



## CONTRACT DOCUMENTS

### SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT PROJECT NO. 7601, PLAN NO. P-732

Prepared By:



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Prepared by: \_\_\_\_\_ Date: 08/19/21  
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Under the Supervision of: \_\_\_\_\_ Date: 08/19/21  
Matthew Baumgardner, P.E., Director of Public Works

## TABLE OF CONTENTS

SECTION	Page No.
<b>Information</b>	
Table of Contents.....	(i)
Notice Inviting Bids .....	1
Instructions to Bidders.....	3
<b>Proposal</b>	
Contractor's Proposal.....	P-1
Bidder's Bond.....	P-4
Contractor Information .....	P-5
List of References .....	P-6
List of Subcontractors.....	P-7
List of Subcontractors, Suppliers, & Vendors Contacted.....	P-8
Non-Collusion Affidavit.....	P-9
<b>Contract/Agreement</b>	
Construction Contract.....	C-1
Performance Bond Form .....	C-5
Payment (Labor and Material) Bond Form .....	C-7
Warranty Performance and Payment Bond Form .....	C-9
<b>Special Provisions</b>	
Part 1 – General Provisions .....	S-2
Part 2 – Construction Materials.....	S-26
Part 3 – Construction Methods .....	S-32
Part 4 – Existing Improvements .....	S-46
Part 5 – Pipeline System Rehabilitation .....	S-51
Part 6 – Temporary Traffic Control .....	S-52
Part 8 – Landscaping and Irrigation .....	S-55
<b>Technical Provisions</b>	
Stormwater Treatment .....	T-2
Stormwater Infiltration System.....	T-6
Flow Meter, Valves, and Miscellaneous Equipment.....	T-10
Signing, Striping, and Pavement Markers .....	T-16
Landscape and Irrigation .....	T-19
Electrical.....	T-38

## NOTICE INVITING BIDS

SEALED PROPOSALS will be received at the Office of the City Clerk, City Hall, 117 Macneil Street, San Fernando, California until **2:30 P.M. on Monday, September 20, 2021**, and said bids will be publicly opened and declared for performing work on the following project:

### **SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT PROJECT NO. 7601, PLAN NO. P-732**

The project consists of a regional stormwater infiltration project within the park. The work includes construction of three storm drain diversions, two pretreatment units, two valves, and two flow meters; diversion piping; excavation, export, and installation of subsurface precast concrete infiltration units; sewer rehabilitation; park pathway improvements; roadway reconstruction; curb ramp replacement; installation of traffic striping and pavement marking; planting of trees; educational signage; new landscape/surface features; removal and replacement of irrigation; electrical panels/connections; and miscellaneous appurtenant work. The bid items, corresponding estimated quantities, and time allowed to complete the work are listed in the Contractor's Proposal. The definitions of bid items are described in the Special Provisions and Technical Specifications. Based on the quantities listed in the Proposal, the construction cost is estimated to be in the range of \$13,000,000.

The contract time for the project is three hundred (300) working days starting at the Part 2 Notice to Proceed (NTP), as indicated in the Special Provisions (Section 6-1.2).

It is the policy of the City, as directed by City Council, to encourage the use of local area businesses in construction contracts including vendors, suppliers, labor, etc.

The City reserves the right to reject any and all bids and to waive any minor irregularities in the bid documents. Bidders may not withdraw their bid for a period of ninety (90) days after date set for opening thereof.

The Contractor must follow the procedures as set forth in the Instructions to Bidders for acceptance of bids. Bids will be accepted only if submitted on a proposal form furnished by the City. Each bid must be accompanied by cash, certified check, cashier's check, or bidder's bond made payable to the City of San Fernando or issued by a surety admitted to do business in California, for an amount equal to at least ten percent (10%) of the amount bid. Such guaranty to be forfeited to the City should the bidder to whom the contract is awarded fail to enter into the contract.

Bids will be accepted only from contractors licensed in accordance with the provisions of the Business and Professional Code of the State of California. Prior to contract execution, the Contractor and his/her subcontractors shall obtain a City business license. At the time of bidding, the Contractor must possess a valid California **Class A** Contractor's License.

AB44 EFFECTIVE JULY 1, 2014. If a bidder submits a bid that includes a subcontractor who would be performing work in amount in excess of ½ of 1% of the bidder's total bid or in the case of bids for the construction of streets or highways, including bridges, in excess of ½ of 1% of the bidder's total bid or \$10,000, whichever is greater, then in addition to the subcontractor's name and business address, the subcontractor's State contractor's license number must be included as part of the information submitted for that proposed subcontractor. Failure to provide the subcontractor's license number shall render the bid non-responsive.

SB854 EFFECTIVE MARCH 1, 2015. Contractors and Subcontractors wishing to work on a public works project must be registered with the State of California, Department of Industrial Relations. All public works projects with bids submitted after March 1, 2015, or awarded on or after April 1, 2015, shall use only registered contractors and subcontractors. No bid will be accepted nor any contract entered into without proof of the Bidder's and its subcontractors' current registration with the Department of Industrial Relations. If awarded a contract, the Bidder and its subcontractors of every tier shall maintain active registration with the Department of Industrial Relations for the duration of the Project.

**The Contractor's duty to pay State prevailing wages can be found under Labor Code Section 1770. et. seq. and Labor Code Sections 1775 and 1777.7 outline the penalties for failure to pay prevailing wages and employee apprentices including forfeitures and debarment.**

At the request and expense of the Contractor, securities equivalent to the five percent (5%) to be withheld from progress payments pursuant to the City's Standard General Conditions shall be deposited with the City Clerk or a state or federally chartered bank as the escrow agent, who shall pay such monies to the contractor upon satisfactory completion of the contract. Securities eligible for investment shall include those listed in Section 16430 of the Government Code or bank or savings and loan certificates of deposit. The contractor shall be the beneficial owner of any securities substituted for monies withheld and shall receive any interest thereof.

Copies of the plans and specifications, including the approved proposal form, are available on the City website, [www.sfcity.org](http://www.sfcity.org), for downloading at no charge. **In order to be eligible to submit a bid for the project, you MUST contact Manuel Fabian, Civil Engineering Assistant II, via e-mail at [mfabian@sfcity.org](mailto:mfabian@sfcity.org) to be placed on the plan holders list.** Compact disk (CD) of the plans and specifications may be obtained for a non-refundable fee of **\$5.00** each at the Public Works Department, City Hall, 117 Macneil Street, San Fernando, California, 91340. If mailing is requested, an additional fee of **\$5.00** is required to cover postage and handling.

**The Contractor must attend a mandatory pre-bid meeting and job walk on Monday, August 30, 2021 at 10:00 a.m.** The pre-bid meeting will be held at the site, San Fernando Recreation Park, 208 Park Avenue, San Fernando, CA 91340 near the intersection of Park Avenue and First Street.

Any questions pertaining to the project shall be submitted by Wednesday, September 1, 2021 by 5:00 p.m. Addenda, if any, will NOT be distributed to the planholders directly, and will ONLY be posted on the City website. **It shall be the Bidder's responsibility to check the City website for any addenda.** Addenda is expected to be posted by Tuesday, September 7, 2021.

The anticipated timeline is as follows:

Element	Schedule
Post request for bid	August 19, 2021
Mandatory pre-bid meeting/job walk	August 30, 2021 at 10:00 a.m.
Questions due to City	September 1, 2021 by 5:00 p.m.
City issue response to questions (addenda)	September 7, 2021
Proposal due	September 20, 2021 by 2:30 p.m.
Anticipated council award	December 2021 (may be sooner, pending external agreement)

City of San Fernando

Date: August 19, 2021

By: Matthew Baumgardner  
Director of Public Works



## INSTRUCTIONS TO BIDDERS

1. GENERAL Proposals under these Contract Documents shall be submitted on the blank forms furnished herewith. When presented, the proposal forms must be completely made out in the manner and form indicated therein, and must be properly signed by the bidder. The bidder's address, telephone number, and California State Contractor's License number must be included. To be eligible to perform work, the bidder must be a state licensed contractor in good standing prior to beginning work. The City Council reserves the right to reject any bid if all the above information is not furnished.

***The contractor shall adopt the current state general prevailing rates of wages applicable to the work to be done.***

Each proposal submitted must be presented in a sealed cover, and must be filed prior to the time and at the place designated in the Notice Inviting Bids. All proposals submitted as prescribed will be publicly opened and read at the time and place designated in the Notice Inviting Bids.

Bid Quotes and Unit Price Extensions – The unit prices and the lump sum prices quoted by the bidder must be entered in the spaces provided on the Contractor's Proposal form. In case there is a discrepancy between the unit price and the item total, the unit price shall govern and will be considered as representing the Bidder's intention. The bid total will be corrected to conform to the specified unit price.

Bid Retention and Award – The City reserves the right to retain all bids for a period of ninety (90) days for examination and comparison. The City also reserves the right to waive non-substantial irregularities in any bid, to reject any and all proposals, to reject or delete one part of a proposal and accept the other, except to the extent that the bids are qualified by specific limitations, and to make award to the lowest responsible bidder as the interest of the City may require.

Communications Regarding Bid – All timely requests for information submitted in writing will receive a written response from the City. Telephone communications with City staff are not encouraged, but will be permitted. However, any such oral communication shall not be binding on the City.

2. EXAMINATION OF PLANS, CONTRACT DOCUMENTS, AND WORK SITE The Contract Documents and plans, if any, are on file and available for inspection in City Hall.

The Bidders are required to carefully examine the site and the proposal, plans, Contract Documents, and contract forms. The Bidders must satisfy themselves as to the requirements of the Contract Documents and the contract; as to the location of the proposed work and by such other means as they may prefer; and as to the actual conditions and requirements of the work, and shall not, at any time after submission of the bid, dispute, complain, or assert that there was any misunderstanding in regard to the nature or amount of work to be done. It is mutually agreed that submission of a proposal shall be considered prima facie evidence that the bidder has made such examinations.

3. DISQUALIFICATION OF BIDDERS AND PROPOSALS More than one proposal for the same work from any individual, firm, partnership, corporation or association under the same or different names will not be accepted and reasonable grounds for believing that any bidder is interested in more than one proposal for the work will be cause for rejecting all proposals in which such bidders are interested.

Proposals which show obviously unbalanced prices, and those which are incomplete or show any alteration of form, or contain any additions or conditional or alternate bids that are not called for or otherwise permitted, may be rejected. Proposals that do not bear the Bidder's signature will be rejected.

4. AWARD AND EXECUTION OF CONTRACT The award of the contract, if awarded, will be made to the lowest responsive bidder whose proposal complies with all the prescribed requirements. The right is reserved, however, to reject any or all bids and to waive technical errors or discrepancies if it is deemed to best serve the interests of the City. An award will be made only until all necessary investigations are made as to the responsiveness of the low bidder.

Failure to execute a contract and file acceptable bonds as provided herein within the above timeline, not including Sundays, shall be just cause for the annulment of the award and the forfeiture of the proposal guaranty.

The Contractor will be required to obtain a City Business License prior to award of the contract.

5. SIGNATURE OF CONTRACTOR

- a. Corporation Any bids submitted by a corporation must include the name of the corporation, and must be signed by the President and Secretary or Assistant Secretary, and the corporate seal must be affixed. Other persons may sign for the corporation in lieu of the above if a certified copy of a resolution of the corporate board of directors so authorizing them to do so is on file in the City Clerk's Office.
- b. Partnerships Any bids submitted by a partnership must contain the names of all persons comprising the partnership or co-partnership. The bid must be signed by all partners comprising the partnership unless proof in the form of a certified copy of a certificate of partnership acknowledging the signer to be a general partner is presented to the City Clerk.
- c. Joint Ventures Any bids submitted by a joint venture must so state that and must be signed by each joint venturer.
- d. Individuals Any bids submitted by an individual must be signed by that individual unless an up-to-date power of attorney is on file in the City Clerk's Office, in which case the person indicated in the power of attorney may sign for the individual.

The above rules also apply in the case of a fictitious firm name. In addition, however, where the fictitious name is used, it must be so indicated where the signature appears.

6. BONDS

- a. Bid Bonds Bid must be accompanied by cash, cashier's check, certified check, or

surety bond in an amount equal to ten percent (10%) of the total amount in the Contractor's Proposal. Checks and bonds shall be made payable to the City of San Fernando.

- b. Contract Bonds The Contractor simultaneously with execution of the Agreement shall furnish a surety bond in an amount equal to one hundred percent (100%) of the contract price as security for the faithful performance of this contract and a separate surety bond in an equal to one hundred percent (100%) of the contract price as security for the payment of all persons performing labor and furnishing materials in connection with this contract, as required by the terms of an Act entitled:

"An Act to secure the payment of the claim of persons employed by Contractors upon Public Works, and the claims of persons who furnish materials, supplies, teams, implements; or machinery used or consumed by such Contractors in the performance of such works, and prescribing the duties of certain public officers with respect thereto," approved May 10, 1919, as amended.

Bond Forms required are included in these specifications. Copies will be furnished to prospective bidders upon request.

Whenever any Surety or Sureties on any such bonds, or any bonds required by Law for the protection of the claims of laborers and material men become insufficient or the City Engineer has cause to believe that such Surety or Sureties have become insufficient, a demand in writing may be made of the Contractor for each further bond or bonds or additional surety, not exceeding that originally required, as is considered necessary, considering the extent of the work remaining to be done. Thereafter, no payment shall be made upon such contract to the Contractor or any assignee of the Contractor until such further bond or bonds or additional surety has been furnished.

7. RETURN OF BIDDER'S GUARANTIES Within ten (10) days after the award of the contract, the City will return the proposal guaranties accompanying those proposals which are not to be considered in making award. All other proposals which are to be held until the contract has been finally executed, will be returned to the respective bidders after award of contract.
8. CONFLICT OF INTEREST In the procurement of supplies, equipment, construction, and services by sub-recipients, the conflict of interest provisions in 24 CFR 85.36, OMB Circular A-110, and 24 CFR 570.611, respectively, shall apply. No employee, officer or agent of the sub-recipient shall participate in selection, award, or administration of a contract supported by Federal funds if a conflict of interest, real or apparent, would be involved.

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***The following documents in the PROPOSAL section of these Contract Documents must be completed and submitted with the bid package:***

- P-1-3 Contractor's Proposal
  - P-4 Bidder's Bond
  - P-5 Contractor Information
  - P-6 List of References
  - P-7 List of Subcontractors
  - P-8 List of Subcontractors, Suppliers, & Vendors Contacted to Receive Prices in Preparation of Bid Proposal
  - P-9 Non-Collusion Affidavit
-

## CONTRACTOR'S PROPOSAL

CITY OF SAN FERNANDO  
117 MACNEIL STREET  
SAN FERNANDO, CALIFORNIA 91340

HONORABLE MAYOR AND  
MEMBERS OF THE CITY COUNCIL:

The undersigned declares that this proposal was prepared by carefully examining the location of the proposed work, the Plans, the Specifications, and the Contract Documents entitled:

### **SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT PROJECT NO. 7601, PLAN NO. P-732**

The undersigned hereby proposes to furnish all labor, materials, equipment, tools, transportation, and services to perform all work required and to complete said work within **three hundred (300)** working days after the commencement date stated in the Notice to Proceed. All work shall be performed in accordance with the Plans, Specifications, and Contract Documents, including the Special Provisions and Technical Specifications, for the prices set forth in the bid schedule.

\_\_\_\_\_  
Dated

\_\_\_\_\_  
Bidder

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name (Print/Type)

\_\_\_\_\_  
Title

**BID SCHEDULE**  
**SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT**  
**PROJECT NO. 7601, PLAN NO. P-732**

ITEM NO.	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	ITEM TOTAL
<b>Miscellaneous</b>					
1	Mobilization (5% Max)	LS	1	\$	\$
2	Traffic Control	LS	1	\$	\$
3	SWPPP Implementation	LS	1	\$	\$
4	Class "A" Field Office	LS	1	\$	\$
<b>Construction</b>					
5	Tree Removal (24" Diameter)	EA	1	\$	\$
6	Remove Manhole (30" Pipe)	EA	1	\$	\$
7	Diversion Structure (78" RCP)	EA	1	\$	\$
8	Diversion Structure (87" RCP)	EA	1	\$	\$
9	Diversion Structure (30" RCP)	EA	1	\$	\$
10	18" RCP Diversion Line	LF	4,420	\$	\$
11	36" RCP Diversion Line	LF	100	\$	\$
12	BI-7001 Pretreatment System	EA	1	\$	\$
13	BI-0256 Pretreatment System	EA	1	\$	\$
14	Flow Meter and Vault	EA	2	\$	\$
15	Gate Valve and Vault (Glenoaks Blvd)	EA	1	\$	\$
16	Gate Valve and Vault (First St)	EA	1	\$	\$
17	Electrical (Float Switches, Panels, Vaults, etc.)	LS	1	\$	\$
18	Subsurface Infiltration System	GAL	3,020,440	\$	\$
19	3' Manhole Access Shaft for Infiltration System	EA	5	\$	\$
20	Remove and Reinstall Chain Link Fence	LF	25	\$	\$
21	Remove and Reinstall Existing Electrical Lines	LF	440	\$	\$
22	Remove and Replace Sewer Line	LF	85	\$	\$
<b>Irrigation and Landscaping Improvements</b>					
23	Irrigation	LS	1	\$	\$
24	Landscaping and Field Restoration	LS	1	\$	\$
25	90 Day Plant Establishment	LS	1	\$	\$
26	Interpretive Sign	EA	1	\$	\$
27	Concrete Sidewalk Restoration	SF	850	\$	\$
<b>Street Improvement and Striping</b>					
28	Street Demolition	LS	1	\$	\$
29	Aggregate Base	CY	1,820	\$	\$
30	AC Pavement	TON	4,160	\$	\$
31	Remove and Replace Curb Ramp	EA	4	\$	\$
32	Detectable Warning Surface	SF	122	\$	\$
33	Striping, Pavement Markers, and Pavement Markings	LS	1	\$	\$
<b>BID TOTAL</b>					<b>\$</b>

In case of discrepancy between unit prices and item totals, the unit prices shall prevail. In case of a discrepancy between item totals and grand total, the item totals shall prevail. The grand total will be subject to adjustment by the City in the event of a discrepancy. The contract award shall be made on the basis of the grand total as described above from among the responsive and responsible bidders.

The City does not expressly or by implication agree that the actual amount of work will correspond with the foregoing quantities, but reserves the right to increase or decrease the amount of any class or portion of the work or to omit portions of the work as may be deemed necessary or advisable by the Engineer.

The bidder further agrees that in case of not executing the required contract with necessary bonds within ten (10) days, not including Sundays, after having received notice that the contract is ready for signature, the proceeds of the check or bond accompanying his bid shall become the property of the City of San Fernando.

By submission of the Contractor's Proposal, the bidder also certifies that the bid is a balanced bid.

The bidder acknowledges receipt of the following addendum issued for the above project. If no addendum has been received, write "None". FAILURE TO ACKNOWLEDGE RECEIPT OF ANY ADDENDA ISSUED WILL RENDER THE CONTRACTOR'S BID NON-RESPONSIVE.

List of Addendum Received: \_\_\_\_\_

## BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS:

that we, \_\_\_\_\_ as Principal,  
and \_\_\_\_\_ as Surety,  
are held and firmly bound unto the City of San Fernando in the sum of \_\_\_\_\_  
(\$ \_\_\_\_\_)  
to be paid to the said City of its certain Attorney, its successors and assigns; for the payment of  
which sum well and truly made, we bind ourselves, our heirs, executors and administrators,  
successors or assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the certain proposal of the  
above bounden \_\_\_\_\_  
to construct \_\_\_\_\_  
(insert names of streets and limits to be improved) dated \_\_\_\_\_ is accepted  
by the City of San Fernando, and if the above bounden his heirs, executors, administrators,  
successors and assigns, shall duly enter into and execute a contract for such construction, and  
shall execute and deliver the two bonds described within ten (10) days (not including Sunday)  
from the date of the mailing of a notice to the above bounden \_\_\_\_\_  
by and from the said City of San Fernando that said contract is ready for execution, then this  
obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, we hereunto set our hands and seals this \_\_\_\_\_ day of  
\_\_\_\_\_, 2021.

Principal

Surety

By \_\_\_\_\_

By \_\_\_\_\_

Its \_\_\_\_\_

Its \_\_\_\_\_

By \_\_\_\_\_

By \_\_\_\_\_

Its \_\_\_\_\_

Its \_\_\_\_\_

Surety signatures on this bond must be acknowledged before Notary Publics, and a sufficiently  
power of attorney must be attached to the bond to verify the authority of any party signing on  
behalf of a surety.

All notices and demands to the surety shall be delivered via first class mail to the following:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**CONTRACTOR INFORMATION**

Company Name \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_ E-mail \_\_\_\_\_

Type of Firm: Individual ( ) Partnership ( ) Corporation ( )

Corporation organized under the laws of the State of \_\_\_\_\_

Contractor's License Number \_\_\_\_\_ State \_\_\_\_ Classification \_\_\_\_\_ Expiration Date \_\_\_\_\_

DIR Registration Number \_\_\_\_\_ Expiration Date \_\_\_\_\_

Names and titles of all officers of the firm

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## LIST OF REFERENCES

(To be submitted by contractors who have not worked with the City of San Fernando.)

1. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_
2. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_
3. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_
4. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_
5. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_
6. NAME OF CITY OR BUSINESS \_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
TYPE/DATE OF WORK PERFORMED \_\_\_\_\_  
TOTAL CONTRACT AMOUNT \$ \_\_\_\_\_

## LIST OF SUBCONTRACTORS

The bidder is required to fill in the following blanks in accordance with the provisions of Section 4100 to 4108, inclusive, of the Government Code of the State of California.

Name under which subcontractor is licensed: \_\_\_\_\_

Address of office, mill or shop: \_\_\_\_\_

Specific description of subcontract: \_\_\_\_\_

License No.: \_\_\_\_\_ Amount of Subcontract: \_\_\_\_\_

DIR Registration Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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Name under which subcontractor is licensed: \_\_\_\_\_

Address of office, mill or shop: \_\_\_\_\_

Specific description of subcontract: \_\_\_\_\_

License No.: \_\_\_\_\_ Amount of Subcontract: \_\_\_\_\_

DIR Registration Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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Name under which subcontractor is licensed: \_\_\_\_\_

Address of office, mill or shop: \_\_\_\_\_

Specific description of subcontract: \_\_\_\_\_

License No.: \_\_\_\_\_ Amount of Subcontract: \_\_\_\_\_

DIR Registration Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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Name under which subcontractor is licensed: \_\_\_\_\_

Address of office, mill or shop: \_\_\_\_\_

Specific description of subcontract: \_\_\_\_\_

License No.: \_\_\_\_\_ Amount of Subcontract: \_\_\_\_\_

DIR Registration Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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**LIST OF SUBCONTRACTORS, SUPPLIERS, & VENDORS CONTACTED TO  
RECEIVE PRICES IN PREPARATION OF BID PROPOSAL**

1. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_
2. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_
3. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_
4. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_
5. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_
6. NAME & LOCATION OF BUSINESS \_\_\_\_\_  
\_\_\_\_\_  
CONTACT PERSON AND PHONE NO. \_\_\_\_\_  
ITEM OR TYPE OF WORK PROPOSED \_\_\_\_\_  
PRICE OR AMOUNT \$ \_\_\_\_\_

## NON-COLLUSION AFFIDAVIT

### SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT PROJECT NO. 7601, PLAN NO. P-732

STATE OF CALIFORNIA )  
 ) SS  
COUNTY OF \_\_\_\_\_)

\_\_\_\_\_, being first duly sworn, deposes and  
says that he is \_\_\_\_\_  
(Sole owner, partner, president, secretary, etc.)

of \_\_\_\_\_  
the party making the foregoing bid; that such bid is not made in the interest of or on behalf of any undisclosed person, partnership, company, association, organization or corporation; that such bid is genuine and not collusive or sham; that such bidder has not directly or indirectly colluded, conspired, connived or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that said bidder has not in any manner, directly or indirectly, sought by agreement, communication or conference with anyone to fix the bid price of said bidder or of any other bidder, or to fix any overhead, profit or cost element of such bid price, or of that of any other bidder, or to secure an advantage against the public body awarding the contract or anyone interested in the proposed contract; that all statements contained in such bid price or of that of any other bidder, or to secure an advantage against the public body awarding the contract or anyone interested in the proposed contract; that all statements contained in such bid are true; and, further, that said bidder has not, directly or indirectly, submitted his bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid and will not pay any fee in connection therewith to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, or to any other individual except to such person or persons as have a partnership or other financial interest with said bidder in his general business.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Bidder

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

STATE OF CALIFORNIA )  
 ) SS  
COUNTY OF \_\_\_\_\_)

\_\_\_\_\_  
Name (Print/Type)

\_\_\_\_\_  
Title

On \_\_\_\_\_, 2021 before me, \_\_\_\_\_,

personally appeared \_\_\_\_\_ who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledge to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument, the person(s) or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

(Notary Seal)

\_\_\_\_\_  
Signature of Notary Public



## SAMPLE CONSTRUCTION CONTRACT/AGREEMENT

### [CONTRACTOR'S NAME]

SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT  
Plans (Plan No. P-732) and Specifications (Project No. 7601)

THIS AGREEMENT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 2021, by and between CITY OF SAN FERNANDO, a municipal corporation of the State of California, hereinafter referred to as "CITY" and \_\_\_\_\_ "CONTRACTOR."

### WITNESSETH:

That the CITY and the CONTRACTOR, for the consideration hereinafter named, mutually agree as follows:

1. The complete contract consists of the Contract Documents which includes all of the following documents incorporated herein by this reference: Approved **San Fernando Regional Park Infiltration Project, Plans (Plan No. P-731) and Specifications (Project No. 7601)**, Notice Inviting Bids, Instructions to Bidders, Contractor's Proposal, Contract/Agreement, Special Provisions, Technical Provisions, and all modifications and amendments thereto.

2. CONTRACTOR shall perform everything required to be performed, shall provide and furnish all the labor, materials, necessary tools, expendable equipment, and all utility and transportation services required for the following work of improvement: **San Fernando Regional Park Infiltration Project, Plans (Plan No. P-731) and Specifications (Project No. 7601)** (the "Work of Improvement") all in accordance with the Contract Documents and Contractor's Proposal dated \_\_\_\_\_.

CONTRACTOR agrees to perform all the work and furnish all the materials at his own cost and expense necessary to construct and complete in a good and workman-like manner and to the satisfaction of the City Engineer of the CITY, the Work of Improvement in accordance with the plans, specifications, and Contract Documents (the "Specifications") therefore prepared by City's Engineering Department and adopted by the City Council.

3. CITY agrees to pay and CONTRACTOR agrees to accept in full payment for this Work of Improvement the stipulated sum of \_\_\_\_\_ (\$\_\_\_\_\_).

CITY agrees to make monthly payments and final payment in accordance with the method set forth in the Specifications.

4. CONTRACTOR agrees to commence construction of the Work of Improvement within thirty (30) days after issuance of a Notice To Proceed, and to continue in a diligent and

**CONSTRUCTION CONTRACT/AGREEMENT**

**San Fernando Regional Park Infiltration Project**

**Plans (Plan No. P-732) and Specifications (Project No. 7601)**

Page 2 of 4

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workman-like manner without interruption, and to complete the construction thereof within **three hundred (300)** working days from the date the Notice to Proceed is issued.

5. Time is of essence of this Contract, and it is agreed that it would be impracticable or extremely difficult to ascertain the extent of actual loss or damage which the CITY will sustain by reason of any delay in the performance of this Agreement. It is, therefore, agreed that CONTRACTOR will pay as liquidated damages to the CITY the following sum: Five Hundred Dollars (\$500.00) for each day's delay beyond the time herein prescribed for finishing work. If liquidated damages are not paid, as designated by the CITY, the CITY may deduct the amount thereof from any money due or that may become due the CONTRACTOR under this Agreement in addition to any other remedy available to CITY. The CONTRACTOR shall not be assessed liquidated damages for any delay caused by the failure of a public utility to relocate or remove an existing utility required for the performance of this Contract.

6. The CONTRACTOR will pay, and will require all subcontractors to pay, all employees on the work of improvement a salary or wage at least equal to the prevailing salary or wage established for such work as set forth in the wage determinations for this work. Travel and subsistence pay shall be paid in accordance with Labor Code Section 1773.8. The CONTRACTOR shall forfeit to the CITY, as penalty, Fifty Dollars (\$50.00) for each calendar day or portion thereof for each worker paid (either by him or any subcontractors under him) less than the prevailing rate described above on the work provided for in this Agreement, all in accordance with Section 1775 of the Labor Code of the State of California. CONTRACTOR, by executing this Agreement, hereby certifies that it shall adopt the current general prevailing Federal and/or State rates of wages applicable to the Work of Improvement.

7. The CONTRACTOR or SUBCONTRACTOR shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract, or such other remedy as City deems appropriate.

8. Attention is directed to Section 7108.5 of the California Business and Professions Code, which requires a prime CONTRACTOR or SUBCONTRACTOR to pay any SUBCONTRACTOR not later than 10 days of receipt of each progress payment, unless otherwise agreed to in writing. Section 7108.5 of the California Business and Professions Code also contains enforcement actions and penalties. These requirements apply to both DBE and non-DBE subcontractors.

9. In the performance of this Contract, not more than eight (8) hours shall constitute a day's work, and the CONTRACTOR shall not require more than eight (8) hours in a day from any person employed by him hereunder, except as provided in the Labor Code of the State of California. The CONTRACTOR shall adhere to Article 3, Chapter 1, Part 7 (Sections 1810, et seq.) of the Labor Code of the State of California, and it is agreed that the CONTRACTOR shall forfeit to the CITY as a penalty the sum of Fifty Dollars (\$50.00) for each worker employed in the execution of this Contract by the CONTRACTOR or any subcontractor for each calendar day

**CONSTRUCTION CONTRACT/AGREEMENT**

**San Fernando Regional Park Infiltration Project**

**Plans (Plan No. P-732) and Specifications (Project No. 7601)**

Page 3 of 4

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during which any worker is required or permitted to labor more than eight (8) hours in violation of that article.

10. CONTRACTOR, by executing this Agreement hereby certifies:

"I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for Worker's Compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of this Contract."

11. CONTRACTOR shall, prior to the execution of this Contract, furnish two bonds approved by the CITY, one in the amount of One Hundred Percent (100%) of the Contract price, to guarantee the faithful performance of the work, and one in the amount of One Hundred Percent (100%) of the Contract price to guarantee payment of all claims for labor and materials furnished. This Contract shall not become effective until such bonds are supplied to and approved by the CITY. CONTRACTOR shall, prior to the release of the performance and payment bonds or the retention payment, furnish a warranty performance and payment bond equal to at least ten percent of the final contract price or \$1,000, whichever is greater.



IN WITNESS WHEREOF, the said CONTRACTOR and the CITY ADMINISTRATOR and CITY CLERK of the CITY have caused the names of said parties to be affixed hereto, each in triplicate, the day and year first above written.

\_\_\_\_\_  
CONTRACTOR

BY \_\_\_\_\_

\_\_\_\_\_  
Title

BY \_\_\_\_\_

\_\_\_\_\_  
Title

CITY OF SAN FERNANDO  
A Municipal Corporation

\_\_\_\_\_  
NICK KIMBALL  
CITY MANAGER

ATTEST:

\_\_\_\_\_  
JULIA FRITZ  
CITY CLERK

APPROVED AS TO FORM:

\_\_\_\_\_  
RICK R. OLIVAREZ  
CITY ATTORNEY  
OLIVAREZ MADRUGA, P.C.

## PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that we, \_\_\_\_\_  
as Principal, and \_\_\_\_\_ as Surety,  
are held and firmly bound unto the CITY OF SAN FERNANDO, hereinafter called the  
Owner, in the sum of \_\_\_\_\_ (\$\_\_\_\_\_)  
for the payment of which sum well and truly to be made, we bind ourselves, our heirs,  
executors, administrators and successors, jointly and severally, firmly by these  
presents.

The conditions of this obligation are such that whereas the Principal entered into a  
contract, attached hereto, with the Owner dated \_\_\_\_\_ for \_\_\_\_\_  
\_\_\_\_\_.

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the  
undertakings, covenants, terms, conditions and agreements of said contract during the  
original term thereof, and any extensions thereof that may be granted by the Owner  
with or without notice of the Surety, and during the life of any guaranty required under  
the contract, and shall also well and truly 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, then this obligation shall be  
void; otherwise this obligation shall remain in full force and virtue.

Further, the said Surety, for value received, hereby stipulates and agrees that no  
change, extension of time, alteration or modification of the contract documents or of  
the work to be performed thereunder shall in any way affect its obligations on this  
bond; and it hereby waives notice of any and all such changes, extensions of time; and  
alterations or modifications of the contract documents and/or of the work to be  
performed thereunder.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument  
under their several seals the \_\_\_\_\_ day of \_\_\_\_\_, 2021, the name and  
corporate seal of each corporate party being hereto affixed and these presents duly  
signed by each party's undersigned representative, pursuant to authority of its  
governing body.

(Principal)

ATTEST:

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

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

ATTEST:

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

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

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

(To be filled in by Surety)

Rate of premium on this bond is \$\_\_\_\_\_ per thousand.

Total amount of premium charge is \$\_\_\_\_\_.

Surety signatures on this bond must be acknowledged before Notary Publics, and a sufficiently power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety.

All notices and demands to the surety shall be delivered via first class mail to the following:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **PAYMENT (LABOR AND MATERIAL) BOND**

KNOW ALL MEN BY THESE PRESENTS: that we, \_\_\_\_\_  
as Principal, and \_\_\_\_\_ as Surety,  
are held and firmly bound unto the CITY OF SAN FERNANDO, hereinafter called the  
Owner, in the sum of \_\_\_\_\_ (\$\_\_\_\_\_)   
for the payment of which sum well and truly to be made, we bind ourselves, our heirs,  
executors, administrators and successors, jointly and severally, firmly by these  
presents.

The conditions of this obligation are such that whereas the Principal entered into a  
contract, attached hereto, with the Owner dated \_\_\_\_\_ for \_\_\_\_\_  
\_\_\_\_\_.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons  
supplying labor and material in the prosecution of the work provided for in said  
contract, and any and all duly authorized modifications of each contract that may  
hereafter be made, then this obligation shall be void, otherwise this obligation shall  
remain in full force and virtue.

The condition of this obligation is such that, if said Principal or his or its subcontractors,  
or the heirs, executors, administrators, successors or assigns thereof, shall fail to pay  
any of the persons named in Section 3181 of the Civil Code of the State of California for  
any materials, provisions, provender or other supplies used in, upon, for or about the  
performance of the work or labor performed by any such claimant or any amounts  
required to be deducted, withheld, and paid over to the Franchise Tax Board from the  
wages of employees of the contractor and his subcontractors pursuant to Section 18806  
of the Revenue and Taxation Code, with respect to such work and labor, then said  
Surety will pay for the same, in the amount not exceeding the sum set forth  
hereinabove and also, in case suit is brought upon the bond, will pay a reasonable  
attorney's fee to be fixed by the court. This bond shall insure to the benefit of any and  
all persons named in the aforesaid Civil Code Section 3131 so as to give a right of  
action to them or their assigns in any suit brought upon the bond.

Further, the said Surety, for value received, hereby stipulates and agrees that no  
change, extension of time, alteration or modification of the contract documents or of  
the work to be performed thereunder shall in any way affect its obligations on this  
bond; and it hereby waives notice of any and all such changes, extensions of time; and  
alterations or modifications of the contract documents and/or of the work to be  
performed thereunder.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals the \_\_\_\_ day of \_\_\_\_\_, 2021, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by each party's undersigned representative, pursuant to authority of its governing body.

\_\_\_\_\_  
(Principal)

ATTEST:

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

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

ATTEST:

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

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

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

(To be filled in by Surety)

Rate of premium on this bond is \$\_\_\_\_\_ per thousand.

Total amount of premium charge is \$\_\_\_\_\_.

Surety signatures on this bond must be acknowledged before Notary Publics, and a sufficiently power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety.

All notices and demands to the surety shall be delivered via first class mail to the following:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## WARRANTY PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that \_\_\_\_\_ as Principal, hereinafter called Contractor, and \_\_\_\_\_, licensed and domiciled in the state of California as Surety, hereinafter called Surety, are held and firmly bound unto CITY OF SAN FERNANDO as Obligee, hereinafter called Owner, in the amount of \_\_\_\_\_ (\$\_\_\_\_\_)

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, \_\_\_\_\_ as Contractor, has by written agreement dated \_\_\_\_\_, 2021, entered into a contract with Owner for in accordance with Drawings and Specifications contained in a written and executed contract, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

WHEREAS, said contract provides that the Principal shall furnish a bond which shall remain in force for a period of **one** year after the date of the notice of completion and which shall be conditioned to guarantee against all defects in workmanship and materials which shall become apparent during said period.

NOW THEREFORE, the condition of this obligation is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notices of any alteration or extension of time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

- (1) Complete the Contract in accordance with its terms and conditions, or;
- (2) Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price, but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

The transaction of insurance as evidenced by this bond is agreed by all parties to have taken place in the State of California in conformance with the laws therein, the Surety hereby accepts jurisdiction for adjudication of all claims in the state wherein the claims have occurred.

This bond is for the protection of the owner and gives no protection to any claimant other than those provided for by statute in the state wherein the claim occurs. The owner hereby agrees that no payments shall be made in excess or advance of any work specifically performed under the contract without the express written consent of the Surety.

For claims regarding non-payment for services provided or materials supplied under the contract, a claimant is defined herein as one having a direct contract with the Principal and/or subcontractor of the Principal. No suit or action shall be commenced hereunder by any claimant unless claimant shall:

1. Notify the Surety of the direct contract with the Principal or Subcontractor of the Principal within 30 days of entering into such contract and;

2. Notify the Surety of any demands for payment under such direct contracts concurrently with the Principal and/or Subcontractor of the Principal and;
3. Notify the Surety by certified mail within 15 days of any payment not made when due, or within 30 days of demand.

As the purpose of this bond is to warrant work previously performed by the Principal in the contract specified herein, the Owner shall notify Surety immediately by certified mail upon demand for work to be performed under this bond.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals the \_\_\_\_\_ day of \_\_\_\_\_, 2021, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by each party's undersigned representative, pursuant to authority of its governing body.

\_\_\_\_\_  
(Principal)

ATTEST:

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

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

ATTEST:

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

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

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

(To be filled in by Surety)

Rate of premium on this bond is \$ \_\_\_\_\_ per thousand.

Total amount of premium charge is \$ \_\_\_\_\_.

Surety signatures on this bond must be acknowledged before Notary Publics, and a sufficiently power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety.

All notices and demands to the surety shall be delivered via first class mail to the following:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **SPECIAL PROVISIONS**



## PART 1 – GENERAL PROVISIONS

### SECTION 1 – GENERAL, TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

#### 1-2 TERMS AND DEFINITIONS.

Add or redefine the following:

**Agency** – The City of San Fernando, herein referred to as CITY or Agency.

**Board** – The City Council of the City of San Fernando, herein referred to as City Council.

**Engineer** – The Public Works Director and/or City Engineer of the City of San Fernando, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

**City** – The City of San Fernando, herein referred to as CITY or Agency.

**Claim** - A separate demand by the Contractor for (A) a time extension, (B) payment of money or damages arising from work done by or on behalf of the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for or the claimant is not otherwise entitled to, or (C) an amount the payment of which is disputed by the Agency.

**Department** – The City of San Fernando Department of Public Works.

**Engineer (or) City Engineer** – The City Engineer of the City of San Fernando or other person designated by the City Engineer acting either directly or through authorized agents.

**Owner** – City of San Fernando.

**Project** – See Work.

**Quality Assurance** – Those standards, systems, processes, procedures, and activities exercised by the Agency and the Engineer to ensure that the Work is constructed by the Contractor in accordance with the Contract Documents.

**Quality Control** – Those standards, systems, processes, procedures, and activities exercised by the Contractor to ensure that the Work is constructed in accordance with the Contract Documents.

**Work** – That which is proposed to be constructed or done under the Contract and/or permit for the San Fernando Regional Park Infiltration Project, including the furnishing of all labor, materials, equipment, and services.

#### 1-3 ABBREVIATIONS.

##### 1-3.2 Common Usage.

Add the following abbreviations:

AC	Asphalt Concrete (pavement)
BC	Beginning of Curve
BCR	Beginning of Curb Return
BM	Benchmark

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

CB	Catch Basin
CF	Curb Face
cfs	Cubic feet per second
Conc.	Concrete
CY	Cubic Yard
DI	Ductile Iron
EA	Each
EC	End of Curve
ECR	End of Curb Return
Elev	Elevation
Ex. or Exist	Existing
GB	Grade Break
gpm	Gallons per minute
hP	Horsepower
I.D.	Inner Diameter
INV	Invert elevation
LF	Linear Foot
MH	Manhole
O.D.	Outer Diameter
OC	On Center
PP	Power Pole
Prop.	Proposed
R/W	Right-of-Way
SD	Storm Drain
SF	Square Feet
SS	Sanitary Sewer
Sta	Station
Std.	Standard
T	Tangent Distance
TC	Top of Curb
TDH	Total Dynamic Head

### **1-7 AWARD AND EXECUTION OF THE CONTRACT.**

#### **1-7.1 General.**

Add the following:

By mutual consent in writing of the parties signatory to the Contract, alterations or deviations; increase or decreases; and/or additions or omissions; in the Plans and Specifications may be made and the same shall in no way affect or make void the Contract.

#### **1-7.2 Contract Bonds.**

Add the following:

The performance bond shall remain in effect at least until the date of substantial completion/notice of completion, except as otherwise provided. The Contractor warrants and guarantees to the Agency that all Work will not be defective. The Contractor shall furnish a warranty performance and payment bond equal to at least one hundred percent of the final contract price or \$1,000, whichever is greater, before the Contract performance and payment bonds can be released or the retention payment paid. The warranty performance and payment bond shall be in effect until at least one year after the date of the notice of completion, except that utility work shall require it to be in effect for three years.

## SECTION 2 – SCOPE OF THE WORK

### 2-2 PERMITS.

Add the following:

The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of the Work. Full compensation for complying with the permit requirements indicated in 2-2 shall be considered as included in the Contract Unit lump sum Bid price for “Mobilization”.

Pursuant to State Bill 854, the following requirements apply to all public works projects (the latest codes referenced below shall be used):

A Contractor or Subcontractor shall not be qualified to bid on, be listed in a bid proposal, subject to the requirements of Section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, as defined in this chapter, unless currently registered and qualified to perform public work pursuant to Section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions Code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded. The website for contractor registration with the Department of Industrial Relations (DIR) is <https://www.dir.ca.gov/Public-Works/Contractor-Registration.html>, the annual non-refundable fee, valid July 1 through June 30 (state fiscal year), is \$400.

Contractors who are awarded a public works project must submit electronic payroll records to the DIR's Compliance Monitoring Unit (CMU) in addition to providing wet-ink original copies to the Agency or its designated labor compliance enforcement officer.

Add the following subsection:

#### 2-2.1 Los Angeles County Department of Public Works Permit.

A permit is required from the Los Angeles County Department of Public Works (“LACPW”) and must be secured by the contractor, instead of the Agency. The Contractor shall prepare documentation, if necessary, and obtain required bonds and insurance. The Contractor shall inform the Agency of required inspection fees, for which the Agency will issue payment directly to LACPW. The approved plans and permit may be obtained from: Los Angeles County Department of Public Works, 900 South Fremont Avenue, 3<sup>rd</sup> Floor, Alhambra, California 91803, (626) 458-4936. Plan checks have been completed and the following permit/plan check numbers apply to the Project:

- FCDP2019000195: includes the 78-inch and 87-inch diversion structures on Glenoaks Boulevard and First Street, respectively
- EIMP2019000117: includes the 30-inch diversion structure on the storm drain aligned with Parkside Drive

Full compensation for complying with the above requirements shall be considered as included in the Contract Unit lump sum price for “Diversion Structure (78” RCP)”, “Diversion Structure (87” RCP)”, and “Diversion Structure (30” RCP)”, as these are the items requiring a permit.

Unless otherwise authorized by the LACPW Permit and approved plan, all storm drain work shall be performed in accordance with the Plans and Specifications.

## 2-8 EXTRA WORK.

Add the following:

The Contractor shall proceed with Extra Work only upon written order from the Engineer. For such Extra Work the Contractor shall receive payment as agreed upon in writing or shall be paid on force account. The Contractor shall not exceed any of the quantities in the proposal unless prior authorization from the Engineer is obtained in writing.

## 2-10 DISPUTED WORK.

Add the following:

- A. In accordance with Public Contract Code Section 20104, and for the purposes of Paragraphs B only, the term "Defined Claim" shall mean a separate demand by the Contractor to the Owner of a value of \$375,000 or less, for any of the following: (a) a time extension, (b) payment of money or damages arising from Work done by the Contractor pursuant to the Contract Documents and payment of which is not otherwise expressly provided for or the Contractor is not otherwise entitled to, or (c) an amount of payment which is disputed by the Owner.
- B. RESOLUTION OF DEFINED CLAIMS: Pursuant to Sections 20104 et seq., of the Public Contracts Code, the provisions of this Paragraph B shall apply to all "Defined Claims," as such term is defined in Paragraph A (i.e., claims that are in the amount of \$375,000 or less).

### Filing and Response to Defined Claim

The Defined Claim shall be in writing, include the documents necessary to substantiate the Defined Claim, and be filed with the Owner (Agency) on or before the date of the final payment for the Work.

If the Defined Claim is less than \$50,000, the new Owner (Agency) shall respond in writing to the Defined Claim within 45 days of its receipt; or the Owner (Agency) may request in writing within 30 days of receipt of the Defined Claim any additional documentation supporting the Defined Claim or relating to defenses or claims the Owner (Agency) may have against the Contractor, and in such event the Owner's (Agency's) response shall be submitted to the Contractor within the later of 15 days after the receipt of the further documentation, or the time taken by the Contractor in producing the additional information.

If the Defined Claim is over \$50,000, the Owner (Agency) shall respond in writing to the Defined Claim within 60 days of its receipt, or the Owner (Agency) may request in writing within 30 days of receipt of the Defined Claim any additional documentation supporting the Defined Claim or relating to defenses or claims the Owner (Agency) may have against the Contractor, and in such event the Owner's (Agency's) response shall be submitted to the Contractor within the later of 30 days after the receipt of the further documentation, or the time taken by the Contractor in producing the additional information or requested documentation.

### Meet and Confer Regarding Defined Claim

If the Contractor disputes the Owner's (Agency's) written response, or if the Owner (Agency) fails to respond within the prescribed time, to the Defined Claim, the Contractor may notify the Owner (Agency) in writing within 15 days, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of the demand, the Owner (Agency) shall schedule a meet and confer conference within 30 days. If the claim or any portion thereof remains in dispute following the meet and confer conference, the Contractor may file a claim pursuant to Government Code Section 900, et seq. For purposes of this Paragraph B, the running of the period of time within which a claim must be filed shall be tolled from the time the Contractor submits the Defined Claim until the time such Defined Claim is denied, including any period of time utilized by the meet and confer conference.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### Procedures for Civil Actions Filed to Resolve Defined Claims

The following procedures shall apply to any civil action filed pursuant to this Paragraph B:

Non-Binding Mediation: Within 60 days, but no earlier than 30 days, following the filing of responsive pleadings, the court shall submit the matter to non-binding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within 15 days by both parties of a disinterested third person as mediator, and shall be commenced within 30 days of the submittal and shall be concluded within 15 days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court.

Judicial Arbitration: If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Section 1141.10, et seq., of the Code of Civil Procedure, notwithstanding Code of Civil Procedure Section 1141.11. The civil discovery procedures of Code of Civil Procedure Section 2016, et seq., shall apply, consistent with the rules pertaining to judicial arbitration. In addition to the provisions of Code of Civil Procedure Section 1141.10, et seq., (a) arbitrators shall, upon stipulation of the parties, be experienced in construction law, and (b) any party appealing an arbitration award who does not obtain a more favorable judgment shall, in addition to payment of costs and fees, also pay the attorney's fees on appeal of the other party.

Interest on Award of Judgment: In any suit filed pursuant to Paragraph (G)3.2, the Owner (Agency) shall pay interest at the legal rate on any arbitration award or judgment, which interest shall begin to accrue on the date the suit is filed in a court of law.

- C. RESOLUTION OF CLAIMS OTHER THAN DEFINED CLAIMS: The provisions of this Paragraph C shall apply to all claims that are not "Defined Claims," as such term is defined in Paragraph A (i.e., claims that are in excess of \$375,000.00).

### Written Claim

If the Contractor is not satisfied with any action by the City Council to resolve the protest of any claim other than a Defined Claim, it shall file with the City Council, within fifteen (15) days after such determination, a written claim which shall comply with the requirements for a claim under Division 3.6 of Title 1 (commencing with Section 810) of the California Government Code. The City Council shall take action with respect to any such claim as provided in Division 3.6 of Title 1 of the Government Code. Denial of such claim by the City Council shall be a prerequisite to the institution of any legal proceeding challenging the action of the City Council. If the Contractor fails to file a claim within the time specified herein, it shall be deemed satisfied with the action of the City Council with respect to its protests, and such failure to file a claim shall be deemed to be a waiver of all claims and demands arising out of or relating to this Contract.

### Limitation Period

Demand for Arbitration of any claim other than a Defined Claim shall be served upon the Owner (Agency) within the time limits set forth in Division 3.6 of the California Government Code for commencement of legal proceedings against a local public agency.

### Arbitration

Except as provided to the contrary herein, arbitration of any claim other than a Defined Claim may be initiated by the Contractor and shall be conducted in accordance with the provisions of California Code of Civil Procedure Sections 1280, et seq. The parties hereto agree that there shall be a single neutral Arbitrator who shall be selected in the following manner: (1) The Demand for Arbitration shall include a list of five names of persons acceptable to the Contractor to be appointed as Arbitrator. The Owner (Agency) shall determine if any of the names submitted by Contractor are acceptable and, if so, such person will be designated as Arbitrator; (2) In the event that none of the names submitted by Contractor are acceptable to Owner (Agency) or if for any reasons the Arbitrator selected in Step (1) is unable to serve, the Owner shall submit to Contractor a list of the

five names of persons acceptable to Owner (Agency) for appointment as Arbitrator to Contractor who shall in turn have 10 days in which to determine if one such person is acceptable; (3) If after Steps (1) and (2) the parties are unable to mutually agree upon a neutral Arbitrator, the matter of selection of an Arbitrator shall be submitted to the Los Angeles County Superior Court pursuant to Code of Civil Procedure Section 1281.6.

## **SECTION 3 – CONTROL OF THE WORK**

### **3-2 SELF PERFORMANCE.**

Replace the second sentence with the following:

The following work will be considered “Specialty Items”:

- a) Precast concrete subsurface infiltration system
- b) Precast concrete stormwater treatment devices (pretreatment units)

### **3-4 AUTHORITY OF THE BOARD AND THE ENGINEER.**

Add the following:

The Engineer shall retain all written protests filed, and, upon completion of the work, shall submit all such protests to the City Council, together with a copy of the Engineer’s prior written decisions for consideration by the City Council at the time of final acceptance of the Work. The Contractor or its representative may appear and be heard by the City Council concerning any such protests. In connection with acceptance of the Work and final payment under the Contract, the City Council shall make its determination with respect to each protest filed with the Engineer. The decision of the City Council shall be final.

### **3-5 INSPECTION.**

Add the following:

Inspection work requested by the Contractor outside of the prescribed Working hours shall be paid by the Contractor at the Agency’s overtime rate.

The Engineer will make, or have made, such inspections and tests as he/she deems necessary to see that the Work is in conformance with the Contract Documents. In the event such inspections or tests reveal noncompliance with the Contract Documents, the Contractor shall bear the cost of such corrective measures as deemed necessary by the Engineer, as well as the cost of subsequent re-inspection and re-testing.

Work done in the absence of inspection by the Engineer may be required to be removed and replaced under the inspection of the Engineer, and the entire cost of removal and replacement shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered without the approval of the Engineer shall, if so directed by the Engineer, be uncovered to the extent required by the Engineer, and the Contractor shall similarly bear the entire cost of performing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, including all costs for additional inspection.

### **3-7 CONTRACT DOCUMENTS.**

#### **3-7.1 General.**

Add the following:

All authorized alterations affecting the requirements and information given on the approved Plans shall be in writing. No changes shall be made of any Plan or Drawing after the same has been approved by the Engineer, except by written direction of the Engineer. Should it appear that the Work to be done, or any matter relative thereto is not sufficiently detailed or explained in these Specifications, Special Provisions, Technical Provisions, or Plans, the Contractor shall apply to the Engineer for such further explanations as may be necessary and shall conform to such explanation or interpretation as part of the original Specifications. In the event of doubt or questions relative to the true meaning of the Specifications, reference shall be made to the City Council, whose decision thereon shall be final.

#### Record Drawings:

All corrections on record drawings shall be done in red ink. Record drawings shall be a control set of the construction plans kept on the site for daily recording of "as built" conditions. The Contractor shall show dimensioned location of all buried facilities, such as drains, sumps, pipe, valves, electrical conduit, and irrigation wire on the record drawings. Dimensions must be taken from above ground permanent, architectural objects, not plants or irrigation heads. All dimensions, notes, etc., shall be legible.

Record drawing shall be reviewed prior to all progress payment requests, and submitted prior to final inspection.

#### **3-7.2 Precedence of Contract Documents.**

Replace the entire subsection with the following:

If there is a conflict between any of the Contract Documents, the document highest in the order of precedence shall control. The order of precedence, from highest to lowest, shall be as follows:

- a) Permits issued by jurisdictional regulatory agencies.
- b) Change Orders and Supplemental Agreements; whichever occurs last.
- c) Contract/Agreement.
- d) Addenda.
- e) Bid/Proposal.
- f) Special/General Provisions and Technical Specifications.
- g) Plans.
- h) City Standard Plans.
- i) Other Standard Plans.
- j) Instructions to Bidders.
- k) Notice Inviting Bids.
- l) Standard Specifications for Public Works Construction.
- m) Reference Specifications.

Detail drawings shall take precedence over general drawings.

The Standard Specifications, Standard Plans, and Manual of Traffic Controls, latest edition of each, of the State of California, Department of Transportation, and the Los Angeles County Department of Public Works Standard Plans, the City of San Fernando Standard Plans, and the American Water Works Association (AWWA) are incorporated herein by reference and are hereby accepted as Reference Specifications. These Reference Specifications are intended to govern certain construction materials, methods, and details except as modified herein or are inconsistent with the provisions herein. In case of conflict between the

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Reference Specifications and the Technical Provisions, the Technical Provisions shall govern. In case of a conflict between drawings and Technical Provisions, Technical Provisions shall prevail.

### 3-8 SUBMITTALS.

#### 3-8.1 General.

Replace the second paragraph with the following:

The Contractor shall allow a minimum of 20 Working Days for each review, unless otherwise approved by the Engineer. Review periods are not cumulative. The aforementioned time frames begin anew upon each submission whether the initial submission or a resubmission after a prior review by the Agency. Each set of submittals shall be accompanied by a letter of transmittal describing exactly what is being transmitted. The Contractor shall consecutively number, thoroughly check, approve, and sign each submittal.

#### 3-8.2 Working Drawings.

Add the following to Table 3-8.2:

Item	Subsection No.	Title	Subject
15	SWT1-3	Stormwater Treatment	Stormwater treatment device installation procedures and operation and maintenance procedures
16	SWI1-3.1	Stormwater Infiltration System	Manufacturer's product data, technical data, installation procedures, and operations and maintenance procedures/instructions
17	FMV1-1.1	Flow Meters and Vaults	Manufacturer's product data, technical data, installation procedures, and operations and maintenance procedures/instructions
18	FMV1-1.1	Gate Valves and Vaults	Manufacturer's product data, technical data, actuator data, installation procedures, and operations and maintenance procedures/instructions
19	FMV1-1.1	Float Switch	Manufacturer's product data, technical data, installation procedures, and operations and maintenance procedures/instructions
20	Landscape and Irrigation Technical Specification	[as required in Technical Specification]	[as required in Technical Specification]
21	Electrical Technical Specification	[as required in Technical Specification]	[as required in Technical Specification]

Revise the fourth paragraph to read as follows:

Working drawings listed in Table 3-8.2 as Items 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19 shall be prepared, wet stamped, and signed by a Civil or Structural Engineer registered by the State of California.



## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### 3-8.3 Shop Drawings.

Add the following before the first paragraph:

Within 14 calendar days after the Award of Contract, the Contractor shall, at his/her expense, transmit by letter to the Engineer for review and acceptance, shop drawings, and/or other available instructive and descriptive information from the manufacturer, when and as required by the Contract Documents, or requested by the Engineer. Shop drawings will normally not be required for standard items in common use for which adequate manufacturers' literature is available.

The Contractor shall consecutively number, thoroughly check, approve, and sign each Shop Drawing and transmit the Shop Drawings by letter to the Engineer for review. In the event that certain Shop Drawings are unacceptable to the Agency, they will be rejected by the Engineer. The Contractor shall thereafter, correct said drawings and resubmit same in quadruplicate within seven (7) calendar days.

In the event that in the process of development of the Shop Drawings, it is discovered that there are defects and/or errors on the Plans, resulting in conflict between said Plans and the Shop Drawings, or if the Shop Drawings show variation from the Plans and/or Contract requirements because of standard shop practice or other reasons, the Contractor shall thoroughly describe and explain said defects and/or conflicts in his/her transmittal letter to the Engineer.

The Engineer's review of the Shop Drawings will be for general design and arrangement only, and shall not relieve the Contractor from responsibility for errors of any sort in the Shop Drawings or of the responsibility for executing the work in accordance with the Contract. The Contractor shall be solely responsible for the correctness of the drawings, for shop fits and field connections, and for the results obtained by use of such drawings. The Contractor shall verify and be fully responsible for all dimensions and job-site conditions affecting the Work and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the Shop Drawings when reviewed.

Add the following to Table 3-8.3:

Item	Subsection No.	Title	Subject
5	SWT1-3	Precast Concrete Stormwater Treatment Devices	Fabrication and Dimensional Details
6	SWI1-3.2	Stormwater Infiltration System	Fabrication and Dimensional Details
7	SWI1-3.2	Stormwater Infiltration System Footing (if required – based on manufacturer)	Fabrication. Dimensional, and Reinforcement Details
8	FMV1-1.2	Flow Meters and Vaults	Fabrication and Dimensional Details
9	FMV1-1.2	Gate Valves and Vaults	Fabrication and Dimensional Details
10	FMV1-1.2	Float Switch	Fabrication and Dimensional Details
11	Landscape and Irrigation Technical Specification	[as required in Technical Specification]	[as required in Technical Specification]
12	Electrical Technical Specification	[as required in Technical Specification]	[as required in Technical Specification]

Add the following after Table 3-8.3:

Shop Drawings listed in Table 3-8.3 as Items 5, 6, 7, 8, 9, and 10 shall be prepared, wet stamped, and signed by a Civil or Structural Engineer registered by the State of California.

### **3-8.4 Supporting Information.**

Replace the second paragraph with the following:

Submittals are required for the following:

- 1) List of subcontractors per 3-3.
- 2) Control set of plans per 3-7.1.
- 3) Sample contract sign per 3-11.
- 4) Interpretive sign per 3-11.1.
- 5) List of materials per 4-4.
- 6) Certificates of Compliance per 4-5.
- 7) Construction schedules per 6-1.
- 8) Spill Prevention and Emergency Response Plan per 3-12.5.3.
- 9) Confined Space Entry Program per 5-7.5.1.
- 10) Lump sum breakdowns (if requested) per 7-2.
- 11) Crushed rock for infiltration system per 200-1.2.
- 12) Lean concrete base mix designs per 200-4.
- 13) Concrete mix designs per 201-1.1.
- 14) Asphalt concrete job mix formulas and/or mix designs per 203-6.3.
- 15) Asphalt rubber hot mix designs and certifications per 203-11.6.
- 16) Pipeline layout diagrams per 207-2.1.
- 17) Storm Drain Bypass Plan per 306-16.
- 18) Equipment and materials lists per 700-1.
- 19) Controller cabinet wiring diagrams per 701-17.2.2.
- 20) Information on landscape materials per 800-1 and/or Technical Specifications.
- 21) Stormwater treatment device manufacturer's performance certificates per SWT1-3.
- 22) Subsurface infiltration system supporting documentation per SIS1-3.
- 23) Flow meter and vault warranty and operation and maintenance manual per FMV1-1.
- 24) Gate valve/actuator and vault warranty and operation and maintenance manual per FMV1-1.
- 25) Landscape and irrigation materials/components per Technical Specifications.
- 26) Electrical and mechanical components and systems per Technical Specifications.
- 27) Pavement markers, markings, and striping per Technical Specifications (Caltrans).
- 28) All written manufacturer's warranties.
- 29) All necessary data and details including, but not limited to, catalog sheets, manufacturer's brochures, technical bulletins, specifications, diagrams, product samples, testing reports, and other information necessary to describe a system, product or item. This information is required for any material, product, manufactured item, or system.

The Contractor shall prepare each submittal, and each submittal must be approved by the Engineer prior to the start of the activity.

### **3-9 SUBSURFACE DATA.**

Add the following:

The Agency will provide a copy of the Geotechnical Engineering Report for both the Regional Park Infiltration Project and Pipeline(s) to the infiltration galleries, prepared by Terracon Consultants, Inc. upon request (dated June 20, 2018 and December 18, 2018). The report is provided for the Contractors convenience and contains information on subsurface conditions as they existed only at the dates and times indicated in the report. The aforementioned report does not govern the Work and shall not be considered a Contract Document. The Geotechnical Engineering Reports identified gravel and boulders at the park, which may be encountered during installation of the subsurface infiltration system and other components.

### **3-10 SURVEYING.**

#### **3-10.1 General.**

Replace the subsection with the following:

All construction surveying necessary to complete the Work shown on the Plans and provided in these Contract Documents shall be accomplished by or under the direction of a Registered Land Surveyor or Registered Civil Engineer authorized to practice land surveying in the State of California, retained and/or provided by the Contractor. The Agency reserves the right to direct additional construction survey work to be performed at no additional cost when the Agency determines additional construction survey is required to adequately construct the Work. The Contractor is responsible for the accuracy of surveying adequate for construction.

The Contractor shall notify the Engineer in writing at least 2 working days prior to the actual survey. The Contractor shall provide any required traffic control necessary for construction surveying. Permission to close more than one travel lane at a time for any survey service activity must be approved by the Engineer. Prior to disturbing survey monuments, the Contractor shall notify the Engineer.

Stakes shall be set and stationed by the Contractor for curbs, curbs and gutters, sidewalks, access ramps, cross gutters, driveways, storm drains, sewers, water lines, spandrels, catch basins, rough grade, and other items as necessary. If there are no elevations shown on the Plans or provided in the Specifications associated with any proposed improvement that requires stakes, the Contractor is directed to immediately notify the Engineer in writing in the form of a Request for Information (RFI). The Agency will respond to each RFI in a timely manner based on the completeness and complexity of the RFI. The Contractor is solely responsible for any time delays and/or any costs when it does not submit an RFI in a timely manner.

The Contractor shall preserve all benchmarks, monuments, survey marks, centerline ties and stakes and, in case of their impending removal or destruction by his/her operations he/she shall be responsible for notifying the City Engineer prior to their removal. Failure to provide such notification will result in the Contractor being liable for all costs associated with their replacement.

Add the following subsections:

#### **3-10.4 Permanent Survey Markers.**

The Contractor shall retain a Licensed Land Surveyor or a Registered Civil Engineer authorized to practice land surveying within the State to Reset Survey Monuments. The Contractor is responsible for the filing and recording of the Survey Monuments at no additional cost to the Agency.

#### **3-10.5 Payment.**

The payment for surveying, related professional services, office calculation, and furnishing all labor, materials, equipment, tools and incidentals, and for doing work involved shall be considered as included in the items of Work requiring the survey.

### **3-11 CONTRACT INFORMATION SIGNS.**

Add the following:

Contract information signs must conform to requirements identified based on funding agreements. The sign shall be a 3MM Polymetal sign, 36 inches by 24 inches (minimum). It is anticipated that the sign will read "Funding for this project has been provided in full or in part from the Department of Water Resources from the Water Quality, Supply, and Infrastructure Improvement Act of 2014, Los Angeles County Flood Control District's Safe, Clean Water Program, City of San Fernando, and Los Angeles Department of Water

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

and Power.”. The sign shall include color logos of agencies/programs contributing funding to the Project, including the Department of Water Resources (Proposition 1), Los Angeles County Flood Control District (Safe Clean Water), City of San Fernando, and Los Angeles Department of Water and Power, which will be provided by the Agency upon request. The Contractor shall submit a sample sign to the Agency for approval in accordance with 3-8.4.

Add the following subsection:

### **3-11.1 Interpretive Sign.**

A permanent interpretive sign shall be installed in accordance with the Plans. The content for the sign will be developed by the Agency and provided to the Contractor. The Contractor shall produce the sign based on the Agency-provided content. The sign structure shall be similar to that shown in the Plans and shall be submitted to the Engineer for review and approval, as indicated in 3-8.4. The final location shall be approved by the Agency.

## **3-12 WORK SITE MAINTENANCE.**

### **3-12.1 General.**

Add the following after the first paragraph:

All excess dirt and construction debris shall be hauled away from job site each day.

Replace the second paragraph with the following:

During all phases of trenching operations and whenever dirt or base material is stored on paved roadways, the Contractor shall furnish and operate a motorized street sweeper with spray nozzles at least once a day within the areas of its operations and, as determined by the Engineer, along haul routes. The sweeping shall be near or after the end of construction operations for the day. At the same time, the Contractor shall also sweep the sidewalks either manually or with a motorized street sweeper in the vicinity of the construction operations. The sweeping operations shall produce a clean surface throughout the Project area.

If, in the opinion of the Engineer, this effort does not result in satisfactorily clean streets and sidewalks, then the Contractor shall take whatever other measures are necessary to keep the streets and sidewalks clean. Such measures may include, but not be necessarily limited to, more frequent use of a motorized street sweeper as noted above, the use of a self-loading vacuum sweeper, and/or sufficient hand labor to satisfactorily comply with this specification.

### **3-12.3 Noise Control.**

Replace the subsection with the following:

The Contractor shall comply with all local sound control and noise level rules, regulations, and ordinances which apply to any Work performed pursuant to the Contract. The noise level requirements shall apply to all equipment on the job or related to the job, including, but not limited to, trucks, transit mixers, or transient equipment that may or may not be owned by the Contractor. Each internal combustion engine used for any purpose on the job shall be equipped with a muffler of a type recommended by the manufacturer. The noise level shall comply with Chapter 34, Article II of the City of San Fernando Municipal Code, unless previously approved by the Agency. Payment for noise control shall be considered as included in the Contract Unit Price for each related item in the Bid requiring noise control.

**3-12.4 Storage of Equipment and Materials.**

**3-12.4.2 Storage in Public Streets.**

Add the following:

Overnight stockpiling of construction debris or excavated materials is not allowed. Contractor must obtain written approval from the Engineer prior to storage of construction materials and equipment on the street where improvements are planned. Adequate flashing barricades shall be provided.

**3-12.5 Sanitary Sewers.**

Add the following subsection:

**3-12.5.4 Payment.**

Payment for the development, implementation, and maintenance (as required) for sanitary sewer bypass and pumping, spill prevention, and emergency response, shall be considered as included in the Contract Unit Price for each related item in the Bid.

**3-12.6 Water Pollution Control.**

**3-12.6.1 General.**

Add the following:

The Contractor shall comply with the requirements of 3-12.6 and shall conduct his/her operations so as to prevent Portland cement, mud, silt, or other materials from entering the surface drainage structures of the adjoining street and any underground storm drainage system. Contractor shall comply with the requirements of project specific Erosion Control Plans included in the Plans.

In addition to complying with all applicable federal, state and local laws and regulations, the Contractor shall take note of the National Pollution Discharge Elimination System (NPDES) Requirements. The Contractor shall take all precautionary actions and implement all necessary Best Management Practices (BMPs) to prevent polluted discharges to any portion of the storm drain conveyance system including discharge of pollutants from activities such as paving operations, concrete waste washouts, cold-milling, and vehicle and equipment fueling from entering storm drain systems. At the minimum, the following shall be implemented:

- a) Handle, store, and dispose of materials properly
- b) Avoid excavation and grading activities during wet-weather
- c) Construct diversion dikes and drainage swales around working sites
- d) Cover stockpiles and excavated soil with secured tarps or plastic sheeting
- e) Implement erosion control plans included in the Plans
- f) Check and repair leaking equipment away from construction sites
- g) Designate a location away from storm drains for refueling
- h) Cover and seal catch basins if work in their vicinity may allow debris or deleterious liquids to enter
- i) Use vacuum with all concrete sawing operations
- j) Never wash excess material from aggregate, concrete, or equipment onto a street
- k) Catch drips from paving equipment with drip pans or absorbent material
- l) Clean up all spills using dry methods

**3-12.6.3 Stormwater Pollution Prevention Plan.**

Replace the section with the following:

The Agency will provide a Project-specific Stormwater Pollution Prevention Plan (SWPPP) to the Contractor. The Contractor shall update the SWPPP with Contractor information prior to issuance of the Part 2 NTP (per Section 6-1.2). The Notice of Intent (NOI) shall be prepared and submitted by the Contractor to the California Stormwater Multiple Applications and Reporting System (SMARTS). The SWPPP shall conform to the requirements of the jurisdictional regulatory agency (State Water Resources Control Board).

**3-12.6.5 Payment.**

Replace the subsection with the following:

Full compensation for the implementation of BMPs, including NOI preparation/fees, construction, removal, and the furnishing of all necessary labor, equipment, and materials, shall be considered as included in the Contract lump sum Price for "SWPPP Implementation".

**3-13 COMPLETION, ACCEPTANCE, AND WARRANTY.**

**3-13.1 Completion.**

Add the following:

Final inspection and recommendation of completion by the Engineer does not constitute acceptance of the project. The Contractor remains responsible for the project until acceptance of the Work by the City Council.

**SECTION 4 – CONTROL OF MATERIALS**

**4-1 GENERAL.**

Add the following paragraph after the second paragraph:

If the work, or any portion thereof, shall be damaged in any way, or if any defective materials or faulty workmanship shall be discovered at any time prior to the final payment, the Contractor shall forthwith, at its own cost and expense, repair said damage, or replace such defective materials, or remedy such faulty workmanship in a manner satisfactory to the Engineer.

**4-3 INSPECTION.**

**4-3.1 General.**

Add the following:

At the option of the Engineer, the source of supply of each of the materials shall be approved by the Engineer before delivery is started and before such material is used in the Work. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer of material to be used in the Work, for testing or examination as desired by the Engineer. All tests of industry materials furnished by the Contractor shall be made in accordance with commonly recognized industry standards or special methods and tests as prescribed in these specifications.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

The Contractor shall furnish such samples of materials as are requested by the Engineer, without charge. No material shall be used until it has been approved by the Engineer. Samples will be secured and tested whenever necessary to determine the quality of material.

#### **4-4 TESTING.**

Revise the third sentence of the first paragraph to read as follows:

Unless otherwise called for hereinafter in these Special Provisions, all testing during construction will be performed by the Agency in such number and at such locations as deemed necessary by the Engineer to ensure compliance with the Plans and Specifications; the cost of all initial testing will be borne by the Agency; the cost of all retesting will be borne by the Contractor, and the amount due the Agency for said retesting will be deducted from the Contractor's progress payments.

### **SECTION 5 – LEGAL RELATIONS AND RESPONSIBILITIES**

#### **5-1 LAWS AND REGULATIONS.**

Add the following:

Eight hours constitutes a legal days' work. The Contractor shall forfeit, as a penalty to the City of San Fernando, \$50.00 for each workman employed in the execution of the Contract by the Contractor when the workman is required or permitted to work more than eight hours in any one calendar day and 40 hours in any one calendar week in violation of the provisions of the Labor Code, and in particular, Sections 1810 to 1815, thereof, inclusive, except that Work performed by employees of Contractors in excess of eight hours per day, and 40 hours during any one week, shall be permitted upon compensation for all hours worked in excess of eight hours per day at not less than one-and-one-half times the basic rate of pay as provided in said Section 1815.

The Contractor shall comply with Labor Code Section 1775 in accordance with said Section 1775, the Contractor shall forfeit as a penalty to the City of San Fernando, \$50.00 for each calendar day or portion thereof, for each workman paid less than the stipulated prevailing rates for such work or craft in which such workman is employed for any Work under the Contract by him/her or by any Subcontractor under him/her in violation of the provisions of the Labor Code and in particular, Labor Code Sections 1770 to 1780, inclusive. In addition to said penalty and pursuant to said Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each workman for each calendar day or portion thereof for which each workman was paid less than the stipulated prevailing wage rate shall be paid to each workman by the Contractor.

In accordance with the provisions of Section 1770 to 1777 inclusive, of the Labor Code of the State of California, the City Council of San Fernando has adopted the general prevailing rates of per diem wages applicable to the Work to be done as have been determined by the Director of the Department of Industrial Relations for the State of California.

#### **5-3 LABOR.**

##### **5-3.1 General.**

Add the following:

Attention is directed to the provisions in Sections 1777.5 (Chapter 1411, Statutes of 1968) and 1777.6 of the Labor Code concerning the employment of apprentices by the Contractor or any Subcontractor under him/her.

Section 1777.5, as amended, requires the Contractor or Subcontractor employing tradesmen in any apprenticeable occupation to apply to the joint apprenticeship committee nearest the site of the public works project and which administers the apprenticeship program in that trade for a certificate of approval. The certificate will also fix the ratio of apprentices to journeymen that will be used in the performance of the Contract. The ratio of apprentices to journeymen in such cases shall not be less than one to five except:



## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

1. When unemployment in the area of coverage by the joint apprenticeship committee has exceeded an average of 15 percent in the 90 days prior to the request for certificate, or
2. When the number of apprentices in training in the area exceeds a ratio of one to five, or
3. When the trade can show that it is replacing at least 1/30 of its membership through apprenticeship training on an annual basis statewide or locally, or
4. When the Contractor provides evidence that he/she employs registered apprentices on all of their Contracts on an annual average of not less than one apprentice to eight journeymen.

The Contractor is required to make contributions to funds established for the administration of apprenticeship programs if he/she employs registered apprentices or journeymen in any apprenticeable trade on such contracts and if other contractors on the public works site are making such contributions.

The contractor and any subcontractor under him shall apply with the requirements of Sections 1777.5 and 1777.6 in the employment of apprentices.

Information relative to apprenticeship standards, wage schedules, and other requirements may be obtained from the Director of Industrial Relations, ex officio the Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

### **5-4 INSURANCE.**

#### **5-4.2 General Liability Insurance.**

Add the following:

The public liability insurance shall include protection from claims caused by automobiles, trucks, or other vehicles of the Contractor or any Subcontractor while in use both within and outside the Contract premises. The property damage insurance shall cover damage or destruction of any and all property other than that which is owned, leased, or in the care, custody, or control of the Contractor or any Subcontractor, with the liability limit applying to any one (1) accident, disaster, or claim. All coverage provided by Contractor shall be considered primary and shall be completely exhausted before City coverage, if any and to be considered secondary, is exercised.

By appropriate endorsement, such policies of insurance required shall name the City of San Fernando as additionally insured with the Contractor with respect to the construction project described in these specifications and shall provide that such insurance coverage shall not be canceled or reduced without thirty (30) days prior written notice to the City of San Fernando. Said endorsement shall be a separate document. Certificates of the insurance carried evidencing such insurance coverage shall be delivered to the City of San Fernando concurrently with the execution of the Contract by the Contractor.

### **5-7 SAFETY.**

#### **5-7.1 Work Site Safety.**

##### **5-7.1.1 General.**

Add the following:

In the event that the Contractor fails to adequately provide for the public safety during the course of construction under this Contract, and the Agency is required to provide for said public safety, the Contractor shall pay the Agency the cost of each service call, which will include all direct labor and material costs including fringe benefits, overhead, and applicable rental rates for the various pieces of equipment. Any and all costs incurred by the Agency as a result of the failure of the Contractor to provide for the public safety will be deducted from the amount due to the Contractor for the Work done under this Contract.

#### **5-7.8 Steel Plate Covers.**

##### **5-7.8.1 General.**

Add the following after the first paragraph:

All trenches shall be fully backfilled at the end of each day or, in lieu thereof, when approved by the Agency, heavy steel plate adequately braced, anchored, and capable of supporting vehicular traffic may be used in certain locations where it is impractical to backfill at the end of each day. Steel plates shall conform to 5-7.8.

## **SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK**

### **6-1 CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK.**

#### **6-1.1 Construction Schedule.**

Revise the first sentence in the first paragraph as follows:

Within 10 days of issuance of the Part 1 NTP (per Section 6-1.2), the Contractor shall submit its proposed baseline construction schedule to the Engineer for approval.

Add the following:

The Contractor shall ensure that an up-to-date schedule is available at each of the weekly site meetings to aid in discussion of upcoming activities.

Prior to issuing the Part 2 Notice to Proceed (per Section 6-1.2), the Engineer will schedule a Pre-Construction Meeting with the Contractor to review the proposed construction schedule and delivery dates, arrange utility coordination and clarify inspection procedures.

Prior to starting any Work, the Contractor may be required to attend a Community Meeting to be scheduled by the Engineer. The meeting, to be held in the evening, will address the residents' questions and concerns regarding the Work, what can be expected during construction and vehicular and pedestrian access that may be temporarily restricted during construction. Compensation for attending these meetings shall be considered a part of the contract lump sum bid price for "Mobilization".

#### **6-1.2 Commencement of the Work.**

Replace the subsection with the following:

The Notice to Proceed (NTP) for this Contract will be issued in two separate parts. The Agency will issue the Part 1 NTP after the Contractor satisfactorily submits all of the documentation required in the Instructions to Bidders and Contract Documents and the Agency has executed the Contract.

Part 1 NTP shall be for the Contractor to perform the following:

1. Submit all required Submittals per Section 3-8 and receive Agency approval for such submittals unless otherwise specified (interpretive signage and as-needed documentation are not required to be completed before Part 2 NTP).
2. Ensure that all labor, equipment, and materials required for the Contract will be available when required by the Construction Schedule per Section 6-1.1.
3. Mobilization, including the physical and operational establishment of the Class "A" Field Office per Section 8-2.
4. Attend pre-construction meeting(s) with the Agency.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

5. Submit Baseline Schedule per Section 6-1.1 and receive Agency acceptance.

The Contractor shall complete all of the above stated activities within 90 Working Days of the Part 1 NTP. Each additional Working Day in which the Contractor is not in compliance with this requirement will be subtracted from the number of Working Days allowed for the Time of Completion per Section 6-3.1. When the number of Working Days specified in Section 6-3.1 is exhausted, the Contractor will be subject to liquidated damages. The counting of Working Days for the completion of Part 1 NTP activities will stop upon the receipt of all required Submittals and resume upon the return of any required submittal to the Contractor per Section 3-8.

The Part 2 NTP shall be for the start of the Work. The Part 2 NTP will not be issued until all Part 1 NTP activities have been completed.

Compensation for compliance with Part 1 and Part 2 NTP requirements, except those as indicated otherwise throughout the Contract Documents, shall be considered a part of the contract lump sum bid price for "Mobilization".

Construction Work is limited to normal working hours unless prior written approval is obtained from the Engineer. Normal working hours for construction are between 7 a.m. and 6 p.m.

### **6-3 TIME OF COMPLETION.**

#### **6-3.1 General.**

Replace the first sentence with the following:

The Contractor shall complete the Work within **300 Working Days** from the start date specified in the Notice to Proceed (following Part 2 NTP as described in Section 6-1.2.

Add the following:

Where a single shift is worked, eight (8) consecutive hours between 7 a.m. and 6 p.m. shall constitute a day's work at straight time for all workers. Forty (40) hours between Monday, 7 a.m., and Friday, 6 p.m. shall constitute a week's work at straight time. Holidays as herein referred to shall be deemed to be:

New Year's Day	Independence Day
Martin Luther King Day	Labor Day
President's Day	Veterans Day
Cesar Chavez's Birthday	Thanksgiving Day and day after
Memorial Day	Christmas

### **6-4 DELAYS AND EXTENSIONS OF TIME.**

#### **6-6.1 General.**

Replace the second paragraph with the following:

Only the physical shortage of material, caused by unusual circumstances, will be considered under these provisions as a cause for extension of time, and no consideration will be given to any claim that material could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the Engineer that such material could have been obtained only at exorbitant prices entirely out of line with current rates, taking into account the quantities involved and usual practices in obtaining such quantities. A time extension for shortage of material will not be considered for material ordered or

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

delivered late or whose availability is affected by virtue of the mishandling of procurement. The above provisions apply equally to equipment to be installed in the Work.

Add the following:

The Contractor shall retain the right to fully complete (include final completion, punch list, and Project close out) the Work in fewer days than established by the Contract. However, neither shall a reduction or increase to the Contract Sum be made, if the Work is so fully completed in fewer days than established by the Contract nor shall a Claim be made or granted for Compensable Delay, or any other increase in Contract Sum, if, for any reason, including but not limited to delay caused by Agency, the Contractor does not so fully complete the Work in fewer days than established herein.

When the Contractor foresees a delay in the prosecution of the Work and, in any event, immediately upon the occurrence of a delay, the Contractor shall notify the Engineer in writing of the probability of the occurrence and the estimated extent of the delay, and its cause. The Contractor shall take immediate steps to prevent, if possible, the occurrence or continuance of the delay. The Contractor agrees that no claim shall be made for delays which are not called to the attention of the Engineer at the time of their occurrence.

Non-excusable delays in the prosecution of the Work shall include delays which could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its subcontractors, at any tier level, or suppliers.

The Contractor shall not be assessed with liquidated damages nor the cost of engineering and inspection during any delay in the completion of the Work caused by Acts of God or of war, acts of the City, fire, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and weather or delays of Subcontractors due to such causes, provided that the Contractor shall within ten (10) days from the beginning of any such delay notify the Engineer in writing of the cause of delay, who shall ascertain the facts and the extent of the delay, and his findings of the facts thereon shall be final and conclusive.

### **6-6 SUSPENSION OF THE WORK.**

#### **6-6.1 General.**

Add the following:

In the event that a suspension of Work is ordered, as provided in this paragraph, the Contractor, at its expense, shall perform all Work necessary to provide a safe, smooth, and unobstructed passageway through construction for use by public, pedestrian, and vehicular traffic, during the period of such use by suspension. Should the Contractor fail to perform the Work as specified, the Agency may perform such Work and the cost thereof may be deducted from monies due the Contractor under the Contract.

The Agency shall also have authority to suspend the Work wholly or in part, for such period as the Agency may deem necessary, due to unsuitable weather, or to such other conditions as are considered unfavorable for the suitable prosecution of the Work. Such temporary suspension of the Work will be considered justification for time extensions to the Contract in an amount equal to the period of such suspension if such suspended Work includes the current critical activity on the latest favorably reviewed schedule.

### **6-7 TERMINATION OF THE CONTRACT FOR DEFAULT.**

#### **6-7.1 General.**

Replace item e) and f) and add the following to the itemized list:

- e) Disregards laws or regulations of any public body having jurisdiction,
- f) Commits continuous or repeated violations of regulatory or statutory safety requirements,

- g) Is not complying in good faith, or
- h) Has assigned or subcontracted any part of the Work without the Agency's consent, then the Agency will consider the Contractor in default of the Contract.

#### **6-7.3 Notice of Termination for Default.**

Add the following before the last paragraph:

In the event of such termination, the Contractor will be paid the actual amount due based on the quantity of Work satisfactorily completed at the time of termination, less damages caused to the Agency by acts of the Contractor causing the termination. The Contractor, in having tendered a Bid, shall be deemed to have waived any and all claims for damages because of termination of the Contract for any such reason.

#### **6-9 LIQUIDATED DAMAGES.**

Add the following:

It is agreed by the parties to the Contract that liquidated damages for Work under this Contract is the sum of Five Hundred Dollars (\$500.00) per day for each and every day's delay beyond the time prescribed to complete the Work. Contractor agrees to pay such liquidated damages as herein provided, and in case the same are not paid, Contractor agrees that the City of San Fernando may deduct the amount thereof from any money due or that may become due the Contractor under the Contract.

It is further agreed that in case the Work called for under the Contract is not finished and completed in all parts and requirements within the time specified, the City Council shall have the right to extend the time for completion or not, as may seem best to serve the interest of the Agency; and if it decides to extend the time limit for the completion of the contract, it shall further have the right to charge to the Contract, his/her heirs, assigns or sureties; and to deduct from the final payment for the Work, all or any part, as it may deem proper, of the actual cost of engineering, inspection, superintendence, and other overhead expenses which are directly chargeable to the Contract, and which accrue during the period of such extension, except that the cost of final surveys and preparation of final estimates shall not be included in such charges.

### **SECTION 7 – MEASUREMENT AND PAYMENT**

#### **7-1 MEASUREMENT OF QUANTITIES FOR UNIT PRICE WORK.**

##### **7-1.2 Methods of Measurement.**

Add the following:

Payment of each item will include full compensation for furnishing all labor, materials, tools, equipment and backup equipment; transportation and technical competence for performing all Work necessary to complete each item as indicated on the Plans and as specified in these Contract Documents, including but not limited to obtaining all applicable certifications necessary for specialty personnel and major equipment, and all other applicable permits; securing a storage yard to store all equipment and materials to be used on the job (if needed), disposal of waste materials, restoration of the site, etc. Costs for mobilization/demobilization shall be included in the lump sum price bid for "Mobilization".

#### **7-2 LUMP SUM WORK.**

Add the following:

The Contractor shall, within five (5) Working Days of receipt of a request from the Engineer, submit a complete breakdown of Lump Sum Bid prices showing the value assigned to each part of the Work, including an allowance for profit and overhead. In submitting the breakdown, the Contractor certifies that

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

it is not unbalanced and that the value assigned to each part of the Work represents its estimate of the actual cost, including profit and overhead, of performing that part of the Work. No extra costs shall be allowed for providing these breakdowns.

### **7-3 PAYMENT.**

#### **7-3.1 General.**

Add the following at the end of the second paragraph:

Payment for cost of Work to comply with the SPPWC General Provisions and as modified by this Contract shall be included in the various bid items, and no additional payment will be made.

Bid prices provided on the appropriate Bid Form will remain in force as Unit Prices under the Contract Documents until the Contract has been fully performed. No cost escalation is allowed due to material price increase for the term of the Project.

When an item of Work is not listed in the "Bid Schedule" in the bid proposal, the cost of such Work shall be considered to be included in the cost of the other Work that is listed. The Contractor is to provide all labor, material, and equipment necessary to complete the Project in accordance with the Plans and Specifications including, but not limited to the following:

- a) All "Special Provisions" Work required to complete the Project in a safe and orderly manner including, but without being limited to, safety measures, hoists, flagmen, clean-up, barricades, fences, temporary utilities, utility fees and charges, parking for the Contractor's and subcontractor's personnel, and temporary facilities as may apply to this Work;
- b) All insurance in accordance with the insurance requirements of the Contract;
- c) Maintain and update current record drawings onsite (3-7.1). Upon project completion, provide the Agency a legible set of record drawings, operation and maintenance manuals, warranties, and guarantees;
- d) All permits required;
- e) Monthly Project status report;
- f) Attend weekly project meetings;
- g) All engineering, testing, and inspection costs for defective Work, and work performed outside of the work hours;
- h) Repair or replace all existing improvements (public or private) damaged by the Contractor. The Contractor is responsible to provide evidence of pre-existing conditions;
- i) All scheduling of utility connections to turn on/off including, but not limited to electrical services (for electrical panel, street lighting, traffic signals, and irrigation controllers) and water meters;
- j) Watchman or security service, as necessary;
- k) Perimeter fencing of work zones and staging area as necessary for public safety and protection of equipment and materials;
- l) Dust control, street cleaning, and protection and/or replacement of existing surfaces or properties;
- m) Submittal Log of all submittals required to the Agency including, but not limited to, material, products, concrete testing data, batch plant testing data, shop drawings, and traffic control and phasing plans. Said log shall be updated for each weekly project meeting.

All costs for the preceding shall be included in the other items for which bids are entered.

The Agency may keep any monies which would otherwise be payable at any time hereunder and apply the same, or so much as may be necessary therefore, to the payment of any expense, losses, or damages, as determined by the Engineer, incurred by the Agency, for which the Contractor is liable under the Contract.

Add the following at the end of the subsection:

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

It is mutually agreed between the parties to the Contract that no certificate given or payments made under the Contract, except the final project acceptance, shall be conclusive evidence of the performance of the Contract, either wholly or in part, against any claim of the party of the first part, and no payment shall be construed to be an acceptance of any defective work or improper materials.

The Contractor further agrees that the payment of the final amount due under the Contract, and the adjustment and payment for any Work done in accordance with any alterations of the same, shall release the Agency (City of San Fernando), City Council, and the Engineer from any and all claims of liability on account of Work performed under the contract or any alteration thereof.

### **7-3.2 Partial and Final Payment.**

Replace the second and third paragraph with the following:

The Agency shall, once in each month, cause an estimate in writing to be made by the Engineer of the total amount of Work done and the acceptable materials furnished and delivered by the Contractor on the ground and not used, at the time of such estimate; and the value thereof. The estimate will be based on the Contract Unit Prices or in accordance with 7-2. The Agency shall retain five percent (5%) of such estimated value of the Work done and fifty percent (50%) of the value of the materials so estimated to have been furnished and delivered and unused as aforesaid as part security for the fulfillment of the Contract by the Contractor, and shall monthly pay the Contractor, while carrying on the Work, the balance not retained, as aforesaid, after deducting therefrom all previous payments and all sums to be kept or retained under the provisions of the Contract. The amount withheld will be retained by the Agency until acceptance of the performance of the Contract by the City Council. No such estimate or payment shall be required to be made, when, in the judgment of the Engineer, the Work is not proceeding in accordance with the provisions of the Contract, or when in his/her judgment, the total value of the Work done since the last estimate amounts to less than Three Hundred Dollars (\$300.00).

The Contractor may be required to submit updated work schedules and current record drawings (as-built) with requests for progress payments.

### **7-3.4 Mobilization.**

Replace the entire subsection with the following:

When a Bid item is included in the Bid for "Mobilization", the costs of Work in advance of construction operations and not directly attributable to any specific Bid item will be included in the progress estimate.

Mobilization shall consist of preparatory Work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site and for all other Work and operations which must be performed or costs incurred prior to beginning Work on the various Contract items on the Project site.

Payments for mobilization will be made as follows:

- a) When the monthly progress payment estimate of the amount earned, not including the amount earned for mobilization, is 5 percent or more of the Contract Price, the total amount earned for mobilization shall be 50 percent of the Contract Unit Price for mobilization or 5 percent of the Contract Price, whichever is less, and said amount will be included in said estimate for payment.
- b) When the monthly progress payment estimate of the amount earned, not including the amount earned for mobilization, is 10 percent or more of the Contract Price, the total amount earned for mobilization shall be 75 percent of the Contract Unit Price for mobilization or 7.5 percent of the Contract Price, whichever is less, and said amount will be included in said estimate for payment.
- c) When the monthly progress payment estimate of the amount earned, not including the amount earned for mobilization, is 20 percent or more of the Contract Price, the total amount earned for

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

- mobilization shall be 95 percent of the Contract Unit Price for mobilization or 9.5 percent of the Contract Price, whichever is less, and said amount will be included in said estimate for payment.
- d) When the monthly progress payment estimate of the amount earned, not including the amount earned for mobilization, is 50 percent or more of the Contract Price, the total amount earned for mobilization shall be 100 percent of the Contract Unit Price for mobilization or 10 percent of the Contract Price, whichever is less, and said amount will be included in said estimate for payment.
  - e) After completion of the Contract Work, the amount, if any, of the Contract Unit Price for mobilization in excess of 10 percent of the Contract Price will be included in the final progress payment.

## **SECTION 8 – FACILITIES FOR AGENCY PERSONNEL**

### **8-1 GENERAL.**

Add the following after the first sentence in the third paragraph:

The Agency may share a field office with the Contractor on site provided that such use does not seriously conflict with the Agency's use.

### **8-2 FIELD OFFICE FACILITIES.**

#### **8-2.1 Class "A" Field Office.**

Add the following after the first paragraph:

The Agency may share the field office with the Contractor if the Class "A" field office requirements are met for the Contractor's field office, so long as a space is dedicated for the sole use of the Agency.

Replace the second paragraph with the following:

Furniture for the Agency's use shall be provided as follows: one desk with a drawer suitable for holding files and one (1) chair.

Add the following at the end of the third paragraph:

Wireless internet shall be provided for Agency use from the field office.

Add the following:

The location of the field office shall be approved by the Engineer. The field office shall be located on the Project site. The Contractor will not be compensated for a field office located outside the Project site.

The field office space shall be in-place and fully operational prior to the date of issuance of the Part 2 Notice to Proceed. No payment will be made for each Working Day in which the field office space is not in-place and fully operational.

### **8-6 BASIS OF PAYMENT.**

Add the following:

Payment for office space will be made at the lump sum price in the Bid for "CLASS "A" FIELD OFFICE." Payment for office facilities will be made as follows: 25 percent when completely installed, 75 percent prorated over the remainder of the Contract duration.



## **PART 2 – CONSTRUCTION MATERIALS**

### **SECTION 200 – ROCK MATERIALS**

#### **200-1 ROCK PRODUCTS.**

##### **200-1.2 Crushed Rock and Rock Dust**

###### **200-1.2.1 General.**

Add the following:

Crushed rock used beneath infiltration systems, such as the subsurface infiltration system, shall be washed prior to delivery. The ¾-inch gravel identified on the Landscape and Irrigation Plans shall be ¾-inch crushed rock per this section.

#### **200-2 UNTREATED BASE MATERIALS.**

##### **200-2.1 General.**

Replace the subsection with the following:

Materials for use as untreated base or subbase shall be crushed aggregate base unless specified otherwise on the Plans or Specifications.

##### **200-2.2 Crushed Aggregate Base.**

###### **200-2.2.3 Quality Requirements.**

Delete footnote number one (1) beneath Table 200-2.2.3 and delete the paragraph following the table. The minimum R-value requirement will not be waived.

### **SECTION 201 – CONCRETE, MORTAR, AND RELATED MATERIALS**

#### **201-1 PORTLAND CEMENT CONCRETE.**

##### **201-1.1 Requirements.**

###### **201-1.1.1 General.**

Add the following at the end of the first paragraph:

The same brand type, source of cement, and aggregate shall be used for all cast in place Portland cement concrete. Fly ash shall not be used.

###### **201-1.1.4 Concrete Specified by Compressive Strength.**

Add the following:

The concrete used in the manhole diversion structures (whether precast or cast-in-place) shall be 5,000 psi concrete. Concrete associated with the pretreatment device, subsurface infiltration system, and valve/flow meter manholes are specified in Section SWT2-1, SIS2-2, and FMV2-5, respectively.

## **SECTION 203 – BITUMINOUS MATERIALS**

### **203-6 ASPHALT CONCRETE.**

#### **203-6.1 General.**

Asphalt concrete within the public right-of-way shall be Type Class B-PG-64-10 for the base courses and AHRM-GG-C for surface courses.

#### **203-6.4 Asphalt Concrete Mixtures.**

##### **203-6.4.1 Class and Grade.**

Add the following:

Acceptance as used in this Subsection 203-6.4 shall mean acceptance of materials after spreading only. Acceptance of material in production shall be subject to all quality requirements based on sampling and testing specified.

### **203-11 ASPHALT RUBBER HOT MIX (ARHM).**

#### **203-11.2 Materials.**

Add the following:

Contractor shall maintain a minimum quality control plans as follows:

- a. Perform sieve analysis test Caltrans Test 202 on a sample taken immediately after 300 tons of production and every 500 tons thereafter.
- b. Perform binder content test Caltrans Test 382 on a sample taken immediately after 300 tons production and every 1,000 tons thereafter.

Tests shall be performed and completed without interruption directly after samples are procured at the production plant laboratory.

Contractor shall provide the correction factor for Caltrans Test 382 for ARHM material at least 5 Working Days prior to paving.

A copy of test results shall be provided to the Engineer immediately upon completion of each test or upon request thereafter if Engineer is not present at time of the test. Adjustments shall be made immediately if test results indicate a need for adjustment.

#### **203-11.2.3 Crumb Rubber Modifier (CRM).**

##### **203-11.2.3.1 General.**

Replace the first paragraph with the following:

The material shall consist of a combination of scrap tire CRM and high natural CRM meeting the requirements of this subsection. Scrap tire CRM shall consist of ground or granulated rubber derived from any combination of automobile tires, truck tires or tire buffing. Whole scrap tire rubber shall be derived from scrap tires generated entirely within the State of California, and the certification of compliance shall so certify.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

The high natural rubber shall be a single source material and not a blend of more than one source. The high natural CRM and CRM rubber components shall not be pre-mixed prior to mixing with paving asphalt.

Replace the fifth paragraph with the following:

The percentage of high natural CRM shall be equal to 1,000 divided by the percentage of natural rubber in the high natural CRM (using whole number percentages), e.g., 1,000/40% equals 25 percent. The remainder of CRM shall be scrap tires.

The binder material must contain a minimum of 300 pounds (equivalent to 15% by weight) of tire-derived crumb rubber per ton of rubberized binder.

The maximum value for Natural Rubber Content in Table 203-11.2.3.1(B) is hereby deleted.

An acceptable source of natural rubber scrap is available from TRF Industries (330) 688-1583 (Bruce Bowers), though any other source of natural rubber meeting specifications is acceptable. A grinding/granulating company is BAS, Harach Sarkis (310) 429-3546, for whatever material is supplied, though any other grinding/granulating company is acceptable.

Delete the sixth (final) paragraph.

### **203-11.3 Composition and Grading.**

Add the following:

Optimum binder content shall be based on Caltrans 367 procedure without modification using air voids of 4%. Once full compliance with Specifications is established at 4% air voids, the binder content shall thereafter be increased to provide 3.5% voids to conform to the residential traffic in the project, all other factors being within specification.

Variations of percent air voids below the minimum specified will be cause to terminate paving operations until changes to conform to the specified percent air voids are demonstrated and approved by the Engineer.

The gradation ranges shown in Table 203-11.3, including the ¾" sieve range added herein, shall be considered the Contract Compliance Range. The Operating Range for the ½" sieve shall be 94% to 99%. The Operating Range for all other sieves, except the 200 sieve, shall be 2 percentage points inside the Contract Compliance Range. If gradation test results do not meet the Operating Range requirements but meet the Contract Compliance Range, placement of ARHM may be continued for the remainder of the day. However, another day's work shall not be started until tests, or other information, indicate to the satisfaction of the Engineer that the next material to be used in the work will comply with the requirements specified for Operating Range.

ARHM shall be Class GG-C.

### **203-11.4 Mixing Asphalt and CRM.**

Replace the first sentence of the third paragraph with the following:

The proportions of the materials, by total weight of asphalt-rubber binder, shall be 80% combined paving asphalt and asphalt modifier, and 20% CRM, except that the percentage of CRM should be reduced by 20% of the difference between total rubber hydrocarbon percentage in the natural CRM and the value 50%, but no less than 18%. (For example, for total rubber hydrocarbon in the high natural CRM of 56%, reduce the total CRM by 20% of 56% minus 50%, which equals 1% reduction, and yields the formulation 19% CRM and 81% asphalt and modifier, in lieu of 20% and 80%. Lack of proper adjustment will cause excessively long reaction times.) Complete documentation shall be provided to the Engineer to approve the formulation.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Replace the fifth and sixth sentences in the third paragraph with the following:

The required mixing/reaction time shall be 75 minutes minimum. The minimum reaction period shall be the time from complete incorporation of materials into the mix to the time that the asphalt-rubber meets all specifications for reacted material. Reaction shall be considered complete only after the second of two viscosity readings taken 15 minutes apart is less than the first. The Engineer's decision shall be final for determination of the minimum reaction period.

Make the following revision in Table 203-11.4:

Change the maximum value for Haake Field Viscosity at 375° F (191° C), (Centipoise) to 2600.

Revise reaction time indicated in the fourth paragraph to 75 minutes.

Add the following at the end of the subsection:

All material shall be tested for viscosity and verified as to complete reaction prior to transfer to any storage tank or use of the reaction tank for feed to the hot mix plant. Material reacted lower than specified temperature, but above 185° C (365° F), or transferred to a storage tank prior to completion of reaction as specified, shall be reacted for a total period of 3 hours prior to use. Any such transfer shall be described in the comments column of the Asphalt Rubber Batch Log.

Each batch of binder shall be tested for viscosity after the minimum reaction time has passed and the following information shall be recorded:

1. Temperature of stored asphalt cement material at time of loading
2. Time at which the reaction tank is fully loaded
3. Tons of asphalt rubber added to the tank for the batch
4. Total asphalt rubber in the tank after loading
5. The beginning time of reaction (Fully loaded and above 375° F)
6. Binder temperature at time of sampling
7. Temperature of tested material
8. Viscosity reading
9. Time of viscosity test (all test results must be completed prior to use)

A copy of the Asphalt Rubber Batch Log shall be provided to the Engineer upon request. A copy of the batch log sheet and all circle charts for the day shall be provided electronically to the Engineer within 12 hours of ending production of ARHM for the day. A log sheet form will be provided at the preconstruction meeting.

Construction shall be considered unauthorized until Contractor has provided electronically the log to the Engineer as arranged at the preconstruction meeting and has in his/her possession a fax confirmation sheet with a time and date conforming to specification. Under any circumstances, Engineer must be contacted for clearance to pave.

### **203-11.5 Equipment for Production of Asphalt-Rubber.**

Add the following clarification to item c) Storage/Reaction Tank:

- A. **Reaction Tank.** The asphalt-rubber material shall be held in a reaction tank separate from the storage tank feeding the ARHM plant, until the reaction is complete. The reaction tank shall have agitation sufficient to increase the viscosity of the mixture to a peak viscosity reading at least 20% higher than the viscosity reading of the material measured at a time that the material otherwise meets specifications for reacted material. The time of reaction may be extended as needed to produce this result. It shall be the responsibility of the Contractor to demonstrate to the Engineer through viscosity readings at appropriate times that the equipment conforms to these requirements.

If this cannot be demonstrated, the reaction time shall be 3 hours. Once established, the reaction time shall be the minimum time for reaction unless there are changes in materials or equipment, in which case a new reaction time shall be established per specifications. The Engineer's decision shall be final.

- B. **Storage Tank.** After a complete reaction is verified by viscosity readings acceptable to the Engineer, the material shall be held in a storage tank that is fully isolated from material that is not fully reacted. This tank shall be the only tank feeding the ARHM plant.

## **SECTION 206 – MISCELLANEOUS METAL ITEMS**

### **206-3 GRAY IRON AND DUCTILE IRON CASTINGS.**

#### **206-3.3 Manufacturing and Finishing.**

##### **206-3.3.2 Manhole Frame and Cover Sets and Grates.**

Add the following subsection:

##### **206-3.3.2.1 Manhole Cover Labels.**

All manhole covers installed within public right-of-way shall be labeled according to Agency requirements.

## **SECTION 211 – MATERIAL TESTS**

### **211-4 HAND HELD VISCOMETER TEST.**

#### **211-4.3 Test Procedure.**

Delete the last two sentences of step d (4) and replace with the following:

Stop stirring the binder. While the spindle is rotating, move the spindle in and out of the binder slowly three times at a location close to the edge of the container (do not disturb the central area).

Replace step e) (5) with the following:

- e. Determine the viscosity of the binder at  $190^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $375^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ) as follows:
- 1) In one continuous operation, turn off the spindle rotation, remove the spindle vertically from the binder, and immediately insert the spindle back into the center of the binder. Wait 5 seconds to fill the spindle. While holding the viscometer level, turn the spindle on, watch the needle on the viscometer dial and record the maximum value obtained on the dial.
  - 2) Record the test temperature and maximum viscosity. (The viscometer shall be maintained and operated in accordance with the manufacturer's instructions. However, this test method shall apply if there are differences in the instructions for the determination of the viscosity.)

## **SECTION 214 – TRAFFIC STRIPING, CURB AND PAVEMENT MARKINGS, AND PAVEMENT MARKERS**

The Contractor shall review the associated Technical Specifications included in this Specifications package, which refers to Caltrans latest (2018) Standard Specifications. Any conflicts with these Special Provisions and the Technical Specifications shall immediately be brought to the attention of the Agency.

## **PART 3 – CONSTRUCTION METHODS**

### **SECTION 300 – EARTHWORK**

#### **300-1 CLEARING AND GRUBBING.**

##### **300-1.2 Root Pruning and Tree Trimming.**

Replace the subsection with the following:

Tree branches which hang within 13.5 feet above finished roadway grade or within 9 feet above finished sidewalk or parkway grade shall be removed to the branch collar in accordance with the current pruning standards of the International Society of Arboriculture (ISA). The Contractor shall remove additional tree branches, under the direction of the Engineer, in such a manner that the tree will present a balanced appearance. No paint or tree sealant shall be applied to the resulting scars. All pruning shall be done under the supervision of an ISA Certified Arborist in the Agency's employ (West Coast or other).

All the root pruning required to place or replace walks, curbs, curbs and gutters, or other permanent facilities shall be limited to the minimum amount necessary to set forms.

All roots two (2) inches and larger shall be cut with sharp tool such as axe or chainsaw. No roots shall be broken off by trenching or other heavy equipment.

No root shall be removed within five (5) diameters of the tree trunk measured at 4 feet, 9 inches above grade without the express written permission of the Agency. Any such root removed without the Agency's written permission may create a hazardous condition for which the Contractor shall be liable.

Should the Contractor create a hazardous condition in the sole judgment of the Engineer, the Contractor shall remove the tree and replace it with a specimen of the same species and value at the Contractor's expense.

All significant root pruning (3-inch diameter and larger) shall be performed under the direct supervision of an ISA Certified Arborist in the Agency's employ (West Coast or other).

#### **300-2 UNCLASSIFIED EXCAVATION.**

##### **300-2.1 General.**

Replace the subsection with the following:

Unclassified excavation shall consist of all excavation, including roadways; bituminous pavement; concrete pavement, curb, walk, gutters, cross gutters, driveways, and access ramps; and park field (for subsurface infiltration system). Additional requirements related to unclassified excavation (removal) are included in 401-3.

##### **300-2.7 Selected Material.**

Replace the subsection with the following:

Selected materials encountered in the excavations within the project limits that meet the specifications for base material, trench bedding or backfill, topsoil, or other specified materials shall be used as shown on the Plans, in the Specifications, or as directed by the Engineer. Topsoil excavated may be considered only for the purpose of backfilling areas to be planted.

**300-2.8 Measurement.**

Revise the second sentence in the third paragraph to read as follows:

The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation or authorized section, except for the invert of the subsurface infiltration system, which shall not be compacted, at its expense.

**300-2.9 Payment.**

Replace the first sentence in the first paragraph with the following:

Payment for unclassified excavation performed as part of the Work for “remove and reconstruct” or “remove and reinstall” Bid items, including removal of extra AC thickness, shall be paid for as part of the Work for that item, and no additional compensation will be allowed therefor.

Add the following:

Payment for unclassified excavation is considered included in the Bid under each Bid item requiring unclassified excavation and includes excavation, hauling, and disposal. No separate payment will be made. Excavation within the project area may require excavation of boulders, as was encountered during the geotechnical exploration per 3-9.

**300-4 UNCLASSIFIED FILL.**

**300-4.10 Payment.**

Replace the subsection with the following:

Full compensation for furnishing all labor, materials, tools and equipment, and doing all the Work involved in unclassified fill construction shall be considered as included in the price paid for “remove and reconstruct” and “remove and reinstall” bid items, as well as other Bid items requiring unclassified fill, and shall include full compensation for the cost of all grading, shaping, compacting or consolidating and extra fill, if required, or other work that is required under this subsection. No additional payment will be made for unclassified fill.

**SECTION 301 –SUBGRADE PREPARATION, TREATED MATERIALS, AND PLACEMENT OF BASE MATERIALS**

**301-1 SUBGRADE PREPARATION.**

**301-1.1 General.**

Add the following:

This subsection does not apply to the natural ground beneath the subsurface infiltration system.

**301-1.3 Relative Compaction.**

Replace the first paragraph with the following:

When pavement is to be placed directly on subgrade material or when base or subbase material, curb, gutter, alley pavement, driveways, or sidewalks are to be placed on the subgrade material, the top six (6) inches of such subgrade material shall be compacted to a relative compaction of 90%.



Add the following sentence:

Subgrade material shall not be compacted below the subsurface infiltration system.

### **301-2 UNTREATED BASE.**

#### **301-2.3 Compacting.**

Add the following:

Crushed rock used in the subsurface infiltration system shall not be compacted.

#### **301-2.4. Measurement and Payment.**

Add the following:

Payment for construction of untreated base under curb, curb and gutter, driveways, sidewalks, ramps, and all other hardscape shall be considered as included in the Bid price for related items of work and no additional compensation will be allowed therefor. Payment for construction of untreated base under AC pavement shall be considered as included in the Contract Bid price per cubic yard for "Aggregate Base".

Payment for crushed rock used in the subsurface infiltration system will be included with the infiltration system, as specified in SIS3-3.

## **SECTION 302 ROADWAY SURFACING**

### **302-5 ASPHALT CONCRETE PAVEMENT.**

#### **302-5.1 General.**

Add the following:

Cracks, joints, and holes to be filled shall be cleaned after cold milling.

AC for AC pavement repairs and for PCC pavement repairs shall be placed the same day as removals are performed

#### **302-5.4 Tack Coat.**

Replace the subsection with the following:

Tack coat for overlay shall be Thermoplastic Polymer Modified High Performance Seal (TPMS) manufactured by Paramount Petroleum Corporation [(562) 531-2060], for overlay, or an Agency approval equal. The Engineer shall approve the exact rate and number of applications.

The tack coat shall be applied as specified in Subsection 302-5.4 of the Standard specifications and these Special Provisions. The Engineer will determine if the pavement is sufficiently dry for the application of the tack coat. Tack coat shall not be applied when the temperature of the surface to be tacked is below 50° F in the shade. Whenever pavement surface temperatures exceed 120° F, a small test section shall be applied approximately 30 feet in length to gauge setup time for the tack to not stick to truck tires. The setup time shall be recorded. Paving, material delivery and tack coat placement must be coordinated and scheduled to provide that tack is setup before placing trucks on the tacked area. Pavement surface temperatures shall be monitored and additional test sections shall be performed to revise the paving operation as conditions change. Upon occurrence of tracking of tack coat, paving shall cease, except remaining material in the hopper shall be used, and the tack shall be allowed time to setup.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

On all vertical joins of AC patching, apply SS-1H tack coat uniformly in two coats of 0.20 gallons per square yard each with full "break" in between, or 0.20 gallons per square yard PG 64-10 uniformly in one coat. Tack coat shall not be applied when the temperature of the surface to be backed is below 60° F in the shade.

The TPMS shall be heated slowly to 350°-425° F. At no time TPMS shall be heated above 450° F. The product shall be applied through a distributor truck equipped with a heating unit capable of raising temperature at least 3° F per hour, and shall maintain tack coat temperature at or above 350° F. It shall be equipped with a full circulating spreader bar and pumping system capable of applying TPMS material within a +0.01 gallons per square yard tolerance of specified application rate and give uniform covering of the surface to be treated. The distributor shall also include a tachometer, pressure gauge, and volume measuring device and thermometer. The application rates shall be 0.15 gallons per square yard for all ARHM overlay or as otherwise directed by the Engineer.

Tack coat shall not be applied until preparation of the existing surface has been completed and thoroughly cleaned, and then only so far in advance of placing the overlay as permitted by the Engineer. Tack coat shall not be left exposed overnight. Immediately in advance of placing the overlay, additional tack coat shall be applied as directed by the Engineer, to areas where the tack coat has been destroyed or otherwise rendered ineffective, and no additional compensation will be allowed for such work.

Paving of overlay shall not proceed until the tack coat has stiffened sufficiently to not stick to truck tires.

Existing concrete curb faces and all concrete not to be overlaid shall be protected against disfigurement from the tack coat. Residue of tack coat material shall be removed from curb faces by sandblasting to return the concrete to its original condition unless otherwise directed by the Engineer.

Excessive tracking of tack coat onto adjacent pavements will require immediate clean-up. If significant amounts of paving asphalt are traced onto existing adjacent pavements, the Contractor shall clean it off to the satisfaction of the Engineer or provide a slurry seal to restore the pavement at their own expense.

### **302-5.5 Distribution and Spreading.**

Add the following after the second sentence of the sixth paragraph:

Contractor shall provide 20-foot long automatic screed control on both sides of the paving machine for all paving with paving machine, as directed by Engineer.

Add the following to the end of the sixth paragraph:

Each paving machine used will require a paving foreman for each machine along with a full set of rollers as specified and two rakers and one shoveler laborer at a minimum.

Add the following after the first sentence of the seventh paragraph:

Truck transfer and bottom-dump trucks are not allowed.

### **302-5.6 Rolling.**

#### **302-5.6.1 General.**

Add the following:

Rolling along a joint shall be such that the widest part of the roller is on the hot side of the joint.

Rubber tire rollers shall be used on any leveling course.

Three rollers shall be provided for installation of AC greater than 200 tons per hour, regardless of thickness.

**302-5.7 Joints.**

Add the following:

Join lines between successive runs shall be within 6 inches of lane lines or center of street or a minimum of 14 feet outside of the outer most lane line or center of street, or 5 to 6 feet from a lane line or center of street and within a lane. The joint pattern for all pavement layers shall be submitted in writing to the Engineer for review and approval 2 weeks in advance of the first lift of pavement to be placed. No exceptions to the specified requirements for joints shall be anticipated, and the Engineer's decision shall be final.

**302-5.9 Measurement and Payment.**

Compensation to provide all of the equipment to the site and operated as specified, including all rollers specified regardless of rolling pattern elected by Contractor, shall be considered included in the Contract Unit price per ton for "AC Pavement", which includes AC and ARHM placement, compaction, utility adjustment, and all other elements necessary to reconstruct the street to the conditions indicated on the Plans and in the Specifications. Removal of existing street section, additional unclassified excavation, hauling, disposal, protection of utilities, removal of pavement markers and markings, and other elements to demolish existing streets to be improved shall be considered included in the Lump Sum Bid price for "Street Demolition".

**302-9 ASPHALT RUBBER HOT MIX (ARHM).**

**302-9.1 General.**

Add the following:

Contractor's attention is directed to 403-3 for requirements for patching manholes and miscellaneous, frames and covers in ARHM pavements.

All PCC surfaces, to be crossed by trucks used to haul ARHM, that are within 500 feet of the Work limits shall be covered with sand or other durable covering prior to applying tack coat.

Contractor shall have sufficient power brooms on site during all periods of distribution and spreading to provide for cleanup of haul routes and work areas. Power broom shall provide miscellaneous cleanup of ARHM spoils as directed by the Engineer.

**302-9.2 Tack Coat.**

Add the following subsection:

**302-9.2.1 Mixing Binder with Aggregate.**

Proportioning shall be performed using an automatic batching system, and the proportioning device shall be automatic to the extent that the only manual operation required for proportioning all materials shall be a single operation of a switch or starter.

For drum plants, the system shall run fully automatic with the only input to the AC plant computer being information transmitted automatically from a Corealis mass flow meter on the line of the asphalt-rubber feed to the AC plant. All automatic shutdown features of the AC plant shall be fully functional.

### **302-9.3 Distribution and Spreading.**

Add the following:

The ARHM, as delivered, shall be deposited directly into the hopper of the spreading and finishing machine. Truck transfer and bottom-dump truck are not allowed except as authorized by the Engineer.

The temperature of ARHM shall be high enough upon delivery that pavement temperature after two passes with the breakdown roller exceeds 240° F.

To avoid picking up loose rock in the overlay area, the tires of all trucks must be lightly oiled with linseed oil, soybean oil, or Agency approved equal. Diesel fuel will not be allowed on the project at all for oil down of any equipment.

Raking of ARHM shall be eliminated as much as possible. ARHM material shall not be cast across the mat under any circumstance. Raking shall be just enough to set up edges for uniform joints without casting material. Screed controls shall be the predominant means of controlling material at joints. In areas where paving machines cannot be used due to space constraints, material shall not be thrown by shovels. Material shall be removed directly from the paving machine hopper and shall be placed directly in its final location, to be distributed with minimal raking. Material may be dumped directly from a truck, but further material distribution shall be by shovel directly to its final location with minimal raking. A small rubber tire tractor with a screed type attachment may be used to spread a pile dumped from a truck, but raking shall be minimized after spreading.

The paving machine screed shall not be pulled across an area already paved with ARHM, even adjacent to narrow areas to be paved. Such narrow areas shall have ARHM distributed by methods specified by shovel or rubber tire tractor, unless the adjacent area has hardened enough and will not be significantly marred by passing the screed over it. Even if hardened adequately, Contractor shall spread rock dust by hand tools to avoid cohesion of the ARHM in the screed to the existing surface of such areas of freshly cured ARHM.

Contractor shall maintain a functioning infrared heat measurement device in close proximity to each paving machine at all times. The infrared device shall be correlated by thermometer to the actual mat temperature prior to use. The correlation difference shall be applied to all readings thereafter. Contractor shall provide a pavement temperature reading, with an infrared heat measurement instrument, when requested by the Engineer. Inaccessibility of a heat measurement shall be cause for termination of paving operations.

Transverse cold joints shall be provided such that longitudinal joints are not left exposed at the end of the workday.

### **302-9.4 Rolling.**

Replace the subsection with the following:

Initial breakdown rolling shall be vibratory. Rolling in vibratory mode shall not be performed after ARHM material temperature falls below 240° F, due to disturbance of the bonds beginning to set up in the binder at lower temperatures.

An intermediate roller of the same or greater width than the breakdown roller shall be rolling directly behind the breakdown roller at all times, and paving shall cease if intermediate rolling is terminated for any reason. Additional intermediate rollers may be necessary depending on production rates.

Once a rolling pattern is elected by Contractor, the rolling pattern shall remain consistent, unless conditions change and/or a modified rolling pattern is needed to conform to specification.

All finish rolling shall be performed by a separate finish roller.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

To ensure optimum quality control, the use of more than one paver will require notification 3 days in advance to the Engineer, and will generally require one foreman, one sweeper, and a full complement of rollers per Subsection 302-5 of the Standard Specifications and this Subsection 302-9.4 for each paving machine.

An extra breakdown roller shall be on site at all times, free of defects.

Add the following subsections:

### **302-9.4.1 Density and Smoothness.**

Density and smoothness shall conform to Subsection 302-5.6.2, except the second and third paragraph of Subsection 302-5.6.2 shall not apply to ARHM.

The compaction after rolling shall be 95% of density obtained with the California Kneading Compactor, California Test 304 as modified and measured in conformance to this Subsection 302-9.4.1.

The field density of compacted ARHM shall be determined by:

- 1) A nuclear asphalt testing device, calibrated in conformance with California Test 375, except as modified in this Subsection 302-9.4.1, in the field designed to measure the density of pavement of the thickness being constructed; or
- 2) Core with density determined as follows:
  - a) Saw the ARHM lift of pavement from the top of the core approximately perpendicular to the axis of the core, just above any underlying pavement or as necessary to obtain a clean flat surface at the bottom of the sample.
  - b) Clean and dry the sample as described in ASTM 1188.
  - c) Perform California DOT Test 308 Method A step a.
  - d) Prior to proceeding to steps 308A b., 308A c., 308A d., and 308A e., place the core, top surface down, firmly into a flat pan of hot liquid paraffin approximately ¼ inches deep. Allow the sample and paraffin to cool to firm solid state and remove the sample from the pan by cutting around the perimeter. Trim the edges of paraffin parallel to the side of the sample cylinder, and weigh the cylinder to obtain:

G = Mass in grams of level sealed paraffin-treated specimen in air.

- e) Perform 308A b., 308A c., and 308A d. on the sample from D) above.
- f) Complete the remainder of Test 308A, except replace the formula in 308A e. with the following:

$$\text{Bulk Specific Gravity} = \frac{A}{(D - E) - \left( \frac{(D - G)}{F} \right)}$$

In case of dispute, 1) shall be used, except Contractor may elect to use 2), but all costs for such procedures shall be borne by the Contractor to provide the full set of coring, tests, and documentation in conformance with the Standard Specifications, except all test methods shall be modified as specified in these Special Provisions. Also, Contractor shall notify the Engineer at least 3 days in advance of coring operations, and immediately after core testing is complete Contractor shall deliver cores to the Agency for verification.

Nuclear test procedures, including correlation with core densities, shall be in conformance with California Test 375, except as follows:

If a test section is placed and compacted for that purpose, rolling shall be provided as follows: 1) 2 passes with a vibratory breakdown roller above 240° F; and 2) 4 passes with a static roller above 200° F. Core locations for correlation with cores shall be selected based on appearance of relatively tight surface texture, and the test strip shall be selected on this basis. If a test location is determined to have a significantly open

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

texture relative to other areas within the test strip, the location shall not be used. This selection criteria is not to be considered significant to the outcome of, but only as a guideline towards obtaining samples that are relatively well compacted to yield results with minimum standard deviation. The locations shall be well clear of grade breaks and joints. One core centered on the gauge will be used instead of two at each location. Use method 2) in this Subsection 302-9.4.1 to determine density of cores. Surface voids shall not be filled with sand.

Contractor will be notified in writing at least 5 days in advance of such correlation testing and will be invited to have a nuclear gauge onsite to correlate a second gauge. If not independently calibrating at that time, Contractor shall bear the full expense of performing correlation for his nuclear gauge under the specified procedures, but shall notify the Agency 5 days in advance of such correlation testing, such that the Agency can correlate with the Contractor's gauge, if Contractor disagrees with Agency's test results.

### **302-9.4.2 Compaction Payment Reductions.**

Based on laboratory tests on AC pavements revealing a highly significant loss of life span for each 1% reduction of compaction, and the well-known catastrophic effect of oxidation and stripping of asphalt products due to interconnected voids that develop below 95% compaction, and the extreme expense of removing and replacing pavement not compacted to the specified minimum, a nominal deduction of payment will be applied for under-compacted ARHM pavement. The bidder in submitting a Bid fully accepts the provisions in this Subsection 302-9.4.2 and agrees that the nominal payment deduction is acceptable and reasonable for these purposes.

Payment reductions will be applied to ARHM compacted less than 95% of maximum density, the specified minimum, and greater than 91.9% of the maximum density based on nuclear testing with Part 3 Test Site Selection of California Test 375 modified as follows:

A lot will be one day's production or other lesser area of paving as determined by the Agency to be deficient in terms of compaction, and a pull will be the width between joints or edge of pavement as the lot is placed.

Test site selection will conform to California Test 375 Part 3, except the number of tests shall be the area of the lot in square feet divided by 400 and any test site within 0.5m of a grade break or pavement joint shall be relocated laterally towards the center of the pull to 0.5m from such joint or grade break.

The mathematical mean average of percent of maximum density represented by all these tests shall be calculated, except any test results outside of this mean plus two standard deviations based on all tests, shall be rejected. The mean average shall be calculated directly from the remaining values. A compensation reduction in conformance with Table 302-9.4.2 will be applied to the contract unit price for ARHM for material within any lot determined to be below minimum relative compaction, except any lot with tests indicating compaction 91.9% or less shall be removed and replaced at Contractor's expense.

**Table 302-9.4.2**

<b>Relative Compaction (Percent)</b>	<b>Reduced Compensation Factor</b>	<b>Relative Compaction (Percent)</b>	<b>Reduced Compensation Factor</b>
95.0	0.000	93.4	0.062
94.9	0.002	93.3	0.068
94.8	0.004	93.2	0.075
94.7	0.006	93.1	0.082
94.6	0.009	93.0	0.090
94.5	0.012	92.9	0.098
94.4	0.015	92.8	0.108
94.3	0.018	92.7	0.118
94.2	0.022	92.6	0.129

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Relative Compaction (Percent)	Reduced Compensation Factor	Relative Compaction (Percent)	Reduced Compensation Factor
94.1	0.026	92.5	0.142
94.0	0.030	92.4	0.157
93.9	0.034	92.3	0.175
93.8	0.039	92.2	0.196
93.7	0.044	92.1	0.225
93.6	0.050	92.0	0.300
93.5	0.056		

### **302-9.7 Rock Dust Blotter.**

Add the following:

Lack of uniformity of application of rock dust shall be cause to terminate paving operations. Rock dust blotter shall not be applied until intermediate rolling is complete, except as approved by the Engineer based on a fine uniform layer of rock dust, or at major intersections and access points.

### **302-9.9 Payment.**

Replace the first sentence with the following:

Payment for AHRM will be made at the Contract Unit Price per ton for "AC Pavement", which includes AC pavement and AHRM based on the detail included in the Plans. Payment further described in 302-5.9 and this subsection.

## **SECTION 303 – CONCRETE AND MASONRY CONSTRUCTION**

### **303-1 CONCRETE STRUCTURES.**

#### **303-1.11 Payment.**

Add the following after the first paragraph:

Payment for concrete manhole structures at the subsurface infiltration system will be based on Contract Unit Price for Each "3' Manhole Access Shaft for Infiltration System". Concrete manholes along with diversion pipeline are considered as included in the per linear foot pipe cost. Payment for the concrete diversion structures will be based on Contract Unit Price for Each "Diversion Structure (78" RCP)", "Diversion Structure (87" RCP)", and "Diversion Structure (30" RCP)" dependent on the location and shall include development and implementation of a storm drain bypass plan per 306-16. Installation of the "Diversion Structure (30" RCP)" requires the removal of the existing manhole structure. Payment for removal of the existing manhole structure will be based on the Contract Unit Price for Each "Remove Manhole (30" Pipe)" and shall include development and implementation of a storm drain bypass plan per 306-16.

### **303-5 CONCRETE CURBS, WALKS, GUTTERS, CROSS GUTTERS, ALLEY INTERSECTIONS, ACCESS RAMPS, AND DRIVEWAYS**

#### **303-5.1 Requirements.**

##### **303-5.1.1 General.**

Replace the second paragraph with the following:

Unless otherwise specified on the Plans, and except as otherwise specified in 303-5.1.3, the minimum thickness of walks shall be 4 inches. The thickness of gutters, cross gutters, alley intersections, access ramps, and driveway aprons shall be as shown on the Plans or as specified in referenced Standard Plans.

Add the following:

All concrete flatwork areas behind sidewalks, driveways, and right-of-way shall be considered as walks.

Detectable warning surface (truncated domes) for curb ramps shall be Cast-in-Place System per Armor Tile Part No. ADA-C-3648 or Agency approved equal. Color shall be yellow or Agency select.

#### **303-5.7 Repairs and Replacements.**

Add the following:

The Contractor shall be responsible to protect all new concrete work from being etched, scratched or otherwise marked following replacement thereof. If new concrete work is marked, the Contractor shall replace it at its expense and no extra costs will be allowed.

#### **303-5.9 Measurement and Payment.**

Add the following:

Payment for detectable warning surface for newly constructed and existing curb shall be included in the Contract Bid price per square foot for "Detectable Warning Surface" and includes the material and labor necessary to install the detectable warning surface in accordance with the Plans and referenced details.

Payment for modified curb ramps and surrounding approach shall be included in the Contract Bid price for each "Remove and Replace Curb Ramp" and includes the removal and construction of new curb ramps or modification of existing curb ramp approach per the details included in the Plans and SPPWC Std. Plan No. 111-5. This payment item includes sawcutting, complete removal of adjacent pavement and subgrade (within 1-foot of the proposed gutter), underlying subgrade and base, disposal, subgrade preparation and compaction, disposal, and all labor and equipment necessary to complete the required removal (in accordance with 401-3). Modification of existing curb ramp shall include the removal and replacement of existing PCC ramp approach including the chevron area.

Payment for concrete walks, sidewalks, access ramps, and curb/gutter along proposed pipe construction shall be included in the Bid under the corresponding pipe-related Bid item.



## **SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION**

### **306-3 TRENCH EXCAVATION.**

#### **306-3.1 General.**

Add the following:

All trenches shall be sawcut to the bottom of the existing concrete or asphalt section to minimize damage to adjacent pavement. The bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe/bedding and shall be given a final trim using a string line for establishing grade, such that each pipe section, when first laid, will be continually in contact with the ground along the extreme bottom of the pipe. Excavated material suitable for backfilling shall be stockpiled in an orderly manner. Excavated material shall be placed to avoid overloading trench sides and to prevent slides or cave-ins. Grading shall prevent surface water from flowing into trenches.

Trenchless pipe installation may be performed along the full alignment or under existing curb, gutter, and cross-gutter to avoid restoration of existing features along the pipe alignment, at the Contractor's choice. The Contractor shall exercise caution and care to prevent any damage due to trenchless installation under these structures. There shall be no additional payment for this Work if trenchless installation is implemented. Payment for this work shall be included in the Contract Unit Price for the installation of the main pipeline. Alternatively, the Contractor shall restore all surface improvements along the pipe alignment to existing conditions or better as part of the Contract Unit Price for installation of the mainline.

### **306-6 BEDDING.**

#### **306-6.1 General.**

Replace the first sentence of the first paragraph with the following:

Bedding material shall conform to 217 and requirements indicated on the Plans.

Add the following:

Where rock is encountered and the native material does not afford a sufficiently solid foundation for pipe subgrade, the Contractor shall excavate below the subgrade and shall construct a stable base by placing crushed rock bedding upon which subgrade can be prepared. Crushed rock for bedding shall be 1-1/2-inch maximum size. All crushed rock bedding up to a depth of 6 inches below the pipe shall be at the Contractor's expense.

### **306-12 BACKFILL.**

Add the following subsection:

#### **306-12.6 Compaction Testing.**

Upon completion of individual lifts of backfilling operations and compacting of the lifts, an independent testing service, designated by the Agency, shall, at locations designated by the Engineer, provide compaction tests. The Agency shall pay the testing service for the initial tests. The Contractor shall be responsible for costs if any re-compaction and retesting is required.

### **306-13 TRENCH RESURFACING.**

#### **306-13.2 Permanent Resurfacing.**

Add the following:

Trench resurfacing in paved areas shall be performed according to the Plans.

If any surface features are disturbed during construction of open trench conduit construction such as curbs, gutters, sidewalks, utility covers, landscape/irrigation components, traffic detector loops, and other existing improvements, the features must be repaired or replaced to original working condition at no additional cost to the Agency.

### **306-14 MEASUREMENT.**

#### **306-14.1 Shoring and Bracing.**

Replace the subsection with the following:

Shoring and bracing, if necessary, will not be measured separately for payment. Shoring and bracing shall be considered as included in the prices in the Bid for the items of Work necessitating it.

#### **306-14.3 Gravity Pipe.**

Replace the first sentence with the following:

Gravity pipe will be measured in a horizontal plane along the pipe centerline between the ends as laid and shall include the length of the actual pipe in-place, including the lay-lengths of in-line tees, fittings, valves, meters, manholes, and appurtenances.

#### **306-14.7 Temporary Resurfacing.**

Replace the subsection with the following:

Temporary resurfacing, if necessary, will not be measured separately for payment. Temporary resurfacing shall be considered as included in the prices in the Bid for the items of Work necessitating it.

### **306-15 PAYMENT.**

#### **306-15.1 General.**

Replace item o) and add the following to the alphabetized list. Items listed are as applicable/necessary.

- o) Shoring and bracing;
- p) Bedding material and placement;
- q) Trench dewatering;
- r) Over-excavation, refilling, and compaction of suitable material;
- s) Temporary resurfacing
- t) Steel plates;
- u) Manholes along pipeline;
- v) Utility support and encasement across, within, and adjacent to trench;
- w) Repair or replacement of any surface features impacted, including, but not limited to, curbs, gutters, sidewalks, curb ramps, utility covers, landscape/irrigation components, traffic detector loops, and other existing improvements; and
- x) All other work necessary to install the pipe or conduit complete in-place.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Add the following:

Payment for pipe and conduit will be made at the Contract Unit Price per lineal foot of "18" RCP Diversion Line" and "36" RCP Diversion Line".

### **306-15.2 Shoring and Bracing.**

Replace the subsection with the following:

No separate payment for shoring and bracing shall be made. Shoring and bracing, as needed, shall be considered as included in the prices in the Bid for the items of Work necessitating it.

### **306-15.5 Valves.**

Remove the words "excluding temporary resurfacing" from the second sentence.

Add the following:

Flow control valves on the diversion lines will be paid as indicated in FMV3-3 of the Technical Specifications.

### **306-15.6 Hydrants.**

Remove the words "excluding temporary resurfacing" from the second sentence.

### **306-15.7 Buried Structures.**

Remove the words "excluding temporary resurfacing" from the third sentence.

### **306-15.8 Pipeline Appurtenances.**

Remove the words "excluding temporary resurfacing" from the second sentence of the second paragraph.

### **306-15.9 Temporary Resurfacing.**

Replace the subsection with the following:

No separate payment for temporary resurfacing shall be made. Temporary resurfacing, as needed, shall be considered as included in the prices in the Bid for the items of Work necessitating it.

Add the following subsection:

## **306-16 STORM DRAIN BYPASS.**

### **306-16.1 General.**

Bypass pumping may be required to divert the flow in existing storm drains around proposed improvements. Work in storm drains shall be limited to the dry season (April 15<sup>th</sup> to September 30<sup>th</sup>), unless otherwise indicated in the LACFCD permit or approved by the Engineer.

**306-16.2 Submittals.**

The Contractor shall submit for the Agency's approval, a written Storm Drain Bypass Plan at least ten (10) working days prior to the beginning of any individual construction process where bypass is needed. The plan shall contain a contingency plan in the event of pump(s) failure, the sequence of construction, and a list of all piping, pumps, plugs, etc. required for each site. The plan shall indicate the locations and capacities of all pumps, sumps, suction lines, and discharge lines.

**306-16.3 Requirements.**

When bypass pumping is required, the Contractor shall supply the pumps, conduits, and other equipment to divert flows around the pipe section in which Work is to be performed. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur. The Contractor shall have onsite backup pumps capable of pumping 150% of the existing flow. Each standby backup pump shall be a complete unit with its own suction and discharge piping.

All pump(s) drives shall have noise suppresser exhaust systems to mitigate the noise levels to within acceptable levels per the Agency's guidelines.

Bypass piping, when crossing areas subject to traffic loads, shall be constructed in trenches with adequate cover and otherwise protected from damage due to traffic. Lay-flat hose or aluminum piping with an adequate casing and/or traffic plates may be allowed if so approved by the Engineer. Bypass pump suction and discharge lines that extend into manholes shall be rigid hose or hard pipe. Lay-flat hose will not be allowed to extend into manholes.

The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.

**306-16.4 Payment.**

Payment for storm drain bypass shall be included in the Contract Unit Price for Each "Diversion Structure (78" RCP)", "Diversion Structure (87" RCP)", and "Diversion Structure (30" RCP)" dependent on the location and shall satisfy payment requirements included in 303-1.11.

**SECTION 314 – TRAFFIC STRIPING, CURB AND PAVEMENT MARKINGS, AND PAVEMENT MARKERS**

The Contractor shall review the associated Technical Specifications included in this Specifications package, which refers to Caltrans latest (2018) Standard Specifications. Any conflicts with these Special Provisions and the Technical Specifications shall immediately be brought to the attention of the Agency.

## **PART 4 – EXISTING IMPROVEMENTS**

### **SECTION 400 – PROTECTION AND RESTORATION**

#### **400-1 GENERAL.**

Add the following:

Existing improvements damaged or removed without written authorization from the Engineer shall be replaced by the Contractor at no cost to the Agency. The Contractor shall leave the Work area in the same or better condition as compared to before beginning Contract Work.

#### **400-2 PERMANENT SURVEY MARKERS.**

Replace “The Agency will:” in second paragraph with “The Contractor shall retain a Registered Land Surveyor or a Registered Civil Engineer authorized to practice land surveying within the State of California to do the following:”.

#### **400-3 PAYMENT.**

Replace the second sentence of the first paragraph with the following:

Permanent survey markers will be restored by a Registered Land Surveyor or a Registered Civil Engineer authorized to practice land surveying within the State of California, retained by the Contractor, at no additional expense to the Agency.

### **SECTION 401 – REMOVAL**

#### **401-1 GENERAL.**

Add the following:

Unless otherwise stated on the Plans or Specifications, all material removed from the Work shall become the property of the Contractor and shall be disposed of in a lawful manner. Removals shall include, but not limited to, all excess excavation material, trees and plants, debris, interfering portions of curb, gutters, asphalt and PCC pavements and sidewalks (including base, where applicable), and miscellaneous items as shown on the Plans. The Contractor shall conform to the following requirements:

- 1) The Contractor shall not start any removal work unless it is prepared to perform reconstruction work within 24 hours of the time removals were begun, unless otherwise approved by the Engineer.
- 2) The Contractor shall complete forming and pouring of PCC construction within five (5) working days following the removal of existing material at any location.
- 3) The Contractor shall not remove on-site improvements until it is prepared to construct the adjacent Work and shall promptly restore all such improvements as applicable, upon completion of the adjacent Work.

Prior to making removals, the Contractor shall meet with the Engineer to verify the limits of removals, locations of joins, to establish smooth joins and to ensure proper drainage. The Contractor may make minor changes in the location of joins and the limits of removals, provided a smooth join and proper drainage can be achieved and it has obtained prior written approval from the Engineer.

## **401-2 ASPHALT CONCRETE PAVEMENT.**

Add the following:

Bituminous pavement shall be removed to neatly sawed edges. Saw cuts shall be to a minimum depth of 3 inches. Where only the surface of existing bituminous pavement is to be removed, the method of removal shall be approved by the Engineer, and a minimum laying depth of 1 inch of new pavement material shall be provided at the join line. Where bituminous pavement adjoins a trench, the edges adjacent to the trench shall be saw cut to neat straight lines before resurfacing to ensure that all areas to be resurfaced are accessible to the rollers used to compact the subgrade or paving materials.

Bituminous pavement on curb and gutter, sidewalk or drive approaches shall be removed by heating with a torch to soften the pavement without creating smoke. Softening shall be performed until the bituminous material can be easily scraped away down to the underlying PCC surface. The blade used for scraping shall be maintained straight along its edge and clean. Bituminous material shall be scraped in this manner until it is completely removed.

## **401-3 CONCRETE AND MASONRY IMPROVEMENTS.**

### **401-3.2 Concrete Curb, Walk, Gutters, Cross Gutters, Curb Ramps, Driveway, and Alley Intersections.**

Replace the subsection with the following:

Concrete shall be removed to neatly sawed edges with saw cuts made through the entire depth. Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk. No section to be replaced shall be smaller than 30 inches in either length or width. If the saw cut in sidewalk, access ramp, or driveway would fall within 30 inches of a construction joint, expansion joint, or edge, the concrete shall be removed to the joint or edge, except that where the saw cut would fall within 12 inches of a score mark, the saw cut shall be made in and along the score mark. Curb and gutter shall be sawed (full depth) on a neat line at right angles to the curb face.

## **401-5 OTHER IMPROVEMENTS.**

Replace the section with the following:

### **401-5.1 Remove and Reinstall Items.**

In locations indicated on the Plans, Bid, and Specifications, or where directed by the Engineer, the Contractor shall remove items, protect them, and then restore them once conflicting Work is completed. The Contractor shall place back features to match conditions at the start of the Work, or better. The Contractor shall take photographs of existing features to be reinstalled prior to removal and once restored, which shall be available if requested by the Agency or Engineer. The Contractor is responsible for recording existing layouts, locations, and feature characteristics, such that they can be restored. If the Contractor identifies conditions that may make it difficult to restore the infrastructure, it shall be brought to the immediate attention of the Engineer. If the Contractor identifies any permanent conflicts that will arise between the restored items and proposed Work, it shall be brought to the immediate attention of the Engineer (within five days from removing the infrastructure). The Contractor is responsible for storing and protecting infrastructure in such a manner that will not degrade quality and performance.

#### 401-6 MEASUREMENT.

Replace the section with the following:

Removal and replacement of improvements for the purpose of installing/constructing Project components are not measured separately (example including proposed piping, in which surface removal and restoration is not indicated separately and is included in the specification and bid for the associated piping).

Measurement for "Remove and Reinstall Chain Link Fence" shall be per Linear Foot.

Measurement for "Remove and Reinstall Existing Electrical Lines" shall be per Linear Foot.

#### 401-7 PAYMENT.

Replace the section with the following:

Payment under this section shall be by the following:

- a) **Bituminous Pavement.** There shall be no separate payment for removal of bituminous pavement, and all costs related thereto shall be considered as included in the Contract Unit Prices for the items of Work for which the removal is required.
- b) **Concrete Ramps, Sidewalks, and Driveways.** With the exception of the curb ramps described in 303-5.9, there shall be no separate payment for removal of concrete ramps, sidewalks, and driveways, and all costs related thereto shall be considered as included in the Contract Unit Prices for the items of Work for which the removal is required.
- c) **Concrete Curb and Gutters.** There shall be no separate payment for removal of concrete curb and gutters, and all costs related thereto shall be considered as included in the Contract Unit Prices for the items of Work for which the removal is required.
- d) **Chain Link Fence.** Payment for chain link fence removal and reinstallation shall be made at the Contract Unit Price per Linear Foot for "Remove and Reinstall Chain Link Fence" and shall include full compensation for the removal, protection (or replacement), reinstallation, connection to protected fencing, and all appurtenant work.
- e) **Electrical Lines.** Payment for electrical line removal and reinstallation shall be made at the Contract Unit Price per Linear Foot for "Remove and Reinstall Existing Electrical Lines" and shall include full compensation for the removal, protection (or replacement), and reinstallation of electrical conduit and wire; connection to protected lines; and all appurtenant work. The Contractor shall determine what each of the lines identified for temporary removal service and inform the Agency of their findings. The Agency will determine if the electrical service must be maintained during construction or if the service can be removed temporarily and restored following completion of the work requiring temporary removal.
- f) **Concrete Sidewalk.** Payment for restoration of the concrete sidewalk/walkway within the park shall be made at the Contract Unit Price per Square Foot for "Concrete Sidewalk Restoration" and shall include full compensation for removal, replacement, and all appurtenant work in accordance with the detail included on the Landscape and Irrigation Plans.
- g) **Irrigation System.** The Contractor shall remove the existing irrigation system servicing the areas shown with a new irrigation system in the Plans. Removal of the existing irrigation system shall be included in the Contract Lump Sum Price for "Irrigation," which also includes replacement in accordance with the Plans and Technical Specifications.

## **SECTION 402 – UTILITIES**

### **402-1 LOCATION.**

#### **402-1.1 General.**

Add the following:

Utilities for the purpose of these Special Provisions shall be considered as including but not limited to; pipelines; conduits; transmission lines; appurtenance of both public utilities and private industries, business, or individual; storm drains; sanitary sewers; and street lighting conduits.

The Agency has endeavored to locate and indicate on the Drawings all underground utilities, facilities, and obstructions within the limit of the Work under this Contract or so nearly adjacent thereto as to interfere with the execution of the Work. However, the accuracy and completeness of the utility locations indicated on the Plans is not guaranteed. Sewer service lines, gas service connections, and street lights and traffic signal conduits may not be shown on the Plans.

The Contractor is responsible to determine the exact location of utilities and its service connections during construction. The Contractor shall notify the Agency of the exact location of any utility or service connection which is not shown or incorrectly shown on the Plans.

The Contractor shall be expected to maintain liaison with the affected utility company representatives, and shall notify them prior to beginning of the job and each time the particular utility is or could possibly be affected at least 24 hours in advance:

- |  |                |
|--|----------------|
| 1. Century Link and Level 3 Network                | (918) 547-0007 |
| 2. Charter Communications                          | (818) 922-6167 |
| 3. Plains All American Pipeline (Pacific Pipeline) | (800) 987-4737 |
| 4. San Fernando Water Department                   | (818) 898-1293 |
| 5. Southern California Edison                      | (800) 611-1911 |
| 6. Southern California Gas Company                 | (800) 427-2200 |
| 7. Spectrum (Time Warner Cable)                    | (818) 700-6500 |
| 8. Verizon Company                                 | (800) 483-1000 |

#### **402-1.2 Payment.**

Replace the subsection with the following:

Payment for utility location by the Contractor, including coordination with individual utility owners, shall be considered included in the Bid as part of other items requiring utility locating and coordination and no additional compensation will be allowed therefor.

### **402-2 PROTECTION.**

Add the following:

The Contractor shall identify locations where the project area and proposed construction is crossed by overhead utilities. The Contractor shall place a sign that reads “DANGER OVERHEAD POWER LINES” (or similar) at each of the locations identified as being crossed by existing overhead utilities. If the Contractor damages overhead utilities within the project area during the course of the Work, then the Contractor must restore them to existing condition or better at no additional cost to the Agency.



## **SECTION 403 – MANHOLE ADJUSTMENT AND RECONSTRUCTION**

### **403-3 MANHOLES IN ASPHALT CONCRETE PAVEMENT.**

Add the following at the end of the section:

Class C or D ARHM shall be used to patch around all frame and cover sets.

Add the following subsections:

#### **403-3.1 Adjustment of Los Angeles County Flood Control District Manhole Frame and Cover.**

Adjustments to grade of Los Angeles County Flood Control District (LACFCD) Manhole Frame and Cover sets do not require a LACFCD permit. However, the Contractor shall notify the Inspection Department at (818) 458-3129, 24 hours in advance of any work in the area of the manhole.

#### **403-3.2 Adjustment of Water Valve Box Frame and Covers.**

Water valve box frame and cover within the area to be paved or graded shall be set to finish grade by the Contractor as required by the Plans and Specifications. In the case of portland cement concrete, water valve box frame and cover shall be set to finish grade by the Contractor before paving.

### **403-4 MEASUREMENT.**

Replace the section with the following:

There shall be no separate measurement for manhole adjustment and reconstruction.

### **403-4 PAYMENT.**

Replace the section with the following:

There shall be no separate payment for manhole adjustment and reconstruction and all costs related thereto shall be considered as included in the Contract Unit Prices for the items of Work for which the manhole adjustment and reconstruction is required.

## **PART 5 – PIPELINE SYSTEM REHABILITATION**

### **SECTION 500 – PIPELINE REHABILITATION**

#### **500-4 PIPELINE POINT REPAIR AND/OR REPLACEMENT.**

##### **500-4.7 Payment.**

Replace the first sentence with the following:

Payment for pipeline point repair and/or replacement shall be made at the Contract Unit Price per Linear Foot for “Remove and Replace Sewer Line” and shall include furnishing and installing all fittings, connections, seals, and special work shown on the Plans.

## **PART 6 – TEMPORARY TRAFFIC CONTROL**

### **SECTION 600 – ACCESS**

#### **600-1 GENERAL.**

Add the following:

In the event that any street must be closed, request must be received by the Engineer for approval and the following parties shall be notified at least 48 hours in advance:

- |    |                                |                |
|----|--------------------------------|----------------|
| a. | Public Works Department        | (818) 898-1293 |
|    | Manuel Fabian                  | (818) 898-1243 |
| b. | San Fernando Police Department | (818) 898-1267 |
| c. | Los Angeles Fire Department    | (818) 989-8561 |
| d. | Mauran Ambulance               | (818) 365-3182 |
| e. | Los Angeles County Metro       | (213) 922-4632 |

The Contractor shall contract the Agency's Public Works Department at least 48 hours in advance of a partial road closure and must receive approval from the Engineer.

The Contractor may choose to comply with the requirements of WATCH (Work Area Traffic Control Handbook) or MUTCD (Manual on Uniform Traffic Control Devices) in providing devices and signage for pedestrian and vehicular traffic. The Contractor shall provide flagmen as necessary.

Overnight parking of construction equipment in the project site shall comply with the Agency parking restriction/regulations. Contractor shall provide adequate flashing barricades.

### **SECTION 601 – TEMPORARY TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE WORK ZONES**

#### **601-1 GENERAL.**

Add the following:

The Contractor shall implement any measures requested by the City Engineer, as deemed necessary to ensure the proper flow of traffic and the protection of the public and the safety of the workers. The Contractor shall maintain, at all times, the ability to respond to calls from the San Fernando Police Department during non-working hours to replace or provide additional traffic control or safety devices as shall be required by the Police Department.

#### **601-2 TEMPORARY TRAFFIC CONTROL PLANS (TCP).**

##### **601-2.1 General.**

Replace the first sentence with the following:

The Contractor shall submit a TCP in accordance with 3-8.2.

**601-2.2 Payment.**

Replace the section with the following:

Payment for preparation of the TCP shall be considered as included in the Bid under the Lump Sum Bid Price for "Traffic Control," which includes preparation of traffic control plans, full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in placing and maintaining temporary pedestrian paths of travel and placing, removing, storing, maintaining, moving to new locations, replacing, and disposing of the components of traffic control system as specified in Part 6. The lump sum price shall also include all associated temporary signs, flashing arrow signs, flagging and/or flagmen, and project notifications.

**601-3 TEMPORARY TRAFFIC CONTROL (TTC) ZONE DEVICES.**

**601-3.5 Signs and Signage**

**601-3.5.1 General.**

Replace the second sentence in the third paragraph with the following:

When parking restrictions are required to perform the Work, the Contractor must notify the Agency's Public Works Department and Police Department at least 24 hours in advance. Signs must be posted at least 24 hours, and no more than 48 hours, in advance. Signs must include "NO PARKING" with the dates for which parking restrictions are to be in place and must cite CVC Section 22651 (L). Temporary no parking signs shall be removed as soon as the Work requiring parking restrictions is completed.

**601-3.5.2 Payment.**

Replace the section with the following:

Payment for signs and signage for temporary traffic control shall be considered as included in the Bid under the Lump Sum Bid Price for "Traffic Control," which includes overall traffic control, as further defined in 601-2.2.

**601-3.6 Channelizing Devices.**

**601-3.6.6 Measurement.**

Replace the entire subsection with the following:

Cones, tubular markers, channelizers, drums, barricades, temporary traffic barriers, and end treatments will not be measured separately for payment.

**601.3.6.7 Payment.**

Replace the entire subsection with the following:

No separate or additional payment will be made for cones, tubular markers, channelizers, drums, barricades, temporary traffic barriers, and end treatments, as they shall be considered as included in the Bid under the Lump Sum Bid Price for "Traffic Control," which includes overall traffic control, as further defined in 601-2.2.

**601-3.7 Warning Lights.**

**601-3.7.8 Measurement.**

Replace the entire subsection with the following:

Flags, high-level warning devices, warning lights, flashing directional bars, PCMS, and flashing arrow signs will not be measured separately for payment.

**601.3.7.9 Payment.**

Replace the entire subsection with the following:

No separate or additional payment will be made for flags, high-level warning devices, warning lights, flashing directional bars, PCMS, and flashing arrow signs, as they shall be considered as included in the Bid under the Lump Sum Bid Price for "Traffic Control," which includes overall traffic control, as further defined in 601-2.2.

**601-4 TEMPORARY TRAFFIC STRIPING AND PAVEMENT MARKINGS.**

**601-4.5 Payment.**

Add the following:

Temporary traffic striping and pavement markings included in the Contractor-developed TCP shall be included in the Bid under the Lump Sum Bid Price for "Traffic Control," which includes overall traffic control, as further defined in 601-2.2.

## **PART 8 – LANDSCAPING AND IRRIGATION**

Add the following before the first section.

Landscape technical specifications are included as part of these Contract Documents. The landscape and irrigation plans also include written notes and specifications. The landscape and irrigation plans take precedence, followed by the technical specifications, and then the standard specifications.

# **TECHNICAL SPECIFICATIONS**

## **STORMWATER TREATMENT**

This specification section describes the continuous deflection system unit for pretreatment of captured runoff, including stormwater and dry-weather runoff.

### **SECTION 1 – GENERAL**

#### **SWT1-1 Scope.**

The Contractor shall furnish all labor, equipment, and materials necessary to install the stormwater treatment device (SWTD) and appurtenances specified in the Contract Documents and these specifications.

#### **SWT1-2 Quality Assurances.**

##### **SWT1-2.1 Inspection.**

All components shall be subject to inspection by the Engineer at the place of manufacture and/or installation. All components are subject to be rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject to repair. Final acceptance of the component is contingent upon the discretion of the Engineer.

##### **SWT1-2.2 Warranty.**

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of one (1) year from the date the project is deemed complete by the Agency. The manufacturer will be notified of repair/replacement issues in writing within the referenced warranty period. The manufacturer shall, upon its determination of repair, correct or replace any manufacturer originated defects identified by written notice within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

##### **SWT1-2.3 Manufacturer's Performance Certificate.**

The Contractor shall submit to the Agency a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies as listed in these specifications. The certification shall be supported by independent third-party research.

#### **SWT1-3 Submittals.**

##### **SWT1-3.1 Working Drawings.**

The Contractor shall prepare and submit working drawings in accordance with Section 3-8.2. The working drawings shall detail installation procedures and operations and maintenance procedures.

##### **SWT1-3.2 Shop Drawings.**

The Contractor shall prepare and submit shop drawings in accordance with Section 3-8.3. The shop drawings shall detail horizontal and vertical dimensioning, reinforcement, and joint type and locations.



## **SECTION 2 – PRODUCTS**

### **SWT2-1 Materials and Design.**

#### **SWT2-1.1 Precast Concrete Components.**

Precast concrete components shall conform to applicable sections of ASTM C478, ASTM C857, and ASTM C858, along with the following:

- 1) Concrete shall achieve a minimum 28-day compressive strength of 5,000 psi;
- 2) Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 3) Cement shall be Type III or V Portland Cement conforming to ASTM C150;
- 4) Aggregates shall conform to ASTM C33;
- 5) Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A615, A185, or A497, respectively;
- 6) Joints shall be sealed with preformed joint sealing compound conforming to ASTM C990; and
- 7) Shipping of components shall not be initiated until a minimum compressive strength of 5,000 psi is attained.

#### **SWT2-1.2 Internal Components and Appurtenances.**

Internal Components and appurtenances shall conform to the following:

- 1) Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F1267-01;
- 2) Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A320;
- 3) Fiberglass components shall conform to ASTM D-4097; and
- 4) Access system(s) conform to the following:
  - a. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A48 Class 30.

### **SWT2-2 Performance.**

#### **SWT2-2.1 Removal Efficiencies.**

- 1) The SWTD shall be capable of achieving an 80 percent average annual reduction in the total suspended solid load.
- 2) The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.
- 3) The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of stormwater runoff ( $20 \pm 5$  mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

The SWTD shall be capable of utilizing sorbent media to enhance removal and retention of petroleum-based pollutants.

**SWT2-2.2 Hydraulic Capacity.**

- 1) The SWTD shall provide a rated-treatment capacity, which is consistent with governing water treatment regulations. At its rated-treatment capacity, the device shall be capable of achieving 80 percent removal efficiency for particle distributions having a mean particle size ( $d_{50}$ ) of 125 microns. This removal efficiency shall be supported by independent third-party research.
- 2) The SWTD shall maintain the peak conveyance capacity of the drainage network as defined by the Engineer.

**SWT2-2.3 Storage Capacity.**

- 1) The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in the table below. The boundaries of the sump chamber shall be limited to that which does not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Agency's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 28 inches in diameter.
- 2) The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills. The minimum storage capacity provided by the SWTD shall be in accordance with the volume listed in the table below.

Model	Minimum Treatment Capacity (cfs)	Minimum Sump Storage Capacity (yd <sup>3</sup> )/(m <sup>3</sup> )	Minimum Oil Storage Capacity (gal)/(L)
Contech CDS5640-10-C, Jensen JDS120-6748, or Agency Approved Equal	8.8	8.7 (6.7)	758 (2,869)
Contech CDS5668-10-C, Jensen JDS120-6782, or Agency Approved Equal	15.4	8.7 (6.7)	1,172 (4,435)

**SWT2-2.4 Alternate Treatment Technologies and Sizing Criteria.**

The sizing criteria for treatment systems must conform to the recommended loading rate and third-party testing data requirements as mentioned below:

- 1) Screening Systems – designed for full treatment of the runoff rate at a loading rate not to exceed the critical flow in the inlet, in order to achieve 80 percent total suspended solids (TSS) removal efficiency (80 percent TSS removal based on an average particles size of 125 microns).

Additionally, the performance of the unit must be evaluated by a third-party and verified in a program that allows a more-or-less direct comparison to other technologies. Performance should be third-party verified, and removal efficiencies across the spectrum of particle sizes reported, at a range of hydraulic loading rates varying over a range of at least 25 to 125 percent of the manufacturer's advertised 'water treatment' loading rate.

**SWT2-3 Manufacturer.**

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of stormwater runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Plans, the SWTD(s) shall be a CDS® device manufactured by:

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Contech Engineered Solutions  
9025 Centre Pointe Drive  
West Chester, OH 45069  
(800) 338-1122

Or a JDS device manufactured by:

Jensen Stormwater Systems  
521 Dunn Circle  
Sparks, NV 89431  
(877) 649-0095

Or Agency approved equal.

### **SECTION 3 – EXECUTION**

#### **SWT3-1 Handling and Storage.**

The Contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation.

#### **SWT3-2 Installation.**

The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the Contract Documents. The manufacturer shall provide the Contractor installation instructions and offer onsite guidance during the important stages of the installation as identified by the manufacturer at no additional expense.

The Contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The Contractor shall trim all protruding lifting provisions flush with the adjacent paved surface in a manner which leaves no sharp points or edges.

The SWTD shall have completed field tested following TARP Tier II protocol requirements.

The Contractor shall remove all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Agency.

#### **SWT3-3 Payment.**

Payment for SWTDs shall be made at the Bid Price for Each for "BI-7001 Pretreatment System" and "BI-0256 Pretreatment System" and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals involving excavation, shoring, backfill, grading, compaction, base, sealant, pipe connections, surface restoration, and all other appurtenances, as shown on the Plans, as specified in the Standard Specifications and these Special Provisions, and as directed by the Engineer, and no additional compensation will be allowed therefore.

## STORMWATER INFILTRATION SYSTEM

This specification describes StormTrap subsurface infiltration system, or Agency approved equal, for use in stormwater storage and infiltration.

### SECTION 1 – GENERAL

#### SW11-1 Design Requirements.

The following design requirements shall apply:

- 1) Precast concrete modular stormwater detention/infiltration shall comply with ASTM C858
- 2) Precast concrete subsurface infiltration system shall be sized in accordance with the following specifications:
  - a. Subsurface infiltration system must have a minimum storage capacity of 3,014,300 gallons (402,980 cubic feet or 9.25 acre-feet) and a minimum footprint of 54,450 square feet
- 3) System shall be designed so modules are aligned and have channels that extend to the bottom of the modules, allowing for relatively unrestricted fluid flow in both directions.
- 4) Minimum structural design loading (ASTM C857)
  - a. Total cover: as indicated on Plans
  - b. Concrete shall be designed for AASHTO HS-20 wheel loading
  - c. Dry-cast concrete shall meet the testing requirements identified in Section SW11-2
  - d. Minimum soil pressure: 130 pounds per square foot (psf)
  - e. Vertical and lateral soil pressures shall be determine using:
    - i. Groundwater below invert
    - ii. Lateral soil pressures to be based on active earth pressure
      1. Lateral soil pressure = 35 pounds per cubic foot (pcf) for 130 pcf backfill unit weight
    - iii. Vertical soil pressures
      1. Live load = HS-20-44 and Dead load = 130 pcf cover fill unit weight
    - iv. Contractor to verify geotechnical requirements

#### SW11-2 Quality Assurance.

The manufacture of the precast concrete modules shall be performed at a precast production facility certified by the National Precast Concrete Association (NPCA) or Precast Concrete Institute (PCI). The Agency and/or Engineer must be able to visit the production facility upon request.

If dry-cast storage is proposed by the Contractor, the Contractor must schedule a visit to the production facility with the Agency, Engineer, and/or their representatives prior to acceptance as a suitable product/material. The submittal shall include three representative core samples for the Agency to review, observe, and test. The Contractor shall test three additional representative core samples (taken from the same unit the samples provided for Agency review are taken). The Contractor's test shall include the criteria in the bulleted list below.

If dry-cast storage is proposed and conditionally accepted by the Agency, the Contractor shall hire a third-party testing firm for review and testing. The third-party testing firm must be approved by the Agency. The third-party firm shall report to the Agency for the sole purpose of testing and assessing dry-cast storage system components delivered to the Project. If dry-cast material is accepted for the infiltration system, then core samples must be taken from the bottom, top, and sides of the units throughout the duration of the Project. A minimum of three (3) core sample shall be taken for every 25,000 gallons of storage provided, which must be distributed evenly throughout the Project. Core samples shall be assessed for the criteria listed below. All core samples shall be reviewed and accepted prior to delivery of any modules. Cores shall be patched at the manufacturing facility, such that the structural integrity and functionality are preserved.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Core sample testing indicated above shall include the following results, at a minimum:

- Moisture value wet
- Moisture value dry
- Water content
- Target water/cement ratio
- Actual water/cement ratio
- Batch weight
- Void ratio
- Compressive strength at 1 day, 7 days, and 28 days

If the test results demonstrate the system does not meet the Project specifications, then the Agency reserves the right to reject the units, require additional testing, and/or require the Contractor install wet-cast or cast-in-place infiltration modules at no additional expense to the Agency.

### **SWI1-3 Submittals.**

#### **SWI1-3.1 Working Drawings.**

The Contractor shall prepare and submit working drawings in accordance with Section 3-8.2. The working drawings shall detail manufacturer's product data, installation procedures, and operations and maintenance procedures/instructions.

#### **SWI1-3.2 Shop Drawings.**

The Contractor shall prepare and submit shop drawings in accordance with Section 3-8.3. The shop drawings shall detail:

- 1) Plan, elevation, sections, and details indicating layout, dimensions, foundation, cover, and joints
- 2) Size and location of roof openings and inlet and outlet pipe openings
- 3) Indicate sealing of joints
- 4) Footing sizing, rebar placement, and calculations, stamped and signed by a Professional Engineer licensed in the State of California (required based on manufacturer)

### **SWI1-4 Delivery, Storage, and Handling.**

Accessories shall be delivered to the site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer. Accessories shall be stored in accordance with manufacturer's instructions and shall be in a clean and dry area away from direct sunlight. All materials shall be protected during handling and installation to prevent damage.

### **SWI1-5 Warranty.**

The manufacturer shall provide a minimum five (5) year warranty, upon Project acceptance by Agency.

## **SECTION 2 – PRODUCTS**

### **SWI2-1 Manufacturer.**

The manufacturer of the precast concrete subsurface infiltration system shall be one that is regularly engaged in the engineering design and production of systems deployed for the retention and infiltration of stormwater runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Plans, the precast concrete subsurface infiltration system shall be a StormTrap system manufactured by:

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

StormTrap, LLC.  
1287 Windham Parkway  
Romeoville, IL 60446  
Phone: (877) 867-6872  
Fax: (331) 318-5347  
Web: [www.stormtrap.com](http://www.stormtrap.com)

Or Agency approved equal.

### **SWI2-2 Stormwater Infiltration.**

All material shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

Stormwater infiltration modules:

- 1) Description: engineered, precast concrete, modular stormwater detention that supports infiltration
- 2) Module type: StormTrap SingleTrap, or Agency approved equal
- 3) Size: as indicated in the Plans and/or within the specifications listed in Section SWI1-1
- 4) Concrete: Manufacturer's approved mix design providing a minimum compressive strength of 6,000 psi at 28 days
- 5) Reinforcing bars: ASTM A615, Grade 60
- 6) Reinforcing mesh: ASTM A1064, Grade 80
- 7) Cover for reinforcing bars: ACI 318

### **SWI2-3 Concrete Pad.**

The Contractor shall construct a reinforced concrete pad foundation in coordination with the Engineer and StormTrap (or other infiltration system manufacturer). The foundation shall have a minimum 1-foot overhang, as shown on the Plans. The concrete shall have a minimum compressive strength of 4,500 psi at 28 days. Foundation reinforcement shall be included in the Contractor's shop drawings per SWI1-3.2. A concrete pad/footing may not be required if another manufacturer is used.

### **SWI2-4 Accessories.**

Joint tape shall meet or exceed the following:

- 1) ASTM C990
- 2) Seven eights inch (7/8") diameter, performed butyl mastic joint sealer
- 3) To be approved by subsurface infiltration system manufacturer and Engineer

Joint wrap shall meet or exceed the following:

- 1) Eight inch (8") wide self-adhesive elastomeric resin bonded woven puncture resistant polymer wrap
- 2) To be approved by subsurface infiltration system manufacturer and Engineer

## **SECTION 3 – EXECUTION**

### **SWI3-1 Examination.**

Area to receive stormwater infiltration modules shall be examined. The Engineer shall be notified if area is not acceptable. Installation shall not begin until unacceptable conditions have been corrected. Dimensions and soil conditions, including groundwater and soil bearing capacity, shall be verified prior to installation. Excavation within the Project area may require excavation of boulders, as was encountered during the geotechnical exploration per 3-9.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### **SWI3-2 Installation.**

Installation of the precast subsurface infiltration system shall meet or exceed the following:

- 1) Install in accordance with the Manufacturer's instructions and ASTM C891
- 2) Install modules plumb, on line, and to proper elevation
- 3) Install modules with minimal space between adjacent modules, no more than ¾-inch
  - a. If space between modules exceeds Manufacturer's recommendations or is not acceptable to the Engineer, then the modules shall be reset with appropriate adjustments made to line and grade to bring the space into compliance
- 4) SingleTrap (or Agency approved equal):
  - a. Place modules on level, cast-in-place foundation with minimum one-foot overhang, as shown on the Plans
  - b. Cast-in-place foundation shall have a minimum compressive strength of 4,500 psi at 28 days
  - c. Concrete pad foundation shall be placed on a minimum of six-inch (6") thick bed of ¾-inch crushed rock, per the Reference Plans and 200-1.2
- 5) Joint tape:
  - a. Seal perimeter horizontal joint between modules with joint tape in accordance with ASTM C891, 8.8, and 8.12
  - b. Prepare surfaces and install joint tape in accordance with manufacturer's instructions
- 6) Field modifications to the modules are strictly prohibited without prior written consent of the precast concrete subsurface infiltration system manufacturer.
- 7) Excavation and fill shall be as specified in the Plans and Specifications
- 8) Fill:
  - a. Backfill material shall be ¾-inch crushed rock, per the Reference Plans and 200-1.2, under the infiltration system
  - b. Backfill along the sides of the chambers shall be structure backfill in accordance with the Manufacturer's recommendations, per the Reference Plans and 217-3
  - c. Deposit fill on both sides of modules at the same time and to approximate same elevation
  - d. Prevent wedging action against structure by stepping or serrating slopes bounding or within area to be backfilled
  - e. Do not disrupt or damage joint wrap during backfilling
- 9) Stormwater infiltration modules that are damaged, as determined by the infiltration system manufacturer or Engineer, shall not be used at no additional expense to the Agency
- 10) Contractor is responsible for installation in accordance with Plans, Specifications, and all federal, state, and local regulations

### **SWI3-3 Payment.**

Payment for the "Subsurface Infiltration System" shall be made at the contract Unit Price per Gallon and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals involving excavation, shoring, backfill, grading, compaction, crushed rock base, infiltration system, reinforced concrete footing, pipe connections, and all other appurtenances, as shown on the Plans, as specified in the Standard Specifications, Special Provisions, and Technical Specifications, and as directed by the Engineer, and no additional compensation will be allowed therefor.

## **FLOW METER, VALVES, AND MISCELLANEOUS EQUIPMENT**

It is the intention of this specification to describe the flow meter and miscellaneous equipment shown in the Plans. This section includes information applicable to the following:

- 1) Flow meters and vaults
- 2) Gate valves and vaults
- 3) Float switch (included in the infiltration system)

### **SECTION 1 – GENERAL**

#### **FMV1-1 Submittals.**

##### **FMV1-1.1 Working Drawings.**

The Contractor shall prepare and submit working drawings in accordance with Section 3-8.2. The following working drawings shall be submitted:

1. Flow meters and vaults: manufacturer's product data, technical data (capacities and operating characteristics), installation procedures, operation and maintenance procedures, and operation and maintenance instructions.
2. Gate valves and vaults: manufacturer's product data, technical data, actuator information, installation procedures, operation and maintenance procedures, and operation and maintenance instructions.
3. Float switch: manufacturer's product data, technical data, installation procedures, operation and maintenance procedures, and operation and maintenance instructions.

##### **FMV1-1.2 Shop Drawings.**

The Contractor shall prepare and submit shop drawings in accordance with Section 3-8.3. The following shop drawings shall be submitted:

1. Flow meters and vaults: detail fabrication and installation details, including, but not limited to, horizontal and vertical dimensioning.
2. Gate valves and vaults: detail fabrication and installation details, including, but not limited to, horizontal and vertical dimensioning.
3. Float switch system: detail fabrication and installation details, including, but not limited to, horizontal and vertical dimensioning.

##### **FMV1-2 Quality Assurance.**

The flow meters, gate valves, actuators, vaults, and float switch system may be furnished by different manufacturers, while each system must be furnished by a manufacturer with over 10 years of relevant experience pertaining to the product provided. Similar components should be from the same manufacturer when possible (for example, both flow meters should be similar, etc.). The manufacturer/supplier must be able to provide references and a list of installations upon request.

##### **FMV1-3 Warranty.**

Separate warranties must be provided for each piece of equipment (flow meters, gate valves, and float switch system). Each warranty must warrant the equipment to be free from defects in materials and workmanship for one (1) year after the date of substantial completion.



## SECTION 2 – PRODUCTS

### FMV2-1 Manufacturer.

The manufacturers of the flow meters, gate valves/actuators, and float switch system shall be one that is regularly engaged in the engineering design and production of systems deployed for similar functions.

The flow meters may be manufactured by:

Hach Company (FLO-DAR AV Sensor)  
(800) 368-2723

Or Agency approved equal.

The gate valves may be manufactured by:

DeZurik/APCO/Hilton (Knife Gate Valve – Extended Service model [KGC-ES])  
(320) 259-2000

Or Agency approved equal.

The gate valve actuators may be manufactured by AUMA Actuators, Inc.  
(724) 743-2862

Or Agency approved equal.

The float switch system may be manufactured by:

Conery (2900 Series)  
(419) 289-1444

Or Agency approved equal.

### FMV2-2 Flow Meter.

The electromagnetic flow meter must meet the following minimum requirements:

- 1) System components
  - a. Non-contact sensor mounted above the flow.
  - b. Data logger (FL1500 series) with 5-minute for 16 parameters.
- 2) Operational requirements
  - a. Surge depth measurements using piezo-resistive pressure transducer with stainless steel diaphragm; velocity measurement using radar; ultrasonic depth measurements; and flow measurement based on continuity equation.
  - b. Engineering units: able to display the following units of measure: U.S. gallons, imperial gallons, million gallons, cubic feet, cubic meters, and acre-feet.
  - c. Programming includes controller keypad, USB upload, and PC software capabilities.
  - d. System performance:
    - i. Surge depth measurement range shall be at least 138 inches, overpressure rating 2.5 x full scale.
    - ii. Velocity measurement range from 0.75 to 20 feet per second with an accuracy of  $\pm 0.5\%$  ( $\pm 0.1$  feet per second).
    - iii. Depth measurement range from 0 to 60 inches with an accuracy of  $\pm 1\%$  ( $\pm 0.1$  inches).
    - iv. Flow measurement accuracy of  $\pm 5\%$  of reading typical where flow is in a channel with uniform flow conditions and is not surcharged,  $\pm 1\%$  full scale max.

**FMV2-3 Gate Valves.**

The gate valves must meet the following minimum requirements:

- 1) Valve shall be the bonnetless knife gate.
- 2) Gate edge shall be machined, finished, and rounded and have a 45-degree beveled knife gate. The gate faces shall be finish ground.
- 3) Exclusive Premium Packing System shall fit a rounded machined packing chamber and shall consist of no less than four layers of packing including an anti-extrusion plate and an aflas cord for live loaded packing. The packing gland shall match the valve body and the fasteners shall be stainless steel.
- 4) Body shall be a one-piece casting of stainless steel. Valve body shall incorporate cast in guides and jams and can handle full reverse pressure without damage. Raised faces shall be full width per ASME B16.20 standards for spiral-wound gaskets.
- 5) Seat shall be resilient seated. Metal seated valves shall have a round port. Resilient seated valves shall have the resilient seat material molded on three sides of the stainless-steel seat ring for installations where drip-tight shutoff is required and shall be replaceable. Resilient seat material shall be chloroprene suitable for use with stormwater.
- 6) Gate Guides and Jams shall be cast into the valve body to provide support for the moving gate. Welded guides are not acceptable. Cast gate jams at the bottom of the body hold the gate securely against the seat to assure positive shutoff. Valves shall handle full reverse pressure without damage. The body has raised face end connections with drilled and tapped lugs.
- 7) Flange drilling shall be in accordance with ANSI B16.5 class 150, 2 to 24 inches.
- 8) Valve shall be power actuated with electric motor actuators per specification in this section. The powered actuator yoke shall be a two-piece design of 304 cast stainless steel.

The gate valve actuators must meet the following minimum requirements:

- 1) Equipment requirements:
  - a. Actuator shall be suitable for use on a 208 V three phase 60 Hz power supply on First Street.
  - b. Actuator shall be suitable for use on a 240 V single phase 60 Hz power supply on Glenoaks Boulevard.
  - c. Actuators must include motor, integral reversing starters, local controls, and terminals for remote control and indication housed within a self-contained, sealed enclosure.
- 2) Actuator sizing:
  - a. The actuator shall be sized to guarantee valve closure at the specified torque and/or thrust requirement as indicated by the valve manufacturer or supplier.
  - b. The actuator must be adequately sized to provide the torque required to operate the valve at 90% of the nominal voltage.
  - c. The operating speed shall provide valve closing and opening at approximately 12 inches per minute for gate valves.
  - d. One actuator size (same outside dimensions) shall be available covering output speeds from 4.8 to 216 rotations per minute (rpm) for a given torque range, to avoid over sizing and unnecessary weight load on valve stem, flange, and yoke. An increase of actuator size caused by higher actuator output speed is not acceptable.
- 3) Enclosure:
  - a. Actuators shall be O-ring sealed, watertight to NEMA 4X/6 and submersible to IP 68-8 (26 feet for 96 hours) in accordance with EN 60529.
  - b. During submersion it must be possible to operate the actuator at least 10 times.
  - c. Enclosure must allow for temporary site storage without the need for electrical supply connection.
  - d. All external fasteners shall be of stainless steel. Gear case shall be cast iron.
  - e. A heater must be installed inside the actuator, suitable for continuous operation, to prevent condensation. Actuator must provide an alarm signal in case of failure of anti-condensation heater.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

- 4) Motor:
  - a. The electric motor shall be Class F insulated, with a duty rating of at least 15 minutes at 104°F (40°C) ambient temperature at an average load of at least 35% of rated actuator torque.
  - b. Motor shall be specifically designed and built by the actuator manufacturer for electric actuator service characterized by high starting torque, low stall torque and low inertia. Commercially available motors shall not be acceptable.
  - c. Motor protection (the following criteria shall be provided):
    - i. The motor shall be de-energized without damage in the event of a stall condition when attempting to move a jammed valve.
    - ii. The motor shall be de-energized in the event of an over torque condition
    - iii. A minimum of three thermal devices imbedded in the motor windings shall be provided to de-energize the motor in case of overheating.
    - iv. Lost phase protection shall be provided.
- 5) Manual operation:
  - a. Manual operation shall be by handwheel which shall not rotate during motor operation.
  - b. Handwheel declutch mechanism shall include an output contact to indicate actuator manual operation.
  - c. Manual operation shall utilize the actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load.
  - d. Actuator designs that bypass electric actuator worm gears when declutched are unacceptable.
- 6) Wiring and terminals:
  - a. Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and 3-phase power (or as indicated above).
  - b. All external wiring shall terminate in a removable plug and socket head, which allows easy disconnection of all power and control voltages.
  - c. Actuators furnished without plug and socket terminal connections must have power and control disconnect switches for ease of maintenance and safety.
- 7) Electric actuator controls:
  - a. Modbus RTU Module may be used for actuator communications.
  - b. All actuators will be furnished with integral actuators/motor controls. The integral controls shall be electrically connected to the actuator via a plug and socket connection. It shall be possible to re-position the integral controls at 90° increments, so that the push buttons and indication lights will face the operator.
  - c. The following control components shall be included with the integral controls:
    - i. Reversing contactors (mechanically and electrically interlocked).
    - ii. Internal power supply/transformer for control power.
    - iii. Control and signal voltage shall be either 24V DC or 110 V as indicated, internally or externally supplied.
    - iv. Programmable control logic.
    - v. Automatic phase correction.
    - vi. Control system interface by one of two modes as follows:
      1. Control by contact closure/discrete input signals via OPEN-STOP-CLOSE signals (either 24 V DC or 115 V as indicated) potentially separated from actuator controls by opto-isolators.
      2. Control by analog signal via positioner board capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of analog (i.e. 4-20mADC) command signal.
  - d. Local controls with 'OPEN - STOP - CLOSE' pushbutton type controls and a lockable selector switch with 'LOCAL - OFF - REMOTE' function. Local controls shall be supplied with indicating lights red for 'OPEN', yellow for 'FAULT', and green for 'CLOSED'.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

- e. The following output signals shall be furnished for remote indication:
  - i. Output signals from selector switch when switch is in LOCAL or REMOTE positions via potential-free contacts.
  - ii. Signals for end-of-travel positions OPEN and CLOSED shall be via potential-free contacts.
  - iii. Monitor relay for collective fault signal (power failure, phase failure, thermal switch tripped and torque switch tripped in mid travel) shall be provided.
  - iv. Where required, 4-20 mA position feedback signal.

### **FMV2-4 Float Switch System.**

The float switch must meet the following minimum requirements:

- 1) Mechanical float (2900 series) or Agency approved equal
- 2) Float switch designed to operate under the following parameters:
  - a. Minimum operating temperature: 32°F
  - b. Maximum operating temperature: 190°F
  - c. Electrical rating: 10 amp – 120 V, 5 amp – 240 V
  - d. Actuation point: 1" above/below horizontal
- 3) Power cord specifications:
  - a. Chlorinated polyethylene
  - b. Electrical for normally open or normally closed switch: 16 AWG 2, type SJOW-300 V
- 4) Float specifications:
  - a. Durable ABS material construction
  - b. Leak proof, shock proof, and impact resistant

### **FMV2-5 Precast Concrete Structures.**

Precast concrete structures shall be of the size indicated on the Plans, with provisions for sealant at joints, meeting ASTM C913, design according to ASTM C890 for A-16 (AASHTO HS20-44), heavy traffic, structural loading. This subsection is applicable to the flow meter and gate valve vaults. The following criteria must be satisfied:

- 1) Round precast concrete well: ASTM C478, precast, reinforced concrete.
  - a. Join sealant: ASTM C990, bitumen or butyl rubber.
  - b. Flexible resilient pipe connectors: ASTM C923.
- 2) Mix design: ACI 318/318R with minimum compressive strength of 5,000 psi with 0.45 maximum water/cementitious materials ratio.

### **FMV2-6 Access Covers.**

All manhole covers installed within public right-of-way shall support H-20 loading and be labeled according to Agency requirements in accordance to Section 206-3.3.2.

## **SECTION 3 – EXECUTION**

### **FMV3-1 Installation.**

Flow meters and miscellaneous equipment shall be installed in accordance with the manufacturer's written installation and operation manuals, as approved in the submittals described in FMV1-1.

### **FMV3-2 Field Testing.**

Flow meters and miscellaneous equipment shall be tested in accordance with manufacturer's recommendations to confirm systems are watertight and function as intended. The flow meter shall be hydraulically calibrated prior to delivery to the site in accordance with manufacturer's recommendations.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

Each actuator shall be performance tested and documentation must be available for the following: torque sensing tripping points in both the open and closed directions of travel, current at the maximum torque tripping point, actuator output speed, and high voltage test.

### **FMV3-3 Payment.**

Payment for the flow meter and vault shall be made at the Contract Unit Price for Each for "Flow Meter and Vault" and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals involving excavation, shoring, system installation, backfill, grading, compaction, base, sealant, pipe connections, surface restoration, startup, testing, and all other appurtenances, as shown on the Plans, as specified in the Standard Specifications and these Special Provisions, and as directed by the Engineer, and no additional compensation will be allowed therefor.

Payment for the gate valves and vault shall be made at the Contract Unit Price for Each for "Gate Valve and Vault (Glenoaks Blvd)" and "Gate Valve and Vault (First St)" and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals involving excavation, shoring, system installation (valve and actuator), backfill, grading, compaction, base, sealant, pipe connections, surface restoration, startup, testing, and all other appurtenances, as shown on the Plans, as specified in the Standard Specifications and these Special Provisions, and as directed by the Engineer, and no additional compensation will be allowed therefor.

Payment for the level switch system shall be considered as included in the Lump Sum price in the Bid for "Electrical (Float Switch, Panels, Vaults, etc.)", which full compensation for furnishing all labor, materials, tools, equipment, and incidentals for electrical components at both First Street and Glenoaks Boulevard, including submittals, float switch, float assembly, electrical panels (distribution and control), PLC, meter pedestal, conduit, wiring, vaults, instruments, conduit, wiring, Supervisory Control and Data Acquisition (SCADA) integration, testing, commissioning, startup, and all other appurtenances as shown on the Plans, as specified in the Technical Specifications (these and the Electrical section), and as directed by the Engineer, and no additional compensation will be allowed therefor.

## **SIGNING, STRIPING, AND PAVEMENT MARKERS**

All equipment, materials, and components for signing and striping, and the installation thereof, shall conform to the latest (2018) California Department of Transportation (Caltrans) Standard Plans and Standard Specifications, Section 81-3, "Pavement Markers," Section 82, "Signs and Markers" and Section 84 "Markings," unless otherwise noted in the Plans or Specifications. Copies of these documents are available from Caltrans, District 7 office at 100 South Main Street, Los Angeles, California 90012 or from Caltrans, 6002 Folsom Boulevard, Sacramento, California 95819, (916) 445-3520 or online at <https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications>.

All materials required for the completion of work as shown on the Plans shall be provided by the Contractor.

The following special provisions apply to the Caltrans Standard Specifications.

### **81-3 PAVEMENT MARKERS.**

#### **81-3.02 Materials.**

##### **81-3.03C Retroreflective Pavement Markers.**

Add the following:

The exterior surface of the shell shall be smooth and the marker shall contain 1 or 2 methyl methacrylate prismatic reflector faces of the number, geometry, and color shown for the respective type on the latest (2018) Caltrans Standard Plans A20A through A20D. The color of the reflector faces, when illuminated by the white light from a sealed-beam automobile headlight as defined in the Society of Automotive Engineers (SAE) Standard J 578, shall be clear, yellow, blue, or red as shown for the respective type on the latest (2018) Caltrans Standard Plans A20A through A20D.

Non-reflective pavement markers shall be either ceramic or plastic. Plastic non-reflective pavement markers shall be either polypropylene or Acrylonitrile Butadiene Styrene (ABS) plastic.

##### **81-3.03 Construction.**

##### **81-3.03C Epoxy Adhesive.**

Add the following:

Adhesive for raised pavement markers shall be rapid set type epoxy.

Removal of pavement markers shall be per Section 81-8.03B, "Remove Pavement Markers."

## **84-2 TRAFFIC STRIPES AND PAVEMENT MARKINGS.**

#### **84-2.02 Materials.**

##### **84-2.02A General.**

Add the following:

Traffic stripes, pavement markings, crosswalks, and arrows shall be thermoplastic unless otherwise shown on the Plans. Curb markings shall be paint, 2 coats. Contractor shall repaint all curb markings within the project's street improvement limits.

**84-2.02C Paint.**

Add the following:

Paint for curb markings shall be ready-mixed rapid dry type.

**84-2.03 Construction.**

**84-2.03A General.**

Add the following:

The Contractor shall furnish the necessary control points for all striping and markings and shall be responsible for the completeness and accuracy thereof to the satisfaction of the Engineer.

The Contractor shall establish all traffic striping between these points by stringline or other method to provide striping that will vary less than 1/2-inch in 50-feet from the specified alignment.

When no previously applied figures, markings, or traffic striping are available to serve as a guide, suitable layouts shall be spotted in advance of the permanent paint application. Traffic lines may be spotted by using a rope as a guide for marking spots every 5-feet, by using a marking wheel mounted on a vehicle, or by any other means satisfactory to the Engineer.

The Contractor shall mark or otherwise delineate the traffic lanes in the new roadway or portion of roadway, or detour before opening it to traffic.

The Contractor shall provide an experienced technician to supervise the location, alignment, layout, dimensions, and application of the paint.

Spotting shall be completed prior to the removal of any existing stripes. Existing stripes and markings shall be removed prior to painting new stripes and markings, but in no case shall any section of street be left without the proper striping for more than 24 hours, or over weekends or holidays.

Existing traffic stripes (including raised pavement markers), pavement legends, and markings that do not conform to the plans shall be removed by wet sandblasting per Section 84-9.03B, "Remove Traffic Stripes and Pavement Markings," and Section 81-8.03B, "Remove Pavement Markers," of the latest Caltrans Standard Specifications.

**84-2.03C Application of Stripes and Markings.**

**84-2.03C(2) Thermoplastic Traffic Stripes and Pavement Markings.**

**84-2.03C(2)(a) General.**

Add the following:

Traffic striping shall be thermoplastic including crosswalks, arrows, and other pavement legends.

The installation of traffic stripes includes placement of raised pavement markers when called for on the Plans.

Adhesive for raised pavement markers shall be per Section 81-3, "Pavement Markers." Epoxy shall be the Rapid Set type.

**84-2.03C(3) Painted Traffic Stripes and Pavement Markings.**

**84-2.03C(3)(a) General.**

Add the following:

Paint shall be applied in two coats. The second coat of paint shall be applied no less than 24 hours from application of the first coat.

**84-2.04 Payment.**

Add the following:

Payment for striping details, pavement markings, and curb marking shall be included in the Contract Lump Sum Bid price for "Striping, Pavement Markers, and Pavement Markings" and no additional compensation will be allowed. Removal of traffic striping, curb and pavement markings, and pavement markers will not be measured for separate payment and shall be considered as included in the bid items necessitating removal.



## LANDSCAPE AND IRRIGATION

It is the intention of this specification to describe the landscape and irrigation design shown in the Plans. This section includes information applicable to the following in CSI format:

- 1) Tree protection (01500)
- 2) Infield surfacing (02790)
- 3) Landscape irrigation (02810)
- 4) Landscape soil preparation (02910)
- 5) Sod (02920)
- 6) Planting (02930)

Payment for the irrigation system proposed in the Plans and specified in these Specifications shall be made at the Contract Lump Sum Price for "Irrigation," which includes removal of the existing irrigation system and installation of the proposed irrigation system, including submittals, connection, all valves, piping, electrical systems, testing, spare parts, 90 day establishment guarantee, warranty, and all other appurtenances required to meet the Contract Documents.

Payment for the landscaping and field restoration proposed in the Plans and specified in these Specifications shall be made at the Contract Lump Sum Price for "Landscaping and Field Restoration," which includes removal of the existing landscape/field surfaces outside of the other work proposed, landscaping, field restoration, and all other appurtenances required to meet the Contract Documents.

The Contractor shall maintain all plantings in a thriving condition, to the satisfaction of the Agency, for 90 calendar days after all foregoing Work is completed and approved (substantial completion). The entire Project shall be cared for, to the satisfaction of the Agency, in such a manner as to present a neat and clean condition. All plant material is to have a 90-calendar day replacement warranty. During the Maintenance and Plant Establishment period, all plants and planted areas shall be kept well-watered and weed free. During the Maintenance and Plant Establishment period, the Contractor is required to apply fertilizer to all planted areas, at a time specified by the Agency (at the beginning of the Maintenance and Plant Establishment period and after thirty days of the plant establishment period). Fertilizer application shall be performed in the presence of the Engineer. Payment for the 90 day plant establishment shall be made at the Contract Lump Sum Price for "90 Day Plant Establishment" and shall meet the specifications above and within this Technical Specification.

## SECTION 01500 – TREE PROTECTION SPECIFICATIONS

### PART 1 – GENERAL

#### 1.01 TREE PROTECTION

- A. All trees that exist within the area of Work, as shown on the Plans, and not specifically designated for removal, shall be protected by the following means:
1. Determining the Tree Protection Zone (TPZ) – The dripline of the crown of the tree determines the fencing boundary.
  2. Beyond the TPZ, the Contractor shall also be responsible for protecting all trees within the boundaries of the construction zone, including vehicular access areas leading to the construction zone, lay down areas, and any other areas impacted by construction activities. Any damage to trees in these areas shall be restored or replaced by the Contractor at no additional cost to the Agency. Any necessary root cutting in this area must be confirmed with approved arborist. Any damage done by the Contractor to landscaping or other park amenities that fall outside the boundaries of the construction zone shall be restored or replaced by the Contractor to a condition matching the pre-project conditions (or better) at no additional cost to the Agency.
  3. Within the boundaries of the construction zone (including the TPZ), the Contractor shall be responsible for mitigating construction-related dust accumulation on all trees by spraying the trunks, limbs, and foliage with water to a maximum height of 30 feet during the months of April through November, at monthly intervals.
  4. Within the TPZ, the contractor shall adhere to the following requirements, including, but not limited to:
    - i. No stockpiling or storage of any material, debris, or soil.
    - ii. No storage of any construction equipment.
    - iii. No vehicular access.
    - iv. No cutting of roots.
    - v. No disturbance of soil or grade changes.
    - vi. No objects of any kind to be attached to tree trunks.
  5. The contractor shall install a 4' high temporary high-density polyethylene fence with 3.5" x 1.5" openings. Color: Orange. Steel posts (2" x 6') shall be placed every 8 feet and embedded 2 feet into finish grade.
  6. A 3-inch layer of coarse mulch or woodchips shall be placed within the dripline of the tree. Keep mulch 12 inches from trunk of tree.
  7. The Contractor shall provide one sign per each 50 lineal feet of fence bordering the TPZ indicating that fencing shall not be removed.
  8. No work is permitted within the TPZ without Agency/Engineer approval.
  9. Irrigation to all trees not specifically designated for removal shall be kept in operation for the duration of the Project. Contractor shall be responsible for hand watering all impacted trees if necessitated by temporary shutdowns to existing irrigation systems. Trees are to be irrigated deeply and infrequently so that soil moisture is detectable at a minimum depth of 18 inches using a soil probe.
  10. Upon job completion, Contractor shall remove all items installed to protect trees during the construction process.

END OF SECTION 01500

## **SECTION 02790 – INFILTRATION SURFACING**

### **PART 1 – GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Section Includes: supply and installation of a complete infield skin surface, including pitcher's mound, batter's box, and warning track mixes including:
  - 1. Diamond Pro infield conditioner
  - 2. 50% brick, 30% Sand, and 20% decomposed granite fine mixed as a binder

#### **1.02 RELATED SECTIONS**

- A. Section 02920 – Sod

#### **1.03 REFERENCES**

- A. ASTM F-1632: Standard Test Method for Particle Size Analysis
- B. ASTM D-422: Standard Test Method for Fine Particle Size Analysis

#### **1.04 SUBMITTALS**

- A. Submit in accordance with Section 3-8 of Special Provisions:
  - 1. Manufacturer's product data sheet and installation instructions for each product to be used.
  - 2. Five (5) pound sample for each product to be used along with a private lab test indicating the particle size analysis of the material. All tests shall be performed in accordance with ASTM F-1632.
  - 3. Manufacturer's maintenance and cleaning instructions for each product to be used.

#### **1.05 PROJECT/SITE CONDITIONS**

- A. All Earthwork shall be performed in accordance with the preceding sections, Standard Specifications, and Special Provisions.
- B. Sub-base material shall be uniformly graded and compacted, and shall mirror finish grade contours to ensure an even depth of material.
- C. Construct skin surfaces with a finish grade that provides adequate surface drainage, ideally 0.5 to 1.5% slope away from the center of the infield.

### **PART 2 – PRODUCTS**

#### **2.01 MATERIALS**

- A. Infield Mix:
  - 1. Diamond Pro Infield Conditioner over 50% brick, 30% sand, and 20% decomposed granite fine mix as a binder to 6 inches deep (or Agency approved equal).

**PART 3 – EXECUTION**

**3.01 PLACEMENT**

- A. Infield surfacing shall be installed in strict conformance with the manufacturer's specifications to the lines and grades as shown in the Plans.
- B. New/Replaced Fields: place material to a final minimum depth of 6 inches when finished and compacted. The final grade shall be leveled and sloped according to standard infield construction specifications. Allow for  $\pm 1$  inch for compaction.

**3.02 WATERING**

- A. After leveling the infield skin, thoroughly water the entire infield surface until the complete depth of the infield mix is moistened. After a period of  $\pm 4$  hours, compact with a minimum 2,000-pound static drum roller. If low areas are present, scarify and level low areas with additional infield mix.

**3.03 INSPECTION**

- A. The finished surface of the infield shall be smooth and free from any visible dips, humps, bumps, for other blemishes which would hinder the removal of water through positive surface drainage. Correct irregularities to the satisfaction of the Agency/Engineer.

**3.04 TOPDRESSING**

- A. Following successful inspection, topdressing may be applied, consisting of a calcified clay product added at a rate of one 50-pound bag per 100 square feet.

END OF SECTION 02790

## SECTION 02810 – LANDSCAPE IRRIGATION

### PART 1 – GENERAL

#### 1.01 SCOPE

- A. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the Plans, installation details, and as specified herein. Items of work specifically included are:
  - 1. Procurement of all applicable licenses, permits, and fees.
  - 2. Coordination of Utility Locates (Call Before You Dig).
  - 3. Verification of existing static pressure.
  - 4. Connection to existing Irrigation Backflow Preventer or Irrigation System.
  - 5. Maintenance period.
- B. Related sections:
  - 1. Section 02930 Planting.

#### 1.02 SUBMITTALS

- A. Follow the submittal guidelines in the Specifications/Special Provisions (Section 3-8).
- B. Materials List: include pipe, fittings, mainline components, water emission components, and control system components. Quantities of materials need not be included.
- C. Manufacturer's Data: submit manufacturers' catalog cut sheets, specifications, and operating instructions for equipment shown on the materials list.
- D. Shop Drawings: submit shop drawings called for in the installation details in accordance with Section 3-8.3 of the Special Provisions. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.
- E. Project Record Drawings: submit project record (as-built) drawings prior to commencement of maintenance period (refer to Section 3-7.1 of the Special Provisions for specific requirements).

#### 1.03 RULES AND REGULATIONS

- A. Work and materials shall be in accordance with the latest edition of the California Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the Plans and Specifications call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the Plans and Specifications.
- C. If quantities are provided either in these Specifications or on the Plans, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the Project and to complete an independent estimate of quantities and wastage.

#### 1.04 TESTING

- A. Notify the Agency/Engineer three (3) days in advance of testing.
- B. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Agency/Engineer.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### E. Hydrostatic Pressure Test:

1. Subject mainline pipe to a hydrostatic pressure of 130 psi for two hours. Test with mainline components installed. A 2-psi pressure variation is allowed.
2. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
3. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance at no additional cost to the Agency. Repeat test until the pipe passes.
4. Cement or caulking to seal leaks is prohibited.

### F. Operational Test:

1. Activate each remote control valve in sequence from controller. The Agency/Engineer will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies at no additional cost to the Agency.
3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies at no additional cost to the Agency.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems at no additional cost to the Agency. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests.

## 1.05 CONSTRUCTION REVIEW

- A. The purpose of on-site reviews by the Agency/Engineer is to periodically observe the work in progress and the Contractor's interpretation of the Plans and Specifications and to address questions with regards to the installation.
1. Scheduled reviews, such as those for irrigation system layout or testing, shall be scheduled with the Agency/Engineer as required by these Specifications.
  2. Impromptu reviews may occur at any time during the Project.
  3. Final review will occur at the completion of the irrigation system installation and Record (As-Built) Drawing submittal.

## 1.06 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to ensure that the Agency receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
1. For a period of one year from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Agency.
  2. Plans and Specifications govern replacements identically as with new work. Make replacements at no additional cost to the Contract Price.
  3. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

## **PART 2 – PRODUCTS**

### **2.01 QUALITY**

- A. Use materials which are new and without flaws or defects of any type, and which are the best of their class and kind.

### **2.02 SUBSTITUTIONS**

- A. Pipe sizes referenced in the Plans are minimum sizes and may be increased at the option of the Contractor.

### **2.03 SLEEVING**

- A. Install separate sleeve beneath paved areas to route each run of irrigation pipe or wiring bundle.
- B. Sleeving material beneath pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- C. Sleeving beneath drives and streets shall be PVC Class 200 pipe with solvent welded joints.
- D. Sleeving diameter: equal to twice that of the pipe or wiring bundle.

### **2.04 PIPE AND FITTINGS**

#### **A. Mainline Pipe and Fittings:**

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters which are not manufactured in Class 200.
3. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.

#### **B. Lateral Pipe and Fittings:**

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use UV radiation resistant Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe.
3. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of a type approved by the pipe manufacturer.

#### **C. Specialized Pipe and Fittings:**

1. Copper pipe: use Type "K" rigid conforming to ASTM Standard B88.
  - a. Use wrought copper or cast bronze fittings, soldered, or threaded per the installation details. Use a 95% tin and 5% antimony solder.
2. Use a dielectric union wherever a copper-based metal (copper, brass, bronze) is joined to an iron-based metal (iron, galvanized steel, stainless steel).
3. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 threaded fittings.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

4. Joint sealant: use only Teflon-type tape pipe joint sealant on plastic threads. Use non-hardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

### 2.05 MAINLINE COMPONENTS

- A. Master Valve Assembly: as presented in the Plan details.
- B. Isolation Gate Valve Assembly: as presented in the Plan details. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- C. Quick Coupling Valve Assembly: double swing joint arrangement as presented in the Plan details.

### 2.06 SPRINKLER IRRIGATION COMPONENTS

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: as presented in the Plan details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- B. Sprinkler Assembly: as presented in the Plans and Plan details.

### 2.07 CONTROL SYSTEM COMPONENTS

- A. Irrigation Controller Unit:
  1. As presented in the Plan details.
  2. Primary surge protection arrestors: as recommended by controller manufacturer.
  3. Valve output surge protection arrestors: as recommended by controller manufacturer.
  4. Lightning protection: 10-foot copper clad grounding rod.
  5. Wire markers: pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.
- B. Instrumentation:
  1. As presented in the Plan details.
- C. Control Wire:
  1. Use American Wire Gauge (AWG) No. 14 solid copper, Type UF or PE cable, UL approved for direct underground burial from the controller unit to each remote control valve. Use AWG No. 12 wire for common wire.
  2. Color: use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of the active control wire. Wire color shall be continuous over its entire length.
  3. Splices: use wire connector with waterproof sealant. Wire connector to be of plastic construction consisting of two (2) pieces, one piece which snap locks into the other. A copper crimp sleeve to be provided with connector.
  4. Encase wiring not located near PVC irrigation pipe in PVC Schedule 40 electrical conduit.
    - a. Warning tape: inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored yellow, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

### 2.08 OTHER COMPONENTS

- A. Tools and Spare Parts: provide operating keys, servicing tools, test equipment, other items, and spare parts indicated in the General Notes of the Plans, including but not limited to, spare parts for sprinkler heads (5 of each type/size used), valves (2 of each type/size used), and risers (10 of each type/size used).



### **PART 3 – EXECUTION**

#### **3.01 INSPECTIONS AND REVIEWS**

**A. Site Inspections:**

1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Agency/Engineer prior to beginning Work.
2. Beginning Work of this section implies acceptance of existing conditions.
3. Contractor will be held responsible for coordination between landscape and irrigation system installation.

**B. Utility Locates ("Call Before You Dig"):**

1. Arrange for and coordinate with local authorities the location of all underground utilities.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the Contract Price.

**C. Irrigation System Layout Review:** irrigation system layout review will occur after the staking has been completed. Notify the Agency/Engineer two days in advance of review. Modifications will be identified by the Agency/Engineer at this review.

#### **3.02 LAYOUT OF WORK**

- A.** Stake out the irrigation system. Items staked include sprinklers, pipe, control valves, manual drains, controller, and isolation valves.
- B.** Install all mainline pipe and mainline components inside of Project property lines.

#### **3.03 EXCAVATION, TRENCHING, AND BACKFILLING**

- A.** Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B.** Minimum cover (distance from top of pipe or control wire to finish grade):
1. 24-inch over mainline pipe and over electrical conduit if planting area allows.
  2. 24-inch over control wire if planting area allows.
  3. 18-inch over lateral pipe to sprinklers.
- C.** Backfill only after lines have been reviewed and tested.
- D.** Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe. Stones larger than 1-inch maximum dimension are not permitted in first (deepest) 6-inches of backfill.
- E.** Backfill unsleeved pipe in either of the following manners:
1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
  2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 12-inch layers and compacting to the density of surrounding soil.
- F.** Enclose pipe and wiring beneath roadways, walks, curbs, etc. in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Conduct one compaction test for each sleeved crossing less than 50 feet long. Conduct two compaction tests for each sleeved crossing greater than 50 feet long. Costs for such testing and any necessary

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

retesting shall be borne by the Contractor. Use of water for compaction around sleeves, "puddling", will not be permitted.

- G. Dress backfilled areas to original grade.
- H. Where utilities conflict with irrigation trenching and pipe work, contact the Agency/Engineer for trench depth adjustments.

### 3.04 SLEEVING AND BORING

- A. Install sleeving at a depth which permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends 12 inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes. Mark concrete with a chiseled "x" at sleeve end locations.
- C. Bore for sleeves under obstructions which cannot be removed. Employ equipment and methods designed for horizontal boring.

### 3.05 ASSEMBLING PIPE AND FITTINGS

#### A. General:

- 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and deburr. Clean pipe ends.
- 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

#### B. Mainline Pipe and Fittings:

- 1. Use only strap-type friction wrenches for threaded plastic pipe.
- 2. PVC Solvent Weld Pipe:
  - a. Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
  - b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
  - c. Snake pipe from side to side within the trench.
- 3. Fittings: the use of cross type fittings is not permitted.

#### C. Lateral Pipe and Fittings:

- 1. Use only strap-type friction wrenches for threaded plastic pipe.
- 2. PVC Solvent Weld Pipe:
  - a. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
  - b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
  - c. Snake pipe from side to side within the trench.
- 3. UV Radiation Resistant Polyethylene Pipe:
  - a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
  - b. Snake pipe from side to side within the trench, on the soil surface, and hold in place with tubing stakes spaced every five feet.
    - 1) Fittings: the use of cross type fittings is not permitted.

#### D. Specialized Pipe and Fittings:

- 1. Copper Pipe:
  - a. Buff surfaces to be joined to a bright finish. Coat with solder flux.
  - b. Solder so that a continuous bead shows around the joint circumference.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

2. Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, stainless steel) are joined.
3. PVC Threaded Connections:
  - a. Use only factory-formed threads. Field-cut threads are not permitted.
  - b. Use only Teflon-type tape.
  - c. When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.
4. Make metal-to-metal, threaded connections with Teflon-type tape or pipe joint compound applied to the male threads only.

### 3.06 INSTALLATION OF MAINLINE COMPONENTS

- A. Master Valve Assembly: install where indicated on the Plans.
- B. Isolation Gate Valve Assembly:
  1. Install where indicated on the Plans.
  2. Locate at least 12-inches from and align with adjacent walls or edges of paved areas.
- C. Quick Coupling Valve Assembly: install where indicated on the Plans.

### 3.07 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:
  1. Flush mainline pipe before installing RCV assembly.
  2. Locate as shown on the Plans. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Connectors and sealant shall be installed as per the manufacturer's recommendations.
  3. Install only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical.
  4. Arrange grouped valve boxes in rectangular patterns.

### 3.08 INSTALLATION OF CONTROL SYSTEM COMPONENTS

- A. Irrigation Controller Unit:
  1. The location of the controller unit as depicted on the Plans is approximate; the Agency shall determine the exact site location upon commencement of contract.
  2. Lightning protection: ground rods are to have a minimum diameter of 5/8-inch and a minimum length of 10 feet. These are to be driven into the ground in a vertical position or an oblique angle not to exceed 45 degrees at a location 10 feet from the electronic equipment, the ground plate, or the wires and cables connected to said equipment, as shown in the irrigation details. The rod is to be stamped with the UL logo. A 6 AWG solid bare copper wire (about 12 feet long) shall be connected to the ground rod by the installer using a Cadweld GR1161G "One-Shot" welding kit [Paige Electric part number 1820037] or Agency approved equal. This wire shall be connected to the electronic equipment ground lug.
  3. Install primary surge protection arrestors on incoming power lines.
  4. Install one valve output surge protection arrestor on each control wire and one for the common wire.
  5. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see Plans) of the remote control valve to which the control wire is connected.
  6. Connect control wires to the corresponding controller terminal.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### B. Instrumentation:

1. Install sensors per the installation details and manufacturer's recommendations. Install in locations shown on the Plans.
2. Install electrical connections between irrigation controller and sensors per manufacturer's recommendations.

### C. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Make wiring loop by turning control wire 5 turns around 1-inch pipe. Coil 24-inch length of wire within each remote control valve box.
3. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
4. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in a valve box which contains an irrigation valve assembly, or in a separate 6-inch round valve box.
  - a. Use same procedure for connection to valves as for in-line splices.
5. Unless noted on Plans, install wire parallel with and under PVC mainline pipe. If wire is installed adjacent to section of metal pipe, separate wire from pipe minimum of 6-inches and install wire in PVC conduit.
6. Encase wire not installed with PVC mainline pipe in electrical conduit.

## 3.09 INSTALLATION OF OTHER COMPONENTS

### A. Tools and Spare Parts:

1. Prior to the Pre-Maintenance Review, supply operating keys to the Agency, servicing tools, test equipment, and any other items indicated on the Plans.
2. Prior to Final Review, supply to the Agency the spare parts indicated in the General Notes on the Plans, including but not limited to, spare parts for the sprinkler heads (5 of each type/size used), valves (2 of each size/type used), and risers (10 of each size/type used).

- B. Other Materials: install other materials or equipment shown on the Plans or installation details to be part of the irrigation system, even though such items may not have been referenced in these specifications.

## 3.10 PROJECT RECORD (AS-BUILT) DRAWINGS

- A. Maintain on-site and separate from documents used for construction, one complete set of Plans and Specifications. Keep documents current. Do not permanently cover Work until as-built information is recorded.
- B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the Plans. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each backflow prevention device, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
- C. Prior to Final Review, Record Drawings shall be submitted to the Agency in accordance with the Special Provisions Section 3-7.1. Completion of the Record Drawings will be a prerequisite for the Final Review.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### 3.11 MAINTENANCE

- A. Upon completion of Final Review, maintain irrigation system for a duration of 90 calendar days. Make periodic examinations and adjustments to irrigation system components to achieve the most desirable application of water.
- B. Following completion of the Contractor's maintenance period, the Agency will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage during the landscape/irrigation maintenance operation.

### 3.12 CLEAN-UP

- A. Upon completion of Work, remove from the site all machinery, tools, excess materials, and rubbish.

END OF SECTION 02810

## **SECTION 02910 – LANDSCAPE SOIL PREPARATION**

### **PART 1 – GENERAL**

#### **1.01 WORK INCLUDED**

- A. Landscape soil preparation shall include topsoil placement and the preparation for the spreading, densification, cultivation, and raking of the topsoil, including fertilization and conditioning.

#### **1.02 RELATED SECTIONS**

- A. Section 02810 Landscape Irrigation
- B. Section 02930 Planting

#### **1.03 QUALITY ASSURANCE**

##### **A. Reviews**

- 1. Contractor shall specifically request the following reviews at least two (2) working days in advance prior to progressing with the Work:
  - a. Rough grading,
  - b. Verification of roto-tilling depths, and
  - c. Finish grade.

##### **B. Certification**

- 1. Written certificates stating quantity, type and composition, weight, and origin for all amendments, chemicals, and any import topsoil shall be delivered to the Engineer before the material is used on the site.

##### **C. Soil Testing**

- 1. Native soil and in-place topsoil shall be tested for amendment determination by a laboratory approved by the Engineer. Contractor shall submit sample and provide the Engineer with copies of all reports and recommendations for amendments in accordance with the Specifications and Special Provisions (Section 3-8).
- 2. Components of the test shall include all major nutrients, pH, salinity, boron, sodium, micronutrients copper, zinc, manganese, and iron, adsorption rate, organic content, and texture.
- 3. All soil installed on the Project shall be screened accordingly, consistent and uniform.

### **PART 2 – PRODUCTS**

#### **2.01 CLASS A TOPSOIL**

- A. Shall be imported from a source outside the limits of the Project selected by the Contractor in compliance with the requirements specified herein.
- B. Import topsoil shall be a homogeneous mineral soil of sandy loam or loamy sand. Import topsoil shall be free of harmful insects, chemicals, all weed growth, clods over four (4) cubic inches that will not pulverize during operations, and free of rocks over two (2) cubic inches. Particle size data shall be based upon standard USDA methodology. The material shall be in the 0.05 to 5.0 millimeters range with 15% in the 0.5 to 2.0 millimeters coarse sand range. Gravel content (greater than 2.0 mm) shall be less than fifteen percent (15%). Import topsoil shall not contain more silt and clay than on site native soil.
- C. Topsoil shall be suitable to sustain the growth of the plants specified.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### 2.02 FERTILIZER

#### A. Commercial Fertilizer

1. Commercial fertilizer shall be pelletized or granular product having a chemical analysis as specified on the Plans or in the Special Provisions or Technical Specifications. Fertilizer shall be free-flowing material and delivered in unopened sacks.

#### B. Organic Soil Amendment

1. Organic soil amendment shall be Type 1, processed wood product derived from redwood or fir and shall comply with the following requirements.

<b>Gradation</b>	<b>Percent Passing (Min.)</b>
¼-inch	95%
No. 8	80%
No. 35	30%
<b>Nitrogen Content</b>	<b>Percent Dry Weight</b>
Redwood	0.4 – 0.6%
Fir	0.56 – 0.84%
Cedar	0.56 – 0.84%
Fir Bark	0.8 – 1.2%
Pine Bark	0.8 – 1.2%

### 2.03 GENERAL

- A. Soil shall not be worked when it is so wet or so dry as to cause excessive compaction or the forming of hard clods or dust.
- B. Existing soil below subgrade for Class A topsoil shall be scarified to a depth of six (6) inches prior to spreading topsoil.

### 2.04 FINISH GRADING

- A. Finished grade shall be smooth, uniform, and free of abrupt grade changes and depressions to ensure surface drainage.
- B. Finished grade adjacent to paving, curbs, or headers shall be one (1) inch below in lawn area shrub or ground cover areas.
- C. After fertilizing and conditioning, the soil shall be watered and allowed to settle to provide a stable surface, not overly densified to the extent that it will prevent aeration and water infiltration. After the soil had dried out to a workable condition, the planting areas shall be regraded, raked, and smoothed to the required grades and contours. Finish surfaces shall be clean and suitable for planting.
- D. No rocks or materials other than specified for backfill shall be allowed in the top six (6) inches of any seedbed.
- E. Surface drainage shall be provided by modeling the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly. All soil shall be free of trash.

END OF SECTION 02910

## **SECTION 02920 – SOD**

### **PART 1 – GENERAL**

#### **1.01 GENERAL REQUIREMENTS**

- A. Sodding shall be performed only during the time of day and during seasons when satisfactory results can be expected unless authorized in writing by the Agency.

### **PART 2 – PRODUCTS**

#### **2.01 SOIL AMENDMENTS AND FERTILIZER**

- A. Composted organic humus shall be tested by the soils testing laboratory prior to being used. Depending on soil test results, you may need some/all of the following:
- B. Nitrogen stabilized sawdust shall be derived from redwood or fir and shall be granular in nature, stabilized with nitrogen and shall have a minimum organic content of 90% by weight, particle size with 95 to 100% passing 2.33 mm standard sieve, 0.5% nitrogen, 1.75 salinity, iron content minimum 0.08% dilute acid soluble Fe (dry weight), ash 0 to 6% (dry weight), pH of 5.5 to 6.0.
- C. Sand shall be fine, clean, and natural, free from deleterious material, weed seed, clay balls, or rock with minimum 95% passing a No.4 sieve and maximum of 10% passing a No.100 sieve.
- D. Gypsum shall be agricultural grade with 90% minimum calcium sulfate.
- E. Fertilizer shall be commercially mixed and packaged pelleted or granular form N-P-K blend with micronutrients as recommended by an approved soils report.
- F. Dolomite lime shall be agricultural grade with 35% minimum magnesium carbonate and 49% minimum calcium carbonate with 100% passing a No. 65 sieve.

#### **2.02 SOD**

- A. The sod shall consist of live, growing, mature Marathon I. The sod shall be cut from the field with a minimum of one-half inch of soil that completely covers the roots of the sod. The sod shall have a healthy, virile root system of dense, thickly matted roots throughout.
- B. The sod shall arrive vigorous and have a lush appearance, uniform texture and dark-green color throughout with no dead or dry edges. The sod shall be sufficiently dense to bear handling and placement without tearing.
- C. The sod shall be free of disease and harmful insects, noxious weeds, or other grasses and shall not contain any other matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted.

### **PART 3 – EXECUTION**

#### **3.01 SOIL PREPARATION**

- A. Prior to planting sod, remove all rocks and debris, eradicate and physically remove all vegetation and weeds, dead or alive, from the site.
- B. Rototill or spade the area to a depth of 4 to 6 inches. Eliminate drainage problems by having soil slope away from foundations, etc.
- C. Incorporate organic matter (humus, redwood, sand, etc.), gypsum, lime and fertilizer as recommended by an approved soils report to a depth of 3 to 4 inches.
- D. Rake and smooth the soil, removing rocks, roots, and large clods. Roll the area lightly, leaving the grade one (1) inch below finish grade.
- E. Water the prepared area to a depth of 6 inches to settle soil and provide a moist base for turf.

#### **3.02 SODDING**

- A. Prior to planting, the irrigation system shall be tested and fully functional.



## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

- B. Sod shall be harvested within 24 hours prior to delivery and planted same day of delivery.
- C. Install sod immediately upon delivery. In hot weather, protect unlaidd sod by placing stacks in shade, covering with moist burlap sacking and sprinkling.
- D. Begin installing sod along the longest straight line, such as a driveway or sidewalk. Butt and push edges and ends against each other tightly, without stretching. Avoid gaps or overlaps. Stagger the joints in each row in a brick-like fashion, using a large sharp knife to trim corners, etc. Avoid leaving small strips at outer edges as they will not retain moisture. On slopes, lay the turf pieces horizontally across the slope. On 2:1 slopes or greater, stake sod to hold in place with 1/2" x 1" x 12" pegs at two-foot spacings. To avoid causing indentations or air pockets, avoid walking or kneeling on the turf while it is being installed or just after watering. Do not lay whole lawn before watering. When a conveniently large area has been sodded, water lightly to prevent drying.
- E. After installing the turf, roll the entire area to improve turf-to-soil contact and remove air pockets.
- F. Begin watering within 30 minutes of installation.

END OF SECTION 02920

## **SECTION 02930 – PLANTING**

### **PART 1 – GENERAL**

#### **1.01 WORK INCLUDED**

- A. Trees, shrubs, plants, and groundcover.
- B. Initial maintenance of planting materials.

#### **1.02 RELATED SECTIONS**

- A. Section 02910 Landscape Soil Preparation

#### **1.03 SUBMITTALS**

- A. Submit in accordance with Section 3-8 of the Special Provisions.
- B. Maintenance Data: submit maintenance data, including maintenance schedule.
- C. Notices: submit 48-hour written notice prior to turnover to Agency for watering and maintenance.
- D. Warranty: warrant trees and shrubs for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth and except for defects resulting from neglect by Agency, abuse by others, or natural phenomena. Replace unsatisfactory plant material at end of warranty period at no additional expense to the Agency. One replacement is required.

#### **1.04 QUALITY ASSURANCE**

- A. Balled and Burlapped Plants and Trees: graded to American Standard for Nursery Stock, ANSI Z60.1

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store products as recommended by supplier until ready for installation.
- B. Handling: handle materials to avoid damage.

#### **1.06 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, watering, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### **1.07 SEQUENCING**

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

### **PART 2 – PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Requests for substitutions will be considered and shall be submitted to the Agency for review.

#### **2.02 MATERIALS**

- A. Plantings:
  - 1. Plant Materials: trees and shrubs.
  - 2. Plant Materials: groundcover and plants.

## SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT

### B. Accessories:

1. Mulch: redwood or pine wood chips
2. Filtration Fabric: water permeable fiberglass or polypropylene fabric.
3. Stakes and Guys: new hardwood, treated softwood, or redwood.

## **PART 3 – EXECUTION**

### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

### 3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best results for the substrate under the Project conditions.

### 3.03 INSTALLATION

- A. Install materials in accordance with approved submittals. Install landscape work in proper relation with Landscape Plans.
- B. Prepare topsoil as noted in soil analysis.
- C. Install soil mix to a depth of 18 inches in plant beds.
- D. Excavate as required for trees and shrubs as noted in Plans.
- E. Install plant material and backfill with soil mix. Stake and guy trees. Water thoroughly. Allow for soil settlement.
- F. Provide maintenance and watering until turnover to Agency for maintenance and watering. Replace damaged materials and dead or unhealthy plants prior to turnover to Agency.

### 3.04 PROTECTION

- A. Touch-up, repair, or replace damaged products before substantial completion.

END OF SECTION 02930

## ELECTRICAL

It is the intention of this specification to describe the electrical design, components, and requirements shown in the Plans. This section includes information applicable to the following in CSI format:

- 1) Electrical General Provisions (16010)
- 2) Electrical Tests (16030)
- 3) Basic Materials and Methods (16050)
- 4) Conduits and Raceways (16110)
- 5) Conductors (16120)
- 6) Grounding (16450)
- 7) Instrumentation and Controls – General Provisions (17010)
- 8) Basic Materials and Methods (17050)
- 9) Meters, General (17100)
- 10) Process Instrumentation and Control (17400)

Payment for the level switch system shall be considered as included in the Lump Sum price in the Bid for “Electrical (Float Switch, Panels, Vaults, etc.)”, which full compensation for furnishing all labor, materials, tools, equipment, and incidentals for electrical components at both First Street and Glenoaks Boulevard, including submittals, float switch, float assembly, electrical panels (distribution and control), PLC, meter pedestal, conduit, wiring, vaults, instruments, conduit, wiring, Supervisory Control and Data Acquisition (SCADA) integration, testing, commissioning, startup, and all other appurtenances as shown on the Plans, as specified in the Technical Specifications (these and the Flow Meter, Valves, and Miscellaneous Equipment Section), and as directed by the Engineer, and no additional compensation will be allowed therefor.

**SECTION 16010**  
**ELECTRICAL GENERAL PROVISIONS**

**PART 1 -- GENERAL**

**1.1 THE REQUIREMENT**

**A. General:**

1. Any conflicts between these sections of the specifications and the construction drawings the more stringent requirement shall prevail. Such conflicts must be brought to the ENGINEER or INSPECTOR prior to purchase of equipment or devices and prior to installation. The construction drawings are not intended to violate any code requirements. If such violation is found CONTRACTOR must bring it to the attention of the ENGINEER or INSPECTOR.
2. The CONTRACTOR shall review the plans for accuracy and completeness and bring to the attention of the Engineer and the Owner any such inaccuracies or incompleteness prior to the execution of work. Work executed which are deficient or in error by design or otherwise shall be the responsibility of the CONTRACTOR. CONTRACTOR will not be granted change order for work completed which are deficient or erroneous.
3. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all electrical work and appurtenant work necessary to provide a complete and operable system, all in accordance with the requirements of the Contract Documents.
4. The provisions of this Section shall apply to all electrical items specified in the various Sections of Division 16 and all other Divisions specifying electrical items of these Specifications, except where otherwise specified or shown in the Contract Documents.

**B. Responsibility:**

1. The CONTRACTOR shall be responsible for:
  - a. Complete and functional systems in accordance with the intent of these Contract Documents.
  - b. Coordinating the details of facility equipment and construction for all Specification Divisions which affect the work covered under Division 16, Electrical.

- c. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

C. Existing Conditions:

- 1. The electrical drawings were developed from past record drawings and information supplied by AGENCY. The CONTRACTOR shall field verify all the existing conditions shown on the plans prior to commencement of work.
- 2. After award of Contract, confer with ENGINEER/INSPECTOR to verify at each area of construction activity the location of existing underground utilities. Protect all existing underground utilities during construction.
- 3. NO work shall be started that involves the existing electrical system without first obtaining and completing all coordination forms required by the facility. All such coordination forms shall be submitted with drawings and procedures showing information about what, where, why and how the work will be done.

D. Intent of Drawings:

- 1. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The CONTRACTOR shall be responsible for the proper routing of raceway, subject to the approval of the ENGINEER.

E. Work Included in Division 16, Electrical:

- 1. Electrical - General Provisions
- 2. Basic Materials and Methods
- 3. Raceways
- 4. Conductors
- 5. Grounding
- 6. Electrical Tests

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials and equipment furnished and installed under other Sections with raceway and electrical conductors furnished, installed, and connected under Division 16, Electrical.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electric Code (NEC); provided, that where a local code or ordinance is in conflict with the

NEC, the provisions of said local code ordinance shall take precedence.

- B. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

1. Codes and Standards:

NEC	National Electrical Code, latest adopted edition.
CEC	California Electrical Code, latest adopted edition.

2. Commercial Standards: All material, equipment, and construction, installation, and testing procedures shall conform to applicable standards of NEMA, ANSI, and IEEE except where modified or supplemented by these Specifications. All equipment and materials shall be in accordance with the applicable requirements of the California Code of Regulations (CCR), Title 8.

- C. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or of an independent testing laboratory acceptable to ENGINEER.
- D. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the Cal OSHA Safety orders (Title 8, CCR), State Building Standards, and applicable local codes and regulations.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 3-8, Special provisions.
- B. The CONTRACTOR shall submit complete material lists for the work of this Section. Such lists shall state manufacturer and brand name of each item or class of material. The CONTRACTOR shall also submit shop drawings for all grounding work.
- C. Shop drawings are required for materials and equipment listed in this and other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
1. Front, side, and rear elevations, footprints and top views, with dimensions
  2. Component data
  3. Connection diagrams, terminal diagrams, schematic wiring diagrams, conductor size, and type, etc.

4. Finish.
  5. Nameplates
  6. Temperature limitations, as applicable
  7. Rating of equipment as per specifications and drawings
  8. Approved listing.
- D. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Materials and Equipment Schedules: The CONTRACTOR shall deliver to the ENGINEER a complete list of all materials, equipment, apparatus, and fixtures which it proposes to use. The list shall include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- F. Manuals: The CONTRACTOR shall furnish manuals as specified herein.
- G. Record Drawings: In addition to the Record Drawings as a part of the record drawing requirements specified herein, the CONTRACTOR shall show depths and routing of all concealed below-grade electrical installations. Said set of record drawings shall be available to the ENGINEER and the INSPECTOR during construction. After final inspection, the CONTRACTOR shall transfer all record drawing information to a set of reproducible vellums which shall then be delivered to the ENGINEER. In addition, the Record Drawings shall show all variations between the work as actually constructed and as originally shown on the Drawings, based upon information supplied by the CONTRACTOR.
- H. Manufacturer's Drawings: One set of equipment manufacturer's drawings shall be submitted to the ENGINEER for its records.
- I. The CONTRACTOR shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment. After approval, CONTRACTOR shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by AGENCY, only. Any spare parts which the ENGINEER permits the CONTRACTOR to use for startup activities shall be replaced by the CONTRACTOR prior to the ENGINEER's acceptance of beneficial use of the equipment.



1. During the term of this Contract the CONTRACTOR shall notify the ENGINEER in writing about any manufacturer's modification of the approved spare parts, such as part number, interchangeability, model change or others. If the ENGINEER determines that the modified parts are no longer applicable to the supplied equipment, the CONTRACTOR at its expense shall provide applicable spare parts.
- J. The CONTRACTOR shall coordinate all necessary material and equipment inspection and testing with ENGINEER as specified under TESTING of these specifications.
- K. The CONTRACTOR shall clearly state deviations from the specifications and/or drawings on the first page of the submittal. When deviations are taken but not specifically noted ENGINEER has the option and the right to have any or all items which deviated from the plans and specifications replaced at the contractor's expense. Liquidated damages, if enforced, shall also apply.

## 1.5 QUALITY ASSURANCE

### A. General:

1. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items only. Exact locations shall be determined by the CONTRACTOR in the field based on the physical size and arrangement of equipment, finished elevations, required clearances and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
2. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost.
3. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the ENGINEER and INSPECTOR. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
4. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
5. Protection of Equipment and Materials: The CONTRACTOR shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the ENGINEER and the INSPECTOR.

6. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
7. The CONTRACTOR shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the AGENCY.
8. Tests: The CONTRACTOR shall make all tests required by the ENGINEER or the INSPECTOR or other authorities having jurisdictions as per applicable standards. All such tests shall be performed in the presence of the ENGINEER or the INSPECTOR. The CONTRACTOR shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
9. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the ENGINEER and the INSPECTOR for review prior to final acceptance of the project.
10. Any test failure shall be corrected in a manner satisfactory to the ENGINEER and INSPECTOR.

B. Area Designations:

1. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
  - a. General Purpose Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Enclosures shall be NEMA Type 1.
  - b. Damp Location: Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations; except, that the air space from walls may be less than 1/4-inch and enclosures shall be NEMA Type 2. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.

- c. Wet Location: In outdoor locations, raceway shall be rigid galvanized steel conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Mounting brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, panels, switchboards and motor control centers shall be "Weatherproof NEMA Type 4." Enclosures shall be mounted 1/4-inch from walls to provide an air space, unless specifically shown otherwise.

C. Cleanup:

- 1. All parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- 2. During the progress of the work, the CONTRACTOR shall clean the premises and shall leave the premises and all portions of the site free of debris.

D. Shop Inspection:

- 1. All electrical materials and equipment shall be subject to shop inspection by the INSPECTOR or representative of a Testing Agency.

## **PART 2 -- PRODUCTS**

### **1.1 GENERAL**

- A. Unless otherwise indicated, provide all first-quality, new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment listed by UL wherever standards have been established by that agency.
- B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment of the same manufacturer are preferred.
- C. All electrical equipment shall be approved by a testing laboratory recognized by the AGENCY and shall conform to all applicable requirements of the AGENCY. This shall include the plant preferred list of equipment and components specified in the plans and specifications. The recommended use of a product in these specifications in no way implies approval by the ENGINEER and acceptance of non-UL listed products. Shop drawings acceptance by the ENGINEER shall in no way invalidate the requirements of the UL for listed equipment.

## 1.2 STANDARD PRODUCTS

- A. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

## 1.3 EQUIPMENT FINISH

- A. Provide materials and equipment with manufacturers' standard finish system. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with NEMA ANSI No. 61, light gray color.

## 2.4 SPECIAL TOOLS

- A. The CONTRACTOR shall provide all special tools required for operation and maintenance of the equipment. The tools shall be considered as part of the product and become the property of the AGENCY.

# PART 3 -- EXECUTION

## 1.1 GENERAL

- A. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise specified.
- B. Coordinate electrical work with ENGINEER and the INSPECTOR and work of all other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.

## 1.2 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not have space heaters.

- B. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the CONTRACTOR's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the ENGINEER and the INSPECTOR. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

### 1.3 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow ENGINEER's decision. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.
- B. Use appropriate conduit and conductor entry fittings with enclosures which maintain the specified enclosure environmental capability after proper installation.

### 1.4 REMOVAL OR RELOCATION OF MATERIALS AND EQUIPMENT

- A. Where existing materials and equipment are removed or relocated, remove all materials no longer used such as studs, straps, conduits, and wires. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 12 inches below the final finished surface.
- B. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Utilize skilled craftsmen of the trades involved.

### 1.5 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut or notch any structural member or structure surface without specific approval of ENGINEER or the INSPECTOR. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Utilize skilled craftsmen of the trades involved.

### 1.6 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides

a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the ENGINEER and the INSPECTOR.

#### 1.7 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the ENGINEER or the INSPECTOR. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the ENGINEER and the INSPECTOR.

#### 1.8 CHECKOUT AND STARTUP

- A. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the ENGINEER. Since coordination with other crafts and CONTRACTORS will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary.

#### 1.9 TESTS

- A. General: Carry out tests specified hereinafter and as indicated under individual items of materials and equipment specified in other sections.
- B. Operations: After the electrical system installation is completed and at such time as the ENGINEER or the INSPECTOR may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings. Demonstrate that protective functions are operating properly and are properly incorporated in control system, circuit breaker, and motor control center circuitry. Perform the test in the presence of the ENGINEER and the INSPECTOR. Furnish all instruments and personnel required for the tests.

END OF SECTION

## **SECTION 16030 ELECTRICAL TESTS**

### **PART 1 -- GENERAL**

#### **1.1 THE REQUIREMENT**

- A. This Section specifies the work necessary to test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.
- B. The work of this Section includes furnishing the labor, equipment and power required to support the testing specified in other Divisions of these Specifications. Electrical testing specified herein, and functional testing of all power and controls shall be completed before commencement of plant start-up. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.

#### **1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Division 16 Electrical as applicable.
- B. Other Technical Sections which include requirements for factory testing, test standards, and test report submittals when requirements are applicable.

#### **1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS: NETA Latest Edition.**

#### **1.4 CONTRACTOR SUBMITTALS: CONTRACTOR shall submit Test Reports forms and Procedures 60 calendar days prior to testing.**

#### **1.5 QUALITY ASSURANCE**

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.
  - 1. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
  - 2. Cable Testing: 120-volt circuits shall be tested for insulation resistance with a 1000-volt megohm meter for 5 minutes. Testing shall be done after the 120-volt equipment is terminated. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during

this test shall be disconnected. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall be submitted to the engineer and shall state equipment used and time of test. Testing shall verify the quality of cable terminations.

3. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Components and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
    - a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with all new and modified equipment.
  4. Complete ground testing of all grounding electrodes and grid prior to testing the equipment.
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
- E. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.
- F. Start-up commissioning shall not be attempted until all subsystems have been found to operate satisfactorily. Start-up shall only be attempted as a function of normal plant operation in which plan process flows and levels are routine and equipment operates automatically in response to flow and level parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

## **PART 2 -- (NOT USED)**



## **PART 3 -- EXECUTION**

### **3.1 CONDUCTORS FIELD TEST**

#### **A. Conductors 600 Volts and less**

1. Perform insulation resistance testing of all power circuits 600 volts and less with a 1000-volt megger.
2. Prepare a written test report of the results and submit to the ENGINEER prior to final inspection.
3. Minimum acceptable value for insulation resistance is 10 megohm at 5 minutes, minimum or as recommended by the cable manufacturer whichever is longer.
4. Disconnect equipment that might be damaged by this test. Perform tests with all other equipment connected to the circuit.

### **3.2 GROUNDING**

#### **A. Field Tests**

1. Grounding system resistance to ground shall not exceed 15 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the AGENCY. Final tests shall assure that this requirement is met.
2. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE Standard 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
3. Services at power company interface points shall comply with the power company ground resistance requirements.
4. Below-grade connections shall be visually inspected by the ENGINEER prior to backfilling. The Contractor shall notify the ENGINEER 24 hours before the connections are ready for inspection.

END OF SECTION

**SECTION 16050**  
**BASIC MATERIALS AND METHODS**

**PART 1 -- GENERAL**

**1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the Drawings and specified herein.
- B. This section covers the work necessary to furnish and install, complete, the materials specified hereinafter.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. The WORK of the following Sections and Divisions applies to the WORK of this Section. Other Sections and Divisions, not referenced below, shall apply to the extent required for proper performance of this WORK.
  - 1. Section 16010 Electrical General Provisions
- B. Materials and equipment furnished and installed under other Divisions with raceway and electrical conductors furnished, installed and connected under Division 16, Electrical.

**1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.
  - 1. Codes and Standards:
    - NEC                                      National Electrical Code, latest adopted edition.
    - Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Code of Regulations.
  - 2. Government Standards:
    - a. FS WW-C-581E                      Conduit, Metal, Rigid, and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated.
  - 3. Commercial Standards:
    - a. ANSI B16.5                          Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and

Other Special Alloys.

- b. ANSI C80.1 Rigid Steel Conduit, Zinc Coated, specification for.
  - c. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment.
  - d. ANSI/UL 467 Grounding and Bonding Equipment, Safety Standard For.
  - e. NEMA WD-1-1.10 General Requirements for Wiring Devices.
  - f. NEMA KS-1 Enclosed Switches.
  - g. ICEA S-61-402 Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  - h. ICEA S-19 Rubber - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or of an independent testing laboratory acceptable to the ENGINEER.
- C. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the Cal/ OSHA Safety Orders (Title 8, CCR), State Building Standards, and applicable local codes and regulations.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of Section 16010 Electrical General Provisions.

#### 1.5 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with all applicable requirements of Section 16010 Electrical General Provisions.

### PART 2 -- PRODUCTS

#### 2.1 TERMINAL BLOCKS 600 VOLTS AND LESS

- A. Provide 600-volts terminal blocks for termination of all control circuits entering or leaving equipment, panels, or boxes. Provide screw clamp compression, dead front barrier type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Provide yoke, current bar, and clamping screw constructed of high strength and high conductivity metal. Utilize yoke that guides all strands of wire into the terminal. Utilize current bar providing dependable vibration-proof connection.

Supply terminals constructed to allow connection of wire without any special preparation other than stripping. Rail mount individual terminals to create a complete assembly and provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.

- B. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field-marked tags. Supply CSA certified and UL approved terminal blocks manufactured by Weidmuller, Ideal, Electrovert, or equal. Provide terminal blocks with 25 percent spare termination points for OWNER'S use following completion of installation.

## 2.2 CONTROL RELAYS

- A. Provide magnetic control relays, NEMA Class A300 (300 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control type with field convertible contacts, and meeting the requirements of NEMA ICS 2. Provide Square D Class 8501, Type KP relay with pilot light and #NR51, no equal.
- B. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a timer attachment adjustable over the range specified on the Drawings. Provide Square D Class 9050, Type JCK timers with socket, no equal.
- C. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts. Utilize an attachment allowing easy manual latching and unlatching.

## PART 3 -- EXECUTION (NOT USED)

END OF SECTION

## **SECTION 16110 CONDUITS AND RACEWAYS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

- A. Furnish and install conduits and raceways as indicated on the Contract Drawings and herein specified.
- B. All raceway terminations will be done with the appropriate devices approved for the purpose.
- C. Comply with the General Conditions, General Requirements and requirements of Section 16010 of this Division 16 concerning definitions, guarantees, submittals, as-builts, etc. as applicable to work of this Section.

#### **1.2 SUBMITTALS**

- A. Shop Drawings: Layout drawings of exposed raceways in public spaces. These will be reviewed by the Engineer for aesthetics only.

### **PART 2 - PRODUCTS**

Contractor shall provide and install all applicable products. The AGENCY Construction Manager shall have final determination as to the product to be used.

#### **2.1 CONDUITS AND RACEWAYS**

- A. Conduit Size: In accordance with the NEC, but not less than 3/4 inch above grade or interior and 1-inch for underground, unless otherwise shown. Where permitted by the NEC, 3/4 inch flexible conduit may be used for tap connections to equipment.
- B. Conduit:
  - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
  - 2. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
  - 3. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC.
- C. Conduit Fittings:
  - 1. Rigid steel conduit fittings:

- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
2. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
3. Direct burial plastic conduit fittings:
- a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
  - b. As recommended by the conduit manufacturer.

D. Conduit Supports:

1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gage steel, cold formed, lipped channels; with not less than 3/8 inch diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.

4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Buried 12 inches below finished grade a Standard, 4-Mil polyethylene 3 inch wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF CONDUITS AND RACEWAYS**

#### **A. Procedure:**

1. All conduit joints shall be cut square, threaded, reamed smooth and drawn up tight. Bends or offsets shall be made with standard conduit ells, field bends made with an approved bender or hickey, or hub-type conduit fittings. Number of bends per run shall conform to Code limitations.
2. Paint male threads of field threaded conduit with homogenized blend of colloidal copper and rust and corrosion inhibitor pipe compound, Thomas and Betts Kopr-Shield or equal. Butt conduit ends.
3. Conduits shall be secured to all boxes with locknuts and bushings in such manner that each system shall be electrically continuous throughout.
4. Conduits shall be securely fastened in place on maximum 10 foot intervals; and within 24" of every outlet box, hangers, supports, or fastenings shall be provided at each elbow and at end of each straight run terminating at a box or cabinet.
5. Underground conduit runs shall be marked with a 3-inch wide red plastic tape installed 12 inches below finished grade, marking shall be "CAUTION BURIED ELECTRIC LINE BELOW".
6. Furnish and install pullboxes where required by Code and where necessary in the raceway system to facilitate conductor installation. In general, conduit runs of more than 100 ft., or with more than three right-angle bends, shall have a pullbox installed at a convenient intermediate location. Support boxes independently of raceways, walls and partitions. Boxes shall have removable screw covers and shall be accessible.

#### **B. Raceways shall be run concealed, except as noted.**

#### **C. Supports Shall Be as Follows:**

1. Ceiling trapeze, strap hangers, or wall brackets.
2. U-bolt or pipe straps at each grating level of riser raceways.
3. Raceways shall be secured to support with pipe straps or U-bolts.
4. Spacing shall be a maximum 10 foot on centers for metallic conduit and wireways.
5. Supports Shall Be Mounted To Structure With:
  - a. Toggle bolts on hollow masonry.
  - b. Expansion shields or inserts on concrete and brick.
- D. Exposed raceways and raceways in hung ceilings shall be run parallel with or at right angles to walls.
- E. Clearance from Water, Steam or Other Piping: Minimum three inches separation from hot water pipes, except one inch from pipe cover at crossings.
- F. Keep raceways clear of motor foundations.
- G. Run raceways in walls vertically.
- H. Maintain grounding continuity of interrupted metallic raceways with ground conductor, and in flexible conduit for feeders and motor terminal connections.
  1. Include equipment grounding conductor in exposed, damp or wet locations.
- I. Raceways Located Underground, Under Building:
  1. Use steel conduit for bends.
  2. Transition from PVC to steel must occur underground at least 3 feet before the riser.
  3. Separate pull boxes/handholes for normal and emergency circuits.
  4. Concrete encasement to be continuous with floor.
- J. Vibration and Noise Control:
  1. Provide flexible conduit connections to all vibrating equipment.
- K. Rigid Steel Conduit:
  1. In slabs (see 3.01.C), maximum outside diameter not to exceed 1/3 of the slab



thickness.

2. Direct Buried Conduit Transition from PVC to RGC: Provide with half lapped 5 mil plastic protective tape approved for the purpose.
3. Minimum one-inch cover in concrete fill.

L. Flexible Metallic Conduit:

1. For short motor or vibrating equipment connections where rigid conduit is impracticable.
2. For Final Connection to Motor Terminal Box, Transformers and Other Vibrating Equipment: With polyvinyl sheathing and ground conductor. Minimum length: 18 inches with minimum 50 percent slack. Connect ground conductor to enclosure or raceway at each end.
3. Provide liquid tight flexible conduit with separate insulated stranded copper equipment ground conductor for connections in area exposed to weather, damp locations and connections to transformers enclosures regardless of location. Use for all connections to kitchen and other appliances.

M. Plastic Conduit: (PVC)

1. Permitted Use: Underground with minimum of 1-inch and interior of underground vaults, chemical rooms with minimum of  $\frac{3}{4}$ -inch.
2. Cut ends square, ream smooth, wipe clean apply approved solvent weld cement and quarter turn as drawing up tight to shoulder. Seal joints watertight.
3. Convert to steel conduit through adaptors when entering building and for risers.
4. Provide ground wire with power wiring and increase size as required.
5. Under roads, roadways and parking areas: outside the outside walls of the building, concrete encase underground.
6. General Interior Use: Where permitted above.

N. Junction and Terminal Boxes:

1. Motor Terminal Boxes: Coordinate with motor branch circuit conduit and wiring.

### 3.2 TESTS

A. Continuity:

1. Test resistance of feeder conduits from service to point of final distribution using 1 conductor return.
2. Maximum: 25 ohms resistance.

END OF SECTION

## **SECTION 16120 CONDUCTORS**

### **PART 1 -- GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall furnish all tools, equipment, material, and supplies and shall perform all labor required to complete the work as indicated on the Drawings and specified herein.

#### **1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. The WORK of the following Sections or Divisions applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

- 1. Division 16 Electrical, applicable Sections.

- B. Materials and equipment furnished and installed under other divisions with raceway and electrical conductors furnished, installed, and connected under Division 16, Electrical.

#### **1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

- B. Comply with the current provisions of the following Codes and Standards.

- 1. Codes and Standards:

- NEC      National Electrical Code, latest adopted edition.
    - CEC      California Electrical Code, latest adopted edition.

- Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Code of Regulations.

- 2. Commercial Standards:

- ANSI/UL 467      Grounding and Bonding Equipment, Safety Standard For.
    - ICEA S-61-402/NEMA WC-5      Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

- ANSI/UL 62      Flexible Cord and Fixture Wire.

ANSI/UL 510	Insulating Tape.
NEMA WC-55	Instrumentation Cables
NEMA WC-57	Control Cables

- C. All Conductors furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL).
- D. The construction and installation of all electrical equipment and materials shall comply with all provisions of the CAL OSHA Safety Orders Title 8 CCR, as applicable), State Building Standards, and applicable local codes and regulations.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with the Section 16010 Electrical General Provisions.
- B. CONTRACTOR shall submit the following items.
  - 1. Catalog cuts and other brochures depicting conductor characteristics.
  - 2. Manufacturer's certified test records and factory test procedures.
  - 3. Manufacturer's recommended splicing, testing, and installation procedures and practices.
  - 4. Field testing using attached Cable Test Data Form, HI-POT and Megger tests including certified test reports. Also, include splicing personnel qualifications.

#### 1.5 QUALITY ASSURANCE

- A. Conductor Identification System:
  - 1. Provide complete power and control conductor identification system so that after installation, circuits can be easily traced from origin to final destination.
  - 2. Identify power and control conductors at each termination and in all accessible locations such as maintenance holes, handholes, panels, switchboards, pull boxes, terminal boxes, etc. For identification, use type of tags specified herein.
  - 3. Tag conductors using a three-segment conductor numbering scheme which defines the origin of the conductor, the function of the conductor, and the destination of the conductor.

Example: LCP-S-PIT-119 where LCP (Local Control Panel) is the origin, S is the function identification (P = power, C = control, S = signal, etc.), and PIT-119 is the destination.

4. For conductors with one point of origin and two or more destinations, expand the function identification number, e.g., PA, PB, etc.
5. Make the origin and destination identification the specific names for the equipment used in the Contract Documents. Make the instrumentation and control identification names exactly as designated, i.e., ZT-131.

**B. Conductor Color Coding:**

1. Color coding of multiconductor control and instrumentation cable is specified in the individual cable type specification.
2. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by applying a heat shrink tube of the appropriate color.
3. Phase A, B, C implies the direction of positive phase rotation.
4. Use the following colors:

<u>System</u>	<u>Conductor</u>	<u>Color</u>
All Systems	Equipment Grounding	Green
240/120 Volts 1-Phase, 3-Wire	Grounded Neutral	White
	One Hot Leg	Black
	Other Hot Leg	Red
208/120 Volts 3-Phase, 4-Wire	Ground Neutral	White
	Phase A	Black
	Phase B	Red
	Phase C	Blue

**C. Control Wiring Color Code (JIC STANDARDS):**

1. Black; plant line voltage.
2. Red; control voltage originating and remaining within the enclosure of origin or control voltage interconnecting controller with external devices and other controllers.
3. White; 120 volt AC neutral (grounded conductor).

4. Green; non-current carrying grounding conductor.
  5. Blue; principal DC voltage.
  6. Gray; DC neutral (current carrying grounded conductor).
  7. Yellow; SCADA control wiring.
  8. Orange, gray, violet, and brown; to be defined per application
  9. Black and white twisted-pair non-shielded; 4-20 MA when for short connecting wiring within a controller, not exceeding 18 inches in length, black is the positive lead.
  10. Black and white Belden twisted-pair shielded; 4-20 MA extension wired beyond the enclosure of origin, field wiring, black is the positive lead.
- D. For all 600 volt cable sized AWG #2 and larger, CONTRACTOR shall furnish cable manufactured no more than one year prior to installation.

## **PART 2 -- PRODUCTS**

### **2.1 GENERAL**

- A. The use of a manufacturer's name and model or catalog number 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 requirement if of the same quality and desired configuration.

### **2.2 CONDUCTORS**

- A. Conductors 600 Volts and Below:
1. Unless otherwise indicated, provide stranded conductors, except provide solid conductors where No. 10 AWG and No. 12 AWG are designated for branch circuit power wiring in lighting and receptacle circuits.
  2. Provide conductors with Type THHN/THWN insulation.
  3. Use only copper conductors.
  5. Where flexible cords and cables are specified, provide Type SO, 600-volt, with the number and size of copper conductors indicated.
  6. Conductors for applications of 600 volts and below shall be rated for 600 volts unless

otherwise specified.

7. The name of the manufacturer, insulation type, voltage rating and wire size shall be clearly and permanently imprinted throughout the length of each conductor. All conductors and cables supplied shall bear the UL label.

B. Multi-Conductor Cable:

1. Provide cable that is UL listed Type TC and conforms to the requirements of UL 1277 and NEC Article 340, or UL listed Power Limited Circuit Cable that conforms to the requirements of Article 725 of the LAEC. Provide cables permanently and legibly marked with the manufacturer's name, the maximum working voltage for which the cable was tested, the type of cable, and labeled UL (or submit evidence of UL listing).
2. Provide cables as specified under the type number in this section (Type 1, Type 2, etc.). Conduits shown on the Drawings and in the Circuit/Raceway Schedule have been sized to accommodate the outside diameter for each type. For this reason, use cable diameters equal to or less than the diameters specified.

a. Type 1 (600-Volt Multi-Conductor Control Cable, Type TC):

(1) General: Multi-conductor control circuit interconnection cable with ground. Suitable for installation in open air, in cable trays, conduit, or other approved raceways. Maximum cable temperature rating 90 degrees C dry locations, 75 degrees C wet locations. Passes vertical tray flame test.

(2) Individual Conductors: No. 14 AWG, 7-strand copper.

(3) Insulation and Jackets: Provide conductors having 15-mil PVC insulation with 4-mil nylon jacket, and UL listed as Type THHN/THWN. Color code the conductor group in accordance with ICEA S-61-402, Appendix K, Method 1, Table K-2. Include one full size green equipment grounding conductor. Bind conductor group with a spiral wrap of barrier tape. Provide cable with overall outer PVC jacket which is flame-retardant, sunlight- and oil-resistant, and has a nominal thickness as shown in the table below.

(4) Manufacturers: The Okonite Company, Rome Cable, or equal.

b. Type 3 (600-Volt No. 16 AWG Twisted, Shielded Pair Instrumentation Cable, Type TC) (UL 62 & 1277):

(1) General: Single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in cable trays, conduit, or other approved raceways. Maximum cable temperature rating shall be 90 degrees C dry locations, 75 degrees C wet locations.

- (2) Individual Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B 8; 16 AWG, 7-strand tinned copper drain wire.
  - (3) Insulation and Jacket: Each conductor 15-mil nominal PVC and 4-mil nylon insulation. Pair conductors pigmented black and red. Jacket flame-retardant and sunlight- and oil-resistant PVC with 45 mils nominal thickness. Shield 1.35-mil aluminum/mylar overlapped to provide 100 percent coverage.
  - (4) Within enclosures use Belden Beldfoil #9464, 20 gage, 0.204" diameter with an insulation rating of 300 volt.
  - (5) Instrumentation conductors in underground raceways use Belden Beldfoil #8719, 16-gage, 0.304" diameter with an insulation rating of 600 volt.
- c. Type 4 (600-Volt No. 16 Twisted, Shielded Triad Instrumentation Cable, Type TC) (UL 62 & 1277):
- (1) General: Single triad instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in cable tray, conduit, or other approved raceways. Maximum cable temperature rating shall be 90 degrees C dry locations, 75 degrees C wet locations.
  - (2) Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B 8; 20 AWG, 7-strand, tinned copper drain wire.
  - (3) Insulation and Jacket: Each conductor, 15-mil nominal PVC and 4-mil nylon insulation. Triad conductors pigmented black, red, and blue. Jacket flame-retardant and sunlight- and oil-resistant PVC with 45 mils nominal thickness. Shield 1.35-mil aluminum/mylar, overlapped to provide 100 percent coverage.
  - (4) Dimension: 0.32 inch nominal OD.
  - (5) Manufacturers: Belden, The Okonite Company, Alpha Wire Corporation, or equal.
- d. Type 5 (600-Volt No. 18 AWG, Multi-twisted Shielded Pairs with a Common Overall Shield Instrumentation Cable, Type TC) (UL 62 & 1277):
- (1) General: Twisted, shielded pairs of instrument cables, grouped in a single cable, designed for use as instrumentation, process control, and computer cable. Suitable for installation in cable tray, conduit, or other



approved raceways. Maximum cable temperature rating shall be 90 degrees C dry locations, 75 degrees C wet locations.

(2) Conductors: Bare soft annealed copper, Class B, 7-strand, concentric per ASTM B 8. Tinned copper drain wires. Pair drain wire size AWG 20, group drain wire size AWG 18.

(3) Insulation and Jacket: Each conductor 15-mil PVC and 4-mil nylon insulation. Pair conductors pigmented black and red with red conductor numerically printed for group identification. Outer jacket flame-retardant and sunlight- and oil-resistant PVC with nominal thickness as shown in table. Individual pair shield 1.35-mil aluminum/mylar. Group shield 2.35-mil aluminum/mylar, overlapped for 100 percent coverage.

(4) Dimensions as noted in table below:

<u>Number of Pairs</u>	<u>Maximum Outside Dimension (inches)</u>	<u>Nominal Jacket Thickness (mils)</u>
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
20	1.05	80
24	1.16	80
36	1.33	80
50	1.56	80

(5) Manufacturers: Belden, The Okonite Company, Alpha Wire Corporation, or equal.

C. Conductor and Cable Tags:

1. Tags relying on adhesives or taped-on markers are not acceptable.
2. Provide conductor tags for conductors No. 12 AWG and below with legible permanent sleeve of yellow or white PVC with machine printed black marking.
3. Provide tags for cables, and for conductors No. 10 AWG and larger, consisting of permanent nylon marker plates with legible designations hot stamped on the plate. Attach these marker plates to conductors and cables with nylon tie cord.

D. Equipment Grounding Conductors:

1. Provide soft-drawn copper conductors, not smaller than AWG12 and as indicated or as required by NEC, for equipment grounding.

2. Provide conductors with green insulation of the same type as all other circuit wires.
- E. Direct Buried Grounding Conductors:
1. Provide bare stranded copper conductors, size as indicated, for the ground system grid at transformers, switchgear, and where indicated.

## **PART 3 -- EXECUTION**

### **3.1 GENERAL**

- A. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved. contractor shall perform and submit pulling calculation per manufacturers recommendation to ascertain that there is no overstrain to the cable. The calculation shall be submitted to the ENGINEER for approval.”
- B. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.
- C. Single conductors and cables in maintenance holes, handholes, vaults, cable trays, and other indicated locations shall be wrapped together by arc and fireproofing tapes, and shall be bundled throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.
- D. Wires and cables in each voltage classification shall be installed in separate raceways and shall be completely isolated at the cable and wire terminations.
- E. No vehicles shall be used to pull conductors.
- F. A means of monitoring cable tension shall be provided at all pulls. (I.e. dynamometer)
- G. Conductor fill for Schedule 80 conduit shall comply with Revised Table 4 at the end of this section.

### **3.2 CONDUCTOR 600 VOLTS AND BELOW**

- A. Provide conductor sizes indicated on Drawings.
- B. Wire nuts may be used on solid conductors of 120-volt and 120-volt receptacle circuits only. Place no more than one conductor in any single-barrel pressure connection. Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors.

- C. Soldered mechanical joints insulated with tape will not be acceptable.
- D. Vinyl plastic insulating tape for wire and cable splices and terminations shall be flame retardant, 7-mil thick minimum, rated for 90 degrees C minimum meeting the requirements of UL 510.
- E. Provide terminals and connectors acceptable for the type of material used.
- F. Arrange wiring in cabinets, panels, and motor control centers neatly cut to proper length, remove surplus wire, and braid and secure in an acceptable manner. Identify all circuits entering motor control centers or other control cabinets in accordance with the conductor identification system specified herein.
- G. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions. Where terminals provided will accept such lugs, terminate all control and instrumentation wiring (except solid thermocouple leads) with insulated, locking-fork compression lugs, Thomas & Betts Sta-Kon or equal.
- H. For terminals designed to accept only bare wire compression terminations, use only stranded wire, and terminate only one wire per terminal. Tighten all terminal screws with torque screwdriver to recommended torque values.
- I. Attach compression lugs with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- J. Cap spare conductors and conductors not terminated with UL listed end caps.
- K. Where conductors pass through holes or over edges in sheet metal, remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors.
- L. For conductors that will be connected by others, provide at least 6 feet spare conductor in freestanding panels and at least 2 feet spare in other assemblies. Provide more spare conductor in any particular assembly where it is obvious that more conductor will be needed to reach the termination point.
- M. CONTRACTOR shall provide cable pulling tension calculations for review and approval before pulling cables sized 4/0 and larger.

### 3.3 CABLES

- A. Do not splice without permission of the ENGINEER or the INSPECTOR. Locate splices, when permitted, only in readily accessible cabinets or junction boxes using terminal strips. Splices will not be permitted unless deemed necessary by approved

pulling tension calculations.

- B. Where connections of cables installed under this section are to be made under Division Instrumentation and Controls, leave pigtails of adequate length for neat bundled type connections.
- C. Instrumentation, computer, and control cables run under infinite access floors in control rooms may be installed under the floor without protection. Run individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least ½ inch in diameter.
- D. Maintaining the integrity of shielding of instrumentation cables is essential to the operation of the control systems. Take special care in cable installation to ensure that grounds do not occur because of damage to the jacket over the shield.
- E. Cables entering maintenance holes, handholes or vaults shall be sealed using an expanding foam product approved for the purpose.

### 3.4 CONDUCTOR ARC AND FIREPROOFING TAPES

- A. Use arc and fireproofing tapes on all 600-volt single conductors and cables except those rated Type TC at splices in all maintenance holes, handholes, vaults, cable trays, and other indicated locations.
- B. Wrap together as a single cable all conductors entering from each conduit.
- C. Follow tape manufacturer's installation instructions. Secure the arc and fireproofing tape at frequent intervals with bands of the specified glass cloth electrical tape. Make each band of at least two wraps of tape directly over each other.
- D. Wrap together as far as possible, conductors carrying phases A, B, and C of the same feeder. Do not wrap together conductors carrying only two of the three phases.
- E. The cables shall be trained as closely as possible to their final positions.
- F. The cables shall be cleaned of all oil, grease, and cable pulling compounds using suitable solvents and cleaners non-injurious to cable and then wiped completely dry.
- G. Any projecting surfaces such as fittings, ground connectors or bonding connections shall be covered with an insulating compound to present a smooth continuous surface for taping.
- H. Fireproofing tapes shall be submitted as shop drawings for approval. Tapes shall be 3-inch width half-lapped and extend a minimum of 6-inches into the raceway. Use ¾" glass tape at three foot intervals to hold tape in place.

### 3.5 FIELD TESTS

- A. Field test shall be performed on conductors in accordance with Section 16030 Electrical Tests.

END OF SECTION

## **SECTION 16450 GROUNDING**

### **PART 1 -- GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the Drawings and specified herein.

#### **1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. The work of the following Divisions and Sections applies to the work of this Section. Other Division and Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

- 1. Division 16 Electrical, applicable sections.

- B. Materials, equipment and devices furnished and installed under other Divisions with raceway and electrical conductors furnished, installed, and connected under Division 16, Electrical.

#### **1.3 REFERENCED SPECIFICATIONS, CODES AND STANDARDS**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.
- B. Comply with the current provisions of the following Codes and Standards.

- 1. Codes and Standards:

NEC	National Electrical Code, latest adopted edition.
CEC	California Electrical Code, latest adopted edition.

California Code of Regulations	Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders.
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- 2. Commercial Standards:

ANSI/UL 467	Safety Standard for Grounding and Bonding Equipment.
IEEE 142	Grounding of Industrial and Commercial Power Systems

- C. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or of an independent testing laboratory acceptable to the ENGINEER.
- D. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the CAL OSHA Safety orders. (title 8 CCR, as applicable), State Building Standards, and applicable local codes and regulations.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of Section 16010 Electrical General Provisions.
- B. General Provisions - Submittals shall conform to the requirements of Section 16030 Electrical tests, Section 16120 conductors and additional requirements specified herein. Submittals shall be made for, but not be limited to the following:
  - 1. Catalog literature for all products.
  - 2. Certified copies of ground test results.
  - 3. Field test procedures including lists of test equipment to be used.

#### 1.5 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with the requirements of Section 16010 Electrical General Provisions and Section 16030 Electrical Tests.

### **PART 2 -- PRODUCTS**

#### 2.1 GROUND CONDUCTORS

- A. Provide grounding conductors of the size shown and the type specified in Section 16120, "Conductors". In no case shall the size of any grounding conductor be less than that stipulated by the NEC for that specific application.
- B. All grounding conductors furnished shall be composed of material resistant to any existing corrosive conditions or shall be suitably protected against such conditions.

#### 2.2 GROUND CONNECTIONS

- A. For below grade connections, provide exothermic-welded connectors.
- B. For above grade connections, provide bolted connectors.

## PART 3 -- EXECUTION

### 3.1 GENERAL

- A. Except where specifically indicated otherwise, ground all exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems, and the neutral of all wiring systems in strict accordance with the state, and other applicable laws and regulations.

Use the following three paragraphs wherever it is decided to run individual equipment grounding wires, rather than rely on raceways as return paths for fault current. Such a grounding wire should be included on all medium voltage circuits.

- B. Where grounding conductors are shown, bond the wires to metallic enclosures at each end and to all intermediate metallic enclosures. Connect grounding conductors to all grounding bushings on raceways. Where any equipment contains a ground bus, extend and connect grounding conductors to that bus. Connect the enclosure of the equipment containing the ground bus to that bus. Run ground conductors inside conduits enclosing the power conductors.
- C. Ground connection to equipment and ground buses shall be by copper ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures other than explosion proof, or by grounding locknuts or bushings. Explosionproof enclosures not provided with any of the above grounding means shall be grounded by the addition of an adjacent junction box with a ground lug. Ground cable connections to anchor bolts, against gaskets, paint, or varnish, or on bolts holding removable access covers will not be permitted.
- C. Ground shields of any shielded power cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer. Ground shields of any control cables in accordance with the details shown.
- D. Ground metal sheathing and any exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.
- E. Bond neutrals of transformers within buildings to the system ground network, or to any additional indicated grounding electrodes.
- F. Ground cable penetrations through building exterior walls shall enter within 3 feet below finish grade and shall be prepared with a water stop. Unless otherwise indicated, the water stop shall include filling the space between the strands with solder and soldering a 12 inch



copper disc over the cable.

- G. Ground cable near the base of a structure shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches.
- H. The main grounding conductor when exposed within a building shall be copper bar supported with suitable spacers at ½ to one inch from the structure. Unless otherwise indicated on the drawings, the ground bus shall not be smaller than 1/4 by one inch rectangular.
- I. The grounding system shall be bonded to station piping by connection to the first flange inside the building on either a suction or discharge pipe which will form a good ground connection. The connection shall be made with a copper bar or strap by drilling and tapping the flange and providing a bolted connection.
- J. Ground conductors on equipment shall be formed to the contour of the equipment and firmly supported.
- K. All ground connection hardware, bolts, and nuts shall be high strength, high conductivity copper alloy.
- L. Ground cables with encased underground conduit banks shall be as indicated on the drawings.
- M. Ground cables in underground circuits shall be bonded with main ground cables in each maintenance hole and handhold. Maintenance hole hardware and cover shall be effectively grounded.
- N. Liquid tight flexible conduits shall be provided with separate equipment grounding conductors sized in accordance with the NEC. The equipment grounding conductor shall be bonded to an approved grounding bushing and terminal lug. The grounding conductor can be installed outside the conduit if the required size is greater than No. 10.
- O. Exposed splices and connections for bare copper conductors and buses shall be protected by wrapping with heat shrink tape or covering.

### 3.2 GROUNDING CONNECTIONS

- A. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.
- B. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.

- C. When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint.
- D. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify the ENGINEER and the INSPECTOR prior to backfilling any ground connections.

### 3.3 FIELD TESTS

- A. Perform all field tests in accordance with Section 16030 Electrical tests.

END OF SECTION

**SECTION 17010**  
**INSTRUMENTATION AND CONTROL - GENERAL PROVISIONS**

**PART 1 GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish all engineering, tools, equipment, materials and supplies; and shall perform all labor required to complete the work as indicated on the Drawings and specified herein.
- B. The work specified in Division 17 shall be the responsibility of a single Contractor in order to ensure compatibility of the various equipment.

**1.02 SCOPE**

- A. This section covers general provisions applying to all sections included in Division 17, INSTRUMENTATION AND CONTROL

**1.03 RELATED WORK SPECIFIED UNDER OTHER SECTIONS**

- A. Unless otherwise noted herein, related work shall be provided as follows:
  - 1. Related electrical work shall meet the applicable requirements of Division 16, ELECTRICAL.

**1.04 CODES AND STANDARDS**

- A. As a minimum requirement, the Contractor shall comply with all prevailing Codes, Standards and Authorities having jurisdiction over the work. When the requirements of the Contract Documents exceed those of said Codes, Standards and Authorities, the requirements of the Contract Documents shall prevail.

Comply with the current provisions of Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Administrative Code.

Comply with the current provisions of the following Standards.

- 1. American National Standards Institute (ANSI)
  - ANSI C2      National Electrical Safety Code
- 2. American Society for Testing and Materials (ASTM)
- 3. Electronic Industries Association (EIA)
- 4. Institute of Electrical and Electronic Engineers (IEEE)
- 5. Instrument Society of America (ISA)
  - ISA S5.4      Instrument Loop Diagrams
  - ISA S20      Specification Forms for Process Measurement and Control Instrumentation

ISA 51.1      Process Instrumentation Terminology

6. National Electrical Manufacturers Association (NEMA)  
NEMA ICS 6      Enclosures for Industrial Control and Systems
7. National Fire Protection Association (NFPA)  
NFPA 70      National Electrical Code
8. Underwriters Laboratories Inc (UL)

1.05      DEFINITIONS

- A. General: The definitions of terminology used in these specifications shall be as defined in ISA Standard S51.1 unless otherwise specified.
- B. Solid State: Circuitry or components of the type which convey electrons by means of solid materials such as crystals or which work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, stepping motors, or any devices employing moving parts are not acceptable substitutes for solid-state components or circuitry.
- C. Integrated Circuit: A number of circuit elements inseparably associated on or within a sealed continuous body to perform the function of a circuit - as distinguished from circuits using discrete individual components.
- D. Two-Wire Transmitter: A transducer which derives operating power supply from the signal transmission circuit and therefore requires no separate power supply connections. As used in this specification, two-wire transmitter refers to a transmitter which produces a 4 to 20 milliamperes current regulated signal in a series circuit with a 24 volt direct current driving potential and a maximum circuit resistance of 600 ohms.
- E. Electrical or Galvanic Isolation: Pertaining to an electrical node having no direct current path to another electrical node. As used in this specification, galvanic or electrical isolation refers to a device with electrical inputs and/or outputs which are galvanically isolated from ground, the device case, the process fluid, and any separate power supply terminals, but such inputs and/or outputs are capable of being externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.
- F. Panel: An instrument support system which may be either flat surface, partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Panels may provide mechanical protection, electrical isolation, and protection from dust, dirt, water and chemical contaminants which may be present in the atmosphere; and may also provide temperature control for protection of enclosed equipment.
- G. Data Sheets: Data sheets used in this specification shall refer to ISA S20.

LCP: Local Control Panel.

RTU: Remote Terminal Unit, equipment, shall consist of microprocessor based electronic hardware for the communication between the pumping plant and OWNER's central supervisory control and data acquisition system.

PLC: Programmable Logic Controller shall consist of microprocessor based electronic hardware and software for the station process logic and control with communications to the OWNER's SCADA.

SCADA: Supervisory Control and Data Acquisition system, existing OWNER equipment, consist of microprocessor based electronic hardware and software for supervision and control of the OWNER 's pumping plants.

## 1.06 SUBMITTALS

- A. Submittals shall be made in accordance with Section 3-8, Special Provisions.
- B. The following submittals and specific information shall be provided:
  - 1. List of Material and Equipment: List of materials and equipment shall be complete covering all items to be furnished. The list shall include manufacturer's name, material identification, such as style, type, model, catalog number, catalog cuts, applicable standards, and other descriptive information in sufficient detail to describe and confirm compliance with the requirements of these specifications. Catalog numbers alone shall not be accepted as sufficient documentation of such compliance. Catalog cuts shall be clearly edited to indicate only those items, options, model or series of equipment which are being submitted. All extraneous materials shall be crossed out or otherwise deleted.
  - 2. Shop Drawings: Complete set of shop drawings and other applicable data shall be submitted for systems, equipment, and other devices, specified in other sections of this specification, and whenever requested by the Engineer. Shop drawings and data shall demonstrate complete compliance with the requirements of this specification. Shop drawings shall include, but not be limited to the following data, as applicable:
    - a. Identification of each piece of equipment and components
    - b. Equipment rating and nameplate data
    - c. Dimensional outlines of enclosures and equipment with structural and construction detail
    - d. Dimensional outlines of components such as switches
    - e. Layout and Arrangement of Equipment: Conduit layout drawings depicting all conduit runs and showing size and number of conductors shall be submitted for the OWNER review and approval prior to the start of any installation work. Equipment layout and arrangement drawings depicting all equipment shall be submitted for the OWNER review and approval prior to the start of any installation work. All drawings shall be clearly drawn to the best industry standards and shall be dimensionally correct using a scale of 1" to 4' or larger as needed to show all details. Additional detail drawings to a larger scale shall be provided to depict all particulars including unique and unusual features of the work. All drawings shall be updated during construction and resubmitted for the OWNER review and approval as the Record Drawings in accordance with Section 1.06-B.6 of this Specification.

- f. Operating and electrical characteristics
- g. Mounting or anchoring data
- h. Elementary and Loop Diagram: Elementary diagrams for all discrete loops and loop diagrams for all status and process control loops shall be submitted for the OWNER review and approval prior to installation of any conduit, cable and instruments/equipment. Loop diagrams shall be prepared in compliance with ISA-S5.4 and shall be provided for all analog and process alarm loops. Elementary diagrams and loop diagrams shall show all circuits and devices of a system. These diagrams shall be arranged to emphasize device elements and their functions as an aid to understanding the operation of a system and maintaining or troubleshooting that system. Elementary and loop diagrams shall also show wire numbers, wire color codes, input and output signals (eg., 4-20 mA DC, etc.), power supplies to devices (eg., 120V AC, 24V DC, etc.), signal polarities and terminal block numbers.

The Contractor shall provide loop diagrams which include all electrical and electronic components of each control loop regardless of whether such components are inside of or outside of control panels. Loop diagrams shall show the interconnections with all field devices regardless of whether they are existing, furnished under this Division 17, or furnished under other Divisions of these Specifications.

Elementary and loop diagrams shall be updated as necessary during construction and shall be made available to the Engineer for review during construction. The updated diagrams shall be submitted as part of the Record Drawings in accordance with the OWNER's Standards.

- i. Interconnection Diagrams: Interconnection diagrams for field wiring shall be submitted for the OWNER review and approval prior to installation. Interconnection diagrams shall show each panel and field device. Wire numbers, cable numbers, raceway numbers, terminal block numbers, panel numbers, and instrument tag numbers shall be shown.

Interconnection diagrams shall be updated as necessary during construction and shall be submitted as part of the Record Drawings in accordance with the OWNER's Standards.

- j. Installation instructions
  - k. Bill of materials cross referenced to parts or components on arrangement drawings
  - l. Factory test reports
- 3. Field Tests: Field test procedures, test formats to identify all simulation inputs and resultant outputs, and test equipment data shall be submitted to the Engineer for approval not less than two weeks prior to the proposed test.
  - 4. Spare Parts Lists: Spare parts lists shall be submitted for equipment provided under this contract and shall include manufacturer's designation or identification of any spare parts recommended by each equipment manufacturer for operation of the equipment for a period of one year following expiration of the equipment guarantee.

The lists shall include the address nearest to the job site where the spare part can be obtained, the ordering nomenclature and current price of each recommended spare part.

5. Operation, Maintenance and Service Manuals: Operation, maintenance, and service manuals shall be submitted for all systems and equipment provided under this contract. The manuals shall be compiled and assembled in an indexed, easily identifiable hardcover form.

In addition, the manuals shall include the following information as applicable to the particular equipment or system.

- a. Operation: This information shall describe the equipment, system, and operating modes, including normal, startup, shutdown and emergency. The detailed information shall include operating parameters, interfaces with other systems, major equipment, physical and operating characteristics, and circuit operating theories.
- b. Pre-operation Checkout: This information shall include calibration procedures and the steps or tasks necessary to completely check the equipment and prepare it for operation following a shutdown condition.
- c. Preventive Maintenance: This information shall describe all maintenance to be performed on a periodic basis, e.g., inspection, lubrication, and calibration.
- d. Fault Isolation: This information shall contain the systematic tests and procedures to be followed in determining the cause of a failure or malfunction. Fault isolation shall be organized by the order of the most likely fault; and shall be sufficiently detailed to permit isolation of the faulty item to component or plug-in board level.
- e. Maintenance: This information shall include all maintenance that can be performed on installed equipment (including removal and replacement) and repairs that can be performed with the equipment installed. The maintenance section shall include the part maintenance checkout to verify that the system can be restored to operation.
- f. Special Tools and Test Equipment: If special tools and test equipment are required to support checkout or maintenance, they shall be listed in the manual.
- g. Complete parts list of each piece of equipment.
- h. "As wired" internal and external wiring and control diagrams for all equipment including voltage levels at test points and component ratings or values.
- i. Pictorial diagrams of solid state and electronic equipment showing component locations.
- j. Final factory test reports.
- k. All other information pertinent to the proper maintenance and servicing of equipment and systems provided under this specification. Information regarding interfacing and coordination with other related systems shall also be included, whether or not these systems are furnished under this specification.

1. Name, address, and telephone number for parts and service of each equipment.
  6. Record Drawings: The Contractor shall prepare record drawings which document the construction as the work progresses. Such drawings shall include dimensions and details to accurately and completely reflect the construction.
- 1.07 WORK PROVIDED OUTSIDE THIS CONTRACT (NOT USED)
- 1.08 WORK INCLUDED IN DIVISION 17, INSTRUMENTATION AND CONTROL
- A. The Contractor shall furnish and install material, devices and equipment as required for the instrumentation and control work specified in the Specifications and as indicated on the Drawings.
  - B. The Contractor shall furnish and install instruments, control panels and temporary instruments as required for the instrumentation and control work specified in the Specifications and as indicated on the Drawings.
  - C. The Contractor shall sequence and coordinate the instrumentation and control work as needed to maintain the pumping plant in operation in accordance with the Contract Documents.
  - D. The Contractor shall sequence and coordinate the instrumentation and control work as needed to maintain the RTU in operation until functionally replaced with PLC in accordance with the Contract Documents.
- 1.09 MATERIALS AND EQUIPMENT FURNISHED UNDER DIVISION 11 AND 16 BUT INSTALLED AND CONNECTED UNDER DIVISION 17
- A. Motor temperature sensors with any required special relay control and monitoring components.
  - B. Motor moisture leak sensors with any required special relay control and monitoring components.
- 1.10 RESPONSIBILITY
- A. The Contractor shall be responsible for:
    1. Complete and operational systems in accordance with the requirements of these Contract Documents.
    2. Coordinating the details of facility equipment and construction for all Specification Divisions which affect the work covered under Division 17, INSTRUMENTATION AND CONTROL.
    3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
- 1.11 INTENT OF DRAWINGS



- A. Instrument and control device plan drawings show only general locations of instruments and control panels, unless specifically dimensioned. The Contractor shall be responsible for the proper construction installation location, subject to the approval of the Engineer.
- B. The intent of the Piping and Instrumentation Diagram (P&ID) is to show the overall process relationship between the instrument and control device input and/or output to the PLC. The Contractor shall note that not all inputs and/or outputs are shown on the P&ID sheet.

## **PART 2 PRODUCTS AND EQUIPMENT**

### **2.01 GENERAL**

- A. All materials, devices and equipment which are subject to the provisions of the National Electrical Code shall be listed and labeled by Underwriters Laboratories Inc. or other test laboratory recognized by the OWNER.
- B. All materials, devices and equipment shall be new unless otherwise specified. No used or previously installed items shall be used without written approval of the Engineer. No seconds, odd lots or otherwise questionable quality materials shall be used.
- C. Where two or more units of the same class of material and equipment are required, furnish products of a single manufacturer. Component parts of materials and equipment of the same manufacturer are required.
- D. All materials, devices and equipment shall be tested in the factory in accordance with the requirements of the applicable standards and manufacturer's practice and as required by this specification.

### **2.02 STANDARD PRODUCTS**

- A. Unless otherwise indicated, furnish materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Furnish the manufacturers' latest standard design that conforms to these Specifications.
- B. All materials, devices and equipment shall be produced by experienced and recognized manufacturers and shall be in strict accordance with the requirements of this specification and governing listed Codes and Standards.

### **2.03 EQUIPMENT FINISH**

- A. Furnish materials and equipment with one coat of rust inhibiting primer and two coats of epoxy based paint. Furnish manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI No. 61, light gray color. All finishes shall be factory applied and shall be touched-up at the site as needed.

## **PART 3 EXECUTION**

### 3.01 GENERAL

- B. Install material and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Carry out work in accordance with National Electrical Contractors Association (NECA) Standard of Installation unless otherwise specified.
- C. Coordinate instrumentation and control work with the Engineer and the work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.
- D. Check the approximate locations of the instruments and control panel and other instrumentation and control system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations.
- E. All equipment shall be mounted and/or anchored using materials and methods suitable for Uniform Building Code Zone 4.

### 3.02 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as instruments, control devices and panels. Energize all space heaters furnished with equipment.
- B. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to heat, dampness, moisture, dirt, and other adverse environments until completion of construction, ensure that adequate protection from these elements is provided that is acceptable to the Engineer. Keep openings in equipment closed during construction. Energize all space heaters furnished with equipment.

### 3.03 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow the manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's decision. Keep a copy of the manufacturers' installation instructions on the jobsite available for review at all times.

### 3.04 CLEANING AND TOUCH-UP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with

finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.

### 3.05 ANCHOR BOLTS

- A. Anchor bolts shall be furnished for all equipment placed on concrete mounting pads, or on concrete slabs. Except as otherwise specified or indicated, anchor bolts and related hardware shall be all #316 stainless steel and shall be of the size and number recommended by the equipment manufacturer, and shall be located by means of template.

### 3.06 NAMEPLATES

- A. In addition to the standard manufacturer's nameplates, engraved nameplates shall be furnished for all instruments whether field or panel mounted, the Local Control Panel, junction boxes and control cabinets and all other component parts of the control system provided under this Contract. Panel mounted instruments shall have nameplates on both the front and back of the panel. Nameplates for equipment located outdoors shall be #316 stainless steel, and for equipment located indoors shall be laminated plastic. Nameplates shall designate the function of the equipment for which they are used. The designation shall be submitted for approval with the shop drawings.
- B. The Contractor shall institute a numbering system consistent with the Construction Documents to identify all field and panel mounted components. Likewise, the submittal drawings shall use the numbering system. Nameplates shall be engraved to show white letters on black background. Letters shall be upper case. Nameplates 1-1/2 inch high and smaller shall be 1/16 inch thick, with engraved lettering 1/8 inch high. Nameplates larger than 1-1/2 inches high shall be 1/8 inch thick, with engraved lettering not less than 3/16 inch high. Edges of 1-1/2 inch high and larger nameplates shall be beveled. Nameplates shall be fastened to equipment and devices by stainless steel screws. Adhesive type nameplates shall not be used; except as otherwise noted.

### 3.07 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.

### 3.08 CHECKOUT AND STARTUP

- A. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the Engineer. Since coordination with other crafts and contractors will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary.

### 3.09 MAINTENANCE CONTRACT

- A. The Contractor shall provide the OWNER with a written contract preventive maintenance program executed by the Contractor which shall cover all of the work

performed under this Contract. Said preventive maintenance program shall include all labor, parts, test equipment, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance and repair for a period of one (1) year after the date of acceptance of the completed project by the OWNER. The cost for such service shall be included in the contract price. A separate, long-term maintenance contract shall be separately quoted.

### 3.10 OPERATIONS PERSONNEL TRAINING

- A. The Contractor shall include in his Bid the cost of training 6 persons, as designated by the OWNER, in the programming and operation of the installed system and in the use of various maintenance procedures and test equipment available to isolate and correct malfunctions to a device/module replacement level.
  - 1. The Contractor shall submit a detailed course outline to the OWNER for approval. This submittal may be made at any time during construction, but not later than one month prior to the proposed start of training. The decision of the Engineer shall be final as to acceptability or non-acceptability of both the course outline and the proposed starting date. If a given submittal is found unacceptable and approval cannot be obtained sooner than 2 weeks prior to the proposed start of training, the Contractor shall reschedule training in order to provide this minimum interval.
  - 2. Training costs shall include classroom instruction, ten copies of training manuals and other course materials, and shall be conducted entirely at the job site.
  - 3. The instruction of each person shall include courses extending for a minimum duration of one (1) 5-day week, and shall be directly related to the installed system, and shall include "hands-on" training as well as classroom instruction.

### 3.11 TEST PROCEDURES

- A. Testing shall be performed by the Contractor in accordance with these Specifications.
- B. No required test shall be performed without prior notice to the Engineer who has the right to witness any test. The Contractor shall provide at least 21 days written notice to the Engineer before the commencement of any testing activity; and such notice shall include a detailed step-by-step test procedure, complete with forms for the recording of test results, catalog data sheets for the testing equipment to be used, and identification of the individual in his employ who is responsible for the proper conduct of the test.
- C. Installation Tests
  - 1. Test reports shall be similar to the reference forms 17010-A through 17010-K included in Section 17010. Test reports shall be compiled by the Contractor and shall be submitted for Engineer approval.
  - 2. Tolerances shall be determined from applicable contract requirements. Where these Specifications do not specify tolerances, they shall be determined from manufacturer's published performance specifications. Overall accuracy requirements for networks consisting of two or more components shall be the root-

summation-square (RSS) of the individual component accuracy requirements. Tolerances for each required calibration point shall be calculated and entered on test forms prior to the commencement of the test.

3. Test equipment used to simulate inputs and read outputs shall be furnished by the Contractor and have a rated accuracy at the point of measurement at least three times greater than the component under test. Each test instrument shall be calibrated prior to the commencement of a testing activity and at the completion of a testing activity. Certified calibration reports traceable to the National Institute of Standards and Technology shall be included with the test report.

### 3.12 TESTS

#### A. TESTING PHASES

##### 1. General

- a. Each control loop shall be tested in the following sequence:

<u>Testing Phases</u>	<u>Form Reference</u>
Wiring	17010-A
Individual components	17010-B through G
Loops and Commissioning	17010-H through I
Deficiency Corrections	17010-J
Performance	17010-K

- b. Testing of wiring and individual components shall be successfully completed with certified test reports provided to the Engineer prior to commencement of individual loop testing, which shall then be successfully completed and certified test reports provided to the Engineer.

##### 2. Wiring Test of Instrumentation and Control System Cable

- a. The following tests shall be performed on each instrumentation and control system cable. Tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any grounded object. Tests reports shall be completed and provided to the Engineer.
  1. Continuity tests shall be performed by measuring wire/shield loop resistances of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than  $\pm 2$  ohms.
  2. Insulation resistance tests shall be performed by using a 500 volt megohmmeter to measure the insulation resistance between each channel wire, between channel wire and its associated channel shield, between individual channel shields in a multichannel cable, between each individual channel shield and the overall cable shield in a multichannel cable, between each wire and the metallic raceway (if provided) or local ground, and between each shield and the metallic raceway (if provided) or local ground. Values of resistance less than 10 megohms are unacceptable.

- b. Cables which do not pass the above tests shall be replaced at no expense to the OWNER.

### 3. Individual Component Calibration and Test

- a. Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure. Instruments shall then be tested in compliance with ISA S51.1 and the data entered on the applicable test form. Alarm trips, control trips, and switches specified in these sections shall be set to initial values at this time. Final elements shall be checked for range, deadband, and speed of response. When possible, actual process inputs such as pressure, temperature, flow, level, etc. shall be used to verify instrument accuracy, repeatability, etc.
- b. Any component which fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.

### 4. Loop Test

- a. Each instrument loop shall be treated as an integrated system. This test shall be designed to verify that indicators operate correctly, alarms operate correctly, final elements move in the correct direction, and control trips cause proper action in interlocking or control circuits. Signals shall be injected at the signal connection to primary measuring elements. When possible, actual process inputs such as pressure, temperature, flow, level, etc. shall be used to verify instrument accuracy, repeatability, etc.
- b. If any output device fails to indicate within required tolerance, corrections to the loop circuitry shall be made as necessary and the test repeated until all outputs are within tolerance. If any final element moves in the wrong direction or fails to move over the required range, corrections shall be made as necessary and the test repeated until final element action is correct.
- c. All circuit modifications required to pass the Loop Tests shall be incorporated into the drawings required under Section 17010. A completed legible set of elementary, loop, connection, and interconnection diagrams shall be included in the certified test report for the Loop Test required under Section 17010 and included in the Record Drawings.

### 5. Loop Commissioning Test

- a. Commissioning test shall demonstrate stable operation of the loop under actual operating conditions. This test shall include adjustment of closed loop tuning parameters.
- b. Tuning parameters (proportional gain, integral time constant and derivative time constant) for each control loop shall be adjusted to provide 1/4-amplitude damping (subsidence ratio of 4). A chart recording showing loop response to a step disturbance shall be provided for each loop. Tuning parameters shall also be shown on the chart. Two charts shall be made for cascade loops, one showing the secondary loop response with its set point on manual and the second showing overall loop response. Each control

loop with "batch" (anti-reset windup) feature shall be adjusted to provide optimum response following start-up from an integral action saturation condition. Chart recording shall be provided showing this response and the setting, where adjustable, of the anti-reset windup unit. Chart recordings shall be made at sufficient speed and amplitude to clearly show 1/4-amplitude damping and shall be annotated to show loop number and title, settings of parameters, and set point. Trace shall permit observation of any controller error or offset.

- c. The Contractor shall provide a report certifying that best possible tuning has been completed for each control loop and that 1/4-amplitude damping has been achieved. If 1/4-amplitude damping is not achieved, damping actually achieved and recommended corrections shall be reported.

## OPERATIONS TEST

### 1. Prior to Commissioning

- a. After the instrumentation and control system installation is completed and at such time as the Engineer may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings. Demonstrate that instruments are operating properly and that control circuits are functional. Perform the test in the presence of the Engineer. Furnish all instruments and personnel required for the tests. The OWNER will furnish the necessary electric power.

### 2. During Commissioning

- a. During the commissioning and at such time as the Engineer may direct, conduct an operating test in conjunction with tests performed by other the OWNER contractors in order to demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings.

### 3. 60 Day Performance Test

- a. After preliminary acceptance, the Contractor shall operate the entire pumping plant system for a period of 60 consecutive days without a single non-field-repairable malfunction. Upon completion of this requirement, the system shall be considered as acceptable. Any malfunction, during this 60-consecutive day test period that cannot be corrected within 24 hours of occurrence by the Contractor shall be considered a non-field-repairable malfunction, and upon completion of repairs, the test shall be continued from the time of failure. The 60 day clock for the failed component, however, shall be restarted. Serious malfunctions of major components of the instrumentation and control system (as judged by the Engineer) shall require restart of the complete system test. All control system hardware shall be warranted by the Contractor for a minimum of 12 months from the date of the OWNER acceptance of the completed project. This shall include all parts and service costs.
- b. The Contractor shall provide the services of a qualified and well-trained instrumentation and controls technician who shall be present at the job site for the first 5 days of the 60 consecutive day operation test period and shall

utilize this time to instruct designated OWNER personnel in all aspects of the operation of the system, and in simple troubleshooting and maintenance procedures. The Contractor shall submit resumes and references for each representative which he plans to send, and approval or rejection of said candidates shall be made at the discretion of the Engineer. During this time, said representative shall be at the site from 8 AM - 5 PM Monday through Friday, with on-site response to trouble calls within 3 hours from 5 PM to 8 AM. Following this, and to the end of the 60 consecutive day test period, the Contractor shall provide on-site response to trouble calls within 24 hours. The clock for non-field-repairable failures shall begin from the time of notification (telephone trouble call). The Contractor shall file with the OWNER a 24 hour telephone number for contacting service personnel and reporting system malfunctions during the 60 day test period.

- c. The Contractor shall furnish all standard and special test, calibration, and maintenance equipment normally utilized for field and shop servicing of control and instrumentation systems of the type being supplied. Said equipment shall become permanent property of the OWNER. Utilize the following test forms as applicable.



### 3.13 TEST FORMS

The Contractor shall utilize the test forms indicated hereafter and complete the appropriate form for all required testing procedures.

<u>Form No.</u>	<u>Title</u>
17010-A	Loop Wiring and Insulation Resistance Test Data
17010-B	Controller Calibration Test Data
17010-C	Panel Indicator Calibration Test Data
17010-D	Signal Trip Calibration Test Data
17010-E	Field Switch Calibration Test Data
17010-F	Transmitter Calibration Test Data
17010-G	Miscellaneous Instrument Calibration Test Data
17010-H	Individual Loop Test Data
17010-I	Loop Commissioning Test Data
17010-J	Deficiency Correction Report
17010-K	60-Day Performance Test Time Log

Sample test forms are provided on the following pages.

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.1

17010-A LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM:

Loop No.:

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	<u>Continuity Resistance<sup>a</sup></u>		<u>Insulation Resistance<sup>b</sup></u>			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A.			--	(A/SH)				
B.			(A/B)	--				
C.			(A/C)	--				
D.			(A/D)	--				
etc.								

a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of  $\pm 2$  ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.2

17010-B CONTROLLER CALIBRATION TEST DATA FORM:

Tag No. and Description: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_ Process Variable (PV) Scale: \_\_\_\_\_

Output: \_\_\_\_\_ Output Scale: \_\_\_\_\_

PV Scale Calibration

<u>% of Range</u>	<u>Input</u>	<u>Reading</u>	<u>Expected Reading</u>	<u>Actual % Deviation</u>
0				
50				
100				

% Deviation Allowed: \_\_\_\_\_

Connect output to PV for following tests; use precision resistor, if required, to match controller output to controller input:

<u>Set Point (SP)</u>			<u>Output Meter</u>		<u>Controller</u>	
<u>SP</u>	<u>PV Reading</u>	<u>%Dev.</u>	<u>Expected Reading</u>	<u>Actual Reading</u>	<u>% Dev.</u>	<u>Expected Output</u>
<u>%Dev.</u>						<u>Actual Output</u>
0						
50						
100						

% Dev. Allowed: \_\_\_\_\_

%Dev. Allowed: \_\_\_\_\_

% Dev. Allowed: \_\_\_\_\_

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.3  
17010-C PANEL INDICATOR CALIBRATION TEST FORM:

Tag No. and Description: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Scale: \_\_\_\_\_ Range: \_\_\_\_\_

PV Scale Calibration

<u>% of Range</u>	<u>Input</u>	<u>Reading</u>	<u>Expected Reading</u>	<u>Actual % Deviation</u>
0				
50				
100				

% Deviation Allowed: \_\_\_\_\_

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.4  
17010-D SIGNAL TRIP CALIBRATION TEST DATA FORM:

Tag No. and Description: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Scale: \_\_\_\_\_ Range: \_\_\_\_\_

Set Point(s): \_\_\_\_\_

After setting set point(s), run signal input through entire range and calculate deadband.

<u>Set Point</u>	<u>Incr. Input Trip Point</u>	<u>Decr. Input Trip Point</u>	<u>Calc. Deadband</u>	<u>Required Deadband</u>
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CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.5

17010-E FIELD SWITCH CALIBRATION TEST FORM:

Tag No. and Description: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Range: \_\_\_\_\_

Set Point(s): \_\_\_\_\_

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

<u>Set Point</u>	<u>Incr. Input Trip Point</u>	<u>Decr. Input Trip Point</u>	<u>Calc. Deadband</u>	<u>Required Deadband</u>
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CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.6  
17010-F TRANSMITTER CALIBRATION TEST DATA FORM:

Tag No. and Description: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Output: \_\_\_\_\_

Range: \_\_\_\_\_ Scale: \_\_\_\_\_

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

<u>% of Range</u>	<u>Input</u>	<u>Expected Output</u>	<u>Actual Output</u>	<u>% Deviation</u>
0				
50				
100				

% Deviation Allowed: \_\_\_\_\_

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.7

17010-G MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative



Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.8  
17010-H INDIVIDUAL LOOP TEST DATA FORM:

Loop No.:

Description: (Give complete description of loop's function using tag nos. where appropriate.)

P&ID No.: (Attach copy of P&ID)

- a. Wiring Tested
- b. Instruments calibrated:
- c. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Engineer's approval.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.9  
17010-I LOOP COMMISSIONING TEST DATA FORM:

Loop No.:

- a. Loop Tested:
- b. Controlled or connected equipment tests confirmed:
- c. Give complete description of loop's interface with process:
- d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1-inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.10  
17010-J DEFICIENCY CORRECTION REPORT FORM:

Loop No.; Instrument/Device  
Tag No. and Description; Wire No.; Other: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Description of Deficiency

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Description of Correction

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

SECTION 17010, PART 3.16-B.11  
17010-K 60-DAY PERFORMANCE TEST TIME LOG FORM:

Loop No.; Instrument/Device  
Tag No. and Description; Other: \_\_\_\_\_

Make and Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

<u>Start</u> <u>Date/Time</u>	<u>Fail</u> <u>Date/Time</u>	<u>Restart</u> <u>Date/Time</u>	<u>Comments</u>
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CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
OWNER's Representative

Contractor to Enter Project Name Here

END OF SECTION

**SECTION 17050**  
**BASIC MATERIALS AND METHODS**

**PART 1 GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the Drawings and specified herein.

**1.02 SCOPE**

- A. This section covers the work necessary to furnish and install, complete, the materials specified hereinafter.
- B. Like items of equipment furnished shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

**1.03 RELATED WORK SPECIFIED UNDER OTHER SECTIONS**

- A. Unless otherwise noted herein, related work shall be provided as follows:
  - 1. Related electrical work shall meet the applicable requirements of Division 16, ELECTRICAL.
  - 2. Related instrumentation and control work shall meet the requirements of other applicable sections of Division 17, INSTRUMENTATION AND CONTROL.

**1.04 CODES AND STANDARDS**

- A. As a minimum requirement, the Contractor shall comply with all prevailing Codes, Standards and Authorities having jurisdiction over the work. When the requirements of the Contract Documents exceed those of said Codes, Standards and Authorities, the requirements of the Contract Documents shall prevail.
- B. Comply with the current provisions of applicable Codes including, but not limited to, Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Administrative Code.
- C. Comply with the current provisions of applicable Standards including, but not limited to, the following:
  - 1. American National Standards Institute (ANSI)  
ANSI C2 National Electrical Safety Code
  - 2. American Society for Testing and Materials (ASTM)
  - 3. Electronic Industries Association (EIA)
  - 4. Institute of Electrical and Electronic Engineers (IEEE)

5. Instrument Society of America (ISA)
  - ISA S5.4 Instrument Loop Diagrams
  - ISA S20 Specification Forms for Process Measurement and Control Instrumentation
  - ISA 51.1 Process Instrumentation Terminology
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
  - NFPA 70 National Electrical Code (NEC)
8. Underwriters Laboratories Inc (UL)

#### 1.05 SUBMITTALS

- A. Submittals shall be made in accordance with Section 3-8, Special Provisions.
- B. Submittals shall be made to meet the requirements of Section 17010, INSTRUMENTATION AND CONTROL - GENERAL PROVISIONS.

### **PART 2 PRODUCTS**

#### 2.01 GENERAL

- A. All materials, devices and equipment which are subject to the provisions of the National Electrical Code shall be listed and labeled by Underwriters Laboratories Inc. or other test laboratory recognized by the OWNER.

#### 2.02 RADIO FREQUENCY INTERFERENCE

- A. To prevent radio frequency interference from walkie-talkies, CB radios, or plant equipment causing noise and false signals, all instrument enclosures shall be built to prevent radio frequency interference entering the cases. There shall be no openings, such as uncovered mounting holes or cracks in seams. Terminal blocks shall have grounding and full spectrum filtering circuits to suppress all common interfering frequencies.

#### 2.03 UNINTERRUPTIBLE POWER SUPPLY

- A. The Uninterruptible Power Supply (UPS) shall be used to power the Programmable Logic Controller (PLC) as specified in Section 17400 and other essential instruments and equipment. The UPS shall be an on-line system suitable to supply continuous, no-break power to the PLC during complete blackouts or momentary interruptions. The UPS output power capacity shall be sized for 150 percent of the power required for the load for 60 minutes but not smaller than specified on the drawings. The larger of the two shall prevail.
- B. During conditions when the normal power supply to the UPS is interrupted, the UPS shall supply power to its load at the voltage level required by the load. When the voltage of the UPS supplied power is less than that required by the load, the UPS output power shall be switched off by the UPS internal monitoring control.

- C. The UPS shall consist of rectifier, inverter, batteries, filters, automatic battery charger and components for a complete functional unit. The UPS shall be 85 percent efficient, minimum.
- D. The UPS shall be suitable for installation in the outdoor Local Control Panel.
- E. Sealed, maintenance-free batteries shall be furnished within the UPS cabinet or mounted in the LCP adjacent to the UPS. The batteries shall be sized to provide not less than 60 minutes of backup time at 100 percent of the power required by the load.
- F. The UPS unit shall have a status indication panel to indicate normal, AC input failure, fault, and low battery.
- G. Nominal input voltage shall be as shown on the drawings. Allowable range shall be minus 20% to plus 15% of input voltage.
- H. Output voltage shall be 120 VAC or 120/208 VAC, 60 hz. Voltage regulation shall be plus or minus 3 percent. Output waveform shall be sine wave, computer-grade power with total harmonic distortion less than 5 percent.
- I. The UPS shall be UL listed.
- J. The UPS shall be Sola, Best, Ferrups; EPE Technologies, Integrity; or equal.

#### 2.04 CONDUIT, RACEWAY AND ACCESSORIES

- A. All conduit, hangers, boxes, outlet bodies, and all other accessories and appurtenances shall be hot-dipped galvanized steel, Crouse-Hinds; or equal.
- B. All flexible conduit for general areas shall be liquid-tight hot-dipped galvanized steel.

#### 2.05 INSTRUMENTATION CABLE

- A. Furnish cable that is UL listed Type TC and conforms to the requirements of UL 1277 and NEC Article 340, or UL listed Power Limited Circuit Cable that conforms to the requirements of Article 725 of the National Electrical Code. Furnish cables permanently and legibly marked with the manufacturer's name, the maximum working voltage for which the cable was tested, the type of cable, and labeled UL (or submit evidence of UL listing).
  - 1. Type 3 (600-Volt No. 16 AWG Twisted, Shielded Pair Instrumentation Cable, Type TC) (UL 62 & 1277):
    - a. General: Single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in cable trays, conduit, or other approved raceways. Maximum cable temperature rating shall be 90 degrees C dry locations, 75 degrees C wet locations.
    - b. Individual Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B 8; 16 AWG, 7-strand tinned copper drain wire.
    - c. Insulation and Jacket: Each conductor 15-mil nominal PVC and 4-mil nylon



insulation. Pair conductors pigmented black and red. Jacket flame-retardant and sunlight- and oil-resistant PVC with 45 mils nominal thickness. Shield 1.35-mil aluminum/mylar overlapped to provide 100 percent coverage.

- d. Within enclosures use Belden Beldfoil #9464, 20 gage, 0.204" diameter with an insulation rating of 300 volt.
- e. Instrumentation conductors in underground raceways use Belden Beldfoil #8719, 16-gage, 0.304" diameter with an insulation rating of 600 volt.

2. Shielded Triad Instrumentation Cable, No. 16 AWG Twisted, 600-Volt, Type TC:

- f. General: Cable shall be single triad designed for noise rejection for use in process control, computer, or data logging applications; suitable for installation in cable tray, conduit, or other approved raceways; minimum cable temperature rating shall be 90 degrees C for dry locations, 75 degrees C for wet locations.
- g. Individual Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B 8; tinned copper drain wire, 18 AWG, 7-strand.
- h. Insulation and Jacket: Each conductor, 15-mil nominal polyvinyl chloride and 4-mil nylon insulation. Triad conductors pigmented black, red, and white. Jacket flame-retardant and sunlight- and oil-resistant polyvinyl chloride with 45 mils nominal thickness. The overall triad shield shall be aluminum/polyester, overlapped to provide 100 percent coverage.
- i. Dimension: 0.33 inch nominal OD.
- j. Manufacturers: Manhattan M8626010; Belden 1119A; or equal.

2.06 TERMINAL BLOCKS, (0 TO 600 VOLTS)

- A. Furnish 600-volt terminal blocks for termination of all control circuits entering or leaving equipment, panels, or boxes. Furnish screw clamp compression, dead front barrier type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Furnish yoke, current bar, and clamping screw constructed of high strength and high conductivity copper alloy. Utilize yoke that guides all strands of wire into the terminal. Utilize current bar providing dependable vibration-proof connection. Supply terminals constructed to allow connection of wire without any special preparation other than stripping. Rail mount individual terminals to create a complete assembly and provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.
- B. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field-marked tags. Supply UL approved terminal blocks manufactured by Weidmuller, Ideal, Electrovert, or equal. Provide terminal blocks with 25 percent spare termination points for OWNER'S use following completion of installation.

2.07 CONTROL RELAYS

- A. Furnish magnetic control relays, NEMA Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control type with field convertible contacts, and meeting the requirements of NEMA ICS 2. Provide Square D Class 8501, Type KP relay with pilot light and #NR51, no equal.
- B. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a timer attachment adjustable from 0.2 to 60 seconds (minimum) and field convertible from ON delay to OFF delay and vice-versa. Provide Square D Class 9050, Type JCK timers with socket, no equal.
- C. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts. Utilize an attachment allowing easy manual latching and unlatching.
- D. Lockout control relay shall be mechanically latched in the reset position after energization of the trip coil. The relay shall be manual-reset. The trip coil shall be 120 VAC. Output contacts shall be rated for 24 VDC and 120 VAC; and the number of contacts required is shown on the Drawings. The relay shall be panel mounted with operator handle and position indication. The relay shall be Electros witch, Series 24 LOR; or equal.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. All construction and installation of electrical and electronic material, devices and equipment shall be suitable for the environment and the area classification involved.
- B. Manufacturer's instructions for receiving, handling, storage and installation of material, devices and equipment shall be followed.
- C. UL listed material, devices and equipment shall not be modified nor in any way used such that the UL listing and/or approval is voided.

#### **3.02 INSTALLATION**

##### **GENERAL**

1. General. The process control system construction must be carefully coordinated with other work. Equipment shall be located so that it is readily accessible for operation and maintenance. All equipment shall be mounted and/or anchored using materials and methods suitable for Uniform Building Code Zone 4.
2. Field Equipment. Equipment shall be installed as specified on the drawings such that ports and adjustments are accessible for in-place testing and calibration. Equipment shall be located between 48-inches and 60-inches above the floor or a permanent work platform, except when such location is not possible or when noted otherwise. Instrumentation equipment shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Instruments shall be located as close as possible to their associated equipment. Instruments shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping or mechanical equipment except for

measuring elements and valve positioners. Small panels, less than 9-inches in any dimension, may be supported from a single floor stand fabricated from a double framing channel section.

Steel used for support of instrumentation systems shall be #316 stainless steel. Support systems including panels shall be designed to prevent deformation greater than 1/8-inch under the attached instrument load plus an external load of 200 pounds in any direction.

3. Process Connections. Process connections shall meet the requirements of the piping specification. Process connections shall be arranged where possible such that instruments may be readily removed for maintenance without disruption of process.
4. Electrical Power Connections. Electrical power (120 VAC) wiring and raceway shall meet the requirements of Division 16, ELECTRICAL. Liquid tight flexible conduit shall be used for all connections between instrument equipment and rigid raceway systems, except as noted otherwise herein; maximum length three feet. Devices requiring power other than 120 VAC shall be provided with individual power supply appropriate for the device and housed in an enclosure suitable for the environment.
5. Signal Connections. Electric signal (4-20mA DC, 24VDC) connections to equipment shall be made on terminal blocks or by suitable, equipment manufacturer furnished, locking plug and receptacle assemblies. Liquid tight flexible conduit shall be used between instrument equipment and rigid raceway systems except that flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible assemblies including both conduit and cable shall not exceed 3 feet.
6. Signal Transmission.
  - a. General. Signal transmission between electric or electronic instruments not located within a common panel shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Measurement loops shall be grounded at external terminals by bonding to the instrument panel signal ground bus. The Contractor shall provide isolating amplifiers for field equipment possessing a grounded input or output.
  - b. Signal Wiring. Signal wiring shall be carried in raceways in compliance with Section 16010, except as otherwise noted herein. Circuits shall be run as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Triads shall not be formed by using two pairs. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.
    - 1) Each signal circuit shall consist of two or more twisted and shielded conductors.

- 2) Shields are not acceptable as a signal path.
- 3) The signal cable shield shall be maintained at a fixed potential with respect to the circuit being protected.
- 4) The minimum signal interconnection shall be a pair of uniform, twisted wires, and all return current paths shall be confined to the same signal cable.
- 5) Low-level analog and digital code signal cables shall be terminated with short, untwisted lengths of wire, which expose a minimum area to inductive pickup.
- 6) Use individual twisted shielded pairs for each transducer.
- 7) Unused shielded conductors in a low-level analog and digital code signal cable shall be single-end grounded with the shield grounded at the opposite end.
- 8) Common ground return conductors for two or more circuits are not acceptable.
- 9) Unless otherwise specified, shields shall be bonded to the signal ground bus at the control panel and isolated from the ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.
- 10) Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.
- 11) Terminal boxes shall be provided at instrument cable splices.

-- END OF SECTION --

## **SECTION 17100 METERS, GENERAL**

### **PART 1 -- GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall furnish and install all meters and pressure measurement devices with associated instrumentation and controls as shown and specified herein, complete and operable, for functions including (but not limited to) pressure measurement, position measurement, level detection, valve controller and intrusion detector in accordance with the requirements of the Contract Documents.
- B. Furnish meters for functions in addition to those listed above wherever required by the Contract Documents and/or required by the specified process.

#### **1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 16050 Basic Materials and Methods (Electrical).
- B. Section 17400 Process Instrumentation and Control.

#### **1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Comply with reference specifications of Section 17400 Process Instrumentation and Control.
- B. Commercial Standards:
  - 1. ANSI/ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, 250).
  - 2. ANSI/AWWA C207 Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
  - 3. ANSI/AWWA C702 Cold-Water Meters - Compound Type.
  - 4. ASME REPORT Fluid Meters, Sixth Edition, 1971.

#### **1.4 CONTRACTOR SUBMITTALS**

- A. Comply with applicable subsections of Section 17400 Process Instrumentation and Control.

- B. Shop Drawings: The CONTRACTOR shall submit complete shop drawings of all meters for review. Each meter shall be identified with its equipment number / tag number as shown or specified.
- C. Manufacturer's Data: With the shop drawings, the CONTRACTOR shall also furnish certified calibration curves indicating flow versus differential pressure and any other information called for in the individual meter specifications.
- D. O & M Manuals: The CONTRACTOR shall furnish to the ENGINEER eight (8) copies of complete operation and maintenance instructions for all of the metering systems provided to the project including instrumentation and controls.
- E. Spare Parts: The CONTRACTOR shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment. After approval, CONTRACTOR shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the AGENCY, only, after expiration of the guaranty period. Any spare parts which the ENGINEER permits the CONTRACTOR to use for startup activities shall be replaced by the CONTRACTOR prior to the ENGINEER's acceptance of beneficial use of the equipment.
- F. During the term of this Contract the CONTRACTOR shall notify the ENGINEER in writing regarding any manufacturer's modification of the approved spare parts, such as part number, interchangeability, model change or others. If the ENGINEER determines that the modified parts are no longer applicable to the supplied equipment, the CONTRACTOR at its expense shall provide applicable spare parts.
- G. Special Tools: A list of special tools required shall be submitted to the ENGINEER for approval. After approval the CONTRACTOR shall supply these tools suitably wrapped and identified for application. Special tools shall include substitute steel spools for each meter for maintenance purposes. Each spool shall be labeled to identify the meter for which temporary replacement is required. The label shall include the meter identification number, size and service.

## 1.5 QUALITY ASSURANCE

- A. Inspection and Testing Requirements: The CONTRACTOR shall obtain the services of an experienced factory service representative to inspect and test all meters for proper performance and installation.
- B. Accuracy Requirements: Unless otherwise specified herein, the flow meters shall be guaranteed to register flow to an accuracy of  $\pm 2$  percent of actual flow throughout the range specified. All density measuring equipment shall have a reference accuracy within  $\pm 2$  percent of actual solids content over the range specified for each density measurement system.

## 1.6 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Erection and Startup Assistance: During erection and startup of the plant the CONTRACTOR shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and high quality installation, in accordance with the Contract Documents and the manufacturer's instructions.
- B. Instruction of the AGENCY's Personnel: After completion of the installation and during startup of the plant, the CONTRACTOR shall instruct the AGENCY'S personnel in the proper operation, maintenance and repair of all metering equipment. For this purpose, the CONTRACTOR shall obtain the services of an experienced factory service representative, who shall spend sufficient time on the site to fully instruct the AGENCY'S operating personnel on all phases of its equipment. The ENGINEER shall be the sole judge of what is appropriate and sufficient training.

## 1.7 CLEANUP

- A. After completion and testing of its work, the CONTRACTOR shall remove all debris from the site, clean all meters, controls, cabinets, and other metering appurtenances, and deliver to the AGENCY each system in proper operating condition.
- B. Purge all piping and capillary tubing before connection to the meter. Use water, high pressure air, and/or mechanical mandrel as applicable.
- C. Purge all electrical and signal conduits before installation of wiring. Use high pressure air followed by mechanical mandrel passed through the conduits from end to end by pull rope.

## 1.8 GUARANTEES, WARRANTIES

- A. After completion the CONTRACTOR shall furnish to the ENGINEER the manufacturer's written guarantees that the metering systems will operate within the published accuracies and flow ranges and meet these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.
- B. Warranty period shall not be less than one (1) year beginning from the day of first beneficial use by the AGENCY. Contractor testing shall not be counted in this period. Where necessary the CONTRACTOR shall purchase extended warranty coverage from the manufacturer to meet this requirement. All costs shall be included in the CONTRACTOR'S Bid price for the project.

## **PART 2 -- PRODUCTS (NOT USED)**

## **PART 3 -- EXECUTION**

### 3.1 INSTALLATION

- A. The CONTRACTOR shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's published instructions, under the supervision of the manufacturer's representative, and under the general review of the ENGINEER. All installations shall be accomplished by competent craftsmen of the appropriate trades and in keeping with the highest industrial standards for workmanship.
- B. The meters shall be installed in easily accessible locations for ease of reading and maintenance. Where indicated, meters may be used for balancing of flow in several lines in conjunction with throttling and shut-off valves. Wherever possible, all meter installations shall provide the manufacturer's recommended straight run of piping upstream and downstream of the meters. All meters, shut-off and balancing valves shall be firmly supported from the structure or from the floor with approved supports. In-line meters shall be installed to provide full-line flow and not less than the manufacturer's recommended head at all times.

### 3.2 TESTING

- A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.
- B. Each item shall be subjected to an operating test over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute. The CONTRACTOR shall obtain copies of factory test certifications and shall notify the ENGINEER 1 week in advance of all tests to be conducted on site.

### 3.3 ACCEPTANCE BY ENGINEER

- A. Final acceptance of the equipment is contingent on satisfactory operation after installation.

### 3.4 INSTALLATION, CALIBRATION, TESTING, PRECOMMISSIONING, START-UP AND INSTRUCTION

- A. Comply with the applicable subsections of Section 17400 Process Instrumentation and Control, Part 3 – EXECUTION.
- B. CONTRACTOR questions regarding conduct of any part of the work shall be submitted in writing to the ENGINEER for resolution.

END OF SECTION



**SECTION 17400**  
**PROCESS INSTRUMENTATION AND CONTROL**

**PART 1 GENERAL**

**1.1 THE REQUIREMENT**

- A. This section sets forth the general specification and requirements for the instrumentation work for the construction of the **City of San Fernando Regional Park Infiltration Project**.
- B. A CONTRACTOR shall furnish, install, and place into service the operating process instrumentation, all the control systems, and all the appurtenant work, being provided under this section of these Specifications and the integration of the Control and Instrumentation system and control devices provided under this project all in accordance with the requirements of the Contract Documents.
  - 1. Supply and install complete instrumentation systems as indicated on the Contract Drawings and as specified herein. Complete all required engineering work such as installation details, As-built drawings, Shop submittals, test procedures, training syllabuses and materials, and similar work described in this Specification, to produce a complete, fully documented and properly operating process instrumentation and control system. It will be necessary to produce additional drawings and text records in order to complete this work.
  - 2. As a minimum, the CONTRACTOR shall assume full responsibility for the following:
    - a. Implementation of the control and instrumentation system;
      - 1) Provide all engineering, labor and materials required to; prepare analog hardware submittals; design, develop, electronic drafting and submit loop drawings and control panel designs; prepare test plan, training plan, and spare parts submittals; procure hardware; fabricate panels; factory test panels; supervise the installation of all instrumentation devices and control panel devices; perform and document all loop tests, system commissioning, and the performance of the **Thirty (30)** day test for the entire control and instrumentation system.
      - 2) Provide all engineering, labor, and materials required to prepare Operations and Maintenance Manuals, conduct training classes, and to submit "as-built" or record drawings which reflect the installed state of the control and instrumentation system at the time of acceptance.

- b. Integration of the control and instrumentation system with instrumentation and control devices being provided under other specification sections;
  - 1) Provide all engineering, labor, and materials required to review vendor drawings and to design, develop, electronically draft and submit all requisite loop drawings and "As-Built" loop drawings associated with;
    - a) Equipment being provided under other divisions of these specifications.
  - 2) Provide all engineering, documentation, labor, and materials required to resolve signal, power, or functional incompatibilities between the control and instrumentation system and interfacing devices.
  - 3) Provide all engineering, labor, and materials required to; supervise and install all instrumentation and control panels; verify compliance with the manufacturer's installation recommendations; supervise the performance and document loop testing.
- c. The design, development, drafting and submission of all required loop drawings and as-built loop drawings associated with; (a) equipment provided under Division 17 and (b) equipment provided under other divisions of these specifications. It is the intent of these specifications that all instrumentation loops associated with this project shall be drafted and documented in a AGENCY approved format as Loop Drawings and shall be submitted for the ENGINEER's review and approval. All loop drawings shall be developed in an electronic format. AutoCAD. The As-Built (final version) shall be submitted both in hard copy and electronic format.
- d. All instruments shown on the loop drawings shall be itemized in an instrumentation summary generated by the CONTRACTOR. The instrument summary shall be on an electronic or oracle and hardcopy format and shall list all of the key attributes of each instrument provided under this contract. As a minimum, attributes shall include:
  - 1) Tag Number
  - 2) Reference Drawing No.
  - 3) Loop Drawing Number
  - 4) Service
  - 5) Area Location
  - 6) Associated LCP, PLC, HMI or RTU
  - 7) Calibrator Range
  - 8) Manufacturer
  - 9) Model Number
- 3. The CONTRACTOR shall obtain the required information on those primary elements, valve actuators, vendor packages, and other control equipment or devices which are furnished by others but are required to be interfaced under this Division.

4. The CONTRACTOR shall coordinate his work to ensure that:
  - a. All components provided under this Section are properly installed.
  - b. The proper type, size, and number of control wires with their conduits are provided and installed.
  - c. The proper type, size, and number of flexible pneumatic tubes with their conduits are provided and installed.
  - d. Proper electric power circuits are provided for all instrumentation components and systems.
- C. CONTRACTOR Experience Requirements: CONTRACTOR shall at bid, submit to the AGENCY documentation listed below:
  1. Documentation describing at least **two** projects of similar size and complexity that have been successfully completed to performed system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and start-up, operator instruction and maintenance training. In addition, list the following information for each project:
    - a. Name of plant, owner, contact name and telephone number.
    - b. Name of manufacturer for the majority of instrumentation furnished.
    - c. Type of equipment furnished (i.e., transmitters, recorders, indicators, etc.).
    - d. Approximate number of input functions to the system, analog and digital.
    - e. Approximate number of output functions from the system, analog and digital.
    - f. Contracted cost of the instrumentation and Control System including change orders cost.
    - g. Date of completion or acceptance.
  2. Identify individual responsible for office engineering and management, and the individual who will be responsible for field testing, calibration, start-up and operator training for this project. Include references of recent projects of these persons.
  3. Documentation showing that the CONTRACTOR has been in the instrumentation and control systems business for minimum of **four** years.

- D. The CONTRACTOR shall full responsibility for the complete operation of all new and modified instrumentation and control systems. The CONTRACTOR shall have performed all engineering and coordination necessary in order to select, furnish, install, connect, calibrate, and place into operation all sensors, instruments, alarm equipment, control boards, panels, computers, process control modules, human-machine interfaces, accessories and all other equipment as specified herein. Furthermore, the CONTRACTOR must calibrate and demonstrate the operability of said systems in accordance with the Contract Documents.
- E. The CONTRACTOR shall provide all engineering work and installation drawings to produce a complete instrumentation system. If it is necessary to produce additional drawings in order to complete and document the work, such drawings shall be made at no additional cost.
- F. The CONTRACTOR shall examine all drawings, specifications, and details to become fully acquainted with the method of construction.
- G. The CONTRACTOR shall note that the equipment loop, logic and elementary diagrams are based on non-certified vendor information and indicate minimum scope of supply from the Equipment Manufacturer. The CONTRACTOR shall include all costs in this bid to add additional instruments, wiring, computer inputs/outputs, controls, conduit, interlocks, electrical hardware, drawing revisions etc., into the design based on Equipment Manufacturer's final certified prints. Such changes to instrumentation and electrical work shall be incorporated into the scope of work at no additional cost.
- H. Provide all instrumentation and all related wiring as specified on any one of the following instrument or electrical documents: instrument location drawings, Instrument Index, I/O Tabulation, Loop Descriptions, one-line electrical diagrams, or as indicated on any other Contract Document. Indication of required instrumentation work on any one of these Contract Documents shall require supply and installation of the instrument and related wiring, supports and appurtenances at no additional cost.
- I. Provide all equipment, all materials, all labor supervision, all consumables and all scaffolding for the installation of the instrumentation systems, including the following:
  - 1. Provide field engineering design, as required, for mounting and supporting details of all field mounted components.
  - 2. Provide coordination, as required, between manufacturer's drawings and Contract Installation Drawings.
  - 3. Provide any additional schematics and any additional interconnection diagrams that may be required to facilitate erection or completion of equipment installation.
  - 4. Assemble and make interconnection of instruments disconnected for shipping purposes.

5. Remove all temporary supports, all bracing or other foreign objects that were installed in instrument control panels or other equipment to prevent damage during shipping, storage and/or erection.
6. Coordinate work with that of the different trades and disciplines so that interference between conduit, piping, equipment, architectural and structural work shall be avoided.
7. Install and support all instruments and all instrument piping not installed and supported by others. The CONTRACTOR shall furnish all hardware and all stands required to mount these items and provide modifications, as required, to meet actual site conditions.
8. All piping shall be field measured prior to fabrication/or erection. Any significant discrepancies between drawings and field measurements shall be reported to the ENGINEER. The AGENCY shall not be responsible for any costs for rework because of failure to field measure prior to initiating fabrication.
9. Capillary tubing shall be adequately supported and protected. All extra tubing shall be carefully coiled, tied, and protected at the instrument location.

## 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
  1. Section 3-8 Special Provisions
  2. Section 16010 General Electrical Provisions
  3. Section 16030 Electrical Tests
  4. Section 16050 Basic Materials and Methods
  5. Section 17050 Basic Materials and Methods
- B. The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment.
- C. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The AGENCY reserves the right to require minor changes in location of equipment prior to roughing in without incurring any additional costs or charges.

- D. Determine exact routing and final terminations for all wiring and cables. A site visit and review of the existing system control panel is mandatory.

### 1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Procure all necessary permits, pay all associated costs, and shall furnish the ENGINEER with evidence of permit procurement prior to the commencement of the Work.
- B. The equipment, materials and installation shall comply with the applicable standards, specifications and regulations of the following:
  - 1. Instrument Society of America (ISA).
  - 2. National Electrical Manufacturers Association (NEMA).
  - 3. Occupational Safety and Health Administration (OSHA).
  - 4. American National Standards Institute (ANSI).
  - 5. National Fire Protection Association (NFPA).
  - 6. Scientific Apparatus Makers Association (SAMA).
  - 7. Institute of Electrical and Electronic Engineers (IEEE).
  - 8. National Electrical Code (NEC).
  - 9. Insulated Cable Engineers Association (ICEA).
  - 10. Local Power Company.
  - 11. Local Authorities having jurisdiction over the work.
  - 12. Underwriters Laboratories (UL)
  - 13. National Institute of Standards and Technology (NIST)
  - 14. American Society for Testing and Materials (ASTM)
  - 15. Steel Structures Painting Council (SSPC)
- C. All electrical equipment, components, devices, etc. shall be Underwriters Laboratories APPROVED (have the UL label and/or be listed with reexamination in UL Publication Reference No.1). Alternatively, the equipment, etc. shall be APPROVED by a testing laboratory recognized by the AGENCY and shall conform to all applicable requirements of the authority having jurisdiction Department of Building and Safety.

1. Particular products being specified in the Contract Specifications does not express or imply approval by UL, the Department of Building and Safety or any other testing laboratory. Shop drawing approval by the ENGINEER shall not supersede the requirements of the UL or Department of Building and Safety for listed equipment.

#### 1.4 SUBMITTALS

- A. Submittals shall be made in accordance with Section 3-8, Special Provisions.
- B. Shop Drawings: Coordinate the work required in these Specifications so that a complete instrumentation and control system for the facility will be provided and will be supported by accurate shop and record drawings. The CONTRACTOR shall prepare and submit complete and organized shop drawings, as specified herein. Interface between instrument devices and other equipment related to instrumentation and control shall be included in the shop drawing submittal.
- C. Submit an analog hardware submittal that utilizes detailed shop drawings and data prepared and organized for easy reference. Section Tabs, Sequential page numbering and Table of Contents / Index Tables shall be used throughout. All shop drawings shall include the letter head and/or title block of the CONTRACTOR responsible for this project. The title block shall include, as a minimum, the CONTRACTOR'S registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets required shall be as specified in Section entitled, "CONTRACTOR Submittals." The analog hardware submittal shall be submitted as a complete bound package at one time within ninety (90) calendar days of receipt of Notice to Proceed, and shall include:
  1. Drawings showing definitive diagrams for every instrumentation loop and system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ANSI/ISA S5.4, extending the format as shown on Drawing I-1 and as defined by the most recent revision in ISA. Each System or Loop diagram shall be drawn on a separate drawing sheet with no more than ten loops per drawing. Develop, submit, update and maintain in an as-built condition the loop drawings for all loops in this project including vendor supplied packages, equipment supplied under Division 17 and AGENCY supplied packages. The loop drawings shall also show all software modules and linkages. In addition to the expanded ISA S5.4 requirements the Loop Diagrams shall also contain the following details:
    - a. ISA tag number
    - b. Functional name of each Loop
    - c. Tag number of the loop
    - d. Reference name, drawing, and Loop diagram numbers for any signal continuing off loop diagram sheet.

- e. Panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation (i.e., 24VDC and 120VAC).
  - f. Designation and if appropriate terminal assignments associated with every manhole, pull box, junction box, conduit and panel the loop circuits pass through.
  - g. Vendor panel, instrument panel, conduit, junction boxes, equipment and DCS terminations, termination identification wire numbers and colors, power circuits, and ground identifications.
2. Fully executed ISA-S20 data sheets for each component, together with a technical product brochure or bulletin. The technical product brochures must be complete enough to verify conformance to all Contract Document requirements. The data sheets, as a minimum, shall show:
- a. Component functional description used herein and on the Drawings;
  - b. Manufacturer's model number or other product designation;
  - c. Project tag number used herein and on the Drawings;
  - d. Project system or loop of which the component is a part;
  - e. Project location or assembly at which the component is to be installed;
  - f. Input and output characteristics;
  - g. Scale range and units (if any) and multiplier (if any);
  - h. Requirements for electric supply (if any);
  - i. Requirements for air supply (if any);
  - j. Materials of component parts to be in contact with, or other wise exposed to, process media;
  - k. Special requirements or features.
3. A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.



4. Drawings showing both schematic and wiring diagrams for control circuits: Complete details on the circuit interrelationship of all devices within and outside each Control Board shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the ENGINEER, piping and wiring diagrams shall be prepared and submitted for review by the ENGINEER; the diagrams shall consist of component layout drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as pumps, valves, chemical feeders and vendor panels. Should an error be found in a shop drawing at any time in the project, it shall be corrected including any field changes found and a "Record" drawing shall be prepared and submitted for review and approval by the ENGINEER prior to the acceptance of the project. Furnish all necessary equipment suppliers' shop drawings to facilitate inclusion of this information. Respond to all comments on the shop drawing re-submittals made by the ENGINEER either by noted corrections or stating why it was not revised. Any resubmittals received by the ENGINEER which do not contain responses to the ENGINEER's previous comments shall be returned marked "Rejected." No further review by the ENGINEER shall be performed until responses are made to all comments.
  5. Assembly and construction drawings for each alarm annunciator, local indicating panel and for other special enclosed assemblies for field installation: These drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
  6. Installation, mounting, and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
  7. A bill of material list shall be submitted for each field mounted device or assembly as well as cabinet assemblies and sub assemblies. Bills of material shall include all items within an enclosure. The submittal shall be a complete and detailed bill of materials. An incomplete submittal shall be rejected and no further evaluation performed until a completed and detailed bill is submitted.
- D. Organization and Binding of Shop Drawings: The organization of the initial shop drawing submittal shall be compatible to eventual inclusion with the technical manuals submittal and shall include final alterations reflecting "record" conditions. Accordingly, the final approved multiple-copy shop drawing submittal shall be separately bound in 3-ring binders of the type specified in Section 3-8, Special Provisions.
- E. Technical Manuals: In addition to updated shop drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, troubleshooting, maintenance and overhaul instructions in complete detail. This

shall provide the AGENCY with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.

- F. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for control panel being provided under this Specification Section. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation components, faceplate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall, as a minimum, be "B" size with all data sheets and manufacturer specification sheets being "A" size. The submittal shall be in conformance with NEMA Standard ICS 1-1.01, shall be submitted as a singular complete bound volume or multi-volume package within 120 calendar days after contract award and shall have the following contents:
1. A complete index shall appear in the front of each bound volume. All drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
  2. Construction drawings drawn to a 1-1/2-inch = 1-foot scale which define and quantify the type and gage of fabrication steel to be used for panel fabrication, the ASTM grade to be used for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details on the utilization of "UNISTRUT" and proposed locations, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations and lifting lug material and locations.
  3. Physical arrangement drawings drawn to 1-1/2-inch = 1 foot scale which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be provided.
  4. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
  5. Wiring/Connection diagrams shall locate and identify electrical devices, terminals and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
  6. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

7. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.
  8. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify the products conformance to the requirements of the Contract Documents.
  9. A bill of material which enumerates all devices associated with the control panel.
- G. Test Procedure Submittal: The CONTRACTOR shall submit the procedures proposed to be followed during the tests required under this project. Procedures shall include statement indicating test objectives, test descriptions, forms, and checklists to be used to control and document the required tests. Prior to the preparation of the detailed test procedures, submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists. Once the Preliminary Test Procedure Submittals have been reviewed by the ENGINEER and returned stamped either "no exceptions noted" or "make corrections noted", the CONTRACTOR shall submit the proposed detailed test procedures, forms, and checklists. Once the detailed Test Procedures Submittals have been reviewed by the ENGINEER and returned stamped either "no exceptions noted" or "make corrections noted", the tests may be scheduled. Upon completion of each required test, a copy of the signed-off test procedures shall be submitted as test documentation. These requirements shall apply to the factory testing of all panels, and all on-site tests.
- H. The organization of the initial shop drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "record" conditions. Submittals not organized as described above and incomplete submittals for a given Loop will not be accepted. Accordingly, the initial multiple-copy shop drawing submittal shall be separately bound in standard size, 3-ring, loose-leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2-inches.
- I. Instrument Installation Detail and Submittal: Submit the following data 180 days after Notice to Proceed:
1. Detail and Instrument Installation drawings
  2. Bill of Materials.
  3. Prior to acceptance, the control valve supplier shall submit function test verification certifications and hydrostatic leak test certifications.

## 1.5 QUALITY ASSURANCE

- A. Accuracy: The accuracy of each instrumentation system or loop shall be as determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of  $\pm 0.5$  percent of full scale and a minimum repeatability of  $\pm 0.25$  percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.
- B. Where materials and equipment are specified to conform to the standards of the Underwriter's Laboratories, the label of, or listing with reexamination in UL Publication Reference No. 1, shall be accepted as sufficient evidence that the items conform to Underwriter's Laboratories requirements. In lieu of such label, listing of the materials or equipment by a recognized approved testing laboratory as stated in National Electrical Code will be acceptable as interpreted by the jurisdiction having authority Department of Building and Safety.

## 1.6 GUARANTEE

- A. The CONTRACTOR shall guarantee all equipment and installation, as specified herein, for a period of one year following the date of completion of the work. To fulfill this obligation, the CONTRACTOR shall utilize technical service personnel designated by the CONTRACTOR to which the CONTRACTOR originally assigned project responsibility for instrumentation. Services of a non-critical nature shall be performed within 5 calendar days after notification by the ENGINEER and critical services within **24** hours after notification.
  - 1. Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified to attain compliance at no additional cost. Following replacement or modification, retest the system and perform any additional procedures needed to replace the complete system in satisfactory operation at no additional cost and attain design compliance approval from the ENGINEER.
  - 2. All parts, materials (excluding consumables), labor, travel, subsistence, or other expenses incurred in providing all services and service visits during the one-year warranty period shall be included in the Bid.

## 1.7 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. Provide jobsite visits and services of a manufacturer's technical field representative of the following items of equipment for calibration, testing and start-up:
  - 1. Programmable Logic Controller
  - 2. Any process sensing devices and indicating devices.

- B. Provide the following services of qualified technical representatives (see Installation, Calibration, Testing, Pre-commissioning, Start-up, and Instruction herein):
1. Install and connect all instruments, all elements, and all components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders.
  2. Make all necessary adjustments, calibrations and tests, as called out in Part 3 of this Specification. The results shall be logged and witnessed on test sheets supplied in this section or provided by the CONTRACTOR at the option of the ENGINEER.
  3. Instruct plant operating and maintenance personnel on the instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be the AGENCY's normal working days and hours.

#### 1.8 SHOP INSPECTION

- A. Shop Inspection and Performance Testing: Arrange for shop inspection and performance testing of the equipment.
1. All equipment shall be subject to shop inspection for sampling, testing and fabrication inspection.
  2. The equipment shall be performance tested and witnessed by the INSPECTOR and/or the Control System ENGINEER.
    - a. Performance testing shall be conducted at the Manufacturer's shop or factory.
  3. For all equipment, obtain and submit the following to the ENGINEER at least 6 weeks before test date for approval:
    - a. The Manufacturer's factory test procedure, including test raw data and report forms, and testing schedule prior to equipment testing.
    - b. Obtain and submit to the ENGINEER for approval the final factory test reports prior to shipping of equipment.
- B. Field Performance Test and Reports: All equipment shall be performance tested after installation at the field operating site.
1. Testing shall not start until all preliminary checks and calibrations have been completed, the installation has been certified ready for testing by the Manufacturer's representative, and the test forms and procedure have been approved by the ENGINEER.

2. All test information shall be recorded on forms provided by the ENGINEER or approved by the ENGINEER. If forms are not available from the ENGINEER, prepare test forms and submit for approval prior to the scheduled start of the test.
3. Submit the test procedure for approval prior to the scheduled start of the test.
4. Prepare a field performance test report, including all raw data, and submit the report within **14** calendar days after approved completion of the equipment field test.

## 1.9 PERSONNEL TRAINING

- A. Provide a comprehensive manufacturer training program for AGENCY personnel in the operation and maintenance of the equipment.

1. The training program shall be divided into at least **two (2)** separate sessions, namely:
  - a. Operations Training: To be conducted during the AGENCY's overall process training sessions.
  - b. Maintenance Training: To be conducted during or after the start-up and commissioning phase of the project.
  - c. Include training for programming and operation of installed PI & Cs.
2. The training program shall be composed of the following elements:

	Number of 8-Hour Sessions:	Number of AGENCY Personnel Attending each Session:
OPERATIONS	1	10
MAINTENANCE	1	8

3. Submit the Manufacturer training program to the ENGINEER for approval.

## PART 2 -- PRODUCTS

### 2.1 GENERAL

- A. Provide all instrumentation and related wiring as specified on any one of the following instrument or electrical documents:

1. Instrument Location Drawings, Piping and Instrumentation Diagrams, Wiring Diagrams, One-Line Electrical Diagrams, or as indicated on any other contract document.
  2. Indication of required instrumentation work on any one of these contract documents shall require supply and installation of the instrument and related wiring, supports, appurtenances, etc., at no additional cost.
  3. Assume full responsibility to perform all engineering to select, furnish, install, program, test, calibrate, and place into operation all instrumentation, indicators, displays, interfaces, controllers, control panels, and programmable controller for a complete and functional system.
- B. The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The AGENCY reserves the right to require minor changes in location of equipment prior to roughing in without incurring any additional costs or charges. The CONTRACTOR shall review the existing site conditions and examine all shop drawings for the various items of equipment in order to determine terminations for all wiring and cables. All deviations from the Drawings or Specifications must be approved in writing by the ENGINEER.
- C. All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.
- D. All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one manufacturer.
- E. All instrumentation shall be rated for operation in the ambient conditions at the equipment installation locations. NEMA 4X rated enclosures suitable for the environment shall be furnished in all general-purpose areas.
- F. Analog measurements and control signals shall be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control board(s) shall be 4 to 20 milliamperes dc except as noted. Signals within enclosures may be 1-5 volts dc. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.
- G. Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent (a) interruption of service upon failure, and (b) interruption

of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of forty (40) percent.

- H. Each control loop shall be individually fused.
- I. Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the ENGINEER. Any changes inherent to a proposed alternative shall be at no additional cost. The required approval shall be obtained in writing by the CONTRACTOR prior to submittal of shop drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.
- J. All field mounted instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120V ac inputs to field mounted equipment shall be secondary surge protectors conforming to the requirements of IEEE Standard 28-1972 (ANSI C62.1-1971).
- K. Provide all equipment, material, labor supervision, consumables, scaffolding, etc., for the installation of the instrumentation systems in accordance with the drawings and specification listed herein.
  - 1. Provide field engineering design, as required, for mounting and supporting details of all field mounted components.
  - 2. Provide coordination, as required, between manufacturer's drawings and contract installation drawings.
  - 3. Provide any additional schematic and interconnection diagrams that may be required to facilitate erection or complete the installation of equipment.
  - 4. Assemble and make interconnection of instruments disconnected for shipping purposes.
  - 5. Remove all temporary supports, bracing or other foreign objects that were installed in instruments, control panels or other equipment to prevent damage during shipping, storage and/or erection.
  - 6. Coordinate his work with that of the different trades so that interference between conduit, piping, equipment, architectural and structural work shall be avoided.



7. Install and support all instruments and instrument piping not installed and supported by others. Furnish all hardware and stands required to mount these items and modify to meet actual site conditions.
  8. All piping shall be field measured prior to fabrication/or erection. Any significant discrepancies between drawings and field measurements shall be reported to the ENGINEER. The AGENCY shall not be responsible for any costs for rework caused by failure to field measure prior to initiating fabrication.
  9. Adequately support and protect capillary tubing. All extra tubing shall be carefully coiled, tied, and protected at the instrument.
- L. The equipment loop, logic and elementary diagrams are based on non-certified vendor information and indicate minimum scope of supply from the equipment manufacturer. Include additional costs in the Bid to add additional instruments, wiring, computer inputs/outputs, controls, conduit, interlocks, electrical hardware, etc., into the design based on equipment manufacturer's final certified vendor prints. Revise or produce new loop, logic, or elementary diagrams to meet the equipment manufacturer's wiring requirements. Such changes to instrumentation and electrical work shall be incorporated into the scope of work at no additional cost.

## 2.2 SPARE PARTS

- A. Obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment.
- B. Furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
- C. During the term of this Contract, notify the ENGINEER in writing about any manufacturer's modification of the approved spare parts, such as part number, interchangeability, model change or others. If the ENGINEER determines that the modified parts are no longer applicable to the supplied equipment, provide applicable spare parts and/or replace the equipment to ensure compatibility of the items furnished.

## 2.3 CONTROL PANELS

- A. General
  1. The CONTRACTOR shall furnish, supply and install control panels and enclosures for this project needed for complete installation of instrumentation and control equipment as shown on the drawings and specified herein.
  2. All panels and enclosures shall be rated NEMA 4 as noted on the plans.

3. Front of panel layouts for control panel shall be submitted to the ENGINEER for review and approval prior to start of fabrication.
4. Dimensions shall be in accordance with manufacturer's requirements. Elevations and horizontal spacing shall be subject to ENGINEER's approval.
5. Furnish, supply and install control panel for this project in accordance with the below listed specifications. This section, also, covers requirements for local control panels being supplied by the Equipment Manufacturer.
6. This specification covers the requirements for the fabrication of instrument panel boards, mounting, finishing, piping and wiring of instrument equipment.
7. Front of panel layouts for control panel shall be submitted to the ENGINEER for review and approval prior to start of fabrication. Refer to other requirements as outlined in Paragraph O-Drawings, below.
8. For panels and enclosures with NEMA ratings of 2, 3, 3S, 3R, 4, 4X, 6 and 12, all conduit entries shall be Myers hubs or equivalent.

B. Mounting of Instruments

1. The panel vendor shall provide cut-outs, and shall mount all instrument items shown or specified to be panel mounted, including any instruments specified to be furnished by other vendors but installed in panel (if applicable).
2. The panel vendor shall also mount, behind the panels, other instrument accessory items as required and/or specified.
3. Enclosure for all the front panel mounted instruments shall be NEMA 4 rated. Instruments which are not rated NEMA 4 shall be covered with a door and a window to provide overall NEMA 4 rating.
4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

C. Electrical Requirements for Control Panels

1. Furnish and install all the necessary conduit, wireways, switches, and electrical fittings with wire for all circuits to instruments and other panel electrical devices to assure a complete and acceptable installation.
2. Signal and low voltage wiring shall be run separately from power and 120-volt control wiring.

3. Conduit, wireways, junction boxes and fittings shall be installed for all signal wire, all thermocouple or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature indicators and between the thermocouple wireway and junction boxes to instruments.
4. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular wire and markers.
5. Freestanding panels shall be provided with switched fluorescent lights. One light shall be provided for every 4-feet of panel width or fraction thereof and shall be mounted inside and in the top of the panel area.
6. Freestanding panels shall be provided with a 15-amp, 120-volt, ground fault interrupted (GFI) service outlet circuit within the back-of-panel area. The circuit shall be provided with three-wire, 120-volt, 15-ampere, duplex receptacles, one for every 4-feet of panel width (two minimum per panel) and spaced evenly along the back-of-panel area.
7. Smaller panels shall be so sized as to adequately dissipate heat generated by equipment mounted in or on the panel.
8. Controls panels shall be provided with thermostatically controlled heaters that will maintain their inside temperature above 40°F. Thermostatically controlled refrigeration type air conditioning shall be provided where necessary to prevent overheating of the equipment.

D. Wiring Methods:

1. Wiring methods and materials for all panels shall be in accordance with the N.E.C. requirements for General Purpose (no open wiring) unless otherwise specified. Open wiring in close cabinet type panels is allowed when specified in the material specifications. Unless otherwise specified by the material specification, design and installation of materials shall conform to the requirements of the latest edition of the following standards and codes as a minimum.
  - a. The National Electrical Code
  - b. All National Safety Codes
  - c. American Petroleum Institute Standard RP-550
  - d. Applicable Local Law and Regulations
2. Unless otherwise specified by the material specifications, all instruments, alarm systems and motor controls shall operate on 115-volt, 60-Hertz circuits.
3. At a location near the top of the panel (or bottom), the panel fabricator is to furnish terminal box connections for the main power supply entry.
4. Power supply switches for alarm units shall be three-pole type, arranged to open both the power and alarm circuits. Each annunciator equipped with a separate switch.

5. Instruments located on the same panel section and serving the same process unit may be connected to a common branch circuit from the power supply. The numbers of circuits depends on the circuit load as noted herein. A 15-amp, two-pole circuit breaker shall be provided in each branch circuit. The circuit load shall not exceed 10 amps. Different panel sections or different process units must not use common branch circuits.
6. When instruments do not come equipped with integral fuses, the panel fabricator shall furnish and install fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel, in fuseholder and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by Bussman, Littelfuse, no equal.
7. Where alarm units are single unit types, one switch may be used to disconnect not more than six alarm units located on the same or adjacent panels.

E. Material:

1. Wire for all 120 volt circuits shall be No. 14 AWG stranded with lugs with Type THWN or THHN insulation. All terminals for external wiring connections shall be suitable for wire sizes No. 16 through 12 AWG.
2. Flexible conduit is not allowed except when specifically approved by the ENGINEER in writing.
3. Conduit fittings shall be cast fittings by Carlon, Crouse-Hinds, Cal Pipes, no equal.
4. Splicing of wires in conduits shall not be permitted. All wire terminations shall have crimped wire lugs and terminated on strips or blocks in pull boxes or panels.
5. For case grounding, panels shall be furnished with a 1/4" x 1" copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be furnished and installed and connected to a system ground loop.

F. Electrical Locations:

1. Terminal boxes for incoming and outgoing signal leads shall be located at the bottom of the panel as specified in the material specification, or as otherwise required.

G. Typical Panel Annunciation

1. Unless otherwise noted, the following color code and inscriptions shall be followed for the lenses of all indicating lights:

STATUS	INSCRIPTION(S)	COLOR
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ON	ON	RED
OFF	OFF	GREEN
OPEN	OPEN	RED
CLOSED	CLOSED	GREEN
LOW	LOW	RED
FAIL	FAIL	RED
HIGH	HIGH	RED

2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
3. Unless otherwise noted, the following color codes and inscriptions shall be followed for all pushbuttons:

LABEL / ABBREV.	INSCRIPTION(S)	COLOR
OO	ON / OFF	GREEN / AMBER
OC	OPEN / CLOSE	GREEN / AMBER
OCA	OPEN / CLOSE / AUTO	GREEN / AMBER / BLUE
OOA	ON / OFF / AUTO	RED / GREEN / AMBER
MA	MANUAL / AUTO	AMBER / BLUE
SS	START / STOP	RED / GREEN
RESET	RESET	RED

4. All unused or non-inscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.

#### H. Construction Methods:

1. Materials: NEMA 3R steel shall be standard. Other types may be proposed in writing for use in specific service locations, but must be reviewed and approved by the ENGINEER.
  - a. Panel section faces shall be #10 gage minimum thickness steel for free standing panels and #14 gage minimum thickness steel for smaller panels. All materials shall be selected for levelness and smoothness.
  - b. Relay rack high density type panels shall utilize standard relay racks with 14 gage steel frame and supports.
  - c. Structural Shapes and Strap Steel: ASTM A-283.
  - d. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, all 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex head machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have S.A.E. standard lock washers.
2. Construction:
  - a. All dimensions shall be in accordance with vendors' requirements.
  - b. The elevations and horizontal spacing shall be subject to the ENGINEER's approval.

#### I. Fabrication Requirements:

1. End plates, top plates and top closure panels (to hung ceiling) shall be furnished when required by the material requisition. End plates, top plates and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-feet 6-inches wide or five 2-feet 0-inches wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
2. End closure or rear closure doors shall be provided. Such doors shall be flush fitting and gasketed and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Where removable access panels are specified they shall be furnished with dish handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.

3. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
4. The face of the panel shall be true and level after flanging.
5. All panel cut-outs and holes may be cut or drilled by any standard method that will not cause deformation. Burrs and sharp edges shall be ground smooth.
6. Adjacent panels shall assemble with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
7. Stiffeners shall be welded to the back of panels as required to prevent panel deformation due to the weight of front of panel mounted instruments.
8. Panels shall be self-supporting as defined below.

J. Frameworks and Supports:

1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, tubing, wireways, switches, air piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must not interfere with instrument connections or access needed for maintenance or adjustments.
2. Steel framework shall extend 2-feet 8-inches back of the panel face, or as specified in the material requisition. Where specified, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel shall be self-supporting.
3. Two removable lifting lugs shall be provided and shall be designed for moving the fully assembled control panel sections without causing distortion or bending.

K. Preparation of Panel Surface:

1. The surface of the panel shall be prepared for finishing in a manner equal to that described below. The entire surface shall comprise the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cut-outs.
2. All high spots, burrs, and rough spots shall be ground smooth.
3. The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
4. All traces of oil shall be removed with a solvent.
5. The first coat of primer shall be applied immediately.

L. Panel Finishing:

1. A thin coat primer surface shall be applied over the entire panel surface. Minimum dry film thickness of primer coat shall be 1 mil.
2. A primer surface shall be applied on the front of the panel only. Minimum dry film thickness of primer coat shall be 1 mil.
3. Wet sand to smooth clear finish and then dry.
4. At least two coats of air-dry, epoxy paint shall be applied over the entire surface. Dry film thickness of lacquer enamel shall be 1 to 2.5 mil. Color to be as approved by the ENGINEER.
5. Supply two one-pint containers of air drying, matching paint for field touch-up of the panel face.

M. Instrument Finishing:

1. The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise specified.
2. Japan black or "crinkle" finishes on instrument cases are not acceptable.

N. Preparation for Shipment and Shipping:

1. All panels are to be crated for shipment using a heavy framework and skids.
2. The panel sections shall further be cushioned satisfactorily to protect the finish of the instruments and panel during shipment.
3. All instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed in a manner to protect instrument parts which could be damaged due to mechanical shock during shipment.
4. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.
5. All shipments shall be by air ride van, unless otherwise specified or approved.

O. Labor and Workmanship:

1. All panels shall be fabricated, piped and wired by fully qualified workers who are properly trained, experienced and supervised.



2. All personnel used on the project shall be subject to AGENCY approval.

P. Drawings:

1. Furnish copies of preliminary drawings for approval. These drawings shall include:
  - a. Complete panel layouts showing all outside dimensions, locations and dimensions of panel cutouts, locations of back of panel stiffeners, and panel face drawings to exact scale.
  - b. Terminal point locations with coded identification for wiring, and piping connections (includes all pneumatic transmission lines).
  - c. Back of panel piping.
  - d. Back of panel wiring, including dimensioned location of connections.
2. Fabrication of panels, piping and wiring shall not proceed without the ENGINEER's written release for fabrication or approval of shop drawings by the ENGINEER.
3. The ENGINEER's requirements for final certified drawings include final approved copies of the above described shop drawings as well as certified drawings of instrument equipment furnished by the panel fabricator.
4. The number of copies of final certified drawings required by the ENGINEER and the required procedure for identification of these drawings are covered by Section 3-8, Special Provisions.

Q. Inspection and Approval:

1. Panel fabricator must carry out the following tests prior to arrival of the ENGINEER and the INSPECTOR:
  - a. All alarm circuits shall be rung out to determine their operability and proper function.
  - b. All electrical circuits shall be checked for continuity and where applicable, proper function.
  - c. All nameplates shall be checked for correct spelling and correct size of letters.
  - d. Perform any/all other tests needed to place the panel in proper operating condition.
2. Furnish all necessary testing devices and sufficient manpower to perform the tests required by the ENGINEER and the INSPECTOR.

3. If the above tests have not been performed prior to the arrival of the ENGINEER and the INSPECTOR, the CONTRACTOR shall be liable for back charges by the ENGINEER for the extra time required for the inspection services.

## 2.4 GENERAL ENCLOSURE COMPONENTS

- A. Signal Isolators, Converters, and Power Supplies: Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to ensure adjacent component impedance match, or where feedback paths may be generated or to maintain loop integrity when the removal of a component of a loop is required. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to ensure sufficient power to each loop component.
- B. General Purpose Relays: General purpose relays in the Control Boards(s) shall be plug-in type with 2DPDT contacts rated 10 amperes at 120 volts ac. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be Square D Class 8501, Type KP relay with pilot light and #NR51, no equal.
- C. Time Delay Relays: Time delay relays shall be pneumatic on-delay or off-delay type, with contacts rated 10-amperes at 120-volts ac. Units shall include adjustable dial with graduated scale covering the time range in each case. Time delay relays shall be Square D Class 9050, Type JCK60 or Type JCK70 timers with socket, no equal.
- D. Slave Relays: Additional relays (slave relays) shall be installed and wired when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.
- E. Circuit Breakers: Circuit breakers shall be single pole, 120-volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels.
- F. Nameplates: Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front panel(s) as shown.
  1. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the panel(s).
  2. These shall be descriptive, to define the function and system of such element.
  3. These nameplates shall be of the same material as those on the front of the panel(s).
  4. The nameplates shall be descriptive to define the equipment tag, function and system.

5. The nameplates shall be made from phenolic material 1/8 inch thick having a black exterior and white center.
  6. They shall be fastened with stainless steel machine screws.
  7. Tag numbers for instruments and Equipment numbers for machinery shall be coded to an AGENCY approved numbering system.
  8. Nameplates shall be fabricated from laminated plastic. Colors, lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP-60.6 (1984) with an intended viewing distance of three (3) to six (6) feet as shown or as selected by the ENGINEER.
  9. Before being produced, submit a list indicating the wording and tag numbering of all equipment identification Nameplates along with a sample to the Engineer for approval.
- G. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600-volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be Weidmuller, Ideal, or Electrovert, no equal.
- H. Signal and Control Circuit Wiring:
1. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire; these shall be UL listed Type MTW and shall be rated 600-volts. Wires for instrument signal circuits and alarm input circuits shall be No. 14 AWG. All other wires, including shielded cables, shall be No. 16 AWG minimum.
  2. All signal and low voltage wiring shall be run in separate conduits from power supply and 120V control wiring.
  3. Wire Insulation Colors: Conductors supplying 120-volts AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120-volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the Control Board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.
    - a. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or shall be permanently marked heat-shrink plastic. Manufacturers shall be Thomas & Betts, Brady, 3M or Tyco, no equal.

- I. Painting: Control Panel(s) shall be thoroughly cleaned and sand blasted per Steel Structures Painting Council Specification SSPC-SP-6 (Commercial Blast) after which surfaces shall receive a prime coat having a dry film thickness of 3-mils, for a total thickness of the complete system of 6 mils. The finished color of the outside surfaces will be selected by, unless otherwise specified. The inside surfaces shall have a white finish coat. Manufacturers shall be Hoffman Enclosure

## 2.5 EQUIPMENT SPECIFICATIONS

- A. Signal Isolator: Signal isolators shall have complete isolation of the input, output and power circuits. Signal input shall be 4-20 mA into 50 ohms maximum; signal output shall be 4-20 mA into 1000 ohms minimum. Power input shall be 120 VAC 60 Hz. Span and zero shall be adjustable; accuracy shall be  $\pm 1$  percent of span. Units shall be surface or rack mounted. Signal isolators shall be:
  1. Phoenix Contacts;
  2. Moore Industries;
  3. Acromag;
  4. Or equal.
- B. Signal Converter: Signal converters shall have complete isolation of the input, output and power circuits. Signal input shall be 1-5 VDC into a minimum of 5 megohms input impedance. Signal output shall be 4-20 mA into 1000 ohms minimum. Power input shall be 120 VAC 60 Hz. Span and zero shall be adjustable; accuracy shall be  $\pm 0.1$  percent of span. Units shall be surface or rack mounted. Signal converters shall be:
  1. Phoenix Contacts;
  2. Moore Industries;
  3. Acromag,
  4. Or equal.
- C. Indicating Lights: Indication lights shall be high-brightness LED, push-to-test type, and shall be NEMA heavy-duty, oil tight. Each light shall have a screwed-on glass prismatic lens approximately one-inch in diameter. Each light shall have a factory-engraved legend plate, as shown on the Drawings. Indicating lights shall be:
  1. Square D Type K;
  2. Allen-Bradley 800T;

3. No equal.

## 2.6 PROGRAMMABLE LOGIC CONTROLLER

- A. General: Program, test, calibrate, and place into operation, a Programmable Logic Controller (PLC). Provide a new HMI + PLC Maple Systems Inc. as shown on the drawings. Refer to the plans for the new components to be provided and installed by the CONTRACTOR. Add all the necessary components albeit not shown or specified but deems necessary for a complete functional system as intended on the plans.
- B. Construction: The PLC Central Processing Unit (CPU) is of solid-state design. The CPU operating logic is contained on plug-in modules for quick replacement. Chassis wired logic is not acceptable. The controller is capable of operating in a hostile industrial environment (i.e., heat, electrical transients, RF1, vibrations, etc.), without fans, air conditioning, or electrical filtering (up to 60 degrees C and 95 percent humidity).
- C. Design - General: The PLC shall have input facilities for the discrete input and 4-20 mA analog unit signals specified and shown on the drawings. The PLC shall produce isolated output contacts and 4-20 mA signals for control functions. Each CPU shall provide internal fault analysis with a fail-safe mode and a dry contact output for remote location alarming, and a local indicator on the PLC frame in the event of a fault in the PLC.
- D. Central Processor: The central processor contains all the relays, timers, counters, number storage registers, shift registers, sequences, arithmetic capability, and comparators necessary to perform the specified control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the specified requirements plus 25 percent excess capacity. The power supply shall contain capacitors to provide for orderly shutdown in the event the incoming power does not meet specifications. If this occurs the processor shall cease operation, forcing all outputs off. The processor shall have a key type memory protect switch to prevent unauthorized program changes.
- E. Memory: The programmable controller memory has CMOS semi-conductor memory with battery backup or EPROM electrically alterable read only memory. The CMOS memory has a minimum of 2K with battery backup to retain the program during power interruptions of up to 1 year. An indicator shows the status of the batteries and a reference shall be available through the discrete outputs, to alarm the operator that the batteries should be changed.
- F. Controller: The controller shall be programmed in annotated "ladder diagram" language. It shall be easily reprogrammed with a portable programmer. The PLC system shall be programmed by BYRD ELECTRONICS, ARCADIAS, or other entity familiar with CITY's system1 to accomplish the control and monitoring specified and shown on the drawings. Two documented copies of the operating program shall be furnished which allow direct, step-by-step, reloading of the system program. Copies of this program shall be furnished in the format used in the contract diagrams for conventional relay control

systems. These diagrams shall reflect equipment name designations used in the PLC as well as the contract diagram equipment name designations (i.e., timer "Q" in the "Contract Drawing may become timer OL in PLC, Program). Two sets of application software on CD shall be provided.

G. Power Supply: The power supply shall operate at the following:

1. 120VAC RMS plus or minus 15 percent continuously.
2. 120VAC RMS plus or minus 30 percent maximum 30 seconds.
3. 120 VAC RMS plus or minus 100 percent maximum 17 milliseconds.
4. Line spikes at 1000V ac (5000 micro-seconds duration; 0.5 percent maximum duty.

H. Input/Output Modules: All I/O housings and modules shall be rugged construction with modules in place. Sufficient input and output modules shall be provided to implement the specified control functions plus 20% spare capacity of each type of I/O point. They shall be as specified on the drawings.

1. Discrete Input Modules: Defined as contact closure inputs from devices external to the programmable controller module. Input modules shall be shielded from short time constant noise and 60 Hz pickup. Individual inputs shall be optically isolated from low energy common mode transients to 1500 volts peak from users wiring or other I/O modules. The modules shall have LED lights to indicate a discrete input.
2. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable controller module. The output modules shall be fused (typically 5-A at 115V AC) with blown fuse indicator lights. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1500 volts peak. All output modules shall have LED lights to indicate output has been cycled ON by the controller.
3. Analog Input Modules: Defined as analog inputs or 1 to 5V DC, 0 to 10V DC, or 4 to 20 mA DC signals, where an analog to digital conversion is performed and the digital result is entered into the processor. Inputs are read every scan.
4. Analog Output Modules: Defined as analog output or 1 to 5V DC, 0 to 10V DC, or 4 to 20 mA DC signals, where a digital to analog conversion is performed and the analog result is produced as an output. Outputs are produced on every scan.
5. Discrete I/O Expander: Where required provide I/O expander to enable the controller to access additional I/O points.

I. Input/Output (I/O) Section: Defined as heavy duty housing containing input and output control devices that are directly connected to the controller.

- J. Shop Drawings: The shop drawings shall include a full description of the PLC system, including documentation of operation theory, programming methods, i.e. ladder logic diagram (All contacts, coils, timers, latches and each section of the ladder shall be clearly annotated and defined. The annotation of each of the input contacts representing a field device shall clearly define the status of the device.), data codes and security features, maintenance and trouble-shooting information. Schematics of all cards or units within the system along with point-to-point wiring diagrams shall be furnished after award of contract.
1. The documentation shall, also, provide a sequential flow chart of the logic implemented. The format of the flow chart and the annotation shall be proposed for acceptance by the ENGINEER before implementation.
  2. Two sets of the program and documentation shall be forwarded for review and comments at least 30 days before factory test.
- K. Test: Control panel and other control system equipment shall be factory tested to verify all functions and features of the equipment; both the manufacturer's published specifications and compliance with all requirements of these Contract Specifications. All electrical equipment containing solid-state logic systems shall be tested for a minimum of 100 hours at an ambient temperature of 120 F prior to shipment from the factory. For testing, the equipment shall be interconnected with devices which will cause it to repeatedly perform all operations and experience all loads on the various components that will be seen in actual service. The ENGINEER may witness testing of the units. Solid-state logic systems shall be tested as complete assemblies. Testing of individual components or modules will not be acceptable. All testing shall be witnessed by the representative of the AGENCY. All costs for travel, lodging, transportation, meals, per-diem and other related expense shall be paid by the CONTRACTOR as part of the Contract Bid price.
- L. Training: A manufacturer's representative shall supply 40 hours of on-site training for AGENCY personnel. The training shall include, but not be restricted to, operation of programming unit, trouble shooting of system hardware, software, and program development.
- M. Thirty Day Acceptance Test: After startup has been completed, the System shall undergo a 30-day acceptance test. The System must run continuously for 30 consecutive days. During this period, all System functions shall be exercised, and any System interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. A failure shall cause termination of the 30-day acceptance test. When the cause of a failure has been corrected, a new 30-day acceptance test shall be started. Skilled technicians shall respond to all trouble calls by the AGENCY.

1. The technician responding to a System malfunction, must prepare a report which includes details concerning the nature of the complaint or malfunction and the resulting repair action required and taken, plus time and date of occurrence and correction.
  2. The System Malfunction Report form shall be submitted to the ENGINEER for review and approval before the time of re-start of testing. Failure to obtain ENGINEER approval for the Report form shall cause postponement of testing.
- N. Operations and Maintenance Manuals: Furnish to the ENGINEER 10 complete sets of Operation and Maintenance manuals. The manuals shall include data sheets, catalog cuts, approved shop drawings, manufacturer's technical manuals, information drawings, etc., for the system, subsystems, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives and repair facilities.
1. This shall include a complete description of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment.
  2. Each set shall include full size assembly and wiring diagrams; drawings showing "as built" conditions shall be furnished to the ENGINEER.

## 2.7 BACK-UP POWER

- A. The back-up power shall be designed to operate as an on-line reverse transfer system in the following modes:
1. Normal: The critical load is continuously supplied with filtered and regulated AC power by the inverter. The rectifier/battery charger derive power from the utility ac source and supply dc power to the inverters while simultaneously float charging the batteries.
  2. Emergency: Upon failure of the utility AC power source, the critical load continues to be supplied by the inverters, which without any switching, obtain power from the storage battery. The inverter shall continue to receive power from the storage battery until utility AC source is available. There shall be no interruption to the critical load upon failure or restoration of the utility AC source. If utility AC source is not restored before the battery discharges to its low voltage dropout value, the back-up power shall automatically shut itself down in an orderly manner. Batteries shall supply power for a minimum of 30 minutes after failure of utility AC source.

## PART 3 -- EXECUTION

### 3.1 INSTALLATION

- A. The CONTRACTOR shall utilize personnel provided by its assigned organization to accomplish, or oversee the physical installation of all elements, instruments, accessories or



assemblies which it furnishes. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories, and assemblies being furnished under this Contract.

- B. In summary, it is the general intent of this Contract that all field wiring, i.e., wiring external to the Local Control Boards, shall be furnished and installed under provisions of Division 16 Electrical. Computer equipment cables, data highway and grounding shall be furnished by the manufacturer and installed by the CONTRACTOR. Further, it is the general intent that all field wiring, i.e., 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, LCPs input and output wiring, be furnished and installed under Division 16 and be terminated and identified under provisions of Division 17 Instrumentation and Control.
- C. The CONTRACTOR's attention is directed to the electrical and mechanical schematics and details of this project. Referral to these portions of the contract design shall be required in order to understand the full intent and scope of work required.

### 3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

- A. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel-mounted components. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.
- B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.
- C. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
- D. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the ENGINEER'S review.
- E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or permanently marked heat-shrink plastic.

### 3.3 INSTRUMENT CABLE TESTS

- A. General: The following tests shall be performed on each instrumentation and control system cable which is installed under this Contract. All tests shall be end-to-end tests of installed cables with the ends supported in free air, not adjacent to any grounded object. Complete records of all tests shall be made and delivered to the ENGINEER.
- B. Continuity tests shall be performed by measuring wire/shield loop resistance of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than  $\pm 2$  ohms from the calculated average loop resistance value.
- C. Insulation resistance tests shall be performed by using a 500 volt megohmmeter to measure the insulation resistance between each channel wire, between each channel wire and the channel shield, between individual channel shields in a multichannel cable, between each individual channel shield and the overall cable shield in a multi channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 1 megohms will be unacceptable.

### 3.4 INSTALLATION, CALIBRATION, TESTING, PRECOMMISSIONING, START-UP AND INSTRUCTION

- A. General: All systems specified in the applicable Sections of Division 17, shall be installed, connected, calibrated and tested, and in coordination with the ENGINEER, shall be started to place the plant processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Contract Documents, including pumps, samplers, valves and chemical feeders. The installation personnel shall be provided with a final reviewed copy of the shop drawings and data.
- B. Installation and Connection: Install and connect all field-mounted components and assemblies under the criteria imposed in this Section under "Manufacturer's Representative Services." The installation personnel shall be provided with a final reviewed copy of the shop drawings and data.
  - 1. The instrument process sensing lines, in general, be installed in a similar manner to the installation of conduit specified under Mechanical drawings. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.
  - 2. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Ends of tubing shall be square-cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe and/or tubing entries.
  - 3. All instruments and connecting lines shall have allowance made for movement of equipment caused by seismic loading, vibration, or expansion or contraction caused by

temperature changes. This shall be demonstrated to the ENGINEER during witnessing of field installation work prior to startup.

4. All accessory items required for installation and proper operation of the equipment shall be provided. Such items may include instrument valves, seal pots pigtails, etc.
5. Lines or connections open to atmosphere shall be protected against ingress of foreign matter. Unprotected openings shall have a goose neck, or equivalent, attached to protect against falling particles. Bird screen and insect screens shall be installed.
6. Comply with installation detail in the specifications for mounting of the instrument.
7. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
8. All power and signal wires shall be terminated with spade type lugs.
9. All connectors shall be, as a minimum, watertight.
10. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
11. All wire and cable shall be connected from terminal to terminal without splices unless specifically approved by the ENGINEER and arranged in a neat manner and securely supported in cable groups. All wiring shall be protected from sharp edges and corners.
12. Verify that all mounting stand and bracket materials and workmanship comply with requirements set forth in the specifications and drawings.
13. Provide a technical field representative to instruct the installation personnel on any and all installation requirements; thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.
14. Finally, after all installation and connection work has been completed, the technical field representative shall check for correctness, verifying polarity of electric power and signal connections, making sure all liquid or pneumatic process connections are free of leaks, and all other similar details. The technical field representative shall certify in writing that for each loop or system checked out, all discrepancies have been corrected by the installation personnel.
15. Bear all costs and provide all personnel, equipment and materials necessary to implement all activities specified herein.

C. Process Connections: Process Connections shall be located so that they are accessible.

1. Consistent with measuring needs, process connections shall be located to have minimum movement. Therefore, they shall be as close to the system anchor points as possible.
  2. For instruments mounted on a local board, the process connection shall be located as close as practical to the board.
  3. Process connections in pipelines shall be oriented to avoid gas pockets in the sensing lines for liquid and vapor, and to avoid liquid pockets in the sensing lines for gas.
- D. Instruments: Locate locally mounted instruments near the most convenient point of use consistent with good measuring practice and accessibility. Sensing lines shall be as short as practical.
1. When consistent with good measuring practice, local boards or racks may be used to mount instruments that are grouped together because of common locations or related function.
  2. Instruments and local boards shall not block walkways. For use, calibration, and repair, they shall be accessible without requiring instrument disassembly or the removal of piping, grating, or other structure.
  3. Instruments shall be 4' - 6" above the floor. Exceptions may be made for seismic supports, for instruments accessibility, or for other factors, but must be approved by the ENGINEER prior to the work being done. Sufficient lighting shall be provided for night-time use.
  4. Instruments shall be protected against shock and vibration. Because of vibration, electro-pneumatic signal converters, in particular, shall not be mounted on control valves.
  5. High temperature, high humidity and other ambient factors must be considered when locating instruments that require access for service.
  6. Fluid-filled sensing systems, or "capillary tubes", are sealed to the instrument by the instrument manufacturer and are not repairable in the field. Such systems shall not be opened or cut during or after installation, and shall be routed and protected as required to guard against damage. Avoid sharp bends in capillary tubing (i.e. bend radius shall not be less than 10 times the diameter of the capillary tubing. Excess lengths of capillary tubing shall be neatly coiled in a protected area or enclosure, e.g., coiled inside a protective shipping cap for 12-inch pipe.
  7. Manufacturer's installation requirements, including those relating to unsupported span and minimum bend-radius of capillary tubing, must be submitted for review and approval by the ENGINEER.

8. All instruments shall have nameplates and tag numbers engraved on tags made of 316 stainless steel and attached with 316 stainless steel wire.
- E. Fittings: Fittings shall not be used between the process connection and the root valve nor for pipe on the process side of condensate or seal pots, except that displacement and float-type level instruments are normally installed using pipe fittings.
1. So far as practical, bends rather than fittings shall be used to change the direction of a run of tubing or pipe. The minimum bending radius for cold-bending of tubing shall be three times the outside diameter of tubing and is covered by ANSI B31.1.
  2. The ferrule of a flareless tube fitting shall be harder than the tube on which it is used.
  3. Lubricant and sealant compounds shall be used as required by the AGENCY and equipment suppliers.
  4. Where a detail specifies a size and type of fitting, a combination of fittings of other sizes but of the same or equivalent type giving the same or better overall effect may be substituted for convenience or if the desired part is not available. Flareless or threaded connections may not be used where weld connections are required. Where a 1/2" socket-weld fitting is required, a pipe 1/2" tube socket-weld fitting plus a 1/2" x 3/8" tube socket-weld fitting may be substituted. A flareless-end valve may be substituted for a threaded valve with flareless connectors, or vice versa. A weld fitting may replace a threaded or flareless fitting unless maintenance access will require the ability to make and break the connection. Each substitution shall require written approval of the ENGINEER.
  5. Welding shall conform to project requirements.
- F. Instrument Installation Notes - Flow: Condensate pots are not required for a sensing element, e.g., a force balance flow transmitter, which has negligible dynamic displacement. If displacement is not negligible, as for a U-tube manometer, and if the process fluid is either steam, other condensable fluid, water hotter than 250 Deg. F, other fluid that may flash, or moisture laden air then condensate pots shall be used. The pots shall have a volume not less than three times the displaced volume.
1. A pair of condensate pots shall be at the same elevation and as high as, or higher than, the higher process connection.
  2. The pipe from a process connection to a condensate pot shall be insulated for process fluids hotter than 250 Deg. F.
  3. A pair of head-type sensing lines shall be run together to the maximum extent practical so as to keep both lines at the same temperature. If they are to be insulated, they shall be insulated together.

4. Head-type sensing lines shall be checked to make sure that they are connected to the proper sides, HP and LP, of the instrument.
  5. The edges of the holes for orifice taps shall be square or slightly rounded, clean, and free from burrs, wire edges, or other irregularities.
  6. A pair of head-type sensing lines shall have an equalizing manifold with bleed valves. Due to support problems, commercial manifold assemblies with flanged outlets shall not be used in seismic applications, nor is their use recommended for other applications.
- G. Instrument Installation Notes - Level: The lower connection on a vessel for piping to a level instrument is preferred to be on the side of the vessel rather than to come vertically down from the bottom. The intent is to minimize the trapping of solids in the sensing lines.
1. Head-type level instruments shall be located below the process connections on the vessel unless a gas purge is used, in which case the instruments may be located at any convenient elevation.
  2. A stilling well shall be used in all cases to reduce the turbulence for displacement or float-type elements located inside a vessel, except for rotary-type floats. A well may be required to protect a bubble tube against excessive turbulence.
  3. So far as practical, level devices shall be placed away from areas of turbulence and shall not interfere with other vessel parts or instruments, such as thermowells or sample nozzles that may be required.
  4. Stilling wells and bubble tubes shall be firmly supported. Head room shall be provided to permit withdrawing the tubes for cleaning and maintenance.
  5. Gage glasses and their associated level instruments shall be installed adjacent to each other. The gage glasses and the other instruments shall be visible from a walkway.
  6. External-chamber level instruments shall be installed with main-line-class pipe. Gate valves shall be used for root valves and other shutoff valves for these instruments, except that the manufacturer's standard pattern may be used for gage-glass valves.
  7. An external-chamber instrument or a differential-pressure-type instrument used to measure level in a vessel that is open to atmosphere may have one of its input connections, as appropriate, open to atmosphere instead of being connected to the vessel. An external-chamber instrument thus installed may require additional bracing.
  8. A pair of sensing lines for head-type level measurement shall have an equalizing manifold with bleed valves. Because of support problems, commercial manifold assemblies having flanged outlets shall not be used in seismic applications. In other applications, their use is not recommended for the same reason.

9. The usual level-instrument connections on vessels are:

Head-type instruments:		
	Piped	3/4"
	Flanged-mounted	3"
	Float or Displacement-type Switches	1-1/2"
	Displacement-type Transmitters and Controllers:	
	External	1-1/2" or 2"
	Internal	4"
	Multi-instrument standpipes	3"

10. Displacement and float-type level instruments shall be placed as close as possible to the vessel to improve response. If any external-chamber instrument or a standpipe unavoidably cannot be located close to the vessel, the size of the connecting pipes shall be enlarged to facilitate the transfer of liquid on level changes, thereby reducing the loss of response caused by the long sensing and equalizing lines. The ENGINEER shall be consulted in such a case.

- H. Calibration: Analog instrumentation and control system equipment shall be calibrated and tested after installation to verify that contract system requirements are satisfied.

1. The CONTRACTOR shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's specifications and instructions.
2. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. A fewer number of calibration steps may be used for selected instruments if prior written approval has been obtained from the ENGINEER.
3. All test equipment and instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have a current calibration record certified to an accuracy greater than that required for the instrument under test. Such test equipment shall have accuracy traceable to the National Bureau of Standards as applicable. All analog instruments shall be calibrated and tested in place without removal.
4. All test data shall be entered on test forms. These test forms shall verify compliance with all applicable contract accuracy requirements, instrument manufacturer published performance specifications and permissible tolerances at each point of calibration.
5. A report shall be delivered to the ENGINEER for each instrument, certifying that the instrument has been calibrated, in the presence of the ENGINEER or the ENGINEER's designated representative and meets contract and system requirements. The report shall include but not be limited to pertinent manufacturers name plate data, units span setting,

any error in percent at each test point, switch and alarm set points, valve stroking and controller balancing information, etc.

- I. Analog Loop Tests: The CONTRACTOR shall provide all necessary labor, tools, and equipment to field test, inspect and adjust each instrument installed under this contract to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument furnished by the CONTRACTOR which fails to meet any Contract requirement, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, by CONTRACTOR at no cost. The CONTRACTOR shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities specified herein.
  1. At least 15 days before the anticipated initiation of installation testing, the CONTRACTOR shall submit to the ENGINEER a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct installation of the instrumentation and control system and the anticipated dates the testing will occur.
  2. Elements such as controllers, electronic function modules, etc., shall be tested and exercised by the CONTRACTOR to demonstrate correct operation, first individually and then collectively as functional analog networks. Each hardwired analog control network shall be tested to verify proper performance within specified accuracy tolerances. Specified accuracy tolerances for each analog network shall be defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as specified by contract requirements or by published manufacturer accuracy specifications, whenever contract accuracy requirements are not specified.
  3. Each analog network shall be tested by applying simulated analog and/or discrete inputs to the first element(s) of an analog network (i.e., applying simulated analog and/or discrete signals to element(s) of the network; e.g., controllers, alarms, indicators, valve operators, etc.). For networks which incorporate analog elements, simulated sensor inputs corresponding to 10 percent, 50 percent, and 90 percent of span shall be applied, and the resulting element outputs read to verify compliance to calculated root-mean-square- summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting off discrete devices (i.e., alarms, etc.). Provisional settings shall be made on controllers, alarms, etc., during analog loop tests. All analog loop test data shall be recorded on test forms, which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.
  4. Air systems shall be tested for leaks in compliance with ISA RP7.1. When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the ENGINEER or the ENGINEER's representative as a witness, with test data entered, shall be furnished



to the ENGINEER together with an unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

- J. System Pre-commissioning: System pre-commissioning shall comply with the requirements specified herein. Pre-commissioning shall commence after acceptance of all wire, calibrating and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all contract requirements. Pre-commissioning shall demonstrate proper operation of all systems under this Contract with process equipment operating over full operating ranges under actual operating conditions.
1. All pre-commissioning and test activities shall follow detailed test procedures, check lists, etc., previously developed by the CONTRACTOR and reviewed and accepted by the ENGINEER. All test data shall be acquired using equipment as specified and recorded on test forms, previously reviewed by the ENGINEER, which include calculated tolerance limits for each step. Completion of all system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the ENGINEER with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.
  2. The proper operation of all final control elements, control panels and instrumentation furnished under this Contract shall be verified by tests conducted in accordance with the requirements specified herein. Where feasible, system pre-commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software-based controllers shall be assured by adjusting the controllers, as required, to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments, as required, to eliminate excessive oscillatory amplitudes and decay rates.
  3. All electronic control stations incorporating proportional, integral and/or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset and/or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at

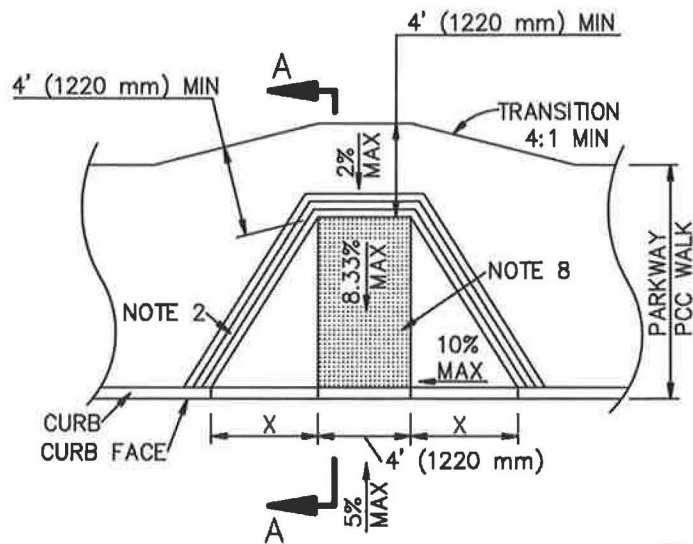
10 percent, 25 percent, 50 percent, 75 percent and 90 percent of span and the results checked against specified accuracy tolerances. Specified accuracy tolerances are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as specified in the Contract or as specified by published manufacturer accuracy specifications whenever Contract accuracy requirements are not specified.

4. The CONTRACTOR shall submit an instrumentation and control system Pre-commissioning Completion Report, which shall state that all Contract requirements have been met, and shall include a listing of all instrumentation and control system maintenance/repair activities conducted during the pre-commissioning testing. Prior to the seven day operational test, acceptance of the instrumentation and control system precommissioning testing must be provided in writing by the engineer before the seven day operational testing may begin. Final acceptance of the control system shall be upon contract completion.
- K. 30-Day Operational Testing: The CONTRACTOR shall provide start-up support personnel, electrical personnel, and any instrument manufacturers' representatives as required during the testing period to produce a fully operational system. This support shall be provided at no additional cost.
- L. Record Drawings: Keep current an approved set of complete loop and schematic diagrams which shall include all field and panel wiring, piping/tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements for the complete instrument loop as furnished under Divisions 16 and 17 of this contract. Drawings shall be a record of work as actually constructed and shall be prepared and submitted.

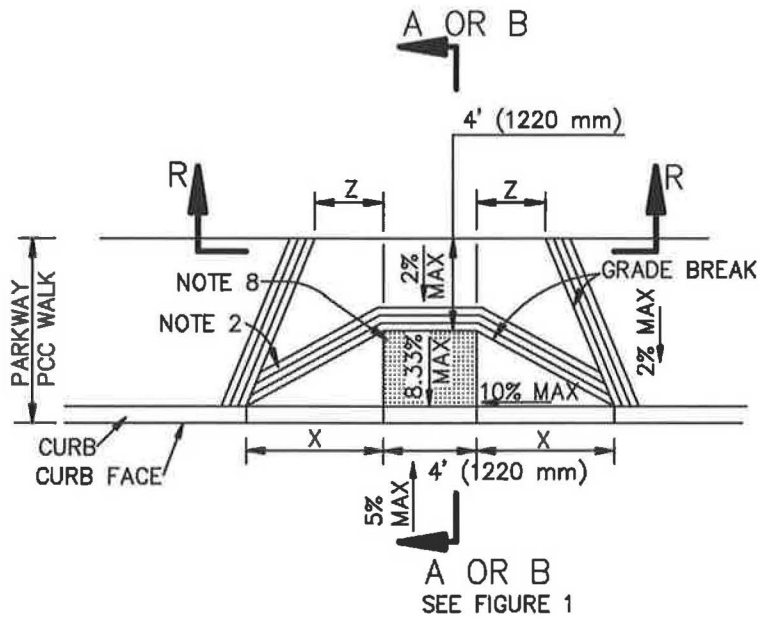
END OF SECTION

**ATTACHMENT A**

**STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION**



TYPE 1



TYPE 2

CASE A

PARTS OF THIS STANDARD PLAN SHOW INSTALLATION FOR TYPICAL RETROFIT CONDITIONS, AND ARE NOT FULLY COMPLIANT WITH CALIFORNIA BUILDING CODE REQUIREMENTS FOR NEW DEVELOPMENT.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1992  
REV. 1998, 2000, 2005, 2009,  
2013

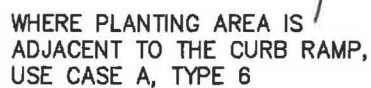
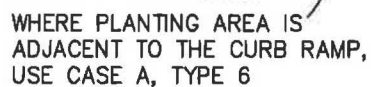
**CURB RAMP**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

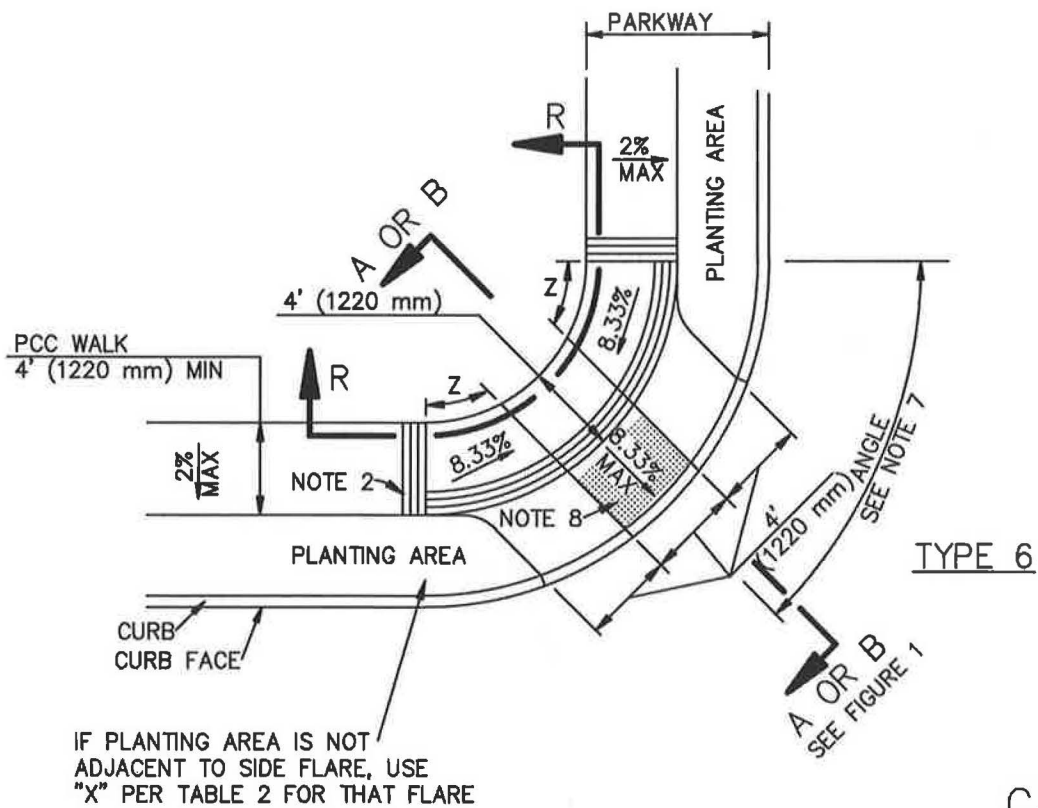
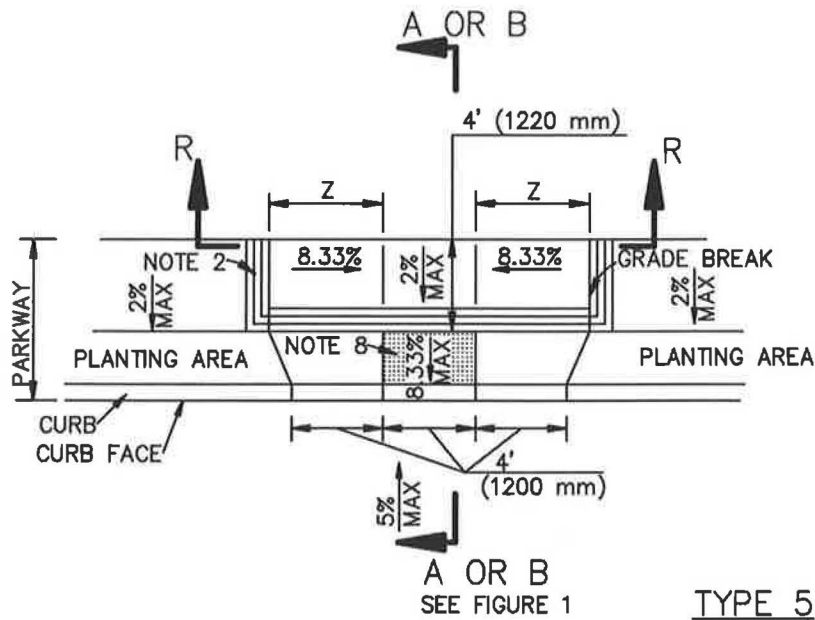
STANDARD PLAN

**111-5**

SHEET 1 OF 10



### CASE A



STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

## CURB RAMP

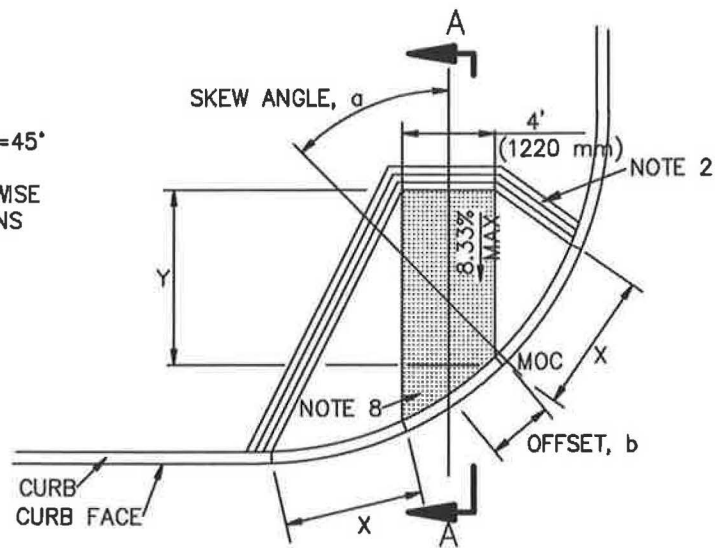
STANDARD PLAN

111-5

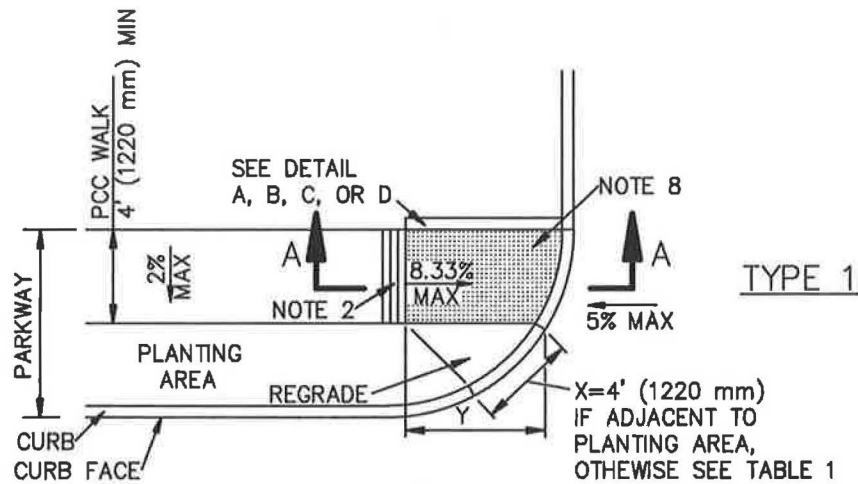
SHEET 3 OF 10



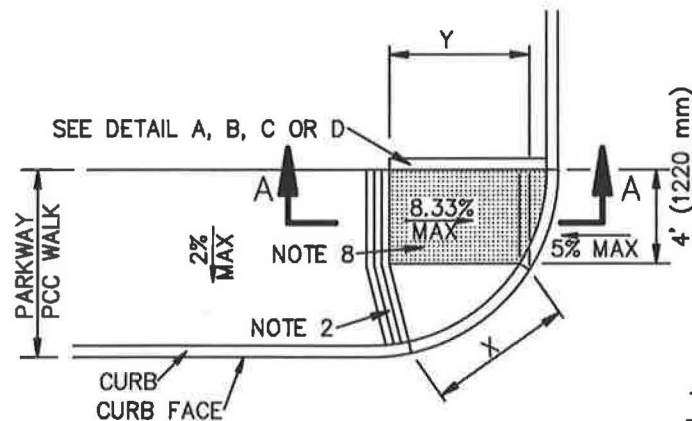
SKEW ANGLE  $\alpha=45^\circ$   
 OFFSET  $b=0$   
 UNLESS OTHERWISE  
 NOTED ON PLANS



CASE C



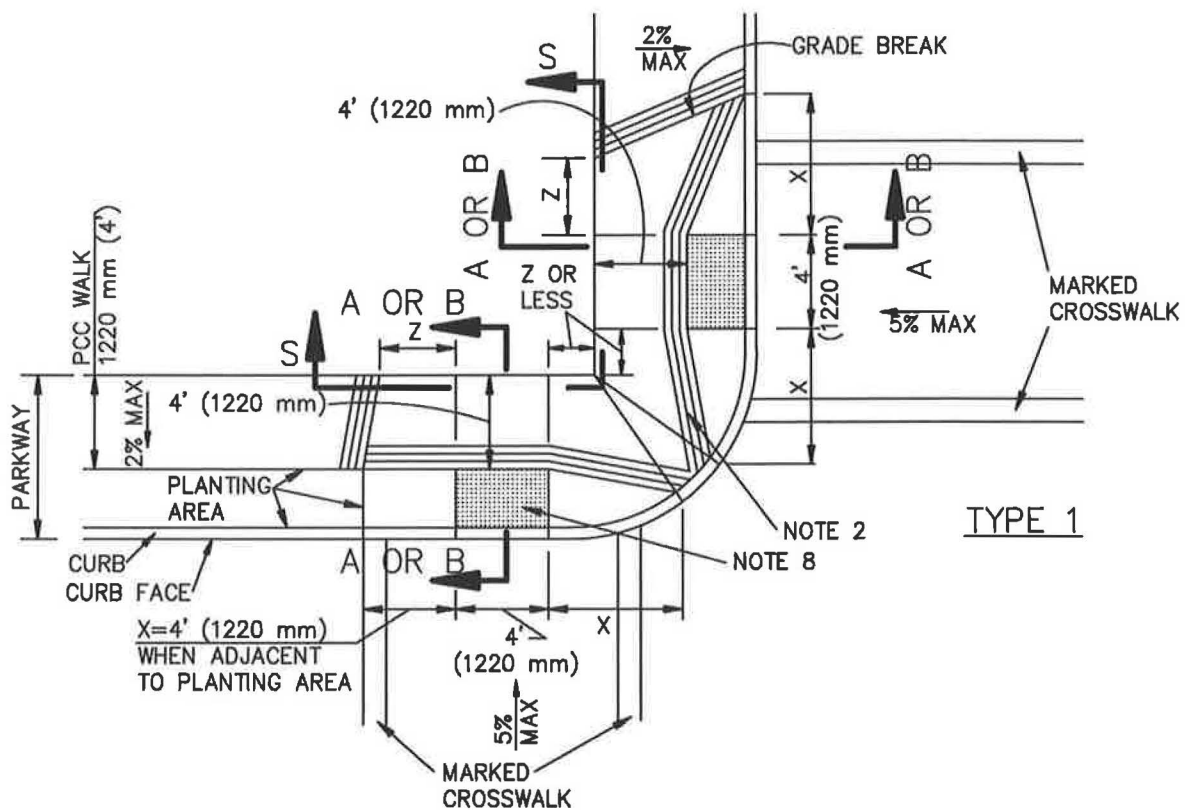
TYPE 1



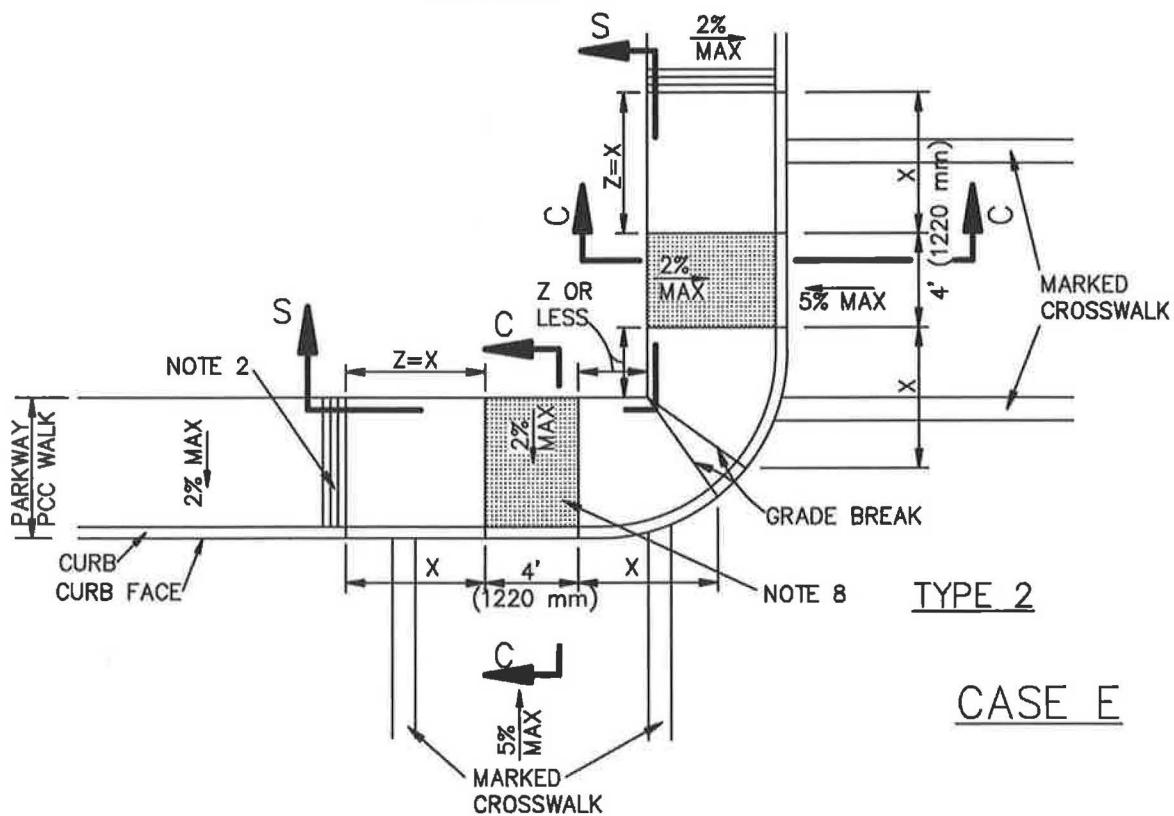
TYPE 2

CASE D





TYPE 1



TYPE 2

CASE E

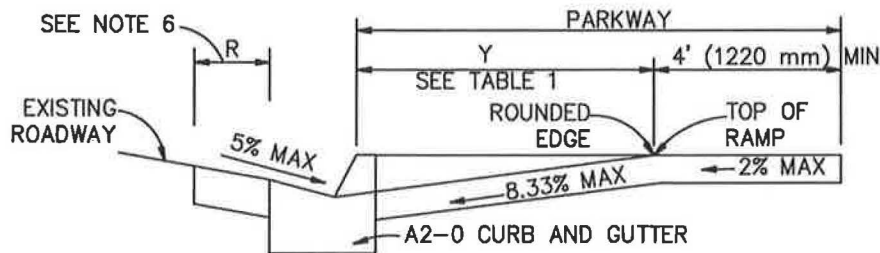
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**CURB RAMP**

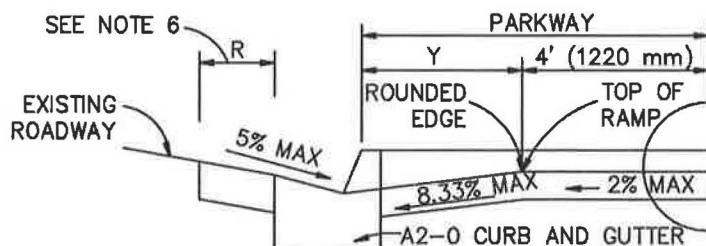
STANDARD PLAN

**111-5**

SHEET 6 OF 10

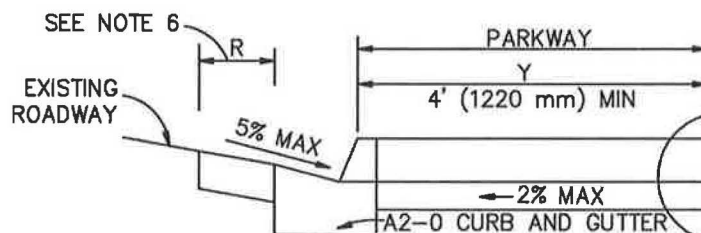


SECTION A-A

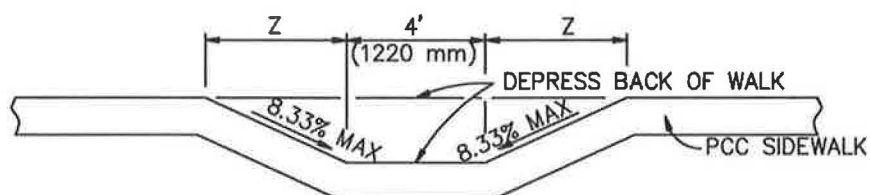


SECTION B-B

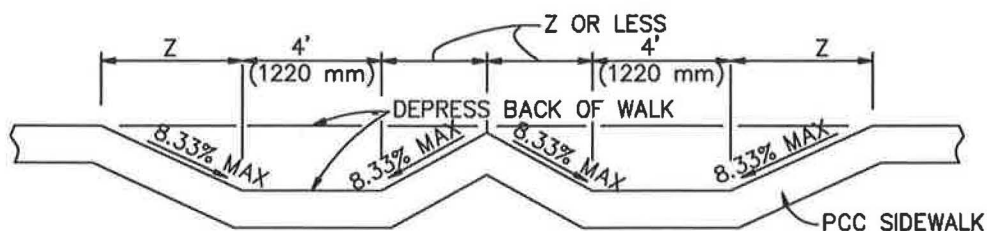
USE FIGURE 1 TO DETERMINE WHICH OF SECTIONS A-A, B-B OR C-C IS APPROPRIATE.



SECTION C-C



SECTION R-R



SECTION S-S

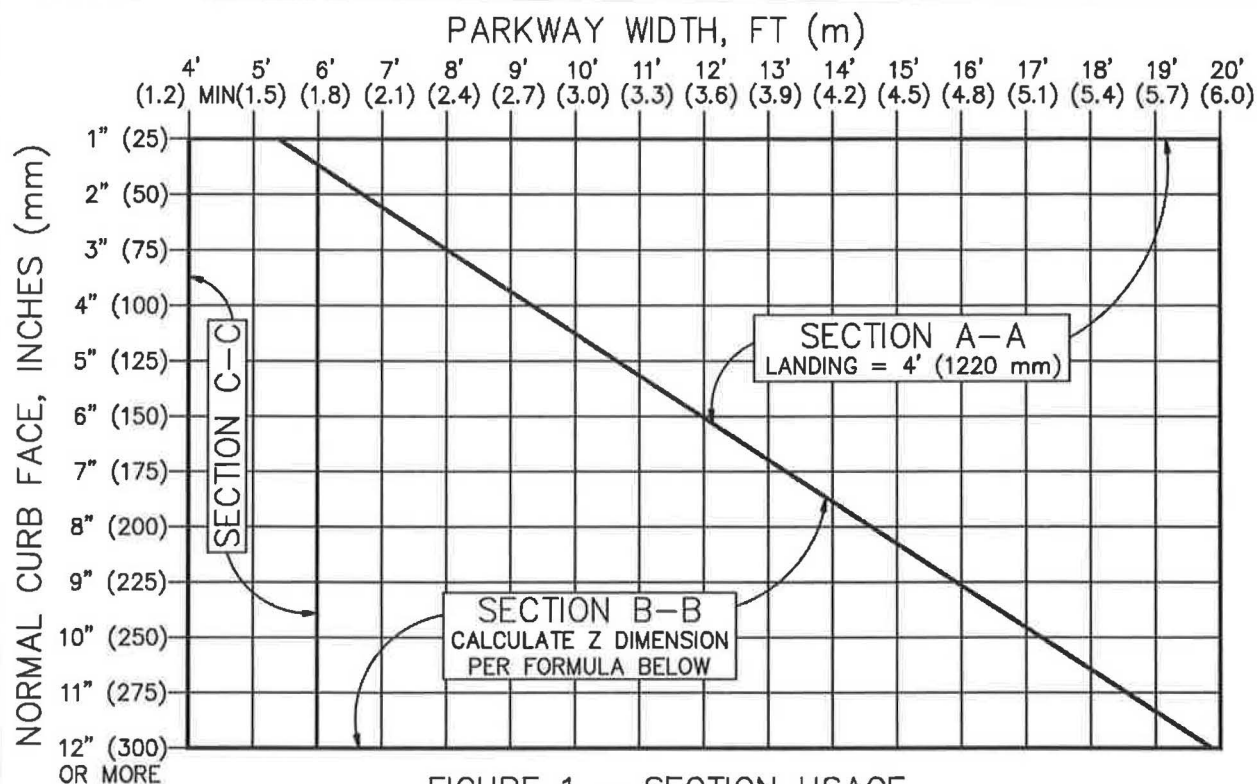


FIGURE 1 – SECTION USAGE

NORMAL CURB FACE, INCHES (mm)	X, FT (mm)	SECTION Y-Y Y, FT (mm)
2" (50)	4.00' (1220) MIN	2.63' (790)
3" (75)	4.00' (1220) MIN	3.95' (1185)
4" (100)	4.00' (1220) MIN	5.26' (1580)
5" (125)	4.17' (1275)	6.58' (1975)
6" (150)	5.00' (1525)	7.90' (2370)
7" (175)	5.83' (1775)	9.21' (2765)
8" (200)	6.67' (2035)	10.53' (3160)
9" (225)	7.50' (2285)	11.84' (3555)
10" (250)	8.33' (2540)	13.16' (3950)
11" (275)	9.17' (2795)	14.47' (4340)
12" (300)	10.00' (3050)	15.79' (4735)

WHERE FIGURE 1 SHOWS USE OF SECTION B-B, FIGURE Z DIMENSION AS FOLLOWS:

W = PARKWAY WIDTH  
L = LANDING WIDTH, 4' (1220 mm) TYP  
 $Z = [(Y+L)-W] \times 0.760$

IF  $(Y+L) < W$ , THEN  $Z = 0$

SEE SHEET 9 FOR STREET SLOPE  
ADJUSTMENT FACTORS, ALL STREETS

TABLE 1 – X AND Y VALUES

TABLE 1 REFERENCE FORMULAS:

$X = CF / 8.333\%$

$Y = CF / (8.333\% - 2\% \text{ WALK CROSS SLOPE})$

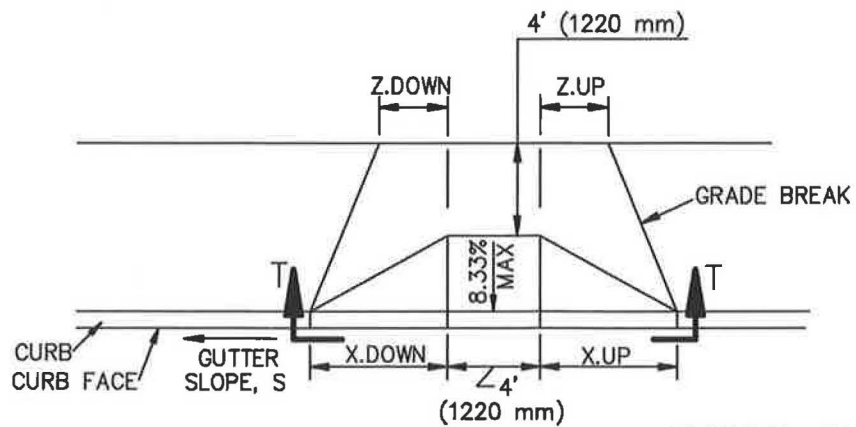
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**CURB RAMP**

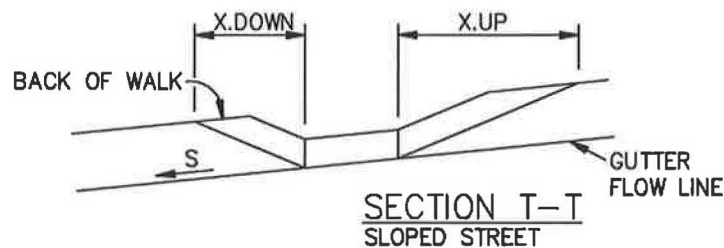
STANDARD PLAN

**111-5**

SHEET 8 OF 10



TYPICAL CURB RAMP



SECTION T-T  
SLOPED STREET

FOR SLOPED STREETS, MULTIPLY THE DIMENSIONS PARALLEL TO THE STREET, X AND Z, UPSTREAM AND DOWNSTREAM OF THE RAMP, BY THE FACTORS IN THE FOLLOWING TABLE.

FOR EXAMPLE,  $X.DOWN = X \times K.DOWN$

S	K.DOWN	K.UP
0%	1.000	1.000
0.2%	0.977	1.025
0.5%	0.943	1.064
1%	0.893	1.136
2%	0.806	1.316
3%	0.735	1.563
4%	0.676	1.923
5%	0.625	2.500

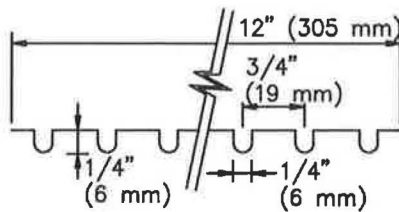
TABLE 2 - SLOPE ADJUSTMENTS

TABLE 2 REFERENCE FORMULAS:

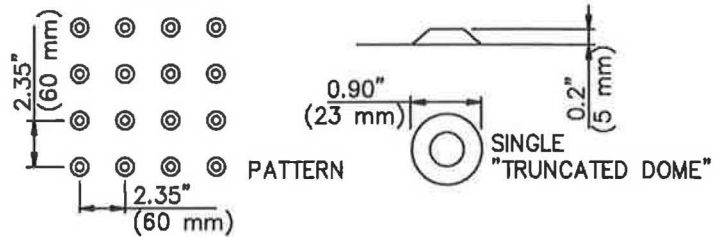
$$K.DOWN = 8.333\% / (8.333\% + S)$$

$$K.UP = 8.333\% / (8.333\% - S)$$

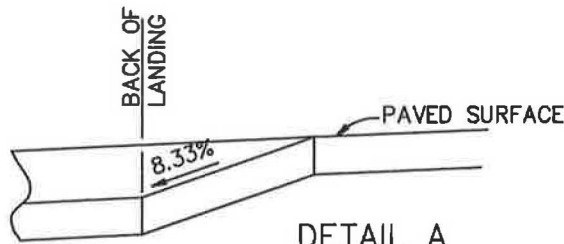
## STREET SLOPE ADJUSTMENTS



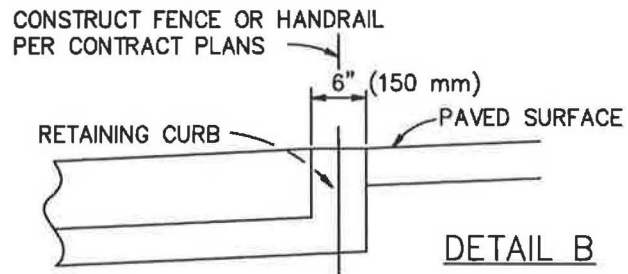
GROOVING DETAIL



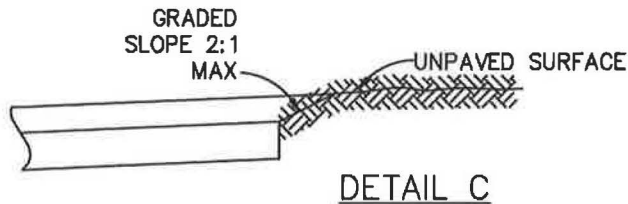
DETECTABLE WARNING DETAIL



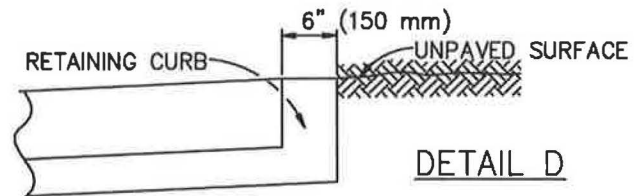
DETAIL A



DETAIL B



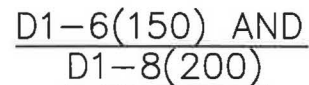
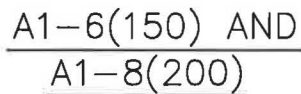
DETAIL C

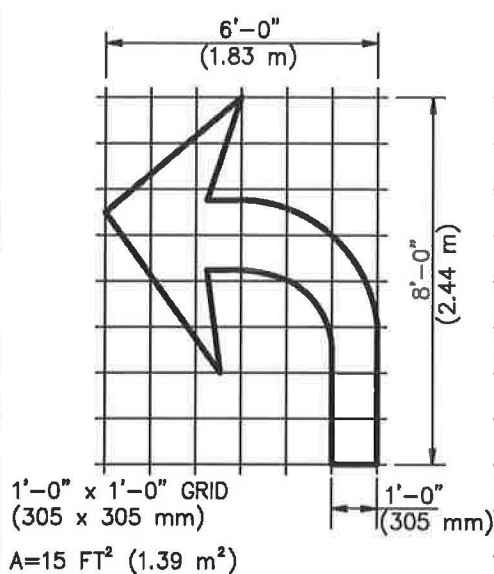


DETAIL D

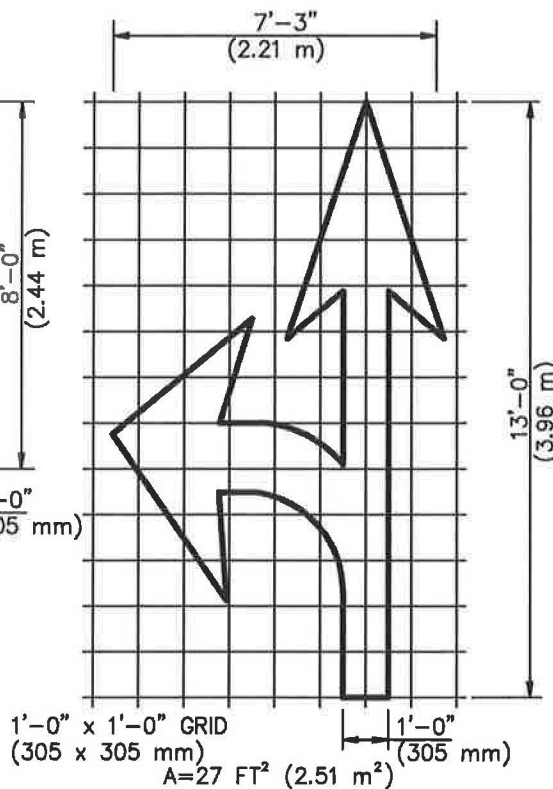
GENERAL NOTES:

1. CONCRETE SHALL BE CLASS 520-C-2500 (310-C-17) CONFORMING TO SSPWC 201-1.1.2 AND SHALL BE 4" (100 mm) THICK.
2. THE RAMP SHALL HAVE A 12" (305 mm) WIDE BORDER WITH 1/4" (6 mm) GROOVES APPROXIMATELY 3/4" (19 mm) OC. SEE GROOVING DETAIL.
3. THE RAMP SURFACE SHALL HAVE A TRANSVERSE BROOMED SURFACE TEXTURE CONFORMING TO SSPWC 303-1.9.
4. USE DETAIL "A" OR "B" IF EXISTING SURFACE BEHIND LANDING IS PAVED.
5. USE DETAIL "C" OR "D" IF EXISTING SURFACE BEHIND LANDING IS UNPAVED.
6.  $R = 3'$  (900 mm) UNLESS OTHERWISE SHOWN ON PLAN. SEE SHEET 7.
7.  $\text{ANGLE} = \Delta/2$  UNLESS OTHERWISE SHOWN ON PLAN.
8. CONSTRUCT DETECTABLE WARNING SURFACE PER DETAIL THIS SHEET. MATERIALS SHALL BE PER CONTRACT DOCUMENTS.

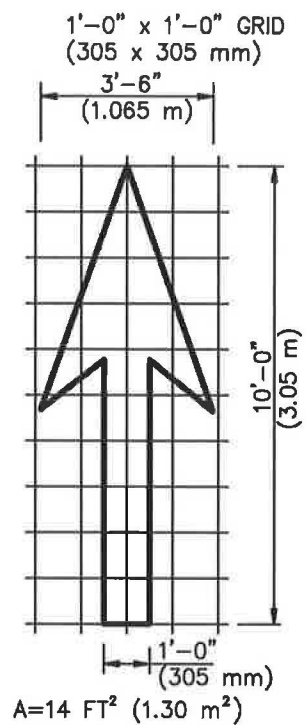




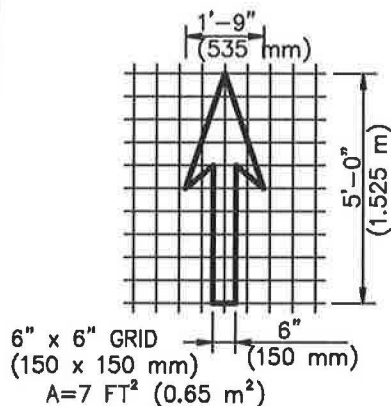
TYPE II (L) ARROW  
(FOR TYPE II (R) ARROW,  
USE MIRROR IMAGE)



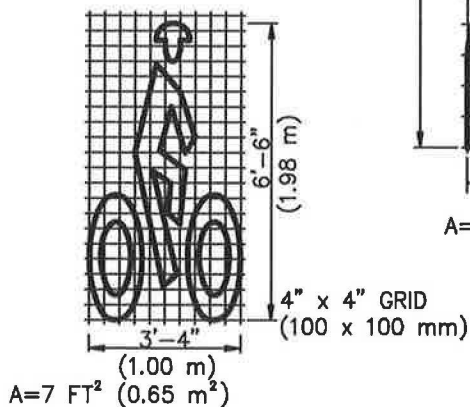
TYPE III (L) ARROW  
(FOR TYPE III (R) ARROW,  
USE MIRROR IMAGE)



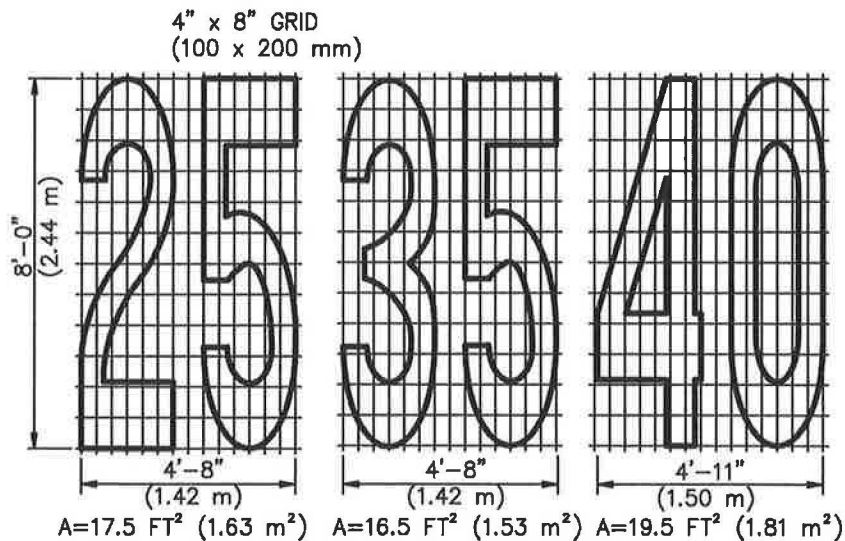
TYPE I 10' (3 m) ARROW



BIKE LANE ARROW



BIKE LANE SYMBOL



NUMERALS

# STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
2011

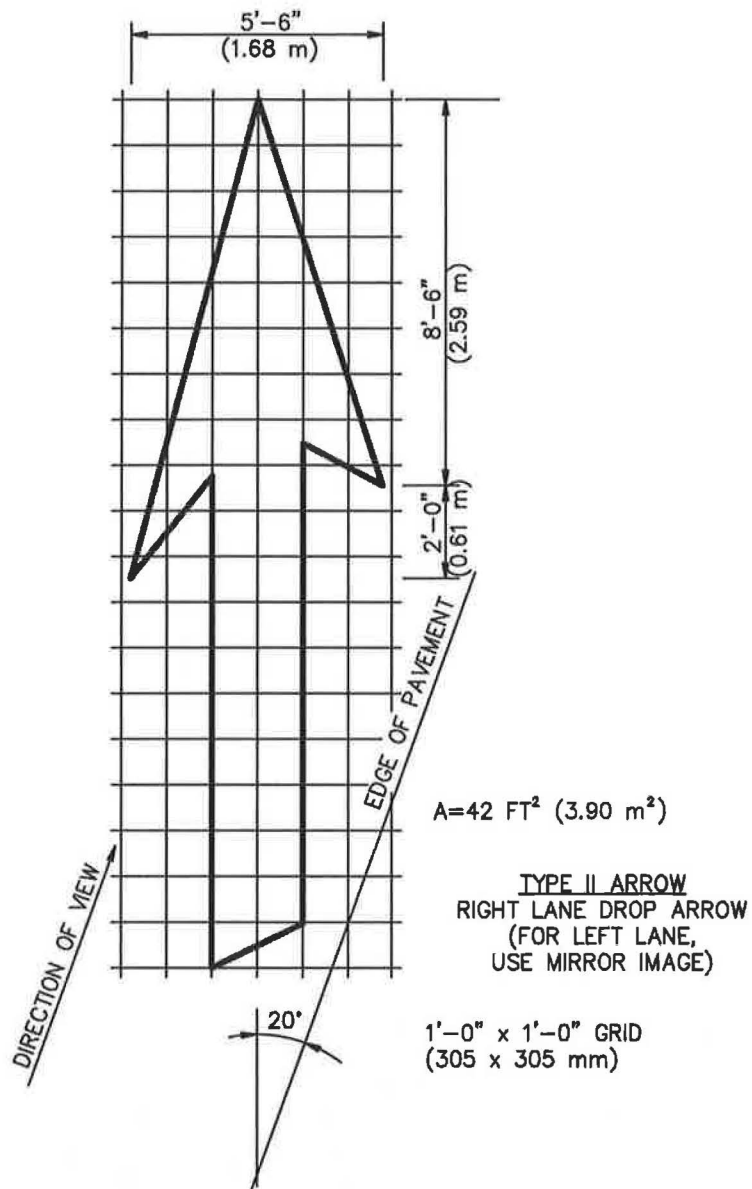
## PAVEMENT MARKINGS ARROWS AND SYMBOLS

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

171-0

SHEET 1 OF 5



NOTES:

1. IF A MESSAGE CONSISTS OF MORE THAN ONE WORD, IT SHALL READ "UP"; THAT IS, THE FIRST WORD SHALL BE NEAREST THE DRIVER.
2. THE SPACE BETWEEN WORDS SHALL BE AT LEAST FOUR TIMES THE HEIGHT OF THE CHARACTERS FOR LOW SPEED ROADS, BUT NOT MORE THAN TEN TIMES THE HEIGHT OF THE CHARACTERS. THE SPACE MAY BE REDUCED APPROPRIATELY WHERE THERE IS LIMITED SPACE BECAUSE OF LOCAL CONDITIONS.
3. MINOR VARIATIONS IN DIMENSIONS MAY BE ACCEPTED BY THE ENGINEER.
4. PORTIONS OF A LETTER, NUMBER, OR SYMBOL MAY BE SEPARATED BY CONNECTING SEGMENTS NOT TO EXCEED 2" (50 mm) IN WIDTH.



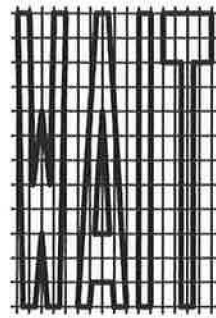
4" x 8" GRID  
(100 x 200 mm)



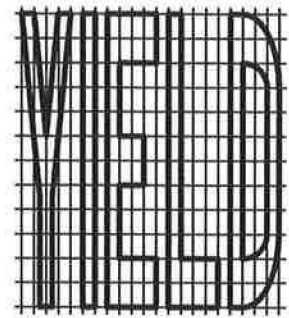
A=22 FT<sup>2</sup> (2.04 m<sup>2</sup>)



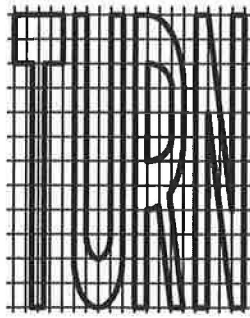
A=23 FT<sup>2</sup> (2.14 m<sup>2</sup>)



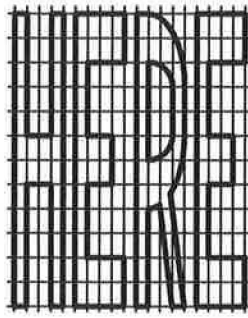
A=19 FT<sup>2</sup> (1.77 m<sup>2</sup>)



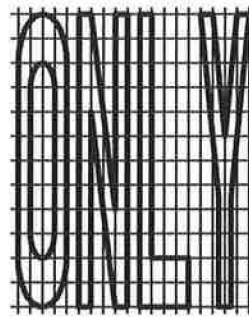
A=24 FT<sup>2</sup> (2.23 m<sup>2</sup>)



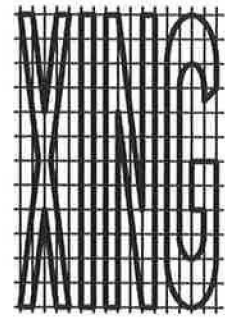
A=24 FT<sup>2</sup> (2.23 m<sup>2</sup>)



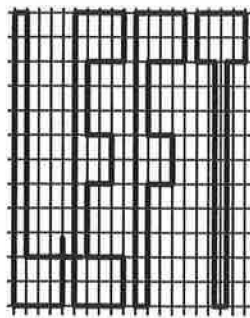
A=26 FT<sup>2</sup> (2.42 m<sup>2</sup>)



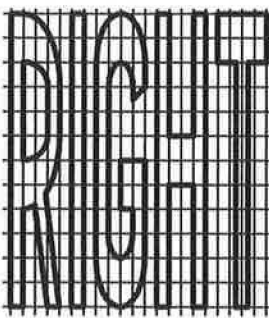
A=22 FT<sup>2</sup> (2.04 m<sup>2</sup>)



A=21 FT<sup>2</sup> (1.95 m<sup>2</sup>)



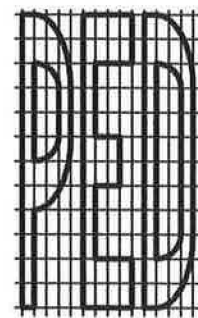
A=19 FT<sup>2</sup> (1.77 m<sup>2</sup>)



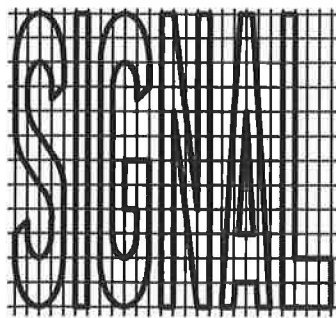
A=26 FT<sup>2</sup> (2.42 m<sup>2</sup>)



A=16 FT<sup>2</sup> (1.49 m<sup>2</sup>)



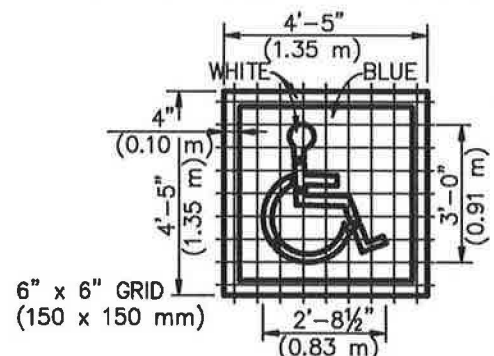
A=18 FT<sup>2</sup> (1.67 m<sup>2</sup>)



A=32 FT<sup>2</sup> (2.97 m<sup>2</sup>)



A=14 FT<sup>2</sup> (1.30 m<sup>2</sup>)



A(WHITE)=9 FT<sup>2</sup> (0.84 m<sup>2</sup>)  
A(BLUE)=14 FT<sup>2</sup> (1.30 m<sup>2</sup>)

DISABLED PERSONS PARKING SYMBOL

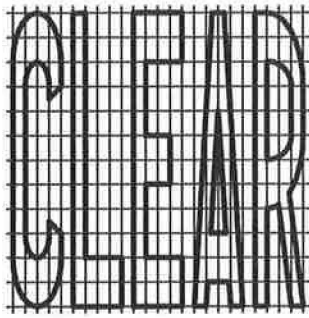
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PAVEMENT MARKINGS  
ARROWS AND SYMBOLS

STANDARD PLAN

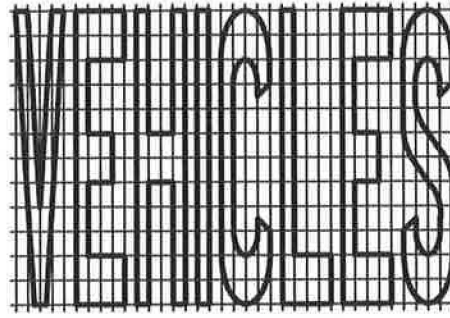
171-0

SHEET 3 OF 5

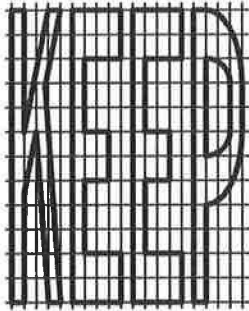


4" x 8" GRID  
(100 x 200 mm)

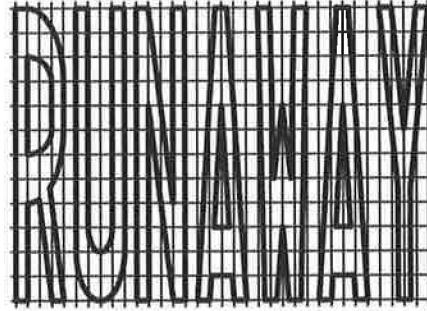
A=27 FT<sup>2</sup> (2.51 m<sup>2</sup>)



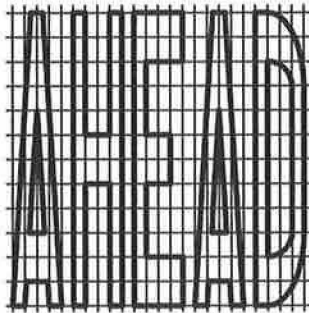
A=42 FT<sup>2</sup> (3.90 m<sup>2</sup>)



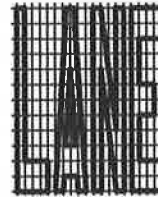
A=24 FT<sup>2</sup> (2.23 m<sup>2</sup>)



A=43 FT<sup>2</sup> (4.00 m<sup>2</sup>)



A=31 FT<sup>2</sup> (2.88 m<sup>2</sup>)

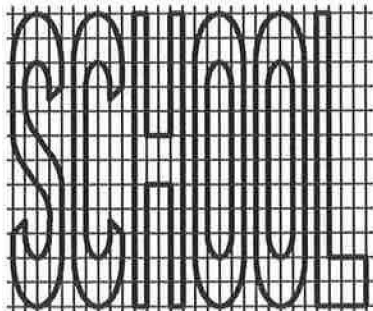


A=6 FT<sup>2</sup> (0.56 m<sup>2</sup>)



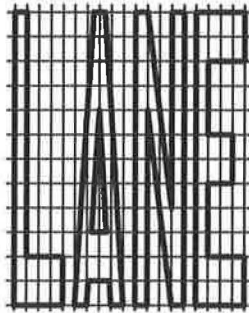
2" x 4" GRID  
(50 x 100 mm)

A=5 FT<sup>2</sup> (0.47 m<sup>2</sup>)



A=35 FT<sup>2</sup> (3.25 m<sup>2</sup>)

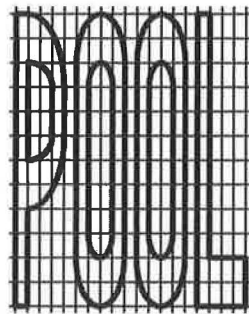
4" x 8" GRID  
(100 x 200 mm)



A=24 FT<sup>2</sup> (2.23 m<sup>2</sup>)



A=21 FT<sup>2</sup> (1.95 m<sup>2</sup>)



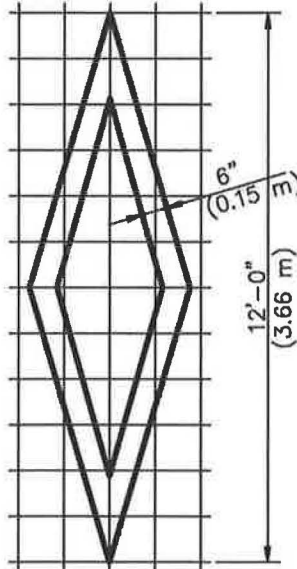
A=23 FT<sup>2</sup> (2.14 m<sup>2</sup>)



A=20 FT<sup>2</sup> (1.86 m<sup>2</sup>)



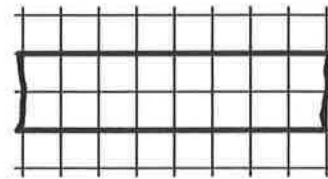
A=17 FT<sup>2</sup> (1.58 m<sup>2</sup>)



3'-3"  
(0.99 m)  
A=11 FT<sup>2</sup> (1.02 m<sup>2</sup>)

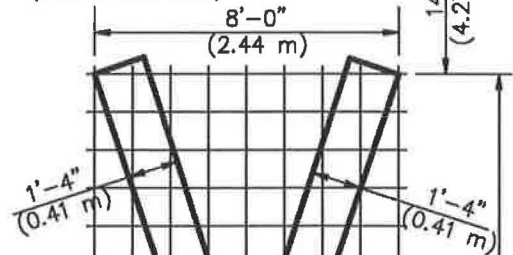
DIAMOND SYMBOL

1'-0" x 1'-0" GRID  
(305 x 305 mm)



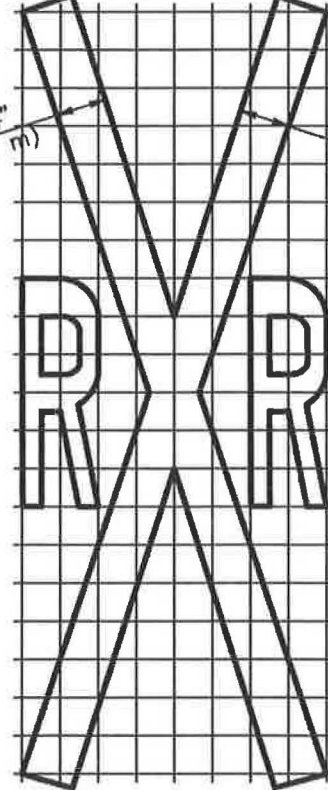
2'-0" (610 mm)  
x WIDTH OF LANE

1'-0" x 1'-0" GRID  
(305 x 305 mm)



8'-0"  
(2.44 m)

14'-0"  
(4.27 m)



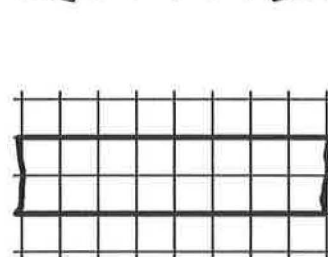
1'-4"  
(0.41 m)

1'-4"  
(0.41 m)

6'-0"  
(1.83 m)

20'-0"  
(6.10 m)

14'-0"  
(4.27 m)



14'-0"  
(4.27 m)

2'-0" (610 mm)  
x WIDTH OF LANE

A=70 FT<sup>2</sup> (1.86 m<sup>2</sup>)\*

\* DOES NOT INCLUDE THE 2'-0" (610 mm)  
TRANSVERSE LINES.

RAILROAD CROSSING SYMBOL

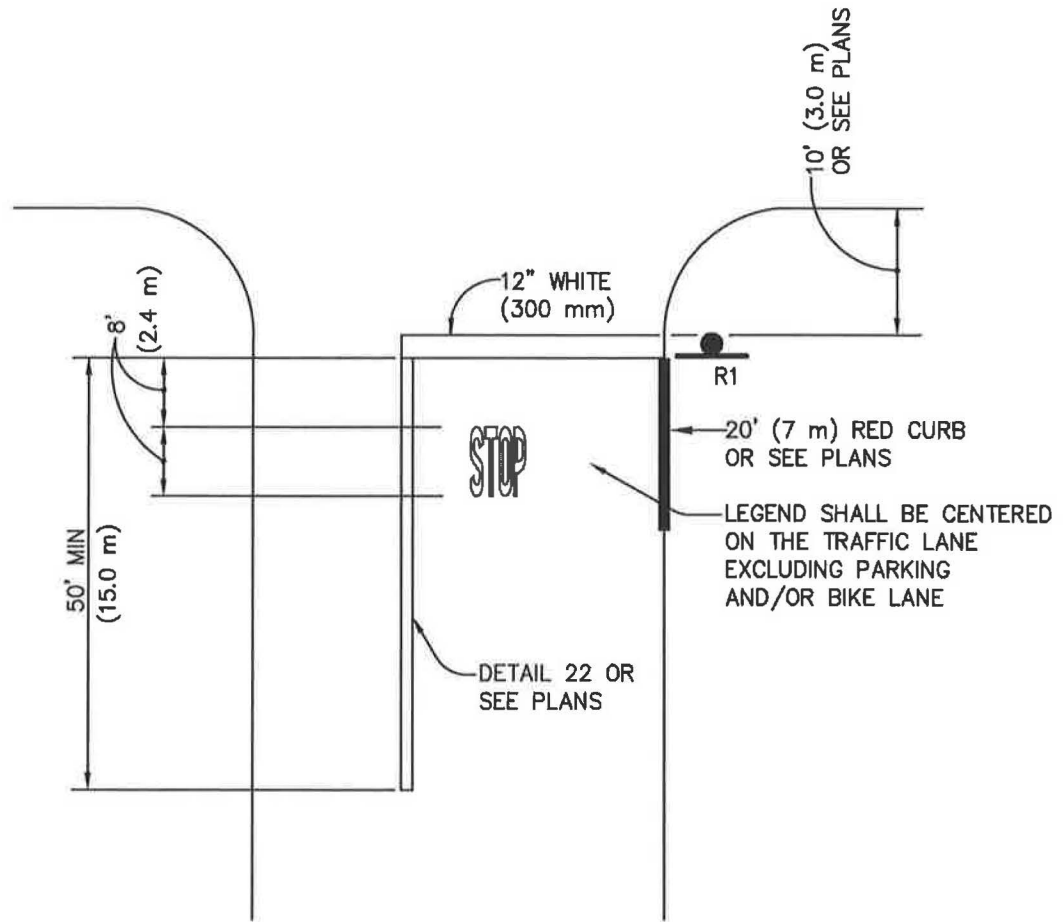
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PAVEMENT MARKINGS  
ARROWS AND SYMBOLS

STANDARD PLAN

171-0

SHEET 5 OF 5



# STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
2011

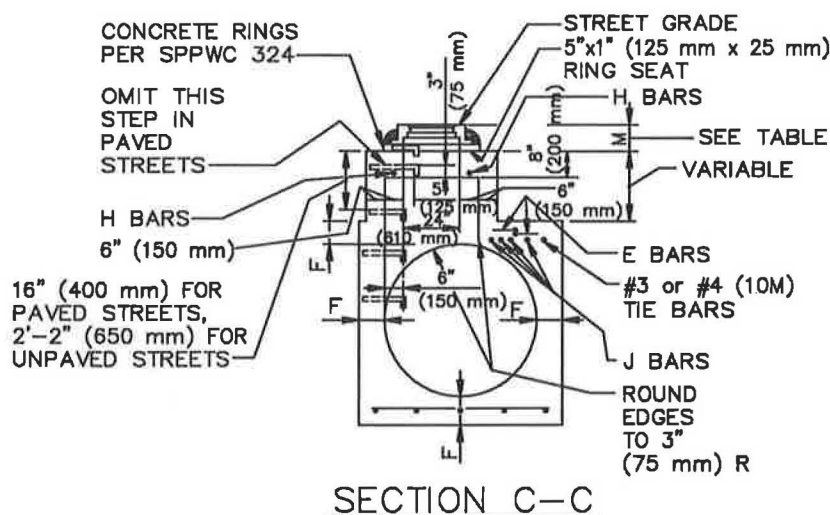
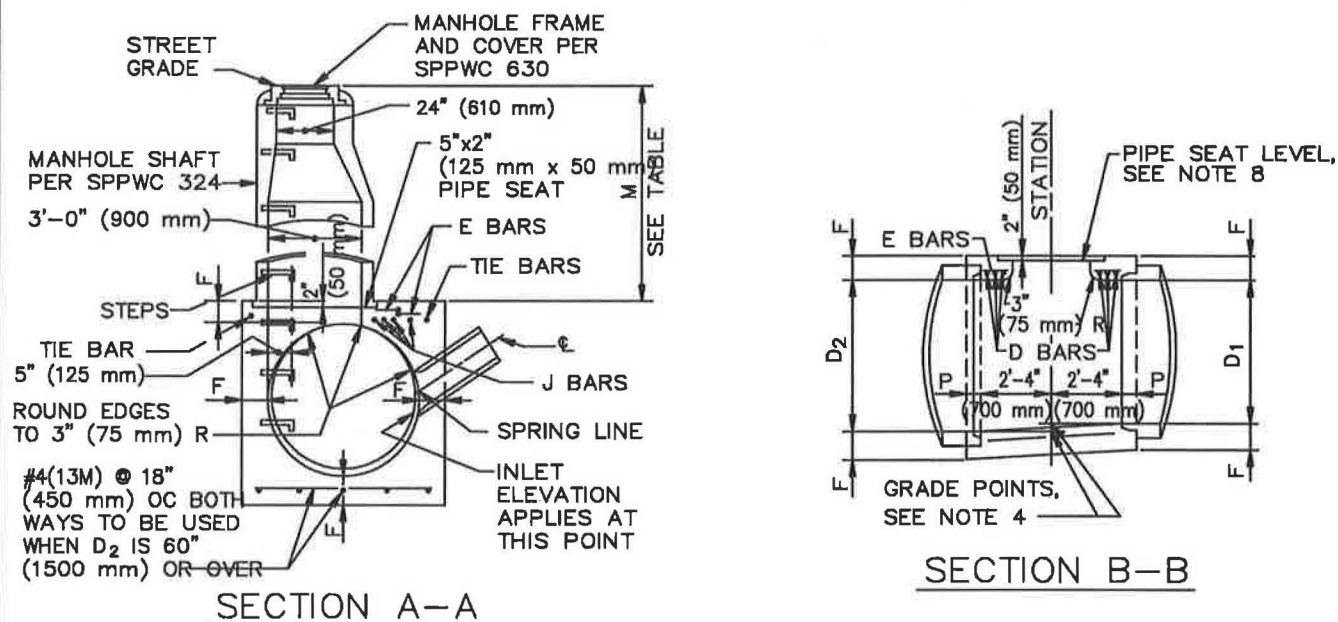
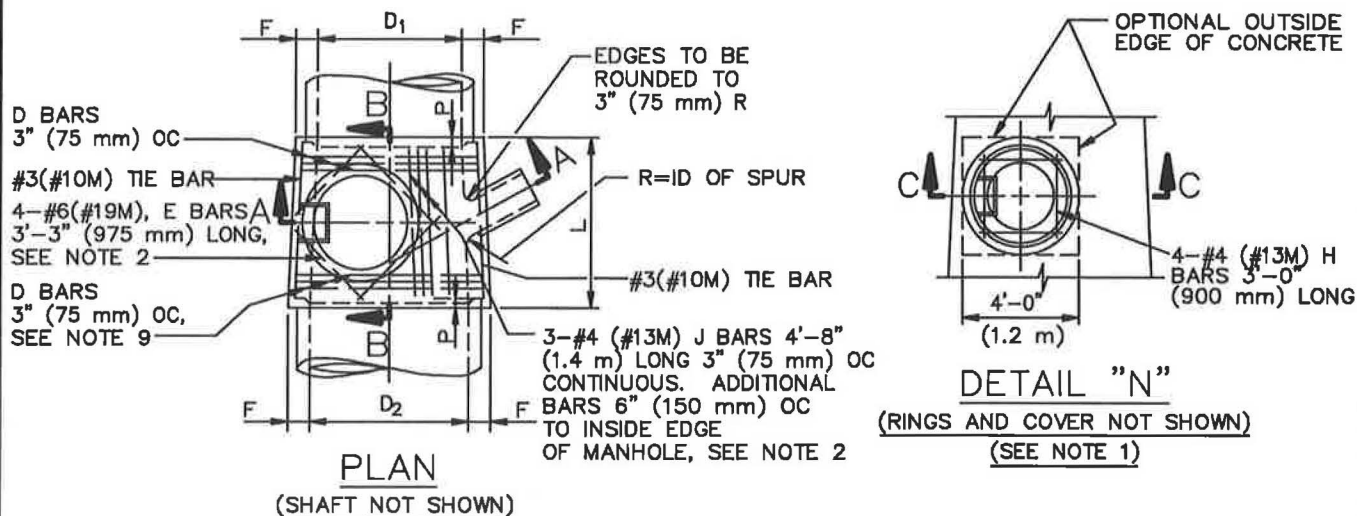
## STOP AND STOP BAR

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

172-0

SHEET 1 OF 1



STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1992  
REV. 1996, 2009

**MANHOLE PIPE-TO-PIPE**  
**MAIN LINE ID=36" (900 mm) OR LARGER**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

**320-2**

SHEET 1 OF 4

TABLE OF VALUES FOR F	
D <sub>2</sub>	F
36" (900 mm)	6 1/2" (165 mm)
39" (975 mm)	7" (180 mm)
42" (1050 mm)	7 1/2" (190 mm)
45" (1125 mm)	7 3/4" (195 mm)
48" (1200 mm)	8" (205 mm)
51" (1275 mm)	8 1/2" (215 mm)
54" (1350 mm)	9" (230 mm)
57" (1425 mm)	9 1/4" (235 mm)
60" (1500 mm)	9 1/2" (240 mm)
63" (1575 mm)	10" (255 mm)
66" (1650 mm)	10 1/4" (260 mm)
69" (1725 mm)	10 3/4" (275 mm)
72" (1800 mm)	11" (280 mm)
78" (1950 mm)	11 3/4" (300 mm)
84" (2100 mm)	12 1/2" (320 mm)
90" (2250 mm)	13 1/4" (335 mm)
96" (2400 mm)	14" (355 mm)
102" (2550 mm)	15 1/2" (395 mm)
108" (2700 mm)	16" (405 mm)
114" (2850 mm)	16 1/2" (420 mm)
120" (3000 mm)	17" (430 mm)
126" (3150 mm)	17" (430 mm)
132" (3300 mm)	17 1/2" (445 mm)
138" (3450 mm)	17 1/2" (445 mm)
144" (3600 mm)	18" (455 mm)

TABLE OF VALUES FOR M (SEE NOTE 1)				
SECTION	PAVED STREET		UNPAVED STREET	
	MAX	MIN	MAX	MIN
A-A		2'-10 1/2" (867 mm)		3'-6" (1060 mm)
C-C	11" (282 mm)	8 1/2" (217 mm)	16" (410 mm)	15" (380 mm)

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**MANHOLE PIPE-TO-PIPE**  
**MAIN LINE ID = 36" (900 mm) OR LARGER**

STANDARD PLAN

**320-2**

SHEET 2 OF 4



## NOTES

1. WHEN DEPTH M FROM STREET GRADE TO THE TOP OF THE BOX IS LESS THAN 2'-10 1/2" (867 mm) FOR PAVED STREETS OR 3'-6" (1060 mm) FOR UNPAVED STREETS, CONSTRUCT MONOLITHIC SHAFT PER SECTION C-C AND DETAIL "N". SHAFT FOR ANY DEPTH OF MANHOLE MAY BE CONSTRUCTED PER SECTION C-C. WHEN DIAMETER  $D_1$  IS 48" (1200 mm) OR LESS, CENTER OF SHAFT MAY BE LOCATED PER NOTE 2.
2. CENTER OF MANHOLE SHAFT SHALL BE LOCATED OVER CENTER LINE OF STORM DRAIN WHEN DIAMETER  $D_1$  IS 48" (1200 mm) OR LESS, IN WHICH CASE PLACE E BARS SYMMETRICALLY AROUND SHAFT AT 45° WITH CENTERLINE AND OMIT J BARS.
3. L AND P SHALL HAVE THE FOLLOWING VALUES UNLESS OTHERWISE SHOWN ON THE PROJECT DRAWINGS:
  - A.  $D_2=96"$  (2400 mm) OR LESS,  $L=5'-6"$  (1.7 m),  $P=5"$  (130 mm)
  - B.  $D_2$  OVER 96" (2400 mm),  $L=6'-0"$  (1.8 m),  $P=8"$  (210 mm)L MAY BE INCREASED OR LOCATION OF MANHOLE SHIFTED TO MEET PIPE ENDS. WHEN L GREATER THAN THAT SHOWN ABOVE IS SPECIFIED, D BARS SHALL BE CONTINUED 6" (150 mm) OC.
4. STATIONS OF MANHOLES SHOWN ON PLANS APPLY AT CENTERLINE OF SHAFT. ELEVATIONS ARE SHOWN AT CENTERLINE OF SHAFT AND REFER TO THE PROLONGED INVERT GRADE LINES.
5. REINFORCEMENT SHALL CONFORM TO ASTM A 615M, GRADE 300 (ASTM A 615, GRADE 40), AND SHALL TERMINATE 1 1/2" (40 mm) CLEAR OF CONCRETE SURFACES UNLESS OTHERWISE SHOWN.
6. FLOOR OF MANHOLE SHALL BE STEEL TROWELED TO SPRING LINE.
7. BODY OF MANHOLE SHALL BE POURED IN ONE CONTINUOUS OPERATION EXCEPT THAT A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MAY BE PLACED AT SPRING LINE.
8. THICKNESS OF THE DECK SHALL VARY WHEN NECESSARY TO PROVIDE A LEVEL SEAT BUT SHALL NOT BE LESS THAN THE TABULAR VALUES FOR F SHOWN ON SHEET 2.
9. D BARS SHALL BE #4 (#13M) FOR  $D_2=39"$  (975 mm) OR LESS, #5 (#16M) FOR  $D_2=42"$  (1050 mm) TO 84" (2100 mm) INCLUSIVE AND #6 (#19M) FOR  $D_2=90"$  (2250 mm) OR OVER.
10. CENTERLINE OF INLET PIPE SHALL INTERSECT INSIDE FACE OF CONE AT SPRING LINE UNLESS OTHERWISE SHOWN.
11. STEPS SHALL CONFORM TO SPPWC 635 OR 636. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC. THE LOWEST STEP SHALL NOT BE MORE THAN 24" (600 mm) ABOVE THE INVERT.
12. THE FOLLOWING CRITERIA SHALL BE USED FOR THIS MANHOLE:
  - A. MAIN LINE = 36" (900 mm) INSIDE DIAMETER OR LARGER. EXCEPT IF THE MAIN LINE RCP DOWNSTREAM OF MANHOLE IS 36" (900 mm) TO 42" (1050 mm) INSIDE DIAMETER AND THE MAIN LINE RCP UPSTREAM IS 33" (825 mm) OR LESS SPPWC 321 SHALL BE USED.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**MANHOLE PIPE-TO-PIPE**  
**MAIN LINE ID = 36" (900 mm) OR LARGER**

STANDARD PLAN

**320-2**

SHEET 3 OF 4

- B. THE OUTSIDE DIAMETER OF THE LATERAL MUST BE LESS THAN OR EQUAL TO  $1/2$  THE INSIDE DIAMETER OF THE MAIN LINE. IF THE UPSTREAM AND DOWNSTREAM DIAMETERS OF THE MANHOLE ARE NOT THE SAME, THE GOVERNING INSIDE DIAMETER OF THE MAIN LINE SHALL BE CONSIDERED TO BE THAT WHERE THE EXTENDED CENTERLINE OF THE LATERAL ENTERS THE MANHOLE.
- C. IN NO INSTANCE SHALL THE INSIDE DIAMETER OF THE LATERAL TO THE MANHOLE BE GREATER THAN 30" (750 mm).
13. MANHOLE FRAME AND COVER SHALL CONFORM TO SPPWC 630 UNLESS OTHERWISE SHOWN.
14. MANHOLE SHAFT SHALL CONFORM TO SPPWC 324 UNLESS OTHERWISE SHOWN.
15. WHERE A MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER IS SPECIFIED REFER TO SPPWC 326.
16. WHERE A PRESSURE MANHOLE SHAFT – WITH ECCENTRIC REDUCER IS SPECIFIED REFER TO SPPWC 328.
17. WHERE A PRESSURE MANHOLE SHAFT – 914 mm (36") WITHOUT REDUCER IS SPECIFIED REFER TO SPPWC 329.
18. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:
- 324 MANHOLE SHAFT – WITH ECCENTRIC REDUCER
  - 326 MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER
  - 328 PRESSURE MANHOLE SHAFT – WITH ECCENTRIC
  - 329 PRESSURE MANHOLE SHAFT 36" (914 mm) WITHOUT REDUCER
  - 630 24" (610 mm) MANHOLE FRAME AND COVER
  - 633 36" (914 mm) MANHOLE FRAME AND COVER
  - 635 STEEL STEP
  - 636 POLYPROPYLENE PLASTIC STEP



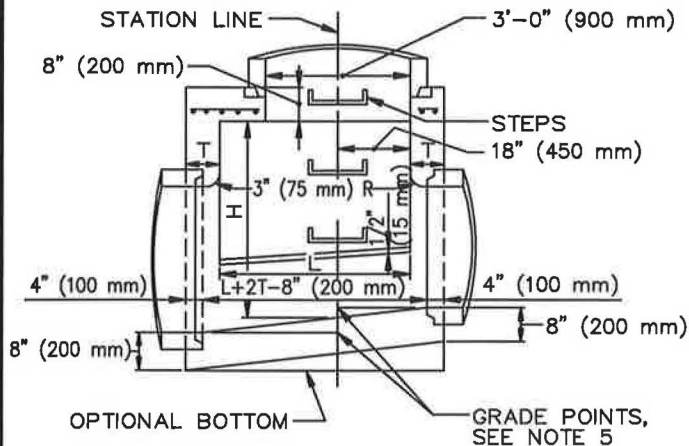
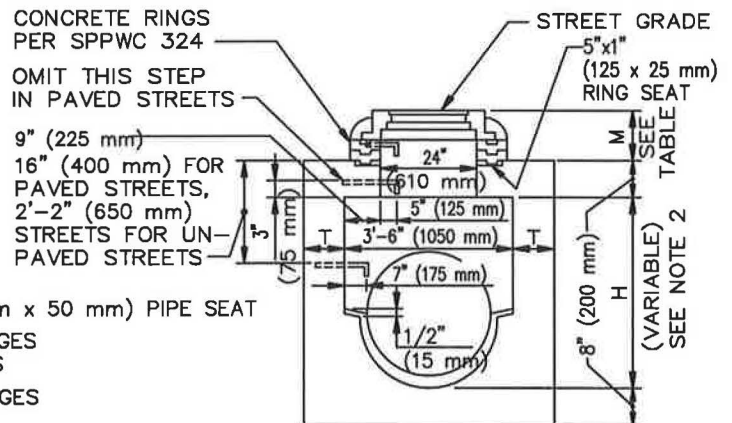
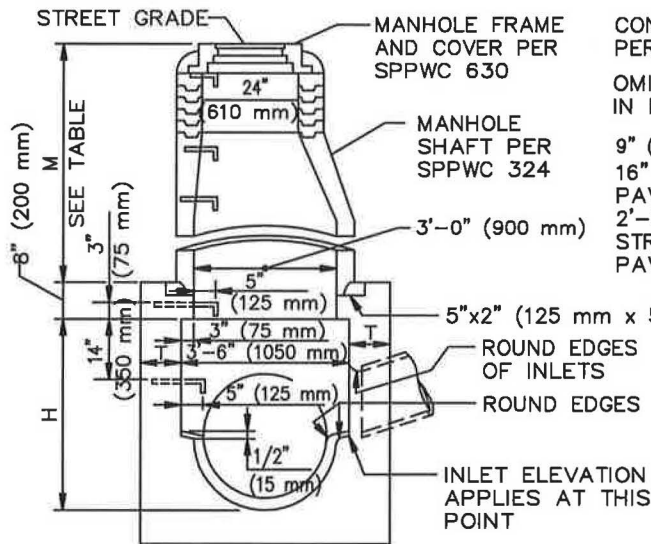
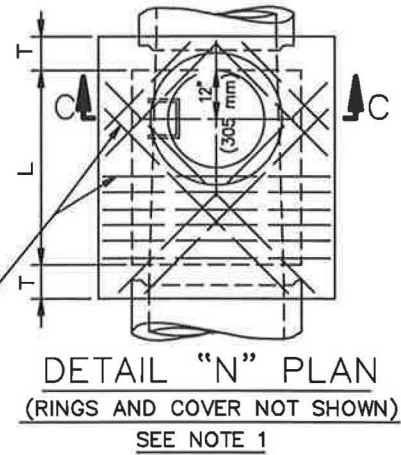
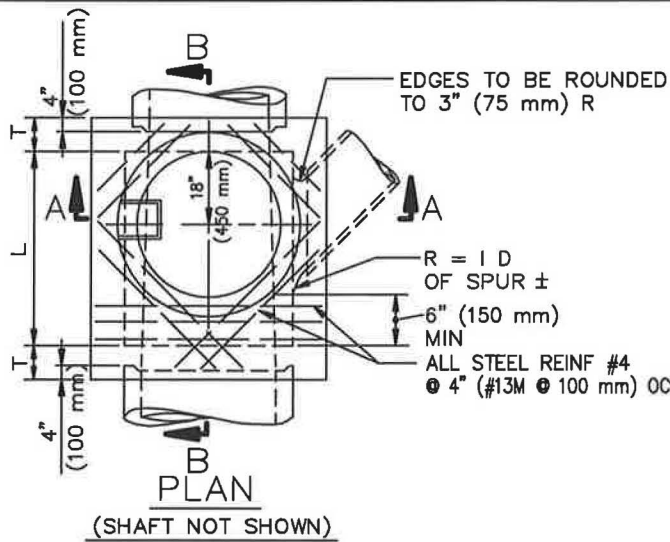


TABLE OF VALUES FOR M (SEE NOTE 1)				
SECTION	PAVED STREET		UNPAVED STREET	
	MAX	MIN	MAX	MIN
A-A		2'-10 1/2" (867 mm)	3'-6" (1060 mm)	
C-C	11" (282 mm)	8 1/2" (217 mm)	16" (410 mm)	15" (380 mm)

# STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1992  
REV. 1996, 2009

**MANHOLE PIPE-TO-PIPE (ONE OR BOTH  
MAIN LINE IDS 33" (825 mm) OR SMALLER)**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

**321-2**

SHEET 1 OF 3

## NOTES

1. WHEN DEPTH M FROM STREET GRADE TO THE TOP OF THE BOX IS LESS THAN 2'-10 1/2" (867 mm) FOR PAVED STREETS OR 3'-6" (1060 mm) FOR UNPAVED STREETS, CONSTRUCT SHAFT PER SECTION C-C AND DETAIL "N". DEPTH M MAY BE REDUCED TO AN ABSOLUTE LIMIT OF 6" (150 mm) WHEN LARGER VALUES OF M WOULD REDUCE H IN SECTION C-C TO 3'-6" (1060 mm) OR LESS.
2. H (IN SECTION A-A AND B-B) SHALL NOT BE LESS THAN 4'-0" (1.2 m), BUT MAY BE INCREASED PROVIDED THAT THE VALUE OF M SHALL NOT BE LESS THAN THE MINIMUM SPECIFIED AND THAT THE REDUCER SHALL BE USED. FOR H (IN SECTION C-C) SEE NOTE 1.
3. L SHALL BE 4'-0" (1.2 m) UNLESS OTHERWISE SHOWN. L MAY BE INCREASED OR LOCATION OF MANHOLE SHIFTED TO MEET PIPE ENDS, BUT ANY CHANGE IN LOCATION OF THE SPUR MUST BE APPROVED BY THE ENGINEER.
4. T SHALL BE 8" (200 mm) FOR VALUES OF H UP TO AND INCLUDING 8'-0" (2.4 m) AND 10" (250 mm) FOR VALUES OF H OVER 8'-0" (2.4 m).
5. STATIONS OF MANHOLES SHOWN ON PLANS APPLY AT CENTERLINE OF SHAFT. ELEVATIONS ARE SHOWN AT CENTERLINE OF SHAFT AND REFER TO THE PROLONGED INVERT GRADE LINES. SEE NOTE 3.
6. REINFORCEMENT SHALL CONFORM TO ASTM A 615, GRADE 40 (ASTM A 615M, GRADE 300), AND SHALL TERMINATE 1 1/2" (40 mm) CLEAR OF CONCRETE SURFACES UNLESS OTHERWISE SHOWN.
7. FLOOR OF MANHOLE SHALL BE STEEL TROWELED TO SPRING LINE.
8. BODY OF MANHOLE SHALL BE POURED IN ONE CONTINUOUS OPERATION EXCEPT THAT A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MAY BE PLACED AT SPRING LINE.
9. THICKNESS OF THE DECK SHALL VARY WHEN NECESSARY TO PROVIDE A LEVEL SEAT BUT SHALL NOT BE LESS THAN 8" (200 mm).
10. STEPS SHALL CONFORM TO SPPWC 635 OR 636. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC. THE LOWEST STEP SHALL NOT BE MORE THAN 24" (600 mm) ABOVE THE LEDGE AT THE SIDE OF THE MANHOLE.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**MANHOLE PIPE-TO-PIPE (ONE OR BOTH  
MAIN LINE IDS = 33" (825 mm) OR SMALLER)**

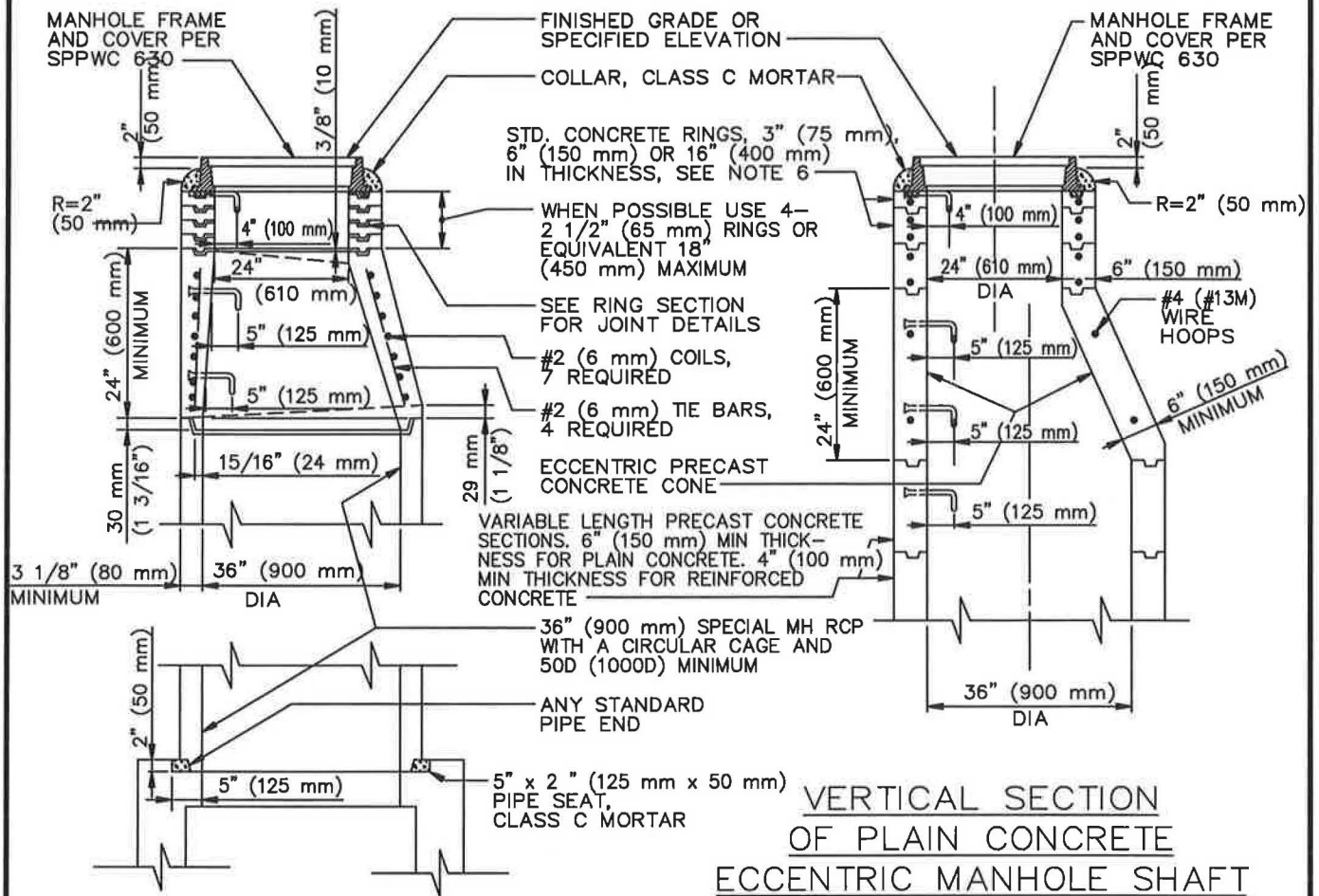
STANDARD PLAN

**321-2**

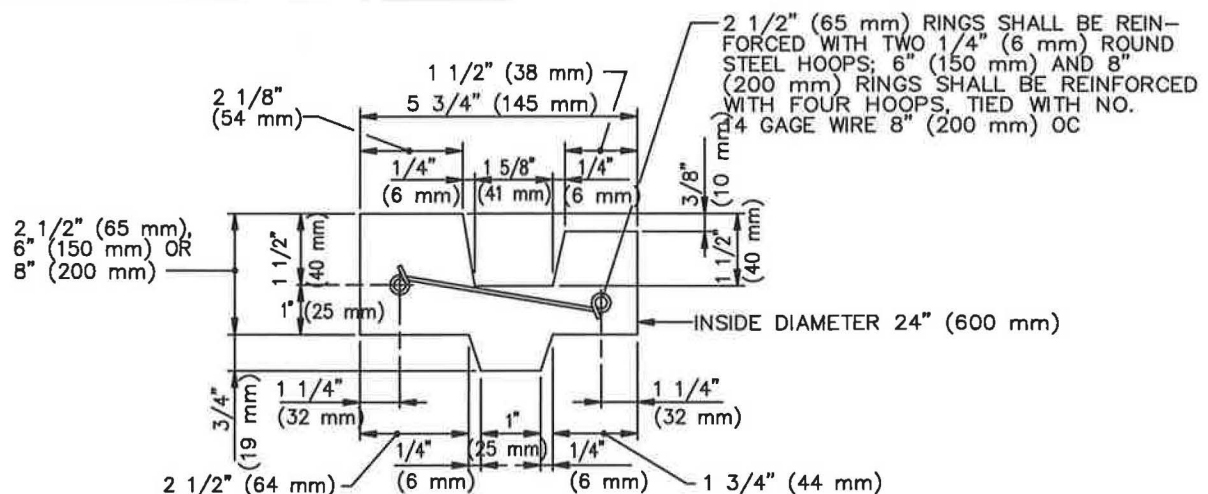
SHEET 2 OF 3

11. THE FOLLOWING CRITERIA SHALL BE USED FOR THIS MANHOLE:

- A. MAIN LINE = 33" (825 mm) INSIDE DIAMETER OR LESS. (EXCEPTION – IF THE MAIN LINE RCP DOWNSTREAM OF THE MANHOLE IS 36" (900 mm) TO 42" (1050 mm) INSIDE DIAMETER AND THE MAIN LINE RCP UPSTREAM IS 33" (825 mm) OR LESS.) SPPWC 320 OR 322 IS NOT APPLICABLE WHERE THE MAIN LINE CONDUIT IS LESS THAN 36" (900 mm) IN DIAMETER.
  - B. SEE SECTION A – A. THE MAXIMUM SIZE LATERAL THAT MAY BE CONNECTED TO THIS MANHOLE IS SUCH THAT THE DISTANCE FROM THE OUTSIDE (TOP) OF THE LATERAL TO THE BOTTOM OF THE 8" (200 mm) THICK TOP OF THE MANHOLE CHAMBER, MEASURED VERTICALLY FROM THE END OF THE RCP, SHALL BE A MINIMUM OF 6" (150 mm).
  - C. IF THE SIZE OF THE LATERAL IS SUCH THAT THE ABOVE–SPECIFIED MINIMUM DISTANCES CANNOT BE MAINTAINED, THEN ONE OF THE FOLLOWING ALTERNATE SOLUTIONS MUST BE USED.
    - 1. PROVIDE A SPECIAL STRUCTURE.
    - 2. PROVIDE TWO STANDARD STRUCTURES, CONSISTING OF THIS MANHOLE PLACED UPSTREAM OR DOWNSTREAM FROM THE APPLICABLE JUNCTION STRUCTURE OR TRANSITION STRUCTURE.
12. MANHOLE FRAME AND COVER SHALL CONFORM TO SPPWC 630 UNLESS OTHERWISE SHOWN.
13. MANHOLE SHAFT SHALL CONFORM TO SPPWC 324 UNLESS OTHERWISE SHOWN.
14. WHERE A MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER IS SPECIFIED REFER TO SPPWC 336.
15. WHERE A PRESSURE MANHOLE SHAFT – WITH ECCENTRIC REDUCER IS SPECIFIED REFER TO SPPWC 328.
16. WHERE A PRESSURE MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER IS SPECIFIED REFER TO SPPWC 329.
17. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:
- 324 MANHOLE SHAFT – WITH ECCENTRIC REDUCER
  - 326 MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER
  - 328 PRESSURE MANHOLE SHAFT – WITH ECCENTRIC
  - 329 PRESSURE MANHOLE SHAFT – 36" (900 mm) WITHOUT REDUCER
  - 630 24" (610 mm) MANHOLE FRAME AND COVER
  - 633 36" (900 mm) MANHOLE FRAME AND COVER
  - 635 STEEL STEP
  - 636 POLYPROPYLENE PLASTIC STEP



VERTICAL SECTION OF REINFORCED CONCRETE ECCENTRIC MANHOLE SHAFT



CROSS SECTION OF REINFORCED CONCRETE RING

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1992  
REV. 1996, 2009

# MANHOLE SHAFT WITH ECCENTRIC REDUCER

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

324-2

SHEET 1 OF 2

## NOTES

1. UNLESS OTHERWISE INDICATED THIS STRUCTURE SHALL CONFORM TO ASTM C 478M (ASTM C 478) AND ALL CONCRETE SHALL BE PER SSPWC 201-1.2.
2. MANHOLE FRAME AND COVER SHALL CONFORM TO SPPWC 630.
3. ALL JOINTS SHALL BE SEALED BY FILLING THE ANNULAR SPACES WITH CLASS C MORTAR. THE INSIDE OF THE SHAFT AT EACH JOINT SHALL BE WIPED CLEAN OF EXCESS MORTAR.
4. PROTECTIVE PLASTIC LINER (T LOCK) OR ENGINEER-APPROVED COATINGS WHERE REQUIRED BY THE PLANS SHALL BE IN ACCORDANCE WITH SSPWC AND THE MANUFACTURER'S DIRECTIONS.
5. STEPS SHALL CONFORM TO SPPWC 635 OR 636. THE TOP STEP SHALL BE PLACED DIRECTLY BENEATH THE MANHOLE FRAME. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC.
6. THE ECCENTRIC MANHOLE SHAFT REDUCER AND RINGS MAY BE PLAIN CONCRETE. FOR PLAIN CONCRETE SECTIONS THE MINIMUM THICKNESS SHALL BE 6" (150 mm).
7. THE PRECAST CONCRETE MANHOLE STRUCTURES WILL BE INSPECTED BY THE ENGINEER WHO WILL INDICATE ACCEPTANCE FOR SHIPMENT TO THE JOB BY MARKING THE STRUCTURES WITH THE AGENCY'S STAMP.
8. THE VERTICAL SIDES OF THE MANHOLE SHAFT AND THE ECCENTRIC REDUCER SHALL BE LOCATED ABOVE AND IN LINE WITH THE SIDE OF THE STORM DRAIN CONDUIT.
9. CONSTRUCT MANHOLE SAFETY LEDGE PER SPPWC 330 IF DEPTH OF MANHOLE TO INVERT IS GREATER THAN 20' (6 m) AND MANHOLE SHAFT IS GREATER THAN 10' (3 m). WHEN SAFETY LEDGE IS REQUIRED AND MANHOLE SHAFT IS LESS THAN 12' (4 m) SPPWC 326 MUST BE USED.
10. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:
  - 630 24" (600 mm) MANHOLE FRAME AND COVER
  - 635 STEEL STEP
  - 636 POLYPROPYLENE PLASTIC STEP

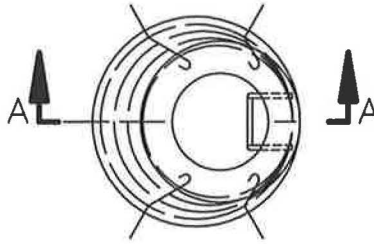


SHEET 1 OF 2

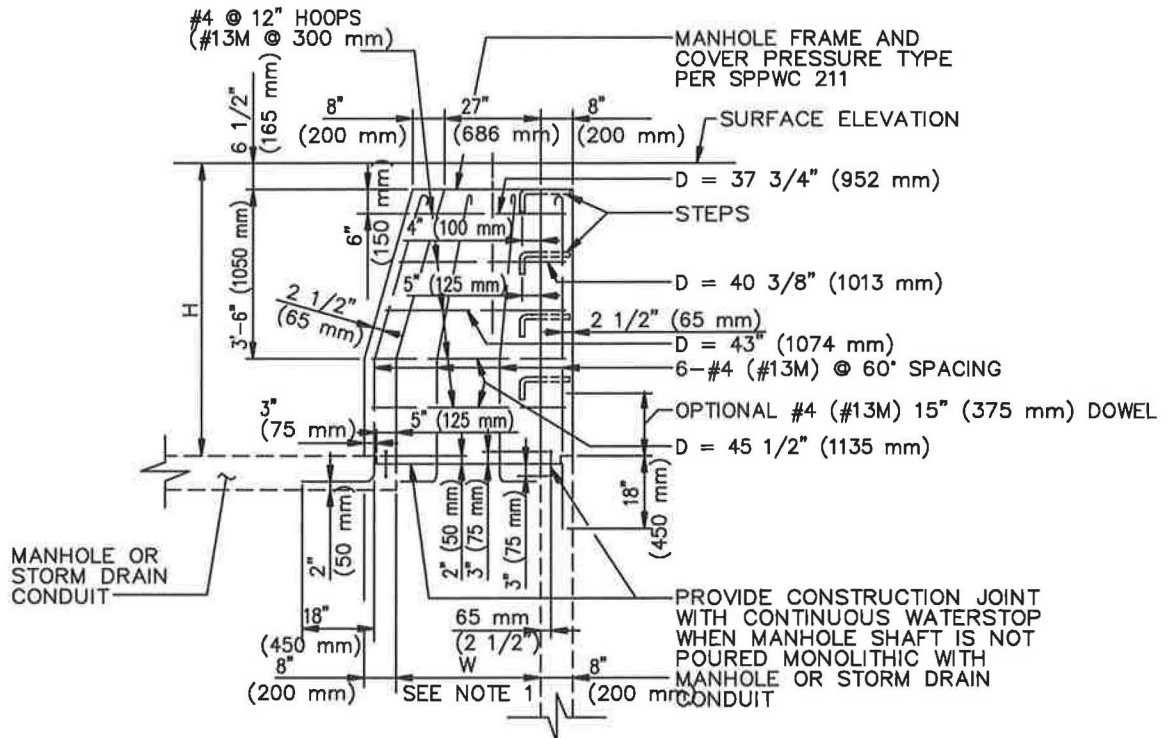


## NOTES

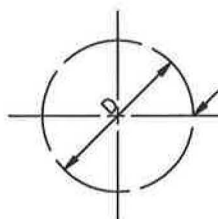
1. UNLESS OTHERWISE INDICATED THIS STRUCTURE SHALL CONFORM TO ASTM C 478 (ASTM C 478M). ALL STEEL SHALL TERMINATE 1 1/2" (40 mm) CLEAR OF CONCRETE SURFACES AND ALL CONCRETE SHALL BE PER SSPWC.
2. WHERE A 36" (900 mm) MANHOLE IS CONSTRUCTED WITH 36" (900 mm) MANHOLE RCP, THE RCP SECTION SHALL CONTAIN A CIRCULAR CAGE AND HAVE A LOAD CARRYING CAPACITY OF AT LEAST 1000D (50D). SPECIAL MANHOLE SHAFT SHALL BE PER THIS STANDARD AND 36" (900 mm) MANHOLE FRAME AND COVER SHALL BE PER SPPWC 633.
3. THE MANHOLE SHAFT AND RINGS MAY BE PLAIN CONCRETE. FOR PLAIN CONCRETE SECTIONS THE MINIMUM THICKNESS SHALL BE 6" (150 mm).
4. ALL JOINTS SHALL BE SEALED BY FILLING THE ANNULAR SPACES WITH CLASS C MORTAR. THE INSIDE OF THE SHAFT AT EACH JOINT SHALL BE WIPED CLEAN OF EXCESS MORTAR.
5. PROTECTIVE PLASTIC LINER (T LOCK) OR ENGINEER-APPROVED COATINGS WHERE REQUIRED BY THE PLANS SHALL BE IN ACCORDANCE WITH SSPWC AND THE MANUFACTURER'S DIRECTIONS.
6. STEPS SHALL CONFORM TO SPPWC 635 OR 636. THE TOP STEP SHALL BE PLACED 6" (150 mm) BENEATH THE MANHOLE COVER FRAME. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC.
7. THE PRECAST CONCRETE MANHOLE STRUCTURES WILL BE INSPECTED BY THE ENGINEER WHO WILL INDICATE ACCEPTANCE FOR SHIPMENT TO THE JOB BY MARKING THE STRUCTURES WITH THE AGENCY'S STAMP.
8. THE VERTICAL SIDES OF THE MANHOLE SHAFT SHALL BE LOCATED ABOVE AND IN LINE WITH THE SIDE OF THE STORM DRAIN CONDUIT.
9. CONSTRUCT MANHOLE SAFETY LEDGE PER SPPWC 330 IF DEPTH OF MANHOLE TO INVERT IS GREATER THAN 20' (6 m) AND MANHOLE SHAFT IS GREATER THAN 10' (3 m).
10. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:
  - 633 36" (900 mm) MANHOLE FRAME AND COVER
  - 635 STEEL STEP
  - 636 POLYPROPYLENE PLASTIC STEP



PLAN



SECTION A-A



ELECTRICALLY BUTT WELD ENDS OR LAP ENDS OF BAR 18" (450 mm)

#4 (#13M) HOOP BARS

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
 PUBLIC WORKS STANDARDS INC.  
 GREENBOOK COMMITTEE  
 1992  
 REV. 1998, 2009

**PRESSURE MANHOLE SHAFT  
 WITH ECCENTRIC REDUCER**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

**328-2**

SHEET 1 OF 2



## NOTES

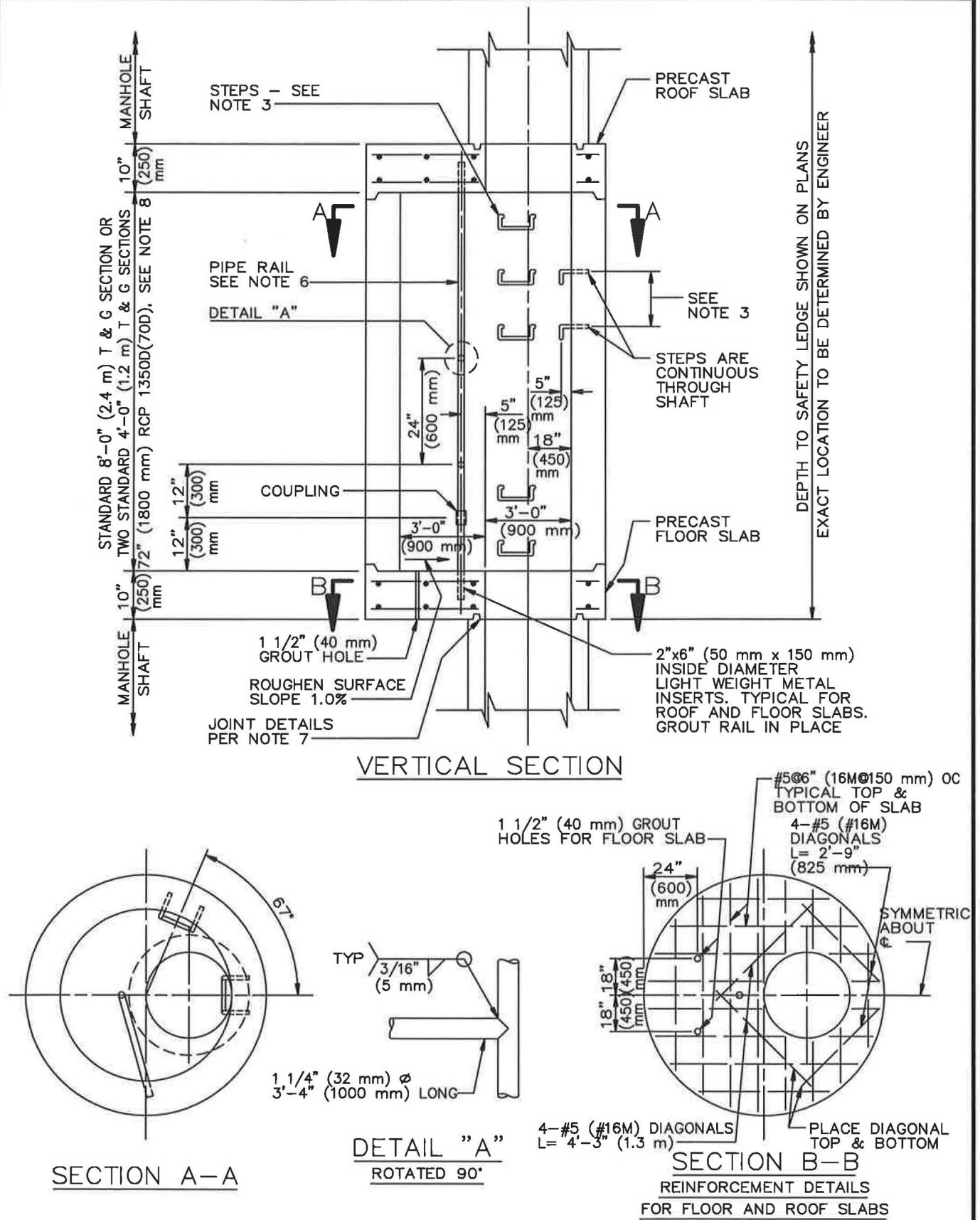
1. IF H IS LESS THAN 18" (450 mm), W=27" (675 mm)  
IF H IS BETWEEN 18" (450 mm) AND 2'-6" (750 mm), W=2'-6" (750 mm).  
IF H IS 2'-6" (750 mm) OR MORE, W=3'-0" (900 mm).  
IF H IS MORE THAN 4'-0 1/2" (1215 mm), BRING WALL VERTICALLY TO 4'-0 1/2" (1215 mm) BELOW SURFACE AND TAPER FROM 3'-0" (900 mm) TO 27" (675 mm) AS SHOWN.
2. THIS STRUCTURE SHALL BE USED WITH MANHOLE FRAME AND COVER PRESSURE TYPE, SPPWC 211. IT MAY BE USED FOR HYDROSTATIC HEADS UP TO 25' (7.5 m) ABOVE THE STEEL PLATE.
3. THE VERTICAL SIDE OF THE MANHOLE SHAFT AND THE ECCENTRIC REDUCER SHALL BE LOCATED ABOVE AND IN LINE WITH THE SIDE OF THE STORM DRAIN CONDUIT.
4. REINFORCEMENT SHALL CONFORM TO ASTM A 615, GRADE 40 (ASTM A 615M, GRADE 300), AND SHALL TERMINATE 1 1/2" (40 mm) CLEAR OF CONCRETE SURFACES UNLESS OTHERWISE SHOWN.
5. STEPS SHALL CONFORM TO SPPWC 635 OR 636. THE TOP STEP SHALL BE PLACED DIRECTLY BENEATH THE MANHOLE FRAME. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC.
6. SEE CONTRACT SPECIFICATIONS FOR PHYSICAL REQUIREMENTS OF WATERSTOP.
7. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:  
  
211 MANHOLE FRAME AND COVER PRESSURE TYPE  
635 STEEL STEP  
636 POLYPROPYLENE PLASTIC STEP



#### NOTES

1. THIS STRUCTURE MAY BE USED FOR HYDROSTATIC HEADS UP TO 25' (7.5 m) ABOVE THE PRESSURE PLATE.
2. 36" (914 mm ) MANHOLE FRAME AND COVER PER SPPWC 633 SHALL BE USED.
3. REINFORCEMENT SHALL BE PER ASTM A 615, GRADE 40 AND SHALL TERMINATE 1 1/2" (40 mm) CLEAR OF CONCRETE SURFACES UNLESS OTHERWISE SHOWN. HOOPS MAY BE ELECTRICALLY BUTT WELDED OR THE ENDS LAPPED 18" (450 mm).
4. THE MANHOLE SHAFT SHALL BE LOCATED ABOVE AND IN LINE WITH THE SIDE OF THE CONDUIT BELOW.
5. STEPS SHALL CONFORM TO SPPWC 635 OR 636. UNLESS OTHERWISE SHOWN, STEPS SHALL BE UNIFORMLY SPACED 14" (350 mm) TO 15" (375 mm) OC.
6. GASKET MATERIAL SHALL BE NEOPRENE (OR EQUAL) 1/16" (2 mm) THICK BY 1 1/4" (32 mm) WIDE.
7. BOLTS SHALL BE STAINLESS STEEL CONFORMING TO ASTM A 320 (ASTM A 320M), GRADE B8.
8. PRESSURE PLATE AND PRESSURE PLATE RING SHALL BE STEEL CONFORMING TO ASTM A 36 (ASTM A 36M) AND SHALL BE GALVANIZED. PLATES SHALL BE MARKED IN SETS AND A CHISELED ARROW STAMPED ON BOTH PLATES, AFTER DRILLING AND TAPPING, TO FACILITATE FIELD ASSEMBLY.
9. SEE CONTRACT SPECIFICATIONS FOR PHYSICAL REQUIREMENTS OF WATERSTOP.
10. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:  

633 36" (914 mm) MANHOLE FRAME AND COVER  
635 STEEL STEP  
636 POLYPROPYLENE PLASTIC STEP



# STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
 PUBLIC WORKS STANDARDS INC.  
 GREENBOOK COMMITTEE  
 1992  
 REV. 1996, 2009

## MANHOLE SHAFT SAFETY LEDGE

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

330-2

SHEET 1 OF 2

## NOTES

1. MANHOLE SHAFT SAFETY LEDGE WILL BE NOTED ON THE PLANS WHEN REQUIRED. IT IS TO BE CONSTRUCTED WHEN DEPTH OF MANHOLE TO INVERT IS GREATER THAN 20' (6 m) AND MANHOLE SHAFT IS GREATER THAN 10' (3 m).
2. A SAFETY LEDGE SHALL NOT BE USED IF A PRESSURE MANHOLE IS REQUIRED.
3. STEPS SHALL CONFORM TO SPPWC 635 OR 636 AND SHALL BE ANCHORED 4" (100 mm) IN THE WALL OF THE STRUCTURE. STEPS SHALL BE PLACED TO MATCH THE SPACING OF THE MANHOLE SHAFT.
4. REINFORCEMENT SHALL BE PER ASTM A 615, GRADE 40 (ASTM A 615M, GRADE 300) AND SHALL TERMINATE 2" (50 mm) CLEAR OF CONCRETE SURFACE UNLESS OTHERWISE SHOWN.
5. GROUT HOLES, PIPE AND FITTINGS SHALL BE PROVIDED IN THE FLOOR SLAB. PRESSURE GROUTING SHALL BE USED TO FILL VOIDS AND TO SECURE UNIFORM BEARING. THE GROUT SHALL BE NEAT CEMENT GROUT AND GROUTING PRESSURES SHALL BE AS DETERMINED IN THE FIELD BY THE ENGINEER.
6. PIPE RAIL SHALL BE FABRICATED OF 1 1/4" (32 mm) STANDARD GALVANIZED PIPE COMPOSED OF TWO SECTIONS 7'-6" (2.25 m) & 18" (450 mm) IN LENGTH JOINED BY A GALVANIZED COUPLING. THE COUPLING SHALL BE THREADED A MINIMUM OF 2" (50 mm) ON EACH PIPE LENGTH.
7. ROOF AND FLOOR SLABS SHALL BE PRECAST AND KEYED FOR REINFORCED CONCRETE PIPE SECTIONS AS SHOWN. ALL JOINTS SHALL BE FILLED WITH CLASS C MORTAR AND NEATLY POINTED OR WIPED ON THE INSIDE.
8. 72" (1800 mm) RCP SHALL BE PROVIDED WITH TWO CIRCULAR CAGES OF REINFORCEMENT.
9. THE FOLLOWING SPPWC ARE INCORPORATED HEREIN:  
  
324 MANHOLE SHAFT — WITH ECCENTRIC REDUCER  
326 MANHOLE SHAFT — 36" (900 mm) WITHOUT REDUCER  
635 STEEL STEP  
636 POLYPROPYLENE PLASTIC STEP

☉ MAIN LINE RCP OR  
REINFORCED MONOLITHIC  
ARCH, SEE NOTE 2

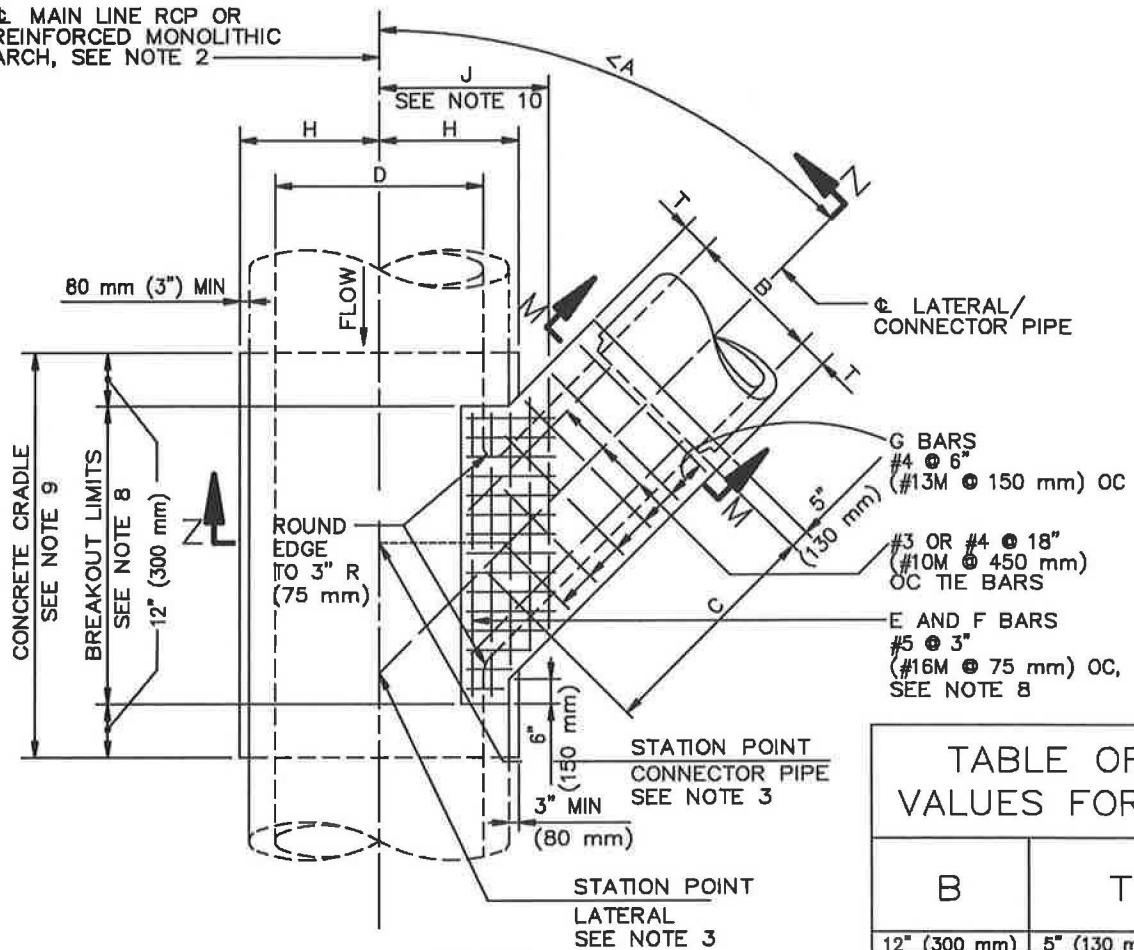
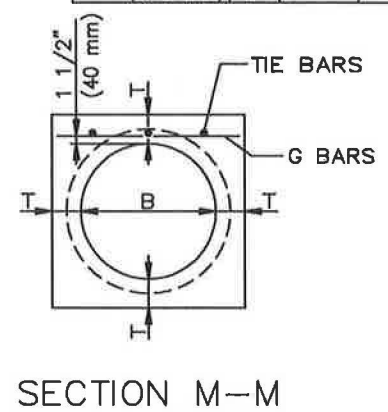
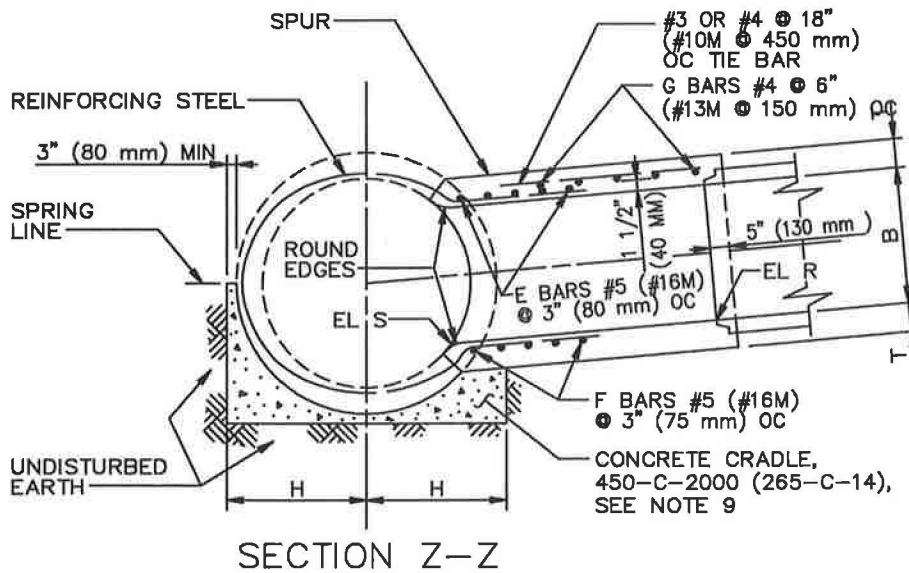


TABLE OF  
VALUES FOR T

B	T
12" (300 mm)	5" (130 mm)
15" (375 mm)	5" (130 mm)
18" (450 mm)	5" (130 mm)
21" (525 mm)	5" (130 mm)
24" (600 mm)	5 1/2" (140 mm)
27" (675 mm)	5 1/2" (140 mm)
30" (750 mm)	6" (150 mm)
33" (825 mm)	6 1/2" (170 mm)
36" (900 mm)	6 1/2" (170 mm)
39" (975 mm)	7" (180 mm)



STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1984  
REV. 1990, 1999, 2009

**JUNCTION STRUCTURE—PIPE TO PIPE**  
INLET ID ≥ 24" (600 mm) OR OD > 1/2 MAIN LINE ID

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

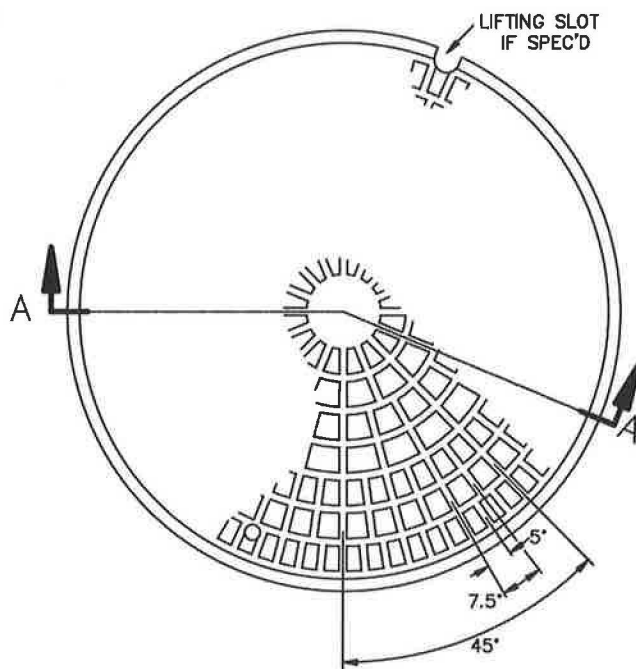
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SHEET 1 OF 2

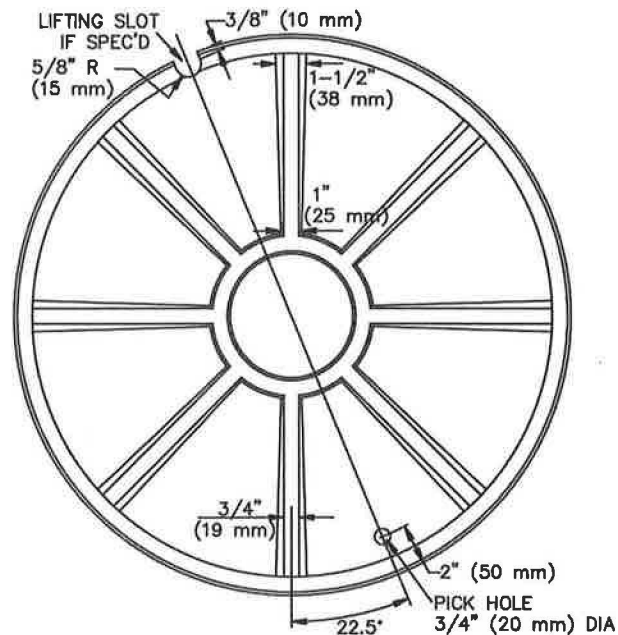
## NOTES

1. THIS JUNCTION STRUCTURE SHALL BE USED WHEN THE OUTSIDE DIAMETER OF THE LATERAL IS GREATER THAN  $1/2$  THE INSIDE DIAMETER D OF THE MAIN LINE; OR WHEN THE INSIDE DIAMETER B OF THE LATERAL IS GREATER THAN 24" (600 mm). B SHALL NOT EXCEED  $0.75 D$  OR 39" (975 mm).
2. IF THE MAIN LINE IS A REINFORCED MONOLITHIC ARCH STORM DRAIN, D SHALL REFER TO THE CLEAR SPAN OF THE ARCH. REINFORCING STEEL SHALL BE CUT AND BENT INTO THE JUNCTION STRUCTURE IN THE SAME MANNER AS FOR A PIPE. A CONCRETE CRADLE IS NOT REQUIRED FOR A REINFORCED MONOLITHIC ARCH.
3. STATIONS SHOWN ON THE PLANS FOR LATERALS APPLY AT THE INTERSECTION OF CENTERLINES OF MAIN LINE AND LATERAL. STATIONS SHOWN ON THE PLANS FOR CATCH BASIN CONNECTOR PIPES APPLY AT THE INTERSECTION OF THE INSIDE WALL OF THE MAIN LINE WITH THE CONNECTOR PIPE CENTERLINE.
4. VALUES FOR A, B, C AND D SHALL BE SHOWN ON THE PLANS. ELEVATION R AND ELEVATION S SHALL BE SHOWN ONLY WHEN REQUIRED PER NOTE 5.
5.
  - a. ELEVATIONS R AND S NEED NOT BE SHOWN ON THE PLANS IF THE INLET PIPE IS TO ENTER THE MAIN LINE RADially.
  - b. ELEVATION R SHALL BE SHOWN ON THE PLANS ONLY IF A STUB IS TO BE PROVIDED IN THE MAIN LINE FOR FUTURE CONNECTION OF AN INLET PIPE.
  - c. ELEVATION S SHALL BE SHOWN ON THE PLANS IF AN INLET PIPE IS TO ENTER THE MAIN LINE OTHER THAN RADially. INLET PIPE SHALL BE LAID ON A STRAIGHT GRADE FROM ELEVATION S TO THE CATCH BASIN OR GRADE BREAK IN LINE.
6. THE INLET PIPE SHALL ENTER THE MAIN LINE RADially UNLESS OTHERWISE INDICATED. THE INLET PIPE MAY ENTER THE MAIN LINE OTHER THAN RADially IF ANGLE A IS GREATER THAN  $45^\circ$ , B IS LESS THAN OR EQUAL TO 24" (600 mm) AND THE OUTSIDE DIAMETER OF THE INLET PIPE IS LESS THAN  $0.5 D$ ; OTHERWISE, SPPWC 340 SHALL BE USED.
7. NO MORE THAN ONE OPENING SHALL BE MADE IN ANY ONE SECTION OF PIPE.
8. THE OPENING FOR THE BREAKOUT SHALL BE RECTANGULAR AND CUT NORMAL TO THE PIPE SURFACE WITHOUT DAMAGING THE REINFORCING STEEL. THE TRANSVERSE REINFORCEMENT OF THE MAIN LINE SHALL BE CUT AT THE CENTER OF THE OPENING AND BENT INTO THE TOP AND BOTTOM SLABS OF THE SPUR.
9. THE MAIN LINE SHALL BE REINFORCED WITH A CONCRETE CRADLE AND ENCASEMENT (AS APPLICABLE). A CONCRETE ENCASEMENT IS REQUIRED IF A JOINT IN THE MAIN LINE FALLS WITHIN THE LIMITS OF THE CRADLE. THE CONCRETE ENCASEMENT SHALL EXTEND 12" (300 mm) ABOVE THE TOP OF THE MAIN LINE AND TO THE LIMITS OF THE CRADLE. IF CONNECTING TO AN EXISTING STORM DRAIN, PORTION OF CRADLE OPPOSITE INLET MAY BE OMITTED.
10. REINFORCING STEEL SHALL CONFORM TO ASTM A 615, GRADE 40, (ASTM A 615M, GRADE 300), AND BE PLACED  $1\frac{1}{2}$ " (40 mm) CLEAR FROM CONCRETE SURFACES, UNLESS OTHERWISE SHOWN F BARS SHALL BE CARRIED TO A POINT NOT LESS THAN J DISTANCE FROM CENTER LINE WITH  $J = 7D/12 + 6"$  (150 mm).
11. FLOOR OF THE SPUR SHALL BE STEEL-TROWELED TO THE SPRING LINE OF THE SPUR.

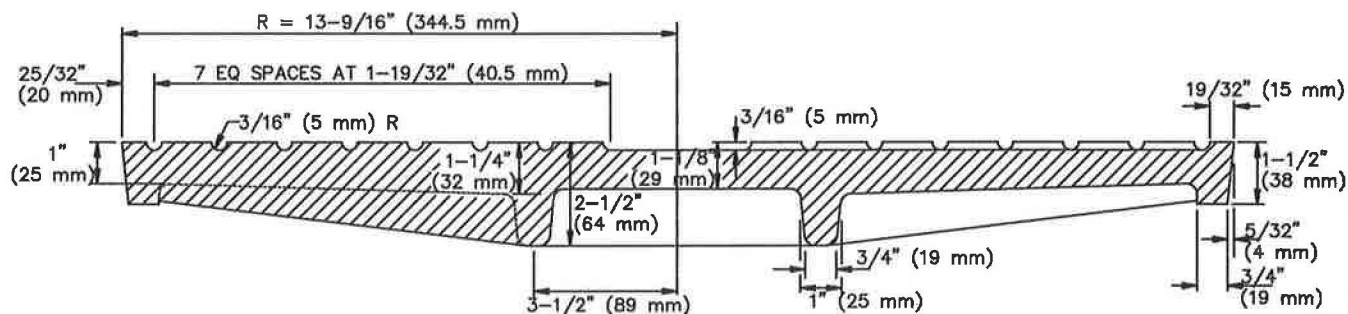




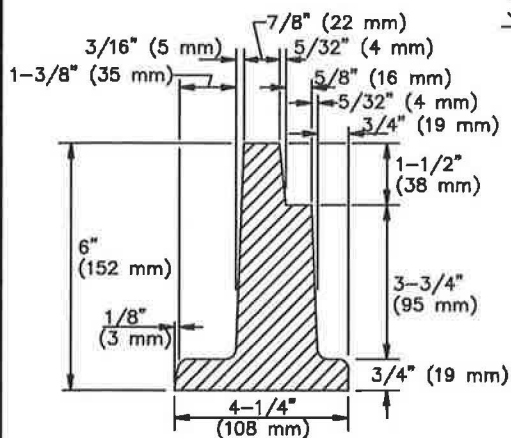
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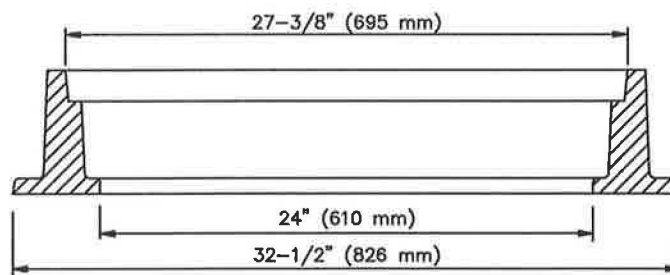
BOTTOM OF COVER



SECTION A-A



FRAME DETAIL



SECTION THRU FRAME

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1984  
REV. 1998, 2009, 2011

**24" (610 mm) MANHOLE FRAME  
AND COVER**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

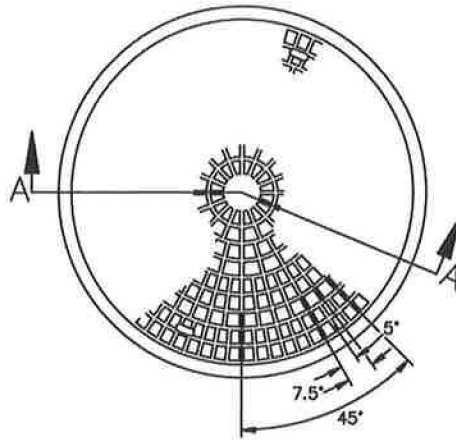
**630-4**

SHEET 1 OF 2

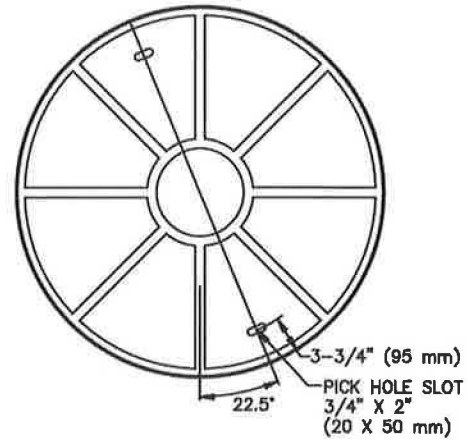


NOTES:

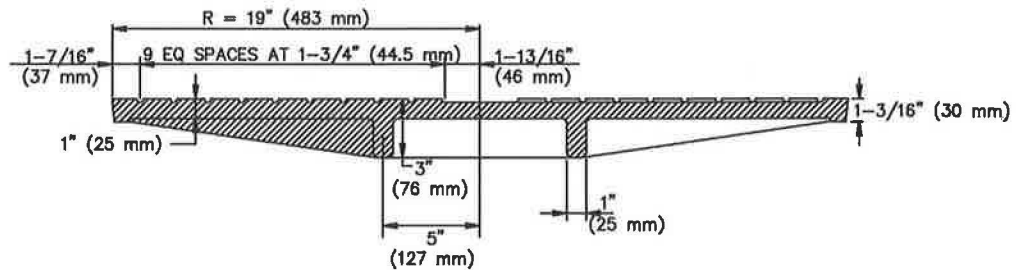
1. THE CAST IRON USED SHALL CONFORM TO ASTM A-48 CLASS 35B.
2. COVERS SHALL BE CAST WITH THE LETTER "D" FOR STORM DRAINS AND "S" FOR SEWERS, AND THE AGENCY'S IDENTIFICATION IN ACCORDANCE WITH INSTRUCTIONS FURNISHED BY THE AGENCY. THE LETTER "D" OR "S" SHALL BE APPROXIMATELY 2-1/2" (65 mm) HIGH WITH 1/2" (15 mm) LINE WIDTH, AND PLACED IN THE CENTER OF THE COVER. ALL LETTERS SHALL BE FLUSH WITH THE FINISHED SURFACE OF THE COVER.
3. FOUNDRY IDENTIFYING MARK, HEAT AND DATE SHALL BE CAST ON THE BOTTOM OF THE COVER AND ON THE INSIDE OF THE FRAME.
4. IMPORTED COVERS AND FRAMES SHALL HAVE THE COUNTRY OF ORIGIN MARKING IN COMPLIANCE WITH FEDERAL REGULATIONS.
5. WEIGHT OF FRAME SHALL BE 260 LBS (118 kg). WEIGHT OF COVER SHALL BE 175 LBS (79 kg). ACTUAL WEIGHTS SHALL BE WITHIN A RANGE OF 95% TO 110%.
6. THE MANHOLE FRAME AND COVER SHALL BE INSPECTED BY THE ENGINEER PRIOR TO SHIPMENT TO THE JOB SITE. ACCEPTANCE WILL BE INDICATED BY THE AGENCY'S MARK.
7. COVERS FOR MANHOLES LOCATED IN EASEMENTS, ALLEYS, PARKWAYS AND ALL PLACES OTHER THAN PAVED STREETS SHALL BE PROVIDED WITH SOCKET-SET SCREW LOCKING DEVICES. DRILL AND TAP TWO HOLES TO A DEPTH OF 1" (25 mm) AT 90 DEGREES TO PICK HOLE AND INSTALL 3/4" x 3/4" (20 x 20 mm) STAINLESS STEEL SOCKET-SET SCREWS WITH 3/8" (10 mm) RECESSED HEX HEAD. ALL THREADS SHALL BE N.C.



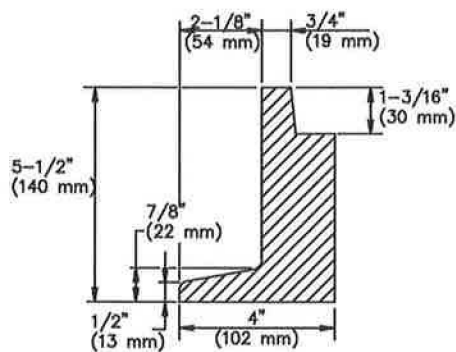
TOP OF COVER



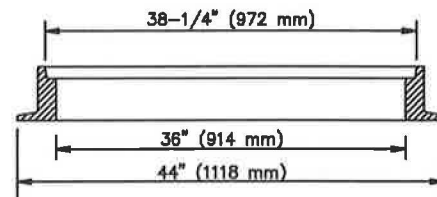
BOTTOM OF COVER



SECTION A-A



FRAME DETAIL



SECTION THRU FRAME

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1984  
REV. 1992, 1996, 2009, 2011

**36" (914 mm) MANHOLE FRAME  
AND COVER**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

**633-4**

SHEET 1 OF 2

NOTES:

1. THE CAST IRON USED SHALL CONFORM TO ASTM A-48 CLASS 35B.
2. COVERS SHALL BE CAST WITH THE LETTER "D" FOR STORM DRAINS AND "S" FOR SEWERS, AND THE AGENCY'S IDENTIFICATION IN ACCORDANCE WITH INSTRUCTIONS FURNISHED BY THE AGENCY. THE LETTER "D" OR "S" SHALL BE APPROXIMATELY 2-1/2" (65 mm) HIGH WITH 1/2" (15 mm) LINE WIDTH, AND PLACED IN THE CENTER OF THE COVER. ALL LETTERS SHALL BE FLUSH WITH THE FINISHED SURFACE OF THE COVER.
3. FOUNDRY IDENTIFYING MARK, HEAT AND DATE SHALL BE CAST ON THE BOTTOM OF THE COVER AND ON THE INSIDE OF THE FRAME.
4. IMPORTED COVERS AND FRAMES SHALL HAVE THE COUNTRY OF ORIGIN MARKING IN COMPLIANCE WITH FEDERAL REGULATIONS.
5. WEIGHT OF FRAME SHALL BE 335 LBS (152 kg). WEIGHT OF COVER SHALL BE 340 LBS (154 kg). ACTUAL WEIGHTS SHALL BE WITHIN A RANGE OF 95% TO 110%.
6. THE MANHOLE FRAME AND COVER SHALL BE INSPECTED BY THE ENGINEER PRIOR TO SHIPMENT TO THE JOB SITE. ACCEPTANCE WILL BE INDICATED BY THE AGENCY'S MARK.
7. COVERS FOR MANHOLES LOCATED IN EASEMENTS, ALLEYS, PARKWAYS AND ALL PLACES OTHER THAN PAVED STREETS SHALL BE PROVIDED WITH SOCKET-SET SCREW LOCKING DEVICES. DRILL AND TAP TWO HOLES TO A DEPTH OF 1" (25 mm) AT 90 DEGREES TO PICK HOLE AND INSTALL 3/4" x 3/4" (20 x 20 mm) STAINLESS STEEL SOCKET-SET SCREWS WITH 3/8" (10 mm) RECESSED HEX HEAD. ALL THREADS SHALL BE N.C.

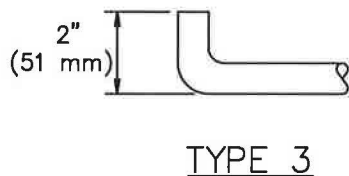
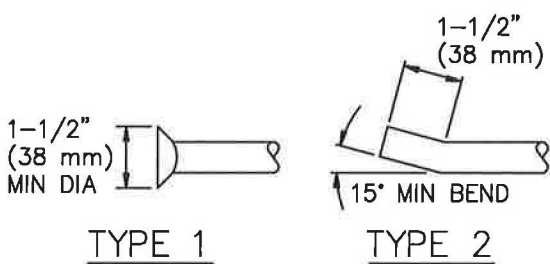
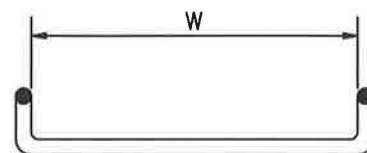
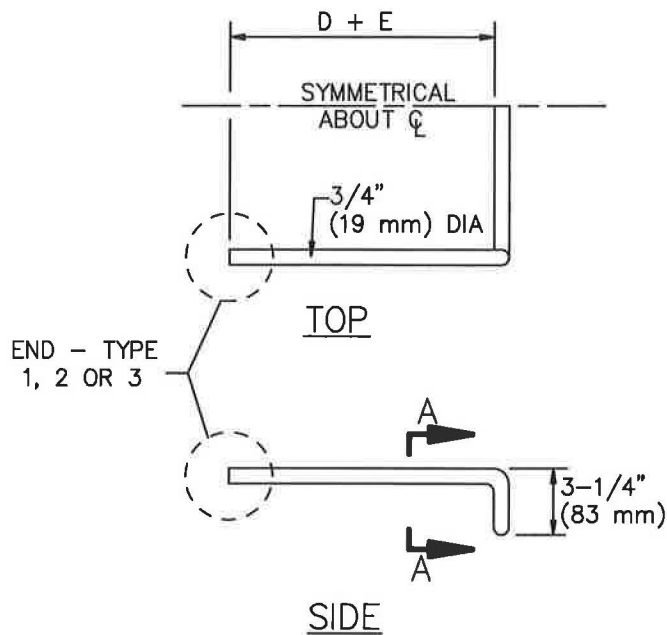
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**36" (914 mm) MANHOLE FRAME  
AND COVER**

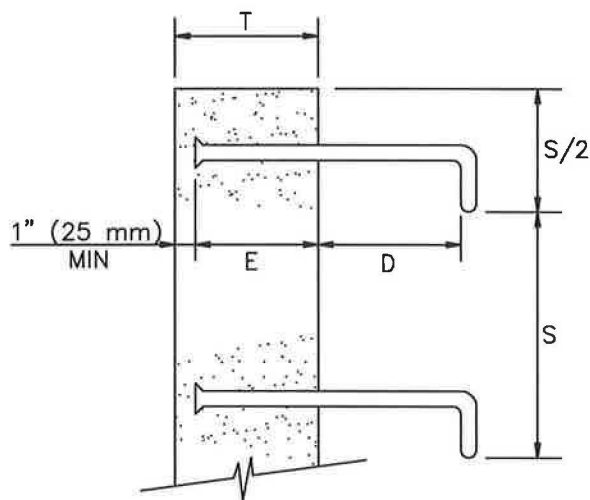
STANDARD PLAN

**633-4**

SHEET 2 OF 2



END DETAILS-SIDE VIEW



INSTALLATION DETAIL

UNLESS OTHERWISE NOTED:

D = 7" (175 mm)  
E = 6" (150 mm) OR T - 1" (25 mm), WHICHEVER IS LESS  
MINIMUM E IS 3" (75 mm)  
S = 12" (300 mm) MAX, EVENLY SPACED  
W = 16" (400 mm) MIN

FOR MANHOLES AND UNDERGROUND VAULTS:  
S = 16" (400 mm) MAX, EVENLY SPACED  
W = 14" (350 mm) MIN

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1984  
REV. 1992, 1996, 2009

STEEL STEP

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

635-3

SHEET 1 OF 2

NOTES:

1. STEPS SHALL BE STEEL CONFORMING TO ASTM A307 AND SHALL BE GALVANIZED AFTER FABRICATION. UNLESS OTHERWISE NOTED, STEPS MAY ALSO BE POLYPROPYLENE STEPS, STEEL REINFORCED, CONFORMING TO SPPWC 636.
2. IF STAINLESS STEEL STEPS ARE REQUIRED, THE MATERIAL SHALL CONFORM TO ASTM A276, 300 SERIES.
3. STEP ENDS MAY BE TYPE 1, 2 OR 3, AS SHOWN.
4. BOTTOM STEP SHALL BE A MAXIMUM OF 2' (600 mm) ABOVE FLOOR OR SHELF.
5. STEPS WITH TYPE 1 OR 2 ENDS MAY BE CAST IN PLACE, OR PLACED IN THE CENTER OF 1-1/2" (40 mm) MIN DIA DRILLED OR FORMED HOLES AND SET WITH HIGH STRENGTH NON-SHRINK GROUT, 6000 PSI (40 MPa) MIN. STEPS WITH TYPE 3 ENDS SHALL BE CAST-IN-PLACE.

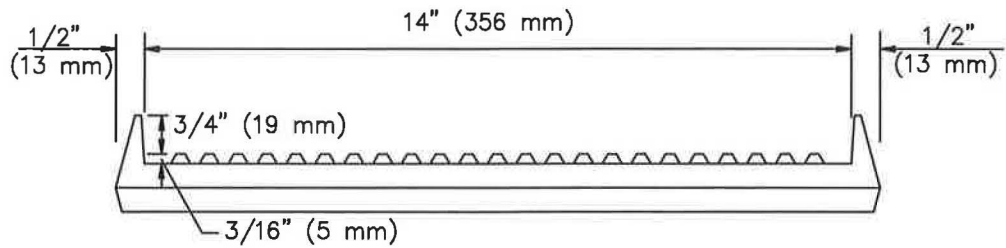
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**STEEL STEP**

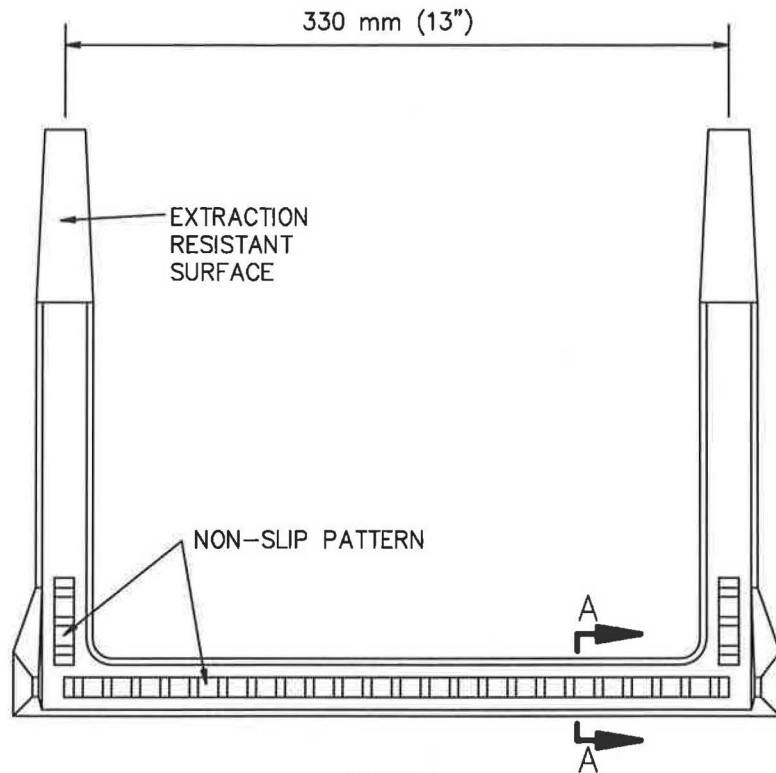
STANDARD PLAN

**635-3**

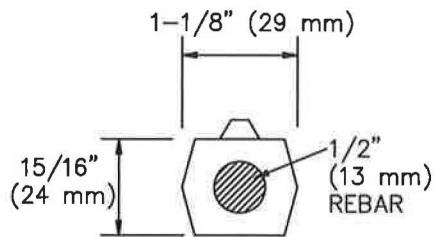
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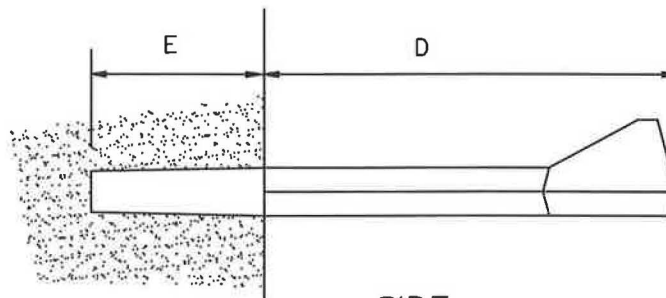
FRONT



TOP



SECTION A-A



SIDE

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE  
PUBLIC WORKS STANDARDS INC.  
GREENBOOK COMMITTEE  
1991  
REV. 1996, 2009

**POLYPROPYLENE-PLASTIC STEP**

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN

**636-2**

SHEET 1 OF 2

**NOTES:**

1. STEPS SHALL BE STEEL-REINFORCED COPOLYMER POLYPROPYLENE PLASTIC CONFORMING TO:
  - (A) ASTM D478 AND C497, EXCEPT THAT THE MINIMUM HORIZONTAL PULLOUT LOAD SHALL BE 1,500 LBS (6.7 kN).
  - (B) ASTM A615 GRADE 60 DEFORMED REINFORCING STEEL BAR.
  - (C) CALIFORNIA CODE OF REGULATIONS TITLE 8, GENERAL INDUSTRY SAFETY ORDERS.
2. STEPS SHALL BE CAPABLE OF WITHSTANDING AN IMPACT LOAD OF 70 FT-LBS (95 N.m) AT 20°F (-7°C) WITHOUT CRACKING OR FRACTURING.
3. THE MINIMUM TOTAL CROSS-SECTIONAL AREA OF THE EXPOSED PORTION OF THE STEP, INCLUDING THE DEFORMED STEEL BAR AND EXCLUDING THE NON-SLIP TREAD SURFACE, SHALL BE 1.0 SQ IN (645 mm<sup>2</sup>).
4. THE ENTIRE POLYPROPYLENE PLASTIC MATERIAL SURROUNDING THE REINFORCING STEEL BAR SHALL BE CAST MONOLITHICALLY. MINIMUM COVER SHALL BE 3/16" (5 mm).
5. A CERTIFICATION OF COMPLIANCE WITH THE REQUIREMENTS OF NOTES 1 THROUGH 4 PREPARED BY AN INDEPENDENT CERTIFIED LABORATORY SHALL BE SUBMITTED TO THE ENGINEER CONCURRENTLY WITH A REQUEST FOR APPROVAL.
6. E = 3-3/8" (86 mm). FOR VAULTS AND MANHOLES, D = 5-1/2" (140 mm). FOR OTHER INSTALLATIONS, D = 7-1/2" (190 mm). THESE DIMENSIONS MAY BE PLUS OR MINUS 1/4" (6 mm).
7. STEPS SHALL BE EVENLY SPACED. MAXIMUM VERTICAL SPACING OF STEPS SHALL BE 16" (400 mm), WITH THE BOTTOM STEP A MAXIMUM OF 2' (600 mm) ABOVE FLOOR OR SHELF.
8. IF TAPERED STEPS ARE INSTALLED INTO STRAIGHT DRILLED OR FORMED HOLES, APPROVED NON-SHRINK GROUT SHALL BE INJECTED INTO THE HOLE PRIOR TO INSTALLATION. HOLES SHALL BE STRAIGHT AND PARALLEL. EXCEPT AS OTHERWISE NOTED, STEPS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDED PROCEDURES.
9. A DROP STEP WITH A MINIMUM DROP OF 3/4" (19 mm) MAY BE USED. THE DROP STEP SHALL MEET ALL OTHER CRITERIA OF THIS PLAN.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

**POLYPROPYLENE-PLASTIC STEP**

STANDARD PLAN

**636-2**

SHEET 2 OF 2

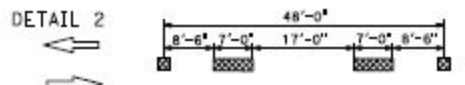
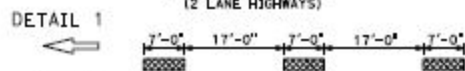
**ATTACHMENT B**

**CALTRANS STANDARD PLANS**

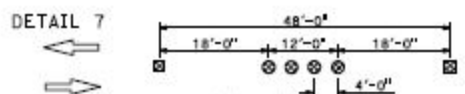
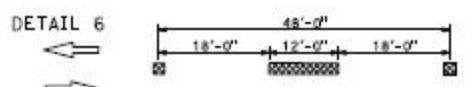
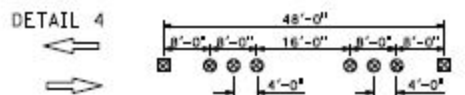
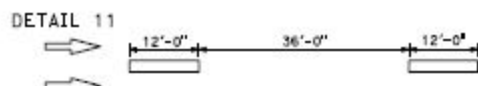
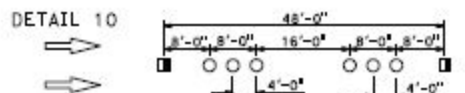
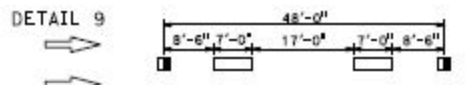
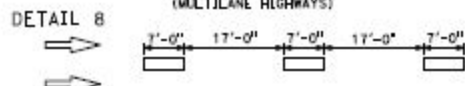


## CENTERLINES

(2 LANE HIGHWAYS)

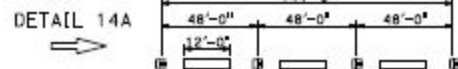
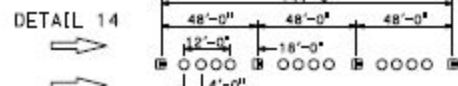
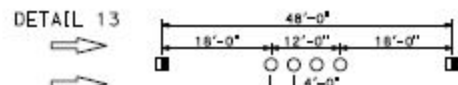
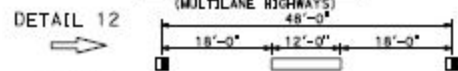


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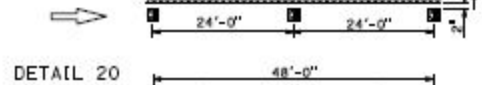
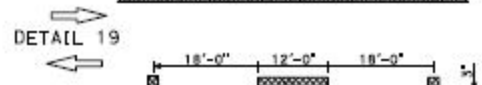
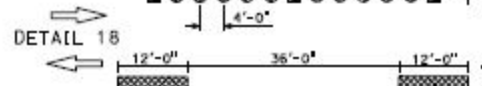
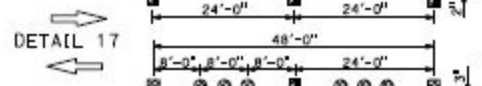
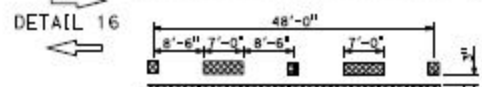
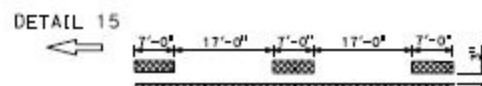
LANELINES  
(MULTILANE HIGHWAYS)

## LANELINES (Cont)

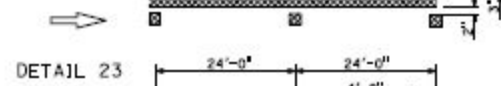
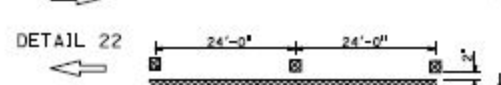
(MULTILANE HIGHWAYS)



## NO PASSING ZONES-ONE DIRECTION



## NO PASSING ZONES-TWO DIRECTION



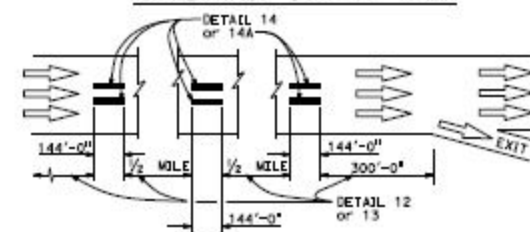
## LEGEND

## MARKERS

- TYPE A WHITE NON-REFLECTIVE
- TYPE AY YELLOW NON-REFLECTIVE
- TYPE C RED-CLEAR RETROREFLECTIVE
- TYPE D TWO-WAY YELLOW RETROREFLECTIVE
- TYPE G ONE-WAY CLEAR RETROREFLECTIVE
- TYPE H ONE-WAY YELLOW RETROREFLECTIVE

## LINES

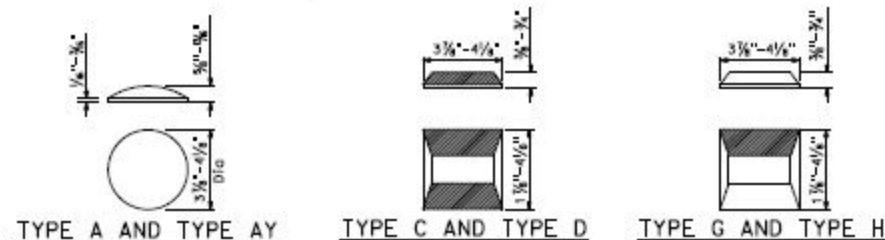
- 4" WHITE
- 4" YELLOW

TYPICAL LANE LINE DELINEATION  
IN ADVANCE OF EXIT RAMP

## NOTE:

Detail 14 is to be used in combination with Detail 13, Detail 14A is to be used in combination with Detail 12.

## MARKER DETAILS



TYPE A AND TYPE AY

TYPE C AND TYPE D

TYPE G AND TYPE H

RETROREFLECTIVE FACE

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**PAVEMENT MARKERS  
AND TRAFFIC LINES  
TYPICAL DETAILS**

NO SCALE

A20A

SHEET	COUNTY	ROUTE	POST MILES	TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

October 30, 2015  
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS  
OF AGENTS SHALL NOT BE RESPONSIBLE FOR  
THE ACCURACY OR COMPLETENESS OF THE  
COPIES OF THIS PLAN SHEET.

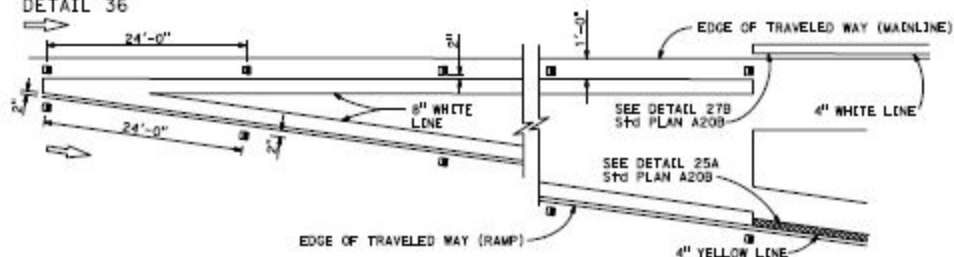
REGISTERED CIVIL ENGINEER  
October 30, 2015  
PLANS APPROVAL DATE

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS



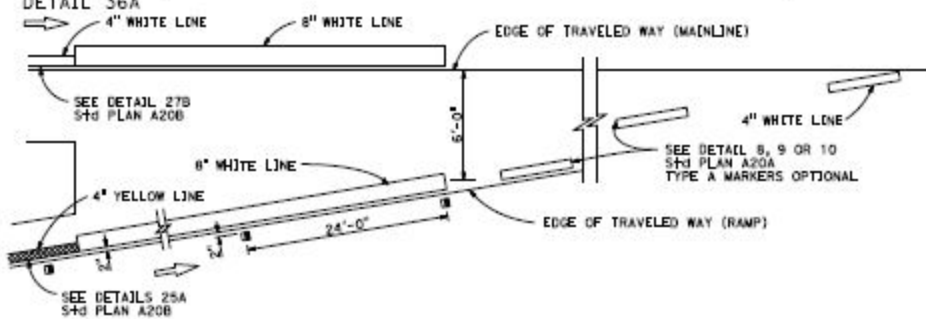
# EXIT RAMP NEUTRAL AREA (GORE) TREATMENT

DETAIL 36



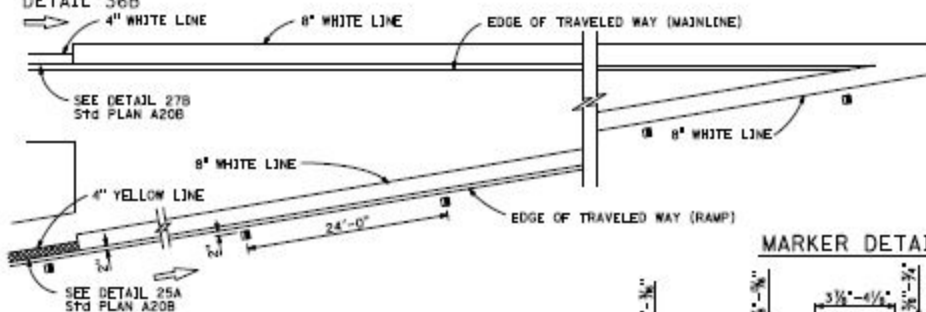
# ENTRANCE RAMP NEUTRAL AREA (MERGE) TREATMENT

DETAIL 36A



# ENTRANCE RAMP NEUTRAL AREA (ACCELERATION LANE) TREATMENT

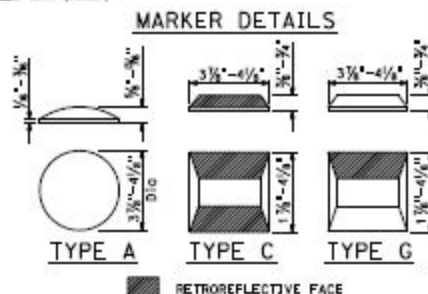
DETAIL 36B



## LEGEND:

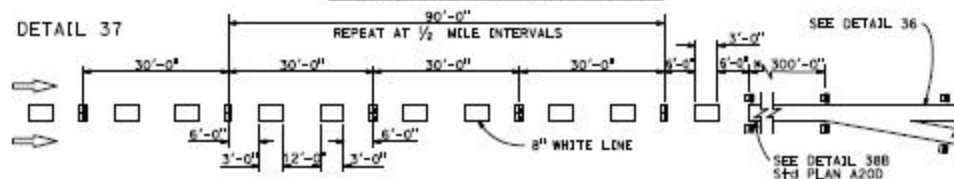
### MARKERS

- TYPE A WHITE NON-REFLECTIVE
- ◻ TYPE C RED-CLEAR RETROREFLECTIVE
- ◼ TYPE G ONE-WAY CLEAR RETROREFLECTIVE

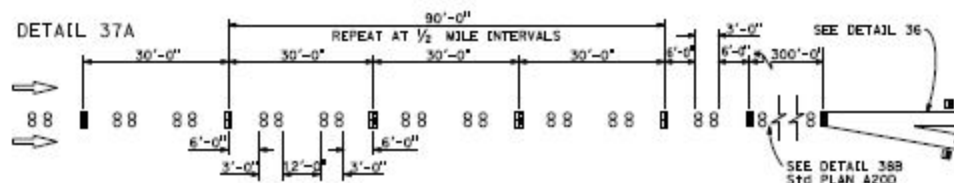


# LANE DROP AT EXIT RAMP

DETAIL 37



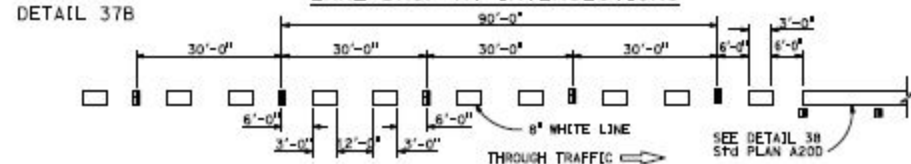
DETAIL 37A



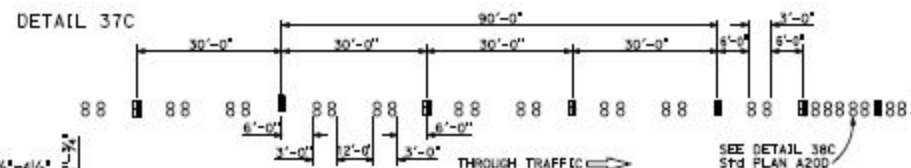
\* The solid channelizing line shown may be omitted on short auxiliary lanes where weaving length is critical.

# LANE DROP AT INTERSECTIONS

DETAIL 37B



DETAIL 37C



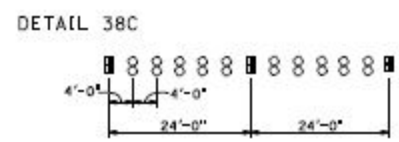
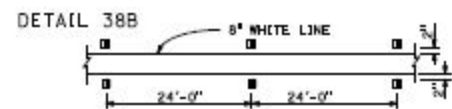
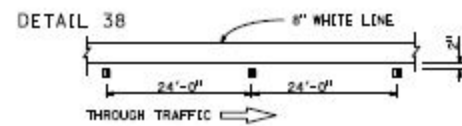
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**PAVEMENT MARKERS  
AND TRAFFIC LINES  
TYPICAL DETAILS**  
NO SCALE

A20C

Return to Table of Contents



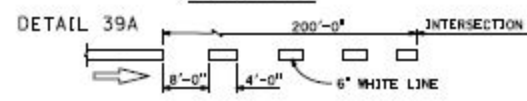
# CHANNELIZING LINE



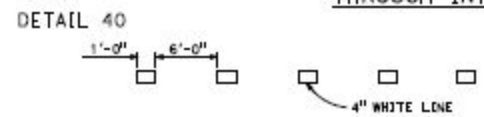
## BIKE LANE LINE



## INTERSECTION LINE BIKE LANE



## LANE LINE EXTENSIONS THROUGH INTERSECTIONS



## CENTER LINE EXTENSIONS THROUGH INTERSECTIONS

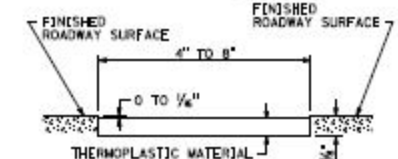
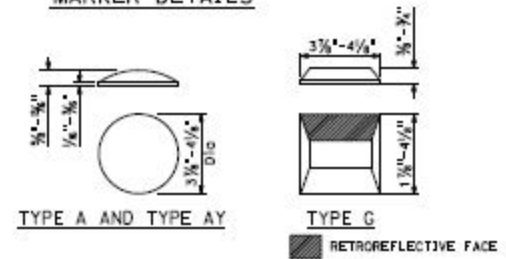


### LEGEND

#### MARKERS

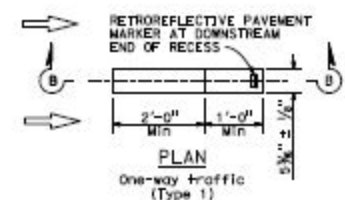
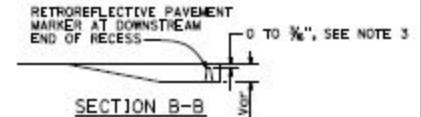
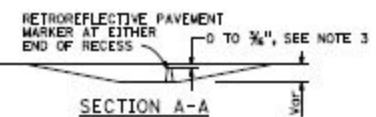
- TYPE A WHITE NON-REFLECTIVE
- TYPE AY YELLOW NON-REFLECTIVE
- TYPE G ONE-WAY CLEAR RETROREFLECTIVE
- ▨ 4" YELLOW LINE

### MARKER DETAILS

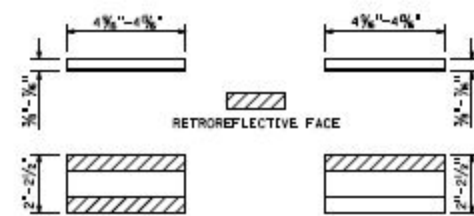


### RECESSED THERMOPLASTIC NOTES

- See typical traffic line details for pavement marking patterns.
- The top of the thermoplastic installed in recessed pavement shall be 0 to 1/8" below the pavement surface.



### RECESS DETAIL FOR RETROREFLECTIVE PAVEMENT MARKER



#### RECESSED MARKER NOTES:

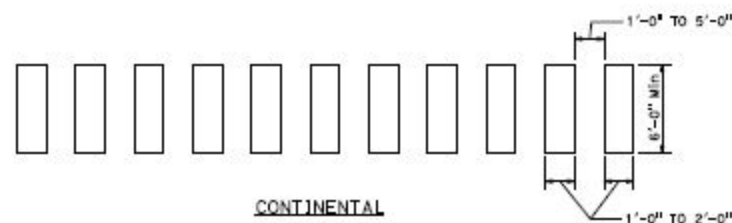
- See typical traffic line details for marker patterns to be used with recessed pavement markers. Detail 14A requires a Type 2 recess.
- The retroreflective pavement markers shown for recessed installations are not to be used for non-recessed installations.
- The top of pavement markers installed in recesses shall be 0 to 3/8" below the pavement surface.

### RETROREFLECTIVE PAVEMENT MARKER FOR RECESSED INSTALLATION

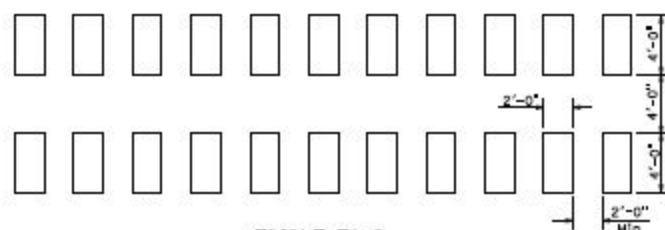
## PAVEMENT MARKERS AND TRAFFIC LINES TYPICAL DETAILS

NO SCALE

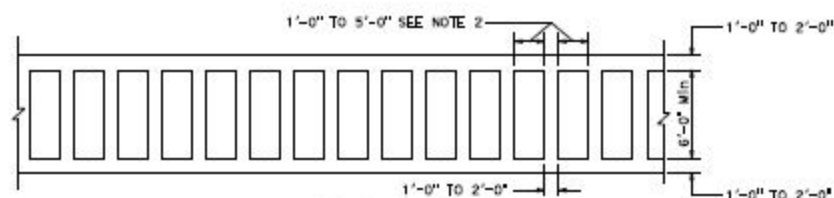
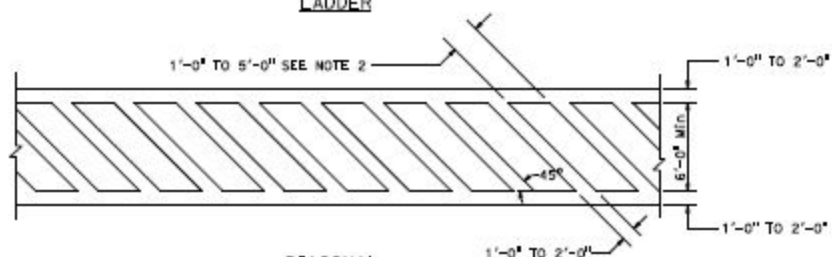
A20D

**CONTINENTAL**

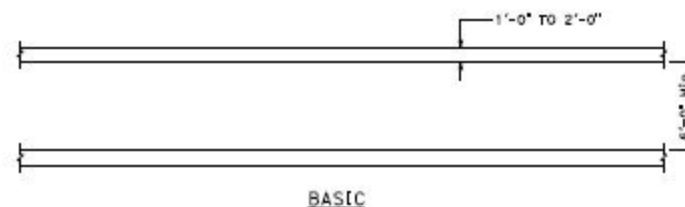
See Note 1

**TRIPLE FOUR**

See Note 1

**LADDER****DIAGONAL****HIGHER VISIBILITY CROSSWALKS****NOTES:**

1. Spaces between markings must be placed in wheel tracks of each lane.
2. Spacings not to exceed 2.5 times width of longitudinal line.
3. All crosswalk markings must be white except those near schools must be yellow.

**BASIC**

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**PAVEMENT MARKINGS  
CROSSWALKS**

NO SCALE

**A24F**

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Atifa Farooq*  
REGISTERED CIVIL ENGINEER

October 30, 2015  
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS  
OF AGENTS SHALL NOT BE RESPONSIBLE FOR  
THE ACCURACY OR COMPLETENESS OF SCANNED  
COPIES OF THIS PLAN SHEET.

Atifa Farooq  
CE-0000  
3-31-17  
SEALED PROFESSIONAL ENGINEER  
STATE OF CALIFORNIA

**ATTACHMENT C**

**OTHER REFERENCED STANDARD PLANS**

© 2006 ENGINEERED PLASTICS  
CONFIDENTIAL AND PROPRIETARY DOCUMENT  
ANY ONE OR MORE OF THE FOLLOWING  
PATENTS MAY APPLY  
U. S. PATENT NO. 5,303,669, 5,775,835,  
6,449,790, AND 6,895,622 BS  
C.D.N. PATENT NO. 2,032,532, 2,070,984  
US PATENTS PENDING.

① KENNETH E. SZEKELY

MATERIAL LIST

#	DESCRIPTION	PART No:	QT'Y
1	ARMOR-TILE	ADA-C-3648W**	1

\*\* COLOR CODE  
YELLOW (YW), RED (RD), BLACK (BK),  
DARK GRAY (DG), LIGHT GRAY (LG),  
WHITE (WH), OCHRE YELLOW (OC),  
BLUE (BL), COLONIAL RED (CR)  
CUSTOM COLORS AVAILABLE

1.	2/27/2013	California Compliance	K.S.
No:	DATE	REVISION	APPR.

SCALE

DESIGNED	BY K.S.	DATE 08/90
DRAWN	D.G.	2/22/2006
CHECKED		

PROJECT MANAGER

TRADE DETECTABLE WARNING SURFACE	PART No: ADA-C-3648W**
-------------------------------------	---------------------------

MATERIAL  
VITRIFIED POLYMER COMPOSITE

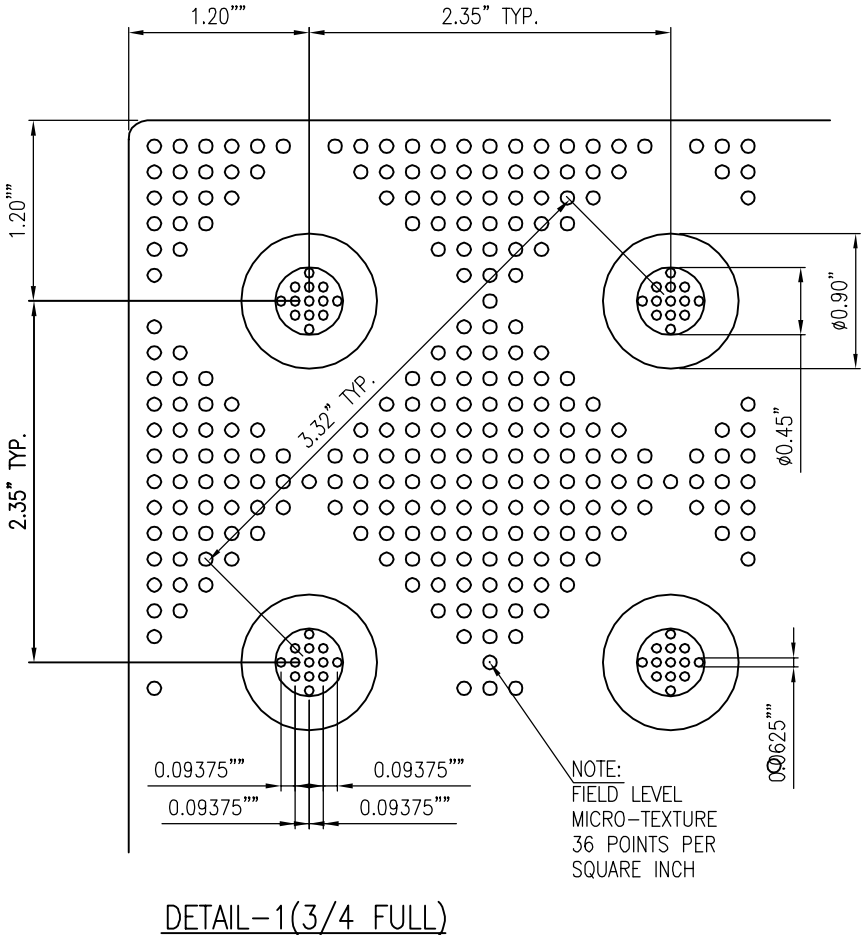
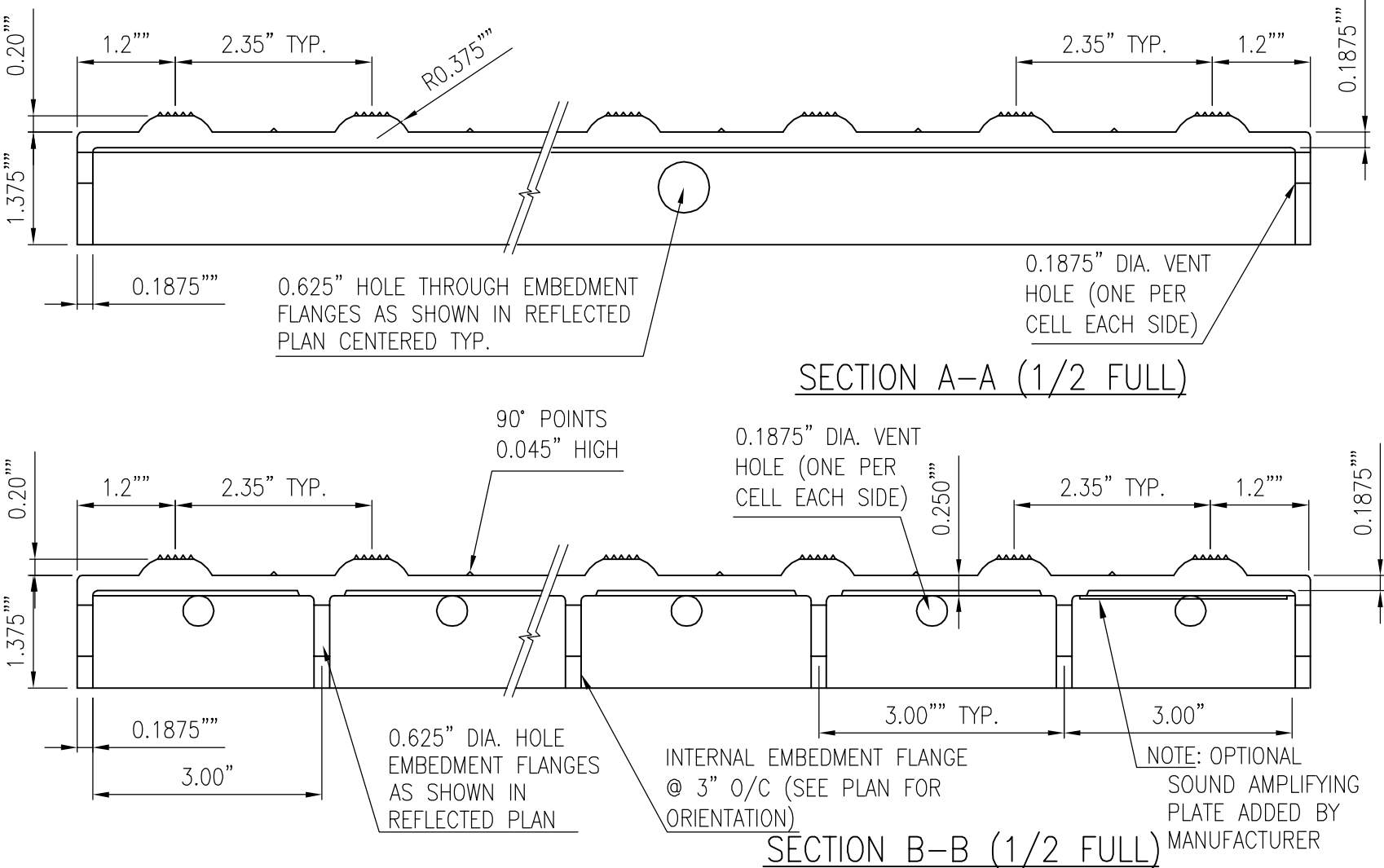
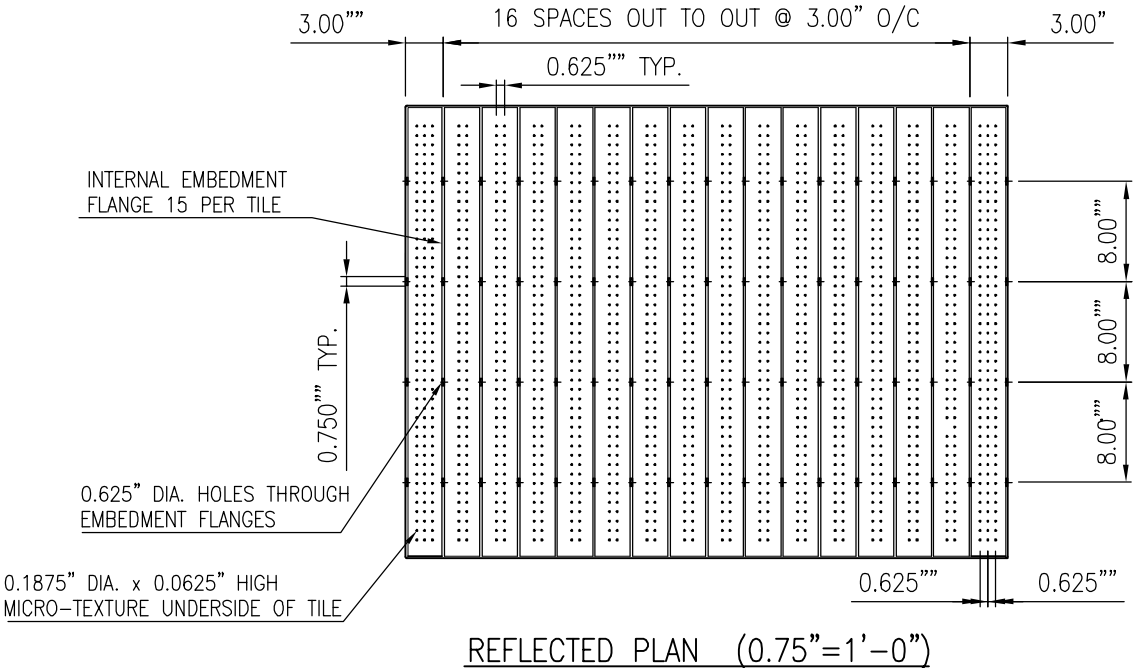
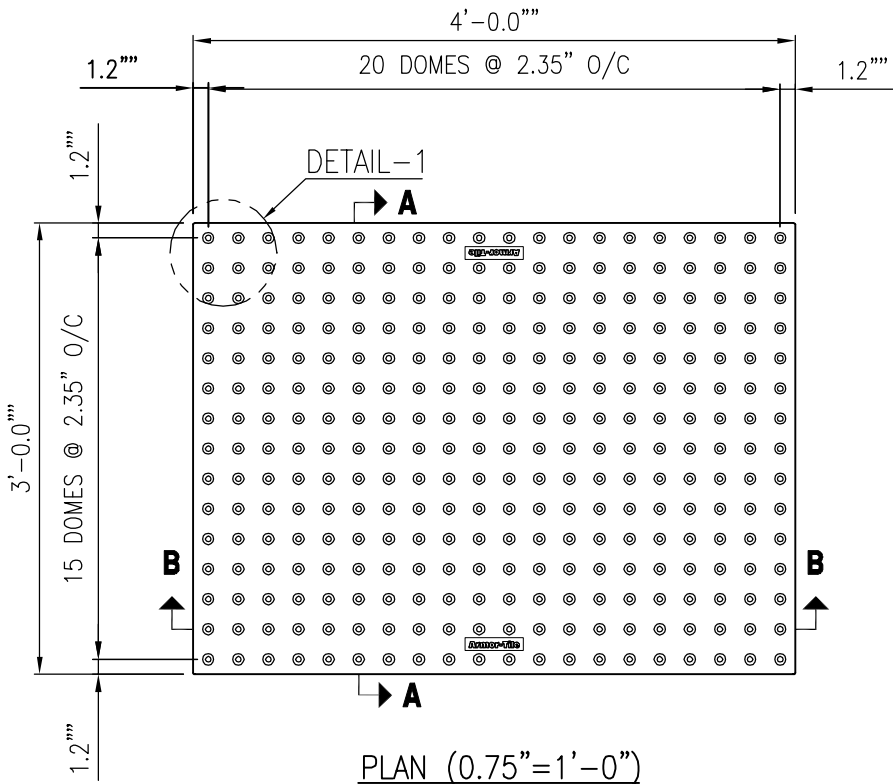
SUBJECT

**Armor-Tile™ ADA**  
SOUND AMPLIFYING DETECTABLE/TACTILE  
WARNING SURFACE TILE

PROJECT

**Armor-Tile™**  
DETECTABLE/TACTILE  
WARNING SURFACE TILE  
36" x 48" CAST IN PLACE  
INLINE DOME TACTILE TILE  
PLANS AND DETAILS

DRAWING No:	REV. No:
ADA-C-3648W	0



**ATTACHMENT D**

**GEOTECHNICAL ENGINEERING REPORTS**

(for reference only – not considered part of Contract Documents)



# Geotechnical Engineering Report

## San Fernando Regional Park Infiltration Project

208 Park Avenue  
San Fernando, California 91340

June 20, 2018  
Terracon Project No. 60185012

**Prepared for:**  
CWE Corporation  
Fullerton, California

**Prepared by:**  
Terracon Consultants, Inc.  
Tustin, California

terracon.com

**Terracon**

Environmental



Facilities



Geotechnical



Materials

June 20, 2018



CWE Corporation  
1561 E. Orangethorpe Avenue, Suite 240  
Fullerton, CA 92831

Attn: Mr. Vik Bapna, P.E.  
Principal  
P: 714-526-7500 ext.212  
E: vbapna@cwecorp.com

Re: **Geotechnical Engineering Report**  
**San Fernando Regional Park Infiltration Project**  
**208 Park Avenue**  
**San Fernando, California 91340**  
**Terracon Project No. 60185012**

Dear Mr. Bapna:

Terracon has completed geotechnical engineering exploration for the proposed infiltration project to be located within the San Fernando Regional Park at 208 Park Avenue, San Fernando, California. The purpose of this study will be to evaluate the pertinent geotechnical conditions at the site and to develop geotechnical parameters which will assist in the design and construction of the planned infiltration systems onsite.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,  
**Terracon Consultants, Inc.**



Sivasubramaniam (Raj) Pirathiviraj, P.E., G.E.  
Senior Engineer



Fouad Fred Buhamdan, P.E.  
Principal



Terracon Consultants, Inc. 1421 Edinger Avenue, Suite C Tustin, California 92780  
P [949] 261 0051 F [949] 261 6110 [terracon.com](http://terracon.com)

Geotechnical



Environmental



Construction Materials



Facilities

**TABLE OF CONTENTS**

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>2</b>
<b>2.0</b>	<b>PROJECT INFORMATION .....</b>	<b>2</b>
<b>3.0</b>	<b>SUBSURFACE CONDITIONS .....</b>	<b>3</b>
3.1	Field Exploration .....	3
3.2	Typical Subsurface Profile .....	4
3.3	Groundwater .....	4
3.4	Percolation Test Results .....	4
<b>4.0</b>	<b>RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION .....</b>	<b>6</b>
4.1	Lateral Earth Pressure .....	6
4.1.2	Cantilevered Shoring Recommendations .....	6
4.1.3	Braced Shoring Recommendations .....	6
4.1.4	Below Grade Structures Considerations .....	7
4.2	Earthwork .....	7
4.3	Utility Trenches .....	8
4.4	Seismic Considerations .....	8
<b>5.0</b>	<b>GENERAL COMMENTS .....</b>	<b>9</b>

**APPENDIX A – FIELD EXPLORATION**

Exhibit A-1	Site Location Plan
Exhibit A-2	Boring Location Diagram
Exhibits A-3 to A-7	Boring Logs

**APPENDIX B – LABORATORY TESTING**

Exhibit B-1	Direct Shear Test
-------------	-------------------

**APPENDIX C – SUPPORTING DOCUMENTS**

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification

**GEOTECHNICAL ENGINEERING REPORT**  
**SAN FERNANDO REGIONAL PARK INFILTRATION PROJECT**  
**208 PARK AVENUE**  
**SAN FERNANDO, CALIFORNIA**  
**Terracon Project No. 60185012**  
**June 20, 2018**

## **1.0 INTRODUCTION**

This report presents the results of our geotechnical engineering services performed for the proposed infiltration project located within San Fernando Regional Park at 208 Park Avenue, San Fernando, California. The Site Location Plan (Exhibit A-1) is included in Appendix A of this report. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- percolation rates
- groundwater conditions
- lateral earth pressures for shoring

Our geotechnical scope of work included the advancement of two (2) test borings to approximate depths of 25.1 and 25.5 feet below existing ground surface (bgs), two (2) percolation borings to approximate depths of 10 and 15 feet bgs and one (1) 20-foot long trench to the depth of about 10 feet bgs.

Logs of the borings along with a Boring Location Diagram (Exhibit A-2) are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

## **2.0 PROJECT INFORMATION**

ITEM	DESCRIPTION
<b>Proposed Systems</b>	This project will include installing an underground premanufactured infiltration/detention system, removing/replacing the existing baseball field and irrigation system. Based on the information provided by CWE, the bottom of infiltration/detention systems is proposed to be at 10 to 15 feet below ground surface.
<b>Location</b>	This project site is located within San Fernando Regional Park at 208 Park Avenue, San Fernando, California.
<b>Existing site features</b>	The project site is an existing baseball field with vegetation
<b>Existing Topography</b>	The project site is relatively level

ITEM	DESCRIPTION
<b>Surrounding developments</b>	Northwest: Park Avenue Southwest: Robert F. Kennedy Drive Northeast: Commercial Building Southeast: Parkside Drive
<b>Current ground cover</b>	The ground within the park is currently covered with landscaping, grass and vegetation

## 3.0 SUBSURFACE CONDITIONS

### 3.1 Field Exploration

The scope of the services performed for this project included site reconnaissance by a field representative, subsurface exploration program, laboratory testing, and engineering analyses for the proposed improvement. Two (2) test borings to approximate depths of 25.1 and 25.5 feet bgs, two (2) percolation borings to approximate depths of 10 and 15 feet bgs and one (1) 20-foot long trench to the depth of about 10 feet bgs were performed on site as shown on Exhibit A-2 in Appendix A. The borings and trench were marked on-site using the site plan, aerial photograph, and a handheld GPS device. The accuracy of the boring locations should only be assumed to the level implied by the method used.

Continuous lithologic logs of the test borings and trench were recorded by our field representative during the drilling operations. At selected intervals, samples of subsurface materials and penetration tests were taken by driving split-spoon or ring-lined barrel samplers. Groundwater conditions were evaluated in the borings at the time of site exploration.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

An automatic hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings and capped with concrete patch prior to the drill crew leaving the site.

Selected soils samples were tested for the following engineering properties:

- |                       |                         |
|-----------------------|-------------------------|
| ■ In-situ Dry Density | ■ In-situ Water Content |
| ■ Sieve Analysis      | ■ Direct Shear Tests    |

### **3.2 Typical Subsurface Profile**

Based on the results of the borings, the subsurface conditions encountered at the project site predominantly medium dense to very dense sand with variable amounts of silt and occasional clay and gravel to the maximum depth explored at 25½ feet bgs. Cobbles and boulders were encountered in the trench within the maximum depth explored at 10 feet bgs.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B. A direct shear test was performed on sandy materials at depth of 2½ feet and indicated an ultimate friction angle of 32° with corresponding cohesion value of 120 psf.

### **3.3 Groundwater**

Groundwater was not encountered in any of the borings at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Lined Pacoima Wash is running near the project site at a distance of about 500 feet southeast of the project site.

Based on the Seismic Hazard Zone Report, the historic high groundwater depth is between 50 and 60 feet bgs<sup>1</sup>.

### **3.4 Percolation Test Results**

Two (2) in-situ percolation tests (using falling head borehole permeability) were performed to approximate depths of 10 and 15 feet bgs. A 2-inch thick layer of gravel was placed in the bottom of each boring after the borings were drilled to investigate the soil profile. A 3-inch diameter perforated pipe was installed on top of the gravel layer in each boring. Gravel was used to backfill between the perforated pipes and the boring sidewall to the top depth of the zone of percolation. The borings were then filled with water for a pre-soak period. At the beginning of each test, the pipes were refilled with water and readings were taken at standardized time intervals. Percolation rates are provided in the following table:

---

<sup>1</sup> Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report 015, Seismic Hazard Zone Report for the San Fernando 7.5-minute Quadrangle, Los Angeles County, California, 1998

TEST RESULTS			
Test Location (depth, feet bgs)	Slowest Measured Percolation Rate (in/hr)	Correlated Infiltration Rate* (in/hr)	Water Head (in)
P-1 (5 to 10 ft)	174	19.8	45
P-2 (10 to 15 ft)	132	12.5	49

\*If the proposed infiltration systems will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The correlated infiltration rates were calculated using the LA County Reduction Factor Method.

Based on our test results, the correlated infiltration rates were found to be greater than 0.3 in/hr between depths of 5 and 15 feet bgs. Since the project site is not located within the liquefaction potential hazard zone, infiltration onsite may be considered feasible.

The field test results are not intended to be design rates. They represent the result of our tests, at the depths and locations indicated, as described above. The design rate should be determined by the designer by applying an appropriate factor of safety. With time, the bottoms of infiltration systems tend to plug with organics, sediments, and other debris. Long term maintenance will likely be required to remove these deleterious materials to help reduce decreases in actual percolation rates.

The percolation test was performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The materials encountered at 10 and 15 feet bgs are very dense. We recommend scarifying the upper 10 inches beneath the proposed infiltration chambers to facilitate infiltration. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located a minimum of 10 feet from any existing or proposed foundation system.



## **4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION**

### **4.1 Lateral Earth Pressure**

#### **4.1.1 Cantilevered Shoring Recommendations**

The lateral earth pressure recommendations herein are applicable to the design of cantilevered shoring system. The lateral earth pressures are based on the free draining level backfill conditions.

The parameters below consider a soil profile of existing sandy soils as backfill materials:

ITEM	VALUE
Active Case Backfill	34 psf/ft
Passive Case	420 psf/ft
At-Rest Case	53 psf/ft
Surcharge Pressure	0.3*(Surcharge)
Ultimate Coefficient of Friction*	0.3

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

The design of any shoring system should consider surcharge loads imposed by the existing buildings and vehicular loads in the vicinity of the shoring. In general, surcharge loads should be considered where they are located within a horizontal distance behind the shoring equal to the height of the shoring.

Surcharge loads acting at the top of the shoring should be applied to the shoring over the backfill as a uniform pressure over the entire shoring height, and should be added to the static earth pressures. Surcharge stresses due to point loads, line loads, and those of limited extent, such as compaction equipment, should be evaluated using elastic theory.

#### **4.1.2 Braced Shoring Recommendations**

For the design of braced shoring, we recommend such shoring be designed using a rectangular-shaped distribution of lateral earth pressure of  $22H$  (in psf) ( $H$  is the total height of excavation).

The design of the shored excavation should be performed by an engineer knowledgeable and experienced with the on-site soil conditions. The contractor should be aware that slope height, slope inclination or excavation depths should in no case exceed those specified in local, state or



federal safety regulations, e.g. OSHA Health and Safety Standards for Excavation, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner or the contractor could be liable for substantial penalties.

#### **4.1.3 Below Grade Structures Considerations**

Based on our understanding of the project, we anticipate that excavations up to 15 feet below existing grade are planned for the construction of the infiltration system. For vertical sided excavations, the excavations will require the use of shoring, bracing or some form of retention to prevent sloughing and caving of the soil into the excavation.

As a safety measure, no equipment should be operated within 5 feet of the edge of the excavation and no materials should be stockpiled within 10 feet of the excavation. Excavations should not approach closer than 10 feet from existing structures/facilities without some form of protection for the facilities. Proper berm or ditch should be performed to divert any surface runoff away from the excavation.

Soils from the pits excavation should not be stockpiled higher than six (6) feet or within ten (10) feet of the edge of an open trench. Construction of open cuts adjacent to existing structures, including underground pipes, is not recommended within a 1½ H:1V plane extending beyond and down from the perimeter of structures. Cuts that are proposed within five (5) feet of light standards, other utilities, underground structures, and pavement should be provided with temporary shoring.

## **4.2 Earthwork**

The recommendations presented are for the design and construction of earth supported elements are contingent upon following the recommendations outlined in this report.

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable. However, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Some additional effort may be necessary to excavate into very dense sand, cobbles, and boulder sized materials. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade.

Underground utility lines may be encountered during construction. Furthermore, evidence of fill materials or underground facilities such as septic tanks, cesspools, and basements was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or utility lines or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

### **4.3 Utility Trenches**

It is anticipated that the on-site soils will provide suitable support for underground utilities and piping that may be installed. Any loose and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 30 is recommended for bedding and shading of utilities, unless otherwise allowed by the utility manufacturer.

On-site materials are considered suitable for backfill of utility and pipe trenches from one foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances. Trench backfill should be mechanically placed and compacted to minimum of 90% of relative compaction per the modified proctor test (ASTM D1557) with moisture contents ranging between -1% and +4% of optimum moisture content. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

### **4.4 Seismic Considerations**

Based on our review of the California Geologic Survey (CGS) maps, the project location is not located within a mapped liquefaction hazard zone. Based on the CGS maps, depth to historic high groundwater depth and the subsurface conditions encountered in the boring logs, liquefaction hazard potential at the site is considered low. The project site is also not located within the Alquist-Priolo (AP) Earthquake Fault Zone.

## **5.0 GENERAL COMMENTS**

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

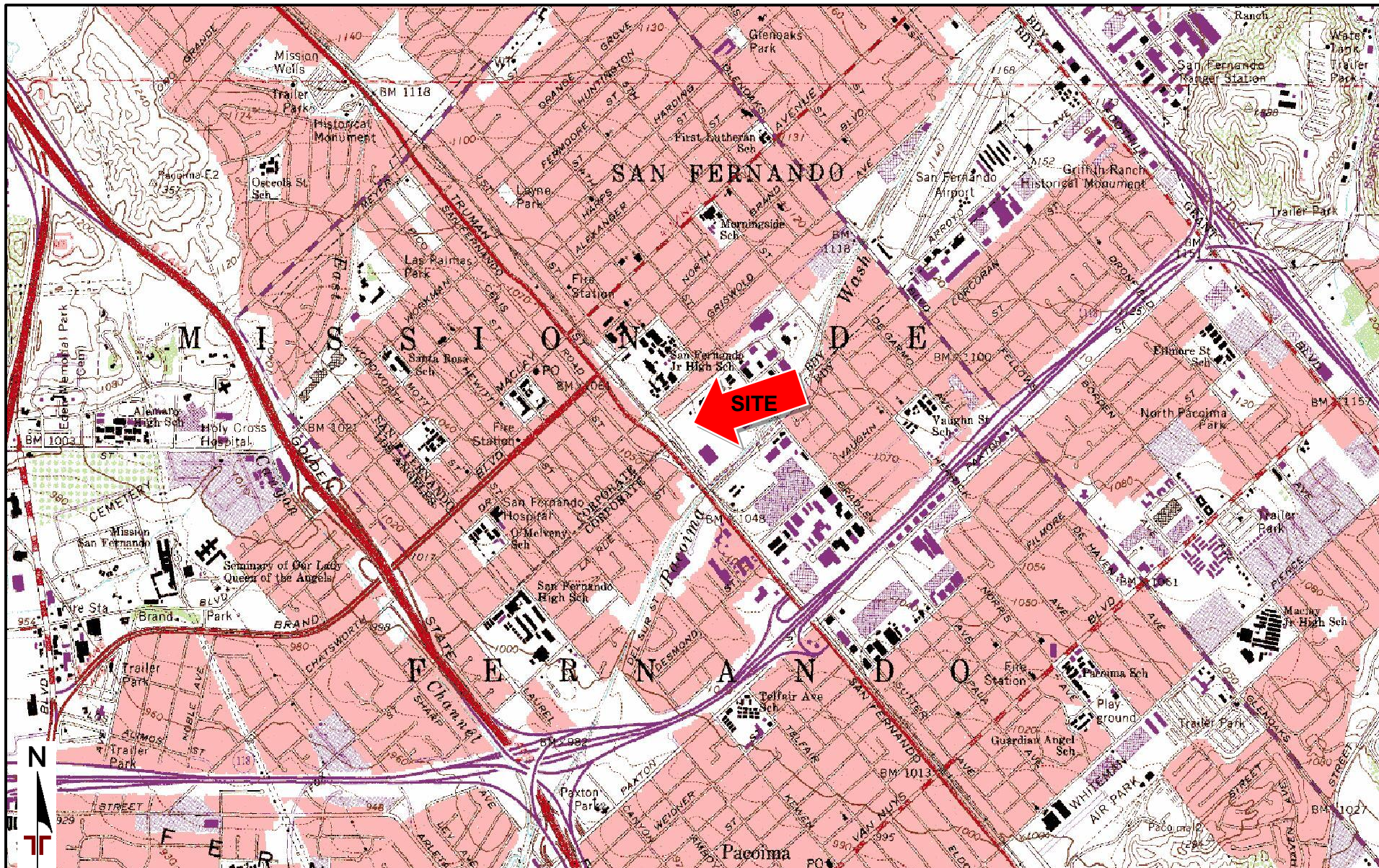
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

**APPENDIX A**  
**FIELD EXPLORATION**





TOPOGRAPHIC MAP IMAGE COURTESY OF  
THE U.S. GEOLOGICAL SURVEY  
QUADRANGLES INCLUDE: SAN FERNANDO,  
CA (1/1/1995).

DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION  
PURPOSES

Project Manager:	SP	Project No.	60185012
Drawn by:	SP	Scale:	1"=2,000'
Checked by:	FFB	File Name:	A-1 & A-2
Approved by:	FFB	Date:	June 2018

**Terracon**

1421 Edinger Ave, Ste C  
Tustin, CA 92780-6287

## SITE LOCATION

San Fernando Regional Park Infiltration Project  
208 Park Avenue  
San Fernando, CA

Exhibit

A-1





AERIAL PHOTOGRAPHY PROVIDED BY  
MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION  
PURPOSES

Project Manager:	SP
Drawn by:	SP
Checked by:	FFB
Approved by:	FFB

Project No.	60185012
Scale:	AS SHOWN
File Name:	A-1 & A-2
Date:	June 2018

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA 92780-6287

## EXPLORATION PLAN

San Fernando Regional Park Infiltration Project  
208 Park Avenue  
San Fernando, CA

Exhibit

A-2


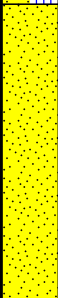
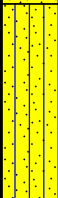
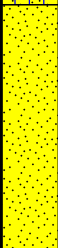
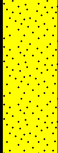
# BORING LOG NO. B-1

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 32.2797° Longitude: -118.4342°  DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
     	<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , brown											12
	2.5	<b>POORLY GRADED SAND (SP)</b> , brown, medium dense			9-10-15				3	104		4
			5			12-12-13 N=25						
		very dense				23-50/6"			4	131		
	10.0	<b>SILTY SAND (SM)</b> , brown, very dense	10			26-36-30 N=66						18
	15.0	<b>POORLY GRADED SAND (SP)</b> , brown, very dense	15			40-50/5"			4	127		
			20			31-40-37 N=77						
	25.1 No recovery <b>Boring Terminated at 25.1 Feet</b>	25			50/1"							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Hollow stem auger	See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Boring backfilled with auger cuttings upon completion.			
<b>WATER LEVEL OBSERVATIONS</b> Groundwater not encountered	 1421 Edinger Ave, Ste C Tustin, CA	Boring Started: 05-15-2018	Boring Completed: 05-15-2018
		Drill Rig: CME 75	Driller:
		Project No.: 60185012	Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_ 60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 6/20/18










# BORING LOG NO. B-2

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 32.2793° Longitude: -118.4347°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTEBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	DEPTH											
	<b>POORLY GRADED SAND (SP)</b> , trace gravel, brown											
2.5												
	<b>CLAYEY SAND (SC)</b> , brown, dense				17-46-48				10	76		45
5.0		5			41-50/4"				2	139		
	<b>SILTY SAND (SM)</b> , trace gravel, brown, very dense											
	dense				10-21-25 N=46							16
	very dense	10			34-50/6"				4	123		
		15			16-27-34 N=61							14
20.0		20			50/3"				6	116		11
	<b>POORLY GRADED SAND WITH CLAY (SP-SC)</b> , brown, very dense											
25.5	trace gravel	25			50/6"							
	<b>Boring Terminated at 25.5 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with auger cuttings upon completion.

See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 05-15-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 05-15-2018

Driller:

Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60185012 BORING LOGS.GPJ TERRACON.DATATEMPLATE.GDT 6/20/18



# BORING LOG NO. P-1

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project


**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.2798° Longitude: -118.4341°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
DEPTH												
	<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, brown	5										7
10.0	<b>Boring Terminated at 10 Feet</b>	10										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Hollow stem auger	See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Boring backfilled with auger cuttings upon completion.			
<b>WATER LEVEL OBSERVATIONS</b> Groundwater not encountered	 <p>1421 Edinger Ave, Ste C Tustin, CA</p>	Boring Started: 05-15-2018	Boring Completed: 05-15-2018
		Drill Rig: CME 75	Driller:
		Project No.: 60185012	Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_ 60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 6/20/18

# BORING LOG NO. P-2

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project


**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.2792° Longitude: -118.4348°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	DEPTH											
	<b>POORLY GRADED SAND (SP)</b> , trace gravel, brown											
		5										
		10.0										
	<b>SILTY SAND (SM)</b> , brown											15
		15.0										
	<b>Boring Terminated at 15 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Hollow stem auger	See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Boring backfilled with auger cuttings upon completion.			
<b>WATER LEVEL OBSERVATIONS</b>	 <p>1421 Edinger Ave, Ste C Tustin, CA</p>	Boring Started: 05-15-2018	Boring Completed: 05-15-2018
Groundwater not encountered		Drill Rig: CME 75	Driller:
		Project No.: 60185012	Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_ 60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 6/20/18


# TEST PIT LOG NO. Trench

Page 1 of 1


**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.2794° Longitude: -118.4346°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	<b>CLAYEY SAND (SC)</b> , brown	1.5										
	<b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , gray	3.0										
	<b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , with cobbles, gray	7.0										
	<b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , with cobbles and boulders, gray	10.0										
Trench is 20 feet long in the northeast-southwest direction along the existing soccer field. The latitude and longitude are to the center of the trench. <b>Test Pit Terminated at 10 Feet</b>												

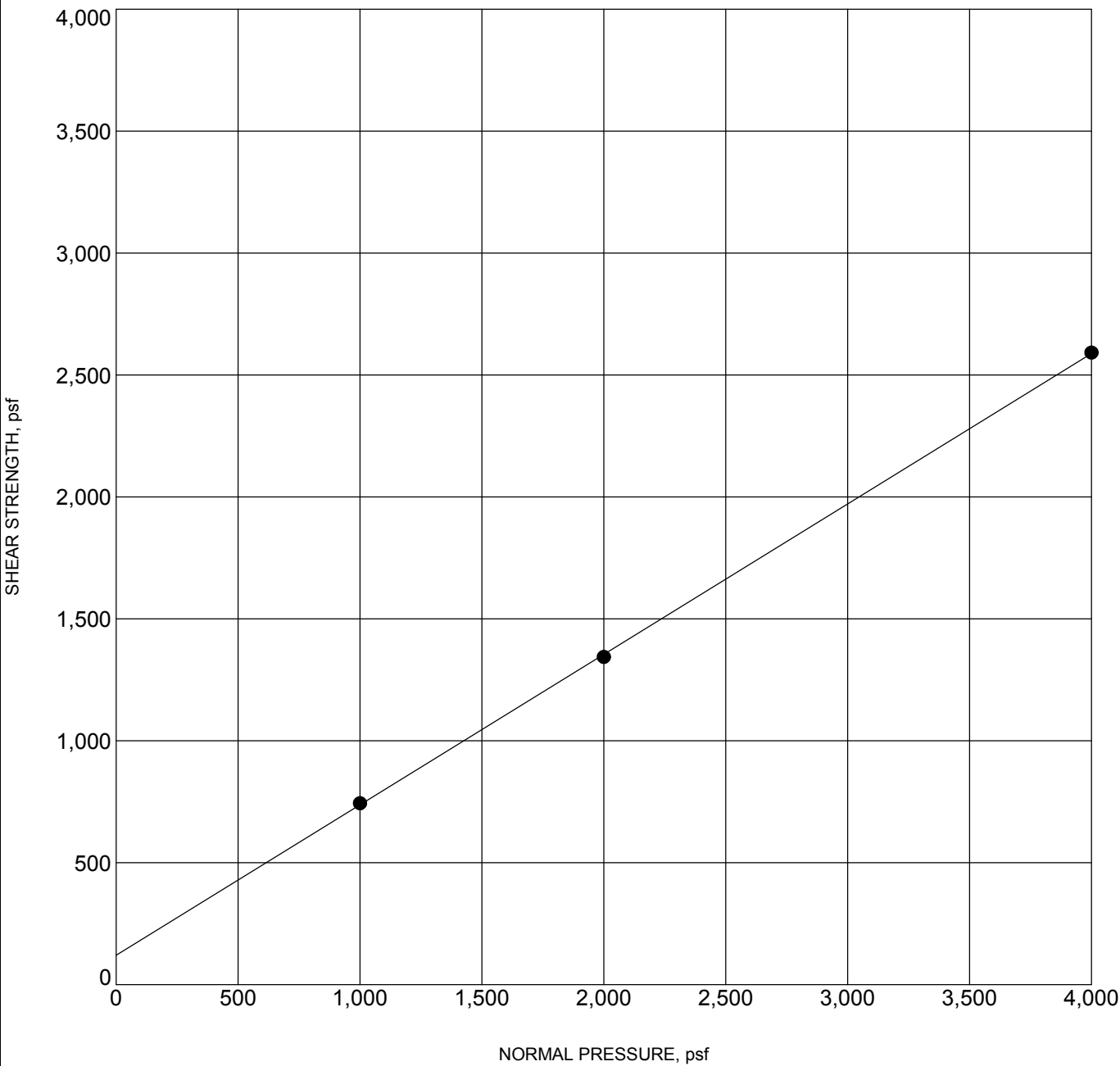
Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Back hoe	See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Boring backfilled with auger cuttings upon completion.			
<b>WATER LEVEL OBSERVATIONS</b> Groundwater not encountered	 1421 Edinger Ave, Ste C Tustin, CA	Test Pit Started: 05-15-2018	Test Pit Completed: 05-15-2018
		Excavator: CME 75	Operator:
		Project No.: 60185012	Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_ 60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 6/20/18

**APPENDIX B**  
**LABORATORY TESTING**

DIRECT SHEAR TEST ASTM D3080



Specimen Identification		Classification	$\gamma_d$ , pcf	WC, %	c, psf	$\phi^\circ$
● B-1	2.5ft	POORLY GRADED SAND SP	104	3	120	32













PROJECT: San Fernando Regional Park Infiltration Project	<div>Terracon</div> <div>1421 Edinger Ave, Ste C Tustin, CA</div>	PROJECT NUMBER: 60185012
SITE: 208 Park Avenue San Fernando, CA		CLIENT: CWE Corporation Fullerton, CA
		EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ...TC\_DIRECT\_SHEAR\_60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 6/19/18

**APPENDIX C**  
**SUPPORTING DOCUMENTS**

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

<b>SAMPLING</b>				<b>WATER LEVEL</b>		Water Initially Encountered	<b>FIELD TESTS</b>	(HP) Hand Penetrometer
						Water Level After a Specified Period of Time		(T) Torvane
						Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)
					Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			N N value
								(PID) Photo-Ionization Detector
								(OVA) Organic Vapor Analyzer
								(WOH) Weight of Hammer

## DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

## LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

<b>STRENGTH TERMS</b>	<b>RELATIVE DENSITY OF COARSE-GRAINED SOILS</b> (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels and sands.			<b>CONSISTENCY OF FINE-GRAINED SOILS</b> (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance Includes silts and clays.		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.
	Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1
	Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4
	Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8
	Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15
	Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30
				Hard	> 8,000	> 30
						> 42

## RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 29
Modifier	> 30

## GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

## RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifier	> 12

## PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

# UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>					Soil Classification	
					Group Symbol	Group Name <sup>B</sup>
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines <sup>C</sup>	Cu ≥ 4 and 1 ≤ Cc ≤ 3 <sup>E</sup>	GW	Well-graded gravel <sup>F</sup>	
			Cu < 4 and/or 1 > Cc > 3 <sup>E</sup>	GP	Poorly graded gravel <sup>F</sup>	
		Gravels with Fines: More than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F,G,H</sup>	
			Fines classify as CL or CH	GC	Clayey gravel <sup>F,G,H</sup>	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines <sup>D</sup>	Cu ≥ 6 and 1 ≤ Cc ≤ 3 <sup>E</sup>	SW	Well-graded sand <sup>I</sup>	
			Cu < 6 and/or 1 > Cc > 3 <sup>E</sup>	SP	Poorly graded sand <sup>I</sup>	
		Sands with Fines: More than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G,H,I</sup>	
			Fines classify as CL or CH	SC	Clayey sand <sup>G,H,I</sup>	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A” line <sup>J</sup>	CL	Lean clay <sup>K,L,M</sup>	
			PI < 4 or plots below “A” line <sup>J</sup>	ML	Silt <sup>K,L,M</sup>	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay <sup>K,L,M,N</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,O</sup>
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay <sup>K,L,M</sup>	
			PI plots below “A” line	MH	Elastic Silt <sup>K,L,M</sup>	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay <sup>K,L,M,P</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,Q</sup>
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

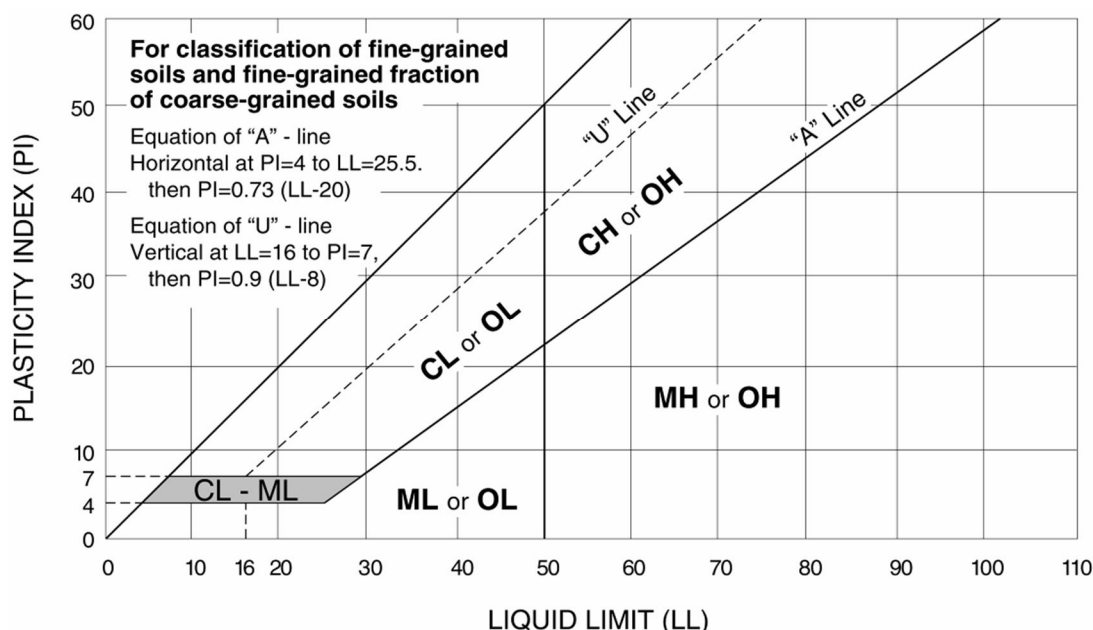
<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup> PI  $\geq 4$  and plots on or above "A" line.

<sup>O</sup> PI < 4 or plots below "A" line.

<sup>P</sup> PI plots on or above "A" line.

<sup>Q</sup> PI plots below "A" line.





# Geotechnical Engineering Report

**San Fernando Regional Park Pipeline Project**

**San Fernando, California**

December 18, 2018

Terracon Project No. 60185012

**Prepared for:**



Fullerton, California

**Prepared by:**

Terracon Consultants, Inc.

Tustin, California

[terracon.com](http://terracon.com)

**Terracon**

Environmental



Facilities



Geotechnical



Materials

December 18, 2018



1561 E. Orangethorpe Ave., Suite 240,  
Fullerton, CA 92831

Attn: Mr. Vik Bapna, P.E.  
Principal  
P: 714-526-7500 ext.212  
E: vbapna@cwecorp.com

**Re: Geotechnical Engineering Report  
San Fernando Regional Park Pipeline  
208 Park Avenue  
San Fernando, California 91340  
Terracon Project No. 60185012**

Dear Mr. Bapna,

Terracon has completed the geotechnical engineering services for the proposed pipeline project near San Fernando Regional Park at 208 Park Avenue, San Fernando, California. These services were performed in general accordance with the email correspondence November 15, 2018.

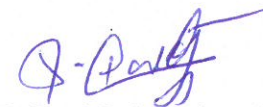
The purpose of our services was to evaluate the pertinent geotechnical conditions at the multiple locations along the proposed alignment and to develop geotechnical parameters which will assist in the design and construction of the proposed storm drain lines.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,  
**Terracon Consultants, Inc.**



  
Joshua R. Morgan, P.E.  
Geotechnical Department Manager

  
for F. Fred Buhamdan, P.E.  
Principal



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Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

**TABLE OF CONTENTS**

<b>EXECUTIVE SUMMARY .....</b>	<b>i</b>
<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 PROJECT INFORMATION .....</b>	<b>1</b>
<b>3.0 SUBSURFACE CONDITIONS .....</b>	<b>2</b>
3.1 Typical Subsurface Profile .....	2
3.2 Groundwater .....	2
3.3 Corrosion Potential .....	3
<b>4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION .....</b>	<b>3</b>
4.1 Geotechnical Considerations .....	3
4.2 Earthwork .....	4
4.2.1 Site Preparation .....	4
4.2.2 Open Trench Construction .....	4
4.2.3 Pipe Trench Subgrade Preparation .....	5
4.2.4 Pipe Bedding .....	5
4.2.5 Fill Materials and Placement .....	5
4.2.6 Compaction Requirements .....	6
4.2.7 Grading and Drainage .....	7
4.2.8 Earthwork Construction Considerations .....	7
4.3 Lateral Earth Pressures .....	7
4.3.1 Cantilevered Shoring Recommendations .....	7
4.3.2 Braced Shoring Recommendations .....	8
4.3.3 Below Grade Structures Considerations .....	8
4.4 Pavements .....	9
4.4.1 Design Recommendations .....	9
4.4.2 Construction Considerations .....	10
<b>5.0 GENERAL COMMENTS .....</b>	<b>10</b>

**APPENDIX A – FIELD EXPLORATION**

Exhibit A-0	Site Location Plan
Exhibit A-1 through A-4	Field Boring Plan
Exhibit A-5	Field Exploration Description
Exhibits A-6 thru A-16	Boring Logs

**APPENDIX B – LABORATORY TESTING**

Exhibit B-1	Laboratory Test Description
Exhibit B-2	Atterberg Test Results
Exhibit B-3	Direct Shear Results
Exhibit B-4	Results of Corrosivity Analyses

**APPENDIX C – SUPPORTING DOCUMENTS**

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification

## **EXECUTIVE SUMMARY**

A geotechnical exploration has been performed for the proposed pipeline project that associated with San Fernando Regional Park, located at 208 Park Avenue, San Fernando, California. Terracon's geotechnical scope of work included the advancement of ten (10) test borings to approximate depths ranging between 15 to 35 feet below the ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is considered suitable for development of the proposed project provided the recommendations included within this report are implemented during the design and construction phases of the project. The following geotechnical considerations were identified:

- Surface conditions at the site consisted of exposed poorly graded sand at one boring locations, and the rest consisted of asphalt pavements with thickness ranging from 2.5 to 7 inches of thickness, overlying aggregate base with thicknesses up to 8 inches. The subsurface materials generally consisted of medium dense to very dense sand with variable amounts of silt and gravel, to the maximum depth explored of 31½ feet bgs. Auger refusal was encountered in boring BP-8 at an approximate depth of 5 feet on cobbles or boulders.
- Groundwater was not encountered in any of the borings. The mapped historic high groundwater depth is between 50 and 60 feet bgs.
- It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Some additional effort may be necessary to excavate into the very dense sand and cobble sized materials. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for this project. Some trench wall instability should be expected throughout the proposed storm drain alignment due to the presence of granular soils with low to no cohesion. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.
- Soils encountered beneath the pavements can generally be used as backfill material for the proposed storm drain pipes, provided they are screened of large particles with dimensions larger than three (3) inches.
- Recommended Asphalt Concrete (AC) and Portland Cement Concrete (PCC) sections are provided for various traffic indices. Pavement section selection should be based on anticipated traffic loading.
- Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

**GEOTECHNICAL ENGINEERING REPORT**  
**SAN FERNANDO REGIONAL PARK PIPELINE PROJECT**  
**MULTIPLE LOCATIONS ON PARK AVENUE,**  
**5<sup>TH</sup> STREET, AND JESSE STREET**  
**SAN FERNANDO, CALIFORNIA**  
Terracon Project No. 60185012  
December 18, 2018

## **1.0 INTRODUCTION**

This report presents the results of our geotechnical engineering services performed for the proposed storm drain pipeline located within San Fernando Regional Park at 208 Park Avenue, San Fernando, California. The Site Location Plan (Exhibit A-1) is included in Appendix A of this report. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- pavement design and construction
- groundwater conditions
- excavation and shoring considerations

Our geotechnical engineering scope of work for this project included the advancement of ten (10) test borings to approximate depths ranging between approximately 5 and 35 feet bgs.

Logs of the borings along with Boring Location Diagrams (Exhibit A-1 through A-4) are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

## **2.0 PROJECT AND SITE INFORMATION**

ITEM	DESCRIPTION
<b>Location</b>	<p>The proposed storm drain is associated with San Fernando Regional Park located at 208 Park Avenue, San Fernando, California.</p> <p>The alignment originates from the park and continues east for approximately ½ mile along Park Avenue, then turns north on 5<sup>th</sup> street and continues for approximately 400 feet to the intersection with Jessie Street. The pipeline alignment then continues east along Jessie street for ¼ mile to the termination point at the intersection with Glenoaks Boulevard.</p>

ITEM	DESCRIPTION
<b>Trench Construction</b>	The proposed storm drain pipes will vary in diameter from 36 to 48 inches. The approximate total linear footage of the alignment is 4,400 linear feet. The anticipated bottom of the proposed pipeline is unknown, but is anticipated to be at variable depths from approximately 5 to 15 feet below ground surface.
<b>Pavement</b>	The project includes the construction of new asphalt concrete (AC) or Portland cement pavements for the new storm drain trench construction.
<b>Current ground cover</b>	Asphalt concrete pavements, Portland cement concrete pavements, Portland cement curb and gutters, and concrete sidewalks.
<b>Existing topography</b>	The proposed alignment is within existing pavements, easements, or right of ways that have been previously graded to relatively flat areas.
<b>Traffic loading</b>	A traffic index (TI) was not provided to Terracon at the time of preparation of this report. We are providing pavement sections for TI values of 5, 6, 7, 8, and 9.
<b>Below grade structures</b>	The proposed project will include excavations to install storm drain pipes at approximate depths of 5 to 15 feet below grade.

### 3.0 SUBSURFACE CONDITIONS

#### 3.1 Typical Subsurface Profile

Specific conditions encountered at the boring locations are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for the borings can be found on the boring logs included in Appendix A. Surface conditions at the site consisted of asphalt pavements with thickness of 2.5 to 7. Aggregate base with thicknesses ranging from 3 to 8 inches was encountered beneath these pavements encountered in borings BP-2 and BP-3 only. The subsurface materials generally consisted of medium-dense to very dense sand with variable amounts of silt and gravel, to the maximum depth explored at 35 feet bgs. Auger refusal was encountered in boring BP-8 at an approximate depth of 5 feet on cobbles or boulders.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B and on the boring logs. Atterberg limit test results indicate that the near surface silty materials exhibit non-plastic to low plasticity. Direct shear test results on a sample obtained at an approximate depth of 5 feet indicate an effective friction angle of 33° with cohesion of approximately 476 psf.

#### 3.2 Groundwater

Groundwater was not encountered to the maximum depth explored of 35 feet bgs. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations.



Based on the Seismic Hazard Zone Report, the historic high groundwater depth is between 50 and 60 feet bgs<sup>1</sup>.

### **3.3 Corrosion Potential**

Results of soluble sulfate testing indicate that ASTM Type I/II Portland cement may be used for all concrete on and below grade. Foundation concrete may be designed for negligible sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

Laboratory test results indicate the on-site soils have a pH of 8.4, a minimum resistivity 3,977 ohm-centimeters, a water soluble sulfate content of 0.01%, Red-Ox potential of +677 mV, negligible sulfides, and a chloride content of 45 mg/kg as shown on the attached Results of Corrosivity Analysis sheet. These values should be used to evaluate corrosive potential of the on-site soils to underground ferrous metals.

Refer to the Results of Corrosivity Analysis sheet in Appendix B for the complete results of the Corrosivity testing conducted in conjunction with this geotechnical exploration.

## **4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION**

### **4.1 Geotechnical Considerations**

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided the geotechnical engineering recommendations contained in this report are implemented in the design and construction of the project. On-site soils should be suitable for use as trench backfill for the proposed storm drain pipes.

Based on the findings summarized in this report, it is our professional opinion that the proposed construction will not be subject to a hazard from settlement, slippage, or landslide, provided the recommendations of our report are incorporated into the proposed construction. It is also our opinion that the proposed construction will not adversely affect the geologic stability of the site or adjacent properties provided the recommendations contained in our report are incorporated into the proposed construction.

Geotechnical engineering recommendations for shoring and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.

---

<sup>1</sup> Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report 015, Seismic Hazard Zone Report for the San Fernando 7.5-minute Quadrangle, Los Angeles County, California, 1998

## **4.2 Earthwork**

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented are for the design and construction of earth supported elements and are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

### **4.2.1 Site Preparation**

Strip and remove existing sidewalk, curb and gutter, pavements and other deleterious materials from the proposed construction areas within the proposed pavements and concrete flatwork.

Subgrade soils beneath pavements, curb, gutter, and sidewalk should be scarified; moisture conditioned, and compacted to a minimum depth of 10 inches. The moisture content and compaction of subgrade soils should be maintained until pavement/flatwork construction.

The bottom of pipe trenches may be surficially compacted such that the trench bottom is level, uniform, firm, unyielding, and free of loose material. Other exposed areas, which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted to a minimum of 90% of the maximum dry density.

### **4.2.2 Open Trench Construction**

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable. However, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Some additional effort may be necessary to excavate into the very dense sand and cobble sized materials. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for this project.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

For the entire storm drain alignment, the subsurface soils consisting of the granular materials can be considered Type C soils when applying the OSHA regulations. OSHA allows a maximum slope



inclination of 1½H:1V for Type C soils in excavations of 20 feet or less. Flatter slopes may be required if caving soils or seepage is encountered in any excavation. If any excavation is extended to a depth of more than 20 feet, it will be necessary to have the side slopes designed by a professional engineer.

Soils from the trench excavation should not be stockpiled higher than six 6 feet or within ten 10 feet of the edge of an open trench. Construction of open cuts adjacent to existing structures, including underground pipes, is not recommended within a 1½ H:1V plane extending beyond and down from the perimeter of the structure. Cuts that are proposed within five 5 feet of light standards, other utilities, underground structures, and pavement should be provided with temporary shoring.

It may be necessary for the contractor to retain a geotechnical engineer to monitor the soils exposed in all excavations and provide engineering services for slopes. This will provide an opportunity to monitor the soils encountered and to modify the excavation slopes as necessary. It also offers an opportunity to verify the stability of the excavation slopes during construction.

#### **4.2.3 Pipe Trench Bottom Preparation**

Any loose and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material. The pipe subgrade should be level, uniform, firm, unyielding, and free of loose material. Pipe subgrade should also be properly graded to provide uniform bearing and support to the entire section of the pipe, over size particles larger than 2 inches in the largest dimension should be removed from the trench bottom and replaced with compacted materials.

#### **4.2.4 Pipe Bedding**

Bedding is defined as the material supporting and surrounding the pipe to 12 inches above the pipe. To provide uniform and firm support for the pipe, compacted granular materials such as clean sand may be used as pipe bedding material. The type and thickness of the granular bedding placed underneath and around the pipe, if any, should be selected by the pipe manufacturer or design. Care should be taken to densify the bedding material below the spring line of the pipe. Pipe design generally requires a granular material with a sand equivalent (SE) greater than 30.

The silty sands and poorly graded sands encountered are anticipated to be suitable as pipe bedding materials, provided they are screened and oversized particles are removed. During construction these stockpiled soils should be tested for conformance with the sand equivalent requirements set forth by the pipe manufacturer.

#### **4.2.5 Fill Materials and Placement**

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

The on-site materials are considered suitable for use as trench backfill on the project, provided they are screened of large particles with dimensions larger than three (3) inches. Imported soils for use as fill material over the proposed pipes should conform to low volume change materials as indicated in the following specifications:

<b><u>Gradation</u></b>	<b><u>Percent Finer by Weight (ASTM C 136)</u></b>
3" .....	100
No. 4 Sieve .....	50-100
No. 200 Sieve .....	10-50
■ Liquid Limit .....	20 (max)
■ Plasticity Index .....	10 (max)
■ Maximum expansive index* .....	20 (max)

\*ASTM D 4829

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed ten inches loose thickness.

#### **4.2.6 Compaction Requirements**

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

<b>Material Type and Location</b>	<b>Per the Modified Proctor Test (ASTM D 1557)</b>		
	<b>Minimum Compaction Requirement (%)</b>	<b>Range of Moisture Contents for Compaction</b>	
		<b>Minimum</b>	<b>Maximum</b>
On-site soils or approved imported fill soils:			
Beneath asphalt pavements:	95	-1%	+3%
Trench backfill:	95	-1%	+3%
Beneath concrete pavements:	95	-1%	+3%
Areas to receive fill*:	90	-1%	+3%
Aggregate base (beneath pavements):	95	-2%	+2%

\* The bottom of pipe trenches may be surficially compacted such that the trench bottom is level, uniform, firm, unyielding, and free of loose material

The contractor should select the equipment and processes to be used to achieve the specified density without damage to adjacent ground, structures, utilities and completed work. It should be the responsibility of the contractor to maintain safe working conditions during all phases of construction.

#### **4.2.7 Grading and Drainage**

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches should be prevented during construction. Backfill in utility trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

#### **4.2.8 Earthwork Construction Considerations**

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to pavement construction.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through March) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork may require additional mitigation measures beyond that which would be expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic. Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

### **4.3 Lateral Earth Pressures**

#### **4.3.1 Cantilevered Shoring Recommendations**

In order to control sand caving during excavations, it is likely that cantilevered shoring systems such as soldier piles with driven steel plates, will be required to support the soils prior to excavation. We recommend consulting with a specialty contractor and obtain a unit price for such shoring systems.

The lateral earth pressure recommendations herein are applicable to the design of cantilevered shoring system. The lateral earth pressures are based on the free draining level backfill conditions.

The parameters below consider a soil profile of existing sandy soils as backfill materials:

ITEM	VALUE
Active Case Backfill	34 psf/ft
Passive Case	420 psf/ft
At-Rest Case	53 psf/ft
Surcharge Pressure	0.3*(Surcharge)
Ultimate Coefficient of Friction	0.4

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

The design of any shoring system should consider surcharge loads imposed by existing buildings and vehicular loads in the vicinity of the shoring. In general, surcharge loads should be considered where they are located within a horizontal distance behind the shoring equal to the height of the shoring.

Surcharge loads acting at the top of the shoring should be applied to the shoring over the backfill as a uniform pressure over the entire shoring height, and should be added to the static earth pressures. Surcharge stresses due to point loads, line loads, and those of limited extent, such as compaction equipment, should be evaluated using elastic theory.

#### **4.3.2 Braced Shoring Recommendations**

For the design of braced shoring, we recommend such shoring be designed using a rectangular-shaped distribution of lateral earth pressure of  $22H$  (in psf) ( $H$  is the total height of excavation).

The design of the shored excavation should be performed by an engineer knowledgeable and experienced with the on-site soil conditions. The contractor should be aware that slope height, slope inclination or excavation depths should in no case exceed those specified in local, state or federal safety regulations, e.g. OSHA Health and Safety Standards for Excavation, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner or the contractor could be liable for substantial penalties.

#### **4.3.3 Below Grade Structures Considerations**

Based on our understanding of the project, we anticipate that excavations up to 15 feet below existing grade are planned for the construction of proposed storm water piping. For vertical sided excavations, the excavations will require the use of shoring, bracing or some form of retention to prevent sloughing and caving of the soil into the excavation.

As a safety measure, no equipment should be operated within 5 feet of the edge of the excavation and no materials should be stockpiled within 10 feet of the excavation. Excavations should not approach closer than 10 feet from existing structures/facilities without some form of protection for the facilities. Proper berm or ditch should be performed to divert any surface runoff away from the excavation.

## 4.4 Pavements

### 4.4.1 Design Recommendations

A correlated design R-Value of 50 was used to calculate asphalt concrete pavement sections for several Traffic Indices (TI). A modulus of subgrade reaction value (k) of 250 pounds per cubic inch (pci) was used in calculating the portland cement concrete pavement sections. R-value testing should be completed prior to pavement construction to verify the design R-value.

Assuming the pavement subgrades will be prepared as recommended within this report, the following pavement sections should be considered minimums for this project for the traffic indices assumed in the table below. As more specific traffic information becomes available, we should be contacted to reevaluate the pavement calculations.

	Recommended Pavement Section Thickness (inches) <sup>a,b</sup>				
	TI = 5.0	TI = 6.0	TI = 7.0	TI = 8.0	TI = 9.0
<u>Section I</u> Portland Cement Concrete	5.0" Plain Jointed Concrete	6.0" Plain Jointed Concrete	6.5" Plain Jointed Concrete	7.0" Plain Jointed Concrete	8.0" Plain Jointed Concrete
<u>Section II</u> Asphaltic Concrete	3" Asphaltic Concrete over 4" Class II Aggregate Base	3" Asphaltic Concrete over 5" Class II Aggregate Base	4" Asphaltic Concrete over 5" Class II Aggregate Base	4" Asphaltic Concrete over 7" Class II Aggregate Base	5" Asphaltic Concrete over 7" Class II Aggregate Base

<sup>a</sup>All materials should meet the CALTRANS Standard Specifications for Highway Construction.

<sup>b</sup>All pavement subgrades should be scarified a minimum depth of 10 inches, moisture conditioned and compacted.

These pavement sections are considered minimal sections based upon the expected traffic and the existing subgrade conditions. However, they are expected to function with periodic maintenance and overlays if good drainage is provided and maintained.

All concrete for rigid pavements should have a minimum flexural strength of 600 psi (4,500 psi compressive strength), and be placed with a maximum slump of four inches. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

#### **4.4.2 Construction Considerations**

Materials and construction of pavements for the project should be in accordance with the requirements and specifications of the State of California Department of Transportation, or other approved local governing specifications.

Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Preventative maintenance should be planned and provided for through an on-going pavement management program in order to enhance future pavement performance. This consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

## **5.0 GENERAL COMMENTS**

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

**APPENDIX A**  
**FIELD EXPLORATION**





## LEGEND

- OUTLINE OF PROJECT SITE
- SHEETS A-1 THROUGH A-4

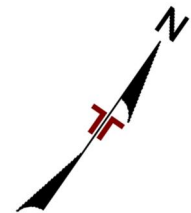


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	SP	Project No.	60185012
Drawn by:	DB	Scale:	1" = 170'
Checked by:	SP	File Name:	PLANS
Approved by:	FFB	Date:	November 2018

**Terracon**  
Consulting Engineers & Scientists

1421 Edinger Avenue, Ste C Tustin, CA 92780  
PH. (949) 261-0051 FAX. (949) 261-6110

## EXPLORATION PLAN

**San Fernando Regional Park Infiltration Project**  
208 Park Avenue  
San Fernando, California

Exhibit

A-0





## LEGEND




BP-1

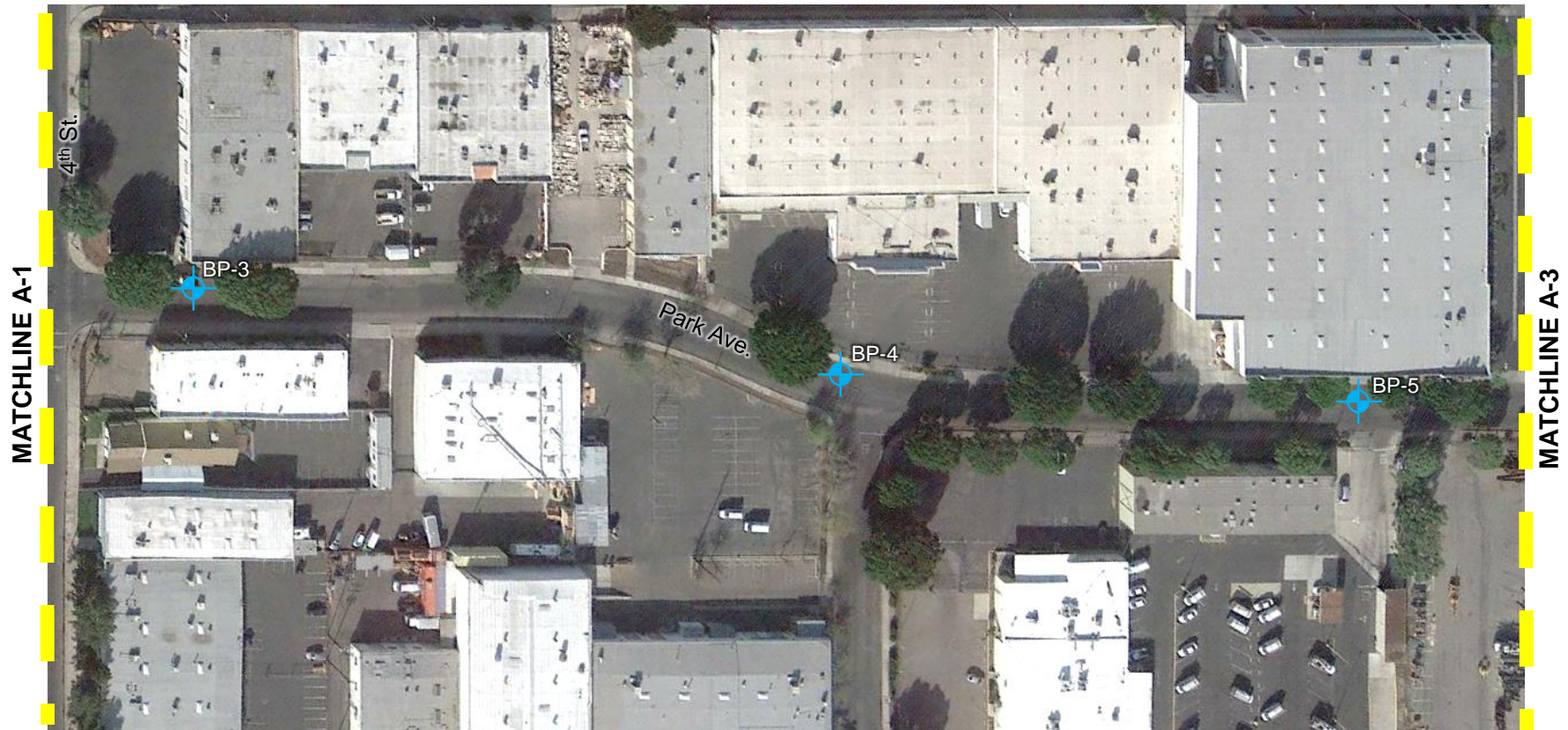
APPROXIMATE BORING LOCATION



DIAGRAM IS FOR GENERAL LOCATION  
ONLY, AND IS NOT INTENDED FOR  
CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185012	 <p>1421 Edinger Avenue, Ste C Tustin, CA 92780 PH. (949) 261-0051 FAX. (949) 261-6110</p>	EXPLORATION PLAN	Exhibit
Drawn by: DB	Scale: 1" = 60'		<b>San Fernando Regional Park Infiltration Project</b> 208 Park Avenue San Fernando, California	<b>A-1</b>
Checked by: SP	File Name: PLANS			
Approved by: FFB	Date: November 2018			





# **LEGEND**



BP-1

APPROXIMATE BORING LOCATION



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	SP	Project No.	60185012
Drawn by:	DB	Scale:	1" = 50'
Checked by:	SP	File Name:	PLANS
Approved by:	FFB	Date:	November 2018

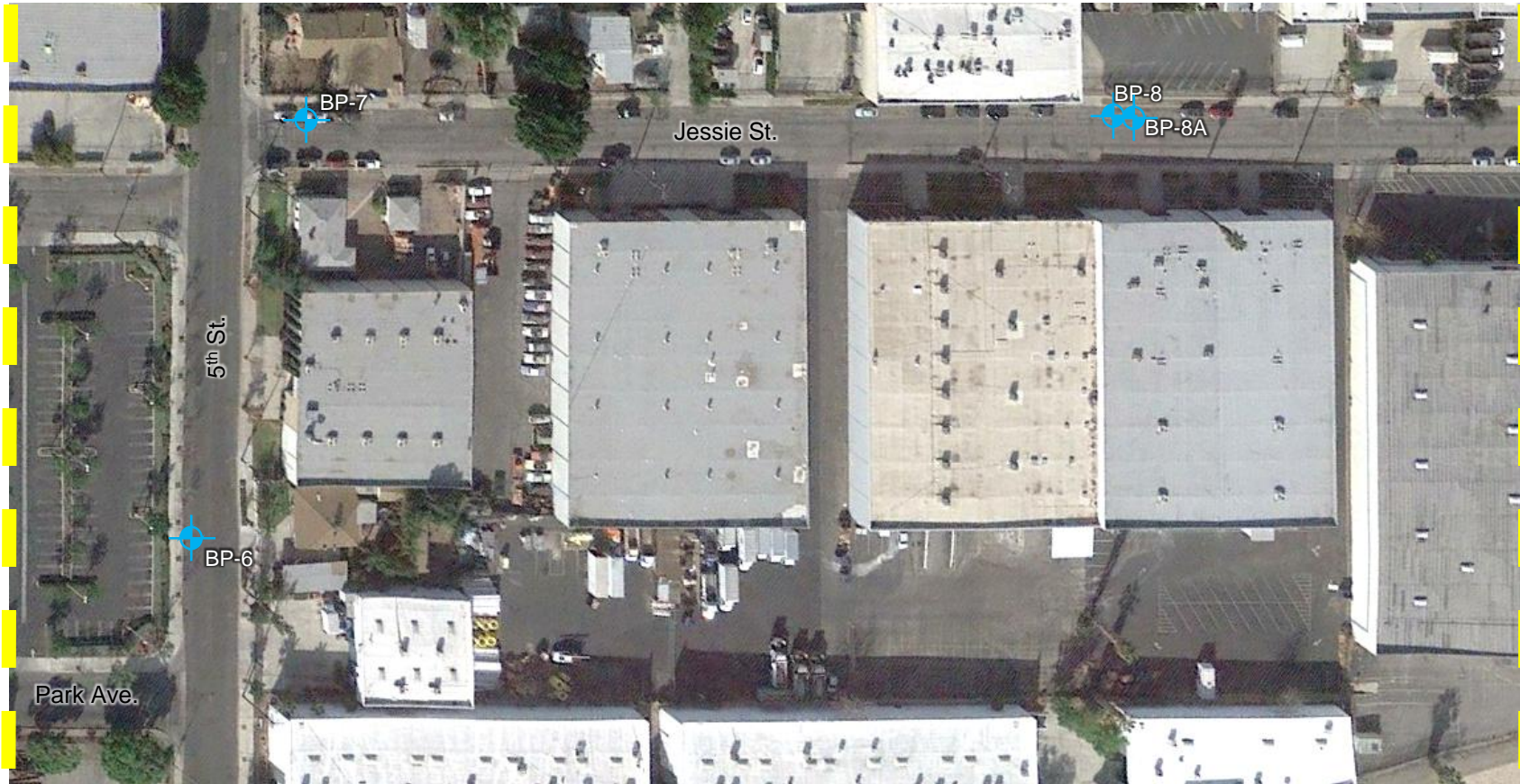
	
1421 Edinger Avenue, Ste C PH. (949) 261-0051	Tustin, CA 92780 FAX. (949) 261-6110

EXPLORATION PLAN
<b>San Fernando Regional Park Infiltration Project</b> 208 Park Avenue San Fernando, California

Exhibit
A-2

MATCHLINE A-2

MATCHLINE A-4



### LEGEND



BP-1

APPROXIMATE BORING LOCATION

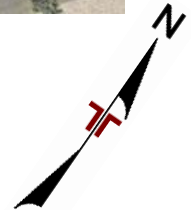


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	SP	Project No.	60185012
Drawn by:	DB	Scale:	1" = 50'
Checked by:	SP	File Name:	PLANS
Approved by:	FFB	Date:	November 2018

**Terracon**  
Consulting Engineers & Scientists

1421 Edinger Avenue, Ste C Tustin, CA 92780  
PH. (949) 261-0051 FAX. (949) 261-6110

EXPLORATION PLAN
<b>San Fernando Regional Park Infiltration Project</b> 208 Park Avenue San Fernando, California

Exhibit
<b>A-3</b>



MATCHLINE A-3



# **LEGEND**



BP-1

APPROXIMATE BORING LOCATION

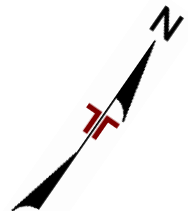



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185012	 <p>1421 Edinger Avenue, Ste C Tustin, CA 92780 PH. (949) 261-0051 FAX. (949) 261-6110</p>	EXPLORATION PLAN	Exhibit
Drawn by: DB	Scale: 1" = 40'		<b>San Fernando Regional Park Infiltration Project</b> 208 Park Avenue San Fernando, California	A-4
Checked by: SP	File Name: PLANS			
Approved by: FFB	Date: November 2018			

## **Field Exploration Description**

A total of ten (10) test borings were drilled at the site on November 28 and December 3, 2018. The borings were drilled to approximate depths ranging between 15 to 35 feet bgs at the approximate locations shown on the attached Boring Location Diagrams, Exhibit A-0 through A-4. Test borings were advanced with a truck-mounted CME 75 drill rig utilizing 8-inch diameter hollow-stem augers.

The borings were located in the field by using the proposed site plan, aerial photographs of the site, and measuring from existing site features. The accuracy of boring locations should only be assumed to the level implied by the method used.

Continuous lithologic logs of the borings were recorded by the field engineer during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers. Bulk samples of subsurface materials were also obtained. Groundwater conditions were evaluated in the borings at the time of site exploration.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

An automatic hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

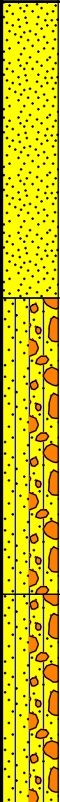
# BORING LOG NO. BP-1

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 34.2804° Longitude: -118.4352°  DEPTH	DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	<b>POORLY GRADED SAND (SP)</b> , trace sand, trace gravel, dark brown   <											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with auger cuttings upon completion.

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 12-03-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 12-03-2018

Driller: Martini Drilling

Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 12/18/18

# BORING LOG NO. BP-2

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 34.2818° Longitude: -118.4336°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES	
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI		
 0.3 1.0 5.0 16.5	DEPTH												
	<b>ASPHALT</b> , 4" thickness												
	<b>AGGREGATE BASE COURSE</b> , 8" thickness												
	<b>SILTY SAND (SM)</b> , trace gravel, dark brown												
	<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, very dense, no Recovery	5				50/4"							
	trace gravel, brown/black				17-50/5"								
		10			29-50/5"				2	114			
		15			21-29-47 N=76								
<b>Boring Terminated at 16.5 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 12-03-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 12-03-2018

Driller: Martini Drilling

Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 12/18/18

# BORING LOG NO. BP-3

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2827° Longitude: -118.4323°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	<b>DEPTH</b> 0.3' <b>ASPHALT</b> , 4" thickness 0.6' <b>AGGREGATE BASE COURSE</b> , 3" thickness <b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, brown  medium dense  very dense  15.3' no recovery											
		5			19-18-27				1			
					9-30-26 N=56							11
		10			45-50/2"				4	103		
		15			50/4"							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 12-03-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 12-03-2018

Driller: Martini Drilling

Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_60185012 BORING LOGS.GPJ TERRACON DATATEMPLATE.GDT 12/18/18



# BORING LOG NO. BP-4

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2834° Longitude: -118.4309°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	0.3' <b>ASPHALT</b> , 4" thickness											
	<b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , brown											
	very dense	5			23-38-50/4"				2	120		
	7.5' <b>SILTY SAND (SM)</b> , trace gravel, brown, medium dense				15-7-10 N=17							
	very dense, no recovery	10			35-50/5"							
	15.0' <b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , brown, dense	15			20-25-19 N=44							
	16.5' <b>Boring Terminated at 16.5 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 12-03-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 12-03-2018

Driller: Martini Drilling

Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 12/18/18


# BORING LOG NO. BP-5

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2842° Longitude: -118.4298°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH 0.3 <b>ASPHALT</b> , 4" thickness											
	<b>POORLY GRADED SAND WITH GRAVEL (SP)</b> , brown											
	dense	5			23-31-50				1	131		
					15-23-18 N=41							
	very dense	10			31-50				1			
	15.9	15			34-50/5"							
	<b>Boring Terminated at 15.9 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 12-03-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 12-03-2018

Driller: Martini Drilling

Exhibit: A-10

# BORING LOG NO. BP-6

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 34.2849° Longitude: -118.4294°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS		PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI		
DEPTH													
	0.6 <b>ASPHALT</b> , 7" thickness												
	<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, light brown												
	5.0	5			50/2"								
	very dense												
	dense	10			20-46-37				5	122			
	tan, very dense, little sample recovered	15			50/5"								
	<b>Boring Terminated at 15.4 Feet</b>												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 11-28-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 11-28-2018

Driller: Martini Drilling

Exhibit: A-11

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 12/18/18

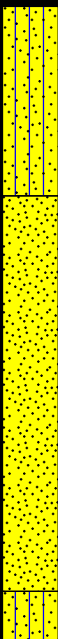
# BORING LOG NO. BP-7

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2  Latitude: 34.2856° Longitude: -118.4299°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	DEPTH											
	0.2' <b>ASPHALT</b> , 2.5" thickness											
	<b>SILTY SAND (SM)</b> , trace sand, trace gravel, brown											
	5.0' <b>POORLY GRADED SAND (SP)</b> , trace gravel, brown, medium dense	5			11-11-16			2	123		5	
	light brown, very dense	10			6-23-27 N=50							
15.0' <b>SILTY SAND (SM)</b> , trace gravel, brown, very dense	15			11-28-50/4"			3	129				
16.3'	<b>Boring Terminated at 16.3 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 11-28-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 11-28-2018

Driller: Martini Drilling

Exhibit: A-12

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_60185012 BORING LOGS.GPJ TERRACON DATATEMPLATE.GDT 12/18/18

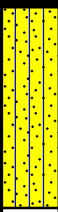
# BORING LOG NO. BP-8

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2867° Longitude: -118.4285°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	0.3											
	5.3											
	ASPHALT, 3" thickness											
	SILTY SAND (SM), trace gravel, brown											
					5-10-30				6	120		
					50/4"							
	large piece of gravel encountered in sample, no recovery											
	Auger Refusal at 5.3 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 11-28-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 11-28-2018

Driller: Martini Drilling

Exhibit: A-13

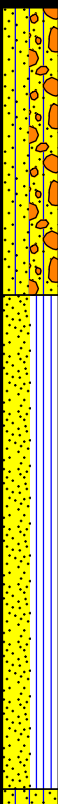
# BORING LOG NO. BP-8A

Page 1 of 1

**PROJECT:** San Fernando Regional Park Infiltration Project

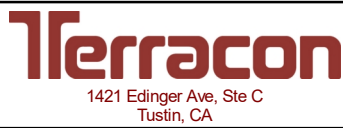
**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2867° Longitude: -118.4285°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	0.3' <b>ASPHALT</b> , 3" thickness											
	<b>SILTY SAND WITH GRAVEL (SM)</b> , brown, very dense											
		5			26-50/5"				5	95		
	7.5' <b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, light brown, dense				15-18-25 N=43							
	very dense	10			21-50/5"				3	133		
		15			24-50/4"							
	20.0'											
	20.8' <b>SILTY SAND (SM)</b> , trace gravel, light brown, very dense	20			26-50/3"				3	119		
	<b>Boring Terminated at 20.8 Feet</b>											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Hollow stem auger	See Exhibit A-5 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Boring backfilled with Auger Cuttings Surface capped with asphalt			
<b>WATER LEVEL OBSERVATIONS</b> Groundwater not encountered		Boring Started: 11-28-2018	Boring Completed: 11-28-2018
		Drill Rig: CME 75	Driller: Martini Drilling
		Project No.: 60185012	Exhibit: A-14

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60185012 BORING LOGS.GPJ TERRACON DATATEMPLATE.GDT 12/18/18

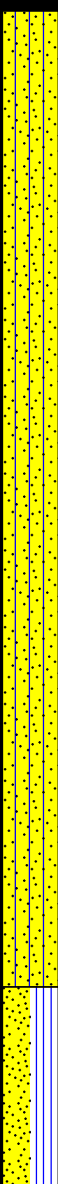
# BORING LOG NO. BP-9

Page 1 of 2

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2878° Longitude: -118.427°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	0.3											
	ASPHALT, 4" thickness											
	SILTY SAND (SM), brown											26
	trace gravel, medium dense				12-15-15				5	129		
	very dense	5			3-12-50/4"							16
	medium dense	10			12-15-11				4	105		
	light brown, very dense	15			17-33-36 N=69							12
	trace gravel, trace clay	20			50				3	130		
		25.0										
	POORLY GRADED SAND WITH SILT (SP-SM), trace gravel, very dense	25			22-50/3"							
		30										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with auger cuttings upon completion.

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 11-28-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 11-28-2018

Driller: Martini Drilling

Exhibit: A-15


# BORING LOG NO. BP-9

Page 2 of 2

**PROJECT:** San Fernando Regional Park Infiltration Project

**CLIENT:** CWE Corporation  
Fullerton, CA

**SITE:** 208 Park Avenue  
San Fernando, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.2878° Longitude: -118.427°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
	DEPTH											
	POORLY GRADED SAND WITH SILT (SP-SM), trace gravel, very dense (continued) no recovery				47-50/3"							
	35.1 no recovery <b>Boring Terminated at 35.1 Feet</b>	35			50/1"							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
Hollow stem auger

Abandonment Method:  
Boring backfilled with auger cuttings upon completion.

See Exhibit A-5 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

## WATER LEVEL OBSERVATIONS

Groundwater not encountered

**Terracon**  
1421 Edinger Ave, Ste C  
Tustin, CA

Boring Started: 11-28-2018

Drill Rig: CME 75

Project No.: 60185012

Boring Completed: 11-28-2018

Driller: Martini Drilling

Exhibit: A-16



**APPENDIX B**  
**LABORATORY TESTING**

## Geotechnical Engineering Report

San Fernando Regional Park Pipeline Project ■ San Fernando, CA

December 18, 2018 ■ Terracon Project No. 60185012



### Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

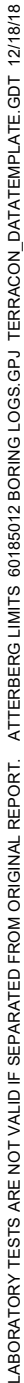
Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

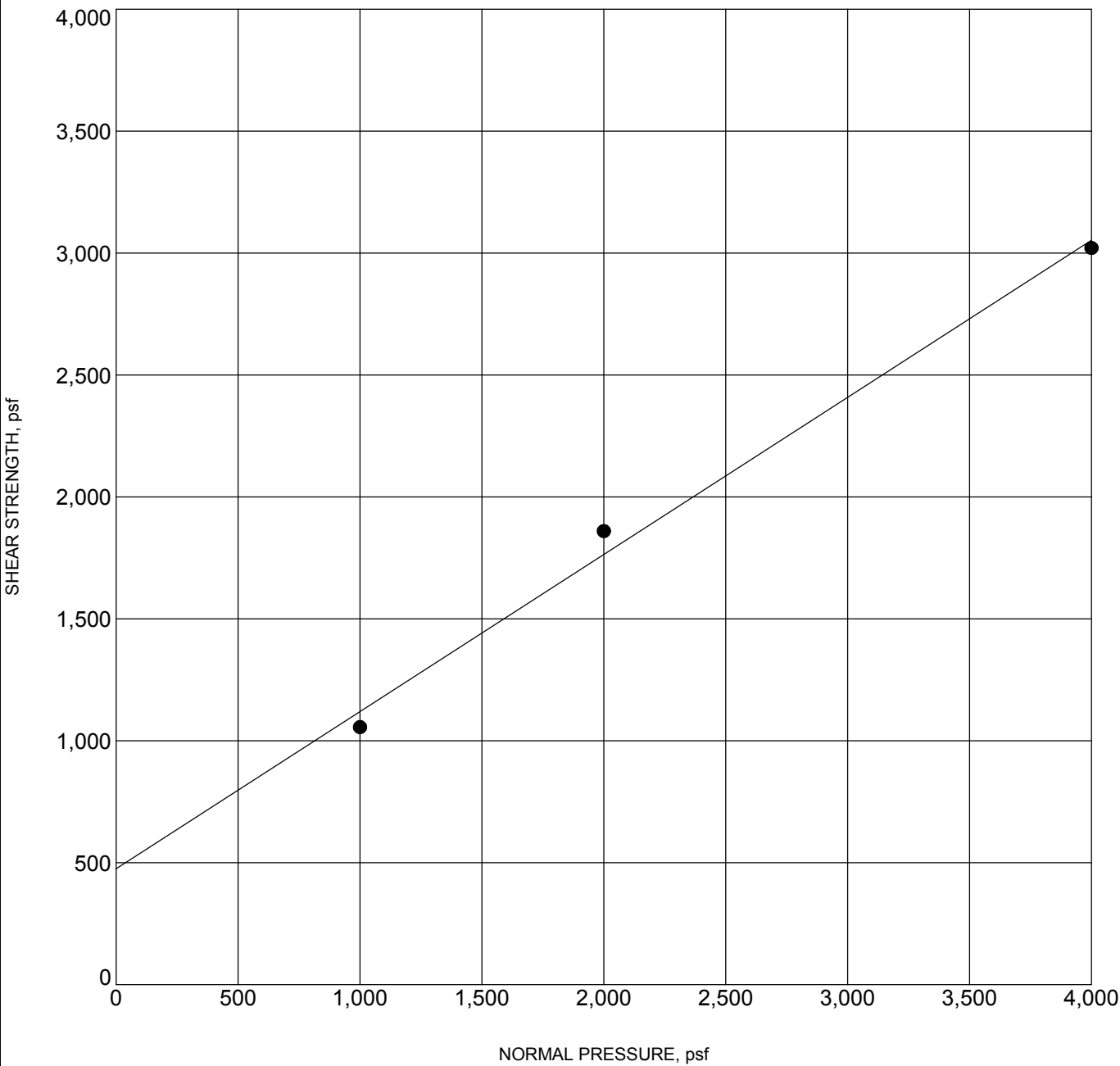
- |                               |  |
|-------------------------------|--|
| ■ ASTM D7263 Dry Density      | ■ ASTM D2216 Moisture Content          |
| ■ ASTM D512 Chloride Content  | ■ AWWA 4500E Soluble Sulfates          |
| ■ AWWA 4500H pH               | ■ ASTM G57 Minimum Resistivity         |
| ■ ASTM D4318 Atterberg Limits | ■ ASTM C136 Percent Passing #200 Sieve |
| ■ ASTM D3080 Direct Shear     |  |

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

## ASTM D4318

EXHIBIT: B-2

# DIRECT SHEAR TEST ASTM D3080



Specimen Identification	Classification	$\gamma_d$ , pcf	WC, %	c, psf	$\phi^\circ$
● BP-7 5 - 6.5	POORLY GRADED SAND SP	123	2	476	33

PROJECT: San Fernando Regional Park Infiltration Project		PROJECT NUMBER: 60185012
SITE: 208 Park Avenue San Fernando, CA		CLIENT: CWE Corporation Fullerton, CA
		EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. \_TC\_DIRECT\_SHEAR\_60185012 BORING LOGS.GPJ TERRACON\_DATATEMPLATE.GDT 12/11/18

# CHEMICAL LABORATORY TEST REPORT

**Project Number:** 60185012  
**Service Date:** 12/10/18  
**Report Date:** 12/13/18  
**Task:**

**Terracon**

750 Pilot Road, Suite F  
Las Vegas, Nevada 89119  
(702) 597-9393

---

## **Client**

CWE Corp

## **Project**

CWE: San Fernando; Infiltration Project

**Sample Submitted By:** Terracon (60)

**Date Received:** 12/10/2018

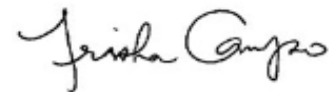
**Lab No.:** 18-1489

## ***Results of Corrosion Analysis***

<i>Sample Number</i>	
<i>Sample Location</i>	BP-2
<i>Sample Depth (ft.)</i>	0.5
pH Analysis, AWWA 4500 H	8.42
Water Soluble Sulfate (SO <sub>4</sub> ), AWWA 4500 E (percent %)	0.01
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (mg/kg)	45
Red-Ox, AWWA 2580, (mV)	+677
Total Salts, AWWA 2520 B, (mg/kg)	660
Resistivity, ASTM G 57, (ohm-cm)	3977

---

**Analyzed By:**















Trisha Campo  
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

**APPENDIX C**  
**SUPPORTING DOCUMENTS**

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

<b>SAMPLING</b>				<b>WATER LEVEL</b>		Water Initially Encountered	<b>FIELD TESTS</b>	(HP) Hand Penetrometer
						Water Level After a Specified Period of Time		(T) Torvane
						Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)
					Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			N N value
								(PID) Photo-Ionization Detector
								(OVA) Organic Vapor Analyzer
								(WOH) Weight of Hammer

## DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

## LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

<b>STRENGTH TERMS</b>	<b>RELATIVE DENSITY OF COARSE-GRAINED SOILS</b> (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels and sands.			<b>CONSISTENCY OF FINE-GRAINED SOILS</b> (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance Includes silts and clays.		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.
	Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1
	Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4
	Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8
	Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15
	Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30
				Hard	> 8,000	> 30
						> 42

## RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 29
Modifier	> 30

## GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

## RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifier	> 12

## PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

# UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>					Soil Classification	
					Group Symbol	Group Name <sup>B</sup>
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines <sup>C</sup>	Cu ≥ 4 and 1 ≤ Cc ≤ 3 <sup>E</sup>	GW	Well-graded gravel <sup>F</sup>	
			Cu < 4 and/or 1 > Cc > 3 <sup>E</sup>	GP	Poorly graded gravel <sup>F</sup>	
		Gravels with Fines: More than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F,G,H</sup>	
			Fines classify as CL or CH	GC	Clayey gravel <sup>F,G,H</sup>	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines <sup>D</sup>	Cu ≥ 6 and 1 ≤ Cc ≤ 3 <sup>E</sup>	SW	Well-graded sand <sup>I</sup>	
			Cu < 6 and/or 1 > Cc > 3 <sup>E</sup>	SP	Poorly graded sand <sup>I</sup>	
		Sands with Fines: More than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G,H,I</sup>	
			Fines classify as CL or CH	SC	Clayey sand <sup>G,H,I</sup>	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A” line <sup>J</sup>		CL	Lean clay <sup>K,L,M</sup>
			PI < 4 or plots below “A” line <sup>J</sup>		ML	Silt <sup>K,L,M</sup>
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay <sup>K,L,M,N</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,O</sup>
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line		CH	Fat clay <sup>K,L,M</sup>
			PI plots below “A” line		MH	Elastic Silt <sup>K,L,M</sup>
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay <sup>K,L,M,P</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,Q</sup>
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup> PI  $\geq 4$  and plots on or above "A" line.

<sup>O</sup> PI < 4 or plots below "A" line.

<sup>P</sup> PI plots on or above "A" line.

<sup>Q</sup> PI plots below "A" line.

