

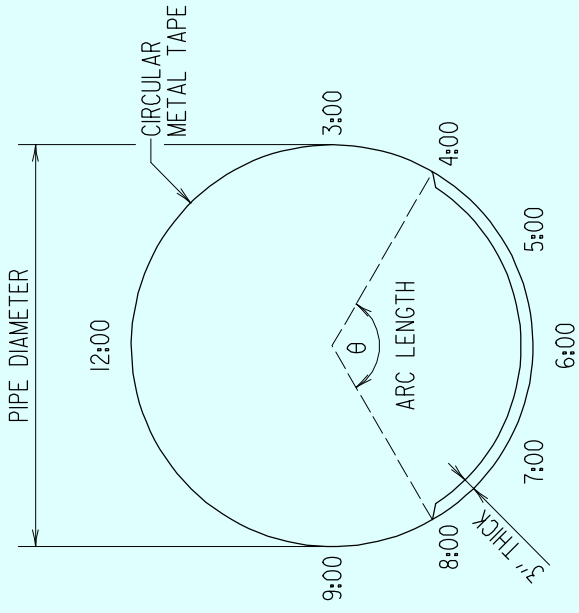
## Chapter 11 - Structural Repairs

### SECTION 08

# PAVED INVERTS (SR-PI)

DESIGN GUIDELINES FOR PAVED INVERTS

1. All structures selected for an invert paving shall be free of any widespread defects above the 3:00 to 9:00 positions. If these types of defects are present, consider either a pipe lining repair or total replacement.
2. For circular pipes, use the chart below to maximize the paving width to the 10% rule if possible, pave to the 3:00 and 9:00 positions.
3. Apply coal tar epoxy to all damaged, missing, and/or cracked areas of existing coating above the proposed paving. If an existing coating is not present, apply coal tar epoxy to the pipe above the paving, for the entire length of the structure.



$$\text{arc length} = \text{diameter} \times \pi \times \frac{\theta}{360}$$

$$\text{area} = \text{arc length} \times 3 \text{ in.}$$

Paving ARC Properties for Various Ranges of Invert Deterioration

- \*For the three ranges of invert deterioration (3:00-9:00, 4:00-8:00, 5:00-7:00) the arc length to be paved is in the left column and corresponding.
- \*The proposed paving lengths that exceed the 10% rule are shaded in grey.
- \*The proposed paving is 3 in. thick.

Circular Pipe Dia. (ft.)	Total Pipe Area (ft. <sup>2</sup> )	Paving Area Not to Exceed 10% (ft. <sup>2</sup> )	Max Paving Length	Paving ARC Properties					
				3:00-9:00 (θ = 180°)		4:00-8:00 (θ = 120°)		5:00-7:00 (θ = 60°)	
				Length (ft.)	Area (ft. <sup>2</sup> )	Length (ft.)	Area (ft. <sup>2</sup> )	Length (ft.)	Area (ft. <sup>2</sup> )
3.0	7.07	0.71	2.8	4.71	1.18	3.14	0.79	1.57	0.39
4.0	12.57	1.26	5.0	6.28	1.57	4.19	1.05	2.09	0.52
4.5	15.90	1.59	6.4	7.07	1.77	4.71	1.18	2.36	0.59
5.0	19.63	1.96	7.9	7.85	1.96	5.24	1.31	2.62	0.65
5.5	23.76	2.38	9.5	8.64	2.16	5.76	1.44	2.88	0.72
6.0	28.27	2.83	11.3	9.42	2.36	6.28	1.57	3.14	0.79
6.5	33.18	3.32	13.3	10.21	2.55	6.81	1.70	3.40	0.85
7.0	38.48	3.85	15.4	11.00	2.75	7.33	1.83	3.67	0.92

\* FOR OFFICE USE ONLY \*

APPROVAL	
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OFFICE OF STRUCTURES	
DATE: 06/28/2017	
VERSION	
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
STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

DESIGN GUIDELINES  
FOR PAVED INVERTS

DETAIL NO. SR-PI-101 SHEET    OF

GENERAL NOTES

- Specifications: - SHA Specifications dated May, 2017.  
 - Revisions thereof and additions thereto and Special Provisions for Materials and Construction.
- Grout: Refer to Section 486.
- Reinforcing Steel: Reinforcing steel shall conform to ASTM A615 or A706, Grade 60. Lap longitudinal reinforcing a minimum of 1'-0", where required.
- Existing Structure: All dimensions affected by the geometrics, and/or location of the existing structure shall be checked by the Contractor, before any work is done, and before any material is ordered or fabricated. It shall be the responsibility of the Contractor to supply the Engineer with all field dimensions required to check all detail drawings. The (±) marks shown with dimensions do not indicate any degree of precision. These marks (±) indicate existing dimensions that may vary and do require field verification by the Contractor.
- Existing structure shown in dashed lines.
- Finished slope of the new paved surface shall match the existing.
- Welding: All welding shall conform to 430.03.19 and 430.03.20. All field welding shall be done by the shielded metal-arc process. All requirements shall be adhered to except the requirements for radiographic and ultrasonic inspection may be waived if a visual inspection by the Engineer indicates the welds are satisfactory for the purpose intended.
- Coal Tar Epoxy: Coating shall comply with AASHTO 190 or equal.
- Construction Joints: Entire face of any construction joint shall be coated with an approved epoxy bonding compound. Reinforcing steel shall be continuous through joint. All joints shall be bulkheaded to provide a vertical surface.
- Maintenance of Traffic: Use Standard No.
- Work Required: (List items of work)

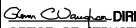
<b>APPROVAL</b>  DIRECTOR OFFICE OF STRUCTURES DATE: 08/11/2017	STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES  INVERT PAVING OF EXISTING PIPE GENERAL NOTES
<b>VERSION</b>  1.01	DETAIL NO. SR-PI-102 <span style="float: right;">SHEET <u>  </u> OF <u>  </u></span>

STRUCTURAL REPAIRS

GENERAL NOTES



- Specifications: - SHA Specifications dated May, 2017.  
 - Revisions thereof and additions thereto and Special Provisions for Materials and Construction.
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- Existing structure shown in dashed lines.
- Finished slope of the new paved surface shall match the existing.
- Welding: All welding shall conform to 430.03.19 and 430.03.20. All field welding shall be done by the shielded metal-arc process. All requirements shall be adhered to except the requirements for radiographic and ultrasonic inspection may be waived if a visual inspection by the Engineer indicates the welds are satisfactory for the purpose intended.
- Coal Tar Epoxy: Coating shall comply with AASHTO 190 or equal.
- Construction Joints: Entire face of any construction joint shall be coated with an approved epoxy bonding compound. Reinforcing steel shall be continuous through joint. All joints shall be bulkheaded to provide a vertical surface.
- Erosion and Sediment Control: All disturbed areas shall be stabilized at the end of each work day. No disturbed area shall be left unstabilized overnight unless the runoff is directed to an MDE approved sediment control device.
- Maintenance of Traffic: Use Standard No.
- Work Required: (List items of work)

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<b>APPROVAL</b>  DIRECTOR OFFICE OF STRUCTURES DATE: 08/11/2017	STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES  INVERT PAVING OF EXISTING PIPE GENERAL NOTES
<b>VERSION</b>  1.01	
DETAIL NO. SR-PI-103 <span style="float: right;">SHEET <u>  </u> OF <u>  </u></span>	

STRUCTURAL REPAIRS


NOTES

1. Size and location of water pump to be determined by contractor.
2.  Denotes limits of invert paving.
3.  Denotes limits of undermined area to be filled with grout.
4. —LOD— Denotes limit of disturbance.
5. —LOA— Denotes limits of access. LOA is the designated area where only foot traffic and work requiring hand held equipment is allowed. No heavy machinery is permitted to be driven or stored within this area. All access disturbances shall be minimal and any disturbance shall be stabilized at the end of each work day. No work is to be conducted outside of the limits of access or disturbance, unless expressed in writing by the MDE Compliance Inspector prior to the change. In addition, the engineer shall contact EPD and MDE at the initiation and completion of this project for compliance.
6. —WET— Denotes limit of wetland.
7. —B— Denotes limit of buffer.
8. —ROW— Denotes limits of right-of-way.
9. (0,0) Number shown circled are field measurements of stream depth in feet as taken on (insert date).
10. Invert paving shall be finished in a workmanlike manner having a cross section conforming to the details with neat edges sloped to drain. The invert shall have a smooth uniform surface that does not exhibit any deformations from the underlying corrugations.
11. The discharge from any construction dewatering area shall be passed through an approved sediment control device. This device may be bypassed if the water being pumped is clear and there is a stabilized outfall. The engineer shall be the sole judge if the sediment control device can be bypassed.
12. If the length of existing deterioration to the pipe extends beyond the limits of proposed paving, the Office of Structures shall be notified immediately to determine if additional paving is required.

<p style="text-align: center; margin: 0;">APPROVAL</p> <p style="margin: 0;"><i>Ben C. Dwyer</i> DIRECTOR OFFICE OF STRUCTURES</p> <p style="margin: 0;">DATE: 06/28/2017</p>	<p style="margin: 0;">STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES</p> <p style="margin: 10px 0 0 0;">INVERT PAVING OF EXISTING PIPE CONSTRUCTION NOTES</p>
<p style="text-align: center; margin: 0;">VERSION</p> <p style="text-align: center; margin: 5px 0 0 0;">1.0</p>	<p style="margin: 0;">DETAIL NO. SR-PI-104 <span style="float: right;">SHEET <u>  </u> OF <u>  </u></span></p>

NOTES

1. The contractor is advised that even small amounts of precipitation can cause flash flooding at any time. The contractor shall obtain updated weather reports each morning and afternoon, and more often when precipitation is in the forecast or appears eminent in the area of work or any surrounding area that the runoff may have an adverse affect on the project site. Prior to beginning work at each jobsite, the contractor shall establish an emergency plan of action with all personnel to evacuate the area should there be any flash flood warnings.
2. If existing structure has been previously lined with asphalt paving, contractor shall completely remove asphalt paving in entire area to be paved. See note 7 Sequence of Construction.
3. The contractor may have to temporarily remove and reset a portion of the existing W-beam traffic barrier daily to accommodate staging needs, if applicable.
4. No heavy equipment shall be used within the area of the stream or floodplain due to the presence of adjacent wetlands.
5. The contractor shall provide the proper ventilation in the structure in conformance with TC-3.04 of the latest OSHA regulations.

<b>APPROVAL</b>  DIRECTOR OFFICE OF STRUCTURES DATE: 06/28/2017	STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
<b>VERSION</b>  1.0	INVERT PAVING OF EXISTING PIPE NOTICE TO CONTRACTORS
	DETAIL NO. SR-PI-105 <span style="float: right;">SHEET <u>  </u> OF <u>  </u></span>

STRUCTURAL REPAIRS

NOTES

1. The contractor is advised that even small amounts of precipitation can cause flash flooding at any time. The contractor shall obtain updated weather reports each morning and afternoon, and more often when precipitation is in the forecast or appears eminent in the area of work or any surrounding area that the runoff may have an adverse affect on the project site. Prior to beginning work at each jobsite, the contractor shall establish an emergency plan of action with all personnel to evacuate the area should there be any flash flood warnings.
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APPROVAL					
DIRECTOR OFFICE OF STRUCTURES DATE: 06/28/2017					
VERSION					
1.0					
DETAIL NO. SR-PI-106	SHEET <u>  </u> OF <u>  </u>				

STRUCTURAL REPAIRS

SEQUENCE OF CONSTRUCTION

1. Set up sediment and erosion control devices.
2. Install sediment bag. Sediment bag shall be placed outside of 25' buffer zone.
3. Place upstream and downstream diversion dikes at locations specified by the Engineer. Diversion dike to be built to a height 1' above the normal water level using sand bags, concrete barrier wrapped in polyvinyl plastic, or a Portadam system, or a combination of these. Install a stable velocity dissipater made of riprap or sand bags at the hose outfall before initiating pumping.
4. Place pump and hose at proper locations and initiate pumping.
5. The stream diversion shall ensure that a reasonably dry work area is continuously maintained during construction of the project and that excess sediment is contained within the limits of disturbance. When needed, the Contractor shall use pits dug into the invert of the pipe at intervals and locations as directed by the engineer to draw down the water leaking into the pipe from holes or seams in the pipe. The Contractor can plug the leaking areas as directed by the engineer or do both of these options as needed.
6. Water blast clean the entire area to be paved, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
7. After area to be paved is clean and dry, place reinforcing steel and pave invert of pipe to limits shown. See details on this drawing. Let grout cure for 36 hours from the end of the last pour, before permitting water to flow over it. The finish surface shall be a broom finish that is protected during the curing process in conformance with 420.03.09 (b), (c), (d) or (f).
8. If Contractor chooses staged construction, repeat steps 5 through 7 until all of invert is paved.
9. Apply coal tar epoxy protective coating so that it covers the entire unpaved portion of the existing pipe and 4" on the top of the new grout invert in accordance with the manufacturer's recommendation. If the pipe does have a protective coating in good condition, this new protection shall lap the original coating where the existing protective coating has been removed from the pipe for the preparation of the installation of the new paved invert.
10. If more than one pipe is to be paved individually, repeat steps 3 through 8 for each pipe. If the Contractor wants to use the existing pipes for diverting the water, if the structure has multiple pipes, the Contractor shall get approval from the Maryland Department of Environment, MDE.
11. Complete any specified repairs including scour countermeasures in accordance with the specification. These can be done anytime between Steps 6 and 12.
12. Remove sediment and erosion control devices and return construction area to preconstruction conditions or better.

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DIRECTOR OFFICE OF STRUCTURES						
DATE: 06/28/2017						
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STRUCTURAL REPAIRS



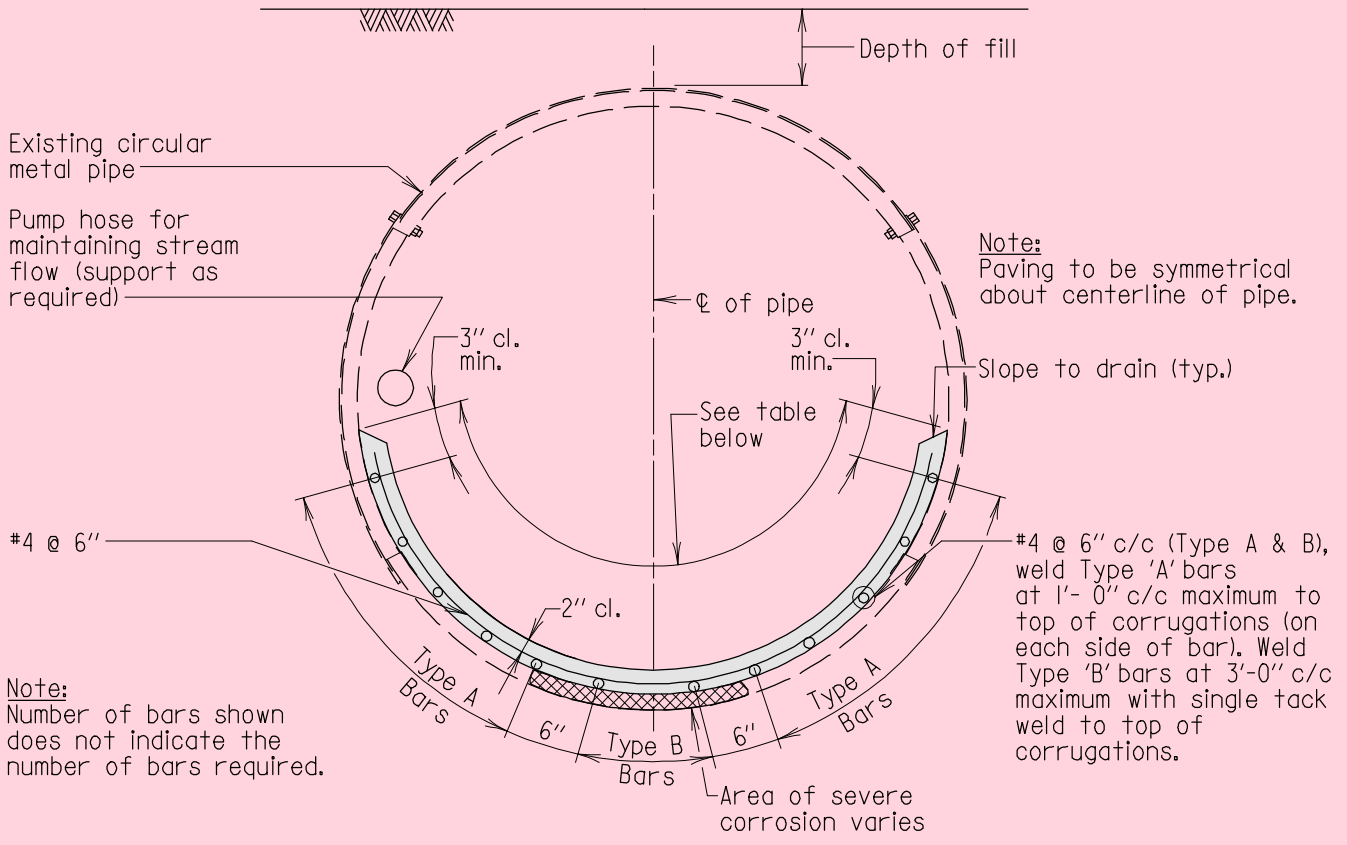
SEQUENCE OF CONSTRUCTION

1. Notify the Maryland Department of the Environment (MDE) at (410)537-3510 a minimum of ten (10) days prior to the start of construction.
2. Set up sediment and erosion control devices.
3. Install sediment bag. Sediment bag shall be placed outside of 25' buffer zone.
4. Place upstream and downstream diversion dikes at locations specified by the Engineer. All flows and dewatering for each stage shall be controlled, including control of secondary in flows. Diversion dike to be built to a height of 1' above normal water level using sand bags, concrete barrier wrapped in polyvinyl plastic, or a Portadam system, or a combination of these. Install a stable velocity dissipater made of single layer, 19" minimum length by 12" width of Class I riprap or Class SE geotextile or sandbags at the hose outfall before initiating pumping. Velocity dissipater is not required if outfall discharges into the concrete or steel invert of another structure instead of a natural stream bottom.
5. Place pump and hose at proper locations and initiate pumping.
6. The stream diversion shall ensure that a reasonably dry work area is continuously maintained during construction of the project and that excess sediment is contained within the limits of disturbance. When needed, the Contractor shall use pits dug into the invert of the pipe at intervals and locations as directed by the engineer to draw down the water leaking into the pipe from holes or seams in the pipe. The Contractor can plug the leaking areas as directed by the engineer or do both of these options as needed.
7. Water blast clean the entire area to be paved, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
8. After area to be paved is clean and dry, place reinforcing steel and pave invert of pipe to limits shown. See details on this drawing. Let grout cure for 36 hours from the end of the last pour, before permitting water to flow over it. The finish surface shall be a broom finish that is protected during the curing process in conformance with 420.03.09 (b), (c), (d) or (f).
9. If Contractor chooses stage construction, repeat steps 5 through 8 until all of invert is paved.
10. Apply coal tar epoxy protective coating so that it covers 8" of the existing pipe above and 4" on the top of the new grout invert in accordance with the manufacturer's recommendation. If the pipe does have a protective coating, this new protection shall lap the original coating where the existing protective coating has been removed from the pipe for the preparation of the installation of the new paved invert.
11. If more than one pipe is to be paved individually, repeat steps 3 through 8 for each pipe. If the Contractor wants to use the existing pipes for diverting the water, if the structure has multiple pipes, the Contractor shall get approval from the Maryland Department of Environment, MDE.
12. Complete any specified repairs including scour countermeasures in accordance with the specification. These can be done anytime between Steps 7 and 13.
13. With approval from the MDE inspector, remove sediment and erosion control devices and return construction area to preconstruction conditions or better. Permanently stabilize area disturbed by removal of erosion and sediment control devices.

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APPROVAL					
DIRECTOR OFFICE OF STRUCTURES DATE: 06/28/2017					
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DETAIL NO. SR-PI-108	SHEET <u>  </u> OF <u>  </u>				

STRUCTURAL REPAIRS



Note:  
Number of bars shown does not indicate the number of bars required.

Note:  
Paving to be symmetrical about centerline of pipe.

TYPICAL SECTION (CIRCULAR PIPE)  
Scale: 1/2" = 1'-0"

Structure No.	
# of pipes to be paved	
Length of individual pipes to be paved	
Diameter of pipe	
Depth of fill	
Overall width to be paved	
# of 'B' bars	
# of 'A' bars on each side of ϕ of pipe	

Note:  
Overall width to be paved is measured along circumference of pipe.

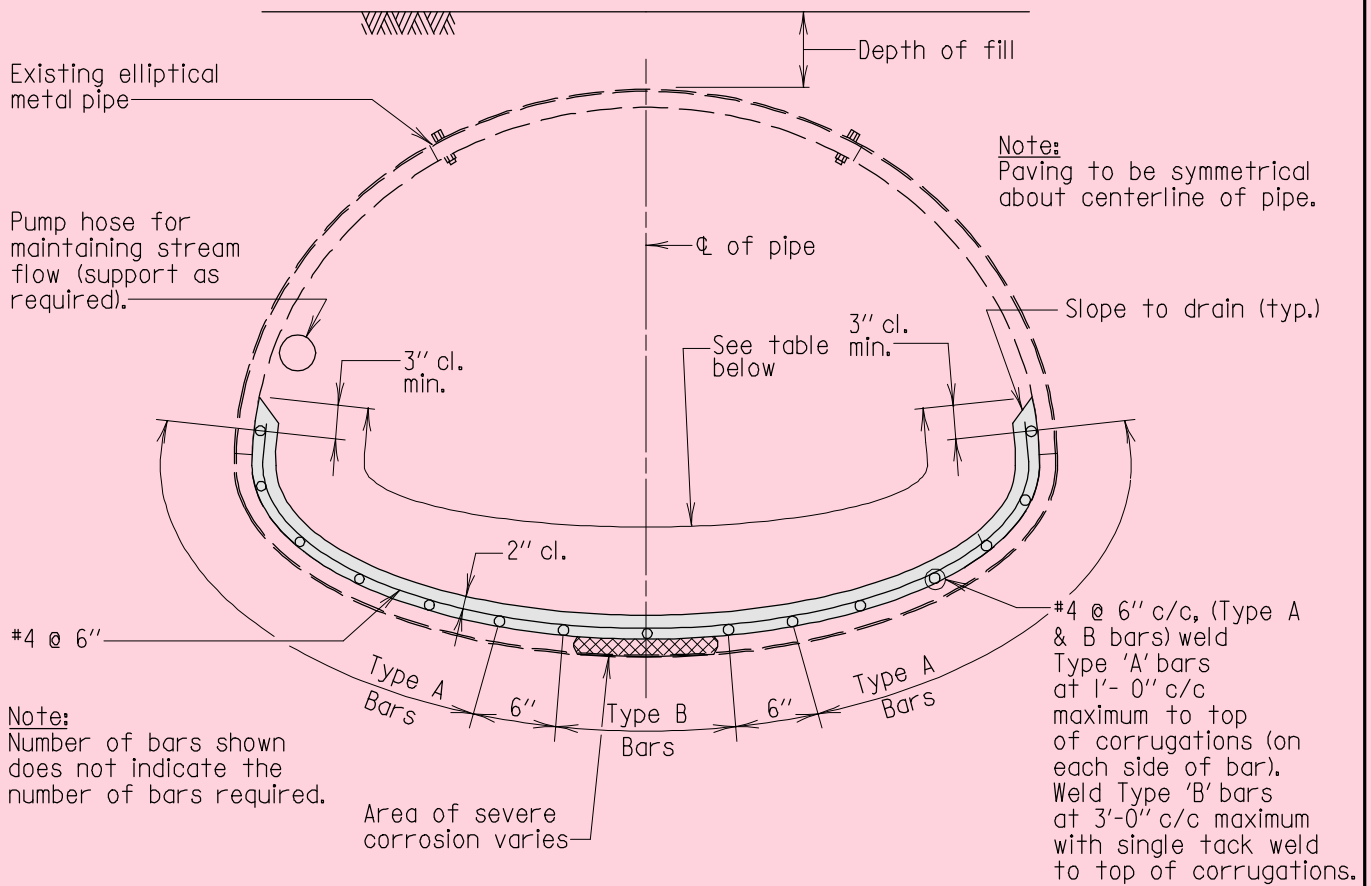
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<i>[Signature]</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 06/28/2017
VERSION
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STATE OF MARYLAND  
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STATE HIGHWAY ADMINISTRATION  
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INVERT PAVING OF EXISTING CIRCULAR METAL PIPE

DETAIL NO. SR-PI-201 SHEET    OF   

STRUCTURAL REPAIRS



**TYPICAL SECTION (PIPE ARCH)**

Scale: 1/2" = 1'-0"

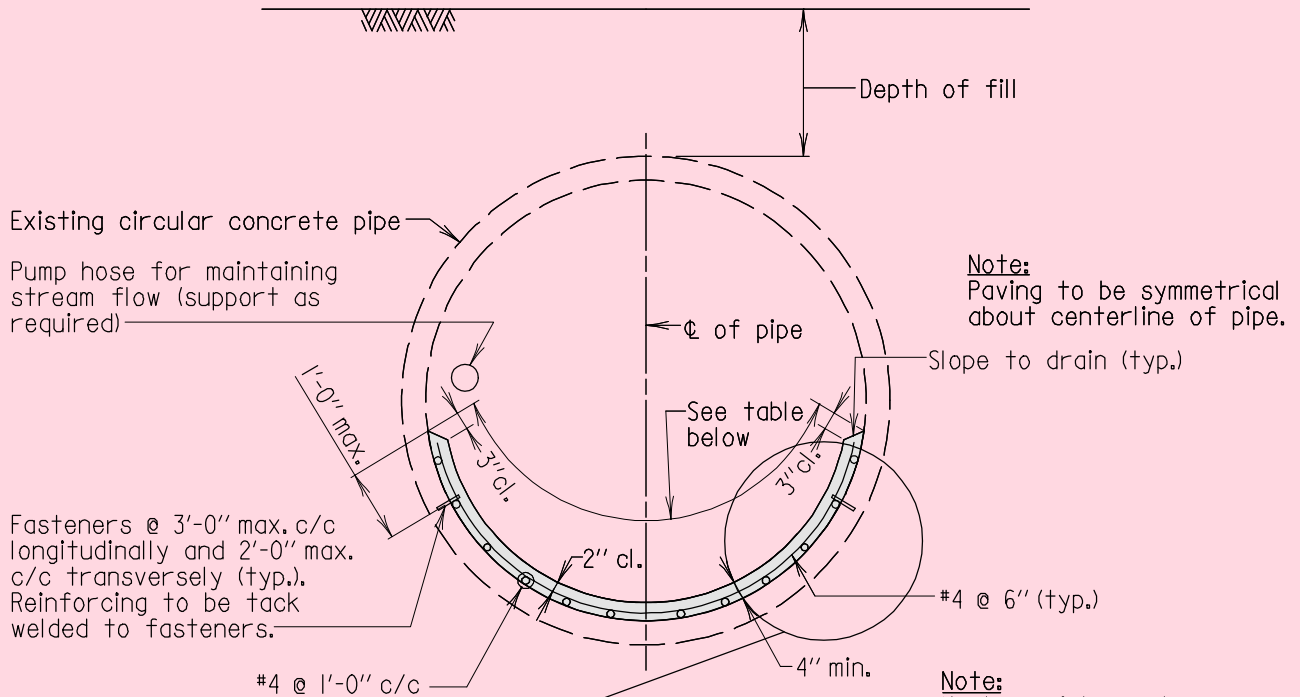
Structure No.	
# of pipes to be paved	
Length of individual pipes to be paved	
Span and rise of pipe	
Depth of fill	
Overall width to be paved	
# of 'B' bars	
# of 'A' bars on each side of $\phi$ of pipe	

Note:  
Overall width to be paved is measured along circumference of pipe.

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DATE: 06/28/2017
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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
INVERT PAVING OF EXISTING METAL PIPE ARCH	
DETAIL NO.	SR-PI-202
SHEET	1 OF 1

STRUCTURAL REPAIRS



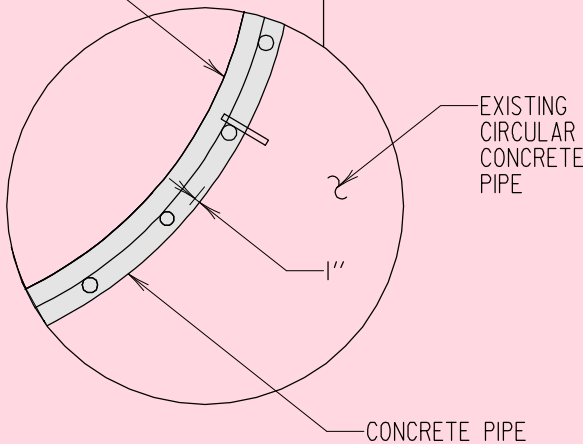
**Note:**  
Paving to be symmetrical about centerline of pipe.

**Note:**  
Number of bars shown does not indicate the number of bars required.

PROPOSED PAVED INVERT

TYPICAL SECTION (CIRCULAR CONCRETE PIPE)

Scale:  $\frac{3}{8}'' = 1'-0''$



Structure No.	
# of pipes to be paved	
Length of individual pipes to be paved	
Diameter of pipe	
Depth of fill	
Overall width to be paved	

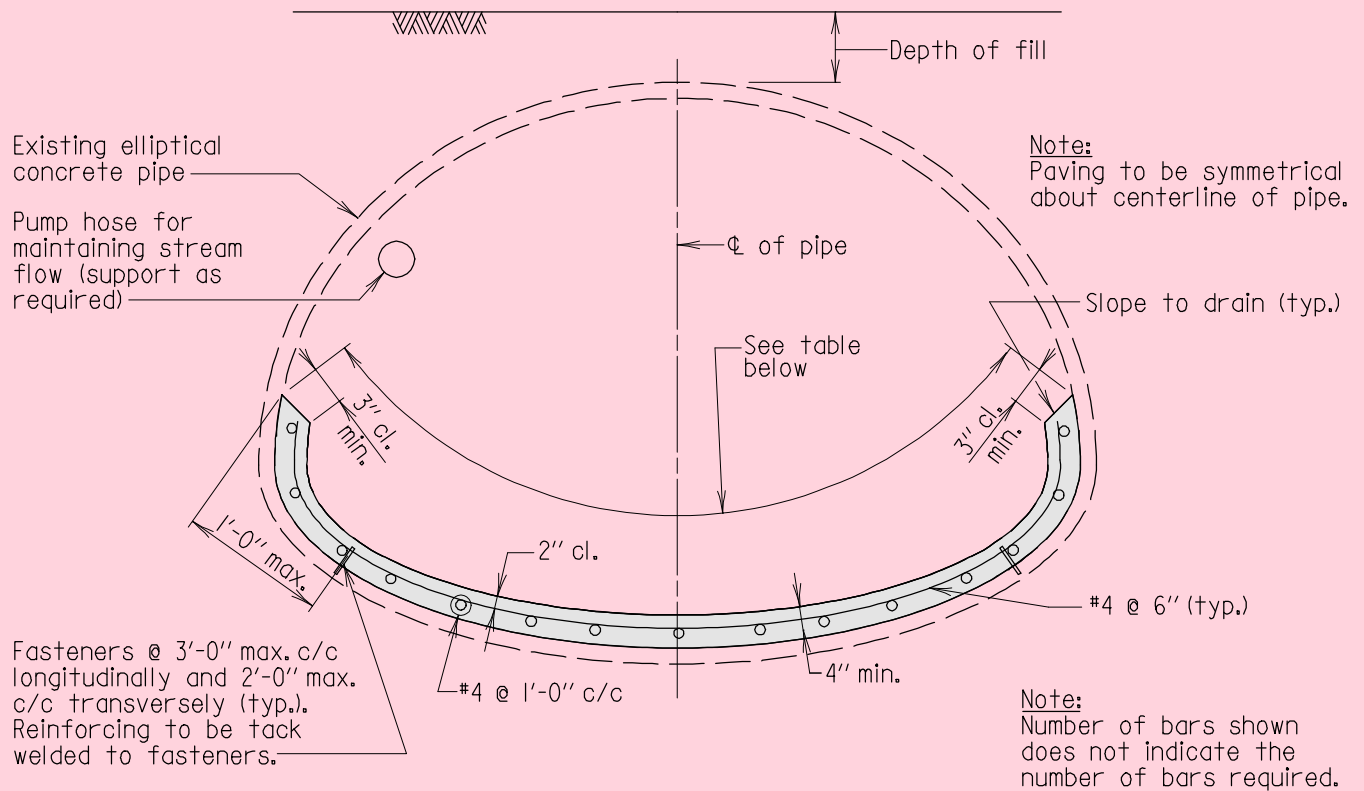
**Notes:**

1. The invert of the pipes shall not be paved until unsound concrete is removed from existing invert.
2. Contractor to provide a smooth transition between pipe sections and/or structure transitions. The transition shall extend 3'-0" into or from the circular concrete pipe.
3. The elevation of the pipe invert shall be placed to avoid any ponding or disruption in the stream flow.
4. All open pipe section joints and/or voids shall be filled with grout.
5. The proposed reinforcing steel shall be tack welded to anchored fasteners. Fasteners shall be epoxyed to a minimum depth of 1" into the existing concrete pipe. The minimum fastener diameter shall be  $\frac{3}{8}''$ . The installed fasteners shall have a pull out resistance of 85 lbs. and a shear resistance of 195 lbs. A height above the pipe invert of 1" shall remain exposed for tack welding the reinforcement bars to.

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DATE: 06/28/2017
<b>VERSION</b>
1.0

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
INVERT PAVING OF EXISTING CIRCULAR CONCRETE PIPE	
DETAIL NO. SR-PI-203	SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



TYPICAL SECTION (ELLIPTICAL CONCRETE PIPE)

Scale:  $\frac{3}{4}'' = 1'-0''$

Structure No.	
# of pipes to be paved	
Length of individual pipes to be paved	
Span and Rise of pipe	
Depth of fill	
Overall width to be paved	

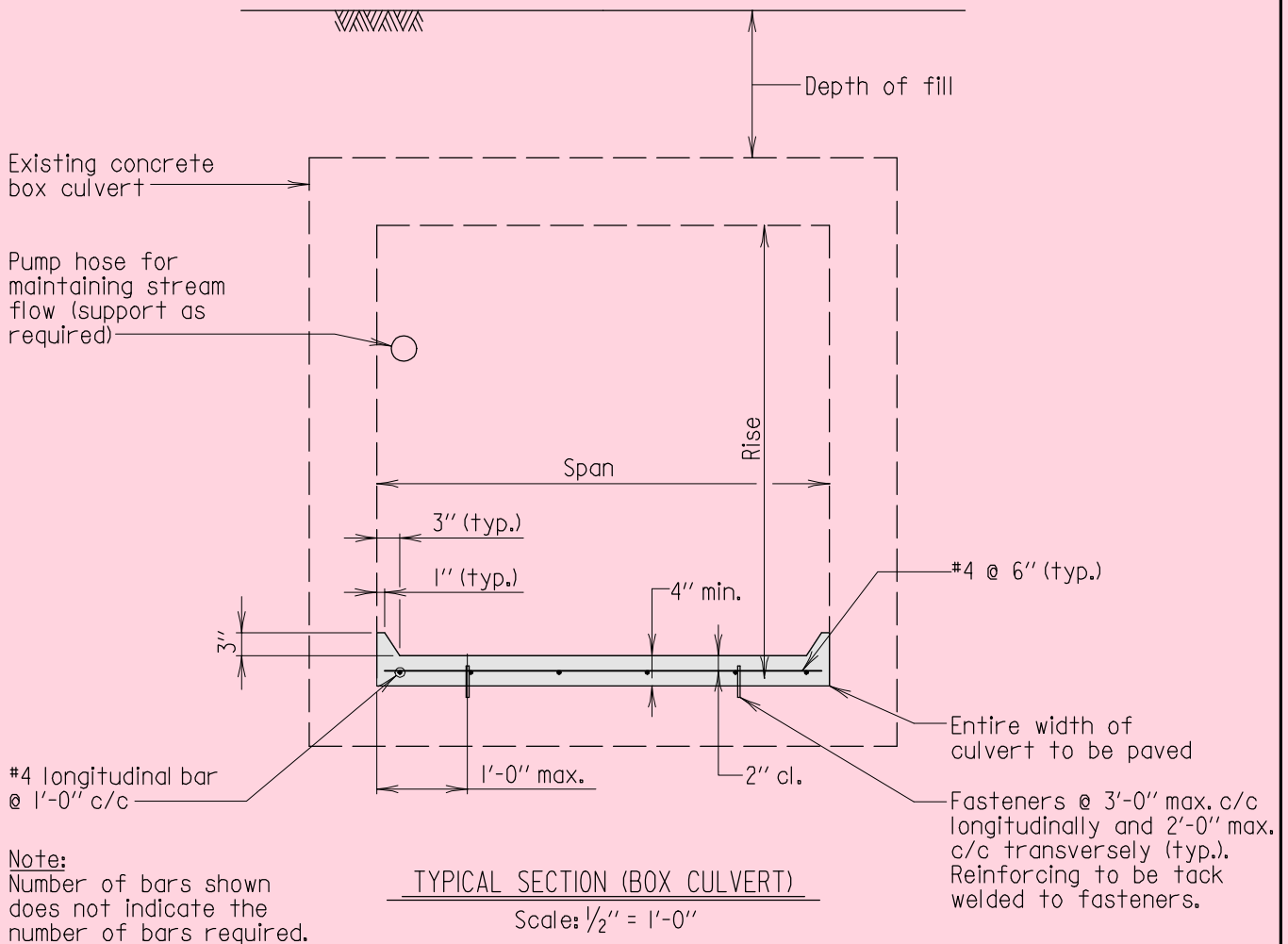
Notes:

1. The invert of the pipes shall not be paved until unsound concrete is removed from existing invert.
2. Contractor to provide a smooth transition between pipe sections and/or structure transitions. The transition shall extend 3'-0" into or from the circular concrete pipe.
3. The elevation of the pipe invert shall be placed to avoid any ponding or disruption in the stream flow.
4. All open pipe section joints and/or voids shall be filled with grout.
5. The proposed reinforcing steel shall be tack welded to anchored fasteners. Fasteners shall be epoxyed to a minimum depth of 1" into the existing concrete pipe. The minimum fastener diameter shall be  $\frac{3}{8}''$ . The installed fasteners shall have a pull out resistance of 85 lbs. and a shear resistance of 195 lbs. A height above the pipe invert of 1" shall remain exposed for tack welding the reinforcement bars to.

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<i>John C. [Signature]</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 06/28/2017
<b>VERSION</b>
1.0

<b>STATE OF MARYLAND</b> <b>DEPARTMENT OF TRANSPORTATION</b> <b>STATE HIGHWAY ADMINISTRATION</b> <b>OFFICE OF STRUCTURES</b>
INVERT PAVING OF EXISTING CONCRETE PIPE ARCH
DETAIL NO. SR-PI-204
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



**Note:**  
 Number of bars shown does not indicate the number of bars required.

TYPICAL SECTION (BOX CULVERT)  
 Scale: 1/2" = 1'-0"

Structure No.	
# of culverts to be paved	
Length of individual culverts to be paved	
Span of culvert	
Rise of culvert	
Depth of fill	

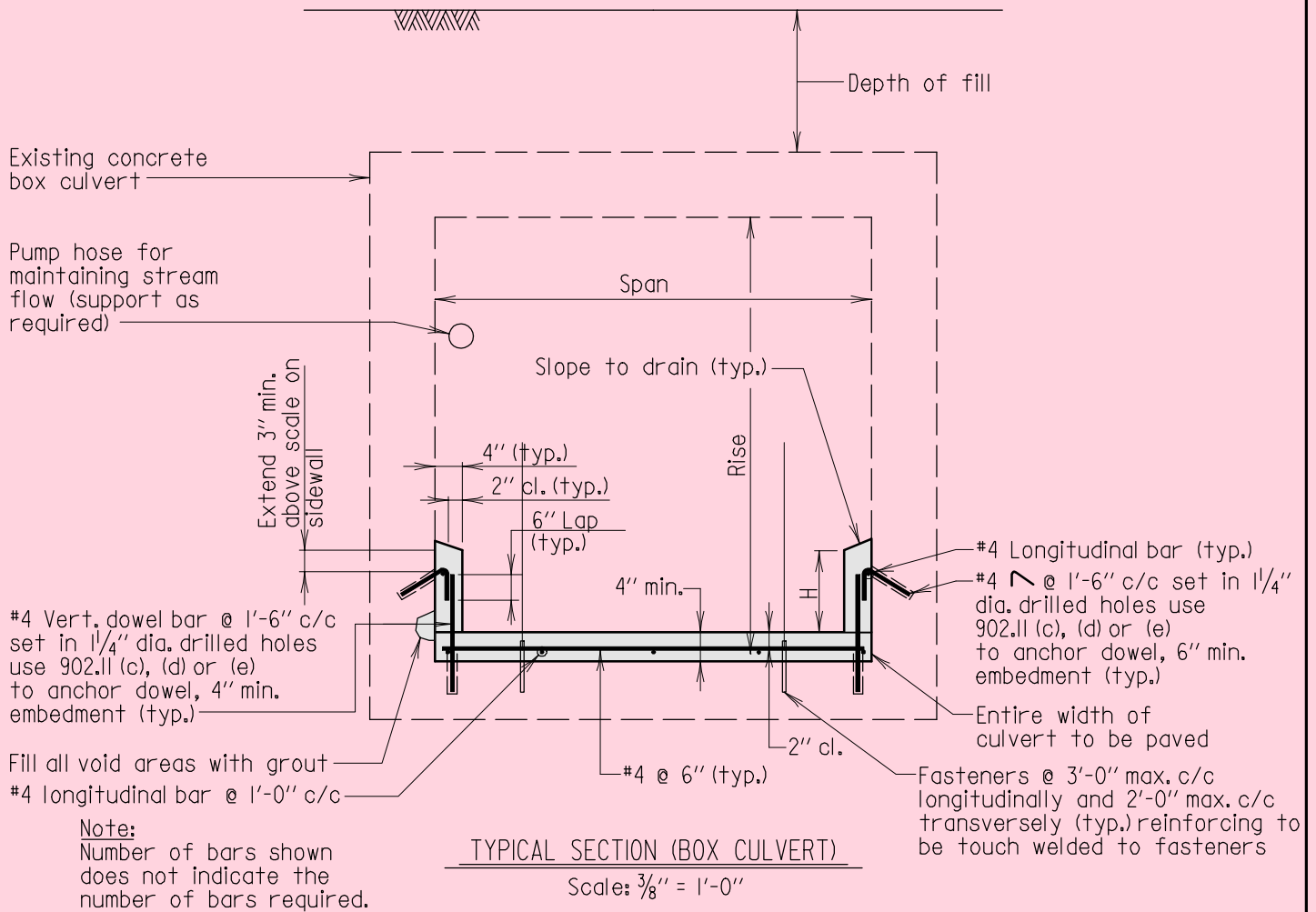
**Notes:**

1. The invert of the culverts shall not be paved until unsound concrete is removed from existing invert.
2. Contractor to provide a smooth transition between culvert sections and/or structure transitions. The transition shall extend 3'-0" into or from the circular concrete pipe.
3. The elevation of the culvert invert shall be placed to avoid any ponding or disruption in the stream flow.
4. All open culvert section joints and/or voids shall be filled with grout.
5. The proposed reinforcing steel shall be tack welded to anchored fasteners. Fasteners shall be epoxyed to a minimum depth of 1" into the existing concrete. The minimum fastener diameter shall be 3/8". The installed fasteners shall have a pull out resistance of 85 lbs. and a shear resistance of 195 lbs. A height above the culvert invert of 1" shall remain exposed for tack welding the reinforcement bars to.

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DATE: 06/28/2017
<b>VERSION</b>
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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
INVERT PAVING OF EXISTING BOX CULVERT
DETAIL NO. SR-PI-205
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



Structure No.	
# of culverts to be paved	
Length of individual culverts to be paved	
Span of culvert	
Rise of culvert	
Depth of fill	
Height of curtain wall	

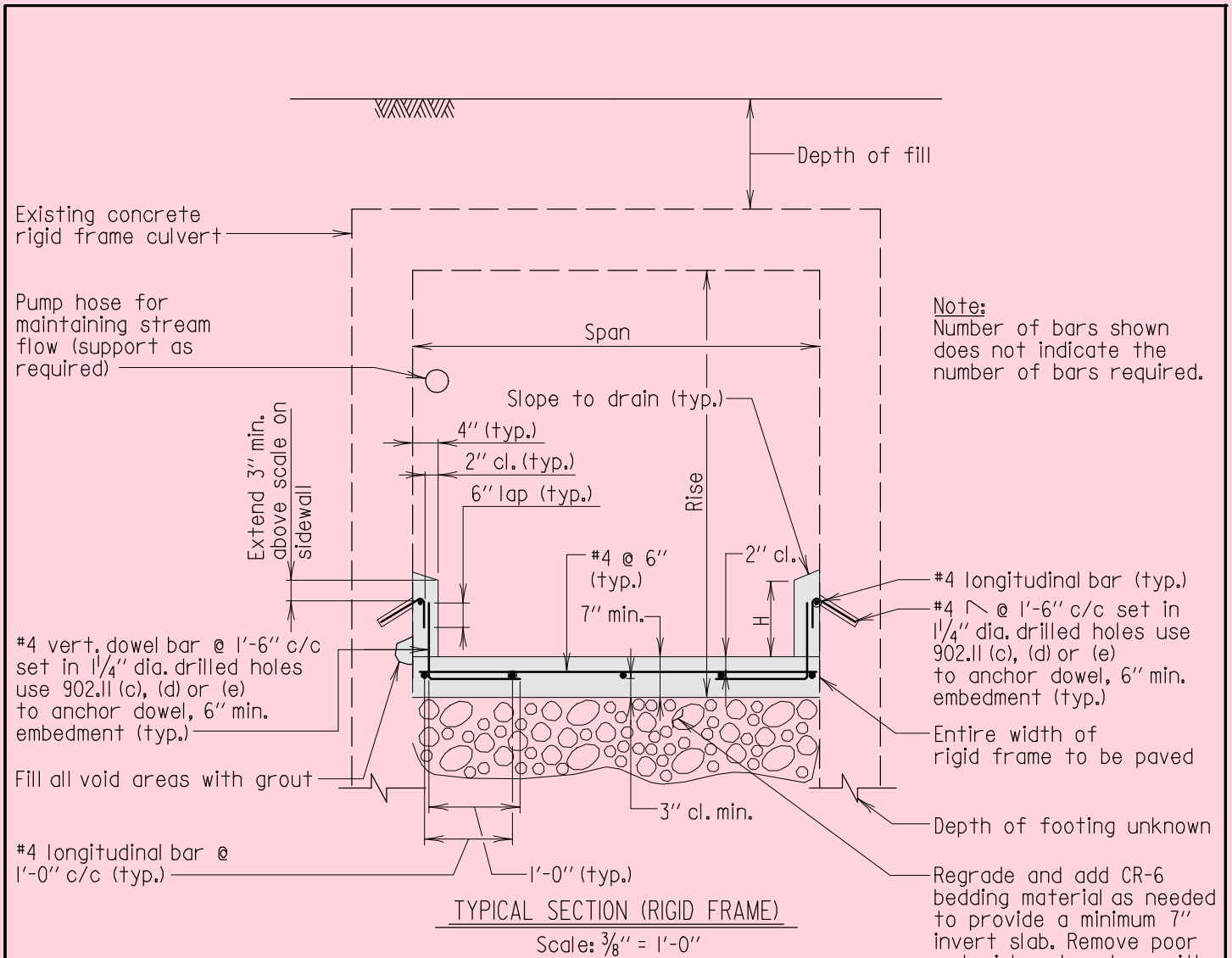
**Notes:**

- The invert of the box shall not be paved until unsound concrete is removed from existing invert. Place # 4 @ 6", 2" clear of top of proposed grout paving.
- If structure is comprised of a pipe and box culvert, the contractor shall provide a smooth transition between pipe and box. The transition shall extend 3'-0" into or from the box culvert.
- The elevation of the pipe invert and the box culvert invert should be equal to avoid any ponding or disruption in the stream flow.
- The proposed reinforcing steel shall be tack welded to anchored fasteners. Fasteners shall be epoxyed to a minimum depth of 1" into the existing concrete depth. The minimum fastener diameter shall be  $\frac{3}{8}''$ . The installed fasteners shall have a pull out resistance of 85 lbs. and a shear resistance of 195 lbs. A height above the culvert invert of 1" shall remain exposed for tack welding the reinforcement bars to.

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DATE: 06/28/2017
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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
INVERT PAVING OF EXISTING BOX CULVERT WITH CURTAIN WALL
DETAIL NO. SR-PI-206
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



Structure No.	
Number of culverts to be paved	
Length of culvert to be paved	
Span of culvert	
Rise of culvert	
Depth of fill	
Height of curtain wall	

Notes:

1. If at any point during the removal of the soil in side the rigid frame exposes the footer, dig until even with the top of the footer. Do not dig past the the bottom of the footer. Then, install a minimum 7" paved invert.
2. Place # 4 @ 6", 2" clear of top of proposed grout paving.
3. If structure is comprised of a pipe and rigid frame, the contractor shall provide a smooth transition between pipe and rigid frame. The transition shall extend 3'-0" into or from the rigid frame.
4. The elevation of the pipe invert and the rigid frame invert should be equal to avoid any ponding or disruption in the stream flow.

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DATE: 06/28/2017
<b>VERSION</b>
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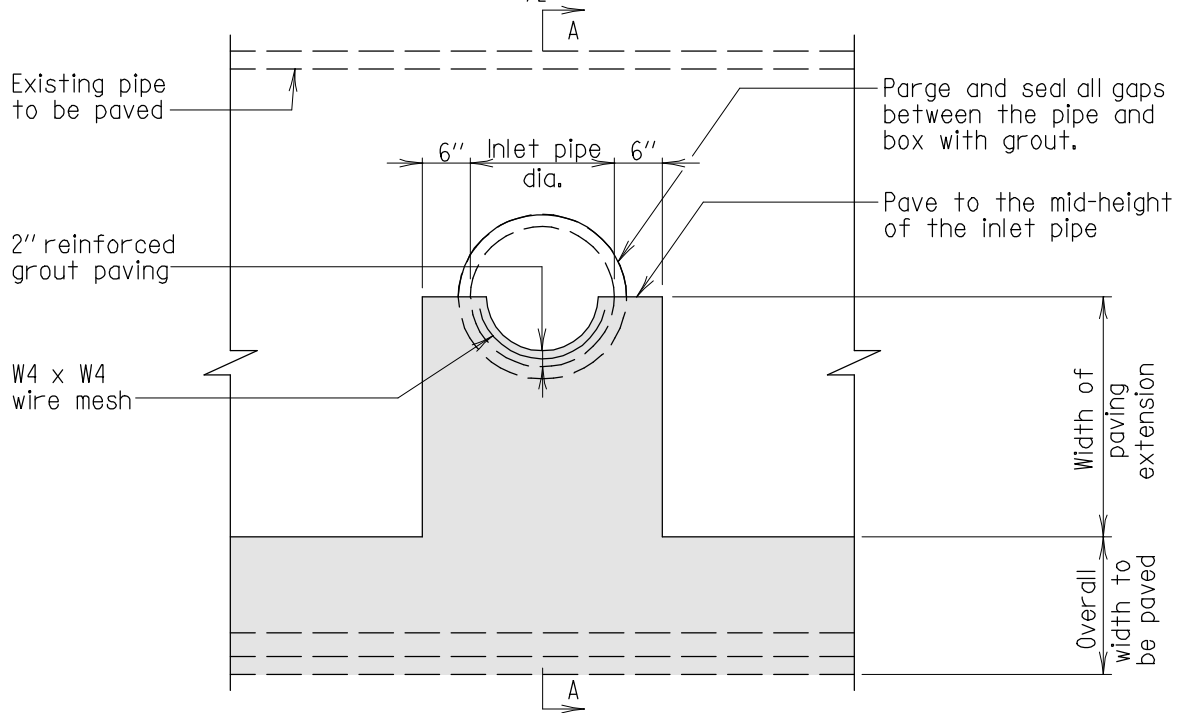
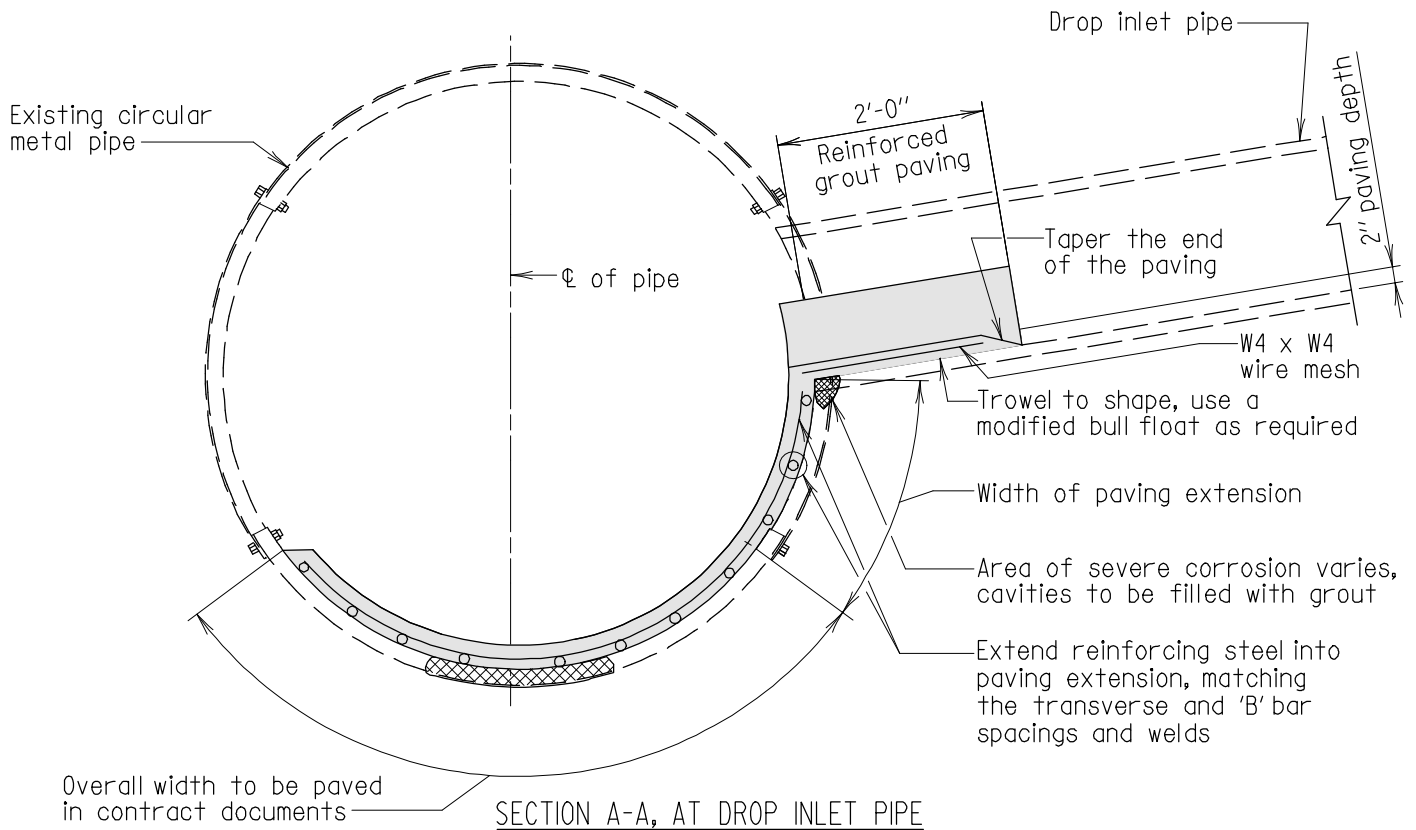
INVERT PAVING OF EXISTING RIGID FRAME CULVERT

DETAIL NO. SR-PI-207

SHEET    OF   

STRUCTURAL REPAIRS





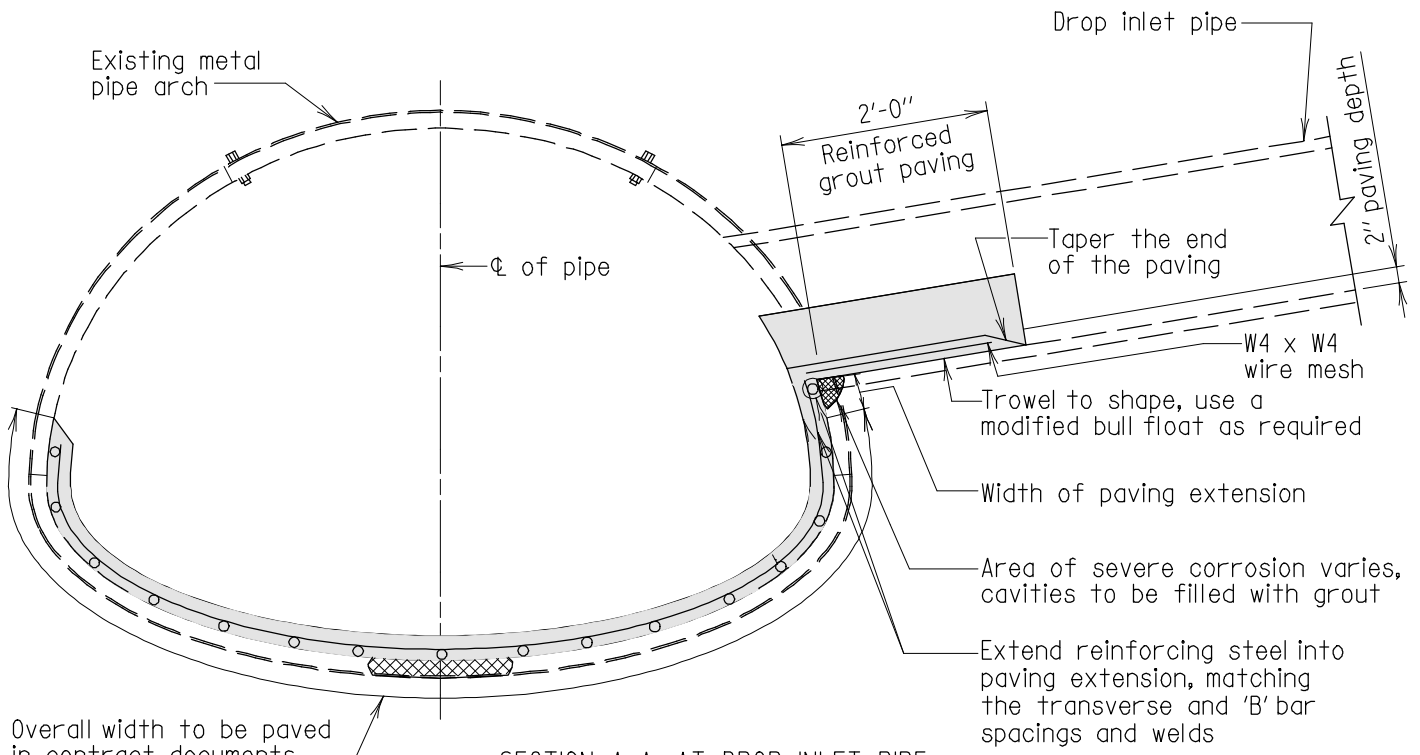
<b>APPROVAL</b>	
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STATE OF MARYLAND  
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INVERT PAVING OF EXISTING CIRCULAR METAL PIPE  
WITH DROP INLET PIPE

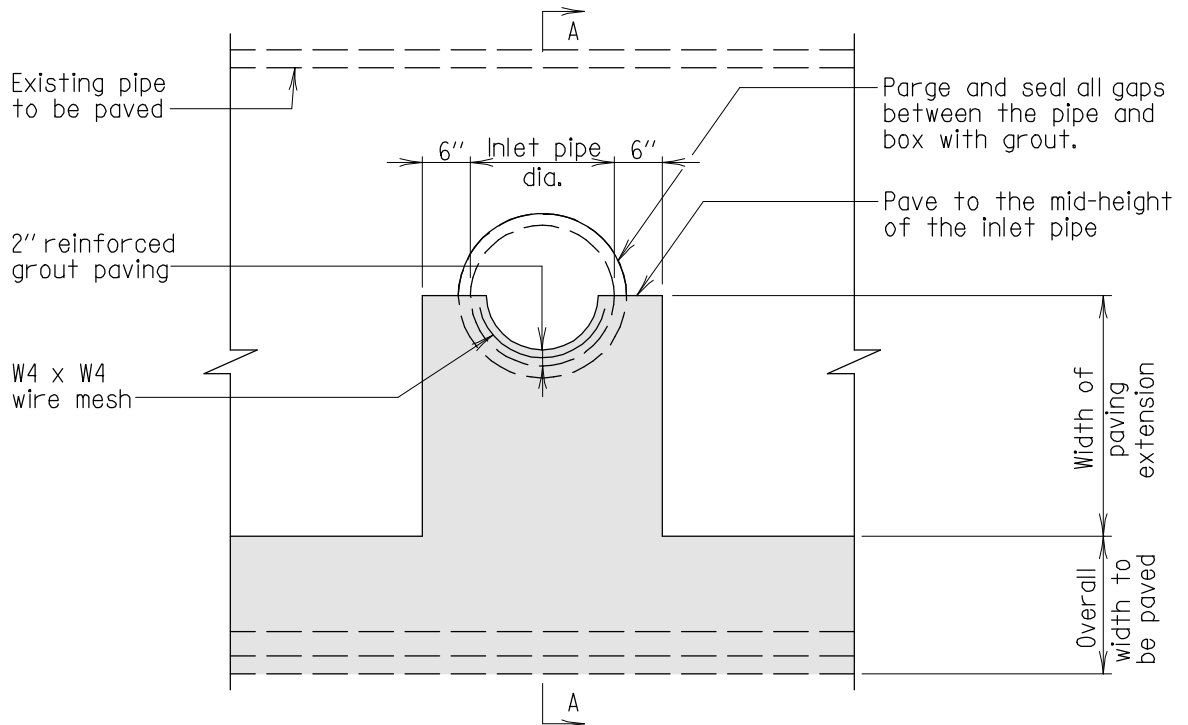
DETAIL NO. SR-PI-301 SHEET    OF   

STRUCTURAL REPAIRS



**SECTION A-A, AT DROP INLET PIPE**

Scale: 1/2" = 1'-0"



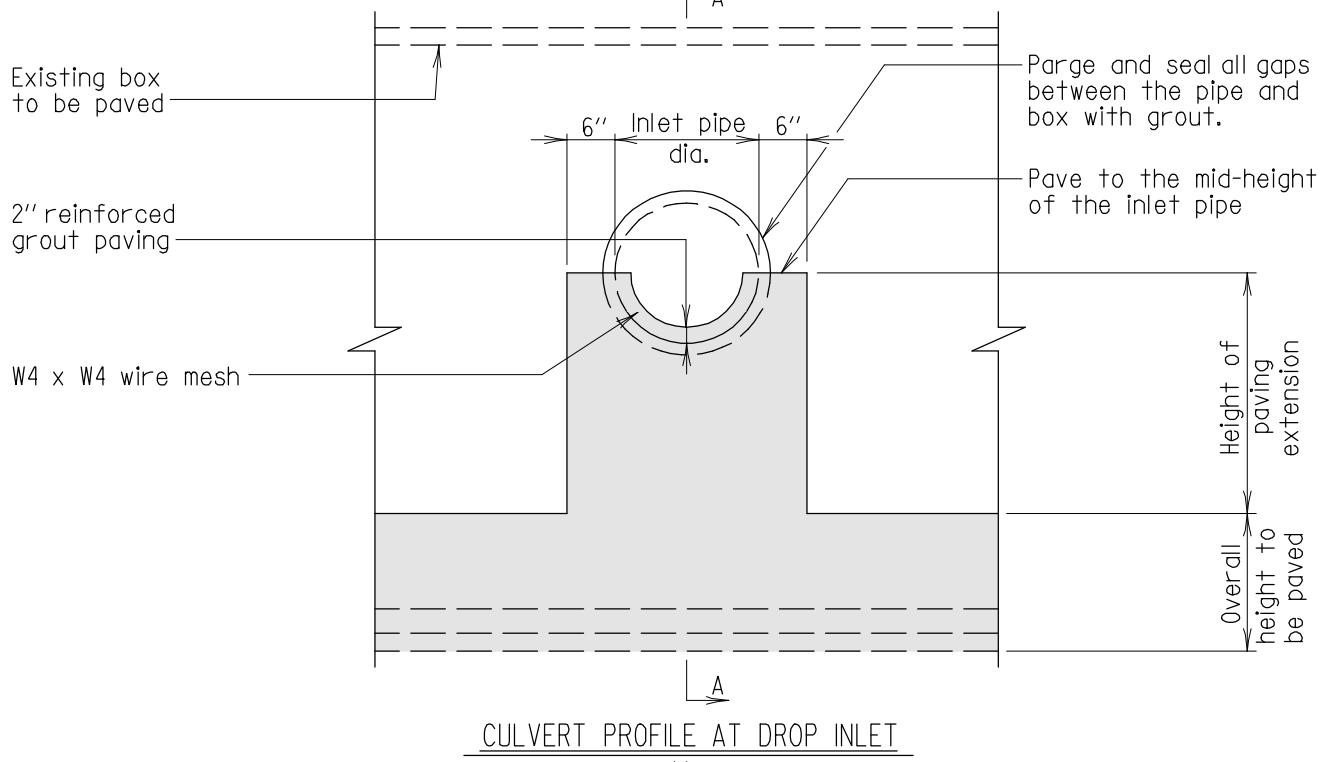
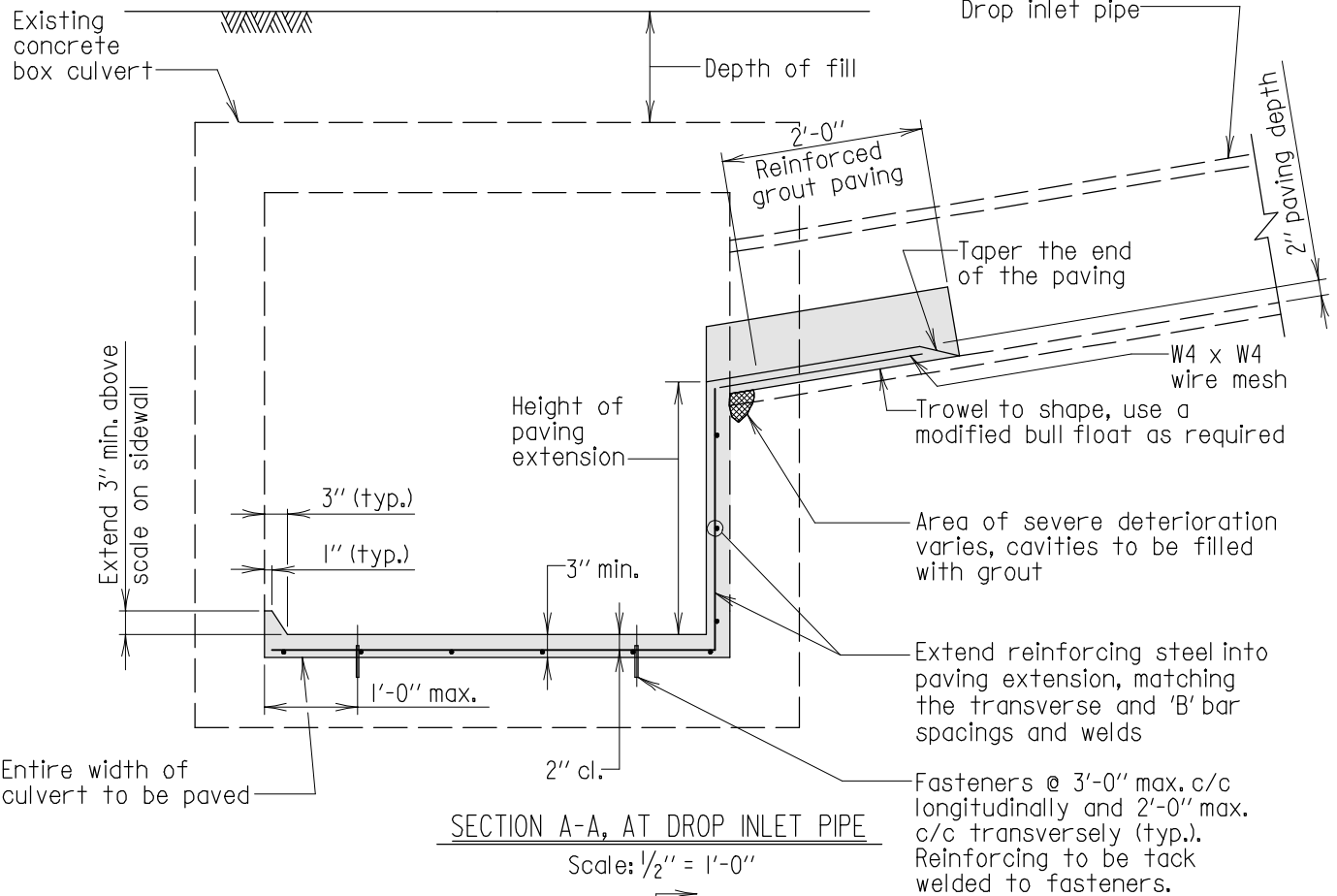
**PIPE PROFILE AT DROP INLET**

Scale: 1/2" = 1'-0"

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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
INVERT PAVING OF EXISTING METAL PIPE ARCH WITH DROP INLET PIPE
DETAIL NO. SR-PI-302
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



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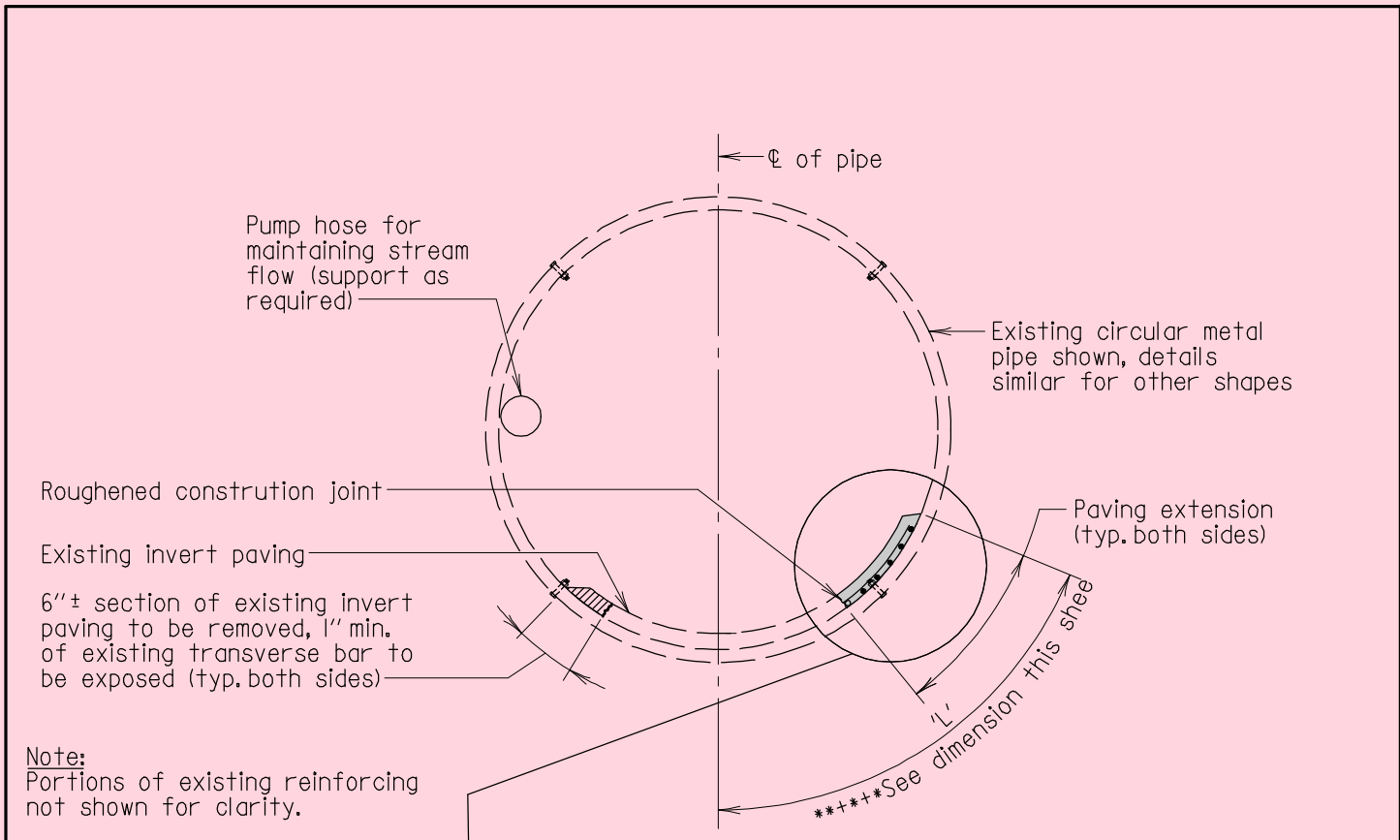
STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

INVERT PAVING OF EXISTING BOX CULVERT  
WITH DROP INLET PIPE

DETAIL NO. SR-PI-303

SHEET 1 OF 1

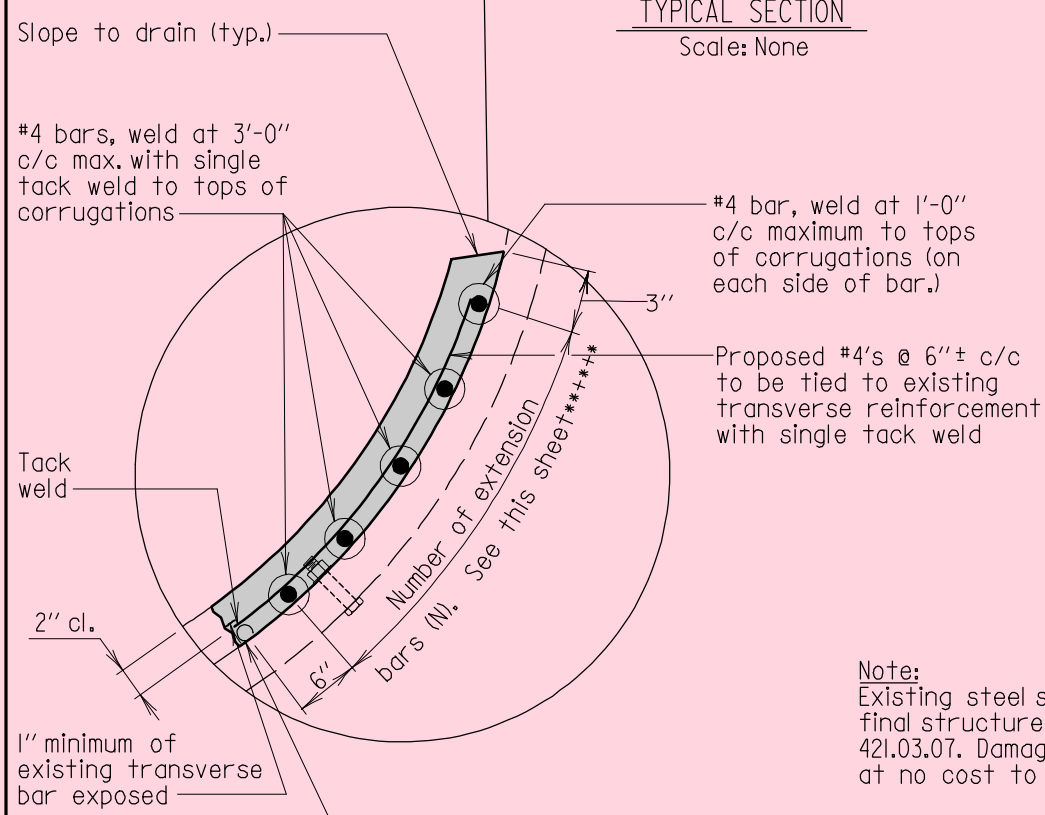
STRUCTURAL REPAIRS



Note:  
Portions of existing reinforcing not shown for clarity.

TYPICAL SECTION  
Scale: None

L	
N	



Note:  
Existing steel shall be incorporated into the final structure in conformance to section 421.03.07. Damaged bars shall be replaced at no cost to the administration.

REPAIR DETAIL  
Scale: None

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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
INVERT PAVING EXTENSIONS OF EXISTING CIRCULAR METAL PIPE WITH PREVIOUS INVERT PAVING
DETAIL NO. SR-PI-401
SHEET <u>  </u> OF <u>  </u>

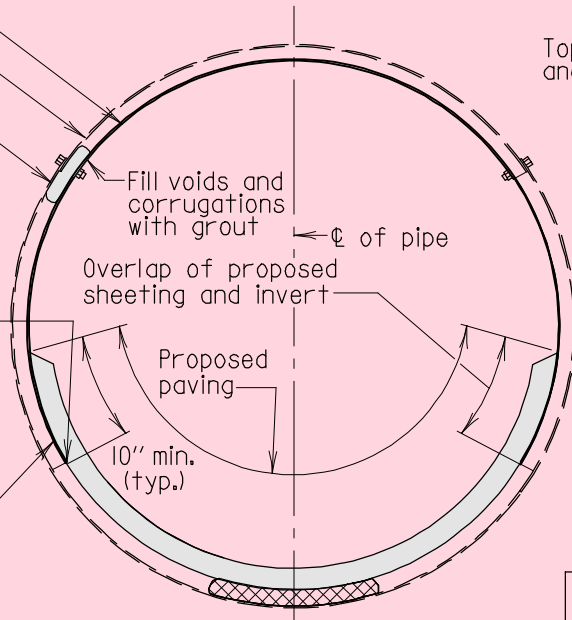
STRUCTURAL REPAIRS

See Note 3  
Existing circular metal pipe  
Area of hole or corrosion varies

For weld option, tack weld to the tops of corrugations @ 3'-0" c/c (max.) (typ.)

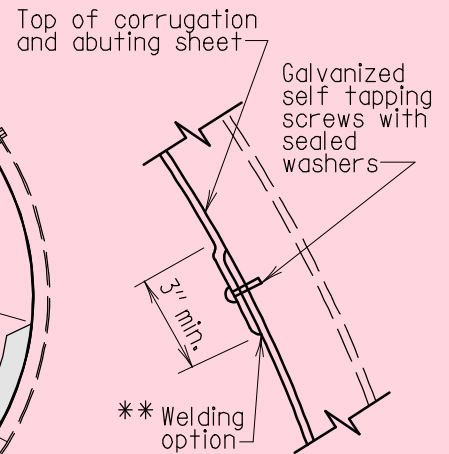
Note:  
Proposed paving details not shown for clarity.

\* Proposed 16 gauge (min.) sheet with matching corrugations conforming to AASHTO M218 or 16 gauge (min.) galv. CS flat steel sheet to match curvature of pipe



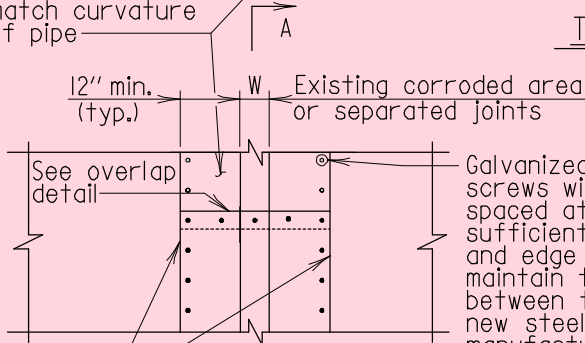
TYPICAL SECTION

Scale: None

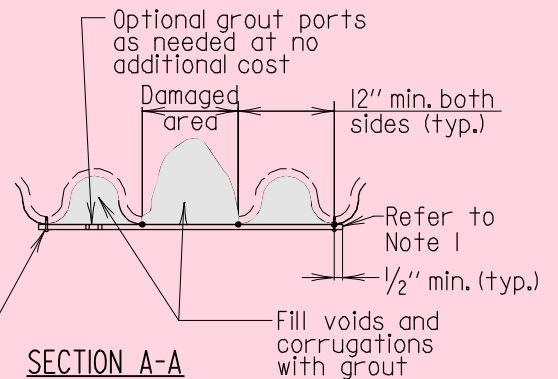


OVERLAP DETAIL  
Scale: None

W =



ELEVATION  
Scale: None



SECTION A-A  
Scale: None

Notes:

- Where possible contractor shall use a 16 gauge (min.) corrugated galvanized sheet that matches existing corrugations and fasten it to the existing pipe with minimum overlap of 3" using self tapping screws at a spacing of 6" max. If a matching corrugated sheet cannot be found, the contractor shall use 16 gauge (min.) galvanized CS flat steel sheet fastened to existing pipe on both sides and grouted as shown in section A-A on this sheet.
- The proposed sheets shall be installed prior to installing the paved invert reinforcement, and they shall be embedded into the invert paving a minimum of 10".
- Water blast clean the entire area to be repaired, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
- Field drill holes into new sheeting to accommodate interruptions such as existing bolts, pipe inlets, etc. which interfere with the installation of the proposed galvanized sheet. Parge over the holes and protrusions with mortar and cover with protective coating after the pipe plating is fastened into place.
- The entire area of the new sheet plus 6" of the surrounding existing pipe is to be coated with coal tar epoxy. If new plate is to be welded, the edge of galvanized sheet and existing pipe shall be ground to remove galvanized or tar coatings.

\*\* In lieu of using self tapping screws, the contractor may elect to use a full length weld to the corrugations, no additional cost will be given for this option.

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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
PIPE PLATING OF EXISTING CIRCULAR METAL PIPE AROUND DEFECTIVE JOINTS AND CIRCUMFERENTIAL DETERIORATION
DETAIL NO. SR-PI-501
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS

See Note 3  
Existing metal pipe arch  
Area of hole or corrosion varies

Top of corrugation and abutting sheet

Galvanized self tapping screws with sealed washers

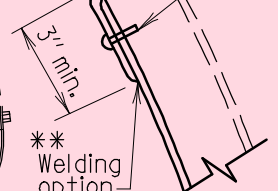
Fill voids and corrugations with grout  
←  $\phi$  of pipe

For weld option, tack weld to the tops of corrugations @ 3'-0" c/c (max.) (typ.)\*\*

Overlap of proposed sheeting and invert

Proposed paving

Note:  
Proposed paving details not shown for clarity.



OVERLAP DETAIL  
Scale: None

\* Proposed 16 gauge (min.) sheet with matching corrugations conforming to AASHTO M218 or 16 gauge (min.) galv. CS flat steel sheet to match curvature of pipe

A

TYPICAL SECTION  
Scale: None

W =

12" min. (typ.)  
Existing corroded area or separated joints

See overlap detail

Galvanized self tapping screws with sealing washers spaced at 6" max., use sufficient diameter, length, and edge distance to maintain tight contact between the existing and new steel per the manufacturer's recommendations (typ.)

Optional grout ports as needed at no additional cost

Damaged area 12" min. both sides (typ.)

Refer to Note 1  
1/2" min. (typ.)

Fill voids and corrugations with grout

\*\* Welding option

ELEVATION  
Scale: None

SECTION A-A  
Scale: None

Notes:

- Where possible contractor shall use a 16 gauge (min.) corrugated galvanized sheet that matches existing corrugations and fasten it to the existing pipe with minimum overlap of 3" using self tapping screws at a spacing of 6" max. If a matching corrugated sheet cannot be found, the contractor shall use 16 gauge (min.) galvanized CS flat steel sheet fastened to existing pipe on both sides and grouted as shown in section A-A on this sheet.
- The proposed sheets shall be installed prior to installing the paved invert reinforcement, and they shall be embedded into the invert paving a minimum of 10".
- Water blast clean the entire area to be repaired, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
- Field drill holes into new sheeting to accommodate interruptions such as existing bolts, pipe inlets, etc. which interfere with the installation of the proposed galvanized sheet. Parge over the holes and protrusions with mortar and cover with protective coating after the pipe plating is fastened into place.
- The entire area of the new sheet plus 6" of the surrounding existing pipe is to be coated with coal tar epoxy. If new plate is to be welded, the edge of galvanized sheet and existing pipe shall be ground to remove galvanized or tar coatings.

\*\* In lieu of using self tapping screws, the contractor may elect to use a full length weld to the corrugations, no additional cost will be given for this option.

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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
PIPE PLATING OF EXISTING METAL PIPE ARCH AROUND DEFECTIVE JOINTS AND CIRCUMFERENTIAL DETERIORATION	
DETAIL NO. SR-PI-502	SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS

See Note 4  
Existing circular metal pipe  
Area of hole or corrosion varies

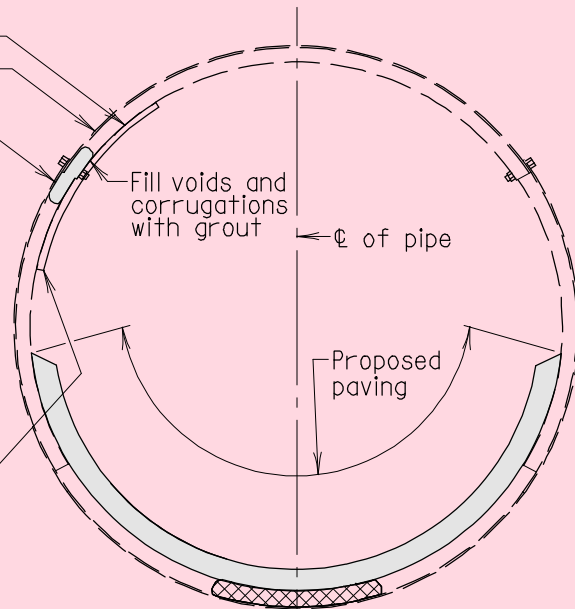
Fill voids and corrugations with grout  
←  $\phi$  of pipe

Note:  
Proposed paving details not shown for clarity.

\* Proposed 16 gauge (min.) sheet with matching corrugations conforming to AASHTO M218 or 16 gauge (min.) galv. CS flat steel sheet to match curvature of pipe

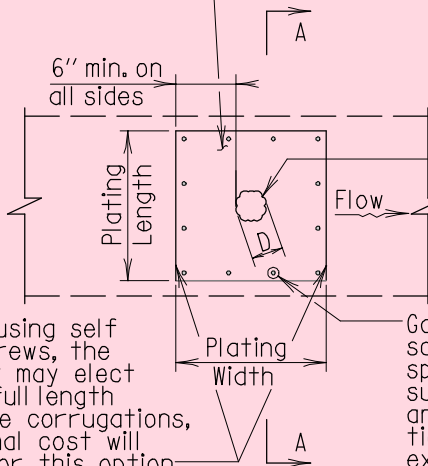
D =	
-----	--

For holes with  $D \leq 6''$ , see Note 1



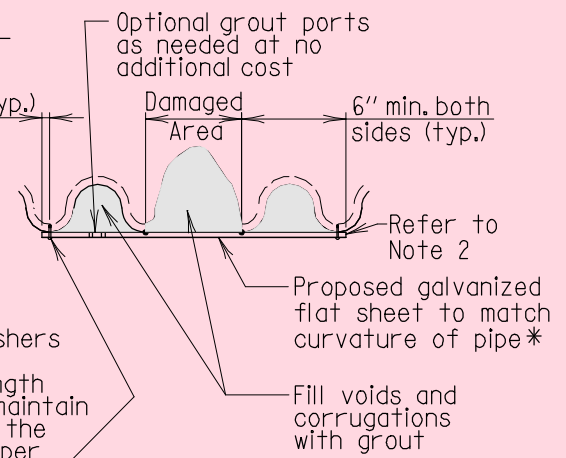
TYPICAL SECTION

Scale: None



ELEVATION

Scale: None



SECTION A-A

Scale: None

In lieu of using self tapping screws, the Contractor may elect to use a full length weld to the corrugations, no additional cost will be given for this option

Existing hole or corrosion see details this sheet

Galvanized self-tapping screws with sealing washers spaced @ 6" max., use sufficient diameter, length and edge distance to maintain tight contact between the existing and new steel per the manufacturer's recommendations (typ.)

Proposed galvanized flat sheet to match curvature of pipe\*

Fill voids and corrugations with grout

Notes:

- For holes with  $D \leq 6''$ , remove exposed fill to 4" behind pipe wall and fill void with grout or rapid set concrete. Trowel the material used to a smooth finish and cover area with coal tar epoxy.
- Where possible contractor shall use a 16 gauge (min.) corrugated galvanized steel sheet that matches existing corrugations and fasten it to the existing pipe on all sides. If a matching corrugated sheet cannot be found, the contractor shall use a 16 gauge (min.) galvanized CS flat steel sheet fastened and grouted as shown in section A-A on this sheet.
- Where holes or corrosion extend into proposed paving areas, the proposed sheets shall be embedded into the paving a minimum of 10" and shall be installed prior to installing the paved invert reinforcing.
- Water blast clean the entire area to be repaired, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
- Field drill or cut holes into new sheeting to accommodate interruptions such as existing bolts, pipe inlets, etc. which interfere with the installation of the proposed galvanized sheet.
- The entire area of the new sheet plus 6" of the surrounding existing pipe is to be coated with coal tar epoxy. If new plating is to be welded, the edge of galvanized sheet and existing pipe shall be ground to remove galvanized or tar coatings.
- The new sheeting shall be deformed to match curvature of the existing pipe.

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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
PIPE PLATING OF EXISTING CIRCULAR METAL PIPE FOR ISOLATED DEFECTS	
DETAIL NO. SR-PI-503	SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS



See Note 4

Existing metal pipe arch

Area of hole or corrosion varies

Fill voids and corrugations with grout

ϕ of pipe

Proposed paving

Note:  
Proposed paving details not shown for clarity.

\*Proposed 16 gauge (min.) sheet with matching corrugations conforming to AASHTO M218 or 16 gauge (min.) galv. CS flat steel sheet to match curvature of pipe

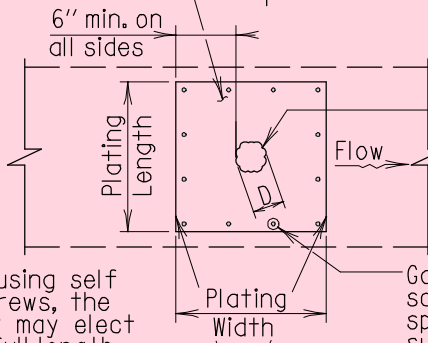
D =

For holes with  $D \leq 6''$ , see Note 1

TYPICAL SECTION

Scale: None

Optional grout ports as needed at no additional cost



Existing hole or corrosion see details this sheet

1/2" min. (typ.)

Damaged Area

6" min. both sides (typ.)

Refer to Note 2

In lieu of using self tapping screws, the Contractor may elect to use a full length weld to the corrugations, no additional cost will be given for this option

Galvanized self-tapping screws with sealing washers spaced @ 6" max., use sufficient diameter, length and edge distance to maintain tight contact between the existing and new steel per the manufacturer's recommendations (typ.)

Proposed galvanized flat sheet to match curvature of pipe\*

Fill voids and corrugations with grout

ELEVATION

Scale: None

SECTION A-A

Scale: None

Notes:

1. For holes with  $D \leq 6''$ , remove exposed fill to 4" behind pipe wall and fill void with grout or rapid set concrete. Trowel the material used to a smooth finish and cover area with coal tar epoxy.
- \*2. Where possible contractor shall use a 16 gauge (min.) corrugated galvanized steel sheet that matches existing corrugations and fasten it to the existing pipe on all sides. If a matching corrugated sheet cannot be found, the contractor shall use a 16 gauge (min.) galvanized CS flat steel sheet fastened and grouted as shown in section A-A on this sheet.
3. Where holes or corrosion extend into proposed paving areas, the proposed sheets shall be embedded into the paving a minimum of 10" and shall be installed prior to installing the paved invert reinforcing.
4. Water blast clean the entire area to be repaired, (minimum pressure of 4000 psi at the nozzle, using a rotary nozzle). All debris, rust layers, asphalt coating, etc. in area of repair shall be removed and properly disposed of at an approved site.
5. Field drill or cut holes into new sheeting to accommodate interruptions such as existing bolts, pipe inlets, etc. which interfere with the installation of the proposed galvanized sheet.
6. The entire area of the new sheet plus 6" of the surrounding existing pipe is to be coated with coal tar epoxy. If new plating is to be welded, the edge of galvanized sheet and existing pipe shall be ground to remove galvanized or tar coatings.
7. The new sheeting shall be deformed to match curvature of the existing pipe.

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DATE: 06/28/2017
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STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
PIPE PLATING OF EXISTING METAL PIPE ARCH FOR ISOLATED DEFECTS
DETAIL NO. SR-PI-504
SHEET <u>  </u> OF <u>  </u>

STRUCTURAL REPAIRS