Storm Damage – Floating Culverts & Other Inlet Issues

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What causes a culvert to float?

1. **Accumulation of debris at inlet.**
2. **Water then evacuates the culvert.**
3. **Water then ponds at the inlet submerging it.**
4. **Buoyancy force then results, lifting the culvert.**
5. **Depending on depth of fill, the culvert may pop through the fill, or it may have its end bent upwards.**

Signs to look for

1. Pipe has upwards deformation.
2. Anchor is damaged or gone.
3. Embankment is disturbed.
4. Trail of fill material at outlet.
5. Bottom of pipe may be severly distorted, or suffer other damage.
6. Stream typically has floating debris.

DEBRIS ACCUMULATION EXAMPLES

SR 56 Dubois @ RP 54.2

April 2015

Debris at inlet.

SR 26 Tippecanoe Co. @ RP 28.10

March 2012

Debris accumulation on collector and on top of structures.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

This 60 ft. bridge is immediately upstream of I-69 Bridge and was plugged by debris, mainly branches and corn stalks. A local farmer unplugged it using a tractor with a backhoe attachment.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

Note the branches and corn stalks.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

Note the corn stalks jammed in between the beams.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

More of the corn stalks and branches in the beams. Note the corn stalks on the bank upstream of the bridge.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

Up stream view of the bridge.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

Up stream view of the bridge and I-69 bridge down stream.

CO Rd 550 E Gibson Co @ Pigeon Creek

May 2011

Looking N from bridge. Note the stains on the County Road due to overtopping, as well as the corn stalks. Also, note how the I-69 bridge extends far onto the flood plain. Br is > 1,300 ft long.

Back to the presentation on floating culverts

SR-60 July 2006
Clark County

11.40 ft x 7.24 ft
Structural Plate Pipe Arch
(SPPA)

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

7-16-2006

Items to observe: 1. Culvert bottom was in poor shape prior to event. 2. Note upwards bending of culvert (looking in inlet direction).

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

7-26-2006

Residual debris in culvert (looking towards inlet)

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

7-16-2006

Looking down at culvert inlet from upper limit of embankment disturbance.

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

7-26-2006

Disturbed embankment at inlet. Again note the upwards bend of the culvert.

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

8-4-2006

Interior bottom damage to culvert near inlet. Again, note the bending of the culvert and debris.

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

8-4-2006

Culvert bottom damage.

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

7-26-2006

Flooding impacts, drying out.

SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA

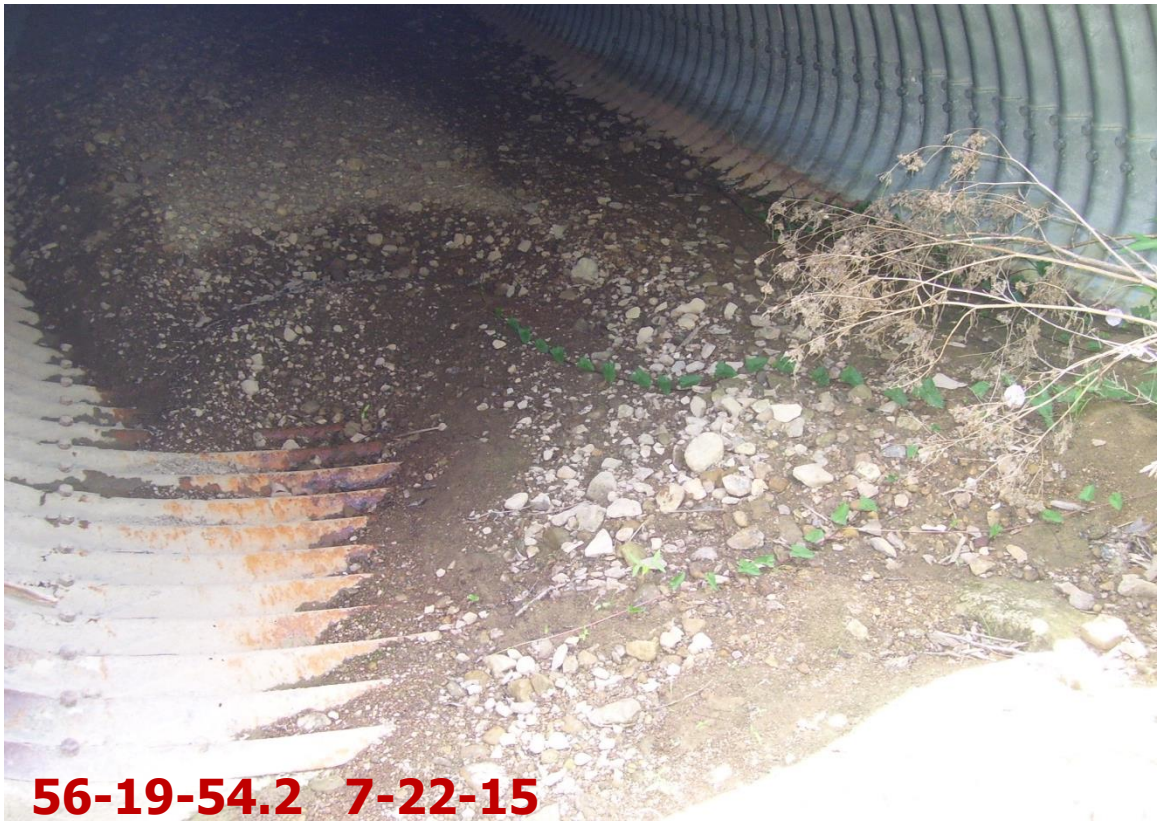
7-26-2006

Flooding impacts, drying out.

A short diversion to discuss multiple pipe issues

Multiple culvert problems

Note that one culvert tends to become the streams choice, and the other may experience sediment accumulation. And, the one the stream chooses to use, also collects floating debris.



Multiple culvert problems

Accumulating sediment

Multiple culvert problems

Double culverts with one set higher to avoid sediment accumulation.

Multiple culvert problems

At the higher culvert outlet sediment and debris accumulation is visible, as well as a tree starting to grow.

Multiple culvert problems

Double culvert where the stream has shifted and abandoned the other culvert, which now has a ridge of soil with trees growing immediately upstream of the inlet.

Multiple culvert problems

Close-up of the same culverts showing how water has to be very deep to get into the second culvert.

Multiple culvert problems

At the outlets it is apparent that the other culvert has been abandoned by the stream.

Multiple culvert problems

Another view of the outlets further downstream.

Back to the presentation on floating culverts

I-74 June 2008
Putnam County

Twin 9.5 ft x 6.0 ft
Structural Plate Pipe Arch
(SPPA)

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-18-2008

Culvert inlets. Closest one was blocked and floated, popping up through the pavement of westbound I-70.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-16-2008

East pipe inlet. Note large dent and debris, including a tree.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-16-2008

Dent on eastern side of east culvert inlet.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-16-2008

Dent on western side of east culvert inlet.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-18-2008

East pipe, bottom damage, looking towards inlet. Note upwards bend in culvert top.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

East pipe, bottom damage, looking towards inlet

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Looking upstream at inlets. Note debris deposits above culverts. And stream has chosen one culvert and abandoned the other resulting in sediment is collecting in the abandoned one.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Temporary patching where culvert popped up through the westbound lane of I-70.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Culvert Outlets, east culvert (one that floated) barely visible in the shade. Note the embankment material that was transported through the culvert when it was floated.

I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Culvert Outlets, east culvert in shade. I-70 embankment material.

SR-26 Event Date Unknown
Tippecanoe County

Twin 7 ft x 7 ft
Precast Reinforced Concrete Box

SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Culvert inlets with debris collected at deflector and tree lodged between separated sections visible on left. Embankment issues.

SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Culvert inlets with separated section and timber lodged in gap.

SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

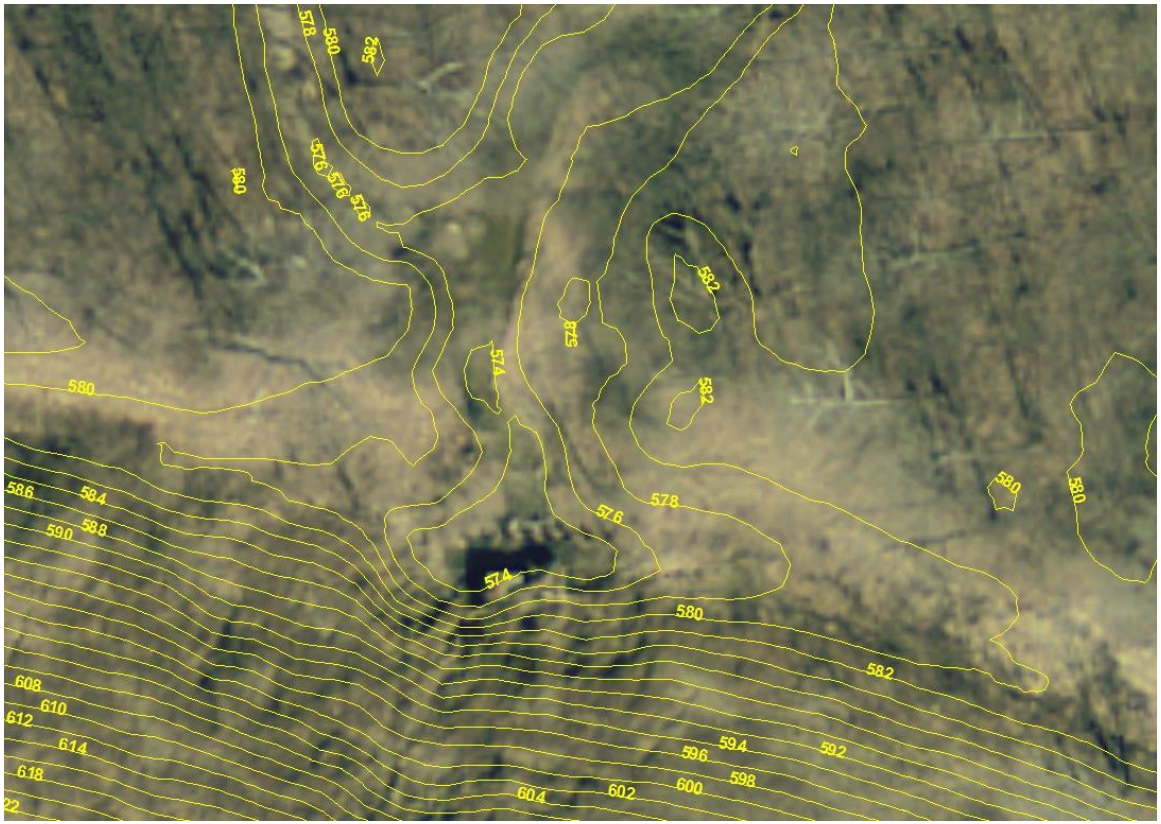
Photo taken 2/10/2012

Culvert inlets with separated section and timber lodged in gap.

SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Slope sloughing on inlet side. Possibly due to embankment disturbance.



SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs Contours – 2011-13 Indiana Map

Note that the stream is contained and depth at the inlet can easily reach 8 feet.

SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs Embankment Damage 2005 Aerial Photo

With ponding at inlet due to blockage, rapid drawdown can result.

Embankment damage due to rapid drawdown Borman Expressway, 2008

Ponding in interchange due to clogged levee flapgate.

Embankment damage due to rapid drawdown Borman Expressway, 2008

Ponding in interchange due to clogged levee flapgate.

SR-46 Event Date Unknown
Brown County

8′-2″ x 5′-9″
Structural Plate Pipe Arch
RP 80.14 – Henderson Creek

Reported to Hydraulics as possibly in failure mode due to pipe deformation and bottom of culvert gone. Anchor was also gone.

8′-2″ x 5′-9″

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken mid-2015

Culvert inlet, invert gone.

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken mid-2015

Culvert inlet, invert gone.

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken 2-27-2015

Culvert inlet.

Note that pipe is in good shape, but is bent upwards at the inlet.

Final Determination

Upwards bend at culvert inlet suggests blockage and buoyancy force occurred in the past.

8′-2″ x 5′-9″

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

Final Determination

Sharp edge on missing floor of culvert suggests that it was manually removed.

8′-2″ x 5′-9″

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

Final Determination

Both factors suggest event occurred when culvert was new and was structurally sound, especially the bottom which didn't deform as seen in older pipes.

8'-2" x 5'-9"

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

Final Determination

The bottom at the inlet was likely tilted upwards when the culvert was new, the bottom was cut out to allow the creek to flow through.

8′-2″ x 5′-9″

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

Final Determination

Recommendation: pave the invert, construct a headwall with wingwalls, and protect the outlet from scour with riprap.

8′-2″ x 5′-9″

Structural Plate Pipe Arch

RP 80.14 – Henderson Creek

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken 2-27-2015

Culvert inlet. Note driveway adjacent. Resident said it is difficult to mow around the inlet. A headwall with wingwalls will satisfy backwater requirements, plus make it easier to mow the grass.

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken 2-27-2015

Upstream. Garage and basement require no increase in backwater necessitating both a paved invert and headwall.

SR-46 RP 80.14 8′-2″ x 5′-9″

Photo taken 2-27-2015

Downstream. Paved invert will increase outlet velocity requiring riprap to protect channel from scour at the outlet.

Quiz

I-70 Morgan Co. RP 55.02 6′-6″ x 4′-6″ SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.

I-70 Morgan Co. RP 55.02 6′-6″ x 4′-6″ SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.

I-70 Morgan Co. RP 55.02 6′-6″ x 4′-6″ SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.

Diagnosis?

I-65 RP 27+15

Photo taken 3-1-2016

Bottom distorted. Pipe has upwards bend.

I-65 RP 27+15

Photo taken 3-1-2016

Bottom distorted. Pipe has upwards bend.

Diagnosis?

The End

Any Questions?