



Culvert Maintenance

CULVERT MAINTENANCE




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Culvert Maintenance

Culvert Maintenance

- Similar to bridges
 - approach road
 - channel
- Structurally different
 - upstream end
 - downstream end
 - barrel



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Culvert Maintenance

Maintenance Recommendations


Alberta Transportation Bridge Inspection & Maintenance System (Web 2017)

Maintenance Recommendations						
Completed Work						
Work Type	Status	Plan. Year	Target Year	Inspector Comments	Department Comments	
PLACE ADDITIONAL RIP RAP						
REMOVE DRIFT ACCUMULATION						

- CULM and CULE form recommendations are identical



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Maintenance Recommendations

Alberta Transportation Bridge Inspection & Maintenance System (Web 2017)


Maintenance Recommendations						
Completed Work						
Work Type	Status	Plan. Year	Target Year	Inspector Comments	Department Comments	
PLACE ADDITIONAL RIP RAP		2017		2.5m ³ of 1 m ² inlet		
REMOVE DRIFT ACCUMULATION		2017		at culvert		
Install Steps		2017		7 ft. steps in R1-R6		
Concrete Fills		2017		Full length		
Other Action		2017		Install delineators along left shoulder		

Structural Condition Rating (Last/Now) / / Sufficiency Rating (Last/Now) / / Est. Repl. Yr 2025 Maint. Req'd. (Y/N) Yes

- CULM and CULE form recommendations are identical




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Approach Road Maintenance

- Embankment
 - slides, slumps, etc.
 - repair by removing failed material & replacement with competent, compacted material
 - remaining items same as for bridges



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Bridge Inspection and Maintenance

Culvert Maintenance


Upstream / Downstream End Maintenance

- Upstream & Downstream ends have the same inspection items
- Head Wall
 - usually a low maintenance item
 - broken, spalled concrete
 - patch
 - scaled concrete
 - repair & seal (when salt applied to roads)



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Bridge Inspection and Maintenance

Culvert Maintenance


Upstream / Downstream End Maintenance (Cont'd)

- Collar / Concrete Slope Protection
 - scoured / eroded
 - compacted fill and rock riprap
 - settled & broken
 - replace with fill and riprap



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Bridge Inspection and Maintenance

Culvert Maintenance

Adding end treatment to existing culvert.





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Bridge Inspection and Maintenance

Culvert Maintenance

Upstream / Downstream End Maintenance (Cont'd)

- Wingwalls
 - deteriorated concrete
 - chip out and replace
 - separated from barrel
 - fill gap with flexible material
 - pushing inwards
 - strut between

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Culvert Maintenance


Damaged floor at outlet transition.




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Culvert Maintenance

Horizontal Strut




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Upstream / Downstream End Maintenance (Cont'd)

- Cutoff Wall
 - usually buried if present
 - if not present and a problem with piping
 - Install cut off wall

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Culvert Maintenance


Adding cut-off wall to existing culvert.



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Culvert Maintenance


Wash out due to piping
(Brewster Creek Sunchild Road)



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**Upstream / Downstream End
Maintenance (Cont'd)**

- Bevel End
 - excessive heaving
 - remove and reset with end treatment
 - replace with new end treatment
 - folding in
 - add collar
 - current end treatment requirements are:
 - 1.5 to 3.0m special conditions
 - 3.0 to 4.5m upstream end only
 - >4.5m both ends

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Heaved inlet on CSP culvert.



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Upstream / Downstream End Maintenance (Cont'd)



- Scour Protection
 - Erosion / scour
 - add suitable size rock riprap with filter cloth to apron and/or around collar or bevel
- Scour / Erosion
 - scour / erosion
 - add rock riprap with filter cloth to suit velocities anticipated

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High velocity at outlet during high water (Big or Bald Mountain Hwy 40)



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Extreme turbulence at outlet.





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Downstream bed erosion and bank erosion at bend.



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Culvert Maintenance

Downstream Apron Repair

BEFORE

AFTER

Rock Riprap
Granular Backfill

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Culvert Maintenance

Upstream / Downstream End Maintenance (Cont'd)

- Rock Riprap Material Size versus Stream Velocity

Riprap Class	Allowable Velocity
Class 1m	- 2.0 m / sec
Class 1	- 3.0 m / sec
Class 2	- 4.0 m / sec
Class 3	- 4.7 m / sec

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Upstream / Downstream End Maintenance (Cont'd)

- Degradation
 - restore stream bed elevation
 - add material
- Aggradation
 - restore stream bed elevation
 - remove material

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Stream degradation and scour hole.

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Hanging outlet due to degradation and scour.



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Typical scour and degradation at outlet



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New rip rap added to bevel and apron




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Streambed aggradation (Cougar Creek Canmore).



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Restored inlet.



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Culvert Maintenance


Barrel Maintenance

- Roof
 - Sagging 15% or more
 - Reverse curvature
 - add struts (or install liner if still adequate capacity).

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Culvert Maintenance


Reverse curvature in roof



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Culvert Maintenance


Barrel Maintenance

- Sidewall
 - deflecting
 - add struts (or install liner if adequate capacity)
 - corroded
 - Install liner
 - cathodic protection (not as common as previously)

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Culvert Maintenance


Failed SPCSP culvert (inadequate backfill).



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Bridge Inspection and Maintenance

Culvert Maintenance


Soil side corrosion, perforated side wall.



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Bridge Inspection and Maintenance

Culvert Maintenance


Barrel Maintenance

- Floor
 - bulging
 - Place U/S cut-off wall if piping
 - add struts or install liner
 - corroding
 - cast concrete floor
 - cathodic protection

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Floor perforations



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Arch shaped CSP with heaved floor and deflecting roof.




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Strutted barrel




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Concrete arch culvert with curved wingwalls in Feb.
(Weed Creek)




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Arch culvert after high water in July.




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Culvert outlet after high water.



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Inlet of new culvert, following winter.






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Hwy. 40 Lineham Creek – Washout of
4.3m SPE – 2013 Flood Event - Outlet





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Culvert Maintenance


Hwy. 40 Lineham Creek – Washout of
4.3m SPE – 2013 Flood Event - Inlet





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Culvert Maintenance


Hwy. 40 Lineham Creek – Washout of 4.3m SPE – 2013 Flood Event






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Bridge Inspection and Maintenance

Culvert Maintenance

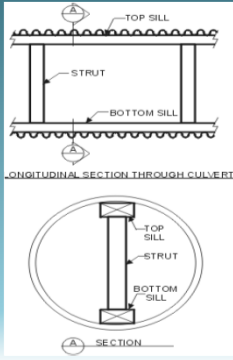
Hwy. 40 Lineham Creek – Replacement with 8-14-8M SLW girders in 2015






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Bridge Inspection and Maintenance

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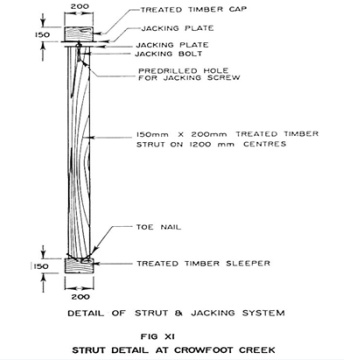
Timber Strutting of Metal Culverts






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Culvert Maintenance

Strut detail (Crowfoot Creek Hwy 1).





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Strutting arrangement for horizontal ellipse.

FIG X
STRUT SYSTEM AT CROWFOOT CREEK



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Installing adjustable struts.



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Completed installation.




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Culvert Maintenance

Culvert Liners



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Culvert Maintenance

Installing a CSP liner.



Culvert Maintenance

SPCSP liner is assembled outside and then pulled into existing culvert.



Culvert Maintenance

For larger culverts, tunnel liner plates are used.



Culvert Maintenance



Liner installed ready for grouting.



Culvert Maintenance


Barrel Maintenance



- Circumferential Seams
 - separated
 - inject concrete or grout
 - Install inside coupler plates
- Longitudinal Seams
 - cracked
 - monitor
 - shotcrete reinforcement
 - cast 1/2 arc concrete
 - install liner

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Culvert Maintenance

Properly lapped seam.



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Culvert Maintenance


Incorrectly lapped seam with poor nesting





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Culvert Maintenance

Incorrectly lapped seam with cracks



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Culvert Maintenance

Longitudinal Seam Reinforcing

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Culvert Maintenance

Shotcrete repairs of cracked seams during winter.

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Culvert Maintenance

Reinforcing and shear connectors fastened to culvert.

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Culvert Maintenance


Shear connector detail.

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Culvert Maintenance

Shear connectors and rebar in place over cracked seam.




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Culvert Maintenance

Shot blaster and heater for inside the culvert.




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Culvert Maintenance

Heater inside culvert. Must be maintained at +5° C.




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Culvert Maintenance

Applying the shotcrete.



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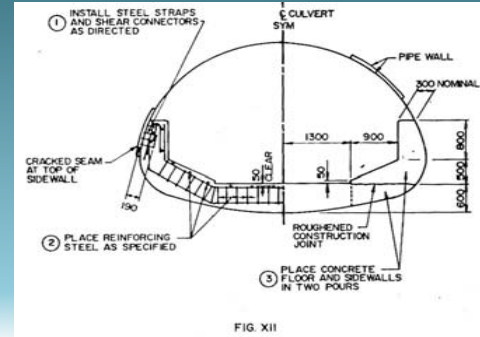
Culvert Maintenance

Completed shotcrete reinforcing beams.



Culvert Maintenance

Bottom reinforcement for arch shaped culvert.
(Nose Creek Hwy 2)



Culvert Maintenance

Reinforcing installed for arch culvert reinforcement.



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Floor cast inside arch culvert.



Culvert Maintenance


Barrel Maintenance

- Coating
 - Corrosion
 - Soil side corrosion
 - Liner
 - Cathodic protection (not as common as previously)
 - Water side corrosion
 - Concrete floor
 - Liner



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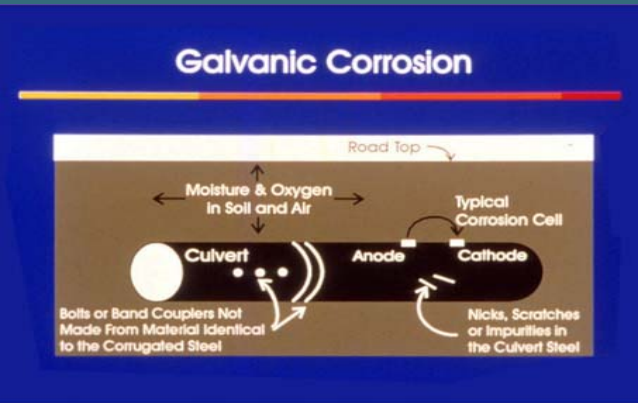
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Galvanic Corrosion





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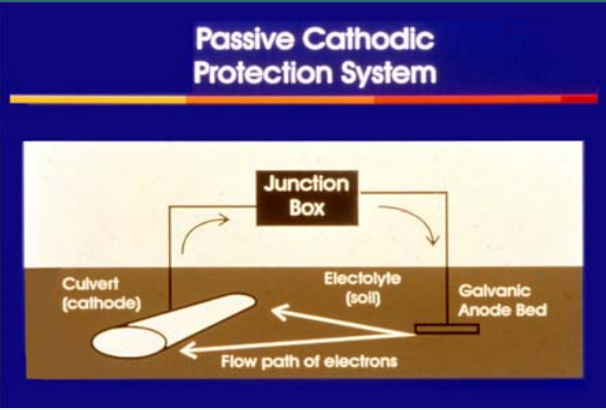
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Culvert Maintenance


Passive Cathodic Protection System





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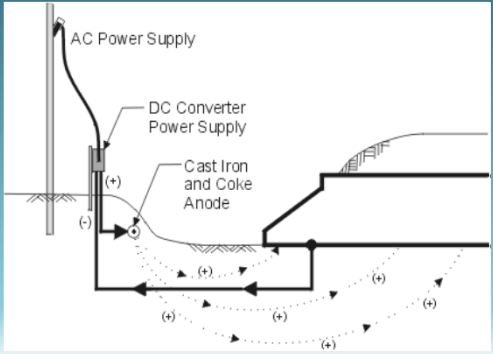
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Culvert Cathodic Protection





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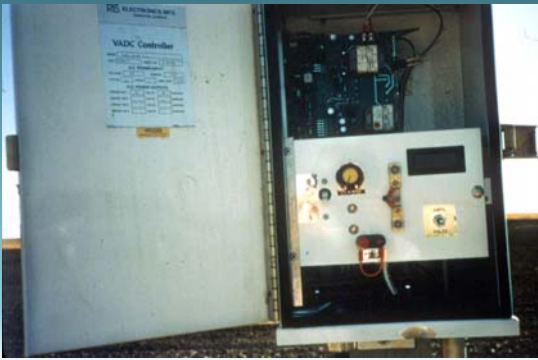
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DC power supply (AC to DC converter).



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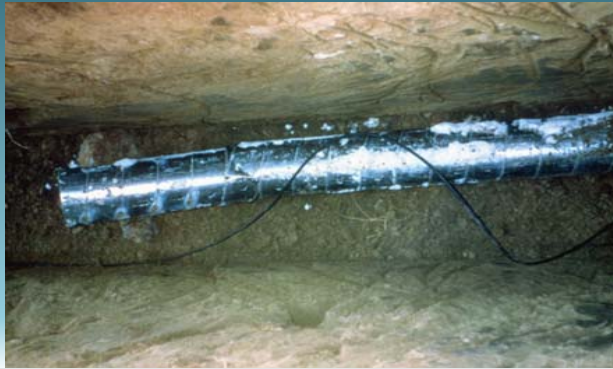
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Cast iron and carbon anode.



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Cross-section of anode.



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Culvert Maintenance


Barrel Maintenance (Cont'd)

- Fish Passage Adequacy
 - add baffles
 - cast concrete
 - rocks
 - weir type
 - repair / build downstream apron
- Waterway Adequacy
 - install additional culvert (jacking)
 - remove drift or silt
 - install stream lining

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Culvert Maintenance


Channel Maintenance



- Similar to bridges - Degrading (scour), Aggrading
- Drift more of a concern
- Beavers are common
- High velocities at outlet

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Culvert Maintenance


Drift collected at inlet (Whitecourt Creek).





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Culvert Maintenance


Drift in strutted barrel



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Culvert Maintenance

Questions???

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