Bring subgrade to proper grade and cross-section and uniformly compact surface.

D. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

E. Maintain prepared ground surface in finished condition until next course is placed.

3.2 COMPACTION

A. Under Earthfill: Compact the upper 6 inches to minimum of 95 percent relative compaction.

B. Under Granular Fill Under Structures: Compact the upper 6 inches to minimum of 95 percent relative compaction.

3.3 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Over excavate as specified in Section 02205, EXCAVATION, and replace with suitable material from the excavation, as specified in Section 02220, FILL AND BACKFILL.

B. Unsuitable Material: Over excavate as specified in Section 02205, EXCAVATION, and replace with suitable material from the excavation, as specified in Section 02220, FILL AND BACKFILL.

END OF SECTION

SECTION 02220
FILL AND BACKFILL

PART 1 GENERAL

1.1 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by RESIDENT ENGINEER.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

D. Completed Course: A course or layer that is ready for next layer or next phase of Work.

E. Lift: Loose (uncompacted) layer of material.

F. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

G. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1 foot outside outermost edge at base of foundations or slabs.
2. 1 foot outside outermost edge at surface of roadways or shoulder.
3. 0.5 foot outside exterior at spring line of pipes or culverts.

H. Borrow Material: Material from required excavations.

I. Selected Fill and Backfill Material: Materials from excavations that RESIDENT ENGINEER determines to be suitable for specific use.

J. Imported Material: Materials obtained from sources offsite, suitable for specified use.

K. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

L. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

M. Standard Specifications: When referenced in this section, shall mean Maricopa Association of Government Standard Specifications.

1.2 SUBMITTALS

A. Samples: Imported material taken at source.

B. Quality Control Submittals:

1. Catalog and manufacturer's data sheets for compaction equipment.
2. Certified test results from independent testing agency.

1.3 QUALITY ASSURANCE

A. Notify RESIDENT ENGINEER when:

1. Structure is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

1.4 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Sections 02050, DEMOLITION; 02100, SITE PREPARATION; 02205, EXCAVATION; and 02215, SUBGRADE PREPARATION, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03300, CAST-IN-PLACE CONCRETE. Obtain RESIDENT ENGINEER's acceptance of concrete work and attained strength prior to placing backfill.

C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 02215, SUBGRADE PREPARATION.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.
2. During production of imported material, test as follows:
   a. Granular Backfill: One per 50 cubic yards (minimum of two per structure).
   b. Aggregate Base Course Rock: One per 500 cubic yards (minimum of five).
   c. Foundation Stabilization Rock: One per 50 cubic yards (minimum of one).

B. Samples: Collected in accordance with ASTM D75-87:

1. During production of imported material, provide Samples as requested by RESIDENT ENGINEER.

2.2 EARTHFILL AND BACKFILL

A. Processed select fill and backfill excavated from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Provide imported material of equivalent quality, if required to accomplish Work.

2.3 EMBANKMENT FILL

A. Processed select fill and backfill from required excavations, free from material greater than 3 inches, roots, and other organic or deleterious materials.

B. Well-graded from course to fine and containing sufficient fines to bind material when compacted, but with a maximum 8 percent by weight passing the No. 200 sieve.

C. CONTRACTOR shall provide imported material of equivalent quality, if required to accomplish Work.

2.4 GRANULAR DRAIN MATERIAL

A. 3-inch minus crushed gravel or crushed rock.

B. Free from dirt, clay balls, and organic material.

C. Well-graded from coarse to fine with less than 5 percent by weight passing the No. 200 sieve.

2.5 GRANULAR FILL

A. 1-inch minus crushed gravel or crushed rock.

B. Free from dirt, clay balls, and organic material.

C. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 200 sieve.

2.6 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.7 AGGREGATE BASE COURSE (ABC)

A. As specified in Section 02236, BASE COURSE.

2.8 FOUNDATION STABILIZATION ROCK

A. Crushed rock or pit run rock.

B. Uniformly graded from course to fine.

C. Free from excessive dirt and other organic material.

D. Maximum 2-1/2 inches particle size.

PART 3 EXECUTION

3.1 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure even.

D. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 02225, TRENCH BACKFILL.
4. Install item.

5. Backfill envelope zone and remaining trench, as specified in Section 02225, TRENCH BACKFILL, before resuming filling or backfilling specified in this section.

E. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

F. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.2 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with granular fill, unless otherwise shown. Place granular fill in lifts of 8-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction.

B. Subsurface Drainage: Backfill with granular drain material, where shown. Place granular drain material in lifts of 8-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction.

C. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction.

3.3 EARTHFILL AND BACKFILL

A. Outside Influence Areas Beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:

1. Allow for surface restoration where required.
2. Maximum 8-inch thick lifts.
3. Place and compact fill across full width of embankment.
4. Compact to minimum 95 percent relative compaction.
5. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.4 EMBANKMENT FILL

A. Backfill with embankment fill material to lines and grades shown, with proper allowance for erosion protection and aggregate base.

B. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 95 percent relative compaction.

C. Comply with additional requirements of Section 211 of the Standard Specifications.

3.5 SITE TESTING

A. General:

1. RESIDENT ENGINEER will provide onsite quality assurance testing. CONTRACTOR shall provide sufficient quality control test to verify the Work meets the required specifications.
2. CONTRACTOR shall provide Samples of finishes provided as requested by RESIDENT ENGINEER.
3. CONTRACTOR shall prepare location for RESIDENT ENGINEER to perform field testing of the finished backfill testing.

3.6 AGGREGATE BASE, SUBBASE, AND SURFACING

A. Place and compact as specified in Section 02236, BASE COURSE.

3.7 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by RESIDENT ENGINEER as follows:

1. Beneath Footings: Granular backfill or concrete fill, as specified in Section 03300, CAST-IN-PLACE CONCRETE.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Granular backfill.
4. Trenches:
   a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 02225, TRENCH BACKFILL.
   b. Authorized Overexcavation: Trench stabilization material, as specified in Section 02225, TRENCH BACKFILL.
5. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
   a. Flat to Moderate Steep Slopes (3:1, Horizontal Run:Vertical Rise or Flatter): Earthfill.
   b. Steep Slopes (Steeper than 3:1):
      1) Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.
      2) Backfilling overexcavated areas is prohibited unless, in RESIDENT ENGINEER's opinion, backfill will remain stable, and overexcavated material is replaced as compacted earth fill.
6. For overexcavation caused by the removal of unsuitable landfill material, replace excavated material with earthfill, embankment fill, or trench stabilization material to within 3 feet of original bottom of

excavation. Place and compact material as specified. Remaining overexcavation shall be backfilled as specified above.

3.8 PLACING FILL OVER GEOSYNTHETICS

A. General:

1. Place fill over geosynthetics with sufficient care so as not to damage them.
2. Place fill only by back dumping and spreading only.
3. Dump fill only on previously placed fill.
4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.

B. Hauling: Operate hauling equipment on minimum of 3 feet of covering.

C. Spreading:

1. Spreading equipment shall be track mounted, low ground pressure, D-6 or lighter.
2. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
4. Never push fill downslope. Spread fill over sideslopes by pushing up from slope bottom. If access to bottom of slope is unavailable, progressively place fill, beginning at toe of slope and working upslope, with backhoe or dragline operated from top of slope. Limit distance material falls onto the geosynthetics to maximum of 2 feet.
5. Flatten wrinkles of geosynthetics and geotextiles in direction of spreading. Correct wrinkles in geotextiles as specified in Section 02225, TRENCH BACKFILL.
6. Maintain proper overlap of unseamed geosynthetics.
7. Avoid overstressing geosynthetics and seams.

D. Compaction: Compact fill only after uniformly spread to full thickness shown.

E. Geosynthetic Damage:

1. Mark punctures, tears, or other damage to geosynthetics, so repairs may be made.
2. Clear overlying fill as necessary to repair damage.
3. Repairs to geosynthetics shall be made by respective installers as specified in respective specification section for each geosynthetic.

3.9 ACCESS ROAD SURFACING

A. Place and compact as specified in Section 02236, BASE COURSE.

END OF SECTION

SECTION 02225
TRENCH BACKFILL

PART 1 GENERAL

1.1 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by the CONTRACTOR from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after stabilization and installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the RESIDENT ENGINEER.

H. Selected Backfill Material: Material available onsite that the RESIDENT ENGINEER determines to be suitable for a specific use.

I. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-Graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

1.2 SUBMITTALS

A. Shop Drawings: Manufacturer's descriptive literature for marking tapes.

B. Samples:

1. Trench stabilization material.
2. Bedding and pipe zone material.
3. Granular backfill.
4. Earth backfill.
5. Aggregate base course.

C. Quality Control Submittals: Catalog and manufacturer's data sheets for compaction equipment.

1. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to site.
2. Controlled Low Strength Material: Certified mix design and test results. Include material types and weight per cubic yard for each component of mix.

PART 2 PRODUCTS

2.1 NONWOVEN GEOTEXTILE FABRIC

A. Nonwoven, previous sheet as shown to match existing product. Fibers of the fabric shall be constructed into a stable network that retain their relative position with respect to each other.

2.2 MARKING TAPE

A. Plastic:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 4 mils.
3. Width: 12 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Manufacturers and Products:
   a. Reef Industries; Terra Tape.
   b. Allen; Markline.

B. Metallic:

1. Solid aluminum foil, visible on unprinted side, encased in a protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 5.5 mils.
3. Width: 12 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Joining Clips: Tin or nickel-coated, furnished by tape manufacturer.
6. Manufacturers and Products:
   a. Reef Industries; Terra "D".
   b. Allen; Detectatape.

C. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color[a]	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Water, irrigation, and slurry lines
[a]As specified in ANSI Z53.1, Safety Color Code.	

2.3 TRENCH STABILIZATION MATERIAL

A. Base Rock:

1. Clean, hard, durable 3-inch minus crushed rock or gravel, or pit run, free from clay balls, other organic materials, or debris.
2. Uniformly graded from coarse to fine, less than 8 percent by weight passing the 1/4-inch sieve.

2.4 PIPE BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Clean, hard, durable 3/4-inch minus crushed rock or gravel, well graded from coarse to fine. Free from clay balls, organic material, and debris.

B. Gradation as determined in accordance with ASTM C117 and C136.

Sieve Size	Percent Passing By Weight
3/4-inch	100
No. 4	25 to 50
No. 50	Less than 20
No. 200	Less than 5

2.5 CONTROLLED DENSITY PIPE ZONE MATERIAL

A. Select and proportion ingredients to obtain compressive strength between 50 and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Cement: ASTM C150, Type I or II.
2. Aggregate: ASTM C33, Size 7.
3. Fly Ash (if used): ASTM C618, Class C.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.6 TRENCH BACKFILL

A. Class A, Class C, Class F, and Class G. Material excavated from trenches suitable for use as backfill as specified in Section 02220, FILL AND BACKFILL.

B. Class D and Class E. Granular backfill as specified in Section 02220, FILL AND BACKFILL.

2.7 CONCRETE FILL AND BACKFILL

A. Provide as specified in Section 03300, CAST-IN-PLACE CONCRETE.

2.8 AGGREGATE BASE COURSE

A. As specified in Section 02236, BASE COURSE.

2.9 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earth backfill, including specified class(es).
2. Trench stabilization material.
3. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs:

1. Controlled low strength fill.
2. Concrete.

PART 3 EXECUTION

3.1 TRENCH PREPARATION

A. Water Control:

1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.
2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.2 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify RESIDENT ENGINEER. RESIDENT ENGINEER will determine the depth of overexcavation, if any, required.

3.3 NONWOVEN GEOTEXTILE FABRIC INSTALLATION

A. Surface Preparation: Remove or compact all materials on surface to receive geotextile. Roll surface with smooth roller to remove all undulations exceeding 1 inch. Obtain RESIDENT ENGINEER's approval of prepared surface.

B. Laying Geotextile: Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

C. Joints: Overlap a minimum of 2 feet, unless otherwise shown.

D. Securing Geotextile: Secure geotextile during installation as necessary with sand bags, or other means approved by RESIDENT ENGINEER.

E. Placing Products Over Geotextile:

1. Before placing material over geotextile, notify RESIDENT ENGINEER. Do not cover installed geotextile until after RESIDENT ENGINEER provides authorization to proceed.
2. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article REPAIRING GEOTEXTILE.

F. Repairing Geotextile: Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as specified above in Article SECURING GEOTEXTILE, or by other means approved by RESIDENT ENGINEER.

3.4 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.5 BEDDING

A. Furnish imported bedding material.

B. Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness: As shown on Drawings or as follows:

1. Pipe, 15-Inch and Smaller: 4 inches.
2. Pipe, 18-Inch and Larger: 6 inches.
3. Conduit: 3 inches.
4. Direct-Buried Cable: 3 inches.
5. Duct Banks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.6 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit: 3 inches, unless shown otherwise.
3. Direct-Buried Cable: 3 inches, unless shown otherwise.
4. Duct Bank: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipes 10 Inches and Smaller Diameter: First lift less than or equal to 1/2 pipe-diameter.
2. Pipes Over 10 Inches Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

E. Compact the material to a minimum 95 percent relative compaction as determined in accordance with ASTM D698. Compact only over the area between the sides of the pipe and the trench walls.

F. Do not use power-driven impact compactors to compact pipe zone material.

3.7 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of all buried piping, at depth of 2 feet. Coordinate with piping installation drawings.

1. Metallic Marking Tape: Install with nonmetallic piping and waterlines.
2. Plastic Marking Tape: Install with metallic piping.

3.8 BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
6. Backfill around structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.

B. Class A and Class C Backfill:

1. Place in lifts not exceeding 9-inch thickness.
2. Mechanically compact each lift to a minimum of 90 percent relative compaction prior to placing succeeding lifts.

C. Class D and Class E:

1. Place granular backfill in lifts not exceeding 6-inch thickness.
2. Mechanically compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

D. Class F and Class G:

1. Place backfill in lifts not exceeding 8-inch thickness.
2. Mechanically compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

E. Concrete Backfill:

1. Place above bedding.
2. Minimum Concrete Thickness: 6 inches on top and sides of pipe.
3. Do not allow dirt or foreign material to become mixed with concrete during placement.
4. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in trench.

5. Prevent flotation of pipe.
6. Begin and end concrete backfill within 4 inches of a pipe joint on each end.
7. Do not encase pipe joints except within the limits of the concrete backfill.

F. Controlled Density Pipe Zone Material:

1. Discharge from truck-mounted drum-type mixer into trench.
2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.

3.9 REPLACEMENT OF TOPSOIL

A. Replace topsoil in top 12 inches of backfilled trench.

B. Maintain the finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

3.10 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep the surface of the backfilled trench even with the adjacent ground surface, and grade and compact as necessary to keep the surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain the surface of the backfilled trench level with the adjacent ground surface.

D. Asphaltic Pavement: Replace settled areas or fill with asphalt meeting the requirements of Maricopa Association of Governments Standard Specifications.

E. Other Areas: Add excavated material where applicable and keep the surface of the backfilled trench level with the adjacent ground surface.

3.11 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 02236
BASE COURSE

PART 1 GENERAL

1.1 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.

C. Standard Specifications: Uniform Standard Specifications for Public Works Construction, Maricopa Association of Government.

1.2 SUBMITTALS

A. Samples: Submit for specified materials 20 days prior to delivery to site.

B. Quality Control Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 20 days prior to delivery of materials to project.

PART 2 PRODUCTS

2.1 BASE COURSE ROCK

A. As specified for crushed aggregate, aggregate base, in Section 702 of the Standard Specifications.

2.2 GRAVEL SURFACING ROCK

A. As specified in Section 702, of the Standard Specifications.

B. Clean, tough, uniform quality, durable fragments of crushed rock, free from flat, elongated, soft or disintegrated pieces, or other objectionable matter occurring either free or as coating on stone.

C. Physical Qualities: Same as for base course.

2.3 SOURCE QUALITY CONTROL

A. CONTRACTOR: Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on materials' test results on installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. As specified in Section 02215, SUBGRADE PREPARATION.

B. Obtain RESIDENT ENGINEER's acceptance of subgrade before placement of base course rock.

3.2 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and obtain the specified density for each layer.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Measure capacity of truck to determine vehicle load and quantity.
4. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.4 CONSTRUCTION OF COURSES

A. General: Complete each lift in advance of laying succeeding lift to provide required results and adequate inspection.

B. Base Course:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.

5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
   a. Use leveling course or surfacing material as keystone.
   b. Spread evenly on top of crushed base course, using spreader boxes or chip spreaders.
   c. Roll surface until keystone is worked into interstices of crushed base course without excessive displacement.
   d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.

C. Gravel Surfacing:

1. Maximum Completed Lift Thickness: 9 inches.
2. Completed Course Total Thickness: As shown.
3. Spread on preceding course in accordance with cross-section shown.
4. Blade lightly and roll surface until material is thoroughly compacted.

3.5 ROLLING AND COMPACTION

A. Rolling and Compaction: In accordance with Section 601.4, of the Standard Specifications.

3.6 SURFACE TOLERANCES

A. Finished Surface of Base Course: Within plus or minus 0.04 foot of grade shown at any individual point.

3.7 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Construct base course so areas shall be ready for testing.
2. Show proof that areas meet specified requirements before requesting that RESIDENT ENGINEER identify density test locations.
3. Perform a minimum of one test on completed course per location in accordance with AASHTO T 191-86, T 205-86, or T 238-86 at locations acceptable to RESIDENT ENGINEER.

3.8 CLEANING

A. Remove excess material; clean stockpile areas of aggregate.

END OF SECTION

SECTION 02271
RIPRAP AND RIPRAP BEDDING

PART 1 GENERAL

1.1 DEFINITIONS

A. Refer to applicable definitions in Section 02220, FILL AND BACKFILL.

1.2 SUBMITTALS

A. Administrative Submittals: Trip tickets showing source, type, and weight of each load of material delivered to site.

B. Shop Drawings: Description and location of proposed sources of riprap bedding and riprap.

C. Quality Control Submittals:

1. Certified Test Results:
   a. Riprap:
      1) Gradation.
      2) Abrasion resistance.
      3) Bulk density.

1.3 QUALITY ASSURANCE

A. Riprap Source: Quarry that has produced riprap and has performed satisfactorily on other projects for at least 5 years.

1.4 SCHEDULING AND SEQUENCING

A. Complete subgrade preparation as specified in Section 02215, SUBGRADE PREPARATION, and geotextile installation as specified in Section 02225, TRENCH BACKFILL, prior to placing riprap.

PART 2 PRODUCTS

2.1 RIPRAP

A. Hard and durable quarry stone free from fractures, bedding planes, pronounced weathering, and earth or other adherent coatings.

B. Minimum Dimension of Individual Pieces: Not less than 1/3 maximum dimension.

C. Abrasion Resistance: Maximum 35 percent wear as determined in accordance with ASTM C535-89.

D. Bulk Density: Minimum 160 pounds per dry cubic foot.

E. Gradation: Smaller pieces shall generally fill voids between larger pieces without either an excess or a deficiency of one or more sizes of stone.

Class	Thickness (Inches)	Tolerance (Inches)	Weight (Pounds)	% Greater Than
II	24	3 inches below to 6 inches above limits shown	250 150 50 25	0 to 5 30 75 90

PART 3 EXECUTION

3.1 PLACING RIPRAP

A. Place riprap over riprap bedding to minimum thickness.

B. Intermix different sizes of pieces to eliminate segregation and to fill voids between larger pieces with smaller pieces and work surface free from irregularities.

C. Use placement and intermixing methods that avoid disturbing riprap bedding or damaging existing facilities, completed Work, or adjacent property.

END OF SECTION

SECTION 02272
GABION MATTRESS CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work necessary for the removal and replacement of gabion mattress and buttress construction, complete.

PART 2 PRODUCTS

2.1 GABIONS

A. New heavy-duty wire mesh galvanized gabions as manufactured by Maccaferri Gabions, Inc., New York, NY, or equivalent. Sizes shall be as shown on the Drawings.

B. Reuse of removed gabions will not be allowed.

2.2 BINDING WIRE

A. U.S. 13-1/2-gauge galvanized wire or as recommended by the manufacturer.

2.3 GABION FILL MATERIAL

A. Clean, hard cobbles or crushed rock; 12-inch maximum particle size, 4-inch minimum particle size. Average stone size is 6 inches.

2.4 EARTH BACKFILL

A. Material from the excavations free from roots, debris, organic material, or other deleterious materials as specified in Section 02200, FILL AND BACKFILL.

2.5 UNCLASSIFIED EXCAVATION

A. All excavation is unclassified. Complete all excavation, regardless of the type, nature, or condition of the materials encountered. CONTRACTOR shall make own estimate of the kind and extent of the various materials to be excavated in order to accomplish the work.

2.6 GEOTEXTILE

A. Nonwoven, pervious sheet as shown to match existing product. Fibers of the fabric shall be constructed into a stable network that retain their relative position with respect to each other.

PART 3 EXECUTION

3.1 STRUCTURAL EXCAVATION

A. Perform all excavation, regardless of the type, nature, or condition of the material encountered. The method of excavation used is optional; however, no equipment shall be operated within 5 feet of existing structures or newly completed construction.

B. Excavation that cannot be accomplished without endangering existing or new structures shall be done with hand tools.

3.2 LIMITS OF EXCAVATION

A. Excavate to the depths and widths required to accomplish the construction. Cuts belowgrade shall be corrected by replacing with compacted earth backfill, compacted to a minimum of 90 percent relative compaction. CONTRACTOR shall bear all costs for correcting overexcavated areas.

3.3 GABION REMOVAL

A. Protect existing gabions from damage from equipment and materials at all times during removal and installation.

B. Remove existing gabion mattresses and buttresses where required to complete the elements of Work.

C. Remove top of gabion mattress by cutting tie wire at side or end of basket or by securing remaining top to internal divider or diaphragm and cutting away top to be removed. Secure top to dividers or diaphragms with tie wire in accordance with manufacturer's requirements.

D. Remove stone fill from mattresses and buttresses in a manner that will not damage the adjacent gabions or structures. Stone fill should be protected from contamination with other material so it can be reused in the replaced gabions.

E. Remove the remaining gabion mattress and basket at an end or side or secure and remove at a divider or diaphragm in accordance with manufacturer's requirement.

F. Cut and remove geotextile beneath gabions leaving 1.5 feet of material for overlap during gabion replacement.

3.4 GABION ASSEMBLY

A. Place the first layer of gabion to the line and grades shown on the Drawings. Gabion edges shall be continuously wired together, using binding wire specified hereinbefore. Adjoining gabions shall be wired together along their vertical edges. Empty gabions shall be stretched and held in place while filling as recommended by the manufacturer. Empty gabions stacked on filled gabions shall be wired to the filled gabions at the front and back.

3.5 GABION CONSTRUCTION

A. Place gabion fill in layers not thicker than 1 foot. Along all exposed gabion faces, place the outer layer of stone by hand in order to provide a neat, compact, square surface. In addition to the gabion fill, within 1 foot from the exposed face, the rock interstitial voids shall be filled with topsoil to permit establishing a vegetative cover. After each 1-foot lift is completed, one binding wire connecting tie shall be placed in each direction, across the fill surface, connecting opposite faces. The connecting wire shall be looped at least twice around two nonadjacent meshes of the gabion wall, then the free end wrapped back around the standing end of the wire to form a snug connection. At no time allow any gabion to be filled to a depth of more than 1 foot above the adjoining gabions. After the gabion is filled to the top and leveled off, fold the lid shut and wire it to the ends, sides, and diaphragms using binding wire.

3.6 GEOTEXTILE

A. Surface Preparation: Remove or compact all materials on surface to receive geotextile. Roll surface with smooth roller to remove all undulations exceeding 1 inch. Obtain RESIDENT ENGINEER's approval of prepared surface.

B. Laying Geotextile: Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

C. Sheet Orientation on Slopes: Orient geotextile with long dimension of each sheet parallel to direction of slope (up and down slope) extending across the top of the embankment below the aggregate base course.

D. Joints: Overlap a minimum of 1.5 feet, unless otherwise shown.

E. Securing Geotextile: Secure geotextile during installation as necessary with sand bags, or other means approved by RESIDENT ENGINEER.

F. Placing Products Over Geotextile:

1. Before placing material over geotextile, notify RESIDENT ENGINEER. Do not cover installed geotextile until after RESIDENT ENGINEER provides authorization to proceed.
2. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article REPAIRING GEOTEXTILE.

G. Repairing Geotextile: Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as specified above in Article SECURING GEOTEXTILE, or by other means approved by RESIDENT ENGINEER.

3.7 SHORING, SHEETING, AND BRACING

A. Furnish and install all shoring, sheeting, and bracing required to support adjacent earth banks and structures, and for the protection and safety of all personnel working in the excavations. All shoring, sheeting, and bracing shall conform to the requirements of the state or local agencies having jurisdiction over such matters.

B. Remove shoring, sheeting, and bracing in a manner that will protect or prevent caving of banks or damage to property as the excavations are backfilled.

3.8 EARTH BACKFILL

A. Remove all form materials and trash from the excavation prior to placing any backfill. Place earth backfill in all areas not designated on Drawings to be backfilled with other materials. Deposit material in horizontal layers and compact each lift to a minimum of 90 percent of relative compaction. Backfill to the specified grade.

3.9 TOLERANCE

A. The following tolerances shall be maintained for the gabion wall construction:

1. Horizontal alignment plus or minus 4 inches, not to exceed 2 inches in any 5-foot length.
2. Slope face tilt not to deviate by more than 1 inch per foot when measured at the top and bottom gabion edges.

END OF SECTION

SECTION 02581
DRILLING METHODS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers Work, materials, equipment, and different drilling methods acceptable for performing the drilling work required for the successful installation and operation of the recovery wells for the Town Lake Project.

B. This section describes drilling methods acceptable to the RESIDENT ENGINEER. The CONTRACTOR's bid proposal shall clearly describe the drilling method(s) that the CONTRACTOR proposes to use to complete the well installations described in these Contract Documents.

1.2 QUALIFICATIONS

A. The CONTRACTOR performing the Work specified herein must have completed at least three similar well drilling projects in the last 3 years and be properly licensed in the State of Arizona to perform this type of work. Similar projects are defined as drilling large diameter (30-inch or larger) vertical boreholes in unconsolidated, coarse-grained (sand, gravel, cobbles) alluvial materials. References for the minimum three similar projects and licensing information shall be submitted to the RESIDENT ENGINEER for review after Bid opening and prior to award of the Contract.

1.3 SUBSURFACE CONDITIONS

A. The CONTRACTOR should be aware of the high probability of encountering difficult drilling conditions because of the nature of the subsurface materials in proximity to the Salt River. The CONTRACTOR is responsible for ensuring and demonstrating that they understand these conditions, and that they have the appropriate experience, equipment, and drilling crews to successfully complete the recovery wells as specified in these Contract Documents.

PART 2 PRODUCTS

2.1 GENERAL

A. All drilling equipment, including drill rigs, shall be in good operating condition at all times and operated and maintained in strict conformance with manufacturer's recommendations.

B. Provide drill rig(s) capable of completing the recovery wells as shown on the Drawings and as described in these Specifications. Provide tools, bits, and all other necessary equipment, including drilling fluids required to complete the work described in these Specifications and as approved by the RESIDENT ENGINEER.

C. The cost of furnishing and installing, or installing and pulling out, any temporary conductor casing or accessory in any well shall be included in the unit price for drilling as stated in the CONTRACTOR's Bid for DRILLING METHODS.

D. If the CONTRACTOR initially drills a small diameter pilot hole before drilling the specified borehole, the cost of drilling such pilot hole shall be included in the CONTRACTOR's Bid for drilling the specified borehole.

2.2 DRILLING EQUIPMENT

A. One or a combination of the following drilling methods may be used by the CONTRACTOR to advance the borings to ensure the satisfactory drilling, sampling, and well installation:

1. Reverse rotary.
2. Cable tool.
3. Bucket auger.
4. Air rotary casing advancement.

B. Equipment shall be properly maintained to prevent introduction of containating fluids (lubricants, solvents, etc.) into the borehole.

2.3 DRILLING FLUIDS

A. Provide all drilling fluids, water, and additives as required. Fluids introduced shall conform to State guidance to prevent contamination of groundwater. Review fluids and additives with the ENGINEER and Factory Representative for Manufacturer prior to drilling.

2.4 DRILL CUTTINGS AND WATER CONTAINMENT

A. CONTRACTOR shall provide rolloff bins to temporarily contain drill cuttings and any formation water produced during drilling. CONTRACTOR to transport drill cuttings to a location designated by OWNER. Provide pumping equipment and up to 300 feet of hose to pump off contained formation water to location designated by OWNER.

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate the start of drilling with the RESIDENT ENGINEER. Provide at all times an experienced, competent, and licensed water well driller during all operations at the drill site. Provide 5 days written notice prior to mobilization or drilling.

B. Drill the boreholes to the dimensions described in these Specifications or as approved by the RESIDENT ENGINEER. The anticipated depth to which each recovery well will be drilled is given in Table 1. Approximate locations are provided in the Drawings. Final well locations and depths will be determined by the RESIDENT ENGINEER in the field.

C. The boreholes shall be drilled so as to permit the installation of the well materials straight and plumb to the tolerance desribed in Section 02670, WATER WELLS.

D. Use only drilling fluids and additives specifically recommended by the manufacturer for use in water well drilling. Avoid contamination of the samples or the aquifer. Do not introduce muds, clays, or drilling aids into the well or use lime, cement, organic matter, or other material to stop circulation losses of the drilling fluid, without obtaining approval of the proposed program from the RESIDENT ENGINEER.

E. The CONTRACTOR may check plumbness, out-of-roundness, and straightness of the drilled hole as the drilling progresses. Such checking shall not relieve the CONTRACTOR from requirements for testing as specified in Section 02670, WATER WELLS.

F. Construct the wells in strict conformance with the laws, rules, regulations, and standards related to the construction of wells in the State of Arizona, Maricopa County, and the City of Tempe.

G. Take all necessary precautions to prevent contaminated water, gasoline, or other substances from entering the boring/well, either through the opening or by seepage through the ground surface. Maintain precautions during and after construction of the well.

3.2 DRILLING RECORDS

A. The RESIDENT ENGINEER will furnish and complete daily a Field Activity Daily Log which shall include tabulation of quantities for each pay item and a description of all decisions made by the RESIDENT ENGINEER. The records shall be kept up to date with the progress of drilling. The Field Activity Daily Log shall be signed by both the CONTRACTOR and the RESIDENT ENGINEER at the completion of each days' drilling.

B. As the drilling proceeds, the driller shall keep a log of the borehole which carefully and accurately describes the materials penetrated. The log shall show all changes in strata and such information as drilling rate, depth at which water is first encountered, and other pertinent phenomena observed during drilling of the borehole. A record shall be kept of any variation in the additional amount of approved clays or chemical products or water required during drilling. The depth at which such changes are required shall be shown in the daily reports.

C. Prepare and submit a final well log for each well that shall include borehole diameters; depth of the bottom of the casing and/or the bottom of the borehole; casing diameters and wall thicknesses; cemented zones; perforated or screened interval(s); type, size, and quantity of gravel or sand pack installed; amount of material removed during development; and other information pertinent to the as-built well construction.

D. Prepare and file all drilling and well records and reports with the proper agencies required by federal, state, and local codes or regulations. A copy of each document will also be filed with the RESIDENT ENGINEER.

3.3 DRILL CUTTINGS AND WATER DISPOSAL

A. Drill cuttings and water produced during well drilling shall be contained in rolloff bins. The water can be pumped into the river channel from the well site. Rolloff bins with cuttings can be dumped at a designated location outside the river channel (within 2 miles of the drill site). If drilling mud is used, spent mud will be disposed with drill cuttings. Water produced during the well pumping tests (Section 02672) can be diverted directly into the river channel.

B. The CONTRACTOR shall obtain all necessary federal, state, and local permits for this disposal. The OWNER will obtain the required ADWR drilling permits.

Table 1
Estimated Depths for Recovery Wells

Recovery Well No.	Estimated Drilled Depth (feet)	Estimated Constructed Depth (feet)
1	145	140
2	165	160
3	160	155
4	160	155
5	140	135
6	145	140
7	165	160
8	165	160
9	165	160
10	155	150

END OF SECTION

SECTION 02582
SOIL SAMPLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section covers the different sampling techniques and the Work necessary to obtain samples of soil during drilling of recovery wells, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. All sampling equipment shall be in good operating condition at all times and operated and maintained in strict conformance with manufacturer's recommendations.

B. Borings shall be sampled as specified or as directed by the RESIDENT ENGINEER.

C. Soil sample containers will be provided by the RESIDENT ENGINEER.

D. Requirements of drilling are as specified in Section 02581, DRILLING METHODS.

E. The general objective of the sampling program is to obtain representative samples with good recovery.

PART 3 EXECUTION

3.1 GENERAL

A. The following technique shall be used to obtain samples of soil.

3.2 GRAB SAMPLES

A. Grab samples shall be collected every 5 feet for lithologic characterization. The CONTRACTOR shall control advancement to allow adequate lithologic characterization. Samples must be representative of the depth to which drilling has progressed and consist of a volume of not less than 1 quart. The CONTRACTOR shall perform this Work at its own expense.

END OF SECTION

SECTION 02595
WELL ABANDONMENT

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the Work, materials, and equipment necessary for abandonment of wells, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Well abandonment shall be performed only by an Arizona licensed well drilling contractor or single well licensee.

B. All equipment shall be in good operating condition and operated and maintained in strict conformance with manufacturer's recommendations.

C. The CONTRACTOR shall have the appropriate equipment and trained personnel to perform the Work as specified.

D. Provide drill rig(s) capable of abandoning wells as shown on the Drawings and as described in these Specifications. Provide all tools, grout, water, bentonite, and other necessary equipment and materials for abandoning wells as described in these Specifications and as approved by the RESIDENT ENGINEER.

2.2 ABANDONMENT OF WELLS

A. The abandonment of wells shall meet or exceed the minimum standards of the Arizona Department of Water Resources (R12-15-816).

B. The Owner of the wells will file the *Notice of Intent* to *Abandon* forms with the Arizona Department of Water Resources prior to the abandonment work.

C. For wells where the existing annulus around the well casing has a cement grout seal of less than 20 feet (Type I wells), CONTRACTOR shall remove the entire existing well casing and screen from the borehole. This applies to Wells PZ-2, PZ-15, PZ-18, PZ-20, PZ-22, and PZ-27.

D. For wells where the existing annulus around the well casing has a cement grout seal of greater than 20 feet (Type II wells), CONTRACTOR shall abandon the existing well casing and screen in place. This applies to Wells PZ-37, PZ-45, PZ-50, PZ-52, PZ-53, and TW-3.

E. The cement grout materials for well abandonment work shall consist of a mixture of water, cement, and powdered (No. 200 mesh) bentonite. The proportion of the mix shall be 8.5 gallons of water and 4.7 pounds of

bentonite per 94-pound bag of cement. Provide a grout mixing plant capable of continuous mixing of the grout seal materials.

PART 3 EXECUTION

3.1 GENERAL

A. Table 1 lists relevant data on the wells to be abandoned. The 12 wells to be abandoned all have aboveground surface completions and all 12 wells are located within the Salt River channel. In the event that a well or wells have been covered by alluvial materials prior to the abandonment work, the CONTRACTOR shall locate the covered wells (using available survey data) and uncover them to facilitate the abandonment work as specified in this section.

B. CONTRACTOR shall remove the existing steel protective casings at each well site. CONTRACTOR shall be responsible for the proper disposal of all materials removed from the wells to be abandoned.

C. For wells falling in category of Item 2.2C, CONTRACTOR shall overdrill the existing well casing and screen and remove them from the boreholes. CONTRACTOR shall then clean out the boreholes to the original 6-inch diameter. Contractor shall, using a tremie pipe placed within 5 feet of the bottom of the boreholes, pump a cement grout mixture to fill the borehole to within 2 feet of ground surface. CONTRACTOR shall then backfill the upper 2 feet of the borehole with native materials.

D. For wells falling in category of Item 2.2D, CONTRACTOR shall pressure grout the existing well casing and screen with a cement grout mixture to force the grout mixture outward through the well screen slots and into the gravel pack around the well screen. CONTRACTOR shall fill the inside of the existing well casing to within 2 feet of ground surface. CONTRACTOR shall excavate down to 2 feet below ground surface and cut off the existing well casing. CONTRACTOR shall then backfill the excavation with native materials.

E. Mix all cement grout ingredients to a uniform consistency free of lumps. Use a portable grout plant designed specifically for continuous mixing and pumping of the specified grout. Method of mixing will be reviewed with the RESIDENT ENGINEER prior to grouting.

3.2 ABANDONMENT RECORDS

A. The OWNER shall notify the Arizona Department of Water Resources within 30 days of the well abandonments per State of Arizona regulations.

END OF SECTION

Abandonment Well Data Table									
Well Type	Well No.	Well Casing Diameter (in)	Well Depth (ft)	Northing	Easting	Remove Well Casing & Screen from Borehole	Well Screen Length (ft)	Existing Grout Thickness (ft)	Original Borehole Diameter (in)
I	PZ-2	2	13	286049.7	286396.5	YES	8	4	6
I	PZ-15	2	23	285377.9	289919.4	YES	10	8	6
I	PZ-18	2	23	284986.9	290596.5	YES	10	8	6
I	PZ-20	2	30	284920.0	291383.7	YES	10	15	6
I	PZ-22	2	44	285650.7	292221.3	YES	20	18	6
I	PZ-27	2	21	285296.8	293245.9	YES	10	6	6
II	PZ-45	2	90	284690.9	296421.6	NO	50	34	9
II	PZ-37	2	84	284520.8	297108.2	NO	40	39	6
II	PZ-53	2	99	284827.1	298444.9	NO	50	47	9
II	PZ-50	2	127	285122.6	299585.2	NO	50	75	9
II	PZ-52	2	108	285873.9	300520.1	NO	50	55	9
II	TW-3	6	127	285130.5	299597.8	NO	100	24	11

SECTION 02670
WATER WELLS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Description of well development.
2. Product Data:
   a. Drilling fluid additives.
   b. Well screens.
   c. Casing and screen fittings.
   d. Grout seal additives.

B. Samples:

1. Gravel Pack Material: 5 pounds.

C. Quality Control Submittals:

1. Daily drilling log and record of quantity and type of any drilling fluids added to the mud that day.
2. Manufacturer's Mill Certificate on stainless steel casing prior to installation.
3. Drilling Fluid Additives: Certification that additives are suitable for water well applications.
4. Grout Seal Additives: Certification that additives are suitable for water well applications.

D. Contract Closeout Submittals: Copies of well logs submitted to ADWR.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver grouting materials, gravel pack, drilling additives, etc., to site in bags or bulk and store and protect from contamination in accordance with AWWA A100-90.

1.3 SCHEDULING AND SEQUENCING

A. Notify RESIDENT ENGINEER of proposed drilling start date at least 5 working days before drilling begins. Notify RESIDENT ENGINEER of anticipated delays whenever they become apparent.

PART 2 PRODUCTS

2.1 SURFACE CASING

A. Surface casing installed at each recovery well shall be low carbon steel.

B. Surface casing shall extend to 40 feet below the original land surface and shall be grouted in place as specified in Part 3.12 of this section.

C. Dimensions:

Nominal Diameter (inches)	Inside Diameter (inches)	Wall Thickness (inches)	Approx. Weight per/ft
36.0	35.25	0.375	143

2.2 WELL CASING

A. Well casing permanently installed in wells shall be new Type 316 stainless steel pipe conforming to ASTM A312, Grade TP316L, Schedule 10S. All well casing shall be of new, first quality material and free of defects in workmanship and handling.

B. Well casing shall be sealed in place as specified in the Drawings.

C. Dimensions:

Nominal Diameter (inches)	Inside Diameter (inches)	Wall Thickness (inches)	Approx. Weight per/ft
24.0	23.5	0.250	64

D. Pipe intended for joining by field butt-welding shall be provided with ends trued and beveled.

E. Fittings: All fittings, drive shoes, and centering guides shall be of standard manufacture for the intended application and compatible with the well screen and casing.

F. Casing that fails, collaspes, or separates during construction shall be removed from hole and repaired or replaced at CONTRACTOR's sole expense.

2.3 WELL SCREEN

A. Fabricated from Type 316 stainless steel.

B. Type: Welded, wire wound, continuous slot.

C. Sizes of Openings: 0.040 inch.

D. Screen that fails, collaspes, or separates during construction shall be removed from hole and repaired at CONTRACTOR's sole expense.

2.4 GRAVEL PACK

A. Conform to AWWA A100-90 with respect to specific gravity, uniformity, absence of deleterious substances, and nonrounded fragments.

B. Material: Silica gravel or sand. Material shall be washed, free of organic material, contain less than 5 percent silt/clay, and have a specific gravity of not less than 2.6.

C. Gradation: 8 to 12.

2.5 ANNULAR SEALS

A. Bentonite: Pure sodium bentonite clay in granular form.

B. Portland Cement: Conform to ASTM C150-89, Type I or Type II.

2.6 CEMENT GROUT MIXES

A. The cement grout mix shall consist of a mixture of water, cement, and powdered (No. 200 mesh) bentonite. The proportion of the mix shall be 8.5 gallons of water and 4.7 pounds of bentonite per 94-pound bag of cement.

2.7 GROUT MIXING

A. Provide a grout mixing plant capable of continuous mixing of the grout seal materials. Batch mixing plants are unacceptable.

PART 3 EXECUTION

3.1 DRILLING EQUIPMENT

A. Provide a drilling rig and accessories required to complete the wells as specified.

3.2 TEMPORARY PIPING

A. Provide temporary piping and appurtenances to convey water produced by drilling, development, and testing to the designated location at each well site. Discharge site for conveyed water shall be within Salt River channel.

3.3 DRILLING

A. Wells shall be drilled by the methods described in Section 02581, DRILLING METHODS.

B. Drilling Fluids and Additives:

1. Approved for use in water wells.
2. Suitable to complete well as specified.

3.4 BOREHOLE

A. Drill boreholes for surface casings to the dimensions and depth as shown.

B. Drill boreholes for well casing and screen to the dimensions as shown and to the depths as determined by RESIDENT ENGINEER.

C. Drill boreholes sufficiently straight and plumb, as described in Part 3.9 of this section, to permit installation of casing and screen.

3.5 LOGS

A. Maintain up-to-date daily logs of drilling progress.

B. Maintain current copy of logs at drill site for inspection.

C. Maintain Borehole Log containing:

1. Description of geologic materials and depth encountered.
2. Presence or absence of water.
3. Depths of lost circulation.
4. Methods used to regain circulation.
5. Drilling rates.
6. Time, depth, and description of unusual occurrences or problems during drilling.
7. Diameter and length of casing installed.

D. Daily Log: Use Daily Drilling Report form located at the end of this section.

E. Final Well Log:

1. Geologic log.
2. Borehole diameters.
3. Depth to bottom of casing and bottom of borehole.
4. Diameters and wall thicknesses of casing.
5. Range of depth of each cemented zone and quantity of cement used.
6. Range of depth of each perforated or screened interval and size of perforations or screen openings.
7. Gradation and quantity of gravel pack installed.
8. Other information from daily logs pertinent to well construction.

3.6 DISPOSAL OF CUTTINGS AND DRILLING FLUIDS

A. Dispose of cuttings and drilling fluids as specified in Section 02581, DRILLING METHODS.

3.7 PROTECTION OF WATER QUALITY

A. Prevent contaminated water, gasoline, or other harmful substances from entering well, either through opening or by seepage into ground.

B. Do not allow cuttings or drilling fluids to contaminate ground or surface water.

3.8 INSTALLATION OF CASING

A. Install casing to depth as directed by RESIDENT ENGINEER.

1. Provide joint with same structural integrity as casing itself.
2. Provide centralizers, casing shoes, grouting accessories, and other fittings necessary to complete the well.

B. Join Casing Ends Watertight:

1. Steel: Welded. Welding shall be in conformance with AWWA C206-91.

C. Surface Casings: Install and cement in hole not less than 12 inches greater in diameter than nominal diameter of casing.

D. Final Casing Strings: Install and cement in hole 10 inches greater in diameter. Do not use end cap on bottom of casing string. Secure bottom of casing 2 to 5 feet above hole bottom. Measure total cement plug. If half filled inside casing, it must be removed prior to installation of cement plug by method approved by RESIDENT ENGINEER.

E. Install Casing Centralizers:

1. One set 5 feet above bottom.
2. One set every 50 feet thereafter to nearest 50 feet from ground surface.

F. A centralizer set includes four equally spaced centralizing guides equally spaced around the casing at each required depth.

G. Attach Centralizers Vertically to Casing:

1. Arranged in four vertical and straight lines along casing.
2. Spaced 90 degrees apart to allow maximum clearance for tremie pipes.

3.9 STRAIGHTNESS AND ALIGNMENT TEST

A. The well shall be adequately plumb and straight so as not to interfere with the installation and operation of the permanent pump and appurtenances.

B. The well shall be deemed adequately plumb if the horizontal displacement from the vertical is less than 2/3 the diameter of the inner casing per 100 feet of the well.

C. The well shall be deemed adequately straight if a section of pipe or a dummy, not less than 40 feet long and not more than 0.5 inch smaller than the inside diameter of the casing can be lowered freely into the well to a depth of 100 feet.

3.10 WELL SCREEN INSTALLATION

A. Install well screen assembly and fittings in conformance with manufacturer's recommendations.

B. Install screens of the lengths and to the depth as directed by RESIDENT ENGINEER.

C. Provide fittings designed for use with the well screen installed. Follow well screen manufacturer's recommendation.

3.11 PLACING GRAVEL PACK

A. Thin high-viscosity drilling fluid with water to the minimum viscosity required to protect well bore from collapse, before placement of gravel.

B. Place gravel at measured uniform rate from bottom of well to point above well screen without segregation or bridging of material.

C. Sound top of gravel continuously during placement to measure its rate of rise and to determine if bridging is occurring.

3.12 MIXING AND PLACING ANNULAR SEALS

A. Annular bentonite seal shall be placed at top of gravel pack by slowly pouring bentonite between surface casing and well casing.

B. Consistency and method of mixing of cement grout annular seal will be reviewed by RESIDENT ENGINEER prior to grouting.

C. RESIDENT ENGINEER will review method of cement grout placement.

1. Force grout from bottom of casing to surface.
2. Grout continuously filling entire annulus in one operation.
3. Drilling operations not permitted until grout has cured.
4. Curing time for is 72 hours for Type I cement, 36 hours for Type II cement.

D. For cement grout plug at bottom of well, use tremmie pipe with packer inside casing to prevent cement from moving upward.

3.13 WELL DEVELOPMENT

A. Develop well on hourly basis using method proposed by CONTRACTOR and approved by RESIDENT ENGINEER. Development will continue until sand-free water is produced as approved by RESIDENT ENGINEER. CONTRACTOR shall propose methods and materials to break down and remove borehole and cake, as approved by RESIDENT ENGINEER. A Factory Representative of the drilling fluids manufacturer will be onsite at start of development to provide recommendations on how to remove the drilling fluids from the well during well development.

B. Sand content of produced water shall be measured by a sand sampler as shown in Appendix D of AWWA A100-90, or equal.

C. Water and solids produced during the development shall be disposed of as specified in Section 02581, DRILLING METHODS.

D. Upon completion of development activities and before test pump is installed, any material that has accumulated in well shall be removed at no additional cost to restore well to original construction depth.

3.14 DISINFECTION AND CAPPING

A. The well shall be disinfected prior to capping as per Section 02682, DISINFECTION.

B. Provide and install a temporary well cap to secure well until permanent test installation work begins.

3.15 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are a part of this Specification.

1. Forms: DAILY DRILLING REPORT.

END OF SECTION

DAILY DRILLING REPORT

Date:_____ Owner:_____

Well No.:_____

Casing/Hole Diameter _____-inch

Depth of Well

Start of Shift _____ feet

End of Shift _____ feet

Depth to Water (belowground)

Start of Shift _____ feet

End of Shift _____ feet

Log of Materials Encountered

Description	Depth From	Depth To

Remarks: (Character of drilling, casing added, miscellaneous work items)

_____

_____

_____

Driller:_____

Helper:_____

(Use other side for more comments)

SECTION 02672
WELL PUMPING TEST

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. List and description of equipment proposed for pumping test, including pump curves and driver horsepower.
2. Calibration curves and supporting laboratory data for flowmeters, orifice plates, or pressure transducers.
3. Description of sand measuring equipment.
4. Size and type of discharge piping.

B. Quality Control Submittals: Test, inspection, and measurement reports for each well tested.

1.2 SITE CONDITIONS

A. Environmental Requirements: Dispose of water produced during pumping tests as specified in Section 02581, DRILLING METHODS, and in an environmentally sound manner in accordance with applicable federal, state, and local regulations. Water leaving the site must be directed so as not to cause flooding or erosion. CONTRACTOR will coordinate water discharges with other CONTRACTOR's working in the river channel.

B. CONTRACTOR will obtain the appropriate disposal and Hydrologic Testing Permits.

C. Sequencing: Individual well pumping tests will be performed immediately following well development.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 TESTS REQUIRED

A. Provide labor, complete test pump assembly and engine, materials, equipment, and fuel for conducting pumping test(s) at each recovery well.

B. Test shall establish the hydraulic characteristics of the well and the aquifer.

3.2 TEST PUMP AND DRIVER

A. Test Pump: Vertical lineshaft turbine assembly, complete with required column, shafting, discharge head, and fittings, capable of pumping at a rate of 5,000 gpm at a total dynamic head of 125 feet with a pumping water level 100 feet below ground surface.

B. Driver: Engine suitable for continuously operating pump at required flow rate and TDH for the duration of the test.

3.3 FLOW MEASUREMENT AND CONTROL

A. Flowmeter: Propeller flowmeter or oriface plate capable of measuring the pump discharge rate within plus or minus 5 percent of the true flow rate.

B. Water Level Measurement: Two electronic meters and a continuous data logging system such as manufactured by In Situ with one pressure transducer capable of measuring up to 50 psi.

C. Sand Content Measurement: Rossum sand tester, or equal.

D. Access Pipes: Two 1-inch diameter Schedule 40 PVC access pipes between well casing and pump column to within 5 feet above the pump inlet.

3.4 PREPARATION

A. Access and Safety: Verify that access to the site is adequate and that equipment can be safely set up and operated at the site.

B. Verify that provisions for water, electric power, and other utilities available at the site are adequate for execution of the Work.

3.5 INSTALLATION

A. Pump and Driver: Set up pump with water inlet 70 feet below the static water level in the well. Install a safety shield around exposed rotating drive line.

B. Access Pipes: Install two 1-inch diameter access tubes to a depth approximately 5 feet above the pump assembly and secure at surface. Install pressure transducer in one of the tubes. Remaining tube is for manual measurements with one of the two electronic meters.

C. Flow Measurement Equipment: Install in accordance with manufacturer's recommendations.

D. Sand Measurement Equipment: Install and operate in accordance with manufacturers' recommendations.

E. Discharge Piping: Install and maintain discharge piping of sufficient length, size, and strength to conduct pumped water to a distance of at least 300 feet from the well location.

1. Discharge the water so as to minimize washouts and creation of turbidity and to avoid damage to existing structures and other portions of the Work.
2. Construct temporary discharge baffles or spreading plates as required to safely discharge the water on the surface.

3.6 OPERATION

A. At the direction of RESIDENT ENGINEER, operate the pumping equipment on an hourly basis to complete the well development. Allow well to recover for a period of 15 minutes before starting the step test.

B. Step Test: The step test shall be conducted prior to the constant rate test. Pump the well at three different pumping rates as directed by RESIDENT ENGINEER. Each step pumping rate shall be maintained for a minimum of 1 hour. At the end of the step test, allow the well to remain undisturbed until the water level recovers a minimum of 95 percent of the drawdown observed during the step test.

C. Constant Rate Test: Start the test pump at the precise time specified by RESIDENT ENGINEER. In addition to taking water level measurements in the pumped well using both a data logging system and manually with an electronic meter, take water level measurements manually with an electronic meter in the piezometers indicated in Table 1.

1. Adjust the pumping rate to the rate specified by RESIDENT ENGINEER.
2. Maintain the pumping rate continuously for 24 hours unless otherwise directed by RESIDENT ENGINEER.
3. At the end of the test, allow the well to remain undisturbed for a period equal to the pumping test duration before removing the pump or proceeding with other tests.

3.7 MEASUREMENTS

A. Records: Make accurate written records of water levels, pumping rates, time intervals, and other pertinent details of the pumping test(s).

B. Pumping Rates: Record pumping rate every 5 minutes for the first 2 hours of the constant rate test, and every 1/2 hour thereafter, for the duration of the test.

C. Background Water Levels: Measure and record the static water level in the well(s) at 1/2-hour intervals for a period of 2 hours immediately preceding the start of the test.

D. Drawdown Measurements: Manually measure the drawdown in the pumped well and in the indicated piezometers using electronic meters in accordance with the following schedule:

1. Every 0.5 minute for the first 10 minutes.
2. Every 1 minute for the next 5 minutes.
3. Every 5 minutes for the next 1.25 hours.
4. Every 10 minutes for the next 3.5 hours.
5. Every 30 minutes for the next 19.0 hours.

E. In addition to the manual drawdown measurements in the well being pump tested, measure water levels with the pressure transducer/data logger system using a logarithmic time step.

SECTION 02726
MANHOLE, VAULTS, AND DIVERSION STRUCTURE CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work necessary for construction of manholes, vaults, and diversion structures, complete. Manhole, vaults, and diversion structure details are shown.

1.2 SUBMITTALS

A. Shop Drawings: Furnish the following:

1. Cast-in-Place Manholes: Details of construction.
2. Precast Base Sections: Details of construction.
3. Manholes Over Existing Sewers: Plans and schedule for diverting flow.
4. Precast Concrete Vaults: Details of design and construction.

B. Quality Control Submittals: Furnish the following:

1. Precast Manhole Sections: Manufacturer's results of tests performed on representative sections to be furnished.

PART 2 PRODUCTS

2.1 BASE ROCK

A. Clean gravel or crushed rock conforming to ASTM C33, Size 67.

2.2 CONCRETE

A. As specified in Section 03300, CAST-IN-PLACE CONCRETE.

2.3 FLY ASH

A. Provide as specified in Section 03300, CAST-IN-PLACE CONCRETE.

2.4 NONSHRINK GROUT

A. As specified in Section 03600, GROUT.

2.5 MORTAR

A. Standard premixed meeting ASTM C387, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen.

B. Admixtures: May be included but do not exceed the following percentages of weight of cement:

1. Hydrated Lime: 10 percent.
2. Diatomaceous Earth or Other Inert Material: 5 percent.

2.6 BONDING AGENT

A. As specified in Section 03300, CAST-IN-PLACE CONCRETE.

2.7 FORMS

A. As specified in Section 03100, CONCRETE FORMWORK, and as follows:

1. Exposed Surfaces: Plywood or steel panels.
2. Other Surfaces: Matched boards, plywood, or other approved material.
3. Trench walls, large rock, or earth are not acceptable form material.

2.8 REINFORCING STEEL

A. As specified in Section 03210, REINFORCING STEEL.

2.9 FLAT BAR LADDER

A. As specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

2.10 CAST-IN-PLACE MANHOLES

A. Acceptable, subject to RESIDENT ENGINEER's approval.

2.11 PRECAST MANHOLE RISER SECTIONS

A. Minimum 60 inches in diameter or as shown on the Drawings, conforming to ASTM C478 and the following:

1. Minimum Wall Thickness: 5 inches or 1/12 times inside diameter, whichever is greater.
2. Provide eccentric cones for manholes. Cones shall have same wall thickness and reinforcement as riser section.
3. Top and bottom of sections shall be parallel.
4. Joints: Tongue and groove or confined groove with preformed plastic gasket or confined O-ring with rubber gaskets meeting ASTM C443.

B. Source Tests:

1. Prior to delivery of any size precast manhole section to jobsite, conduct yard tests at point of manufacture.
2. Precast sections to be tested will be selected at random from stockpiled material to be supplied for the job.

3. All test specimens shall be mat tested and meet the permeability test requirements of ASTM C14.

2.12 MANHOLE EXTENSIONS

A. Concrete Grade Rings for Extensions: Maximum 6 inches high with a minimum of two No. 2 hoops for 4-inch high ring and four No. 2 hoops for 6-inch high ring.

B. In general, provide manhole extensions on manholes in streets or other locations where a subsequent change in existing grade may be likely. Limit extensions to maximum height of 12 inches.

2.13 PREFORMED PLASTIC GASKETS

A. Conform to requirements of Federal Specification SS-S-00210.

B. Manufacturers:

1. Hamilton Kent Manufacturing Co., Box 178, Kent, OH 44240, Kent-Seal No. 2.
2. K. T. Snyder Co., Inc., Central National Bank Bldg., Houston, TX 77002, Ram-Nek.

2.14 PVC VENT PIPE

A. Polyvinyl Chloride (PVC) Pipe: ASTM 3034, SDR 35.

2.15 GRATINGS AND GRATING SUPPORTS

A. As shown and as specified in Section 05530, METAL GRATINGS.

2.16 MANHOLE FRAMES AND COVERS

A. Cast or ductile iron of size and shape shown.

B. Castings:

1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Conform to ASTM A48, Class 30B, for cast iron and ASTM A536, Grade 60-40-12 for ductile iron.
3. Plane or grind bearing surfaces to ensure flat, true surfaces.

C. Covers: True and seat within ring at all points.

D. Capscrews for Watertight Covers: High temper phosphor bronze with 60,000 psi minimum tensile strength meeting ASTM B139.

2.17 MARKER POSTS

A. Provide as shown and located on the Drawings.

2.18 PRECAST CONCRETE VAULTS

A. Furnish vault with embeds and grating as shown. Manufacture in accordance with ASTM C858.

B. Design for loads shown and in accordance with ASTM C857.

2.19 SOURCE QUALITY CONTROL

A. Fly Ash: Test as specified in Section 03300, CAST-IN-PLACE CONCRETE.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

A. As specified in Section 02205, EXCAVATION, and 02225, TRENCH BACKFILL.

B. Backfill Around Manholes: Use highest class of trench backfill immediately adjacent, as shown.

C. Use granular backfill around and under vaults as specified in Section 02220, FILL AND BACKFILL.

3.2 BASE ROCK

A. Remove water from the excavation.

B. Place minimum of 6 inches of rock base and thoroughly compact with a mechanical vibrating or power tamper.

3.3 CONCRETE BASE

A. Construct concrete base as shown.

B. Vibrate to densify concrete and screed so first precast manhole section to be placed has a level, uniform bearing for full circumference.

C. Deposit sufficient mortar on base to assure watertight seal between base and manhole wall, or place first precast section of manhole in concrete base before concrete has set. Properly locate and plumb first section.

D. If material in bottom of trench is unsuitable for supporting manhole, excavate below the base as directed by RESIDENT ENGINEER, and backfill to required grade with rock, as specified in Section 02225, TRENCH BACKFILL, Article TRENCH STABILIZATION MATERIAL.

3.4 PLACING PRECAST MANHOLE SECTIONS

A. Preformed Plastic Gaskets: Install in accordance with manufacturer's instructions and the following:

1. Carefully inspect precast manhole sections to be joined.
2. Do not use sections with chips or cracks in the tongue.
3. Use only pipe primer furnished by gasket manufacturer.
4. Install gasket material in accordance with manufacturer's instructions.
5. Completed Manholes: Rigid and watertight.

B. Rubber Gasketed Joints: Install in accordance with manufacturer's instructions.

3.5 MANHOLE INVERT

A. Construct as shown with smooth transitions to ensure an unobstructed flow through manhole. Remove sharp edges or rough sections which tend to obstruct flow.

B. Where full section of pipe is laid through manhole, break out top section as shown and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.6 FLEXIBLE JOINTS

A. Provide joints in all pipe at the distance from the manhole wall shown on the Drawing.

3.7 PERMANENT PLUGS

A. Clean interior contact surfaces of pipes to be cut off or abandoned as shown, and construct plug as follows:
1. Construct plugs of common brick, concrete block, or concrete a minimum of 5 feet.
2. Plaster exposed face of block or brick plugs with mortar.
3. Plugs shall be watertight and capable of withstanding internal and external pressures without leakage.

3.8 MANHOLE EXTENSIONS

A. Install extensions as shown, to height not exceeding 12 inches.

B. Lay grade rings with sides plumb and tops level. Seal joints with performed plastic gaskets as specified for manhole sections, and make watertight.

3.9 MANHOLE FRAMES AND COVERS

A. Install on top of manholes to positively prevent infiltration of surface or groundwater into manholes.

B. Set frames in bed of mortar as shown.

C. Set tops of covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

D. Wrap asphalt paper around grade rings and construct concrete coller as shown

3.10 MANHOLES OVER EXISTING SEWERS

A. Obtain RESIDENT ENGINEER's approval of plans for diverting flow before starting. RESIDENT ENGINEER's approval does not eliminate CONTRACTOR's responsibility for maintaining adequate capacity for flow at all times and for adequately protecting new and existing work.

B. Construct manholes over existing operating pipelines at locations shown as follows:

1. Perform necessary excavation and construct manhole.
2. Apply a bonding agent on all surfaces to be in contact with concrete and construct new base under existing sewer.
3. Place precast sections as specified.
4. Break out existing pipe within new manhole, cover edges with mortar, and trowel smooth.

C. Maintain flow through existing pipelines at all times, and protect new concrete and mortar work for 7 days after placing concrete.

3.11 CONNECTION TO EXISTING MANHOLES

A. Connect to existing manholes at locations shown.

1. Break out existing manhole bases or grouting as necessary.
2. Clean all surfaces and apply a bonding agent.
3. Regrout to provide smooth flow into and through existing manholes.

B. Provide diversion facilities and perform work necessary to maintain sewage flow during connection to manholes.

3.12 DIVERSION STRUCTURES

A. Excavation and Formwork:

1. Remove and keep all water clear from the excavation.
2. Place 6-inch minimum layer of base rock to undisturbed earth.
3. Thoroughly compact base rock with a mechanical vibrating or power tamper.
4. Form all vertical surfaces with materials as specified.

B. Reinforcing Steel: As specified in Section 03210, REINFORCING STEEL.

C. Placing and Finishing Concrete: As specified in Section 03300, CAST-IN-PLACE CONCRETE.

D. Backfill:

1. Remove all form materials and debris from excavations before placing any backfill.
2. Backfill around structures only after concrete has attained 2/3 of specified compressive strength.
3. Obtain RESIDENT ENGINEER's approval of concrete work prior to backfilling.

3.13 MANHOLE MARKER POSTS

A. Install manhole marker posts as shown.

3.14 PRECAST CONCRETE VAULTS

A. Installation shall be level in position shown.

3.15 FIELD QUALITY CONTROL

A. Hydrostatic Testing:

1. When, in RESIDENT ENGINEER's opinion, the groundwater table is too low to permit visual detection of leaks, hydrostatically test all manholes.
2. Procedure: Plug inlets and outlets and fill manhole with water to height determined by RESIDENT ENGINEER.
3. A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into the pipe walls to take place.
4. Leakage in each manhole shall not exceed 0.1 gallon per hour per foot of head above the invert.
5. Repair manholes that do not meet the leakage test, or do not meet specified requirements from visual inspection.
6. If more than 25 percent of the manholes tested fail the hydrostatic test, test all or as many manholes as RESIDENT ENGINEER deems necessary.

END OF SECTION

SECTION 02831
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 DEFINITIONS

A. Terms as defined in ASTM F552-88b.

1.2 SUBMITTALS

A. Shop Drawings: Detailed information and specifications for materials, finishes, and dimensions.

B. Samples: Approximately 6 inches square, or 6 inches long of posts, rails, braces, fabric, wire, ties, and fittings.

C. Quality Control Submittals:

1. Manufacturer's recommended installation instructions.
2. Evidence of Supplier and installer qualifications.

1.3 SCHEDULING AND SEQUENCING

A. Complete necessary site preparation and grading before installing chain link fence and gates.

PART 2 PRODUCTS

2.1 GENERAL

A. Match style, finish, and color of each fence component with that of other fence components.

2.2 CHAIN LINK FENCE FABRIC

A. Galvanized fabric conforming to ASTM A392-89, Class 1; galvanized after weaving.

B. Height: 72 inches, unless otherwise shown.

C. Wire Gauge: No. 9.

D. Pattern: 2-inch diamond-mesh.

E. Diamond Count: Manufacturer's standard and consistent for fabric furnished of same height.

F. Loops of Knuckled Selvages: Closed or nearly closed with space not exceeding diameter of wire.

G. Wires of Twisted Selvages:

1. Twisted in a closed helix three full turns.
2. Cut at an angle to provide sharp barbs that extend minimum 1/4 inch beyond twist.

2.3 POSTS

A. General:

1. Strength and Stiffness Requirements: ASTM F669-90a, Heavy Industrial Fence, except as modified in this section.
2. Steel Pipe: ASTM F1083-90.
3. Roll-Formed Steel Shapes: Roll-formed from ASTM A570-90, Grade 45, steel.
4. Lengths: Manufacturer's standard with allowance for minimum embedment below finished grade of 22 inches plus 3 inches for each 1 foot of fence height greater than 4 feet.
5. Protective Coatings:
   a. Zinc Coating: ASTM F1234-90a, Type A external and internal coating.

B. Line Posts:

1. Steel Pipe:
   a. Outside Diameter: 2.375-inch.
   b. Weight: 3.65 pounds per foot.
2. Roll-Formed Steel C Shape:
   a. Outside Dimensions: 2.25-inch by 1.625-inch.
   b. Weight: 2.70 pounds per foot.
3. Steel H-Section:
   a. Outside Dimensions: 2.25-inch by 1.70-inch.
   b. Weight: 3.26 pounds per foot.

C. End, Corner, Angle, and Pull Posts:

1. Steel Pipe:
   a. Outside Diameter: 2.875-inch.
   b. Weight: 5.79 pounds per foot.

2.4 TOP RAILS AND BRACE RAILS

A. Galvanized steel pipe or roll-formed steel C shapes.

B. Protective Coatings: As specified for posts.

C. Strength and Stiffness Requirements: ASTM F669-90a, Top Rail, Heavy or Light Industrial Fence.

D. Steel Pipe:

1. ASTM F1083-90.
2. Outside Diameter: 1.66-inch.

3. Weight: 2.27 pounds per foot.

E. Roll-Formed Steel C Shapes:

1. Roll formed from ASTM A570-90, Grade 45.
2. Outside Dimensions: 1.625-inch by 1.25-inch.
3. Weight: 1.40 pounds per foot.

2.5 FENCE FITTINGS

A. General: In conformance with ASTM F626-90, except as modified by this article.

B. Post and Line Caps: Designed to accommodate passage of top rail through cap, where top rail required.

C. Tension Bars:

1. One-piece vinyl-clad.
2. Equal in length to full height of fabric.

D. Truss Rod Assembly: 3/8-inch diameter.

E. Barb Arms: 45-degree arms for supporting three strands of barbed wire.

2.6 TENSION WIRE

A. Zinc-coated steel marcelled tension wire conforming to ASTM A824-86 Type II, Class 2.

2.7 BARBED WIRE

A. Zinc-Coated Barbed Wire: ASTM A121-86, Chain Link Fence Grade:

1. Line Wire: Two strands of No. 12-1/2 gauge.
2. Barbs:
   a. Number of Points: Four.
   b. Length: 3/8-inch minimum.
   c. Shape: Round.
   d. Diameter: No. 14-gauge.
   e. Spacing: 5 inches.

B. Aluminum-Coated Barbed Wire: ASTM A585-86, Type I.

2.8 CONCRETE

A. Provide as specified in Section 03300, CAST-IN-PLACE CONCRETE.

PART 3 EXECUTION

3.1 GENERAL

A. Install chain link fences in accordance with ASTM F567-84, except as modified in this section, and in accordance with fence manufacturer's recommendations, as approved by RESIDENT ENGINEER. Erect fencing in straight lines between angle points.

B. Provide all necessary hardware for a complete fence installation.

3.2 PREPARATION

A. Establish locations of fence lines and terminal posts.

B. Embedment Coating: Coat portion of galvanized or aluminum-coated steel posts that will be embedded in concrete with System No. 27, as specified in Section 09900, PAINTING. Extend coating 1 inch above top of concrete.

3.3 POST SETTING

A. Driven posts are not acceptable.

B. Post Hole Depth:

1. Minimum 3 feet below finished grade.
2. 2 inches deeper than post embedment depth below finish grade.

C. Backfill post holes with concrete to 2 inches above finished grade.

D. Before concrete sets, crown and finish top of concrete to readily shed water.

3.4 BRACING

A. Brace gate and corner posts diagonally to adjacent line posts to ensure stability.

3.5 TOP RAILS

A. Install top rail sleeves with springs at 105 feet maximum spacing to permit expansion in rail.

3.6 CHAIN LINK FABRIC

A. Do not install fabric until concrete has cured minimum 7 days.

B. Install fabric with twisted and barbed selvage at top.

3.7 BARBED WIRE

A. Install three strands of barbed wire on brackets, tighten, and secure at each bracket.

3.8 ELECTRICAL GROUNDING

A. Ground fences in accordance with applicable requirements of IEEE C2-90, National Electrical Safety Code.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Layout of panel joints, tie hole pattern.
2. Form Ties—Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.

B. Samples: One each as follows:

1. Form ties.

C. Quality Control Submittals:

1. Statements of qualification for formwork designer.
2. Manufacturer's Certificate of Proper Installation in accordance with Section 01640, MANUFACTURERS' SERVICES.

1.2 QUALITY ASSURANCE

A. Qualifications: Formwork, falsework, and shoring designs prepared by an engineer licensed in the state of Project.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 SYSTEM DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 347-89 and ACI 318-89 to provide the concrete finishes specified in Section 03300, CAST-IN-PLACE CONCRETE.

B. Make joints in forms watertight.

C. Limit panel deflection to 1/360 of each component span to achieve tolerances specified.

3.2 FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.

B. Column Forms:

1. Rectangular Columns and Pilasters: As specified for walls.
2. Circular Columns and Pilasters: Fabricated steel with bolted together sections or seamless cardboard column forms continuous for height of column.

C. All Other Forms: Materials as specified for wall forms.

D. Form Sealer:

1. Material: Surface sealer will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces when applied to most forms. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations.
2. Manufacturer and Product: Master Builders, Inc.; Rheofinish.

E. Reveal Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

F. Form Ties:

1. Material: Steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1 inch to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms, furnish plastic or rubber inserts with minimum 1-inch depth and sufficient dimensions to permit patching of tie hole.
5. Water Stop Ties: For water-holding structures, basements, and accessible spaces below finish grade, furnish one of the following:
   a. Integral steel water stop 0.103-inch thick and 0.625 inch in diameter tightly and continuously welded to tie.
   b. Neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is 1/2 diameter of tie, or a molded plastic water stop of comparable size.
   c. Water Stop: Oriented perpendicular to tie and symmetrical about center of tie.
   d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.
6. Through-Bolts: Tapered minimum 1-inch diameter at smallest end.
7. Elastic Vinyl Plug: Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming a watertight seal.
   a. Manufacturer and Product: Dayton Superior Co., Miamisburg, OH; Dayton Sure Plug.

3.3 ERECTION

A. General: Unless specified otherwise, follow the applicable recommendations of ACI 347-89.

B. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain RESIDENT ENGINEER's approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in an uninterrupted pattern for smooth and uniform surface.
3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.

D. Forms for Curbs, Sidewalks, and Driveways:

1. Provide standard steel or wood forms to prevent movement.
2. Set forms to true lines and grades, and securely stake in position.

E. Form Tolerances: Provide forms in accordance with ACI 347-89 and ACI 318-89 and the following tolerances for finishes specified:

1. Wall Tolerances:
   a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
   b. Plumb within 1/4 inch in 10 feet or within 1/2 inch from top to bottom.
      1) Depressions in Wall Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
   c. Thicknesses: Maximum 1/4-inch minus or 1/2-inch plus from dimensions shown.
2. Slab Tolerances:
   a. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
   b. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow a block of twice the tolerance in thickness to pass under the supported 10-foot straightedge.
   c. Slab steel gauge block 1/4-inch thick.
   d. Finish Slab Elevation: Slope slabs to adequately drain regardless of tolerances.
   e. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown, except where thickness tolerance will not affect slope, drainage, or slab elevation.

3. Beams and Columns Tolerances:
   a. Exposed Straight Horizontal and Vertical Surfaces: Flat planes within tolerances specified.
   b. Beam:
      1) Physical Dimensions: Maximum 1/4-inch minus or 1/2-inch plus from dimension shown.
      2) Elevations: Within 1/2-inch plus or minus except where tops of beams become part of finished slab. In this case refer to slab tolerances.
   c. Column:
      1) Physical Dimensions: Maximum 1/4-inch minus or 1/2-inch plus from dimension shown.
      2) Plumb within 1/4 inch in 10 feet in all directions with maximum 1/2-inch out-of-plumb at top with respect to bottom.

3.4 FORM SURFACE PREPARATION

A. Thoroughly clean form surfaces in contact with concrete or previous concrete, dirt, and other surface contaminants prior to coating surface.

B. Exposed Wood Forms in Contact with Concrete: Apply form sealer as recommended by the sealer material manufacturer.

C. Steel Forms: Apply form sealer to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

3.5 FORM REMOVAL

A. Formwork not supporting weight of concrete, (i.e., sides of beams, walls, columns, and similar parts of the Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Leave forms and shoring for elevated structural slabs or beams in place, in accordance with ACI 318-89, Chapter 6, and until concrete has reached compressive strength equal to 80 percent of the specified 28-day compressive strength as determined by test cylinders.

END OF SECTION

SECTION 03210
REINFORCING STEEL

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Prepare in accordance with CRSI 1990 Manual of Standard Practice and ACI SP-66 Detailing Manual:
   a. Bending lists.
   b. Placing drawings.
2. Welded splice, Cadweld splice, and mechanical threaded splice.

B. Quality Control Submittals:

1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
   a. Current International Conference of Building Officials (ICBO) Research Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
   b. Manufacturer's instructions.
   c. Verification that device threads have been checked and meet all requirements for thread quality, in accordance with manufacturer's published methods.
3. Welding Qualification: Prior to welding, submit welder qualifications and radiographic nondestructive testing procedures.
4. Test results of field testing.

1.2 QUALITY ASSURANCE

A. Welder Qualifications: Certified in accordance with AWS D1.4-79.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

PART 2 PRODUCTS

2.1 MATERIALS

A. Deformed Billet-Steel Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615-90, Grade 60, including Supplemental Requirements S1 where welding is not required.
3. ASTM A706/A706M-90, Grade 60, including Supplemental Requirements for reinforcing to be welded.

B. Splices and Mechanical Connections:

1. Mechanical Threaded Connections: Furnish metal coupling sleeve for splicing reinforcing in secondary members or in areas of low stress with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
   a. Manufacturers and Products:
      1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
      2) Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.

C. Welded Wire Fabric:

1. ASTM A185-90a or A497-90b and ACI 318/318R-89, using ASTM A82-90a wire of 75 ksi minimum tensile strength.
2. Furnish flat sheets only, rolled sheets not permitted.

2.2 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Precast concrete bar supports, cementitious fiber-reinforced bar supports, or all-plastic bar supports and side form spacers meeting the requirements of CRSI Manual of Standard Practice. Do not use other types of supports or spacers.
2. In Beams, Columns, Walls, and Slabs Exposed to View After Stripping: Small rectangular concrete blocks made up of same color and strength as concrete being placed around them or all-plastic bar supports and side form spacers.
3. Precast concrete supports of same strength as concrete for reinforcing in concrete placed on grade.

2.3 FABRICATION

A. Follow CRSI Manual of Standard Practice.

B. Bend all bars cold.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify RESIDENT ENGINEER when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Clean metal reinforcement of loose mill scale, oil, earth, and other contaminants.

C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

3.2 REINFORCING BAR INSTALLATION

A. Bundle or space bars, instead of bending where construction access through reinforcing is necessary.

B. Spacing and Positioning: Conform to ACI 318/318R-89.

C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars".

D. Splicing:

1. Follow ACI 318/318R-89.
2. Use lap splices unless otherwise shown or permitted in writing by DESIGN ENGINEER.
3. Welded Splices: Accomplish by full penetration groove welds and develop at least 125 percent of yield strength of bar.
4. Stagger splices in adjacent bars.

E. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by RESIDENT ENGINEER.
2. Install as required by manufacturer with threads tightened and in accordance with ICBO Research Report.
3. Maintain minimum edge distance and concrete cover.

F. Tying Deformed Reinforcing Bars:

1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
2. Bend all tie wire to prevent tie wire from being closer than 1 inch from the surface of concrete.

G. Welding Reinforcement:

1. Only A706/A706M-90 bars may be welded.
2. Do not perform welding until welder qualifications are approved.

H. Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.

I. Unless permitted by DESIGN ENGINEER, do not cut reinforcing bars in the field.

3.3 WELDED WIRE FABRIC INSTALLATION

A. Use only for reinforced slabs on grade.

B. Extend fabric to within 2 inches of edges of slab, and lap splices at least 1-1/2 courses of fabric or minimum 8 inches.

C. Tie laps and splices securely at ends and at least every 24 inches with tie wire.

D. Place welded wire fabric on concrete blocks at correct distance as shown, above bottom of slab and rigidly support equal to that provided for reinforced bars. Do not use broken concrete, brick, or stone.

E. Follow ACI 318/318R-89 and current Manual of Standard Practice, Welded Wire Fabric.

F. Do not use fabric that has been rolled. Install flat sheets only.

3.4 TESTS AND INSPECTION

A. Test all welds using radiographic, nondestructive testing procedures referenced in AWS D1.4-79.

B. Inspect each splice and verify each component is in accordance with manufacturer's instructions and ICBO Research Report.

END OF SECTION

SECTION 03215
DOWELING FOR CONCRETE AND CSA

PART 1 GENERAL

1.1 DEFINITIONS

A. ICBO Reports: Published by ICBO for concrete anchor manufacturers.

B. Special Inspection: As governed by the ICBO UBC-94.

1.2 SUBMITTALS

A. Shop Drawings: Technical data for epoxy adhesive, vinyl ester adhesives, grouts, and bonding agents.

1. Mixed Adhesive: Current test data indicating cured adhesive meets or exceeds design loads required.

B. Samples: Two random Samples of each batch of products delivered to site, for independent testing.

C. Quality Control Submittals:

1. Manufacturer's specific instructions for preparation, placement, drilling of holes, installation of anchors and epoxy or vinyl ester, and handling of cartridges, nozzles, and equipment.
2. Manufacturer's qualifications, to include client name, address, contact person, phone number, project location, and description of work.
3. Manufacturer's Certificate of Proper Installation.
4. Manufacturer's written letter of certification identifying installer's qualifications to install products.
5. Doweling system manufacturer's ICBO Reports.
6. Provide detailed step-by-step instructions for the Special Inspection procedure in accordance with ICBO Reports and Section 1701 of UBC-94.
7. Copy of manufacturer's operation and repair manuals for each type of equipment delivered to site.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: At least three similar projects with same products within the last 3 years.
2. Installer: Trained and certified by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Epoxy Components:

1. Store epoxy components on pallets or shelving in a covered storage area.
2. Control temperature above 60 degrees F and dispose of product if shelf life has expired.
3. Dispose of product if stored at other than manufacturer's instructions.
4. Container Markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

B. Vinyl Ester Products:

1. Store components on pallets or shelving in a covered storage area with locking door.
2. Control temperature within 41 to 77 degrees F and dispose of product if shelf life has expired.
3. Dispose of product if stored at other than manufacturer's instructions.
4. Container Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

PART 2 PRODUCTS

2.1 EPOXY ADHESIVES

A. General:

1. Meet ASTM C881-90, Type 1, Grade 3, Class A, B, or C, depending on site conditions.
2. Two-component, 100 percent solids, nonsag, paste, insensitive to moisture, designed to be used in adverse environments and gray in color.
3. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
4. Mixing: Follow manufacturer's instructions.

B. Component "A" Base Resin: Modified biphenyl-A type epoxy.

1. Viscosity: Light paste, 350 cps maximum prior to mixing to ensure proper wetting of moist concrete surfaces.
2. Fillers: 100 percent solids, fumed silica and selected annular micro silica powders. Do not use micro spheres, fly ash, or Asbestos.
3. Color: White.

C. Component "B" Hardener or Curing Agent:

1. Viscosity: Light paste.
2. Fillers: 100 percent solids, fumed silica and selected annular micro silica powders. Do not use micro spheres, fly ash, or Asbestos.

3. Color: Black.

D. Mixed Epoxy Adhesive:

1. Nonsag light paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runout, holding the following properties:
   a. Slant Shear Strength, ASTM C881-90/882-91, No Failure In Bond Line, Dry/Moist Conditions: 5,000 psi.
   b. Compressive Strength, ASTM D695-90: 14,000 psi, minimum.
   c. Tensile Strength, ASTM D695-90: 4,500 psi.
   d. Heat Deflection Temperature, ASTM D648-82e: 135 degrees F, minimum.
2. Manufacturers and Products:
   a. Adhesives Technology Corp., Kent, WA 98031; Anchor-It Fastening Systems, HS 200 Epoxy Resin; telephone 1-800/262-4748.
   b. ITW Ramset/Red Head, Wood Dale, IL, 60191; Epcon Ceramic 6 Epoxy Anchor System.
   c. Covert Operations, Long Beach, CA 90853, NJ; CIA Epoxy Anchors with viscosity to suit application.

2.2 VINYL ESTER ADHESIVES

A. Materials:

1. Two-component, insensitive to moisture, designed to be installed in adverse environments.
2. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.

B. Manufacturer and Product: HIT Doweling Anchor System (HIT C-100), by Hilti, Inc., Tulsa, OK 74146.

2.3 ANCHOR RODS

A. Reinforcing Bars: As specified in Section 03210, REINFORCING STEEL.

PART 3 EXECUTION

3.1 GENERAL

A. Dispensing, Metering, or Mixing Epoxy Adhesive Components: Use portable, automatic metering and mixing device or machine capable of maintaining prescribed mix ratio within deviation of 5 percent or less, by volume. Do not use epoxy where fire or temperatures above 100 degrees F can occur.

B. Install in accordance with manufacturer's specific instructions.

C. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

D. Mixing Nozzles:

1. Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.
2. Nonremovable internal static mixer required to ensure proper blending of components.

E. Where large meter and mixing pumps are impractical, provide adhesive packaged as follows:

1. Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
2. Dispense components through a mixing nozzle that thoroughly mixes components and places adhesive at base of predrilled hole.
3. Mixing Nozzles:
   a. Disposable, manufactured in several sizes to accommodate sizes of reinforcing dowels.
   b. Nonremovable internal static mixer required to ensure proper blending of components.

3.2 TESTING OF AUTOMATIC METERING AND MIXING DEVICES

A. Tests for Proper Ratio:

1. Retain small amount of dispensed adhesive for inspection after each time the pump is refilled.
2. Check these Samples for color change.
3. Should change in color occur, follow manufacturer's service instructions to obtain proper operation.

B. Frequency of Tests: Make full ratio check after each 100 gallons of adhesive is dispensed or if color of mixed adhesive becomes noticeably darker or lighter.

C. Ratio Check Procedure:

1. Disconnect dispensing head behind ON/OFF valve.
2. Place volume containers of the required proportions under the "B" and "A" component hose ends.
3. Actuate the pump.
4. Both cups should fill in an equal time, thereby verifying the proportion ratio by volume.

3.3 DOWEL SIZING AND INSTALLATION

A. Follow adhesive manufacturer's instructions for installation.

B. Drilling Equipment:

1. Drilling Hammers for Dowel Holes: Electric or pneumatic rotary type with medium or light impact.
2. Hollow drills with flushing air systems are preferred.
3. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

C. Hole Diameter:

1. As small as possible to allow dowel to be embedded to required depth.
2. Use drill bit diameter meeting ICBO Report requirements.
3. Epoxy Adhesive: Dowel diameter plus 1/8 inch for ambient temperature at time of installation above 60 degrees F, or dowel diameter plus 1/4 inch for ambient temperature at time of installation below 60 degrees F.
4. For large reinforcing bars No. 8 or greater embedded 18 diameters or more, verify hole diameter with manufacturer.
5. Vinyl Ester Adhesive: As recommended by manufacturer.

D. Obstructions in Drill Path:

1. When existing reinforcing steel is encountered during drilling and when approved by RESIDENT ENGINEER, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter; or redrill hole 1 inch from original location, beginning in the same line at the surface, redirecting the drill to miss reinforcing steel.
2. Place dowels in both the misdrilled hole and the new one.
3. When using epoxy anchors, dowels may be prebend prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
4. Bent Bar Dowels: Where edge distances are critical, and striking reinforcing steel is likely, drill hole at 10-degree angle or less and use prebend reinforcing bars.

3.4 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at site in accordance with Section 01640, MANUFACTURERS' SERVICES, for installation assistance, inspection, and certification of proper installation.

END OF SECTION

SECTION 03251
EXPANSION, CONSTRUCTION, AND CONTROL JOINTS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Plastic Type Water Stops: Details of splices to be used and method of securing water stop in the forms and supporting water stop so as to maintain proper orientation and location during concrete placement.
2. Construction Joints: Layout and location indicating type to be used.
3. Water stop.

B. Quality Control Submittals: Water stop manufacturer's written instructions for product shipment, storage, handling, installation field splices, and repair.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Verify that water stops delivered are in accordance with cross-section dimensions as shown and manufacturer's *product data* prior to unloading and storing onsite.

PART 2 PRODUCTS

2.1 PLASTIC WATER STOP

A. Extruded from an elastomeric plastic compound of which the basic resin shall be polyvinyl chloride (PVC). Reclaimed PVC in the compound is not acceptable.

B. Specific Gravity: Approximately 1.37.

C. Shore Durometer Type A Hardness: Approximately 80.

D. Performance Requirements: Corps of Engineers' Specification CRD-C-572.

E. Type: Center bulb with a number of parallel ribs or protrusions on each side of strip center.

F. Corrugated or tapered type water stops are not acceptable.

G. Thickness: Constant from bulb edge to the outside stop edge.

H. Minimum Weight per Foot of Water Stop:

1. 0.90 pound for 3/16 inch by 4 inch.
2. 1.62 pounds for 3/8 inch by 6 inch.
3. 2.30 pounds for 3/8 inch by 9 inch.

I. Manufacturers and Catalog Numbers:

1. Vulcan Metal Products, Inc., Construction Materials Division, Birmingham, AL; Catalog No. 3/81-15M: Type 8067 (4 inch by 3/16 inch), Type 8069 (6 inch by 3/8 inch), and Type 8070 (9 inch by 3/8 inch).
2. Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN (1987): No. RB6-38H (6 inch by 3/8 inch) and No. RB9-38H (9 inch by 3/8 inch).
3. Greenstreak Plastic Products, St. Louis, MO; Catalog No. 03250/ GRD (1987): Style 732 (6 inch by 3/8 inch) and Style 735 (9 inch by 3/8 inch).
4. A. C. Horn, Inc., Beltsville, MD; Catalog No. CSP-162 (1987): Type 3 (4 inch by 3/16 inch), Type 9 (6 inch by 3/8 inch), and Type 10 (3/8 inch by 9 inch).

2.2 WIRE LOOPED PLASTIC WATER STOP

A. Furnish as an alternative to plastic water stops.

B. Same material and geometry as plastic water stops.

C. Furnish with continuous galvanized wire looping at edge for convenience in positioning and securing stop in place in the forms.

D. Manufacturers and Catalog Numbers: Paul Murphy Plastics, Roseville, MI; "Wire Stop Water Stop"; geometry numbers ACR 6380, ACR 9380, as shown on Paul Murphy Plastics Co. Drawing No. CCP-120-12M dated 12-89 or Greenstock Hydrotite (modified chloroprene rubber).

2.3 GASKET WATER STOP

A. Manufacturer: BBZ, U.S.A., Southing, CT; Duroseal Gasket Waterstop, Type C.

2.4 BOND BREAKER

A. Tape for Expansion Joints: Adhesive-backed glazed butyl or polyethylene tape, same width as the joint, that will adhere to the premolded joint material or concrete surface.

B. Use either bond breaker tape or a bond prevention material as specified in Section 03300, CAST-IN-PLACE CONCRETE, except where a tape is specifically called for.

2.5 PREMOLDED JOINT FILLER

A. Bituminous Type: ASTM D994-71e or D1751-83.

B. Sponge Rubber: Neoprene, closed-cell, expanded; ASTM D1056-85, Type 2C5, with a compression deflection, 25 percent deflection (limits), 119 to 168 kPa (17 to 24 psi) minimum.

1. Manufacturer and Product: Rubatex Corp.; R45IN.

2.6 ACCESSORIES

A. Joint Sealants: As specified in Section 07900, JOINT SEALANTS.

B. Nonshrink Grout:

1. As specified in Section 03600, GROUT.
2. Compatible with joint sealant.

C. Roofing Felt: ASTM D226-89, Type II, 30-pound asphalt-saturated or equal weight of ASTM D227-89 coal-tar saturated felt.

D. Reinforcing Steel: As specified in Section 03210, REINFORCING STEEL.

PART 3 EXECUTION

3.1 GENERAL

A. Construct straight joints; make vertical or horizontal, except where walls intersect sloping floors.

B. Commence concrete placement after the joint preparation is complete.

C. Time Between Concrete Pours: As specified in Section 03300, CAST-IN-PLACE CONCRETE.

3.2 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface:

1. Remove laitance and spillage from reinforcing steel and dowels.
2. Roughen surface to a minimum of 1/4-inch amplitude:
   a. Sandblast after the concrete has fully cured.
   b. Water blast after the concrete has partially cured.
   c. Green cut fresh concrete with high pressure water and hand tools.
3. Perform cleaning so as not to damage water stop, if one is present.

3.3 INSTALLATION OF WATER STOPS

A. General:

1. Join water stops at intersections to provide continuous seal.
2. Center water stop on joint.
3. Secure water stop in correct position to avoid displacement during concrete placement.
4. Repair or replace damaged water stop.
5. Place concrete and vibrate to obtain impervious concrete in the vicinity of all joints.
6. Joints in Footings and Slabs:
   a. Ensure that space beneath plastic water stop is completely filled with concrete.
   b. During concrete placement, make a visual inspection of the entire water stop area.
   c. Limit concrete placement to elevation of water stop in first pass, vibrate the concrete under the water stop, lift the water stop to confirm full consolidation without voids, then place remaining concrete to full height of slab.
   d. Apply procedure to full length of plastic water stops.

B. Plastic Water Stop:

1. Install in accordance with manufacturer's written instructions.
2. Splice in accordance with the water stop manufacturer's written instructions using a thermostatically controlled heating iron. Butt splice unless specifically detailed otherwise.
   a. Allow at least 10 minutes before the new splice is pulled or strained in any way.
   b. Finished splices shall provide a cross-section that is dense and free of porosity with tensile strength of not less than 80 percent of the unspliced materials.
3. Wire looped plastic water stop may be substituted for plastic water stop.

C. Gasket Water Stop:

1. Install between reinforcing steel and wet face of wall.

2. Use manufacturer's standard adhesive to attach to joint surface.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 DEFINITIONS

A. Architectural Concrete: Concrete surfaces that are exposed and can be seen inside or outside of structures regardless whether concrete is above water, dry at all times, or can be seen when structure is drained.

B. *Defective* Areas: Surface defects that include honeycomb, rock pockets, indentations, cracks 0.005-inch wide and larger, and cracks that leak in water-retaining structures, spalls, chips, air bubbles, pinholes, bug holes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins and other projections, form popouts, texture irregularities, and stains and other color variations that cannot be removed by cleaning.

C. New Concrete: Less than 60 days old.

D. MAG: Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction.

1.2 SUBMITTALS

A. Shop Drawings:

1. Product Data: Admixtures, bonding agent, bond breaker, and patching materials.
2. Design Data: Concrete mix designs signed by qualified mix designer.
3. Placement Drawings: Concrete, identifying location of each type of construction joint.
4. Gradation for coarse and fine aggregates, and combined together. List gradings, percent passing through each sieve size.
5. Detailed plan for cold weather curing and protection of concrete placed and cured in weather below 40 degrees F.

B. Quality Control Submittals:

1. Proposed application schedule and instructions for patching materials.
2. Manufacturers' Certificate of Compliance:
   a. Portland cement.
   b. Admixtures.
   c. Fly ash.
   d. Aggregates.
   e. Bonding agent.
   f. Bond breaker.
   g. Patching materials.
3. Statements of Qualification:
   a. CONTRACTOR's resident superintendent for concrete installation.

b. Mix designer.
c. Batch plant.

4. Test Reports:
   a. Admixtures, test reports showing chemical ingredients and percentage of chloride in each admixture and fly ash.
   b. Source test analysis report for fly ash.
   c. Statement identifying aggregates reactivity and aggregate effects on concrete finish and appearance. Showing total chloride in each component of aggregates utilizing grinding to 50-mesh screen and determination of total chloride. Use Florida DOT method.
   d. For each trial mix design and signed by qualified mix designer.
   e. Cylinder test results from laboratory mixes.
5. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at site.
   b. Record of drum revolution counter, type, brand, test certification, and amount of fly ash if used in accordance with ASTM C94-90, Section 16.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. CONTRACTOR's Resident Superintendent for Concrete Installation:
   a. Supervised successful construction of at least three large volume concrete projects in similar environmental conditions.
2. Mix Designer: Licensed professional engineer registered in the state of Project.
3. Batch Plant: Currently certified by the National Ready Mixed Concrete Association.

B. Preinstallation Meetings:

1. Required Meeting Attendees:
   a. CONTRACTOR.
   b. Ready-mix producer.
   c. Admixture representative.
   d. Testing personnel.
   e. RESIDENT ENGINEER.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify RESIDENT ENGINEER of location and time.
3. Agenda shall include:
   a. Admixture types, dosage, performance, and redosing at site.
   b. Mix designs, test of mixes, and Submittals.
   c. Placement methods, techniques, equipment, consolidation, and form pressures.
   d. Slump and placement time to maintain slump.
   e. Finish, curing, and water retention.
   f. Other specified requirements requiring coordination.
4. Conference minutes as specified in Section 01040, COORDINATION.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Placement:

1. Do not place concrete when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling, without special protection as specified or approved by RESIDENT ENGINEER.
2. Do not place concrete against frozen earth or ice, or against forms and reinforcement with frost or ice present.
3. Provide heated enclosures when air temperatures are below 40 degrees F.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: Furnish from one source.

1. Portland Cement Type II:
   a. Meet ASTM C150-89.
   b. Alkalies: Maximum 0.60 percent.

B. Aggregates: Furnish from one source.

1. Natural Aggregates:
   a. Free from deleterious coatings and substances in accordance with ASTM C33-90, except as modified herein.
   b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
2. Nonpotentially Reactive: In accordance with ASTM C33-90, Appendix XI, paragraph X1.1.
3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33-90 and ASTM C88-90 using sodium sulfate solution.
4. Fine Aggregates:
   a. Clean, sharp, natural sand.
   b. ASTM C33-90.
   c. Materials Passing 200 Sieve: 4 percent maximum.
   d. Limit deleterious substances in accordance with ASTM C33-90, Table 1 with material finer than 200 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
5. Coarse Aggregate:
   a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
   b. Materials Passing 200 Sieve: 0.5 percent maximum.
   c. Limit deleterious substances in accordance with ASTM C33-90, Table 3 for exposed architectural concrete.

C. Admixtures: Furnish from one manufacturer.

1. Characteristics: Compatible with each other and free of chlorides or other corrosive chemicals.
2. Air-Entraining Admixture:
   a. ASTM C260-86, nontoxic after 30 days and contain no chlorides.
   b. Concrete with air-entrainment admixture added shall maintain air percentage as batched, within plus or minus 2 percent for time required for placement into structure.
3. Water-Reducing Admixtures: ASTM C494-90, Type A or Type D.
   a. Manufacturers and Products:
      1) Master Builders, Inc., Cleveland, OH; Pozzolith or Pozzolith Polyheed.
      2) W. R. Grace & Co., Cambridge, MA; WRDA-64
      3) Euclid Chemical Co., Cleveland, OH; Eucon WR-90.
4. Superplasticizers:
   a. ASTM C494-90.
   b. Hold slump of 5 inches or greater for time required for placement into structure with water-cement ratio.
   c. Furnish type as recommended by manufacturer for allowed temperature ranges.
   d. Type F or G.
   e. Manufacturers and Products:
      1) Master Builders, Inc., Cleveland, OH; Rheobuild or Pozzolith Polyheed at dosage greater than 10 ounces per 100 pounds of cement.
      2) W. R. Grace & Co., Cambridge, MA; WRDA-19.
      3) Euclid Chemical Co., Cleveland, OH; Eucon Super F or 537G.
      4) No "or-equal" or substitute products will be considered.
5. Pozzolan (Fly Ash): Class F fly ash in accordance with ASTM C618-91, Table 1 and 2, except as modified herein:
   a. Loss on Ignition: Maximum 3 percent.
   b. Water Requirement: Maximum 100 percent of control.
   c. $\frac{CaO\ (\%)-5}{Fe_2O_3(\%)}$: Maximum 1.5
   d. ASTM C618-91, Table 1A apply when aggregates or portion of coarse or fine aggregates used are reactive as specified under paragraph Aggregates.
   e. ASTM C618-91, Table 2A, Reactivity with Cement Alkalies, apply when aggregates or portions of aggregates are reactive as specified under paragraph Aggregates.
   f. ASTM C618-91, Table 2A, Uniformity Requirements, apply when loss on ignition of fly ash furnished exceeds 3 percent.
6. For fly ash not meeting the requirements of the chemical ratio listed above, furnish the following:
   a. Test fly ash in accordance with ASTM C1012-89.
   b. Furnish test data confirming fly ash in combination with cement used meets strength requirements and is compatible with air-entraining agents and other additives.

D. Water: Clean and potable containing less than 50 ppm of chlorides.

2.2 ANCILLARY MATERIALS

A. Bonding Agent: Furnish as recommended by manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.

1. Manufacturers:
   a. Master Builders Technologies, Cleveland, OH.
   b. Sika Chemical Corp., Lyndhurst, NJ.
   c. Euclid Chemical Co., Cleveland, OH.

B. Bond Breaker: Nonstaining type, providing a positive bond prevention.

1. Manufacturers and Products:
   a. Williams Distributors, Inc., Seattle, WA; Williams Tilt-Up Compound.
   b. SCA Construction Supply Div., Superior Concrete Accessories, Franklin Park, IL; Silcoseal 77.
   c. Burke Co., San Mateo, CA; Burke Clean Lift Bond Breaker or Burke Tilt Free Bond Breaker.

C. Patching Material: Contain no chlorides or other chemicals causing steel corrosion.

2.3 CONCRETE MIX DESIGN

A. Design: Select and proportion ingredients using trial batches; sample, cure and test concrete mix through an approved independent testing laboratory in accordance ACI 309-89 per ACI 211.1-91.

1. Concrete Compressive Strength, F'c:
   a. 4,000 psi at 28 days, unless otherwise shown. (MAG Class AA, except as modified in this Specification).
   b. Design lab-cured trial mix cylinders.
   c. Use additional cement or cement plus fly ash above minimum specified if required to meet average compressive strength, F'cr.
   d. Use F'cr as basis for selection of concrete proportions as set forth in Chapter 5 of ACI 318-89 and commentary ACI 318R-89.
   e. F'cr: Equal to F'c plus 1,200 when data is not available to establish standard deviation.
2. Concrete Fill:
   a. Design for 2,500 psi at 28 days using 1-inch aggregate (MAG Class B), 4-inch maximum slump and 0.50 maximum water-cement ratio.
   b. Use water-reducing admixture.

B. Proportions:

1. Design mix to meet aesthetic and structural concrete requirements.
2. In accordance with ACI 211.1-89, unless specified otherwise.

C. Truck Mixers:

1. Equip with electrically actuated counters to readily verify number of revolutions of drum or blades.
2. Counter:
   a. Resettable, recording type, mounted in driver's cab.
   b. Actuated at time of starting mixers at mixing speeds.
3. Truck mixer operation shall furnish a concrete batch as discharged that is homogeneous with respect to consistency, mix, and grading.
4. If slump tests taken at approximately 1/4 and 3/4 points of load during discharge give slumps differing by more than 2 inches when specified, slump is more than 4 inches, discontinue use of truck mixer unless causing condition is corrected and satisfactory performance is verified by additional slump tests.
5. Before attempting to reuse unit, check mechanical details of mixer, such as water measuring, and discharge apparatus, condition of blades, speed of rotation, general mechanical condition of unit, admixture dispensing equipment, and clearance of drum.
6. Do not use nonagitating or combination truck and trailer equipment for transporting ready-mixed concrete.
7. Concrete Volume in Truck:
   a. Limit to 63 percent of total volume capacity in accordance with ASTM C94-90 when truck mixed.
   b. Limit to 80 percent of total volume capacity when central mixed.
8. Mix each batch of concrete in truck mixer for minimum 70 revolutions of drum or blades at rate of rotation designated by equipment manufacturer.
9. Perform additional mixing, if required, at speed designated by equipment manufacturer as agitating speed.
10. Place materials, including mixing water, in mixer drum before actuating the revolution counter for determining number of mixing revolutions.

D. Aggregates: Thoroughly and uniformly wash before use.

E. Admixtures:

1. Air-Entraining Admixture: Add at plant through manufacturer-approved dispensing equipment.
2. Water Reducers: Add prior to addition of superplasticizer.
3. Superplasticizers and Air-Entraining Admixtures:
   a. Add at concrete plant only through equipment furnished or approved by admixture manufacturer.
   b. Accomplish variations in slump, working time, and air content for flowable mixes by increasing or reducing superplasticizer dose or air-entraining admixture dose at ready-mix plant only.
   c. Equipment shall provide for easy and quick visual verification of admixture amount used for each dose.
   d. Add discharge amount to each load of concrete into separate dispensing container, verify amount is correct, then add to concrete.

e. Additional dosage of superplasticizer may be added in the field using manufacturer-approved dispensing when unexpected delays cause too great of a slump loss.

2.5 SOURCE QUALITY CONTROL

A. Cement: Test for total chloride content.

B. Fly Ash: Test in accordance with ASTM C311-90.

C. Batch Plant Inspection: RESIDENT ENGINEER shall have access to and have the right to inspect batch plants, cement mills, and supply facilities of Suppliers, manufacturers, and Subcontractors, providing products included in these Specifications.

1. Weighing Scales: Tested and certified within tolerances set forth in the National Bureau of Standards Handbook No. 44.
2. Batch Plant Equipment: Either semiautomatic or fully automatic in accordance with ASTM C94-90.

PART 3 EXECUTION

3.1 PLACING CONCRETE

A. Preparation: Meet requirements and recommendations of ACI 304R-89 and ACI 301-89, except as modified herein.

B. Inspection: Notify RESIDENT ENGINEER at least 1 full working day in advance before starting to place concrete.

C. Discharge Time:

1. As determined by set time, do not exceed 1-1/2 hours after adding cement to water unless special approved time delay admixtures are used. Coordinate information with admixture manufacturer and RESIDENT ENGINEER prior to placing concrete.
2. Adjust slump or air content at site by adding admixtures for particular load when approved by RESIDENT ENGINEER, then adjust plant dose rest of placement. Additional dosage at site shall be through an approved dispenser supplied by admixture manufacturer.
3. Maintain required slump throughout time of concrete placement and consolidation. Discontinue use of superplasticizer if it fails to maintain slump in required range for the length of time required. Redesign mix adjusting set control admixtures to maintain setting time in the range required.

D. Placement into Formwork:

1. Before depositing concrete, remove debris from space to be occupied by concrete.
2. Prior to placement of concrete, dampen fill under slabs on ground, dampen sand where vapor retarder is specified, and dampen wood forms.

3. Reinforcement: Secure in position before placing concrete.
4. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
5. Use placement devices, for example, chutes, pouring spouts, and pumps.
6. Vertical Free Fall Drop to Final Placement: 5 feet in forms, 8-inch or less wide and 8 feet in forms wider than 8 inches, except as specified.
   a. Superplasticized Mixes: Up to 15 feet if slump is over 6 inches.
   b. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
   c. Free fall limit to prevent segregation caused by aggregates hitting reinforcing steel.
7. Do not use aluminum conveying devices.
8. Provide sufficient illumination for interior of forms so concrete at places of deposit are visible permitting confirmation of consolidation quality.
9. Joints in Footings and Slabs:
   a. Ensure space beneath plastic water stop completely fills with concrete.
   b. During concrete placement, make visual inspection of entire water stop area.
   c. Limit concrete placement to elevation of water stop in first pass, vibrate concrete under water stop, lift water stop to confirm full consolidation without voids, place remaining concrete to full height of slab.
   d. Apply procedure to full length of water stops.
10. If reinforcement is in direct sunlight or is more than 20 degrees F higher in temperature than concrete temperature before placement, wet reinforcement with water fog spray before placing concrete to cool reinforcement.
11. Round off top exposed edges of walls with a 1/4-inch radius steel edging tool.

E. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
4. Conveyor Belts:
   a. Approved by RESIDENT ENGINEER.
   b. Wipe clean with device which does not allow mortar to adhere to belt.
   c. Cover conveyor belts and chutes.

F. Retempering: Not permitted for concrete where cement has partially hydrated.

G. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to assure completion of concrete placement without cold joints in case of a primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

H. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change due to shrinkage.
2. Where expansion joints or control joints are not shown or where expansion joints or control joints are spaced at more than 60 feet, or where wall expansion or control joints are spaced more than 30 feet from wall corners or intersections, provide intermediate construction joints at maximum spacing of 40 feet.
3. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.

I. Minimum Time Between Adjacent Placements:

1. Construction Joints: 14 days.
2. Control Joints: 6 days.
3. Expansion Joints: 1 day.
4. At least 2 hours shall elapse after depositing concrete in long columns and walls thicker than 8 inches before depositing concrete in beams, girders, or slabs supported thereon.
5. For columns and walls, 10 feet in height or less, wait at least 45 minutes prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

J. Removal of Water: Remove water from space to be occupied by concrete.

K. Consolidation and Visual Observation:

1. Consolidate concrete with internal vibrators with minimum frequency of 8,000 cycles per minute and amplitude required to consolidate concrete in section being placed.
2. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.
3. Consolidation Equipment and Methods: ACI 309R-87.
4. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
5. Vibration consolidation shall not exceed a distance of 5 feet from point of placement.

6. Vibrate concrete in vicinity of joints to obtain impervious concrete there.

L. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R-89.
2. Placement frequency shall be such that lift lines will not be visible.
3. Maintain concrete temperature below 80 degrees F at time of placement. Ingredients may be cooled before mixing.
4. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.
5. Prevent differential temperature between reinforcing steel and concrete.
6. Evaporation Retardant: As specified in Section 03370, CONCRETE CURING.

M. Cold Weather:

1. Maintain surface temperature of concrete above 40 degrees F and cure concrete as specified in Section 03370, CONCRETE CURING, for minimum of 7 days.
2. Provide maximum and minimum thermometers placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work.
3. In accordance with ACI 306R-88 and ACI 318-89.
4. External Heating Units:
   a. Vent heating units to atmosphere, and do not locally heat or dry concrete. Where water cure is specified, maintain wet condition.
   b. Do not exhaust flue gases directly into an enclosed area to prevent concentrated carbon dioxide from causing concrete carbonation.

3.2 CONCRETE BONDING

A. To New Concrete Wall Horizontal Construction Joints:

1. Thoroughly clean and saturate joint with water.
2. Cover horizontal wall surfaces with minimum 2 inches of grout, as specified in Section 03600, GROUT, and immediately place concrete.
3. Limit concrete lift placed immediately on top of grout to 12 inches thick.
4. Thoroughly vibrate to mix and consolidate grout and concrete together.

B. To Old Concrete:

1. Mechanically roughen existing concrete surfaces to a clean, rough surface using a "Blastrac" by Wheelabrator-Frye, Inc.; or "Porta-Shotblast" by Nelco Manufacturing Corp, to remove existing concrete surface, and provide a minimum roughness profile of 1/4-inch.

2. Saturate surface with water for 24 hours, cover with 2 inches of grout and place grout as specified for new concrete.

3.3 CONSTRUCTION JOINTS

A. As specified in Section 03251, EXPANSION, CONSTRUCTION, AND CONTROL JOINTS.

3.4 PATCHING

A. General:

1. Prior to starting patching work, obtain quantities of color-matched patching material and manufacturer's detailed instructions for use to provide a structural patch with finish to match adjacent surface.
2. Develop patching techniques with grout manufacturer on mockup panel.
3. Dress surface of patches that will remain exposed to view to match color and texture of adjacent surfaces. Patching of concrete shall provide a structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to RESIDENT ENGINEER.

B. Tie Holes:

1. Fill with Category I or II grout as specified in Section 03600, GROUT, except where sealant is shown. Use only enough water to dry pack.
2. Match color of adjacent concrete.
3. Compact grout using steel hammer and steel tool to drive grout to high density. Cure grout with water.

C. Alternate Form Ties—Through-Bolts:

1. Seal through-bolt hole by sandblasting or mechanically cleaning and roughening entire interior surface of hole, epoxy coating roughened surface and driving elastic vinyl plug and then dry packing entire hole on each side of plug with Category II grout, as specified in Section 03600, GROUT. Use only enough water to dry pack grout. Dry pack while epoxy is still tacky or remove epoxy by mechanical means and reapply new epoxy.
2. Fill through-bolt openings with Category II grout, as specified in Section 03600, GROUT.
3. Compact grout using steel hammer and steel tool to drive grout to high density. Cure grout with water.

D. *Defective* Areas:

1. Remove *defective* concrete to a depth of sound concrete.
2. Small shallow holes caused by air entrapment at surface of forms shall not be considered *defective* unless amount is so great as to be considered not the standard of the industry.

3. If chipping is required, make edges perpendicular to surface with a minimum of 1/2 inch in depth. Do not feather edges. Obtain RESIDENT ENGINEER's approval of chipping work.
4. Patch *defective* area to match appearance of adjacent concrete surfaces after cracks are filled.

E. Blockouts at Pipes or Other Penetrations:

1. Meet details shown or submit proposed blockouts for review.
2. Use nonshrink, nonmetallic grout, Category I or II.

3.5 CONCRETE WALL FINISHES

A. Ordinary Wall Finish:

1. Use on all walls unless shown otherwise.
2. Patch tie holes.
3. Knock off projections.
4. Patch *defective* areas.

B. Smooth Wall Finish:

1. Use on all exterior exposed walls to an elevation 1 foot below finished grade.
2. Patch tie holes.
3. Grind off projections, fins, and rough spots.
4. Patch *defective* areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.

3.6 CONCRETE SLAB FINISHES

A. General:

1. Do not use "jitterbugs" or other special tools designed for the purpose of forcing coarse aggregate away from the surface and allowing a layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
2. Do not dust surfaces with dry materials.
3. Use evaporation retardant.
4. Round off edges of slabs with a steel edging tool, except where a cove finish is shown. Steel edging tool radius shall be 1/4 inch.

B. Steel Troweled Finish:

1. Use on all slabs unless shown otherwise.
2. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation. Use evaporation retardant.
3. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float to true, even plane with no coarse aggregate visible.
4. Use sufficient pressure on wood floats to bring moisture to surface.

5. After surface moisture has disappeared, hand trowel concrete to produce smooth, impervious surface, free from trowel marks.
6. Burnish surface with an additional troweling. Final troweling shall produce a ringing sound from trowel.
7. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
8. Power Finishing:
   a. An approved power machine may be used in lieu of hand finishing in accordance with directions of machine manufacturer.
   b. Do not use power machine when concrete has not attained the necessary set to allow finishing without introducing high and low spots in slab.
   c. Do first steel troweling for slab S-1 finish by hand.

C. Wood Float Finish:

1. Finish for slabs to receive concrete fill and mortar setting beds.
2. Screed with straightedges to bring surface to required finish plane.
3. Wood float finish to compact and seal surface.
4. Remove laitance and leave surface clean.
5. Coordinate with other finish procedures.

D. Underside Elevated Slab Finish: When forming is removed, grind off projections on underside of slab and patch *defective* areas.

E. Light Broomed Finish: Finish concrete well equipment pads as specified for steel troweled finish, except omit final troweling and finish surface by drawing a fine-hair broom lightly across the surface.

1. Brooming: In long direction of slab, or, in the case of inclined slabs or surfaces, perpendicular to slope.

F. Concrete Curbs:

1. Float top surface of curb smooth, and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish.

3.7 BEAM AND COLUMN FINISHES

A. Beam:

1. Repair rock pockets.
2. Fill air voids.
3. Match smooth wall finish.

B. Column:

1. Fill air pockets.
2. Match smooth wall finish.

3.8 BACKFILL AGAINST WALLS

A. Do not backfill against walls until concrete has obtained 28-day compressive strength.

B. Place backfill simultaneously on both sides of wall, where required, to prevent differential pressures.

3.9 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Provide concrete for testing of slump, air content, and for making cylinders from the point of discharge into forms.
3. Evaluation will be in accordance with the MAG Specifications Sections 725.10 and 725.11 and these Specifications.
4. Specimens will be made, cured, and tested in accordance with ASTM C31-90a and ASTM C39-86.
5. Frequency of testing may be changed at discretion of RESIDENT ENGINEER.
6. Pumped Concrete: Take concrete samples for slump (ASTM C143-90a) and test cylinders (ASTM C31-90a and C39-86) and shrinkage specimens (ASTM C157-89) at placement (discharge) end of line.

B. Admixture Segregation Test: Test each truck prior to use on job.

1. Segregation Test Objective: Concrete with 5- to 9-inch slump must stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

C. Tolerances:

1. Measure and inspect walls and slabs for compliance with tolerances specified in Section 03100, CONCRETE FORMWORK.
2. Slab Finish Tolerances and Slope Tolerances:
   a. Slab flatness measurements will be made the day after slab is finished and before shoring is removed, to eliminate effects of shrinkage, curing, and deflection.
   b. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
   c. Compliance with designated limits in four of five consecutive measurements is satisfactory unless *defective* conditions are observed.

3.10 MANUFACTURER'S SERVICES

A. Provide the following representative at site in accordance with Section 01640, MANUFACTURERS' SERVICES, for installation assistance, inspection and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

1. Batch Plant Representative:
   a. Observe how concrete mixes are performing.
   b. Be present during first placement of each type of concrete mix.
   c. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout the Project.
   d. Establish control limits on concrete mix designs.
2. Admixture Manufacturer's Representative:
   a. Demonstrate special features, product performance, product mixing, testing, and placement or installation for each type of admixture.
   b. Observe how concrete mixes are performing.
   c. Be present during the first placement of each type of concrete mix.
   d. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout the Project, including instructions for redosing.
   e. Provide equipment for control of concrete redosing for air entrainment or superplasticizer at the site to maintain proper slump and air content if so needed.
3. Bonding Agent Manufacturer's Representative: Demonstrate product performance, product mixing, and placement.

3.11 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03370, CONCRETE CURING, and after applying final slab finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep slab clean and protect it from material and damage due to other construction work.

B. Patch and repair *defective* areas and areas damaged by construction.

END OF SECTION

SECTION 03370
CONCRETE CURING

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Curing methods proposed.
2. Manufacturers' data for the following products:
   a. Evaporation retardant.
   b. Curing compound.

B. Quality Control Submittals:

1. Curing Compound: Manufacturer's Certificate of Compliance showing moisture retention requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Curing Compound:

1. Solvent-based, high chlorinated rubber solids content curing compound meeting requirements of ASTM C309-89.
   a. Moisture Loss: 0.030 gm/square cm/72 hours maximum.
   b. Capable of meeting moisture retention with one coat.
2. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; Masterkure CR.
   b. Euclid Chemical Co., Cleveland, OH; Euco Super Floor Coat.
   c. No "or-equal" or substitute products will be considered.

B. Evaporation Retardant:

1. Optional: Fluorescent color tint that disappears completely upon drying.
2. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; CONFILM.
   b. Euclid Chemical Co., Cleveland, OH; Eucobar.
   c. No "or-equal" or substitute products will be considered.

C. Water: Clean and potable, containing less than 50 ppm of chlorides.

PART 3 EXECUTION

3.1 CURING OF CONCRETE

A. Use one of the following methods as approved by RESIDENT ENGINEER:

1. Walls:
   a. General: Where walls are to receive coatings, painting, cementitious material, or other similar finishes, or where solvent-based coatings are not permitted, use only water curing procedures.
   b. Method 1: Leave concrete forms in place and keep entire surfaces of forms and concrete wet for 10 days.
   c. Method 2: Apply curing compound, where allowed, immediately after removal of forms.
   d. Method 3: Continuously sprinkle with water 100 percent of exposed surfaces for 10 days starting immediately after removal of forms.
2. Slabs and Curbs:
   a. Method 1: Protect surface by water ponding for 10 days.
   b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 10 days.
   c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 10 days.
   d. Method 4: Continuously sprinkle exposed surface for 10 days.
   e. Other agreed upon method that will keep moisture present and uniform at all times on surface of slabs. Do not use curing compounds.
   f. Protect slabs during cold weather with plastic sheets or other material inside required heated enclosure if foot traffic is permitted on slabs.

B. Use only water curing methods where solvents in the curing compounds are prohibited by state or federal air quality laws.

C. Use only water curing where additional finishes such as clear sealer, hardeners, painting, and other special coatings are required.

3.2 EVAPORATION RETARDANT APPLICATION

A. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.

B. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.3 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at site in accordance with Section 01640, MANUFACTURERS' SERVICES, for installation assistance, inspection, and certification of proper installation for products specified.

B. Provide curing compound manufacturer's representative to demonstrate proper application of curing compound to show coverage in one coat.

END OF SECTION

SECTION 03600
GROUT

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Product data of grouts.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Compliance:
   a. Grout free from chlorides and other corrosion-causing chemicals.
   b. Nonshrink grout properties of Category II, verifying expansion at 3 or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
2. Manufacturer's Certificate of Proper Installation.
3. Statements of Qualification: Nonshrink grout manufacturer's representative.
4. Test Reports:
   a. Test report for 24-hour evaluation of nonshrink grout. Independent testing laboratory to certify that testing was conducted within the past 18 months.
   b. Test results and service report from the demonstration and training session, and from field tests.
   c. Field test reports and laboratory test results for field-drawn samples.

1.2 QUALIFICATIONS

A. Nonshrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this Project.

1.3 GUARANTEE

A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

B. Manufacturer guarantees participation with CONTRACTOR in replacing or repairing grout found *defective* due to faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.1 NONSHRINK GROUT SCHEDULE

A. Furnish nonshrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 to 100 deg F	20 min	Greater than 20 min
Filling tie holes	I	I	I
Blockouts for gate guides	I or II	I	II
Column baseplates	I or II	I	II
Through-bolt openings	II	II	II
Patching concrete walls	II	II	II

2.2 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating flowable fluid.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107-91:
   a. Flowable consistency 140 percent, five drops in 30 seconds, in accordance with ASTM C230-90.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; SET GROUT.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburge, OH; Sure-Grip High Performance Grout.

B. Category II:

1. Nonmetallic, nongas-liberating flowable fluid.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with CRD-C621-83 and ASTM C1107-91, Grade B:
   a. Fluid consistency 20 to 30 seconds in accordance with CRD-C611-81.
   b. Temperatures of 40, 80, and 100 degrees F.

5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 2,500 psi at 1 day, 4,500 psi at 3 days, and 7,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1- to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; Master Flow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.

2.3 GROUT FOR HORIZONTAL CONSTRUCTION JOINTS IN WALLS

A. Flowable, consisting of sand, water, and minimum 12 sacks of cement per cubic yard.

PART 3 EXECUTION

3.1 NONSHRINK GROUT

A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's representative training instructions.

B. Form Tie or Through-Bolt Holes: Provide nonshrink grout, Category I and II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes, coordinate dry pack dense grout application with vinyl plug in Section 03100, CONCRETE FORMWORK and bonding agent in Section 03300, CAST-IN-PLACE CONCRETE.

3.2 HORIZONTAL CONSTRUCTION JOINTS IN REINFORCED CONCRETE WALLS

A. Use positive measuring device such as a bucket or other device that will contain only enough sand-cement grout, for depositing in one place in wall to ensure that portion of form does not receive too much grout. Limit grout placement to 2-inch maximum thickness.

B. Do not deposit grout from pump hoses or large concrete buckets, unless inspection windows close to joint are available to allow visual measurement of grout thickness and means for excess grout removal are available.

3.3 FIELD QUALITY CONTROL

A. Evaluation and Acceptance of Nonshrink Grout:

1. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.
2. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Restraining caps for cube molds in accordance with CRD-C-621-83.

3. For large grout applications make three more cubes, one more flow cone test, including bleed test for each additional 25 cubic feet of nonshrink grout placed.
4. Consistency: As specified in Article 2.2 NONSHRINK GROUT. Reject grout with consistencies outside range requirements.
5. Segregation: As specified in Article 2.2 NONSHRINK GROUT. Reject grout when aggregate separates.
6. Nonshrink grout cubes shall test equal to or greater than minimum strength.
7. Strength Test Failures: Reject nonshrink grout work failing strength tests, remove and replace grout.
8. Perform bleeding test to demonstrate grout will not bleed.
9. Store cubes at 70 degrees F.
10. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with CRD-C621-83.

3.4 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative.
2. Provide and conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of nonshrink grout.
3. Coordinate necessary equipment and materials are available for demonstration.

B. Training:

1. Grout manufacturer's representative shall train CONTRACTOR to preform grout work.
2. Establish location at site and schedule time for grout manufacturer's demonstration and training session of proposed nonshrink grouts. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, e.g., baseplates and tie holes to provide actual on-the-job training.
3. Use minimum of five bags for grout Category II. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1, 3, and 28 days. Use remaining grout for final Work. Training includes methods for curing grout.
4. Mix sufficient grout Category I for minimum of 15 tie holes.
5. Transport test cubes to an independent test laboratory and obtain test reports.

3.5 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION," is part of this Specification.

1. 24-Hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

(Test Lab Name)

(Address)

(Phone No.)

24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain five bags of each type of grout.

1. From intended grout supplier for Project.
2. Five bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

A.	Product data and warranty information contained in company literature and data?	Yes____ No____
B.	Literature and bag information meet specified requirements?	Yes____ No____
C.	Manufacturer guarantees grout as specified in Article GUARANTEE?	Yes____ No____
D.	Guarantee extends beyond grout replacement value and allows participation with CONTRACTOR in replacing and repairing *defective* areas?	Yes____ No____
E.	Water demands and limits printed on bag?	Yes____ No____
F.	Mixing information printed on the bag?	Yes____ No____
G.	Temperature restrictions printed on bag?	Yes____ No____

*Rejection of a grout will occur if one or more answers are noted NO.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

Signature of Independent Testing Laboratory	Date Test Conducted

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Meet requirements of AISC.
2. Provide details showing:
   a. Members and their connections.
   b. Anchor bolt layouts.
   c. Hardened washer details.
   d. Schedules for fabrication procedures.
3. Name and address of manufacturer(s).
4. Product specifications.

B. Quality Control Submittals:

1. Welder Certifications:
   a. Submit for shop and field welders.
   b. Issued by recognized testing laboratory.
2. Weld Inspection Test Reports: Submit for review prior to completion of Work.
3. High-Strength Connection Bolts (Galvanized and Nongalvanized):
   a. Certificates of Compliance that products meet chemical and mechanical requirements of standards specified.
   b. Manufacturer's inspection test report results for production lot(s) furnished, to include:
      1) Tensile strength.
      2) Yield strength.
      3) Reduction of area.
      4) Elongation and hardness.
   c. Certified Mill Test Reports for Bolts and Nuts:
      1) Name and address of manufacturer.
      2) Bolts correctly marked.
      3) Marked bolts and nuts used in required mill tests and manufacturer's inspection tests.
4. Mill Certificates.
5. Methods proposed to resolve misalignment between anchor bolts and bolt holes in steel members.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Welders: Meet requirements of AWS D1.1-94 for procedures and qualifications of welders.

B. Regulatory Requirements: Comply with current provisions, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including "Commentary of the AISC Specification".
3. AISC "Specifications for Structural Joints Using ASTM A325-93a or ASTM A490-93 Bolts" approved by Research Council on Structural Connections of the Engineering Foundation, November 13, 1985; endorsed by American Institute of Steel Construction and Industrial Fasteners Institute.
4. AWS Structural Welding Code AWS D1.1-94 and "Standard Qualification Procedure".
5. Manual of Steel Construction, American Institute of Steel Construction, Inc.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.

B. Storage:

1. Protect structural steel members and packaged materials from corrosion and deterioration.
2. Store in dry area and not in direct contact with ground.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rolled Plates, Shapes, and Bars: ASTM A36-93a unless otherwise shown.

B. Structural Steel Pipe: ASTM A501-93, or ASTM A53-90b, Type E or S, Grade B.

C. Structural Tubing: ASTM A500-93, Grade B (fy equals 46 ksi); provide full length members without splices unless otherwise noted or approved.

2.2 FASTENERS

A. Anchor Bolts: As specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

B. High-Strength Connection Bolts: ASTM A325-93 or ASTM A490-93, Type 3 bolts, with the length required when hardened washers are used.

C. Hardened Washers: ASTM F436-93, type to match bolt type and finish.

D. Welded Anchor Studs: Furnish headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded anchor studs (TAS) as shown.

1. Manufacturer: Nelson Stud Welding Co., Loraine, OH.

2.3 ANCILLARY MATERIALS

A. Surface Preparation and Primer: As specified in Section 09900, PAINTING.

B. Grout: As specified in Section 03600, GROUT.

2.4 FABRICATION

A. General:

1. Fabricate as shown on Drawings and in accordance with AISC Specifications, CONTRACTOR's erection requirements, and approved Shop Drawings.
2. Mark and match mark materials for field assembly.
3. Complete assembly, including bolting and welding of units, before start of finishing operations.
4. Fabricate to agree with field measurements.

B. Connections:

1. Shop Connections: Weld or bolt, as shown.
2. Develop full strength of members joined and meet requirements of AISC Standard Connections, unless otherwise shown.

C. Welded Construction: Comply with AWS D1.1-94 for procedures, appearance, and quality of welds, and methods used in correcting welding Work.

1. Butt Welds: Complete penetration unless otherwise specified.

D. Interface With Other Work:

1. Holes: As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members.
   a. No torch cut holes are permitted.
2. Weld threaded nuts to framing, and other specialty items as shown to receive other Work.

E. Shop Paint Primer:

1. Surface Preparation: Clean and remove slag from welds before painting.

2. Coat members with primer except at future field welds, bolt-ups, and concrete embedment.
3. Apply primer in accordance with Section 09900, PAINTING, within 8 hours after surface preparation.

2.5 SOURCE QUALITY CONTROL

A. Shop Inspection:

1. RESIDENT ENGINEER may inspect fabrication and shop assembly of members and high-strength bolted and welded connections, to perform tests and prepare test reports.
2. Furnish facilities for inspection of materials and workmanship. Provide RESIDENT ENGINEER with unlimited access to the Work.

PART 3 EXECUTION

3.1 ERECTION

A. Install CONTRACTOR designed temporary construction bracing to provide necessary support until all components are in place and construction is complete.

B. Sequence erection.

C. Meet requirements of AISC Specifications and Code of Standard Practice.

D. Hardened Washers:

1. Provide at locations required by Washer Requirements section of AISC Specification for Structural Joints using ASTM A325-94 or ASTM A490-94 Bolts.
2. Install under turned element (bolt head or nut) and between turned element and indicator washer protrusions.

E. High-Strength Connection Bolts: Use ASTM A325-94 bolts unless otherwise shown.

3.2 ANCHOR BOLTS

A. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.

B. Provide templates and other devices for presetting bolts and other anchors to accurate locations.

3.3 SETTING BASES AND BEARING PLATES

A. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.

B. Clean bottom surface of base and bearing plates.

C. Set loose and attached baseplates and bearing plates for structural members on wedges, leveling nuts, or other adjustable devices.

D. Tighten anchor bolts after supported members have been positioned and plumbed.

E. Grout Under Baseplates: As specified in Section 03600, GROUT, prior to placing loads on structure.

3.4 FIELD ASSEMBLY

A. Set structural frames accurately to lines and elevations shown.

B. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.

C. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.

D. Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

E. Level and plumb individual members of structure within AISC tolerances.

F. Establish required leveling and plumbing measurements on mean operating temperature of structure.

G. Bolt field connections except where welded or other connections are shown.

3.5 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, immediately notify RESIDENT ENGINEER for selection of industry standard remedy method:

1. Ream holes that must be enlarged to admit bolts and use oversized bolts.
2. Plug weld misaligned holes and redrill holes to admit standard size bolts.
3. Drill additional holes in the connection, conforming with AISC Standards for bolt spacing and end and edge distances, and add additional bolts.
4. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate a new member to ensure proper fit.

B. Do not enlarge incorrect sized or misaligned holes in members by burning or by use of drift pins.

3.6 MISFITS AT ANCHOR BOLTS

A. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved submittal.

B. Do not flame cut to enlarge holes.

3.7 GAS CUTTING

A. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.

1. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by RESIDENT ENGINEER.

B. Finish gas-cut sections equivalent to sheared appearance.

3.8 PAINTING

A. Touchup:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of slag and shop paint primer.
2. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application.

END OF SECTION

SECTION 05500
METAL FABRICATIONS AND CASTINGS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Metal fabrications, including welding and fastener information.
2. Specific instructions for all phases of installation including hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Samples:

1. Epoxy Anchors: Two self-contained epoxy adhesive cartridges for each batch of epoxy delivered to site, for independent testing.
2. Vinyl Ester Anchors: Two self-contained adhesive cartridges for each batch of adhesive delivered to site, for independent testing.

C. Quality Control Submittals:

1. Vinyl Ester and Epoxy Anchors:
   a. Manufacturer's Certificate of Compliance.
   b. Manufacturer's past project experience data.
   c. Test reports for each batch of vinyl ester or epoxy delivered to site.
   d. Manufacturer's Certificate of Qualification for installers.
   e. Current design load test data.
2. Welders: Evidence of certification.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Welders: Certified in accordance with AWS D1.1-92, Chapter 5.
2. Vinyl Ester and Epoxy Anchor Manufacturers: Experience on at least three similar projects within the last 3 years.
3. Vinyl Ester and Epoxy Anchor Installers: Trained and certified by manufacturer.

B. Regulatory Requirements:

1. Anchoring Systems: Current evaluation and acceptance reports by ICBO.

C. Welding Procedures: Follow the requirements of AWS D1.1-94 and AWS D1.2-90.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipment:

1. Insofar as practical, factory assemble items specified herein.
2. Package and clearly tag parts and assemblies that are of necessity shipped unassembled, in a manner that will protect materials from damage, and facilitate identification and field assembly.

B. Storage of Epoxy Adhesive:

1. Store epoxy cartridges on pallets or shelving in a covered storage area.
2. Control temperature above 60 degrees F and dispose of cartridges if shelf life has expired.

C. Storage of Vinyl Ester Products:

1. Store components on pallets or shelving in a covered storage area with locking door.
2. Control temperature within 41 to 77 degrees F and dispose of product if shelf life has expired.

PART 2 PRODUCTS

2.1 MATERIALS

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Specification
Steel Shapes and Plates	A36-91
Steel Pipe	A501-89 or A53-90b, Type E or S, Grade B
Structural Steel Tubing	A500-90a, Grade B
Stainless Steel:	
Bars and Shapes	A276-92, AISI Type 316
Steel Plate, Sheet, and Strip	A167-92b, AISI Type 316
Bolts and Threaded Rods	A193-92, AISI Type 316, B8MN, B8M2, or B8M3
Nuts	A194-92a, AISI Type 316, B8MN, B8M2, or B8M3
Steel Bolts and Nuts:	
Carbon Steel	A307-92a or A36-90
High-Strength	A325-92a, Type 3

Item	ASTM Specification
Galvanized Steel Bolts and Nuts	A307-92a or A36-91, with A153-82 Zinc Coating, and ANSI B1.1-89
Eyebolts	A489-90
Threaded Rods	A36-91
Flat Washers (Unhardened)	F844-90; use A153-82 for Zinc Coating
Flat Washers (Hardened)	F436-92
Aluminum, Structural Shapes, and Plates	B209-92a and B308-92a, Alloy 6061-T6
Aluminum Bolts and Nuts	F468-90b, Alloy 2024-T4
Cast Iron	A48-92, Class 35

B. Checkered Plates:

1. Steel: Federal Specification QQ-F-461, Class I, minimum 1/4 inch; galvanize after fabrication.
2. Aluminum: ASTM B209-92a, Alloy 6061-T6, tread plate, thickness minimum 1/4 inch.

C. Anchor Bolts: As shown in FASTENER SCHEDULE at the end of this section and as specified in various equipment sections.

D. Anchor Bolt Sleeves:

1. High Density Polyethylene Plastic:
   a. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.
   b. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
   c. Material requirements:
      1) Plastic: High density polyethylene.
      2) Density: ASTM D1505-90.
      3) Vicat Softening Point: ASTM D1525-91.
      4) Brittleness Temperature: ASTM D746-79 (1987).
   d. Manufacturer: Sinco West, Simi Valley, CA.
2. Fabricated Steel Sleeve: A36-91 steel.

E. Antiseizing Lubricant: Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper. Use Loc Tite Co., Permatex.

F. Neoprene Gasket:

1. ASTM D1056-91 RE-41-E, soft, closed-cell, neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturers and Product:
   a. Rubatex Division of Great American Industries, Bedford, VA; Rubatex No. R-411-N.
   b. Garlock Manufacturing, San Francisco, CA.

G. Pipe Sleeves: ASTM A53-90b, Schedule 40 steel pipe sleeves with continuously welded 3/16-inch thick seep ring of outside diameter 3 inches greater than sleeve outside diameter. Galvanize in accordance with ASTM A123-89a.

2.2 ANCHORING SYSTEMS FOR CURED CONCRETE

A. Wedge Anchors:

1. AISI Type 316 stainless steel throughout.
2. Manufacturers and Products:
   a. ITW Ramset/Red Head, Wood Dale, IL 60191; Trubolt Wedge Anchor.
   b. Hilti, Inc., Tulsa, OK 74121; Kwik-Bolt II Steel Anchor.
   c. Wej-It Corp., Tulsa, OK 74152; Wej-It Anchor Bolt.
   d. The Rawl Plug Co., New Rochele, NY 10802, Rawl Stud Anchor.

B. Expansion Anchors:

1. Self-drilling anchors, snap-off type or flush type.
2. Furnish anchors for use with galvanized bolts.
3. Nondrilling Anchors: Flush type for use with bolt, or stud type with projecting threaded stud.
4. Manufacturers and Product:
   a. ITW Ramset/Red Head, Wood Dale, IL 60191; Multi-Set Anchor.
   b. Hilti, Inc., Tulsa, OK 74121; Hilti HDI Drop-In Anchor.
   c. The Rawl Plug Co., New Rochele, NY 10802, Rawl Steel Drop-In and Rawl Saber Tooth Anchors.

C. Epoxy Anchors:

1. Anchor Rod: Stainless steel threaded rod free of grease, oil, or other deleterious material with a 45-degree chisel point.
2. Epoxy Adhesive:
   a. ASTM C881-90, Type 1, Grade 3, Class A, B, or C.
   b. Two-component, 100 percent solids, nonsag, paste, insensitive to moisture, designed to be used in adverse environments and gray in color.

c. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.

3. Mixed Epoxy Adhesive: Nonsag paste consistency, with ability to remain in a 1-inch diameter overhead drilled hole without runout, having the following properties:
   a. Slant Shear Strength, ASTM C881-90, No Failure In Bond Line, Dry/Moist Conditions: 5,000 psi.
   b. Compressive Strength, ASTM D695-91: 14,000 psi, minimum.
   c. Tensile Strength, ASTM D695-91: 4,500 psi.
   d. Heat Deflection Temperature, ASTM D648 E2-82: 135 degrees F, minimum.
4. Epoxy Adhesive Packaging:
   a. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
   b. Cartridge Markings: Include manufacturer's name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
5. Manufacturers and Products:
   a. Adhesives Technology Corp., Kent, WA 98031; Anchor-It Fastening Systems, HS 200 Epoxy Resin.
   b. ITW Ramset/Red Head, Wood Dale, IL 60191; Epcon Ceramic 6 Epoxy Anchor System.
   c. Covert Operations, Long Beach, CA 90853; CIA Epoxy Anchors with viscosity to suit application.
   d. Rawl Plug Co., New Rochele, NY 10802; Rawl/Sika Foil Fast Epoxy Injection Gel System.

D. Adhesive Anchors:

1. Two-component vinyl ester adhesive, insensitive to moisture, designed to be installed in adverse environments.
2. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Container Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
4. Anchor rods as shown.
5. Manufacturer and Product: Hilti, Inc., Tulsa, OK 74121; HIT Doweling Anchor System (HIT C-100).

2.3 FLAT BAR LADDERS

A. Punch rails, pass rungs through rails, and weld on outside.

B. Weld brackets to the ladder for fastening ladder to wall.

C. Hot-dip galvanize steel after fabrication in accordance with ASTM A123-89a and A385-80.

D. Ladder Safety Post: Equip ladders beneath sidewalk doors, roof hatches, skylights, or other floor or roof openings, and as shown on the Drawings, with telescoping tubular safety post, spring balanced and automatically locking in the raised position, with release lever for unlocking.

1. Hot-dip galvanized post.
2. Spring Mechanism: Corrosion-resistant steel alloy.
3. Furnish dissimilar metal protective coatings at connections.
4. Manufacturer and Product: Bilco Co., New Haven, CT; "Ladder Up" to fit ladder rungs.

2.4 FABRICATED UNITS

A. T-Handled Operating Wrenches: Galvanized operating wrenches, 4 feet total length, No. A-2461 as manufactured by Mueller.

2.5 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Material Thinner than 1/8 Inch: Either galvanize before fabrication in accordance with ASTM A525-91b, Coating Designation G210, or after fabrication in accordance with ASTM A123-89a, except the weight of zinc coating shall average minimum 1.2 ounces per square foot of actual surface area with no individual specimen having a weight of less than 1 ounce per square foot.

B. Materials: Use steel shapes unless otherwise noted.

C. Fabrication:

1. Fit and assemble in largest practical sections for delivery to site.
2. Fabricate as shown on Drawings and in accordance with ASTM A385-80.
3. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
4. Use fasteners as shown or scheduled.
5. Grind cut edges smooth and straight.

D. Finish:

1. ASTM A123-89a hot-dip galvanize after fabrication, unless otherwise noted.

2. For items embedded in concrete, coat with System No. 2 as specified in Section 09900, PAINTING.
3. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.
4. Prepare galvanized surfaces to be painted in the field approximately 48 to 72 hours before painting as specified in Section 09900, PAINTING, System No. 10, Galvanized Metal Conditioning.
5. Completely seal edges of tightly contacting surfaces, where galvanizing is required, by welding before galvanizing.

E. Watertight: Where required or shown, furnish rubatex gaskets of a type that is satisfactory for use in contact with sewage. Cover full bearing surfaces.

F. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

G. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

H. Aluminum:

1. Fabricate in accordance with the Aluminum Association Standards and manufacturers' recommendations as approved.
2. Grind smooth sheared edges exposed in finished work.

2.6 WELDING

A. Steel:

1. Meet requirements of AWS D1.1-92 for techniques of welding employed, appearance, quality of welds made, and the methods of correcting *defective* work.
2. Meet visual acceptance standards of AWS D1.1-92, paragraph 8.15.1.
3. Complete welding before applying finish.

B. Aluminum: Meet requirements of AWS D1.2.

PART 3 EXECUTION

3.1 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb or level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Erect steel in accordance with applicable portions of AISC Code of Standard Practice, except as modified.
4. Install manufactured products in accordance with manufacturer's recommendations.

5. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
6. Field weld components indicated.
7. Perform field welding in accordance with AWS D1.1-92.
8. Obtain RESIDENT ENGINEER approval prior to site cutting or making adjustments not scheduled.
9. After erection, apply prime or galvanize coating to welds, abrasions, and surfaces not in contact with concrete.

B. Erection Tolerances:

1. Maximum Variation from Plumb: 1/4 inch per 10-foot story, noncumulative.
2. Maximum Offset from True Alignment: 1/4 inch.

C. Aluminum:

1. Erection: In accordance with the Aluminum Association specifications.
2. Do not remove mill markings from concealed surfaces.
3. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.

D. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.

3.2 ANCHOR BOLTS

A. Accurately locate and hold anchor bolts in place with templates at the time concrete is placed.

B. Use sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt. Minimum bolt size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.3 ANCHORING SYSTEMS FOR CONCRETE

A. Begin installation only after concrete or masonry receiving anchors have attained design strength.

B. Do not install an anchor closer than six times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.

C. Install in accordance with manufacturer's specific quality control submittal instructions. Hole diameters are critical to installation, use only drills recommended by anchor manufacturer. Follow manufacturer's safe handling instructions.

D. Epoxy or Adhesive Anchors: Do not install when temperature of concrete is below 40 degrees F or above 100 degrees F, unless stated otherwise in manufacturer's written instructions.

E. Follow specific manufacturer safe handling practices when handling and installing concrete anchors.

3.4 ELECTROLYTIC PROTECTION

A. Aluminum:

1. Where in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces as specified in Section 09900, PAINTING, System No. 27.
2. Allow paint to dry before installation of the material.
3. Protect painted surfaces during installation.
4. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

B. Where titanium equipment is in contact with concrete or dissimilar metals, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70 durometer hardness.

3.5 MANUFACTURERS' SERVICES

A. Epoxy and Vinyl Ester Anchors: Conduct site training of installation personnel for safe and proper installation, handling, and storage of epoxy or vinyl ester adhesive system. Notify RESIDENT ENGINEER of time and place for sessions.

3.6 FASTENER SCHEDULE

A. Provide fasteners as follows:

Service Use and Location	Product	Remarks
Anchor Bolts Cast Into Concrete for Equipment Bases:		
All Areas	Stainless steel bolts, unless otherwise specified with equipment	

Service Use and Location	Product	Remarks
Submerged or Wet Areas	Stainless steel bolts with fusion bond coating unless otherwise specified with equipment	See System No. 29, Section 09900, PAINTING
Anchor Bolts Cast Into Concrete for Metal Fabrications and Structural Components:		
Dry or Protected Areas	Zinc-coated steel bolts	
Exterior, Wet, and Washdown Areas	Stainless steel bolts with fusion bond coating	See System No. 29, Section 09900, PAINTING
Anchors for Metal Components to Concrete; e.g., Electrical Panels and Equipment:		
Dry Areas	Galvanized or stainless steel wedge or expansion anchors	
Wet and Damp Areas	Epoxy or adhesive stainless steel anchors	
Submerged or Buried in Earth	Epoxy or adhesive stainless steel anchors	
Connections for Structural Steel Components:		
Exterior and Interior	High-strength steel bolts	See Section 05120, STRUCTURAL STEEL
Connections for Steel Fabrications and Wood Components:		
Exterior and Interior	Zinc-coated steel bolts	
Connections of Aluminum Components:		
Exterior and Interior	Stainless steel bolts	
All Others:		
Exterior and Interior	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use epoxy anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05530
METAL GRATING

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Grating: Show dimensions, weight, and size, and location of connections to adjacent grating, supports, and other Work.
2. Grating Anchorage: Show structural calculations and details of anchorage to supports to prevent displacement from traffic impact.
3. Grating Supports: Show dimensions, weight, size, location, and anchorage to supporting structure.
4. Catalog information and catalog cuts.
5. Manufacturer's specifications, to include coatings.

B. Quality Control Submittals:

1. Special handling and storage requirements.
2. Installation instructions.
3. Factory test reports.
4. Manufacturer's Certification of Compliance for specified products.
5. Written Test Report that swaged crossbars, if used on grating, meet the requirements of the specified test and additional requirements of these Specifications.

1.2 PREPARATION FOR SHIPMENT

A. Insofar as is practical, factory assemble items provided.

B. Package and clearly tag parts and assemblies that are of necessity shipped unassembled and protect the materials from damage, and facilitate identification and final assembly in the field.

PART 2 PRODUCTS

2.1 FOOT TRAFFIC GRATING

A. Design:

1. Uniform Service Load: 200 psf minimum, unless otherwise shown.
2. Maximum Deflection: 1/4 inch, unless otherwise shown.
3. Space bearing bars at 1-3/16-inch center-to-center.
4. Banding: 3/16-inch minimum.

B. Material: Galvanized Steel Bar Type Grating: Press-locked, deep rectangular crossbar design, as manufactured by IKG/Borden, Clark, NJ; Type B or Type F.

2.2 ACCESSORIES

A. Anchor Bolts and Nuts:

1. Carbon Steel: ASTM A307-91 or A36-90.
2. Stainless Steel: ASTM A193-90a and ASTM A194-91, Type 316.
3. Galvanized Steel Bolts and Nuts: ASTM A153-82, zinc coating for ASTM A307-91 or A36-90.

B. Flat Washers (Unhardened): ASTM F844-90; use ASTM A153-82 for zinc coating.

C. Partially Removable Anchor:

1. Bolt: Threaded stud, mild steel, galvanize after fabrication, provide galvanized nut and washer to fit thread.
   a. Manufacturer: Nelson Stud Welding Co., Loraine, OH.
2. Hat Bracket: Galvanized steel.
   a. Manufacturer: STRUCT-FAST, Wellesley Hills, MA.

2.3 FABRICATION

A. General:

1. Exposed Surfaces: Smooth finish and sharp, well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in a neat, substantial manner.
3. Conceal fastenings where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Weld Connections: Not permitted on grating except at banding bars.

B. Design:

1. Field measure areas to receive grating, verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
2. Section Length: Sufficient to prevent its falling down through clear opening when oriented in the span direction when one end is touching either the concrete or the vertical leg of grating support.
3. Minimum Bearing: ANSI/NAAMM MBG 531-88.
4. Metal Crossbar Spacing: 4-inch maximum, unless otherwise shown or specified.
5. Crossbars: Flush with top of main bar and extend downward a minimum of 50 percent of the main bar depth.
6. Do not use weld type crossbars.
7. Banding: Same material as grating; ANSI/NAAMM MBG 531-88 and ANSI/NAAMM MBG 532-88.
8. Furnish threaded anchor studs, as fasteners for grating attachment to metal supports either not embedded or partially embedded in concrete, as manufactured by Nelson Studs Welding Co., Loraine, OH.
9. Hot-dip galvanize after fabrication.

C. Supports:

1. Seat angles and beams where shown: Same material as rectangular bar grating.
2. Coordinate dimensions and fabrication with grating to be supported.
3. Coordinate dimensions with increased depth due to serrations.
4. Welded Frames With Anchors: Continuously welded.

D. Foot Traffic Grating: Any single grating section shall be not less than 1 foot 6 inches or greater than 3 feet 0 inch in width or weigh more than 150 pounds.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install supports such that grating sections have a solid bearing on both ends, and that rock and wobble grating movement does not occur under designed traffic loading.

B. Install plumb or level as applicable.

C. Install welded frames with anchors to straight plane without offsets.

D. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

E. Completed installation shall be rigid and neat in appearance.

F. Commercially Manufactured Products:

1. Install in accordance with manufacturer's recommendations.
2. Secure grating to support members with fasteners.
3. Welding is not permitted.
4. Permit each grating section to be easily removed and replaced.

END OF SECTION

SECTION 07160
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Manufacturer's product data for dampproofing materials.

B. Quality Control Submittals:

1. Manufacturer's application instructions for dampproofing materials.
2. Manufacturer's Certificate of Compliance.
3. Statement of Qualification: Bituminous dampproofing installer.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Engage experienced installer who has completed bituminous dampproofing work similar in material, design, and extent for Project.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials in area where temperatures are not less than 50 degrees F or over 85 degrees F.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Weather: Proceed with dampproofing Work only when existing and forecast weather conditions will permit Work. Do not apply dampproofing in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.

B. Temperature:

1. Do not apply materials when ambient temperature is less than 50 degrees F.
2. Do not apply materials when low temperature of 40 degrees F or less is predicted within a period of 24 hours after application.

PART 2 PRODUCTS

2.1 BITUMINOUS DAMPPROOFING, GENERAL

A. Odor Elimination: Provide type of bituminous dampproofing warranted by manufacturer to be substantially odor-free after drying for 24 hours under normal conditions.

2.2 COLD-APPLIED ASPHALT EMULSION DAMPPROOFING

A. Asphalt Emulsion: Asphalt and water emulsion coating, formulated to penetrate substrate and build to moisture-resistant coating.

1. Heavy fibrated type mastic asbestos-free emulsion; ASTM D1227-87, Type IV, except containing nonasbestos, inorganic fibrous reinforcement materials.

B. Manufacturers:

1. Celotex Corp.
2. ChemRex, Inc./Sonneborn Building Products Div.
3. J & P Petroleum Products, Inc.
4. Koch Materials Co.
5. Tremco, Inc.

2.3 PROTECTION BOARD

A. Protection Course, Board Type: Asphalt-impregnated and coated organic fiberboard, 1/2-inch thick.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Clean surfaces to remove dust, dirt, oil, wax, efflorescence, and other foreign materials, in accordance with dampproofing manufacturer's instructions.

B. Allow 3 days' drying time following washing down of substrate surfaces.

C. Fill cracks, voids, and honeycombs with mortar to provide sound surface for dampproofing.

3.2 APPLICATION

A. Apply materials at rate and as recommended by the manufacturer and in two coats.

B. Start application at top of wall and work down surface, keeping a wet edge at all times, forming a continuous, unbroken film, free from pinholes and other surface breaks.

3.3 FIELD QUALITY CONTROL

A. Inspection: Examine surfaces to receive dampproofing to assure conditions are satisfactory for application of materials.

B. After dampproofing has dried, spray surfaces with water.

C. Recoat, as recommended by manufacturer, surfaces showing water absorption. To prevent blistering, protect surfaces from heat and direct sunlight until dried.

D. Apply protection board then backfill.

3.4 ADJUST AND CLEAN

A. Clean spillage and overspray from adjacent surfaces as recommended by manufacturer.

3.5 APPLICATION SCHEDULE

A. Dampproof areas shown and as follows: Apply dampproofing to exterior surfaces of concrete structures below finish ground level that enclose spaces that can be occupied.

B. On belowgrade walls apply dampproofing from top of footings to 6 inches below finished grade.

END OF SECTION

SECTION 07900
JOINT SEALANTS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Surface preparation and installation instructions. Indicate where each product is proposed to be used.

B. Samples: Material proposed for use showing color range available.

C. Quality Control Submittals:

1. Applicator Qualification: Documentation showing minimum of 5 years' experience installing sealants in projects of similar scope.
2. Certificates of Compliance: Proposed materials meet Specification requirements.

D. Contract Closeout Submittals: Special guarantee.

1.2 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 and 80 degrees F (4 and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.3 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the OWNER, removal and replacement of Work specified in this section found *defective* during a period of 5 years after the date of Substantial Completion.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Sealant Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.
4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.

B. Sealant Color: Unless specifically noted, match the color of the principal material adjoining the area of application.

C. One-Part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920-87, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Mameco International; Vulkem 116.
4. Manufacturers and Products for Self-Leveling:
   a. Sonneborn; Sonolastic SL-1.
   b. Mameco International; Vulkem 45.

2.2 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.

C. Manufacturers and Products:

1. Haveg Industries; Minicel.
2. Dow Corning; Ethafoam SB.
3. Sonneborn; Sonofoam.
4. Hercules, Inc.; HBR.

2.3 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193-91.

C. Horizontal and Sloping Joints of 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.

E. Use joint sealant as required for the applicable application.

3.2 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of subsurfaces.
3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify that joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Carefully follow manufacturer's instructions for mixing multi-component products.

3.3 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.
2. Where possible, provide full length sections without splices; minimize number of splices.
3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.

C. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

D. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

E. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.4 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

END OF SECTION

SECTION 09900
PAINTING

PART 1 GENERAL

1.1 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HC1: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness.
5. MDFTPC: Minimum Dry Film Thickness Per Coat.
6. Mil: Thousandth of an inch.
7. MIL-P: Military Specification–Paint.
8. PSDS: Paint System Data Sheet.
9. SFPG: Square Feet Per Gallon.
10. SFPGPC: Square Feet Per Gallon Per Coat.
11. SP: Surface Preparation.

1.2 SUBMITTALS

A. Shop Drawings:

1. Data Sheets:
   a. For each paint system, furnish a Paint System Data Sheet (PSDS), the manufacturer's Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system. The PSDS form is appended to the end of this section.
   b. Submit required information on a system-by-system basis.
   c. Furnish copies of paint system submittals to the coating applicator.
   d. Indiscriminate submittal of manufacturer's literature only is not acceptable.

B. Quality Control Submittals:

1. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.
2. Manufacturer's written instructions and special details for applying each type of paint.

C. Contract Closeout Submittals: Special guarantee.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Applicator's Experience: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC-PA Guide No. 3, Guide to Safety in Paint Applications.
   c. Federal, state, and local agencies having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

B. Shipping:

1. Where precoated items are to be shipped to the site, protect coating from damage. Batten coated items to prevent abrasion.
2. Use nonmetallic or padded slings and straps in handling.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.

B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

1.6 SPECIAL GUARANTEE

A. Furnish manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the OWNER, removal and replacement of Work specified in this Specification section found *defective* during a period of 2 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of *defective* Work as specified in the Special Provisions.

B. CONTRACTOR and paint manufacturer shall jointly and severally furnish guarantee.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Coatings Manufacturers Code A (Able to supply most heavy-duty industrial coatings and architectural paints):

1. Ameron Protective Coatings, Brea, CA.
2. Carboline Coatings Co., St. Louis, MO.
3. Devoe & Raynolds Co., Louisville, KY.
4. DuPont Chemical Co., Wilmington, DE.
5. Hempel/Reliance Paints, Houston, TX.
6. Keeler and Long, Inc., Watertown, CT.
7. Master Builders, Inc., Cleveland, OH.
8. Plas-Chem Coatings, St. Louis, MO.
9. Porter-International, Louisville, KY.
10. Sigma Coatings, Inc., Harvey, LA.
11. Tnemec Coatings, Kansas City, MO.
12. Valspar Corp., Azusa, CA.
13. Wisconsin Protective Coatings, Green Bay, WI.

B. Paint Manufacturers Code B (Able to supply most architectural and institutional paints):

1. Ameritone, Long Beach, CA.
2. Benjamin Moore Paints, New York, NY.
3. Detroit Graphite Co., Rockford, IL.
4. Fuller/O'Brien Paint Co., San Francisco, CA.
5. Pittsburgh Paints, Pittsburgh, PA.
6. Pratt and Lambert, Inc., Buffalo, NY.
7. Rustoleum Corp., Evanston, IL.
8. Samuel Cabot, Inc., Boston, MA.
9. Sherwin Williams, Cleveland, OH.
10. Textured Coatings of America, Los Angeles, CA.
11. Thoro Systems, Miami, FL.

C. Fusion Bonded Coating Applicators Code E:

1. Industrial Operations, Inc., Phoenix, AZ.
2. Waterworks Manufacturing, Marysville, CA.
3. Water Specialties, Porterville, CA.

2.2 MATERIALS

A. General:

1. Material Quality: Manufacturer's highest quality products and suitable for intended service.
2. Materials Including Primer and Finish Coats: Produced by same manufacturer.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by manufacturer of the particular coating.

B. Products are listed below according to their approximate order of appearance in the systems. The letter designating the manufacturer code refers to Article MANUFACTURERS.

Product	Definition	Manufacturer Code
Coal-Tar Epoxy	Amine or phenolic epoxy type; 70 percent volume solids minimum, suitable for immersion service	A
Organic Zinc Rich Primer	Converted epoxy, epoxy/phenolic or urethane type, minimum 10 pounds metallic zinc content per gallon	A
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading	A,B
Alkyd Enamel	Optimum quality, gloss finish, medium long oil	A,B
Wash Primer	Vinyl butyral acid	A
Bituminous Paint	Single-component, coal-tar pitch based	A
Epoxy Primer	Polyamide, anticorrosive, converted epoxy primer containing rust-inhibitive pigments	A
Fusion Bonded Coating	100 percent solids, thermosetting, fusion bonded, dry powder epoxy or polyurethane resin, suitable for the intended service	E
Polyamide Epoxy	Potable grade polyamide epoxy coatings approved for potable water contact and conforming to NSF 61-92	A

2.3 MIXING

A. Multiple-Component Coatings:

1. Prepare using the contents of the container for each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.

5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

2.4 COLORS

A. Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at the site.

B. Colors shall be as selected by RESIDENT ENGINEER.

PART 3 EXECUTION

3.1 EXAMINATION

A. Surface Preparation Verifications:

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.
2. Perform such work only in presence of RESIDENT ENGINEER, unless RESIDENT ENGINEER grants prior approval to perform such work in RESIDENT ENGINEER's absence.

B. Schedule inspection with RESIDENT ENGINEER in advance for cleaned surfaces and all coats prior to succeeding coat.

3.2 PREPARATION

A. Shop Blast Cleaning:

1. Notify RESIDENT ENGINEER at least 7 days prior to start of shop blast cleaning to allow for inspection of the work during surface preparation and shop application of paints.
2. Structural steel, metal doors and frames, metal louvers, and similar items, as reviewed by RESIDENT ENGINEER, may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning.

B. Field Abrasive Blasting: Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed.

C. Protection of Items not to be Painted:

1. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

2. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
3. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
4. Mask openings in motors to prevent paint and other materials from entering the motors.

3.3 PREPARATION OF SURFACES

A. Metal Surfaces:

1. Where indicated, meet requirements of the following SSPC Specifications:
   a. Solvent Cleaning: SP 1-82.
   b. Hand Tool Cleaning: SP 2-89.
   c. Power Tool Cleaning: SP 3-89.
   d. White Metal Blast Cleaning: SP 5-91.
   e. Commercial Blast Cleaning: SP 6-91.
   f. Brush-Off Blast Cleaning: SP 7-91.
   g. Pickling: SP 8-91.
   h. Near-White Blast Cleaning: SP 10-91.
   i. Power Tool Cleaning to Bare Metal: SP 11-91.
2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specifications refer to the applicable SSPC Specifications.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
4. DeLavaud Process Ductile Iron Pipe:
   a. Use SSPC SP grades as guide only.
   b. For high performance (epoxy) coatings, follow recommendations of pipe and coating manufacturers.
   c. For conventional (alkyd) coatings, clean asphalt varnish supplied on pipe and apply one full coat of a tar stop before two full coats of the color coats specified.
5. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Reference existing surfaces to be painted.
6. Hand tool clean areas that cannot be cleaned by power tool cleaning.
7. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
8. Welds and Adjacent Areas:
   a. Prepare such that there is:
      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or any other area to be painted.
      3) No sharp peaks or ridges along weld bead.
   b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

9. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
10. Blast Cleaning Requirements:
   a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
   b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.
   c. Use only dry blast cleaning methods.
   d. Do not reuse abrasive, except for designed recyclable systems.
   e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
11. Post-Blast Cleaning and Other Cleaning Requirements:
   a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
   b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

3.4 SURFACE CLEANING METHODS

A. Brushoff Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC-SP 7-91, Brushoff Blast Cleaning.
2. Abrasive: Either wet or dry blasting sand, grit, or nut shell.
3. Select various surface preparation parameters such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. RESIDENT ENGINEER will approve acceptable trial blast cleaned area and will use area as a representative sample of surface preparation.
6. Repair or replace surfaces damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
2. Meets requirements of SSPC-SP 1-82.

3.5 APPLICATION

A. General:

1. The intention of these Specifications is for new, metal, surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Exterior concrete surfaces will not be painted unless specifically indicated.
2. Apply coatings in accordance with these Specifications and the paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
3. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
4. Sand metal lightly between coats to achieve required finish.
5. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
6. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
7. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
8. Keep paint materials sealed when not in use.
9. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

B. Film Thickness:

1. Number of Coats: Minimum required without regard to coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Maximum film build per coat shall not exceed coating manufacturer's recommendations.
3. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
4. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

C. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Apply finish coats, including touchup and damage-repair coats in a manner which will present a uniform texture and color-matched appearance.

D. Unsatisfactory Application:

1. If item has an improper finish color, or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
4. Repair defects in accordance with written recommendations of coating manufacturer.
5. Leave staging and lighting up until RESIDENT ENGINEER has inspected surface or coating. Replace staging removed prior to approval by RESIDENT ENGINEER. Provide additional staging and lighting as requested by RESIDENT ENGINEER.

3.6 FIELD QUALITY CONTROL

A. Testing Gauges:

1. Provide a magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest.
2. Provide an electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing, for holidays and discontinuities as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide a high voltage holiday detector for elastomeric coatings in excess of 25 mils dry film thickness. Unit to be as recommended by the coating manufacturer.

3.7 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.

C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.8 COATING SYSTEMS

A. System No. 2 Submerged Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5-91)	Polyamide, Anticorrosive, Epoxy Primer	1 coat, 2.5 MDFT
	Coal-Tar Epoxy	2 coats, 16 MDFT

B. System No. 4 Contained Metal

Surface Prep.	Paint Material	Min. Coats, Cover
Commercial Blast, Cleaning (SP 6-91)	Polyamide, Epoxy	2 coats, 10 MDFT

C. System No. 6 Exposed Metal–Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6-91)	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

D. System No. 8 Buried Metal–General:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast or Centrifugal Wheel Blast (SP 10-91)	Standard Hot Coal-Tar Enamel -OR- Coal-Tar Epoxy -OR- Tape Coat System	AWWA C203-86 AWWA C210-84 AWWA C214-83
	For Acidic Soil, Brackish Water High Bacteria: Hot Coal-Tar, Double Felt	AWWA C203-86, App. A, Sec. A1.5

Surface Prep.	Paint Material	Min. Coats, Cover
	For Highly Abrasive Soil, Brackish Water: Hot Coal-Tar, Fibrous Glass -OR- Tape Coat System	AWWA C203-86, App. A, Sec. A1.5 AWWA C214-83 with Double Outer Wrap

E. System No. 10 Galvanized Metal Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1-82) Followed by Hand Tool (SP 2-89) or Power Tool (SP 3-89)	Wash Primer or Coating Manufacturer's Recommendation	1 coat, 0.4 MDFT

F. System No. 11 Galvanized Metal Repair:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1-82) Followed by Hand Tool (SP 2-89), Power Tool (SP 3-89), or Brushoff Blast (SP 7-91)	Organic Zinc Rich Primer	1 coat, 3 MDFT

G. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1-82)	Wash Primer	1 coat, 0.4 MDFT
	Bituminous Paint	1 coat, 10 MDFT

H. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10-91) or Acid Pickling (SP 8-91)	Fusion Bonded 100 Percent Solids Epoxy or Polyurethane	1 or 2 coats, 7 MDFT

3.9 APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from RESIDENT ENGINEER before starting work in question.

B. System No. 2 Submerged or Concrete Embedded Items: Use on submerged or concrete-embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel.

C. System No. 4 Contained Metal: Use for ferrous piping and steel in vaults.

D. System No. 6 Exposed Metal−Atmospheric: Use on the following items or areas:

1. Exposed metal surfaces, new located inside or outside of structures or exposed to weather.
2. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

E. System No. 8 Buried Metal−General: Use on buried, below grade portions of steel items, except buried carbon steel, stainless steel, or ductile iron.

F. System No. 10 Galvanized Metal Conditioning: Use on the following items or areas:

1. Galvanized surfaces requiring painting as noted on the Drawings or in the Specifications.
2. Piping exposed to view, outside or inside of accessible structures.

G. System No. 11 Galvanized Metal Repair: Use on galvanized surfaces that are abraded, chipped, or otherwise damaged.

H. System No. 27 Aluminum and Dissimilar Metal Insulation: Use on concrete embedded aluminum surface.

I. System No. 29 Fusion Bonded Coating: Use on the following items:

1. As noted on the Drawings or in the Specifications.
2. As noted in Section 05500, METAL FABRICATIONS AND CASTINGS.
3. As noted in Section 15060, PIPING–GENERAL.

J. Surfaces Not Requiring Painting: Unless otherwise stated or shown, the following areas or items will not require painting or coating:

1. Concrete and masonry surfaces.
2. Reinforcing steel.
3. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
   a. Required for electrical insulation between dissimilar metals.
   b. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
   c. Color coding of equipment and piping is required.
4. Nonmetallic materials such as glass, PVC, wood, porcelain, and plastic (FRP) except as required for architectural painting or color coding.
5. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches (if prefinished in OSHA yellow), acoustical tile, cabinets, elevators, building louvers, and wall panels; color coding of equipment is required.
6. Nonsubmerged electrical conduits attached to unpainted concrete surfaces.
7. Items specified to be galvanized after fabrication, unless specified elsewhere or subject to immersion.
8. Insulated piping and insulated piping with jacket will not require exterior coating, except as required for architectural painting or color coding.

(See PSDS form attached)

END OF SECTION

PAINT SYSTEM DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PSDS for each coating system.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	**Product Name/Number (Proprietary)**	**Min. Coats, Coverage**

SECTION 11280
SLUICE GATES AND ELECTRIC OPERATOR

PART 1 GENERAL

1.1 DEFINITIONS

A. Slenderness Ratio: The ratio of maximum unsupported stem length to stem or rod cross-section radius of gyration.

B. Self-Contained: The arrangement of gate operator, supported by gate frame, such that operating thrust loads are not applied external to gate assembly.

1.2 SUBMITTALS

A. Shop Drawings:

1. Equipment Assembly: Make, model, weight, and horsepower of each.
2. Manufacturer's catalog information, descriptive literature, specifications, dimensional layouts, and identification of materials of construction and paint system.
3. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
4. Gate opening and closing thrust forces that will be transmitted to support structure with operator at extreme positions and load.
5. Gate operator and stem calculations for each gate and service condition.
6. Complete motor rating including motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at 110 percent voltage; motor efficiency and power factor at 1/2, 3/4, and full-load at rated voltage.
7. Field performance test procedures.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Compliance for materials.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's installation instructions.
4. Routine maintenance requirements prior to plant startup.
5. Manufacturer's Certificate of Proper Installation.
6. Operation and maintenance manual.

C. Contract Closeout Submittals: Service records for maintenance performed during construction.

1.3 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage following spare parts and special tools.

Item	Quantity
Stem collars for gate stems	One of each different size
Bronze lift nuts	One of each different size
Special tools required to maintain or dismantle	One complete set

PART 2 PRODUCTS

2.1 SUPPLEMENTS

A. See supplement to this section for additional product information.

2.2 SLUICE GATES

A. General:

1. Conform to AWWA C501, rising stem type.
2. Minimum Acceptable Casting Thickness for Cast Iron Components: 3/4 inch.

B. Wall Thimbles:

1. Cast iron, one-piece construction, in accordance with ASTM A126-84, Class B.
2. Cast center ring or water stop around periphery.
3. Front Flange: Machined, with tapped holes for sluice gate frame attaching studs.
4. Stamp vertical center lines of metal with word "top."
5. Furnish permanent gasket of uniform thickness or mastic between sluice gate frame and thimble.

C. Frames:

1. Cast iron one-piece construction, in accordance with ASTM A126, Class B.
2. Machine contact surfaces.
   a. Machine dovetailed grooves on front face, into which seat facings shall be driven and machined.
   b. Machine back flange to bolt directly to machined face of wall thimble cast in concrete.
3. For frames with top and bottom wedges, furnish integrally cast pads machined with keyways to receive wedge seats.
4. Where side clearance is limited, flanged frames may require mounting holes to be drilled through to front face of frame.

D. Discs:

1. Cast iron, one-piece construction with integrally cast vertical and horizontal ribs in accordance with ASTM A126 Class B.
2. Machine dovetailed grooves on seating face, into which seat facings shall be driven and machined.
3. Wedge Pads: Integrally cast on disc and machined to receive adjustable wedges.
4. Cast a heavily reinforced nut pocket integrally on vertical centerline above horizontal centerline to receive thrust nut.

E. Guides:

1. Cast iron, one-piece, in accordance with ASTM A126 Class B designed to withstand total thrust from water pressure and wedging action.
2. Machine contact surfaces.
3. Length: Sufficient to retain and support at least half disc in fully OPEN position.
4. Attach to frame with ASTM A167-91, Type 316 stainless steel studs; dowel to prevent relative motion between guides and frame or cast guides integrally with frame.
5. Securely attach wedge seats to machined pads on guides.

F. Wedges and Seat Facings:

1. Side wedges for all conditions.
2. Solid cast ASTM B584-93, Alloy 865 manganese bronze.
3. Machine contact surfaces. Key to cast iron pads to prevent rotation or lateral motion.
4. Attach wedges to disc with AISI Type 316 stainless steel studs and nuts.
5. Seat Facings: ASTM B21-90e, Alloy B, shaped to fill and permanently lock in machined dovetail grooves when pneumatically impacted into place. Attaching pins and screws not permitted.

G. Stems:

1. 1-1/8-inch minimum diameter for 24-inch gate; 1-1/8-inch for 30-inch gate; and 2-inch for 54-inch gate, ASTM A276-92, AISI Type 316 stainless steel.
2. Threads: Acme type with RMS surface roughness of 63 micro-inches or less on flanks for manually operated gates and 32 micro-inches or less on flanks for electrically operated gates. Extend threaded portion of stem 2 inches above operator when gate is in CLOSED position.
3. Couplings:
   a. Use when stems have more than one section.
   b. Same material as stem.
   c. Furnish with internal threads that transmit full thrust of stem.
   d. Hold in place on stem with bolts or keys and keyways.
   e. Same size and interchangeable.

4. Size so that ratio of unsupported stem length (L) to radius of gyration (r), both in inches, does not exceed 200.
5. Withstand in compression, without damage, thrust equal to at least 2-1/2 times rated output of hoisting mechanism, with a 40-pound effort applied to handwheel or crank.
6. Electric motor-driven floor stands to withstand at least 1.25 times output thrust of motor in stalled condition.
7. Cast iron, bushed stem guides, mounted on cast iron brackets, adjustable in two directions and spaced so that L/r ratio does not exceed 200.
8. Adjustable stop collar for CLOSED position.

H. Stem Covers:

1. Transparent plastic, vented pipe stem cover and cap.
2. OPEN/CLOSED designators and with 1-inch graduations on clear mylar pressure sensitive, adhesive tape, suitable for outdoor application.

I. Flush-Bottom Closure Seals:

1. Compressible Resilient Seal:
   a. Attached to bottom of disc with a bronze or stainless steel bar and bronze or stainless steel fasteners.
   b. Specially molded shape designed to fit a lip machined on bottom rib of disc.
   c. Shaped to produce a wide sealing area on a machined cast iron stop bar, bolted and keyed to gate frame to form a flush invert.
   d. Differential sealing pressure of resilient seal on stop bar shall be variable by adjustment of side wedges on gate.
2. Alternative Closures:
   a. Solid, square-cornered, resilient rubber seal in place of bottom dovetail facing and wedging devices.
   b. Securely fastened to bottom cross member of frame on a stop plate, with a retainer bar and stainless steel fasteners.
   c. Make top surface of seal flush with invert of gate opening.
   d. Machine full length of bottom edge of disc accurately to make contact with seal when disc is closed.

J. Manufacturers:

1. HydroGate Corp.
2. Rodney Hunt Co.
3. Waterman Industries, Inc.

2.3 OPERATORS

A. General:

1. Components: Withstand a minimum of 250 percent of design torque or thrust at extreme operator positions without damage.

2. Gear train and gate stem sections shall produce a self-locking drive train.
3. Lift Nuts: Internally threaded with cut or cold-rolled Acme threads corresponding to stem threading.
4. Roller Bearings: Ball-thrust or tapered above and below lift nut to support both opening and closing thrusts.
   a. Grease lubrication fittings for bearings.
   b. Input pinions with needle or ball bearings.
5. Lubrication: Furnish rising stem gates with an insert lubricator flange in lift, with a grease fitting for greasing stem threads below stem nut.
6. Manual Operator Limit Switches:
   a. Mounted on an angle adjacent to stem and actuated through limit switch wands by stop collar.
   b. Single-pole, double-throw type, with contacts rated 5 amps at 120V ac.

B. Type 1, Manual, Handwheel-Operated Floor Stands:

1. Manual Effort: Not to exceed 40 pounds.
2. Handwheel: Directly drive a replaceable bronze stem nut for a rising gate stem, bearing mounted on a cast iron pedestal and base.

C. Type 3, Electric Motor Operators:

1. Description: 28-inch high steel pedestal, totally enclosed weatherproof electric drive unit, and a totally enclosed gear box that operates a two-piece, bronze stem nut, which lifts gate stem.
2. Gears:
   a. Heat treated alloy steel, supported throughout by antifriction ball or roller bearings and grease lubricated.
   b. Operate on hammer-blow principle for starting of operation.
3. Limit and Torque Switches:
   a. Automatic double-acting, geared directly to operating gear train and "in step" at all times, whether in motor or manual operation.
   b. Wire limit switches internally to stop motor at fully OPEN and fully CLOSED positions.
   c. Provide dry contacts, rated 5A at 120V ac, for remote indication of FULL OPEN and FULL CLOSED.
   d. Wire torque switches internally so that, in event of a mechanical overload in either direction, motor will be stopped.
4. Handwheel:
   a. Side mounted.
   b. Include an automatic clutch to positively disengage handwheel when drive motor control is energized.
   c. Design handwheel operator so that failure of motorized gearing will not prevent hand operation of gate.
5. Drive Unit: Electric motor with integral OPEN/STOP/CLOSE weatherproof pushbuttons, reversing controller, control power transformer, space heaters in motor, space heaters in limit switches and in control compartments, mechanical dial type position indicator, and transparent plastic pipe stem cover and cap.

a. Furnish motor enclosure with drainage and breathing holes.
b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of gate.
c. Self-locking, with 12 inches per minute gate travel speed, and a rated running torque equal to 20 percent of motor starting torque at a rated running time of 5 minutes, without exceeding allowable NEMA temperature rise for insulation class used.

6. Operation: Drive gate to its fully OPEN or CLOSED position when OPEN or CLOSED pushbutton is depressed momentarily. Motor shall stop in mid-travel when STOP button is depressed.
7. Power Supply: 240V ac, single-phase.
8. Remote Control: Operator shall accept dry contact closure signals for remote operation.
9. Manufacturers and Products:
   a. Limitorque L-120 Series.
   b. EIM, Inc.; Type EB-20.

2.4 APPURTENANCES

A. Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer at least 1/2 inch in diameter, or as shown, and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

2.5 SHOP/FACTORY FINISHING

A. Factory prepare, prime, and finish coat exposed metal surfaces with manufacturer's standard coating.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments: Fully assemble, including motor, and test sluice gates actually furnished.

1. Functional Test: Perform manufacturer's standard, test on equipment.
2. Performance Test: In accordance with AWWA C540.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Accurately place anchor bolts using templates furnished by manufacturer and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

C. Grease threads above stem nut prior to placing gate in operation.

3.2 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each sluice gate.

B. Performance Test:

1. Conduct on each sluice gate.
2. Perform under actual or approved simulated operating conditions.
3. Test for a continuous 3-hour period without malfunction.
4. Adjust, realign, or modify units and retest if necessary.
5. Leakage shall not exceed 0.1 gallon per minute per foot of gate periphery under either seating or unseating head conditions.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection.
2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

B. See Section 01640, MANUFACTURERS' SERVICES, and Section 01650, FACILITY STARTUP.

3.4 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION," is a part of this Specification.

1. Schedules: Sluice Gate.

END OF SECTION

SLUICE GATE SCHEDULE

Location	Gate Opening Diameter (inches)	Frame Type	Thimble Type and Thickness (inches)	Gate Invert Elevation and Type	Design Operating Heads: Seating/ Unseating Condition	Design Operating Heads: Normal Application	Design Operating Heads: Max. Dif. Head	Operator Type/Control Style
Rural Road Diversion Structure	54	Flat square, round opening	As required by manufacturer	1,144.30 FLUSH	20/0	Seating/unseating	20	Type 3
Miller Weir	24	Flat round	F-12	1,145.95 STD	5/0	Seating/unseating	5	Type 1
Indian Bend Wash*	30	Flat round	–	1,147.5 FLUSH	4/0	Seating/unseating	4	Type 1

Legend:
STD–Standard Invert Type
FLUSH–Flush Bottom Invert Type
*Mounted on 45-degree slope over opening in 18-inch diameter CMP.

SECTION 11305
SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work necessary to furnish and install, complete, the submersible pumps specified herein.

1.2 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.3 SUBMITTALS

A. Shop Drawings:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

B. Quality Control Submittals:

1. Factory Functional and Performance Test Reports.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's printed installation instructions.
4. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
5. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
6. Operation and maintenance manual in accordance with Section 01430, OPERATION AND MAINTENANCE DATA.

1.4 FINAL PUMP SELECTION AND DELIVERY

A. The Bid Proposal shows the estimated number of submersible pump assemblies by horsepower category for this work. However, the final pump hydraulic requirements/characteristics for the submersible pump assemblies will be determined in accordance with information obtained from the individual well pumping tests described in Section 02672, WELL PUMPING TEST. This information shall be provided by the RESIDENT

ENGINEER to the CONTRACTOR, who shall notify the pump manufacturer of necessary modifications to the pumping system(s). These modifications may include, but are not limited to, motor and/or pump downsizing, cable resizing, pump column pipe length, and removal or addition of one or more bowl assemblies.

PART 2 PRODUCTS

2.1 GENERAL

A. All equipment and materials to be furnished shall be new.

B. The use of a manufacturer's name is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

C. Provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

D. Electrical materials and workmanship required to complete the Work under this section shall conform to the applicable requirements of Division 16, ELECTRICAL.

2.2 PUMP MANUFACTURER

A. The submersible pumps covered by these specifications shall be Byron Jackson, Dempster, Pleuger, or approved equal and have the driving motor mounted below the pump section.

2.3 SERVICE CONDITIONS

A. Pumps shall be installed in shallow wells (estimated 130 to 160 feet deep) with a casing internal diameter of 23.5 inches and a screen internal diameter of approximately 22.75 inches.

B. The water being pumped is from the Salt River groundwater basin. The groundwater temperature is approximately 70 degrees F. The pH is approximately 7.1 to 7.8.

C. The static groundwater level fluctuates continually in response to river events and subsequent recharge. Additionally, the occurrence of the Town Lake with its long-term recharge will effect groundwater elevations. Estimated static groundwater levels will be approximately 30 feet below ground surface. The drawdown is expected to be not over 50 feet. Previous hydrologic testing at the project site indicated specific capacities on the order of 82 to 131 gallons per minute per foot.

2.4 PERFORMANCE REQUIREMENTS

A. Expected capacities are 2,500 to 4,500 gpm at approximately 90 feet TDH.

2.5 PUMP CONSTRUCTION DETAILS

A. Pump Type: Submersible, vertical diffuser multistage, centrifugal type pump, designed for continuous submerged operations. Rotation of all like pumps shall be the same.

B. Pump Materials: Cast-iron bowls, bronze impellers, Type 416 stainless steel impeller shaft.

C. Impeller Type: Radial mixed flow of the enclosed type.

D. Pump Check Valve: Pump shall be equipped with a check valve integrally designed into the pump discharge housing with the same taper thread as the column pipe.

2.6 SURFACE PLATE

A. Surface plate shall be capable of supporting the total weight of the entire submersible pump assembly.

B. Surface plate shall be sized as indicated on the Drawings or as approved by the RESIDENT ENGINEER and shall be equipped with heavy-duty lifting lugs.

C. Surface plate pipe section shall be suitable threaded connection to column pipe. Discharge elbows shall be long radius with 150-pound flange.

D. Surface plate shall be drilled with eight holes allowing bolting directly to a CONTRACTOR-provided well casing flange. Surface plate shall be equipped with a rubber gasket to protect against dissimilar metals contact between stainless steel casing flange and low carbon steel surface plate. Well casing flange shall be made of Type 316 stainless steel and shall be suitable for welding onto a 24-inch OD stainless steel well casing. Each bolt hole shall be fitted with a dielectric insulating kit (sleeves and washers).

E. Surface plate shall be provided with a screened 1-inch air vent. Provide additional holes and access tubes as follows: (1) Nominal 1-inch Schedule 40 PVC flush-threaded manual sounding tube and (2) Nominal 1-inch Schedule 40 PVC flush-threaded tube for permanent transducer installation. Terminate the two PVC access tubes not more than 2 feet above the submersible pump bowl assemblies. Secure both 1-inch PVC sounding tubes at the surface plate to prevent slippage into the wellbore and secure to pump column pipe by suitable noncorrosive clamps at intervals not exceeding 10 feet.

2.7 PUMP COLUMN PIPE

A. The riser pipe shall be 14 inches in diameter, standard AWWA, ASA Schedule 40 low carbon steel, threaded and coupled, 20-foot random lengths, 3/4-inch taper thread, and shall provide a suitable locking method to prevent column unthreading during operation. Total length of column pipe in each well installation is to be determined based on results of well pumping tests as described in Section 02672, WELL PUMPING TEST.

2.8 PUMP INTAKE SCREEN

A. A strainer will be built into the lower part of the pump between the motor and lower pump bowl.

2.9 POWER CABLE

A. Provide power cable from the pump manufacturer of proper size to reach from the submersible motor terminal connection to the motor cable junction box on the wellhead surface plate. The cable shall comply in every respect to NEMA requirements for submerged electrical cables. Cable conductors shall have not less than seven strands. Each conductor to be in an insulating watertight synthetic rubber or plastic polyethylene jacket. The whole to be enclosed in an outer synthetic rubber or PVC nitrile outer jacket that is impervious to oil and water. The cable shall be supported on the column pipe by suitable noncorrosive clamps at intervals not exceeding 10 feet.

2.10 SUBMERSIBLE PUMP MOTOR

A. Motors shall be 460-volt, 60-cycle, three-phase alternating current, and shall be designed and constructed for continuous underwater operation. Motors shall be 100 to 150 hp and shall be nominal 1,200 or 1,800 rpm.

B. The nameplate horsepower rating of the motors supplied with the submersible pumps shall not be exceeded at any head-capacity point on the manufacturer's pump curve.

C. The motors shall be squirrel-cage induction motors designed for continuous underwater operation in conformance with NEMA standards.

D. The motors shall have thrust bearings capable of carrying the maximum pump thrust loads.

E. Motor cooling shrouds shall be provided as recommended by the manufacturer for motor cooling at no additional charge.

F. Motor housings may be either oil (nontoxic food-grade) or water filled.

2.11 PUMP ACCESSORIES

A. Pump Identification Plate: A 16-gauge stainless steel identification plate shall be securely mounted on each pump in a readily visible location. At a

minimum, the plate shall bear the pump size and manufacturer's name and model number.

B. Lifting Lugs: Equipment weighing more than 100 pounds shall be provided with lifting lugs.

2.12 COOLING SHROUD

A. Shrouds shall provide a positive centering of the motor inside the shroud to assure uniform motor cooling.

PART 3 EXECUTION

3.1 GENERAL

A. Care during storage and procedures for installation and startup of the pumps and motors shall be in strict conformance with the manufacturer's instructions.

B. A complete set of manufacturer's instructions covering storage, installation, operation, and maintenance shall be available at the jobsite no later than the date the pumps are received.

C. CONTRACTOR shall supply one set of any special tools as required to service all pumps.

3.2 PUMP INSTALLATION

A. Install pumps in the well vaults as specified in the Drawings. Pipe all connections at the wellhead as shown.

B. Connect discharge piping without imposing strain to pump flanges.

3.3 FIELD TESTS

A. All equipment described in this section shall be inspected for proper alignment, quiet operation, correct rotation, proper connection, and satisfactory performance by means of a functional test in accordance with the requirements of Section 01650, FACILITY STARTUP.

B. The CONTRACTOR, assisted by the pump manufacturer's representative, shall conduct performance tests on all pumps for at least 8 hours per pump to demonstrate conformance to the service conditions specified herein. Performance testing shall be in accordance with the requirements of Section 01650, FACILITY STARTUP.

C. The CONTRACTOR shall be responsible for resolving and correcting any unsatisfactory conditions that are found during field testing. This Work shall be accomplished prior to final inspection and acceptance of the Project.

D. Perform electrical tests in accordance with Section 16950, ELECTRICAL TESTING.

3.4 MANUFACTURERS' SERVICES

A. A manufacturer's representative for the equipment specified herein shall be present at the jobsite for each pump installation for the minimum person-days listed for the services hereinunder, travel time excluded:

1. 2 person-days for installation assistance, inspection, and certification of the installation.
2. 1 person-day for functional and performance testing.
3. 1 person-day for training of OWNER's personnel (one time only training).

B. Provide manufacturer's certificates as follows:

1. Manufacturer's Certification of Proper Installation.
2. Functional Test Certification.
3. Field Performance Test Reports.

END OF SECTION

SECTION 15060
PIPING–GENERAL

PART 1 GENERAL

1.1 GENERAL

A. For reinforced concrete pipe, refer to Section 15082, REINFORCED CONCRETE PIPE AND FITTINGS.

1.2 SUBMITTALS

A. Quality Control Submittals:

1. Manufacturer's Certification of Compliance.
2. Certified welding inspection and test results.
3. Qualifications:
   a. Weld Inspection and Testing Agency: Certification and qualifications.
   b. Welding Inspector: Certification and qualifications.
   c. Welders:
      1) List of qualified welders and welding operators.
      2) Current test records for qualified welder(s) and weld type(s) for factory and field welding.
4. Weld Procedures: Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
5. Nondestructive inspection and testing procedures.
6. Manufacturer's Certification of Compliance:
   a. Pipe and fittings.
   b. Welding electrodes and filler materials.
   c. Factory applied resins and coatings.
7. Certified weld inspection and test reports.
8. Test logs.
9. Pipe coating applicator certification.

1.3 QUALITY CONTROL

A. Tests to be provided by OWNER and performed by independent inspection and testing agency for welding operations.

1.4 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01600, MATERIAL AND EQUIPMENT, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Linings and Coatings: Prevent excessive drying.
4. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.1 PIPING

A. As specified on Piping Data Sheet(s) located at the end of this section as Supplement.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M-85.
3. Cement-Lined Steel Pipe: Lining inside diameter.

2.2 JOINTS

A. Flanged Joints:

1. Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

B. Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1-83.

C. Thrust Tie-Rod Assemblies: In accordance with MAG Standard Details 302-1 and 302-2.

D. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276-94, Type 305 bands.
2. Manufacturers:
   a. Pipeline Products Corp.
   b. Ferno Joint Sealer Co.

2.3 COUPLINGS

A. Steel Middle Rings and Followers: Fusion bonded, epoxy-lined, and coated in accordance with Section 09900, PAINTING.

B. Flexible Couplings:

1. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser; Style 38.
      2) Smith-Blair; Style 411.
   b. Ductile Iron Pipe:
      1) Dresser; Style 153.
      2) Smith-Blair; Style 411.

C. Transition Couplings:

1. Manufacturers and Products:
   a. Dresser; Style 162.
   b. Smith-Blair; Style 413.

D. Flanged Coupling Adapters:

1. Manufacturers and Products:
   a. Steel Pipe:
      1) Smith-Blair; Series 913.
      2) Dresser Industries, Inc.; Style 128.
   b. Ductile Iron Pipe:
      1) Smith-Blair; Series 912.
      2) Dresser Industries, Inc.; Style 127.

2.4 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

2.5 VENT AND DRAIN VALVES

A. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.6 FINISHES

A. Factory prepare, prime, and finish coat in accordance with paragraph INSTALLATION–GENERAL, hereinafter.

B. Galvanizing:

1. Hot-dip applied, meeting requirements of ASTM A153-82.
2. Electroplated zinc or cadmium plating is unacceptable.
3. Stainless steel components may be substituted where galvanizing is specified.

2.7 PIPE ANCHORS

A. Galvanized steel anchor chair with U-bolt strap.

1. Manufacturers and Models:
   a. Grinnell, Figure 198.
   b. B-Line, Figure B3147A or B3147B.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.2 PREPARATION

A. Notify RESIDENT ENGINEER at least 2 weeks prior to field fabrication of pipe or fittings.

B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

C. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.3 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.1-92 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting manufacturer.

B. Weld Identification: Mark each weld with symbol identifying welder.

C. Pipe End Preparation:

1. Machine Shaping: Preferred.
2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
3. Beveled Ends for Butt Welding: ANSI B16.25-92.

D. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

F. Climatic Conditions: Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 32 degrees F.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not *defective*. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Passes: As required in welding procedure.

J. Weld Quality: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.4 INSTALLATION–GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

D. Threaded and Coupled Joints:

1. Conform with ANSI B1.20.1-83.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

F. Couplings:

1. General:
   a. Install in accordance with manufacturer's written instructions.
   b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
   c. Do not remove pipe coating. If damaged, repair before joint is made.
2. Application:
   a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
   b. Nonmetallic Piping Systems: Teflon bellows connector.
   c. Concrete Encased Couplings: Sleeve type coupling.

G. Penetrations:

1. Watertight Penetrations:
   a. Provide wall pipes with thrust collars.
   b. Provide taps for stud bolts in flanges to be set flush with wall face.
2. Nonwatertight Penetrations:
   a. Pipe Sleeves With Seep Ring:
      1) Steel Pipe Sleeve:
         a) Material: 3/16-inch minimum thickness steel pipe.
         b) Seep Ring:
            (1) 3/16-inch minimum thickness center steel flange for water stoppage on sleeves in exterior or water-bearing walls.
            (2) Outside Diameter: 3 inches greater than pipe sleeve outside diameter.
            (3) Continuously fillet weld on each side all around.
         c) Factory Finish:
            (1) Galvanizing:
               (a) Hot-dip applied, meeting requirements of ASTM A153-82.
               (b) Electroplated zinc or cadmium plating is unacceptable.
            (2) Shop Lining and Coating: Factory prepare, prime, and finish coat in accordance with Section 09900, PAINTING.
      2) Insulated and Encased Pipe Sleeve:
         a) Manufacturer: Pipe Shields, Inc.; Models WFB, WFB-CS and-CFW Series, as applicable.
   b. Pipe sleeves with modular mechanical seal may be provided where fabrication of seep ring on pipe sleeve is impractical.
3. Existing Walls:
   a. Pipe Sleeve with Modular Mechanical Seal:
      1) Type: Interconnected synthentic rubber links shaped and sized to continously fill annular space between pipe and wall sleeve opening.
      2) Fabrication: Assemble interconnected rubber links with ASTM A276-94, Type 316 stainless steel bolts, nuts, and pressure plates.

3) Size: According to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 40 feet of water.
4) Manufacturer: Thunderline Link-Seal.

b. Rotary drilled holes may be provided in lieu of sleeves in concrete walls.

H. PVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.

I. Ductile Iron and Cement-Lined Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.
2. Dressing Cut Ends:
   a. General: As required for the type of joint to be made.
   b. Rubber Gasketed Joints: Remove sharp edges or projections.
   c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
   d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.
3. Corrosion Protection Buried Pipe: Pipe, joints, fittings, and all other appurtenances shall be wrapped with loose polyethylene encasement and bedded in sand according to AWWA C105.
4. Corrosion Protection Exposed Pipe: Pipe, joints, fittings, and all other appurtenances shall be painted as specified in Section 09900, PAINTING, System No. 6.
5. Corrosion Protection Submerged Pipe: Pipe, joints, fittings, and all other appurtenances shall be painted as specified in Section 09900, PAINTING, System No. 2.

J. Carbon Steel Pipe:

1. Cut, makeup, and install pipe in accordance with pipe manufacturer's written instructions.
2. Corrosion Protection: Tape wrap pipe, joints, fittings, and all other appurtenances (AWWA C209).
3. For pipe, joints, fittings, and all other appurtenances in contact with water, coat with fusion-bonded epoxy (AWWA C213).

3.5 INSTALLATION–EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

C. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

D. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

E. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inch, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Head room in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.6 INSTALLATION–BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
   a. Provide flexible mechanical compression joints for pressure pipe.
   b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete unless specifically shown.

B. Placement:

1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone: As specified in Section 02225, TRENCH BACKFILL.

3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure section and adapters for gravity piping at location where pipe laying changed direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. Tolerances:

1. Deflection From Horizontal Line: Maximum 2 inches.
2. Deflection From Vertical Grade: Maximum 1/4 inch.
3. Joint Deflection: Maximum of 50 percent of manufacturer's recommendation.
4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 3 feet, unless otherwise shown.

3.7 THRUST RESTRAINT

A. Location:

1. Buried Piping: At pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.
2. Exposed Piping: At all joints in pressure piping.

B. Thrust Ties:

1. Install where shown and as detailed.
2. Anchoring of retainer glands or thrust ties with setscrews is unacceptable.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or thrust tie-rods and socket clamps.

3.8 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09900, PAINTING.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie wires.

3.9 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.10 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines only where shown.

3.11 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. Blow clean of loose debris with compressed air at 4,000 fpm; do not flush with water.

C. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

D. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

E. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.12 FIELD FINISHING

A. Notify RESIDENT ENGINEER at least 3 days prior to start of any surface preparation or coating application work.

B. As specified in Section 09900, PAINTING.

3.13 PIPE IDENTIFICATION

A. See Section 02225, TRENCH BACKFILL.

3.14 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 15992, PIPING LEAKAGE TESTING.

B. Minimum Duties of Welding Inspector:

1. Job material verification and storage.
2. Qualification of welders.
3. Certify conformance with approved welding procedures.
4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to RESIDENT ENGINEER of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:

1. Perform examinations in accordance with the Piping Code, except that 5 percent of the circumferential butt welds shall be random radiographed.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be *defective* under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the *defective* weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

3.15 SUPPLEMENTS

A. Data Sheets.

Number	Title
-01	Cement-Mortar Lined Ductile Iron Pipe and Fittings
-03	Carbon Steel Pipe and Fittings–General Service
-10	Polyvinyl Chloride (PVC) Pipe and Fittings

END OF SECTION

CEMENT-MORTAR LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Pipe	Buried Liquid Service Using Proprietary Restrained Joints: AWWA C151/A21.51-91, thickness Class 52 minimum and as shown on Drawings conforming to Table 51.7. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15-88, and AWWA C151/A21.51-91, thickness Class 53 minimum conforming to Table 51.7.
Lining	Cement-Mortar: AWWA C104/A21.4-90. Double thickness.
Fittings	Lined and coated same as pipe. Mechanical: AWWA C110/A21.10-93, C111/A21.11-90, and C153/A21.53-88 ductile iron, 250 psi minimum working pressure. Proprietary Restrained: AWWA C111/A21.11-90 and C153/A21.53-88, ductile iron, 250 psi minimum working pressure. Clow Corp., Super-Lock Joint; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring Joint; U.S. Pipe, TR Flex. Flange: AWWA C110/A21.10-93 and ANSI B16.1-89, ductile iron, faced and drilled, 125-pound flat face. Gray cast iron will not be allowed.
Joints	Mechanical: 250 psi minimum working pressure. Proprietary Restrained: 250 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Flange: 125-pound flat face ductile iron, flat face, threaded conforming to AWWA C115/A21.15-88. Gray cast iron will not be allowed.
Couplings	Grooved End Adapter Flanges: 250-pound malleable iron per ASTM A47-90 or ductile iron per ASTM A536-84. Victaulic; Gustin-Bacon.
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard. 125-Pound Flat-Faced Flange: ASTM A307-94, Grade A carbon steel hex head bolts and ASTM A563-93, Grade A carbon steel hex head nuts.

CEMENT-MORTAR LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Gaskets	Mechanical and Proprietary Restrained Joints: Rubber conforming to AWWA C111/A21.11-90. Grooved End Joints: Halogenated butyl conforming to ASTM D2000-90 and AWWA C606-87. Flanged, Water and Sewage Service: Full-face, 1/8-inch thick, cloth-inserted rubber conforming to ANSI B16.21-92 and AWWA C207-86, corrosive acid and alkali free for potable water and sewage service, full face for 125-pound flat-faced flanges. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard.

CARBON STEEL PIPE AND FITTINGS–GENERAL SERVICE		
Item	**Size**	**Description**
Pipe	All Welded: 2" thru 10" Grooved: 2" thru 6"	Black carbon steel, ASTM A106-94, Grade B seamless or ASTM A53 Rev A-93, Grade B seamless or ERW. Threaded, butt-welded, and flanged joints: Schedule 40. Schedule 40.
Joints	2" & larger	Butt-welded or flanged at valves and equipment, or grooved end meeting the requirements of AWWA C606-87.
Fittings	2" & larger	Butt Welded: Wrought carbon steel butt-welding, ASTM A234/A234M-94, Grade WPB meeting the requirements of ANSI B16.9-93; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise. Grooved End: Malleable iron ASTM A47-90 or ductile iron ASTM A536-84, grooved ends to accept couplings without field preparation. Victaulic; Gustin-Bacon.
Branch Connections	2-1/2" & larger	Butt-welding or grooved end tee in conformance with Fittings specified above.
Flanges	2" & larger	Butt-Welded Systems: Forged carbon steel, ASTM A105/A105M-94, ANSI B16.5-88 Class 150 or Class 300 slip-on or welding neck, 1/16-inch raised face; weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings. Grooved End Adapter Flange: Malleable iron ASTM A47-90 or ductile iron ASTM A536-84. Victualic; Gustin-Bacon. Cast Iron Mating Flange: AWWA C207-86, Class D or E, hub or ring type, ANSI B16.1-89, 125-pound drilling, AWWA C207-86 Class F hub type or ASTM A105/A105M-94, ANSI B16.5-88 Class 300-pound, drilling.

CARBON STEEL PIPE AND FITTINGS–GENERAL SERVICE		
Item	**Size**	**Description**
Couplings	2" & larger	Grooved End: Rigid joint malleable iron, ASTM A47-90 or ductile iron, ASTM A536-84. Victaulic; Gustin-Bacon. Screwed End: Malleable iron, ASTM A197-88 or A47-90.
Bolting	All	Flanges: Carbon steel ASTM A307-94, Grade A hex head bolts and ASTM A563-93, Grade A hex head nuts. Use 1/8-inch undersize bolting material for insulating flanges. Grooved End Couplings: Carbon steel, ASTM A183-83 bolts and nuts, 110,000 psi minimum tensile strength.
Gaskets	All flanges	General Service, Oil and Gas: 1/16-inch thick compressed nonasbestos composition flat ring type. Garlock, Style 3000; Manville, Style 978. Water and Sewage Service: 1/8-inch cloth-inserted rubber, nylon reinforced over 150 psi service pressure, corrosive acid and alkali free, suitable for potable water where applicable, conforming to ANSI B16.21-92 and AWWA C207-86. Grooved Couplings: EPDM per ASTM D2000 for water and air to 230 degrees F, nitrile for oil service to 180 degrees F.

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
Pipe	All	Schedule 40 and Schedule 80: Type I, Grade I or Class 12454-B conforming to ASTM D1784-92 and ASTM D1785-93. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule 40 and Schedule 80 as Specified Under Pipe Above: ASTM D2466-94 and ASTM D2467-93 for socket-weld type and ASTM D2464-93 for threaded type.
Joints	All	Solvent socket-weld except where connection to valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1-89 drilling
Bolting	All	Flat Face Mating Flange or In Corrosive Areas: ASTM A193/A193M Rev A-94 Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M-94 Grade 8M hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564-93.
Thread Lubricant	All	Teflon Tape.

SECTION 15082
REINFORCED CONCRETE PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Submit before starting fabrication.
2. Furnish an overall laying plan and details of a standard pipe section and special fittings. Show dimensions, plate size, coating, wire dimension and spacing, and other pertinent information. Show the location of each pipe section and each special length with each piece numbered or otherwise designated in sequence.
3. Furnish design calculations to RESIDENT ENGINEER for review. Review of the Drawings or calculations by the RESIDENT ENGINEER shall not relieve the CONTRACTOR of responsibility for complying with all requirements of the Contract Documents.

B. Hydrostatic Test Results: Submit before shipping pipe.

C. Furnish a certified statement from the manufacturer of the gaskets, setting forth the basic polymer used in the gaskets and results of the tests of the physical properties of the compound.

PART 2 PRODUCTS

2.1 GENERAL

A. Do not internally or externally coat reinforced concrete pipe with any substance of any type in an attempt to improve its performance when air or hydrostatically tested. The use of a coating will be cause for rejection of all pipe delivered to the jobsite.

2.2 PIPE

A. ASTM C361, Class B-25, C-25, or D-25 as shown on the Drawings.

B. Internal Diameters: Shown on the Drawings.

C. Cement: ASTM C150, Type I and II.

D. Manufacture Process: Centrifugally spun or cast in forms with the concrete compacted by high-frequency vibration.

E. Wall Thickness: Minimum of 3 inches.

F. Length: A minimum of 12 feet.

G. Reinforcement Steel: Circular.

H. Identify class, location number on the laying plan, and date of manufacture on each piece of pipe. Code pipe markings to shop drawings.

I. Test 7 percent of the pipe sections under Section 10.4 "Hydrostatic Tests" of ASTM C361.

2.3 PIPE JOINTS

A. Rubber-gasketed type with "captive gasket in groove" design. Free movement of water through the pipe joint or pipe wall will be grounds for rejection of the pipe.

B. Flared bell-and-spigot joint, R-4 type. The R-4 type joint is a recognized joint configuration of the Bureau of Reclamation. The bell-and-spigot gasket joint mating length shall provide allowance for the maximum possible joint deflection, preset joint opening to allow for joint deflection, joint creep, and safety allowances to ensure positive gasket sealing during joint movement.

2.4 RUBBER GASKET

A. ASTM C361.

B. Ship in containers with identification of the batch from which the gaskets were fabricated.

C. Store all rubber gaskets in a cool, well-ventilated place and do not expose to the direct rays of the sun. Do not allow contact with oils, fuels, or petroleum solvents.

D. Gaskets shall be given a field test by RESIDENT ENGINEER. Twenty percent of all rubber gaskets of each lot delivered to the job shall be bent a minimum of 180 degrees and a maximum of 270 degrees around a bar the same diameter as the gasket. The test section of the gasket shall be at the point where the ends of the gasket are joined together. If any of the tested gasket joints separate during the test, the entire lot will be rejected and new gaskets supplied and tested as specified.

2.5 JOINT LUBRICANT

A. Furnish joint lubricant in the amount and type recommended by the pipe and gasket manufacturer.

2.6 FEELER GAUGE

A. Furnish feeler gauges of the proper size, type, and shape to check the rubber gasket seating after the joint is made up.

2.7 INSPECTION

A. Provide RESIDENT ENGINEER and his representatives access to all phases of the Work.

B. Material, fabricated parts, and pipe which are discovered to be defective, or which do not conform to the requirements of this Specification, will be subject to rejection at any time prior to final acceptance of the pipe.

2.8 FITTINGS AND SPECIALS

A. Shop fabricate.

B. Design for the same internal and external pressures as the adjoining pipe or as shown.

C. Test each special or fitting in accordance with Section 10.4 "Hydrostatic Tests" of ASTM C361.

2.9 CLOSURE SECTIONS

A. Used only when authorized by RESIDENT ENGINEER.

B. Submit complete details and calculations for each proposed closure section.

PART 3 EXECUTION

3.1 PIPE DISTRIBUTION

A. Distribute material on the job no faster than it can be used to good advantage. Unload pipe by forklift or other means which will not damage the pipe. Do not drop pipe of any size from the bed of the truck to the ground.

3.2 BELL HOLES

A. Excavate bell holes at each joint to permit proper assembly and visual and feeler gauge inspection of the entire joint.

3.3 PIPE PREPARATION AND HANDLING

A. Inspect all pipe, fittings, and specials prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are being used.

B. Clean ends of pipe thoroughly, remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

C. Use proper implements, tools, and facilities for the safe and proper protection of the work. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

D. Remove all damaged pipe from the jobsite.

3.4 LINE AND GRADE

A. Do not deviate more than 0.1 foot for line or grade.

B. Measure grade at the pipe invert—not at the top of the pipe—because of permissible variation in pipe wall thickness.

3.5 LAYING AND JOINTING PIPE AND FITTINGS

A. Pipe laying shall proceed with the bell ends pointing uphill.

B. After a section of pipe has been lowered into the prepared trench, clean the end of the pipe to be joined, the inside of the joint, and the rubber ring immediately before joining the pipe.

C. Assemble joint in accordance with the recommendations of the manufacturer. Provide all special tools and appliances required for the jointing assembly.

D. Check the gasket position with a feeler gauge, furnished by the pipe manufacturer, to assure proper seating. After the joint has been made, check pipe for alignment and grade. Apply sufficient pressure in making the joint to assure that the joint is "home," as defined in the standard installation instructions provided by the pipe manufacturer. To assure proper pipe alignment and joint make-up, place sufficient pipe zone material to secure the pipe from movement before the next joint is installed.

E. Whenever it is necessary to deflect pipe from a straight line, either in the horizontal or vertical plane, do not exceed 75 percent of the amount of deflection recommended by the pipe manufacturer.

F. Take the necessary precautions required to prevent excavated or other foreign material from entering the pipe during the laying operation. At all times, when laying operations are not in progress, at the close of the day's work, or whenever the workmen are absent from the job, close and block the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints.

G. Take all precautions necessary to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.

H. When cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer.

3.6 MATERIALS, TESTS, AND INSPECTIONS

A. Basic Tests: Furnish and test specimens in the required amounts.

B. Test Methods: Specimens for tests will be selected by RESIDENT ENGINEER in accordance with the applicable ASTM Specifications from pipe in the pipe manufacturer's yard.

3.7 HYDROSTATIC TESTS ON INSTALLED PIPE

A. As specified in Section 15992, PIPING LEAKAGE TESTING.

3.8 FINAL CLEANING

A. Prior to final acceptance, clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system.

B. Upon RESIDENT ENGINEER's final inspection of the system, if any foreign matter is still present in the system, clean the sections and portions of the lines as required.

END OF SECTION

SECTION 15100
VALVES AND OPERATORS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Product data sheets for make and model.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Power and control wiring diagrams, including terminals and numbers.
4. Complete motor nameplate data.
5. Open/close and throttle actuators sizing calculations.

B. Quality Control Submittals:

1. Certificate of Compliance for:
   a. Electric operators; full compliance with AWWA C540.
   b. Butterfly valves; full compliance with AWWA C504.
2. Tests and inspection data.
3. Manufacturer's Certificate of Proper Installation.
4. Operation and maintenance manual.

PART 2 PRODUCTS

2.1 GENERAL

A. Valve to include operator, actuator, handwheel, extension stem, operator, operating nut, wrench, and accessories for a complete operation.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe.

D. Valve ends to suit adjacent piping.

E. Size operator to operate valve for the full range of pressures and velocities.

F. Valve to open by turning counterclockwise.

G. Factory mount operator, actuator, and accessories.

H. Valves to be suitable for chlorinated reclaimed water service.

2.2 MATERIALS

A. Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

B. Approved alloys are of the following ASTM designations:

1. B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

2.3 FACTORY FINISHING

A. Epoxy Lining and Coating:

1. In accordance with AWWA C550 unless otherwise specified.
2. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves: In accordance with Section 09900, PAINTING.

2.4 VALVES

A. Gate Valves:

1. Type V132 Resilient Seated Gate Valve 3-Inch to 12-Inch for Buried Service:
   a. Iron body, resilient seat, bronze mounted, mechanical joint ends, nonrising stem in accordance with AWWA C509, rated 200 psi cold water, full port, fusion epoxy-coated inside and outside.
   b. Coating in accordance with AWWA C550.

B. Butterfly Valves:

1. General: Butterfly valve specified as AWWA C504 to be in compliance with AWWA C504 and following requirements:
   a. Suitable for throttling operations and infrequent operation after periods of inactivity.
   b. Elastomer seats bonded or vulcanized to body shall have adhesive integrity of bond between seat and body assured by testing with minimum 75-pound pull in accordance with ASTM D429, Method B.
   c. Bubble-tight with rated pressure applied from either side.
   d. No travel stops for the disc on interior of the body.
   e. Self-adjusting V-type or O-ring shaft seals.
   f. Isolate metal-to-metal thrust bearing surfaces from flowstream.
2. Type V504 Butterfly Valve: Mechanical joint end type AWWA 504, Class 150B.
3. Type V506 Butterfly Valve: Rated 250 psi cold water at 16 fps flow velocity, nonshock, watertight shutoff, conform to AWWA C504 where applicable, suitable for throttling operations, suitable for infrequent use after extended periods of inactivity, body flanged end, flange drilling in accordance with ANSI B16.1, Class 125, body and disc cast iron, ductile iron, or alloy cast iron, seals self-adjusting V-type or O-rings, and tested in accordance with AWWA C504.

a. Manufacturers and Products:
1) Pratt; Triton HP-250.
2) Mueller; XP250.

4. Type V510 Lug Butterfly Valve 2 Inches to 12 Inches for Low Pressure Process Air Service: Cast iron or ductile iron body, aluminum bronze or ductile iron discs, Type 18-8 stainless steel one-piece stem, self-lubricating sleeve type bearing, EPDM replaceable resilient seat, self-adjusting packing, suitable for temperatures up to 250 degrees F, bubble-tight at 50 psi differential pressure, valve body to fit between ANSI B16.1 flanges.
a. Manufacturers and Products:
1) Keystone; Model AR2.
2) Centerline; LT.

C. Self-Contained Automatic Valves:

1. Type V746 Combination Air Release and Vacuum Valve:
a. Suitable for water service, combines the operating features of both an air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. The air release portion to automatically exhaust entrained air that accumulates in system.
b. Rated 150 psi working pressure, cast iron, ductile iron, or semi-steel body, cover with stainless steel float and trim.
c. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves.
d. Test pipe with isolation valve closed. Use low pressure seats (30 psi).
e. Manufacturers and Products:
1) APCO Valve and Primer Corp.; 145C.
2) Val-Matic Valve; 202C.

D. Check Valves:

1. Type V612 Double Door Swing Check Valve:
a. Wafer style, spring loaded, cast or ductile iron body, aluminum-bronze or ductile iron doors, resilient seats, stainless steel hinge pin, stop pin spring.
b. Valve 2 inches through 12 inches rated 200-pound cold water and valve 14 inches through 54 inches rated 150-pound cold water.
c. Manufacturers and Products:
1) Stockham; 970.
2) APCO; Series 9000.

E. Ball Valves:

1. Type V300 Ball Valve 2 Inches and Smaller for General Water and Air Service: All-bronze, end entry type, RTFE seats, Teflon packing, hand lever operator, rated 150-pound SWP, 600-pound WOG.

2. Manufacturers and Products:
   a. Milwaukee; BA100, threaded end.
   b. Nibco; T-585-70, threaded end.
   c. Milwaukee; BA150, soldered ends.
   d. Nibco; S-858-70, soldered ends.

2.5 OPERATORS

A. Manual Operator:

1. General:
   a. Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.
   b. Operator self-locking type or equipped with self-locking device.
   c. Position indicator on quarter-turn valves.
   d. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
   a. Galvanized and painted handwheels.
   b. Lever operators allowed on quarter-turn valves 8 inches and smaller.
   c. Cranks on gear type operators.
   d. Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
   e. Valve handles to take a padlock, and wheels a chain and padlock.
3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

B. Electric Operator:

1. General:
   a. Comply with AWWA C540.
   b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.
   c. Controls integral with the actuator and fully equipped as specified in AWWA 540.
   d. Stem protection for rising stem valves.

2. Actuator Operation—General:
   a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves.
   b. Manual override handwheel.
   c. Valve position indication.
   d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in 30 seconds.
3. Modulating Service:
   a. Size motors for continuous duty.
   b. Feedback potentiometer and integral electronic positioner/ comparator circuit to maintain valve position.
   c. Valves shall remain in last position upon loss of signal unless otherwise indicated.
   d. Ac motor with reversing starter or dc motor with solid state reversing controller, and built-in overload protection.
   e. Duty cycle limit timer and adjustable band width to prevent actuator hunting.
4. Actuator Power Supply:
   a. 480-volt, three-phase unless otherwise indicated.
   b. Control power transformer, 120-volt secondary.
   c. Externally operable power disconnect switch.
5. Enclosure:
   a. As defined in NEMA 250, Type 4.
   b. Contain 120-volt space heaters.
6. Limit Switch:
   a. Single-pole, double-throw (SPDT) type, field adjustable cam-operated, with contacts rated for 5 amps at 120 volts ac.
   b. Each valve actuator to have a minimum of two transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
   c. Housed in actuator control enclosure.
7. Control Features:
   a. No local controls mounted on actuator. Provision for operation from local control station provided by others, consisting of the following:
      1) LOCAL-OFF-REMOTE selector switch.
      2) OPEN-STOP-CLOSE pushbuttons.
      3) 4 to 20 mA analog position command from remote location.
   b. Position feedback circuit which generates a 4 to 20 mA signal in proportion to valve position. Signal shall drive loads up to 750 ohms, using 24V dc loop power provided by the actuator.
   c. External Interfaces:
      1) Discrete Inputs: OPEN, STOP, CLOSE, and REMOTE.
      2) Analog Input: 4 to 20 mA position command.
      3) Analog Output: 4 to 20 mA actual position indication.
   d. Operation:
      1) Actuator shall respond to OPEN-STOP-CLOSE pushbuttons when selected for LOCAL operation.
      2) Actuator shall respond to the 4 to 20 mA position signal when selected for REMOTE operation.
8. Manufacturers:
   a. EIM Co.

b. AUMA.
c. Limitorque.
d. Keystone.

2.6 ACCESSORIES

A. Tagging: 1-1/2-inch diameter heavy brass or stainless steel tag for each valve operator, bearing the valve tag number shown on the Electric Operator Schedule.

B. Limit Switch:

1. Factory installed limit switch by actuator manufacturer.
2. SPST, rated at 5 amps, 120 volts ac.

C. T-Handled Operating Wrench:

1. Two each galvanized operating wrenches, 4 feet long.
2. Manufacturers and Products:
   a. Mueller; No. A-24610.
   b. Clow No.; F-2520.

D. Extension Bonnet for Valve Operator: Complete with stem and accessories for valve and operator.

1. Manufacturers:
   a. Pratt.
   b. Allis-Chalmers.

E. Cast Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches, marked WATER.
3. Extensions: Cast iron.

PART 3 EXECUTION

3.1 INSTALLATION

A. Flange Ends:

1. Flanged valve boltholes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. Valve Orientation:

1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.
3. Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.
4. If no plug valve seat position is shown, locate as follows:
   a. Horizontal Flow: The flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve.
   b. Vertical Flow: Install seat in the highest portion of the valve.

D. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

E. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

F. Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3 feet below grade, furnish an operating extension stem with 2-inch operating nut to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover.

3.2 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for all relief and regulating valves.

F. Automatic valve to be tested in conjunction with control system testing.

END OF SECTION

SECTION 15992
PIPING LEAKAGE TESTING

PART 1 GENERAL

1.1 SUBMITTALS

A. Quality Control Submittals:

1. Testing Plan: Submit prior to testing and include at least the information that follows.
   a. Testing dates.
   b. Piping systems and section(s) to be tested.
   c. Test type.
   d. Method of isolation.
   e. Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. All pipe and appurtenances shall successfully pass a hydrostatic test prior to acceptance and shall be free of visible leakage.

3.2 PREPARATION

A. Notify RESIDENT ENGINEER in writing 7 days in advance of testing. Perform testing in presence of RESIDENT ENGINEER.

B. Furnish all testing equipment and water and make all taps in the pipe to perform the test in a manner satisfactory to RESIDENT ENGINEER.

C. Gauges for testing shall be calibrated with a standardized test gauge provided by RESIDENT ENGINEER at the start of each testing day. The calibration shall be witnessed by RESIDENT ENGINEER.

D. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Wait 5 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

4. Test Pressure for Water Piping: 200 psi.
5. Test Pressure for Aeration Piping: 25 psi.

E. Test section may be filled with water and allowed to stand under low pressure prior to testing.

F. Gravity Piping:

1. Perform testing after manholes, and backfilling have been completed between stations to be tested.
2. Pipe 42-Inch Diameter and Larger Piping: Joint testing device may be used to isolate and test individual joints.

3.3 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.
2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets,.
4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
5. Examine joints and connections for leakage.
6. Correct visible leakage and retest as specified.
7. Empty pipe of water prior to final cleaning or disinfection.

C. Buried Piping:

1. Test after backfilling has been completed.
2. Expel air from piping system during filling.
3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
4. Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.
5. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
6. Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

where:

L = Allowable leakage, in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of pipe, in inches.
P = Test pressure during leakage test, in pounds per square inch.

7. Correct leakage greater than allowable, and retest as specified.

D. Defective Piping Sections: Replace and retest as specified.

3.4 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus 1/2 gallon of water leakage under specified conditions.

B. Maximum Allowable Leakage: 0.5 gallon per hour per inch diameter per 100 feet.

C. Exfiltration Test:

1. Hydrostatic Head:
   a. At least 6 feet above maximum estimated groundwater level in section being tested.
   b. No less than 6 feet above inside top of highest section of pipe in test section.
2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.

D. *Defective* Piping Sections:

1. Repair or replace and retest.
2. Submit proposed method for review prior to starting any repair work.

3.5 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by CONTRACTOR and RESIDENT ENGINEER to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Requirements specified within this section apply to all sections in Division 16, ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

1.2 DESIGN REQUIREMENTS

A. All equipment anchoring and mounting shall be in accordance with manufacturer's requirements for the seismic zone criteria given in Section 01600, MATERIALS AND EQUIPMENT.

1.3 ELECTRICAL COORDINATION

A. Work Provided Outside this Contract:

1. Details of facility equipment and construction for all Specification Divisions which affect work covered under Division 16, ELECTRICAL.
2. Incoming underground primary and secondary service power cables, materials, installation, termination, and connection. Provide trench, backfill, and duct system under this Contract in accordance with the utility design documents.
3. Transformers supplying main electrical service to the facility; site preparation and transformer pad(s) included in this Contract.
4. Utility primary switch cabinets and capacitor cabinet; box pads furnished by utility, installed under this contract.
5. Power company metering facilities, except as indicated.
6. Incoming telephone service, as indicated.
7. Interior telephone system, except as indicated.

B. Primary and Secondary Electrical Service:

1. Provide in accordance with Arizona Public Service (APS) Design Documents.
2. CONTRACTOR shall obtain all relevant design documents, drawings, details, specifications, standards, and instructions from APS.

1.4 SUBMITTALS

A. Quality Control Submittals:

1. Voltage Field Test Results.
2. Voltage Balance Report.
3. Equipment Line Current Report.

4. Factory test certification and reports for all major electrical equipment.
5. Site test certification and reports as specified in other Division 16, ELECTRICAL sections.
6. City agent to be present during field testing.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials and equipment listed by UL wherever standards have been established by that agency.

B. Equipment Finish:

1. Provide manufacturers' standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

PART 3 EXECUTION

3.1 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

C. All Work shall be performed in accordance with the City of Tempe Electrical Code and all other applicable state or local codes.

3.2 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.3 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all three phases simultaneously on the same graph) for 24 hours during normal working day.
   a. Submit Voltage Field Test Report within 5 days of test.
4. Unbalance Corrections:
   a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
   b. Obtain a written certification from a responsible power company official that the voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Junction and pull boxes used at, or below, grade.
2. Terminal junction boxes.
3. Panelboards and circuit breaker data.
4. Fuses.
5. Contactors.
6. Transformers.
7. Service and telemetry pedestal.

1.2 QUALITY ASSURANCE

A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

B. Hazardous Areas: Materials and devices shall be specifically approved for hazardous areas of the class, division, and group shown and of a construction that will ensure safe performance when properly used and maintained.

1.3 SPARE PARTS

A. Furnish, tag, and box for shipment and storage and deliver prior to 90 percent Project completion the following spare parts:

1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.1 METERING FACILITIES

A. Furnish materials as required by electric utility for utility's installation of metering equipment, service conductors, and mounting of utility company equipment.

2.2 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.

B. Cast Metal:

1. Box: Malleable iron.
2. Cover: Gasketed, weatherproof, malleable iron, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs (Cast Mounting) Manufacturer:
   a. Crouse-Hinds; Type FS or FD.
   b. Appleton; Type FS or FD.

C. PVC-Coated Sheet Steel:

1. Type: One-piece.
2. Material: Zinc- or cadmium-plated.
3. Coating: All surfaces; 40-mil PVC.
4. Manufacturer: Appleton.

D. Nonmetallic:

1. Box: PVC.
2. Cover: PVC, weatherproof, with stainless steel screws.
3. Manufacturer: Carlon; Type FS or FD, with Type E98 or E96 covers.

2.3 JUNCTION AND PULL BOXES

A. Outlet Boxes Used as Junction or Pull Box: As specified under Article OUTLET AND DEVICE BOXES.

B. Large Sheet Steel Box: NEMA 250, Type 1.

1. Box: Code-gauge, galvanized steel.
2. Cover: Full access, hinged. screw type.
3. Machine Screws: Corrosion-resistant.

C. Large Cast Metal Box: NEMA 250, Type 4.

1. Box: Cast malleable iron, hot-dip galvanize finished, with drilled and tapped conduit entrances.
2. Cover: Hinged with screws.
3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
4. Manufacturers, Surface Mounted Type:
   a. Crouse-Hinds; Series W.
   b. O.Z./Gedney; Series Y.
5. Manufacturers, Recessed Type:
   a. Crouse-Hinds; Type WJBF.
   b. O.Z./Gedney; Series YR.

D. Large Steel Box: NEMA 250, Type 1 and 12.

1. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces, with final ANSI Z55.1, No. 61 gray enamel on exterior surfaces.
2. Cover: Hinged with screws.
3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
4. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.

E. Concrete Box: See Section 16110, RACEWAYS.

2.4 SERVICE AND TELEMETRY PEDESTAL

A. General:

1. The service equipment cabinet shall meet the requirements of the serving utility.
2. The service cabinet shall bear a UL508 industrial control panel label for service entrance equipment.
3. The service and telemetry pedestal shall provide power distribution and control functons, as shown for the rural drain diversion structure.

B. Cabinet Fabrication:

1. Width 30 inch, height 46 inch, depth 22.75 inch, minimum.
2. Cabinet shall be fabricated from 12 gauge hot-dipped galvanized steel.
3. Internal parts shall be fabricated from 14 gauge cold rolled steel.
4. Cabinet shall be of all welded construction with welding materials specifically designed for the material used.
5. All fasteners, hinges, latches, and hardware shall be of stainless steel and hinges shall be continuous piano style.
6. There shall be no exposed nuts, bolts, screws, rivets, or other fasteners on the exterior.
7. Cabinet shall have a fully framed side hinged outer door with swaged close tolerance sides for flush fit with top drip lip and closed cell neoprene flange compressed gaskets.
8. Cabinet door shall have 2,000-pound stress rated stainless steel hasp, welded to cabinet and door.
9. Provide SPDT door switch wired to terminal strip for use as an intrusion alarm.

C. Deadfront Safety Door:

1. Distribution and control panel shall have a hinged deadfront panel with 1/4 turn latch and knurled knobs.
2. Deadfront shall be hinged on the same side as the front door and shall open a minimum of 120 degrees.
3. Removable backpan shall be mounted on four welded 1/4-inch studs.

D. Power Distribution:

1. Main breaker shall be two-pole.
2. Provide separate main and disconnects as required.
3. All circuit breakers shall be installed in a vertical position, handle up for "On," handle down for "Off."
4. Circuit breakers shall be industrial grade, Westinghouse Quicklag C, or equal.
5. Provide one duplex GFI convenience receptacle.
6. Provide typed panel directory.

E. Control Compartment:

1. Provide a minimum of 30-inch by 20-inch by 10-inch deep blank panel space for OWNER installation of telemetry equipment.
2. Terminate external interfaces and power distribution wiring on numbered terminal blocks.
3. The cabinet shall be completely prewired in the factory.
4. Wiring shall be to NEMA IIB standards showing external connections and equipment.
5. All control wires shall be permanently labeled with machine engraved clip-on nylon sleeve markers.
6. Provide 100 percent spare terminals.
7. Control devices shall be as specified elsewhere in this section.

F. Manufacturer: Tesco Controls, Class 24-200 LB, or approved equal.

2.5 WIRING DEVICES

A. Switches:

1. NEMA WD 1 and FS W-S-896E.
2. Specification grade, totally enclosed, ac type, with quiet tumbler switches and screw terminals.
3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
4. Rating: 20 amps, 120/277 volts.
5. Color: Brown.
6. Manufacturers:
   a. Bryant.
   b. Leviton.
   c. Hubbell.
   d. Pass and Seymour.
   e. Arrow Hart.

B. Receptacle, Single and Duplex:

1. NEMA WD 1 and FS W-C-596.
2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
3. High strength, thermoplastic base color.
4. Color: Brown

5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
7. Manufacturers:
   a. Bryant.
   b. Leviton.
   c. Hubbell.
   d. Pass and Seymour.
   e. Sierra.
   f. Arrow Hart.

C. Receptacle, Ground Fault Circuit Interrupter: Duplex, specification grade, tripping at 5 mA.

1. Color: Brown.
2. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, capable of interrupting 5,000 amps without damage.
3. Size: For 2-inch by 4-inch outlet boxes.
4. Standard Model: NEMA WD 1, with screw terminals and provisions for testing.
5. Feed-Through Model: NEMA WD 1, with feed-through screw terminals and provisions for testing.
6. Manufacturers:
   a. Pass and Seymour.
   b. Bryant.
   c. Leviton.
   d. Hubbell.
   e. Arrow Hart.

2.6 DEVICE PLATES

A. General: Sectional type plates not permitted.

B. Plastic:

1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
2. Color: To match associated wiring device.
3. Mounting Screw: Oval-head metal, color matched to plate.

C. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
2. Finish: ASTM A167, Type 302/304, satin.
3. Mounting Screw: Oval-head, finish matched to plate.

D. Cast Metal:

1. Material: Malleable ferrous metal, with gaskets.
2. Screw: Oval-head stainless steel.

E. Weatherproof:

1. For Receptacles: Gasketed, cast metal or stainless steel, with individual cap over each receptacle opening.
   a. Mounting Screw: Stainless steel.
   b. Cap Spring: Stainless steel.
   c. Manufacturers:
      1) General Electric.
      2) Bryant.
      3) Hubbell.
      4) Sierra.
      5) Pass and Seymour.
      6) Crouse-Hinds; Type WLRD or WLRS.
      7) Bell.
      8) Arrow Hart.
2. For Switches: Gasketed, cast metal incorporating external operator for internal switch.
   a. Mounting Screw: Stainless steel.
   b. Manufacturers:
      1) Crouse-Hinds; DS-181 or DS-185.
      2) Appleton; FSK-1VTS or FSK-1VS.

F. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel boxes.

2.7 FUSE, 0 TO 600 VOLTS

A. Current-limiting, with 200,000 ampere rms interrupting rating.

B. Provide to fit mountings specified with switches and features to reject Class H fuses.

C. Motor and Transformer Circuits, 0- to 600-Volt:

1. Amperage: 0 to 600.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers:
   a. Bussmann; Type LPS-RK.
   b. Littelfuse; Type LLS-RK.

D. Feeder and Service Circuits, 0- to 600-Volt:

1. Amperage: 0 to 600.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers:
   a. Bussmann; Type LPS-RK.
   b. Littelfuse; Type LLS-RK.

2.8 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCHES

A. Contact Rating: NEMA ICS 2, Type A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Lights: Transformer, push-to-test.

D. Pushbutton Color:

1. ON or START: Black.
2. OFF or STOP: Red.

E. Pushbuttons and selector switches lockable in the OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum, with black letters.
2. Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.
3. Letter Height: 7/64 inch.

G. Manufacturers:

1. Heavy-Duty, Oiltight Type:
   a. Allen Bradley; Type 800T.
   b. Square D; Type T.
   c. Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D; Type SK.
   b. Allen Bradley; Type 800H.
   c. Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.

2.9 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Terminal Blocks: Provide separate connection point for each conductor entering or leaving box.

1. Spare Terminal Points: 25 percent.

C. Interior Finish: Paint with white enamel or lacquer.

2.10 TERMINAL BLOCK (0 TO 600 VOLTS)

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of all control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between the compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller.
2. Ideal.
3. Electrovert.
4. Thomas and Betts.

2.11 MAGNETIC CONTROL RELAY

A. Contacts:

1. DPDT (2 Form C) or 3PDT (3 Form C) as required.
2. Rating: 120V ac, 10A continuous.

B. Time Delay Relay Attachment:

1. Electronic timer, adjustable as required.
2. Field convertible from ON delay to OFF delay and vice versa.

C. Latching Attachment: Mechanical latch having unlatching coil and coil clearing contacts.

D. Manufacturers:

1. Allen Bradley.
2. General Electric.
3. IDEC.
4. Agastat.

2.12 ELAPSED TIME METER

A. Drive: Synchronous motor.

B. Range: 0 to 99,999.9 hours, nonreset type.

C. Mounting: Semiflush, panel.

D. Manufacturers:

1. General Electric; Type 240, 2-1/2-inch Big Look.
2. Eagle Signal; Bulletin 705.

2.13 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

A. UL 1561, NEMA ST 20, unless otherwise indicated.

B. Self-cooled, two-winding.

C. Insulation Class and Temperature Rise: Manufacturer's standard.

D. Core and Coil: Encapsulated for single-phase units 1/2 to 25 kVA.

E. Voltage Taps: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.

F. Impedance: 4.5 percent minimum on units 75 kVA and larger.

G. Maximum Sound Level: NEMA ST 20: 40 decibels.

H. Vibration Isolators:

1. Rated for transformer's weight.
2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.

I. Manufacturers:

1. General Electric.
2. Square D.
3. Westinghouse.

2.14 LOW VOLTAGE, SECONDARY SURGE PROTECTIVE EQUIPMENT

A. NEMA LA 1, ANSI C62.11.

B. Surge Capacitor:

1. Impregnated with non-PCB, biodegradable dielectric fluid.

2. Integral discharge resistor which will drain residual voltage to 50 volts crest in less than 1 minute after disconnection from circuit.

C. Arrestor: High strength metal oxide valve elements enclosed in high strength, corrosion resistant, molded resin housing.

D. Equip capacitor and arrestor with mounting nipple, flat washer, and nut suitable for knockout or bracket mounting.

2.15 SUPPORT AND FRAMING CHANNELS

A. Material: Rolled, mild strip steel, 12-gauge, ASTM A570, Grade 33.

B. Finish:

1. Dry and Wet Areas: Hot-dip galvanize.
2. Corrosive and Wet Areas: ASTM A167, Type 316 stainless steel.

C. Inserts: Continuous.

D. Beam Clamps: Zinc/cadmium-plated mild steel.

E. Manufacturers:

1. B-Line.
2. Unistrut.

2.16 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: White, engraved to a black core.

D. Engraving:

1. Pushbuttons/Selector Switches: Name of drive controlled on one, two, or three lines, as required.
2. Panelboards: Panelboard designation, service voltage, and phases.

E. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Panelboards: 1/4 inch.

PART 3 EXECUTION

3.1 GENERAL

A. Install equipment in accordance with NECA 5055.

3.2 OUTLET AND DEVICE BOXES

A. Install suitable for conditions encountered at each outlet or device in the wiring or raceway system, sized to meet NFPA 70 requirements.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by RESIDENT ENGINEER.

D. Install plumb and level.

E. Support boxes independently of conduit by attachment to building structure or structural member.

F. Fasten boxes directly with bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws threaded into steelwork.

G. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

H. Provide plaster rings where necessary.

I. Boxes embedded in concrete or masonry shall be wrapped with 20 mil pipe wrap.

J. Install galvanized mounting hardware in industrial areas.

K. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.

L. Box Type (Steel Raceway System):

1. Exterior Locations: Cast metal.
2. Cast-In-Place Concrete Slabs: Sheet steel.

M. Box Type (Rigid Aluminum Raceway System): Cast aluminum.

N. Box Type (Nonmetallic Raceway System):

1. Corrosive Locations: Nonmetallic.

2. Exposed Raceways: Nonmetallic.
3. Concealed Raceways: Nonmetallic.
4. Concrete Encased Raceways: Cast metal.

3.3 JUNCTION AND PULL BOXES

A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

B. Install pull boxes where necessary in raceway system to facilitate conductor installation.

C. Install in conduit runs at least every 100 feet or after the equivalent of three right-angle bends.

D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

E. Conduits shall terminate in threaded hubs of cast boxes; bore no holes in cast boxes.

F. Installed boxes shall be accessible.

G. Do not install on finished surfaces.

H. Install plumb and level.

I. Support boxes independently of conduit by attachment to building structure or structural member.

J. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded threaded studs on steelwork.

K. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

L. Boxes embedded in concrete or masonry need not be additionally supported.

M. At or Below Grade: See Section 16110, RACEWAYS.

N. Mounting Hardware:

1. Noncorrosive Areas: Zinc coated galvanized.

O. Location/Type:

1. Unfinished, Indoor, Dry: NEMA 250, Type 12.
2. Unfinished Indoor and Outdoor, Wet: NEMA 250, Type 4.
3. Underground Conduit: Concrete.

3.4 WIRING DEVICES

A. Switches:

1. Mounting Height: See Article OUTLET AND DEVICE BOXES.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switches such that toggle is in up position when switch is on.

B. Receptacles:

1. Install with grounding slot down except where horizontal mounting is shown, in which case install with neutral slot up.
2. Ground receptacles to boxes with grounding wire only.
3. Weatherproof Receptacles:
   a. Install in cast metal box.
   b. Install such that hinge for protective cover is above receptacle opening.
4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for "downstream" conventional receptacles. Label "downstream" receptacles as GFI protected.
5. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.

3.5 DEVICE PLATES

A. Securely fasten to wiring device; ensure a tight fit to the box.

B. Surface Mounted: Plate shall not extend beyond sides of box unless plates have no sharp corners or edges.

C. Install with alignment tolerance to box of 1/16 inch.

D. Types (Unless Otherwise Shown):

1. Exterior: Weatherproof.
2. Interior:
   a. Flush Mounted Boxes: Metal.
   b. Surface Mounted, Cast Metal Boxes: Cast metal.
   c. Surface Mounted, Sheet Steel Boxes: Metal.
   d. Surface Mounted, Nonmetallic Boxes: Metal.

3.6 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Heavy-Duty, Oiltight Type: Locations (Unless Otherwise Shown): Nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.

B. Heavy-Duty, Watertight, and Corrosion-Resistant Type:

1. Locations (Unless Otherwise Shown): Nonhazardous, outdoor, or normally wet areas.
2. Mounting: NEMA 250, Type 4X enclosure.

3.7 TERMINAL JUNCTION BOX

A. Install in accordance with Article JUNCTION AND PULL BOXES.

B. Label each block and terminal with permanently attached, nondestructible tag.

C. Do not install on finished outdoor surfaces.

D. Location:

1. Unfinished, Indoor, Dry: NEMA 250, Type 12.
2. Unfinished, Indoor and Outdoor, Wet: NEMA 250, Type 4.

3.8 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

A. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.

B. Provide liquid-tight, flexible metal conduit for electrical connections.

C. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.

3.9 SUPPORT AND FRAMING CHANNEL

A. Furnish zinc-rich primer; paint cut ends prior to installation.

B. Install where required for mounting and supporting electrical equipment and raceway systems.

3.10 MOTOR SURGE PROTECTION

A. Ground in accordance with NFPA 70.

B. Low Voltage: Ground terminals to equipment bus.

3.11 TERMINAL BLOCK

A. Identify with engraved nameplates matching the shematic diagrams.

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's Literature:
   a. Rigid galvanized steel conduit.
   b. Intermediate metal conduit.
   c. PVC Schedule 40 conduit.
   d. PVC-coated rigid galvanized steel conduit.
   e. Flexible metal, liquid-tight conduit.
   f. Conduit fittings.
2. Precast Pullboxes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
3. Conduit Layout:
   a. Plan and section type, showing arrangement and location of conduit and duct bank required for:
      1) Low and medium voltage feeder and branch circuits.
      2) Instrumentation and control systems.
      3) Communications systems.
      4) Empty conduit for future use.
   b. Reproducible mylar; scale not greater than 1 inch equals 20 feet.
4. Equipment and machinery proposed for bending metal conduit.
5. Method for bending PVC conduit less than 30 degrees.

1.2 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of ANSI C80.1 and UL6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. Intermediate Metal Conduit (IMC):

1. Meet requirements of ANSI C80.6 and UL 1242.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

C. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
   a. Conduit: Meet requirements of ANSI C80.1 and UL 6.
   b. PVC Coating: 40 mils nominal thickness, bonded to metal.

E. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.

2.2 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers:
      1) Thomas & Betts.
      2) O.Z. Gedney.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers:
      1) Appleton.
      2) O.Z. Gedney.
4. Conduit Hub:
   a. Material: Malleable iron with insulated throat.
   b. Manufacturers:
      1) O.Z. Gedney.
      2) T & B.
5. Conduit Bodies:
   a. Material: Malleable iron, sized as required by NFPA 70.
   b. Manufacturers (For Normal Conditions):
      1) Appleton.
      2) Crouse-Hinds.
      3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Expansion Fitting Manufacturers:
   a. Appleton.
   b. Crouse-Hinds.

8. Cable Sealing Fittings:
   a. To form watertight nonslip cord or cable connection to conduit.
   b. For Conductors With OD of 1/2 Inch or Less: Neoprene bushing at connector entry.
   c. Manufacturers:
      1) Crouse-Hinds.
      2) Appleton.

B. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type: PVC, slip-on.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Type: Rigid galvanized steel, PVC coated by conduit manufacturer.
3. Overlapping pressure sealing sleeves.
4. Conduit Hangers, Attachments, and Accessories: PVC-coated.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Long design type extending outside of box or other device at least 2 inches.
4. Manufacturer: T & B

E. Watertight Entrance Seal Device:

1. New Construction:
   a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
   b. Manufacturer: O.Z. Gedney; Type FSK or WSK, as required.
2. Cored-Hole Application:
   a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
   b. Manufacturer: O.Z. Gedney; Series CSM.

F. Corrosive Locations:

1. Material: 40-mil PVC-coated rigid steel.
2. Manufacturers:
   a. Robroy Industries.
   b. Carlon.
   c. Crouse-Hinds.

2.3 PRECAST PULLBOXES

A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.

B. Loading: AASHTO Division 1, H-20 in accordance with ASTM C857.

C. Access: Provide cast concrete 6- or 12-inch risers and access adapters between top of pullbox and finished grade at required elevations.

D. Drainage:

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.

E. Raceway Entrances:

1. Provide on all four sides.
2. For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.
3. At entrances where raceways are to be installed by others, provide minimum 12-inch high by 24-inch wide knockout panels for future raceway installation.

F. Embedded Pulling Iron:

1. Material: 3/4-inch diameter stock, fastened to overall steel reinforcement before concrete is placed.
2. Location:
   a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
   b. Floor: Centered below pullbox cover.

G. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving, including spares.
2. Wall Attachment:
   a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
   b. Insert Spacing: Maximum 3-foot on center entire inside perimeter of manhole.
   c. Arrange so that spare raceway ends are clear for future cable installation.

H. Pullbox Frames and Covers:

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, torsion spring, of nonskid design.
3. Cover Loading: H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
   a. Above 600 Volts: ELECTRIC HV.
   b. 600 Volts and Below: ELECTRIC LV.
   c. TELEPHONE.

I. Hardware: Steel, hot-dip galvanized.

J. Furnish knockout for ground rod in each pullbox.

K. Manufacturers:

1. Brooks Products, Inc.
2. Penn-Cast Products, Inc.
3. Concrete Conduit Co.
4. Associated Concrete Products, Inc.
5. Utility Vault Co.
6. Pipe, Inc.

2.4 ACCESSORIES

A. Duct Bank Spacers:

1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturer: Underground Device, Inc.; Type WUNPEECE.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nonferrous metal.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge.
   b. Color: Red.
   c. Width: Minimum 3-inch.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Manufacturers:
      1) Blackburn, Type RT.
      2) Griffolyn Co.
3. Buried Raceway Marker:
   a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
   b. Designation: Incise to depth of 3/32-inch, ELECTRIC CABLES, in letters 1/4-inch high.
   c. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.

C. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Manufacturer: Raychem; Type TWDB.

PART 3 EXECUTION

3.1 GENERAL

A. Conduit and tubing sizes shown are based on the use of copper conductors.

B. All installed Work shall comply with NECA 5055.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

H. Group raceways installed in same area.

I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

L. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.

M. Install watertight fittings in outdoor, underground, or wet locations.

N. Paint threads, before assembly of fittings, of galvanized conduit or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

O. All metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

P. Do not install raceways in concrete equipment pads, foundations, or beams.

Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

3.2 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum cover 1-1/2 inches.

B. Provide support during placement of concrete to ensure raceways remain in position.

C. Floor Slabs:

1. Outside diameter of conduit not to exceed one-third of the slab thickness.
2. Separate conduit by minimum six times conduit outside diameter, except at crossings.

3.3 CONDUIT APPLICATION

A. Diameter: Minimum 3/4-inch.

B. Exterior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.
3. PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.
3. PVC-coated rigid galvanized steel.

D. Interior, Concealed (Not Embedded in Concrete):

1. Rigid galvanized steel.
2. Intermediate metal.

E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. Rigid galvanized steel.
2. Intermediate metal.
3. PVC Schedule 40.

F. Direct Earth Burial: PVC Schedule 40.

G. Under Slabs-On-Grade:

1. Rigid galvanized steel.
2. PVC Schedule 40.
3. PVC-coated rigid galvanized steel.

3.4 CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible metal, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Length: 18-inch minimum, 60-inch maximum, of sufficient length to allow movement or adjustment of equipment. Provide supports for lengths 42 inches or longer.

B. Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Transition From Underground to Exposed: Coated rigid steel conduit.

E. Under Equipment Mounting Pads: Rigid galvanized steel, PVC-coated rigid steel conduit.

3.5 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Fire-stop openings around penetrations to maintain fire-resistance rating.

D. Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.

e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3. Heating, Ventilating, and Air Conditioning Equipment:
   a. Penetrate equipment in area established by manufacturer.
   b. Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
4. Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.
5. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
   a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
   b. Fill space between raceway and sleeve with an expandable plastic compound, or an oakum and lead joint, on each side.
6. Pullboxes:
   a. Metallic Raceways: Provide insulated grounding bushings.
   b. Nonmetallic Raceways: Provide bell ends flush with wall.
   c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.6 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze.

C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.

D. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.7 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30-Degree and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows.
3. Use manufacturer's recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.8 EXPANSION/DEFLECTION FITTINGS

A. Provide on all raceways at all structural expansion joints, and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer's instructions.

3.9 PVC CONDUIT

A. Solvent Welding:

1. Provide manufacturer recommended solvent; apply to all joints.
2. Install such that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.10 TERMINATION AT ENCLOSURES

A. Utilize fittings that maintain the NEMA 250 Environmental Rating of the enclosure.

B. Cast Metal Enclosure: Provide manufacturer's pre-molded insulating sleeve inside metallic conduit terminating in threaded hubs.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. Rigid Galvanized Intermediate Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
   d. Install insulated bushing on ends of conduit where grounding is not required.
   e. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
2. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
3. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut.

D. Motor Control Center, Switchgear, and Free-Standing Enclosures: Terminate conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.

3.11 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so that couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

I. Metallic Raceway Coating: At couplings and joints, apply wraparound duct band with one-half tape width overlap to obtain two complete layers.

J. Backfill:

1. As specified in Section 02225, TRENCH BACKFILL.
2. Do not backfill until inspected by RESIDENT ENGINEER.

3.12 PULLBOXES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 02205, EXCAVATION, and Section 02225, TRENCH BACKFILL.

B. Do not install until final raceway grading has been determined.

C. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

D. Grounding: As specified in Section 16450, GROUNDING.

E. Identification: Field stamp covers with manhole or pullbox number as shown. Stamped numbers to be 1-inch minimum height.

3.13 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article IDENTIFICATION DEVICES, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.14 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
3. Provide nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.

C. Buried Raceway Markers:

1. Install at grade to indicate direction of underground raceways.

2. Install at all bends and at intervals not exceeding 100 feet in straight runs.
3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.15 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up damage to coating on PVC-coated conduit with patching compound approved by manufacturer.

END OF SECTION

SECTION 16120
CONDUCTORS

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Wire and cable descriptive product information.
2. Wire and cable accessories descriptive product information.
3. Cable fault detection system descriptive product information.

B. Quality Control Submittals: Certified Factory Test Report for conductors 600 volts and below.

1.2 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.1 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 3, WC 5, and WC 7.

B. Conductor Type: Stranded copper.

C. Insulation:

1. Type THHN/THWN.
2. Type XHHW to be used in all pump and blower vaults.

2.2 600-VOLT RATED CABLE

A. General:

1. Type: TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu/hr, and NFPA 70, Article 340, or UL 13 Listed Power Limited Circuit Cable meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 3—No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nominal nylon.
   e. Color Code: Pair conductors black and red.
5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.

2.3 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.4 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
   a. 30-mil, elastomer
   b. Manufacturers and Products:
      1) Scotch; Brand 77, with Scotch Brand 69 glass cloth tapebinder.
      2) Plymount; Plyarc 30, with Plymount Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.
2. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
3. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Insulated, Locking-Fork, Compression Lugs:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) ILSCO; ILSCONS.
4. Uninsulated Crimp Connectors and Terminators:
   a. Manufacturers and Products:
      1) Square D; Versitide.
      2) Thomas & Betts; Color-Keyed.
      3) ILSCO.
5. Uninsulated, Bolted, Two-Way Connectors and Terminators:
   a. Manufacturers and Products:
      1) Thomas & Betts; Locktite.
      2) Brundy; Quiklug.
      3) ILSCO.

E. Cable Ties: Nylon, adjustable, self-locking, and reusable.

1. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation: Thermally stabilized, crosslinked polyofin.

1. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

2.5 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

D. Manufacturers and Products:

1. Ideal Co.; Yellow 77.
2. Polywater, Inc.
3. Cable Grip Co.

2.6 WARNING TAPE

A. As specified in Section 16110, RACEWAYS.

2.7 SOURCE QUALITY CONTROL

A. Conductors 600-Volts and Below: Test in accordance with UL 44 and 854 Standards.

PART 3 EXECUTION

3.1 GENERAL

A. Conductor installation to be in accordance with NECA 5055.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.

E. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

F. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.

G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

3.2 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
2. No. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with an identifiable colored strip other than green in accordance with NFPA 70.

3.3 CIRCUIT IDENTIFICATION

A. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
3. Identify termination point of opposite end of wire.

C. Method:

1. Conductors No. 3 AWG and Smaller: Identify with sleeves.
2. Cables, and Conductors No. 2 AWG and Larger:
   a. Identify with marker plates.
   b. Attach marker plates with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.4 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger unless specifically indicated or approved by RESIDENT ENGINEER.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 6 AWG and smaller.
3. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
4. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.
5. Install uninsulated bolted, two-way connectors for motor circuit conductors No. 12 and larger.
6. Tape insulate all uninsulated connections.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose.
    b. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    c. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Indoors: Use general purpose, flame retardant tape.
2. Outdoors: Use waterproof, heat shrink type insulation.

F. Cap spare conductors and conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Cable Protection:
    a. Maintain integrity of shielding of instrumentation cables.

b. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.5 CONDUCTOR ARC AND FIREPROOFING

A. Install arc and fireproofing tape on 600-volt single conductors and cables except those rated Type TC at splices in manholes, handholes, vaults, cable trays, and other indicated locations.

B. Wrap conductors of same circuit entering from separate conduit together as a single cable.

C. Follow tape manufacturer's installation instructions.

3.6 FIELD QUALITY CONTROL

A. In accordance Section 16950, ELECTRICAL TESTING.

END OF SECTION

SECTION 16450
GROUNDING

PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Product Data:
   a. Exothermic weld connectors.
   b. Mechanical connectors.
   c. Compression connectors.

1.2 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.1 GROUND ROD

A. Material: Copper or copper-clad steel.

B. Diameter: Minimum 5/8-inch.

C. Length: 10 feet.

2.2 GROUND CONDUCTORS

A. As specified in Section 16120, CONDUCTORS.

2.3 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers:
   a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
   b. Thermoweld.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.

5. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.
   c. Ilso Corp.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.

2.4 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. Manufacturers:

1. Christy Co.; No. G5.
2. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 EXECUTION

3.1 GENERAL

A. Grounding shall be in compliance with NFPA 70 and ANSI C2.

B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

D. Bond together system neutrals, service equipment enclosures, exposed non-current-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

E. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

F. Shielded Control Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground control cable shield at more than one point.

3.2 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.3 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.4 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

3.5 GROUNDING WELLS

A. Install inside buildings, asphalt, and paved areas.

B. Install riser ring and cover flush with surface.

C. Place 6 inches crushed rock in bottom of each well.

3.6 CONNECTIONS

A. General:

1. Abovegrade Connections: Use either exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify RESIDENT ENGINEER prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.7 METAL STRUCTURE GROUNDING

A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.8 PULLBOX GROUNDING

A. Install one ground rod inside each.

B. Ground Rod Floor Protrusion: 4 to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with No. 6 AWG copper conductor.

3.9 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

3.11 FIELD QUALITY CONTROL

A. As specified in Section 16950, ELECTRICAL TESTING.

END OF SECTION

SECTION 16490
WELL ELECTRICAL AND CONTROLS

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory. Perform onsite installation assistance, inspection, startup functional and performance testing.

1.2 UL COMPLIANCE

A. Products manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL Listing Mark.

1.3 PACKING AND SHIPPING

A. Shipping Splits: Established by CONTRACTOR to facilitate ingress of equipment to final installation location.

B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

1.4 SUBMITTALS

A. Shop Drawings:

1. Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
2. Catalog information on electrical devices furnished with system.
3. Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.
4. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
5. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.

B. Quality Control Submittals:

1. Manufacturer's installation instructions.
2. Operation and Maintenance Manual.
3. Factory tests reports, certified.
4. Manufacturer's list of proposed spares, expendables, and test equipment.

PART 2 PRODUCTS

2.1 WELL CONTROL PANELS

A. General

1. Like items of equipment: End product of one manufacturer.
2. Make adjustments as necessary to wiring, conduit, disconnecting devices, motor starter, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.
3. Short Circuit Rating: 22,000 amperes rms symmetrical for the entire control panel as a complete assembly.
4. Access: All controls, circuit breakers, wire connections, and other devices to be front mounted and accessible unless otherwise noted.
5. Lifting lugs on all equipment and devices weighing over 100 pounds.
6. Anchor Bolts: Galvanized, sized by manufacturer.
7. Control and Indicating Devices: As indicated and as specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
8. Operating Conditions:
   a. Ambient Temperature: Maximum 50 degrees C.
   b. Equipment to be fully rated without any derating for operating conditions listed above.
9. Manufacturer: Tesco Controls Tescoflex Series, or approved equal.

B. Enclosure

1. NEMA 250 Type 3, 3R, and 12, dust-tight, gasketed, enclosure.
2. Compartmentalized into sections as shown on drawings.
3. Dimensions: 60 inches high, depth and width as required.
4. Hinged, gasketed, outer doors with 3-point latches, padlockable stainless steel handles, and intrusion switches arranged to close when the associated door is not fully closed.
5. Mount operator controls and indications on interior dead front doors or panels.
6. Door Interlocking: Interlock interior dead front compartment doors mechanically so that doors cannot be opened with internal components energized. Provide defeater mechanism to allow intentional access at any time.
7. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.
8. Construction:
   a. Hot dipped galvanized steel; exterior 12 gauge, interior 14 gauge, minimum. Reinforced with channel or angle irons.
   b. Welded exterior seams.
   c. All hardware shall be stainless steel.
9. Provide thermostatically controlled heating and cooling systems as required to maintain a suitable operating environment for all components under specified ambient conditions.
10. Lighting: Door switch controlled, internal flourscent light for each section.
11. Minimum of one 120-volt duplex GFI receptacle in distribution section.

12. Equipment Finish:
    a. Electrocoating process applied over a rust-inhibiting phosphated base coating.
    b. Exterior color: Manufacturers standard.
    c. Interior surfaces: White enamel.

C. Terminating, Main and Metering Section

1. To be in accordance with the serving utilities requirements.
2. Incoming service feeder to enter section from the bottom.
3. Molded case circuit breaker:
    a. In accordance with NEMA AB1 and UL 489.
    b. UL labeled as suitable for service entrance.
    c. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
    d. Indicate tripping by operating handle position.
    e. Suitable for use with 75 degrees C wire, at full NEC 75 degrees C ampacity.
    f. 100 percent rated.

D. Distribution Section

1. Molded case circuit breakers:
    a. In accordance with NEMA AB1 and UL 489.
    b. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
    c. Indicate tripping by operating handle position.
    d. Suitable for use with 75 degrees C wire, at full NEC 75 degrees C ampacity.
2. Transformer: As specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.

E. Motor Starter Section

1. Combination Reduced Voltage, Solid-State Controller:
    a. Solid-state motor controller shall be combination type with a circuit breaker as shown, capable of full voltage starting, and having a voltage ramp mode with adjustments and controls for a time ramped voltage with an adjustable initial voltage and a current limit mode with adjustable initial step, current limit, and ramp time. Circuit breaker shall have 42,000-amp interrupting rating.
    b. The starting time shall be adjustable from 2 to 30 seconds, and the stopping time adjustable from 2 to 120 seconds.
    c. Starting of the controller is inhibited or the controller is shut down whenever one of the following conditions occur:
        1) Starting fault.
        2) Line fault.
        3) Temperature fault.
        4) Stalled motor.
    d. The controller's power semiconductors shall be protected against load side faults for the available short circuit specified.

e. The controller's power semiconductors shall also be protected and guaranteed against transient voltage damage.
f. Auxiliary and control equipment shall be as shown. Each controller shall have a 120V control circuit supplied by an integral control power transformer having primary and secondary fuses and having capacity for supplying the devices shown. An elapsed running time meter shall be included.
g. Bypass contactor to automatically bypass the controller.
h. Manufacturers: Allen Bradley, SMC Plus, or equal.

2. Thermal Overload Protection:
   a. Inverse-time-limit characteristic.
   b. Heater: Directly heated melting alloy, ratchet principle type element.
   c. Relay Trip: Standard, Class 20.
   d. Manual reset.
   e. Provide in each ungrounded phase.
   f. Mount within starter unit.
3. Control Transformer:
   a. Two winding, 120-volt secondary, primary voltage to suit.
   b. Two current-limiting fuses for primary circuit.
   c. One fuse in secondary circuit.
   d. Mount within starter unit.

F. Controls and Telemetry

1. Provide instruments and controls as shown and as specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS, and Component Specifications supplement to this section.
2. Provide a minimum of 30 inches by 30 inches by 8 inches deep blank panel space for OWNER to install future telemetry equipment.
3. Terminate power, signal, and control wiring on numbered terminal blocks for future use with telemetry equipment.

G. Wiring:

1. ac Circuits:
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current to be carried, but not less than No. 14 AWG.
2. Analog Signal Circuits:
   a. Type: 600-volt, Type 3 stranded copper, twisted shielded pairs.
   b. Size: No. 16 AWG, minimum.
3. Other dc Circuits.
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: No. 18 AWG, minimum.
4. Separate analog and other dc circuits at least 6 inches from any ac power and control wiring.
5. Enclose wiring in sheet metal raceways or plastic wiring ducts.
6. Wire Identification:
   a. Numbered and tagged at each termination.
   b. Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Do not use adhesive or taped-on tags.

H. Wiring Interface:

1. For analog and discrete signal, terminate at numbered terminal blocks.
2. For special signals, terminate power (240 volts or greater) at device manufacturer's standard connectors.

I. Terminal Blocks:

1. Quantity:
   a. For external connections.
   b. Wire spare or unused panel mounted elements to their panels' terminal blocks.
   c. Spare Terminals: 20 percent of connected terminals, but not less than 10.
2. General: Group to keep 120V ac circuits separate from 24V dc circuits.
   a. Connection Type: Screw connection clamp.
   b. Compression Clamp:
      1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.
      2) Guides strands of wire into terminal.
   c. Screws: Hardened steel, captive and self-locking.
   d. Current Bar: Copper or treated brass.
   e. Insulation:
      1) Thermoplastic rated for minus 55 to plus 110 degrees C.
      2) Two funnel shaped inputs to facilitate wire entry.
   f. Mounting:
      1) Rail.
      2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
      3) End Stops: One at each end of rail, minimum.
   g. Wire Preparation: Stripping only.
   h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
   i. Marking System:
      1) Terminal number shown on both sides of terminal block
      2) Allow use of preprinted and field marked tags.
      3) Terminal strip numbers shown on end stops.

J. Grounding: Internal copper grounding bus for ground connections, bonded to site grounding electrode.

K. Relays:

1. General:
   a. Relay Mounting: Plug-in type socket.
   b. Relay Enclosure: Provide dust cover.
   c. Socket Type: Screw terminal interface with wiring.
   d. Socket Mounting: Rail.
   e. Furnish holddown clips.
2. Control Circuit Switching Relay, Nonlatching:
   a. Type: Compact general purpose plug-in.
   b. Contact Arrangement: 3 Form C contacts.

c. Contact Rating: 10A at 28V dc or 240V ac.
d. Contact Material: Silver cadmium oxide alloy.
e. Coil Voltage: As noted or shown.
f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
g. Expected Mechanical Life: 10,000,000 operations.
h. Expected Electrical Life at Rated Load: 100,000 operations.
i. Indication Type: Neon or LED indicator lamp.
j. Push-to-test button.
k. Manufacturer and Product: Potter and Brumfield; Series KUP.

3. Control Circuit Switching Relay, Latching:
   a. Type: Dual coil mechanical latching relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 120V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
   g. Expected Mechanical Life: 500,000 operations.
   h. Expected Electrical Life at Rated Load: 50,000 operations.
   i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.
4. Control Circuit Switching Relay, Time Delay:
   a. Type: Adjustable time delay relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As specified or shown.
   f. Operating Temperature: Minus 10 to 55 degrees C.
   g. Repeatability: Plus or minus 2 percent.
   h. Delay Time Range: Select range such that time delay set point falls between 20 to 80 percent of range.
   i. Mode of Operation: As shown.
   j. Adjustment Type: Integral potentiometer with knob external to dust cover.
   k. Manufacturer and Products: Potter and Brumfield.
      1) Series CB for 0.1-second to 100-minute delay time ranges.
      2) Series CK for 0.1- to 120-second delay time ranges.

L. Nameplates:

1. Laminated plastic; white, engraved to black core.
2. Provide for each circuit breaker and dead front mounted device.
3. Engrave with inscription shown on three-line diagram.
4. Attach with stainless steel panhead screws on face of control center.

2.2 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General: Equip control panels with surge-arresting devices to protect equipment from damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

B. Suppressor Locations:

1. At point of connection between each equipment item, including ac powered transmitters and its power supply conductors (direct wired equipment).
2. On analog pairs at each end when the pair travels outside of building.
3. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

C. Power Supply Suppressor Assemblies:

1. Suitable for connection to 120-volt, single-phase power supplies EDCO "HSP SERIES."
2. Suitable for connection to 480-volt, three-phase power supplies; Square D J9200-9A.

D. Analog Signal Cable Suppressor Assemblies:

1. Epoxy encapsulated within a phenolic enclosure.
2. Flame retardant.
3. Four lead devices; include a threaded mounting/grounding stud.
4. Manufacturers and Products:
   a. EDCO; SRA-64 Series.
   b. Joslyn; Series 1800 and 1669.

2.3 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsule Manufacturers:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A-HCI.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

B. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.

C. Install equipment plumb and in longitudinal alignment with pad or wall.

D. Coordinate terminal connections with installation of secondary feeders.

E. Grout mounting channels into floor or mounting pads.

F. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

3.2 CIRCUIT BREAKERS

A. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.

B. Adjust to approximately 11 times motor rated current.

C. Determine motor rated current from motor nameplate following installation.

3.3 OVERLOAD RELAY

A. Select and install overload relay heaters after the actual nameplate full-load current rating of motor has been determined.

3.4 ELECTRICAL POWER AND SIGNAL WIRING

A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.

D. Do not splice or tap wiring except at device terminals or terminal blocks.

3.5 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

3.6 FIELD QUALITY CONTROL

A. In accordance with Section 16950, ELECTRICAL TESTING.

3.7 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01640, MANUFACTURERS' SERVICES, for the following services at jobsite for minimum person-days listed below, travel time excluded:

1. 5 person-days for installation assistance, and inspection of installation.
2. 5 person-days for functional and performance testing.

3.8 SUPPLEMENT

A. Supplement listed below, following "END OF SECTION", is part of this Specification.

1. Component Specification.

END OF SECTION

COMPONENT SPECIFICATIONS

A. F4 Flow Element and Transmitter, Electromagnetic:

1. General:
   a. Function: Measure, indicate, and transmit the flow of a process liquid in a full pipe.
   b. Type: Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
   c. Parts: Flow element, transmitter, interconnecting cables, mounting hardware, and calibrator.
2. Service:
   a. Stream Fluid: Well water.
3. Performance:
   a. Flow Range: Coordinate with well pump selection.
   b. Accuracy: Plus or minus 1 percent of rate for all flows resulting from pipe velocities of 1 to 33 feet per second.
   c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
4. Features:
   a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
   b. No obstructions to flow.
   c. Very low pressure loss.
5. Process Connection:
   a. Meter Size: 14 inch.
   b. Connection Type: 150-pound ANSI raised-face flanges or wafer style depending on meter size, unless otherwise noted.
   c. Flange Material: Carbon steel, unless otherwise noted.
6. Signal Interface:
   a. 4 to 20 mA dc for load impedance 0 to 800 ohms minimum for 24V dc supply.
7. Power: 120V ac, 60-Hz, unless otherwise noted.
8. Element:
   a. Meter Tube Material: 304 stainless steel, unless otherwise noted.
   b. Liner Material: Polyurethane.
   c. Liner Protectors: Covers on each end to protect liner during shipment.
   d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
   e. Electrode Material: Type 316 stainless steel, unless otherwise noted.
   f. Enclosure: NEMA 4, unless otherwise noted.
   g. Grounding Ring/Electrode Material: Type 316 stainless steel, unless otherwise noted.
9. Transmitter:
   a. Display: Blind or indicating and/or totalizing as noted.
   b. Mounting: In-well control panel.
   c. Enclosure: NEMA 4X.
   d. Zero and Span: Field adjustable.

e. Indicator: Digital 16-character display, with scale range as noted.
f. Totalizer: Digital 16-character display, with totalizer unit digit value as noted.

10. Cables:
    a. Types: As recommended by manufacturer.
    b. Lengths: As required to accommodate device locations.
11. Calibration System:
    a. Features:
        1) Field programmable electronics.
        2) Self-diagnostics with troubleshooting codes.
        3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
        4) Initial flow tube calibration and subsequent calibration checks.
    b. Equipment: Built-in electronics with each unit provided.
12. Manufacturers:
    a. Sparling Instruments, Tigermags, FM655, as applicable;
    b. Foxboro, Series 8000 or Series 2800 flow tube with Model 896 transmitter, as applicable;
    c. Fischer & Porter, miniMAG, COPA-X or MAG-X, as applicable;
    d. Rosemount, Model 8701 flow tube with Model 8712 transmitters.
    e. Krone.

B. P4 Pressure Gauge:

1. General:
    a. Function: Pressure indication.
    b. Type: Bourdon tube actuated for ranges 10 psig and above.
2. Performance:
    a. Range: 0-100 psi.
    b. Accuracy: Plus or minus 0.5 percent of span.
3. Features:
    a. Mounting: Lower stem, unless otherwise noted.
    b. Dial: 4-1/2-inch diameter, unless otherwise noted.
    c. Case Material: Phenolic plastic, unless otherwise noted.
    d. Element Material: Phosphor-bronze, unless otherwise noted.
    e. Dampening: Pulsation dampener when noted, piston type with multiple choice of piston placement to vary the desired amount of dampening.
    f. Case Type: Solid front design with solid wall between window and element. Rear of case, gasketed pressure relief.
    g. Pointer: Micrometer pointer with self-locking adjustment.
    h. Movement: Stainless steel, rotary geared.
4. Process Connection:
    a. Line Size: 1/2 inch.
    b. Connection Type: Threaded.
5. Manufacturers:
    a. Ashcroft Duragauge Model 1279/1379.
    b. Robert Shaw Acragage.

c. Marsh Mastergauge.

C. P5 Pressure Transmitter, Submersible:

1. General:
   a. Function: Measure and transmit a signal proportional to pressure or level.
   b. Type: Totally submersible, two-wire transmitter.
   c. Parts: Transmitter, cable, and terminating enclosure.
2. Service:
   a. Fluid: Well water.
3. Performance:
   a. Range: Coordinate with individual well pump installation.
   b. Accuracy: 0.1 percent of full scale.
   c. Sensitivity: Plus or minus 0.5 percent of reading.
   d. Temperature, Operating: Minus 5 to plus 140 degrees F.
   e. Expected Range: 0 to 90 feet of water.
4. Features:
   a. Dimensions: 0.69-inch diameter by 8.66-inch length.
   b. Materials: Titanium diaphragm and body.
5. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 750 ohms minimum for 24V dc supply without load adjustment.
6. Termination Enclosure:
   a. Rating: NEMA 4X.
   b. Terminals: DIN standard.
   c. Surge Protector: MTL Model 377-32V.
   d. Desiccant: Replaceable module.
   e. Mounting: 2-inch pipe mounting kit.
   f. Manufacturer: Druck Model STE-110.
7. Cable Type: Molded polyurethane vented cable assembly with Kevlar strength member.
8. Cable Length: As required to measure well depth and reach the termination enclosure.
9. Manufacturer:
   a. Druck Type PTX 161/D.
   b. Delta.
   c. Endress-Hauser.

D. P8 Pressure Switch, *Fixed Dead Band*:

1. General:
   a. Function: Monitor pressure and provide contact closure(s) when pressure is at the noted set point.
   b. Type: Diaphragm sealed piston actuator.
2. Performance:
   a. Set Point:
      1) Adjustable from 10 to 100 psi.
      2) Set at 50 psi.
   b. Range: 100 psi.
   c. Set Point Repeatability: Plus or minus 1 percent of range.
3. Features:
   a. Diaphragm Material: Buna-N, unless otherwise noted.

b. Pressure Connection: Type 304 stainless steel, unless otherwise noted.
c. Reset: Automatic, unless otherwise noted.

4. Enclosure: NEMA 4X, unless otherwise noted.
5. Signal Interface:
   a. Contact Type: SPDT, snap action switch, rated for 15 amps at 120V ac.
   b. Number of Switch Elements: One, unless otherwise noted.
6. Manufacturers:
   a. Ashcroft, B Series.
   b. United Electric, Series 400.
   c. SOR.

E. S20 Switch, Current:

1. General:
   a. Function: Operate contact at preset current signal level.
   b. Type: Electronic with electromechanical relays.
2. Performance:
   a. Set Point: Recommended by well pump manufacturer.
   b. Repeatability: Plus or minus 0.1 percent of full scale.
   c. Temperature, Operating Range: 32 to 120 degrees F.
3. Features:
   a. Dead Band: Continuously adjustable 1 to 50 percent full input span or better (minimum).
   b. Activation: Rising or falling; internally selectable.
   c. Set Point Adjustment: Continuously adjustable over full input span.
   d. Input Resistance: 50 ohms maximum.
4. Signal Interface:
   a. Input: 4 to 20 mA dc.
   b. Contacts: Rated 5A continuous at 120V ac; DPDT for single set point, SPDT for dual set point.
5. Enclosure: Metallic, with dust cover and integral bracket for rear of panel mounting.
6. Power: 120V ac.
7. Manufacturers:
   a. AGM Electronics, PTA 4034 or PTA 4035.
   b. Transmation, Model 3510A or 3520A.
   c. Rochester Instrument Systems, Model ET-1218 or ET-1219.

F. S27 Indicator, Digital Panel:

1. General:
   a. Function: Display analog signal.
   b. Type: 7-segment digital, horizontal edgewise.
2. Performance:
   a. Range:
      1) 0 to 100 percent for valve position.
      2) As required for well water level.
   b. Accuracy: Plus or minus 0.1 percent full scale.
   c. Temperature, Operating: 32 to 120 degrees F.

3. Features:
   a. Digits: 3-1/2; 0.43-inch high minimum; 7-segment LED, gas plasma, or vacuum fluorescent.
   b. Decimal Point: Field selectable.
   c. Input Impedance: 100 ohms maximum.
   d. Service Legend: Permanent, display of engineering units.
   e. Response Time: 1 second maximum to 0.1 percent accuracy.
4. Signal Interface: 4 to 20 mA dc.
5. Enclosure:
   a. Type: NEMA 1.
   b. Mounting: Panel; approximately 2-inch high, 4-inch wide, 5-inch deep.
6. Power: 120V ac, 50/60-Hz unless otherwise noted.
7. Manufacturers:
   a. Action Instruments, Model V508.
   b. Analogic, Measurometer Series, Model PI-2455 or PI-4455.
   c. Moore Industries, Model DSM.

G. S30 Power Supplies:

1. Furnish to power instruments requiring external dc power, including two-wire transmitters and dc relays.
2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
3. Provide output over voltage and over current protective devices to:
   a. Protect instruments from damage due to power supply failure.
   b. Protect power supply from damage due to external failure.
4. Enclosures: NEMA 1 in accordance with NEMA 250.
5. Mount such that dissipated heat does not adversely affect other components.
6. Fuses: For each dc supply line to each individual two-wire transmitter.
   a. Type: Indicating.
   b. Mount so fuses can be easily seen and replaced.

END OF COMPONENTS

SECTION 16950
ELECTRICAL TESTING

PART 1 GENERAL

1.1 SUBMITTALS

A. Administrative Submittals: Submit 30 days prior to performing inspections or tests:

1. Schedule for performing inspection and tests.
2. List of references to be used for each test.
3. Sample copy of equipment and materials inspection form(s).
4. Sample copy of individual device test form.
5. Sample copy of individual system test form.

B. Quality Control Submittals: Submit within 30 days after completion of test:

1. Test or inspection reports and certificates for each electrical item tested.

C. Contract Closeout Submittals:

1. Operation and Maintenance Data:
   a. In accordance with Section 01430, OPERATION AND MAINTENANCE DATA.
   b. After test or inspection reports and certificates have been reviewed by RESIDENT ENGINEER and returned, insert a copy of each in operation and maintenance manual.

1.2 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers, of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by National Institute for Certification of Engineering Technologists (NICET), or International Electrical Testing Association and having a minimum of 5 years testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.

8. In compliance with OSHA Title 29, Part 1907 criteria for accreditation of testing laboratories.

B. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.3 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment are to be:

1. Scheduled with OWNER prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify OWNER at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. Tests specified in this section are to be performed in accordance with the requirements of Section 01650, FACILITY STARTUP.

B. Tests and inspection shall establish that:

1. Electrical equipment is operational within industry and manufacturer's tolerances.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, and ANSI C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

D. Adjust mechanisms and moving parts for free mechanical movement.

E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

F. Verify nameplate data for conformance to Contract Documents.

G. Realign equipment not properly aligned and correct unlevelness.

H. Properly anchor electrical equipment found to be inadequately anchored.

I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

K. Provide proper lubrication of applicable moving parts.

L. Inform RESIDENT ENGINEER of working clearances not in accordance with NFPA 70.

M. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

N. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Functional test each intrusion switch for action and proper signal.
3. Vacuum and wipe clean enclosure interior.
4. Remove corrosion found on metal surfaces.
5. Repair or replace, as determined by RESIDENT ENGINEER, door and panel sections having dented surfaces.
6. Repair or replace, as determined by RESIDENT ENGINEER, poor fitting doors and panel sections.
7. Repair or replace improperly operating latching, locking, or interlocking devices.
8. Replace missing or damaged hardware.
9. Finish:
   a. Provide matching paint and touch up scratches and mars.
   b. If required due to extensive damage, as determined by RESIDENT ENGINEER, refinish the entire assembly.

O. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.

3.2 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.

7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
   d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.3 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect Each Individual Exposed Power Cable No. 6 and Larger For:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
   d. Color coding conformance with specifications.
   e. Proper circuit identification.
2. Mechanical Connections For:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables For:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables For:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
   b. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.4 MOLDED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 10.1.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 480- and 600-volt circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 10.2.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each pole.
   b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
   a. Long-time minimum pickup and delay.
   b. Short-time pickup and delay.
   c. Ground fault pickup and delay.
   d. Instantaneous pickup by run-up or pulse method.

e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
f. Trip times shall be within limits established by NEMA AB 4, Table 5-3.
g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4.

3.5 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually Check Current, Potential, and Control Transformers For:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.
2. Verify Mechanically That:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
   a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
   b. Polarity test.
2. Potential Transformer Tests:
   a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 7.1.1 for 1 minute on:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 7.1.1.

3.6 METERING

A. Visual and Mechanical Inspection:

1. Verify meter connections in accordance with appropriate diagrams.
2. Verify meter multipliers.
3. Verify that meter types and scales conform to Contract Documents.
4. Check calibration of meters at cardinal points.
5. Check calibration of electrical transducers.

3.7 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control centers and panelboards for proper connection and tightness.
2. Ground bus connections in motor control centers for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-Of-Potential Test:
   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
   b. Main ground electrode system resistance to ground to be no greater than 1 ohm.
2. Two-Point Direct Method Test:
   a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
   b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

3.8 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 5 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Operate Motor and Check For:
   a. Excessive mechanical and electrical noise.
   b. Overheating.
   c. Correct rotation.
   d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
   e. Excessive vibration.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 10.2 for 1-minute duration with resistances tabulated at 30 and 60 seconds.
   b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

2. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

3.9 WELL ELECTRICAL AND CONTROLS

A. Visual and Mechanical Inspection:

1. Proper operation of indicating and monitoring devices.
2. Proper overload protection for each motor.
3. Improper blockage of air cooling passages.
4. Integrity and contamination of bus insulation system.
5. Check Door and Device Interlocking System By:
   a. Closure attempt of device when door is in OPEN position.
   b. Opening attempt of door when device is in ON or CLOSED position.
6. Check Nameplates for Proper Identification Of:
   a. Equipment title and tag number with latest one-line diagram.
7. Verify that fuse and circuit breaker sizes and types conform to Contract Documents.
8. Verify that current and potential transformer ratios conform to Contract Documents.
9. Check Bus Connections for High Resistance by Low Resistance Ohmmeter and Calibrated Torque Wrench Applied to Bolted Joints:
   a. Ohmic value to be zero.
   b. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
10. Verify performance of each control and signal device and feature furnished as part of the motor control center.
11. Control Wiring:
    a. Compare wiring for local and remote control devices, and protective devices with elementary diagrams.
    b. Check for proper conductor lacing and bundling.
    c. Check for proper conductor identification.
    d. Check for proper conductor lugs and connections.
12. Exercise active components.
13. Inspect Contactors For:
    a. Correct mechanical operations.
    b. Correct contact gap, wipe, alignment, and pressure.
    c. Correct torque of all connections.
14. Compare overload heater rating with full-load current for proper size.
15. Compare motor protector and circuit breaker with motor characteristics for proper size.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
   b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
   c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.

d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
e. Test values to comply with NETA ATS, Table 10.2.

2. Overpotential Tests:
   a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 7.1.2.
   b. Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.
   c. Test results evaluated on pass/fail basis.
3. Current Injection Through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
   a. Trip time in accordance with manufacturer's published data.
   b. Investigate values in excess of 120 seconds.
4. Control Wiring Tests:
   a. Apply secondary voltage to control power and potential circuits.
   b. Check voltage levels at each point on terminal boards and each device terminal.
   c. Insulation resistance test at 1,000 volts dc on control wiring except that connected to solid state components.
      1) Insulation resistance to be 1 megohm minimum.
5. Operational test by initiating control devices to affect proper operation.

3.10 LOW VOLTAGE SURGE ARRESTORS

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus.

B. Electrical Tests:

1. Varistor Type Arrestors:
   a. Clamping voltage test.
   b. Rated RMS voltage test.
   c. Rated dc voltage test.
   d. Varistor arrester test values in accordance with ANSI C62.33, Sections 4.4 and 4.7.

END OF SECTION

APPENDIX

US COE Section 404 Permit

US EPA National Pollution Discharge Elimination System Permit

Arizona Department of Environmental Quality State Water Quality Certification

Arizona Department of Water Resources Dam Safety (Not Included)

Arizona Department of Water Resources Recovery Well Permit

Arizona Department of Transportation Permit (Not Included)

Flood Control District of Maricopa County (Not Included)

City of Tempe Building Permit (Not Included)

Union Pacific Railroad Company (Not Included)

Arizona Public Service

Salt River Project (Not Included)

DEPARTMENT OF THE ARMY PERMIT

Permittee:

City of Tempe
City Engineer's Office
Mr. Howard Hargis
P.O. Box 5002
Tempe, Arizona 85280

Permit Number: 94-40904-00-CJL

Issuing Office: Los Angeles District

Note: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: To construct the City of Tempe's 200 acre Rio Salado Town Lake as shown on the attached drawings. Activities within the waters of the United States include construction of an upstream and downstream air-inflatable rubber dam, foundations, energy dissipating structures, slurry wall installations, channel grading, material storage during construction, and a stormwater detention/riparian area.

Project Location: In the Salt River between Priest Drive and McClintock Drive, at (Sections 14, 15, and 16, T1N, R4E), Tempe, Maricopa County, Arizona.

Permit Conditions

General Conditions:

1. The time limit for completing the authorized activity ends on April 22, 1998. If

you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification from this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished with the terms and conditions of your permit.

Special Conditions: See attached sheet.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 403).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application

proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measure ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give you favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Howard C. Hargis 4/21/95

(PERMITTEE) (DATE)

Assistant City Engineer

Howard C. Hargis, P.E., Assistant City Engineer

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Diane K. Noda 4 May 1995

Diane K. Noda (DATE)

Acting Chief, Regulatory Branch

(for the District Engineer)

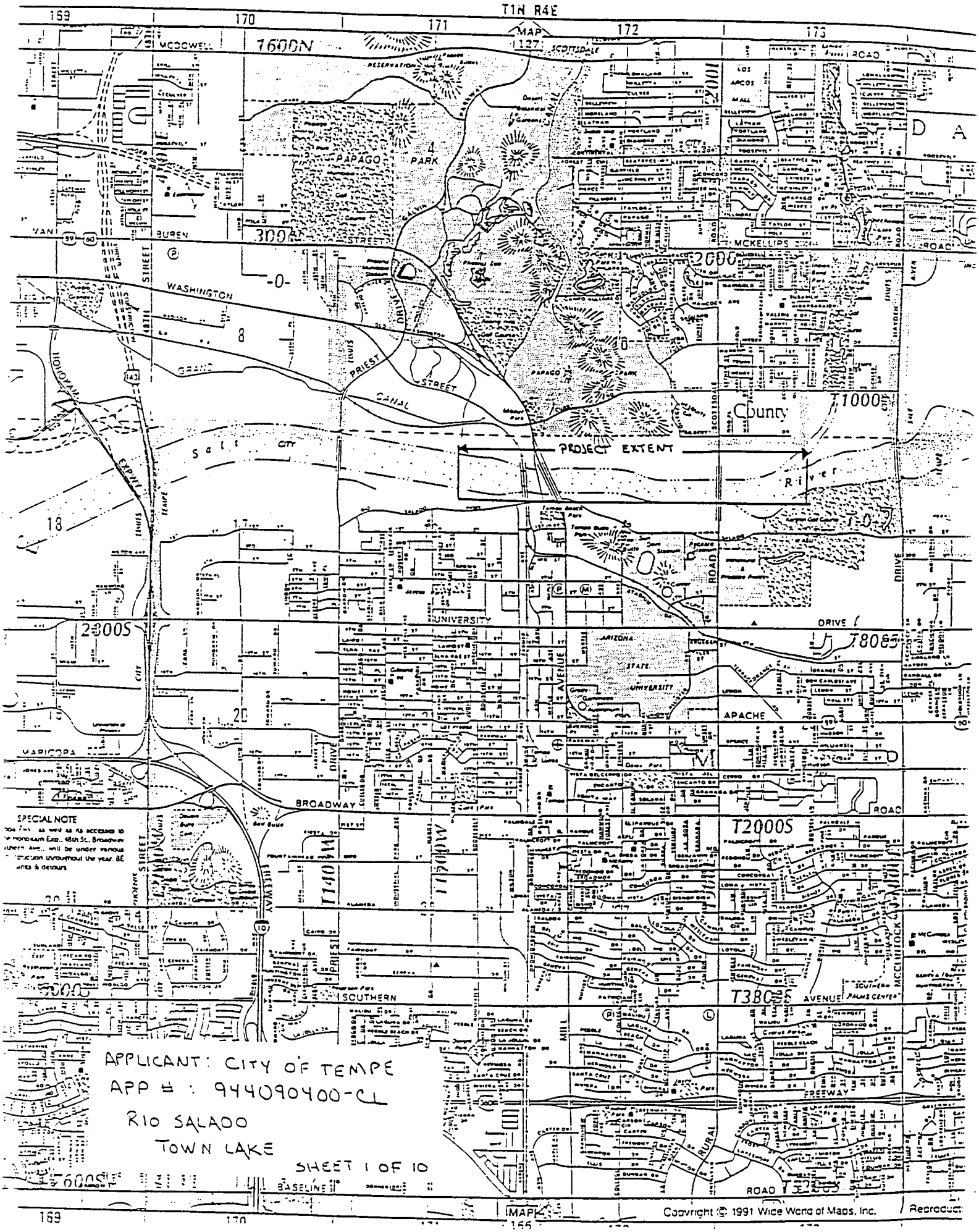
When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

_____ _____

(TRANSFEREE) (DATE)

SPECIAL CONDITIONS
PERMIT NO. 94-40904-00-CJL

1. The permittee shall abide by the terms and conditions of the attached letter of water quality certification issued by the Arizona Department of Environmental Quality on March 13, 1995.



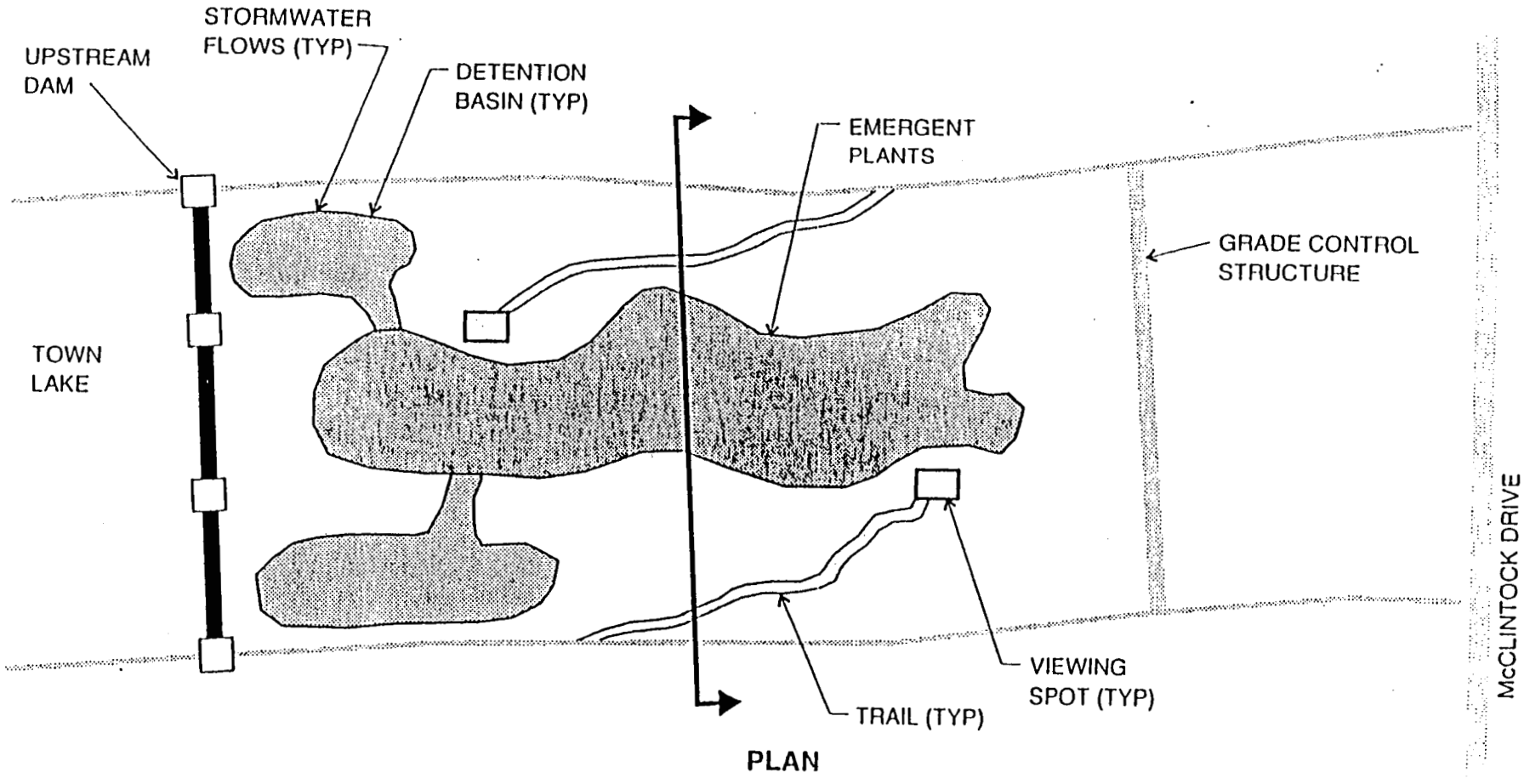
APPLICANT: CITY OF TEMPE

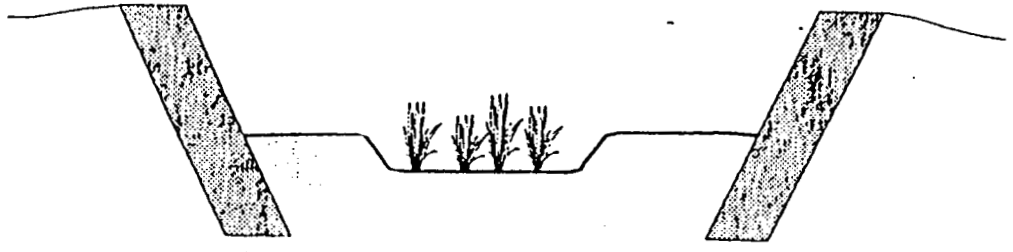
APP # : 9440904OO-CL

RIO SALADO

TOWN LAKE

SHEET 1 OF 10





SECTION

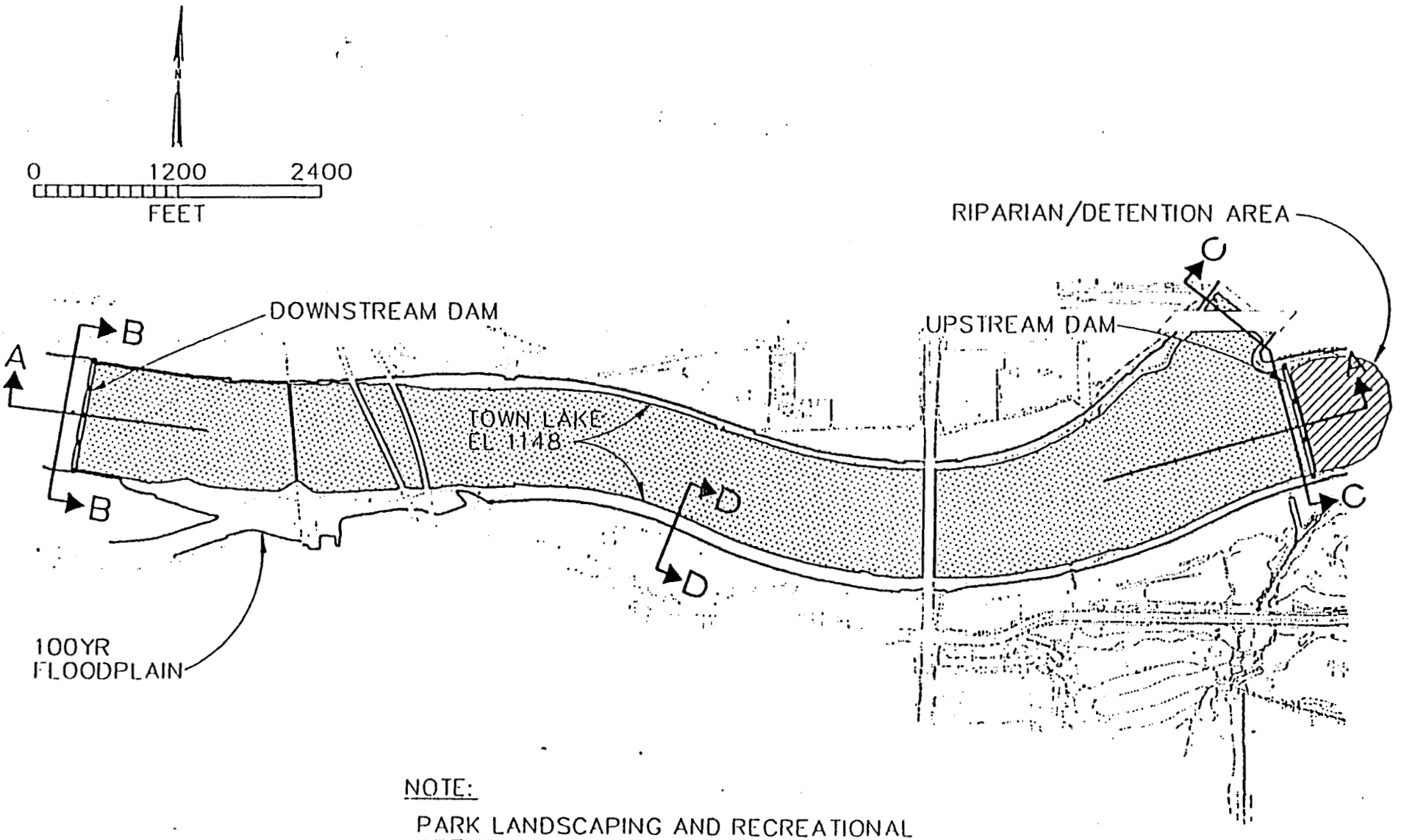
APPL: CITY OF TEMPE
APPL #: 9440909 00-CL
SHEET 3 OF 10

RIPARIAN/DETENTION AREA

Rio Salado COE 404
Permit Application

CH2M HILL

05-19-94



NOTE:

PARK LANDSCAPING AND RECREATIONAL AREAS WILL BE CREATED AROUND THE PERIMETER OF THE LAKE.

APPL: CITY OF TEMPE
APPL #: 9441090400-CL

SHEET 5 OF 10

TOWN LAKE PLAN

RIO SALADO COE 404
PERMIT APPLICATION

CH2MHILL

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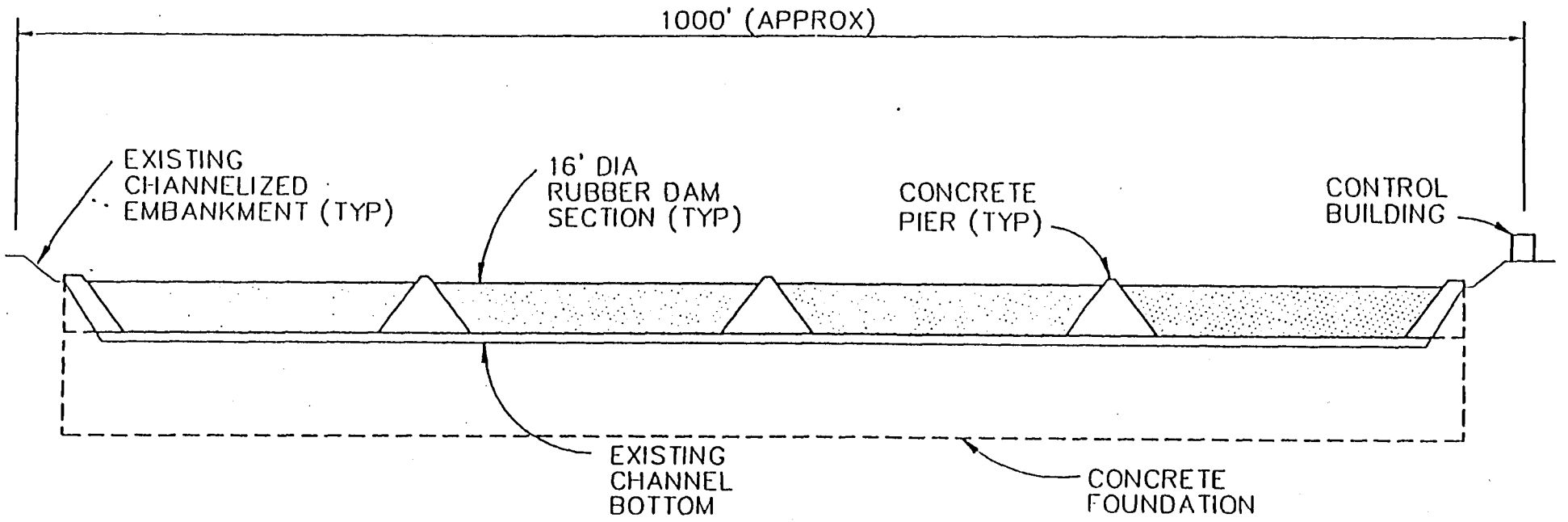
05-18-94



APPL: CITY OF TEMPE
APPL #: 9440904OO-CL

SHEET 1 OF 10

SECTION B-B

RIO SALADO COE 404
PERMIT APPLICATION

CH2MHILL

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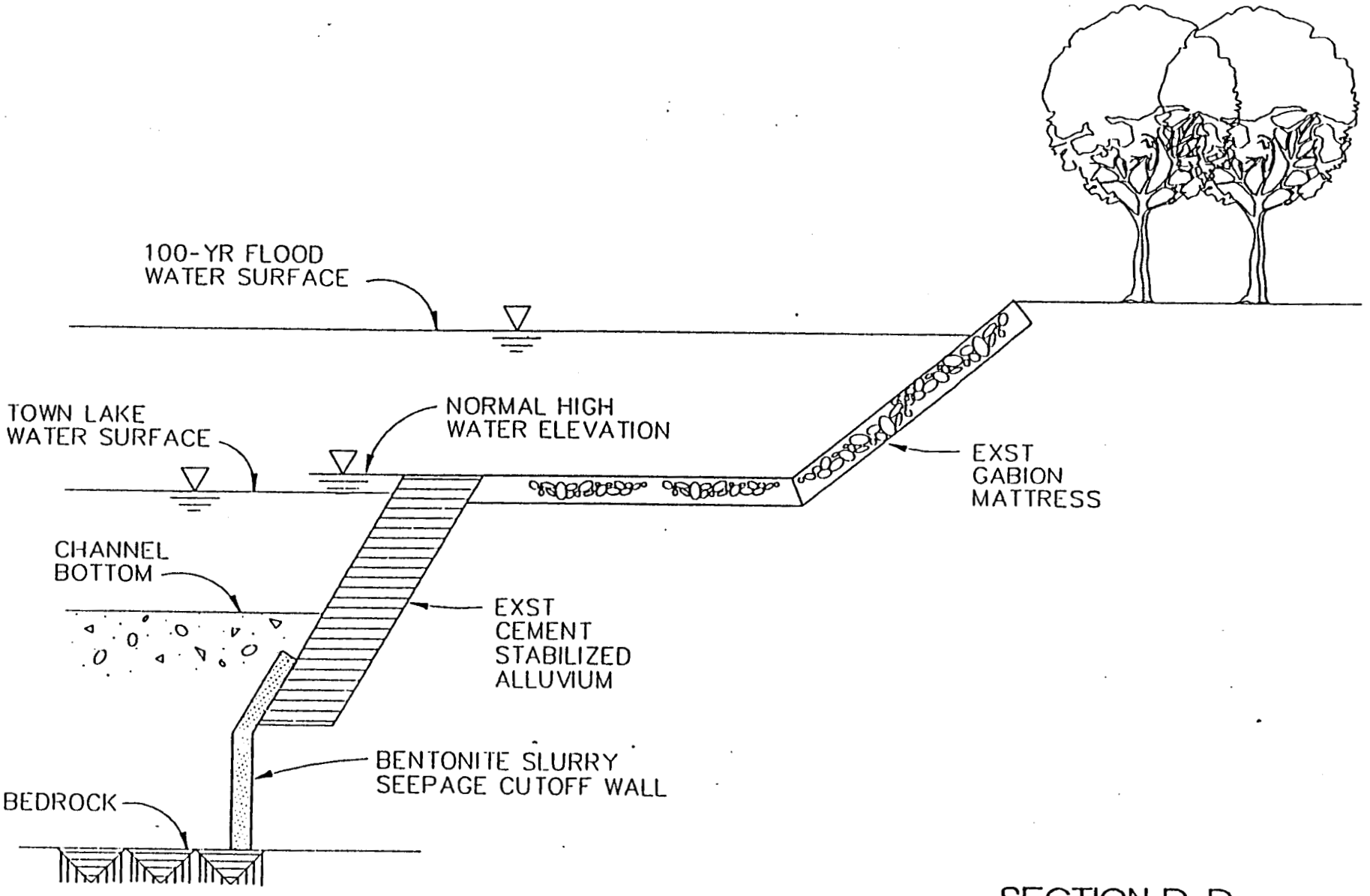
06-17-94



APPL: CITY OF TEMPE
APPL #: 9440904 00-CL

SHEET 9 OF 10

SECTION D-D

RIO SALADO COE 404
PERMIT APPLICATION

CH2MHILL

D:\USR2\PROJECTS\3696J036.DWG

STORM WATER POLLUTION PREVENTION PLAN AND N.P.D.E.S. PERMIT SPECIAL PROVISIONS

This project is subject to National Pollutant Discharge Elimination System (N.P.D.E.S.) requirements under the E.P.A. General Permit for Arizona. Under provisions of that permit, the contractor shall be designated as permittee, and shall be responsible for providing necessary material and for taking appropriate measures to assure removal of at least 80 percent of the additional sediment generated in storm water runoff from the project (relative to pre-project sediment levels), and for completing the following documents:

- Storm Water Pollution Prevention Plan (S.W.P.P.P.) for the project, including certification of compliance form.
- Notice of Intent (N.O.I.) to be covered by N.P.D.E.S. General Permit for Arizona, including certification of signature.
- Notice of Termination (N.O.T.) of coverage under N.P.D.E.S. General Permit (upon project completion).

All subcontractors shall comply with all N.P.D.E.S. requirements under the supervision of the General Contractor, and shall submit a completed, signed subcontractor certification form, thereby designating themselves as co-permittees. A draft framework for the S.W.P.P.P. is enclosed in this Project Specification Book. Contingency bid items likely to be necessary to carry out the S.W.P.P.P. are included in the bid proposal. The contractor will be expected to review this framework S.W.P.P.P. and update/revise it as necessary throughout the construction of the project, in order to assure compliance with the E.P.A. permit requirements. Revisions to the S.W.P.P.P. requiring use of these contingency bid items, or any other additional costs, shall be subject to approval by the City prior to implementation. The finalized S.W.P.P.P. shall be kept on the project site at all times, and shall be retained by permittee for three years following project completion.

The unit prices bid for the proposal items shall include all material, labor, and other incidental costs relating to the provision, installation, and maintenance of that bid item during project construction. Such incidental costs shall include contractor costs in order to assure proper operation of the pollution-control devices installed, including all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events or other runoff or releases on the project. No additional payment will be made for these incidental costs.

The contractor shall submit completed signed N.O.I. forms prior to the project preconstruction conference to the following addresses: U.S. E.P.A. Storm Water Notice of Intent, P.O. Box 1215, Newington, VA 22122 and ADEQ-Storm Water Coordinator, P.O. Box 600, Phoenix, AZ 85001. Copies shall be transmitted to the City's construction project manager, as provided on the N.O.I. form, at the time of the preconstruction meeting. The Contractor shall prepare a final SWPPP and submit it at the preconstruction meeting for discussion and approval.

Failure by the contractor (or any of its appropriate subcontractors) to submit the N.O.I. forms within this time frame (or to promptly make revisions to those forms as requested by the City) which prevents submittal of the forms to E.P.A. within the mandated deadline of 48 hours prior to start of construction will result in delay of the start of construction. The contractor will not be entitled to any claim for additional compensation for additional costs resulting from such a delay in the construction start date. The N.O.I. shall be posted on the construction site along with the S.W.P.P.P.

It is the permittee's responsibility to perform inspections of all storm water pollution control devices on the project on a monthly basis, and following each rainfall of 0.50 inches or more. The contractor is responsible for maintaining those devices in proper working order, including cleaning and/or repair. No separate payment will be made for such inspections, cleaning, or repair.

All S.W.P.P.P. reports required under this contract shall be available to the public in accordance with the requirements of Section 308 (b) of the Clean Water Act. The contractor as a permittee of construction activities with storm water discharges covered by the Arizona General Permit shall make plans available to the public upon request through the E.P.A.

No condition of the Arizona General Permit as well as the S.W.P.P.P. shall release the contractor from any responsibilities or requirements under other environmental statutes or regulations.

Upon total project completion, acceptance, and de-mobilization, the contractor shall submit its completed, signed N.O.T. form to the E.P.A. Storm Water Notice of Termination, P. O. Box 1185, Newington, VA 22122, with copies to the same agencies who received copies of the N.O.I., thereby terminating all N.P.D.E.S. permit coverage for the project.

Necessary forms for the N.O.I., and the draft S.W.P.P.P. are contained in this booklet. Additional forms will be available through the City's Construction Project Manager and Inspector.

WQMS-301.210-944090400-CL

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor Edward Z. Fox, Director

March 13, 1995

Mr. Howard Hargis
City of Tempe
City Engineers Office
P.O.Box 5002
Tempe, AZ 85280

RE: To Construct Rio Salado's Town Lake and Associated Facilities in the Salt River Between Priest Drive and McClintock Drive in the City of Tempe, Maricopa County, Arizona - PUBLIC NOTICE NO. 944090400-CL.

Dear Mr. Hargis:

The Arizona Department of Environmental Quality (ADEQ) staff has reviewed the referenced Public Notice and other information for State Water Quality Certification pursuant to Sections 401 and 404 of the Federal Clean Water Act. Information appearing in Section A describes the project. Information listed in Section B were used as the basis for this State Certification. Our technical review has determined that no negative impacts will occur to the chemical, physical or biological integrity of the Salt River when the Conditions shown below in Section C are adhered to during construction and post construction activities.

A. PROJECT DESCRIPTION

1. The Tempe Town Lake will be formed by the construction of two inflatable dams in the Salt River. A six foot high dam will be placed upstream of the Indian Bend Wash confluence with the Salt River and a 16 foot high dam will be placed ½ mile upstream of Priest Drive. The lake will be two miles long and cover 200 surface acres.

2. Ancillary facilities consist of: boat slips, a City Park, operations building, bike paths, hiking trails, lighting, docks, streets, plantings of trees and shrubs, pump house, public art, water features, parking and picnic areas and other facilities designed to appeal to the public.

B. BASIS FOR CONDITIONAL STATE 401 WATER QUALITY CERTIFICATION

1. State of Arizona, Water Quality Standards for Navigable Waters, Arizona Administrative Code (A.A.C.) Title 18, Chapter 11, Article 1.

2. Arizona Department of Environmental Quality Policy for Protecting Water Quality During Facility Construction, adopted December 21, 1994.

3. Final Report and Recommendations of the Governor's Riparian Habitat Task Force, Executive Order 89-16, dated October 1990, and Executive Order No. 91-6 dated February 14, 1991.

4. A letter dated May 2, 1994 to Ed Swanson from Steve Neilson of the City of Tempe inviting Ed to a Pre-application meeting at the COE office on May 19, 1994.

5. On May 19, 1994 a meeting was held to introduce the Tempe Town Lake project at the COE office in Phoenix. The meeting was attended by representatives of the COE, ADEQ, USFWS, AGF, the City of Tempe and the consultant, CH2M Hill.

6. U.S. Army Corps of Engineers (COE) Public Notice No. 944090400-CL dated September 1, 1994 and received by ADEQ on December 8, 1994.

7. Completed ADEQ form 404-033 dated November 14, 1994 and received by ADEQ on November 16, 1994 from Steve Walker of CH2M Hill (CH2M) including the following items:

   a. Five pages of technical data relating to water quality issues.

   b. A two page report dated September 22, 1994 from George Cotton concerning Salt River Sedimentation.

   c. Twenty 11 X 14 inch drawings of the project.

   d. Eighteen pages of drawings and explanations of the project.

   e. A one page letter dated June 20, 1994 to Steve Neilson from Wayne Palsma concerning the applicability of an NPDES Permit for the Town Lake.

   f. A one page letter dated August 4, 1994 to Steve Neilson from James Du Bois concerning the applicability of an Aquifer Protection Permit.

8. A six page alternatives analysis dated August 30, 1994 to Cindy Lester (COE) from Rich Randall (CH2M).

9. A letter dated December 14, 1994 to Rich Hill (CH2M) from Jim Matt requesting clarification on 14 items concerning the Town Lake.

10. A letter dated January 9, 1995 to James Matt from Steve Walker (CH2M) responding to the December 14, 1994 letter in Item B.9.

11. A letter dated January 12, 1995 from James Matt to Rich Randall requesting clarification on nine items concerning the town lake.

12. A letter dated February 14, 1995 to James Matt from Steve Walker responding to the questions in Item B.11.

13. A meeting at ADEQ on February 27, 1995 attended by Howard Hargis of the City of Tempe, Steve Walker of CH2M Hill and Jim Matt of ADEQ. This meeting was primarily concerned with a discussion of the sampling plan.

14. Letter dated March 13, 1995 from Tom Trent, Clean Lakes Coordinator to Jim Matt discussing the sampling parameters for the Tempe Town Lake.

C. CONDITIONS FOR STATE 401 WATER QUALITY CERTIFICATION

This State Water Quality Certification is issued by the Arizona Department of Environmental Quality under the authority of Section 401(a) of the federal Clean Water Act (33 U.S.C. §1251 *et seq.)*. The conditions listed below apply to this Section 404 Permit issued by the U.S. Army Corps of Engineers. These conditions are enforceable by the U.S. Environmental Protection Agency. Civil penalties up to a maximum of $25,000 per day of violation may be levied if these certification conditions are violated. Criminal penalties may also be levied if a person knowingly violates any provision of the federal Clean Water Act.

1. Other permits or approvals may be required by Maricopa County, the Arizona Department of Environmental Quality (ADEQ), or the U.S. Environmental Protection Agency if the overall project includes a potable water supply, Stormwater management, wastewater reuse facilities, or wastewater collection/holding/treatment/ disposal facilities.

2. No disposal of construction or demolition wastes, wastewater, contaminated water or any other potential pollutant is authorized by this State 401 Water Quality Certification by ADEQ, except as expressly provided in the Section 404 Permit.

3. This Certification is only for the project described in Section A and is valid for a period of 30 months from the date signed by the Director of the Water Quality Division. If project construction has not started by this deadline, the applicant must notify ADEQ, Attention Surface Water Quality Certification, Water Quality Division, 3033 North Central Avenue, 5th Floor, Phoenix, Arizona 85012. ADEQ will then have the option of extending, modifying or denying this Certification.

4. The applicant must provide a copy of these State 401 Water Quality Certification Conditions to all appropriate contractors and subcontractors. The applicant must also post a copy of these conditions in a weather resistant location at the construction site where it may be seen by the workers.

5. There can be no substantive changes/modifications in the project plans and analyses identified in Sections A and B or the implementation of those plans which might affect surface water quality. If a substantive change/modification is desired, notice and supporting information must be submitted to ADEQ for review. ADEQ will then modify this Certification to include the changes/modifications, provided that Water Quality Standards for Navigable Waters (A.A.C. Title 18, Chapter 11, Article 1) will be achieved. Failure of the operator to promptly notify ADEQ of any proposed substantive changes/modifications could result in a revocation of this Certification. Correspondence to ADEQ must be addressed per Condition C.3, above.

6. When this project is physically commenced at the construction site, ADEQ must be notified by the applicant or his designee within seven days of the start date. When this notification is made, please provide the start date and the names and phone numbers of the prime contractor and a contact person. ADEQ may conduct inspections to determine compliance with A.A.C. Title 18, Chapter 11, Article 1. When the project is complete ADEQ must be similarly notified. Notification must be addressed to ADEQ per Condition C.3, above.

7. Runoff and seepage from roadways, embankments, and other alterations of the natural environment must not cause a violation of A.A.C. Title 18, Chapter 11, Article 1.

8. All off-site material sources for the project must have valid and current permits under the Federal Clean Water Act [Sections 402 (NPDES) and 404] and the State Aquifer Protection Program, where necessary. Facilities and activities not covered by individual permits under these programs are not exempt from the duty to comply with water quality standards, and will be subject to compliance action if violation is documented. Other permits pertaining to air quality may be required for material sources and are the responsibility of the applicant or his agent(s).

9. Water for dust suppression, if used, must not contain contaminants that could violate ADEQ water quality standards for surface waters or aquifers.

e. Sampling for Total Petroleum Hydrocarbons (TPH) will be conducted monthly at the same locations as the nutrient and metals samples.

f. Sampling for metals will commence at monthly intervals after the lake has been filled. Metals and nutrients may be sampled at the same time and location. A pattern should soon be apparent and the sampling frequency reduced. The enclosed page titled "Inorganic Chemistry Test Sets" show the list of metals to be sampled for originaly under the column "SURFACE WATER-ALL INORGANICS".

g. An important parameter for judging the health of a lake is the presence of chlorophyll. During the summer months when fecal coloform is being sampled, chlorophyll a, b, c and pheophytin a shall be sampled for at the same time and locations.

This is the initial sampling program for the Tempe Town Lake. Sample results will be sent to ADEQ at the address shown in Item C.3 above. The sampling program will be modified as sample results are received and reviewed. Mr. Howard Hargis, the applicant, will be notified when it is necessary to implement a change in the sample plan.

Construction procedures must be consistent with the Arizona Department of Environmental Quality Policy for Protecting Water Quality During Facility Construction. The specific procedures for preventing water pollution indicated in ADEQ policy statements #1 through #13, together with Conditions C.1 through C.18, listed above, should ensure compliance with water quality standards. Subject to the above Project Description, Basis and Conditions of Certification, this letter certifies that the proposed project of the City of Tempe in the Salt River Channel complies with existing navigable water quality standards. If you have any questions about this Letter of Certification, please call James Matt (602) 207-4502. Thank you for your cooperation and efforts to protect our natural environment.

Sincerely,

Authorized ADEQ Signature _____ Date _____

Kimberly W. MacEachern, Director
Water Division

Enclosuer.

KWM:JRM:jrm

cc: James Romero, EPA Region 9
Corps of Engineers Regulatory Branch - Phoenix
Larry Rielly, AGFD
Sam Spiller, USFWS

INORGANIC CHEMISTRY TEST SETS

	SDW ALL INORGANIC	PRIMARY STANDARDS	SECONDARY STANDARDS	SURFACE WATER-ALL INORGANICS	SURFACE WATER NUTRIENTS	P.P. METALS	DISS. METALS	TOTAL RECOV. METALS	MAJOR CATIONS/ ANIONS
TO USE, CHECK:	ABOVE BLOCKS ONLY					INDIVIDUAL TESTS REQUIRED			
ALKALINITY, TOTAL	X		X	X					X
ALKALINITY, PHENOL	X		X	X					X
AMMONIA					X				
CHLORIDE	X		X	X					X
CONDUCTIVITY	X		X	X					
FLUORIDE	X	X		X					X
HARDNESS	X		X	X					X
NO2 NO3 TOTAL	X	X		X	X				X
NITRITE					X				
PHOSPHORCUS					X				
TKN					X				
pH	X		X	X					X
SULFATE	X		X	X					X
TDS	X		X	X					X
TSS				X					
TURBIDITY		X		X					
Ag (Silver)	X	X		X		X	X	X	
As (Arsenic)	X	X		X		X	X	X	
B (Boron)				X					
Ba (Barium)	X	X		X			X	X	
Be (Beryllium)						X			
Cd (Cadmium)	X	X		X		X	X	X	
Ca (Calcium)	X		X	X					X
Cr (Chromium)	X	X		X		X	X	X	
Cu (Copper)	X		X	X		X	X	X	
Fe (Iron)	X		X	X				X	X
K (Potassium)				X					X
Hg (Mercury)	X	X		X		X	X	X	
Mg (Magnesium)	X		X	X					X
Mn (Manganese)	X		X	X				X	
Na (Sodium)	X		X	X					X
Ni (Nickel)						X			
Pb (Lead)	X	X		X		X	X	X	
Se (Selenium)	X	X		X		X	X		
Sb (Antimony)						X			
Tl (Thallium)						X			
Zn (Zinc)	X		X	X		X	X	X	

ARIZONA DEPARTMENT OF WATER RESOURCES

RECOVERY WELL PERMIT

PERMIT NO. 74-547332

STATE OF ARIZONA)
) ss.
County of Maricopa)

This is to certify that I have examined Application No. 74-547332 for a recovery well permit. I have determined that the application meets the requirements of Title 45, Chapter 3.1, Article 3, Arizona Revised Statutes. The Department hereby grants the applicant authority to operate the recovery wells subject to the following limitations and conditions:

Permit Limitations

Applicant:

City of Tempe
P.O. Box 5002
Tempe, Arizona 85280

PERMIT 74-547332

Permitted recovery well(s):

Well Registration Number	Location of Well	Design Pump Capacity (GPM)	Well Depth (Feet)	Casing Diameter (Inches)	Maximum Annual Recovery (Acre Feet)
55-551601	SE¼NE¼NE¼ Sec.15 T1N R4E	3200	140	24	51.6
55-551602	SW¼NW¼NW¼ Sec.14 T1N R4E	3200	160	24	51.6
55-551603	SE¼NW¼NW¼ Sec.14 T1N R4E	3200	155	24	51.6
55-551604	NW¼NE¼NW¼ Sec.14 T1N R4E	3200	155	24	51.6
55-551605	NE¼NW¼NE¼ Sec.14 T1N R4E	3200	135	24	51.6
55-551606	NW¼SW¼NE¼ Sec.14 T1N R4E	3200	140	24	51.6
55-551607	NE¼SE¼NW¼ Sec.14 T1N R4E	3200	160	24	51.6
55-551608	SW¼SE¼NW¼ Sec.14 T1N R4E	3200	160	24	51.6
55-551609	SW¼SW¼NW¼ Sec.14 T1N R4E	3200	160	24	51.6
55-551610	SE¼SE¼NE¼ Sec.15 T1N R4E	3200	150	24	51.6

Recovery wells are subject to the operating plans of Facility Permit Numbers 71-516371, 71-551762, and 72-533659, and are subject to the conditions of Water Storage Permit Numbers 73-516371.7000, 73-551761, and 73-533659.

Recovered water will be used for: The beneficial municipal use of the permittee including but not limited to maintaining the Town Lake water levels and/or delivery for uses within the municipal water system.

Legal description of the land on which recovered water will be used: Parts of Sections 14, 15 and 16 of Township 1 North Range 4 East GSRB&M.

Permit Conditions

1. In accordance with A.R.S. § 45-875.01.(D), an annual report shall be submitted no later than March 31 following the end of each completed annual reporting permit. The first annual reporting period shall be from the date of this permit through December 31, 1996. Subsequent annual reporting periods shall be January 1 through December 31.

2. The annual report shall include the following information:

   a. The well registration number and location of the wells used to recover stored water.

   b. The quantity of water recovered from each well as measured in a manner consistent with the requirements and specifications for water measuring devices adopted pursuant to A.R.S. § 45-604.

   c. For all stored water recovered each year, report the Water Storage Permit Number(s) from which the water storage originated, the amount of recovery (in acre feet) attributed to each Water Storage Permit, and the source of water originally stored pursuant to each Water Storage Permit.

3. Recovery from each of the Well Registration Numbers referenced above shall not exceed the specified annual volume limit of 51.6 acre feet.

WITNESS my hand and seal of office this 8th day of August, 1996.

Herb Dishlip, Assistant Director

Tel xxx/xxx-xxxx
Fax xxx/xxx-xxxx
e-mail: xxxxxxxx@apsc.com
http://www.apsc.com

Mail Station xxxx
P.O. Box 53933
Phoenix, AZ 85072-3933

August 29, 1996

Mr. Howard Hargis
Assistant City Engineer
City of Tempe
P.O. Box 5002
Tempe, AZ 85280

RE: SOUTH BANK INTERCEPTOR STORMWATER DIVERSION PIPELINE ENCROACHMENT AGREEMENT

Dear Mr. Hargis:

Enclosed is your copy of the fully executed Encroachment Agreement for the above referenced project.

If you have any questions regarding this matter, please call me on 371-7031.

Sincerely,

Barbara H. Cowdery

Barbara H. Cowdery
Land Agent
SI Land Services

Enclosure

ENCROACHMENT PERMIT
AND INDEMNIFICATION AGREEMENT

This Encroachment Permit and Indemnification Agreement (the "Agreement") is entered into this 29th day of August, 1996, by and between City of Tempe, an Arizona municipal corporation ("Tempe") and Arizona Public Service Company, an Arizona corporation ("APS").

RECITALS:

A. APS is the owner a Right of Way Easement recorded in Docket 4380, Pages 152-158, and a Utility Easement recorded in Docket 7695, Page 359 Maricopa County Records referred to herein as the ("Easements").

B. APS presently has transmission lines along with appurtenant fixtures and equipment within the Easements (the "Lines").

C. Tempe wishes to encroach upon the Easements by constructing and maintaining the South Bank Interceptor Stormwater Diversion Pipeline within the Easements as shown on Exhibit "A" attached hereto and by this reference incorporated herein (the "Pipeline").

D. APS is willing to allow said encroachment upon the terms and conditions contained herein.

PROMISES AND COVENANTS:

NOW, THEREFORE , in consideration of the foregoing recitals and in further consideration of the following covenants, promises, and provisions, the parties hereby agree as follows:

1. APS hereby authorizes Tempe, at Tempe's sole cost and expense, to install the Pipeline in the locations as shown on Exhibit "A" attached hereto and by this reference incorporated herein.

2. No vehicle over 14 foot in height shall be parked within the Easements for the contractor staging area shown on Dwg. Nos. A-G-6 and A-G-7 attached hereto.

3. No vehicles shall be refueled within the Easements.

4. No flammable or hazardous materials shall be stored within the Easements.

5. Tempe shall obtain independent permission to cross the Easements from the underlying landowner and any other easement holders.

6. Only clean sand and gravel shall be deposited in the designated waste disposal area shown on Dwg. A-G-7 and the material shall be leveled and compacted to avoid restricting APS' access in the Easements. Extreme care must be used when despositing material in the vicinity of tower foundations to avoid damaging these foundations.

7. The final elevation of the waste disposal area shall be no greater than the top of the foundation concrete for the towers located approximately in the center of this area.

8. APS shall not be liable for damage to Tempe's facilities located within the Easements as a result of APS operation and maintenance of the Lines.

9. At all times during the construction and maintenance of the Pipeline within the Easements, Tempe shall comply with all applicable laws, ordinances, rules, regulations, and safety requirements, including but not limited to the Arizona Revised Statutes, the Occupational Safety and Health Standards for General Industry (29 C.F.R. Part 1910), and the National Electrical Safety Code.

10. Tempe shall indemnify, hold harmless, and waive all claims against APS, its employees, agents, and representatives, for any and all claims, demands, suits, losses, costs, and damages of every kind and description, including any attorneys' fees or litigation expenses, on account of loss of, or damage to, any property or for injury to, or death of, any person caused by, arising out of, or contributed to, in whole or in part, by reason of the location, construction, operation, use, maintenance, repair or removal of the Pipeline, or equipment or vehicles within the Easement; provided, however, that this indemnification, waiver and release shall not extend to active negligence or willful misconduct of APS.

11. Tempe further hereby indemnifies APS against loss of revenue if Tempe, its employees, agents, or representatives during construction, maintenance, use, or removal of the Pipe in any way damage the Lines or APS' towers or equipment located within the Easements; provided, however, that this indemnity shall not extend to active negligence or willful misconduct of APS.

12. Tempe acknowledges that APS has provided it with general electric and magnetic field-related information for its consideration and use prior to execution of this Agreement.

13. This Agreement shall not limit or restrict APS' rights granted under the Easement, including the right to add or remove electric facilities in the Easements. Tempe shall not interfere with APS' use of the Easement or APS' business conducted thereon.

IN WITNESS WHEREOF, the parties have executed this Agreement on the day and year first above written.

CITY OF TEMPE

By Howard A Darrow

Its Assistant City Engineer

ARIZONA PUBLIC SERVICE COMPANY
an Arizona corporation

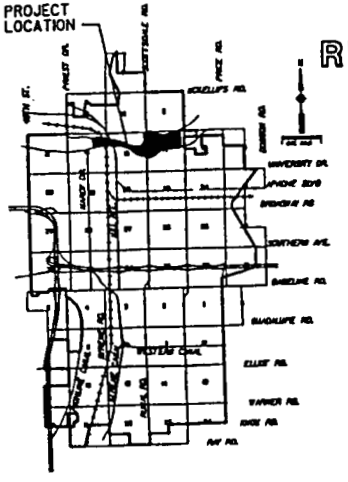
By Michael A Pfutt

Its Acting Group Leader

Exhibit "A"

CITY OF TEMPE
PUBLIC WORKS DEPARTMENT
DIVISION OF ENGINEERING

RIO SALADO TOWN LAKE - PROJECT NO. 946523-A
SCHEDULE A - PIPE AND WELL SYSTEMS



MAYOR
NEIL G. GIULIANO

CITY COUNCIL
LINDA SPEARS
DENNIS J. CAHILL
P. BEN ARREDONDO
JOSEPH LEWIS
JOSEPH P. SPRACALE
CAROL E. SMITH

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ELECTRICAL LEGEND AND NOTES		A-G-4
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NOT USED		
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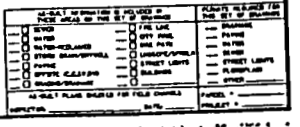
UTILITY INFORMATION

	DATE
MCI	DATE
AT & T	DATE
US WEST	DATE
ARIZONA PUBLIC SERVICE CO.	DATE
AIR PRODUCTS	DATE
SALT RIVER PROJECT-WATER	DATE
SALT RIVER PROJECT-POWER	DATE
EL PASO NATURAL GAS CO.	DATE
SOUTHWEST GAS CORP.	DATE
DIMENSION CABLE	DATE

APPROVED

CITY ENGINEER — DATE

DEPT. OF ENVIRONMENTAL MGMT.



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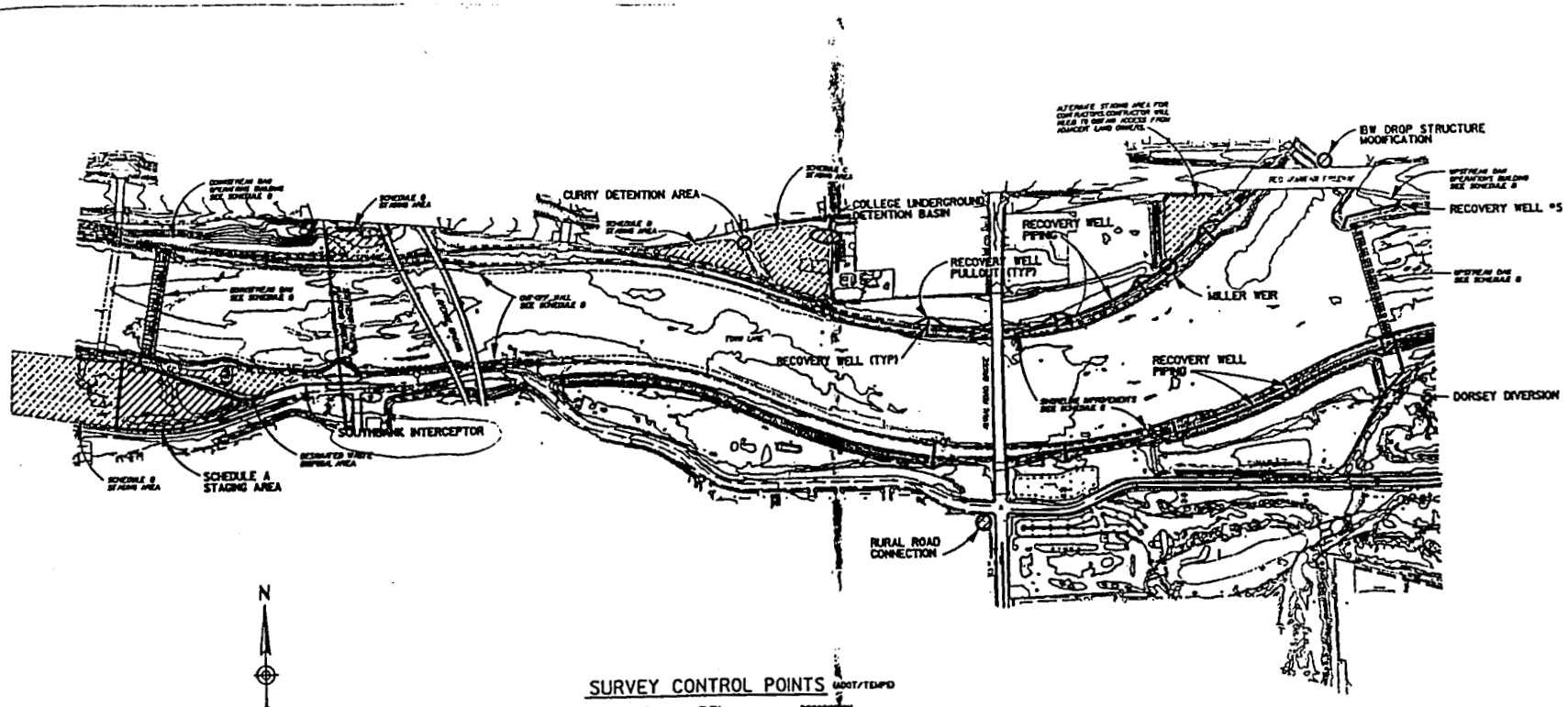

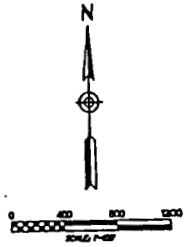

SURVEY CONTROL POINTS (ADOT/TEMPE)

NO	N	E	ELEV	DESCRIPTION
174	283837.0774	297359.7527	867.70	B.C. IN HANDHOLE AT CENTERLINE SCOTTSDALE RD 200'± N. INTERSECTION OF 1ST ST 9'EN OF HANDHOLE PANEL PTI
517	284596.1093	292858.4672	848.72	½" REBAR FLUSH W/ GROUND 50'± OF NL FENCE TEMPE BEACH PARK 200'± E. OF OLD MILL BRIDGE
527	286314.7598	294798.2278	861.90	½" REBAR FLUSH W/ GROUND IN ACCESS ROAD S. BANK OF IRRIGATIONCANAL NEAR S. BORDER PAPAGO PARK. (PANEL PTI)
1	285893.95	290632.8		½" REBAR FLUSH W/ GROUND IN UPPER LEVEE
2	284859.86	290470.8		½" REBAR FLUSH W/ GROUND IN UPPER LEVEE
3	286000.00	300250.00		½" REBAR FLUSH W/ GROUND IN UPPER LEVEE
4	284887.93	300545.25		½" REBAR FLUSH W/ GROUND IN LOWER ACCESS ROAD

ALL COORDINATES SHOWN ARE PROJECT DATUM GROUND COORDINATES

THE COORDINATES ARE REDUCED BY 200,000 IN THE E DIRECTION AND 600,000 IN THE N DIRECTION, FROM ADOT COORDINATES

263-1100
CALL BEFORE

DEPARTMENT OF PUBLIC WORKS
CITY OF TEMPE
DIVISION OF ENGINEERING
P.O. BOX 5002 TEMPE, ARIZONA 85280

SURVEYED	DESCRIPTION: SCHEDULE A GENERAL	DATE: APRIL 1996
DESIGNED: RLF		PROJECT NO. 9465234
DRAWN: CMP	OVERALL PROJECT PLAN	SHEET 6 OF 8
CHECKED: CMP		DWG. NO. A-0-6
SCALE: 1"=400'		

PRELIMINARY 90% REVIEW

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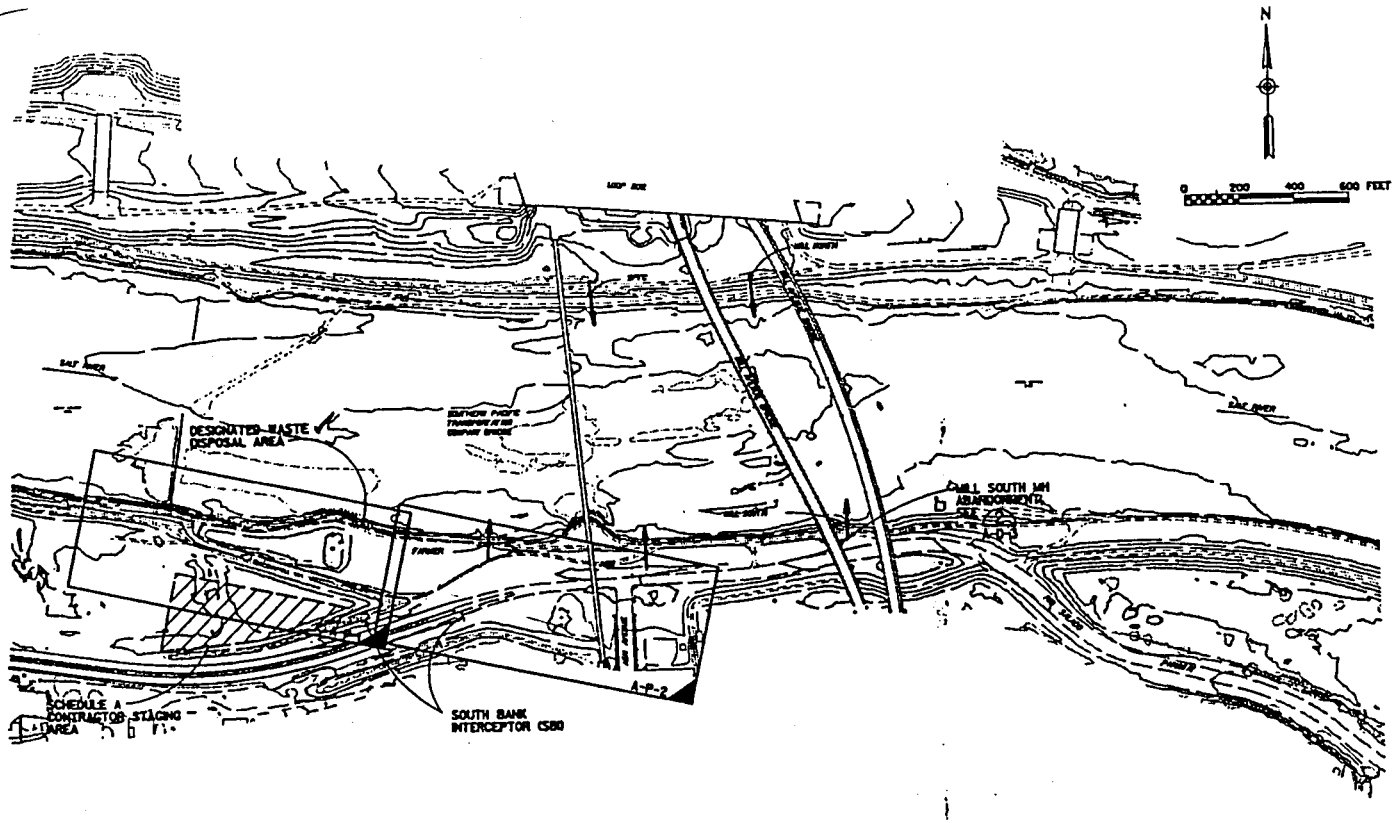


LEGEND:

EXISTING STORM DRAINS TO BE MODIFIED, SEE A-0-3

SHEET WINDOW AREA

DRAWING NO.

LOWER RIGHT HAND CORNER

CONSTRUCTION NOTES

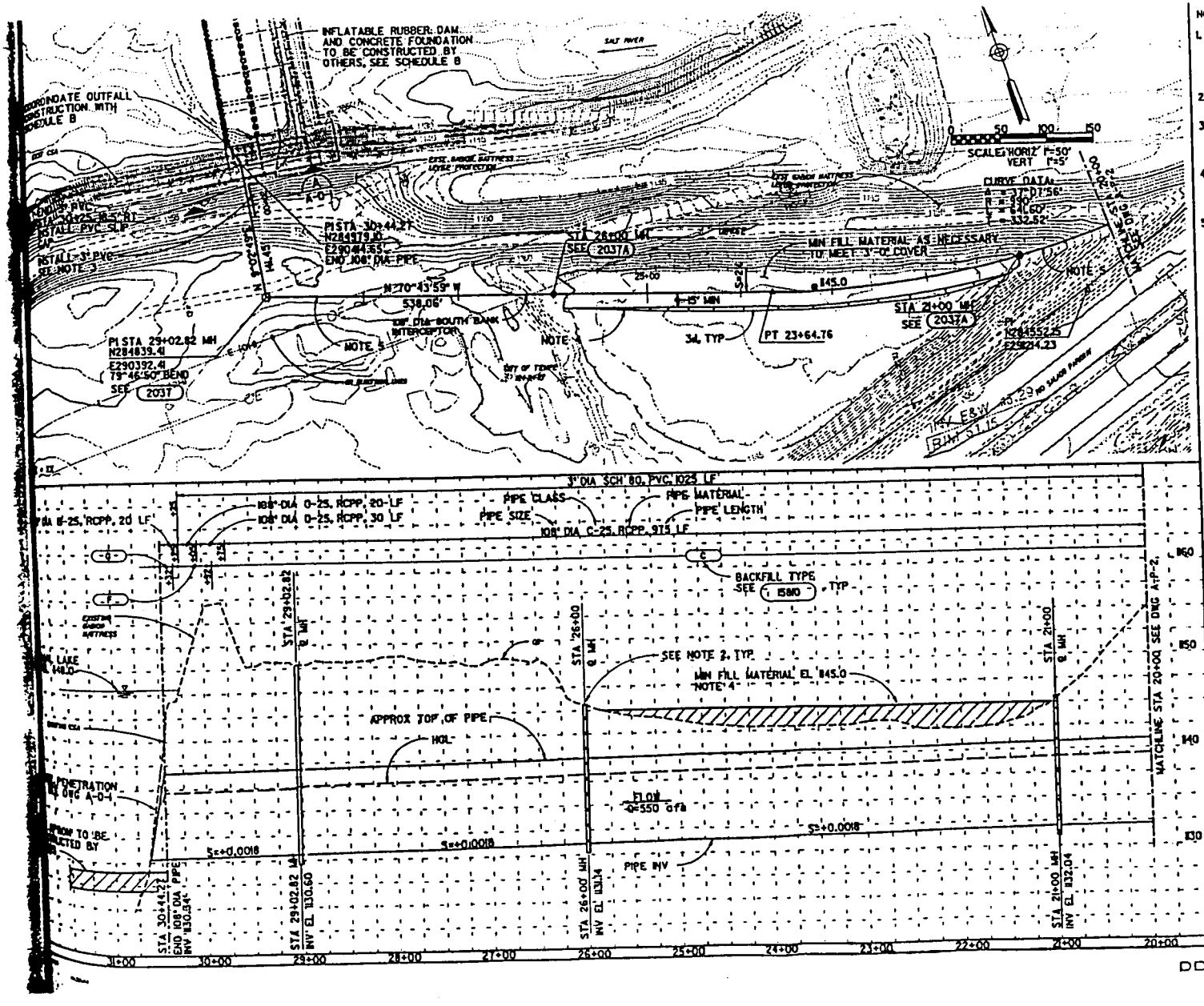
263-1100

CITY OF TEMPE
DIVISION OF ENGINEERING

SCHEDULE A
GENERAL
STORMWATER DIVERSION
PLAN WEST

DATE APRIL 1996
PROJECT NO. 94652.3A
SHEET 1 OF 2
DWG NO. A-0-1

PRELIMINARY 90% REVIEW



NOTES:

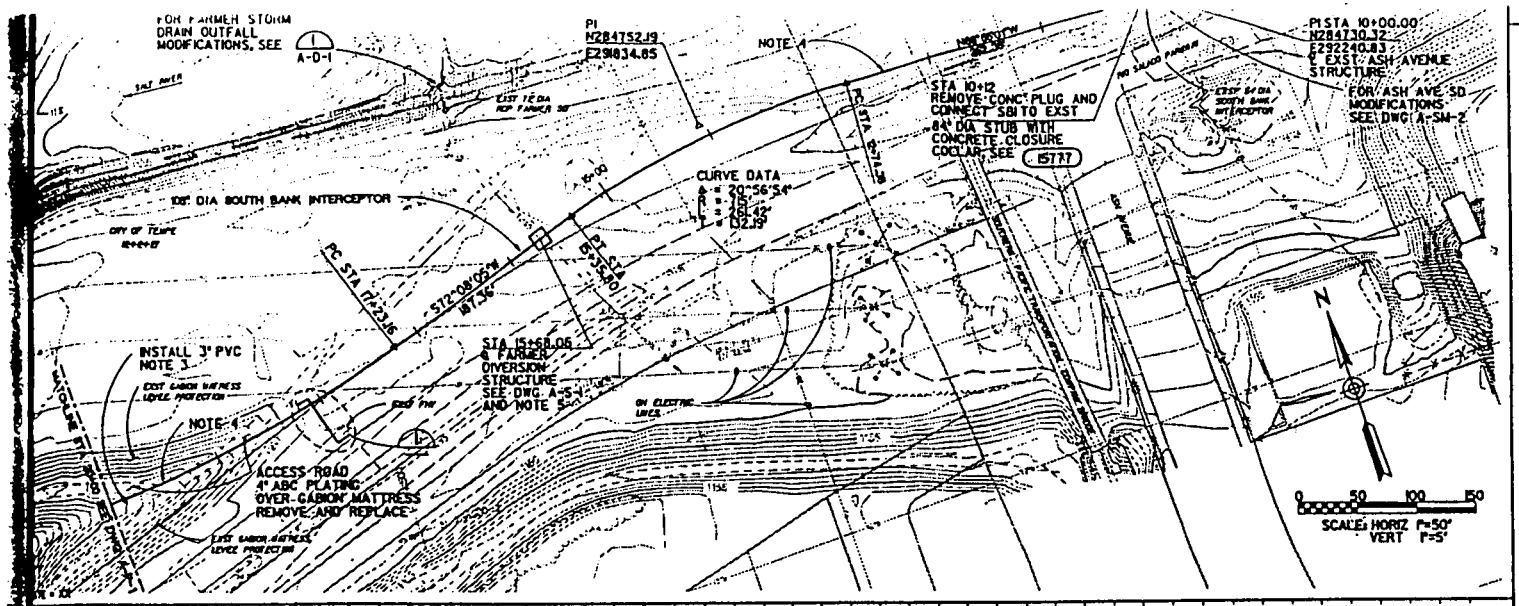
1. EXCAVATE TEST PITS OR BORINGS ALONG CENTERLINE OF SBI ALIGNMENT AT 50' INTERVALS FROM STA 15+50 TO STA 29+00 PRIOR TO EXCAVATING TRENCH. REFER TO SPECIFICATIONS FOR DETAILS OF TEST PIT OR BORING REQUIREMENTS.
2. TOP OF MH RISERS SHALL MATCH THE FINISHED GRADE ALONG THE PIPELINE ALIGNMENT.
3. 3" PVC WATER LINE SHALL BE PLACED IN THE SAME TRENCH AS THE 108" SBI FROM STA 18+10 TO STA 30+25. REFER TO THE PIPE BACKFILL DETAIL ON DWG A-D-8
4. RECENT GRADING ACTIVITIES MAY HAVE ALTERED GROUND SURFACE ELEVATIONS IN THIS AREA. CONTRACTOR SHALL FIELD VERIFY GROUND SURFACE ELEVATIONS.
5. LIMIT EQUIPMENT TRAFFIC OVER NEW PIPELINE FACILITIES TO HS20 LOADS. CONTRACTOR SHALL SUBMIT ACCESS PLANS FOR EQUIPMENT THAT EXCEEDS HS20 LOADS.

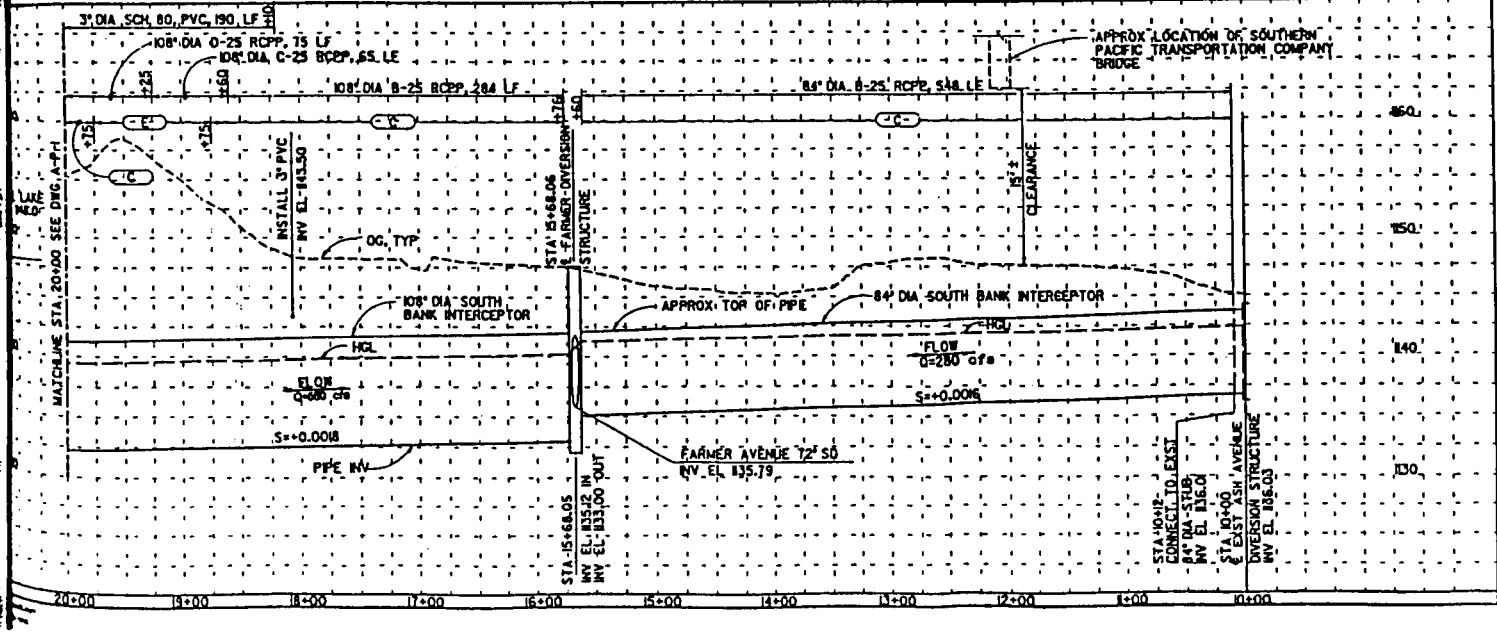
263-1100
CALL BLUE STAKE

DEPARTMENT OF PUBLIC WORKS
CITY OF TEMPE
DIVISION OF ENGINEERING
P.O. BOX 5002 TEMPE, ARIZONA 85280

SURVEYED: E	DESCRIPTION: SCHEDULE A CIVIL	DATE: APRIL 1996
DESIGNED: E	SOUTH BANK INTERCEPTOR PLAN AND PROFILE	PROJECT NO. 946523A
DRAWN: M&A		SHEET X OF X
CHECKED: E		DWG NO. A-P-1
SCALE: 1"=50'		

PRELIMINARY

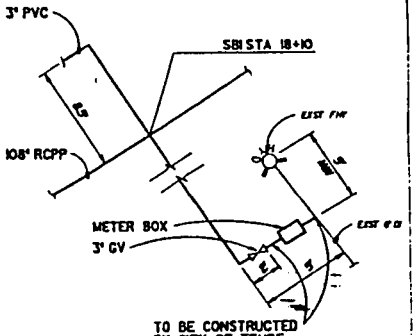




CONSTRUCTION NOTES

NOTES:

1. EXISTING FARMER SD AND ASH AVE SD SHALL REMAIN IN-SERVICE UNTIL SCHEDULES A AND B ARE SUBSTANTIALLY COMPLETE.
2. EXCAVATE TEST PITS OR BORINGS ALONG CENTERLINE OF SBI ALIGNMENT AT 50' INTERVALS FROM STA 15+50 TO STA 29+00 PRIOR TO EXCAVATING TRENCH. REFER TO SPECIFICATIONS FOR DETAILS OF TEST PIT OR BORING REQUIREMENTS.
3. 3" PVC WATER LINE SHALL BE PLACED IN THE SAME TRENCH AS THE 108" SBI FROM STA 18+10 TO STA 30+25. REFER TO THE PIPE BACKFILL DETAIL ON DWG A-D-8.
4. LIMIT EQUIPMENT TRAFFIC OVER NEW PIPELINE FACILITIES TO HS20 LOADS. CONTRACTOR SHALL SUBMIT ACCESS PLANS FOR EQUIPMENT THAT EXCEEDS HS20 LOADS.
5. LOCATION OF EXST 72" SD IS APPROXIMATE BASED ON THE BEST AVAILABLE RECORDS. CONTRACTOR SHALL FIELD VERIFY EXACT LOCATION PRIOR TO MATERIALS PURCHASE.



DETAIL
NTS

263-1100
CALL ONE CALL

DEPARTMENT OF PUBLIC WORKS
CITY OF TEMPE
DIVISION OF ENGINEERING
P.O. BOX 5002 TEMPE, ARIZONA 85280

SURVEYED: E	DESCRIPTION: SCHEDULE A CIVIL	DATE: APRIL 1996
DESIGNED: E	SOUTH BANK INTERCEPTOR PLAN AND PROFILE	PROJECT NO. 946523A
DRAWN: KEA		SHEET X OF X
CHECKED: E		DWG NO. A-P-2
SCALE: 1"=50'		

PROPOSAL

Place: Tempe, Arizona

Date: _____

Mayor and City Council
City of Tempe
Tempe, Arizona 85281

In compliance with your invitation for bids and all conditions of the Contract

Documents, the _____,

a corporation organized under the laws of the State of _____,

a partnership consisting of _____,

or individual trading as _____,

of the City of _____, hereby proposes and agrees to furnish any and all plant, materials, labor, construction equipment, service and transportation (all applicable taxes included) of the **RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A (PROJECT NO. 946523A)** and to install the material therein for the Owner in a good and workmanlike and substantial manner and to the satisfaction of the Owner, or their properly authorized agents and strictly pursuant to and in conformity with the Contract Documents and other documents that may be made by the Owner or their properly authorized agents, as provided herein, at the following prices:

SCHEDULE A BID LIST

The following are the bid items for Schedule A:

Item	Description	Quan.	Unit	Unit Price	Extended Total Amount
1.	Mobilization/Demobilization for Pipeline Work, Demolition, Diversion and Care of Water, and Miscellaneous Items	1	LS	$	$
2.	3" PVC Pipe w/Class C Backfill	2,287	LF	$	$
3.	3" PVC Pipe w/Class E Backfill	132	LF	$	$
4.	3" PVC Pipe w/Class F Backfill	223	LF	$	$
5.	3" PVC Pipe w/Class G Backfill	27	LF	$	$
6.	6" BSP Pipe w/Class D Backfill	12	LF	$	$
7.	6" BSP Pipe w/Class E Backfill	669	LF	$	$
8.	6" BSP Pipe w/Class F Backfill	526	LF	$	$
9.	6" BSP Pipe w/Class G Backfill	190	LF	$	$
10.	6" BSP Pipe w/Class H Backfill	81	LF	$	$
11.	14" Class 52 DIP w/Class D Backfill	12	LF	$	$
12.	14" Class 52 DIP w/Class E Backfill	129	LF	$	$
13.	14" Class 52 DIP w/Class F Backfill	526	LF	$	$
14.	14" Class 52 DIP w/Class G Backfill	190	LF	$	$
15.	14" Class 52 DIP w/Class H Backfill	81	LF	$	$
16.	14" Class 54 DIP w/Class E Backfill	439	LF	$	$
17.	14" Class 54 DIP w/Class F Backfill	59	LF	$	$
18.	14" Class 54 DIP w/Class G Backfill	13	LF	$	$
19.	14" Class 54 DIP w/Class H Backfill	14	LF	$	$
20.	18" Class 52 DIP w/Class D Backfill	100	LF	$	$
21.	18" Class 52 DIP w/Class E Backfill	1,837	LF	$	$
22.	24" Class 52 DIP w/Class E Backfill	1,331	LF	$	$
23.	30" Class 52 DIP w/Class E Backfill	8	LF	$	$
24.	14" Butterfly Valve, Valve Box and Cover	6	EA	$	$
25.	18" Butterfly Valve, Valve Box and Cover	2	EA	$	$
26.	24" Butterfly Valve, Valve Box and Cover	2	EA	$	$
27.	30" C-25 RCPP w/Class C Backfill	27	LF	$	$

Item	Description	Quan.	Unit	Unit Price	Extended Total Amount
28.	48" RCPP w/Class C Backfill	403	LF	$	$
29.	54" C-25 RCPP w/Class E Backfill	52	LF	$	$
30.	78" B-25 RCPP w/Class C Backfill	195	LF	$	$
31.	78" B-25 RCPP w/Class D Backfill	25	LF	$	$
32.	78" C-25 RCPP w/Class C Backfill	669	LF	$	$
33.	78" D-25 RCPP w/Class C Backfill	373	LF	$	$
34.	78" D-25 RCPP w/Class E Backfill	90	LF	$	$
35.	78" D-25 RCPP w/Class F Backfill	70	LF	$	$
36.	78" D-25 RCPP w/Class G Backfill	8	LF	$	$
37.	84" B-25 RCPP w/Class C Backfill	548	LF	$	$
38.	108" B-25 RCPP w/Class C Backfill	284	LF	$	$
39.	108" B-25 RCPP w/Class G Backfill	15	LF	$	$
40.	108" C-25 RCPP w/Class C Backfill	965	LF	$	$
41.	108" C-25 RCPP w/Class E Backfill	25	LF	$	$
42.	108" C-25 RCPP w/Class F Backfill	70	LF	$	$
43.	108" D-25 RCPP w/Class C Backfill	50	LF	$	$
44.	108" D-25 RCPP w/Class E Backfill	17	LF	$	$
45.	108" D-25 RCPP w/Class F Backfill	63	LF	$	$
46.	66" Flap Gate	1	EA	$	$
47.	78" Flap Gate	1	EA	$	$
48.	108" Flap Gate	1	EA	$	$
49.	Connection to Existing Karsten Storm Drain	1	LS	$	$
50.	Pressure Manhole	6	EA	$	$
51.	Farmer Diversion Structure	1	LS	$	$
52.	Rural Road Diversion Structure and Connection	1	LS	$	$
53.	Dorsey Diversion Structure	1	LS	$	$
54.	Karsten Diversion Structure	1	LS	$	$
55.	Miller Weir	1	LS	$	$
56.	Indian Bend Wash Drop Structure Modifications	1	LS	$	$
57.	College Underground Detention Basin	1	LS	$	$
58.	Curry Detention Area	1	LS	$	$

Item	Description	Quan.	Unit	Unit Price	Extended Total Amount
59.	Existing Storm Drain Modifications	1	LS	$	$
60.	Mobilization, Demobilization, Cleanup, and Temporary Construction Pad for 10 Wells	1	LS	$	$
61.	Site Work for Permanent Well Pullout Pads for 10 Wells	1	LS	$	$
62.	Drilling of 34" Well Borehole	1,650	LF	$	$
63.	Drilling of 48" Well Borehole	400	LF	$	$
64.	24" Well Casing	100	LF	$	$
65.	36" Well Casing	400	LF	$	$
66.	Well Screen Assembly	700	LF	$	$
67.	Recovery Well Annular Materials	1,650	LF	$	$
68.	Recovery Well Pump Column Pipe	1,000	LF	$	$
69.	Recovery Well Submersible Pump and Motor (150 hp)	7	EA	$	$
70.	Recovery Well Submersible Pump and Motor (100 hp)	3	EA	$	$
71.	Furnishing of Spare Submersible Pump and Motor (150 hp)	1	EA	$	$
72.	Development of 10 Wells	100	HR	$	$
73.	Well Pumping Test and Disinfection	10	EA	$	$
74.	Well Vault	10	EA	$	$
75.	Aeration Blower Vault	9	EA	$	$
76.	Aeration Diffuser	1	LS	$	$
77.	Abandonment of 6 Type I Wells	1	LS	$	$
78.	Abandonment of 6 Type II Wells	1	LS	$	$
79.	Relocate Bike Path and Light Pole	1	LS	$	$
80.	Rock Excavation	50	CY	$	$
81.	Trench Stabilization Material	50	CY	$	$
82.	Removal of Landfill Material	6,500	CY	$	$
83.	Removal of Unsuitable Material	50	CY	$	$
84.	Concrete Cap for Manholes	1	LS	$	$
85.	2" Electrical Conduit for Primary Service	3,675	LF	$	$

Item	Description	Quan.	Unit	Unit Price	Extended Total Amount
86.	3" Electrical Conduit for Primary Service	3,600	LF	$	$
87.	4" Electrical Conduit for Primary Service	240	LF	$	$
88.	5" Electrical Conduit for Primary Service	15,350	LF	$	$
89.	Installation of 4" Communications Conduits Furnished by Others	20,000	LF	$	$
90.	Installation of Communications Pullboxes Furnished by Others	15	EA	$	$
91.	Transformer Pads	9	EA	$	$
92.	Control Cabinets and Pads	10	EA	$	$
93.	Installation of APS Furnished Pullboxes	13	EA	$	$
94.	Installation of APS Furnished Electrical Box Pads	13	EA	$	$
95.	Electrical and Instrumentation and Control	1	LS	$	$
	Base Bid Extended Total			$	$

Deductive Alternate A1 for Omission of Well No. 5 and Related Piping:

Bidder further proposes that if OWNER elects to omit the construction of Well No. 5 and related piping as shown on the Drawings, with necessary changes in construction as required to complete the Work with this omission, based on undersigned's own estimate of quantities and cost, the Contract Price will be reduced in the amount of:

_____ Dollars

and _____Cents $_____

Deductive Alternate A2 for Omission of Recovery Well Distribution Piping:

Bidder further proposes that if OWNER elects to omit the construction of the recovery well distribution piping as shown on the Drawings, with necessary changes in construction as required to complete the Work with this omission, based on undersigned's own estimate of quantities and cost, the Contract Price will be reduced in the amount of:

_____ Dollars

and _____Cents $_____

The undersigned hereby declares that he has visited the site and has carefully examined the Contract Documents related to the work covered by the above bid.

The Undersigned understands that the City of Tempe reserves the right to award a contract or to reject all bids and to waive any informalities in any bid, deemed to be in the best interests of the City.

"NOTICE: THIS CONTRACT CONTAINS AN EXCLUSIVE AND MANDATORY PARTNERING AND AN ALTERNATIVE DISPUTE RESOLUTION PROCESS FOR THE EFFICIENT AND EXPEDITIOUS RESOLUTION OF ALL CLAIMS WHICH MAY ARISE FROM THIS CONTRACT AND OTHER CONTRACTS CONTAINING THESE PROVISIONS FOR THE PROJECT."

Performance shall not start until after receiving the Notice to Proceed, and the Project will be completed within four-hundred twenty (420) consecutive calendar days after receiving the Notice to Proceed.

The Undersigned hereby acknowledges receipt of the following Addenda:

_____ and his bid has been adjusted to reflect any changes.

Respectfully submitted,

_____
(Name) (Signature)

_____
(Title)

_____
Contractor's License No.

_____
Federal I.D. No./Social Security No.

ATTEST:

_____
(Name)

_____
(Title)

(Corporate Seal)

_____
Witness: If Bidder is an Individual

_____
(Company Name)

Address:_____

_____

Phone: _____

BIDDERS PROJECT REFERENCES

All bidders shall list at least three (3) projects, if possible, similar in scope to this project, that they have completed. Show references in the space provided below (or attached separate sheet):

Job Title/Description	Contracting Agency	Phone No./Contact Person

LIST OF SUBCONTRACTORS

In accordance with the provisions of Section 108.2 of the "Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction", the bidder shall provide the information listed below regarding proposed subcontractors. Failure to provide complete and accurate information may disqualify the bid.

Subcontractor Name	Address	Type of Work	% of Total Contract

CONTRACT

THIS AGREEMENT, made and entered into this _____ day of _____, 1996, by and between the City of Tempe, a Municipal Corporation, organized and existing under and by virtue of the laws of the State of Arizona, party of the First Part, hereinafter designated the **OWNER**, and_____, of the City of _____ County of _____, and State of _____, party of the Second Part, hereinafter designated as the **CONTRACTOR**:

WITNESSETH: That said Contractor, for and in consideration of the sum to be paid him by said Owner, in the manner, amount and at the time hereinafter provided in the "Proposal" and of the other covenants and agreements herein contained, and under the penalties expressed in the bonds hereto attached, hereby agrees, for himself, his heirs, administrators, successors, and assigns as follows:

ARTICLE I - SCOPE OF THE WORK: The Contractor shall furnish any and all plant, materials, labor, construction equipment, services and transportation (all applicable taxes included) required for performing all work for the installation of the

RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A
PROJECT NO. 946523A

for the sum of _____ ($_____), and to construct the same and install the material therein for the Owner, in a good and workmanlike and substantial manner and to the satisfaction of the Owner or his properly authorized agents and strictly pursuant to and in conformity with the Specifications and Plans for the above referenced project(s) and other documents that may be made by the Owner through the Engineer or his properly authorized agents, as provided herein.

ARTICLE II - CONTRACT DOCUMENTS: The "Notice to Contractor", "Special Provisions", "Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction", as amended by the City of Tempe, "Proposal", "Plans", together with "Bid Security", "Performance Bonds", "Payment Bond", and Addenda thereto, if any.

ARTICLE III - TIME OF COMPLETION: The Contractor further covenants and agrees at his own proper cost and expense, to do all work and furnish all plant, materials, labor, construction equipment, services and transportation for performing all of the work for the construction of said improvements and to construct the same and install the material therein, as called for by this Agreement free and clear in all claims, liens, and charges whatsoever, in the manner and under the conditions specified within the time stated in the Proposal.

IN WITNESS WHEREOF, three (3) identical counterparts of this Contract, each of which shall be for all purposes, be deemed an original thereof, have been duly executed by the parties hereinabove named, on the date and year first herein written.

CITY OF TEMPE
a Municipal Corporation

_____
Name

_____
Title

ATTEST:

_____
Authorized Officer

_____
Official Title

(Corporate Seal)

APPROVED AS TO FORM:

_____
City Attorney

CONTRACTOR:

_____
Party of the Second Part

_____
Name

_____
Title

City of Tempe Transaction Privilege
License Permit No.

_____

ATTEST:

_____
Name

_____
Title

(Corporate Seal)

_____
Witness: If Contractor is an Individual

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), are held and firmly bound unto _____ (hereinafter called the Obligee) in the amount of _____ Dollars ($_____), 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 Obligee, dated the _____ day of _____, 19___, to complete Project No. 946523A 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 said Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extension thereof, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full force and effect.

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

The prevailing party or any party which recovers judgment on this bond shall be entitled to such reasonable attorney's fees as may be fixed by the Court or a judge thereof.

Witness our hands this _____ day of _____, 19 _____.

_____

PRINCIPAL SEAL

BY:_____

**_____

SURETY SEAL

BY:_____

_____

AGENCY ADDRESS

Surety hereby acknowledges they are licensed to do business in the State of Arizona

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 held and firmly bound unto_____ (hereinafter called the Obligee) in the amount of _____ Dollars ($_____), 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 Obligee, dated the _____ day of _____, 19___, to complete Project No. 946523A 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 said Principal shall promptly pay all moneys due to all persons supplying labor of materials to him or his subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond having been required of the said Principal in order to comply with the provision of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, all rights and remedies on this bond shall inure solely to such persons and shall be determined in accordance with the provisions, conditions and limitations of said Title, Chapter and Article, to the same extent as if it were copied at length herein.

The prevailing party or any party which recovers judgment on this bond shall be entitled to such reasonable attorney's fees as may be fixed by the Court or a judge thereof.

Witness our hands this _____ day of _____, 19 ____.

_____

PRINCIPAL SEAL

BY:_____

**

_____

SURETY SEAL

BY:_____

_____

AGENCY ADDRESS

Surety hereby acknowledges they are licensed to do business in the State of Arizona

CITY OF TEMPE

CERTIFICATE OF INSURANCE

CITY OF TEMPE PROJECT NO. 946523A

The _____ certifies that the listed insurance policies have been issued on behalf of

Name of Insured: _____
Address of Insured: _____

It is further certified that the **City of Tempe** has been named as additional insured as is required under said contract and that the independent contractor's insurance is primary as to any claims resulting from the contract.

Required Insurance	Company(s) Name	Policy Number	Expiration Date	Minimum Limits Required
WORKERS COMPENSATION				Statutory
GENERAL LIABILITY:				
Comprehensive Form				$5,000,000.00 per occurrence Bodily Injury
Premises/ Operations				$1,000,000.00 per occurrence Property Damage
Products/ Completed Operations				
Contractual				
Broad Form Property Damage				
Independent Contractors				
AUTOMOBILE LIABILITY:				
Owned/Non-Owned				Same as above
PROPERTY COVERAGE				See below

When the project includes construction of a new or modification of an existing building, property insurance shall be secured covering **Fire, Extended Coverage and Vandalism and Malicious Mischief** in an amount equal to the Contract amount less costs for any foundation, underground utilities and/or landscaping. The **CITY OF TEMPE** shall be named as additional insured.

Liability Policy Includes Coverage for:

1) A. Damage caused by blasting.
   B. Damaged caused by collapse or structural injury.
   C. Damage to underground utilities.

2) Liability assumed in construction agreements and other types of contracts or agreements in effect in connection with insured operations.

3) All owned, hired or non-owned automotive equipment used in connection with the insured operation.

_____It is agreed that none of these policies will be canceled or changed so as to affect this certificate until ten (10) days after written notice of such cancellation or change has been delivered to the **City of Tempe.**

It is further agreed that:

1) These policies shall not expire until all work has been completed and the project has been accepted by the **City of Tempe.** (If a policy does expire during the life of the **Contract,** a renewal **Certificate** of the required coverage must be sent to the **City of Tempe** not less than five (5) days prior to expiration date.)

This certificate is not valid unless countersigned by an authorized representative of the **Insurance Company.**

DATE: _____ COUNTERSIGNED BY _____
NAME

_____
SIGNATURE

_____
ADDRESS

_____
TELEPHONE NUMBER

CITY OF TEMPE
TEMPE, ARIZONA
DEPARTMENT OF PUBLIC WORKS

CONTRACTOR'S AFFIDAVIT
REGARDING
SETTLEMENT OF CLAIMS

_____, Arizona

Date _____

PROJECT: **RIO SALADO TOWN LAKE PIPE AND WELL SYSTEMS SCHEDULE A, PROJECT NO. 946523A**

To the City of Tempe, Arizona

Gentlemen:

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the consideration of $_____, as set out in the final pay estimate, as full and complete payment under the terms of the contract, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project against the City of Tempe. The undersigned further agrees to indemnify and save harmless the City of Tempe against any and all liens, claims of liens, suits, actions, damages, charges and expenses whatsoever, which said City may suffer arising out of the failure of the undersigned to pay for all labor performances and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____, 19____.

_____
Contractor

By:_____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

The foregoing instrument was subscribed and sworn to me before this _____ day of _____, 19_____.

_____
Notary Public

_____
My Commission Expires