

# Geomembrane Liner Installation Quick Guide\*

July 2022



**PHILADELPHIA**  
**WATER**  
— DEPARTMENT —

*\*This quick guide is intended to provide lessons learned to increase successful geomembrane liner installation. This guide is not intended as a comprehensive procedure. Contractor is responsible for following all standards, manufacturer instructions and best practices.*



# OVERVIEW

- 1. Motivation**
- 2. Liner Welding Best Practices**
- 3. Liner Pipe Penetrations**
- 4. Inlet and Control Structures**

# Motivation

Design of a system may require lining for the following reasons:

**1. Proximity of the system to a basement**

- Stormwater leaving the system and infiltrating the soil could flow into a nearby basement and cause water damage and even flooding

**2. Proximity of the system to a collection system**

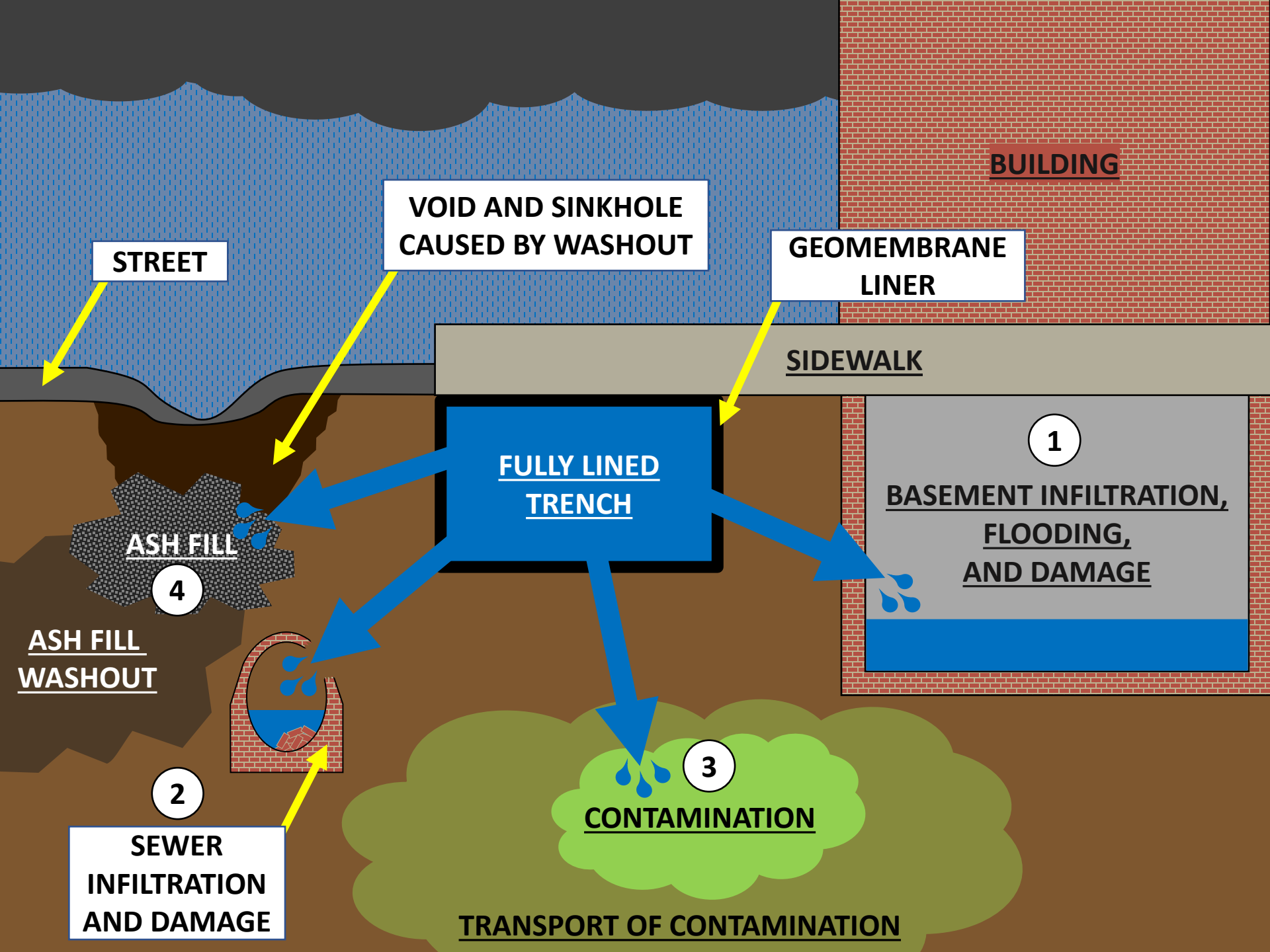
- Stormwater leaving the system and infiltrating the soil could flow into nearby sewers through brick and mortar, pipe joints, or laterals (both active and abandoned)
- The main objective of GSI is preventing stormwater from immediately entering sewers to avoid combined sewer overflows
- Leakage into sewer could cause structural damage and collapse

**3. Contaminated soils in the area of the system**

- Stormwater leaving the system and infiltrating the soil could transport contamination through soil into groundwater
- Due to the prevalence of historical fill, it is not uncommon to find areas of soil contamination throughout the City

**4. Ash or loose fill in the area of the system**

- Stormwater leaving the system and infiltrating the soil could transport ash or loose fill and create voids in the soil
- Due to the prevalence of historical fill, it is not uncommon to find areas ash fill in soil throughout the City
- Ash or loose fill is more susceptible to washout from infiltration and could create a hazard like a pothole or sinkhole on the surface



## Motivation - Proximity of the system to a basement



## Motivation - Proximity of the system to a collection system



**Water entering sewer from adjacent GSI (green dye used during test)**

## Motivation - Contaminated soils in the area of the system



# Motivation - Ash or other loose fill in the area of the system



Image of sinkhole formed near GSI



# Liner Welding Best Practices\*

## Before Welding

- Skilled workers with proper training and experience
- Install geotextile or sand layer (refer to Contract Documents) underneath liner
- Sweep street and lay geotextile down prior to rolling out liner to minimize punctures

## Fusion Welding

- Fusion weld on a clean, flat surface before installing liner in the ground
- Adjust welding temperatures as needed based on ambient temperature
- Line up panels and direct the machine along the seam in a straight line
- Avoid too much overlap between liner sheets as this may cause wrinkles and machine malfunction

## Extrusion Welding

- Only use where fusion welding equipment cannot operate
- Position welds away from corners of trench for ease of welding
- Provide support behind liners during welding process using a hard surface such as a wood plank
- Clear off dust and debris from overlying geomembrane liner edge and from underlying liner surface where weld to be placed
- Using the hot air tool, heat edge of overlying liner onto underlying liner to temporarily hold it in place
- Grind edge of overlying liner to taper the edge down and roughen surface on either side of seam
- Holding extrusion welder perpendicular to liner, slightly lean welder away from direction of weld to allow welder bead to guide the welder forward and ensure welder bead covers both sides of seam

## After Welding

- Install geotextile on top of liner (bottom and sides of trench) prior to laying stone inside trench

*\*These steps are not intended to be a comprehensive procedure. Contractor is responsible for following all standards, manufacturer instructions and best practices.*

# Liner Welding Best Practices – Before Welding



**Skilled workers with proper training and experience**

- Consider certifying one or more staff in fusion and extrusion welding **OR**
- Hire lining specialist subcontractor for welding work

# Liner Welding Best Practices – Before Welding



**Install geotextile and/or sand layer (refer to Contract Documents) underneath liner**

- To prevent punctures in the liner from uneven subgrade, geotextile fabric should be laid on the bottom and sides of the trench before installing the liner
- A layer of sand may be placed on the subgrade before installing the liner however geotextile fabric is still needed on all sides; refer to Contract Documents



# Liner Welding Best Practices – Before Welding



**Clear flat area and lay geotextile down prior to rolling out liner to minimize punctures**

- Rolling out the liner on an uneven surface or area with debris can cause punctures
- Locate a flat surface such as a roadway or sidewalk
- Sweep or use an air blower to remove debris from surface
- Lay down geotextile prior to rolling out liner to minimize risk of liner punctures

# Liner Welding Best Practices – Fusion Welding



**Fusion weld on a clean, flat surface before installing liner in the ground**

- Liner to be welded on a clean, flat surface to ensure a uniform, straight weld
- Avoid too much overlap between liner sheets as this can cause wrinkling or machine malfunction
- Adjust the welding temperature as needed based on ambient temperatures

# Liner Welding Best Practices – Extrusion Welding



**Position welds away from corners of trench for ease of welding**

- Welding is extremely difficult in corners due to liner folds and uneven surfaces
- Welds in corners of the trench could be strained when the trench is filled with stone and water leading to seam failure



# Liner Welding Best Practices – Extrusion Welding



**Provide support behind liners during welding process using a hard surface such as a wood plank**

- Welding against a hard surface, such as a wood board, will prevent puncturing the liner with the tools and will allow for a smoother weld

# Liner Welding Best Practices – Extrusion Welding



**Clear off dust and debris from overlying geomembrane liner edge and from underlying liner surface where weld to be placed**

- Dust or debris on the surface of the liner reduces weld adhesion
- Even if the weld looks strong, a film of dust may create a weaker weld which could lead to breakage





# Liner Welding Best Practices – Extrusion Welding



**Using the hot air tool, heat edge of overlying liner onto underlying liner to temporarily hold it in place**

- Securing the liner in place prior to welding will prevent movement of the overlying liner piece and create a smoother weld without gaps

# Liner Welding Best Practices – Extrusion Welding



**Grind edge of overlying liner to taper the edge down and roughen surface on either side of seam**

- Roughening the surface of the planned weld will allow for better adhesion of the welding rod
- Better adhesion of the welding rod will create a stronger weld and reduce risk of breakage when the trench is filled with stone

# Liner Welding Best Practices – Extrusion Welding

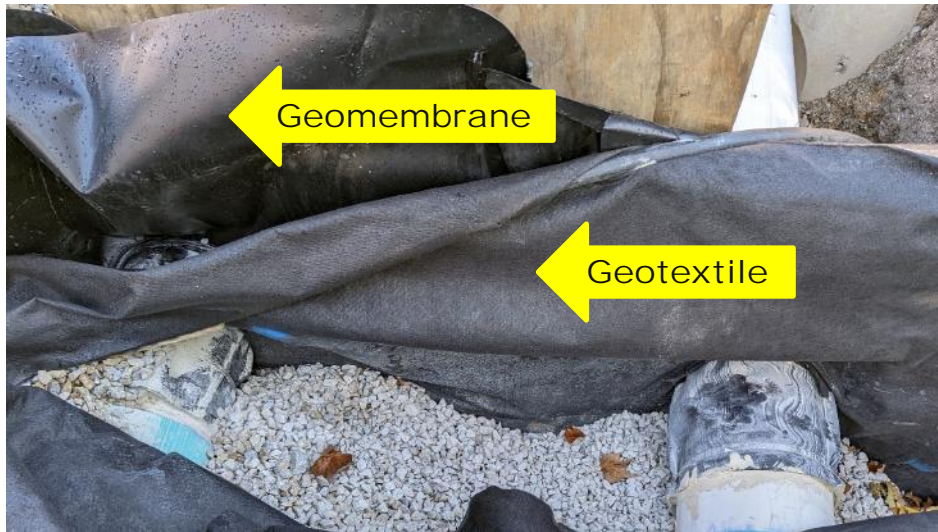


Completed extrusion weld

## Use extrusion welder and HDPE welding rod for weld

- Center the welder along the seam to allow welding rod to adhere securely to both pieces of liner
- Once extrusion starts, lean welder away from the direction of the weld and welder will push itself forward

# Liner Welding Best Practices – After Welding



**Install geotextile on top of liner (bottom and sides of trench) prior to laying stone inside trench**

- The geotextile is intended to protect the liner from punctures as the stone and other work is performed on top of the liner

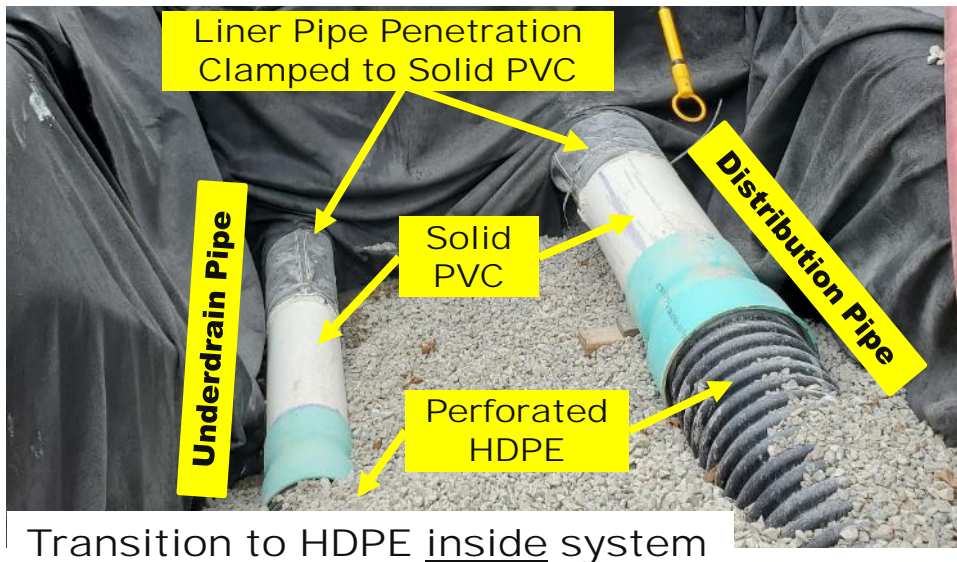
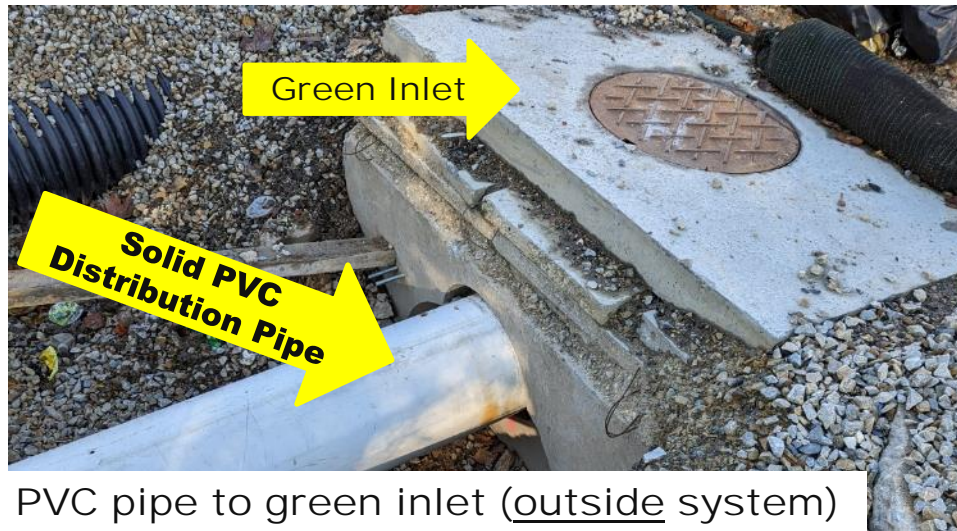
# Liner Pipe Penetrations

## Suggestions for creating watertight pipe penetrations through liners\*

- Current design specifications of pipe penetrations call for inserting a gasket into the corrugations of the HDPE pipe to create a flat surface for clamping the liner boot
  - *Alternatively*, consider installing solid PVC piping from outside the liner through the pipe penetration and then transitioning to perforated HDPE inside the liner\*
- Additional suggested techniques for improving watertightness:
  - Ensure adapters/fittings are sealed and meet the required pressure rating

*\*Note: These suggestions are based only on the observed watertightness of various configurations of pipe penetrations and transitions during liner performance testing. Not all designs and specifications are included in these suggestions, and not all designs and specifications will require the configurations within these suggestions.*

# Liner Pipe Penetrations – Alternative Configuration



Install solid PVC piping from outside the liner through the pipe penetration and then transition to perforated HDPE inside the liner

- Connecting liner boot to solid PVC rather than corrugated HDPE provides a smoother surface for clamping liner
- This applies to underdrain pipes
- This may be applied to distribution pipes as directed by PWD (*Note: Watertight boot collar needed at green inlet connections*)

# Liner Pipe Penetrations – Suggested Techniques



Pipe adapter



Pipe fitting

**Ensure adapters/fittings are sealed and meet the required pressure rating**

- Fittings and adapters at pipe connections must be the proper size and material to ensure a sealed joint between pipes

# Inlet and Control Structures

## Pipe Connections

- For solid PVC pipe connections, install watertight boot collar (do not apply non-shrink grout)
- Where corrugated HDPE pipe connections are used, seal connection with non-shrink grout
- For ductile iron pipe connections to inlets, ensure pipe connection is sealed with non-shrink grout

## Structural Joints

- Ensure precast concrete sections of inlets include a key joint and gasket per contract requirements
- Ensure cast iron traps of inlets include gasketing per contract requirements
- Seal precast concrete, weir, and trap joints with non-shrink grout per contract requirements

## Prior to PWD Liner Testing

- Plug distribution pipes within all green inlets directly connected to system
- Install solid cap on underdrain



# Inlet and Control Structures – Pipe Connections

**For solid PVC pipe connections, install watertight boot collar (do not apply non-shrink grout)**

- Using solid PVC for inlet connections allows for a watertight seal using the boot collar around the pipe
- Solid PVC also allows an adapter for a cap to be installed



Underdrain with cap

# Inlet and Control Structures – Pipe Connections

**Where corrugated HDPE pipe connections are used, seal connection with non-shrink grout**



- Current design specifications often call for HDPE pipe for connections to inlets and control structures
- In these cases, non-shrink grout should be applied between the pipe and the concrete to completely seal the connection

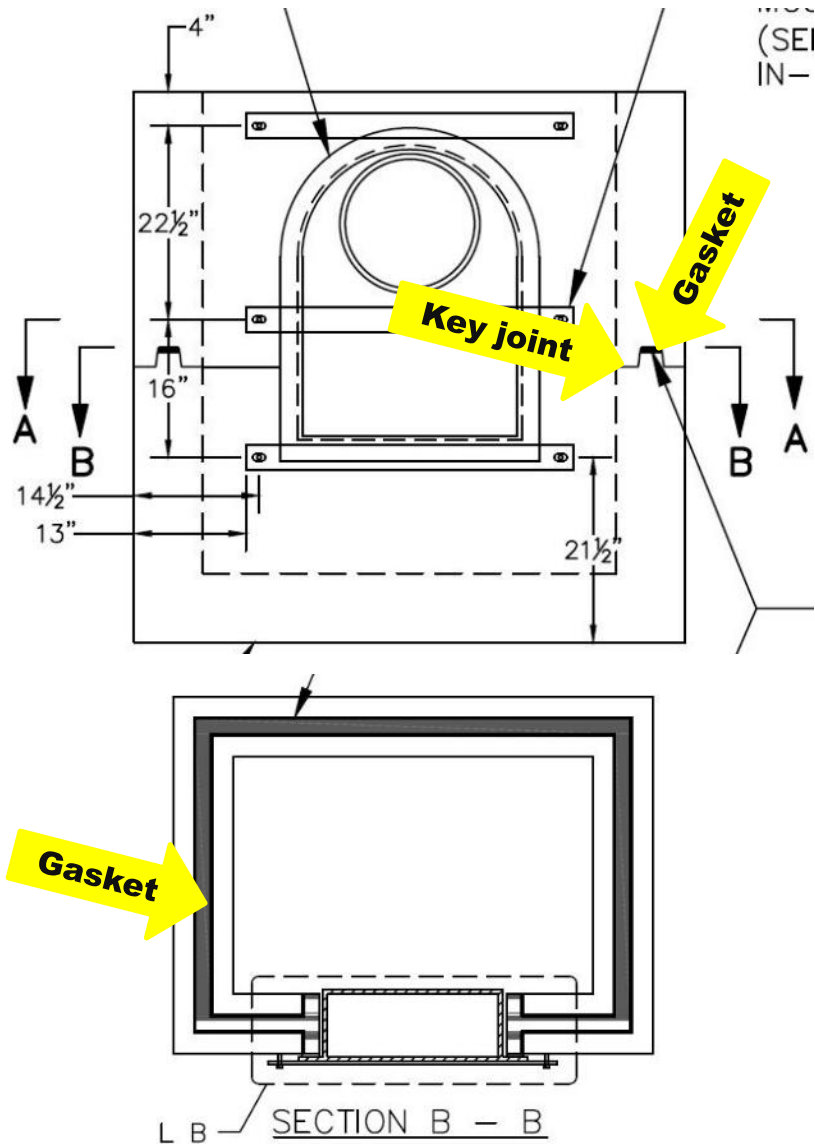
# Inlet and Control Structures – Pipe Connections



**For ductile iron pipe connections to inlets, ensure pipe connection is sealed (on both sides) with non-shrink grout**

- For piping that crosses roadways, ductile iron pipe is used, and in these cases, non-shrink grout must be applied between the pipe and the concrete to completely seal the connection

# Inlet and Control Structures – Structural Joints



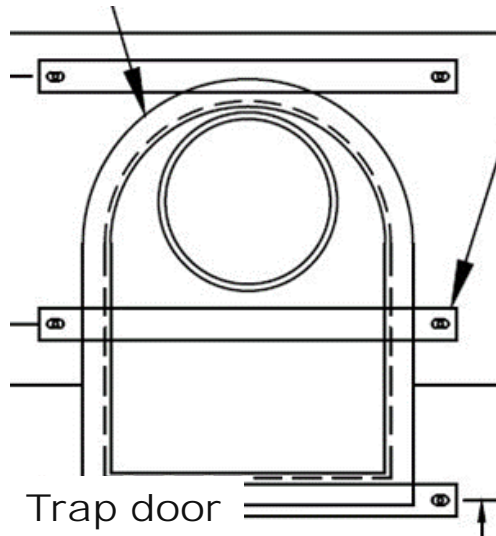
**Ensure precast concrete sections of inlets include a key joint and gasket per contract requirements**

- The key joint and gasket prevents water from entering or leaving the inlet
- Properly align the key joint when stacking precast concrete sections

# Inlet and Control Structures – Structural Joints

**Ensure cast iron traps of inlets include gasketing per contract requirements**

- The gasket prevents water from entering or leaving the inlet



# Inlet and Control Structures – Structural Joints



**Seal precast concrete, weir, and trap joints with non-shrink grout**

- Non-shrink grout should be applied on the inside and outside surfaces of inlet joints



# Inlet and Control Structure – Prior to PWD Liner Testing



Green inlet



Green-grey inlet

For PWD to test the liner for leaks, the Contractor must plug all distribution pipes directly connected to the system and install a solid cap on the underdrain

- Distribution pipe connections directly connected to the system must be plugged with an expandable plug
- The underdrain pipe connection in the green-grey inlet must be capped with a white PVC cap

# Questions?

**Refer to the designated  
PWD Construction Contacts for your project**