Pipe Outfalls
Construction Guidance Checklist

MILE HIGH FLOOD DISTRICT

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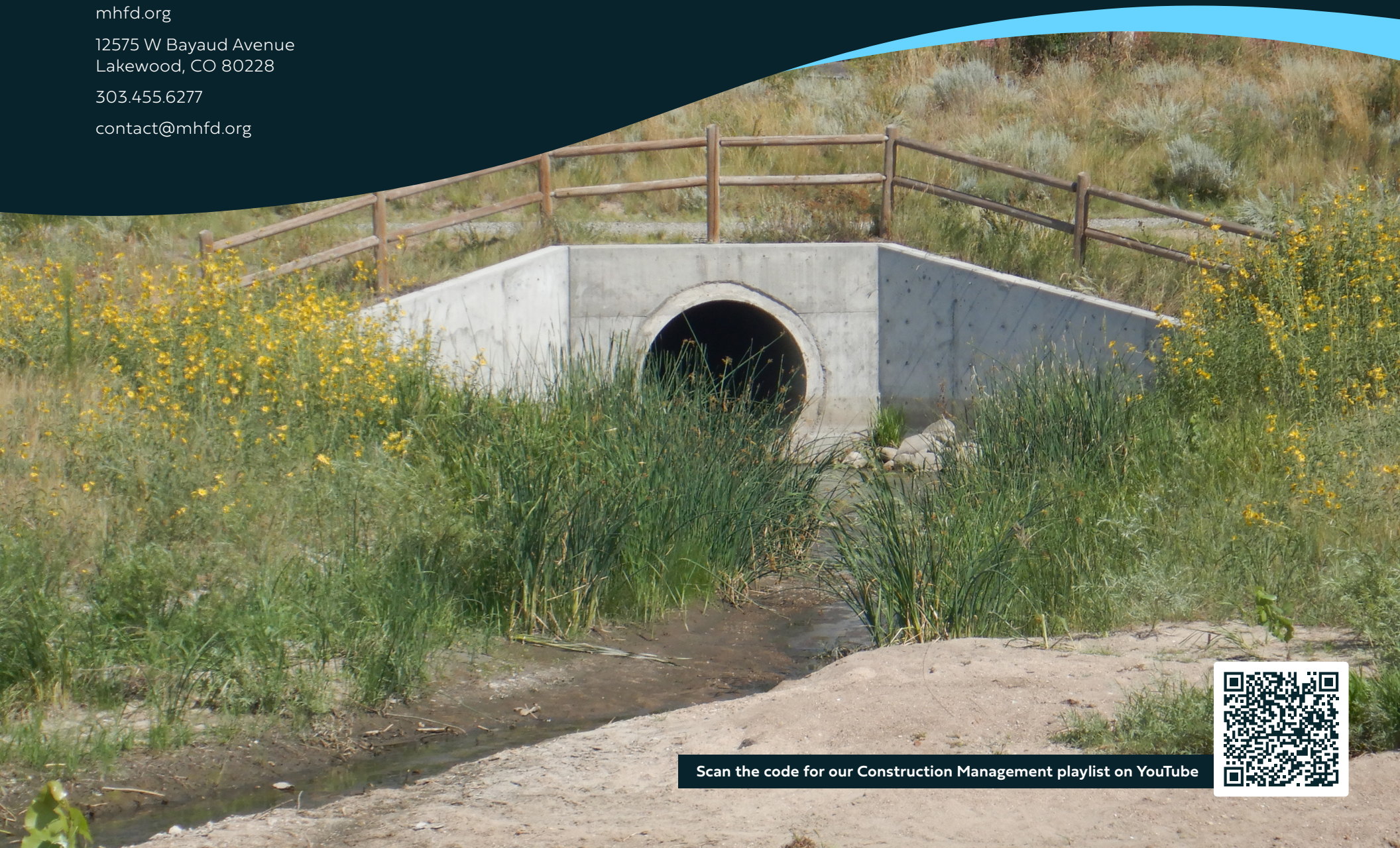

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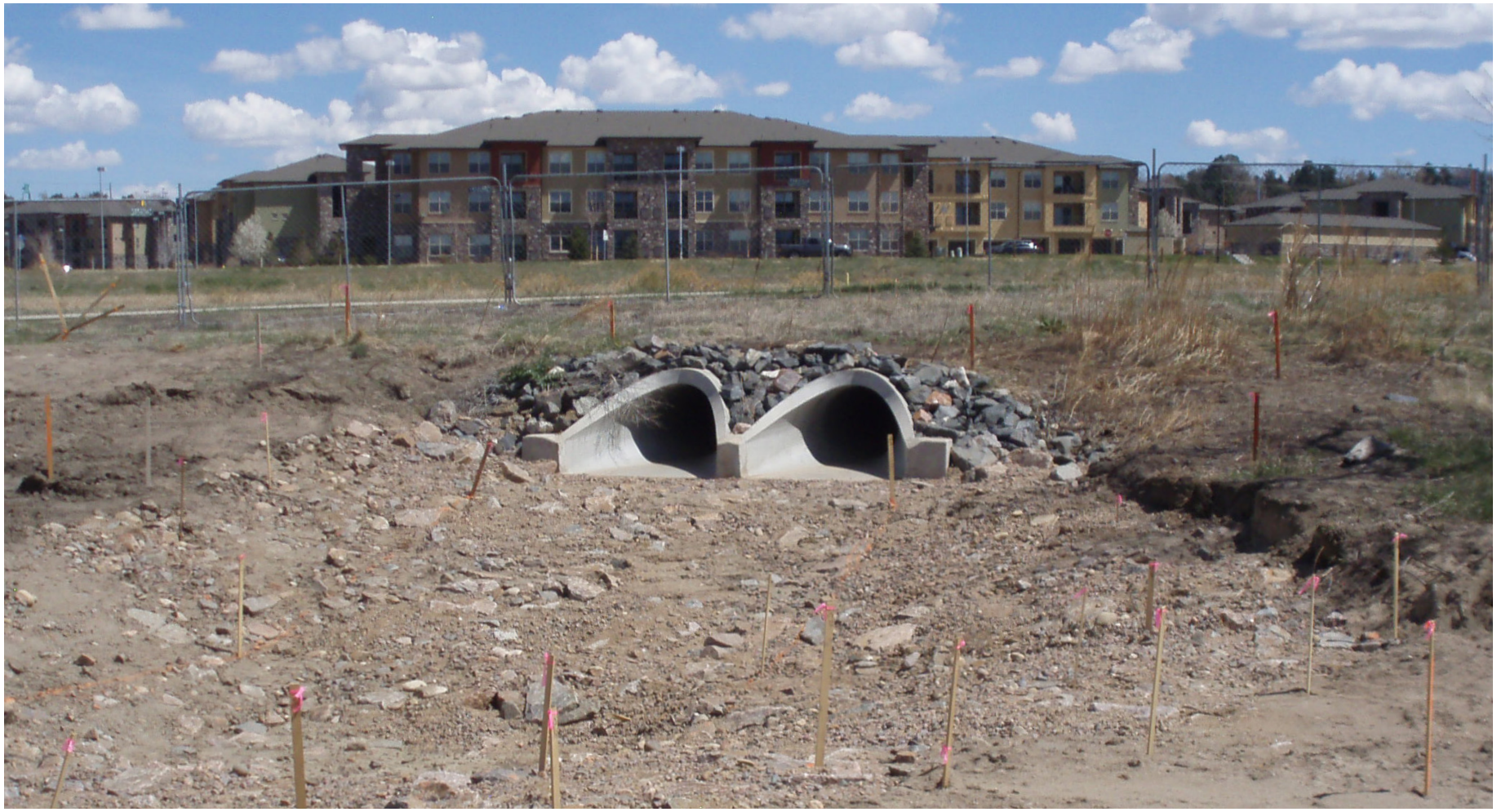
Pipe Outfalls Introduction

A pipe outfall is the discharge point or outlet of a storm drainage pipe into a stream, channel, or pond. Pipe outfalls require special end treatment and erosion protection.



Pipe Outfalls Introduction

- Pipes at outfalls are typically round pipe ranging from 18 to 72-inch in diameter, elliptical pipe, and also larger box culverts.
- Pipe outfalls require special end treatment and erosion protection as flow transitions from concentrated pipe flow into an open channel.
- Pipe End Treatment usually consists of:
  - Flared End Sections (FES) with toe walls
  - Concrete Headwalls/Wingwalls
- Erosion Protection/Energy Dissipation usually consists of:
  - Riprap aprons, riprap low tailwater basins
  - Grouted boulders
  - Concrete impact basins.
- MHFD requires that outfalls meet all their requirements to be accepted for maintenance eligibility.

Pipe Outfalls – End Treatment

Precast concrete flared end sections (FES) are seen on most outfalls.

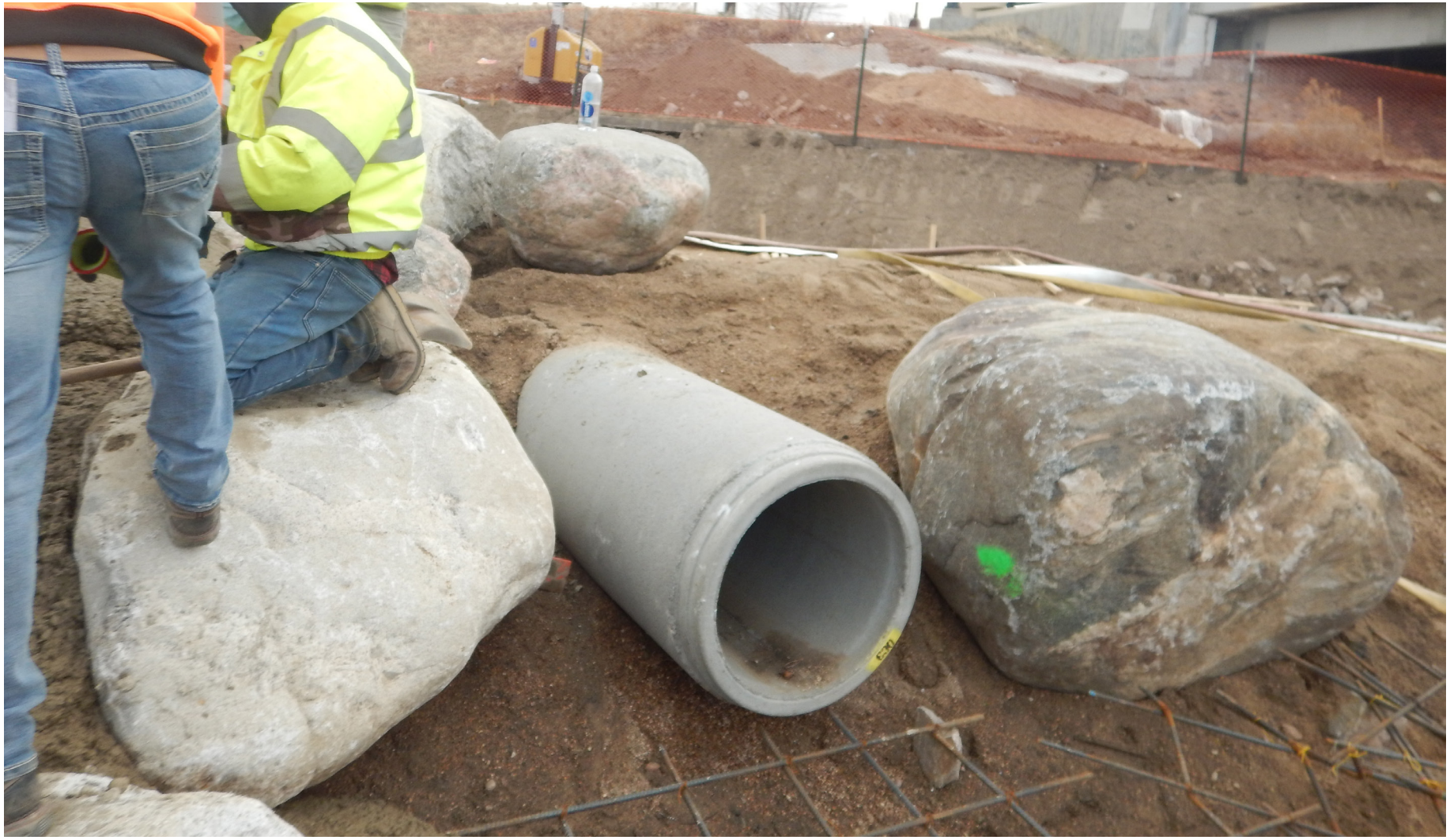
Cast-in-place concrete headwalls and wingwalls can be used in place of FES and are commonly used on larger pipe or box culvert outfalls.

Precast concrete FES

Cast-in-place concrete head wall with wing walls (not shown)

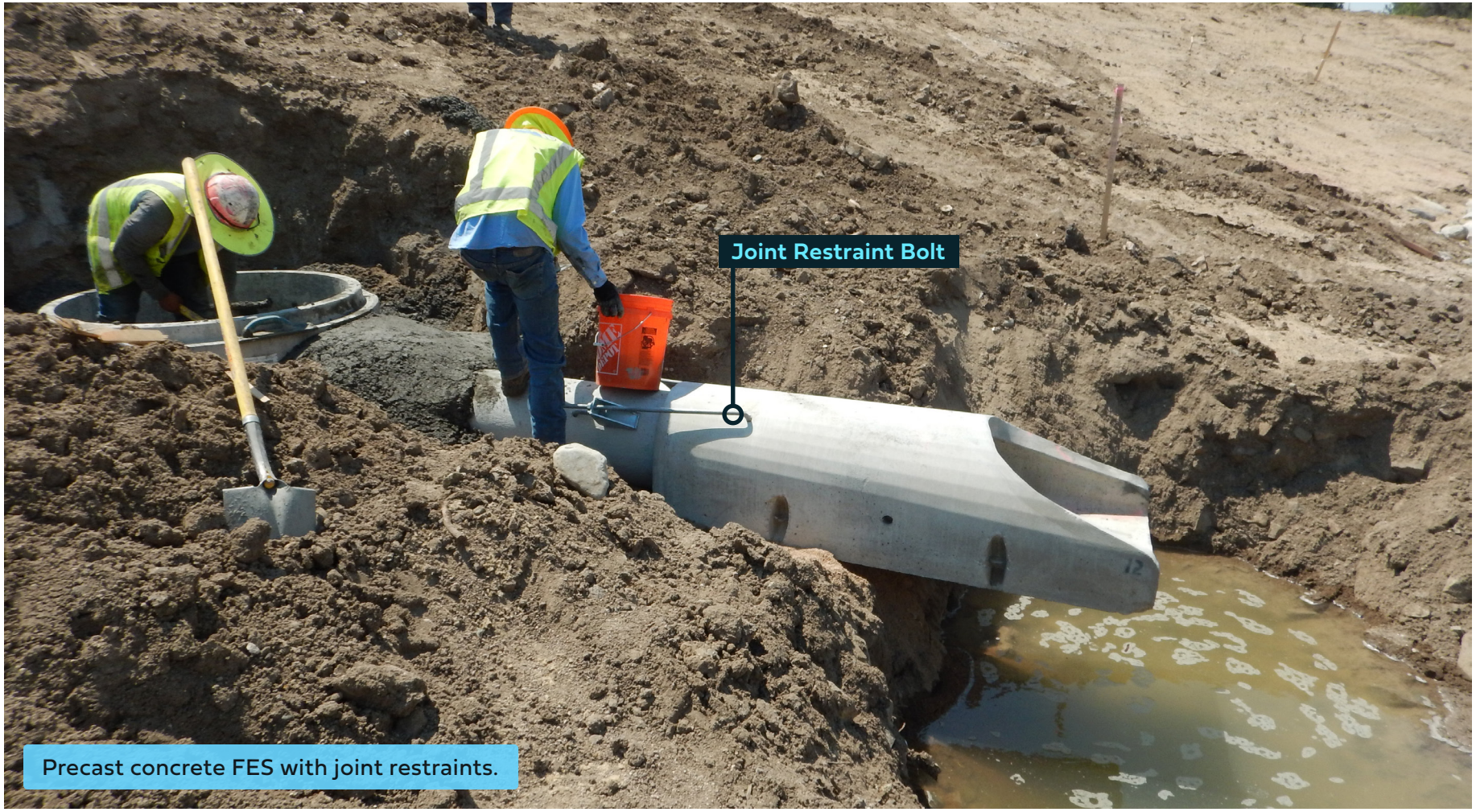
Pipe Outfalls – End Treatment

Some outfalls are also cast into grouted boulder drops structures as shown here.



Pipe Outfalls – FES

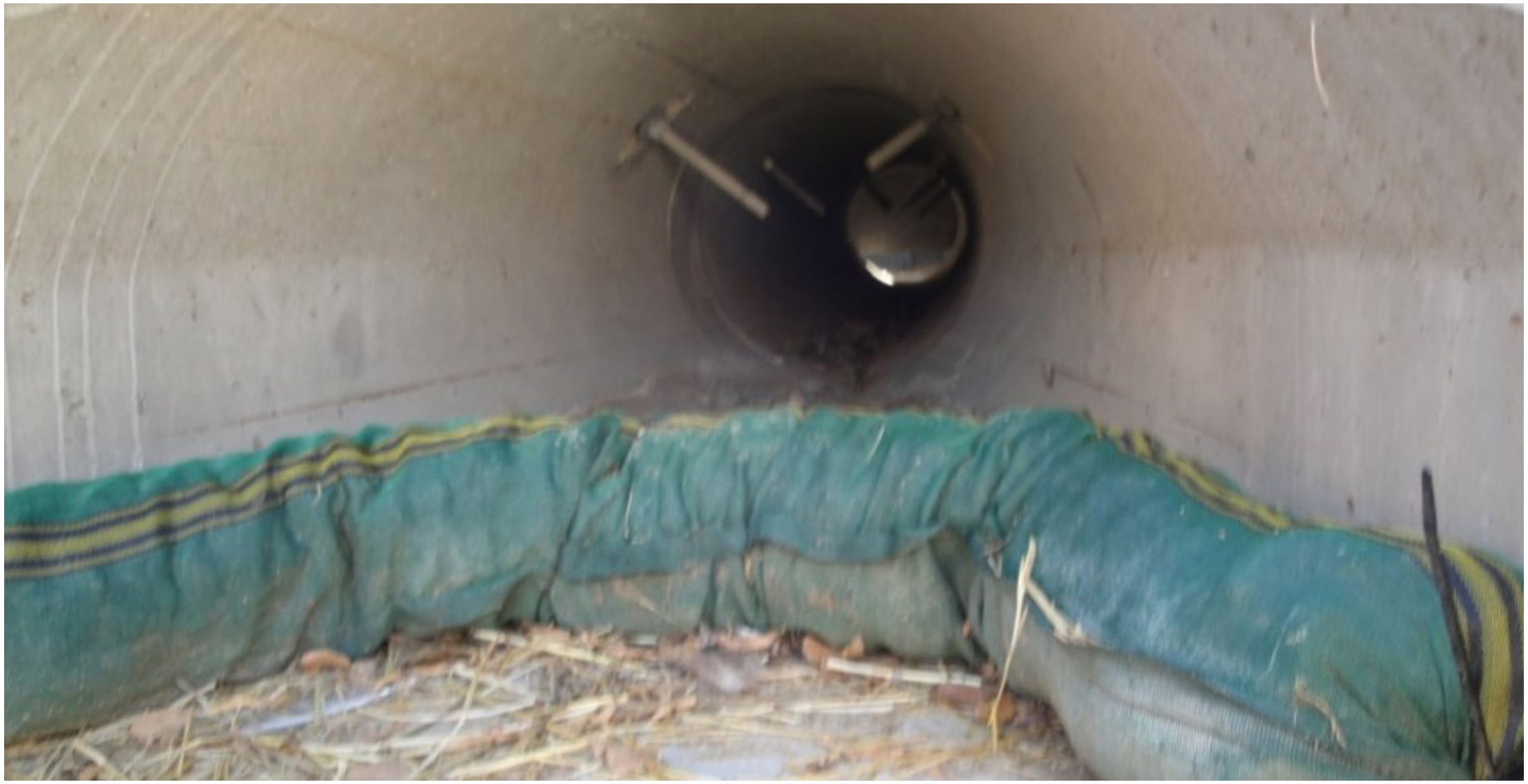
Precast concrete pipes must have joints with water-tight gaskets along with bolted joint restraints on the last two joints of pipe/FES.



Precast concrete FES with joint restraints.

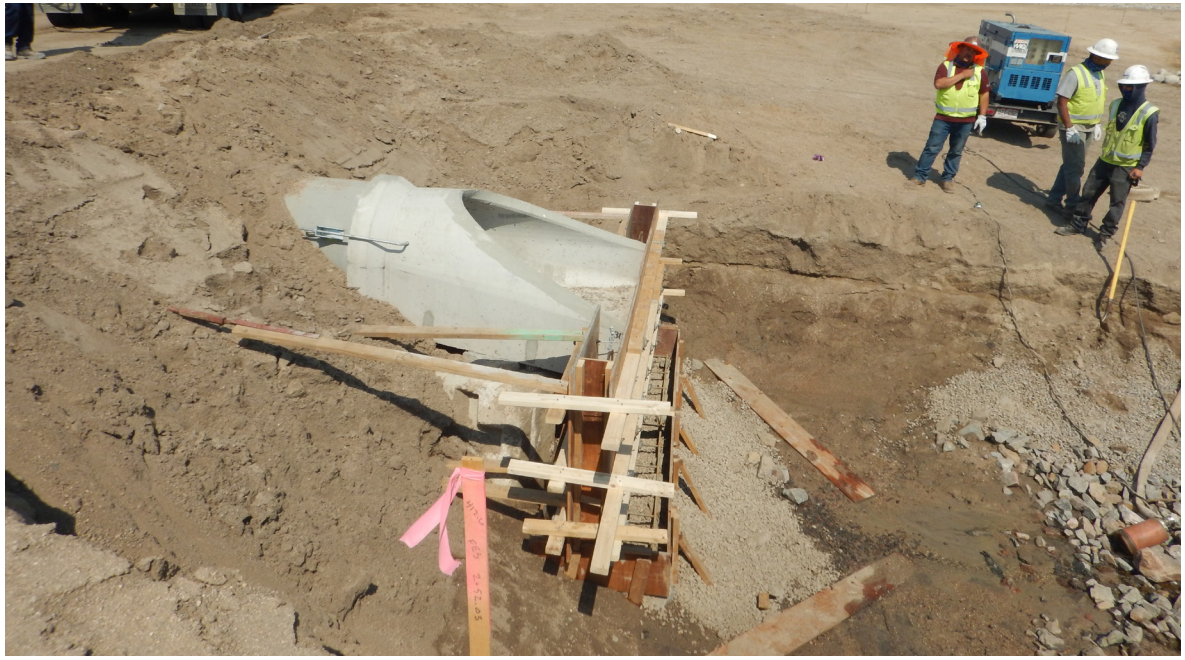
Pipe Outfalls – FES

Make sure that bolts for joint restraints are trimmed in the interior of the pipe, so that they don't protrude into the flow area. If left untrimmed as shown in this photo, the bolts can create maintenance issues by catching debris and blocking flow.



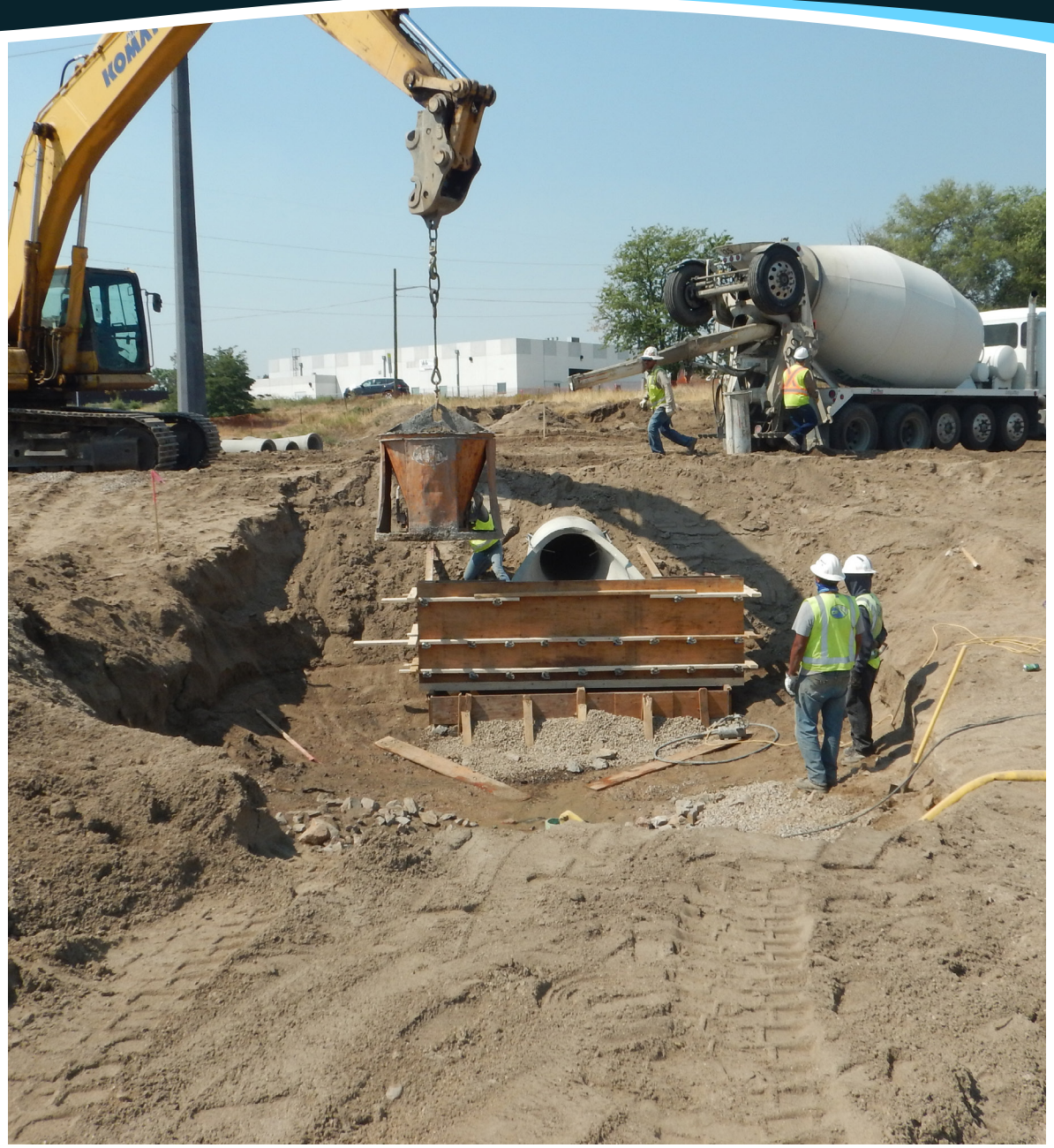
Pipe Outfalls – Toe Walls

- For outfalls with precast FES, a concrete toe wall is usually required to protect the pipe from undermining if the erosion protection at the outlet were to fail.
- Confirm that if a cast-in-place toe wall is needed, the contractor dewaters the excavation and forms and pours the wall.



Pipe Outfalls – Toe Walls

Here is a precast FES with a concrete toe wall being poured with an excavator and concrete bucket.



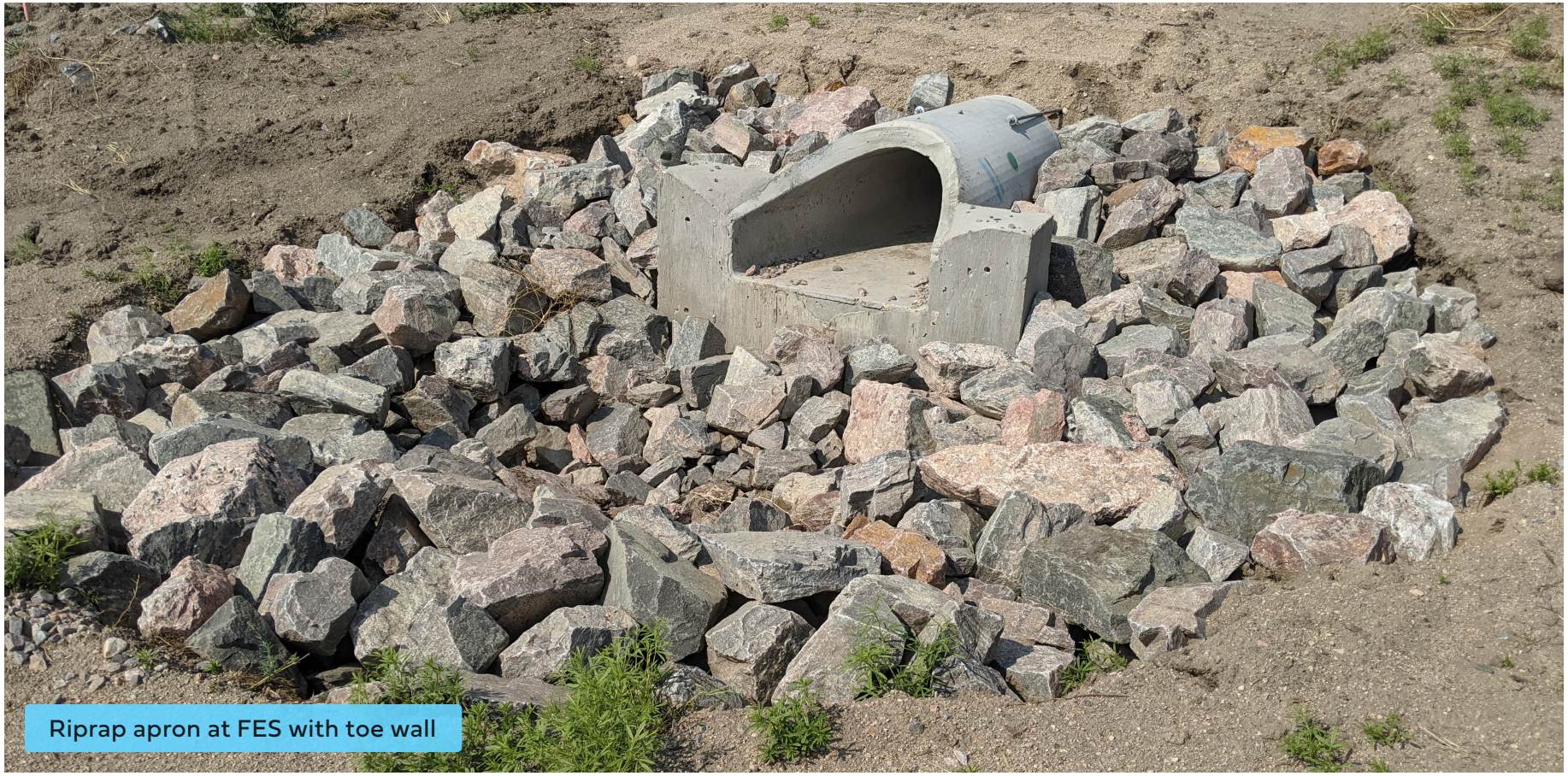
Pipe Outfalls – Erosion Protection

- When a low tailwater basin is used for erosion protection at pipe outfalls, verify that the basin is shaped properly in length, width, and depth to provide the specified pool size for energy dissipation.
- Verify that riprap extends up the banks as specified to contain turbulent water.

Low Tailwater Basin with properly shaped soil riprap basin

Pipe Outfalls – Erosion Protection

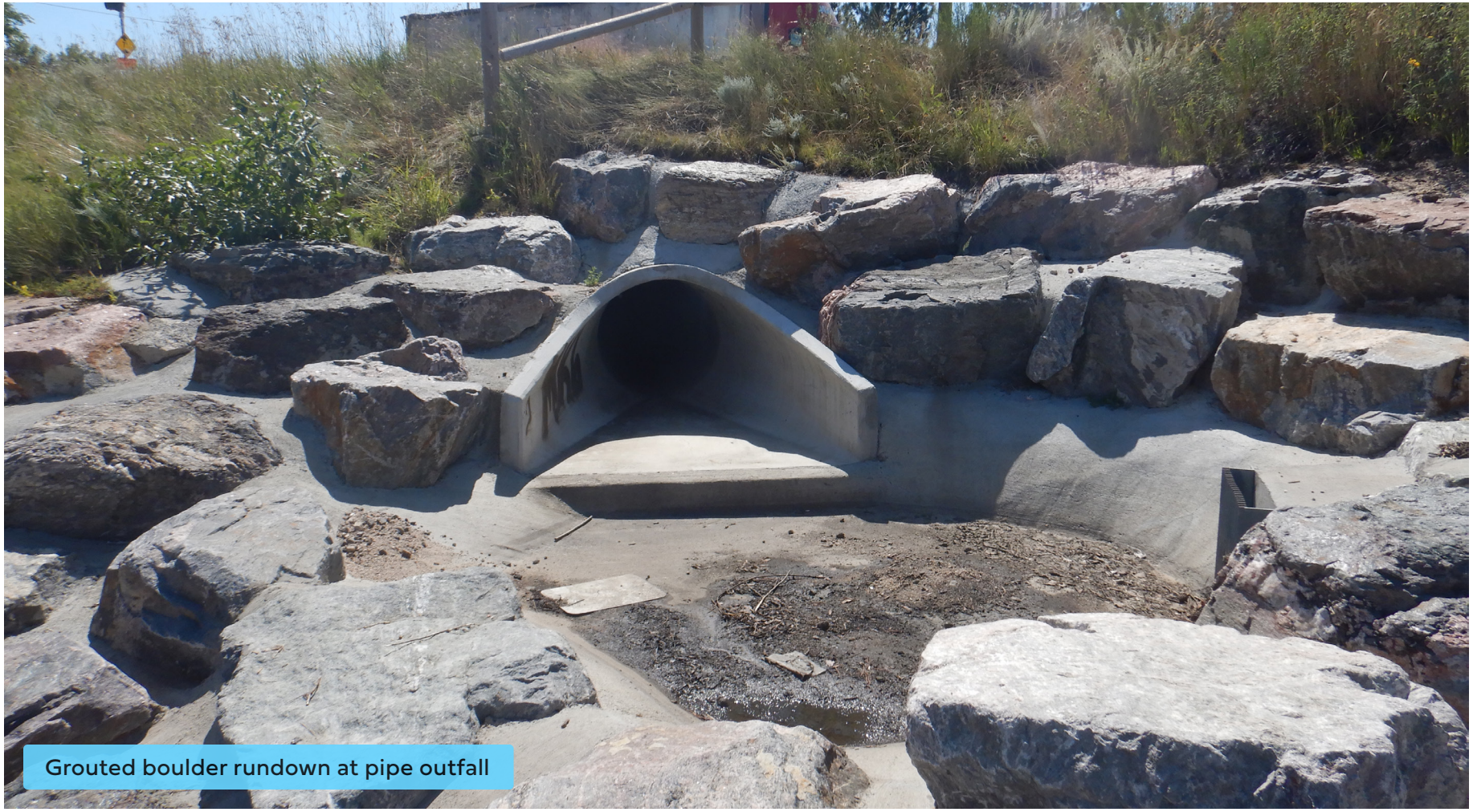
- When riprap aprons are used for erosion protection at pipe outfalls, verify the riprap thickness and width and length of the apron.
- Verify that riprap protection extends around the side of the FES to protect from turbulent water.



Riprap apron at FES with toe wall

Pipe Outfalls – Erosion Protection

Grouted boulders can also be used for erosion protection at pipe outfalls. For information on inspecting grouted boulders, refer to the "Construction Guidance Checklist – Grouted Boulders".



Grouted boulder rundown at pipe outfall