CyclopsShield™

Safe Culvert End

SafeDirection
CRASH BARRIER SOLUTIONS

safedirection.com.au

1.0 Introduction

Safe Direction's CyclopsShield™ safe culvert end has been developed to address the long-standing safety problem of roadside culvert end impacts.

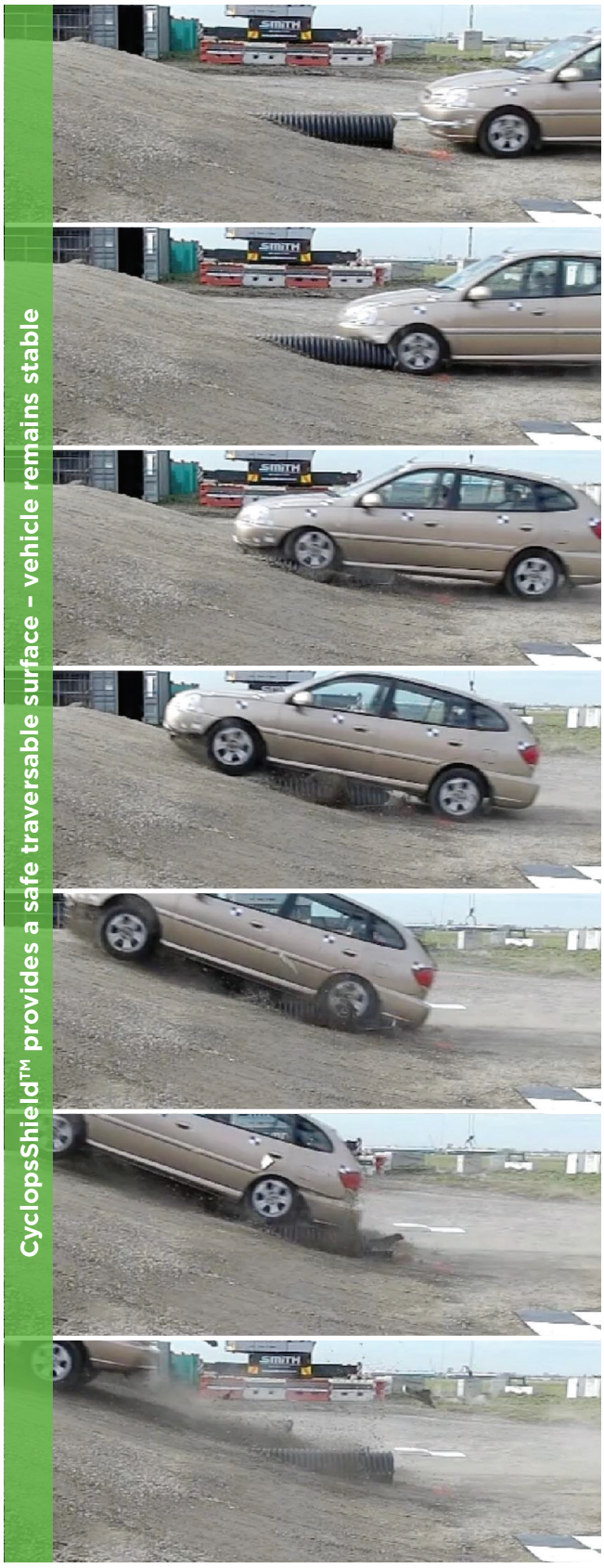
A vehicle entering a roadside ditch will encounter parallel drainage culverts under crossroads or driveways. The general effect following an unprotected culvert end snag will be a high severity impact on the culvert end, often followed by the catastrophic flipping of the vehicle.

Crash impact severity is significantly reduced through creating a deformable culvert safety end that provides a traversable surface and eliminates vehicle snagging hazards. A vehicle impact at speeds up to 100 km/h with the CyclopsShield™ safe culvert end can override the culvert, saving the occupants from what would otherwise likely be a fatal incident.

The CyclopsShield™ safe culvert end has the following advantages:

- Significantly reduces culvert crash impact severity
- The only MASH performance tested Test Level 2 and Test Level 3 culvert safety end;
- Cost saving wingwall alternative
- Eliminates snagging hazards
- Available for culverts with internal diameters from DN225 to 450mm
- Can easily be installed onto existing concrete culvert pipe

Typical rollover caused by blunt end culvert



CyclopsShield™ provides a safe traversable surface – vehicle remains stable

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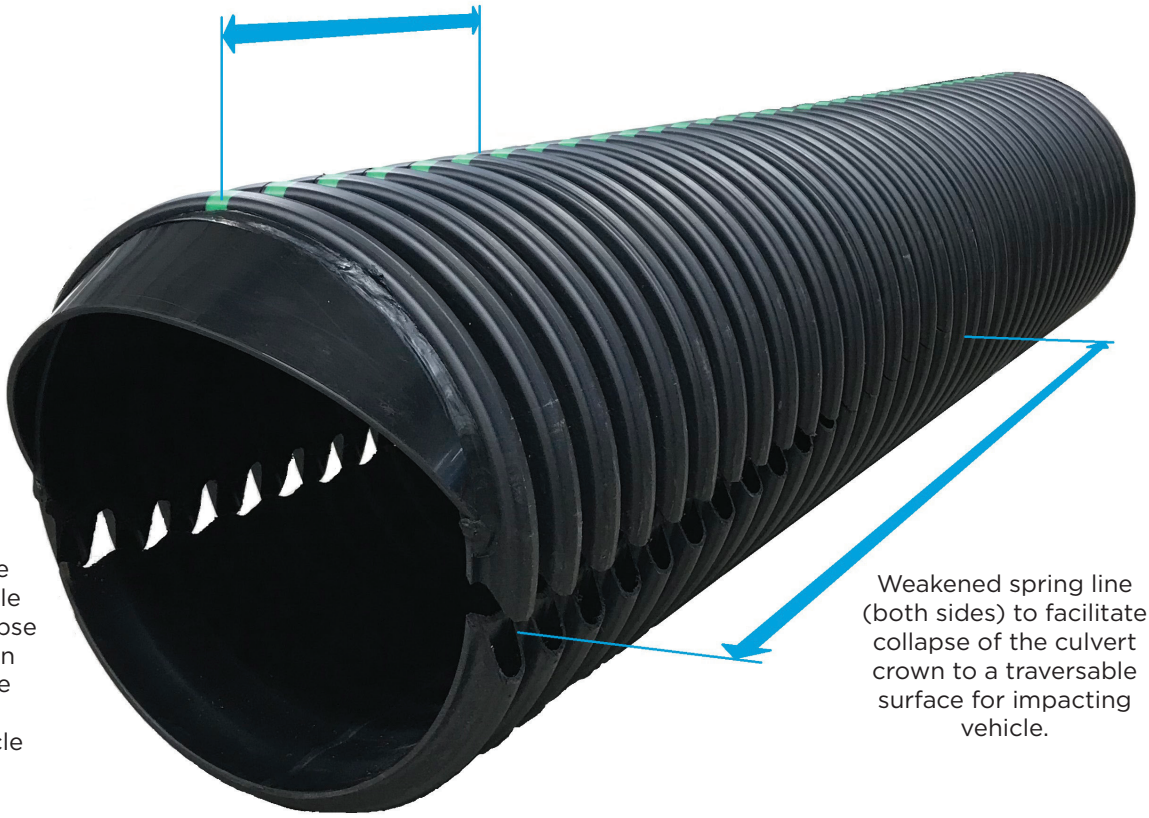
Dangerous concrete headwall – potential fatality to errant vehicle

CyclopsShield™ Replacement – Safe traversable end for errant vehicle

CYCLOPS SHIELD
SAFE CULVERT ENDS

Australian Patent: 2011200248

Weakened obvert to facilitate collapse of the culvert crown to a traversable surface for impacting vehicle.



Nose to reduce snag with vehicle and initiate collapse of culvert crown to a traversable surface for impacting vehicle

Weakened spring line (both sides) to facilitate collapse of the culvert crown to a traversable surface for impacting vehicle.

Flex Coupling for butt joining to concrete pipe

Optional Spigot Fitting for connection to concrete pipe Bell/ Collar End. (Required on DN 225 and DN 300 pipe only)

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2.0 A Desperate Need

Approximately 55% of vehicle crashes leading to death and serious injury are the result of run-off road incidents.

Run-off road crashes generally end with the impact of a roadside hazard. As culvert ends under driveways or intersecting roads are located very close to the edge of the roads, they are a common hazard that features in high severity impacts.

It is anticipated that there are approximately 38 fatal crashes and over 380 serious crash incidents involving culvert end snags in Australia each year.

Although solutions have been developed to prevent wheel snag, they have typically been ineffective, relatively expensive and often interfered with culvert drainage.

3.0 Austroads Guidance

The Austroads Guide to Road Safety cautions that drains of both the abrupt and gradual slope designs can funnel a vehicle along the drain bottom, and this increases the probability of impact with an object that has high-severity attributes that is present on the bottom or sides of the drain. The most common such obstruction is culvert ends.

The reference goes on to advise where drainage features are unavoidable that for drains parallel to the road (e.g. under a driveway or side road) that traversible culvert end treatments should be installed wherever a culvert exists parallel to the road and within the area of interest.

4.0 Compliance Testing

The CyclopsShield™ culvert safety end has been tested to MASH test Level 2 and MASH Test Level 3 for the critical vehicle (1100kg sedan). The CyclopsShield™ culvert safety end performed predictably and within the preferred limits for occupant velocities and accelerations. The test vehicles' steering and suspension remained operational following the impacts.

Demonstration of snagging risk of chamfered culvert end

5.0 Inadequate Alternate Options

There are two often deployed types of culvert safety end treatments installed in Australia. The lowest cost treatment is the chamfered culvert in a graded slope, which retains the inherent wheel snagging problem on culverts greater than about 250mm diameter.

Safe performance was greatly improved through the addition of traverse bars across the chamfered opening to enable a vehicle to climb the culvert end. Unfortunately, the bars are prone to catching debris and blocking drainage. Moreover, the bars limit accessibility for maintenance. Further, the very expensive culvert end is generally written off on impact through the bending bars breaking from the culvert.

Expensive, blocks drainage and still a potential snag risk

Dangerous concrete headwall

6.0 The CyclopsShield™ Safe Culvert End Solution

The CyclopsShield™ safe culvert end presents a predictable, controlled collapse of the culvert end into a traversible surface. The mechanism is initiated at a low energy level that is easily activated by a vehicle bumper, undercarriage or wheel.

The CyclopsShield™ safe culvert end then deforms to create a surface that transitions an errant vehicle over the snagging hazard of the culvert end.

The patented design incorporates a brow mechanism that initiates the collapse through engagement with the impacting vehicle and then structurally weakened failure planes enable the partial collapse of the upper section of the end, on impact loading. The structural brow is of particular benefit with increasing culvert diameter.

A CyclopsShield™ safe culvert end installation along with the adjacent grading of the embankement side slope will provide a smooth redirective surface that will enable an impacting vehicle to smoothly transition over the culvert end.

The CyclopsShield™ safe culvert end poses no reduction in the drainage cross section of the culvert and as such it remains completely open for maintenance access. Furthermore, it is less likely to accumulate debris that may result in a blockage of the culvert and subsequent overtopping of the drain.

7.0 Retrofit to Concrete Pipe

The CyclopsShield™ safe culvert end can be manufactured in lengths as part of a new culvert installation or as part of an extension to new or existing concrete pipes.

The CyclopsShield™ safe culvert end is easily joined to concrete flush joint profiles with a Flex Coupling and joins to the bell end of a concrete pipe in the conventional spigot and collar arrangement (Flex Coupling not required).

CyclopsShield™ Installations

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8.0 Product Details

The CyclopsShield™ safe culvert end is available in the following sizes:

DN (mm)	Joining to:			CyclopsShield™ Item Number	Inside Diameter (mm)	Outside Diameter (mm)	Length (m)	Flex Coupling Item Number
	Concrete Pipe		Plastic Pipe					
	Flush Joint or Spigot End	Bell or Collar end						
225	✔	✖	✔	CY-SH-225-1500-PP	220	259	1500	CY-JN-225-0000
225	✖	✔	✖	CY-SH-225-1500-PP	220	259	1500	Not required
300	✔	✖	✔	CY-SH-300-2000-PP	305	353	2000	CY-JN-300-0000
300	✖	✔	✖	CY-SH-300-2000-PP	305	353	2000	Not required
375	✔	✖	✔	CY-SH-375-2000-PP	383	442	2000	CY-JN-375-0000
375	✖	✔	✖	CY-SH-375-2000-PP	383	442	2000	Not required
450	✔	✖	✔	CY-SH-450-3000-PP	459	531	3000	CY-JN-450-0000
450	✖	✔	✖	CY-SH-450-3000-PP	459	531	3000	Not required

9.0 Installation

The CyclopsShield™ safe culvert end's ability to reduce the severity of a car impact greatly depends on the way it is installed. It is crucial that CyclopsShield™ safe culvert ends are properly installed. Please carefully read and understand the following installation instructions before installing CyclopsShield™ safe culvert ends.

10.0 Laying Culvert End

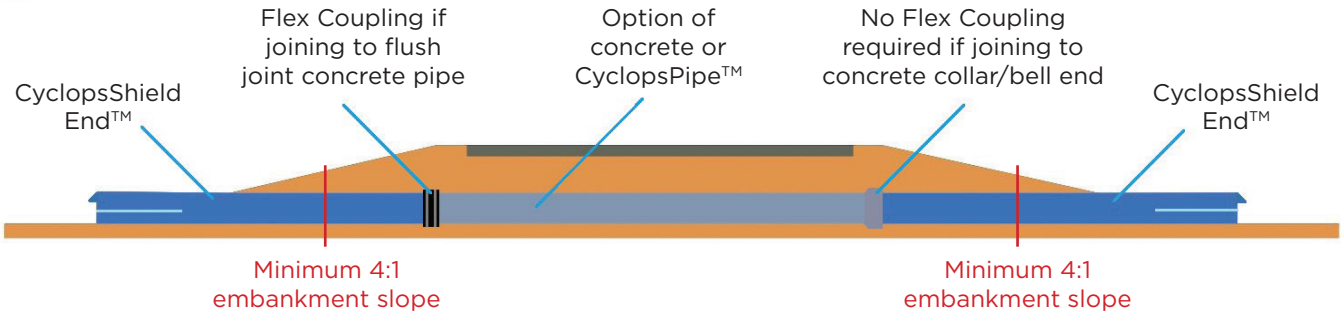
Requirements for the installation of buried flexible pipelines are given in AS/NZS 2566.2 2002. The requirements of this standard with respect to trench excavation and backfilling is relevanct to installation of CyclopsShield™ if installed in an area under live load.

Most often, Cyclops Shield is installed as an extension to existing concrete culverts. In such instances the Cyclops Shield is generally beyond the area of live load in which case observance for the cover height can be reduced to a practical 100mm or as required to achieve embankment stability surrounding the pipe.

- Where the CyclopsShield™ safe culvert end is under live load it should be installed at a depth exceeding the minimum cover (H) in accordance with the requirements of AS/NZS 2566.2

Application	H (mm)
Driveways and intersecting roads (area outside of area of live traffic load)	100
Driveways (area under live traffic load and not subject to heavy vehicles)	450
Sealed roads or agricultural roads	600
Unsealed roads subject to heavy loads	750

- Make sure the top failure plane is in the 12 o'çlock position. The top failure plane is generally located on the longitudinal stripe on the culvert safety end.
- The culvert safety end slope should be graded to 4:1 (horizontal/vertical) or flatter. The 4:1 slope can be constructed through grading a sloping surface that runs from the culvert end invert through the end of the side planes to the edge of the driveway or road formation. It is important to ensure that all material that could interfere with the deflection of the side failure planes be cleared away.



11.0 Coupling

- If joining to a concrete pipe collar/bell end, simply insert the end of the CyclopsShield™ into the collar end. There is no need for a Flex Coupling
- If joining to a concrete flush joint then a Flex Coupling is required. Evenly overlap the coupling over the adjacent pipes and tighten the stainless band fitting on each side.

12.0 Backfilling and Embankment Slope

Of greatest importance is to observe a maximum gradient for the embankment of 4:1. Where possible reducing this to 6:1 will further enhance the safety of the end treatment to the exposed culvert.

Materials used for the backfilling of the embankement slope should be of a sufficiently cohesive or stabilised nature to ensure protection against erosion of the embankment and or undercutting of the pipe

The embankment slope should be sufficiently compacted to ensure a firm traversable surface under a vehicle live load.

The danger of blunt end culverts