TRANSPORTATION CABINET
Frankfort, Kentucky 40622
www.transportation.ky.gov/

Steven L. Beshear
Governor

Michael W. Hancock, P.E.
Secretary

February 17, 2011

CALL NO. 339
CONTRACT ID NO. 111004
ADDENDUM # 2

Subject: Estill County, JL03 033 0089 012-015
Letting February 18, 2011

(1)Revised - Plan Sheets - Sheet # 2d & 17
(2)Revised - Table of Contents - Page 2 of 101
(3)Added - Specifications for Water Line - Pages 21(a)-21(xxxx) of 101
(4)Revised - Bid Items - Pages 94-101 of 101

Proposal revisions are available at http://transportation.ky.gov/contract/.
Plan revisions are available at http://www.lynnimaging.com/kytransportation/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Ryan Griffith

Ryan Griffith
Director
Division of Construction Procurement

RG:ks
Enclosures

COUNTY OF	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
ESTILL		17	164

ITEM NO. 10-363.20

DITCH CONSTRUCTION

STATION	LOCATION	SIZE-SHAPE TYPE	LINING TYPE	LINING QUANTITY
44+00 TO 44+70	RIGHT	2' F.B. SURF.	CL. II	35 TONS
45+07 TO 46+16	RIGHT	2' F.B. SURF.	CL. II	54 TONS
46+65 TO 49+14	RIGHT	2' F.B. SURF.	CL. II	109 TONS
45+72 TO 46+00	LEFT	2' F.B. SPCL.	CL. III	24 TONS
46+00 TO 47+00	LEFT	2' F.B. SPCL.	CL. II	71 TONS

RESIDENTIAL ENTRANCES

LT. KY 1840 STA. 45+44.02 CONST. 12' ENTRANCE
W/ 13 TONS AS, 21 TONS AB, 47 TONS DGA
(174 SQ. YDS.)

COMMERCIAL ENTRANCES

RT. KY 1840 STA. 43+82.97 CONST. 21.5' ENTRANCE
W/ 34'-24' ENTR. PIPE W/1 JUNCTION BOX
W/ 8 TONS AS, 12 TONS AB, 39 TONS DGA
(111 SQ. YDS.)

RT. KY 1840 STA. 44+89.88 CONST. 16' ENTRANCE
W/ 37'-24' PIPE W/ NO HEADWALLS
W/ 10 TONS AS, 16 TONS AB, 53 TONS DGA
(140 SQ. YDS.)

RT. KY 1840 STA. 46+41.78 CONST. 24' ENTRANCE
W/ 42'-24" PIPE W/ NO HEADWALLS
W/ 11 TONS AS, 18 TONS AB, 61 TONS DGA
(162 SQ. YDS.)

a N 46°52'10" W 25.57'
b S 43°07'50" W 48.82'
c S 43°07'50" W 133.05'
d S 43°07'51" W 58.17'
e S 42°02'34" W 40.39'
f S 42°02'34" W 28.04'
g S 73°20'46" W 36.10'
h S 73°20'46" W 51.88'
i S 89°14'26" W 20.95'
j S 89°14'26" W 85.77'
k N 42°48'17" E 50.00'
l N 42°48'17" E 48.88'
m S 46°44'29" E 25.84'
n S 46°44'29" E 10.00'
o N 47°09'59" W 36.01'
p N 47°09'59" W 36.78'
q Radius=586.45' Arc=209.81' Chord=208.70' S 32°55'07" W
r N 42°48'05" E 133.05'
s Radius=624.72' Arc=98.88' Chord=98.88' N 38°15'00" E
t Radius=624.72' Arc=60.46' Chord=60.44' N 30°56'18" E
u Radius=624.72' Arc=62.04 Chord=62.01' N 25°19'15" E
v Radius=624.72' Arc=35.49' Chord=35.48' N 20°50'55" E
w Radius=828.32' Arc=68.29' Chord=68.27' N 12°51'30" E
x N 42°16'44" E 26.04'
y S 47°10'00" E 22.46'
z N 47°10'00" W 44.43'
aa S 47°43'05" E 21.37'
ab N 19°04'43" W 36.26'
ac S 47°09'59" E 74.82'
ad N 17°21'02" E 88.04'
ae Radius = 828.32' Arc = 59.69' Chord = 59.68' N 17°17'05" E

R/W MONUMENT TYPE 1

LT. STA. 45+20.73 TO 47+05, CONST. 3

REMOVE PAVEMENT

LT. STA. 47+11.96 TO STA 47+89.79
REMOVE 276 SQ. YD.

REMOVE PAVEMENT

LT. KY 1840 STA. 61.64 TO STA. 90.75
REMOVE 65 L.F. EXISTING GUARDRAIL

P.I. 47+28.62
Δ = 36°07'36" Rt.
C = 17°21'44"
T = 107.63'
L = 208.07'
R = 330.00'
E = 17.11'
e = 4.0%
Runoff = 110'
Runout = 55'
(Full Super:
Sta. 46+57-
Sta. 47+93)
C.W. = 2'

BEGIN CONSTRUCTION
KY 1840
STA. 42+60

℄ KY 1840

N 43°07'50" E

N 79°19'57" E

MATCHLINE STA. B - SEE SHEET NO. 9

MATCHLINE STA. 49+00 - SEE SHEET NO. 7

MATCHLINE A - SEE SHEET NO. 7

PROP. R/W

2' F.B. SPCL. DT.

2' F.B. SURF. DT.

2' F.B. SURF. DT. TO R. 24" PIPE

15" PIPE

12" X 5' RCBC

24" PIPE

T/E

P/E

P.I. 47+28.62

P.C. 46+20.76

O.E. 630.00

I.E. 640.18

RIM 637.01
INV. 629.66

RIM 632.41
INV. 623.47

RIM 639.28
INV. 633.80

RIM 650.19
INV. 640.14

1-STY. FR. RES.

2-STY. FR. RES.

FR. SHED

Septic Tank

NORTH IRVINE HOLINESS CHURCH
1-STY. MASONRY

1-STY. FR. COM.

2-STY. FR. COM.

COUNTRYSIDE FLEA MARKET AND SANITATION SERVICE

MONITORING WELL (TYP.)

Wilberta Scrivner

Danny Dale Hoover
Wilma Hoover (Wf.)

Mickey E.Hardy

Millie H.Lees

Mary E. Hardy et al.

Raymond S.Carroll
Mary W.Carroll (Wf.)

Millie E.Lees
Charles Lees (Husb.)

Mary E.Hardy

Mickey E.Hardy
Teresa Hardy (Wf.)

North Irvine Holiness Church, Trustees

Mary Elizabeth Hardy et al.

P.No. 105, 106, 111, 112, 113, 114, 115, 116, 117, 153

RIGHT OF WAY MONUMENT TYPE 1

RT. STA. 45+31.83 TO 45+90, CONST. 2
RT. STA. 48+97.95, CONST. 1

RIGHT OF WAY MONUMENT TYPE 1A

RT. STA. 43+68.82 TO 43+98.78, CONST. 3
RT. STA. 46+68 TO 47+80, CONST. 2

REMOVE STRUCTURE

RT. KY 1840 STA. 44+50
REMOVE EXISTING 7'X8' METAL BOX CULVERT

GUARDRAIL STEEL W BEAM - S FACE (7 FT POST)

RT. STA. 42+60.00 TO 42+70.00
CONST. 150 LF STEEL W BEAM GUARDRAIL SINGLE FACE
WITH 1 TERMINAL SECTION NO. 1 AND 1 END TREATMENT TY. 7.

SCALE: 1"=30'

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

Cell Library: roadway.cel
Cell Name: sp
$DATE$ $TIME$
$FILE$

KY 1840 STA. 42+60 TO STA. 50+00

COUNTY OF	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
ESTILL		17	164

ITEM NO. 10-363.20

REVISED 02-16-2011

DITCH CONSTRUCTION

STATION	LOCATION	SIZE-SHAPE TYPE	LINING TYPE	LINING QUANTITY
44+00 TO 44+70	RIGHT	2' F.B. SURF.	CL. II	35 TONS
45+07 TO 46+16	RIGHT	2' F.B. SURF.	CL. II	54 TONS
46+65 TO 49+14	RIGHT	2' F.B. SURF.	CL. II	109 TONS
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- n S 46°44'29" E 10.00'
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- p N 47°09'59" W 36.78'
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- w Radius=828.32' Arc=68.29' Chord=68.27' N 12°51'30" E
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- z N 47°10'00" W 44.43'
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REMOVE 276 SQ. YD.

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T = 107.63'
L = 208.07'
R = 330.00'
E = 17.11'
e = 4.0%
Runoff = 110'
Runout = 55'
(Full Super:
Sta. 46+57-
Sta. 47+93)
C.W. = 2'

BEGIN CONSTRUCTION
KY 1840
STA. 42+60

MATCHLINE STA. B - SEE SHEET NO. 9

MATCHLINE A - SEE SHEET NO. 7

MATCHLINE STA. 49+00 - SEE SHEET NO. 7

REMOVED CONSTRUCTION NOTE FOR ADJUST MONITORING WELL

REMOVE STRUCTURE

RT. KY 1840 STA. 44+50
REMOVE EXISTING 7'X8' METAL BOX CULVERT

RIGHT OF WAY MONUMENT TYPE 1

RT. STA. 45+31.83 TO 45+90, CONST. 2
RT. STA. 48+97.95, CONST. 1

RIGHT OF WAY MONUMENT TYPE 1A

RT. STA. 43+68.82 TO 43+98.78, CONST. 3
RT. STA. 46+68 TO 47+80, CONST. 2

GUARDRAIL STEEL W BEAM - S FACE (7 FT POST)

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CONST. 150 LF STEEL W BEAM GUARDRAIL SINGLE FACE
WITH 1 TERMINAL SECTION NO. 1 AND 1 END TREATMENT TY. 7.

SCALE: 1"=30'

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

Cell Library: roadway.cel
Cell Name: sp
$DATE$ $TIME$
$FILE$

KY 1840 STA. 42+60 TO STA. 50+00

GENERAL SUMMARY

COUNTY OF	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
ESTILL		2d	164

ITEM NO. 10-363.20

ITEM CODE	ITEM	UNIT	PLAN SHEET 3	PLAN SHEET 5	PLAN SHEET 7	PLAN SHEET 9	PLAN SHEET 11	PLAN SHEET 13	PLAN SHEET 15	PLAN SHEET 17	CARRYOVER FROM PIPE SUMMARY	PER GEOTECHNICAL NOTE 20				PROJECT TOTALS
0021	DRAINAGE BLANKET - EMBANKMENT ③	CU YD														600
1982	DELINEATORS FOR GUARDRAIL-WHITE	EACH		8												8
2014	BARRICADE-TYPE III	EACH														8
2091	REMOVE PAVEMENT	SQ YD		927		1881		2310	351	276						5745
2159	TEMPORARY DITCH	LF	85	3114	850	2913	1101	1685	847							10595
2200	ROADWAY EXCAVATION	CU YD														377831
2223	GRANULAR EMBANKMENT	CU YD		713				498	460							1671
2242	WATER ①	M GAL														5000
2360	GUARDRAIL TERMINAL SECTION NO 1	EACH		6	2				2	1						11
2369	GUARDRAIL END TREATMENT TYPE 2A	EACH		1												1
2371	GUARDRAIL END TREATMENT TYPE 7	EACH							1	1						2
2381	REMOVE GUARDRAIL	LF		124		831				65						1020
2391	GUARDRAIL END TREATMENT TYPE 4A	EACH	1	1	1			3								6
2397	TEMP GUARDRAIL	LF							213							213
2429	RIGHT-OF-WAY MONUMENT TYPE 1	EACH		27	15	12	13	20	11	6						104
2430	RIGHT-OF-WAY MONUMENT TYPE 1A	EACH								5						5
2432	WITNESS POST	EACH		27	15	12	13	20	11	11						109
2482	CHANNEL LINING CLASS IA	TON		187	24						148					359
2483	CHANNEL LINING CLASS II	TON		531	218	410	841	1336	671	269	482					4758
2484	CHANNEL LINING CLASS III	TON		384				730		24	969					2107
2545	CLEARING AND GRUBBING ②	LP SUM														1
2562	SIGNS	SQ FT														135
2568	MOBILIZATION	LP SUM														1
2569	DEMOBILIZATION	LP SUM														1
2598	FABRIC-GEOTEXTILE TYPE III	SQ YD		2583				1806	1667							6056
2650	MAINTAIN AND CONTROL TRAFFIC	LP SUM														1
2671	PORTABLE CHANGEABLE MESSAGE SIGN	EACH														2
2701	TEMP SILT FENCE	LF	85	3114	850	2913	1101	1685	847							10595
2703	SILT TRAP TYPE A - ALT. NO. 1	EACH		5	4	5	4									18
2703	SILT TRAP TYPE A - ALT. NO. 2	EACH		1		2										3
2704	SILT TRAP TYPE B	EACH		12	27	11	25	24	21							120
2706	CLEAN SILT TRAP TYPE A - ALT. NO. 1	EACH		15	12	15	12									54
2706	CLEAN SILT TRAP TYPE A - ALT. NO. 2	EACH		3		6										9
2707	CLEAN SILT TRAP TYPE B	EACH		36	81	33	75	72	63							360
2709	CLEAN TEMP SILT FENCE	LF	85	3114	850	2913	1101	1685	847							10595
2726	STAKING	LP SUM														1
2731	REMOVE STRUCTURE (STA 165+00 RT)	LS		1												1
2731	REMOVE STRUCTURE (STA 232+90 RT)	LS							1							1
2731	REMOVE STRUCTURE (KY 1840 STA 44+50 RT)	LS								1						1
5950	EROSION CONTROL BLANKET	SQ YD	97	488	173	406	662	171	127			16281				18405
5952	TEMPORARY MULCH	SQ YD	1436	40463	37010	39683	22828	35462	12704	7370						196956
5953	TEMP SEEDING AND PROTECTION	SQ YD	718	20232	18505	19842	11414	17731	6352	3685						98479
5966	TOPDRESSING FERTILIZER	TON	0	3	3	3	2	3	1	1						16
5985	SEEDING AND PROTECTION	SQ YD	1436	40463	37010	39683	22828	35462	12704	7370						196956
6510	PAVE STRIPING-TEMP PAINT-4 IN	LF	142	3723	2955	4060	4999	4794	1169	1115						22957
6514	PAVE STRIPING-PERM PAINT-4 IN	LF	285	7445	5909	8119	9997	9587	2339	2230						45911
6547	PAVE STRIPING-THERMO-12 IN Y	LF		67	496	158	245	232		50						1248
6550	PAVE STRIPING-TEMP REM TAPE-W	LF	28	745	591	812	1000	959	234	223						4592
6551	PAVE STRIPING-TEMP REM TAPE-Y	LF	57	1489	1182	1624	1999	1917	468	446						9182
6574	PAVE MARKING-THERMO CURV ARROW	EACH		3	5		4	8		1						21
21802EN	G/R STEEL W BEAM-S FACE (7FT POST) ④	LF		2146	242			419	231	150						3188
23131ER701	PIPELINE VIDEO INSPECTION	LF														727
10203ND	PAVEMENT ADJUSTMENT (ASPHALT) ⑤	DOLLAR														364214
10203ND	PAVEMENT ADJUSTMENT (CONCRETE) ⑤	DOLLAR														165792

TOTAL PROJECT EARTHWORK CALCULATIONS

EXCAVATION		EMBANKMENT	
152,701	CU. YD. COMMON	226,802	CU. YD. EMBANKMENT
202,861	CU. YD. ROCK	23,023	CU. YD. CLAY SOIL
8,506	CU. YD. SURF. DTS.	2,174	CU. YD. TOP SOIL
3,647	CU. YD. EMB. BENCHES	251,999	CU. YD. TOTAL EMBANKMENT
10,116	CU. YD. TRANS. BENCHES	3,647	CU. YD. EMB. BENCHES
377,831	CU. YD. TOTAL EXCAVATION	10,116	CU. YD. TRANS. BENCHES
		265,762	CU. YD. TOTAL EMBANKMENT

CROSS-SECTIONS FOR THIS PROJECT WERE DEVELOPED FOR A PAVEMENT THICKNESS OF 16.75 INCHES. THE PAVEMENT DESIGN WAS LATER REVISED. TYPICAL SECTIONS WERE ADJUSTED TO REFLECT THIS CHANGE. HOWEVER, CROSS-SECTIONS AND EARTHWORK QUANTITIES WERE NOT REVISED AND, IN THIS CASE, TYPICAL SECTIONS GOVERN OVER CROSS-SECTIONS.

① FOR CONTROLLING DUST CAUSED BY MAINTAINING TRAFFIC ONLY.
② APPROXIMATELY 53.17 ACRES.
③ ROCK DRAINAGE BLANKET. SEE GEOTECHNICAL NOTE #17. TY IV FABRIC INCLUDED IN PAVING SUMMARY.
④ CONTRARY TO STANDARD DRAWING, GUARDRAIL POSTS SHALL BE 7 FEET IN LENGTH AND USED WHERE NOTED IN THE PLANS.
⑤ SEE PROPOSAL FOR ALTERNATE PAVEMENT BID

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

Cell Library: roadway.cel
Cell Name: sgs
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ITEM NO. 10-363.20

REVISED 02-16-2011

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2159	TEMPORARY DITCH	LF	85	3114	850	2913	1101	1685	847							10595
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2360	GUARDRAIL TERMINAL SECTION NO 1	EACH		6	2				2	1						11
2369	GUARDRAIL END TREATMENT TYPE 2A	EACH		1												1
2371	GUARDRAIL END TREATMENT TYPE 7	EACH							1	1						2
2381	REMOVE GUARDRAIL	LF		124		831				65						1020
2391	GUARDRAIL END TREATMENT TYPE 4A	EACH	1	1	1			3								6
2397	TEMP GUARDRAIL	LF							213							213
2429	RIGHT-OF-WAY MONUMENT TYPE 1	EACH		27	15	12	13	20	11	6						104
2430	RIGHT-OF-WAY MONUMENT TYPE 1A	EACH								5						5
2432	WITNESS POST	EACH		27	15	12	13	20	11	11						109
2482	CHANNEL LINING CLASS IA	TON		187	24						148					359
2483	CHANNEL LINING CLASS II	TON		531	218	410	841	1336	671	269	482					4758
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2545	CLEARING AND GRUBBING ②	LP SUM														1
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2568	MOBILIZATION	LP SUM														1
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2650	MAINTAIN AND CONTROL TRAFFIC	LP SUM														1
2671	PORTABLE CHANGEABLE MESSAGE SIGN	EACH														2
2701	TEMP SILT FENCE	LF	85	3114	850	2913	1101	1685	847							10595
2703	SILT TRAP TYPE A - ALT. NO. 1	EACH		5	4	5	4									18
2703	SILT TRAP TYPE A - ALT. NO. 2	EACH		1		2										3
2704	SILT TRAP TYPE B	EACH		12	27	11	25	24	21							120
2706	CLEAN SILT TRAP TYPE A - ALT. NO. 1	EACH		15	12	15	12									54
2706	CLEAN SILT TRAP TYPE A - ALT. NO. 2	EACH		3		6										9
2707	CLEAN SILT TRAP TYPE B	EACH		36	81	33	75	72	63							360
2709	CLEAN TEMP SILT FENCE	LF	85	3114	850	2913	1101	1685	847							10595
2726	STAKING	LP SUM														1
2731	REMOVE STRUCTURE (STA 165+00 RT)	LS		1												1
2731	REMOVE STRUCTURE (STA 232+90 RT)	LS							1							1
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5966	TOPDRESSING FERTILIZER	TON	0	3	3	3	2	3	1	1						16
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6547	PAVE STRIPING-THERMO-12 IN Y	LF		67	496	158	245	232		50						1248
6550	PAVE STRIPING-TEMP REM TAPE-W	LF	28	745	591	812	1000	959	234	223						4592
6551	PAVE STRIPING-TEMP REM TAPE-Y	LF	57	1489	1182	1624	1999	1917	468	446						9182
6574	PAVE MARKING-THERMO CURV ARROW	EACH		3	5		4	8		1						21
21802EN	G/R STEEL W BEAM-S FACE (7FT POST) ④	LF		2146	242			419	231	150						3188
23131ER701	PIPELINE VIDEO INSPECTION	LF														727
10203ND	PAVEMENT ADJUSTMENT (ASPHALT) ⑤	DOLLAR														364214
10203ND	PAVEMENT ADJUSTMENT (CONCRETE) ⑤	DOLLAR														165792
	REMOVED BID ITEM 23878EC ADJUST MONITORING WELL															

TOTAL PROJECT EARTHWORK CALCULATIONS

EXCAVATION		EMBANKMENT	
152,701	CU. YD. COMMON	226,802	CU. YD. EMBANKMENT
202,861	CU. YD. ROCK	23,023	CU. YD. CLAY SOIL
8,506	CU. YD. SURF. DTS.	2,174	CU. YD. TOP SOIL
3,647	CU. YD. EMB. BENCHES	251,999	CU. YD. TOTAL EMBANKMENT
10,116	CU. YD. TRANS. BENCHES	3,647	CU. YD. EMB. BENCHES
377,831	CU. YD. TOTAL EXCAVATION	10,116	CU. YD. TRANS. BENCHES
		265,762	CU. YD. TOTAL EMBANKMENT

CROSS-SECTIONS FOR THIS PROJECT WERE DEVELOPED FOR A PAVEMENT THICKNESS OF 16.75 INCHES. THE PAVEMENT DESIGN WAS LATER REVISED. TYPICAL SECTIONS WERE ADJUSTED TO REFLECT THIS CHANGE. HOWEVER, CROSS-SECTIONS AND EARTHWORK QUANTITIES WERE NOT REVISED AND, IN THIS CASE, TYPICAL SECTIONS GOVERN OVER CROSS-SECTIONS.

① FOR CONTROLLING DUST CAUSED BY MAINTAINING TRAFFIC ONLY.
② APPROXIMATELY 53.17 ACRES.
③ ROCK DRAINAGE BLANKET. SEE GEOTECHNICAL NOTE #17. TY IV FABRIC INCLUDED IN PAVING SUMMARY.
④ CONTRARY TO STANDARD DRAWING, GUARDRAIL POSTS SHALL BE 7 FEET IN LENGTH AND USED WHERE NOTED IN THE PLANS.
⑤ SEE PROPOSAL FOR ALTERNATE PAVEMENT BID

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

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Specifications

for:

KY 89 Water Line & Sanitary Sewer Relocations North of the Irvine Bypass Item 10-363.20

Estill County, Kentucky

Irvine Municipal Utilities
239 Broadway
Irvine, Kentucky 40336

December 2010

Prepared by:

CDP Engineers, Inc.
3250 Blazer Parkway

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SECTION 02225 - EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall make excavations in such widths and depths as will give suitable room for below grade vaults, pump stations, etc., laying pipe to the lines, grades and elevations, furnish, place and compact all backfill materials specified herein or denoted on the Drawings. The materials, equipment, labor, etc., required herein are to be considered as part of the requirements and costs for installing the various pipes, structures and other items they are incidental to.

1.02 RELATED WORK

A. Section 02221 - Rock Removal.

B. Section 02610 - Water Pipe and Fittings.

C. Section 02731 - Gravity Sewers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Crushed stone material shall conform with the requirements of the applicable sections of the Kentucky Bureau of Highways Standard Specifications and shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetation or objectionable materials.

B. Two classes of crushed stone material are used in this Section. The type of material in each class is as follows:
   1. Class I - No. 9 Aggregate.
   2. Class II - Dense Graded Aggregate (DGA).

PART 3 - EXECUTION

3.01 EXCAVATION OF TRENCHES

A. Unless otherwise directed by the Engineer, trenches are to be excavated in open cuts.

1. Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed.
2. Where pipe is to be laid directly on the trench bottom, the lower part of trenches in earth shall not be excavated to subgrade by machinery. However, just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom.

B. Trenches shall be sufficient width to provide working space on each side of the pipe and to permit proper backfilling around the pipe.

1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the Work. The pavement shall be cut with pneumatic tools, without extra compensation to the Contractor, to prevent damage to the remaining road surface. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.

C. All excavated materials shall be placed a safe distance back form the edge of the trench.

D. Unless specifically directed otherwise by the Engineer, not more than 500 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 500 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions, shall be provided by and at the expense of the Contractor.

E. When so required, or when directed by the Engineer, only one-half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and the property owners abutting the improvements shall be taken into consideration. All public or private drives shall be promptly backfilled or bridged at the direction of the Engineer.

F. Trench excavation shall include the removal of earth, rock, or other materials encountered in the excavating to the depth and extent shown or indicated on the Drawings.

3.02 WATER PIPE BEDDING

A. Piping for water mains shall be supported as follows:

1. The trench bottom for water main piping shall be stable, continuous, relatively smooth and free of frozen material, clodded dirt, foreign material and rock or granular material larger than 1/2 inch in diameter. The foundation for water main piping shall be prepared so that the entire load of the backfill on top of the pipe will be carried uniformly on the barrel of the pipe. Any uneven areas in the trench bottom shall be shaved-off or filled-in with Class I granular bedding. When the trench is made through rock, the bottom shall be lowered to provide 6 inches of clearance around the pipe. Class I granular bedding shall be used to bring the trench bottom to grade.

B. After each pipe has been brought to grade, aligned, and placed in final position, earth material for water main piping shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.

C. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.

D. Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate.

E. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required Class I bedding material can be placed.

F. It should be noted that no pipe shall be laid on solid or blasted rock.

G. Pipe bedding as required in Paragraphs A, B, and D of this Section is **not** considered a separate pay item.

3.03 WATER PIPE BACKFILLING

A. Initial Backfill:

1. This backfill is defined as that material which is placed over the pipe from the spring line to a point 6 inches above the top of the pipe. For water main piping,

initial backfill material shall be earth material free of rocks, acceptable to the Engineer or with Class I material when a condition exists mentioned in Paragraph A, 3. below.

2. Material used, whether earth or Class I, in the initial backfilling is **not** a separate pay item. Payment for the material is included in the unit price per linear foot of water main.
3. In areas where large quantities of rock are excavated and the available excavated earth in the immediate vicinity is insufficient for placing the required amount of backfill over the top of the pipe as set forth in Paragraph A.1, the Contractor shall either haul in earth or order Class I material for backfilling over the pipe. Neither the hauling and placement of earth nor the ordering and placement of Class I material to fulfill the backfill requirements set forth herein is considered a separate pay item.

B. Final Backfill:

1. There are two cases where the method of final backfilling varies. The various cases and their trench situations are as follows:
   a. Case I - Areas not subject to vehicular traffic.
   b. Case II - Paved areas including streets, drives, parking areas, and walks.
2. In all cases, walking or working on the completed pipelines, except as may be necessary in backfilling, will not be permitted until the trench has been backfilled to a point 6 inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:
   a. Case I - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 8 inches below the surface of the ground with earth material free from large rock (over one-half cubic foot in volume), acceptable to the Engineer. The remainder of the trench shall be backfilled with earth material reasonably free of any rocks.
   b. Case II - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 12 inches below the existing pavement surface with Class I (No. 9 crushed stone aggregate) material. The backfill shall be mechanically tamped in approximately 6-inch layers to obtain the maximum possible compaction. The remaining backfill shall be Class II (dense graded aggregate) material mechanically tamped to maximum possible compaction. The trench may be left with a slight mound if permitted by the Engineer. Where required by state or local regulations, a bituminous binder coarse detailed on the Drawings and specified in Section 02510 shall be incorporated in the final backfill.
3. Earth and Class I material used in final backfill is not a separate pay item. Payment shall be included in the price of water main.
4. Class II material used in final backfill shall be included in the unit price of the pipe.

C. A sufficient amount of Class II material shall be stockpiled to insure immediate replacement by the Contractor of any settled areas. No extra payment will be made for the filling in of settled or washed areas by the Contractor.

D. Excavated materials from trenches, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. It shall be the responsibility of the Contractor to obtain location or permits for its disposal, unless specific waste areas have been designated on the Drawings or noted in these Specifications. The cost of disposal of excess excavated materials, as set forth herein, no additional compensation being allowed for hauling or overhaul.

3.04 GRAVITY SEWER AND FORCE MAIN PIPE BEDDING

A. Piping for gravity sewers and force mains shall be supported as follows:
   1. All gravity sewer piping shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be Class I (No. 9 crushed stone aggregate) and shall be placed to a depth of 4 inches in an earth trench and 6 inches in a rock trench. Aggregate bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.
   2. The trench bottom for force main piping shall be stable, continuous, relatively smooth and free of frozen material, clodded dirt, foreign material and rock or granular material larger than 1/2 inch in diameter. The foundation for force main piping shall be prepared so that the entire load of the backfill on top of the pipe will be carried uniformly on the barrel of the pipe. Any uneven areas in the trench bottom shall be shaved-off or filled-in with Class I granular bedding. When the trench is made through rock, the bottom shall be lowered to provide 6 inches of clearance around the pipe. Class I granular bedding shall be used to bring the trench bottom to grade.

B. After each pipe has been brought to grade, aligned, and placed in final position, Class I material for gravity sewer piping and earth material for force main piping shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.

C. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.

D. Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate.

E. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required Class I bedding material can be placed.

F. It should be noted that no pipe shall be laid on solid or blasted rock.

G. Pipe bedding as required in Paragraphs A, B, and D of this Section is **not** considered a separate pay item.

3.05 GRAVITY SEWER AND FORCE MAIN BACKFILL

A. Initial Backfill:

1. This backfill is defined as that material which is placed over the pipe from the spring line to a point 6 inches above the top of the pipe. For gravity sewer piping the material shall be Class I (No. 9 crushed stone aggregate) and may be machine placed without compaction. Uneven places in the backfill shall be leveled by hand. For force main piping, initial backfill material shall be earth material free of rocks, acceptable to the Engineer or with Class I material when a condition exists mentioned in Paragraph A, 3. below.
2. Material used, whether earth or Class I, in the initial backfilling is **not** a separate pay item. Payment for the material is included in the unit price per linear foot of gravity sewer or force main.
3. In areas where large quantities of rock are excavated and the available excavated earth in the immediate vicinity is insufficient for placing the required amount of backfill over the top of the pipe as set forth in Paragraph A.1, the Contractor shall either haul in earth or order Class I material for backfilling over the pipe. Neither the hauling and placement of earth nor the ordering and placement of Class I material to fulfill the backfill requirements set forth herein is considered a separate pay item.

B. Final Backfill:

1. There are two cases where the method of final backfilling varies. The various cases and their trench situations are as follows:
   a. Case I - Areas not subject to vehicular traffic.
   b. Case II - Paved areas including streets, drives, parking areas, and walks.
2. In all cases, walking or working on the completed pipelines, except as may be necessary in backfilling, will not be permitted until the trench has been backfilled to a point 6 inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:
   a. Case I - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 8 inches below the surface of the ground with earth material free from large rock (over one-half cubic foot in volume), acceptable to the Engineer. The remainder of the trench shall be backfilled with earth material reasonably free of any rocks.

b. Case II - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 12 inches below the existing pavement surface with Class I (No. 9 crushed stone aggregate) material. The backfill shall be mechanically tamped in approximately 6-inch layers to obtain a compaction of 95 percent density as measured by the modified Procter Test. The remaining backfill shall be Class II (dense graded aggregate) material mechanically tamped to the compaction as required above for Class I material. The trench may be left with a slight mound if permitted by the Engineer. Where required by state or local regulations, a bituminous binder coarse detailed on the Drawings and specified in Section 02510 shall be incorporated in the final backfill.

3. Earth and Class I material used in final backfill is not a separate pay item. Payment shall be included in the price of gravity sewer and force main.
4. Class II material used in final backfill shall be included in the unit price for gravity sewer and force main.

C A sufficient amount of Class II material shall be stockpiled to insure immediate replacement by the Contractor of any settled areas. No extra payment will be made for the filling in of settled or washed areas by the Contractor.

D. Excavated materials from trenches, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. It shall be the responsibility of the Contractor to obtain location or permits for its disposal, unless specific waste areas have been designated on the Drawings or noted in these Specifications. The cost of disposal of excess excavated materials, as set forth herein, no additional compensation being allowed for hauling or overhaul.

3.06 PLACEMENT OF IDENTIFICATION TAPE

A. The placement of detectable underground marking tape shall be installed over all utility lines. Care shall be taken to insure that the buried marking tape is not broken when installed and shall be Lineguard brand encased aluminum foil, Type III. The identification tape is manufactured by Lineguard, Inc., P.O. Box 426, Wheaton, IL 60187.

B. The identification tape shall bear the printed identification of the utility line below it, such as "Caution - Buried Below". Tape shall be reverse printed; surface printing will not be acceptable. The tape shall be visible in all types and colors of soil and provide maximum color contrast to the soil. The tape shall meet the APWA color code, and shall be 2 inches in width. Colors are: yellow - gas, green - sewer, red - electric, blue - water, orange - telephone, brown - force main.

C. The tape shall be the last equipment installed in the trench so as to be first out. The tape shall be buried 4 to 6 inches below top of grade. After trench backfilling, the tape shall be placed in the backfill and allowed to settle into place with the backfill. The tape may be plowed in after final settlement, installed with a tool during the trench backfilling process, unrolled before final restoration or installed in any other way acceptable to the Owner or Engineer.

END OF SECTION 02225

SECTION 02610 - WATER PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install water main piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02222 - Excavation.

B. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

C. Section 02630 - Encasement Pipe.

D. Section 02640 - Water Valves and Gates.

E. Section 02675 - Disinfection of Potable Water Pipe.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE (DIP) AND FITTINGS

A. Ductile iron pipe (DIP) shall conform to ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51 Standard. The pipe shall conform to pressure class 350 minimum unless noted otherwise. All pipe, fittings and joints should be capable of accommodating pressure up to 350 psi. The ductile iron pipe shall be as manufactured by Clow Corporation, U.S. Pipe & Foundry Company or approved equal.

B. Fittings shall be ductile iron and in accordance with AWWA C153 and have a body thickness and radii of curvature conforming to ANSI A21.10 or ANSI A21.53 for compact fittings. Push-on type joints shall be single rubber gasket, with cast gasket socket and recessed bell with a tapered annular opening and flared socket. Plain spigot ends shall be suitably beveled to permit easy entry into the bell, centering and compressing the gasket. Push-on joints shall be equal to the "Tyton Joint" as manufactured by US Pipe & Foundry Company.

C. Ductile iron flanged joint pipe shall conform to ANSI/AWWA C115/A 21.15 Standard and have a thickness Class of 53. The pipe shall have a rated working pressure of 250 psi with Class 125 flanges. Gaskets shall be ring gaskets with a thickness of 1/8 inch. Flange bolts shall conform to ANSI B 16.1.

D. Flanged fittings shall meet all requirements of ANSI/AWWA C110/A21.10 (or A21.53 for compact fittings) and have Class 125 flanges. Fittings shall accommodate a working pressure up to 250 psi and be supplied with all accessories.

E. Ductile iron mechanical joint fittings shall be in accordance with AWWA C153 and have a body thickness and radii of curvature conforming to ANSI A21.10 (or A21.53 for compact fittings) and have joints in accordance with ANSI/AWWA C111/A21.11. Fittings and joints shall be supplied with all accessories.

F. All pipe and fittings shall be tar coated outside and shall receive a standard cement lining with bituminous seal coat on the inside in accordance with ASA Specification A21.40 (AWWA-C104).

G. Cement mortar lining and seal coating for pipe and fittings, where applicable shall be in accordance with ANSI/AWWA C104/A21.4. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.

H. All ductile fittings shall be rated at 250 psi water working pressure plus water hammer. Ductile iron fittings shall be ductile cast-iron grade 80-60-03 per ASTM Specification A339-55.

I. No separate pay item has been established for fittings and no determination of the number of fittings required on the job has been made. The Contractor, during the bidding phase, shall determine the number of fittings required on the job and include the cost of the fittings and installation in the unit price for pipe.

J. Restrained joint pipe and fittings shall be a boltless system equal to "Field- Lok" restraining gaskets or "TRFLEX Joint" as manufactured by US Pipe & Foundry Company.

K. Ball and socket restrained joint pipe and fittings shall be a boltless system equal to USIFLEX manufactured by U.S. Pipe and Foundry Company or FLEX-LOK manufactured by American Pipe Company. Pipe shall have a working pressure rating of 250 psi and have a maximum joint deflection of 15 degrees. Nominal laying lengths shall be in the range of 18-feet 6-inches to 20-feet 6-inches.

L. Pipe shall be as manufactured by U.S. Pipe & Foundry Company, American Cast Iron Pipe Company, or equal.

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Polyvinyl chloride (PVC) pipe for water mains shall be Class 200 (SDR 21) or Class 250 (SDR 17) PVC pressure rated pipe with either twin gasket joints or integral bell joints with rubber O-ring seals. All class 200 pipe shall meet the requirements of SDR 21 and all class 250 pipe shall meet the requirement of SDR 17.

B. All PVC pipe shall conform to the latest revisions of ASTM D-1784 (PVC Compounds), ASTM D-2241 (PVC Plastic Pipe, SDR), and ASTM D-2672 (Bell-end PVC Pipe). PVC pipe shall have a minimum cell classification of 12454B or 12454C as defined in ASTM D-1784. Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869.

C. Fittings shall be ductile iron and in accordance with Article 2.01 of this section.

D. Rubber gasket joints shall provide adequate expansion to allow for a 50 degree change in temperature on one length of pipe. Lubrication for rubber connected couplings shall be water soluble, non-toxic, be non-objectionable in taste and odor and have no deteriorating affect on the PVC or rubber gaskets and shall be as supplied by the pipe manufacturer.

E. All pipe and couplings shall bear identification markings that will remain legible during normal handling, storage and installation, which have been applied in a manner what will not reduce the strength of the pipe or the coupling or otherwise damage them. Pipe and coupling markings shall include the nominal size and OD base, material code designation, dimension ratio number, ASTM Pressure Class, ASTM designation number for this standard, manufacturer's name or trademark, seal (mark) of the testing agency that verified the suitability of the pipe material for potable-water service. Each marking shall be applied at intervals of not more than 5 feet for the pipe and shall be marked on each coupling.

2.03 POLYVINYL CHLORIDE (PVC) WATER PIPE - C.I. PIPE SIZE

A. This pipe shall meet the requirements of AWWA C900-75 for Polyvinyl Chloride (PVC) Pressure Pipe. The pipe shall be PVC 1120 pipe with cast iron pipe equivalent ODs. All Class 150 pipe shall meet the requirements of SDR 18 and Class 200 meet the requirements of SDR 14.

B. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the laboratory performance of ASTM D3139. The bell section shall be designed to be at least as strong as the pipe wall.

C. Standard laying lengths shall be 20 feet ± for all sizes. At least 85 percent of the total footage of pipe of any class and size shall be furnished in standard lengths, the remaining 15% in random lengths. Random lengths shall not be less than 10 feet long. Each standard and random length of pipe shall be tested to four times the class pressure of the pipe for a minimum of 5 seconds. The integral bell shall be tested with the pipe.

2.04 POLYETHYLENE PIPE

A. Polyethylene pipe shall be of high density, high molecular weight polyethylene and conform to the requirements of ASTM Specification D-3350 with pressure rating of psi (SDR ___), and have recommended designation values of 3-4-5-4-3-4-C. Fittings shall be SDR 9.3.

B. Pipe shall have dimensions and workmanship in accordance with ASTM F-714.

C. Polyethylene pipe shall be supplied in standard lengths of at least 12 feet 6 inches. Longer lengths are permitted.

D. Polyethylene pipe shall be marked with the manufacturer's name, production lot number, ASTM designation, minimum cell classification and nominal diameter.

E. Polyethylene pipe shall be joined by the butt-fusion technique utilizing controlled temperature and pressure to produce a fused, leak-free joint, stronger than the pipe itself in both tension and hydrostatic loading.

F. Pipe shall be Phillips Driscopipe, or approved equal.

PART 3 - EXECUTION

3.01 LAYING DEPTHS

In general, water mains shall be laid with a minimum cover of 30 inches, except as otherwise indicated on the Drawings.

3.02 UTILITY CROSSING CONCRETE ENCASEMENT

A. At locations shown on the Contract Drawings, required by the Specifications, or as directed by the Engineer, concrete encasement shall be used when the clearance between the proposed water pipe and any existing utility pipe is 18 inches or less. Utility pipe includes underground sewer, gas, telephone, and electrical conduit, storm sewers, and any other pipe as determined by the Engineer.

B. There are two cases of utility crossing encasement. Case I is applicable when the proposed water line is **above** the existing utility line. Case II is applicable when the proposed water line is laid **below** the utility line. In either case, the concrete shall extend to at least the spring line of each pipe involved.

C. Concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow between the pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.

D. Concrete for this Work is not a separate pay item and will be considered incidental to utility pipe installation.

3.03 PIPE LAYING

A. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the plans. Pipe shall be fitted and matched so that when laid in the Work, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.

B. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure it being clean. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fittings shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe. Bevel can be made with hand or power tools.

C. The interior of the pipe, as the Work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted so as to exclude earth or other material and precautions taken to prevent floatation of pipe by runoff into trench.

D. Anchorage of Bends:

1. At all tees, plugs, caps and bends of 11-1/4 degrees and over, and at reducers or in fittings where changes in pipe diameter occur, movement shall be prevented by using suitable harness, thrust blocks or ballast. Thrust blocks shall be as shown on the Drawings, with sufficient volumes of concrete being provided; however, care shall be taken to leave weep holes unobstructed and allow for future tightening of all nearby joints. Unless otherwise directed by the Engineer, thrust blocks shall be placed so that pipe and fitting joints will be accessible for repair.
2. Bridles, harness or pipe ballasting shall meet with the approval of the Engineer. Steel rods and clamps shall be galvanized or otherwise rust-proofed or painted.

3. No extra pay shall be allowed for work on proper anchorage of pipe, fittings or other appurtenances. Such items shall be included in the price bid for the supported item.

E. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has the opportunity to make an inspection of the joints, alignment and grade in the section laid, but such inspection shall not relieve the Contractor of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are noted later.

3.04 JOINTING

All joint surfaces shall be cleaned immediately before jointing the pipe. The bell or groove shall be lubricated in accordance with the pipe manufacturer's recommendations. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. All pipe shall be provided with home marks to insure proper gasket seating. Details of gasket installation and joint assembly shall follow the direction of the manufacturer's of the joint material and of the pipe. The resulting joints shall be watertight and flexible.

3.05 TESTING OF WATER PIPE

A. The completed work shall comply with the provisions listed herein, or similar requirements which will insure equal or better results. Suitable test plugs, water pump or other equipment and apparatus, and all labor required to properly conduct the tests shall be furnished by the Contractor at no expense to the Owner.

B. Water main piping shall be pressure tested to 250 percent of the normal system operating pressure or to 150 percent of the rated working pressure of the pipe, whichever is less. At no time shall the test pressure exceed 150 percent of the pipe's rated working pressure. A pipe section shall be accepted if the test pressure does not fall more than 5 psi during the minimum 2-hour test period. The pipe shall be tested for allowable leakage according to AWWA C-600 (latest revision) concurrently with the pressure test.

C. Where practicable, pipelines shall be tested between line valves or plugs in lengths of not more than 6,000 feet. Testing shall proceed from the source of water toward the termination of the line. The line shall be tested upon the completion of the first 6,000 feet. After the completion of two (2) consecutive tests without failure, the Contractor, at his option and with the Engineer's approval, may discontinue testing until the system is complete.

D. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.

E. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at high points within the test section, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water.

F. All piping shall be tested for leakage at a pressure no less than that specified for the pressure test. The leakage shall be defined as the quantity of water that must be supplied to the tested section to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. The leakage shall be less than an allowable amount determined by the following equation:

$$L = \frac{SD\,(P)^{1/2}}{133{,}200}$$

Where

L =allowable leakage (gallons/hour)
S =length of pipe tested, in feet
D =nominal diameter of pipe (inches)
P =test pressure (psig)

G. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation. All visible leaks are to be repaired regardless of the amount of leakage.

H. If in the judgement of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

3.06 PLACEMENT OF IDENTIFICATION TAPE

The placement of detectable underground marking tape shall be installed over all water mains as specified in Section 02225.

END OF SECTION 02610

SECTION 02630 - ENCASEMENT PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install encasement pipe together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02222 - Excavation.

B. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

C. Section 02610 - Water Pipe and Fittings.

PART 2 - PRODUCTS

2.01 STEEL PIPE

A. Steel seamless pipe shall be new material, with a minimum yield of 35,000 psi and a wall thickness as shown below. All joints in the encasement pipe shall be welded.

Table of Minimum Wall Thickness for Steel Encasement Pipe

Nominal Diameter Inches	Minimum Thickness Inches	
	Highway Crossing	Railroad Crossing
14 & Under	0.250	0.219
16	0.375	0.250
18	0.375	0.281
20 & 22	0.375	0.312
24	0.500	0.344
26	0.500	0.375
28	0.500	0.406
30	0.500	0.438
32	0.500	0.469
34 & 36	0.500	0.500
42	0.625	0.625
48	0.625	0.625

B. Weldings of the steel casing pipe shall be solidly butt-welded with a smooth non-obstructing joint inside and conform to all specifications as required by American Welding Society (AWS). The casing pipe shall be installed without bends. All welders and welding operators shall be qualified as prescribed by AWS requirements.

C. The material shall conform to the chemical and mechanical requirements of the latest revision of ASTM A139 "Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over)," unless otherwise stated herein.

D. Grade B steel shall be used. The steel shall be new and previously unused.

E. Hydrostatic testing shall not be necessary.

F. The wall thickness at any point shall be within 0.025 inches of the nominal metal thickness specified.

G. A protective coating shall be applied to each length of pipe. Following an SSPC SP-7 "Brush-Off Blast Cleaning" surface preparation, 3 (dry) mils of Tnemec-Primer 10-99 (red), of Porter International Primer 260FD (red), or of an approved equal shall be applied in the manner recommended by the respective paint manufacturer.

H. Each length of pipe shall be legibly marked, stating: manufacturer, diameter, wall thickness and primer.

I. Precaution shall be taken to avoid deforming the pipe and damaging the primer during shipping.

J. Pipe shall be within the following tolerances:

Straightness	1/4 -- 3/8
Roundness	1 Percent
Thickness	12 1/2 Percent

PART 3 - EXECUTION

3.01 INSTALLATION

A. Where shown on the Drawings, the Contractor shall install encasement pipe. Two methods of installation are designated, the open-cut method and the boring method.

1. The open-cut method shall consist of placing the encasement pipe in the excavated trench, then installing the carrier pipe inside the encasement pipe. Excavation, bedding and backfilling shall be in accordance with Section 02225.

2. The boring method consists of pushing or jacking the encasement pipe into the hole as an auger cuts out the material or after the auger has completed the bore. The encasement pipe shall be installed in a manner that will not disrupt traffic.

B. The carrier pipe shall be ductile iron, polyvinyl chloride, or polyethylene pipe as designated on the Drawings. The carrier pipe will not be permitted to rest on bells or couplings.

C. Pipeline Spacers

1. Carrier pipes installed inside encasement pipes shall be centered throughout the length of encasement pipe. Centering shall be accomplished by the installation of polyethylene pipeline spacers attached to the carrier pipe in such manner as to prevent the dislodgement of the spacers as the carrier pipe is pulled or pushed through the encasement pipe. Spacers shall be of such dimensions to provide: full supportive load capacity of the pipe and contents; of such thickness to allow installation and/or removal of the pipe; and to allow no greater than 1/2 inch movement of the carrier pipe within the cover pipe after carrier pipe is installed.
2. Spacers shall be located immediately behind each bell and at a maximum spacing distance as follows:

Carrier Pipe Diameter (inches)	Maximum Spacing (feet)
2 - 2-1/2	4
3 - 8	7
10 - 26	10
28	9
30	8
32	7
34	6
36 - 38	5.5
40 - 44	5
46 - 48	4

The materials and spacing to be used shall be accepted by the Engineer prior to installation. The polyethylene pipeline spacers shall be manufactured by Pipeline Seal and Insulator, Inc. (PSI), Raci Spacers, Inc., or equal. Installation shall be in accordance with manufacture's recommendations.

3.02 SEALING

After installation of the carrier pipe within the encasement pipe, the ends of the casing shall be sealed in the following manner. The space between the casing and the carrier pipe shall be filled with a waterproofing bitumastic compound until a tight seal is obtained. An Ethylene Propylene Diene Monomer (EPDM) elastomeric membrane shall

be wrapped around the end of the encasement pipe in three layers and securely bound to the casing and the carrier pipe barrel with stainless steel bands. The EPDM membrane shall be 0.045 inches thick and have a tear resistance of 125 pounds/inches. The membrane shall be manufactured by Carlisle Tire & Rubber Company, Firestone Industrial Products Company, or approved equal.

3.03 DAMAGE

The cost of repairing damage which is caused by the boring operation to the highway or railroad shall be borne by the Contractor.

END OF SECTION 02630

SECTION 02640 - WATER VALVES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install valves together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

B. Section 02610 - Water Pipe and Fittings.

C. Section 02646 - Flushing Hydrants.

1.03 SUBMITTALS

A. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer in accordance with the requirements of Section 01300.

B. The manufacturer shall furnish the Engineer two (2) copies of an affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of the latest revision of the applicable AWWA Standard, and that all tests specified therein have been performed and that all test requirements have been met.

C. The Engineer shall be furnished two (2) copies of affidavit that the "Valve Protection Testing" has been done and that all test requirements have been met.

D. The Engineer shall be furnished with two (2) copies of affidavit that inspection, testing and rejection are in accordance with the latest revision of the applicable AWWA Standard.

PART 2 - PRODUCTS

2.01 GATE VALVES

A. All gate valves shall be of the resilient seat type in accordance with the latest revision of AWWA C509 Standard. The valve body, bonnet and gate castings shall be ductile iron or cast iron. The valve shall have a non-rising stem (NRS), fully bronze mounted with o-ring seals. Valve body and bonnet, inside and out, shall be fully coated with

fusion bonded epoxy coating in accordance with AWWA C550 Standard. Valves shall have a rated working pressure of 200 psi.

B. Gate valves for buried service shall be furnished with mechanical joint end connections, unless otherwise shown on the Drawings or specified herein. The end connection shall be suitable to receive ductile iron or PVC pipe.

C. Gate valves for meter pits, pump stations, or other installations as shown on the Drawings shall be furnished with flanged joint and connections, outside screw and yoke and handwheel operator. The gate valve shall have the direction of opening cast on the rim of the handwheel and provided with chain and lock.

D. All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.

E. Buried service gate valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counterclockwise).

F. Buried service gate valves shall be installed in a vertical position with valve box as detailed on the Drawings. They shall be set vertically and properly adjusted so that the cover will be in the same plane as the finished surface of the ground or street.

G. Valves shall be those manufactured by Mueller, M & H Valve Company, American, or approved equal.

2.02 CHECK VALVES

A. General: Check valves shall be all iron body, bronze mounted, full opening swing type. Valve clapper shall swing completely clear of the waterway when valve is full open, permitting a "full flow" through the valve equal to the nominal pipe diameter. They shall comply with AWWA Standard C-508 latest revision. The valves shall be M & H Valve Company, Anniston, AL, Valve Type 159-Lever Weight, or approved equal.

B. Rating: Check valves shall be rated at 175 psi water working pressure, 350 psi hydrostatic test for structural soundness (2-inch through 12-inch) and 150 psi water working pressure and 300 psi hydrostatic test (sizes 14-inch through 30-inch). Seat tightness at rated working pressure shall be in accordance with valves shown in AWWA Standard C-500 for gate valves and fully conform to AWWA C508.

C. End Configurations: Check valves shall be furnished with 125-pound ANSI flanges ends with accessories.

D. Materials: All cast iron shall conform to ASTM-A-126 Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Clappers shall be all bronze for sizes through 4-inch and cast iron, neoprene faced for sizes 6-inch and larger. Hinge pins shall be 18-8 stainless steel rotating in bronze plugs. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307 and A-563, respectively.

E. Design: Check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Glands shall be o-rings, 2-inch to 12-inch sizes and conventional in 14-inch to 30-inch sizes. Check valves shall be equipped with adjustable outside lever and weight to accomplish faster closing and to minimize slamming effect. All valves 14-inch and larger shall have extended hinge pins for future addition of levers and springs required. Valves shall be suitable for installation in either horizontal or vertical position.

F. Painting: The inside and outside of all valves, together with the working parts except bronze and machined surfaces, shall be coated in accordance with the latest revision of AWWA C550 Standard.

G. Marking: Marking shall be in accordance with AWWA C-508 and shall include size, working pressure, and cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture.

2.03 SILENT CHECK VALVES

A. Silent check valves 3 inches and larger shall be iron body, bronze mounted with a stainless steel spring and Buna-N-Resilient seating. The valves shall be Apco Series 600 globe style or approved equal. The valve plug shall be brass and center guided at both ends with a through integral shaft and spring loaded.

B. Valves shall be designed for a water working pressure of 150 psi.

C. The seat and plug shall be replaceable manually in the field.

D. The flow area through the valve body shall be equal to or greater than the cross-sectional area of the equivalent pipe length.

E. Valves shall be capable of operating in either a horizontal or vertical position.

2.04 ELECTRIC CHECK VALVE

A. Operation: The pump control valve shall minimize pump starting and stopping surges by placing the pump "on line" and taking it "off line" slowly. The controls shall consist of adjustable independent, opening and closing speed control valves, a cam operated limit switch, a three-way solenoid valve with a manual operator, and a two-way solenoid valve for power failure quick closure.

B. Design:

1. The pump control valve shall be flanged globe body, fully bronze mounted, external pilot operated, with free floating piston (operated without springs, diaphragm or levers), single seat with seat bore equal to size of valve.
2. The minimum travel of the piston shall be equal to 25 percent of the diameter of the seat and for true alignment (to correct lateral thrust and stem binding) the piston shall be guided above and below the seat a distance equal to no less than 75 percent of the diameter of the seat. The piston shall be cushioned and so designed as to insure positive closure.
3. The piston shall carry a contoured cushion device that will cause a gradual change in flow area as the valve approaches the seat. This cushion device must move with the piston to minimize head loss when the valve is fully opened.
4. The valve shall be packed with leather (or other soft material) to insure tight closure and prevent metal to metal friction and seating; furnished with indicator rod, to show position of opening of the piston, and pet-cocks for attachment to valve body for receiving gauges for testing purposes.
5. The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.
6. The installation shall incorporate the emergency close (or power-failure quick close) feature. This uses a second solenoid pilot valve to bypass the normal slow closing speed control valve on power outage to close the valve quickly (but still at a controlled rate).

C. Physical and Chemical Properties:

1. The 125-pound and 250-pound flanged assemblies shall conform to A.S.A. standards for flange thickness and drilling and wall thickness of body and caps. The valve shall be constructed of first class grey iron free from cold shuts, defective or spongy spots and conforming to ASTM Specification A-126 Class B.
2. The bronze parts shall conform to ASTM specification B-62.

D. Test: The test before shipment may be witnessed by a representative of the Engineer for simulated field conditions and a cold hydrostatic test of at least 100 percent above the maximum pressure for which the valve is to operate.

E. Painting:

1. All iron castings shall be coated on all sides with at least two (2) coats of a rust inhibiting synthetic resin and asphaltum enamel.
2. The valve shall be equal to the Model 42 WRS Pump Control Valve as manufactured by the Ross Valve Mfg. Co., Inc.

2.05 BUTTERFLY VALVES (NON-BURIED)

A. For Valves 4-inch or Larger: The butterfly valves shall be DeZurik AWWA C504 series (or approvable equal), lug style, resilient seat, cast iron body and seat, stainless steel seat ring and shaft, class 150, and furnished with a manual handwheel actuator.

B. For Valves 3-inch or Smaller: The butterfly valves shall be DeZurik BGS series (or approvable equal), lug style, resilient seat, cast iron body and EPDM seat, stainless steel seat ring and shaft, ductile iron nickel plated disc, class 150, and furnished with a manual lever actuator.

2.06 BUTTERFLY VALVES (BURIED)

For Valves 4-inch through 24-inch: The butterfly valve shall be DeZurik or M&H Valve Company AWWA C504 series (or approvable equal), mechanical joint, resilient seat, cast iron body and disk, stainless steel shaft and seating edge (ring), Chloroprene seat, Class 150B, cast iron housing with 2-inch operator nut in vertical position for use with a valve box. The valve shall be fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA C550 Standard.

2.07 TAPPING VALVES

A. All tapping valves shall be of the resilient seat, gate valve type in accordance with the latest revision of AWWA C509 Standard. The valve body, bonnet and gate castings shall be cast iron. The valve shall have a non-rising stem (NRS), fully bronze mounted with o-ring seals. Valve body and bonnet, inside and out, shall be fully coated with fusion bonded epoxy coating in accordance with AWWA C550 Standard. Valves shall have a rated working pressure of 200 psi.

B. Valve shall be furnished with ANSI B16.1 flanged end with centering ring on tapping side. Outlet side shall be mechanical joint. All valves through 12 inches shall mate all sleeves through 12-inch outlet regardless of manufacturer.

C. All cast iron shall conform to ASTM A126, Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts shall be electric-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307 and A-563.

D. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield of 20,000 psi. NRS stem collars shall be cast integral with them and machined to size. The housing for the valve stem collar shall be machined. All thrust bearing shall be incorporated as required, to optimize operating torques. NRS valves shall be furnished with two (2) o-ring stem seals located above the thrust collar and one (1) below. O-rings shall be set in grooves in the stem. The o-ring grooves shall not be less than the root diameter of the stem threads.

Gates for valve shall be totally encapsulated in rubber, be field replaceable, and provide a dual seal on the mating body seat. Valve shall be capable of installation in any position with rated sealing in both directions. Rubber sets of specially compounded SBR materials shall be utilized and be capable of sealing even under conditions of normal wear. The valve body shall have integral guide engaging lugs in the gate in a tongue-and-groove manner, supporting the gate throughout the entire open/close travel.

E. Tapping valves shall be capable of making taps by using a cutter not less than 1/4-inch smaller than nominal pipe size.

F. All tapping valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.

G. Tapping valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left counterclockwise).

H. Tapping valves shall be installed in a vertical position with valve box as detailed on the Drawings. They shall be set vertically and properly adjusted so that the cover will be in the same plane as the finished surface of the ground or street.

I. Valves shall be those manufactured by Mueller, M & H Valve Company, American or approved equal.

2.08 AIR RELEASE AND AIR/VACUUM VALVES

A. The air release valves shall be the size noted on the Drawings and equal to APCO Series 140C as manufactured by Valve and Primer Corp.

B. The combination air/vacuum valves shall be the size noted on the Drawings and equal to APCO Series 140C as manufactured by Valve and Primer Corp.

C. The air and vacuum valves for vertical turbine pumps shall be the size noted on the Drawings and equal to APCO Series 140DAT as manufactured by Valve and Primer Corp.

D. The valves shall be in accordance with ANSI/AWWA C512.

E. The valves shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. The overall height less back wash accessories shall not exceed 21 inches. Valves shall be constructed of cast iron body and cover, stainless trim and float with a Buna-N seat for positive seating.

F. The baffle shall be ductile iron and shall protect float from direct impact of air and water. The seat shall slip fit into the baffle or cover and lock in place without any distortion. The float and baffle assembly shall be shrouded with a water diffuser. The float shall be stainless steel center guided for positive seating and be rated at 1,000 psi non-shock service.

G. The discharge orifice shall be fitted with a double-acting throttle device to regulate and restrict air venting.

H. All parts of the valves and the operating mechanisms shall be made of non-corrodable materials.

2.09 COMBINATION PRESSURE REDUCING/PRESSURE SUSTAINING VALVE (PRV/PSV)

A. The valve shall maintain a constant downstream pressure regardless of fluctuations in demand. When the upstream pressure lowers to a pre-set minimum the valve shall throttle to maintain a constant inlet pressure.

B. The valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single renewable seat. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.

C. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting. The pressure sustaining pilot control shall be a direct-acting, adjustable, spring-loaded, normally closed diaphragm valve which opens when upstream pressure exceeds the spring setting.

D. Valve shall have a cast iron body with bronze trim.

E. Pressure reducing range shall be 30 psi to 300 psi and pressure sustaining range shall be 20 psi to 200 psi.

F. The valve shall be similar to a Model 92G-01 Combination Pressure Reducing, Pressure Sustaining Valve (globe style) as manufactured by Cla-Val Co.

2.10 PRESSURE REDUCING VALVE (PRV)

A. The valve shall automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure. The main valve and pilot valve shall close drip-tight when downstream pressure exceeds the pressure setting of the control pilot.

B. The valve shall include a check feature that will close the valve when pressure reversal occurs. The closing of valve shall be accomplished by transmitting downstream pressure to the main valve cover chamber.

C. The valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single renewable seat. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.

D. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting.

E. Valve shall have a cast iron body with bronze trim.

F. Upstream adjustment range shall be 20 psi to 200 psi and downstream adjustment range 30 psi to 300 psi.

G. The valve shall be similar to a Model 90G-01 Pressure Reducing Valve (globe style) as manufactured by Cla-Val Co.

2.11 SURGE ARRESTOR VALVES

A. Function:

1. The surge arrestor valve shall open quickly at a pre-determined over-pressure to dissipate surge and close slowly after restoration of normal pressure. Plus, open quickly at a pre-determined under-pressure setting, remain open for a suitable time period to dissipate surge and then slowly close. Plus, open quickly on electrical power failure, remain open for a suitable time period to dissipate surge and then slowly close.

2. Needle valves shall be furnished to provide independent and adjustable control of the main valve opening and closing speed.
3. The valve shall be completely piped ready for installation.

B. Description:

1. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area, and the area on the upper surface of the piston is of a greater area than the underside of the piston.
2. The valve piston shall be guided on its outside diameter by long stroke stationary Vee ports which shall be downstream of the seating surface to minimize the consequences of throttling. Throttling shall be done by the valve Vee ports and not the valve seating surfaces.
3. The valve shall be capable of operating in any position and shall incorporate only one flanged cover at the valve top from which all internal parts shall be accessible. There shall be no stems, stem guides, or spokes within the waterway. There shall be no springs to assist the valve operation.

C. Construction:

1. The valve body shall be of cast iron ASTM A-126 with flanges conforming to the latest ANSI Standards. The valve shall be extra heavy construction throughout. The valve interior trim shall be bronze B-62 as well as the main valve operation.
2. The valve seals shall be easily renewable while no diaphragm shall be permitted within the main valve body.
3. All controls and piping shall be of non-corrosive construction.
4. A visual valve position indicator shall be provided for observing the valve position at any time.

D. Manufacturer: The valve shall be Model 735 as manufactured by Bermad, Model 6700-D (globe) or 6600-D (angle) as manufactured by Golden Anderson, or approvable equal.

2.12 ALTITUDE VALVES

A. Single Acting (one direction):

1. Function: The single acting altitude valve shall be a one-way valve of the delayed opening, non-throttling type that controls the high and low water level in a standpipe as shown on the Drawings. The valve shall assume either a fully open or fully closed position and shall be able to control a water level change of a minimum of 5 feet and a maximum of 50 feet between closing and opening points. Opening and closing points shall be adjustable.

2. Description: The altitude valve shall be a hydraulically operated, pilot controlled, diaphragm type globe valve. The valve shall be single seated and shall have a resilient disc for tight closure. Small changes in storage tank level shall cause an immediate action of the pilot control. The control system shall consist of a main valve and pilot valve to control the reservoir level. The opening and closing rates of the valve shall be adjustable to prevent surges and line shock. The valve shall be provided complete with all piping and appurtenances necessary for operation, including a valve position indicator, a pilot valve strainer, and a 3/4-inch minimum brass or copper pressure sensing line. The entire valve and control assembly shall be readily accessible and easily removable, and its design shall be such that repairs to the main valve can be made without its removal from the line.
3. Construction: Valve body and trim shall be bronze or cast-iron conforming to ASTM B62, ASTM B61, or ASTM A126 Class B, respectively. Ends shall be Class 125, according to ANSI B16.1 and flanged. The valve shall be Class 125 with a pressure rating of 175 psi. All iron castings shall be coated on all sides with at least two (2) coats of rust-inhibiting synthetic resin and asphaltum enamel.
4. Manufacturer: Altitude valve shall be model 30R-AWR, figure 29A, as manufactured by Ross Valve Manufacturing Company; Model 210-3 as manufactured by CLA-VAL Company; or equal.

B. Double Acting (two directions):

1. Function: The double acting altitude valve shall be a two-way valve of the delayed opening, non-throttling type that controls the high water level in a tank as shown on the Drawings. The valve shall assume either a fully open or fully closed position and shall be able to control a water level change of a minimum of 5 feet and a maximum of 50 feet between closing and opening points. The closing point shall be adjustable and the opening point shall be non-adjustable and activates when the distribution pressure drops 1 to 4 feet below the closing point.
2. Description: The altitude valve shall be a hydraulically operated, pilot controlled, diaphragm type globe valve. The valve shall be single seated and shall have a resilient disc for tight closure. Small changes in storage tank level shall cause an immediate action of the pilot control. The control system shall consist of a main valve and pilot valve to control the reservoir level. The opening and closing rates of the valve shall be adjustable to prevent surges and line shock. The valve shall be provided complete with all piping and appurtenances necessary for operation, including a valve position indicator, a pilot valve strainer, and a 3/4-inch minimum brass or copper pressure sensing line. The valve shall have a factory installed "vacuum break" line on the control circuit. The entire valve and control assembly shall be readily accessible and easily removable, and its design shall be such that repairs to the main valve can be made without its removal from the line.

3. Construction: Valve body and trim shall be bronze or cast-iron conforming to ASTM B62, ASTM B61, or ASTM A126 Class B, respectively. Ends shall be Class 125, according to ANSI B16.1 and flanged. The valve shall be Class 125 with a pressure rating of 175 psi. All iron castings shall be coated on all sides with at least two (2) coats of rust-inhibiting synthetic resin and asphaltum enamel.
4. Manufacturer: Altitude valve shall be model 40R-DAWR, figure 33A, as manufactured by Ross Valve Manufacturing Company; Model 210-02 as manufactured by CLA-VAL Company; or equal.

2.13 VALVE BOXES

A. Each buried stop and valve shall be provided with a suitable valve box. Boxes shall be of the adjustable, telescoping, heavy-pattern type with the lower part of cast iron and the upper part of steel or cast iron. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.

B. The upper or sliding section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the valve bonnet.

C. The boxes shall be adjustable through at least 6 inches vertically without reduction of the lap between sections to less than 4 inches.

D. The inside diameter of boxes for valves shall be at least 4-1/2 inches, and the lengths shall be as necessary for the depths of the valves or stops with which the boxes are to be used.

E. Covers for valves shall be close fitting and substantially dirt-tight.

F. The top of the cover shall be flush with the top of the box rim. An arrow and the word OPEN to indicate the direction of turning to open the valve shall be cast in the top of the valve covers.

2.14 TAPPING SLEEVES

A. Tapping sleeves shall be cast iron and capable of containing pressure within the full volume of the sleeve. Sleeve shall be mechanical joint suitable for use with ductile iron or PVC pipe.

B. Sleeve shall be rated at 200 psi working pressure through 12-inch size and 150 psi for sleeves 14-inch through 24-inch.

C. Flanged throat section of mechanical joint sleeves through 12-inch size shall conform to MSS SP60 Standard. For throat sections larger than 12 inches, flanged section shall mate valves of same manufacture as sleeves.

D. All cast iron shall conform to ASTM A126, Class B. Castings shall be cleaned and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts, nuts, and gaskets shall be in accordance with mechanical joint requirements of AWWA C111.

E. Tapping sleeves shall be capable of withstanding their rated pressure without leakage past the side gaskets and end gaskets of the sleeve. Sleeves shall be supplied with split end gaskets and two-piece glands. Side flange rubber gaskets shall butt against the rubber end gaskets to make a watertight seal. Side and end bolts shall be of a T-head design. The throat flange shall be designed to center the tapping valve to the sleeve. Tapping sleeve shall be equipped with a test plug.

F. Tapping sleeves shall be fully coated with fusion bonded epoxy coating in accordance with AWWA C550 Standard.

G. Sleeves shall be marked with the name of the manufacturer and size (run x branch).

H. Tapping sleeve shall be manufactured by Mueller, M & H Valve Company, or approved equal.

2.15 COMPOUND WATER METER

A. Master meter shall be a compound meter in the size noted on the Drawings.

B. Meter shall be in accordance with AWWA C702.

C. Meter shall meet the following specifications:

Typical Operating Range (100%± 1.5%)	1-700 GPM
Low Flow Registration	1/2 GPM
Maximum Continuous Flow	500 GPM
Pressure Loss at Maximum Continuous Flow	6 PSI at 500 GPM
Pressure Loss at Crossover	6 PSI
Minimum Crossover Accuracy	95%

Maximum Operating Pressure	150 PSI
Maximum Operating Temperature	120^0F
Meter Flanges	Round flanges, Class 150
Register	Straight reading, single register, sealed magnetic drive standard. Remote reading units optional
Total Flow	100,000,000 gallons
Registration	100 gallons/sweep hand revolution
Low Flow	10,000,000 gallons
Registration	10 gallons/sweep hand revolution
Housing	Cast bronze
Nose Cone and Straightening Vanes	Thermoplastic
Rotor	Thermoplastic
Rotor and Valve Casing	Thermoplastic
Rotor Spindle, Bearing and Endstone	Ceramic
Measuring Chamber and Disc	Thermoplastic
High Flow Valve	Thermoplastic
High Flow Swing Weight	Cast bronze
Triggers	Stainless steel
Magnets	Ceramic and alnico
Register Lens	Glass/thermoplastic

Register Housing and Cover	Thermoplastic
Trim	Stainless steel

D. Meter shall be equal to the Recordall as manufactured by Badger Meter or Neptune Tru/Flo as manufactured by Schlumberger Industries.

2.16 TURBINE WATER METER

A. General:

1. The turbine type water meters provided for the Project shall be of single manufacturer. The meter manufacturer shall have a minimum of five (5) years of experience in the design and manufacture of turbine water meters of equal size and quality to those specified.
2. Water meter shall meet or exceed the latest requirements of AWWA C701 for Class II turbine type, magnetic drive, flanged meter tube with 150 psi working pressure.
3. Water meters provided for this Project shall be Neptune as manufactured by Schlumberger Industries or approved equal.

B. Components:

1. Meter tube shall be flanged cast bronze. The internal and external of the meter tube and meter head shall be free of any casting flaws or sharp corners or burrs. The meter tube shall have manufacturer's name, meter size, AWWA Class II and flow arrow cast into both sides. Meter tubes shall offer minimum obstruction to the flow. Four-inch and 6-inch meters shall be furnished with 1-inch NPT coupling on outlet side.
2. Meter head shall be connected to the tube by means of gasket sealed connection with stainless steel bolts. The meter shall be designed for easy removal of water wetted parts form the tube for inspection or repair without having to remove the complete tube. Water wetted meter components that are permanently attached to the tube or meter head will not be accepted. The meter head shall incorporate a sealed stainless steel flow adjusting vane for recalibration. The vane shall be set at the factory, capped and sealed to prevent unauthorized adjustment.
3. Measuring chamber shall be removable from the meter head. The drive mechanism shall be directly coupled to the rotor by mean of gears. The gearbox shall be integral with the outlet housing and shall be designed to facilitate easy replacement of gears.
4. Rotor shall be permanently attached to the rotor shaft and shall rotate on an axis that is parallel to the direction of the water flow through the pipe. The rotor shall be resistant to normal corrosion and deformity due to high flow velocities, and shall be directly coupled to the gear train.

5. Bearings for the rotor shaft dual out-board graphite bearings, position to provide uniform loading of the rotor. Dual thrust bearings shall handle flows in both forward and reverse directions. All bearings must be field replaceable.
6. Totalizer shall be a six-digit, straight reading type with a 3-inch diameter, 100 division dial and center sweep test hand to permit timing for an accurate determination of flow rate. The totalizer shall be equipped with a leak detector hand to indicate very low flow. The totalizer shall read in units of gallons per day and shall be magnetically driven and equipped with change gears to facilitate easy change of registration without removing pressure from the line. The totalizer shall be encased in an o-ring sealed bonnet made of cast bronze.

C. Quality Control: Volumetric testing of all meters must be performed and approved prior to shipment. The complete head assembly must be accurately tested in the same pipe size and same tube that the meter will be mounted in. The test shall be minimum, intermediate, and maximum AWWA flow ranges of the meter. The amount of water used to conduct the test must be left on the totalizer. Prior to shipping, a tag shall be attached to the meter showing the totalizer reading after the test. A copy of the certified accuracy test record must be furnished to the Owner at no charge.

2.17 ULTRASONIC FLOW METER (FOR POTABLE WATER)

A. The flowmeter shall be of the ultrasonic clamp on, transit-time and provide indicating, totalizing, and transmitting of liquid flow rate in full pipes.

1. The operational specifications shall be accuracy +/- 0.5 percent of velocity or +/- .05 FPS.

B. The meter shall operate on the following pipe materials: carbon steel, stainless steel, mortar-lined ductile iron, copper, aluminum, cast iron, FRP, ASB, and PVC.

1. The meter shall be programmable for use on all pipe schedules and diameters 1 inch through 90 inches using the same hardware and electronics.
2. The instrument shall be of the Auto Zero type. There will be no requirement to stop or alter flow during installation.
3. The ultrasonic flowmeter shall measure flow rates in clean liquids with a velocity span of +/- 0 to 50 feet per second in pipe sizes of 1 to 90 inches.

C. The meter shall have four (4) outputs which can be programmed for signal loss, reverse flow, totalizer pulses, or over scale functions.

D. The electronics shall be provided in a NEMA-4X enclosure with viewing window for reading indicators with door closed.

E. The 4-20 mA output shall be proportional to flow rate. The maximum, resistive load shall be 600 OHMS and current limited.

F. The meter shall have a 4-20 mA input for display locally in scalable units of measure.

G. Unit to have a built-in microprocessor to provide capability for:

1. Adapting instrument hardware to existing piping and flow conditions
2. Automatically calculating transducer spacing.
3. Programming the scale factor.
4. Programming the low flow cut-off.
5. Selecting English or Metric units.
6. Automatic speed of sound calculation of measured fluid.
7. Bi-directional totalization with selectable resolution.
8. Displaying, in percent, 4-20 mA inputs from external sources.
9. Flow output selection in GPM, GPH, MGD, and FPS (or metric equivalent).
10. Adjustable damping from 1 to 99 seconds.
11. LCD indication or flow diagnostics to include a "fault" status.
12. Section of zero functions:
    a. Auto zero under flow conditions.
    b. Set zero when flow can be stopped.
    c. Zero operate for fast response.
13. Storage of data for up to eight pipes with recall capability.

H. The transmitter shall be wall mounted in meter vault.

I. A remote flow rate indicator/totalizer terminal shall be provided. It shall be panel mounted in the MTU located in the laboratory. (The MTU is provided as part of Specification Section 13400). A 4-20 mA analog output signal proportional to the flow rate shall be included for connection to the remote flow indicator/totalizer.

J. The flowmeter shall be equal to TYME-FLYTE ISTT by POLYSONICS.

2.18 STRAINER FOR METERS

Strainer for meters shall be installed upstream of meter at location shown on the Drawings. In no case shall there be less than a minimum of five (5) pipe diameters of straight unobstructed pipe upstream of strainer. Strainer body and cover shall be bronze in sizes 2-inch through 6-inch and cast iron in sizes 8-inch and 10-inch. Strainer plate and cover bolts shall be stainless steel. Strainer shall be rated for 150 psi working pressure and be equal to the Neptune Turbine Strainer manufactured by Schlumberger Industries.

2.19 FLEXIBLE JOINT

Flexible joint shall be in size as shown on the Drawings and equal to the Standard Spool Type Expansion Joint manufactured by Metraflex Company. Flexible joint carcass shall be _____ arch and constructed by Chlorobutyl and polyester with bias-ply tire cord reinforcement and rated for working pressure shown in table. Flexible joint shall have integral rubber flange with ductile iron retaining ring. Flexible joint shall have _____ control rods. Flanges shall be 150-pound strength.

Joint Size (Inches)	*Joint Length (Inches)*		*Pressure Rating (psi)*		*Gusset Plate Thickness (Inches)*	*Rod Diameter (Inches)*
	1-Arch	*2-Arch*	*2-Rods*	*3-Rods*		
2	6	10	200	200	3/8	5/8
2 1/2	6	10	200	200	3/8	5/8
3	6	10	200	200	3/8	5/8
4	6	10	200	200	3/8	5/8
5	6	10	200	200	3/8	5/8
6	6	10	140	200	1/2	5/8
8	6	10	140	190	1/2	3/4
10	8	12	140	190	3/4	7/8
12	8	12	140	190	3/4	1
14	8	12	85	130	3/4	1
16	8	12	65	110	3/4	1 1/8
18	8	12	65	110	3/4	1 1/8
20	8	12	65	110	3/4	1 1/8
24	10	14	65	100	1	1 1/4

2.20 COUPLING ADAPTER

A. The pipe couplings shall be of a gasketed, sleeve-type with diameter to properly fit the pipe. Each coupling shall consist of one (1) steel middle ring, of thickness and length specified, two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient track-head steel bolts to properly compress the gaskets. Field joints shall be made with this type of coupling. The middle ring and followers of the coupling shall be true circular sections free from irregularities, flat spots, or surface defects. They shall be formed from mill sections with the follower-ring section of such design as to provide confinement of the gasket. After welding, they shall be tested by cold expanding a minimum of 1 percent beyond the yield point. The coupling bolts shall be of the elliptic-neck, track-head design with rolled threads. The manufacturer shall supply information as to the recommended torque to which the

bolts shall be tightened. All bolt holes in the followers shall be oval for greater strength. The gaskets of the coupling shall be composed of a crude or synthetic rubber base compounded with other products to produce a material which will not deteriorate from age, from heat, or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow of the material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration, pulsation and temperature or other adjustments of the pipe line. The couplings shall be assembled on the job in a manner to insure permanently tight joints under all reasonable conditions of expansion, contraction, shifting and settlement, unavoidable variations in trench gradient, etc.

B. Nuts and bolts shall be in accordance with AWWA C111.

C. Couplings shall be shop primed and field painted in accordance with Division 9 (or one coat of coal tar epoxy if not specified in Division 9).

D. Compression couplings shall be equal to Style 38 manufactured by Dresser. Flanged couplings shall have flanges in accordance with AWWA C207 and be equal to Style 128 manufactured by Dresser.

2.21 PRESSURE GAUGES

A. Pressure gauges shall have cast brass cases with bourdon tubes and precision rotary movements of bronze, nickel, or other material suitable to the environment in which they will be located. Dials shall be 6 inches in diameter with a pressure range of 0 to 100 psi. Provide female quick coupler for connection to corporation stop. Each gauge shall be provided with snuffer.

B. Corporation stops shall be similar to Ford Products and shall have iron pipe threads with pack joint connection outlets. Provide male quick coupler for attachment of pressure gauge.

2.22 FIBERGLASS LINE MARKER

A. General:

1. Design: The continuous fiberglass reinforced composite line marker (CRM-375) shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. The CRM-375 upon proper installation shall resist displacement from wind and vehicle impact forces. The CRM-375 shall be of a constant flat "T" cross-sectional design with reinforcing support ribs incorporated longitudinally along each edge to provide sheeting protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.
2. Material: The CRM-375 marker shall be constructed of a durable, UV resistant,

continuous glass fiber and marble reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40^0 F to $+140^0$ F.

3. Workmanship: The CRM-375 marker shall exhibit good workmanship and shall be free of burns, discoloration, cracks, bulges or other objectionable marks which would adversely affect the marker's performance or serviceability.
4. Marking: Each CRM-375 shall be permanently marked "Water Valve Below". The letters shall be a minimum of 2 inches in height. A black line shall be stamped horizontally across the front of the marker near the bottom to indicate proper burial depth as shown in the standard detail.

B. Physical and Mechanical Requirements:

1. Dimensions: The CRM-375 marker shall conform to the shape and overall dimensions shown in the standard detail.
2. Mechanical Properties: The CRM-375 shall have the minimum mechanical properties as follows:

Property	ASTM Test Method	Minimum Value
Ultimate Tensile Strength	D-638	50,000 psi
Ultimate Compressive Strength	D-638	45,000 psi
Specific Gravity	D-792	1.7
Weight % Glass Reinforcement	D-2584	50%
Barcol Hardness	D-2583	47

3. Color Fastness: The CRM-375 shall be pigmented throughout the entire cross-section so as to produce a uniform color which is an integral part of the material. Ultraviolet resistant materials shall be incorporated in the construction to inhibit fading or cracking of the delineator upon field exposure.
4. Vehicle Impact Resistance: The Carsonite CRM-375 marker shall be capable of self-erecting and remain functional after being subjected to a series of ten head on impacts by a typical passenger sedan at 35 miles per hour. The CRM-375 shall retain a minimum of 60 percent of its sheeting.

C. Reflectors:

1. The reflector shall be of impact resistant, pressure sensitive retro-reflective sheeting which shall be subject to approval by the Engineer. The sheeting shall be of appropriate color to meet MUTCD requirements.

2. Mounting: The retro-reflective sheeting shall consist of a minimum of a 3-inch wide strip placed a maximum of 2 inches from the top of the post unless otherwise specified.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Valves shall be installed as nearly as possible in the positions indicated on the Drawings consistent with conveniences of operating the handwheel or wrench. All valves shall be carefully erected and supported in their respective positions free from all distortion and strain on appurtenances during handling and installation.

B. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness.

C. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

D. Valves shall not be installed with stems below the horizontal.

E. Valves shall be set plumb and supported adequately in conformance with the instructions of the manufacturer. Valves mounted on the face of concrete shall be shimmied vertically and grouted in place. Valves in the control piping shall be installed so as to be easily accessible.

F. Where chain wheels are provided for remote operation of valves, two (2) S-shaped hooks shall be provided for each valve to enable the chains to be hooked so as not to interfere with personnel traffic.

G. Valves shall be provided with extension stems where required for convenience of operation. Extension stems shall be provided for valves installed underground and elsewhere so that the operating wrench does not exceed 6 feet in length.

H. A permanent type gasket of uniform thickness shall be provided between flanges of valves and sluice gates and their wall thimble.

I. Wall thimbles shall be accurately set in the concrete walls so that the gates can be mounted in their respective positions without distortion or strain.

J. Floorstand operators and stem guides shall be set so that the stems shall run smoothly in true alignment. Guides shall be anchored firmly to the walls. Distances from the centerlines of gates to the operating level or base of floorstand shall be checked by the Contractor and adjusted if necessary to suit the actual conditions of installation.

3.02 PAINTING

A. Valves shall be factory primed and fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA C550 Standard.

B. Other painting is specified in Division 9.

END OF SECTION 02640

SECTION 02642 - SEWAGE VALVES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install valves, gates, and miscellaneous piping appurtenances, as indicated on the Drawings and as herein specified.

B. The Drawings and Specifications direct attention to certain features of the equipment, but do not purport to cover all the details of their design. The equipment furnished shall be designed and constructed equal to the high quality equipment manufactured by such firms as are mentioned hereinafter, or as permitted by the Engineer. The Contractor shall furnish and install the equipment complete in all details and ready for operation.

C. Valves for use in the following services are specified under their appropriate sections:

1. Chlorination/dechlorination equipment.
2. Heating and air conditioning.
3. Plumbing.
4. Instrumentation.

D. Electrical work and equipment specified herein shall conform to the requirements of the applicable electrical sections.

E. Enclosures shall be of a suitable type for the atmospheres in which they are installed.

F. Sizes and capacities not specified herein are indicated on the Drawings.

1.02 RELATED WORK

A. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

B. Section 02732 - Sewage Force Mains.

C. Section 02733 - Sewage Pump Station.

1.03 SUBMITTALS

A. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer in accordance with the requirements of Section 01300.

B. The manufacturer shall furnish the Engineer two (2) copies of an affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of

ANSI/AWWA valve, and that all tests specified therein have been performed and that all test requirements have been met.

C. The Engineer shall be furnished two (2) copies of affidavit that the "valve protection testing" has been done and that all test requirements have been met.

D. The Engineer shall be furnished with two (2) copies of affidavit that inspection, testing and rejection are in accordance with AWWA Standard.

PART 2 - PRODUCTS

2.01 BALL VALVES

A. Ball valves shall have double union ends to permit removal of the valve without disconnecting the pipeline and shall be of the type which will not leak when the downstream union end is disconnected.

B. Viton "O" ring seals shall be used with teflon seats. Ball valves shall be installed with the flow arrow pointed in the direction of flow to permit disconnection of downstream piping.

C. During installation, the valve handle shall be oriented for ease of operation by rotating the valve body about its axis prior to tightening the ends.

D. Where indicated on the Drawings, the valve shall be equipped with a pointer and scale plate which will indicate the position of the valve at all times.

2.02 CHECK VALVES

A. Check valves 3 inches and larger shall be iron body, bronze mounted, full opening, swing type check valves with bolted covers and flanged ends. Flanges shall be faced and drilled in accordance with the 125-pound AN Standard. Valves shall comply with AWWA Standard C508 latest revision.

B. Valves shall be equipped with outside levers and weights.

C. Valves shall be designed for working pressures as follows:

Valve Size (Diameter)	Pressure
3 to 12 inches	175 psi
14 to 24 inches	150 psi
30 inches and larger	120 psi

D. Check valves smaller than 3 inches in size shall be 200-pound WOG minimum bronze or all brass swing check valves. Valves shall have screw-on cap and renewable composition disks. Valve body shall be as herein specified for gate valves.

E. Check valves in pipelines carrying sewage or sludge shall be installed horizontally.

2.03 PLUG VALVES

A. Plug valves shall conform to the latest revision of AWWA C507 and shall be of the nonlubricated eccentric type with resilient plugs faced with natural or synthetic rubber suitable for service in sewage and sludge piping.

B. Port areas shall be unobstructed when open and have smoothly shaped waterways of not less than 80 percent (80%) of full pipe area except that valves 30 in. and larger shall have only 70 percent (70%) area.

C. Bodies shall be of semisteel, suitable for 125-pound working water pressure and shall have raised seats.

D. Valves 3 inches and larger shall have seats of a welded in overlay of not less than 90 percent (90%) pure nickel or other acceptable material.

E. Valves less than 3 inches shall have plastic-covered seats.

F. Valves shall have permanently lubricated upper and lower stainless steel bushings on plug journal ends.

G. Valves shall have bolted bonnets. Valves 4 inches and larger shall be designed so that they can be repacked under line pressure without removing the bonnet from the valve. Packing shall be adjustable.

H. Valves 6 inches and larger shall be gear-operated with handwheels and valves smaller than 6 inches shall be wrench operated, except as hereinafter specified or indicated on the Drawings.

I. Where there is a lack of space for the valve wrench to operate gear operators, handwheels shall be provided in lieu of the wrench.

J. Chain operators, consisting of sprocket wheels, chain guides and operating chains shall be provided for all valves with operator centerlines located more than 6 feet 6 inches above the operating level. Operating chain shall be stainless and shall extend within 3 feet of the operating level.

K. Gear operators shall be totally enclosed, worm gear type, permanently lubricated, and shall be watertight and dusttight.

L. Gear operators shall be provided with adjustable stops for the open and closed position to prevent overtravel, and shall have a valve disk position indicator.

M. A suitable lever or wrench shall be provided for each six wrench operated valves but at least one wrench for each operating station. Wrenches or wheels and chains shall be of suitable size and sufficient length for easy operation of the valves at their rated working pressure.

N. Plug valves 2-1/2 inches and smaller shall have screwed ends.

O. Plug valves 3 inches and larger shall have mechanical joint or flanged ends faced and drilled in accordance with 125-pound ANSI Standard.

P. Plug valves shall be those manufactured by DeZurik, Clow, or approved equal.

2.04 GATE VALVES

A. All gate valves shall be of the double disc, parallel seat type, iron body, non-rising stem, fully bronze mounted with O-ring seals. Valves shall be of standard manufacture and of the highest quality both as to materials and workmanship and shall conform to the latest revisions of AWWA Specification C-509. Valves shall have a rated working pressure of 200 psi.

B. Gate valves for buried service shall be furnished with mechanical joint end connections, unless otherwise shown on the Drawings or specified herein. The end connection shall be suitable to receive ductile iron or PVC pipe.

C. Gate valves for meter pits, pump stations, or other installations as shown on the Drawings shall be furnished with flanged joint and connections, outside screw and yoke and handwheel operator. The gate valve shall have the direction of opening cast on the rim of the handwheel and provided with chain and lock.

D. All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.

E. Buried service gate valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counterclockwise).

F. Buried service gate valves shall be installed in a vertical position with valve box as detailed on the Drawings. They shall be set vertically and properly adjusted so that the cover will be in the same plane as the finished surface of the ground or paved surface (concrete, bituminous, etc.).

G. Valves shall be those manufactured by Mueller, M & H Valve Company, American, or approved equal.

2.05 SOLENOID VALVES

A. Solenoid valves shall be bronze body, screwed-end, single integral seat, full pipe area, globe type valves, with renewable composition disk seats.

B. Solenoid enclosures shall meet NEMA Type 4X requirements with coils epoxy encapsulated and suitable for high ambient temperatures (140 degrees F).

C. Valves shall be suitable for operation on 120 volt, single-phase, 60 Hz current, and designed to open when energized.

D. The solenoid valves shall be manufactured by Automatic Valve Co., Inc., Indianapolis, IN; J.D. Gould Co., Indianapolis, IN; Automatic Switch Co., Florham Park, NJ; Magnatrol Valve Corp., Hawthorne, NJ; or be an acceptable equivalent product.

2.06 TAPPING SLEEVES AND VALVES

A. Tapping sleeves and valves shall consist of a split cast iron sleeve tee with mechanical joint ends on the main and a flange on the branch, and a tapping type gate valve with one flange end and one mechanical joint end.

B. The valve shall, in general, conform to the requirements hereinbefore specified for gate valves and shall be furnished with a 2-inch square operating nut.

C. The Contractor shall be responsible for verifying the outside diameter of the pipe to be correct. Sleeves and valves shall be manufactured by M&H Valve & Fittings, Div. of Dresser, Inc., Anniston, AL; Clow Corporation, Chicago, IL; Traverse City Iron Works, Traverse City, MI; or an acceptable equivalent product.

2.07 MUD VALVES

A. Mud valves shall be located and sized as indicated on the Drawings and as specified herein. Mud valves shall be designed for basin drain applications, and shall be of the nonrising stem type. The valve body shall be constructed of cast iron with the stem, stem nut, disc ring, and seat ring of bronze. All bolts and nuts shall be rustproofed steel.

B. The valves shall be furnished with operating nuts to be located at the positions shown on the Drawings. They shall also be furnished with extension stems, stem guides if required, and bench stands.

C. The mud valves shall be as manufactured by Clow Corporation, or an approved equivalent product.

2.08 TELESCOPING VALVES

Telescoping valves shall be equipped with handwheel operated floorstands and shall be sized as indicated on the Drawings. Valves shall be as manufactured by Keene Corporation, Aurora, IL, or an approved equivalent product.

2.09 AIR RELEASE AND AIR/VACUUM VALVES

A. The combination valve shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. The over-all height less back wash accessories shall not exceed 21 inches. Valves shall be constructed of cast iron body and cover, stainless trim and float with a Buna-N seat for positive seating.

B. All back wash accessories shall be furnished and assembled to the valve, consisting of an inlet shut-off valve clear water inlet valve, rubber supply hose and quick disconnect couplings.

C. All parts of the valves and the operating mechanisms shall be made of non-corrodible materials.

D. The following table may be used to determine air/vacuum valve sizing requirements. If the selection is unclear or if the selection of the valve appears critical to the operation of the system, contact the Engineer for assistance in the selection.

1. Sizing table:

Flow Rate (GPM)	**0 to 1300**	**1301 to 3800**	**3801 to 7100**
Valve Size (inch)	1	2	3

E. On sewage or sludge lines, the combination air/vacuum valve shall be Series 440 SCAV manufactured by APCO, or an acceptable equivalent.

2.10 SLIDE GATES

A. Self-contained slide gates shall be rising stem, fabricated gates complete with frames and anchor rods, plate disk, stem, and bench stand. All metal parts except the stem and bench stand shall be of aluminum. Stems shall be made of stainless steel. Bench stands are described hereinafter.

B. Side frame shall be made of extruded aluminum members having a slot in which the disk shall be guided. The bottom frame members shall be an aluminum tee or an angle to serve as a flat seat for the rubber seat on the bottom edge of the disk.

C. The disk shall be reinforced as necessary to prevent buckling and to support the attachment for the stem.

D. The top frame member or concrete structure shall support the bench stand as indicated on the Drawings.

E. The slide gates shall be flush bottom fabricated metal gates made by Rodney-Hunt Machine Co., Orange, MA; Waterman Industries, Inc., Lubbock, TX; Hydro-Gate Corporation, Commerce City, CO; or be acceptable equivalent products.

F. Manually lifted slide gates shall have embedded or surface mounted frames and shall be as indicated on the Drawings and as herein specified.

G. Disk and frame shall be 6061-T6 aluminum alloy and temper designation of the Aluminum Association. Disk shall be formed from aluminum plate and frames for the disk shall be of extruded aluminum. The handle shall be of the same material as the gates.

H. Frame shall be set into the concrete as the concrete is being placed. The frame shall be straight and true, and shall permit the gates to be moved easily and to seat tight without binding.

2.11 SLUICE GATES

A. Sluice gates shall conform to the AWWA Standard for sluice gates (C501-80) and as supplemented hereinafter. Sluice gates shall be manufactured by the Rodney-Hunt Co., Orange, MA; Waterman Industries, Inc., Lubbock, TX; Hydro-Gate Corporation, Commerce City, CO; or be acceptable equivalent products. All sluice gates shall be products of the same manufacturer.

B. Sluice gates shall be cast iron, full bronze mounted with side wedges for seating head conditions and, where necessary, bottom and top wedges for unseating head conditions. Machined surfaces shall be finished to exact dimensions. Disks and frames shall have machined dovetail grooves into which the bronze seat facings shall be driven and securely fastened. Reinforcing ribs shall be cast opposite the grooves in the disk. All holes for bolts and studs shall be drilled. Frames shall be of the flat or flange type as indicated on the Drawings, having the rear face machined and drilled for bolting directly to cast iron wall thimbles set flush with the concrete wall or to standard cast iron pipe flanges or wall castings. Wall thimbles shall be furnished for all sluice gates not depth indicated on the Drawings and shall be made of one piece cast iron construction of adequate thickness to withstand the stress of operation and installation. A center ring or water stop shall be cast around the periphery of the wall thimbles. Front flanges shall be machined and shall be provided with drilled and/or tapped holes for installation of bolts or studs as necessary.

C. Large rectangular thimbles shall be provided with holes in the invert to allow satisfactory concrete placement beneath the thimble.

D. Self-contained sluice gates shall be nonrising stem gates equipped with suitable cast iron yoke adequately designed to support the loading resulting from operating the gate. The yoke shall have an integrally cast boss centrally located and accurately machined to hold the stem in alignment. It shall be fitted with a removable bronze stem in alignment. It shall be fitted with a removable bronze stem thrust cap securely folded to the yoke. Disks shall have a pocket to hold a square bronze thrust nut.

E. The self-contained sluice gate shall be equipped with a suitable cast iron yoke mounted on the upper ends of the guides and adequately designed to support the load resulting from the operator and operating the gate.

F. Flush bottom gates shall have a compressible resilient bottom seal.

G. The entire stem, including extension stem, if any, of the sluice gates shall be of rolled Tobin bronze with a tensile strength of not less than 60,000 psi, or of stainless steel.

H. Stems shall be designed to transmit at least 2-1/2 times the rated output of the floorstand in compression.

I. The sections of extension stems shall be jointed together by solid, manganese bronze, or stainless steel couplings to match the stems, and threaded and keyed to the stems. All couplings of the same size shall be interchangeable. Stems shall be furnished with adjustable, bronze bushed, stem guides, spaced as necessary for as indicated on the Drawings. Guides shall be supported by cast iron brackets bolted to the concrete.

J. Where the operating floor is located above the self-contained sluice gate, an extension stem coupled to the operating stem shall be provided with a 2" square operating nut, terminating in a cast iron floor box. Operation shall be by a T-handled wrench.

K. Operators of the type indicated on the Drawings and herein specified shall be provided with each sluice gate.

2.12 VALVE BOXES

A. Each buried stop and valve shall be provided with a suitable valve box. Boxes shall be of the adjustable, telescoping, heavy-pattern type with the lower part of cast iron and the upper part of steel or cast iron. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.

B. The upper or sliding section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the valve bonnet.

C. The boxes shall be adjustable through at least 6 inches vertically without reduction of the lap between sections to less than 4 inches.

D. The inside diameter of boxes for valves shall be at least 4-1/2 inches, and the lengths shall be as necessary for the depths of the valves or stops with which the boxes are to be used.

E. Covers for valves shall be close fitting and substantially dirt-tight.

F. The top of the cover shall be flush with the top of the box rim. An arrow and the word OPEN to indicate the direction of turning to open the valve shall be cast in the top of the valve covers.

2.13 FLOORSTANDS

A. Floorstands shall be handwheel or crank operated as indicated on the Drawings or as required to suit the application.

B. Handwheel operated type shall be without gear reduction and crank-operated type will have either single or double gear reduction depending upon the lifting capacity required. Each type shall be provided with a threaded cast bronze lift nut to engage the operating stem. Tapered roller bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts. Floorstands shall develop their maximum capacity with not greater than a 40-pound pull on the crank or handwheel. Gears, where required, shall be steel with machined cut teeth designed for smooth operation. The pinion shafts on crank-operated floorstands, either single or double ratio, shall be supported on tapered roller bearings or other approved bearings. All components shall be totally enclosed in a cast iron case and cover. Positive mechanical seals will be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist. Lubricating fittings shall be provided for the lubrication of all gears and bearings. Floorstands shall include a cast iron pedestal with the input shaft or handwheel approximately 36 in. above the operating floor. An arrow with the word OPEN shall be cast on the floorstand or handwheel indicating the direction of rotation to open.

C. Floorstands for rising stem sluice gates shall have clear, transparent, rigid, plastic stem covers.

D. Floorstands for nonrising stem sluice gates shall have stem indicators.

E. Floorstands shall be provided by the valve or gate manufacturer with each valve or gate requiring floorstands.

2.14 T-HANDLE OPERATING WRENCHES

T-handle operating wrenches shall be provided in the number and lengths necessary to permit operation of all valves by operators of average height working in normal positions.

2.15 FLOOR BOXES

A. The floor boxes shall be cast iron with a bronze bushing of the size necessary to accommodate the extension stem. The boxes shall be suitable for installation in a concrete floor of the thickness indicated on the Drawings.

B. They shall be similar to those made by Mueller Co., Decatur, IL; Clow Corporation, Chicago, IL; Coldwell-Wilcox Co., Fairfield, CT; or be acceptable equivalent products.

2.16 PRESSURE GAUGES

A. Pressure gauges shall have cast brass cases with bourdon tubes and precision rotary movements of bronze, nickel, or other material suitable to the environment in which they will be located. Dials shall be 6 inches in diameter with a pressure range of 0 to 100 psi. Provide female quick coupler for connection to corporation stop.

B. Corporation stops shall be similar to Ford Products and shall have iron pipe threads with pack joint connection outlets. Provide male quick coupler for attachment of pressure gauge.

C. Pressure gauges shall have a snuffer to prevent shock damage to gauges.

2.17 FIBERGLASS LINE MARKER

A. General:

1. Design: The continuous fiberglass reinforced composite line marker (CRM-375) shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. The CRM-375 upon proper installation shall resist displacement from wind and vehicle impact forces. The CRM-375 shall be of a constant flat "T" cross sectional design with reinforcing support ribs incorporated longitudinally along each edge to provide sheeting protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.
2. Material: The CRM-375 marker shall be constructed of a durable, UV resistant, continuous glass fiber and marble reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40^0 F to $+140^0$ F.
3. Workmanship: The CRM-375 marker shall exhibit good workmanship and shall be free of burns, discoloration, cracks, bulges or other objectionable marks which would adversely affect the marker's performance or serviceability.

4. Marking: Each CRM-375 shall be permanently marked "Sewer Line Below". The letters shall be a minimum of 2 inches in height. A black line shall be stamped horizontally across the front of the marker near the bottom to indicate proper burial depth as shown in the standard detail.

B. Physical and Mechanical Requirements:

1. Dimensions: The CRM-375 marker shall conform to the shape and overall dimensions shown in the standard detail.
2. Mechanical Properties: The CRM-375 shall have the minimum mechanical properties as follows:

Property	**ASTM Test Method**	Minimum Value
Ultimate Tensile Strength	D-638	50,000 psi
Ultimate Compressive Strength	D-638	45,000 psi
Specific Gravity	D-792	1.7
Weight % Glass Reinforcement	D-2584	50%
Barcol Hardness	D-2583	47

3. Color Fastness: The CRM-375 shall be pigmented throughout the entire cross-section so as to produce a uniform color which is an integral part of the material. Ultraviolet resistant materials shall be incorporated in the construction to inhibit fading or cracking of the delineator upon field exposure.
4. Vehicle Impact Resistance: The Carsonite CRM-375 marker shall be capable of self-erecting and remain functional after being subjected to a series of ten head on impacts by a typical passenger sedan at 35 m.p.h. The CRM-375 shall retain a minimum of 60 percent (60%) of its sheeting.

C. Reflectors:

1. The reflector shall be of impact resistant, pressure sensitive retroreflective sheeting which shall be subject to approval by the Engineer. The sheeting shall be of appropriate color to meet MUTCD requirements.
2. Mounting: The retroreflective sheeting shall consist of a minimum of a three-inch wide strip placed a maximum of two inches from the top of the post unless otherwise specified.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Valves shall be installed as nearly as possible in the positions indicated on the Drawings consistent with conveniences of operating the handwheel or wrench. All valves shall be carefully erected and supported in their respective positions free from all distortion and strain on appurtenances during handling and installation.

B. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness.

C. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

D. Valves shall not be installed with stems below the horizontal.

E. Valves shall be set plumb and supported adequately in conformance with the instructions of the manufacturer. Valves mounted on the face of concrete shall be shimmed vertically and grouted in place. Valves in the control piping shall be installed so as to be easily accessible.

F. Where chain wheels are provided for remote operation of valves, two S-shaped hooks shall be provided for each valve to enable the chains to be hooked so as not to interfere with personnel traffic.

G. Valves shall be provided with extension stems where required for convenience of operation. Extension stems shall be provided for valves installed underground and elsewhere so that the operating wrench does not exceed 6 feet in length.

H. A permanent type gasket of uniform thickness shall be provided between flanges of valves and sluice gates and their wall thimble.

I. Wall thimbles shall be accurately set in the concrete walls so that the gates can be mounted in their respective positions without distortion or strain.

J. Plug valves in horizontal sewage and sludge piping shall be installed with the shaft horizontal such that when in the open position, the plug is located in the upper part of the valve body. Valves shall be oriented so that in the closed position, the plug is at the upstream end of the valve.

K. Floorstand operators and stem guides shall be set so that the stems shall run smoothly in true alignment. Guides shall be anchored firmly to the walls. Distances from the centerlines of gates to the operating level or base of floorstand shall be checked by the Contractor and adjusted if necessary to suit the actual conditions of installation.

3.02 PAINTING

A. Valves shall be factory primed and fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA C550 Standard.

B. Other painting is specified in Division 9.

END OF SECTION 02642

SECTION 02646 - FLUSHING HYDRANTS

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, materials, and equipment required to complete the work of installing flushing hydrants with all appurtenances as shown on the Drawings and specified herein.

PART 2 - PRODUCTS

2.01 FLUSHING HYDRANTS

A. Flushing hydrants shall be box hydrants, with 4 cubic feet of crushed stone beneath hydrant to allow drainage. All working parts shall be brass, with hydrant main valve opening being at least 2-1/8". Inlet connection shall be 2" MJ, with the outlet being 2-1/2" NST. The operating rod shall be non-turning, and all operating parts shall be removable from above ground with no special wrenches. This self-draining, non-freeze hydrant's barrel will be made of 3" ductile iron pipe, and shall have a lockable cast iron box, equal to the Eclipse #85 as manufactured by Kupferle Foundry or the Mueller 2-1/8" flush type hydrant.

B. Inlet cover depth shall be minimum of 30 inches and the minimum dimension from ground to centerline of lowest opening shall be 18 inches. Flushing hydrants shall be supported with flat thrust rocks and provided with a drainage pits as indicated on Standard Detail Sheet.

C. All hydrants shall receive one (1) coat of manfacturer's standard shop primer and two (2) field coats of Tnemec Hi-Build Tneme-gloss, type 2H, enamel in color selected by Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

Flushing hydrants shall be installed in accordance with the manufacturer's directions and as detailed on the Drawings.

3.02 ACCESSORIES

A. The Owner shall be furnished with a total of two (2) operating nut wrenches and two (2) standard hydrant hoses (2-1/2" dia.) in lengths of twenty-five (25) feet with brass nozzle and inlet connection (2 1/2" NST).

END OF SECTION 02646

SECTION 02660 - DOMESTIC WATER DISTRIBUTION CONNECTIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install water service piping together with all appurtenances including but not limited to tapping saddle, corporation stop, meter, meter setter, meter box with lid, pressure reducing valve (PRV) (as required), and service line as shown and detailed on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02222 - Excavation.

B. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

C. Section 02610 - Water Pipe and Fittings.

D. Section 02675 - Disinfection of Potable Water Pipe.

PART 2 - PRODUCTS

2.01 CORPORATION STOP

A. Corporation stops to be used with copper pipe (or polyethylene service pipe in copper pipe sizes) with compression type connections, where connected into PVC pipe, shall be the same, except with compression type outlet connections. Stops shall be Mueller Model H15008, Ford F-1000, or equal.

B. Corporation stops shall be factory tested to 150 psi to be compatible with the pipes in which they are installed.

2.02 WATER METERS

A. The potable water flow shall be monitored by a disc or piston type positive displacement meter. The flow shall be totalized at the meter body.

B. Characteristics are as follows:

Size:	5/8 inch x 3/4 inch
Flow Range:	3/4 inch - 2 to 30 gallons per minute (GPM)
Maximum Pressure Loss:	5/8 inch - 10.8 psi @ 20 GPM
Register Type:	Straight reading, hermetically sealed, magnetic drive
Registration:	
Capacity:	5/8 inch - 10 gallons or 1 cubic feet 5/8 inch - 1,000,000 gallons or 100,000 cubic feet
Maximum Operation Pressure	
Connection:	150 psi
Main Case:	As shown on the Drawings
Measuring Chamber:	Bronze
Piston:	Bronze
Strainer:	Hard rubber
Trim/Bolts:	Stainless steel or copper
Accuracy:	Stainless steel
Maximum Continuing Flow Rate:	Within 1.5 percent of through-put 5/8 inch - 10 GPM

C. Meters shall be Hersey Hotrod, Model # 430 (non integral), 3/4" x 5/8", Translator Register, IB, SG, TRL6, HR, HP . Three feet of wire shall be allowed to connect transmitter to meter. See attached data in Appendix A.

2.03 METER COPPER SETTERS

Meter setters shall be iron meter yoke, riser type, vertical inlet and outlet for copper pipe. They shall be 5/8-inch x 3/4-inch single or tandem Ford VBHH172-7W-3344 with dual check, Mueller 132404-2-67-7 with dual check, or equal. **The dual check valves must be manufactured in the setter in a vertical position so that access to the valve is from the top.** A master lock No. 1, Model #2085 shall be provided with each setter. The key shall match Owner's existing key.

2.04 METER BOX

A. Meter box shall be a polyvinyl chloride (PVC) or polyethylene (PE) box 18 inches in diameter x 30 inches deep (inside dimensions) and include a cast iron hinged reader lid. The box shall be able to withstand 1,200 pounds compression. The box shall be used for both single and tandem setters.

B. The meter box shall be equal to the Sonoloc as manufactured by Sonoco Products or MS Meter Box by Mid-States Plastics. The cast iron lid shall be equal to the 18-inch meter box cover, Model 6150 as manufactured by Tyler Pipe and shall read "Water Meter" on top of the lid.

2.05 SADDLES

Saddles shall be brass for PVC pipe equal to Ford S70 or Mueller H13000 Series.

2.06 POLYETHYLENE SERVICE PIPE AND FITTINGS

A. Polyethylene flexible pipe for sizes 1/2-inch through 2-inch water service piping shall be PE 3408, SDR-9, OD Base for 200 psi working pressure at 73.4^0 F, meeting latest edition of ASTM Specification D 2737 for material. Pipe shall be in copper tubing sizes (CTS).

B. Pipe shall meet all applicable provisions of the Commercial Standards and shall bear the National Sanitation Foundation (NSF) seal of approval.

C. Fittings shall be standard bronze fittings in copper tubing sizes and manufactured by Ford or Mueller.

2.07 PRESSURE REDUCING VALVE (PRV)

Pressure reducing valves for water service shall be single seated for dead-end or continuous service. Size 3/4-inch shall have bronze bodies with screwed ends. The cup packing and valve seat shall be of high grade leather; the diaphragm of nylon-inserted neoprene. The valves shall be equal to Wilkins #600 or Watts Regulator Series US No. 35130.

2.08 MASTER METERS

Master meters (3" and 4") shall be Hersey Horizon horizontal turbine meters. See attached data in Appendix A.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All service connection accessories shall be installed in the locations shown, true to alignment and rigidly supported.

B. After installation, all service connection accessories shall be tested at least one hour at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the Engineer.

C. All materials shall be carefully inspected for defects in workmanship and materials; all debris and foreign material cleaned out of valve openings, etc.; all operating mechanisms operated to check their proper functioning, and all fittings checked for tightness. Accessories which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.

3.02 INSPECTION AND TESTING

All service connection accessories shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected, device replaced or otherwise made acceptable to the Engineer.

END OF SECTION 02660

SECTION 02675 - DISINFECTION OF POTABLE WATER PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material and water necessary to disinfect the potable water pipe as shown on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

B. Section 02610 - Water Pipe and Fittings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 DISINFECTION OF WATER MAINS

A. All water pipe shall be disinfected by the use of chlorine or chlorine compound in such amounts as to produce a concentration of at least 50 ppm and a residual of at least 25 ppm at the end of the twenty-four (24) hours. Pipes shall be thoroughly flushed upon meeting the chlorine residual requirements. Before the pipes are placed in service, samples of the water must be taken by the Contractor and submitted to the State Department of Health for testing. No pipes shall be placed in service until the samples have been approved by the Health Department. The Contractor shall bear all the cost of sampling, testing, and postage. The cost of the disinfection and sampling shall be included in the unit price of the pipe.

B. Copies of the results of the testing shall be submitted to the Owner and/or Engineer.

END OF SECTION 02675

SECTION 02731 - GRAVITY SEWERS

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install gravity sewer piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 02222 - Excavation.

B. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.

C. Section 02733 - Sewage Pump Station.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile Iron (DI) Pipe:

1. Ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151) (latest revision). The pipe shall be designed for an internal working pressure of 150 psi and external loading based on flat bottom trenches without blocks and untamped backfill laying conditions. The pipe shall have a minimum pressure class of 150 psi.
2. Fittings shall be ductile iron fittings in accordance with AWWA C153.
3. Joints shall be push-on type or mechanical joint type conforming to ANSI A21.11 (AWWA C111). Unless specifically required at designated locations by the Drawings, the type of joint used is optional.

    a. Push-on joints shall have an annular recess in the pipe socket to accommodate a single rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is located in place against displacement as the joint is assembled.
    b. Mechanical joints shall be bolted and of the stuffing box type and shall consist of a bell with exterior flange and interior recess for the sealing gasket, a pipe or fitting plain end, a sealing gasket, a follower gland, tee-head bolts and hexagon nuts.

4. All ductile iron pipe and fittings shall have the manufacturer's outside asphaltic coating and an interior lining of ceramic epoxy (no cement interior lining). The ceramic epoxy lining shall be a high build multi-component amine cured Novalac epoxy polymeric coating/lining equal to the Protecto 401 as manufactured by Vulcan Painters, Inc. of Birmingham, AL. The coating/lining shall have a permeability rating in accordance with Method A of ASTM E-96-66. The surface preparation shall remove all loose laitance, form oils, and other loose materials and include a "brush blast" per SSPC SP-7. The coating and lining shall be applied in accordance with the manufacturer's requirements and have a minimum dry film thickness of 40 mils.
5. Pipe shall be furnished in lengths of 16, 16.5, 18, and 20 feet nominal laying lengths. The weight of any single pipe shall not be less than the tabulated weight by more than 5 percent for pipe 12 inches or smaller in diameter, not by more than 4 percent for pipe larger than 12 inches in diameter.
6. The net weight, class or nominal thickness and sampling period shall be marked on each pipe. The pipe shall also be marked to show that it is ductile iron.
7. Pipe shall be as manufactured by U.S. Pipe & Foundry Company, American Cast Iron Pipe Company, or equal.

B. Polyvinyl Chloride (PVC) Pipe:

1. Solid Wall PVC Pipe (SDR 35):

   a. PVC pipe and fittings less than 15 inches in diameter shall conform to the requirements of ASTM Standard Specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, Designation D 3034. Pipe and fittings shall have a minimum cell classification of 12454B or 12454C as defined in ASTM D-1784. All pipe shall have a pipe diameter to wall thickness ratio (SDR) of a maximum of 35.
   b. PVC pipe and fitting with diameters 18-inch through 27-inch shall conform to the requirements of ASTM D-1784 and ASTM F-679. Pipe and fittings shall have a minimum cell classification of 12454C. The minimum wall thickness shall conform to T-1 as specified in ASTM F-679.
   c. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D 3212 and F 477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
   d. Pipe shall be furnished in lengths of not more that 13 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length

e. PVC pipe shall not have a filler content greater than ten percent (10%) by weight relative to PVC resin in the compound.

f. PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the legend "Type PSM SDR 35 PVC Sewer Pipe" and the designation "ASTM D 3034", or "ASTM F-679". Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", "PSM" and the designation "ASTM D 3034", or "ASTM F-679".

g. PVC pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5 percent vertical ring deflection and tested in accordance with ASTM D-2412.

h. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2321 latest revision.

i. Pipe shall be as manufactured by H & W Pipe Company, or equal.

2. Corrugated Wall PVC Pipe with Smooth Interior:

a. Corrugated PVC pipe and fittings shall conform to the requirements of ASTM F-949. Pipe and fittings shall have a minimum cell classification of 12454B or 12454C as defined in ASTM D-1784.

b. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D 3212 and F 477. The gaskets shall be double sealed so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial waste, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.

c. Corrugated PVC pipe shall be furnished in lengths of 13 or 20 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length.

d. Corrugated PVC pipe shall have a smooth interior.

e. PVC pipe shall not have a filler content greater than ten percent (10%) by weight relative to PVC resin in the compound.

f. Corrugated PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the plastic "PVC", the designation "ASTM F-949", and extrusion code, including date and location of manufacture. Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", and the designation "ASTM F-949".

g. Corrugated PVC pipe shall have a minimum stiffness of 50 psi when measured at 5 percent vertical ring deflection (tested in accordance with ASTM D-2412), as defined in ASTM F-949.

h. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2321 latest revision.

i. Corrugated PVC pipe shall be A2000 as manufactured by Contech Construction Products, Inc. or approved equal.

C. Truss Pipe:

1. Truss pipe and fittings shall conform to the requirements of ASTM D-2680.
2. The thermoplastic material shall be rigid PVC plastic and shall be in accordance with ASTM D-1784. PVC plastic shall be manufactured with minimum cell classification of 12454B or 12454C.
3. The truss annulus shall be filled with cement pearlite concrete (or other inert filler material exhibiting the same degree of performance as cement pearlite concrete) to form a semi-rigid composite pipe.
4. Truss pipe and fittings shall have a minimum stiffness of 200 psi for each diameter when measured at 5 percent vertical ring deflection and tested in accordance with ASTM D-2412.
5. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D-3212 and F-477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use. **No solvent cement joints shall be allowed.**
6. All field cutting of pipe shall be done in a neat, trim manner using a hand saw per manufacturer's recommendations. Care shall be taken to protect the filler material. All field cuts shall be sealed according to manufacturer's recommendations.
7. Pipe shall be furnished in lengths of not more than 13 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length.
8. PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the legend "PVC Composite Pipe", the designation "ASTM D-2680", and the extrusion code, including date and location of manufacture. Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", and the designation "ASTM D-2680".
9. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2680 latest revision.
10. Truss pipe shall be PVC truss pipe as manufactured by Contech Construction Products, Inc. or an approved equal.

D. Reinforced Concrete Pipe:

1. All reinforced concrete pipe shall conform to the requirements of ASTM C76-89. Class shall be as shown on the Drawings.
2. Joints shall be bell and spigot type using Forsheda 138 or Forsheda 103 gaskets (or equal) and shall conform to ASTM C443.
3. The pipe shall be furnish in standard lengths of 8 feet to 16 feet.
4. The pipe shall be permanently marked showing the nominal inside diameter, manufacture date, ASTM C76 class, and manufacturer's name. These markings for 30-inch diameter and larger shall be inscribed on the pipe exterior and stencilled on the interior with paint or permanent ink.
5. There shall be no lift holes.
6. Pipe shall be as manufactured by Independent Concrete Pipe Company or an approvable equal.
7. Coating and Lining:

    a. All concrete pipe shall be coated and lined at the pipe manufacturer's plant.
    b. The exterior coating and interior lining shall be a high build multi-component Amine cured Novalac epoxy polymeric coating/lining equal to the Protecto 401 as manufactured by Vulcan Painters, Inc. of Birmingham, AL.
    c. The coating/lining shall have a permeability rating in accordance with Method A of ASTM E-96-66.
    d. The surface preparation shall remove all loose laitance, form oils, and other loose materials and include a "brush blast" per SSPC.
    e. The coating and lining shall be applied in accordance with the manufacturer's requirements and have a minimum dry film thickness (DFT) of:

        (1) Exterior Coating: 25 mil DFT.
        (2) Interior Coating: 40 mil DFT.

8. Connection of existing and proposed sewer lines to the reinforced concrete pipe shall be accomplished by the following methods:

    a. Precast concrete fittings with joints using Forsheda 138 or Forsheda 103 gaskets (or equal) conforming to ASTM C443, or
    b. Core drilling the reinforced concrete pipe and installing a KOR-N-TEE Model 1200 GP flexible watertight connector (or equal) as manufactured by KOR-N-SEAL. Connector shall be made of EPDM rubber. All hardware shall be 304 stainless steel.

E. High Density Polyethylene Pipe:

1. Material: The polyethylene pipe shall be high performance, high molecular weight, high density polyethylene pipe equal to Driscopipe 1000 as manufactured by Phillips Driscopipe, Inc., Richardson, TX, conforming to ASTM D 1248 (Type III, Class C, Category 5, Grade P34). Minimum cell classification values shall be 3 4 5 4 3 4 C as referenced in ASTM D 3350.
2. Physical Properties of Pipe Compound:

    a. Density - The density shall be no less than 0.941 - 0.955 gm/cm^3 as referenced in ASTM D 1505.
    b. Melt Flow - Flow rate shall not be greater than 0.14gm/10 min when tested in accordance with Method D1238 - Condition E.
    c. Flex Modulus - Shall be 120,000 to less than 160,000 psi as referenced in ASTM D 790.
    d. Tensile Strength at Yield - Shall be 3000 - to less than 3500 psi as referenced in ASTM 638.
    e. ESCR - The stress crack resistance shall be in excess of 1000 hours with less than 20 percent failure when tested in accordance with ASTM D 1693 Condition C.
    f. Hydrostatic design shall be 1600 psi at 23° C when tested in accordance with ASTM 2837.
3. Owner may request certified lab data to verify the physical properties of pipe or may take random samples and have them tested at an independent laboratory.
4. Rejection: Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this Specification.
5. Rating: The polyethylene pipe shall have a manufacturer's recommended hydrostatic design stress rating of 800 psi based on a material with a 1600 psi design basis determined in accordance with ASTM D-2837. Standard method for obtaining hydrostatic design basis for thermoplastic pipe materials.
6. Dimensions: The polyethylene sewer pipe to be nominal I.P.S. with a wall thickness minimum of SDR-32.5. The pipe shall be nominal I.P.S. size.

PART 3 - EXECUTION

3.01 PIPE LAYING

A. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the Drawings. The pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. Pipe shall be fitted and matched so that when laid in the trench, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.

B. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure its being clean. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and beveled to match the factory bevel for insertion into gasketed joints. Bevel can be made with hand or power tools.

C. The interior of the pipe, as the work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell so as to exclude earth or other material and precautions taken to prevent flotation of pipe by runoff into trench.

D. All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of flow.

3.02 JOINTING

All joint surfaces shall be cleaned immediately before jointing the pipe. The bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. All pipe shall be provided with home marks to insure proper gasket seating. Details of gasket installation and joint assembly shall follow the direction of the manufacturer's of the joint material and of the pipe. The resulting joints shall be watertight and flexible. **No solvent cement joints shall be allowed.**

3.03 UTILITY CROSSING CONCRETE ENCASEMENT

A. At locations shown on the Drawings, required by the Specifications, or as directed by the Engineer, concrete encasement shall be used when the clearance between the proposed sanitary sewer pipe and any existing utility pipe is 18 inches or less. Utility pipe includes underground water, gas, telephone and electrical conduit, storm sewers, and any other pipe as determined by the Engineer.

B. There are two cases of utility crossing encasement. Case I is applicable when the proposed sanitary sewer line is **below** the existing utility line. Case II is applicable when the proposed sanitary sewer line is laid **above** the utility line. In either case, the concrete shall extend to at least the spring line of each pipe involved.

C. Concrete shall be Class B (3000 psi) and shall be mixed sufficiently wet to permit it to flow between the pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.

D. Concrete for this Work is not a separate pay item and will be considered incidental to utility pipe installation.

3.04 TESTING OF GRAVITY SEWER LINES

A. After the gravity piping system has been brought to completion, and prior to final inspection, the Contractor shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole, appropriate tools for the removal from the line of any and all dirt, debris, and trash. If necessary during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris and trash.

B. During the final inspection, the Engineer will require all flexible sanitary sewer pipe to be mandrel deflection tested after installation.

1. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) evenly spaced arms of prongs. The mandrel dimension shall be 95 percent of the flexible pipe's published ASTM average inside diameter. Allowances for pipe wall thickness tolerances of ovality (from shipment, heat, shipping loads, poor production, etc.) shall not be deducted from the ASTM average inside diameter, but shall be counted as part of the 5 percent allowance. The contact length of the mandrel's arms shall equal or exceed the nominal diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance " 0.001 inch.
2. The mandrel inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade provided, in the opinion of the Engineer, sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. Short-term (tested 30 days after installation) deflection shall not exceed 5 percent of the pipe's average inside diameter. The mandrel shall be hand pulled by the contractor through all sewer lines. Any sections of the sewer not passing the mandrel test shall be uncovered and the Contractor shall replace and recompact the embedment backfill material to the satisfaction of the Engineer. These repaired sections shall be retested with the go/no-go mandrel until passing.
3. The Engineer shall be responsible for approving the mandrel. Proving rings may be used to assist in this. Drawings of the mandrel with complete dimensioning shall be furnished by the Contractor to the Engineer for each diameter and type of flexible pipe.

C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made. All apparatus and equipment required for testing shall be furnished by the Contractor and the cost shall be included in the unit price bid for pipe and manholes.

1. The Engineer may require the Contractor to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Engineer.
2. Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or low pressure air tests on the completed pipeline.
3. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or low pressure air tests on the completed pipeline.

D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig.

1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The Engineer or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these Specifications.
2. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.
4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe in Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
30 & larger	13.5

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.
6. Reinforced concrete pipe shall be tested in accordance with ASTM C 924 (joint testing shall be in accordance with ASTM C 1103). Test time shall be a function of pipe diameter and the length of installed line to be tested as provided in ASTM C 924.

E. Infiltration tests shall be made after underdrains, if present, have been plugged and other groundwater drainage has been stopped such that the groundwater is permitted to return to its normal level insofar as practicable.

1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including manholes, tees and connections, shall not exceed 200 gallons per nominal inch diameter per mile of sewer per 24 hours.

F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces and wedges to secure the plugs against leakage resulting from the test pressure.

1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.

G. The Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The Contractor shall construct weirs or other means of measurements as may be necessary.

H. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.

I. If in the judgement of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

3.05 INSTALLATION OF HDPE PIPE

A. Construction Practices:

1. Handling Pipe:

   a. Pipe shall be stored on clean level ground to prevent undue scratching or gouging.
   b. Sections of pipe with deep cuts or gouges in excess of 10 percent of the wall thickness shall be removed completely and the ends of pipeline rejoined.
   c. The handling of the joined pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.

2. Pipe Joining:

   a. Sections of the polyethylene pipe shall be joined into continuous lengths on the job site above the ground. The joining method shall be the butt fusion method and shall be done in strict accordance with the pipe manufacturer's recommendation.
   b. The hydraulically operated machines shall have a pressure regulator to preset the correct pressure for the desired fusion force, and there shall be an auxiliary system to control "feed" rate for the pipe face-off. Each machine shall be permanently equipped with a chart showing correct fusion pressure for each pipe size and wall thickness (SDR).

3. Direct Burial Installation:

   a. The trench and trench bottom shall be constructed in accordance with the Drawings.
   b. Embedment materials to be used shall be as recommended in ASTM D-2321-74, Section 6.
   c. The proper bedding practices to be followed shall be subject to those described in ASTM D-2321-74, Section 8.
   d. Installation practices shall be those specified in ASTM D-2321-74, Section 9.

END OF SECTION 02731

SECTION 02735 - MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to construct manholes for sanitary sewers, including steps, frames and covers, together with all appurtenances as shown and detailed on the Drawings and specified herein. Manhole materials shall be precast concrete or high density polyethylene (HDPE).

1.02 RELATED WORK

A. Section 02731 - Gravity Sewers.

B. Division 3 - Concrete.

1.03 DEFINITIONS

A. Standard Manhole: A standard manhole is defined as any manhole that is greater than 4 feet in depth, as measured from the invert of the manhole base at its center to the bottom of the manhole frame.

B. Shallow Manhole: A shallow manhole is defined as any manhole that is 4 feet or less in depth, as measured in the preceding sentence.

PART 2 - PRODUCTS

2.01 CONCRETE MANHOLES - GENERAL

A. Manholes shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the Drawings or bound in the Specifications.

B. All concrete manholes shall have precast reinforced concrete developed bases. No other type of base will be allowed. Invert channels shall be factory constructed when the base is made. Sloping invert channels shall be constructed whenever the difference between the inlet and outlet elevation is 2 feet or less.

C. The concrete manhole walls (barrels and cones) shall be precast concrete sections. The top of the cone shall be built of reinforced concrete adjustment rings to permit adjustment of the frame to meet the finished surface. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.

D. For concrete manholes, the inverts of the developed bases shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines.

E. For concrete manholes, the cast-iron frames and covers shall be the standard frame and cover as indicated on the Drawings and specified hereinafter in this Section.

F. Manholes shall be manufactured by Sherman Dixie Concrete Industries, or approved equal.

2.02 PRECAST CONCRETE SECTIONS

A. Precast concrete sections and appurtenances shall conform to the ASTM Standard Specifications for Precast Reinforced Concrete Manhole Sections, Designation C478, latest revision, with the following exceptions and additional requirements.

B. The base section shall be monolithic for 4-foot diameter manholes. Manholes with diameter of 5 feet or larger shall have base slab.

C. The wall sections shall be not less than 5 inches thick.

D. Type II cement shall be used except as otherwise permitted.

E. Joints between sections shall be made watertight through the use of rubber 0-ring gaskets or rubber profile gaskets such as Forsheda 138. Gaskets shall conform to the ASTM Standard C-443, latest revision. Rope mastic or butyl mastic sealant will not be allowed except as noted in Article 2.02 F.

F. Butyl mastic sealant shall be installed between the cone section, any adjusting sections or rings, and casting.

2.03 CONCRETE MANHOLE - FRAMES AND COVERS

A. The Contractor shall furnish all cast-iron manhole frames and covers conforming to the details shown on the Drawings, or as herein before specified.

B. The castings shall be of good quality, strong, tough, evengrained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.

C. All casting shall be thoroughly cleaned and subject to a careful hammer inspection.

D. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications

for Gray Iron Casting, Designation A48, latest revision.

E. Unless otherwise specified, manhole covers shall be 22-3/4 inches in diameter, weighing not less than 350 pounds per frame and cover. Manhole covers shall set neatly in the rings, with contact edges machined for even bearings and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The covers shall have two (2) pick holes about 1-1/4 inches wide and 1/2 inches deep with 3/8-inch undercut all around. Covers shall not be perforated. Frames and covers shall be J.R. Hoe and Sons, Mc-350, or approved equal.

F. All covers shall be marked in large letters "SANITARY SEWER" in the center.

2.04 MANHOLE STEPS (CONCRETE MANHOLES)

Manholes steps shall be the polypropylene plastic type reinforced with a deformed steel rod. The steps shall be of the size and configuration as shown on the Drawings. Steps shall line up over the downstream invert of the manhole. The steps shall be embedded into the manhole wall a minimum of 3-3/8 inches. Steps shall be uniformly spaced at 12-inch to 16-inch intervals.

2.05 PREMOLDED ELASTOMERIC-SEALED JOINTS

All holes for pipe connections in concrete barrels and bases shall have a factory-installed flexible rubber gasket to prevent infiltration. The manhole boots shall conform to the latest revision of ASTM-C973. The boots shall be Contour Seal or Kor-N-Seal made by National Pollution Control Systems, Inc., Nashua, NH; A-Lok Manhole Pipe Seal made by A-Lok Corporation, Trenton, NJ; or an approved equal.

2.06 HDPE MANHOLES

A. The HDPE manholes shall be manufactured from high density, high molecular weight polyethylene and have a PPI listing as a PE 340R material. Using ASTM D 3350, the pipe resin shall be a cell classification of 3 4 5 4 3 4 C.

B. The HDPE manholes shall have a cone-shaped traffic cap and cover made of the same materials as the manholes.

C. Pipe connections to the HDPE manholes shall be with flexible couplings and stainless steel clamps.

D. All HDPE manholes shall be fabricated to be installed with precast concrete anchors and anti-flotation rings. The HDPE manhole manufacturer shall determine the type, location and size of anchors and/or antiflotation rings if manhole is fully submerged in ground water.

E. The HDPE manholes shall be one piece construction for heights beneath the traffic cones of 12 feet or less.

F. All HDPE manholes shall be "topped" with a cone-shaped traffic cap and manufactured from the same materials as the manhole. Except in non-traffic areas, the manhole top elevation shall be 3 to 5 inches above existing grade.

G. Covers/lids for the HDPE shall be manufactured from the same materials as the manhole and shall be designed to support the potential wheel loads (design basis shall be similar to the CI manhole cover).

H. The manholes shall be manufactured without lifting holes and ladders (steps).

I. All HDPE shall be manufactured by Phillips Driscopipe or an approved equal.

2.07 POLYETHYLENE DIAPHRAGM

A. Polyethylene diaphragm manhole inserts shall be manufactured from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and diluted sulfuric acid. Diaphragm shall be installed in manholes susceptible to inflow as indicated on the Drawings.

B. The body of the manhole insert shall be made of high density polyethylene copolymer material meeting ASTM Specification D 1248, Class A, Category 5, Type III (the insert shall have a minimum impact brittleness temperature of -180 degrees fahrenheit). The thickness shall be uniform 1/8 inches or greater. The manhole insert shall be manufactured to dimensions as shown on the Drawings to allow easy installation within the manhole frame.

C. Gaskets shall be made of closed cell neoprene. The gasket shall have a pressure sensitive adhesive on one side and shall be placed under the weight bearing surface of the insert by the manufacturer. The adhesive shall be compatible with the manhole insert material so as to form a long lasting bond in either wet or dry conditions.

D. Lift strap shall be attached to the rising edge of the bowl insert. The lift strap shall be made of 1 inch wide woven polypropylene web and shall be seared on all cut ends to prevent unraveling. The lift strap shall be attached to the manhole insert by means of a stainless steel rivet. Location of the lift strap shall provide easy visual location.

E. Standard ventilation shall be by means of vent hole on the side wall of the manhole insert approximately 3/4-inches below the lip. The vent hole will allow a maximum release of 10 gallons per 24 hours when the insert is full.

F. The manhole insert shall be manufactured to fit the manhole frame rim upon which the manhole cover rests. The Contractor is responsible for obtaining

specific measurements of each manhole cover to insure a proper fit. The manhole frame shall be cleaned of all dirt, scale and debris before placing the manhole insert on the rim.

2.08 CLEANOUTS

Cleanouts shall be extended to finish grade and capped with a clean-out plug in accordance with details and at locations shown on the Drawings. Pipe shall be the same as the gravity sewer line in which the cleanout is located. A 4-inch thick concrete pad, 2 feet 0-inches square, with the valve box lid section, shall be provided around each cleanout.

2.09 DROP CONNECTIONS

Drop connections shall be installed in the manhole as shown on the Drawings.

PART 3 - EXECUTION

3.01 FABRICATION - PRECAST SECTIONS

A. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast.

B. Sections shall be cured in an enclosed curing area and shall attain a strength of 4,000 psi prior to shipment.

C. No more than two (2) lift holes or inserts may be cast or drilled in each section.

D. Flat slab tops shall have a minimum thickness of 6 inches and reinforcement in accordance with ASTM C478.

E. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the precast sections.

F. Acceptance of the sections will be on the basis of material tests and inspection of the completed product and test cylinders if requested by the Engineer.

G. Cones shall be precast sections of similar construction.

3.02 SETTING PRECAST MANHOLE SECTIONS

A. Precast-reinforced concrete manhole sections shall be set so as to be vertical and with sections and steps in true alignment.

B. Rubber gaskets shall be installed in all manhole joints in accordance with the

manufacturer's recommendations.

C. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose.

3.03 ADJUSTING MANHOLE FRAMES AND COVERS TO GRADE

A. Except where shown on the Drawings, the top of the precast concrete eccentric cone of a standard manhole or the top of the flat slab of a shallow manhole shall terminate 4 inches below existing grade in an unpaved non-traffic area except in a residential yard and 13 inches below existing grade in a paved or unpaved traffic area and in a residential yard. The remainder of the manhole shall be adjusted to the required grade as described hereinafter in paragraphs B and C of this article.

B. When a manhole is located in an unpaved non-traffic area other than in a residential yard, the frame and cover shall be adjusted to an elevation 3 inches to 5 inches above the existing grade at the center of the cover. If field changes have resulted in the installed manhole invert elevation to be lower than the invert elevation shown on the Drawings, the adjustment to an elevation of 3 inches to 5 inches above existing grade shall be accomplished by the use of precast concrete rings. If field changes have resulted in the completed manhole invert to be greater than the invert shown on the Drawings and the cover higher than 5 inches above existing grade, then the top of the eccentric cone, when used, or the top of the barrel section, when used, shall be trimmed down so that the manhole cover, after installation, is no greater than 5 inches above existing grade at the center of the cover. The area around the adjusted frame and cover shall be filled with the required material, sloping it away from the cover at a grade of 1 inch per foot.

C. When a manhole is located in a bituminous, concrete, or crushed stone traffic area, or in a residential yard, the frame and cover shall be adjusted to the grade of the surrounding area by the use of precast concrete rings. The adjusted cover shall conform to the elevation and slope of the surrounding area. If field changes have resulted in the installed manhole invert elevation to be so much higher than the invert elevation shown on the Drawings that the top of the eccentric cone, when used, or the top of the flat slab, when used, is less than the thickness of the frame and cover 7 inches from the grade of the surrounding area, then the top of the cone or barrel section shall be trimmed down enough to permit the cover, after installation, to conform to the elevation and slope of the surrounding area. After installation, the inside and outside surfaces of the brick shall receive a waterproofing bitumastic coating.

1. The Contractor shall coordinate elevations of manhole covers in paved streets with the Owner. If resurfacing of the street in which sewers are laid is expected within twelve (12) months, covers shall be set 1-1/2 inches above the existing pavement surface in anticipation of the resurfacing operations.

3.04 ADJUSTING SECTIONS

Only clean adjusting sections shall be used. Each adjusting section shall be laid in a bead of butyl mastic sealant and shall be thoroughly bonded.

3.05 SETTING MANHOLE FRAMES AND COVERS

A. Manhole frames shall be set with the tops conforming to the required elevations set forth herein before. Frames shall be set concentric with the top of the concrete and in a full bead of butyl mastic sealant so that the space between the top of the masonry and the bottom flange of the frame shall be completely watertight.

B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

3.06 VACUUM TESTING OF MANHOLES

A. Manholes shall be tested after installation with all connections in place.

1. Lift holes, if any, shall be plugged with an approved, non-shrinkable grout prior to testing.
2. Drop connections shall be installed prior to testing.
3. The vacuum test shall include testing of the seal between the cast iron frame and the concrete cone, slab or grade rings.
4. The manholes shall be backfilled and finished to design grade.

B. Testing Procedure:

1. Temporarily plug, with the plugs being braced to prevent the plugs or pipes from being drawn into the manhole, all pipes entering the manhole at least eight inches into the sewer pipe(s). The plug must be inflated at a location past the manhole/pipe gasket.
2. The test head shall be placed inside the frame at the top of the manhole and inflated, in accordance with the manufacturer's recommendations.
3. A vacuum of 10 inches of mercury shall be drawn on the manhole. The valve on the vacuum line to the manhole shall be shut and the vacuum line disconnected.
4. The pressure gauge shall be liquid filled, having a 3.5 inch diameter face with a reading from zero to thirty inches of mercury.
5. The manhole shall be considered to pass the vacuum test if it holds at least 9 inches of mercury for the following time durations:

	Time (Minutes)		
Manhole Depth	4' Dia.	5' Dia.	6' Dia.
20 feet or less	1	2	3
20.1 to 30 feet	2	3	4

6. If a manhole fails the vacuum test, the manhole shall be repaired with a non-shrinkable grout or other suitable material based on the material of which the manhole is constructed and retested, as stated above.
7. All temporary plugs and braces shall be removed after each test.

END OF SECTION 02735

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Formwork.

B. Reinforcing Steel.

C. Expansion and Contraction Joints.

D. Concrete.

1.02 RELATED REQUIREMENTS

A. Section 00700 - General Conditions.

B. Section 02222 - Excavation.

1.03 REFERENCES

A. ACI 350R-89 Environmental Engineering Concrete Structures.

B. ACI318 - Building Code Requirements for Reinforced Concrete.

C. ACI347 - Recommended Practice for Concrete Formwork.

D. CRSI - Manual of Standard Practice.

E. CRSI - Placing Reinforcing Bars.

F. ASTM - A-615, A-616, A-617, A-120, A-185, C-31, C-39

1.04 SUBMITTALS

The Contractor shall submit the following data to the Engineer for review:

1. Mix designs for all mixes proposed or required to be used, including all mixes containing admixtures.
2. Certification by the manufacturer that cement meets the Specification contained herein.
3. Shop drawing for reinforcing steel showing bar schedules, location, and splices.
4. Reports on laboratory compression tests of cylinders taken during concrete

placement.

PART 2 - PRODUCTS

2.01 CLASSES OF CONCRETE AND USAGE

A. Structural concrete of the various classes required shall be proportioned to produce the following 28-day compressive strengths:

1. Selection of Proportions for 4,000 psi Concrete:

   a. 4,000 psi compressive for strength at 28 days.
   b. Type I cement plus air.
   c. Maximum water/cement ratio - 0.50.
   d. Minimum cement content - 564 lbs. (6.0 bags)/cubic yard concrete.
   e. Nominal maximum size coarse aggregate - No. 67 (3/4-inch maximum) or No. 57 (1-inch maximum).
   f. Air content - 5% plus or minus 1% by volume.
   g. Slump - 4 inches in accordance with ASTM C-143.

2. Selection of Proportions for 3,000 psi Concrete:

   a. 3,000 psi compressive strength at 28 days.
   b. Type I cement plus air.
   c. Maximum water/cement ratio - 0.56.
   d. Minimum cement content - 470 lbs. (5.0 bags)/cubic yard concrete.
   e. Nominal maximum size coarse aggregate - No. 67 (3/4-inch maximum) or No. 57 (1-inch maximum).
   f. Air content - 5% plus or minus 1% by volume.
   g. Slump - 4 inches in accordance with ASTM C-143.

B. Concrete shall be used as follows:

1. 4,000 psi concrete for all concrete work except as noted below.
2. 3,000 psi concrete for encasement of sanitary sewers and thrust blocking.

C. All testing of aggregates and determination of proportions shall be or have been performed by a recognized independent testing laboratory.

D. Cement for exposed concrete shall have a uniform color classification.

E. Type I cement conforming to ASTM C-150 shall be used in all concrete.

F. Coarse aggregate shall be crushed stone having clean, hard, uncoated particles, and shall be free from injurious amount of soft, friable, thin, elongated or laminated pieces.

Coarse aggregates shall conform to all requirements of ASTM C-33.

G. Fine aggregates shall be natural sand having clean, hard, uncoated grains, free from injurious amounts of clay, dust, organic matter or other deleterious substances, and shall conform to ASTM C-33.

H. Water for concrete shall be clean, fresh, and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

2.02 ADMIXTURES

A. An air-entraining admixture shall be used on all concrete and shall be the neutralized vinsol resin type such as Master Builders MB-VR, Euclid Chemical Company AIR-MIX or equal. The admixture shall meet the requirements of ASTM C-260.

B. Admixtures shall be used in concrete design mixes in the same manner and proportions as in the field so that the effects of the admixtures are included in preliminary test submitted to the Engineer for review prior to the start of construction.

2.03 REINFORCEMENT

A. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A-615, A-616, or A-617. All bar reinforcement shall be deformed.

B. Welded wire fabric shall conform to ASTM A-185 and shall be of weight and gauge as indicated on the Drawings.

C. Reinforcement supports and other accessories in contact with the forms for members which will be exposed to view in the finished work shall be of stainless steel or shall have approved high-density polyethylene tips so that the metal portion shall be at least one-quarter of an inch from the form or surface. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast stone concrete blocks.

2.04 FORMS

A. Forms shall be of suitable material, design, and construction so as to be rigid, tight enough to prevent the passage of mortar, and plane surfaces with a tolerance of 1/16-inch in 4 feet.

B. For surfaces to be given burlap-rubbed finish, the form surface in contact with the concrete shall be made of heavy gauge metal, new plywood (used plywood which, in the opinion of the Engineer, is substantially equal to new plywood may be used), tempered wood fiberboards with smooth surface, or similar materials. Metal forms or form linings shall have square edges so that the concrete will not have fins or fluting. Forms shall not be pieced out by use of materials different from those in the adjacent

form or in such manner as will detract from the uniformity of the finished surface.

C. For surfaces other than those to be given burlap-rubbed finish, forms shall be made of wood, metal, or other acceptable material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be reasonable good, as accepted. Metal forms shall be of an acceptable type for the work involved. Edges of forms in contact with concrete shall be flush within 1/16-inch.

D. Form for walls, columns, or piers shall have removable panels at the bottom for cleaning, inspection, and scrubbing-in of bonding grout. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete, unless special spouts are used to place concrete, and so that construction joints can be properly keyed and treated.

E. Forms for exposed surfaces shall be built with 3/4-inch chamfer strips attached to produce smooth, straight chamfers at all sharp edges of concrete.

F. Form ties to be encased in concrete shall not be made of through-bolts or common wire, but shall be of a well-established type, so made and installed as to embody the following features:

1. After removal of the protruding part of the tie, there shall be no metal nearer than 1 inch to the face of the concrete.
2. That part of the tie which is to be removed shall be at least 1/2-inch in diameter, or if smaller, it shall be provided with a wood or metal cone 1 inch long placed against the inside of the forms. Cones shall be carefully removed from the concrete after the forms have been stripped.
3. Ties which pass through walls subject to hydrostatic pressure shall be provided with acceptable water stops, such as washers, securely fastened to the ties.

2.05 OTHER MATERIALS

A. Anchorage items shall be of standard manufacture and of type required to engage with the anchors to be installed therein under other sections of the Specifications and shall be subject to approval by the Engineer.

B. Pre-molded expansion-joint filler strips shall conform to ASTM D-1752 and shall be 3/8-inch thick unless otherwise shown.

C. Joint sealants shall conform to ANSI 116.1. The following joint sealants are acceptable:

1. Colma by Sika Corporation.
2. Hornflex by A. C. Horn, Inc.
3. Sonolastic by Sonneborn Division of Contech, Inc.

D. Nonshrink grout shall be Embeco 636 grout by Master Builders Company, Euco Firmix grout by the Euclid Chemical Company, or equal. The approved product shall be delivered to the site of the work in the original sealed containers, each bearing the trade name of the material and the name of the manufacturer.

PART 3 - EXECUTION

3.01 FORMING

A. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions and to the elevations indicated on the Drawings or specified, and exposed concrete will be substantially free from board or grain marks, poorly matched joints, and other irregularities or defects.

B. Forms shall be sufficiently rigid to prevent displacement or sagging between supports, and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.

C. All falsework to support structural slabs, beams, girders, etc., shall be designed to safely and adequately support the concrete and forms during placement and curing. The adequacy and safety of the falsework shall be the sole responsibility of the Contractor.

D. All forms shall be oiled with an acceptable non-staining oil or liquid form coating before reinforcement is placed.

E. Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged places repaired, and all projecting nails withdrawn.

F. Except as otherwise specifically authorized by the Engineer, forms shall not be removed until the concrete has aged for the following number of days-degrees*:

1. Beams and slabs: 500 day-degrees.
2. Walls and vertical surfaces: 100 day-degrees.
3. *Day-degree: Total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily average temperature of 60 degrees F, equals 300 day-degrees.

G. Shores under beams and slabs shall not be removed until the concrete has attained at

least 60 percent of the specified compressive strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

3.02 PLACING REINFORCEMENT

A. Reinforcement shall be bent cold to the dimensions and shapes shown on the Drawings and within tolerances specified in the CRSI Manual of Standard Practice.

B. Before being placed in position, reinforcement shall be cleaned of loose mill and rust scale, dirt and other coatings that will interfere with development of proper bond.

C. Reinforcement shall be accurately placed in positions shown on the Drawings and firmly held in place during placement and hardening of concrete by using annealed wire ties. Bars shall be tied at all intersections except where spacing is less than one foot in both directions, then alternate intersections may be tied.

D. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers or other approved supports. Blocks for holding the reinforcement from contact with the forms shall be precast mortar blocks or approved metal chairs. Layers of bars will be separated by precast mortar blocks or other equally suitable devices; the use of pebbles, pieces of broken stone or brick, metal pipe and other such blocks will not be permitted. If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

E. Before any concrete is placed, the Engineer shall have inspected the placing of the steel reinforcement and given permission to deposit the concrete. Concrete placed in violation of this provision will be rejected and thereupon shall be removed.

F. Unless otherwise specified, reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the approval of the Engineer. Where splices are made, they shall be staggered insofar as possible.

3.03 TESTING AGGREGATES AND DETERMINING PROPORTIONS

A. No concrete shall be used in the work until the materials and mix design have been accepted by the Engineer.

B. The conformity of aggregates to the Specifications hereinbefore given shall be demonstrated and determined by tests per ASTM C-33 made with representative samples of the materials to be used on the work.

C. The actual proportions of cement, aggregates, admixtures and water necessary to

produce concrete conforming to the requirements set forth herein shall be determined by making test cylinders using representative samples of the materials to be used in the work. A set of four standard 6-inch cylinders shall be made and cured per ASTM C-31. Two shall be tested at 7 days and two at 28 days per ASTM C-39. The slump shall not be less than the greatest slump expected to be used in the work.

D. Reports on the tests and a statement of the proportions proposed for the concrete mixture, shall be submitted in triplicate to the Engineer for review as soon as possible, but not less than five days prior to the proposed beginning of the concrete work. If the Contractor furnishes in writing, similar, reliable detailed information from an acceptable source, and of date not more than four months prior to the time when concrete will be used on this project, the above requirements for laboratory test may be modified by the Engineer. Such data shall derive from mixtures containing constituents, including the admixtures where used, of the same types and from the same sources as will be used on this project.

E. The Engineer shall have the right to make check tests of aggregates and concrete, using the same materials, and to order changes as may be necessary to meet the specified requirements.

F. The Contractor may request permission to add water at the job site; and when the addition of water is permitted by the Engineer, the quantity added shall be the responsibility of the Contractor and in no case shall the total water per bag of cement exceed the ratio set forth herein.

G. If concrete of the required characteristics is not being produced as the work progresses, the Engineer may order such changes in proportions or materials or both, as may be necessary to secure concrete of the specified quality. The Contractor shall make such changes at his own expense and no extra compensation will be allowed because of such changes.

3.04 MIXING

A. All central-plant and rolling-stock equipment and methods shall conform to the Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready Mixed Concrete Association, as well as the ACI Standards for measuring, Mixing and Placing Concrete (ACI 614), and with the ASTM Standard Specification for Ready-Mixed Concrete, Designation C94, insofar as applicable.

B. Ready-mixed concrete shall be transported to the site in watertight agitator or mixer trucks. The quantity of concrete to be mixed or delivered in any one batch shall not exceed the rated capacity of the mixer or agitator for the respective conditions as stated on the nameplates.

C. Central-mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch,

and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the premixed concrete is placed in the truck and shall continue without interruption until discharge. For transit-mixed concrete the major portion of the mixing water shall be added and mixing started immediately after the truck is charged.

D. The amount of water initially added shall be recorded on the delivery slip for the Engineer's information; no additional water shall be added, either in transit or at the site, except as directed. Mixing (at mixing speed) shall be continued for at least 10 minutes followed by agitation without interruption until discharge. Concrete shall be discharged at the site within 1-1/2 hours after water was first added to the mix, and shall be mixed at least 5 minutes after all water has been added.

E. Concrete, which has become compacted or segregated during transportation to or in the site of the work, shall be satisfactorily remixed just prior to being placed in the forms.

F. Partially hardened concrete shall not be deposited in the forms. The re-tempering of concrete which has partially hardened (that is, the remixing of concrete with or without additional cement, aggregate, or water) will not be permitted.

3.05 COMPRESSION TESTS

A. During the progress of the work, at least one (1) set of four (4) compression test cylinders shall be made for each 50 cubic yards of concrete or major fraction thereof, and not less than one such set for each type of concrete for each day's pouring. Cylinders made in the field shall be made and cured in accordance with the ASTM Standard Method of Making and Curing Concrete Test Specimens in the Field, Designation C31, except that wherever possible molds shall be left on the cylinders until they have reached the laboratory. Testing services to satisfy the requirements of ACI shall be paid for by the Contractor at his expense. Testing lab must be approved by the Engineer.

B. One cylinder of each set shall be broken in accordance with ASTM C-39 at seven (7) days and the other two at twenty-eight (28) days. Two copies of these test results shall be submitted to the Engineer on the same day of the tests.

C. On evidence of these tests, any concrete that fails to meet the specified strength requirements shall be strengthened or replaced as directed by the Engineer at the Contractor's expense.

3.06 METALWORK IN CONCRETE

A. All trades shall be notified, at the proper time, to install items to be embedded in

concrete.

B. All castings, inserts, conduits, and other metalwork shall be accurately built into or encased in the concrete by the Contractor, as directed, and all necessary precautions shall be taken to prevent the metalwork from being displaced or deformed.

C. Anchor bolts shall be set by means of substantial templates.

3.07 PLACING AND COMPACTING CONCRETE

A. At least twenty-four (24) hours before the Contractor proposes to make any placement of concrete, he shall notify the Engineer of his intention and planned procedure. Unless otherwise permitted, the work shall be so executed that a section begun on any day shall be completed during daylight of the same day.

B. No concrete shall be placed on frozen sub grade or in water, or until the sub grade, forms, and preliminary work have been accepted. No concrete shall be placed until all materials to be built into the concrete have been set and have been accepted by the various trades and by the Engineer. All such materials shall be thoroughly clean and free form rust, scale, oil, or any other foreign matter.

C. Forms and excavations shall be free from water and all dirt, debris, and foreign matter when concrete is placed. Except as otherwise directed, wood forms and embedded wood called for or allowed shall be thorough wetted just prior to placement of concrete.

D. Concrete placed at air temperatures below 40 degrees shall have a minimum temperature of 50 degrees F. and a maximum of 70 degrees F. when placed.

E. Concrete shall be transported from the mixer to the place of final deposit as rapidly as practicable and by methods, which will prevent separation of ingredients and avoid re-handling.

F. Chutes for conveying concrete shall be metal or metal-lined and of such size, design, and slope as to ensure a continuous flow of concrete without segregation. The slope of chutes shall be not flatter than 1 on 2 and all parts of a chute shall have approximately the same slope. The discharge end of the chute shall be provided with a baffle, or, if required, a spout; and the end of the chute or spout shall be kept as close as practicable to, but in no event more than 5 feet above the surface of the fresh concrete. When the operation is intermittent, the chute shall discharge into a hopper.

G. In thin sections of considerable height (such as walls and columns), concrete shall be placed in such a manner as will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the mass of concrete being placed. To

achieve this end, suitable hoppers, spouts with restricted outlets, etc., shall be used as required or permitted unless the forms are provided with suitable openings.

H. Chutes, hoppers, spouts, etc., shall be thoroughly cleaned before and after each run and the water and debris shall not be discharge inside the form.

I. For any one placement, concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section, and so as to maintain, until the completion of the unit, an approximately horizontal, plastic surface.

J. No wooden spreaders shall be left in the concrete.

K. During and immediately after being deposited, concrete shall be thoroughly compacted by means of suitable tools and methods, such as internal-type mechanical vibrators operating at not less than 5,000 rpm., or other tool spading, to produce the required density and quality of finish. Vibration shall be done only by experienced operators under close supervision and shall be carried on in such a manner and only long enough to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents, "pumping" of air, or other objectionable results. All vibrators shall be supplemented by proper spade puddling approximately 2 to 3 inches away from forms to remove included bubbles and honeycomb. Excessive spading against the forms, causing the deposition of weak mortar at the surface, shall be avoided.

L. The concrete shall be thoroughly rodded and tamped about embedded materials so as to secure perfect adhesion and prevent leakage. Care shall be taken to prevent the displacement of such materials during concreting.

3.08 BONDING CONCRETE AT CONSTRUCTION JOINTS

A. In order to secure full bond at construction joints, the surface of the concrete previously placed (including vertical, inclined, and substantially horizontal areas) shall be thoroughly cleaned of foreign materials and laitance, if any, and then roughened.

B. The previously placed concrete at the joint shall be saturated with clean water and kept thoroughly wet overnight, after which all pools shall be removed. After free or glistening water disappears, the concrete shall be given a thorough coating of neat cement mixed to a suitable consistency. The coating shall be 1/8-inch thick on vertical surfaces and 1/4-inch thick on horizontal surfaces, and shall be well scrubbed in by means of stiff bristle brushes wherever possible. New concrete shall be deposited

before the neat cement dries.

3.09 CURING AND PROTECTION

A. All concrete, particularly slabs and including finished surfaces, shall be treated immediately after concreting or cement finishing is completed, to provide continuous moist curing for at least seven days, regardless of the adjacent air temperature. Walls and vertical surfaces may be covered with continuously saturated burlap, or kept moist by other acceptable means. Horizontal surfaces, slab, etc., shall be ponded to a depth of 1/2-inch wherever practicable, or kept continuously wet by the use of lawn sprinklers, a complete covering of continuously saturated burlap, or by other acceptable means.

B. For at least seven (7) days after having been placed, all concrete shall be so protected that the temperature at the surface will not fall below 45 degrees F.

1. No manure, salt, or other chemicals shall be used for protection.
2. Wherever practicable, finished slabs shall be protected form the direct rays of the sun to prevent checking and crazing.

3.10 TRIMMING AND REPAIRS

A. The Contractor shall use suitable forms, mixture of concrete, and workmanship so that concrete surfaces, when exposed, will require no patching.

B. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired.

C. Defective concrete shall be cut perpendicular to the surface until sound concrete is reached, but less than 1 inch deep. The remaining concrete shall be thoroughly roughened and cleaned. Concrete around the cavity or the form-tie recess shall be thoroughly wetted and promptly painted with a 1/16-inch brush coat of neat cement mixed to the consistency of lead paint. The hole shall then be filled with mortar.

1. Mortar shall be 1:1-1/2 cement and sand mix with sufficient white cement, or fine limestone screenings in lieu of sand, to produce a surface matching the adjoining work. Cement and sand shall be from the same sources as in the parent concrete.
2. For filling form-tie recesses, the mortar shall be mixed slightly damp to the touch (just short of "balling"), hammered into the recess until it is dense and an excess of paste appears on the surface, and then troweled smooth. Mortar in patches shall be applied so that after partial set it can be compressed and rubbed to produce a finish flush and uniform in texture with the adjoining work. All patches shall be warm-moist cured as above specified.

D. The use of mortar patching as above specified shall be confined to the repair of small defects in relatively green concrete. If substantial repairs are required, the defective portions shall be cut out to sound concrete and the masonry replaced by means of a cement gun, or the masonry shall be taken down and rebuilt, all as the Engineer may decide or direct.

3.11 SURFACE FINISH

A. Fins and irregularities on formed surfaces to receive no other finish shall be smoothed.

B. The top of concrete on which other concrete or unit masonry will later be placed shall be struck off true at the surface indicated on the Drawings or as permitted by the Engineer, as the concrete is being placed. As soon thereafter as the condition of the concrete permits and before it has hardened appreciably (normally within 2 hours after being deposited), all water, scum, laitance, and loose aggregate shall be removed from the surface by means of wire or bristle brooms in such a manner as to leave the coarse aggregate slightly exposed and the surface clean.

C. Concrete surfaces shall be finished as follows, except as otherwise required by various sections of the Specifications or shown on the Drawings.

1. Wood-float finish shall be given to all top, substantially horizontal, exposed surfaces.
2. Burlap-rubbed finish shall be given to all interior and exterior surfaces placed against forms, which will be exposed to view on completion of the work. (Finish shall be to one foot below ground and below normal liquid surface elevations).
3. All surfaces shaped without forms and over which liquids will flow shall be given a steel-trowel finish.
4. Concrete surfaces to which roof insulation or roofing are to be applied shall be finished sufficiently smooth to receive the roofing material, as obtained by steel trowel or very smooth wood-float finish.

3.12 METHOD OF FINISHING

A. Broomed Finish:

1. Surfaces to be given broomed finish shall first be given a steel-trowel finish. Immediately after troweling, the surface shall be lightly brushed in one direction with a hair broom to produce a non-slip surface of uniformly good appearance.

B. Wood-float Finish:

1. Surfaces to be given a wood-float finish shall be finished by tamping with

special tools to force aggregates away from the surface, and screening with straight edges to bring the surface to the required line.

2. As soon after the condition of concrete permits and before it has hardened appreciably, all water, film, and foreign material, which may work to the surface, shall be removed. Rough finishing shall be done with straight edges and derbies. Machine floating if used, shall not be started until the surface will support the float adequately without digging in and bringing excess fines to the surface. At such time, a minimum of machine and hand floating with a wood float shall be employed to bring the finish to a true and uniform surface with no coarse aggregate visible.
3. Under no circumstances will sprinkling with water or dusting with cement be permitted during finishing of the slab.

C. Steel Trowel Finish:

1. Surfaces to be given a steel-trowel finish shall first be given a wood-float finish. This shall be followed by hand troweling with steel trowels to bring the surface to a uniform, smooth, hard, impervious surface free from marks and blemishes. Troweling shall not be started until all water has disappeared from the surface. Over-troweling shall be avoided. Dusting with dry cement or other mixtures or sprinkling with water will not be permitted in finishing.

D. Burlap Rubbed Finish:

1. Immediately after the forms have been stripped and before the concrete has changed in color, all fins and other projections shall be carefully removed by use of a hammer or other suitable means, and imperfections shall be repaired as hereinbefore specified under "Trimming and Repairs". While the surface is still damp, a thin coat of cement slurry of medium consistency shall be applied by means of bristle brushes to provide a bonding coat within pits and minor blemishes in the parent concrete; the coating of large areas of the surface with this slurry shall be avoided.
2. Before the slurry has dried or changed color, a dry (almost crumbly) grout composed of 1 volume of cement to 1-1/2 volumes of masonry sand shall be applied. The sand shall have a fineness modulus of approximately 2.25 and comply with the gradation requirements of the ASTM Standard Specifications for Aggregate for Masonry Mortar, Designation C144-76.
3. The grout shall be uniformly applied by means of damp (neither dripping wet nor dry) pads of burlap of convenient size (approximately 6 inches square) and shall be allowed to harden for one to two hours, depending on the weather. In hot, dry weather the surface shall be kept damp by means of a fine fog spray during the hardening period.
4. When the grout has hardened sufficiently, but before it becomes so hard as to be difficult to remove, excess grout shall be scraped from the surface of the parent concrete by the edge of a steel trowel, without removing the grout from the imperfections. Thereafter, the surface shall be allowed to dry thoroughly and

then be rubbed vigorously with burlap to remove all dried grout so that no visible film remains on the surface after the rubbing. The entire cleaning operation for any area shall be so planned that sufficient time is allowed for the grout to dry and be rubbed after it has been cut with the trowel.

5. On the day following the grouting and burlap rubbing, the concrete surface shall again be rubbed clean with a dry burlap to remove inadvertent dust. If any built-up film remains on the parent surface, it shall be removed by being rubbed with a fine abrasive stone without breaking through the surface film of the original concrete. Such rubbing shall be light and sufficient only to remove excess material without working up a lather of mortar or changing the texture of the concrete. Following the final rubbing with burlap or abrasive stone, the surface shall be thoroughly washed with stiff bristle brushes (worked only along parallel lines) to remove extraneous materials from the surface. The surface shall then be sprayed with a fine fog spray to maintain a continually damp condition for at least three (3) days after application of the grout.
6. When the burlap-rubbed finish has been completed, the concrete surface shall be smooth, free from discolorations and stains, and of uniformly good appearance.

3.13 HOT WEATHER CONDITIONS

Placing of concrete under conditions of high temperature, low humidity or wind shall be done in accordance with the American Concrete Institute "Hot Weather Conditions" (latest edition).

3.14 COLD WEATHER CONDITIONS

Cold weather concreting procedures precautions shall conform with American Concrete Institute "Cold Weather Concreting" (latest edition).

END OF SECTION 03300

APPENDIX B

INDEX

1. HERSEY HOTROD METERS (RESIDENTIAL)

2. HERSEY HORIZON METERS (MASTER)

Integral HOT ROD™

Mueller SYSTEMS

Features

APPLICATIONS: The Integral HOT ROD™ is a high performance, transmitter designed for mobile AMR. It is compatible with all current 5/8" through 1" Hersey Positive Displacement and 3/4" through 2" MVR and RFM Meters utilizing the Translator® Positional Encoder Register. The primary function of the Integral HOT ROD module is to transmit an encoded serial number, water consumption, leak detection information and status data via radio frequency. When combined with the STREET MACHINE™ Mobile Receiver and EZ Reader™ Software, it provides the basis for high speed, high performance meter reading.

INSTALLATION: Integral HOT ROD modules are available in two options; metal and standard variant. The metal variant is a high power version for installation in a metal box and the standard version is a low power version for installation in a plastic meter box. Each meter is shipped with the Integral HOT ROD preprogrammed and permanently attached to simplify installation, eliminate exposed wires and mounting hardware in all installation environments. The HOT ROD is also available with exposed wire lengths appropriate for installation on Hersey meters not listed above.

PERFORMANCE: The Integral HOT ROD module utilizes the 902MHz to 928MHz ISM band which are FCC license exempt frequencies and translates to lower initial start up costs. The Integral HOT ROD module transmits or "bubbles up" every 2 seconds on multiple frequencies without the need of a "wake up call' insuring a continuous information stream for absolute data collection. Each transmission lasts only 2.5 milliseconds. That equates to almost 16 million opportunities per year to read each Integral HOT ROD module and unparalleled performance.

CONFORMANCE TO STANDARDS: FCC compliance: Part 15 certified. The Integral HOT ROD complies with Standard C707 for Encoded Remote Reading Systems. No FCC License is required for operation.

CONSTRUCTION: The Integral HOT ROD module consists of a compact printed circuit board which is encapsulated to provide complete protection against shock and water intrusion. The enclosure is made of UV stable, high density thermoplastic and is completely waterproof. All modules are integrally mounted to the meter for all installations. One C size lithium battery provides plenty of power for reading the register and sending RF data. The battery is sealed within the module and is not replaceable. There are no customer serviceable parts inside the HOT ROD.

INSTANT DATA LOGGING ALARMS: Along with the standard meter reading the HOT ROD modules also transmit any instant data logging alarms for a specific account identifying a potential problem or issue with that account. The instant data logging alarms can be viewed on the Mapping screen of EZ Mobile™ and trigger the meter reader to stop and take action; such as leaving a door hanger or downloading the hourly consumption data for further investigation of the issue. The types of Instant Data Logging Alarms that can be communicated along with the meter reading are: small and continuous leak, reverse flow, no flow, and register disconnect. These instant data logging alarms can also be viewed with the Extended Data report from EZ Mobile.

HOURLY CONSUMPTION DATA: The HOT ROD modules come standard with the ability to log and store up to 170 days of hourly consumption data that can then be downloaded by a meter reader/technician using the same Street Machine™ Mobile Receiver that is used to read meters. The meter reader would just start up EZ Profiler™ Software and swipe a magnet over the top of the Hot Rod module to begin the process. The monthly, daily or hourly consumption profiling data can then be displayed on a bar graph that can be supplied to the customer to help justify the amount being charged and resolve high water bill disputes/complaints. This information can also be used to monitor and address water conservation initiatives, such as, odd-even watering restrictions.

Integral HOT ROD™

Materials and Specifications

RADIO FREQUENCY	Operates on 902 to 928MHz
MODEL	Integral HOT ROD™ Standard and Metal Pit Options
POWER SOURCE	C Cell Lithium Battery
TYPICAL RANGE	Up to 1200 feet
TRANSMIT FREQUENCY	902 MHz – 928 MHz
DATA INTEGRITY	Verified with every data message
TEMPERATURE RANGE	Operating Temperature: -40°F to + 158°F (-40°C to + 70°C) Storage Temperature: -40°F to + 158°F (-40°C to + 70°C) Humidity: 0% - 100% condensing
OPTIONS	Wired Hot Rod Devices

Mueller SYSTEMS

Integral HOT ROD

FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING – Changes or Modifications

Any changes or modifications not expressly approved by the party responsible for Compliance could void the user's authority to operate the equipment.

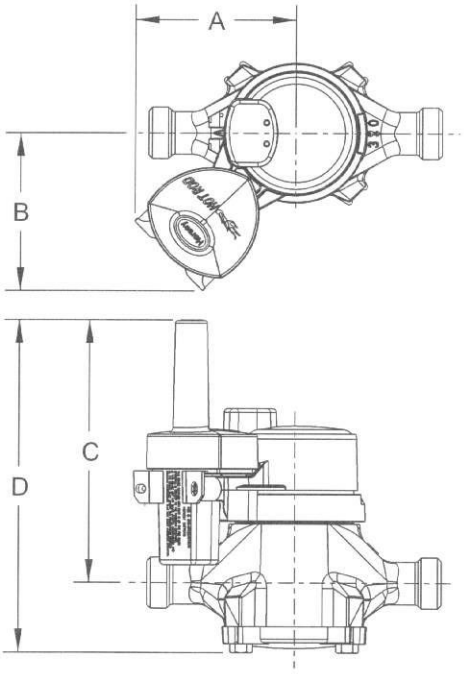
Caution: Exposure to Radio Frequency Radiation.

The radiated output power of this device is far below the FCC radio frequency exposure limits. Nevertheless, the device shall be used in such that the potential for human contact during normal operation is minimized.

For devices having the following FCC ID: SSDHOTRODMETALV1

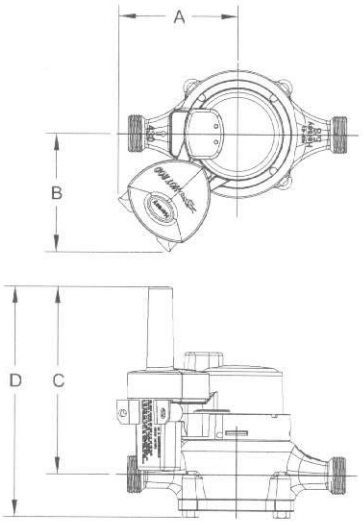
Such devices are authorized for use only in water pit installations using metal enclosures comparable in mechanical construction to the type specified in the filing and is only for below ground use. Professional installation is required. Installation instructions provide appropriate details for the installation of the transmitter in the pits and specify the types of pits and lids that can be used and provide information about any materials necessary to comply with the conditions of the grant.

MVR Meter



Meter Size	3/4"	1"	1-1/2	2"
Model	**MVR 30**	**MVR 50**	**MVR 100**	**MVR 160**
Dimensions				
A	4-1/8"	4-1/8"	4-1/8"	4-1/8"
B	4-1/8"	4-1/8"	4-1/8"	4-1/8"
C	6-5/8"	6-31/32	6-15/16	7-1/64
D	8-5/8"	9-9/32	9-13/32	10-1/4

PD Meter



Meter Size	5/8"	3/4"	1"
Model	**430**	**442**	**452**
Dimensions			
A	4-1/8"	4-1/8"	4-1/8"
B	4-1/8"	4-1/8"	4-1/8"
C	6-7/16"	7-3/16"	7-5/ 8"
D	7-7/8"	8-7/8"	9-3/8"

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Hersey® Meters

HORIZON®

Horizontal Turbine Meters
Sizes 3", 4", 6", 8", 10"

Features

APPLICATIONS: For use in the measurement of potable water for applications where flow is consistently moderate to high. Designed for applications where accuracy is an essential part of maintaining revenue. The Horizon horizontal turbine meter is built to maintain accuracy over extended periods of use.

CONFORMANCE TO STANDARDS: Horizon turbine meters have some of the widest flow ranges of any turbine meters on the market. All Horizon series turbine meters meet or exceed the latest performance and accuracy standards of AWWA C701. Horizon meters in sizes 4"-8" are FM Approved. Maximum continuous flow rates may be exceeded by as much as 25% for intermittent periods.

CONSTRUCTION: The Horizon consists of three basic parts; maincase; measuring insert; and register. Maincases are made of bronze. Measuring elements are thermoplastic with unique inlet and outlet straightening vanes.

To simplify maintenance, the Horizon is designed to allow quick, easy, in-line exchange of the measuring element without removing the maincase from the installation. Interchangeability of many parts within various sizes minimizes spare parts inventory. Built-in test ports are standard for ease of field testing.

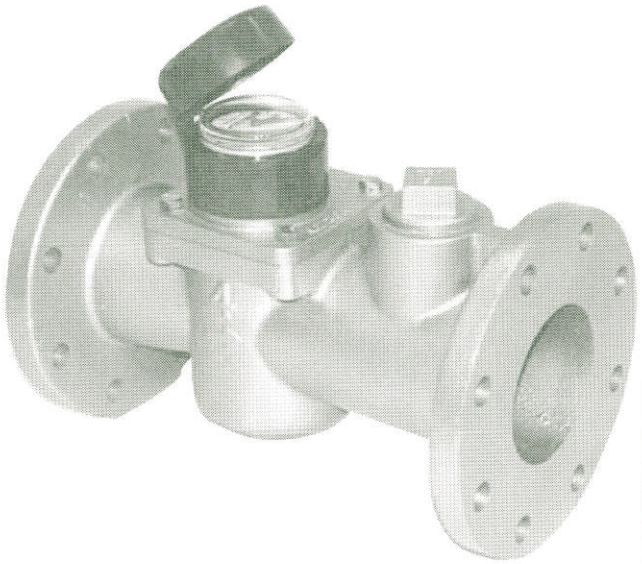
REGISTER: Permanently sealed register has a unique seal and heat-treated glass to eliminate dirt, moisture infiltration and lens fogging. An integral tamper-proof locking feature is provided to resist tampering with the register or calibration vane. The totalizing register has a straight-reading odometer type display, a 360° test circle with center sweep hand and a low flow (leak) detector. Standard gearing is used, making registers interchangeable by size.

All Hersey Meter Models have electronic meter reading systems available for increased reading efficiency (see Meter Reading Systems.)

OPERATION: Water flows straight through the measuring element where it turns a rotor at a rate in direct proportion to the quantity of water flowing through the meter. The straight-through design allows high volumes to flow with a minimum of head loss. Retro Thrust® design extends the life of the meter by dividing wear between two points: during low flow the tungsten carbide bearing in the rotor floats against a stainless steel shaft; during high flow a second tungsten carbide bearing gently moves back against another stainless steel shaft. During medium flow, the rotor floats between both tungsten carbide bearings with sapphire bushings providing radial support for the rotor.

STRAINER: A separate optional strainer is recommended to protect the measuring element.

CONNECTIONS: ANSI Class 150 Flanges on 3" through 10" sizes; 2" NPT pipe threads on test outlet.



Horizon

Materials and Specifications

- **MODEL DESIGNATION** ..... HORIZON
- **SIZES** ..... 3", 4", 6", 8", 10"
- **STANDARDS** ..... Manufactured and tested to meet or exceed all applicable parts of ANSI/AWWA C701 class II Standard. 4"-8" Horizon meters are FM Approved
- **SERVICE** ..... Cold water measurement with flow in one direction.
- **OPERATING FLOW RANGE** ..... See Chart on page 3.4-3.5
- **ACCURACY** ..... See Chart on page 3.4-3.5
- **PRESSURE LOSS** ..... See Charts on pages 3.4-3.5
- **MAXIMUM WORKING PRESSURE** ..... 175 PSI
- **TEMPERATURE RANGE** ..... 33°F to 100°F water temperature
- **MEASURING ELEMENT** ..... Stainless Steel and Thermoplastic
- **REGISTER TYPE** ..... Straight reading, permanently sealed, magnetic drive with low flow indicator. Remote Readings units optional.
- **MATERIALS** ..... Maincase – bronze UNSC84400; Casing bolts – Stainless steel ANSI B18; Rotor – Thermoplastic; Rotor radial bearing – Sapphire; Rotor thrust bearings – tungsten carbide; Rotor bearing pivots – Stainless steel ANSI B18; Magnet - rare earth/ceramic; Register box and lid – Thermoplastic or optional bronze.
- **INSTALLATION** ..... Horizontal or Vertical
- **METER CONNECTIONS** ..... 3" – 10" ANSI Class 150
- **OPTIONS** ..... AMR Reading Systems

HORIZON®

Hersey Meters

Horizontal Turbine Meters
Sizes 3", 4", 6", 8", 10"

Meter Registration

Meter Size	Initial Dial*	Capacity	Initial Dial*	Capacity
3"	100 Gallons	100 Million	10 Cubic Feet	10 Million
4"	100 Gallons	100 Million	10 Cubic Feet	10 Million
6"	1000 Gallons	1 Billion	100 Cubic Feet	100 Million
8"	1000 Gallons	1 Billion	100 Cubic Feet	100 Million
10"	1000 Gallons	1 Billion	100 Cubic Feet	100 Million

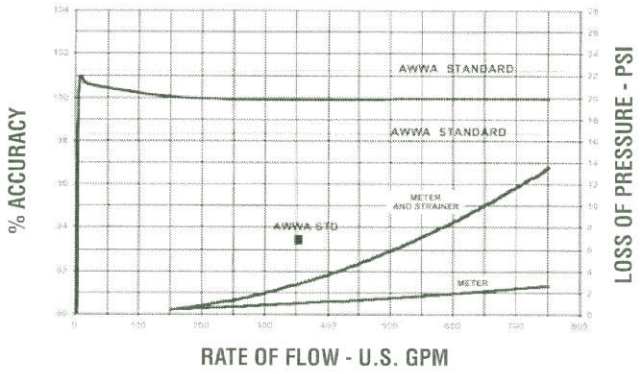
*Registration equal to one full revolution of the sweep hand.

Flow Characteristics

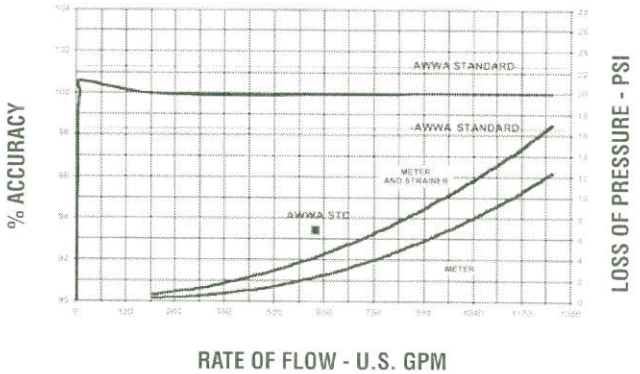
Meter Size	Typical Low Flow (95% Minimum)	Typical Operating Range (100% ± 1.5%)	Maximum Continuous Operation	Maximum Intermittent Flow
3"	3 GPM	6 to 600 GPM	600 GPM	750 GPM
4"	4 GPM	8 to 1000 GPM	1000 GPM	1250 GPM
6"	9 GPM	15 to 2000 GPM	2000 GPM	2600 GPM
8"	18 GPM	30 to 3500 GPM	3500 GPM	4400 GPM
10"	30 GPM	40 to 5500 GPM	5500 GPM	7000 GPM

Performance*

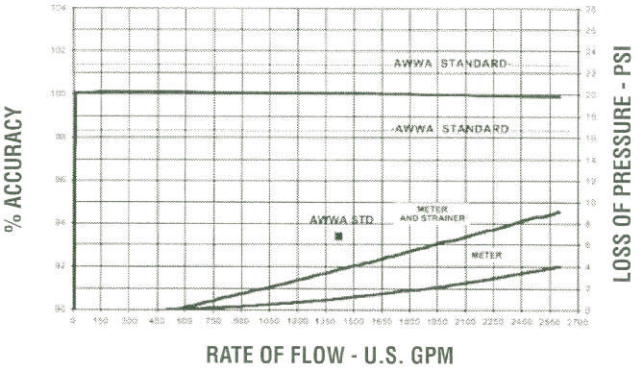
3" HORIZON



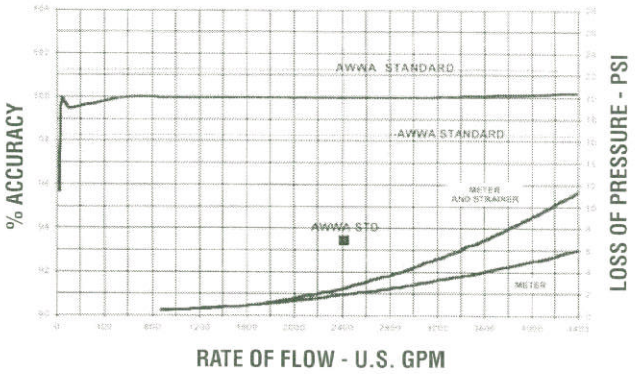
4" HORIZON



6" HORIZON



8" HORIZON



*Performance curves are typical only and not a guarantee of performance

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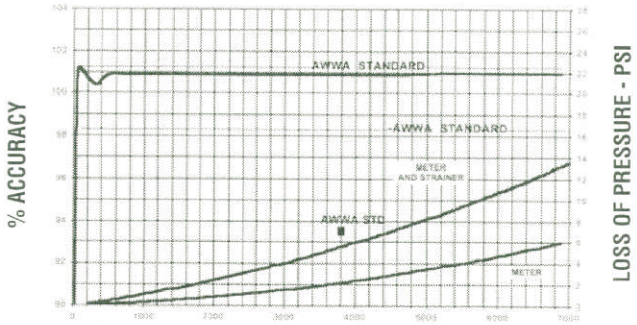
Hersey Meters

HORIZON®

Horizontal Turbine Meters
Sizes 3", 4", 6", 8", 10"

Performance*

10" HORIZON

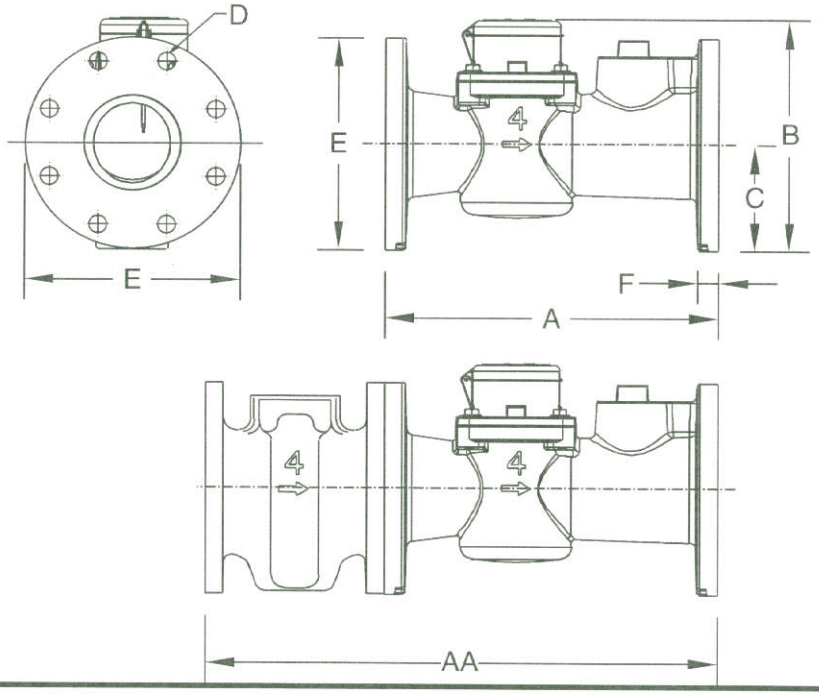


*Performance curves are typical only and not a guarantee of performance

Dimensions & Weights

Meter Size	3"	4"	6"	8"	10"
Dimension					
A	12"	14"	18"	20"	24"
AA	18"	21-1/2"	27"	30"	36"
B	10"	10-3/4"	13-1/2"	15-1/2"	18"
C	3-3/4"	4-1/2"	5-1/2"	6-3/4"	8"
D	3/4"	3/4"	7/8"	7/8"	1"
E	7-1/2"	9"	11"	13-1/2"	16"
F	3/4"	7/8"	7/8"	1-1/8"	1-3/16"
Net weight	38	50	100	130	210

Note: Length AA is with standard strainer. Weights are in pounds and are approximate.



Horizon

CONTRACT ID: 111004 PAGE: 1
COUNTY: ESTILL LETTING: 02/18/11
PROPOSAL: JL03 033 0089 012-015 CALL NO: 339

LINE NO	ITEM	DESCRIPTION	APPROXIMATE QUANTITY	UNIT PRICE	AMOUNT
ALT GROUPIAA10001		PAVING-ALT A ASPHALT WITH ASPH SHOULDER			
0010	00003	CRUSHED STONE BASE	32,117.000 TON		
0020	00078	CRUSHED AGGREGATE SIZE NO 2	38,553.000 TON		
0030	00100	ASPHALT SEAL AGGREGATE	172.000 TON		
0040	00212	CL2 ASPH BASE 1.00D PG64-22	22,733.000 TON		
0050	00291	EMULSIFIED ASPHALT RS-2	21.000 TON		
0060	00301	CL2 ASPH SURF 0.38D PG64-22	1,664.000 TON		
0070	00307	CL2 ASPH SURF 0.38B PG64-22	2,997.000 TON		
0080	02599	FABRIC-GEOTEXTILE TYPE IV	117,549.000 SQYD		
0090	10203ND	PAVEMENT ADJUSTMENT ASPHALT	(1.00) LS	364,214.00	364,214.00
ALT GROUPIAA20002		PAVING-ALT B CONC WITH CONC SHOULDER			
0100	00003	CRUSHED STONE BASE	27,970.000 TON		
0110	00078	CRUSHED AGGREGATE SIZE NO 2	38,553.000 TON		
0120	00100	ASPHALT SEAL AGGREGATE	172.000 TON		
0130	00212	CL2 ASPH BASE 1.00D PG64-22	3,212.000 TON		
0140	00291	EMULSIFIED ASPHALT RS-2	21.000 TON		
0150	00301	CL2 ASPH SURF 0.38D PG64-22	484.000 TON		
0160	00307	CL2 ASPH SURF 0.38B PG64-22	1,011.000 TON		
0170	02073	JPC PAVEMENT-9 IN	28,885.000 SQYD		
0180	02599	FABRIC-GEOTEXTILE TYPE IV	117,549.000 SQYD		
0190	10203ND	PAVEMENT ADJUSTMENT CONCRETE	(1.00) LS	165,792.00	165,792.00
0200	23950EC	RCC SHOULDER-6 IN	17,155.000 SQYD		
ALT GROUPIAA30003		PAVING-ALT B1CONC WITH ASPH SHOULDER			

CONTRACT ID: 111004 PAGE: 2
COUNTY: ESTILL LETTING: 02/18/11
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LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
0210	00003	CRUSHED STONE BASE	28,771.000 TON		
0220	00078	CRUSHED AGGREGATE SIZE NO 2	38,553.000 TON		
0230	00100	ASPHALT SEAL AGGREGATE	172.000 TON		
0240	00212	CL2 ASPH BASE 1.00D PG64-22	6,368.000 TON		
0250	00291	EMULSIFIED ASPHALT RS-2	21.000 TON		
0260	00301	CL2 ASPH SURF 0.38D PG64-22	1,664.000 TON		
0270	00307	CL2 ASPH SURF 0.38B PG64-22	1,011.000 TON		
0280	02073	JPC PAVEMENT-9 IN	28,885.000 SQYD		
0290	02599	FABRIC-GEOTEXTILE TYPE IV	117,549.000 SQYD		
0300	10203ND	PAVEMENT ADJUSTMENT CONCRETE	(1.00) LS	165,792.00	165,792.00
	SECTION 0004	ROADWAY			
0310	00021	DRAINAGE BLANKET-EMBANKMENT	600.000 CUYD		
0320	00440	ENTRANCE PIPE-15 IN	398.000 LF		
0330	00441	ENTRANCE PIPE-18 IN	165.000 LF		
0340	00443	ENTRANCE PIPE-24 IN	168.000 LF		
0350	00461	CULVERT PIPE-15 IN	4.000 LF		
0360	00462	CULVERT PIPE-18 IN	107.000 LF		
0370	00464	CULVERT PIPE-24 IN	446.000 LF		
0380	00469	CULVERT PIPE-42 IN	422.000 LF		
0390	00470	CULVERT PIPE-48 IN	349.000 LF		
0400	00472	CULVERT PIPE-60 IN	125.000 LF		

CONTRACT ID: 111004 PAGE: 3
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LINE NO	ITEM	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT PRICE	AMOUNT
0410	01000	PERFORATED PIPE-4 IN	1,021.000	LF		
0420	01010	NON-PERFORATED PIPE-4 IN	230.000	LF		
0430	01020	PERF PIPE HEADWALL TY 1-4 IN	11.000	EACH		
0440	01450	S & F BOX INLET-OUTLET-18 IN	1.000	EACH		
0450	01451	S & F BOX INLET-OUTLET-24 IN	1.000	EACH		
0460	01490	DROP BOX INLET TYPE 1	2.000	EACH		
0470	01517	DROP BOX INLET TYPE 5F	1.000	EACH		
0480	01644	JUNCTION BOX-30 IN	1.000	EACH		
0490	01982	DELINEATOR FOR GUARDRAIL-WHITE	8.000	EACH		
0500	02014	BARRICADE-TYPE III	8.000	EACH		
0510	02091	REMOVE PAVEMENT	5,745.000	SQYD		
0520	02159	TEMP DITCH	10,595.000	LF		
0530	02200	ROADWAY EXCAVATION	377,831.000	CUYD		
0540	02223	GRANULAR EMBANKMENT	1,671.000	CUYD		
0550	02242	WATER	5,000.000	MGAL		
0560	02360	GUARDRAIL TERMINAL SECTION NO 1	11.000	EACH		
0570	02369	GUARDRAIL END TREATMENT TYPE 2A	1.000	EACH		
0580	02371	GUARDRAIL END TREATMENT TYPE 7	2.000	EACH		
0590	02381	REMOVE GUARDRAIL	1,020.000	LF		
0600	02391	GUARDRAIL END TREATMENT TYPE 4A	6.000	EACH		
0610	02397	TEMP GUARDRAIL	213.000	LF		

CONTRACT ID: 111004 PAGE: 4
COUNTY: ESTILL LETTING: 02/18/11
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LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
0620	02429	RIGHT-OF-WAY MONUMENT TYPE 1	104.000 EACH		
0630	02430	RIGHT-OF-WAY MONUMENT TYPE 1A	5.000 EACH		
0640	02432	WITNESS POST	109.000 EACH		
0650	02482	CHANNEL LINING CLASS IA	359.000 TON		
0660	02483	CHANNEL LINING CLASS II	4,758.000 TON		
0670	02484	CHANNEL LINING CLASS III	2,107.000 TON		
0680	02545	CLEARING AND GRUBBING 53.17 ACRES	(1.00) LS		
0690	02562	SIGNS	135.000 SQFT		
0700	02598	FABRIC-GEOTEXTILE TYPE III	6,056.000 SQYD		
0710	02600	FABRIC GEOTEXTILE TY IV FOR PIPE	4,152.000 SQYD	2.00	8,304.00
0720	02650	MAINTAIN & CONTROL TRAFFIC	(1.00) LS		
0730	02671	PORTABLE CHANGEABLE MESSAGE SIGN	2.000 EACH		
0740	02701	TEMP SILT FENCE	10,595.000 LF		
0750	02703	SILT TRAP TYPE A ALT. NO. 1	18.000 EACH		
0760	02703	SILT TRAP TYPE A ALT. NO. 2	3.000 EACH		
0770	02704	SILT TRAP TYPE B	120.000 EACH		
0780	02706	CLEAN SILT TRAP TYPE A ALT. NO. 1	54.000 EACH		
0790	02706	CLEAN SILT TRAP TYPE A ALT. NO. 2	9.000 EACH		
0800	02707	CLEAN SILT TRAP TYPE B	360.000 EACH		
0810	02709	CLEAN TEMP SILT FENCE	10,595.000 LF		
0820	02726	STAKING	(1.00) LS		

CONTRACT ID: 111004 PAGE: 5
COUNTY: ESTILL LETTING: 02/18/11
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LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
0830	02731	REMOVE STRUCTURE STA. 165+00 RT	(1.00) LS		
0840	02731	REMOVE STRUCTURE STA. 232+90 RT	(1.00) LS		
0850	02731	REMOVE STRUCTURE STA. 44+50 RT	(1.00) LS		
0860	05950	EROSION CONTROL BLANKET	18,405.000 SQYD		
0870	05952	TEMP MULCH	196,956.000 SQYD		
0880	05953	TEMP SEEDING AND PROTECTION	98,479.000 SQYD		
0890	05966	TOPDRESSING FERTILIZER	16.000 TON		
0900	05985	SEEDING AND PROTECTION	196,956.000 SQYD		
0910	06510	PAVE STRIPING-TEMP PAINT-4 IN	22,957.000 LF		
0920	06514	PAVE STRIPING-PERM PAINT-4 IN	45,911.000 LF		
0930	06547	PAVE STRIPING-THERMO-12 IN Y	1,248.000 LF		
0940	06550	PAVE STRIPING-TEMP REM TAPE-W	4,592.000 LF		
0950	06551	PAVE STRIPING-TEMP REM TAPE-Y	9,182.000 LF		
0960	06574	PAVE MARKING-THERMO CURV ARROW	21.000 EACH		
0970	08100	CONCRETE-CLASS A	54.000 CUYD		
0980	08150	STEEL REINFORCEMENT	3,653.000 LB		
0990	21802EN	G/R STEEL W BEAM-S FACE (7 FT POST)	3,188.000 LF		
1000	23131ER701	PIPELINE VIDEO INSPECTION	727.000 LF		
	SECTION 0005	25195-CULVERT			
1020	08002	STRUCTURE EXCAV-SOLID ROCK	342.000 CUYD		
1030	08003	FOUNDATION PREPARATION 25195	(1.00) LS		

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LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
1040	08003	FOUNDATION PREPARATION 25196	(1.00) LS		
1050	08003	FOUNDATION PREPARATION 25197	(1.00) LS		
1060	08100	CONCRETE-CLASS A	2,086.300 CUYD		
1070	08150	STEEL REINFORCEMENT	323,163.000 LB		
	SECTION 0006	SEWER			
1080	01050	SEWER PIPE-4 IN PVC	229.000 LF		
1090	01052	SEWER PIPE-8 IN PVC	1,905.000 LF		
1100	01067	STEEL ENCASEMENT PIPE-10 IN BORE AND JACK	72.000 LF		
1110	01071	STEEL ENCASEMENT PIPE-14 IN BORE AND JACK	154.000 LF		
1120	01071	STEEL ENCASEMENT PIPE-14 IN OPEN CUT	369.000 LF		
1130	01073	STEEL ENCASEMENT PIPE-16 IN OPEN CUT	240.000 LF		
1140	01799	SANITARY SEWER MANHOLE	16.000 EACH		
1150	03444	RECONNECT SEWER SERVICE	2.000 EACH		
1160	05985	SEEDING AND PROTECTION	3,762.000 SQYD		
1170	20097ES601	CONCRETE CAP	10.000 LF		
1180	20425ED	ABANDON MANHOLE	7.000 EACH		
1190	20772ND	TIE-IN TO MANHOLE	9.000 EACH		
1200	24072EC	MANHOLE WATER TIGHT FRAME AND LID (REVISED: 2-17-11)	14.000 EACH		
	SECTION 0007	WATERLINE			
1210	01067	STEEL ENCASEMENT PIPE-10 IN BORE AND JACK	132.000 LF		
1220	01067	STEEL ENCASEMENT PIPE-10 IN OPEN CUT	408.000 LF		

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COUNTY: ESTILL LETTING: 02/18/11
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LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
1230	01069	STEEL ENCASEMENT PIPE-12 IN BORE AND JACK	89.000 LF		
1240	01091	DUCTILE IRON PIPE-4 IN	445.000 LF		
1250	01093	DUCTILE IRON PIPE-6 IN	937.000 LF		
1260	03379	PVC PIPE-3/4 IN	282.000 LF		
1270	03380	PVC PIPE-1 IN	349.000 LF		
1280	03381	PVC PIPE-2 IN	20.000 LF		
1290	03382	PVC PIPE-3 IN	832.000 LF		
1300	03383	PVC PIPE-4 IN	1,220.000 LF		
1310	03387	PVC PIPE-8 IN	514.000 LF		
1320	03423	REMOVE METER	2.000 EACH		
1330	03430	INSTALL WATER METER 3/4 IN	6.000 EACH		
1340	03437	RECONNECT SERVICE	6.000 EACH		
1350	03439	FLUSH HYDRANT	1.000 EACH		
1360	03550	CUT & CAP EXIST WATER MAIN	13.000 EACH		
1370	05985	SEEDING AND PROTECTION	3,252.000 SQYD		
1380	20097ES601	CONCRETE CAP	69.000 LF		
1390	21228ND	AIR RELEASE VALVE ASSEMBLY-2 IN INSTALL	4.000 EACH		
1400	23596EC	TAPPING SLEEVE AND VALVE-6 IN	4.000 EACH		
1410	23597EC	TAPPING SLEEVE AND VALVE-4 IN	4.000 EACH		
1420	24073EC	TAPPING SLEEVE AND VALVE-3 IN	4.000 EACH		
1430	24076EC	CONCRETE ANCHOR	13.000 EACH		

CONTRACT ID: 111004 PAGE: 8
COUNTY: ESTILL LETTING: 02/18/11
PROPOSAL: JL03 033 0089 012-015 CALL NO: 339

LINE NO	ITEM	DESCRIPTION	APPROXIMATE UNIT QUANTITY	UNIT PRICE	AMOUNT
1440	24077EC	TAPPING SLEEVE AND VALVE-8 IN	4.000 EACH		
1450	24078EC	WATER MASTER METER AND PIT	2.000 EACH		
	SECTION 0008	DEMOB AND MOB			
1460	02568	MOBILIZATION (NO MORE THAN 5%)	LUMP		
1470	02569	DEMOBILIZATION (AT LEAST 1.5%)	LUMP		
		TOTAL BID			