DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

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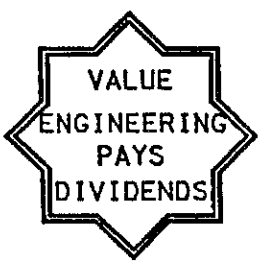

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PROJECT TITLE: WATER RESOURCES DEVELOPMENT PROJECT TOWN BROOK LOCAL PROTECTION **REVISIONS TO CENTRE STREET JUNCTION STRUCTURE** SIGNATURE SHEET	DATE: APR., 1999 PROJ. NO.	SPEC. NO. PURCHASE ORDER DRAWING NO. TOW-4 1 OF 7

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SCOPE OF WORK:

① REMOVE THE TWO TWELVE FOOT LONG HALVES OF 20" DIAMETER CLASS 56 CEMENT-LINED DUCTILE IRON PIPE.

② PREPARE AN EXIT AND ENTRANCE WEIR OPENING TO INSTALL A 1/4" THICK x 1' HIGH x 4'-3" WIDE A36 GALVANIZED CARBON STEEL TROUGH.

③ FABRICATE AND INSTALL THE NEW 1/4"x1'x4'-3" A36 GALVANIZED CARBON STEEL TROUGH AS SHOWN.

④ INSTALL THE 1 1/2"x1'-4"x4'-3" BEARING PLATES AND REQUIRED A36 GALVANIZED CARBON STEEL ANGLES AS SHOWN.

NOTES:

1. TOWN BROOK IS LOCATED APPROXIMATELY ONE THOUSAND FEET FROM THE QUINCY ADAMS MBTA STATION AND BEHIND RAYTHEON COMPANY.
2. NEW CARBON STEEL TROUGH AND PADS SHALL BE OF ASTM A36 OR ANSI 1018 STEEL (36,000 PSI MINIMUM YIELD STRENGTH) OR APPROVED EQUAL.
3. ALL WELDS SHALL BE PERFORMED BY A CERTIFIED WELDER USING E70XX ELECTRODES.
4. NON-SHRINK GROUT SHALL MEET REQUIREMENTS OF ASTM C-1107.
5. THERE IS NO STORAGE AREA PROVIDED TO CONTRACTOR UNDER THIS CONTRACT. ANY STORAGE AREA REQUIRED BY CONTRACTOR SHALL BE OBTAINED BY CONTRACTOR IN ACCORDANCE WITH LOCAL PERMITS AND REGULATIONS.

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SCOPE OF WORK, NOTES AND INDEX

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1'x4'-3" GALVANIZED A36 STEEL TROUGH INSTALLATION PROCEDURE:

1. THE CONTRACTOR WILL NOT BE PERMITTED TO INSTALL THE GALVANIZED STEEL TROUGH UNLESS THE CONSTRUCTION CONDITIONS ARE CONSIDERED FAVORABLE. CONSTRUCTION IS NOT ALLOWED BETWEEN MARCH 1 TO JUNE 1, 1999.

2. CONTRACTOR IS REQUIRED TO VISIT SITE TO VERIFY CONDITIONS/ DIMENSIONS PRIOR TO FABRICATION OF TROUGH.PRIOR TO INSTALLATION OF THE TROUGH, THE EXISTING WALLS WILL BE SAW CUT AND THE CEMENT-LINED DUCTILE IRON PIPE WILL BE REMOVED AS SHOWN ON THE DRAWINGS. THIS IS TO ENSURE THAT THE STEEL BEARING PLATES, STEEL ANGLES AND THE STEEL TROUGH CAN BE PLACED AND INSTALLED AS REQUIRED IN THE DRAWINGS.

3. CONTRACTOR IS RESPONSIBLE TO CONTROL/MOVE WATER INFLOWS THROUGH THE CENTRE ST. JUNCTION STRUCTURE ~~DURING~~ THIS WORK. DISCHARGE SHALL BE TO THE NATURAL TOWN BROOK CHANNEL, AND NOT INTO THE CENTRE ST. CULVERT.

4. SECTIONS OF THE STEEL TROUGH WILL BE BROUGHT INTO THE CENTRE STREET JUNCTION STRUCTURE AND PLACED USING ANY APPROPRIATE EQUIPMENT OR HYDRAULIC CRANES: IT IS ANTICIPATED THAT THE LARGEST OF THE SECTIONS WILL WEIGH APPROXIMATELY 500 POUNDS. THE WORK AREA MAY BE ACCESSED THROUGH (2) 3'x5' HATCHED OPENINGS. ALL EQUIPMENT TO BE USED INSIDE THE CENTRE STREET CULVERT WILL BE INSPECTED PRIOR TO ENTERING THE WORK AREA FOR FUEL, OIL, OR HYDRAULIC FLUID LEAKS. ANY REPAIRS REQUIRED SHALL BE MADE BEFORE THE EQUIPMENT WILL BE ALLOWED INTO THE CULVERT.

5. ALL ANCHOR BOLTS FOR BEARING PLATES AND ANGLES SHALL BE HILTI STAINLESS STEEL KWIK BOLTS, SIZES AS INDICATED ON DRAWINGS.

6. LOWER THE STEEL TROUGH SECTIONS INTO THE CULVERT AND WELD THE THREE SECTIONS TOGETHER AS SHOWN ON THE DRAWINGS. CONTRACTOR IS RESPONSIBLE TO PROVIDE ADEQUATE TEMPORARY SUPPORT STRUCTURES AS NEEDED TO INSTALL/WELD THIS TROUGH AT ITS PROPER LOCATION/ELEVATION. REMOVE THIS SUPPORT SYSTEM AT CONCLUSION OF WORK. ALL FIELD WELDS SHALL HAVE AN APPROPRIATE FIELD APPLIED GALVANIZED PAINT.

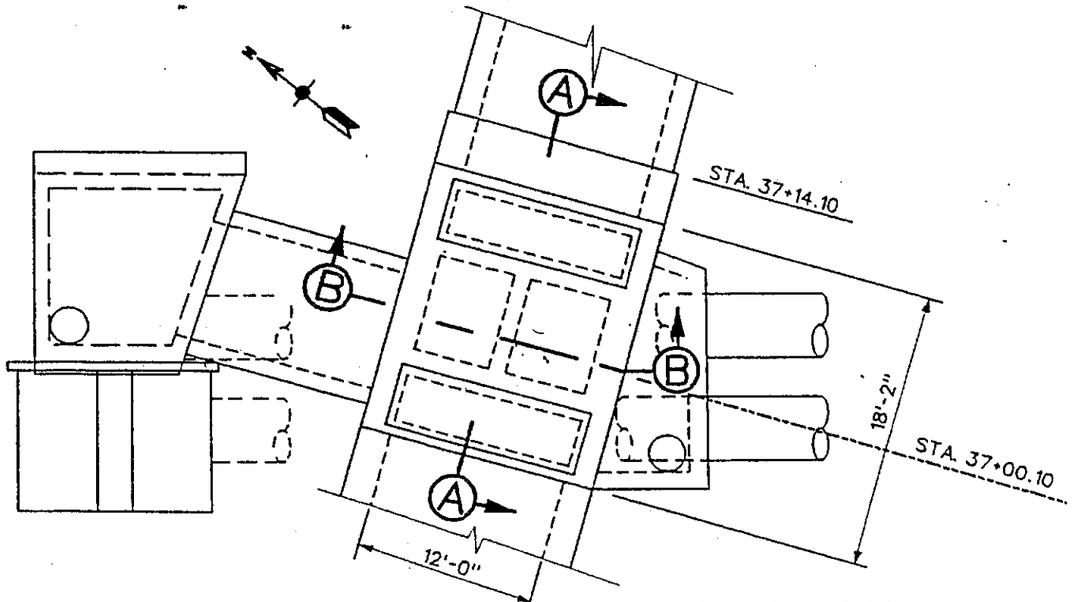
7. ONCE SITE WORK IS STARTED, IT IS INTENDED TO COMPLETE THE CONSTRUCTION IN ONE CONTINUOUS OPERATION (EACH DAY) WITHOUT ANY DELAY.

8. SAWCUTTING WALL AND REMOVING PIPE AND REINFORCED CONCRETE WILL LEAVE A GAP ON EITHER SIDE OF THE NEW STEEL TROUGH CENTERED AT STA 37.00.10. THESE GAPS SHALL BE COMPLETELY FILLED WITH NON-SHRINK GROUT.

9. EM385-1-1, CORPS OF ENGINEERS SAFETY MANUAL IS APPLICABLE TO THIS CONTRACT. SPECIFICALLY, ACTIVITY HAZARD ANALYSIS FOR WORKING AND WELDING INSIDE THE CENTRE STREET JUNCTION STRUCTURE SHALL BE PROVIDED FOR REVIEW/COMMENT PRIOR TO START OF WORK.

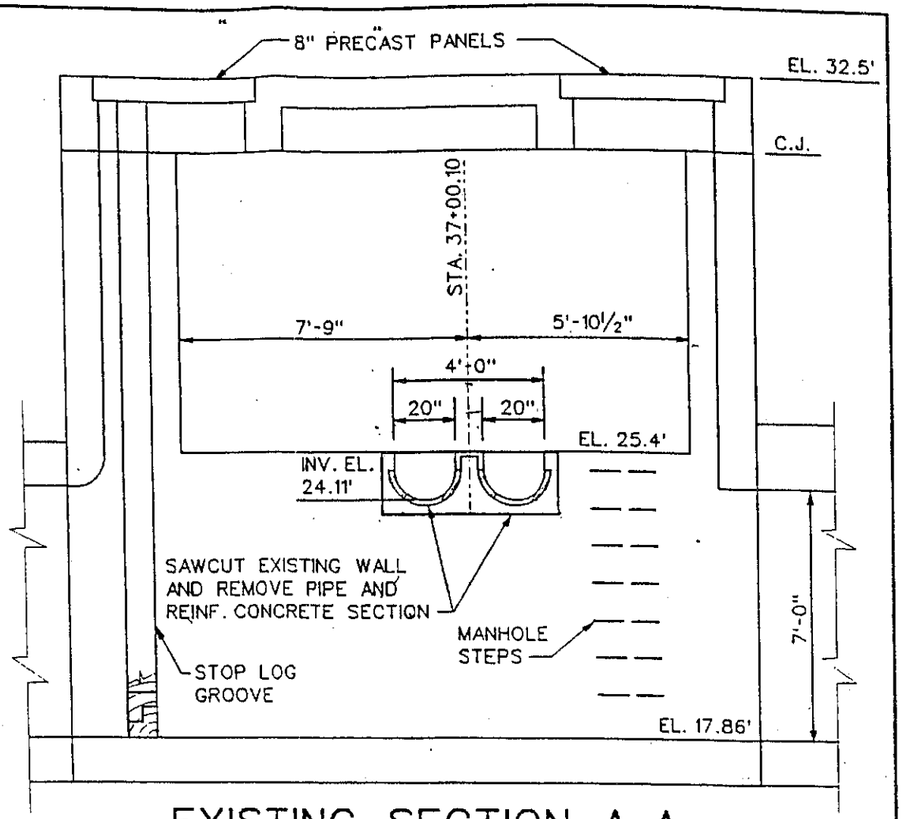
10. TRAFFIC CONTROL EACH DAY OF WORK AT THE SITE REQUIRES THE SERVICES OF A UNIFORMED POLICE OFFICER FROM THE CITY OF QUINCY OR MASSACHUSETTS STATE POLICE TO DIRECT/COORDINATE TRAFFIC AND OR CONSTRUCTION VEHICLES IN THE AREA. CONTRACTOR IS TO PROCURE AND PAY FOR THESE DETAILS AS PART OF THE COST OF PERFORMING THIS CONTRACT. IN ADDITION, CONTRACTOR IS REQUIRED TO FURNISH, INSTALL, AND REMOVE TRAFFIC CONTROL DEVICES SUCH AS DRUMS AND/OR CONES ON A DAILY BASIS TO DELINEATE WORK AREA AND/OR CHANNEL VEHICULAR TRAFFIC IN THIS AREA. MAINTAIN TWO (2) WAY FLOW ON CENTRE STREET AT ALL TIMES DURING THE COURSE OF THE WORK.

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASS.	WATER RESOURCES DEVELOPMENT PROJECT TOWN BROOK LOCAL PROTECTION **REVISIONS TO CENTRE STREET JUNCTION STRUCTURE** TROUGH INSTALLATION PROCEDURE	4/7



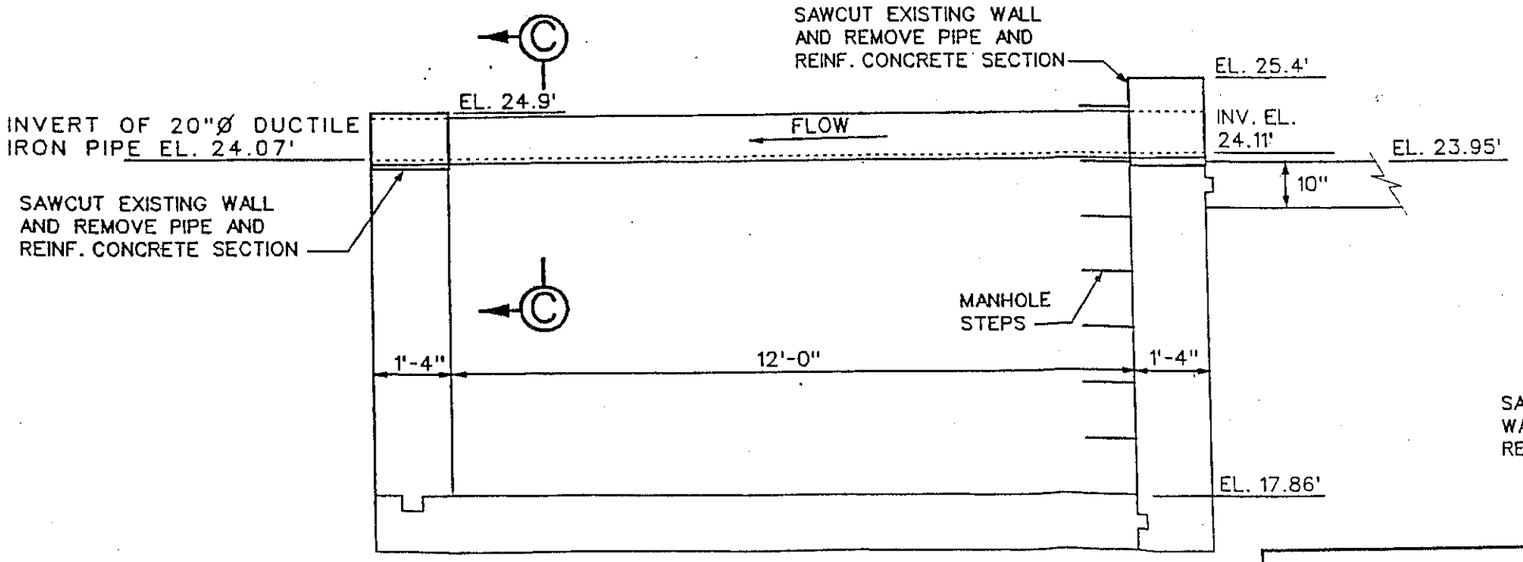
PLAN AT CENTRE ST. (CULVERT #Q-1-55)

SCALE: 1"= 10'



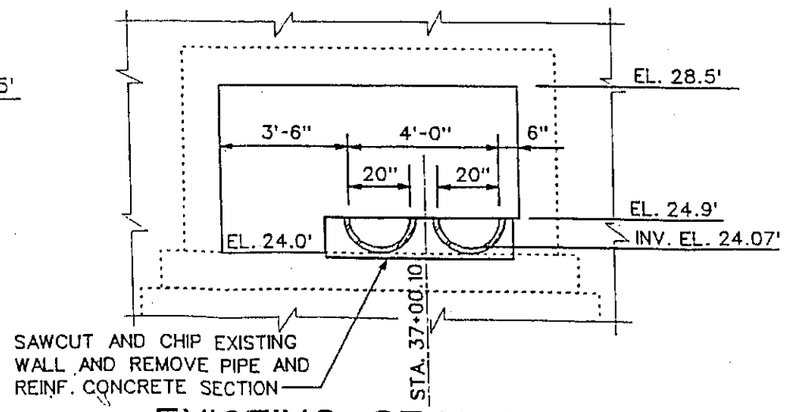
EXISTING SECTION A-A

SCALE: ¼"= 1'-0"



EXISTING SECTION B-B

SCALE: ⅜"= 1'-0"



EXISTING SECTION C-C

SCALE: ¼"= 1'-0"

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EXISTING PLAN AND SECTIONS

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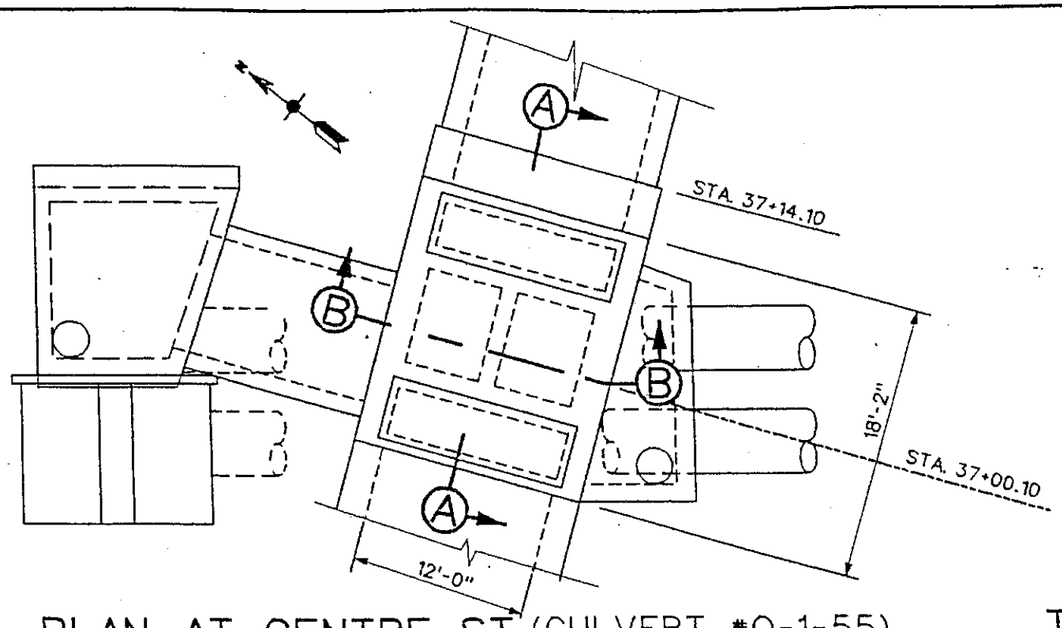
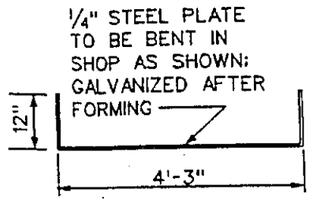


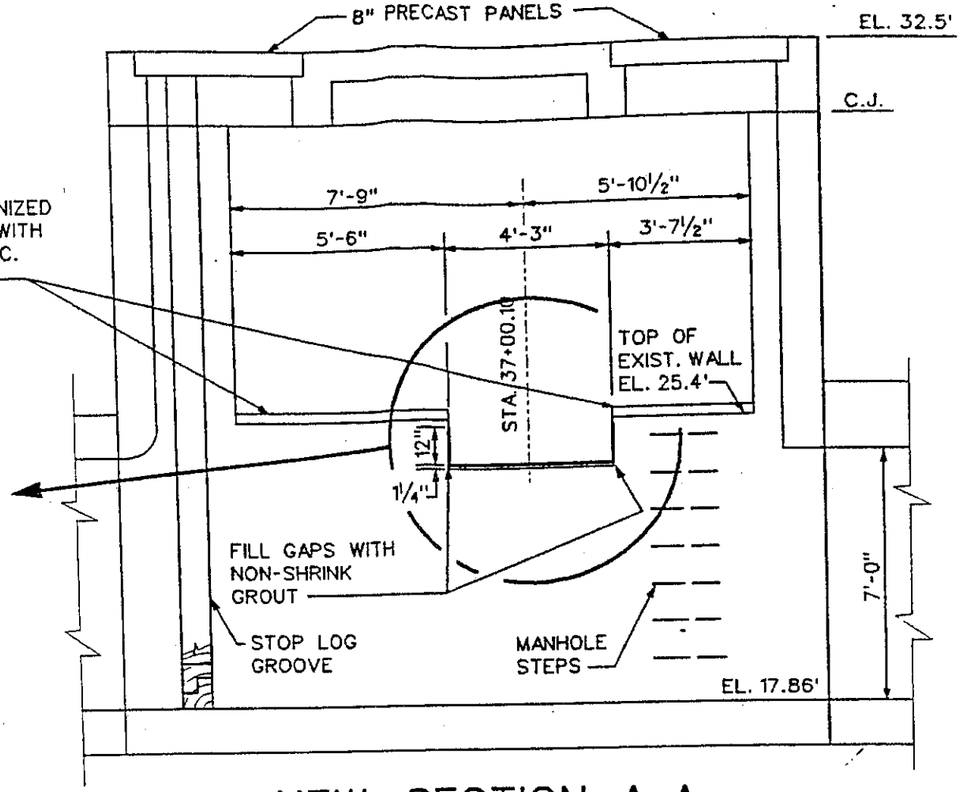
PLAN AT CENTRE ST. (CULVERT #Q-1-55)

SCALE: 1"= 10'



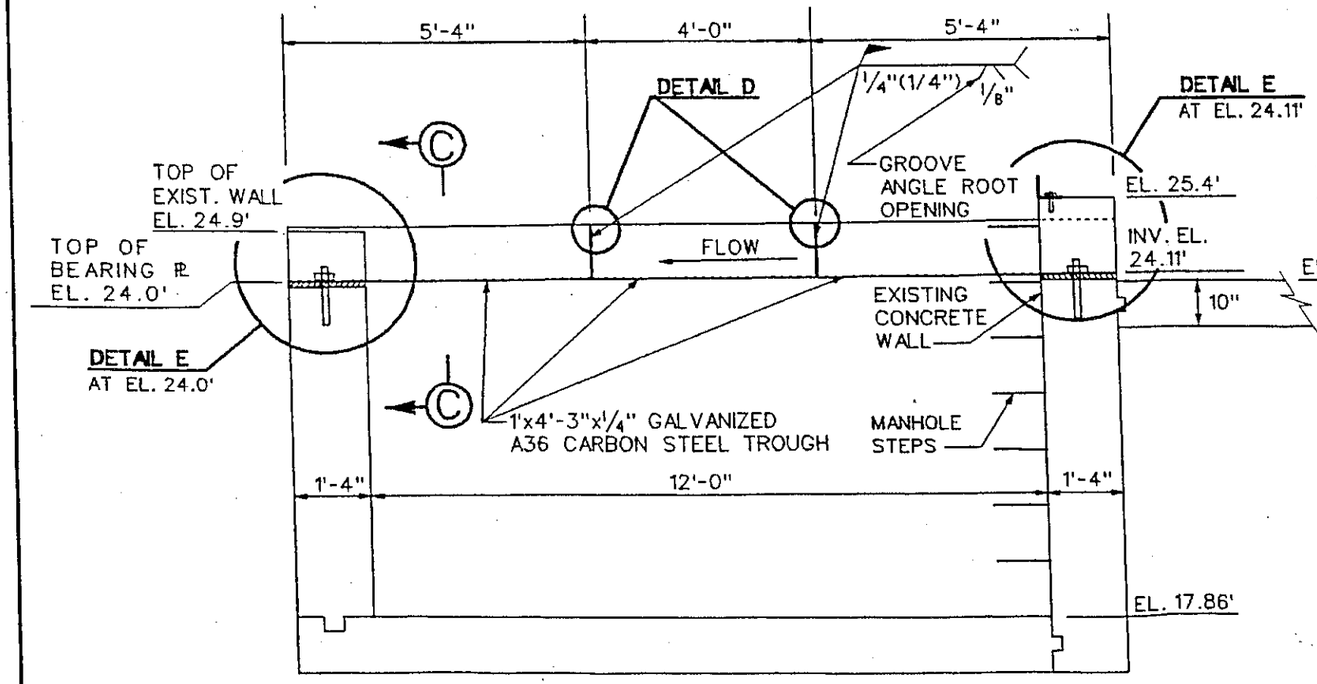
TROUGH DETAIL

SCALE: 3/8"= 1'-0"



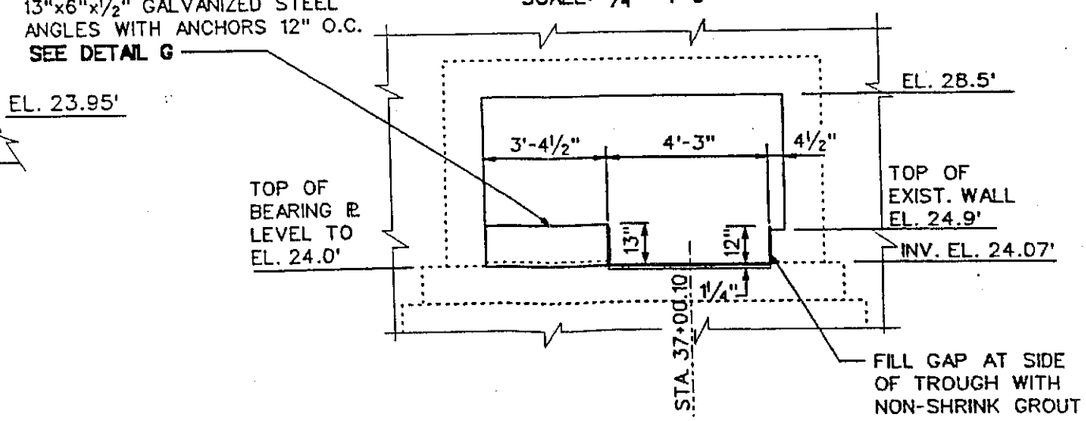
NEW SECTION A-A

SCALE: 1/4"= 1'-0"



NEW SECTION B-B

SCALE: 3/8"= 1'-0"



NEW SECTION C-C

SCALE: 1/4"= 1'-0"

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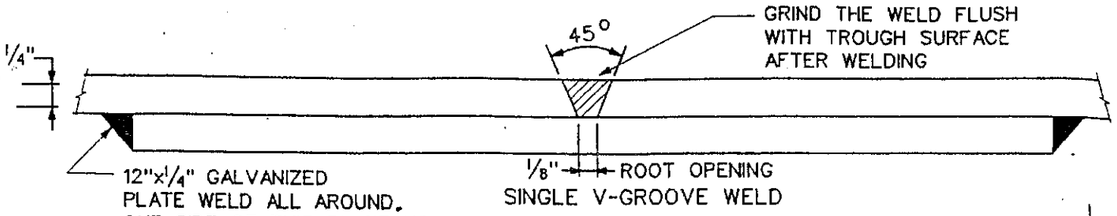
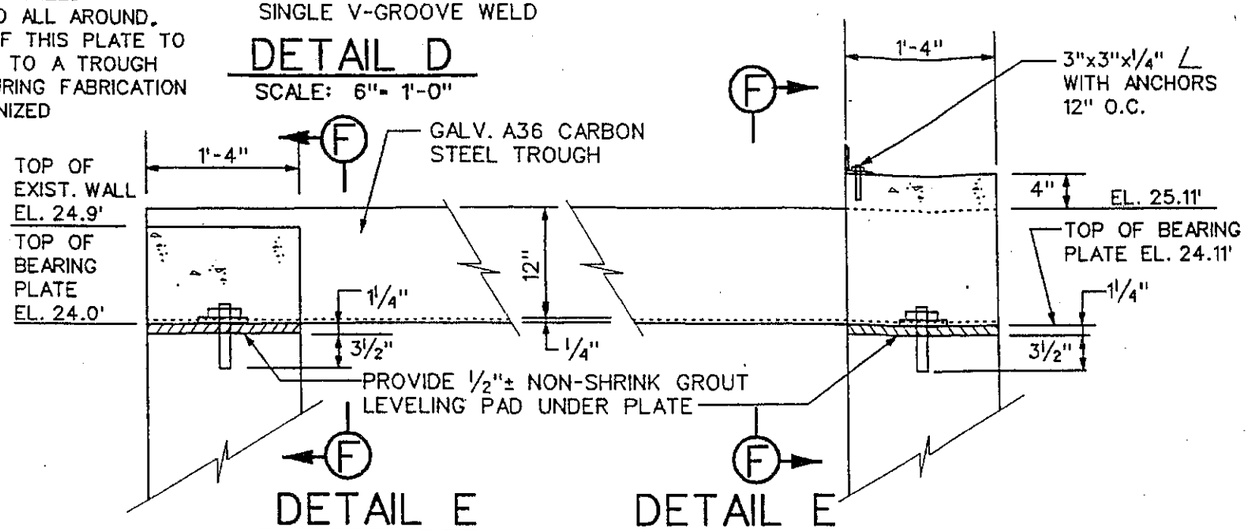
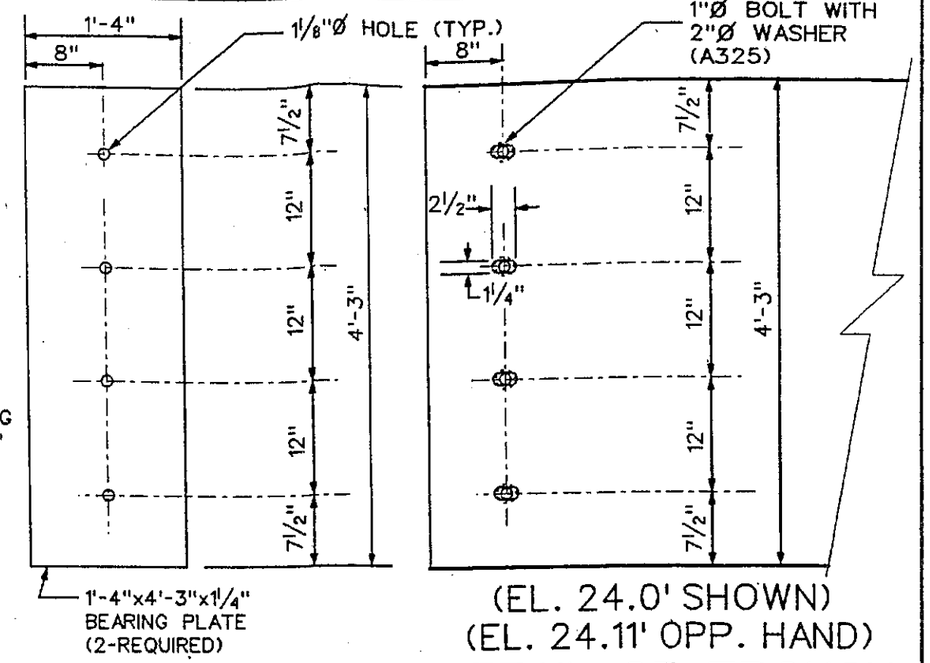


DETAIL D
SCALE: 6"= 1'-0"



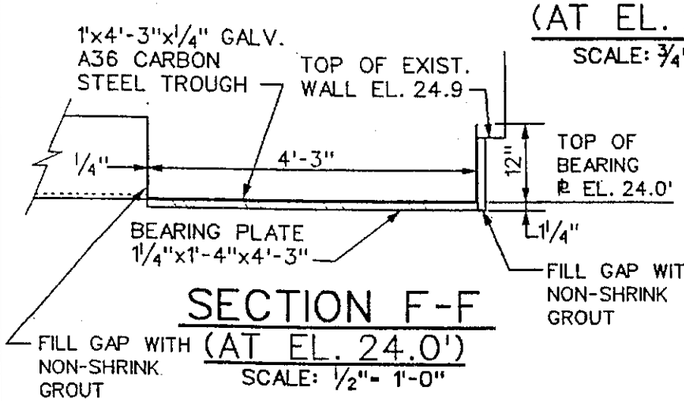
DETAIL E (AT EL. 24.0')
SCALE: 3/4"= 1'-0"

DETAIL E (AT EL. 24.11')
SCALE: 3/4"= 1'-0"

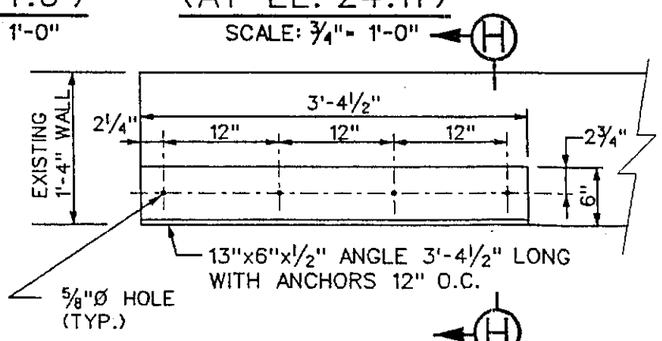


BEARING PLATE DETAIL
SCALE: 3/4"= 1'-0"

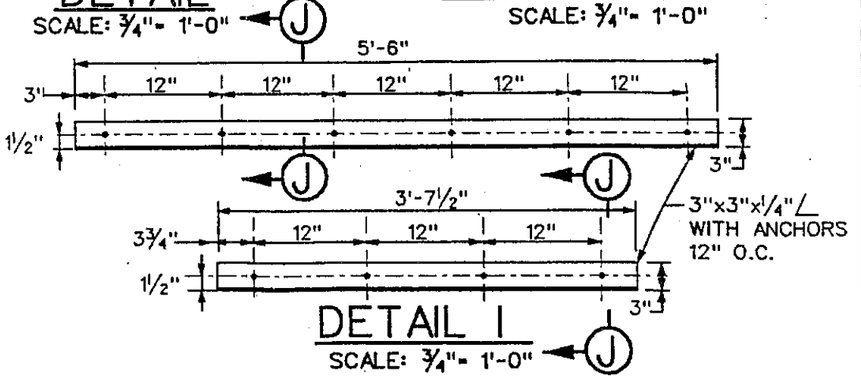
DETAIL OF TROUGH CONNECTIONS
SCALE: 3/4"= 1'-0"



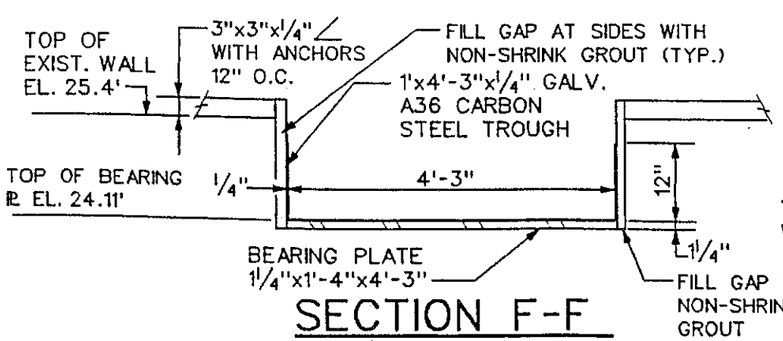
SECTION F-F (AT EL. 24.0')
SCALE: 1/2"= 1'-0"



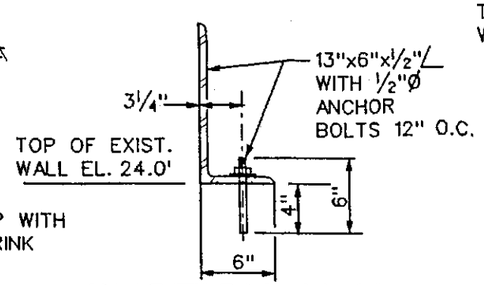
DETAIL G
SCALE: 3/4"= 1'-0"



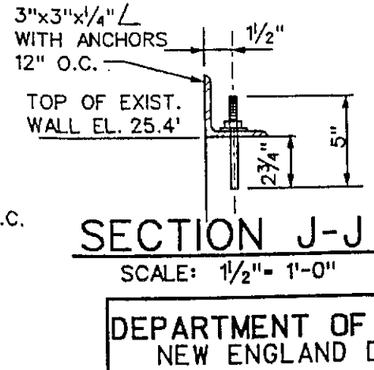
DETAIL I
SCALE: 3/4"= 1'-0"



SECTION F-F (AT EL. 24.11')
SCALE: 1/2"= 1'-0"



SECTION H-H
SCALE: 1"= 1'-0"



SECTION J-J
SCALE: 1 1/2"= 1'-0"

QUANTITY (FIELD VERIFY DIMENSIONS BEFORE FABRICATION):

- (1) 1'x4'-3"x1/4" TROUGH 4'-0" LONG
- (2) 1'x4'-3"x1/4" TROUGH 5'-4" LONG (MIN.)
- (2) 1 1/4"x1'-4"x4'-3" BEARING PLATE
- (1) 3"x3"x1/4" ANGLE 5'-6" LONG
- (1) 3"x3"x1/4" ANGLE 3'-7 1/2" LONG
- (1) 13"x6"x1/2" ANGLE 3'-4 1/2" LONG
- (2) 1'x4'-3"x1/4" TROUGH WELD BACKER/SPLICE PLATE-12" LONG

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NEW SECTIONS AND DETAILS

7/7

Explanation of Hydraulic Design Assumptions for Centre Street Junction Structure New Trough

As best as I could determine, the original design by Metcalf and Eddy, Inc for the Centre Street junction structure was that it should pass 10 cfs before water was diverted into the Burgin Parkway conduit. When the pipes were observed on 6 April, they were flowing close to capacity, which I roughly estimated as 4 cfs (although flow may have been restricted by upstream debris I did not see that day). Therefore, the design of the replacement trough was based on the assumption that a minimum of 10 cfs had to be passed before water spilled into the Burgin Parkway conduit, and that the hydraulic assumptions that predicted a 10 cfs capacity for the two pipe halves had actually produced a capacity of only 4 cfs.

Townsend Barker

File NEWTRGH.WK4 24-Sep-98

This calculates flow assuming inlet control

King & Brater table 5-5
Q=CLH^1.5
He

assume approach velocity of	2	fps
V^2/(2g)	0.06	
Depth	1.29	ft
He	1.35	ft
C	2.9	

What is average width of a 20-inch pipe?

20 in =	1.67	ft
Area	1.09	ft ^2
Height	0.83	
Ave width	1.31	ft
Ave width	15.7	in
Ave width 2	31.4	in

Length (in)	C	CLH^1.5 One pipe	Two pipes	
15.7	2.9	6.0	11.9	cfs
15.7	2	4.1	8.2	cfs
15.7	1	2.1	4.1	cfs

If the C of 2.9 and length of 15.7 in are correct, then inlet conditions are not controlling.
If the length is correct and inlet conditions are controlling, then C = 1.

For the new 1 x 4 ft culvert with an inlet wall height of 1.29 + 0.5 ft:

Length (ft)	He	C	CLH^1.5	
4	1.85	1	10.1	cfs
4	1.85	2.9	29.2	cfs

This says that a 1 x 4 ft culvert should not be constrained by inlet on normal depth in passing at least 10 cfs

File NEWTRGH.WK4 24-Sep-98

Calculates new structure to replace the old two 20" pipe halves in the Centre Street junction structure.

Existing two 20" pipe halves have an area of 2.18 ft^2

According to a 5 May 1998 MFR:

Slope of 0.11 ft over 14.75 ft length	0.007458	ft/ft
Manning's "n" assumed	0.015	
Hyd Rad	0.42	
Capacity	10	cfs

However, as observed on 6 April 1998, the actual capacity was more like 4 cfs

The existing two 20" pipes have a 4 ft wide footprint.

A box culvert 1 x 4 ft would have the following characteristics

Area	4	ft^2
Wetted P	6	ft
Hyd Rad	0.67	ft
Manning's "n"	0.015	
Slope	0.007458	ft/ft
Capacity	26	cfs

Reduced capacity based on 4 cfs observed to 10 cfs theoretical 10 cfs

Note: the above assumes that normal depth in the channel controls the flow. In reality, it is unlikely normal depth conditions will develop and become controlling in such a short distance.

File CSJHGT Analysis of Wall Height Increase 19-Feb-99

As part of the replacement of the two pipe halves in the Centre Street junction structure, it is necessary to raise the weir at the entrance to these pipes. This weir is slightly higher than the existing pipe halves to channel water into them.
The original idea was to raise this weir 3 inches; however, Francis Fung says that he needs to make an addition at least 6 inches thick for structural stability. He wants to know if the weir can be raised 6 inches; otherwise, the contractor will first have to cut 3 inches from the weir.

1. Determine width of weir.

M&E's plans show the opening as 7' 9" + 5' 10.5" =	13.625 ft
Width taken up by pipe halves =	4 ft
therefore, total length of weir =	9.625 ft

2. Determine height of weir crest above pipe halves

Invert of pipe halves at upstream end =	24.11 ft
Thickness of pipe =	0.07 ft
Radius of 20" pipe =	0.83 ft
Top of pipe =	25.01 ft
Top of wall (weir crest) =	25.40 ft, from Section 1/5 of drwg 5 of 7
Height of weir crest above pipe halves =	4.64 inches

3. Determine entrance losses into existing pipe halves
Treat the openings as orifices with a high "C" to account for being open at the top
Q=CA(2gh)^.5
take one pipe half and multiply by 2 for total capacity

a =	1.09 ft^2
h =	0.87 ft^2
C =	0.90
q =	7.36 cfs
Q =	14.72 cfs

4. Adjust estimate to match M&E's design
As explained in a 28 Sept 1998 memo to the file, M&E's estimate of the capacity

of the 2 pipe halves =	15.8 cfs
This estimate is based on Manning's equation with an "n" of	0.010
Therefore, a C of	0.97
would give a capacity of	15.8 cfs

5. Calculate capacity of 1' x 4' trough

A =	4 ft^2
C =	0.97
h =	0.79
Q =	27.6 cfs

6. Calculate capacity of 1x4' trough with 3" higher weir crest

A =	4 ft^2
C =	0.97
h =	1.04
Q =	31.6 cfs

Based on these numbers, it does not look like we really need to add the extra 3 inches of wall height, because it doesn't give us that much more capacity. Most of the capacity increase comes from having more cross sectional area.