

Document 00911

NOTICE OF
ADDENDUM No.

Date of Addendum: ^{Plu} 2 5/6/16

PROJECT NAME: Clinton Drive Paving and Drainage from Hirsch to Harvey Wilson Drive

PROJECT NO: N-000804-00R3-4

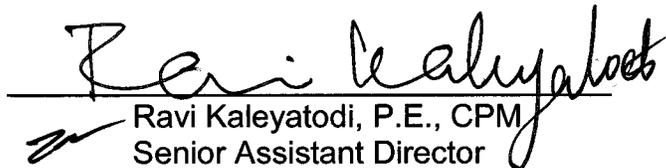
BID DATE: May 12, 2016 (There is no change to the Bid Date.)

FROM: J. Timothy Lincoln, P.E., City Engineer
City of Houston
Department of Public Works and Engineering
611 Walker, 15th Floor
Houston, Texas 77002
Attn: Mike Cordova, Project Manager

TO: Prospective Bidders

The referenced Addendum forms a part of the Bidding Documents and will be incorporated into the Contract documents, as applicable.

Written questions regarding this Addendum may be submitted to the Project Manager following the procedures specified in Document 00200 – Instructions to Bidders. Immediately notify the City Engineer through the named Project Manager upon finding discrepancies or omissions in the Bid Documents.


Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Department of Public Works and
Engineering

END OF DOCUMENT

Document 00910

ADDENDUM NO. 2

Date of Addendum: 05/06/2016

PROJECT NAME: Clinton Drive Paving and Drainage from Hirsch to Harvey Wilson Drive

PROJECT NO: WBS No. N-000804-00R3-4

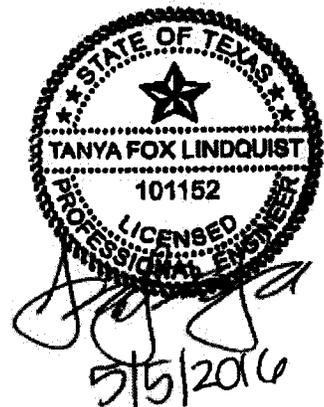
BID DATE: May 12, 2016 (There is no change to the Bid Date.)

FROM: J. Timothy Lincoln, P.E., City Engineer
City of Houston, Department of Public Works and Engineering
611 Walker Street
Houston, Texas 77002
Attn: Mike Cordova, Project Manager

TO: Prospective Bidders

This Addendum forms a part of the Bidding Documents and will be incorporated into the Contract documents, as applicable. Insofar as the original Project Manual and Drawings are inconsistent, this Addendum governs.

This Addendum uses the change page method: remove and replace or add pages, or Drawing sheets, as directed in the change instructions below. Change bars (|) are provided in the outside margins of pages from the Project Manual to indicate where changes have been made; no change bars are provided in added Sections. Reissued Drawing Sheets show the Addendum number below the title block and changes in the Drawing are noted by a revision mark and enclosed in a revision cloud.



CHANGES TO PREVIOUS ADDENDA

Change of Bid Date from April 28, 2016 to May 12, 2016

ADDENDUM NO. 2

CHANGES TO PROJECT MANUAL

CONTRACT FORMS

Document 00410 – Unit Price Item in its entirety
Document 01110- Summary of Work in its entirety

SPECIFICATIONS

Section 02082-S – Precast Concrete Manholes. Add section including pages 02082-S-1
Section 02555-S – Manhole Rehabilitation Add section including pages 02555-S-1
through 02555-S-2
Section 03151 – Joints in concrete Structures Add section including pages 03151-1
through 03151- 14
Section 03211 – Reinforcing Steel Add section including pages 03211-1
through 03211- 10
Section 03310 – Structural Concrete Add section including pages 03310-1
through 03310- 27
Section 03350 – Concrete Finishing Add section including pages 03350-1
through 03350- 13
Section 03390 – Concrete Curing Add section including pages 03390-1
through 03390- 15
Section 03600 – Structural Grout Add section including pages 03600-1
through 03600- 5
Section 03931 – Concrete Repair and Rehabilitation Add section including pages 03931-1
through 03931- 14
Section 03600 – Structural Grout Add section including pages 03600-1
through 03600- 5
Section 09917 – Corrosion Protective Coating System Add section including pages 09917-1
through 09917-17
Section 09918 – Grouted In Place Lining of Sewers & Manholes with Profiled PVC Add
section including pages 09918-1 through 09918- 10
Section 010083 – Fiberglass Reinforced Polymer Manholes Add section including pages
010083-1 through 010083- 7
Section 010227 – Infiltration Control Add section including pages 010227-1 through
010227- 6

CHANGES TO DRAWINGS

Remove Sheets 215, 216, 218, & 238 Clinton Dr. Utilities Plan and Replace with Sheets 215R, 216R, 218R, 238R

Add Sheets

- Ref - Binkley Barfield Existing Manhole Rehabilitation Details
- Ref – Binkley Barfield Proposed Deep Tunnel Manhole Details

CLARIFICATIONS

END OF ADDENDUM NO. 2

DATED: Ravi Kaleyatodi
Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Department of Public Works and
Engineering

JK

RK:JHK:SAB:JC

END OF DOCUMENT

Document 00410B

BID FORM – PART B

1.0 TOTAL BID PRICE HAS BEEN CALCULATED BY BIDDER, USING THE FOLLOWING COMPONENT PRICES AND PROCESS (PRINT OR TYPE NUMERICAL AMOUNTS):

A. STIPULATED PRICE: \$ _____ **N/A**

(Total Bid Price; minus Base Unit Prices, Extra Unit Prices, Cash Allowances and all Alternates, if any)

B. GENERAL (CLINTON DRIVE):

Item No.	Spec. Ref	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
1	01502	Mobilization	LS	1	\$ _____ \$294,000.00 ⁽¹⁾	\$ _____ \$294,000.00 ⁽¹⁾
2	01555	Traffic Control and Regulation	LS	1	\$ _____ \$180,100.00 ⁽¹⁾	\$ _____ \$180,100.00 ⁽¹⁾
3	01555	Install Low Profile Concrete Barriers	LF	3,827		
4	01555	Relocate Low Profile Concrete Barriers	LF	5,867		
5	01555	Remove Low Profile Concrete Barriers	LF	3,827		
6	01562	Tree and plant protection	LS	1		
7	01562	Zero Curb Cutback	LF	1460		
8	01555	Flagman	LS	1	\$ _____ \$92,400.00 ⁽²⁾	\$ _____ \$92,400.00 ⁽²⁾
9	01570	Inlet Protection Barrier	EA	624		
10	01570	Storm Inlet Sediment Trap	EA	60		
11	01570	Gravel-bag Barrier	LF	100		
12	01570	Filter Fabric Fence	LF	8,890		
13	01570	Inlet Protection Barrier (8" Diameter and Curb Inlet Logs)	LF	820		
14	01575	Stabilized Construction Exit	EA	4		
15	02086	Adjust Existing Manhole frame and cover to new grade	EA	48		
16	02086	Adjust Existing Inlet new grade	EA	15		
17	02260	Trench Safety for trench excavations	LF	5,610		
18	02233	Clearing and Grubbing	AC	7.6		

19	02915	Tree Planting	EA	225		
20	02915	Remove trees	EA	10		
21	02922	Sodding	SY	36,784		
22	02555 09917	Manhole Rehabilitation	EA	4		
22A	BBI Drawings	Manhole./J-box Lid Adjustments	EA	3		
TOTAL GENERAL (CLINTON DRIVE) UNIT PRICES						\$ _____

C. PAVING (CLINTON DRIVE):

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimate Quantity	Unit Price (this column control)	Total in Figures
23	01554	Placement of Permanent Signs (signs, poles, anchors and hardware provided by the Contractor)	EA	18		
24	02221	Remove/Dispose Reinforced Concrete with Asph Overlay/ with or without Base	SY	31,417		
25	02221	Remove/Dispose Conc driveway 6-inch thick/More	SY	6,066		
26	02221	Remove/ Dispose Conc Sidewalk 4-inch thick/More	SY	6,362		
27	02221	Remove and Dispose of Existing Concrete Curb or Curb and Gutter	LF	11,535		
28	02221	Remove Existing Loading Dock	CY	500		
29	02315	Roadway Excavation with or without Subgrade	CY	12,057		
30	02319	Borrow (Offsite)	CY	480		
31	02336	Lime Stabilized Subgrade 8-inch	SY	31,885		
32	02336	Lime for Lime stabilized Subgrade (DRY WEIGHT) (6% by dry weight)	TON	833		
33	02714	Flexible Base Course for Temporary Driveways including commercial driveways	EA	24		
34	02741	Hot Mix Asphalt Concrete Pavement for Transitions	TON	474		
35	02741	Hot Mix Asphalt Concrete Pavement 2-inch thick	TON	3,230		
36	02751	Reinforced Concrete Pavement 11-inch thick	SY	32,216		
37	02751	High Early Strength Reinforced Con Pav 9-inch thick	SY	200		
38	02751	High Early Strength Reinforced Con Pav 11-inch thick	SY	444		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimate Quantity	Unit Price (this column control)	Total in Figures
39	02752	Street Pavement Expansion Joint	LF	3500		
40	02752	Preformed Expansion Joints	LF	470		
41	02754	High Early Strength Reinforced Con Pav 7-inch thick (For Driveways)	SY	2,000		
42	02754	Concrete Driveways including Excavation 7-inch thick	SF	52,281		
43	02762	Blast cleaning pavement markers 4-inch wide lines	LF	24,859		
44	02762	Blast cleaning pavement markers 12-inch wide lines	LF	4,156		
45	02762	Blast cleaning pavement markers 24-inch wide lines	LF	887		
46	02762	Removal Raised Pavement Markers All Types	LS	1		
47	02764	Raised Pav Marker TY I with one face Reflective (W/Y)	EA	948		
48	02764	Raised Pav Marker TY I with two face Reflective (W/Y)	EA	25		
49	02765	Temporary Pavement Markers (4-inch-wide) white or yellow	LF	71,174		
50	02765	Temporary Pavement Markers (24-inch-wide) white or yellow	LF	1,228		
51	02765	Temporary Pavement Markers (Arrow)	EA	55		
52	02765	Temporary Pavement Markers (Word)	EA	146		
53	02767	Thermoplastic Pavement Marking 4-inch wide White/Yellow(SLD/BRK)	LF	24,859		
54	02767	Thermoplastic Pavement Marking 8-inch wide White/Yellow	LF	241		
55	02767	Thermoplastic Pavement Marking 6-inch wide White/Yellow	LF	1,574		
56	02767	Thermoplastic Pavement Marking 12-inch wide White/Yellow	LF	4,156		
57	02767	Thermoplastic Pavement Marking 24-inch wide White/Yellow	LF	887		
58	02767	Thermoplastic Pavement Marking symbol ARROW	EA	25		
60	02767	Thermoplastic Pavement Marking Elongated Word ONLY	EA	3		
61	02767	Rail Road Cross Marking	EA	11		
62	02771	6-inch Concrete Curb	LF	11,535		
63	02771	6-inch Concrete Curb and Gutter	LF	100		
64	02771	4-inch x 12-inch laydown curb	LF	242		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimate Quantity	Unit Price (this column control)	Total in Figures
65	02771	Concrete Paving Header	LF	48		
66	02775	Sidewalk 4-1/2-inch thick	SF	75,567		
66	02775	6-inch Concrete Pad for Metro Bus Shelters	SF	1,150		
67	02775	Wheelchair Ramps and sidewalks, complete in place	SF	1,872		
68	02960	Milling Asphalt pavement up to 2-inches	SY	29,354		
69	02752S	Saw Cut	LF	534		
70	02775	4-inch thick Reinforced Concrete Slope Paving	SY	10		
71	DWG	Chain Link Fence	LF	27		
72	DWG	8" W x 4" D Trench Drain	LF	120		
73	04813/ DWG	Brick Masonry Wall	LF	163		
TOTAL PAVING (CLINTON DRIVE) UNIT PRICES						\$ _____

D. STORM WATER (CLINTON DRIVE):

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
74	02221	Remove /Dispose Manholes all Sizes/depth	EA	17		
75	02221	Remove/Dispose Inlets all sizes/depth	EA	28		
76	02221	Remove and Dispose of 15" storm sewer or culvert pipe	LF	700		
77	02221	Remove/Dispose storm pipe 18-inch dia	LF	835		
78	02221	Remove/Dispose storm pipe 24-inch dia	LF	1,595		
79	02221	Remove/Dispose storm pipe 36-inch dia	LF	280		
80	02221	Abandon and fill (Grout) existing 36-inch storm sewer	LF	95		
81	02222	Plug existing 36-inch storm sewer	EA	2		
82	02081/ 02082/ 02087	Type C manhole for 42-inch diameter and smaller sewers	EA	29		
83	02081/ 02087	Type E manhole for 48-inch diameter and greater existing monolithic reinforced concrete sewers	EA	1		
84	02081/ 02082/	Extra depth, manholes for 42-inch diameter and smaller	VF	57		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
	02087	sewers				
85	02081/ 02082/ 02087	Type C manhole for 48-inch to 72-inch diameter sewers	EA	5		
86	02081/ 02082/ 02087	Extra depth, manholes for 42-inch to 72-inch diameter sewers	VF	28		
87	02506	Roof/Yard drains, all sizes and types	LF	62		
88	02632 / 02633	Type BB inlet	EA	6		
89	DWG	TxDOT C Inlet	EA	6		
90	DWG	TxDOT C-10 FT Inlet	EA	2		
91	02632 / 02633	Type C Inlet	EA	1		
92	02632 / 02633	Type C-1 inlet	EA	36		
93	02632 / 02633	Type C-2 inlet	EA	5		
94	02631	12-inch diameter storm sewer lead	EA	60		
95	02631	18-inch diameter storm sewer lead	EA	175		
96	02631	24-inch diameter storm sewer by open cut	LF	730		
97	02631	24-inch diameter storm sewer lead by open cut	LF	1,605		
98	02631	30-inch diameter storm sewer by open cut	LF	855		
99	02631	36-inch diameter storm sewer by open cut	LF	1,545		
100	02631	42-inch diameter storm sewer by open cut	LF	610		
101	02631	48-inch diameter storm sewer by open cut	LF	280		
102	02631	54-inch diameter storm sewer by open cut	LF	277		
TOTAL STORM WATER (CLINTON DRIVE) UNIT PRICES						\$ _____

E. SANITARY SEWER (CLINTON DRIVE)

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
103	02082	4-foot diameter precast concrete manholes	EA	10		
104	02082	Extra depth, 4-foot diameter precast concrete manhole	VF	6		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
105	02086	Adjustment of existing manhole and frame and cover to new grade	EA	28		
106	02221	Remove and Dispose 8 inch sewer line	LF	995		
107	02221	Remove /Dispose Manholes all Sizes/depth	EA	7		
108	02222	Abandon and grout fill manhole	EA	1		
109	02222	Plug and grout fill existing 6-inch sanitary sewer	EA	2		
110	02222	Abandon and grout fill 6-inch diameter sewer	LF	265		
111	02531	6-inch diameter sanitary sewer, by open-cut	LF	270		
112	02531	8-inch diameter sanitary sewer, by open-cut	LF	995		
113	02534	6-inch diameter sanitary sewer service lines	LF	40		
114	02534	Service stubs or reconnections without stack on sanitary sewer	EA	15		
TOTAL SANITARY WATER (CLINTON DRIVE) UNIT PRICES						\$ _____

F. WATER (CLINTON DRIVE)

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
115	02511	2-inch diameter water line by open-cut	LF	45		
116	02511	4-inch diameter water line by open-cut	LF	40		
117	02511	6-inch diameter water line by open-cut	LF	75		
118	02511	8-inch diameter water line by trenchless construction	LF	145		
119	02511	8-inch diameter DIP water line by trenchless construction with restrained joints	LF	20		
120	02511	8-inch diameter water line in steel casing by trenchless construction	LF	70		
121	02511	8-inch diameter water line by open-cut	LF	255		
122	02511	8-inch diameter DIP water line by open-cut with restrained joints	LF	270		
123	02511	12-inch diameter water line by open-cut	LF	3,760		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
124	02511	12-inch diameter water line by open-cut with restrained joints	LF	150		
125	02511	12-inch diameter DIP water line by open-cut with restrained joints	LF	645		
126	02511	12-inch diameter water line in 2-inch steel casing by trenchless construction	LF	75		
127	02511	12-inch diameter water line in 20-inch steel casing by open-cut	LF	155		
128	02512	3/4-inch to 1-inch diameter water taps and copper service line with meter box, short side	EA	1		
129	02512	3/4-inch to 1-inch diameter water taps and copper service line with meter box, long side	EA	6		
130	02512	1-1/2-inch to 2-inch diameter watertap and service line with meter box, short side	EA	3		
131	02512	1-1/2-inch to 2-inch diameter watertaps and service line with meter box, long side	EA	8		
132	02513	2-inch diameter Wet Connection	EA	3		
133	02513	6-inch diameter Wet Connection	EA	5		
134	02513	8-inch diameter Wet Connection	EA	8		
135	02513	12-inch diameter Wet Connection	EA	4		
136	02516	Cut, plug, and abandon existing 2-inch diameter water line	EA	3		
137	02516	Cut, plug, and abandon existing 6-inch diameter water line	EA	5		
138	02516	Cut, plug, and abandon existing 8-inch diameter water line	EA	12		
139	02516	Cut, plug, and abandon existing 12-inch diameter water line	EA	7		
140	02520	Fire hydrant assembly, all depths, including 6-inch diameter gate valve and box	EA	16		
141	02520	6-inch diameter fire hydrant branch by open-cut	LF	164		
142	02520	6-inch diameter fire hydrant branch with restrained joints by open-cut	LF	30		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
143	02520	Removal and Salvage of existing fire hydrant	EA	9		
144	02525	12-inch by 12-inch diameter tapping sleeve and valve with box	EA	1		
145	02525	20-inch by 12-inch diameter tapping sleeve and valve with box	EA	1		
TOTAL WATER (CLINTON DRIVE) UNIT PRICES						\$ _____

G. TRAFFIC (CLINTON DRIVE)

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
146	01555	Temporary traffic signals	EA	2		
147	02221	Remove existing pole foundation	EA	7		
148	02582 / 02465	35-feet mast arm pole assembly	EA	2		
149	02582 / 02465	40-feet mast arm pole assembly	EA	3		
150	02582 / 02465	50-feet mast arm pole assembly	EA	1		
151	02582 / 02465	55-feet mast arm pole assembly	EA	2		
152	02893-07	Pedestal pole assembly with concrete foundation	EA	5		
153	02893-14	Electrical service pedestal assembly 70amp (square D breakers included)	EA	2		
154	02893	Remove and salvage existing traffic signal equipment	EA	2		
155	02893	Overhead street name signs	EA	8		
156	02893	Sign left on green arrow only R10-5 all sizes	EA	9		
157	02893	Sign left turn yield on green (symbolic green ball) R10-12 all sizes	EA	4		
158	02893	Intersection lane control sign R3-8 mod	EA	1		
159	16710	Type A pull box with gravel and ground rod	EA	16		
160	16710	Type B pull box with gravel and ground rod	EA	6		
161	16710	Type C pull box with gravel and ground rod	EA	2		
162	16711	Conduit 2-inch Sch 80 PVC trench	LF	800		

Item No.	Spec Ref.	Base Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in Figures
163	16711	Conduit 2-inch RMC trench	LF	100		
164	16711	Conduit 3-inch Sch 80 PVC trench	LF	60		
165	16711	Conduit 4-inch Sch 80 PVC trench	LF	140		
166	16711	Conduit 4-inch Sch 80 PVC bore	LF	1650		
167	16715	3-section vehicle signal head assembly	EA	20		
168	16715	3-section vehicle signal head assembly (all arrows)	EA	9		
169	16713	Vehicle loop detector, 6' x 6' (pre-formed)	EA	74		
170	16719	Pedestrian signal head assembly, (LED) (symbolic) countdown	EA	16		
171	16720	2/C #14 shielded cable	LF	12,770		
172	16720	3/C #14 AWG solid cable	LF	2,390		
173	16720	5/C #14 AWG solid cable	LF	2,590		
174	16720	7/C #14 AWG solid cable	LF	5,760		
175	16720	#4 THHN service wire	LF	750		
176	16724 16724S	Emergency vehicle preemption system	EA	2		
177	16730	ITS controller cabinet assembly (Model 340) (Type 2070L)	EA	2		
178	16732	Uninterruptible power supply	EA	2		
179	16734	Wimax	EA	2		
180	02893-10C	Controller cabinet foundation with apron	EA	2		
181	16750	Accessible pedestrian push button station	EA	16		
182	16785	GPS serial communication module	EA	2		
183	02893-03	Pedestrian Push Button Pole Assembly with Foundation	EA	3		
TOTAL TRAFFIC (CLINTON DRIVE) UNIT PRICES						\$ _____

H. CLINTON DRIVE TOTAL BID PRICE:

(Add Totals for Items B, C, D, E, F, and G above)

\$ _____

(Mailing)

(Street, if different)

Telephone and Fax Number: _____
(Print or type numbers)

- * If Bid is a joint venture, add additional Bid Form signature sheets for each member of the joint venture.
- ** Bidder certifies that the only person or parties interested in this offer as principals are those named above. Bidder has not directly or indirectly entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding.

Note: This document constitutes a government record, as defined by § 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in § 37.10 of the Texas Penal Code.

Footnotes for Tables B through E:

- (1) Fixed Unit Price determined prior to Bid. Cannot be adjusted by the Bidder.
- (2) Minimum Bid Price determined prior to Bid. Can be increased by the Bidder by crossing out the Minimum and noting revised price on the line above.
- (3) Maximum Bid Price determined prior to Bid. Can be decreased but not increased by Bidder by crossing out the Maximum and noting revised price on the line above. A Bid that increases the Maximum Bid Price may be found non-conforming and non-responsive.
- (4) Fixed Range Bid Price determined prior to Bid. Unit Price can be adjusted by Bidder to any amount within the range defined by crossing out prices noted and noting revised price on the line above.

Section 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Summary of the Work including work by the City, City-furnished Products, work sequence, future work, Contractor use of Premises, special conditions for substantial completion and City occupancy.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work of the Contract is separated into two project sections. The project is located approximately 1.6 miles east of US 59 and 0.6 miles south of Interstate 10 and runs east along Clinton Drive to approximately 715-feet west of Hirsch Street to approximately 205-feet east of Gazin Street. For the purpose of detailing the Work of the Contract, the project is separated into two project segments referred to as the Segment 1 and Segment 2. Segment 1 is located from the start of the project west of Hirsch Street to just east of Lockwood Drive. Segment 2 is located from Lockwood Drive to east of Gazin Street.

The project limits is generally located within the City of Houston and within the existing Right-of-Way (ROW). Corner Clips are located on all four corners of the Clinton Drive and Hirsch Street intersection, both corners of the Clinton Drive and Schweikhardt Street intersection, and the two western corners of the Clinton Drive and Lockwood intersection. In addition, there is a parcel acquisition on the south side of Clinton Drive opposite Schweikhardt Street from Japhet Creek to the abandoned ROW of Schweikhardt Street.

The roadway geometric improvements for Segment 1 will consist of reconstructing the existing pavement along Clinton Drive. The roadway section for Segment 1 consist of a 48-foot (measured face to face of curb) undivided roadway urban section and will have two lanes in each direction. The construction of the pavement for Segment 1 will include the removal the existing concrete pavement with asphalt overlay and concrete curb along Clinton Drive. The pavement will be replaced with a standard 11-inch concrete pavement with 6-inch curbs within the limits as shown in the plans. In addition, the proposed pavement will have an 8-inch stabilized base utilizing 6% Lime. Segment 1 consists of approximately 31,135 square yards of 11-inch reinforced concrete pavement with 6-inch curb.

The construction for Segment 2 will consist of milling and overlaying the existing pavement along Clinton Drive. The roadway section for Segment 2 is approximately 96-foot wide with six 11-foot lanes (three in the eastbound direction and three in the westbound direction) and 30-foot raised median. The milling will be approximately 2-inches, but some additional milling might be required at the intersections. Removal and reconstruction of the existing curbs, sidewalk, and driveways, along Clinton Drive within Section 2 is no longer considered part of the scope of work for this project.

Asphalt Transition Pavement shall be paid under specification 02741 - Hot Mix Asphaltic Concrete Pavement for Transitions. All materials and labor to perform and install the Asphalt Transition Pavement will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B.

Removal of the existing loading dock as shown on Clinton Drive Plan and Profile sheet for Stations 31+00 to Station 36+00 shall be paid for as lump sum. All materials and labor to remove the existing loading dock will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B. Concrete removal behind the existing pole is to be performed at the beginning of construction in order to facilitate for the relocation of the power poles. Notify City of Houston Utility Coordinator Philip DeWalt at (832) 395-2360 two weeks in advance prior to dock removal.

8-inch wide by 4-inch Trench Drain shown on Miscellaneous Sheet 2 of 3 shall be by the linear foot. All materials and labor to perform and install the 8-inch wide by 4-inch Trench Drain will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B.

SUMMARY OF WORK

Clinton Drive Reconstruction Project Project No. N-000804-00R3-4

Brick Fence on the northwest corner of Clinton Drive and Hirsch Street shall be paid for by the linear foot. Assure location behind the existing brick fence is secure during construction. All materials and labor to perform and install Brick Fence will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B. Any Temporary fence used to secure the location behind the existing brick fence shall be incidental to brick wall construction.

Pavement Cuts and replacement will be in accordance with the City of Houston Street Cut requirements. The condition of existing pavement and/or Right-of-Way adjacent to the project limits, but not part of the proposed improvements shall be returned to as good as or better than condition prior to the start of work. The contractor will also overlay the existing asphalt pavement to the limits shown in the plans with Type D Asphalt Concrete Pavement. All materials and labor to perform and install the asphalt overlay will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B. Contractor is responsible for obtaining all necessary permits related to the proposed construction activities.

Driveway reconstructed past the existing Right-of-Way will match the existing width and elevations to meet necessary driveway grade requirements. For driveway requirements, see sheet label "City of Houston Roadway Standards Sheet 2 of 4" included in the plans.

The contractor will be responsible to use caution and due diligence where the proposed improvements are in proximity to existing utilities including, but not limited to, gas lines, buried or overhead cable, and force mains so as not adversely impact the utilities inside/outside the project area. The contractor will contact and coordinate with all utility owners/agencies whose facilities may be impacted by the proposed improvements, as required. Utilities presented in the plans are shown based on the best available information. The Contractor shall verify the exact locations in the field prior to commencing construction.

Contractor shall be responsible for damages to any existing water, waste water, storm sewer lines and traffic control devices during construction. Damages shall be repaired in accordance with the City of Houston Department of Public Works and Engineering Standard Construction Specifications wastewater collection systems, water lines, storm drainage and street paving and standard construction details for wastewater collection systems, water lines, storm drainage and street paving, at no additional cost to the City.

Approximately 5,705 linear feet of water lines will be constructed. The waterline construction consist of 45 linear feet of 2-inch, 40 linear feet of 4-inch, 75 linear feet of 6-inch, 760 linear feet of 8-inch and 4,785 linear feet of 12-inch diameter water lines including valves, fittings, connections, fire hydrants and appurtenances as shown on the construction drawings, Project Manual and/or instructed by the City Engineer and for construction of the service lines. All waterlines should be constructed by open cut unless specified on drawings. Waterlines shall be constructed such that minimal disruption in service is experienced by adjacent commercial properties. The exact location of the existing waterlines should be determined by exposing to ensure that the proposed waterline may be located as shown without causing a significant disruption to service.

Approximately 6,137 linear feet of storm sewers will be constructed. The storm sewer construction consists of 60 linear feet of 12-inch, 175 linear feet of 18-inch and 1,605 linear feet of storm sewer leads, 730 linear feet of 24-inch, 855 linear feet of 30-inch, 1,545 linear feet of 36-inch, 610 linear feet of 42-inch, 280 linear feet of 48-inch and 277 linear feet of 54-inch diameter reinforced concrete pipe. Proposed storm sewer appurtenances include manholes (Type C and Type E) and inlets (Type BB, Type C, Type C-1, Type C-2, TxDOT Type C). Contractor shall install the proposed storm sewers after the existing service connections have been transferred to the proposed water line and the existing water line is abandoned, between stations 29+87 and 35+36. The work also includes removal and disposal of existing storm sewers and appurtenances. All storm sewers should be constructed by open cut unless specified on drawings. The existing storm sewers that serve the streets named above

will remain in service unless noted on the drawings. Temporary drainage shall be maintained at all times throughout the duration of the project.

Approximately 1,265 linear feet of sanitary sewers will be constructed. Sanitary Sewer construction consists of 270 linear feet of 6-inch and 995 linear feet of 8-inch diameter sanitary sewers. Proposed sanitary sewer appurtenances include 4-foot diameter manholes. The work also includes service stubs and reconnections, abandonment and grout-fill of existing sanitary sewers, and removal and disposal of existing sanitary sewers. All sanitary sewers should be constructed by open cut unless specified on drawings. Temporary diversion pumping should be provided during the construction to maintain services to the adjoining properties, as described below.

Contractor must submit a Diversion Pumping Plan and obtain approval from the design engineer and COH Waste Water Operations prior to installation of Diversion Pumping Plan. The contractor shall coordinate with the City to select the method of diversion pumping of the existing sanitary sewer system during its replacement. Methods must conform to Section 01504 – Temporary Facilities and Controls and Section 01506 – Diversion Pumping. Contractor must include the following items before commencing diversion pumping:

- 1) An alarm agent / cellular guard for contacting key personnel in the event of high water level and/or problems with the diversion pumping system.
- 2) Diversion pumping submittal submitted to the design engineer and COH Waster Water Operations describing equipment. Submittal must include pump data sheets, pump and system curves, pump dimension drawings, variable frequency drive controller data sheet, contractor's responsibilities, communication equipment, bill of materials, temporary bypass system references, pump supplier qualifications and the bypass system application criteria.
- 3) Provide a 48-hour to 72-hour notice to City of Houston Project Manager.
- 4) Provide an independent power source for managing operation of diversion pumping equipment.

Two existing signals will be removed and replaced. The signal at the Intersection of Clinton Drive and Hirsch Street consist of removing the existing two signal poles and appurtenances; constructing four new signal poles with mast arms, signal controller with cabinet assembly and appurtenances. The signal at the Intersection of Clinton Drive and Lockwood Drive consist of removing the existing four signal poles and appurtenances; constructing four new signal poles with mast arms, signal control box and appurtenances.

Ten (10) Manholes/Junction boxes locations and One (1) abandoned Manhole location on the existing 132-inch and 144-inch sanitary sewers on Clinton Drive will either be rehabilitated per specification 2555 (Manhole Rehabilitation) or their concrete lids/manhole rings will be adjusted to grade. It is recommended that these adjustments be based on the Binkley & Barfield (BBI) record drawings referenced in the plan set.

The approximate stations and sheet numbers are (1) 23+60 on sheet 215, (2) 23+92 on sheet 215, (3) 24+19 on Sheet 216 & 238, (4) 30+55 on sheets 218 & 219 (5) 35+20 on sheets 220 & 221, (6) 49+30 on sheets 228 & 229, (7) 49+80 on sheets 229 & 230 (8) 54+10 on sheets 230 & 231, (9) 61+70 on sheets 234 & 235, (10) 64+70 on sheet 236 & 237 and (11) (Hirsch St. Sta. 27+91) on Sheet 216 & 238.

The following table below lists the locations with the application required:

	STA	Manhole Type	Application	Reference Drawing
1	23+60	Manhole w/J-Box	Standard Manhole/Ring	Binkley & Barfield

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			Adjustment (per EA)	NSRT detail
2	23+92	Manhole w/J-Box & Concrete Lid	Standard Manhole/Concrete Lid Adjustment (per EA)	Binkley & Barfield NSRT detail
3	24+19	Manhole w/J-Box	Standard Manhole/Ring Adjustment (per EA)	Binkley & Barfield NSRT detail
4	30+55	Manhole w/J-Box & Concrete Lid	Standard Manhole/Concrete Lid Adjustment (per EA)	Binkley & Barfield NSRT detail
5	35+20	Manhole w/J-Box	Standard Manhole/Ring Adjustment (per EA)	Binkley & Barfield NSRT detail
6	49+30	Manhole w/J-Box	Manhole Rehabilitation	Rehab according to spec 2555
7	49+80	Abandoned Manhole	Standard Manhole/Ring Adjustment (per EA)	Binkley & Barfield NSRT detail
8	54+10	Manhole w/J-Box	Manhole Rehabilitation	Rehab according to spec 2555
9	61+70	Manhole w/J-Box	Manhole Rehabilitation	Rehab according to spec 2555
10	64+70	Manhole w/J-Box	Manhole Rehabilitation	Rehab according to spec 2555
11	28+08 (Hirsch St.) 24+32 (Clinton Dr.)	Manhole	Standard Manhole/Concrete Lid Adjustment (per EA)	Binkley & Barfield NSRT detail

The contractor shall follow the following process for the manhole rehabilitation locations:

1. Open manhole to determine grade adjustment
2. Remove and dispose of the manhole tunnel top
3. Design, fabrication and installation of a new removable pre-cast concrete lid (rated for H-20 traffic loading) to match the new pavement elevation (design shall be signed and sealed and submitted to the City of Houston for approval by a Professional Engineer licensed in the State

- of Texas).
4. Anchor the precast lid to the existing tunnel walls;
 5. Install erection anchors/eye bolts in the precast lid with manhole covers; touch up the plastic liner at the wall saw cut; and, apply a Corrosion Protective Coating per Specification Section 09971 to the underside of the precast lid.
 6. If the lid is removable then the lid should be removed and the Junction boxes should be adjusted to match the proposed pavement grade.

Contractor shall field verify all dimensions and detail required to rehabilitate the Manhole Tunnels and bid accordingly.

Conduct all construction operation under this contract in conformance with the erosion control practices described in Document 01410 "TPDES Requirements" and Document 01570 "Storm Water Pollution Control" and the Storm Water Pollution Prevention Plans included in the construction drawings. Work identified in this project falls under Small Construction Activity with area disturbed to be one or more acres but less than five acres. TPDES requirements applicable to Small Construction Activity will apply.

The Contractor will be responsible for the removal and replacement of permanent signs and pavement markings, as denoted in the plans. Pavement striping shall be in accordance to standard City of Houston specifications and details. All materials and labor to perform and install the Placement of Permanent Signs (signs, poles, anchors and hardware provided by the Contractor) will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B. Removal of signs is incidental to the installation of new signs.

The Contractor will be responsible for maintaining traffic control for the duration of the project. The construction traffic control signs, devices, and barricades shown in the plans constitute minimum requirements and are not intended to cover special circumstances or other conditions that may arise due to unforeseen field conditions. The contractor shall place and maintain sufficient additional signs, barricades, and warning devices to warn the public and provide for safe movement of traffic and the construction zone safely. Where special circumstances or other unforeseen condition that are not fully addressed by either the plans or standards provided, "The Texas Manual on uniform traffic control devices" (TXMUTCD) shall govern.

The Contractor shall note that Project ID Signs, Lane Blocked Use Detour Signs and Intersection Closure Use Detour Signs are incidental to Traffic Control and Regulation bid for each respective project location.

The Contractor shall provide a Field Office as specified under Section 01502 and will be paid for in accordance with the provided bid items as specified in Document 00410 – BID Form, Parts A & B.

1.03 CASH ALLOWANCES

- A. Include the following specific Cash Allowances in Contract Price under provision of General Conditions Paragraph 3.11:
 1. Relocate Electrical Risers-(Approx. Sta. 26 + 25 & Sta. 19 + 00).
 2. Railroad Permits
- B. Union Pacific Railroad (UPRR) – The contractor will be required to apply and receive all required UPRR permits from UPRR directly. The fees associated with these permits will be reimbursed to the contractor as a cash allowance.
 1. The contractor is responsible for scheduling all UPRR Flagmen directly with UPRR, as required. Cash Allowance Item in 00410B includes the maximum reimbursement amount

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allowed for UPRR flagmen. The amount was calculated as follows: \$1,400/day for 5 days + \$2,000 (permit fee).

1.04 ALTERNATES

A. None

1.05 CITY-FURNISHED PRODUCTS

A. Items Furnished by the City for Installation and final connection by Contractor:

1. None

B. Contractor's Responsibilities:

1. Arrange and pay for Product delivery to the site.
2. Receive and unload Products at the site; jointly with the City, inspect for completeness or damage.
3. Handle, store, Install, and finish Products.
4. Repair or replace damaged items.

1.06 WORK SEQUENCE

- A. Construct the Work in Phases during the construction period; coordinate construction schedule and operations with the City. All work within each phase and subsequent phases shall be substantially completed prior to beginning the construction within the next phase or the contractor may begin a new phase of construction with consent of the City of Houston Project Manager.
- B. The phrase 'Proposed Improvements' as used below refers to the following construction activities, as applicable: construction of all pavement work, construction of the storm sewer system and appurtenances, and construction of the waterline and appurtenances. The Proposed Improvements also includes tree planting, storm water pollution prevention, traffic control, site restoration, and inspections.
- C. The Contractor has the option to begin construction starting with Phase 2 versus Phase 1 to better accommodate the construction of the proposed improvements along Clinton Drive. If the Contractor elects to begin construction starting with Phase 2, the contractor will coordinate with the City Project Manager.
- D. For the purpose of traffic control, the segment west of Lockwood will be constructed as shown in the plans. The milling and overlay segment east of Lockwood will be constructed using Mobile Operation as shown in TXDOT Standard TCP (3-1)-98 included in the plans. The Contractor shall coordinate project segment schedule with the Project Manager.
- E. Contractor shall place Advance Warning Signs at least two week in advance of starting construction at the listed locations. This is to be paid under 01555 Traffic Control and Regulation.
 - a. Hirsch Street approximate station 27 + 80
 - b. Hirsch Street approximate station 30 + 00
 - c. Lockwood Drive approximate station 25 + 50
 - d. Lockwood Drive approximate station 28 + 00

- F. Contractor shall notify Alan Henrikson of Hahn & Clay (located at 5100 Clinton Drive, Houston, TX 770200) at 713-249-2586 at least 48 hours prior to the start of construction. The contractor is made aware of the potential for oversized vehicles that might be exiting the Hahn & Clay facilities onto Clinton Drive. Due to the length of the oversized vehicles, it might be necessary to temporarily close Clinton Drive to allow the oversized vehicles to turn onto Clinton Drive. During this time, flaggers shall be employed to assist the oversized trucks with turning onto Clinton Drive. Payment for employing flaggers at Hahn & Clay shall be incidental to 01555 – Flagman.
- G. Temporary signals will be required for all phases of construction except Phase IIC and Phase 3 as shown in the plans.
- H. A 48-SF of a Parks Parcel extends into the existing roadway (Approx. Sta. 39-20) which construction may precede using prescriptive rights. However, the city is working on obtaining formal clearance through the Chapter 26 process which could take thru August 2014.

Construction Sequence:

Phase IA (South Side)

1. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Clinton Drive down to two lanes (one in each direction). Shift both lanes of Clinton Drive north as shown in the traffic control plans.
2. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Hirsch Street down to two lanes (one in each direction). Shift both lanes of Hirsch Street east as shown in the traffic control plans.
3. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Lockwood Drive down to two lanes (one in each direction). Shift both lanes of Lockwood Drive east as shown in the traffic control plans.
4. Place Signing, Channelizing Devices, and Work Zone Pavement Markings at the intersection of Clinton Drive and Emile Street as shown in the traffic control plans.
5. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along the south side of Clinton Drive from Begin Project to End Pavement Reconstruction at STA 41+22.09 and from Begin Pavement Reconstruction at STA 46+29.35 to End Pavement Reconstruction at STA 67+30.07 as shown on the Plans.
6. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Hirsch Street on the west side from the Begin of Construction to Clinton Drive.
7. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Lockwood on the west side from the Begin of Construction to Clinton Drive.

Phase IB (Intersections)

1. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Clinton Drive down to two lanes (one in each direction) and to keep both lanes of Clinton Drive shifted north as shown in the traffic control plans.
2. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Hirsch Street down to two lanes (one in each direction) and to shift both lanes west east onto the newly constructed

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pavement as shown in the traffic control plans.

3. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Lockwood Drive down to two lanes (one in each direction) and to shift both lanes west east onto the newly constructed pavement as shown in the traffic control plans.
4. Place Signing and Channelizing Devices to close Emile Street as shown on the plans. This includes sign/s on Clinton Drive notifying the public of the Emile Street Closure.
5. Remove Existing Pavement and Construct Proposed Improvements along the east side of Hirsch Street as shown on the Plans from the Begin of Construction to Clinton Drive.
6. Remove Existing Pavement and Construct Proposed Improvements along the east side of Lockwood Drive as shown on the Plans from the Begin of Construction to Clinton Drive.
7. Construct Fast Track pavement at the intersection of Clinton Drive and Hirsch Street using flaggers and during off-peak hours.
8. Construct Fast Track pavement at the intersection of Clinton Drive and Lockwood Drive using flaggers and during off-peak hours.

Phase IIA (North Side)

1. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Clinton Drive down to two lanes (one in each direction). Shift both lanes of Clinton Drive south onto newly constructed pavement as shown in the traffic control plans.
2. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Hirsch Street down to two lanes (one in each direction). Shift both lanes of Hirsch Street east as shown in the traffic control plans.
3. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce the lane width of the two lanes on Schweikhardt Street and shift both lanes of Schweikhardt Street east as shown in the traffic control plans.
4. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Lockwood Drive down to two lanes (one in each direction). Shift both lanes of Lockwood Drive east as shown in the traffic control plans.
5. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along the south side of Clinton Drive from Begin Project to End Pavement Reconstruction at STA 41+22.09 and from Begin Pavement Reconstruction at STA 46+29.35 to End Pavement Reconstruction at STA 67+30.07 as shown on the Plans.
6. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Hirsch Street on the west side from Clinton Drive to the End of Construction.
7. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Schweikhardt Street on the west side from Clinton Drive to the End of Construction.
8. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Lockwood Drive on the west side from Clinton Drive to the End of Construction.
9. Construct Fast Track pavement at the intersection of Clinton Drive and Hirsch Street using flaggers and during off-peak hours.
10. Construct Fast Track pavement at the intersection of Clinton Drive and Lockwood Drive using flaggers and during off-peak hours.

Phase IIB (Intersections)

1. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Clinton Drive down to two lanes (one in each direction) and to keep both lanes of Clinton Drive shifted south as shown in the traffic control plans.
2. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Hirsch Street down to two lanes (one in each direction) and to shift both lanes west east onto the newly constructed pavement as shown in the traffic control plans.
3. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce the lane width of the two lanes on Schweikhardt Street as shown in the traffic control plans. Keeping the northbound lane shifted east on existing pavement and shifting the southbound lane west onto newly constructed pavement.
4. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Lockwood Drive down to two lanes (one in each direction) and to shift both lanes west east onto the newly constructed pavement as shown in the traffic control plans.
5. Remove Existing Pavement and Construct Proposed Improvements along the east side of Hirsch Street as shown on the Plans from the Begin of Construction to Clinton Drive.
6. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Schweikhardt Street between the northbound and southbound lanes from Clinton Drive to the End of Construction.
7. Remove Existing Pavement and Construct Proposed Improvements along the east side of Lockwood Drive as shown on the Plans from the Begin of Construction to Clinton Drive.

Phase IIC

1. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce Clinton Drive down to two lanes (one in each direction) and to keep both lanes of Clinton Drive shifted south as shown in the traffic control plans.
2. Place Signing, Channelizing Devices, and Work Zone Pavement Markings to reduce the lane width of the two lanes on Schweikhardt Street as shown in the traffic control plans. Keeping the southbound lane shifted west and shifting the northbound lane west onto newly constructed pavement.
3. Remove Existing Pavement and Construct Proposed Improvements, including propose storm sewer, along Schweikhardt Street on the east side from Clinton Drive to the End of Construction.

Phase III

1. Mill and Overlay Clinton Drive from Lockwood Drive to the End of Project using Mobile Operations.
 2. Construct Final Pavement Markings along Clinton Drive as shown on the plans using Mobile Operations during off-peak hours.
 3. Complete Final Grading Adjacent to Work Zone Areas and Complete Punch List Items
 4. After Acceptance from the Engineer, Remove any remaining Signing, Channelizing Devices, and Work Zone Pavement Markings and open all lanes of Clinton Drive to Traffic.
- I. Coordination of the Work: Refer to Section 01312 - Coordination and Meetings.
1. Coordinate activity schedule and extend full cooperation to other contractors who have responsibilities

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either concurrent with, proceeding or following this Contractor's time along work site. Ensure availability of access, availability of selected portions of this area to others and provide appropriate information for planning purposes to other contractors.

2. Coordinate with private utilities with facilities along Clinton Drive and the intersecting streets within the project limits. Anticipate impact by other construction activities, which may impede work progress.
 3. Coordinate work around existing METRO bus operations, (713) 739-4000. Provide minimum of two (2) weeks' notice before construction begins in this area.
 4. Contractor and electrician to coordinate with Center-Point Energy during relocation of wood poles and risers.
- J. Should the contractor elect to use a different plan of traffic control, the contractor shall prepare and submit an alternate set of traffic control plans to the traffic management and maintenance division of the city of Houston public works and engineering department, for review and approval ten (10) working days prior to proceeding with the work. These plans shall be prepared by a registered professional engineer and drawn to an acceptable scale on reproductive mylars and shall become part of the contract drawings.

1.07 CONTRACTOR USE OF PREMISES

- A. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in Section 01145 – Use of Premises.
- B. Construction Operations: Limited to the City's rights-of-way provided by the City and areas shown or described in the Contract documents.
- C. Utility Outages and Shutdown: Provide a minimum of 48 hours notice to the City and private utility companies (when applicable), excluding weekends and holidays, in advance of required utility shutdown. Coordinate all work as required.
- D. Private Utility Relocations: Pursuant to Section 40-395 of the City of Houston (City) Utility Relocation Ordinance Program (URO), the following private utilities were identified and scheduled for relocation within the scope of the project limits. Because the following utilities need to be relocated during construction, the contractor will need to coordinate with the utility owners on completing the work.

The following is a description of the private utilities identified for relocation within the project limits:

Utility Owner	Type of Facility	Approximate Location	Anticipated Effect to Construction
AT&T Texas	Manholes	Various	Contractor to Coordinate with AT&T to adjust their Manholes during construction
AT&T Texas	Switch Box	Station 10+60 Schweikhardt St	Switch Box will be relocated during construction
Centerpoint Electric	Power Poles	Station 32+85 Clinton Drive	Remove existing Loading dock to relocate power poles

1.08 STREET CUT ORDINANCE

- A. Excavations on or under pavement in the City's right-of-way must have a permit. Comply with City of Houston, Texas Ordinance No. 2000-1115, an ordinance amending Chapter 40 of the Code of Ordinances, Houston, Texas, relating to excavating in the Public right-of-way.
- B. Comply with the latest edition of street cut New Pavement Repair and Pavement Replacement details.
- C. Quantities are included for street cut pavement repair and replacement in applicable Specification sections for Unit Price contracts.
- D. Include payment for street cut pavement repair and replacement in lump sum bid for Stipulated Price contracts.
- E. For detailed information concerning the ordinances' latest detail drawings and permits related to compliance with excavation in the Public Right-of-Way and Street Cut, visit the City's web site at: <http://documents.publicworks.houstontx.gov/document-center/engineering-and-construction/index.htm> and <http://pwegis.pwe.ci.houston.tx.us/>

1.09 WARRANTY

- A. Comply with warranty requirements in accordance with Document 00700 - General Conditions.

1.10 ADDITIONAL CONDITIONS FOR SUBSTANTIAL COMPLETION

- A. In addition to requirements outlined in Document 00700 – General Conditions, for Contractor to be substantially complete with the Work and call for inspection by Project Manager to confirm, the following conditions must be met or completed:
 - 1. All testing shall be completed and accepted by Project Manager.
 - 2. All Safety related work including pavement stripping and signing.
 - 3. All pay items complete report.
 - 4. Contractor shall contact Construction Project Manager to complete Texas Department of Licensing and Regulation Post Construction Inspection of pedestrian elements for Texas Accessibility Standards
- B. No other additional condition described in Paragraph 1.10 may be included in Contractor's punch list.

1.11 EXISTING UTILITIES

- A. All utilities presented on these drawings are shown at approximate locations based on the best available information. Updated Center-Point gas line locations will be provided prior to commencement of construction.. The contractor shall field determine the exact locations prior to commencing construction. He or she shall be fully responsible for any and all damages caused by his or her failure to exactly locate and maintain these underground utilities, at no additional cost to the City of Houston.

PART 2 PRODUCTS - Not Used

SUMMARY OF WORK

PART 3 EXECUTION - Not Used

END OF SECTION

SUPPLEMENTARY SPECIFICATION

Section 02082-S

PRECAST CONCRETE MANHOLES

The following supplements modify Section 02082 – Precast Concrete Manholes Standard Specification. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

- 1.01 SECTION INCLUDES: *Delete Paragraphs 1.01.B. and replace with the following Paragraph B.*
- B. Precast concrete sanitary sewer manholes with Corrosion Protective Coating System specified in Section 09917 where corrosion resistant manholes are specifically indicated in Drawings.
- 1.02 MEASUREMENT AND PAYMENT: *Delete Paragraphs 1.02.A. 1, 3, 4, 5, 6, 7, and 8 and replace with the following Paragraph 1. Renumber 1.02.A.9 and 10 to be 1.02.A.3 and 4.*
1. Payment for manholes is on a unit price basis for each Precast Concrete manhole installed. The price shall be full compensation for all precast sections and throat rings, cones, watertight rings and covers, manhole reinforced concrete ring encasement, manhole concrete base encasement, concrete mortar, drop pipes and fittings, corrosion protection coating, initial backfill material, labor, tools, equipment testing, tees, wyes, and incidentals necessary to complete the work.
- 2.09 CORROSION RESISTANT MANHOLE MATERIALS: *Delete Paragraphs 2.09.A. and replace with the following Paragraph A.*
- A. Where corrosion-resistant manholes are indicated on Drawings, provide Protective Coating System specified in Section 09917, or approved equal.

END OF SUPPLEMENT

Approved By:

Rem
MR

Ravi Kaleyatodi

Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Engineering Branch
Engineering and Construction Division

2/2/14
Date

SUPPLEMENTARY SPECIFICATION

Section 02555-S

MANHOLE REHABILITATION

The following supplements modify Section 02555 – Manhole Rehabilitation Standard Specification. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1.02 MEASUREMENT AND PAYMENT

Delete Paragraphs 1.02.A.1.a through j and replace with the following Paragraphs 1.02.A.1.a through j:

- a. Measurement for manhole wall lining (including bench repair) or junction box is on a square foot basis to the nearest tenth of a square foot, measured from the bottom of the frame to the top of the bench. If the bench is not required, measurement will be from the bottom of the frame to the top of the effluent pipe (Refer to Drawing No. 02534-03A).
- b. Measurement for Japhet Street Junction Box Rehabilitation shall be lump sum.
- c. Measurement for the adjustment using a new watertight manhole frame and cover, including raising or lowering the height of the cover within one vertical foot, is included in the unit price for rehabilitated manholes; no separate payment will be made.
- d. Measurement for the adjustment of an existing manhole frame and cover, including raising or lowering the height of the cover within one vertical foot, is included in the unit price for rehabilitated manholes; no separate payment will be made.
- e. Measurement for new or existing manhole frame and cover adjustment of over one foot is included in the unit price for rehabilitated manholes; no separate payment will be made.
- f. Backfill, including cement-stabilized sand, is included in the unit price for rehabilitated manholes; no separate payment will be made.
- g. Measurement for pavement restoration will be in accordance with Section 02951 – Pavement Repair and Resurfacing.
- h. Measurement for new manhole insert dishes is included in the unit price for rehabilitated manholes; no separate payment will be made.

MANHOLE REHABILITATION

- i. Chemical grout injection to stop water intrusion is included in the unit price for rehabilitated manholes; no separate payment will be made.
- j. Refer to Section 01270 – Measurement and Payment, for unit price procedures.

2.02 WALL REPAIR MATERIALS

Delete Paragraphs A and B and add the following Paragraph A:

- A. Wall repair materials shall be 100 percent solids, solvent-free Epoxy Grout specifically formulated for Epoxy top coating compatibility as depicted on Drawing Sheet D-14.

2.03 MANHOLE WALL LINERS, BENCH FORMING AND REPAIR MATERIAL

Add Paragraph B:

- B. Contractor shall use products in accordance with Specification Section 09917 – Corrosion Protective Coating System, Item 2.03 Coating Product, or Approved Equal.

3.07 MANHOLE WALL SEALING

Add Paragraph J.

- J. In addition to the methodology described in paragraphs A thru I, Contractor shall also follow directions in accordance to Specification Section 10227 - Infiltration Control.

END OF SUPPLEMENT

Approved By:

Ravi Kaleyatodi

2/3/14

Date

RCM
MR
E.N.
Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Engineering Branch
Engineering and Construction Division

Section 03151

JOINTS IN CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Waterstops and similar joints in concrete structures intended to retain water or withstand hydrostatic pressure.

1.02 UNIT PRICES

- A. No separate payment will be made for joints under this Section. Include payment in unit price for structural concrete.
- B. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- B. ASTM C 920 - Specification for Elastomeric Joint Sealants.
- C. ASTM D 412 - Test Methods for Rubber Properties in Tension.
- D. ASTM D 624 - Test Method for Rubber Property - Tear Resistance.
- E. ASTM D 638 - Test Method for Tensile Properties of Plastics.
- F. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- G. ASTM D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
- H. ASTM D 1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- I. ASTM D 1752 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

JOINTS IN CONCRETE STRUCTURES

- J. ASTM D 2000 - Specification for Rubber Products in Automotive Applications.
- K. ASTM D 2240 - Test Method for Rubber Property - Durometer Hardness.
- L. ASTM D 2241 - Specification for PVC Tubing.
- M. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic for Expansion Joints and Pipe Joints.
- N. Federal Specification TT-S-0227E(3) Sealing Compound, Elastomeric Type, Multi-Component, for Caulking, Sealing, and Glazing Buildings and Other Structures.
- O. U.S. Army Corps of Engineers Specification CRD-C 572 PVC Waterstop.

1.04 DEFINITIONS

- A. The following definitions refer to concrete joints in water-retaining structures. Unless otherwise indicated, all such joints shall have a waterstop or sealant groove to prevent water penetration at the joint.
- B. Construction Joint: The joint or surface between two concrete pours, produced by placing fresh concrete in contact with a hardened concrete surface.
 - 1. A bond breaker may or may not be used, as indicated.
 - 2. Reinforcing steel is continuous through the joint, unless otherwise indicated.
- C. Contraction Joint: A joint similar to a construction joint, but intended to accommodate concrete shrinkage and similar movement.
 - 1. A bond breaker is always used.
 - 2. Reinforcing steel is held back 4-1/2 inches from the joint surface, and sleeved dowels are used so pours can move apart, unless otherwise indicated.
- D. Expansion Joint: A joint similar to a construction or contraction joint, but intended to accommodate both expansion and contraction.

1. Compressible joint filler is placed against the hardened concrete, to form and separate the second pour so pours can move together or apart.
 2. A centerbulb waterstop and joint sealant are used to fill the gap, unless otherwise indicated.
 3. Reinforcing steel is held back, and sleeved dowels are used to allow and control movement, unless otherwise indicated.
- E. Control Joint: A groove cut or formed in the face of a single pour, producing a weaker plane more likely to crack; used in an attempt to control locations of normal shrinkage cracks.
1. Joint sealant is used to fill the groove.
 2. Reinforcing steel is continuous, since the pour is monolithic.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01330 – Submittal Procedures.
- B. Product Data: Information sufficient to indicate compliance with Contract Documents, including manufacturer's descriptive literature and specifications.
- C. Shop Drawings: Indicate type, size, and location of each joint in each structure, and installation details.
- D. Samples: For extrusions, submit 6-inch lengths. For molded or fabricated items, submit whole items. Submit 6-inch beads for sealants and 6-inch square samples for coatings, on appropriate substrates.
- E. Quality Control Submittals: Submit manufacturer's instructions and recommendations for storage, handling and installation including material safety data sheets, and, where specified, test reports certified by an independent testing laboratory or the manufacturer, and manufacturer's certification that products furnished comply with Contract Documents.

1.06 QUALITY ASSURANCE

- A. Waterstop Inspection: Notify City Engineer to schedule inspection at least 24 hours prior to work involving waterstop installation or fabrication of waterstop field joints.

JOINTS IN CONCRETE STRUCTURES

B. Defects include but are not limited to the following:

1. Offsets at joints greater at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
2. Exterior cracks at joints due to incomplete bond, which are deeper at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
3. At any point, any combination of offsets or exterior cracks resulting in a net reduction in the cross-sectional area of the waterstop greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
4. Misalignment of joint resulting in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
5. Porosity in the welded joint as evidenced by visual inspection.
6. Bubbles or inadequate bond which can be detected with a pen knife. If, while probing the joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint is defective.

C. **Field Joint Samples:** Prior to use of the waterstop material in the field, fabricate and submit for review a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used. Fabricate samples so material and workmanship represent fittings to be furnished. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the City for testing by a laboratory at City's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D 638. Contractor shall pay cost of failed tests and retesting required by failures.

D. **Construction Joint Sealant:** Prepare adhesion and cohesion test specimens, as specified, at intervals of 5 working days while sealants are being installed.

E. Sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Prepare sealant specimen between 2 concrete blocks (1 inch by 2 inches by 3 inches); spacing between the blocks shall be 1 inch. Use coated spacers (2 inches by 1-1/2 inches by 1/2 inch)

to ensure sealant cross-sections of 1/2 inch by 2 inches with a width of 1 inch.

2. Cast and cure sealant according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
3. Following curing period, widen the gap between blocks to 1-1/2 inches. Use spacers to maintain this gap for 24 hours prior to inspection for failure.

F. Sealant Installer: A competent waterproofing specialty contractor, approved by sealant manufacturer, having a record of successful performance in similar installations. Before beginning work, sealant manufacturer's representative shall instruct installer's crew in proper method of application.

1.07 WARRANTY

A. Provide a written warranty covering entire sealant installation against faulty and incompatible materials and workmanship, and agreeing to repair or replace defective work at no additional cost to the City, for a period of 5 years.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with manufacturer's printed instructions.
- B. Store waterstops to permit free circulation of air around waterstop material.

PART 2 PRODUCTS

2.01 EPA POTABLE CLASSIFICATION

A. All joint materials shall be materials that reach acceptability for use in potable water systems no later than 30 days after installation, as classified by the Environmental Protection Agency.

2.02 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or

JOINTS IN CONCRETE STRUCTURES

- exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops: As detailed, and as manufactured by: Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the City Engineer, provided that at no place shall waterstop thickness be less than 3/8 inch.
- C. Multi-Rib Waterstops: As detailed, and as manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the City Engineer. Use prefabricated joint fittings at intersections of ribbed-type waterstops.
- D. Other Waterstops: When types of waterstops not listed above are indicated on the Drawings, they are subject to these specifications.
- E. Waterstop Properties: When tested in accordance with specified standards, waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Standard</u>
Tensile Strength-min (psi):	1750	D638, Type IV
Ultimate Elongation-min (percent):	350	D638, Type IV
Low Temp Brittleness-max (degrees F):	-35	D746
Stiffness in Flexure-min (psi):	400	D747
Accelerated Extraction (CRD-C572) -		
Tensile Strength-min (psi):	1500	D638, Type IV
Ultimate Elongation-min (percent):	300	D638, Type IV
Effect of Alkalies (CRD-C572) -		
Change in Weight (percent):	+0.25/-0.10	-----
Change in Durometer, Shore A:	+5	D2240
Finished Waterstop -		
Tensile Strength-min (psi):	1400	D638, Type IV
Ultimate Elongation-min (percent):	280	D638, Type IV

2.03 JOINT SEALANT

- A. Material: Polyurethane polymer designed for bonding to concrete which is continuously submerged in water. Use no material with an unsatisfactory history of bond or durability when used in joints of liquid-retaining structures.
- B. Sealant Properties at 73 degrees F, 50 percent relative humidity:

1. Work Life: 45 - 180 minutes
2. Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gr quantity): 24 hours, maximum
3. Ultimate Hardness (ASTM D 2240): 20 - 45 Shore A
4. Tensile Strength (ASTM D 412): 200 psi, minimum
5. Ultimate Elongation (ASTM D 412): 400 percent, minimum
6. Tear Resistance (Die C ASTM D 624): 75 pounds per inch of thickness, minimum
7. Color: Light Gray

C. Polyurethane Sealants for Waterstop Joints in Concrete:

1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for 2-part material.
2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ANSI/ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
3. Plane horizontal joints: Self-leveling compounds meeting ANSI/ASTM C 920, Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I. For joints subject to either pedestrian or vehicular traffic, use a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45.
4. Primer: Use only compatible materials manufactured or recommended for the application by the sealant manufacturer, in accordance with the printed instructions and recommendations of the sealant manufacturer.

D. Acceptable Products: Polymeric Systems Inc. "PSI-270"; Pacific Polymers "Elastothane 227R"; Sika Corporation "Sikaflex 2C", or equal acceptable to the City Engineer.

E. Sealants for non-waterstop joints: Conform to Section 07920 - Sealants and Caulking.

2.04 MISCELLANEOUS MATERIALS

JOINTS IN CONCRETE STRUCTURES

- A. Bearing Pad: ASTM D 2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.
- B. Neoprene Sponge: ASTM D 1056, Type 2C3-E1 closed-cell expanded neoprene.
- C. Preformed Joint Filler: ASTM D 1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. Bituminous fiber type will not be permitted.
- D. Control Joint Former: Continuous plastic insert strips with anchorage ribs located at the bottom and an enlarged upper portion that is readily removable without damage to the concrete, and is sized to form sealant groove. Size to extend to at least 1/4 slab depth.
- E. Backing Rod: Extruded closed-cell polyethylene foam rod, compatible with joint sealant materials used, with a tensile strength not less than 40 psi, and compression deflection approximately 25 percent at 8 psi. Size: 1/8-inch larger in diameter than joint width, except use one-inch diameter rod for 3/4-inch wide joints.
- F. Bond Breaker: "Super Bond Breaker" manufactured by Burke Company, San Mateo, California; "Select Cure CRB", manufactured by Select Products Co., Upland, California, or equal acceptable to the City Engineer. Bond breaker shall contain a fugitive dye so areas of application will be readily distinguishable.
- G. Slip Dowels: Smooth epoxy-coated bars conforming to ASTM A 775.
- H. PVC Tubing: ASTM D 2241, Schedule SDR 13.5.

2.05 RESILIENT WATERSTOP

- A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite or adhesive type material.
- B. Bentonite Waterstop:
 - 1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
 - 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.

3. Cross-sectional dimensions, unexpanded waterstop: One inch by 3/4 inch.
 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
1. Adhesive waterstop shall be at least 2 inches in diameter and shall be Synko-Flex preformed plastic adhesive waterstop by Synko-Flex Products, Inc., or equal. The waterstop shall meet or exceed requirements of Federal Specification SS-S-210A.
 2. The adhesive waterstop shall be supplied wrapped completely by a two part protective paper.
 3. The adhesive waterstop material shall have independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.
 4. Primer, to be used on hardened concrete surfaces, shall be provided by the same manufacturer as the waterstop material.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 SPLICES IN WATERSTOPS

- A. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

JOINTS IN CONCRETE STRUCTURES

1. Do not damage material by heat sealing.
 2. Splice tensile strength: At least 60 percent of unspliced material tensile strength.
 3. Maintain continuity of waterstop ribs and tubular center axis.
- B. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.
- C. Prior to placement in formwork, prefabricate all waterstop joints involving more than 2 ends to be joined together, an angle cut, an alignment change, or the joining of 2 dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the City Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.
- D. Where a centerbulb waterstop intersects and is joined to a non-centerbulb waterstop, take care to seal the end of the centerbulb, using additional PVC material if needed.

03 JOINT CONSTRUCTION

A. Setting Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Flat-strip waterstop: Prevent folding over by concrete during placement. Unless otherwise shown, hold waterstops in place with wire ties on 12-inch centers passed through the waterstop edge and tied to reinforcing steel.
 - a. Horizontal waterstops (with flat face in vertical plane): Hold in place by fastening upper waterstop edge to continuous supports.
 - b. Horizontal waterstops (with flat face in horizontal plane): Work concrete under waterstops by hand to eliminate air and rock pockets.

3. Place centerbulb waterstops in expansion joints centered on joint filler material.
 4. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.
- B. **Joint Location:** Unless specifically noted otherwise, provide construction joints at 25-foot maximum spacing for concrete construction. Where joints are shown spaced greater than 40 feet apart, provide additional joints to maintain the 25-foot maximum spacing. Submit joint locations for review by the City Engineer.
- C. **Joint Preparation:** Prepare surfaces in accordance with Section 03310 - Structural Concrete. Unless otherwise indicated, bonding is required at horizontal concrete joints in walls. Except on horizontal wall construction joints, wall-to-slab joints, or where otherwise shown or specified, at joints where waterstops are required, coat the joint face of the first pour with bond breaker as specified.
- D. **Replacement of Defective Field Joints:** Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Contract Documents.
- E. **Construction Joint Sealant:**
1. In water-bearing floor slabs and elsewhere where indicated, provide construction joints with tapered grooves filled with construction joint sealant. Leave groove-forming material in place until time grooves are cleaned and filled with joint sealant. After removing groove forms, remove laitance and fins and sand-blast the grooves. Allow grooves to dry thoroughly, then blow out, immediately prime surfaces, place bond-breaker tape in bottom of groove and fill with construction joint sealant. Use no sealant without a primer. Completely fill sealant grooves. Thoroughly clean areas designated to receive sealant, as specified for tapered grooves, prior to sealant application.
 2. Mix and install primer and sealant in accordance with manufacturer's printed instructions and recommendations. Do not coat sides of sealant groove with bond breaker, curing compound or other substance which would interfere with proper sealant bond. Allow at least 7 days for sealant to achieve final cure before filling structure with water.

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3. Thoroughly and uniformly mix 2-part catalyst-cured material.
4. Remove and replace improperly cured sealants after the manufacturer's recommended curing time; thoroughly sandblast the groove to remove all traces of uncured or partially-cured sealant and primer, then re-prime and re-seal with specified sealant.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations except as otherwise indicated and specified.
2. When requested by the Project Manager, provide technical assistance by manufacturer's representative in the field at no additional cost to the City.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.
5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:

- a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
- b. Where thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into the concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
- c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the

material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

- d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
- e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

7. Adhesive Waterstop:

- a. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.
- b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.
- c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with the protective paper.
- d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

G. Control Joints:

- 1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to City Engineer. Minimum insert or sawcut: 1/4 slab depth.

JOINTS IN CONCRETE STRUCTURES

2. Perform sawcutting during the curing period as soon as possible after concrete has reached its final set, has attained sufficient strength to support sawcutting operations without damage, and while it remains fully saturated.
3. Leave the removable portion of plastic inserts in place and protect sawcuts against damage and intrusion of foreign material until the end of the curing period and until concrete has dried sufficiently to allow sealant installation.
4. Sealant Installation: Blow foreign material from formed or sawcut space. Insert a foam backer rod to form a sealant depth equal to the width of the space but not less than 3/8 inch. Install sealant as specified elsewhere in the Contract Documents.

END OF SECTION

Section 03211

REINFORCING STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

- A. No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid. Include payment in unit price for structural concrete.
- B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.
- C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ACI 315 - Details and Detailing of Concrete Reinforcement.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ASTM A 36 - Standard Specification for Structural Steel.
- D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- E. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- F. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
- G. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- H. ASTM A 675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

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- F.** ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- J.** ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- K.** AWS D 1.4 - Structural Welding Code - Reinforcing Steel.
- L.** WRI - Manual of Standard Practice for Welded Wire Fabric.
- M.** CRSI MSP-1 - Manual of Standard Practice.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings:

1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.
2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.
3. Detail shop drawings in accordance with ACI 315, Figure 6.
4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03151 - Joints in Concrete Structures, and obtain approval of City Engineer, prior to submitting reinforcing steel shop drawings.

C. Bill of Materials: Submit with shop drawings.

D. Product Data:

1. **Mechanical Bar Splices:** Submit manufacturer's technical literature,

including specifications and installation instructions.

2. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.

E. Certificates:

1. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.
2. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

1.05 HANDLING AND STORAGE

- A. Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

1.06 QUALITY ASSURANCE

- A. Notify City Engineer at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

PART 2 PRODUCTS

2.01 MATERIAL

- A. Reinforcing Bars: Deformed bars conforming to ASTM A 615, grade as indicated on Drawings, except column spirals and those shown on Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.
- B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A 36; ASTM A 615, Grade 60; or ASTM A 675, Grade 70.
- C. Column Spirals: Bars conforming to ASTM A 615, Grade 60, or wire

REINFORCING STEEL

conforming to ASTM A 82.

- D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars:
Conform to ASTM A 775/A 775M.
- E. Welded Wire Fabric:
 - 1. Welded Smooth Wire Fabric: Conform to ASTM A 185.
 - 2. Welded Deformed Wire Fabric: Conform to ASTM A 497.
 - 3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.
 - 4. Furnish welded wire fabric in flat sheets only.
- F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.
- G. Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.
- H. Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.
- I. Mechanical Bar Splices:
 - 1. Conform to ACI 318; use where indicated on Drawings.
 - a. Compression splices shall develop ultimate stress of reinforcing bar.
 - b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.
 - 2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.

- J. Welded Splices:
1. Provide welded splices where shown and where approved by the City Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.
 2. Provide materials for welded splices conforming to AWS D1.4.
- K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C 881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

2.02 FABRICATION

- A. Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A 775/A 775M.
- B. Splices:
1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of City Engineer. Use minimum number of splices located at points of minimum stress. Stagger splices in adjacent bars.
 2. Length of lap splices: As shown on Drawings.
 3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.
- C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.
- D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.
- E. Standard Hooks: Conform to the requirements of ACI 318.

REINFORCING STEEL

- F. Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.02 INSTALLATION

- A. Placement Tolerances: Place reinforcement within tolerances of Table 03210A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.
- B. Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify City Engineer. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without approval of City Engineer.
- C. Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03210B at the end of this Section, unless otherwise indicated on Drawings.
- D. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection, and to accessories. Blocking reinforcement with concrete or masonry is prohibited.
- E. Placement for Concrete on Ground: Support bar and wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.

- F. Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.
- G. Splices:
 - 1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of City Engineer.
 - 2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.
 - 3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the City Engineer. Install in accordance with manufacturer's instructions.
 - a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.
 - b. Couplers intended for future connections: Recess 1/2 inch minimum from concrete surface. After concrete is placed, plug coupler and fill recess with sealant to prevent contact with water or other corrosive materials.
 - c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.
- H. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.
- I. Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.

REINFORCING STEEL

- J. Field Bending: Shape reinforcing bent during construction operations to conform to Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by City Engineer. Do not bend reinforcement after it is embedded in concrete.
- K. Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.
- L. Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.
- M. Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 GROUTING OF REINFORCING AND DOWEL BARS

- A. Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially-filled hole.

REINFORCING STEEL

Table 03210B
MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists - Top and bottom bars for dry conditions - No. 14 and No. 18 bars: No. 11 bars and smaller:	1-1/2 1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact with, sewage; and for bottoms bearing on work mat, or slabs supporting earth cover - No. 5 bars and smaller: No. 6 through No. 18 bars:	1-1/2 2
Beams and Columns - For dry conditions - Stirrups, spirals and ties: Principal reinforcement: Exposed to earth, water, sewage or weather - Stirrups and ties: Principal reinforcement:	1-1/2 2 2 2-1/2
Walls - For dry conditions - No. 11 bars and smaller: No. 14 and No. 18 bars: Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground - Circular tanks with ring tension: All others:	1 1-1/2 2 2
Footings and Base Slabs - At formed surfaces and bottoms bearing on concrete work mat: At unformed surfaces and bottoms in contact with earth: Over top of piles: Top of footings -- same as slabs	2 3 2

END OF SECTION

Section 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place normal-weight structural concrete and mass concrete.

1.02 UNIT PRICES

- A. Measurement for structural concrete is on lump-sum basis for each structure as bid. Payment includes related work performed on these structures in accordance with related sections of these Specifications.
- B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.
- C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304.2R - Placing Concrete by Pumping Methods
- C. ACI 305R - Hot Weather Concreting.
- D. ACI 306.1 - Standard Specification for Cold Weather Concreting.
- E. ACI 309R - Guide for Consolidation of Concrete.
- F. ACI 318 - Building Code Requirements for Reinforced Concrete.
- G. ACI 350R - Environmental Engineering Concrete Structures.
- H. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- I. ASTM C 33 - Standard Specification for Concrete Aggregates.
- J. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

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- K. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- L. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- M. ASTM C 94 - Standard Specifications for Ready-Mixed Concrete.
- N. ASTM C 127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
- O. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- P. ASTM C 136 - Sieve Analyses of Fine and Coarse Aggregates.
- Q. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- R. ASTM C 150 - Standard Specification for Portland Cement.
- S. ASTM C 157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
- T. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- U. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- V. ASTM C 192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.
- W. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- X. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- Y. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
- Z. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- AA. ASTM C 535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

- AB. ASTM C 567 - Standard Test Method for Unit Weight of Structural Lightweight Concrete.
 - AC. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
 - AD. Concrete Plant Manufacturer's Bureau (CPMB), Plant Mixer Manufacturers Division: Concrete Plant Mixer Standards.
 - AE. National Ready-Mixed Concrete Association (NRMCA): Certification of Ready-Mixed Concrete Production Facilities (checklist with instructions).
 - AF. John Wiley and Sons, Interscience Publishers Division, "Encyclopedia of Industrial Chemical Analysis," Vol. 15, Page 230 (alkalinity test procedure).
- 1.04 DEFINITIONS
- A. Mass Concrete: Concrete sections 4 feet or more in least dimension.
 - B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.
 - C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.
- 1.05 SUBMITTALS
- A. Conform to Section 01330 – Submittal Procedures.
 - B. Mill Certificates: Required for bulk cement.
 - C. Design Mixes:
 - 1. Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio; compressive strength test results for 7 and 28 days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.
 - 2. Submit abrasion loss and soundness test results for limestone aggregate.

STRUCTURAL CONCRETE

3. Testing of aggregates, including sieve analysis, shall be performed by a certified independent testing laboratory. Tests shall have been performed no earlier than 3 months before Notice to Proceed.
 4. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.
 5. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.
- D. Admixtures: Submit manufacturer's technical information, including following:
1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.
 2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.
- E. High-range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.
- F. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed procedure will not relieve Contractor of responsibility for quality of finished product.
- G. Project Record Drawings: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.06 QUALITY ASSURANCE

- A. Provide necessary controls during evaluation of materials, mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.
- B. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.
- C. Testing and Other Quality Control Services:
 - 1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an independent commercial testing laboratory employed and paid by the City in accordance with Section 01454 - Testing Laboratory Services.
 - 2. Provide material for and cooperate fully with City's testing laboratory technician in obtaining samples for required tests.
 - 3. Standard Services: The following testing and quality control services will be provided by City in accordance with Section 01454, Testing Laboratory Services:
 - a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".
 - b. Testing of proposed materials for compliance with this Specification.
 - c. Review of proposed mix design submitted by Contractor.
 - d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.
 - e. Strength testing of concrete according to following procedures:
 - (1) Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 100 cubic yards for each mix design placed each day, according to ASTM C

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- 172, with each sample obtained from a different batch of concrete on a representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.
- (2) Molding four specimens from each sample according to ASTM C 31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C 31.
 - (3) Testing two specimens at 7 days and two specimens at 28 days according to ASTM C 39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.
- f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C 231.
 - g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C 143.
 - h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C 1064.
 - i. Lightweight concrete: For each strength test, or more frequently when requested by Project Manager, determination of air content by ASTM C 567 and unit weight by ASTM C 567.
 - j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.
 - k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:
 - (1) Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each

case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157, modified as follows:

- (a) Wet curing: Remove specimens from molds at an age of 23 hours \pm 1 hour after trial batching and immediately immerse in water at 70 degrees F \pm 3 degrees F for at least 30 minutes;
- (b) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");
- (c) Then submerge in saturated limewater, at 73 degrees F \pm 3 degrees F, for 7 days;
- (d) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);
- (e) Calculate expansion (base length expressed as a percentage of original length);
- (f) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, \pm 3 degrees F and 50 percent \pm 4 percent relative humidity, for the remainder of the test.
- (g) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.

- (h) Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and paid by the City in accordance with Section 01454, Testing Laboratory Services, when requested by City Engineer.
- a. Checking of batching and mixing operations.
 - b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.
 - c. Molding and testing reserve 7-day cylinders or field cylinders.
 - d. Conducting additional field tests for slump, concrete temperature and ambient temperature.
 - e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.
5. Contractor shall provide the following testing and quality control services:
- a. Employ an independent commercial testing laboratory, acceptable to City, to prepare and test design mix for each class of concrete for which material source has been changed.
 - b. Notify commercial testing laboratory employed by City 24 hours prior to placing concrete.
6. Testing of deficient concrete in place:
- a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls below specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by Project Manager.
 - b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the City

- Engineer, or the independent commercial testing laboratory selected by the City.
- c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the City.
- d. Core Tests:
- (1) Obtain and test cores in accordance with ASTM C 42. Where concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C 42.
 - (2) Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Project Manager so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.
 - (3) Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.
 - (4) Patch core holes in accordance with Section 03350 - Concrete Finishing.
- e. Structural Analysis: When core tests are inconclusive or impractical to obtain, Project Manager may perform additional structural analysis at Contractor's expense to confirm safety of structure.
- f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.
- g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by Project Manager to determine relative strengths at various locations in structure, to evaluate concrete strength in

place, or for selecting areas to be cored. However, such tests, unless properly calibrated and correlated with other test data, shall not be used as basis for acceptance or rejection of structure's safety.

1.07 STORAGE AND HANDLING OF MATERIALS

- A. **Cement:** Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.
- B. **Aggregate:** Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before next is started.
- C. **Fine Aggregate:** Before using, allow fine aggregate to drain until uniform moisture content is reached.
- D. **Admixtures:** Store admixtures to avoid contamination, evaporation or damage. For those used in form of suspensions or nonstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.
- E. **Lightweight Aggregates:** Uniformly predampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow predampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

PART 2 PRODUCTS

2.01 MATERIALS

- A. **Cement:**
 - 1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.

2. Portland Cement: ASTM C 150, Type I or Type II, gray in color. Use Type III only when specifically authorized by City Engineer in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.
- B. Admixtures:
1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.
 2. Air-Entraining Admixtures: ASTM C 260, compatible with other admixtures used.
 3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C 494, Type A, C, D or E.
 4. High-Range Water Reducer (Superplasticizer): ASTM C 494, Type F or G, compatible with and by the same manufacturer as other admixtures.
- C. Mixing Water: Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C 94.
- D. Aggregates: Use coarse aggregate from only one source, and fine aggregate from only one source, for exposed concrete in any single structure.
1. Coarse Aggregate: Gravel, crushed gravel or crushed limestone conforming to ASTM C 33.
 2. Fine Aggregate: Natural sand complying with ASTM C 33.
 3. Limestone aggregate shall conform to ASTM C 33 and the following additional requirements: Clean, hard, strong and durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. Select crushed limestone: High-calcium limestone (minimum 95 percent CaCO_3 and maximum 3.5 percent MgCO_3) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C 131 or ASTM C 535. Test aggregate for soundness in accordance with ASTM C 88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test.
 4. Maximum size of coarse aggregate:

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- a. Normal weight concrete, except as noted below: 1-1/2 inches.
 - b. Formed members 6 inches or less in least dimension: 1/5 least dimension.
 - c. Slabs: 1/3 depth of slab.
 - d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.
 - e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.
5. Coarse aggregate for lightweight concrete: ASTM C 330.
Grading limits: 3/4 inch to No. 4.
6. Abrasive Aggregate: Conform to requirements of Section 03350 - Concrete Finishing.
- E. Calcium Chloride: Not permitted.
- F. Evaporation Retardant: Masterbuilders "Confilm", Euclid "Euco-bar", or equal.
- G. Miscellaneous Materials:
1. Bonding Agent: Two-component modified epoxy resin.
 2. Vapor barrier: 6 mil clear polyethylene film of type recommended for below-grade application.
 3. Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.02 CONCRETE MIX

- A. Objective: Select proportions of ingredients to produce concrete having proper placability, durability, strength, appearance, and other specified properties.
- B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to City, to prepare and test mix designs for each

type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.

1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.
2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Test 3 compression test cylinders at 7 days and 3 at 28 days. Average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.
3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C 136. Report percentage passing each sieve.
4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.

C. Shrinkage Limitations, Class A and D Concrete

1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.
2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

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3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the City, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.

D. Selecting Ingredient Proportions for Concrete:

1. Proportion concrete mix according to ACI 301, Chapter 3.
2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI 318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.
3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.

E. Water-Cement Ratios:

1. Maximum allowable water-cement ratios shall be as follows:
 - a. Concrete for liquid-containing structures: 0.45.
 - b. Concrete subjected to brackish water, salt spray or deicers: 0.40.
 - c. All other concrete: 0.55.
2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.

- F. Adjustment of Mix Proportions:** After sufficient data becomes available during construction, mix may be adjusted upon approval of Project Manager, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.

- G. **Entrained Air:** Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C 173: 4 to 6 percent.
- H. **Consistency, Workability, and Slump:**
1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

<u>Concrete Type</u>	<u>Minimum Slump</u>	<u>Maximum Slump</u>
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"
Lightweight Concrete after dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"*	8"

* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site; however, do not use as basis for mix design. Do not exceed water-cement ratios specified.
- I. **Admixtures:** Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.
- J. **High-Range Water Reducers (Superplasticizers):** Use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals.

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K. Concrete Classification and Strength:

1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
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Concrete for Structures Containing Water or Wastewater

A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3000	470 (5 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)

Concrete for Buildings, Slabs on Grade and Miscellaneous Structures

AB	4000	Not Applicable
BB	1500	Not Applicable
CB	3000	Not Applicable
DB	5000	Not Applicable

Class (Light-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
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E	3000	Not Applicable
F	4000	Not Applicable
G	5000	Not Applicable

3. Maximum size aggregate for Class H concrete: 3/8 inch.
Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.

5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on Drawings. Determine air-dry unit weight in accordance with ASTM C 567.

Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

L. Use of Classes of Concrete:

1. Use classes of concrete as indicated on the Drawings and in other specifications.
2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:
 - a. Class A: All reinforced concrete and where not otherwise defined.
 - b. Class B: Unreinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.
 - c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.
3. All other structures: If not otherwise indicated, use the following classes in the locations described:
 - a. Class AB: All reinforced concrete and where not otherwise defined.
 - b. Class CB: Duct banks; see Section 16402 - Underground Duct Banks for additional requirements.
 - c. Class BB: Unreinforced concrete fill under structures.

2.03 MIXING NORMAL WEIGHT CONCRETE

- A. Conform to ACI 301, Chapter 7.
- B. Ready-Mixed Concrete:

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1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C 94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".
2. Provide batch tickets with information specified in ASTM C 94. Deliver batch ticket with concrete and give to City's on-site testing laboratory representative.

C. Batch Mixing at Site:

1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.
2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.
3. Mix each batch of 2 cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.
4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.

D. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure admixture to accuracy within ± 3 percent. Do not use admixtures in powdered form.
2. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.

3. Add retarding admixtures as soon as practicable after addition of cement.

E. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.
2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.
3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so that time of transport and placement does not generate unacceptable temperatures.
4. Submit hot weather and cold weather concreting plans for approval.

2.04 MIXING LIGHTWEIGHT CONCRETE

- A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before predampening in accordance with ASTM C 127.
- B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low-absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.
- C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:
 1. Place approximately 80 percent of mixing water in mixer.
 2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.
 3. When aggregates have not been predampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30

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revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.

4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.
5. Complete mixing using procedures for normal-weight concrete.

2.05 MASS CONCRETE

- A. Do not use high early-strength cement (Type III) or accelerating admixtures.
- B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.
- C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

2.06 EQUIPMENT

- A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.
- B. Truck mixers, agitators and manner of operation: Conform to ASTM C 94. Use of non-agitating equipment for transporting concrete is not permitted.
- C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.
- D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2 nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.
- E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

PART 3 EXECUTION

3.01 SPECIAL CONSIDERATIONS

- A. **Concreting Under Water:** Not permitted except where shown otherwise on Drawings or approved by City Engineer. When shown or permitted, deposit

concrete under water by methods acceptable to the City Engineer so fresh concrete enters mass of previously-placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.

- B. Protection from Adverse Weather: Unless adequate protection is provided or City Engineer's approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.
2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

B. Construction Joints:

1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgment of the Project Manager, new concrete cannot be incorporated integrally with that previously placed.
2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Project Manager.
3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.

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4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.
- C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain Project Manager's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.
- D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Project Manager. Clean surfaces of forms and embedded items that have become encrusted with grout or previously-placed concrete before placing adjacent concrete.
- E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.
- F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to Project Manager's review.
- G. Corrosion Protection: Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.
- H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.
- I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.

- J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

- A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.
- B. Rejected Work: Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the City.
- C. Unauthorized Placement: Place no concrete except in the presence of the Project Manager. Notify the Project Manager in writing at least 24 hours before placement of concrete.
- D. Placement in Wall Forms:
 - 1. Do not drop concrete through reinforcing steel.
 - 2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.
 - 3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.
 - 4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.
 - 5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.
 - 6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.
 - 7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.
- E. Conveyors and Chutes: Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing

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- system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the City Engineer. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.
- F. **Placement of Slabs:** In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Screenshot the slab surface in an up-slope direction.
- G. **Concrete Temperature:** When placed, not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick, nor less than 50 degrees for all other sections. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.
- H. **Cold Weather Placement:** Conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.
1. Remove snow, ice and frost from surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. Warm reinforcement and embedded items to above 32 degrees F prior to concrete placement.
 2. Maintain concrete temperature above 50 degrees F for at least 3 days after placement.
- 3.04 **PUMPING OF CONCRETE**
- A. If pumped concrete does not produce satisfactory results, in the judgment of the Project Manager, discontinue pumping operations and proceed with the placing of concrete using conventional methods.

- B. Pumping Equipment: Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.
- C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.
- D. Replace pumping equipment and hoses (conduits) that do not function properly.
- E. Do not use aluminum conduits for conveying concrete.
- F. Field Control: Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

3.05 CONCRETE PLACEMENT SEQUENCE

- A. Place concrete in a sequence acceptable to the Project Manager. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.
- B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

3.06 TAMPING AND VIBRATING

- A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the City Engineer for specific locations.

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- B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.
- C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously-placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 PLACING MASS CONCRETE

- A. Observe the following additional restrictions when placing mass concrete.
1. Use specified superplasticizer.
 2. Maximum temperature of concrete when deposited: 70 degrees F.
 3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously-placed layer.

3.08 REPAIRING SURFACE DEFECTS AND FINISHING

- A. Conform to Section 03350 - Concrete Finishing.

3.09 CURING

- A. Conform to Section 03390 - Concrete Curing.

3.10 PROTECTION

- A. Protect concrete against damage until final acceptance by the City.
- B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

- C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the City Engineer.

END OF SECTION

Section 03350

CONCRETE FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Repairing surface defects.
- B. Finishing concrete surfaces including both formed and unformed surfaces.
- C. Sealing concrete surfaces.
- D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete finishing under this Section. Include payment in unit price for structural concrete.

1.03 REFERENCES

- A. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
- B. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- D. ASTM D 4587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.
- E. ASTM E 1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F Number System.

1.04 SUBMITTALS

- A. Conform to Section 01330 - Submittal Procedures

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3. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.
1. Floor hardener.
 2. Sealer.
 3. Epoxy floor topping.
 4. Epoxy penetrating sealer.
 5. Latex bonding agent.
 6. Epoxy adhesive.
 7. Abrasive aggregate.
 8. Evaporation retardant.

RT 2 PRODUCTS

2.01 MATERIALS

- A. Sealer/Dustproofer (VOC Compliant): Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D 4587. Conform to local, state and federal solvent emission requirements.
- B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C 881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.
- C. Abrasive Aggregate for Nonslip Finish: Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and nonglazing, and unaffected by freezing, moisture and cleaning materials.
- D. Epoxy Penetrating Sealer: Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to

- hydrostatic pressure from below. Color, transparent amber or gray; surface, nonslip.
- E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C 1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- F. Bonding Grout: Prepare bonding grout by mixing approximately one part cement to one part fine sand meeting ASTM C 144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially-prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.
- G. Patching Mortar:
1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.
 2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C 881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C 881, Type V.
- I. Non-shrink Grout: See Section 03600 - Structural Grout.

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- J. Spray-Applied Coating: Acceptable products are Thoro System Products "Thoro Seal Plaster Mix" or equal. Color: Gray.
- K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.
- L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 - Structural Concrete.
- M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

PART 3 EXECUTION

3.01 AGGREGATE CONCEALMENT

- A. Unless indicated otherwise on Drawings or approved by City Engineer, all surfaces to be finished shall be free of exposed aggregate.

3.02 REPAIRING SURFACE DEFECTS

- A. Defective Areas: Repair immediately after removal of forms. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than one inch. Make edges of cuts perpendicular to concrete surface. Thoroughly work bonding grout into the surface with a brush as that the entire surface is covered. Alternatively, a proprietary bonding agent may be used. Use bonding agent in accordance with manufacturer's instructions. While bonding coat is still tacky, apply premixed patching mortar. Thoroughly consolidate mortar into place and strike off to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before final finishing. Keep patched area damp for 7 days. Alternatively, a proprietary cementitious repair mortar may be used and placed in accordance with manufacturer's instructions. Do not use metal tools in finishing patches in formed walls which will be exposed.
- B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in Section 03100 - Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.

- C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval prior to making repairs.
- D. Structural Repair: When required, make structural repairs after prior approval of City Engineer as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

3.03 FINISHING OF FORMED SURFACES

- A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.
- B. Rough Form Finish:
 - 1. No form facing material is required on rough form finish surfaces.
 - 2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.
 - 3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.
- C. Smooth Form Finish:
 - 1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
 - 2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.
 - 3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.
- D. Rubbed Finish:

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1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
 2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.
 3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.
- E. **Spray-applied Coating:** At Contractor's option, in lieu of rubbed finish, spray-applied coating may be applied after defects have been repaired and fins removed. Remove form oil, curing compound and other foreign matter that would prevent bonding of coating. Apply coating in uniform texture and color in accordance with coating manufacturer's instructions.
- F. **Related Unformed Surfaces:** Tops of piers, walls, bent caps, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to texture reasonably consistent with that of formed surfaces. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.04 HOT WEATHER FINISHING

- A. When hot weather conditions exist, as defined by Section 03310 - Structural Concrete and as judged by the City Engineer, apply evaporation retardant to the surfaces of slabs, topping and concrete fill placements immediately after each step in the finishing process has been completed.

3.05 FINISHING SLABS AND SIMILAR FLAT SURFACES TO CLASS A, B, AND C TOLERANCES

- A. Apply Class A, B, and C finishes at locations indicated on Drawings.
- B. **Shaping to Contour:** Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 - Concrete Formwork for edge forms and screeds.
- C. **Consolidation and Leveling:** Concrete to be consolidated shall be as stiff as practicable Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade.

Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.

- D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

<u>Class</u>	<u>Straightedge Length in Feet</u>	<u>Tolerance in Inches</u>
A	10	1/8
B	10	1/4
C	2	1/4

- E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify City Engineer prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect raked, base-slab finish from contamination until time of topping. Provide raked finish for following:

1. Surfaces to receive bonded concrete topping or fill.
2. Steep ramps, as noted on Drawings.
3. Additional locations as noted on Drawings.

F. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.
3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.

G. Trowel Finish:

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1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional troweling by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.
3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.

H. Broom or Belt Finish:

1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.
2. Provide broom or belt finish at locations indicated on Drawings.

3.06 FINISHING SLABS AND SIMILAR FLAT SURFACES TO "F-NUMBER SYSTEM" FINISH

- A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.
- B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.
- C. Tolerances for Finished Surfaces: Independent testing laboratory will check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.
- D. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
2. Check tolerance of surface after initial floating with a 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots. Immediately refloat slab to uniform, smooth, granular texture to F_F20/F_L17 tolerance, unless shown otherwise on Drawings.
3. Provide "F-Number System" float finish at locations indicated on Drawings.

E. Trowel Finish:

1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to an F_F25/F_L20 tolerance for slabs on grade and F_F25/F_L17 for elevated slabs, unless shown otherwise on Drawings. On surfaces intended to support floor coverings, remove defects, which might show through covering, by grinding.
3. Provide "F-Number System" trowel finish at locations indicated on Drawings.

3.07 BONDED CONCRETE TOPPING AND FILL

A. Surface Preparation:

1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.
2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping

CONCRETE FINISHING

or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.

B. Concrete Fill:

1. Where concrete fill intersects a wall surface at an angle steeper than 45 degrees from vertical, provide a 1.5-inch deep keyway in the wall at the point of intersection; size keyway so that no portion of the concrete fill is less than 1.5 inches thick. Form keyway in new walls; create by saw cutting the top and bottom lines and chipping in existing walls.
2. Apply wood float finish to surfaces of concrete fill.
3. Provide concrete fill at locations shown on Drawings.

C. Bonded Concrete Topping in Bottom of Clarifiers and Thickeners:

1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.
2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.
3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.
4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the City Engineer, fill the tank with sufficient water to cover the entire floor for 14 days.
5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

3.08 EPOXY PENETRATING SEALER

- A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.

- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surface to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Provide epoxy penetrating sealer at locations indicated on Drawings.

3.09 EPOXY FLOOR TOPPING

- A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping: 1/8 inch.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: apply 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surfaces to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Finished surface shall be free of trowel marks and dimples.
- F. Provide epoxy floor topping at locations indicated on Drawings.

3.10 SEALER/DUSTPROOFER

- A. Where sealer or sealer/dustproofers is indicated on Drawings, just prior to completion of construction, apply coat of specified clear sealer/dustproofing compound to exposed interior concrete floors in accordance with manufacturer's instructions.

3.11 NONSLIP FINISH

CONCRETE FINISHING

A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.

B. Provide nonslip finish at locations indicated on Drawings.

3.12 FIELD QUALITY CONTROL

A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by City in accordance with Section 01454 - Testing Laboratory Services.

B. Tolerances for "F-Number System" finished surfaces:

1. Floor tolerance shall be determined in accordance with ASTM E 1155.

2. Floor flatness and levelness tolerances:

a. F_F defines maximum floor curvature allowed over 24 inches. Computed on the basis of successive 12-inch elevation differentials, F_F is commonly referred to as the "flatness F-Number."

$$F_F = \frac{\quad}{4.57}$$

Maximum difference in elevation, in decimal inches, between successive 12-inch elevation differences.

b. F_L defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance. F_L is commonly referred to as "levelness F-number."

$$F_L = \frac{\quad}{12.5}$$

Maximum difference in elevation, in inches, between two points separated by 10 feet.

3. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by City Engineer): 2/3 of specified tolerance.

4. Tolerance for floated finish: F_F20/F_L17 , unless otherwise shown on Drawings.
5. Tolerance for troweled finish: F_F25/F_L20 for slabs on grade, and F_F25/F_L17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

- A. Conform to requirements of Section 03390 - Concrete Curing.

END OF SECTION

Section 03390

CONCRETE CURING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Curing of structural concrete.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for structural concrete.

1.03 REFERENCES

- A. ACI 308 - Standard Practice for Curing Concrete.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- D. ASTM D 44587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.

1.04 DEFINITIONS

- A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

1.05 SUBMITTALS

- A. Conform to Section 01330 - Submittal Procedures.
- B. Product Data: Submit description of proposed curing method for concrete. When use of membrane-forming compound is proposed, submit manufacturer's technical information including material specifications, installation instructions and recommendations, and evidence that compound is satisfactory for intended application. State locations where curing compound will be used.

CONCRETE CURING

- C. When membrane-forming compounds are to be used, submit certification by the manufacturer of compliance with specified requirements and compatibility with toppings, coatings, finishes, and adhesives to be applied.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Membrane-forming Curing Compound: Conform to ASTM C 309, Type 1D, and following requirements.
1. Minimum solids content: 30 percent.
 2. Compound shall not permanently discolor concrete. When used for liquid-containing structures, curing compound shall be white-pigmented.
 3. When used in areas that are to be coated, or that will receive topping or floor covering, material shall not reduce bond of coating, topping, or floor covering to concrete. Curing compound manufacturer's technical information shall state conditions under which compound will not prevent bond.
 4. Conform to local, state and federal solvent emission requirements.
- B. Clear Curing and Sealing Compound (VOC Compliant): Conform to ASTM C 309, Type 1, Class B, and the following requirements: 30 percent solids content minimum; non-yellowing under ultraviolet light after 500-hour test in accordance with ASTM D 4587. Sodium silicate compounds are not permitted. Conform to local, state and federal solvent emission requirements.
- C. Sheet Material for Curing Concrete: ASTM C 171; waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
- D. Curing Mats (for use in Curing Method 2): Heavy shag rugs or carpets, or cotton mats quilted at 4 inches on center; 12 ounce per square yard minimum weight when dry.
- E. Water for curing: Clean and potable.

PART 3 EXECUTION

3.01 CURING PROCEDURES

- A. Comply with ACI 308 and the requirements specified herein. Protect freshly-deposited concrete from premature drying and excessively hot or cold temperatures. Maintain minimal moisture loss and relatively constant temperature during time necessary for hydration of cement and proper hardening of concrete.
- B. Unformed Surfaces: For concrete surfaces not in contact with forms, use one of following procedures immediately after completion of placement and finishing.
1. Ponding or continuous sprinkling.
 2. Absorptive mat or fabric kept continuously wet.
 3. Sand or other covering kept continuously wet.
 4. Continuous steam bath (not exceeding 150 degrees F at surface of concrete).
 5. Vapor mist bath.
 6. Membrane-forming curing compound applied according to manufacturer's recommendations. After the curing compound has dried, wet slab surfaces and cover with waterproof paper, polyethylene film, or white burlap-polyethylene sheeting after the application of the curing compound. Tape sheet seams together and provide sufficient weights to keep the sheeting in place. Wet the slab surface again if the sheeting becomes dislodged, and replace the sheeting.
 7. Other moisture-retaining coverings as approved by City Engineer.
- C. Restrictions on Use of Curing Compounds: Unless curing compound manufacturer certifies that curing compound will not prevent bond to cured surface, do not use curing compound on surfaces that will be rubbed or receive additional concrete, mortar, topping, terrazzo or other cementitious finishing materials, on slabs under resilient floors or built-up roofing, or on surfaces to be waterproofed, sealed, hardened or painted.
- D. Curing and Sealing Compounds: At locations indicated, cure exposed interior slabs and troweled slabs receiving mastic-applied adhesives with specified clear curing and sealing compound in accordance with manufacturer's recommendations. Do not store materials directly on curing membranes. Use plywood to protect curing membrane from damage. Immediately repair membranes damaged by foot traffic or other operations.

CONCRETE CURING

- E. Duration of Curing: Continue curing until cumulative number of days or fractions of days during which ambient temperature is above 50 degrees F has totaled 7. Continue curing of water-retaining structures for a total of 14 days. When high-early-strength concrete has been used, continue curing for total of 3 days. Prevent rapid drying at end of curing period.
- F. Formed Surfaces: During the curing period keep wet steel forms heated by sun and wood forms in contact with concrete. When forms are to be removed during curing period, employ curing materials or methods immediately. Continue such curing for remainder of curing period.
- G. Temperature:
1. Cold Weather. When mean daily temperature of atmosphere is less than 40 degrees F, maintain temperature of concrete between 50 and 70 degrees F for required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain required temperature and moisture conditions. Prevent damage or injury due to concentration of heat. When combustion heaters are necessary in enclosed or protected area where concrete slabs are being placed, vent heaters.
 2. Hot Weather. In advance of placement make arrangements for shading, fog spraying, sprinkling, ponding or installation of windbreaks or wet covering of light color. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
 3. Temperature Changes. Control so rate of change in temperature of concrete is as uniform as possible. Do not permit temperature change to exceed 5 degrees F in any one hour or 50 degrees F in any 24-hour period.
- H. Protection from Mechanical Injury. During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water. Do not load self-supporting structures in a way that over stresses concrete.

3.02 CURING MASS CONCRETE

- A. Observe the following additional restrictions when curing mass concrete.
1. Minimum curing period: 2 weeks.

2. When ambient air temperature falls below 32 degrees F, protect surface of concrete against freezing.
3. Do not use steam or other curing methods that will add heat to concrete.
4. Keep forms and exposed concrete continuously wet for at least the first 48 hours after placing, and whenever surrounding air temperature is above 90 degrees F during final curing period.
5. During 2-week curing period, provide necessary controls to prevent ambient air temperature immediately adjacent to concrete from falling more than 30 degrees F in 24 hours.

END OF SECTION

Section 03600

STRUCTURAL GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-shrink grout used wherever grout is shown in the Documents, unless another type is specifically referenced. Two classes of non-shrink grout (Class I and II) and areas of application are specified.

1.02 UNIT PRICES

- A. Include the cost for grout in the lump sum for each structure in which it will be used. No separate payment will be made for grout.
- B. Measurement for extra grout (Class I and II) is on cubic foot basis. Payment includes associated work performed in accordance with related sections included in the Contract Documents.
- C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. CRD C 621 - Corps of Engineers Specification for Non-shrink Grout
- B. ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
- C. ASTM C 230 - Specifications for Flow Table for use in Tests of Hydraulic Cement
- D. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.04 SUBMITTALS

- A. Conform to Section 01330 - Submittal Procedures.
- B. Quality Control:
 - 1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.

STRUCTURAL GROUT

2. The Contractor shall submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. The Contractor shall submit manufacturer's written warranty as specified.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Project Manager to ensure continued compliance with these Specifications. The specimens will be made by the Project Manager or its representative.
2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Project Manager. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the City.
4. The cost of laboratory tests on grout will be borne by the City, but the Contractor shall assist the Project Manager in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.

B. Warranty:

1. Provide one-year warranty for work provided under this Section.
2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.
3. Manufacturer shall warrant participation with Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.01 APPLICATION

- A. The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

Application:	Type of Grout
Structural member base plates	Non-shrink Class II
Storage tanks and other equipment	Non-shrink Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-shrink Class II (Class I where placement time exceeds 15 minutes)
Under precast concrete elements	Non-shrink Class I
Toppings and concrete fill less than 3 inches thick	Concrete Topping per Section 03310 – Structural Concrete

Application:	Type of Grout
Toppings and concrete fill greater than 3 inches thick	Concrete Topping per Section 03310 – Structural Concrete
Any application not listed above, where grout is called for on the Drawings	Non-shrink Class I, unless noted otherwise

2.02 PREPACKAGED GROUTS

A. **Basic Requirements for Cementitious Non-Shrink Grout**

1. Provide prepackaged non-shrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.
2. Deliver grout in original packaging with manufacturer's instructions printed on each container.
3. Select the specific formulation for each class of non-shrink grout specified to conform to that recommended by the manufacturer for the particular application.
4. Compressive strength at 28 days: 7000 psi minimum.

STRUCTURAL GROUT

5. Do not use a grout for which the non-shrink property is based on a chemically generated gas or gypsum expansion.

B. Class I Non-Shrink Grout:

1. Supply Class I Grout conforming to these specifications and to CRD C 621 and ASTM C 1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:
 - a. Fluid consistency (20 to 30 seconds) per CRD C 611 at initial testing.
 - b. Fluid consistency (45 seconds) per CRD C 611 at 30 minutes after mixing.
 - c. At temperatures of 45, 73.4, and 95 degrees F.
2. To satisfy non-shrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.
3. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.
4. Demonstrate in tests that grout maintains contact with the baseplate to provide an minimum effective bearing area of 95 percent of the gross contact area after final set.
5. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

C. Class II Non-Shrink Grout:

1. Supply Class II Grout confirming to ASTM C 1107 and the following requirements when tested using the amount of water needed to achieve the following properties:
 - a. Flowable consistency: 140 percent flow on ASTM C 230, five drops in 30 seconds.
 - b. Fluid working time: 15 minutes, minimum.

c. Flowable duration: 30 minutes, minimum.

2. When tested, the grout shall not bleed at maximum allowed water.

2.03 CURING MATERIALS

A. Curing materials: As specified in Section 03390 - Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

2.04 CONSISTENCY

A. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that base concrete or masonry has attained design strength before grout is placed.

B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.02 GROUTING PROCEDURES

A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.03 CONSOLIDATION

A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

Section 03931

CONCRETE REPAIR AND REHABILITATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Repair of cracks, holes and surface defects, and repair of deteriorated concrete surfaces.
- B. Installation of embedded items into existing concrete.

1.02 UNIT PRICES

- A. Measurement for repair materials for Sanitary Sewer Pipe Crown Repair is on Linear Foot as bid. Payment includes work performed on the Crown Repair on this Sanitary Sewer Pipe in accordance with related sections included in the Contract Documents.
- B. Measurement for repair materials is on a lump-sum basis for each structure as bid. Payment includes work performed on these structures in accordance with related sections included in the Contract Documents.
- C. Measurement for extra removal of deteriorated concrete and placement of repair mortar is on a cubic-foot basis. Measurement for other repair materials is as defined in the appropriate related sections. Payment includes associated work performed in accordance with related sections included in the Contract Documents.
- D. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ASTM C 109 - Compressive Strength of Hydraulic Cement Mortars.
- B. ASTM C 881 - Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ASTM C 882 - Bond Strength of Epoxy-Resin Systems Used with Concrete.

1.04 SUBMITTALS

- A. Under provisions of Section 01330 -Submittal Procedures, submit manufacturer's product information, installation instructions and

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← recommendations, and certification of compliance with required properties for all repair materials.

1.05 REPAIR SCOPE

- A. Patch and fill openings in existing concrete indicated to be patched or filled.
- B. Patch, fill holes in and otherwise repair damage to concrete and concrete surfaces resulting from removal of penetrating pipes and other embedded items, from installation of pipes or other items embedded in or passed through concrete, and from other construction activities.
- C. Crack Repair: Repair the full length of cracks in concrete members in new structures, and in existing structures as follows:
- D. Deteriorated Concrete:
 - 1. Repair interior concrete surfaces showing signs of deterioration in the following existing structures:
 - 2. The level of deterioration of the concrete varies within each of the listed structures. For bidding purposes, average depth of deteriorated concrete walls and undersides of top slabs is assumed to be one inch. Repair for the portion exceeding one inch in depth, as measured from the existing wall surface, will be paid as extra work as defined above.
- E. Make other repairs to existing structures as follows:

1.06 QUALITY ASSURANCE

- A. Field Tests of Cement-based Grouts:
 - 1. Compression test specimens will be prepared during construction by the City Engineer, or his authorized representative, from the first placement of each type of mortar or grout, and at intervals thereafter as determined by the City Engineer, to ensure continued compliance with these specifications.
 - 2. Specimen preparation and compression testing for repair mortar and non-shrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for testing at 7 days, 28 days, and additional testing as appropriate.
 - 3. Material failing to meet Contract requirements is subject to removal, and replacement with new material meeting requirements, at no additional cost to the City.

4. Cost of laboratory tests on mortar and grout will be borne by the City, except Contractor shall pay for tests failed, and additional testing and investigation work performed because of work not meeting Contract requirements.
 5. Contractor shall supply all materials necessary for fabricating test specimens and assist the Project Manager in obtaining specimens for testing.
- B. Repair concrete shall be tested as required in Section 03310 - Structural Concrete.
- C. Epoxy grout shall be tested as required in Section 03600 - Structural Grout.
- D. Chemical Grout:
1. Installer: A waterproofing contractor with a minimum of 3 years experience in the installation of chemical grout systems as specified herein, and shall be certified or approved by the manufacturer.
 2. Waterproofing contractor shall submit a list of 5 previous jobs successfully completed by that firm that successfully utilized the specified chemical grout system.
- E. Construction Tolerances: As specified in Section 03100 - Concrete Formwork, and Section 03350 - Concrete Finishing, except as otherwise indicated.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

- A. Repair Mortar: Prepackaged polymer-modified cement-based product specifically formulated for repair of surface defects in concrete, having the following properties:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Standard</u>
Compressive Strength (minimum)		C 109
1 day		2000 psi
28 days	6000 psi	
Bond Strength (minimum)		C 882 (modified)
1 day		1200 psi
7 days	2000 psi	

B. Manufacturer and Product: Emaco by Master Builders, SR93 by Euclid Chemical Company, Sikacem by Sika Corporation, Five Star Structural Concrete by Five Star Products, Inc., or equal. Where the manufacturer offers products in formulations intended for specific application conditions such as overhead and shotcrete application, use the formulation recommended by the manufacturer for the condition required.

C. Minimum Repair Thickness: 0.50 inch.

2.02 NON-SHRINK GROUT

A. Non-shrink Grout: Comply with requirements of Section 03600 - Structural Grout.

2.03 CONCRETE MATERIALS

A. Cement: Type II Portland cement, unless indicated otherwise. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, blend white Portland cement with Type II cement as needed to match the color of adjacent existing concrete surface.

B. Repair Concrete: Class A (4000 psi) concrete with one-inch maximum coarse aggregate, complying with Section 03310 - Structural Concrete; minimum repair thickness, 2 inches.

C. Cement Grout: Comply with Section 03600 - Structural Grout; minimum repair thickness, one inch.

D. Curing Materials, Bonding Agents, and Other Miscellaneous Materials: Comply with Section 03310 - Structural Concrete and Section 03390 - Concrete Curing.

2.04 AGGREGATE

A. Aggregate for Extending Repair Mortar and Non-shrink Grout Products: 3/8 inch clean, washed gravel or crushed stone complying with Section 03390 - Concrete Curing.

2.05 CHEMICAL GROUT

A. Chemical Grout: Hydrophobic urethane or polyurethane material of low viscosity suitable for pumped injection into cracks, which reacts with water to form a closed-cell foam material that completely fills and seals all cracks against leakage. Cured material shall remain elastic and maintain an expansive pressure through repeated wet-dry cycles.

- B. Manufacturer and Product: Scotch Seal 5600 by the Adhesives, Coatings, and Sealers Division of 3M Products; Flex LV by De Neef America, Inc.; SikaFix by Sika Corporation; or equal. Use different formulations in the same family of materials, accelerators, and other materials necessary for installation where recommended by the manufacturer for specific application conditions.
- C. Reacted and cured chemical grout shall be resistant to organic solvents, mild acids, alkali and micro-organisms. Cured material shall be approved for use with potable water by the appropriate federal, state, or local government agency.

2.06 EPOXY PRODUCTS

- A. Epoxy Grout: Comply with Section 03600 - Structural Grout, modified as specified herein.
- B. Epoxy for Crack Injection: ASTM C 881, Type IV; low viscosity, moisture-insensitive material specifically formulated for that use; 2500 psi minimum bond strength when tested in accordance with ASTM C 882 at 14 days, moist cured.

2.07 SEALANT

- A. Sealant: 2-part polyurethane.

2.08 FORMWORK

- A. Formwork, Where Needed: Comply with Section 03100 - Concrete Formwork.

2.09 REINFORCEMENT

- A. Reinforcement, Where Required: Comply with Section 03211 - Reinforcing Steel.

2.10 RESILIENT WATERSTOP

- A. Resilient Waterstop.

PART 3 EXECUTION

3.01 PREPARATION AND CURING

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- A. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, installed repair material shall match adjacent concrete surface in color.
- B. Surface Preparation:
1. Clean entire area to be repaired of laitance, foreign material and loose or deteriorated concrete by chipping, hydroblasting or sandblasting; further roughen surfaces as specified herein. Where non-shrink grout or repair mortar is used, perform any additional surface preparation steps recommended by the manufacturer.
 2. Where cementitious repair materials are used, maintain surfaces to be repaired in a saturated surface dry condition and prevent concrete from drying until repair operations are completed. Re-wet surfaces to be repaired by water spray on at least a daily basis. Remove standing water in areas to be repaired prior to placement of repair material. Provide means to remove excess water from the structure.
 3. Where repair material manufacturer recommends use of an epoxy bonding agent, follow recommendations of both the repair material and epoxy bonding agent manufacturers.
- C. Fully consolidate repair material, completely filling all portions of areas to be filled.
- D. Bring repair surfaces into alignment with adjacent existing surfaces to provide uniform, even surfaces. Unless indicated otherwise, repair surfaces shall match adjacent existing surfaces in texture and receive coatings or surface treatments provided for adjacent existing surfaces.
- E. Curing:
1. Cure repair mortar and non-shrink grout according to manufacturer's recommendations, except that minimum cure period shall be 3 days.
 2. Cure other materials in accordance with Section 03390 - Concrete Curing.
 3. If manufacturer recommends use of a curing compound, use no material that would interfere with the bond of any coating or adhesive required to be applied to the surface.

3.02 TREATMENT OF SURFACE DEFECTS

- A. Definition - Surface Defects: Depressions in concrete surfaces not extending all the way through a member, caused by physical damage, unrepaired rock

pockets created during original placement, spalling due to corroded reinforcing steel or other embeds, or removal of embedded items or intersecting concrete members.

B. Preparation:

1. Remove loose, damaged concrete by chipping to sound material.
2. Where existing reinforcing bars are exposed, remove concrete at least one inch deep all around the exposed bars. If the existing bars are cut through, cracked, or cross-sectional area is reduced by more than 25 percent, notify City Engineer immediately.

C. Repair Material:

1. Use only repair mortar to repair surface defects in members normally in contact with water or soil, and defects in interior surfaces of structures which are intended to contain water.
2. Repair of other surface defects may be by application of repair mortar, repair concrete or cement grout, as appropriate.

3.03 PATCHING OF HOLES IN CONCRETE

A. General:

1. **Definition - Holes:** For the purposes of this section, holes are defined as penetrations completely through a concrete member, with interior surfaces approximately perpendicular to the surface of the existing member. Chip interior surface areas which are inclined and do not meet this criterion as necessary to meet this requirement.
2. Perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments. Provide at least the minimum placement depth specified for the material used at all locations. Score existing concrete by sawcutting and chip as needed to meet this requirement.
3. Roughen the interior surface of holes less than 12 inches in diameter to at least 0.125 inch amplitude. Roughen larger holes to at least 0.25 inch amplitude.
4. At holes not filled with repair mortar or non-shrink grout, and where otherwise recommended by the repair material manufacturer, coat existing surfaces to be repaired with epoxy bonding agent.

5. Where a surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing concrete, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout. Roughen the surface of the repair material when placed to improve bond with the cement grout.

B. Patching Small Holes:

1. Fill holes less than 12 inches in least dimension and extending completely through concrete members with repair mortar or non-shrink grout.
2. Fill holes in members normally in contact with water or soil with Class I non-shrink grout in accordance with Section 03600 - Structural Grout.

C. Patching Large Holes:

1. Fill holes larger than 12 inches in least dimension with repair concrete, repair mortar or non-shrink grout.
2. Provide large holes normally in contact with water or soil and not filled with Class I non-shrink grout with resilient waterstop placed in a groove approximately 0.25 inch deep ground into the interior edge of the hole at the center of the wall providing a smooth surface in which to place the resilient waterstop. Alternatively, bond bentonite waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.
3. Provide reinforcing steel in layers matching existing reinforcement locations, except provide concrete cover required by the Contract Documents for the applicable service condition.
4. For holes smaller than 48 inches, reinforcement shall be at least #5 bars on 12 inch centers in each layer required. At all holes larger than 30 inches, drill and grout the reinforcement into the existing concrete.
5. For holes larger than 48 inches, see the drawings for reinforcement details.

3.04 PATCHING OF LINED HOLES

- A. These provisions apply to openings which have embedded material over all or a portion of the inside edge. Requirements for repairing holes in concrete specified above shall apply as modified herein. The City Engineer will determine when the embedded material is allowed to remain.

- B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface. Roughen or abrade the embedded material to promote good bonding to the repair material. Completely remove any substance that interferes with good bonding.
- C. Completely remove embedded items not securely and permanently anchored in the concrete.
- D. Completely remove embedded items larger than 12 inches in least dimension unless composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, weld it to the embedded metal.
- E. The following additional requirements apply to concrete in contact with water or soil.
 - 1. Fill lined openings less than 4 inches in least dimension with epoxy grout.
 - 2. Coat lined openings greater than 4 inches but less than 12 inches in least dimension with an epoxy bonding agent prior to filling with Class I non-shrink grout.
 - 3. Coat lined openings greater than 12 inches in least dimension with an epoxy bonding agent and bond bentonite waterstop to the interior of the opening prior to filling with approved repair material.

3.05 INSTALLATION OF PIPES AND FRAMES

- A. The following applies to installation of permanent pipes and frames in openings cut into existing concrete members.
- B. Cut opening to a size which is a minimum of one inch and a maximum of 3 inches larger than the outside edge of the embedded item. At openings with sharp corners, take care not to sawcut beyond the opening so as to damage existing reinforcing bars. At openings which are greater than 24 inches in least dimension, chip a keyway into the center of the wall. Keyway shall be at least 1.5 inches in depth and from 3 inches to 1/3 the member thickness in width. All surfaces except at the keyway shall be perpendicular to the member surface as specified herein for patching holes.
- C. Provide embedded items with a flange or other positive means of anchorage to repaired members. At members in contact with soil or water, provide continuous waterstop flanges around embeds. Where concrete pipe will be embedded, provide resilient waterstop around pipe at wall centerline.

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- D. Roughen the interior surface of openings to at least 1/4-inch amplitude. Sandblast the embed surface to be in contact with concrete clean to promote good bonding to the repair material.
- E. Fill the space between the frame and the existing concrete with Class I non-shrink grout.
- F. Where surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing material, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout.

3.06 NON-FIXED INSTALLATION OF PIPES

- A. The following applies to installation through existing concrete of piping to be sealed with adjustable linked seals, resilient connectors, or packing and sealant. When more appropriate, City Engineer may require installation of a sleeve instead of the core-drilled hole specified herein.
- B. Size core-drilled opening to permit installation of the required seal; locate to minimize cutting of existing reinforcing steel.
- C. Where linked or resilient seals are to be installed, coat the interior surface of the opening with epoxy at least 1/8 inch thick for a smooth and even surface promoting a good seal.
- D. Where packing and sealant are required, seal exposed reinforcing bars with at least an 1/8-inch thick layer of epoxy extending 1/2 inch beyond the bars on all sides. Prepare the surface of the cut concrete and the pipe as recommended by the sealant manufacturer.

3.07 GENERAL CRACK REPAIR

- A. Repair cracks identified by the Project Manager as caused by shrinkage or thermal movement by injection with chemical grout as specified herein.
- B. Repair cracks not caused by shrinkage or thermal movement by epoxy injection or as otherwise directed by the Project Manager.

3.08 CHEMICAL GROUT CRACK REPAIR

- A. Inject chemical grout into all cracks as directed by the Project Manager in those structures included in the scope of work listed herein in accordance with the chemical grout manufacturer's installation instructions and recommendations.

- B. Location of Injection Ports: Locate injection ports as recommended by the chemical grout manufacturer and as needed to insure complete penetration of the joint or crack with the grout. Spacing of injection ports shall not exceed 2 feet.
- C. Drilling Ports: Drill holes for injection ports to the depth needed for proper distribution of the chemical grout. Take care to not damage any reinforcing steel.
- D. Port preparation: Clean holes for injection ports of all debris and fit with an injection fitting as provided by the manufacturer of the chemical grout, or equal. Install injection fittings in accordance with manufacturer's instructions; allow fittings to remain in place until chemical grout injection work is complete in that area. Install caps or valves at injection ports to prevent back flow of uncured chemical grout after it has been injected.
- E. Chemical Grout Injection:
 - 1. Follow instructions and recommendations of the chemical grout manufacturer and its representatives for chemical grout mixing and injection procedures.
 - 2. Seal cracks at the surface where needed to assure complete penetration of injected chemical grout and prevent loss of material.
 - 3. Prior to chemical grout injection, inject water into ports to provide water for the reaction process, flush out foreign matter and verify continuity between adjacent ports. Inject water into each port until it begins to flow from an adjacent or nearby port.
 - 4. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, notify the Project Manager immediately.
 - 5. Beginning at the lowest injection port, inject chemical grout until the grout begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, port-to-port travel of the injection process will be from low to high in a continuous operation.
 - 6. If port-to-port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the Project Manager.
 - 7. Avoid sudden application of high pressure during the injection process.

8. After completion of the grouting operation, remove all ports and surface sealing materials leaving an undamaged surface.

3.09 EPOXY CRACK REPAIR

- A. Inject epoxy into all cracks in damaged concrete as indicated by the City Engineer in structures included in the scope of work listed herein. Follow installation instructions and recommendations of the epoxy manufacturer.
- B. Inject cracks with sufficient pressure to ensure full penetration of epoxy but without causing further damage.
- C. Location, drilling and preparation of ports for injection: As specified for chemical grout herein.
- D. Epoxy Injection:
1. Follow instructions of the epoxy manufacturer and its representatives for all mixing and injection procedures.
 2. Seal all cracks at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.
 3. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.
 4. If port-to-port continuity does not occur, mark the location and notify Project Manager.
 5. Avoid sudden application of high pressure during the injection process.
 6. After completion of injection operations, remove all ports and surface sealing materials to leave an undamaged surface.

3.10 REPAIR OF DETERIORATED CONCRETE

- A. These provisions pertain to concrete damaged by abrasion, chemical attack or corrosion of reinforcing steel. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner or other protective material, coordinate finishing details with the liner material manufacturer.
- B. Surface Preparation:

1. Remove loose, broken, softened and acid-contaminated concrete to sound, uncontaminated concrete.
2. Notify the City Engineer when removal of deteriorated concrete is complete. Schedule two weeks for the City Engineer to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be needed. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, schedule another two week period for further evaluation after completion of the additional removal.
3. Follow repair mortar manufacturer's instructions for additional surface preparation.

C. Repair Mortar Placement:

1. Follow manufacturer's recommendations for mixing and placement of repair mortar. After the initial mixing of the repair mortar, do not add additional water to change the consistency should the mix begin to stiffen.
2. Place repair mortar to the minimum thickness recommended by manufacturer but not less than 1/2 inch. Should there be areas where less than the minimum repair mortar depth of concrete is removed, Contractor may remove additional concrete to attain the minimum repair mortar thickness or may place repair mortar so as to increase the original thickness of the member. In any case, add repair mortar so that minimum cover over existing reinforcing steel is 2 inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, do not feather the repair mortar at the transition. Sawcut a score line to not less than the minimum repair mortar depth and chip concrete out to it to form the transition. Take care not to cut or otherwise damage reinforcing steel.
3. Finish repair mortar in an even, uniform plane to restore the member to its original surface. Out-of-plane tolerance: No localized depressions or projections; 0.25 inch maximum gap between repair mortar surface and a 10-foot straight edge in any orientation at any location.

D. Finishing:

1. Apply a smooth magnesium float finish to repair mortar.

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2. When completed: No sharp edges. Exterior corners, such as at penetrations: One-inch radius. Interior corners: Square, except 2-inch repair mortar fillet at corners to receive PVC lining.

END OF SECTION

Section 09917

CORROSION PROTECTIVE COATING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Application of a corrosion protective coating system to existing junction boxes, manholes and/or sanitary sewer pipe, as depicted on the plans.

1.02 RELATED SECTIONS

- A. Section 02427– Plastic Liner for Large Diameter Concrete Sewer and Structures
- B. Section 02555 – Manhole Rehabilitation
- C. Section 03931 – Concrete Repair and Rehabilitation
- D. Section 09918 – Grouted in Place Lining of Sewers and Manholes with Profiled PVC

1.03 UNIT PRICES

- A. No separate payment will be made for protective coatings unless specifically listed in Document 00410 – Schedule of Unit Price Work. Include payment for protective coatings in unit prices for items to which coatings are applied.
- B. Measurement for protective coatings, when included as a separate pay item, is on a square-foot basis for completed protective coating systems.
- C. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide the corrosion protective coating systems specified in this section and apply this coating in accordance with the manufacturer's recommendations.
- B. The completed coating system shall coat the junction box and/or manhole with a corrosion protective coating to prevent deterioration from contact with sewage, hydrogen sulfide and other corrosive compounds within the wastewater stream.

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- C. The repair mortar and epoxy topcoat must share the same epoxy matrix to ensure a bonded weld at the molecular level in order to prevent migration of bacteria and sewer gasses throughout the monolithic system.
- D. Upon project completion, the Contractor shall provide a certification that the corrosion protective coating was applied in accordance with the procedures recommended by the manufacturer.

1.05 REFERENCES

- A. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
- B. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- C. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- E. ASTM D2584 – Standard Test Method for Ignition Loss of Cured Reinforced Resins.
- F. ASTM D2240 – Durometer Standard Test Method for Rubber Property- Durometer Hardness.
- G. ASTM D543 – Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
- H. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- I. ASTM C579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes.
- J. ASTM D4414 – Standard Practices for Measurement for Wet Film Thickness by Notch Gages.
- K. ASTM E84- Surface Burning Characteristics of Building Materials(
- L. BSS 7239-88-Toxic Smoke Generation Upon Combustion (important to have for confined space work)
- M. NACE- Published Standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

1.06 SUBMITTALS

- A. Make submittals in accordance with Section 01330 – Submittal Procedures and Section 01340 – Shop Drawings, Product Data, and Samples.
- B. Submit the following information at least 30 days prior to corrosion protective coating work:
 - 1. Coating Manufacturer's Information: For each coating system to be used, submit the following data:
 - a. Coating Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Coating Manufacturer's instruction and recommendations on surface preparation and application.
 - d. Colors available for each product, where applicable.
 - e. Compatibility of shop and field applied coats, where applicable.
 - f. Material Safety Data Sheet for each product used.
- C. Samples
 - 1. Submit color samples of coating materials on 8 ½-inch by 11-inch sheet metal or heavy cardstock. Have each sheet completely coated over its entire surface with one coating material, type, and color.
 - 2. Provide two sets of color samples to match each color selected by the City Engineer from the manufacturer's standard color sheets. If custom-mixed colors are indicated, prepare color samples using color formulations prepared to match the color samples furnished by the City Engineer.

1.07 QUALIFICATIONS

- A. Where corrosion protective coatings are to be applied by a subcontractor (Applicator), employ and Applicator who possesses a valid state license as required for performance of coating work called for in this Specification.
- B. Submit five (5) recent references which show that the coating Applicator has previous successful experience with the indicated or comparable coating

CORROSION PROTECTIVE COATING SYSTEM

systems in the last three (3) years. Include the name, address, and the telephone number for the owner of each installation for which the coating Applicator provided the protective coating.

- C. The coating Applicator has been manufacturer certified, trained and approved in the handling, mixing and application of the products to be used.
- D. Certification that the equipment to be used for applying the products has been manufactured or approved by the coating manufacturer and the coating Applicator personnel have been trained and certified for proper use of the equipment.
- E. Approved Equal Submittal: In order to be considered as an equal product, said product will have to meet the minimum physical properties of the approved products as referenced in Paragraph 2.02, as measured by the applicable ASTM standards referenced in Paragraph 1.05. Testing results must be performed and presented by a third-party testing laboratory.

Equal products must be submitted to the City Engineer for approval. A coating Applicator that has been trained and certified by the manufacturer must install all products.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Ventilate area where coating is being applied. Post and enforce "NO SMOKING OR OPEN FLAME" signs until coating has cured.
- B. Provide lighting level of 80-foot candles (860 lx) measured mid-height at substrate surface.
- C. Restrict worker access and construction traffic from area where coating is being applied or is curing.

1.09 WARRANTY

- A. Contractor shall extend the standard one (1) year materials and installation warranty one (1) additional year for a total of two (2) years for the coating material used in the rehabilitation of Manholes, Junction Boxes and Sanitary Sewer Pipe (other than the main line pipe designated on the Plans to be rehabilitated with materials per Sections 02504 and 02550).
- B. Warranty Inspection
 - 1. A warranty inspection may be conducted during the eleventh (11th) and twenty-third (23rd) months following completion of corrosion protective coating. The Contractor and a representative of the coating material manufacturer shall attend this inspection, along with a City representative. The warranty inspections shall comprise a Television

- Inspection, any required traffic control, and any required coordination with the City Wastewater Operations to manipulate flows. No separate payments will be made for the Warranty Inspections. Include such work in the cost of the line work.
2. The City Engineer may, by written notice to the Contractor, reschedule the warranty inspections to other dates within the two (2) year warranty period, or may cancel the warranty inspections altogether. Cancellation of the warranty inspections does not relieve the Contractor of his responsibilities under the Contract Documents.
 3. Repair defective work discovered during the warranty inspections in accordance with these Specifications.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the epoxy coating. Generally, 28 days is adequate cure time for standard Portland. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred. (Note: Bond strength of the coating to the concrete surface is generally limited to the tensile strength of the concrete itself.)
- B. Patching and repair materials shall be 100% solids, solvent free Epoxy Grout formulated for Epoxy Top Coating compatibility to provide smooth surface profile for Top Coating. Project specific submittals and procedures should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the Epoxy Coating.
- C. Remove existing coatings prior to application of the new Epoxy Coating. Applicator is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.02 COATING CRITERIA

- A. Compatibility: In any coating system, use only approved and compatible materials from a single source and manufacturer.
- B. Containers: Supply coating material in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all plainly legible at the time of use.

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- C. Colors: Use color and shades of colors of all coats of coatings as selected by the City Engineer. Make each coat of a slightly different shade to facilitate inspection of surface coverage of each coat. The City Engineer will select finish colors from the manufacturer's standard color samples.
- D. Thickness: Coating thickness shall be designed for hydrostatic loading.
- E. Substitute or Equal Products:
1. To establish equality under Section 01630 – Product Substitution Procedures, furnish satisfactory documentation from the manufacturer of the proposed substitute product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Resistance to abrasion and physical damage.
 - b. Resistance to chemical attack.
 - c. Life expectancy.
 - d. Ability to recoat in future.
 - e. Solids content by volume.
 - f. Dry film thickness per coat.
 - g. Compatibility with other coatings.
 - h. Suitability for the intended service.
 - i. Temperature limitations in service and during application.
 - j. Type and quality of recommended undercoats and topcoats.
 - k. Ease of application.
 - l. Ease of repairing damaged areas.
 - m. Stability of colors.
 2. For substitutions, submit protective coating materials which are standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, provide the City Engineer with the names of not less than ten successful applications of the proposed manufacturer's products which comply with these requirements.

2.03 COATING PRODUCT

- A. Contractor shall use City of Houston Approved Products List for rehabilitation and corrosion protection of existing Junction Boxes, Manholes, Sanitary Sewer Pipe (at selected locations indicated on the Contract Drawings) and corrosion protection of proposed RCP manhole risers.

2.04 REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the City Engineer and coating Applicator. Repair materials must be compatible with the specified coating and shall be applied in accordance with the manufacturer's recommendations.
- B. The following product may be accepted and approved as compatible repair basecoat materials for epoxy topcoating for use within the specifications.
1. 100% solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. The epoxy grout manufacturer shall provide instruction for trowel or spray application and for epoxy topcoating procedures.

2.05 CORROSION PROTECTIVE COATING

- A. 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance acceptable to these specifications:

<u>Product Type</u>	<u>Amine cured epoxy</u>
Color	Blue, White or Light Grey
Solids Content (vol %)	100
Mix Ratio	3:1 or as required by System
Compressive Strength, psi	11,000
Tensile Strength, psi	2,600
Tensile Elongation, %	4
Flexural Modulus, psi	400,000
Hardness, Type D	88
Bond Strength – Concrete >	400 psi
Chemical Resistance:	
Severe Municipal Sewer:	All types of service
Successful Pass:	Sanitation District of L.A. County Coating Evaluation Study

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

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- A. Require the coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable or associate with manufacturer's products.
- B. For submerged and severe service coating systems, require the coating manufacturer to furnish the following services:
 - 1. At least 8 hours of on-site instruction on the proper surface preparation, use, mixing, application, and curing of the coating system.
 - 2. Observe action of the start of surface preparation, mixing, and application of the coating materials for each coating system by the manufacturer's representative.

3.02 WORKMANSHIP

- A. Use skilled craftsmen and experienced supervision.
- B. Apply corrosion protective coating to produce an even film of uniform thickness. Give special attention to edges, corners, crevices, and joints. Ensure thorough cleaning and an adequate thickness of coating material. Apply corrosion protective coatings to produce finished surfaces free from runs, drop, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Effect complete hiding so that the addition of another coat would not increase the hiding. Give special attention to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas. Protect installations by use of drop cloths or other precautionary measures.
- C. If surfaces are damaged, clean, repair, and refinish to original condition.

3.03 EXAMINATION

- A. All structures to be coated shall be readily accessible to the coating Applicator.
- B. Appropriate actions shall be taken to comply with local, state, and federal regulatory and other applicable agencies with regard to environment, health and safety.
- C. Any active flows shall be dammed plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert. All extraneous flows into the manhole or vaults at or above the area coated shall be plugged and/or diverted until the epoxy has set hard to the touch.

- D. Installation of the corrosion protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.
- E. Temperature of the surface to be coated should be maintained between 40 degree F and 120 degree F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated.

3.04 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. **Manufacturer's Recommendations:** Unless otherwise indicated, strictly comply with the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating.
- B. Use corrosion protective coating materials within the manufacturers recommend shelf life.
- C. **Storage and Mixing:** Store coating materials under conditions recommended by the Material Safety Data Sheets. Keep coating materials thoroughly stirred, strained and with uniform consistency during application. Do not mix coatings of different manufacturers.

3.05 SURFACE PREPARATION

- A. Applicator shall inspect all specified surfaces prior to surface preparation. Applicator shall notify the City Engineer of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair material and/or corrosion protective coating.
- B. Applicator shall perform all surface preparation and corrosion protective coating installation.
- C. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the repair materials and/or corrosion protective coating to be applied. Surfaces to receive repair materials and/or corrosion protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a

CORROSION PROTECTIVE COATING SYSTEM

strong bond between the repair materials and/or corrosion protective coating and the substrate.

- E. Infiltration shall be stopped by using a material which is compatible with the repair materials and is suitable for topcoating with the corrosion protective coating.
- F. All surfaces should be inspected by the Inspector during and after preparation and before the repair material is applied.

3.06 PREPARATION FOR COATING

- A. **Cleaning and Touch-up:** Clean and prepare surfaces to receive corrosion protective coatings using water blasting or abrasive blasting in accordance with the manufacturer's recommendations. Examine surfaces to be coated. Correct surface defects before application of any coating material. Touch up marred or abraded spots on shop-primed and on factory-finished surfaces prior to coating application. Verify that surfaces to be coated are dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Protect surfaces which are not to receive corrosion protective coatings during surface preparation, cleaning, and coating operations.
- C. **Remove, mask or otherwise protect hardware, grease fittings, machined surfaces, nameplates on machinery, and other surfaces not to be coated.** Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect the working parts of mechanical and electrical equipment from damage during surface preparation and coating operations. Mask openings in motors to prevent entry of coating or other materials.
- D. **Do not damage adjacent work during blast cleaning operations.** Conduct spray operations under carefully controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Coated Surfaces:** Coordinate cleaning and coating so that dust and other contaminants from the cleaning process will not fall on we, newly-coated surface.

3.07 APPLICATION OF REPAIR MATERIALS

- A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Contract Drawings or manufacturer's recommendations.
- B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces.

The material thickness shall be specified according to manufacturer's recommendations.

- C. Cementitious repair materials shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the corrosion protective coating. No bug holes or honeycomb surfaces should remain.
- D. The repair material shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified corrosion protective coating.
- E. After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to corrosion protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast, or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair material and prior to application of the corrosion protective coating.
- F. All surfaces should be inspected by Inspector during and after preparation and before the corrosion protective coating is applied

3.08 APPLICATION OF CORROSION PROTECTIVE COATING

- A. Application procedures shall conform to the recommendations of the corrosion protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.
- B. The spray equipment shall be specifically designed to accurately ratio and apply the specified corrosion protective coating materials and shall be regularly maintained and in proper working order.
- C. The corrosion protective coating material must be spray applied by a Certified Applicator of the corrosion protective coating manufacturer.
- D. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, corrosion protective coating as further described herein. Spay application shall be a minimum wet and dry thickness as defined below with a minimum of two coats:

Composite System: ½" minimum approved epoxy grout repair
 plus 250 mils epoxy topcoat.

- E. If necessary, subsequent topcoating or additional coats of the corrosion protective coating should occur as soon as the basecoat becomes tack free,

CORROSION PROTECTIVE COATING SYSTEM

but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

- F. Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired. Sloped surfaces of the floor may be made non-skid by broadcasting aluminum oxide or silica sand into the surface prior to gelation.

3.09 CURING OF COATS

- A. Maintain curing conditions in accordance with the recommendations of the coating material manufacturer and this Section, whichever is the most stringent. Complete curing before placing the coating systems into service.
- B. In the case of enclosed areas, force air ventilation using heated air if necessary, may be required until the coatings have fully cured.
- C. Forced Air Ventilation of Enclosed Hydraulic Structures: Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods, continuously exhaust air from the lowest level of the structure using portable ducting. After interior coating operations have been completed, provide a final curing period for a minimum of 10 days, operating the forced air ventilation system continuously.

3.10 SHOP AND FIELD INSPECTION AND TESTING

- A. Give the City Engineer a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work.
- B. Perform surface preparation and coating applications in the presence of the City Engineer, unless the City Engineer has granted prior approval to perform such Work in his absence.
- C. Inspection by the City Engineer, or the waiver of inspection of any particular portion of the work, does not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.
- D. Erect and move scaffolding where requested by the City Engineer to facilitate inspection. Provide additional illumination to light areas to be inspected.
- E. Inspection Devices: Until final acceptance of coating, furnish inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness of corrosion protective coatings. Make dry-film thickness gauges available for the City Engineer's use while coating is being done, until final acceptance of such coatings. Provide the services of a trained operator of the holiday detection devices until the final acceptance of

- such coatings. Operate holiday detection devices in the presence of the City Engineer.
- F. During application, Applicator shall regularly perform and record corrosion protective coating thickness readings with a wet film thickness gauge, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges, to ensure a monolithic coating and uniform thickness during application. A minimum of three readings per 200 square foot area shall be recorded. Applicator will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.
- G. Applicator shall perform holiday detection on all surfaces coated with the corrosion protective coating in the presence of Inspector. After the corrosion protective coating has set hard to the touch, surfaces shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional corrosion protective coating material can be hand applied to the repair area. All touch-up/repair procedure shall follow the corrosion protective coating manufacturer's recommendations.
- H. A minimum of 10% of the total surface area or structures coated may be subjected to adhesion (bond) testing per this section at the option of the City Engineer. Measurement of bond strength of the corrosion protective coating to the substrate may be examined in accordance with ASTM D4541. Any areas detected to have inadequate bond strength of less than 400 psi shall be evaluated by the City Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.
- I. A final visual inspection shall be made by the Inspector and Applicator. Any deficiencies in the finished coating shall be marked and repaired by Applicator according to the procedures set forth herein.
- J. The municipal sewer system may be put back into non-severe operational service as soon as the final inspection has taken place. Consult corrosion protective coating manufacturer for further recommendations.

END OF SECTION

SECTION 09918

**GROUTED-IN-PLACE-LINING OF SEWERS &
MANHOLES WITH PROFILED PVC**

PART I. GENERAL

1.01 SECTION INCLUDES

- A. The rehabilitation of existing sewers using an unplasticized rigid polyvinylchloride (uPVC) spiral wound or panel grouted-in-place liner system. The lining process uses a PVC profile strip which is installed into the existing sewer through an existing access point or a newly installed access location as identified on the contract drawings. The adjacent ribbed profile strips shall be mechanically locked together with a separate joiner strip with an integral seal to form a complete liner system closely fitting to the inside of the host sewer. The liner system shall be installed to a fixed diameter or shape leaving an annular space between the installed liner and existing sewer wall. Depending on the installation and approved design calculations, additional reinforcing may be installed in the annular space. The annular space is then filled with cementitious grout as specified. The annulus shall be grouted in controlled lifts and/or an independent internal bracing system shall be utilized during the grouting operations to prevent buckling and deformation of the liner. Grouting and bracing shall be per the liner manufacturer's recommendation. The PVC ribs shall be mechanically locked into the grout. This lining process is only intended for the Clinton Drive Lift Station junction box.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Measurement and payment for Grouted-In-Place Lining of sewers and conduit with profiled PVC is by the square foot and shall be considered full compensation for all labor and materials required to install the liner to specified requirements.
2. No separate payment will be made for the following items of work. Include cost of these items in the unit price for installing profiled PVC lining:
 - a. Diversion pumping.
 - b. Sealing the liner at manholes or junction chambers.
 - c. Sealing the liner and transitioning to the existing pipe or lining at the ends.
3. No separate payment for pre-installation and post-installation cleaning and television inspection as specified in Section 02558.

**GROUTED-IN-PLACE-LINING OF SEWERS AND
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4. Payment for point repairs and obstruction removals will be made according to Section 02553.

5. Refer to Section 01270 – Measurement and Payment.

B. Stipulated Price (Lump Sum): If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCE SPECIFICATIONS

A. This section contains references to the following documents. They are a part of this section as specified and as modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

C. ASTM C138 – Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

D. ASTM C939 – Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).

E. ASTM C942 – Standard Test Method for Compressive Strength of Grout for Preplaced-Aggregate Concrete in the Laboratory.

F. ASTM C1090 – Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.

G. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Compounds.

H. ASTM D2122 – Determining Dimensions of Thermoplastic Pipe and Fittings.

I. ASTM F1698 – Standard Practice for Installation of Poly (Vinyl Chloride) (PVC) Profile Strip Liner and Cementitious Grout for Rehabilitation of Existing Man-Entry Sewers and Conduits.

J. ASTM F1735 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits.

1.04 SUBMITTALS

- A. Make Submittals in accordance with Section 01330.
1. Submit drawings defining the liner dimensions, minimum grout thickness and reinforcing steel (if required) prepared by the Contractor and design calculations prepared by a licensed professional engineer.
 2. Show any modification required to line host pipe with profiled PVC liner including restoring host pipe wall thickness.
 3. Grout design mix and grouting plan.

1.05 QUALITY ASSURANCE

- A. The manufacturer of the liner system shall have a minimum of 50,000 linear feet (LF) of sanitary, combined sewers, storm sewers or culverts 60- inches in diameter or larger, successfully lined in North America.
- B. Only manufacturer certified contractor or subcontractor may install PVC Pipe Lining System.
- C. The Contractor and/or Subcontractor shall be able to demonstrate that they have successfully completed a minimum of 5,000 linear feet (LF) of trenchless sewer lining rehabilitation in sewers 36 inches in diameter or larger. In lieu of the required experience for this lining system, the Contractor and/or their Subcontractor shall obtain technical training from the product manufacturer and be certified as an installer. If the lining system manufacturer does not have an installer certification process, the Contractor and/or their Subcontractor shall obtain, in lieu of a certification, a letter from the product manufacturer indicating that the Contractor and/or their Subcontractor has completed the requisite training needed to install their product.

1.06 STRUCTURAL DESIGN CONSIDERATIONS

- A. The liner shall be designed in accordance with the requirements of ASTM F1698 except as modified herein. The structural design analysis shall consider the existing condition to be Load Analysis presented herein or as shown on the Drawings, defined as follows:
1. Load Analysis: It is assumed that the host-pipe/soil structure interaction system is sufficient to carry all the earth loading and live loading (including impact). Use a virtual water table standing 65 feet above the top of the lining or the actual level of the water table, as shown on the plans or as specified herein, whichever is higher, for the design analysis.

In those situations where due to loss of wall section from H₂S corrosion (or other causes) the existing in-service safety factor has been reduced to lower than desirable levels, the rehabilitation design will be based upon the current state-of-stress of the existing host pipe and the required design safety factor.

- B. The structural design shall be based on the following conditions:
1. The earth loads shall be based on the ground elevation shown on the Drawings.
 2. Unit Weight of Soil = 120lbs/ft³.
 3. Minimum service life = 50 years.
 4. H-20 live load, unless noted otherwise on the Drawings or in these specifications.
 5. Modulus of soil reaction = 1,000 psi.
 6. Design Safety Factor = 2.0 in buckling due to ground water pressure of PVC liner at any grout void 6-inches or less in diameter.
 7. Design Safety Factor = 1.5 in flexural cracking of either the grout or host pipe due to total load from all sources, by grout thickness and strength OR Safety Factor = 2.0 in ultimate strength if reinforcing steel is included in the rehabilitation design.
 8. Uniform vertical and horizontal soil pressure distribution with $P_H/P_V = 0.4$.

1.07 WARRANTY

- A. Contractor shall extend the standard one (1) year materials and installation warranty nine (9) additional years to a total of Ten (10) years for the coating material used in the rehabilitation of Manholes, Junction Boxes and Sanitary Sewer Pipe.
- B. Warranty Inspection
1. A warranty inspection may be conducted during the eleventh month following completion of corrosion protective coating. The Contractor and a representative of the coating material manufacturer shall attend this inspection.
 2. The City Engineer may, by written notice to the Contractor, reschedule the warranty inspection to another date within the one-year warranty period, or may cancel the warranty inspection altogether. Cancellation of the warranty inspection does not relieve the Contractor of his responsibilities under the Contract Documents.
 3. Repair defective work discovered during the warranty inspection in accordance with these Specifications.

PART II. PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Danby, LLC of Houston, Texas or approved equal.

2.02 MATERIALS

- A. Liner: The liner shall be made from unplasticized PVC compounds and shall meet the minimum requirements of cell class 12343 of ASTM D1784. The PVC profile shall comply with ASTM F1735.

1. Compounds that have different cell classifications because one or more properties are superior (higher number) to those of the specified compounds are also acceptable.
2. The minimum thickness and minimum profile height of the PVC panels shall be as follows:

Nominal ID of Original Pipe	Minimum Base Thickness	Minimum Profile Rib Height
Inches	Inches	Inches
36" to 72"	0.060	0.488
78" and larger	0.065	0.976

- B. Grout: The grout shall consist of, but not limited to, any or all of the following:

1. Portland cement, water, fly ash or pulverized lime, and admixtures.
2. The grout mix design shall be as recommended by the PVC liner supplier and approved by the Engineer prior to commencement of work.
3. Fly ash, if used, shall meet ASTM C618, Class F.
4. Grout components should be clean, fresh, and stored in a suitably dry condition.
5. Premixed grouts and grout admixtures should be used in accordance with the manufacturer's specifications. Mixing and pump equipment may be paddle or colloidal mixers, and screw, piston, progressive cavity or peristaltic pumps.
6. All equipment should be kept clean and free from cured grout build-up.

7. Grout Tests:

TEST	ASTM	REQUIREMENT
Density	C138	115-125 lbs/ft ³
Flow Characteristic	C939	< 35 seconds
Compressive Strength	C942	> 5,000 psi @ 28 days
Compressive Strength	C942	> 1,000 psi @ 1 day
Shrinkage	C1090	< 2.0%

8. These characteristics of the Contractor proposed grout mix design shall be supported by tests of sample mixes by a certified testing laboratory.

9. Grout shall be sampled and tested with the following frequency:

- a. Three sets of 3 cubes each shall be taken during each full day of grouting.
- b. The sample sets shall be taken from freshly mixed grout at least 2 hours apart.
- c. One cube from each set shall be tested for compressive strength at 28 days and the average of the results of those 3 cubes shall be compared to the strength used in the approved design calculations.
- d. The remaining cubes may be used for the Contractor's QC purposes.
- e. Sample preparation and testing shall conform to ASTM C942.

2.03 MATERIAL TESTS

A. Tests shall be made in accordance with the applicable ASTM specification when testing for compliance with this specification.

1. The manufacturer shall provide a certificate of compliance with this specification for all material furnished under this specification.

2.04 LINED PIPE DIMENSIONS

A. Unless otherwise noted on Drawings or in these specifications, the interior dimensions of the relined sewer shall be the maximum allowed by the thickness of the material (liner plus grout), structural strength, and shape considerations.

B. Placement of the liner relative to the existing wall of the sewer, if not shown on the Drawings, shall be as proposed by the Contractor and approved by the Engineer.

PART III. EXECUTION

3.01 INSTALLATION PROCEDURES

- A. Standards: The following installation procedures and ASTM F1698 shall be adhered to unless otherwise approved by the Engineer.
- B. Safety: The Contractor shall carry out operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving working in confined spaces.
- C. Cleaning of Sewer Line: Prior to any profile lining of a pipe so designated, it shall be the responsibility of the Contractor to clean debris out of the sewer line and clean the pipe walls in accordance with ASTM F1698. All infiltration leaks (continuous stream) that may, in the opinion of the manufacturer, impact the successful installation of the liner must be corrected by using a cementitious water-plug or pressure/chemical grouting at no additional cost to the Owner.
- D. Television Inspection: Perform a pre-installation television inspection in accordance with Section 02558. Verify that sewer is clean and pipe conditions are suitable for installation for profiled PVC lining. Notify Engineer if conditions exist which will impact installation.
- E. Line Obstructions: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that will prevent PVC liner installation.
 1. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a separate pay item.
- F. Liner Installation (Panels): If the job entails the lining of only a portion of the circumference of circular pipes/conduits or the conduit is highly non circular (e.g. low rise arch or semi-elliptical), the PVC liner will be supplied as flat panels. These panels shall be cut and trimmed to fit as near as practical to the internal circumference of the structure to be lined, or as specified. The panels shall be kept square with the pipe wall. The adjacent panel edges shall be locked together using the manufacturer supplied joiner strip as recommended by the manufacturer.
 1. If necessary, the panels may be shimmed off the wall to avoid discontinuities on the surface or to insure a minimum required annulus. Such shims shall be of such a configuration that they will not significantly impede the flow of grout into the annulus.
- G. Liner Installation (Coils): If the profiled PVC liner is provided in the form of coils, the liner shall be spirally wound with the ribbed profile of the strip as near as

practical (but not less than 0.5") to the wall of the existing structure or as specified by the Owner.

1. If necessary, the strip may be shimmed off the wall to avoid discontinuities of the wall surface or to maintain the specified annulus. Such shims shall be of such a configuration that they will not significantly impede the flow of grout into the annulus.
2. The adjacent panel edges shall be locked together using the manufacturer supplied joiner strip as recommended by the manufacturer.
3. Additional coils of PVC strip may be introduced by joining the ends of the strip by means of a manufacturer supplied splice strip. The joint shall be sealed on both sides of the splice strip with an approved sealant/adhesive or thermally welded.
4. Right-angle corner strips, curved corner panels, or combinations of profile panels and splice strips shall be used to accommodate non circular shaped pipes.

H. Liner Installation at Curves, Bends, Structures and Changes in Size or Shape: Where the existing pipe alignment is curved (either smooth or chords with deflection angles) or angular bends, at structures, manholes and junction chambers, or changes in size, shape or slope; the Contractor shall modify the liner as appropriate to closely follow the existing shape and dimensions or as shown on the Drawings. The methods used to make these modifications shall be:

1. Stretching and/or compressing the adjacent panel joints.
2. Using fittings or profile accessories as provided by the liner manufacturer.
3. Field trimming panels, fittings or accessories to fit the existing conditions.
4. Modifying panels, fittings or accessories by heating and bending to shape.

I. Reinforcing Steel Installation: The Contractor shall install reinforcing steel (steel bars or welded wire fabric) when the design calculations determine it is necessary. The reinforcing steel shall be installed to maintain a minimum cover of 1-inch and shall be anchored to the host pipe to maintain its position during liner and grout installation.

J. Grouting Procedures: The grouting of the annular space is very important to the structural integrity of the renovated sewer and should be designed and executed with great care. Once the liner is in place, the annulus is sealed at the manhole by dry packing with rapid setting mortar. Through this mortar and around the liner are placed a series of tubes that act as grout injection tubes or breather (vent) tubes. Alternatively, or in addition, grout holes may be drilled in the PVC lining at appropriate points and grout pumped into them until satisfactory fill is obtained.

1. Grout holes in the liner shall be sealed with PVC plugs that are then sealed with liner-manufactured approved sealant/adhesive.
 2. Grout shall be placed in controlled stages (lifts) to avoid floating or deforming the liner in accordance with the approved grouting plan.
 3. The Contractor shall submit a grout plan with supporting calculations to demonstrate that the proposed grout lift heights will not buckle or deform the liner.
 4. The Contractor may propose internal bracing to allow greater grout lift heights.
 5. Elapsed time between successive grout stages shall be adequate to allow the grout to attain a minimum compressive strength of 1,000 psi.
 6. The grouting plan shall be reviewed and approved by the Engineer in advance of the work.
- K. Service Connections: Service connections shall be cut-in as the PVC lining is being installed, leaving the lateral flow unobstructed by the lining. A short PVC sleeve, as large as can fit into the existing lateral pipe, shall be inserted into and sealed with the lateral to isolate the grout in the liner annulus from sewerage flows out of the lateral and to prevent the flow of grout into the lateral during the grouting operation. The lateral sleeve shall be sealed with a sealant/adhesive recommended by the liner manufacturer or thermally welded to the PVC liner and shall be cut flush with the liner (protrude less than 0.5 inch). Cut-outs in the PVC liner to accommodate side sewers shall be sealed by bulkheads similar to those at manholes.
- L. Liner Terminations: The beginning and end of the liner shall be cut flush at the termination of the liner system and permanently sealed to the sewer to prevent any infiltration between the installed liner and the host sewer, manhole or structure. All terminations shall be sealed with a sealing material that is recommended by the liner manufacturer that is compatible with the liner materials installed and provides a watertight seal. Sealing shall be performed at no additional cost. The transition between the liner ends and the host sewer shall be rendered smooth to reinstate the sewer flow line.

3.02 FINAL ACCEPTANCE

- A. After installation of the liner, the Contractor shall CCTV inspect the sewer line as specified. See Section 02558 Final acceptance of the liner shall be based on the Engineer's evaluation of the installation including a review of the CCTV inspection videos and/or physical inspection of the lined sewer.
- B. After the liner installation is complete there shall be no groundwater infiltration.
- C. All service connections shall be open and clear, and unobstructed. All service and manhole connections shall be watertight.

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- D. The finished liner shall be continuous over the length of sewer to rehabilitated and shall conform to the size and shape of the host sewer and allowable cross sectional reduction in size as shown on the contract drawings or as specified herein. The installed liner should be free of visual and material defects. There shall be no pits, pinholes, pilot holes, gouges, bulges, unsecured or separated joints/seams or cracks in the finished liner system. The surface shall be smooth and free of excessive waviness, bumps, or bulges throughout the sewer lining.
- E. If any defective liner is discovered after or during the installation of the liner, it shall be repaired according to manufacturer's recommendations at no additional cost to the owner.
- F. After grouting is completed, the liner must be tested by sounding for complete filling of the annular space with grout. A "hammer test" shall be performed by the Owner's representative on the interior wall surfaces of the lined pipe to check for voids in the grouted annular space. The "hammer test" shall consist of tapping on the interior liner surface to determine the location and size of voids within the annular space. Voids detected during this process shall be measured to determine the extent of the void. Voids found larger than 6 inches in circumferential extent (radial direction) shall be filled by drilling a hole into the void, pumping grout into the void, and then plugging the grouting hole with a PVC plug as above at the Contractor's own expense.

It is possible, using the "hammer test" to detect soil voids outside the existing pipe, even in locations where the annular space between the existing pipe and the PVC liner is completely filled with grout. If the Owner's representative directs the Contractor to drill a hole to confirm a grout void which, in fact does not exist, due to a false hammer test, then the cost of drilling and plugging the hole shall be paid by the Owner on a time and materials basis.

3.03 CLEANUP

- A. After the installation work has been completed and testing accepted, the Contractor shall clean up the project area affected by his operations. All excess material and debris not incorporated into the permanent installation shall be disposed of off-site in a lawful manner by the Contractor. No waste material or construction debris shall be permitted to remain in the sewer.

END OF SECTION

Section 10083

FIBERGLASS REINFORCED POLYMER MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item shall govern the construction of FRPM sanitary sewer complete in place and the material therein, including manhole ring and covers. All plans, materials and specifications shall be in accordance with the Texas Administrative Code (TAC) rules to include: 30 TAC 213.5 and design criteria for sewerage systems 30 TAC 217.53, 30 TAC 217.54, 30 TAC 217.54 and 30 TAC 217.55, or any revisions thereto as applicable.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for manholes is on a unit price basis for each FRPM manhole installed. The price shall be full compensation for all precast sections or throat rings, cones, watertight rings and covers, manhole reinforced concrete ring encasement (top slab), manhole concrete base encasement, concrete mortar, drop pipes and fittings, backfill material, labor, tools, equipment testing, tees, wyes, and incidentals necessary to complete the work.

1.03 REFERENCES

- A. ASTM D 3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- B. ASTM D 3681 - Method for Determining Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.
- C. ASTM D 3754 - Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
- D. ASTM D 4161 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
- E. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

FRPM MANHOLES

4 SUBMITTALS

- A. Make submittals in accordance with Section 01330 – Submittal Procedures and Section 01340 – Shop Drawings, Product Data, and Samples.
- B. Provide sufficient data for the Project Manager to properly evaluate the manhole.
- C. Product data submittals shall include the following, as a minimum:
 - 1. Details of the proposed Manhole.
 - 2. Properties and capabilities of the Manhole
 - 3. Details of manhole risers and inserts.
 - 4. Manhole design analysis.
 - 5. Instruction on storage, handling, transporting, and installation.
 - 6. Standard catalog sheets.
- D. Test Reports: Provide test reports upon request, certifying that the manhole has been tested in accordance with and exceeds minimum requirements of ASTM D 3262 and ASTM D 3681.
- E. Certification from manufacturer that fiberglass manhole was hydrostatically tested at factory.
 - 1. Hydrostatic Test Pressure: 100 psi.
 - 2. Test Duration: Two (2) minutes.
- F. An affidavit of compliance stating that all materials delivered comply with the requirements of these specifications.
- G. For approval, FRPM manhole manufacturer shall provide shop drawings signed and sealed by Professional Engineer registered in State of Texas showing:
 - 1. Manufacturer's manhole design calculations including constrained buckling and wall crush design.
 - 2. Details of pictorial nature of critical features and specials indicating, laying dimensions, fabrication, and fully dimensioned details, with plan view detailing manhole invert elevations, and other critical features. Indicate station numbers for manhole locations corresponding to Drawings. Do not start production of manholes prior to review and approval by Project Manager. Provide final approved lay schedule on CD-ROM in Adobe Portable Document Format (*.PDF).

3. Certification from manufacturer that design was performed for project in accordance with requirements of this section. Certification to be signed and sealed by Professional Engineer registered in State of Texas.

1.05 WARRANTY

- A. The Contractor shall guarantee that manholes and workmanship furnished under this contract will be as specified and will be free of defects due to faulty materials or workmanship for a period of five (5) years from the date of acceptance. In addition, FRPM manholes furnished by the Contractor shall be guaranteed to be free from defects in design.
- B. Within the warranty period, the Contractor shall promptly make needed adjustments, repairs or replacements arising out of defects which become necessary during such period. The cost of materials, parts, labor, transportation, supervision, special tools and supplies required for correction of abnormalities shall be paid by the Contractor.

PART 2 PRODUCTS

2.01 FIBERGLASS REINFORCED POLYESTER (FRPM) MANHOLES

- A. All manholes shall be watertight. Glass-Fiber Reinforced Polyester Manholes shall be a sectional designed unit constructed of glass-fiber reinforced, supplier certified, unsaturated isophthalic polyester resin containing chemically enhanced silica to improve corrosion resistance, strength and overall performance. FRP manholes shall be manufactured in strict accordance with ASTM D-3753.
 1. Exterior Surface: For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added for a minimum thickness of 0.125 inches.
 2. Dimensions: Manholes shall be a circular cylinder, reduced at the top to a circular manway not smaller than 48" inside diameter. Manholes shall also be produced in whole foot increments of length +1-2 inches. Nominal inside diameter shall be 78-inch. Tolerance on the inside diameter shall be +/- 1%. The minimum wall thickness for all FRPM manholes at all depths shall be that correspondent to a minimum SN of 59. Unless otherwise shown on the plans and details or approved by the Engineer, deep sanitary sewer FRPM manholes shall be mounted on existing 132-inch in diameter sewer. The maximum vertical height of the diameter adjustment section or cone shall be 20-inches.
 3. Configuration: The Concrete manway reducer (top slab) must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The top slab shall be separated from the barrel section

FRPM MANHOLES

a minimum of 2 inches, to prevent transferring loads to the FRPM manhole barrel.

4. Class: Manholes top slab shall be manufactured in one class of load rating. This class shall be AASHTO H-20 wheel load. Top slab shall bear on cement stabilized sand.
5. Stub-outs and Connections: Several methods exist that may be used to connect primary and secondary lines to manholes, and these shall be performed per Engineer's request. The most common of these methods include: installation of SDR PVC sewer pipe stub-outs to manhole, Kor-N-Seal boots or Insert-a-Tee fittings in the manhole wall. Installation of SDR PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand lay-up. The resin and fiberglass shall be same type and grade as used in the fabrication of the fiberglass manhole. Kor-N-Seal boots may be installed by manhole manufacturer using fiberglass reinforced pipe stub-out for Kor-N-Seal boot sealing surface. Insert-a-Tee fittings maybe installed only with the approval of the Engineer and shall be installed per manufacturers' instructions.
6. Marking and Identification: All manholes shall be marked in letters no less than 1inch in height with the following information:

Manufacturer's name or trademark

Manufacturer's factory location

Manufacturer's serial number

Manhole Length

ASTM Designation

Installations assist marks (vertical lines 90 deg. apart at base of manhole).

- B. Manhole Rings and Covers: Watertight rings and covers shall be cast iron to the dimensions shown on details.
- C. Requirements and Features Throat Rings: Adjustment throat rings shall be precast non-reinforced concrete rings having a maximum thickness of 2 inches. The diameter shall not be less than 48-inches, and the width shall be a minimum of 5 inches. Concrete shall conform to the provisions of Structural Concrete Specification, Section 03310 from the City of Houston. No more that 4 throat rings shall be used on any manhole.
- D. Sealant Materials: Approved products in accordance with Section 01630 Product Substitution Procedures. Provide sealing materials between precast concrete

adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal. Provide Butyl Sealant from Press-Seal EZ Stick, or equal, for HDPE or FRPM rings.

- D. Mortar: Mortar shall be composed of 1 part Portland Cement, 2 parts sand and sufficient potable water to produce a working mixture.
- E. Concrete Encasements: Concrete encasement shall conform to the provisions of Structural Concrete Specification, Section 03310 from the City of Houston.
- F. Reinforcing Steel: All reinforcing steel shall conform to provisions of Reinforcing Steel, Specification Section 03211 from the City of Houston.
- G. Backfill Material: The backfill material shall be cement stabilized sand in accordance to Cement Stabilized Specification, Section 02321 from the City of Houston.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Manholes shall be constructed of materials and workmanship as prescribed by these specifications, at such places shown on the plans and in conformity with the typical details.
- B. Fiberglass manholes must be installed according to manufacturer's installation instructions. In addition to these instructions, local codes may apply and should be consulted as applicable in manhole installation. Correct manhole installation requires proper concrete foundation, good backfill and proper handling to prevent manhole damage and insure long-term corrosion resistant service.
- C. Prepared excavation at manhole location should be at least wide enough to accommodate the reinforced concrete saddle and to provide working room around manhole. Insure the depth of manhole is sufficient to allow at least two concrete rings for adjustment of ring and cover at top of final grade. Quarter marks have been provided on barrel to facilitate alignment.
- D. Reinforced Concrete Saddle: Tie to rebar from existing 132-inch sanitary sewer and provide a leveled surface to mount FRPM risers.
- E. Set Manhole: To lift manhole, insert 4 inches x 4 inches timber crosswise inside the manhole to the underside of the collar with a rope or woven fabric slings attached to backhoe or other lifting device and lower the manhole. Level manhole and connect sewer lines to manhole. A concrete base encasement shall be placed at least 12 inches from the manhole and shall come over the top of the anti-flotation ring a minimum of 12 inches.

FRPM MANHOLES

- F. Invert and Bench Area: The invert and bench area can be formed with wet concrete and finished with an epoxy sealant.
- G. Backfill Material: The Contractor shall be required to backfill all manholes with cement stabilized sand. This material will be subject to approval by Engineer.
- H. Bring to Grade: Construct reinforced concrete ring encasement as identified on details.
- I. Testing
 - 1. Hydrostatic Testing: Hydrostatic testing shall be conducted by plugging an approved plug into all influent and effluent pipes in the manhole and filling the manhole to the top of the manhole cone with water. Additional water may be added over a 24 hour period to compensate for evaporate losses. At the conclusion of the 24 hour saturation period, the manhole shall be filled to the top of the manhole cone and observed. Any losses of water within a 30 minute period shall be considered an unsuccessful test.
- J. Vacuum Testing
 - 1. General: Manholes shall be tested after installation and prior to backfilling with all connections (existing and proposed) in place.
 - 2. Test Procedure: The lines entering the manhole shall be temporarily plugged with braced plugs in order to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond drop connections, gas sealing connections, etc. The test head shall be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum shall be read after the required test time. If the drop in the level is less than 1 inch of mercury (final vacuum greater than 9 inches of mercury), the manhole will have passed the vacuum test. The required test time is determined from Table 1.

MINIMUM REQUIRED FOR A VACUUM DROP OF 1" Hg (10" Hg - 9" Hg) (Min : Sec)	
Height of Manhole (Depth in Ft.)	48 "
0' - 20'	:40
22'	:44
24'	:48
26'	:52
28'	:56
30'	1:00
Additional 2' Depths - Add T for each 2'	:04

3. Acceptance: Manholes will be accepted with relation to the hydrostatic test requirements and the vacuum test requirements if they meet the criteria above. Any manhole which fails the initial test must be repaired or replaced prior to backfilling. The manhole shall be re-tested as described above until successful test have been made. After the successful tests, the temporary plugs will be removed.

END OF SECTION

Section 10227

INFILTRATION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification describes the materials and methods for stopping infiltration, void filling, stabilizing, and strengthening of soils around existing sanitary sewer prior to rehabilitation.
- B. The technology used to control infiltration shall consist of materials using two components High Density Polyurethane (HDP) from URETEK or approved equal. The material must be hydro-insensitive (capable of reacting and expanding in the presence of water), hydrophobic (capable of driving away water and sealing thru water), and capable of expansion rates of up to 20 times initial volume. Material shall cure to 90% of ultimate compressive strength within 15 minutes of injection.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices:

- 1. Infiltration Control in Sanitary Sewer Tunnel: Measurement for infiltration control is for each Infiltration Location, which comprises a construction joint of the existing monolithic cast-in-place reinforced concrete sanitary sewer all around as described on the plans and on drawing No. D-6. The Contract unit price for infiltration control is full payment for stopping infiltration inside the sewer line at each construction joint identified as leaking. Infiltration Control using normal equipment includes:
 - a. Charges for equipment setup and usage.
 - b. Locating, exposing, drilling, injecting, sealing and cleaning each infiltration location (construction joint) to be stopped.
 - c. Each infiltration location (construction joint) must be injected to cover the entire perimeter of the location. This will guarantee that the 360 degrees of the sanitary sewer circumference are protected.
- 2. Infiltration Control in Rehabilitated Manholes: No separate payment will be made for infiltration control inside manholes. Include price in the cost per vertical foot of Rehabilitated Manhole in accordance to specification section 02555 Manhole Rehabilitation.

INFILTRATION CONTROL

3 Post-Installation Television Inspection: No separate payment will be made for post-installation television inspection. Include cost for post-installation television inspection in the cost of infiltration control work. Post-installation television inspection tape policy allows payment for work based on field-measured lengths indicated on the inspector's daily reports, but still requires Contractor to submit a post-installation videotape within one calendar month after infiltration control completion. If no tape is received within that period, credit for the previously-paid infiltration control points will automatically be deducted from pay estimates in following months until the required tape is submitted.

B. Stipulated Price (Lump Sum): If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 DEFINITIONS

A. Normal Infiltration Control Equipment:

1. Personnel Safety Apparatus including harnesses, man-hoist, breathing equipment, and vent blowers.
2. A Working platform to properly reach infiltration points in the crown of the pipe.
3. Drills with the capability of drilling 5/8" diameter holes through a minimum of 16 inches minimum of cast in place structural concrete.
4. A mobile metering and pumping unit capable of metering two components HDP to the injection units at controlled temperature rate and pressure, hose lengths capable of reaching remote locations, injection units capable of precisely mixing and injecting HDP thru 5/8" drilled holes or 1/2" diameter tubes, self contained power units for electrical power and compressed air are considered normal infiltration control equipment.

B. Post-Installation Television Inspection: Video inspection to determine whether infiltration control of the sanitary sewer has been completed according to the Drawings and Specifications.

C. Television Inspection Report: A form that is filled out by each television operator for any television inspection effort that is submitted to the City, on a form provided by the City.

1.04 PERFORMANCE REQUIREMENTS

- A. Stop infiltration entering the sanitary sewer at the pre-determined infiltration points using infiltration control equipment as defined under Section 1.03 A. Select infiltration control methods that will completely stop water from entering the sanitary sewer.
- B. Injection points shall be enough to guarantee that the entire 360 degrees of the circumference will be protected with the high density polyurethane.
- C. Provide videotapes for the City Engineer to evaluate the condition of the sanitary sewer after the infiltration control has been performed. If infiltration control has not been achieved, re-inject and provide a new videotape and report of the sanitary sewer at no additional cost to the City. Camera distortion, inadequate lighting, dirty lens and blurred or hazy pictures will be causes for rejection of tape and associated line segment.

1.05 SUBMITTALS

- A. Comply with Section 01330 - Submittal Procedures.
- B. Material Safety Data Sheets for all pertinent production materials.
- C. Submit equipment manufacturer's operational manuals and guidelines to the City Engineer for review. Strictly follow such instructions, unless otherwise directed by the City Engineer.
- D. Submit videotapes and Television Inspection Reports to the City Engineer for review.
 - 1. Provide tapes of quality sufficient for the City Engineer to evaluate the condition of the sanitary sewer, after the infiltration control has been performed.
 - 2. Videotapes submitted become the property of the City and will be retained by the Maintenance Support Division.
 - 3. Contractor shall maintain the master originals of all videotapes and Television Inspection Reports submitted, until final acceptance of the Contract.

1.06 QUALITY ASSURANCE

- A. **Qualifications:** Contractor shall have a minimum of 3 years experience performing infiltration control and soil stabilization projects by this method on similar jobs. Contractor shall furnish 5 references from work done within the past 24 months utilizing this method.

INFILTRATION CONTROL

3. Acceptance of infiltration control work is subject to successful completion of the television inspection. If videotape inspection shows infiltration points remaining in the line, the infiltration control is considered unsatisfactory. Repeat injection, inspection and videotaping of the sewer line until infiltration control is acceptable by the City Engineer.

PART 2 PRODUCTS

2.01 INFILTRATION CONTROL PRODUCT

- A. Provide the following infiltration control system for rehabilitation of existing sanitary sewer, junction boxes and/or manholes.
1. Uretex 486
 2. Approved Equal

2.02 INFILTRATION CONTROL EQUIPMENT

- A. Select infiltration control equipment and methods based on the depth of the sanitary sewer, the hydrostatic pressure at approximately 70 ft below grade and a minimum distance between manholes of 1,200 LF. More than one method or type of equipment may be required on a single project or at a single location.
- B. When requested by the City Engineer, demonstrate the performance capabilities of infiltration control equipment and methods proposed for use on the project. If results obtained by demonstration are not satisfactory, provide other equipment that will control infiltration into the sewer line.
- C. The infiltration control equipment shall consist of a mobile metering and pumping unit capable of metering two components HDP to the injection units at controlled temperature rate and required pressure. It should also include hoses in lengths capable of reaching remote locations. Also, it shall consist of Injection guns (units) capable of precisely mixing and injecting HDP thru 5/8" drilled holes or 1/2" diameter tubes. Finally, the infiltration control equipment shall be operated with self contained power units for electrical power and compressed air.

2.03 INFILTRATION CONTROL ACCESSORIES

- A. A rolling platform supported on the walls of the pipe can be used to reach the crown of the sanitary sewer. This platform will have to withstand the weight of the equipment used in the infiltration control process and the weight of the personnel operating the equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin cleaning until sanitary sewer has been properly cleaned. Refer to Section 02558 – Cleaning and Television Inspection.

3.02 PREPARATION

A. Set Up:

1. Lower and Install platform inside the sanitary sewer. Platform shall allow operator to reach the crown of the pipe to drill injection holes and inject HDP.
2. Provide operator with safety equipment and ventilation and breathing equipment.
3. Lower equipment, hoses and injection guns and place them on top of the working platform.

3.03 INFILTRATION CONTROL

- A. Drill multiple injection holes (5/8" dia.). These holes shall be drilled thru the wall of the pipe up to a minimum of 15 inches at locations and at spacing as required to guarantee 360 degree coverage of the circumference at the location of the infiltration point.
- B. HDP is injected in multiple shots directly through the injection holes or through tubes that are driven or jetted to varying distances into the soils of the area being stabilized and controlled for infiltration.
- C. Once injected, the material is allowed to expand, void fill, stabilize affected area and stop infiltration.
- D. The Contractor shall complete a repair documentation form indicating the approximate injection locations on a daily basis.
- E. Excess material Disposal: Remove solid or semi-solid foamed material resulting from the infiltration control operation at the downstream manhole of the section being worked. Passing debris from any sewer section to any other sewer section is not allowed. Load debris from the manholes into an enclosed container permitted by the City of Houston Health Department for liquid waste hauling. Remove solids and semi-solids resulting from cleaning operations from the site and dispose them lawfully at the end of each work day. Do not accumulate

INFILTRATION CONTROL

debris, liquid waste, or sludge on the site except in totally enclosed containers approved by the City Engineer.

- F. Disposal Sites: Dispose of waste at a lawfully-permitted disposal site using a transporter having a valid City of Houston Liquid Waste Transporter Permit.
- G. Perform post-installation television inspection to confirm completion of infiltration control work. Verify that infiltration control work conforms to the requirements of the Drawings and Specifications. Provide a color videotape showing the completed work. Prepare and submit Television Inspection Report forms providing location of infiltration points along with the location of any discrepancies.

3.04 FLOW CONTROL

- A. Perform infiltration control on the sanitary sewer in one infiltration point at a time. Adequately control the flow in the section being worked. Do not exceed 3 ft depth.
 - 1. If during infiltration control in one section, the wastewater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the infiltration control work during minimum flow hours, by diversion pumping, or other acceptable flow control device.
- B. Minimize flow in the line while performing post-installation television inspection. Divert the normal flow as specified in Section 01540 - Diversion Pumping.

3.05 FIELD QUALITY CONTROL

- A. Do not under any circumstances, allow sewage or solids removed in the infiltration control process to be released onto streets or into ditches, catch basins, cleanouts, storm drains, or sanitary or storm sewer manholes.
- B. Acceptance of infiltration control work is subject to successful completion of the television inspection, as described under Section 02558 - Cleaning and Television Inspection. If the television inspection shows infiltration points allowing water into the sanitary sewer, the infiltration control work will be considered unsatisfactory. Repeat infiltration control, inspection, and videotaping of the sewer line until infiltration control is judged satisfactory by the City Engineer.

END OF SECTION

BENCH MARK:
 CITY OF HOUSTON MONUMENT NO. 5457-1915 (FLOODPLAIN REFERENCE MARKER NO. 050055), LOCATED AT SOUTHWEST CORNER OF CLINTON DRIVE AND JUDD STREET.
 (NAVD. 88 GPS OBSERVATION MADE IN SEPTEMBER 2011)
 CITY OF HOUSTON MONUMENT NO. 5557-0314 LOCATED AT SOUTHEAST CORNER OF CLINTON DRIVE AND JUDG STREET.
 (NAVD. 88 GPS OBSERVATION MADE IN SEPTEMBER 2011)

- KEY NOTES:**
- EXISTING STORM SEWER/SANITARY SEWER/ MANHOLE/INLET TO REMAIN IN SERVICE
 - EXISTING STORM SEWER TO BE ABANDONED IN ACCORDANCE WITH SPECIFICATION 02222
 - REMOVE EXISTING STORM SEWER/SANITARY SEWER/ MANHOLE IN ACCORDANCE WITH SPECIFICATION 02221
 - RECONNECT EXISTING STORM SEWER/SANITARY SEWER TO PROP 12" WATER LINE
 - REMOVE EXISTING 24" STORM SEWER AND REPLACE W/36" STORM SEWER
 - WARNING!! CRITICAL LOCATE, SEE SPECIFICATION SECTION 02317
 - RECONNECT EXISTING METAL DRAINS/HARD DRAINS TO PROPOSED CURB
 - REMOVE EXISTING INLET IN ACCORDANCE WITH SPECIFICATION 02221
 - PROPOSED STORM SEWER MANHOLE/INLET TO BE INSTALLED AFTER EXISTING WATER LINE IS ABANDONED AND PLUGGED
 - ADJUST EXISTING MANHOLE FRAME AND COVER TO GRADE

TO ARRANGE FOR LINES TO BE TUNED UP OR MOVED, CALL CENTERPOINT DESIGN AT 713-807-2222.

NOTICE:
 FOR YOUR SAFETY, YOU ARE REQUESTED BY THIS LAW TO CALL AT LEAST 48 HOURS BEFORE ANY WORK BEGINS TO VERIFY THE LOCATION OF ALL UNDERGROUND UTILITIES. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811.

VERIFICATION OF PRIVATE UTILITY LINES

H. H. Moore Date: 3/24/10
 CenterPoint Energy/Natural Gas Facilities Verification ONLY
 This signature verifies existing underground facilities - not to be used for any other purpose. (See appendix for more details)
 Signature valid for six months.

H. H. Moore Date: 3/24/10
 CenterPoint Energy/Underground Electrical Facilities Verification ONLY
 This signature verifies existing underground electrical facilities - not to be used for any other purpose. (See appendix for more details)
 Signature valid for six months.

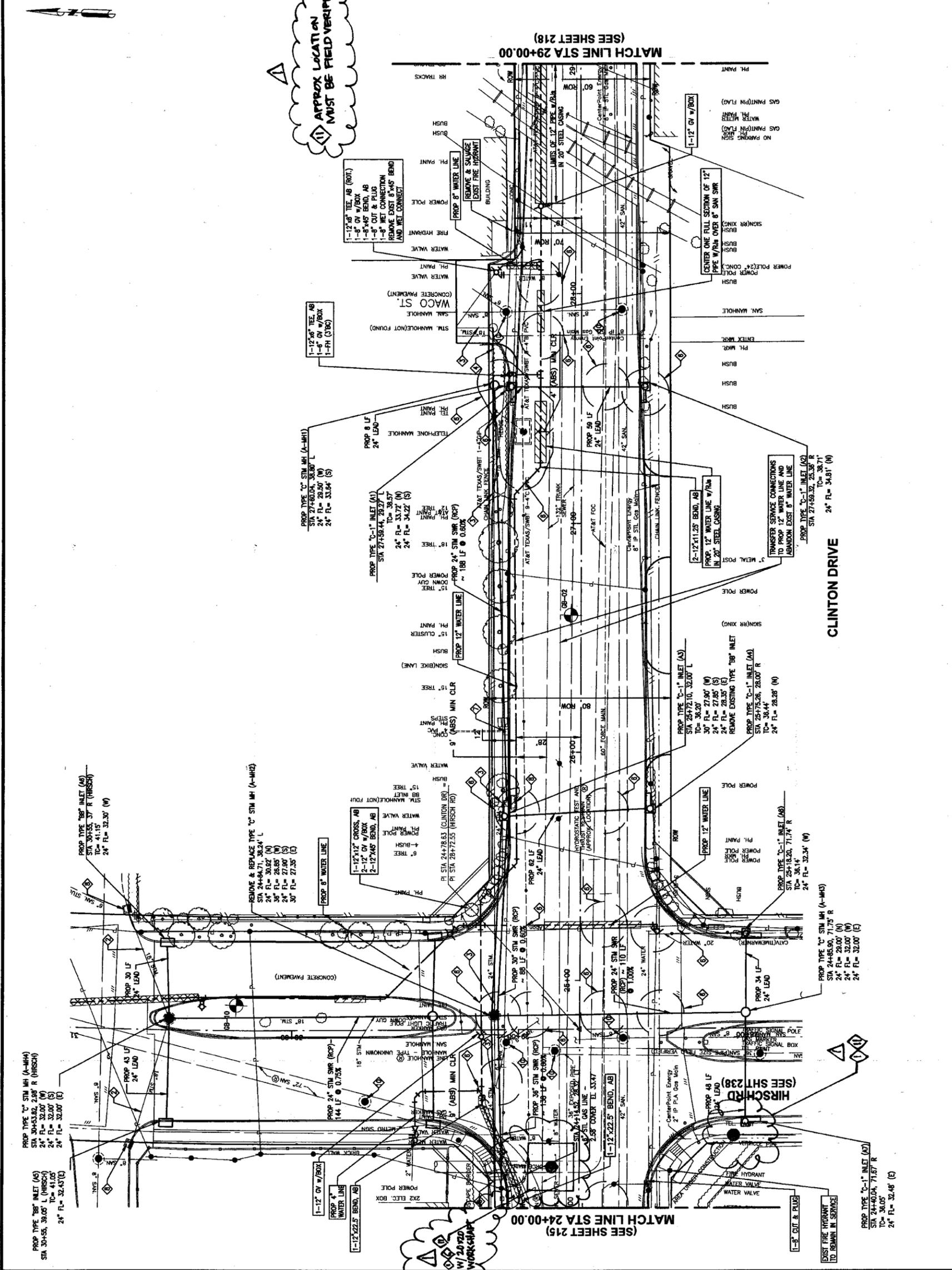
[Signature] Date: 3/24/10
 AT&T Texas/SNET Underground conduit
 This signature verifies existing underground conduit facilities - not to be used for any other purpose. (See appendix for more details)
 Signature valid for six months.

TranSystems
 EXPERIENCE | Transportation
 2777 ALLEN PARK, STE. 500
 HOUSTON, TX 77019
 713-807-0600 FAX 713-807-0607

CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
CLINTON DRIVE RECONSTRUCTION PROJECT
 CLINTON DRIVE UTILITIES PLAN
 STA 24+00 TO 29+00

WBS NO. N-000804-0001-4
 DRAWING SCALE
 VERT. 1"=2' HORIZ. 1"=20'
 CITY OF HOUSTON, TX
 MICHAEL CORDOVA
 SHEET NO. 216

DATE: 03/24/10
 CHECKED BY: [Signature]
 DESIGNED BY: [Signature]
 DRAWN BY: [Signature]



APPROX LOCATION MUST BE FIELD VERIFIED

EXIST FIRE HYDRANT TO REMAIN IN SERVICE

BENCH MARK:
 CITY OF HOUSTON MONUMENT NO. 5457-1515 (FLOODPLAIN REFERENCE MARKER NO. 050095) LOCATED AT SOUTHWEST CORNER OF CLINTON DRIVE AND JUDD STREET. EL=28.62' (NAVD 88 GPS OBSERVATION MADE IN SEPTEMBER 2011)
 CITY OF HOUSTON MONUMENT NO. 5557-0314 LOCATED AT SOUTHEAST CORNER OF CLINTON DRIVE AND JAPHET STREET. EL=40.28' (NAVD 88 GPS OBSERVATION MADE IN SEPTEMBER 2011)

KEY NOTES:
 1. EXISTING STORM SEWER/SANITARY SEWER/ MANHOLE/INLET TO REMAIN IN SERVICE
 2. EXISTING STORM SEWER TO BE ABANDONED IN ACCORDANCE WITH SPECIFICATION 02222
 3. REMOVE EXISTING STORM SEWER/SANITARY SEWER/ MANHOLE IN ACCORDANCE WITH SPECIFICATION 02221
 4. RECONNECT EXISTING STORM SEWER/SANITARY SEWER TO PROP MH/INLET
 5. REMOVE EXISTING 24" STORM SEWER AND REPLACE WITH 12" WATER MAIN
 6. WASHINGTON CRITICAL LOCATE, SEE SPECIFICATION SECTION 02317
 7. RECONNECT EXISTING METAL DRAINS/HARD DRAINS TO PROPOSED CURB
 8. REMOVE EXISTING INLET IN ACCORDANCE WITH SPECIFICATION 02221
 9. PROPOSED STORM SEWER MANHOLE/INLET TO BE INSTALLED AFTER EXISTING WATER LINE IS ABANDONED AND PLUGGED
 10. ADJUST EXISTING MANHOLE FRAME AND COVER TO GRADE
 11. NOTICE:
 12. ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT ENERGY AT 713-207-2222.
 13. FOR YOUR SAFETY, YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 PRIOR TO ANY EXCAVATION. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811.
 14. VERIFICATION OF PRIVATE UTILITY LINES
 15. CenterPoint Energy/Natural Gas Facilities Verification ONLY (This signature verifies existing underground facilities - not to be used for conflict verification) (See service lines one not shown) Signature valid for six months.
 16. CenterPoint Energy/Underground Electrical Facilities (This signature verifies existing underground facilities - not to be used for conflict verification) (See service lines one not shown) Signature valid for six months.
 17. Approved for AT&T Trench/SMBT underground conduit installation only for one year.
 18. 777 ALLEN PARK, STE. 500 HOUSTON, TX 77018 713-867-8900 FAX 713-867-8922
 19. KIT Professionals, Inc. 109787 S. C.E.N.S. PROFESSIONAL
 20. DATE MARK 2018 CHECKED BY: SP DESIGNED BY: SV/SC DRAWN BY: J/S
 21. CITY OF HOUSTON
 22. DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
 23. CLINTON DRIVE RECONSTRUCTION PROJECT
 24. CLINTON DRIVE UTILITIES PLAN STA 29+00 TO 33+00
 25. WBS NO. N-000804-0001-4
 26. DRAWING SCALE
 27. VERT. 1"=2' HORIZ. 1"=20'
 28. CITY OF HOUSTON, TX
 29. MICHAEL CORDOVA
 30. SHEET NO. 218

RECONNECT PROP 6" SANITARY SEWER STUB TO EXIST 6" SANITARY SEWER

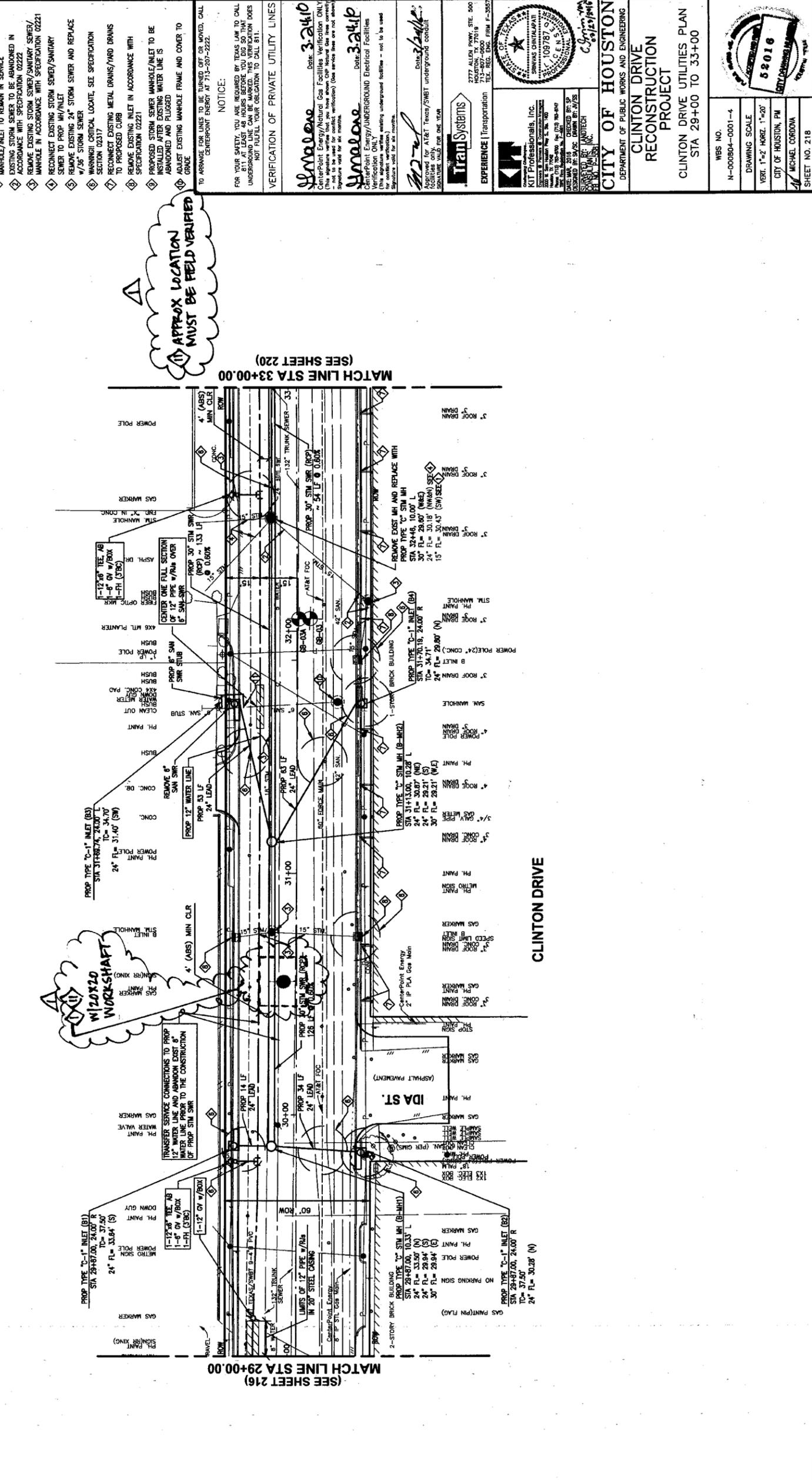
APPROX LOCATION MUST BE FIELD VERIFIED

W10X20 WORKSHAFT

TRANSFER SERVICE CONNECTIONS TO PROP 12" WATER LINE AND ABANDON EXIST 8" WATER LINE PRIOR TO THE CONSTRUCTION OF PROP STW SWR

REMOVE EXIST MH AND REPLACE WITH PROP TYPE "C" STW MH

REMOVE EXIST MH AND REPLACE WITH PROP TYPE "C" STW MH



CLINTON DRIVE

MATCH LINE STA 29+00.00 (SEE SHEET 216)
MATCH LINE STA 33+00.00 (SEE SHEET 220)

BENCH MARK:
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 EL=28.62
 (NAVD 88 OPS OBSERVATION MADE IN SEPTEMBER 2011)

CITY OF HOUSTON MONUMENT NO. 5557-0314 LOCATED AT SOUTHEAST CORNER OF CLINTON DRIVE AND JAPPHET STREET.
 EL=40.28
 (NAVD 88 OPS OBSERVATION MADE IN SEPTEMBER 2011)

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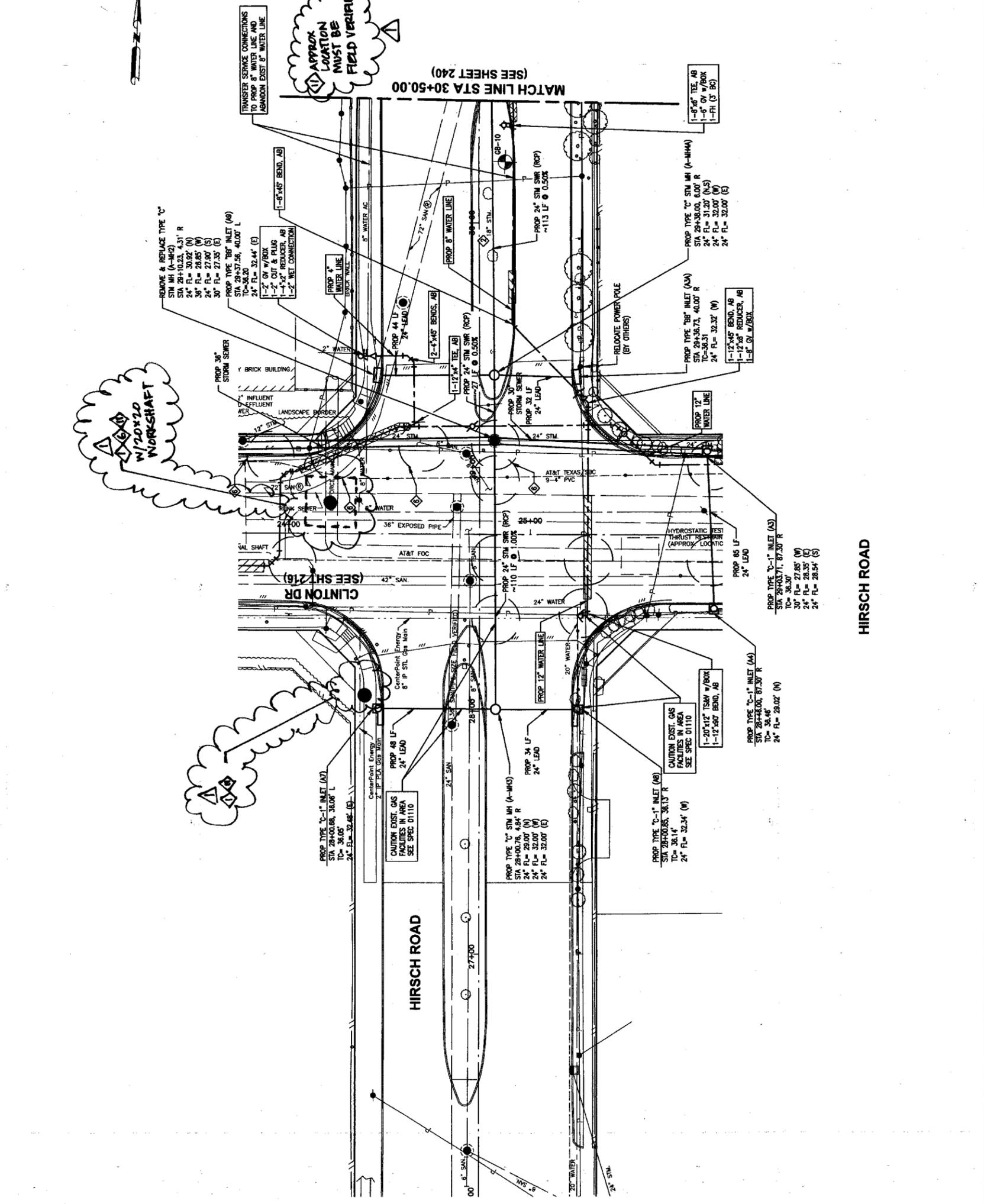
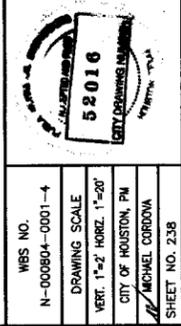
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VERIFICATION OF PRIVATE UTILITY LINES
 Approved for AT&T Trench/SMBT underground conduit
 Signature valid for six months.
 Signature valid for six months.

TranSystems
 EXPERIENCE | TRANSPORTATION
 2777 ALLEN PARK, STE. 500
 HOUSTON, TEXAS 77019
 TEL: 281-467-3000
 FAX: 281-467-3000

CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
 CLINTON DRIVE
 RECONSTRUCTION
 PROJECT
 HIRSCH ST UTILITIES PLAN
 STA 26+00 TO 30+50

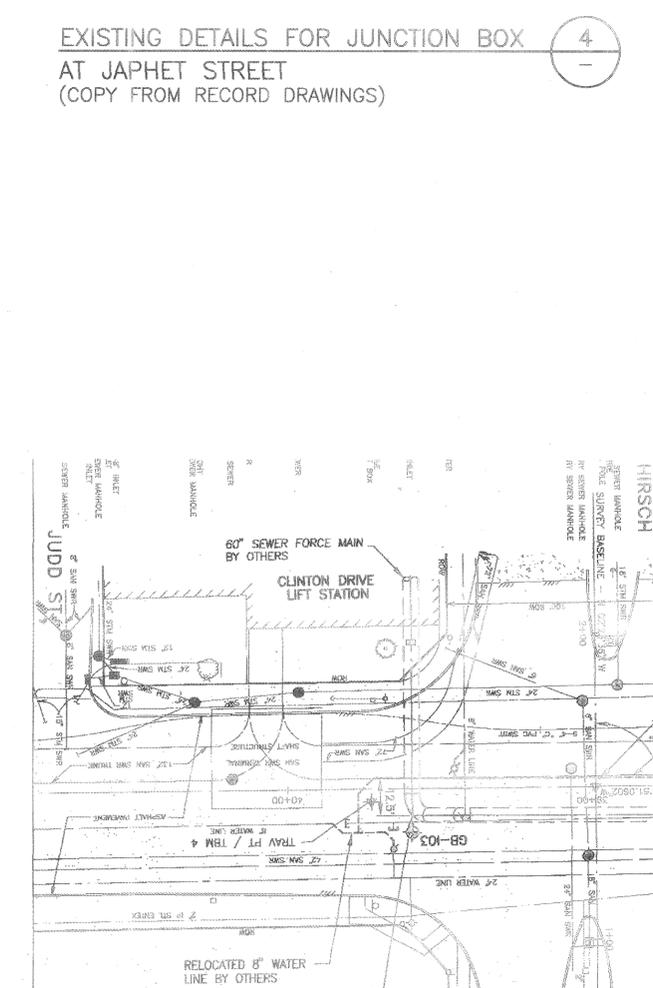
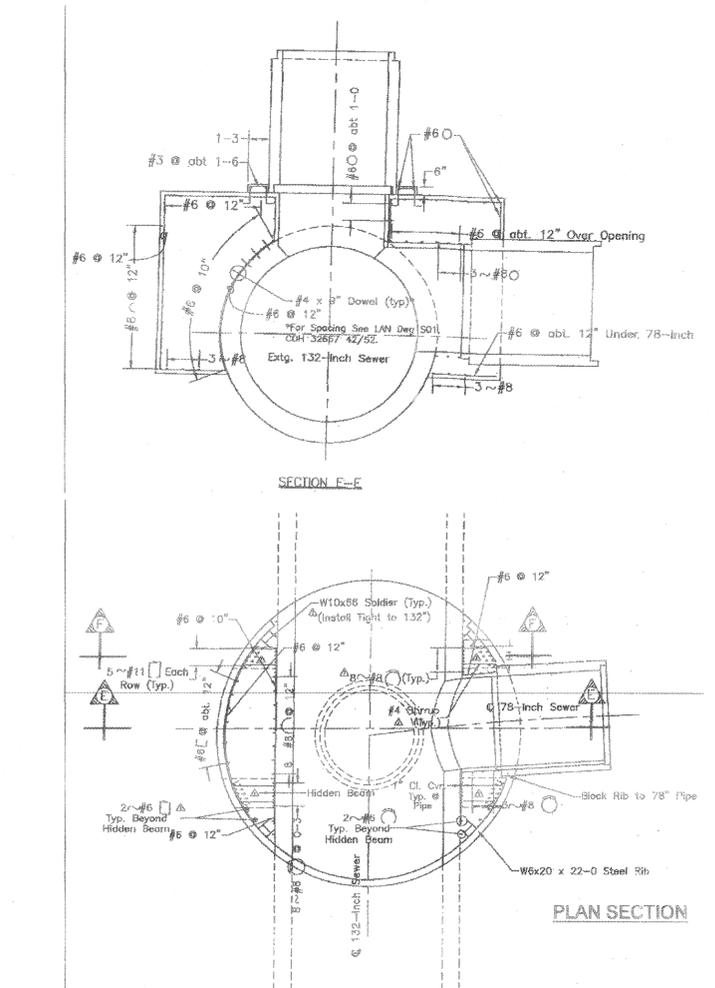
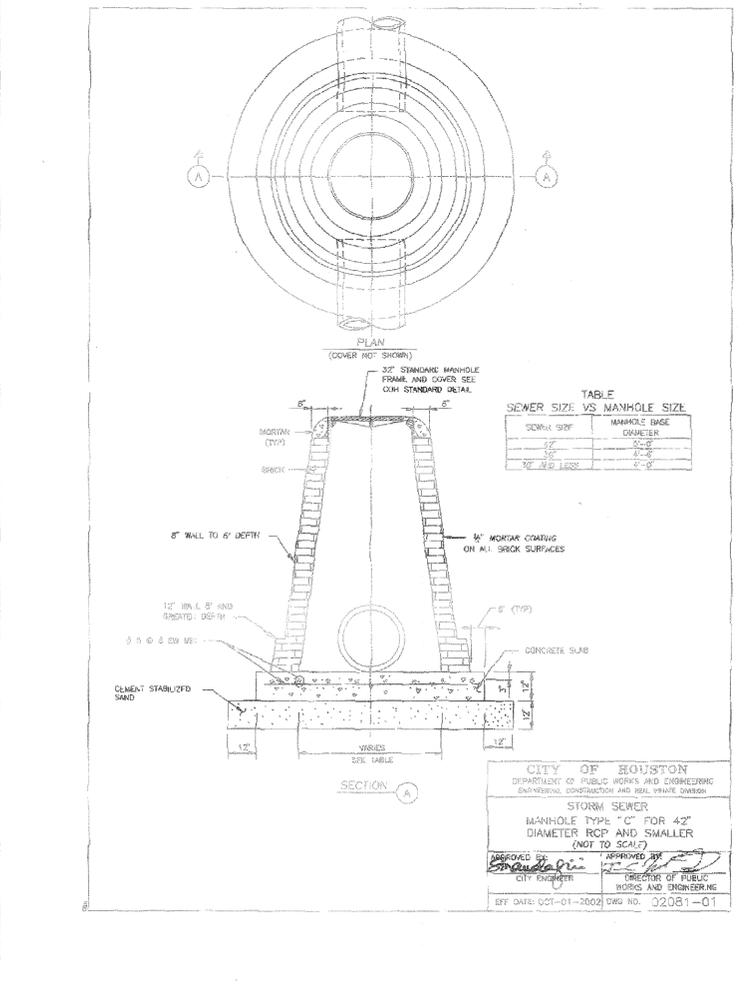
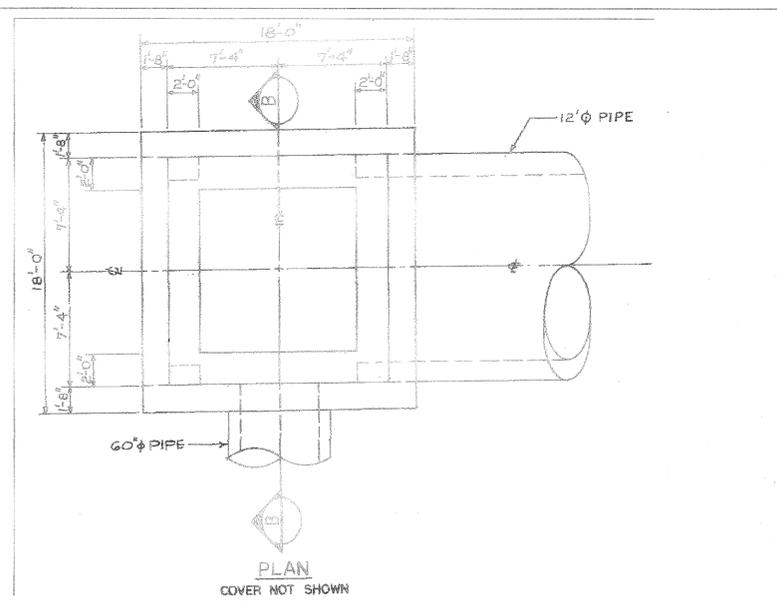
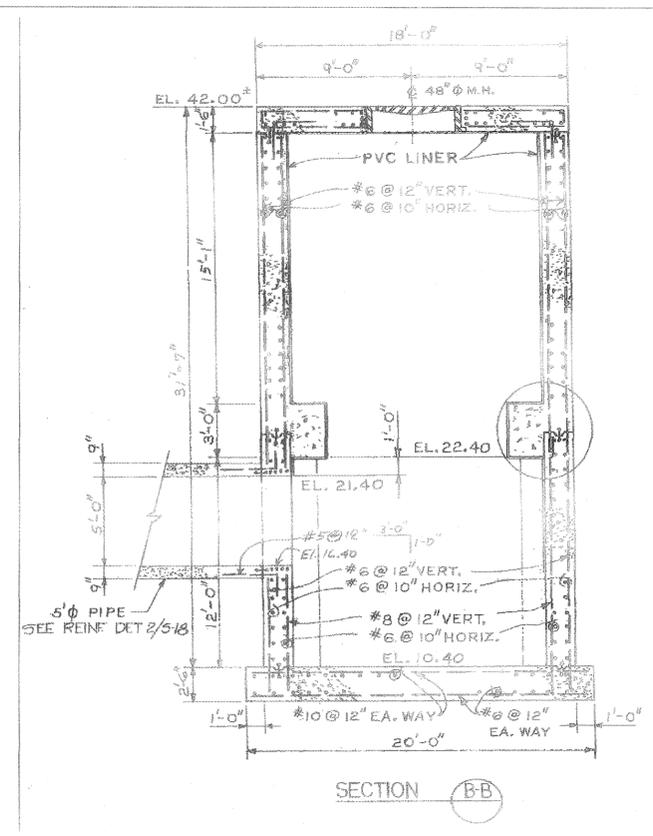
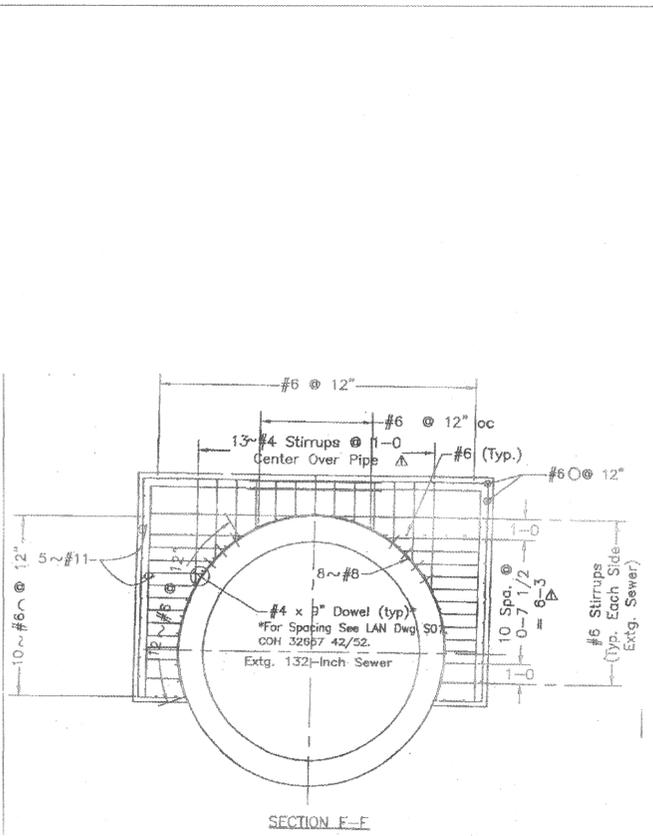
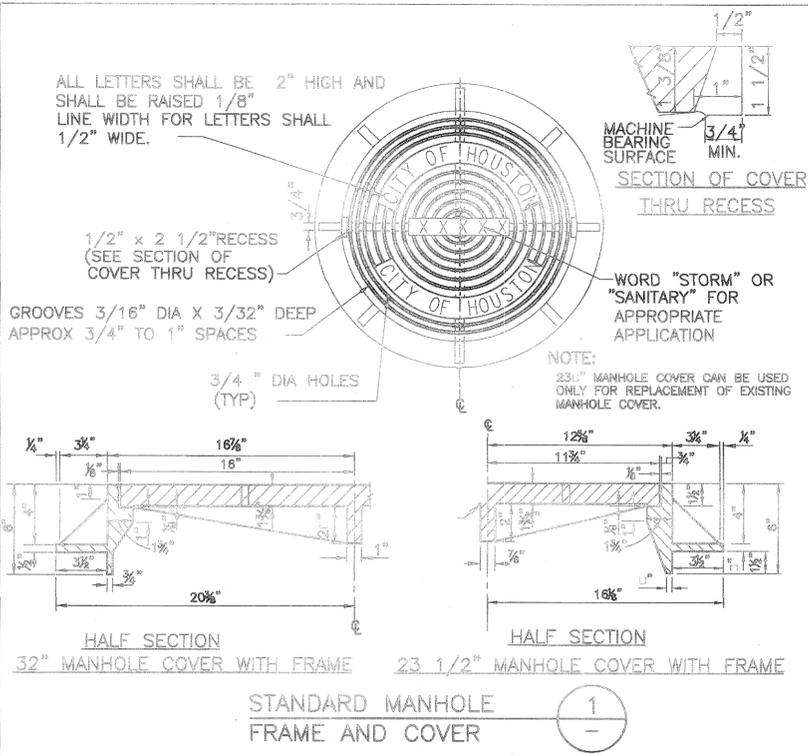
WBS NO. N-000804-0001-4
 DRAWING SCALE
 VERT. 1"=2' HORIZ. 1"=20'
 CITY OF HOUSTON, TX
 MICHAEL CORDOVA
 SHEET NO. 238



HIRSCH ROAD

FOR REDUCED PLANS

G:\8070\DRAWING-Records\Sewer Miscellaneous Details 1d2.dwg Mar 04 2011 1:06pm rpd



EXISTING DETAILS FOR JUNCTION BOX AT JAPHET STREET (COPY FROM RECORD DRAWINGS)

STORM SEWER MANHOLE FOR 42-INCH DIAMETER AND SMALLER

EXISTING CONNECTION DETAILS FOR 78-INCH TIE-IN AT GREGG ST. (COPY FROM RECORD DRAWINGS)

WATER LINE CONFLICT IN FRONT OF CLINTON DR. LIFT STATION (COPY FROM RECORD DRAWINGS)

No.	Date	Revisions	App.
	02/18/11		

STATE OF TEXAS
CARLOS E. QUINTERO
94548
LICENSED PROFESSIONAL ENGINEER

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seaman Drive
Houston, Texas 77008-3189
(713) 959-3433

SURVEYED BY: LANDTECH FIELD BOOK NO.: P-5548

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
NORTHSIDE SEWER RELIEF TUNNEL
REHABILITATION AREA No. 5
SEWER MISCELLANEOUS DETAILS (SHEET 1 OF 2)

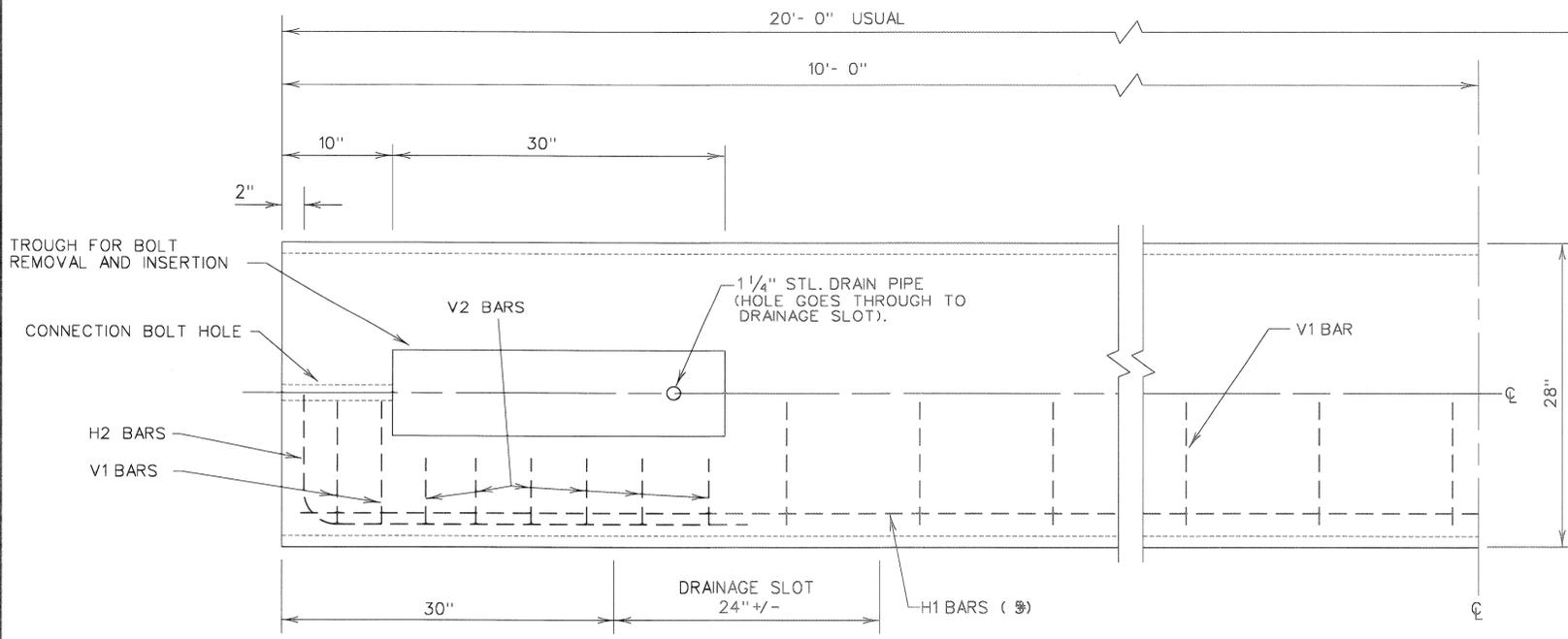
FILE NO: 4724
WBS: R-002005-0005-4
DRAWING SCALE
NO SCALE
CITY OF HOUSTON PM
ROBERT MILES, P.E.
DWG NO.: D-7
SHEET NO. 42 OF 69

48271
CITY DRAWING NUMBER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

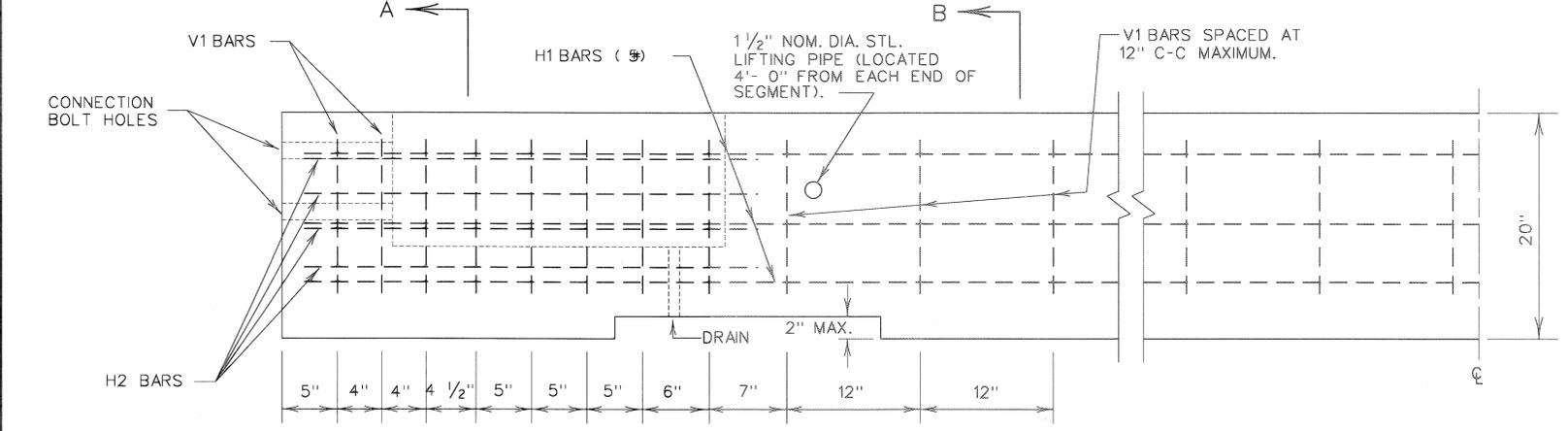
DISCLAIMER: The use of this standard is governed by the Texas Engineering Practice Act. No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

LEVELS DISPLAYED	
1	

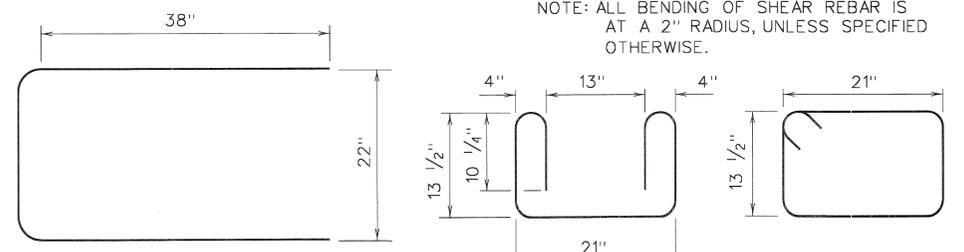


PLAN VIEW - TYPE 1
(SYMMETRICAL ABOUT CENTER LINES)

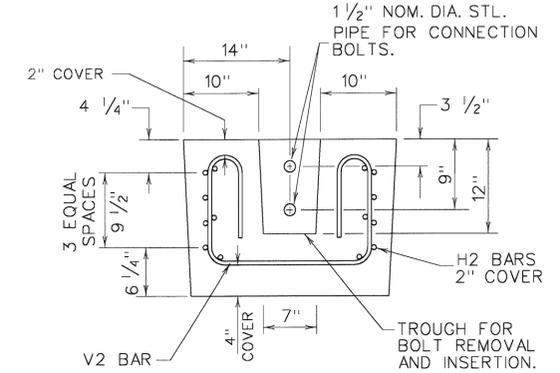
NOTE: CONCRETE ON BOTTOM HALF OF PLAN VIEW IS REMOVED IN ORDER TO SHOW DETAILS



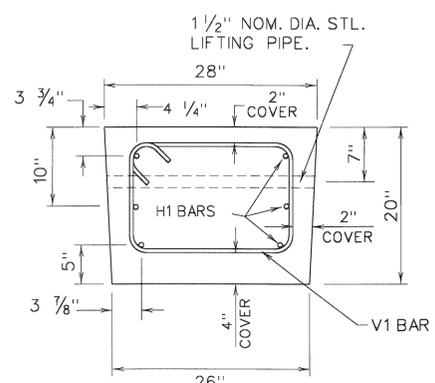
ELEVATION - TYPE 1
(SYMMETRICAL ABOUT CENTER LINES)



H2 BAR (#5)
(GRADE 60 MIN.)
NOTE: H2 REBAR IS TO BE BENT AT A 3" RADIUS.
REINFORCING STEEL DETAILS
V2 BAR (#4)
V1 BAR (#4)



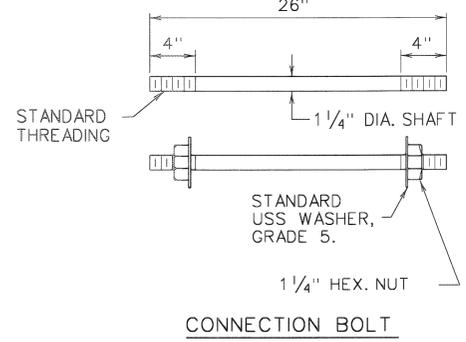
SECTION A-A



SECTION B-B

GENERAL NOTES

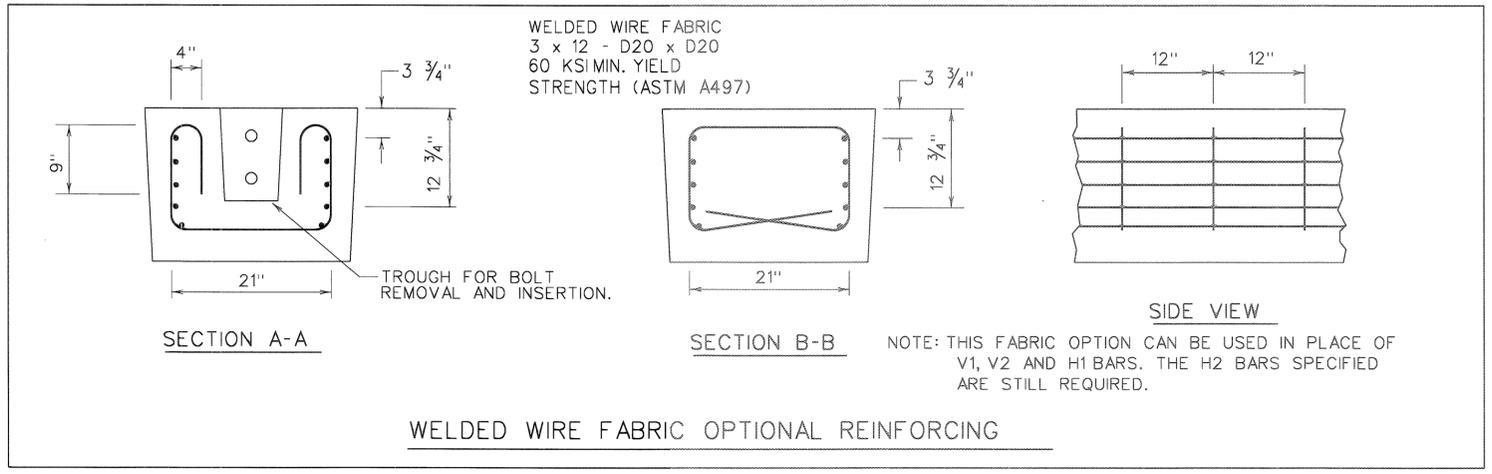
1. BARRIER LENGTH SHALL BE 20 FEET (/ 4 INCH) UNLESS OTHERWISE SPECIFIED IN THE PLANS.
2. ALL CONCRETE, REINFORCEMENT, ANCHOR BOLTS, BLOCKING, ETC., AS SHOWN ARE CONSIDERED AS PART OF THE BARRIER FOR PAYMENT.
3. ALL CONCRETE SHALL BE CLASS A, C, OR H, UNLESS OTHERWISE SPECIFIED.
4. ALL REINFORCING STEEL SHALL BE GRADE 40, UNLESS OTHERWISE SPECIFIED.
5. CHAMFER ALL EDGES 3/4 INCH, AS DIRECTED BY THE ENGINEER.
6. STEEL PIPE SHALL BE HOT DIP GALVANIZED IN CONFORMANCE TO ASTM DESIGNATION A123. BOLTS, NUTS AND WASHERS SHALL BE HOT-DIP GALVANIZED TO ASTM DESIGNATION A153.
7. BOLTS SHALL CONFORM TO ASTM A36. NUTS SHALL CONFORM TO A307 REQUIREMENTS AND SHALL BE TAPPED OR CHASED AFTER GALVANIZING. BOLTS AND NUTS SHALL HAVE CLASS 2A AND 2B FIT TOLERANCES.
8. THE BARRIER SHOULD BE LIGHT IN COLOR AND SHOULD BE SUPPLEMENTED BY DELINEATION AS DETAILED ELSEWHERE IN THE PLANS.



CONNECTION BOLT

FOR CONTRACTORS INFORMATION ONLY

(TYPE 1) APPROX. QUANTITIES 20 FT. SECTION		
CONCRETE	CY	2.6
REINFORCING STEEL	LBS	330
TOTAL BARRIER WT.	LBS	11000



WELDED WIRE FABRIC OPTIONAL REINFORCING



Texas Department of Transportation
Design Division (Roadway)

LOW PROFILE
CONCRETE BARRIER
(PORTABLE AND PRECAST)

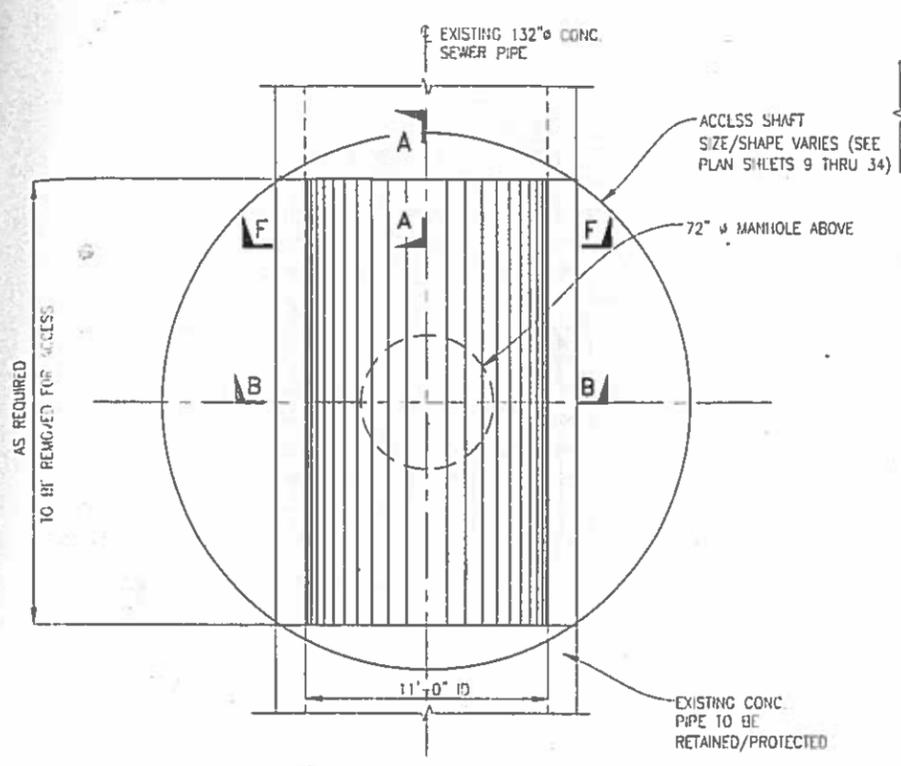
LPCB(1)-92

SHEET 1 OF 2

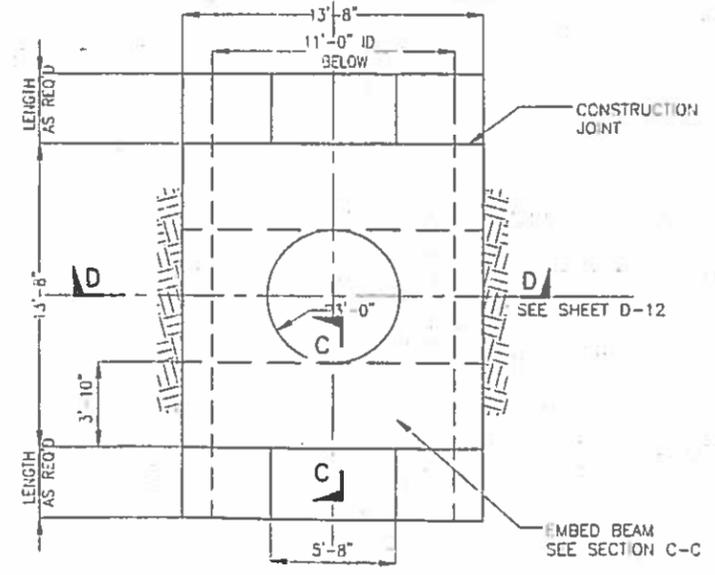
FILE: lpcb192.dgn	DN:	CK:	DW:	CK:
© TxDOT September 1992	DISTRICT	FEDERAL AID PROJECT		SHEET
REVISIONS				157
COUNTY		CONTROL SECT	JOB	HIGHWAY

MH RISER
 ← 6' DIA

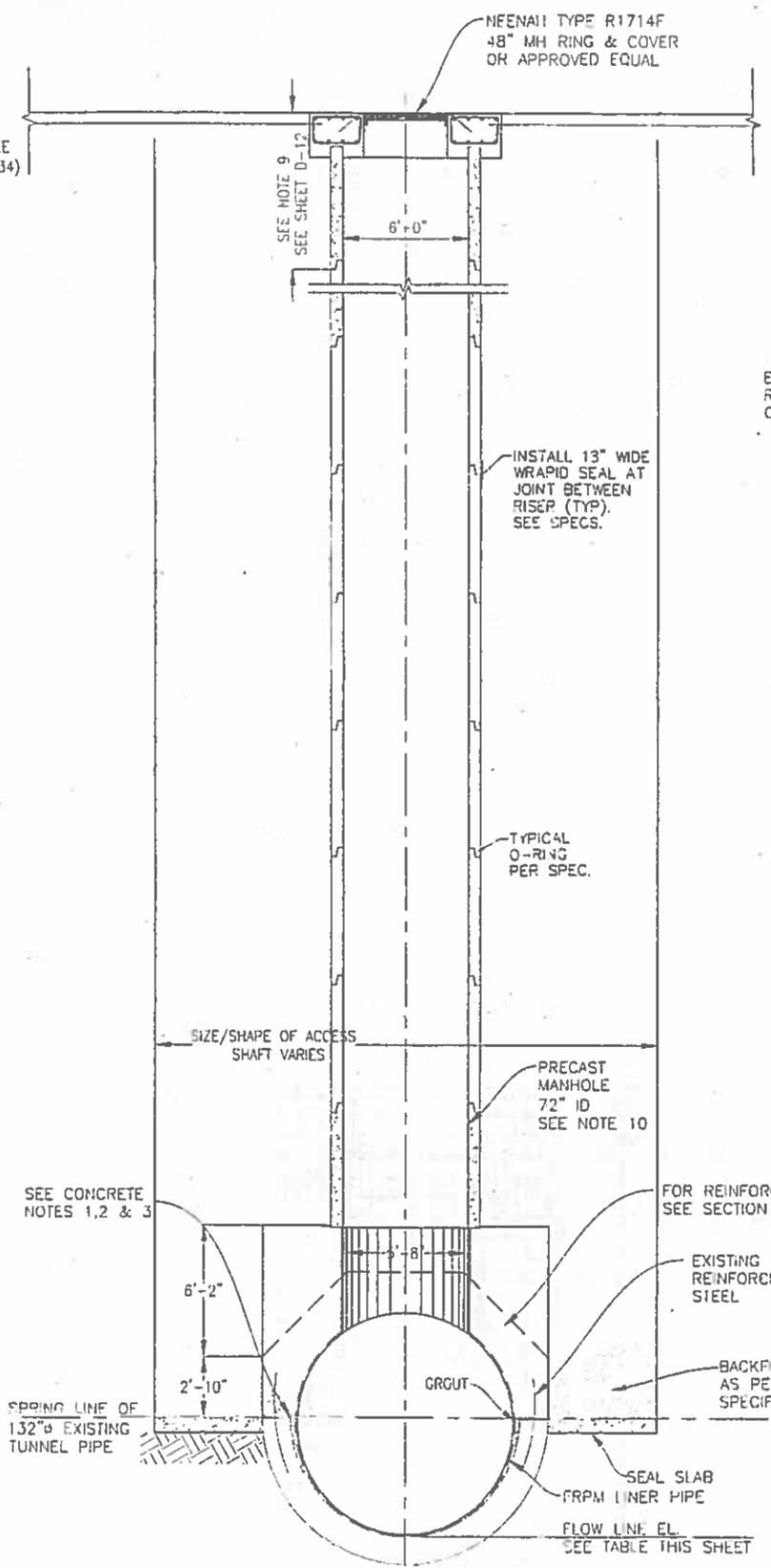
NOTES:
 1. FOR GENERAL AND CONCRETE NOTES
 SEE DWG NO. D-13.



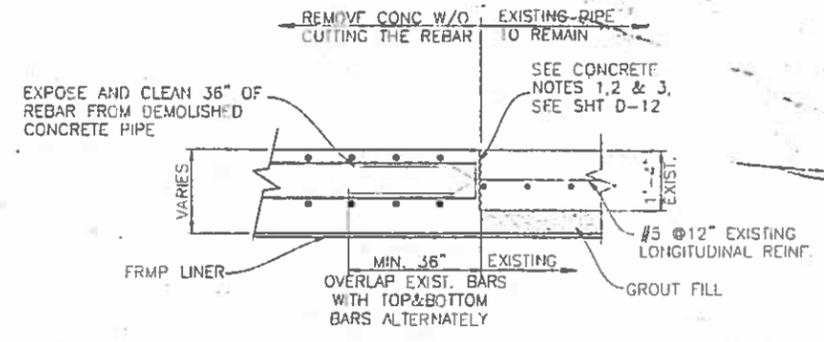
ACCESS SHAFT PLAN AT PIPE SPRING LINE
 SCALE 1/4" = 1'-0"



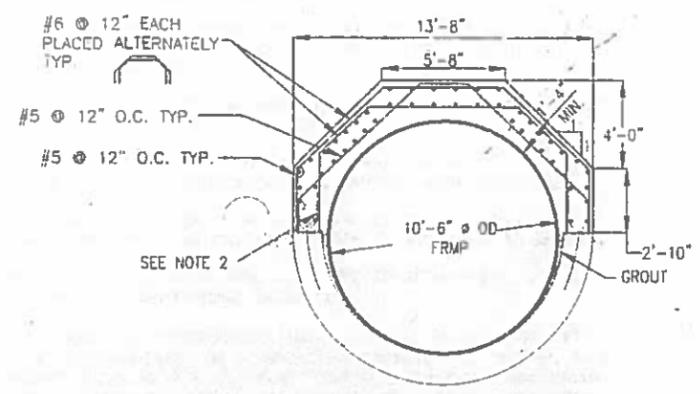
PLAN ABOVE TOP OF PIPE
 SCALE 1/4" = 1'-0"



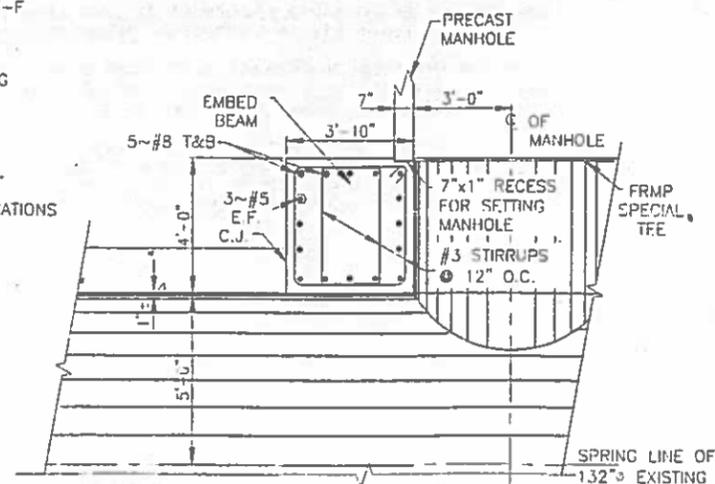
SECTION B-B
 SCALE 1/4" = 1'-0"



SECTION A-A
 SCALE 1/2" = 1'-0"



SECTION F-F
 SCALE 1/4" = 1'-0"



SECTION C-C
 (TYP.)
 SCALE 3/8" = 1'-0"

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
 0 1 2 3
 COLOR TABLE:
 I:\2010 Jobs\2010-022 BAB SWPPP & TCP\Manhole Design\BAB Manhole design.dwg - 11/24/10 - 11/24/10

FILE NO: 4724	WHS: R-002003-0009-4
DRAWING SCALE: AS SHOWN	CITY OF HOUSTON PM: ROBERT MILES, P. E.
DWG NO.: D-12	SHEET NO. 47 OF 69

RATNALA & BAHL, INC.
 Engineers - Architects - Surveyors
 11707 KATY FREEWAY, SUITE 610
 HOUSTON, TEXAS 77057
 TWP# FIRM REGISTRATION NO. 2086

Binkley & Barfield, Inc.
 consulting engineers
 Texas Registration Number F-257
 1713 Sam Houston Blvd
 Houston, Texas 77006-3189
 (713) 869-3433

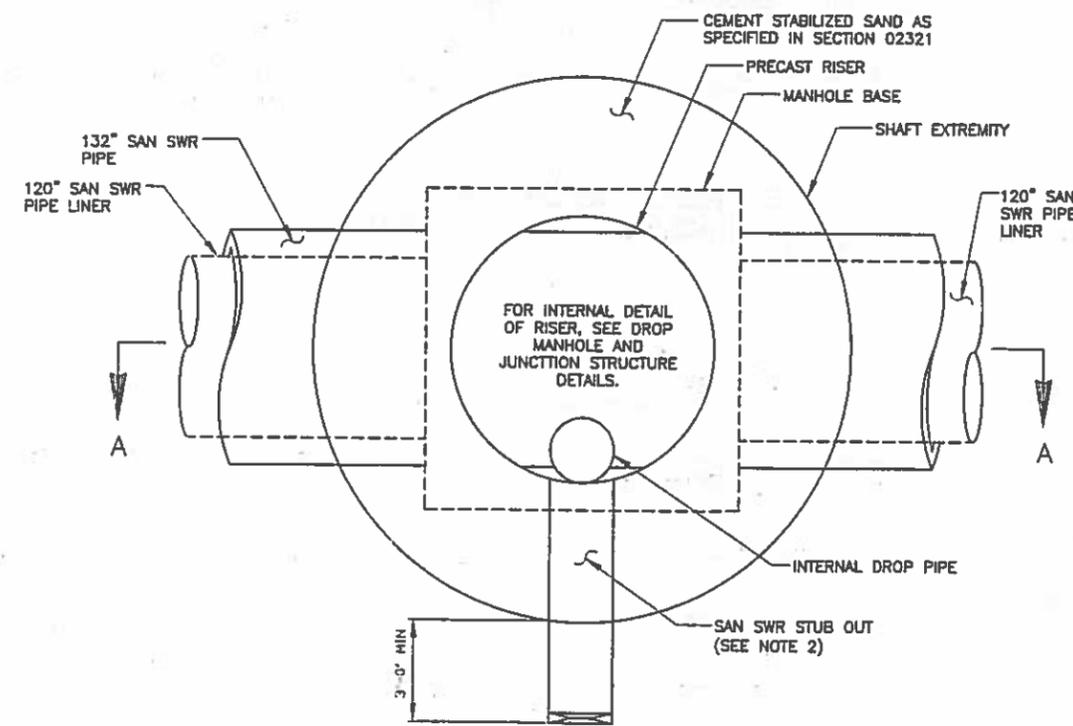
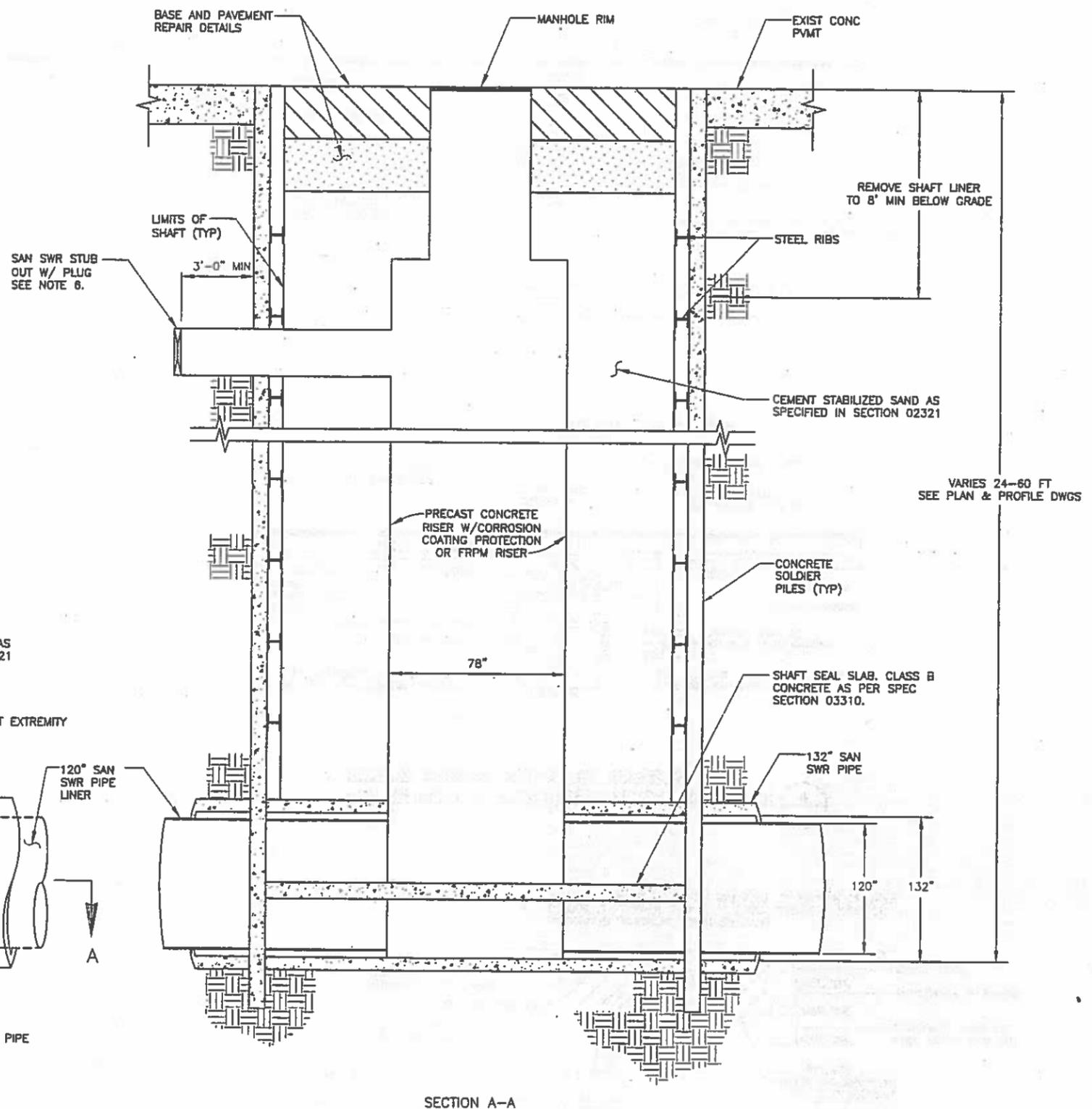
CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
 NORTHSIDE SEWER RELIEF TUNNEL
 REHABILITATION-AREA No. 5

**PROPOSED DEEP TUNNEL
 MANHOLE DETAILS
 (SHEET 2 OF 3)**

CLINTON
NEED DETAIL
FOR MH ADJUST.

NOTES:

1. EXCESS EXCAVATION SHALL BE BACK-FILLED AT NO EXTRA COST TO THE CITY.
2. STUB OUT LENGTH, DIAMETER, AND INTERSECTION ANGLE WITH 132" SAN SWR PIPE VARIES. SEE PLAN AND PROFILE SHEETS FOR SPECIFIC INFORMATION.
3. GROUTING OF MANHOLE STRUCTURE ANNULAR SPACE WILL BE PERMITTED IN CASES WHERE INSUFFICIENT WORK SPACE EXISTS FOR PLACEMENT AND COMPACTION OF CEMENT STABILIZED SAND, IN ACCORDANCE WITH SPEC 02958-SLIPLINING GROUT.
4. THIS DETAIL ALSO APPLIES TO BACKFILL OF SHAFTS WITHOUT STRUCTURES.
5. ARRANGE PIPES JOINTS AS SHOWN WHEN USING RIGID CONNECTIONS TO CAST-IN-PLACE MANHOLE BASE.
6. THE STUB OUT LENGTHS SHALL PROTRUDE BEYOND THE OUTSIDE OF THE SHAFT A MINIMUM OF 3 FEET. THE CONTRACTOR SHALL PROVIDE THE MINIMUM LENGTHS SHOWN ON THE PLAN AND PROFILE SHEETS. IF ADDITIONAL LENGTH IS REQUIRED BASED UPON THE SIZE OF SHAFT CONSTRUCTED, THEN THE CONTRACTOR SHALL PROVIDE SUCH AT NO ADDITIONAL COST TO THE OWNER.



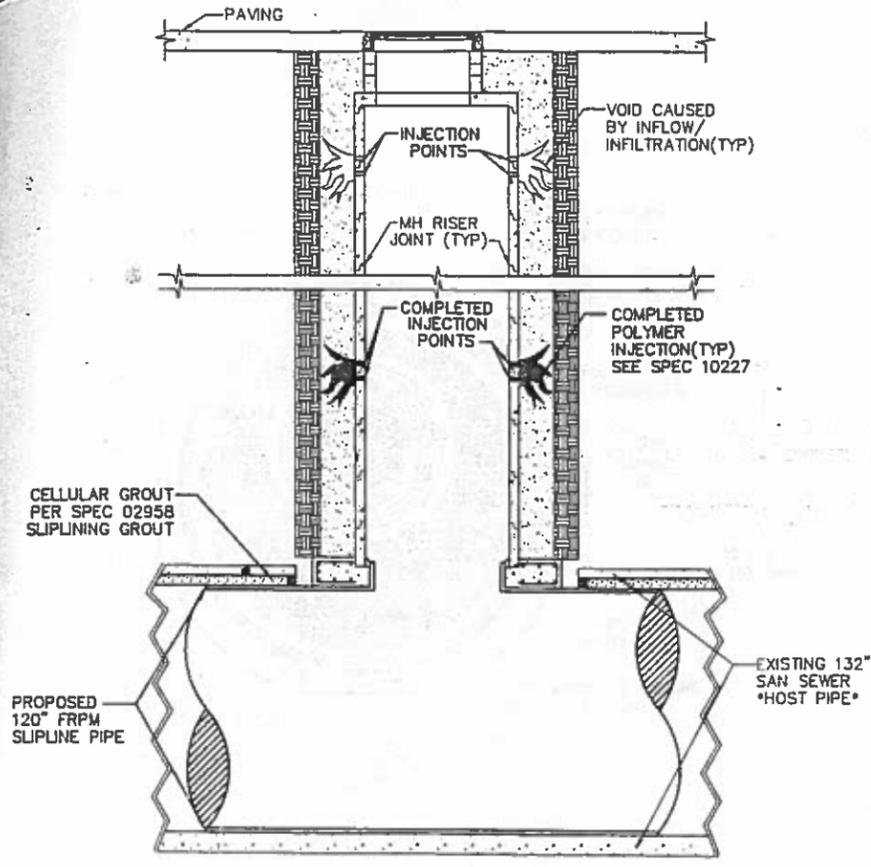
1 STUB-OUT BACKFILL DETAIL UNDER PAVEMENT - PLAN VIEW

CROSS SECTION STRUCTURE/SHAFT BACKFILL UNDER PAVEMENT DETAIL

02/28/11	
STATE OF TEXAS CARLOS E. QUINTERO 94948 LICENSED PROFESSIONAL ENGINEER	
 Binkley & Barfield, Inc. consulting engineers Texas Registration Number F-257 1710 Beaman Drive Houston, Texas 77058-3188 (713) 869-3433	
SURVEYED BY: LANDTECH	FIELD BOOK NO.: P-5548
CITY OF HOUSTON DEPARTMENT OF PUBLIC WORKS AND ENGINEERING	
NORTHSIDE SEWER RELIEF TUNNEL REHABILITATION AREA No. 5	
PROPOSED MANHOLE BACKFILL DETAILS	
FILE NO: 4724	
WBS: R-002003-0009-4	
DRAWING SCALE	
NO SCALE	
CITY OF HOUSTON PM	
ROBERT MILES, P.E.	
DWG NO.: D-16	
SHEET NO. 51 OF 69	

G:\B0701\CADD\D-16 Manhole Backfill Details.dwg Mar 04 2011 - 1:14pm rpd

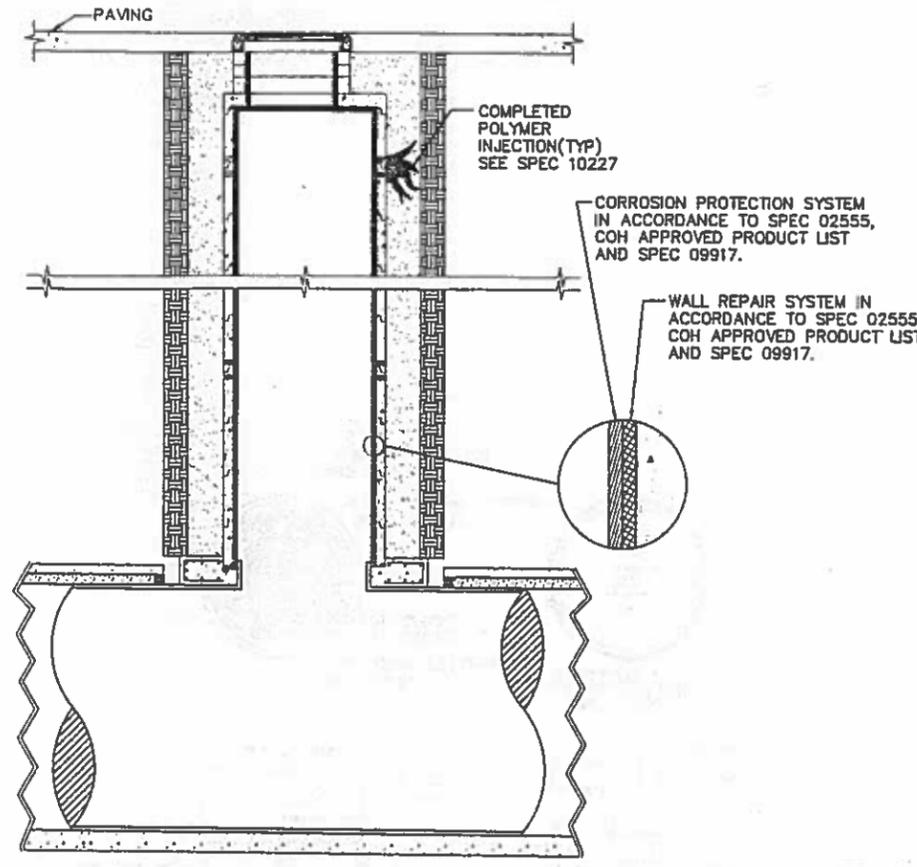
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS



2 EXISTING SANITARY SEWER MANHOLE INJECTION POINTS

NOTES:

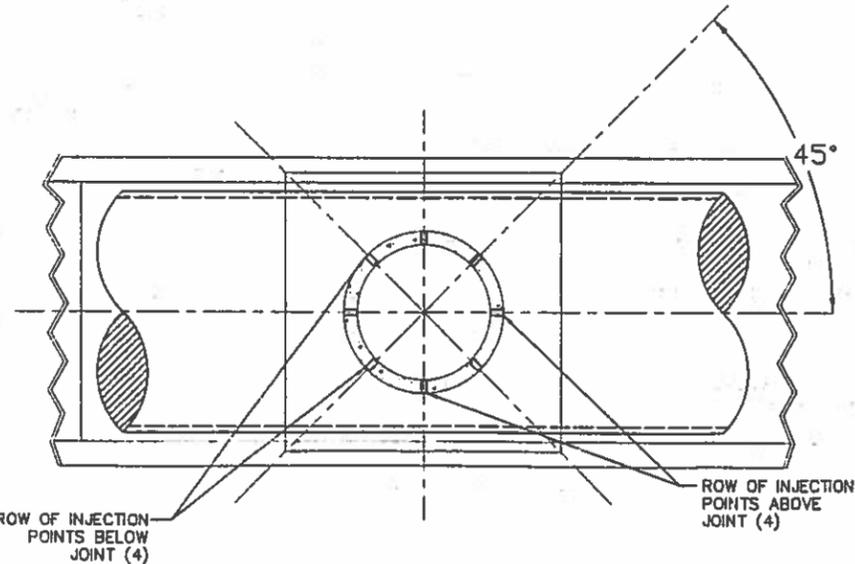
1. MANHOLE SHALL BE THOROUGHLY CLEANED TO MEET MANUFACTURER'S SPECIFICATIONS PRIOR TO REHABILITATION.
2. THE CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT AND MATERIALS TO SEAL EXISTING INFILTRATION IDENTIFIED BY THE CONTRACT DOCUMENTS UTILIZING A HIGH DENSITY POLYMER. THIS MATERIAL SHALL BE INJECTED BEHIND THE WALLS OF THE PIPE SEWER THROUGH DRILLED HOLES IN VERTICAL OR HORIZONTAL SURFACES WHERE IT WILL EXPAND, SEAL OUT WATER AND BLOCK THE EXISTING INFILTRATION FROM THE BACK SIDE, AND FILL ANY VOIDS CREATED BY THE ACTIVE INFILTRATION. CONTRACTOR SHALL REMOVE REMNANT MATERIAL THAT HAS OUT-CROPPED INTO THE SEWER AND THAT WILL INTERFERE WITH THE FLOW OR FUNCTION OF THE SEWER. CONTRACTOR SHALL FOLLOW THE INJECTION PATTERN AS SHOWN ON DETAILS 1 AND 2 AND DESCRIBED UNDER NUMERAL 3. CONTRACTOR WILL CONTROL THE INJECTION RATE, AND THE AMOUNT OF INJECTED MATERIAL REQUIRED TO SATISFACTORILY ACHIEVE THE DESIRED RESULT.
3. INJECTION HOLES SHALL BE DRILLED AT 90° FROM EACH OTHER AND AT THE SAME ELEVATION. INJECTION HOLES SHALL BE PATCHED WITH WATERPROOF QUICK-SETTING MORTAR.
4. CONTRACTOR SHALL PROVIDE A SOURCE OF FRESH AIR INFLOW FEED, AS WELL AS COMMUNICATION DEVICES, LIVE VIDEO FEED, SAFETY ROPES, PRESET RESCUE REQUIREMENTS AND A MOBILE CRANE FOR EQUIPMENT PLACEMENT.
5. IN THE EVENT A CONFINED SPACE ENTRY IS REQUIRED, CONTRACTOR SHALL PROVIDE PERSONNEL CERTIFIED IN CONFINED SPACE ENTRY AND SHALL USE THE PROPER EQUIPMENT AND OSHA APPROVED PROCEDURES TO PERFORM THE WORK WITHOUT ADDITIONAL COST TO THE OWNER.
6. THE FOLLOWING DESCRIBES THE GENERAL APPLICATION METHOD:
 - MULTIPLE INJECTION HOLES (5/8 INCH DIA) SHALL BE DRILLED THROUGH THE WALL OF THE PIPE OR STRUCTURE AT LOCATIONS AND AT SPACING AS DESCRIBED ABOVE.
 - POLYMER IS INJECTED IN MULTIPLE SHOTS DIRECTLY THROUGH THE INJECTION HOLES OR THROUGH TUBES THAT ARE DRIVEN OR JETTED TO VARYING DISTANCES INTO THE SOILS OF THE AREA BEING STABILIZED. ONCE INJECTED, THE MATERIAL IS ALLOWED TO EXPAND, FILL VOIDS AND STABILIZE AFFECTED AREA AND STOP ALL INFILTRATION.
 - A REPAIR DOCUMENTATION FORM INDICATING THE APPROXIMATE INJECTION LOCATIONS AND VOLUME OF MATERIAL IS COMPLETED BY THE CONTRACTOR.



INTERIOR COATING SYSTEM NOTES:

1. MANHOLE SHALL BE THOROUGHLY CLEANED TO MEET MANUFACTURER'S SPECIFICATIONS PRIOR TO REHABILITATION.
2. ACTIVE LEAKS SHALL BE STOPPED USING PRODUCTS SPECIFICALLY DEVELOPED FOR THAT PURPOSE.
3. MATERIALS SHALL BE PREPARED, MIXED AND PLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS AND SPECIFICATIONS.
4. MATERIAL SHALL BE SPRAYED TO A MINIMUM UNIFORM THICKNESS. IF REQUIRED, SURFACE SHALL BE TROWELED TO ENSURE A CONSOLIDATED COATING AND LEAVE A SMOOTH SURFACE. TROWELING SHALL COMPACT MATERIAL INTO VOIDS AND CREVICES.
5. IF REQUIRED BY MANUFACTURER'S SPECIFICATIONS, A SECOND COAT SHALL BE APPLIED AFTER THE FIRST APPLICATION HAS TAKEN AN INITIAL SET, BUT NOT OVER 72 HOURS. THICKNESS SHALL BE A TOTAL OF 1/4" MINIMUM.

3 EXISTING SANITARY SEWER MANHOLE WALL REHABILITATION



1 EXISTING SANITARY SEWER MANHOLE INJECTION POINTS PLAN VIEW

NOTES:

1. SEAT MANHOLE FRAME IN SEALANT PER SPECIFICATION SECTION 02082.
2. OMIT CEMENT MORTAR WHEN MANHOLE IS LOCATED IN PAVED AREAS.
3. PROVIDE BACKFILL TO MATCH ADJACENT PIPE TRENCH BACKFILL PER SPECIFICATION SECTION 02801.
4. PROVIDE RESILIENT CONNECTORS FOR NEW PIPE SEWERS. SECTION B SHOWS CONNECTION DETAIL FOR NEW SEWERS WHEN PIPE DIAMETER EXCEEDS AVAILABLE RESILIENT CONNECTOR DIAMETER.
5. DEPTH OF MANHOLE DETERMINES SECTIONS REQUIRED.
6. PRECAST RINGS SHALL BE PROVIDED FOR A COMBINED ADJUSTMENT HEIGHT OF AT LEAST 12". THE TOTAL HEIGHT OF THE ADJUSTMENT RINGS SHALL NOT EXCEED 1'-6".
7. MANHOLE WALL THICKNESS FOR DEPTH EXCEEDING 12'-0" SHALL BE DETERMINED TO MEET LOADING CONDITIONS. MIN THICKNESS 5".
8. MIN REINFORCING IN THE PRECAST CONCRETE BASE SHALL BE # 5 @ 8" EW.

DATE	06/08/11
DESIGNED BY	CARLOS E. QUINTERO
CHECKED BY	[Signature]
PROFESSIONAL ENGINEER	94848

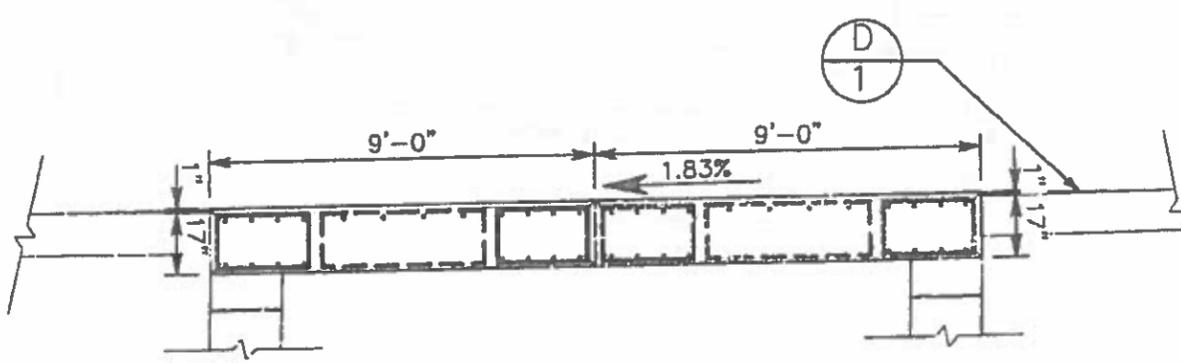
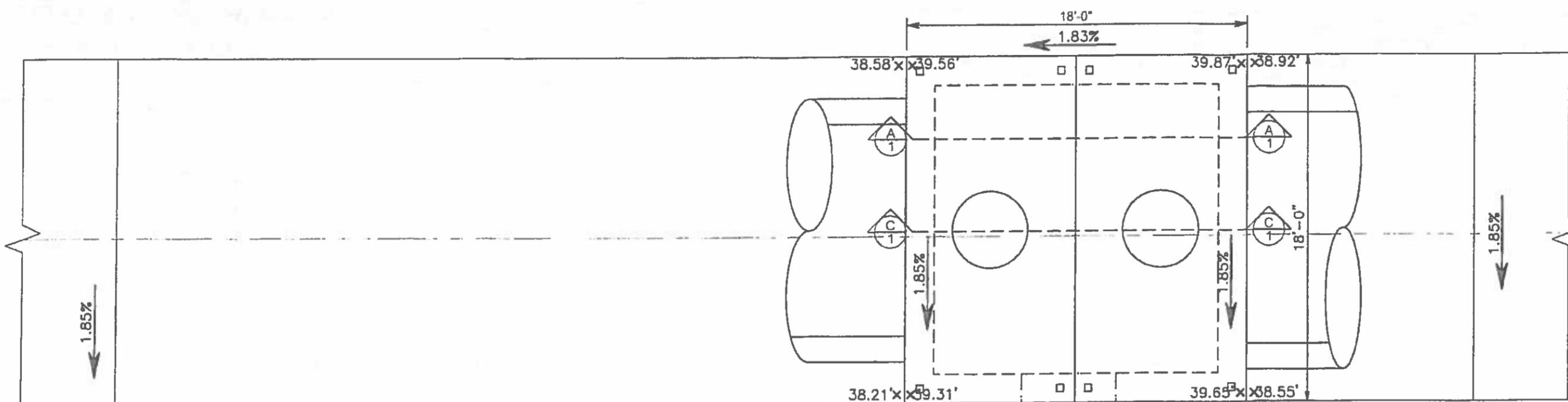
Binkley & Barfield, Inc
 consulting engineers
 Texas Registration Number F-257
 1710 Seaman Drive
 Houston, Texas 77008-3189
 (713) 869-3433

SURVEYED BY: LANDTECH FIELD BOOK NO.: P-5548
CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
 NORTHSIDE SEWER RELIEF TUNNEL
 REHABILITATION AREA No. 5
 EXISTING MANHOLE
 REHABILITATION DETAILS

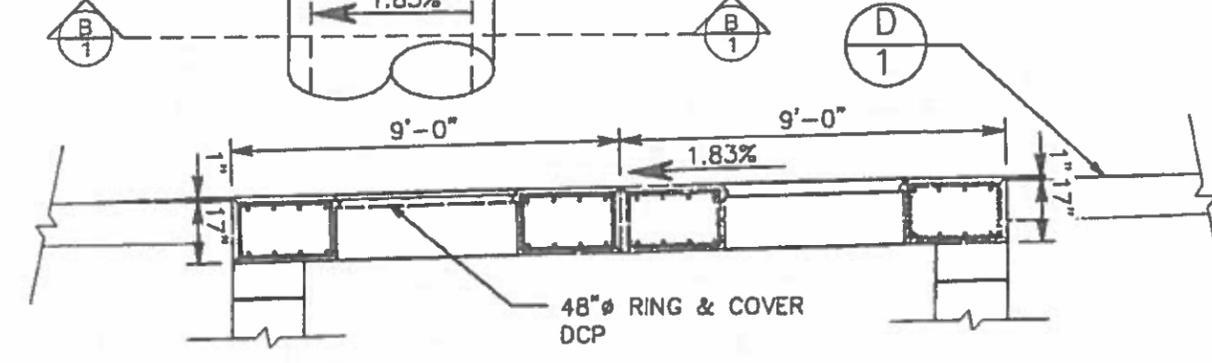
FILE NO:	4724
WBS:	R-002003-0009-4
DRAWING SCALE:	NO SCALE
CITY OF HOUSTON PM:	ROBERT MILES, P.E.
DWG NO.:	D-14
SHEET NO.:	49 OF 69



ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
 0 1 2
 COLOR TABLE
 G:\80701\CAD\14 Existing Manhole Rehabilitation Details.dwg Jul 18 2011 9:37am.rpd

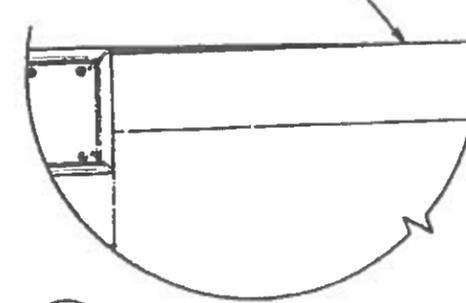


A
1 PLAN SECTION A-A (NEW LID)
SCALE: 1/2"=1'-0"

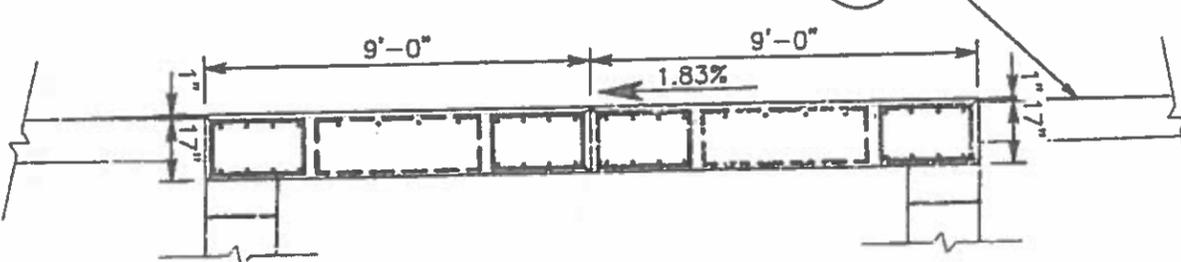


C
1 PLAN SECTION B-B (NEW LID)
SCALE: 1/2"=1'-0"

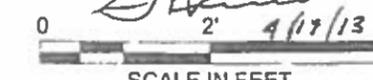
BLEND PAVEMENT TO THE EDGE OF THE LID



D
1 DETAIL
SCALE: 1"=1'-0"



B
1 PLAN SECTION B-B (NEW LID)
SCALE: 1/2"=1'-0"

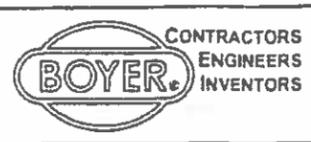


JAPHET ST J-BOX

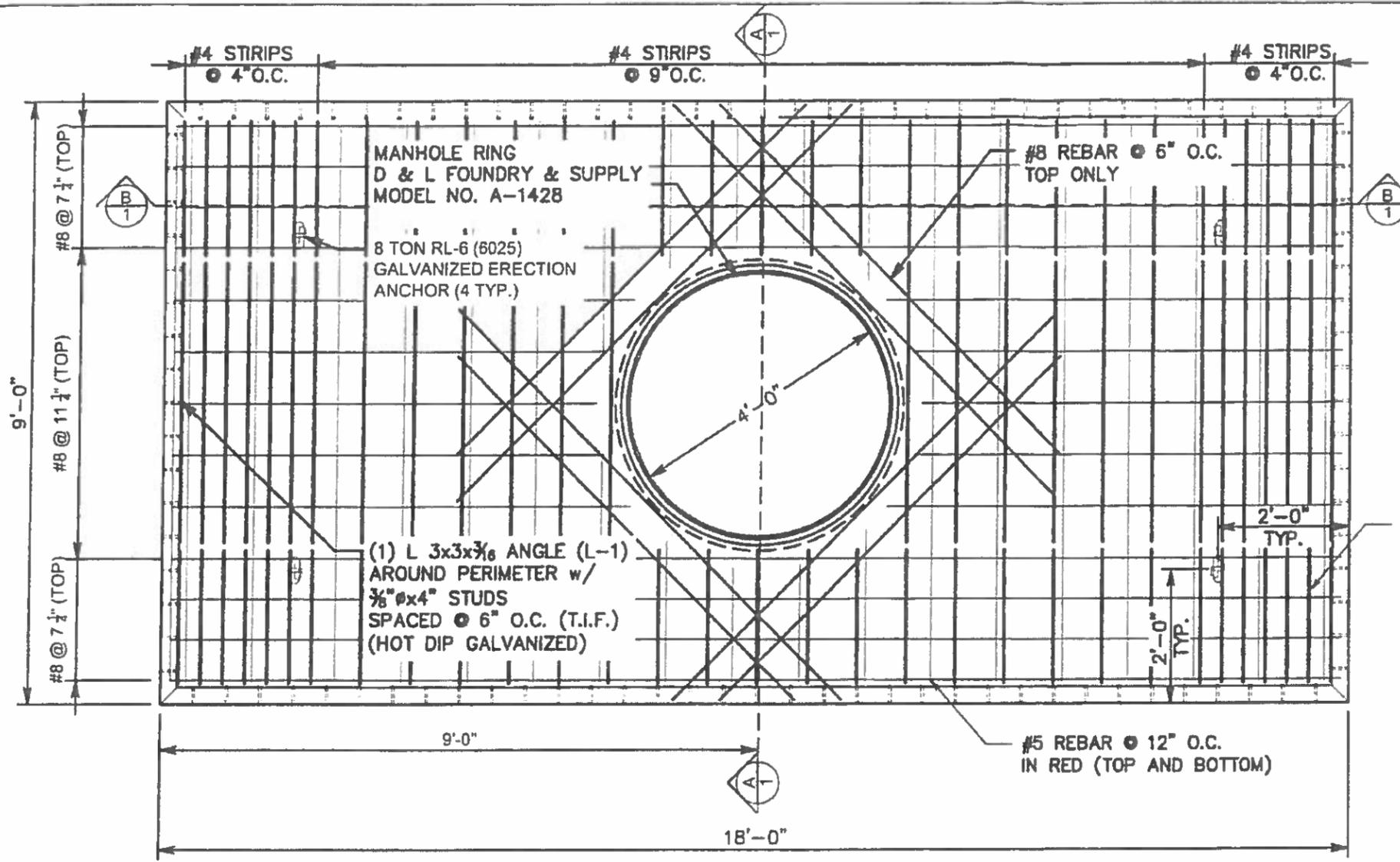
DATE	REVISION	APPROVED

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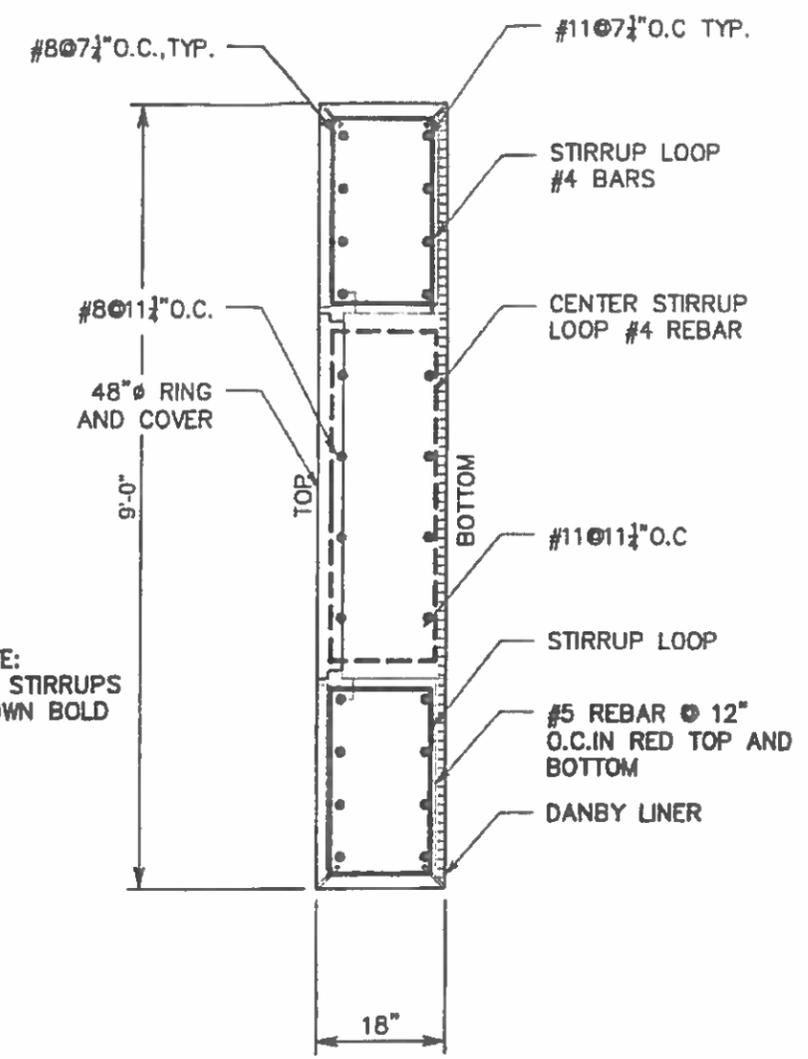
www.boyerinc.com
8904 Fairbanks N. Houston Rd.
Houston, TX 77064
Tel: 713-466-5395
Fax: 713-466-8198



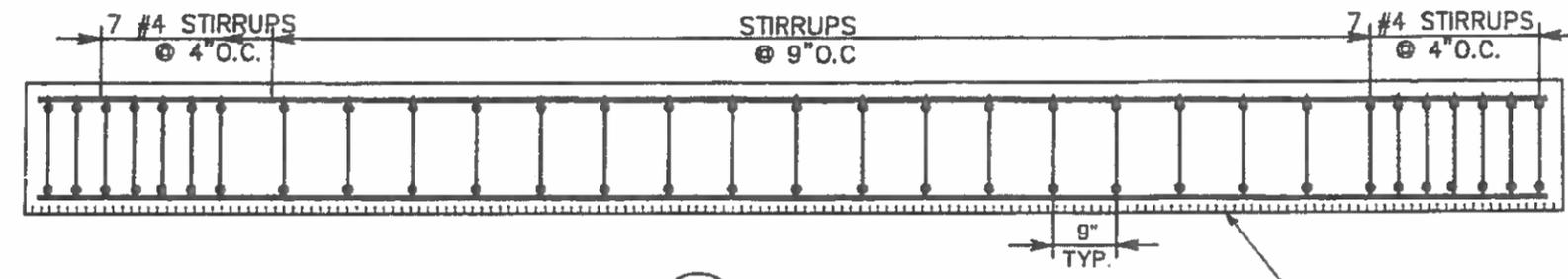
SHEET 2 of 5	FILE 430_Japhet St J-Box_1_A_rev2.dwg
SCALE: 1/2"=1'-0"	DATE 04-17-2013 JOB: 430
DSN 430-1	DRWN TDS CHKD QTY 1
PHASE I	
NSRT REHABILITATION AREA #5	



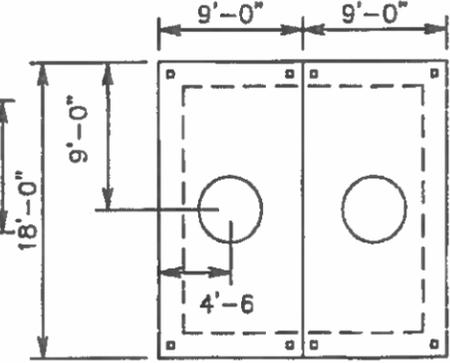
LID PLAN (TOP)
SCALE: 1/2" = 1'-0"



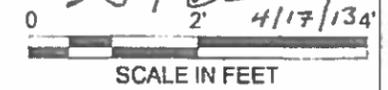
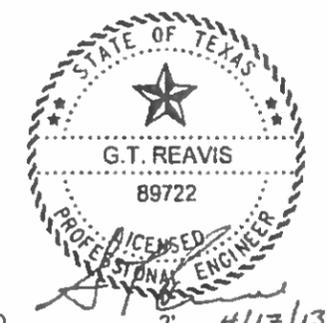
CROSS SECTION A
SCALE: 1/2" = 1'-0"



CROSS SECTION B
SCALE: 1/2" = 1'-0"



GENERAL ARRANGEMENT
SCALE: 3/32" = 1'-0"



REMOVABLE PRECAST
LID FOR J.B. AT JAPHET ST.

DATE	REVISION	APPROVED

PROPRIETARY AND CONFIDENTIAL RIGHTS ARE INCLUDED IN THE INFORMATION DISCLOSED HEREIN. NEITHER THIS DOCUMENT NOR THE INFORMATION DISCLOSED HEREIN SHALL BE REPRODUCED OR TRANSFERRED TO OTHER DOCUMENTS OR BE USED OR DISCLOSED TO OTHERS FOR MANUFACTURING OR FOR ANY PURPOSE EXCEPT AS SPECIALLY AUTHORIZED IN WRITING BY BOYER, INC. TEXAS PROFESSIONAL ENGINEERS REG. NO. F-2023

www.boyerinc.com
8904 Fairbanks N. Houston Rd.
Houston, TX 77064
Tel: 713-466-5395
Fax: 713-466-8188

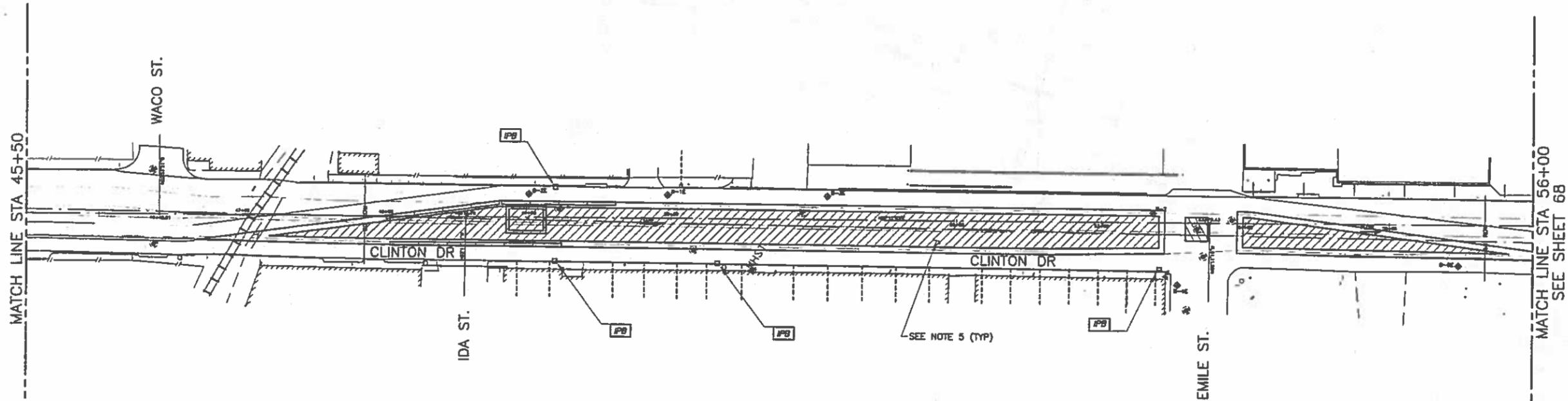


SHEET: 3 of 5	FILE: 430_Japhet St J-Box 1 A_rev2.dwg
SCALE: 1/2" = 1'-0"	DATE: 04-17-2013
DSN: 430-1	DRWN: CSM
	CHKD:
	QTY: 1
PHASE I	
NSRT REHABILITATION AREA #5	

C:\80761\1_CADD_SIV-3_SyPPP_Phase2_Sht_1of2.dwg Mar 04 2011 - 2:37pm.rpd

COLOR TABLE

ORIGINAL SCALE IN INCHES
FOR REDUCED PLANS



MATCH LINE STA 45+50

MATCH LINE STA 56+00
SEE SHEET 68

LEGEND:

-  INLET PROTECTION BARRIER
-  CONSTRUCTION AREA/LAY DOWN AREA
-  PROPOSED SHAFT

NOTES:

1. REFERENCE GENERAL NOTES, SHEET 3.
2. STORM WATER POLLUTION PREVENTION PLAN SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND DRAWINGS.
3. ALL DISTURBED AREAS THAT ARE NOT PAVED, COVERED BY PAVEMENT, SIDEWALK OR STRUCTURES SHALL BE SOODED.
4. PROVIDE A STABILIZED CONSTRUCTION ENTRANCE AND EXIT FOR ALL OF THE CONTRACTOR'S LAY DOWN OR STORAGE AREAS, IF SUCH ARE NOT PAVED.
5. CONTRACTOR SHALL PROVIDE A SPILLGUARD CONTAINMENT SYSTEM (RAIN FOR RENT, OR APPROVED EQUAL) FOR ALL TEMPORARY/STATIONARY RECIPROCATING ENGINE EQUIPMENT UTILIZED ON THE PROJECT. THIS REQUIREMENT APPLIES TO BOTH THE CONSTRUCTION AREAS DESIGNATED WITHIN CLINTON DRIVE ROW AND ALL OTHER CONSTRUCTION/LAY DOWN AREAS OBTAINED BY THE CONTRACTOR.



MATCH LINE STA 45+50

DATE	02/28/11
DESIGNED BY	LANDTECH
CHECKED BY	LANDTECH
APPROVED BY	LANDTECH
DATE	02/28/11
DESIGNED BY	LANDTECH
CHECKED BY	LANDTECH
APPROVED BY	LANDTECH

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Sequest Drive
Houston, Texas 77006-3189
(713) 865-3433

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
NORTHSIDE SEWER RELIEF TUNNEL
REHABILITATION AREA No. 5
STORM WATER POLLUTION
PREVENTION PLANS
PHASE 2 - SHEET 1 OF 2

FILE NO:	4724
WBS:	R-002003-000B-4
DRAWING SCALE	1"=40'
CITY OF HOUSTON PM	ROBERT MILES, P.E.
DWG NO.:	SW-3
SHEET NO.	67 OF 69





MATCH LINE STA 56+00
SEE SHEET 67

SCHWEIKART ST.

GAMMEL ST.

GOVAN ST.

CLINTON DR.

JAPHET

SEE NOTE 5 (TYP)

G:\60701\CADD\SW-4 SWPPP Phase2 Sht 2of2.dwg Mar 04 2011 - 2:39pm.rpd

COLOR TABLE:

LEGEND:

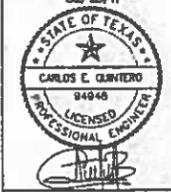
-  INLET PROTECTION BARRIER
-  CONSTRUCTION AREA/LAY DOWN AREA
-  PROPOSED SHAFT

NOTES:

1. REFERENCE GENERAL NOTES, SHEET 3.
2. STORM WATER POLLUTION PREVENTION PLAN SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND DRAWINGS.
3. ALL DISTURBED AREAS THAT ARE NOT PAVED, COVERED BY PAVEMENT, SIDEWALK OR STRUCTURES SHALL BE SOODED.
4. PROVIDE A STABILIZED CONSTRUCTION ENTRANCE AND EXIT FOR ALL OF THE CONTRACTOR'S LAY DOWN OR STORAGE AREAS, IF SUCH ARE NOT PAVED.
5. CONTRACTOR SHALL PROVIDE A SPILLGUARD CONTAINMENT SYSTEM (RAIN FOR RENT, OR APPROVED EQUAL) FOR ALL TEMPORARY/STATIONARY RECIPROCATING ENGINE EQUIPMENT UTILIZED ON THE PROJECT. THIS REQUIREMENT APPLIES TO BOTH THE CONSTRUCTION AREAS DESIGNATED WITHIN CLINTON DRIVE ROW AND ALL OTHER CONSTRUCTION/LAY DOWN AREAS OBTAINED BY THE CONTRACTOR.

ORIGINAL SCALE 1/4" = 1'-0"
FOR REDUCED PLANS

No.	Date	Revisions	App.
	02/25/11		



Binkley & Barfield, Inc
 consulting engineers
 Texas Registration Number F-257
 1710 Seaman Drive
 Houston, Texas 77008-3189
 (713) 866-3433

SURVEYED BY: LANOTECH FIELD BOOK NO.: P-9548

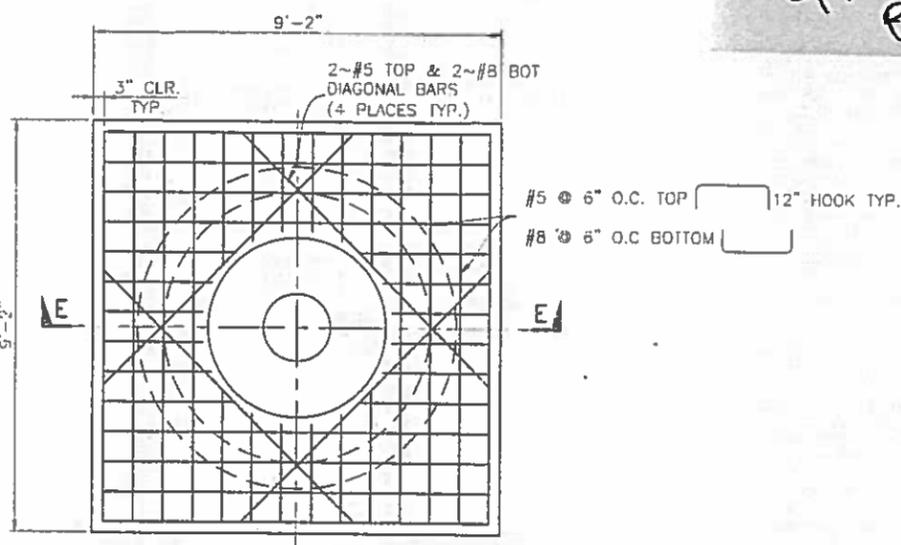
CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NORTHSIDE SEWER RELIEF TUNNEL
REHABILITATION AREA No. 5
STORM WATER POLLUTION
PREVENTION PLANS
PHASE 2 - SHEET 2 OF 2

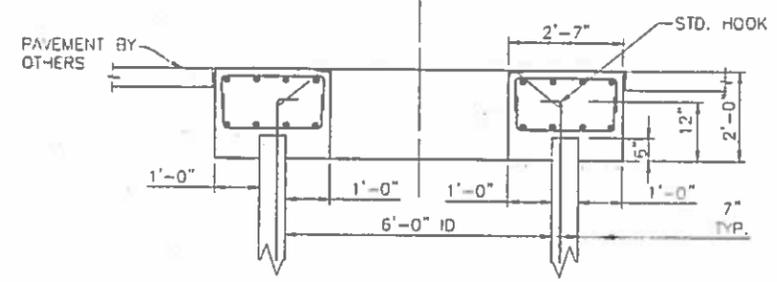
FILE NO: 4724
 WBS: R-002003-0000-4
 DRAWING SCALE
 HORIZ: 1"=20' VERT: 1"=2'
 CITY OF HOUSTON PM
 ROBERT MILES, P.E.
 DWG NO.: SW-4
 SHEET NO. 68 OF 69



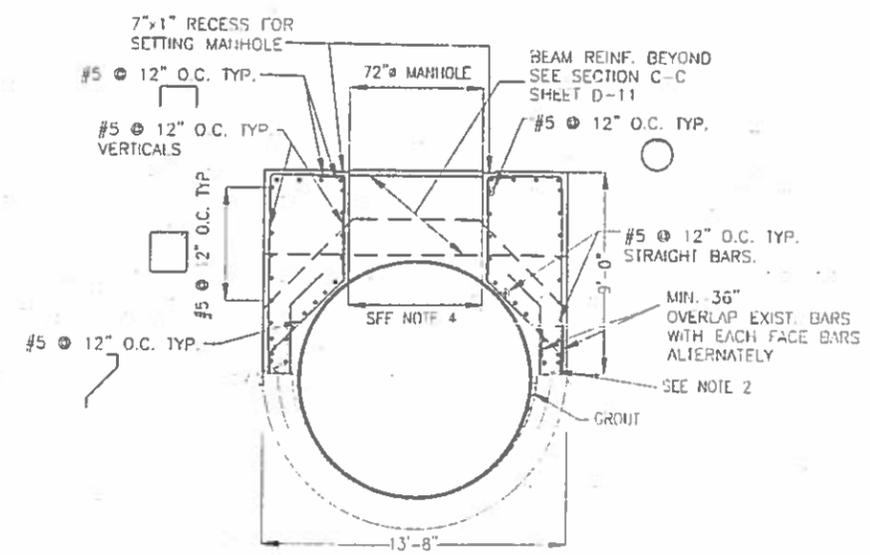
9' x 9' CONC. PAD



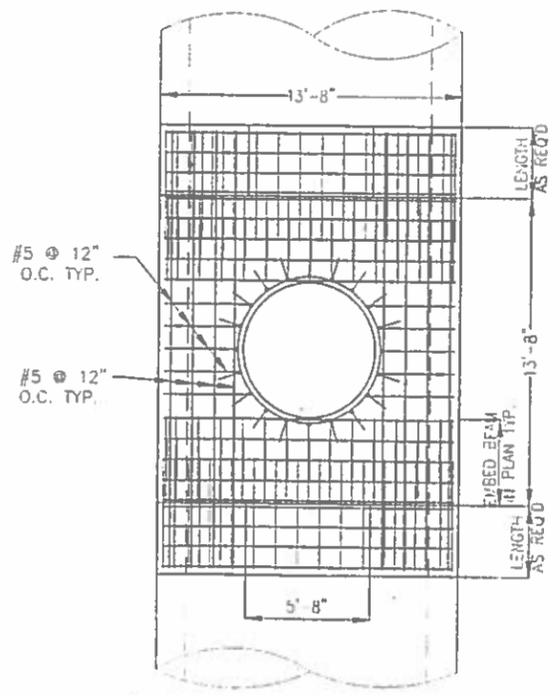
MANHOLE-TOP PLAN
SCALE 1/2" = 1'-0"



SECTION E-E
SCALE 1/2" = 1'-0"



SECTION D-D
(SEE SHEET D-11)
SCALE 1/2" = 1'-0"



REBAR PLAN
SCALE 1/4" = 1'-0"

MANHOLE AT	TOP OF RIM EL. (FIELD VERIFY)	FLOWLINE EL. (FIELD VERIFY)
STA 28+70.00	42.00	-24.00
STA 42+48.13	36.50	+12.00
STA 48+98.15	34.00	+9.00
STA 60+72.00	35.50	-8.20

GENERAL NOTES:

- DESIGN LIVE LOADS FOR TRUNK SEWER AND APPURTENANCE
 - H2O TRUCK LOADING
 - E80 RAILROAD LOADING WHERE APPLICABLE.
- STRUCTURAL DESIGN CODES:
 - CONCRETE - ACI 318-2008(WORKING STRESS) "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE" AS MODIFIED BY ACI 350R "CONCRETE SANITARY ENGINEERING STRUCTURES".
 - STRUCTURAL STEEL - AISC "MANUAL OF STEEL CONSTRUCTION", THIRTEENTH EDITION.

CONCRETE NOTES:

- DEMOLISH PART OF PIPE SO THE EXPOSED CONCRETE INTERFACE REMAINS ROUGH. NO SAW CUTTING PERMITTED.
- CLEAN EXPOSED CONCRETE SURFACE AND EXISTING REBAR FREE OF DUST AND APPLY EPOXY BONDING COMPOUND PRIOR TO FORMING IN-PLACE CONCRETE.
- CLEAN EXISTING CONCRETE THOROUGHLY AND APPLY EPOXY BONDING AGENT BEFORE PLACING NEW CONCRETE.
- CUT AND ROUTE LONGITUDINAL BARS AT THE HARNESS TO ALLOW ATLEAST 36" EMBEDMENT INTO HARNESS REINFORCEMENT.
- ALL CONCRETE, EXCEPT FOR SEAL SLAB AND FILL CONCRETE, SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
- ALL REINFORCING STEEL SHALL CONFORM TO ASTM A-615, GRADE 60. 3" COVER ALL REINFORCING STEEL TYP.
- ALL CONCRETE CONSTRUCTION SHALL CONFORM TO THE "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" ACI 318-08, WITH MODIFICATIONS AS PER ACI 350R: "CONCRETE SANITARY ENGINEERING STRUCTURES". DETAILING OF REINFORCING SHALL BE IN ACCORDANCE WITH ACI 315, LATEST EDITION, UNLESS SHOWN OTHERWISE. PLACING OF REINFORCING SHALL BE IN ACCORDANCE WITH C.R.S.I. "RECOMMENDED PRACTICE FOR PLACING OF REINFORCING BARS", LATEST EDITION.
- BACKFILL SHALL BE THOROUGHLY COMPACTED TO 95% STANDARD PROCTOR DENSITY AS SPECIFIED IN ASTM D-698.
- ADJUSTMENT RINGS TO BE COMBINED AS NECESSARY AND SEALED WITH APPROVED SEALANT. EXPOSE TOP 12" OF REINF FROM TOP RING AND EMBED INTO SLAB CONCRETE AS SHOWN (SEE SECTION E-E).
- PRECAST REINFORCED CONCRETE PER SPEC SECTION 02082 PRF CAST MANHOLES SET WITH APPROVED SEALANT, WITH CORROSION PROTECTION IN ACCORDANCE TO SPEC SECTION 09917 CORROSION PROTECTIVE COATING SYSTEMS AND THE COH APPROVED PRODUCTS LIST.

No.	Date	Revisions	By



RATNALA & BAHL, INC.
Engineers - Architects - Surveyors
11707 KATY FREEWAY, SUITE 510
HOUSTON, TEXAS 77059
TYPE FORM REGISTRATION NO. 2008

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seawall Drive
Houston, Texas 77008-3128
(713) 885-3433

SURVEYED BY: LANDTECH FIELD BOOK NO. P-5518

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
NORTHSIDE SEWER RELIEF TUNNEL
REHABILITATION-AREA No. 5

**PROPOSED DEEP TUNNEL
MANHOLE DETAILS
(SHEET 3 OF 3)**

FILE NO: 4724	
WBS: R-002003-0009-4	
DRAWING SCALE AS SHOWN	
CITY OF HOUSTON PM ROBERT MILES, P.E.	
DWG NO.: D-13	
SHEET NO. 48 OF 69	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
 COLOR TABLE
 E:\2010 Jobs\2010-022 BAB SWPPP & TUP\Manhole Detailing\BAB Manhole design.dwg Mar 03,2011 11:20am