

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT			1. CONTRACT ID CODE N/A	PAGE 1 OF PAGES 32
2. AMENDMENT/MODIFICATION NO. 0002	3. EFFECTIVE DATE 03 MAY 7	4. REQUISITION/PURCHASE REQ. NO. N/A		5. PROJECT NO. (If applicable) SPEC. NO. 1294
6. ISSUED BY CODE		7. ADMINISTERED BY (If other than Item 6) CODE		
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO 1325 J STREET SACRAMENTO, CALIFORNIA		SEE ITEM 7		

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)		(√)	9A. AMENDMENT OF SOLICITATION NO. DACW05-03-B-0005
		×	9B. DATED (SEE ITEM 11) 15 APR 2003
			10A. MODIFICATION OF CONTRACTS/ORDER NO. N/A
			10B. DATED (SEE ITEM 13) N/A
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers is extended, is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(√)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor is not, is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)
AMERICAN RIVER WATERSHED PROJECT(COMMON FEATURES), CALIFORNIA LEVEE STRENGTHENING, ALTERNATE METHODS CONTRACT A SACRAMENTO, CALIFORNIA

- 2 ENCLS 1) PRICING SCHEDULE, TABLE OF CONTENTS, SUBMITTAL REGISTER, 02251 AND 02252.
2) DRAWING SHEETS C-16 AND C-20.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)	

PRICING SCHEDULE

CONTRACTOR SHALL FURNISH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC. NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTACHMENTS THERETO.

LINE ITEM NO.	DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL PRICE
<u>SITE - R3</u>					
0001	MOBILIZATION AND DEMOBILIZATION	1	LUMP SUM	LUMP SUM	\$ _____
0002	LEVEE RESTORATION AND EARTHWORK	970*	M3	\$ _____	\$ _____
0003	AGGREGATE BASE COURSE	350*	MT	\$ _____	\$ _____
0004	CLEARING, GRUBBING AND STRIPPING	3,200*	M2	\$ _____	\$ _____
0005	EROSION CONTROL SEEDING	3,200*	M2	\$ _____	\$ _____
0006	SLURRY WALL	2,100*	M2	\$ _____	\$ _____
0007	REMOVAL AND REINSTALLATION OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0008	ABANDONMENT OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0009	PROTECTION OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0010	TEMPORARY FLOW BYPASS	1	LUMP SUM	LUMP SUM	\$ _____
SUBTOTAL ESTIMATED PRICE					\$ _____
(ITEMS 0001 THRU 0010)					
<u>SITE - R1A</u>					
0011	MOBILIZATION AND DEMOBILIZATION	1	LUMP SUM	LUMP SUM	\$ _____
0012	LEVEE RESTORATION AND EARTHWORK	3,400*	M3	\$ _____	\$ _____
0013	AGGREGATE BASE COURSE	690*	MT	\$ _____	\$ _____
0014	BITUMINOUS COURSE	110*	MT	\$ _____	\$ _____

0015	CLEARING, GRUBBING AND STRIPPING	2,300*	M2	LUMP SUM	\$ _____
0016	EROSION CONTROL SEEDING	3,200*	M2	\$ _____	\$ _____
0017	SLURRY CUTOFF WALL	600*	M2	\$ _____	\$ _____
0018	MISCELLANEOUS STRUCTURES	1	LUMP SUM	LUMP SUM	\$ _____
0019	REMOVAL AND REINSTALLATION OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0020	REMOVAL AND REPLACEMENT OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0021	ABANDONMENT OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0022	TEMPORARY FLOW	1	LUMP SUM	LUMP SUM	\$ _____

SUBTOTAL ESTIMATED PRICE \$ _____
(ITEMS 0011 THRU 0022)

SITE - L5

0023	MOBILIZATION AND DEMOBILIZATION	1	LUMP SUM	LUMP SUM	\$ _____
0024	AGGREGATE BASE	70*	MT	\$ _____	\$ _____
0025	CLEARING, GRUBBING AND STRIPPING	6,800*	M2	\$ _____	\$ _____
0026	EROSION CONTROL SEEDING	2,700*	M2	\$ _____	\$ _____
0027	SLURRY CUTOFF WALL	640*	M2	\$ _____	\$ _____
0028	SEEPAGE BERM AND AREA GRADING	1	LUMP SUM	LUMP SUM	\$ _____
0029	INCLINOMETER ABANDONMENT	1	LUMP SUM	LUMP SUM	\$ _____
0030	PERMEATION GROUTING	1	LUMP SUM	LUMP SUM	\$ _____
0031	INSTRUMENTATION	1	LUMP SUM	LUMP SUM	\$ _____

SUBTOTAL ESTIMATED PRICE \$ _____
(ITEMS 0023 THRU 0031)

SUBTOTAL ESTIMATED PRICE \$ _____
(ITEMS 0001 THRU 0031)

OPTIONS

SITE - R4

0032	MOBILIZATION AND DEMobilIZATION	1	LUMP SUM	LUMP SUM	\$ _____
0033	TEMPORARY FILL	5,000*	M3		\$ _____
0034	IMPERMEABLE BLANKET	4,000*	M2		\$ _____
0035	AGGREGATE BASE COURSE	770*	MT		\$ _____
0036	BITUMINOUS COURSE	260*	MT		\$ _____
0037	CRUSHED STONE PAVING	70*	MT		\$ _____
0038	EROSION CONTROL SEEDING	9,000*	M2		\$ _____
0039	SLURRY CUTOFF WALL	5,400*	M2		\$ _____
0040	CHANNEL CONCRETE SLAB	1	LUMP SUM	LUMP SUM	\$ _____
0041	REMOVAL AND REPLACEMENT OF UTILITY	1	LUMP SUM	LUMP SUM	\$ _____
0042	TEMPORARY FLOW BYPASS	1	LUMP SUM	LUMP SUM	\$ _____
0043	CLEARING, GRUBBING AND STRIPPING	9,000*	M2	LUMP SUM	\$ _____
0044	DISCONNECT AND RECONNECT ELECTRIC CONDUIT	1	LUMP SUM	LUMP SUM	\$ _____

SITE - R3

0045	TEMPORARY RECONNECTION OF DISCHARGE PIPING	1	LUMP SUM	LUMP SUM	\$ _____
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SITE - R1A

0046	TEMPORARY RECONNECTION OF DISCHARGE PIPING	1	LUMP SUM	LUMP SUM	\$ _____
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SITE - L5

0047	BILLBOARD REMOVAL	1	LUMP SUM	LUMP SUM	\$ _____
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SITE - R4

0048	STANDBY FLOW BYPASS SYSTEM	1	LUMP SUM	LUMP SUM	\$ _____
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SUBTOTAL OPTION ESTIMATED PRICE \$ _____
(ITEMS 0032 THRU 0048)

TOTAL ESTIMATED PRICE \$ _____
(ITEMS 0001 THRU 0048)

MT - METRIC TONS
M2 - SQUARE METERS
M3 - CUBIC METERS

** QUANTITY IS AN ESTIMATED AMOUNT. SEE SECTION 00700, FAR 52.211-18, FOR VARIATION IN ESTIMATED QUANTITY CONTRACT CLAUSE.*

- 1. Prices must be submitted on all individual items of this Pricing Schedule. Failure to do so may be cause for rejection of bids.*
- 2. If a modification to a price based on unit price is submitted which provides for a lump sum adjustment to the total estimated price, the applications of the lump sum adjustment to each unit price in the Pricing Schedule must be stated. If it is not stated, the bidder/offeror agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the Pricing Schedule.*
- 3. The bidder/offeror shall distribute his indirect costs (overhead, profit, bond, etc.) over all the items in the Pricing Schedule. The Government will review all submitted Pricing Schedules for any unbalancing of the items. Any submitted Pricing Schedule determined to be unbalanced may be considered nonresponsive and cause the bidder to be ineligible for award.*
- 4. The lump sum, "LS", line items above are not "estimated quantity" line items and therefore are not subject to the Variation in Quantity contract clause.*
- 5. The successful bidder/offeror grants the options listed in the Pricing Schedule to the Government. This option may be exercised any time up to (30) days after receipt of Notice to Proceed. Exercise of the option occurs upon mailing of written notice to the Contractor. Exercise will be made by the Contracting Officer. The price for exercise of the option includes all work and effort associated with the scope of that item. For determination of lowest bid, see paragraph titled EVALUATION OF OPTIONS in Section 00100 of this solicitation. No additional time for contract completion will be allowed when an option is exercised. The given contract completion time was formulated to include time necessary to perform all option work.*
- 6. EFARS 52.214-5000 ARITHMETIC DISCREPANCIES (MAR 1995)*
 - (a) For the purpose of initial evaluation of bids/offers, the following will be utilized in resolving arithmetic discrepancies found on the face of the Pricing Schedule as submitted by bidders/offerors:*
 - (1) Obviously misplaced decimal points will be corrected;*
 - (2) Discrepancy between unit price and extended price, the unit price will govern;*
 - (3) Apparent errors in extension of unit prices will be corrected;*
 - (4) Apparent errors in addition of lump-sum and extended prices will be corrected.*
 - (b) For the purpose of bid/offer evaluation, the Government will proceed on the assumption that the bidder/offeror intends the bid/offer to be evaluated on basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid/offer will be so reflected on the abstract of bids/offers.*
 - (c) These correction procedures shall not be used to resolve any ambiguity concerning which bid/offer is low.*

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SUBMITTAL REGISTER (SR 415 1-10)																				CONTRACT NO.							
TITLE AND LOCATION AMERICAN RIVER WATERSHED PROJECT (COMMON FEATURES), CALIFORNIA LEVEE STRENGTHENING ALTERNATIVE METHODS CONTRACT A										CONTRACTOR					SPECIFICATION SECTION 02251												
ACTIVITY NO	TRANSMITTAL NO	ITEM NO	SPECIFICATION PARAGRAPH NO	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL										CLASSIFICATION	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION		GOVERNMENT ACTION		REMARKS				
					PRECONSTRUCTION	SHOP DRAWINGS	PRODUCT DATA	SAMPLES	DESIGN DATA	TEST REPORTS	CERTIFICATION	MANUFACTURING	MAINTENANCE	OPERATION		INFORMATION	GOVERNMENT REVIEW	START	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE		SUBMIT TO GOVERNMENT	CODE	DATE	
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.	z.	aa.	bb.
	SD-01		1.7	Qualifications of Contractor and Contractor's personnel	x												x										
	SD-01		1.8	Work Plan for conducting grouting project	x												x										
	SD-03		2.4	Drilling and grouting equipments			x										x										
	SD-04		4.1	Samples of all grout materials				x									x										
	SD-04		3.9	Cores obtained in verification hole drilling				x									x										
	SD-05		3.6	Grout mixes					x								x										
	SD-06		3.2	Survey data of injection holes						x							x										
	SD-06		3.7	Grout injection reports						x							x										
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SECTION 02251

PERMEATION GROUTING

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SECTION 02251
PERMEATION GROUTING

PART 1 GENERAL

1.1 SCOPE

This section of the specifications covers the requirements for permeation grouting with ultrafine cement for protection of the northbound lanes of the Capital City Freeway bridge, as shown on the contract drawings. The work includes constructing a two-row grout curtain as shown in the contract drawings. This work shall be completed prior to the slurry wall construction.

The principal components of the work to be performed under this section include the following:

- Surveying to accurately place and ascertain the elevations of all grout holes.
- Installation of grouting nipples.
- Drilling grout holes.
- Performing, mixing, pumping and injecting grout into grout holes.
- Drilling verification holes
- Tremie backfilling all grout holes and verification holes.
- Proper disposal of all drill water, wash water and waste grout.
- Cleaning the work site and disposing all waste products and materials produced by or resulting from grouting operations.

The required dimensions of the grout curtain are shown in the contract drawings. Also, expected locations and numbers of injection points to achieve the permeation grouting of the specified dimensions are shown in the drawings. The injection pressures and grout mixtures will depend on the nature of the soil materials encountered at the site and the results of the grouting operations. The injection pressures and grout mixtures should be appropriate to ensure that the grouting will cover the volume specified in the contract drawings.

The Contractor shall keep the Contracting Officer informed of the progress of the work and the work planned for any day, to permit the Contracting Officer to be present at critical times.

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM C 940	Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 150	Portland Cement
ASTM A 120	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM A 53/A 53M	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASME INTERNATIONAL (ASME):

ASME B16.3	Malleable Iron Threaded Fittings
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AMERICAN PETROLEUM INSTITUTE (API):

API RP 13B	Standard Procedure for Testing Drilling Fluids, Section 1, Density (Mud Weight) and Section 2, Viscosity and Gel Strength.
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U.S. ARMY CORPS OF ENGINEERS (USACE)

CRD-C614	Methods of Test for Time of Setting of Grout Mixtures.
EM 1110-2-3506	Engineering Manual, Grouting Technology (1984)

1.3 DEFINITIONS

1.3.1 Curtain Grouting

Curtain grouting consists of low pressure shallow hole grouting and intermediate to high pressure grouting of deeper zones in rows of holes.

1.3.2 Zone

A zone is a predetermined depth interval of grout curtain.

1.3.3 Stage

A stage is an interval or segment of a grout hole, either preselected or selected on the basis of condition encountered in the hole, which is isolated for the purpose of grouting.

1.3.4 Ascending Stage Grouting

Ascending stage grouting consists of drilling the hole to the full planned depth, or to such depth as may be dictated by the conditions, and using a

packer set at progressively shallower depths, to isolate and grout consecutive stages or intervals of the hole; i.e., grout hole from bottom-up.

1.3.5 Descending Stage Grouting

Descending stage grouting consists of drilling a hole to an increment of the final planned depth, injecting grout from the nipple or through a packer at a selected depth or series of depths, and allowing the grout to take an initial (false) set before deepening the hole for further grouting; i.e., grout hole from top-down.

1.3.6 Split-Spacing Method

The split-spacing method is the procedure of starting drilling and grouting operations in relatively widely-spaced primary holes, and drilling and grouting secondary holes midway between the primary holes after the grout has set.

1.3.7 Refusal

Refusal is the verified non-acceptance (zero take) of 1:1 or thicker grout at the required pressure for the stage, as measured for a period of 5 minutes on a properly functioning, accurate flow meter. For grouts thinner than 1:1 by weight, refusal is the acceptance of grout at a rate of less than 0.028 cubic meter (1 cubic foot) in 20 minutes at the required pressure for the stage, as measured for a period of at least 10 minutes.

1.3.8 Water/Cement Ratio

Water/Cement Ratio is the ratio by weight of water to Portland cement, or water to ultrafine cement.

1.3.9 Special Washing

Special washing refers to washing to jet out and clear loose materials clogging a grout hole as a result of raveling or caving of the hole walls.

1.3.10 Thixotropic Set Time

Time beyond which a grout sample in a beaker will not flow when the beaker is tipped to a 45° angle.

1.4 MEASUREMENT AND PAYMENT

Permeation grouting will be paid at the contract lump sum price for the payment item "PERMEATION GROUTING" that shall constitute full compensation for all labor, equipment, materials, tools and incidentals (including mobilization and demobilization, drilling grout holes, steel pipe and fittings, grout mixture materials, placing grout, drilling verification holes, grouting all holes and cleaning up) necessary to complete the work specified herein.

1.5 SUBSURFACE DATA

Contractor shall familiarize himself with the subsurface conditions at the location of the Work.

Subsurface data in the area of the Work are presented in the Contract Drawings and are discussed in Section 02020 of the Specifications. Additional information is contained in the geotechnical reports referenced in Section 02020.

In summary, a gravel and cobbles layer underlies a thick surficial layer consisting of silts, silty sand and clayey sand at the site. The gravel and cobbles layer is the layer to be grouted. The gravel and cobbles layer was encountered above and below the groundwater level. The layer may contain cobbles up to 0.3 meter (1 foot). Some of this layer may be cemented. The material may collapse into a drill hole, and casing may be required to keep the hole open.

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only "FIO". The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 PRECONSTRUCTION SUBMITTALS

Qualifications of Contractor and Contractor's personnel as specified in paragraph QUALIFICATIONS; GA

Detailed work plan for conducting the grouting project, as specified in paragraph GROUTING WORK PLAN; GA

SD-03 PRODUCT DATA

Drilling Equipment; GA

Grouting Equipment; GA

Grout Plant: A detailed plan shall be submitted showing equipment and grout plant layout proposed for mixing and placing grout; GA

These details and data on the drilling and grouting equipment shall be submitted for conformance with the requirements of paragraph GROUTING EQUIPMENT.

SD-04 SAMPLES

Samples of all grout materials, as specified in paragraph LABORATORY TESTING; FIO

Cores obtained in verification hole drilling, as specified in paragraph CORED VERIFICATION HOLE DRILLING; FIO

SD-05 GROUT MIXES

Grout mixes to be used, as specified in paragraph GROUT PROPORTIONING AND MIXING; GA

SD-06 TEST REPORTS

Survey data of injection holes, as specified in paragraph PREPARATION FOR GROUTING

Grout injection reports, as specified in paragraph GROUT INJECTION; FIO

Logs of verification holes, as specified in paragraph CORED VERIFICATION HOLE DRILLING; FIO

1.7 QUALIFICATIONS

The Contractor and the Contractor's personnel shall be qualified to do the Work, and shall have performed satisfactorily on comparable projects. Accordingly, submit the following information within 14 days of the Notice to Proceed.

1.7.1 Previous Projects

A list of previous projects and owners for which the Grouting Contractor has done similar work within the past 5 years.

1.7.2 Resumes

Resumes showing the qualifications and applicable experience of the Grouting Contractor's superintendent and project engineer for the job.

1.7.3 Background Information

Names, Organizations, and Phone Numbers of Owner's representatives on at least 5 (five) comparable projects completed by the Grouting Contractor and by the Contractor's key supervisory personnel who will be assigned to the work, during the past five years.

1.8 GROUTING WORK PLAN

Submit the following items to the CONTRACTING OFFICER 7 (seven) days prior to mobilizing for grouting operations

1.8.1 A list of all major items of drilling and grouting equipment proposed for use, including water meters and flow meters, together with copies of manufacturer's brochures relating to that equipment. For each piece of equipment listed, submit sufficient technical data to clearly show that the equipment meets the requirements specified herein.

1.8.2 The names and addresses of the suppliers of the materials to be used, product brochures and safety information on all special materials that are

to be used (including environmental safety hazards and handling precautions), and a list of all materials that are to be provided in bulk.

- 1.8.3 A description of methods proposed for mixing, transporting, and injecting grout.
- 1.8.4 A drawing showing the proposed locations of temporary product storage, waste material storage, equipment repair facilities and office facilities.
- 1.8.5 A description of special safety equipment and procedures that will be used for the drilling and grouting operations.
- 1.8.6 A description of communications system (i.e. field telephones, two-way radios, etc) to be provided and used.
- 1.8.7 A description of the methods proposed to contain water, waste grout and other contaminants at the Work site.

1.9 PROJECT RECORD DOCUMENTS

Keep progress records of dates and times that each hole is drilled to completion and that each stage is grouted to completion, and use these records to create a continually updated list of holes available for drilling and grouting. Present this list to the Contracting Officer at the beginning of each shift, with the objectives of verifying that all holes on the list are available for the planned operations and that the proper sequence is being followed.

PART 2 PRODUCTS

2.1 GROUTING MATERIAL

- 2.1.1 Ultrafine cement shall be a Portland/slag cement or Portland cement with a grain size range equivalent to MC-500 as supplied by Geochemical Corporation, of Ridgewood, New Jersey, or approved equal.
- 2.1.2 Superplasticizers used for the formulation of grout shall be conventional superplasticizer as recommended by the ultrafine cement supplier when formulating ultrafine cement or neat Portland cement grouts.
- 2.1.3 Water used for formulation of grout shall be free of sulfates and organic or other particulate matter. The temperature of the water shall not be less than 4 degrees C (40 degrees F) nor more than 24 degrees C (75 degrees F).
- 2.1.4 Protect all grouting materials other than water from becoming wet or contaminated. Take special care with ultrafine cement, which may absorb moisture from the air. Do not use broken or partial bags of ultrafine cement, or bags containing hardened lumps.

2.2 MISCELLANEOUS MATERIALS, SUPPLIES AND EQUIPMENT

Supply and use such miscellaneous materials, supplies and equipment as may be needed to perform the Work. The miscellaneous materials, supplies and equipment to be provided shall include, but not be limited to, those listed below.

2.2.1 Foaming agents, if used to assist in removing drill cuttings from the grout holes, shall be an environmentally acceptable type.

2.2.2 Provide and install grout nipples and caps in all grout holes. The nipples used for grouting shall be Schedule 40 black steel pipe, ASTM A120, about ½ inch larger in diameter than the drill bits that are to be used. The tops of the nipples shall be threaded to allow them to be capped and shall extend 0.1 meter (4 inches) above the ground surface.

2.2.3 Provide scales and volumetric devices capable of accurately measuring all ingredients.

2.3 METAL PIPE AND FITTINGS

Metal pipe and fittings required for constructing grouting and confirmation holes shall be furnished, cut, threaded, and fabricated by the Contractor.

2.3.1 Pipe

All pipes shall conform to ASTM A 53/A 53M.

2.3.2 Fittings

The fittings shall be black, malleable iron in accordance with ASME B16.3.

2.4 GROUTING EQUIPMENT

2.4.1 General

All drilling and grouting equipment used shall be of a type, capacity and mechanical condition suitable for performing the work, as determined by the Contracting Officer. The power and equipment and the layout thereof shall meet all applicable requirements of local, State, and Federal regulations and codes, both safety and otherwise.

2.4.2 Grout Mixer

Grout mixer shall be of the high-shear, high-speed "colloidal" type, providing tangential return flow from the centrifugal pump. The mixer shall be used exclusively for ultrafine cement. The rotational velocity of the pump impeller shall not be less than 1500 r.p.m. The mixer shall be equipped with an accurate, easily read water meter that can be reset to zero after mixing each batch of grout.

2.4.3 Grout Agitators

Grout agitators consisting of cylindrical tanks of appropriate capacity shall be used to hold the grout subsequent to completion of mixing. These tanks shall be suitably equipped with baffles to induce turbulence, and shall be equipped with rotating paddles that will promote thorough agitation of the grout at all times prior to and during injection. The motors used to operate the paddles and the paddles themselves, shall be so designed and maintained that no oil or grease is allowed to come in contact with the grout.

2.4.4 Pumps

Pumps used for injection of grout shall be capable of delivering water and/or grout with non-pulsating flow at pressures up to 300 psi at the grout header. Due to the potential for ingesting air, with consequent undesirable effects in the grout holes, use of open-throat pumps will not be allowed. A water connection shall be provided on the grout pump to facilitate flushing of the system and injection of water into the grout holes.

2.4.5 Grout Hoses

Grout hoses shall not exceed 0.038 m in diameter. The minimum inside diameter at all hoses and fittings shall be 0.025 m. Circulating lines shall be used to facilitate injection pressure control.

2.4.6 Packers

Packers shall be of the hydraulically or pneumatically inflatable variety, and shall be of an appropriate diameter and length so as to minimize seating problems. They shall be capable of tightly sealing the grout holes at pressures up to 250 psi at the selected locations and depths.

2.4.7 Pressure Gauges

The Contractor shall provide and use a calibration kit to verify proper functioning of the pressure gauges.

2.4.8 Automated Recording Equipment

Automated recording equipment capable of accurately and simultaneously recording the injection pressure and flow rate at the header shall be provided, and shall be employed whenever and wherever grout is being injected in grout holes. Standard pressure gauges, as described above, also shall be used to verify the proper operation of the chart recorders.

2.4.9 Grout Headers

Grout headers shall be designed so that the injection pressure can be controlled in part by use of a return line to the agitator and in part by appropriately located Saunders-type valves. The grout headers shall be equipped with a pressure recorder, a pressure gauge, and a flow meter recorder, as described above. Each header also shall be equipped with bleed-

off valve and fitting between the pressure gauge and the hole, for use in sampling the grout and for verifying that the system is not clogged.

PART 3 EXECUTION

3.1 GENERAL

The Work to be performed under this part of the Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power and communications, and for performance of all labor, Work and other operations required for the efficient, effective and safe performance of the grouting operation described in the Contract Documents. The Work consists of constructing a two-row grout curtain as shown in the Contract Drawings.

The Work includes the following requirements:

- Perform all drilling and grouting operations as specified.
- Furnish communications facilities between the grout plant, the agitator (if remotely located from the grout plant), and the holes(s) being grouted.
- Provide all necessary cooperation with the Contracting Officer in the keeping of technical, payment, and progress records.
- Take all necessary and appropriate means to ensure that the temperature of the grout does not fall below 2 degrees C (35 degrees F) or exceeds 33 degrees C (90 degrees F).
- Any grout hole lost due to interruptions in the grout supply, failure or breakdown of the Contractor's equipment, or any other cause related to the Contractor's operations shall be replaced at no additional cost to the Government.

3.2 PREPARATION FOR GROUTING

- Install Survey Monument and Inclinometer in the locations shown in the Drawings and as described in Section 02252.
- Accurately locate and stake or mark the locations of rows 1 and 2 as shown in the Contract drawings. Provide the survey data, including elevations to an accuracy of 0.03 meter (0.1 foot) for each planned grout hole location, to the Contracting Officer.
- Install nipples for all grout holes, to facilitate identifying, protecting and capping the holes. Secure the nipples properly against movement.

3.3 SEQUENCE OF DRILLING AND GROUTING

The Contractor shall implement the grouting program to achieve two rows of permeation grouting with the layout and dimensions shown in the drawings. The first row consists of a minimum of five injection points. The second row consists of a minimum of six injection points. The Contractor has the option, subject to approval by the Contracting Officer, to use a different pattern of injection points to achieve a 1.7 m by 3.34 m (in plan) grout curtain following the criteria dictated by the split spacing method.

The drilling and grouting sequence shall be conducted following the procedure described next:

- Drill and grout curtain holes in a split-spacing sequence. Successive reductions in the hole spacing will be made until the minimum number of injection points in rows one and two have been accomplished and in the judgment of the Contracting Officer no further reductions in spacing are needed as indicated by the conditions encountered.
- Do not commence drilling to reduce the primary spacing until grout injected into adjacent primary holes has had time to harden. Unless proven otherwise by testing, the minimum time shall be assumed to be 24 hours. Alternatively drilling may be stopped periodically and air may be introduced into the grout stream to clear the hole during the time that drilling is stopped. No hole in which grout has been injected before the hole has been advanced to the final planned depth shall be deepened until the grout has had time to harden.
- When grouting in downward stages, clean grout out of the hole after it takes an initial set so that redrilling will be avoided, unless otherwise directed or allowed by the Contracting Officer.

3.4 GROUT HOLE DRILLING

- Do all drilling using water circulation, so as to create and maintain a clean hole.
- Stop drilling immediately and grout the hole if a partial or total loss of drill water circulation occurs or if there is evidence of caving conditions. In the absence of such loss or conditions, drilling of each hole shall proceed to the full planned depth unless otherwise ordered by the Contracting Officer.
- An environmentally acceptable foaming agent may be added to the drill water if necessary in order to help carry cuttings out of the hole. Use of drilling mud or polymers shall not be allowed.
- Use of a casing may be required to keep the grout holes open prior to grout injection.

3.5 GROUTING EQUIPMENT LAYOUT

- Place the grout agitators near the center of the grout curtain.

- The mixing plant may be placed at any locations convenient for delivery of the materials as well as for inspection.

3.6 GROUT PROPORTIONING AND MIXING

- All grout mixes shall be approved by the Contracting Officer.
- Do all mixing of grout for injection in high-shear, "colloidal mill" type mixers, operated at maximum rpm. Add superplasticizers and other additives to the water prior to adding the cementitious materials, unless otherwise recommended by the supplier. Make small batches, so as to minimize waste, unless otherwise authorized by the Contracting Officer.
- The water: cement ratio of the grout that will be used shall not exceed 3:1 by weight.
- Take action to improve proportioning and mixing procedures if the results of field testing of the grout indicate that such action may be appropriate.

3.7 GROUT INJECTION

- In general, grouting shall be done in ascending stages, using pneumatic packers, following drilling to the final planned depth. The exceptions to this general approach shall include the following circumstances: partial or total loss of circulation, artesian flow from hole, grout flow from hole, or caving conditions.
- Stop injection when the refusal criterion has been met, or when the total volume of fluid grout injected in any stage reaches about 1.4 cubic meters (50 cubic feet). In the latter case, inject water to clear the hole, and allow the grout to set overnight. Regrout the same interval the following day, and repeat this same procedure until the refusal criterion is met unless otherwise required by the Contracting Officer.
- Where drilling is stopped due to special conditions deemed by the Contracting Officer to require grouting before the hole is drilled to the final planned depth, grout with the packer seated immediately above the zone in which special treatment is needed.
- Reduce the injection pressure and inject grout intermittently if grout is observed to flow from the surface. Depending upon the nature of the soil at the location of the flow from the surface leak, caulk the leak with lead wool, oakum, burlap, dry-pack, and/or wooden wedges, or create a pond of grout over the leak location. Thicken the grout if required by the Contracting Officer.
- The Contractor will not be required to continue injecting grout thinner than 1:1 by weight into any interval in which the rate of grout take has fallen below 0.028 cubic meter (1 cubic foot) in 20 minutes, as measured over a period of a least 10 minutes. The packer may be

released as soon as the back pressure dissipates. For 1:1 or thicker grout, the refusal criterion is zero take in five minutes. If no grout was injected into the interval, or fluid grout in the injection pipe has a water:cement ratio of 3:1, the packer may be raised to the top of the next higher stage and seated. If thicker grout was used, the packer shall be released and raised approximately 1.5 meters. With the packer still deflated, flush the thick grout from the injection pipe and hole until the return flow is sufficiently clear to verify that the thick grout has been displaced; the packer can then be seated at the next planned location.

- Mixed grout shall not be used if it is older than 2 (two) hours or if it shows signs of hardening.

3.8 GROUT HOLE BACKFILLING

Backfill grout holes with thick zero-bleed grout (0.5:1 or thicker by weight) injected through a pipe or hose extending to the bottom of the hole. Gradually withdraw this pipe or hose during the backfilling process. Repeat this process as many times as may be needed in order that the hole is filled with hard grout to within 0.3 meter (1 foot) of the surface. Following the Contracting Officer's acceptance of the completed backfill cut off the grout nipples at 0.3 meter (1 foot) below the surface and backfill with compacted soil.

3.9 CORED VERIFICATION HOLE DRILLING

- The Contractor shall notify the Contracting Officer 48 hours before starting verification hole drilling.
- Three (3) cored verification holes shall be drilled by Contractor to the specified depth of the bottom of the grout curtain at such locations, on such orientations and inclinations as specified by the Contracting Officer. The holes shall be drilled in such a manner as to maximize core recovery. Carefully remove the cores from the core barrel and place them into the core boxes in the correct orientation. Mark the depth of the end of each run on a wooden block placed at the end of the run. Drill and log all verification holes and submit logs and cores to the Contracting Officer upon completion of drilling.
- Immediately stop drilling and notify the Contracting Officer if circulation loss is experienced at any depth before the final planned depth is reached.
- Grout verification holes in the manner specified for the grout holes.

PART 4 QUALITY ASSURANCE AND CONTROL

4.1 LABORATORY TESTING

Provide to the Contracting Officer samples of each of the grout materials that are specified for use. These materials are to be obtained from suppliers that will be used for the actual grouting operations. Each grout mixture planned for use shall be formulated and tested by the Contractor in

a commercial laboratory prior to beginning the Work, using these materials. The test shall include specific gravity, Marsh viscosity, true viscosity as measured by a viscometer test, bleed, cohesion, initial set time, and thixotropic set time. Results shall be submitted to the Contracting Officer.

4.2 FIELD SAMPLING AND TESTING

Use the grout plant to mix a series of test batches of grout for field calibration testing prior to beginning the Work. The field calibration test shall be made on three ultrafine cement grout mixes. The test shall include specific gravity, Marsh viscosity, bleed, and thixotropic set time. The first formulation in each group of three shall consist of grout with relatively low water:cement ratio, and the remaining two formulations may be made by diluting the initial batch.

4.3 FIELD CALIBRATION TEST

The Contractor shall conduct field calibration tests of grout mixes, and the test results will be used as a basis for periodic assessment by the Contracting Officer of how accurately and well the grout is being formulated and mixed. The Contracting Officer will sample and test the grout on a frequent and regular basis. The Contractor shall revise the proportioning and mixing procedures as necessary to keep the test results within 10 % of those experienced in the field calibration test. The thixotropic set time test will be used to ascertain the proper amount of time to wait between grouting a hole and drilling an adjacent hole. Until proven otherwise by test results, this time shall be 24 hours.

4.4 ACCESS TO GROUT PLANT

Provide the Contracting Officer with safe access to the grout plant and grout agitator at all times during grouting operations, and provide cooperation and assistance in taking of grout samples for testing.

4.5 RECORDS

The Contractor shall maintain complete and accurate records of the drilling, grouting and verification drilling operations. Such records shall be submitted to the Contracting Officer in draft form at the end of each shift. A complete record of the Work shall be submitted to the Contracting Officer not later than 7 (seven) days after the completion of grouting and verification drilling.

4.6 EQUIPMENT MAINTENANCE

Maintain all grouting equipment in proper operating condition at all times, and wash out the pumps, grout hoses, headers, mixers, screens, and agitators with sufficient frequency to ensure that no flakes of dried grout, and no overly thick grout, can enter the grout holes.

Maintain all gauges, scales and other measuring devices in a clean condition and proper working order, and promptly repair or replace any

malfunctioning gauge or device. Perform calibration checks at the request of the Contracting Officer.

4.7 CLEANUP AND PROTECTION OF SITE

Provide pumps or any other equipment or facilities as may be necessary to care for the drilling water, waste grout, and any other contaminated liquids from Contractor's operations in accordance with all applicable laws, permits and standards. Upon completion of grouting and verification drilling, clean up all waste resulting from Contractor's operations that is unsightly or would interfere with the construction of the remainder of the project, all to the satisfaction of the Contracting Officer.

Any grouting waste shall not be permitted to be disposed at the Florin Perkins landfill.

END OF SECTION 02251

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DIVISION 02 - SITE WORK

SECTION 02252

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SECTION 02252
INSTRUMENTATION

PART 1 GENERAL

1.1 SUMMARY

The work specified in this section includes, but is not limited to requirements for furnishing, installing and reading the geotechnical instrumentation required for monitoring the ground and structure deformations associated with the construction of the slurry wall and permeation grouting specified in Section 02251. Instrumentation includes one inclinometer (including probe, cable and readout device) and one surface survey monument.

1.2 DEFINITIONS

1.2.1 Inclinometer

Plastic casing installed in a borehole, allowing internal electronic measurements that define horizontal deformations of the casing. The plastic casing is specially manufactured with internal grooves that control the passage and orientation of an electronic probe that measures direction and magnitude of changes in the casing displacement profile.

1.2.2 Survey Monument

A structural survey monument installed to monitor structure movements of the northbound lane of the Capitol City Freeway bridge as shown on the contract drawings during the construction of the slurry wall and permeation grouting. Horizontal and vertical surveys of survey monument shall be to the accuracy specified in paragraph READINGS.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. All calculations shall be stamped by a California licensed civil engineer. The following shall be submitted to the Contracting Officer 7 (seven) days prior to the initiation of the permeation grouting for review and general comments in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-01 PRECONSTRUCTION SUBMITTALS

Instrumentation Installation and Abandonment Plans; GA

The installation plan for the inclinometer shall include the following:

- (1) Method used for drilling including cleaning the inside of the drill casing.
- (2) Mix design of grout material, including commercial names, proportions of the mix and any admixtures, mixing sequence, mixing method and duration.
- (3) Method of placing grout including pumping methods, tremie pipe type, and estimated quantity of grout.

- (4) Method of overcoming buoyancy of inclinometer casing during grouting.
- (5) Method of sealing joints in inclinometer casing to prevent ingress of grout.
- (6) Proposed orientation or alignment control for inclinometer casing grooves.
- (7) Method for protecting casing from damage during and after installation.
- (8) Method of disposing waste generated from installation (i.e. drill cuttings, ground water, drilling mud, etc.)

The abandonment plan for the inclinometer shall include the following:

- (1) Method of removing upper 1.2 meters of inclinometer casing including auger size.
- (2) Grout mixture used for backfilling, including commercial names, proportions of the mix used and any admixtures, mixing sequence, mixing method and duration.
- (3) Method of placing backfill grout including pumping methods, tremie pipe type, and estimated quantity of grout.
- (4) Method of disposing waste generated from abandonment.

The installation plan for the survey monument shall include method of attaching monument including commercial product names and manufacturer's recommendations.

Qualifications of Instrumentation Specialist Personnel; GA

Submit instrumentation specialist qualifications, sufficient to define details of relevant field experience and data reduction experience. Include information meeting requirements specified in paragraph QUALIFICATIONS.

Qualifications of Land Surveyor; GA

Submit land surveyor qualifications for monitoring structure survey monument, sufficient to define details of relevant field experience and data reduction experience. Include information meeting requirements specified in paragraph QUALIFICATIONS.

SD-05 DESIGN DATA

Inclinometer and Survey Data; FIO

Submit within 24 hours reduced data and preliminary plots collected from instrumentation readings. Upon completion of the project, data shall be presented in the Monitoring Report.

Monitoring Report; GA

As specified in Paragraph MONITORING REPORT.

1.4 QUALIFICATIONS

The Contractor shall provide an Instrumentation Specialist, who shall be a Civil or Geotechnical Engineer, registered Professional Engineer in the State of California, or Engineering Geologist, registered Engineering Geologist in the State of California, with a minimum of 5 years experience in the installation, reading, and reduction of data for instrumentation specified herein. The Instrumentation Specialist shall prepare, supervise and direct technicians and be responsible for instrument installations and readings. The Instrumentation Specialist shall be physically present at the installation sites to supervise the installations.

Technicians shall have a minimum of 2 years experience in the installation and reading of geotechnical instrumentation similar to those specified herein. Inclinator readings must be taken by the same technician throughout the project to minimize the risks of operator-based errors.

Surveyor who is in responsible charge of the surveying shall be a registered Land Surveyor in the State of California with a minimum of 5 years of experience in measuring accuracies specified herein. The field survey party chief shall have a minimum of 3 years of experience in survey measurements similar to the types and accuracies specified herein.

1.5 MEASUREMENT AND PAYMENT

1.5.1 Inclinator Casing and Survey Monument Installation, Instrumentation Readings and Abandonment

The cost associated with installing an inclinometer casing and a survey monument at Site L5, reading the inclinometer and survey monument and abandoning the inclinometer casing and the survey monument shall be made at the contract lump sum price for the bid item "Instrumentation". Such price shall include all costs of plant, labor, equipment, and materials, for the installation of inclinometer casing and survey monument, and for the inclinometer sensor probe and supporting equipment, connectors, readout unit, supporting equipment, survey equipment, and data reduction in accordance with the contract drawings and specification. See Sheet C-20 for anticipated length of inclinometer casing.

PART 2 PRODUCTS

2.1 INCLINOMETER

The inclinometer system (as manufactured by Slope Indicator Co. or approved equivalent) shall consist of inclinometer casing, bottom plug and top cap, centralizers, an inclinometer probe, readout unit, sensor control cable, traction pulley device (including required accessories), licensed data reduction, management and plotting software to determine the subsurface horizontal deformation along the entire vertical profile of the installed inclinometer casing.

The Contractor shall provide inclinometer casing of 70 mm O.D. and 60 mm I.D. with flush joints, self-aligning couplings, end caps, and stick-up as shown in the contract drawings, consistent with the requirements of the inclinometer monitoring equipment including all ancillary items required for installation and monitoring. Casing shall have broached internal grooves,

and spiral tolerance equal to or less than one degree per 3.05-meter casing length or acceptable equivalent.

The Contractor shall provide inclinometer monitoring equipment consisting of an inclinometer probe (bi-axial) equipped with wheel sets matching the configuration and design of the inclinometer casing's internal key ways, signal control cable, a readout unit with software for transferring readings to a PC. Signal control cable for the inclinometer probe shall be shielded and have a neoprene jacket or acceptable equivalent with permanent depth markers for probe positioning (minimum of 0.6-meter intervals). The minimum signal control cable length shall be 30 meters.

The contractor shall provide proof of factory calibration for the inclinometer probe prior to taking any readings. The calibration shall be dated within one month of the start of inclinometer readings. If any reading sets indicate a change in probe calibration or if initial data sets indicate out-of-calibration performance of any component of the entire reading system, the contractor shall have the probe recalibrated by the factory and new baseline data sets collected when the probe is placed back into service. Recalibration of the probe will not be an acceptable reason to skip readings or delay submission of reports.

2.2 SURVEY MONUMENT

The Contractor shall supply a 0.051 m domed brass cap, and other associated hardware and materials needed for a complete installation of the survey monument. The survey monument is to be set on the structure. The Contractor shall submit a proposed method of installation as part of the Instrumentation Installation Plan.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall obtain all necessary permits for the installation of the instrumentation. Permits shall be obtained prior to start of installation of inclinometer casing. Fines or increased fees resulting from failure of contractor to satisfy permit agency regulations shall be the Contractor's responsibility. Fees associated with inspection or abandonment of instrumentation shall be the Contractor's responsibility. Access to the instruments shall be provided at all times.

3.1.1 Inclinometer

The Contractor shall install an inclinometer at Site L5 at the location shown on the drawings. The inclinometer shall be installed at least 10 days prior to the start of the permeation grouting, to allow for the grout to set. Prior to start of permeation grouting, baseline data trends are needed to interpret monitoring data so as to understand the impact of the permeation grouting and slurry wall installation on the adjacent bridge abutment foundation.

Inclinometer hole shall be drilled vertically and the verticality shall be maintained to insure correct installation for the casing with no vertical deviations greater than 2 percent. The inclinometer casing shall be installed to the depth shown on the contract drawing. Centralizers shall be used to maintain the casing in the center of the hole. The hole diameter for the inclinometer casing shall be large enough to allow grout placement.

The grout shall consist of cement, bentonite, and water and shall meet the

inclinometer casing manufacturer's recommendations. Grout shall be tremied from the bottom of the hole and move upward. No part of the casing shall deviate from vertically more than 2 percent of the depth to that part. Casing groove orientation, approved by the Contracting Officer's representative, shall be maintained at the same position throughout the installation. Post installation test shall be performed to verify that there is no grout in the inclinometer casing, that groove orientation and verticality within specified tolerances are correct, and that the inclinometer probe tracks correctly in all four orientations. Failure to meet the requirements herein shall result in rejection of the casing with the requirement that the Contractor removes and replaces the casing at his cost.

The casing shall be grouted in stages not to exceed 50 feet each. Grout shall be allowed to set at least 24 hours between stages. The casing shall be bottom-weighted to prevent preloading of the casing in compression during grouting.

A dummy probe shall be passed through both sets of grooves in the casing following installation of casing and before grouting to confirm casing groove alignment. A dummy probe shall be passed through the casing following each grout stage and then following installation of the bolt-down cover.

Casing will not be accepted by the contracting Officer until baseline capture readings demonstrate casing verticality within specified tolerance.

A traffic-rated bolted-down well cover shall be installed over the inclinometer as shown on the drawings. The cover shall be secured in position with backfill concrete and its top shall be positioned at an elevation about 0.05 meters (2-inches) above the surrounding ground surface.

All details for handling and placing the inclinometer shall be approved by the Contracting Officer, where such details are not explicitly given in the drawings and specifications.

3.1.2 Survey Monument

A survey monument shall be installed at Site L5, at the location shown on the drawings. The survey monument shall be installed at least ten days prior to the start of the permeation grouting to establish baseline data trends.

The survey monument shall be installed according to the instructions provided by the manufacturer and in accordance with the contract drawing and specifications.

3.2 INSTRUMENTATION AND SURVEY MONITORING

3.2.1 Readings

On each occasion that the readings are taken from an instrument, the measured values shall be recorded on a record sheet. The format of the record sheet for each type of instrument shall be prepared by the Contractor and submitted to the Contracting Officer for approval at least one week before readings commence. For readings that are recorded on data loggers, a record sheet shall be required giving references to the data stored. A computer system including interfaces, plotter, printer and software shall be available to make the data transfers, listings and plots required.

Horizontal and vertical surveys of survey monument shall be to the accuracy of plus or minus 3 millimeters. Surveys shall be referenced to a stable benchmark with documented performance.

The format of the plotted results shall be submitted to the Contracting Officer for approval. Details of information and values to be stored on each record sheet in addition to the general information required are given below:

<u>Instrument</u>	<u>Data Required</u>
Inclinometer	<ul style="list-style-type: none"> - Orientation of groove sets in true north map coordinates - Reduced level of top of access tube - Reduced level of ground adjacent to access tube - File name of data stored in data logger - File name of data after transfer to floppy disk - Listing of deflection values and face errors every 0.5 m - Graph and listing of horizontal movement of access tube relative to base readings against depth - Status of permeation grouting and slurry wall excavation including date and depth
Survey Monument	<ul style="list-style-type: none"> - Reduced level of top of rod - Change in reduced level of top of rod relative to base readings and previous reading (mm) - Status of permeation grouting and slurry wall excavation including date and depth

The Contractor shall submit to the Contracting Officer the specified number of copies of each record sheet with necessary listings and graphs within one working day of taking the readings unless otherwise directed by the Contracting Officer.

Inclinometer readings showing movement equal to or greater than 10 millimeters shall be reported to the Contracting Officer's representative immediately and work shall stop until conditions have been assessed that resuming work is not detrimental to the structure.

Monument readings showing movement equal to or greater than 5 millimeters in any direction shall be reported to the Contracting Officer's representative immediately and work shall stop until conditions have been assessed that resuming work is not detrimental to the structure.

3.2.2 Frequency of Measurement

The survey monument and inclinometer shall be read as follows:

- A set of three consecutive baseline readings shall be taken not more than three days following completion of second stage grouting of the inclinometer casing. These readings shall be presented to the Contracting Officer along with a recommendation for the one reading to be used as baseline for successive readings. Baselines must be recaptured if one of the three original sets is not accepted.

- During construction of grouting and slurry wall monitoring shall be carried out on alternate days.
- Readings after completion of the slurry wall shall be performed on weekly basis for one month.

Any instruments found to be faulty shall be promptly brought to the Contracting Officer's attention so that appropriate action can be taken.

Whenever sets of data are measured, they shall be compared to previous sets of data. If anomalous readings are present which differ from the expected value or trend, the Contracting Officer shall be informed and further readings shall be taken immediately. If the anomalous values persist, then the Contracting Officer shall be informed and an investigation shall be carried out to find the reasons for the anomalous readings.

3.2.3 Monitoring Report

The contractor shall submit a monitoring report every week. A proposal for the format of the report shall be submitted to the Contracting Officer including all graphical presentations for approval at least 14 days before submission of the first report. Each weekly report shall include:

- A description of monitoring effort that have been in operation during the preceding period
- Information on reading anomalies or corrections, and factors which may influence measured data
- Observations or remarks
- Plans showing installed locations of instruments
- Data tabulation or plots of instrument readings as given below. The Contractor shall have available software for generating the required plots and tabulations. Zero time to be used in all plots and tabulations shall be agreed upon with the Contracting Officer. The time axis shall be days from "day zero", and an indication of date or months shall be included on the axis. The plots and tabulations presented each month shall be an update of the previous plots and tabulations, giving a complete record starting from the time of installation.

<u>Instrument</u>	<u>Plots and Summaries Required</u>
Inclinometer	<ul style="list-style-type: none"> - Latest graph and 3 other earlier graphs of horizontal movement relative to base readings against depth - Maximum horizontal movement relative to base readings versus time (tabulation and plot) - Important activity (e.g. grout stage) should be plotted in the graph.
Survey Monument	<ul style="list-style-type: none"> - Settlement versus time (tabulation and plot)

All plots where time is the horizontal axis shall have the same scale for time axis. The Contractor shall submit to the Contracting Officer for comment on the graphic presentation of the monitored readings. The presentation shall be agreed by the Contracting Officer prior to the field work. Hand plotted graphs are not acceptable.

The contractor shall submit a final monitoring report summarizing all weekly reports in a format acceptable to the Contracting Officer.

3.3 INSTRUMENTATION ABANDONMENT

The Contractor at the direction of the Contracting Officer shall properly abandon the inclinometer casing at the completion of the required monitoring period. Abandonment of the inclinometer casing shall include complete removal of the casing cover and removal of the access tube (casing) to a depth of 1.2 meters and grouting of the pipe to the ground surface with neat cement grout. The methods of abandonment shall be submitted to and approved by the Contracting Officer. All wastes generated from the abandonment shall be disposed off site in a manner in accordance with the specifications.

--END OF SECTION--