

Technical Bulletin

Headwalls & Endwalls

Headwall or Endwall– An integrated wall located at either end of drainage pipe or a stream crossing structure. A wall built at a pipe inlet is a **headwall**. A wall built at a pipe outlet is an **endwall**.

PURPOSES

Headwalls and endwalls support the road and protect the ends of the pipe. Properly constructed headwalls and endwalls improve pipe efficiency while reducing erosion around pipe installations.

BENEFITS OF HEADWALLS AND ENDWALLS

- Provide a low-cost, long-lasting solution to erosion problems at pipe openings.
- Prevent flowing water from damaging the road structure.
- Provide structural support for the road shoulder.
- Increase the efficiency of pipes by directing flow and reducing turbulence.
- Headwalls can reduce flow by-pass of the pipe, or “piping.”
- Visually identify pipe openings and protect them from damage by traffic and maintenance equipment.

NECESSITY FOR PROTECTION AT PIPE OPENINGS

It is necessary to protect pipe openings for several reasons:

- Water is turbulent when it changes direction or velocity, increasing its erosive potential.
- Water accelerates as it passes through a pipe, creating the need to stabilize surrounding soil to prevent erosion.
- Erosion of unprotected areas increases sediment pollution and maintenance costs.
- Physical support for the road and banks may be necessary at pipe openings.
- Headwalls and endwalls help guard against crushed pipes.

MATERIALS

Headwalls and endwalls can be built with many different materials. Several factors influence the choice of materials, including: local availability, skill and time required for construction, durability, and cost. Materials used in Pennsylvania include *:

- Stackable stone, either collected or purchased
- Rounded rocks and boulders
- Pre-cast concrete and cast-in-place concrete
- Modular masonry products (various sized blocks)
- Modular plastic products (fillable)

*Construction techniques using stone is detailed in the *Stacked Stone Headwalls technical bulletin*.

Headwalls and Endwalls can be made with a variety of materials including native stone (a), boulders (b), poured concrete (c), or pre-cast concrete (d).



SHAPE

The shape of a headwall or endwall is important to direct water flow, to support and protect the road and the banks from erosive flow, and to improve drainage efficiency.

Headwalls can be built with wing walls to steer flow to the pipe inlet and with bank walls to stabilize steep road banks (see pictures). These structures reduce erosion and the potential for pipe plugging. At the outlet, the endwall supports the road edge and reduces possible undermining of the road structure.

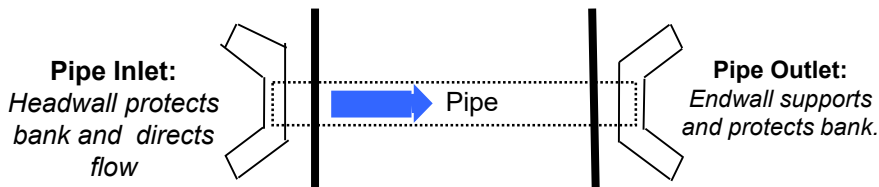


Figure 1: Plan or Bird's Eye View
Figure not drawn to scale.



On roads with linear grade, it is important to plug the road ditch to force ditch flow into the pipe. Water forced to change direction can be very erosive. Erosion at a pipe inlet is not only a pollution source but can cause increased maintenance. Adding angle to a headwall directs, protects, and improves pipe function (Figure 2).

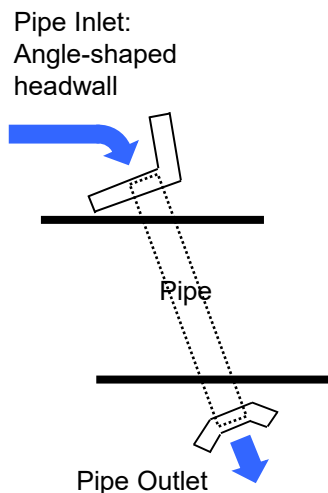


Figure 2: Plan or Bird's Eye View
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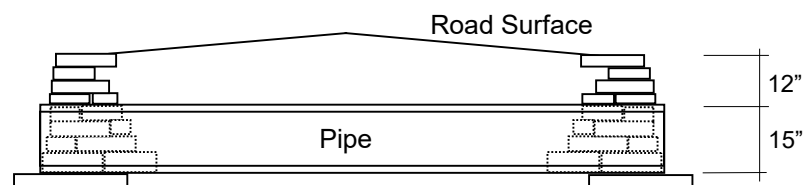


Figure 3: Longitudinal Section of Pipe Installation.
The headwall and endwall extend 12" above the pipe to ensure proper cover, to support the road, and to improve pipe capacity.
Figure not drawn to scale.

IMPORTANT CONSIDERATIONS:

- Headwalls and endwalls should be built high enough to support the full depth of pipe cover recommended by the manufacture, typically 12" for both plastic and corrugated steel pipe 48" in diameter and smaller (Figure 3).
- It is critically important to anticipate the forces of drainage water under high flow conditions. Drainage structures should be built to protect the road and banks during large storm events. Headwalls and endwalls built to the proper height improve pipe efficiency during very high flows and help prevent flow by-pass, road washouts, and compounding damage caused by pipe failure.