**The Director - Infrastructure Projects,**

Department of Planning and Infrastructure,

GPO Box 39, Sydney NSW 2001.

17th December 2012.

**Re : Foxground and Berry Bypass, Princes Highway upgrade, Environmental Assessment.**

We make the following submission in regard to inadequacies in the Environmental Assessment relating to fauna matters, particularly the issues of "fauna fencing", agricultural fencing associated with the farm/project interface, exclusion of fauna from the project corridor and the underestimation of the movement of fauna from the farm lands to the road corridor with its associated road kill when the project moves into the operational phase.

## SECTION 1

This part of the submission focuses on the appropriateness of fauna fencing in various parts of the project area.

In particular we request that serious consideration be given to:

A) The type, location and extent of the "fauna fencing" mentioned in the Environmental Assessment;

B) The lack of consideration of the fauna in the broadly farm/agricultural areas;

C) The lack of detail concerning the fencing along the boundaries of the project area and farm land and

D) The lack of detail concerning the design of "fauna fencing" which is referred to many times throughout the Environmental Assessment.

Please note that when we refer to "fauna fencing" we refer to the use of that term in the Environmental Assessment. We refer to other fencing as "farm fencing" or "agricultural fencing" to distinguish it from the above.

### PLANT COMMUNITIES AND THE LINK WITH FAUNA "IMPACT MITIGATION"

We note that in section 3.2 - Plant communities (Appendix F) - the final classification is "Cleared land and paddocks".

We also note that there is a commitment to maintaining the "rural" character of the agricultural landscapes however we believe that more thought should be given to finding ways of satisfying the need for fauna "safety" as well as the need for maintaining "rural" character, part of which is the design of rural fences which have been predominantly designed to keep cattle out of road corridors.

Reference to the map in Figure 3.1 suggests that "Cleared land and paddocks" is in fact the **principal** classification of plant communities directly in contact with the project corridor. Whilst it is recognised that other habitat areas are likely to have a higher concentration of fauna and a proportionally higher focus when it comes to looking at the impact on connectivity and mobility issues for fauna we are concerned that the documents:

- **Underestimate** the role that the agricultural lands will have in regard to road kill events when the highway is operational;
- **Underestimate** the requirements for special fencing along the boundary between agricultural land and the project corridor;
- **Underestimate** the requirements for "fauna fencing" in the farmlands located near to the recognised crossing points associated with the riparian and forested areas to direct "farmland native fauna" to the crossing points.

This means that more effort needs to be made to:

A) **Ensure** that appropriate exclusion fencing is used which prevents access by animals to the road corridor from the agricultural land;

B) **Provide** fauna-friendly fencing to prevent the killing or injuring of fauna associated with boundary fencing designed principally to ensure that cattle do not stray onto the road corridor;

C) **Ensure** that boundary fencing acts as a guide for fauna to access the nearest fauna underpass or other crossing point;

D) **Provide** extra crossing options in the middle of very long sections of agricultural land.

## UNDERVALUING AND UNDERESTIMATING THE CONNECTION BETWEEN FAUNA AND AGRICULTURAL LAND

It is acknowledged in the documents that within the cleared land and paddocks "some of the older trees are likely to provide habitat (such as tree hollows or perch sites) for native fauna and, as such, are an important feature within an otherwise denuded landscape".

Whilst the landscape would seem to be "denuded" when compared with the richer vegetated forest and riparian areas, the farmland is home to many fauna species which actively feed there and which under normal circumstances would move from one side of the corridor to the other. Such fauna is not restricted to the older habitat trees mentioned above.

Some examples of the way that the documents undervalue the need to consider fauna mitigation methods in agricultural land are set out below:

> *"Native vegetation at Site 20 (Figure 2.1 and Appendix J) would be impacted by the project. Vegetation at site 20 is represented by disturbed stands of warm temperate layered forest. The condition of vegetation at site 20 was considered to be in poor condition along edges where large infestations of the noxious weed Lantana are present and have displaced most native species. These edges are likely to have little or no capacity for the regeneration of natural vegetation without significant resources allocated to weed control and regeneration", etc., etc.*

**Comment**: Whilst the above quote may well be correct with regard to the vegetation, the "poor condition" vegetation referred to is also the habitat of many individuals from native fauna species. Those individuals and their communities should not be discarded from the project simply because of the state of the vegetation in which they feed and reside.

> *Pg 46* ***Fauna Species*** *says "The fauna surveys generally focused on habitats with greater potential to contain native species.......................and highly modified areas such as grazing paddocks and cropped pastures were only routinely observed throughout the course of the field work".*

**Comment**: This indicates that from the start, the farmland and its native fauna were never really taken seriously in the study.

> *Pg 41 refers to non-native plant communities as representing an "unnatural landscape".*

**Comment**: once again, the "unnatural landscape" is very much the home of "natural" native fauna.

**RECOMMENDATION 1:**

**That further acknowledgement be given to the need for and design of fauna mitigation structures related to the interface between the agricultural land and the project corridor .**

## MOVEMENT OF ANIMALS WITHIN AND FROM THE AGRICULTURAL AREAS

There are a number of implications for fauna impact mitigation in the agricultural areas. This is particularly the case because the agricultural land is the **largest** vegetation "type" along the project corridor.

### Provision of "fauna fencing"

Fauna which seeks to move across the road corridor from within agricultural land could well make use of the proposed crossing options if the length of farm land was relatively small and there was a proper crossing point within a reasonable distance. This would require that the official "fauna fencing" would extend far enough into the farm land to guide the fauna to the crossing point. Our reading of the documents would suggest that this is not a principle that has been applied throughout the project area. In fact it would seem that is some cases "fauna fencing" has not been used because the land has been seen as unlikely to result in fauna impacts.

For example page F- 68 says:

> *"Due to the reasonable height of the Broughton Creek crossings above the existing riparian vegetation, and that each creek will be crossed perpendicularly within a predominantly cleared area, fauna fencing is not recommended at these crossings. However, should road kill become an issue during the operational phase of the highway upgrade at these locations, fauna fencing may be required".*

**Comment:** The "predominantly cleared area" refers to the farm land on each side of the narrow riparian corridors along Broughton Creek. We are suggesting that "fauna fencing" extending outwards (not perhaps the preferred 200m) on both sides will direct fauna movements toward the under pass provided by the "reasonable height" of the bridges. We note that all three bridges over Broughton Creek would satisfy the need for this treatment as they are all within farm land and they all have a very narrow riparian strip of vegetation.

It would be a faulty assumption to suggest that all fauna movements between say two bridges would take place within the riparian vegetation. The diagram would suggest that the distances between successive bridges were approximately 400m and 500m.

We note also that the document has actually predicted the possibility of future road kill in this area.

We submit that provision of such fencing in the construction phase is appropriate and necessary.

**RECOMMENDATION 2**

**That there be greater consideration given to the provision of "fauna fencing" adjacent to the bridges and other fauna mitigation structures indicated in Figures 5.1 to 5.4 in Appendix F.**

**For example**:

In Figure 5.1 there is proposed fencing on the north west of the bridge along the established riparian vegetation but no recognition of the need to direct fauna which may inhabit the farmland on the southern side of the western end of the bridge towards the underpass.

It is further not obvious why "fauna fencing" is not required along the vegetation on the north eastern side of the same bridge. It would also seem likely that fauna might be moving from the vegetated areas on the south eastern end of the bridge and no attempt has been made to direct such fauna towards the bridge.

As stated above it would seem that "fauna fencing" has not been used where there is less than a high probability of fauna movements and where the principal vegetation type is farmland.

A similar approach would apply to those features represented in Figures 5.2, 5.3 and 5.4.

**<u>Provision of appropriate "farm fencing</u>"**

Fauna in the agricultural land will be the subject of predation by raptors of various types. There is much evidence that traditional farm fencing with its focus on barbed wire will be the cause of death of such birds. Barbed wire is also well documented as the cause of damage to larger mammals, many of which frequent the open grass lands of the farm areas.

As suggested above the boundary between farm land and the project corridor will be the largest component of the project interface. This will mean that over the length of the project area there will be a very large amount of such fencing. This will make up for what otherwise is measured as a small number of projected fauna specimens that may be affected by an inappropriate design of rural fencing.

In areas where there is likely to be higher concentration of gliders and other arboreal mammals, such as in the forested areas and riparian zones the presence of barbed wire is also going to be a major threat, and expert advice contained within the documents advises that barbed wire not be used.

There are many examples of studies of the impact of barbed wire on fauna. One such study is:

***Barbed Wire Fencing as a Hazard for Wildlife*** by Rodney van der Ree (*The Victorian Naturalist 116 (6), 1999, 210-217.*) (See attachment 1 at the end of this submission)

The abstract is as follows:

> *Anecdotal reports from landholders and biologists suggest that the entanglement and subsequent death of animals on barbed wire fences is widespread in Australia. In this report, I collate records of at least 62 species of wildlife that have become entangled on barbed wire fences in Australia. This paper is divided into two components; the first focuses on an area near Euroa in northern Victoria as a case study, and the second lists records from throughout Australia. In the Euroa study area, the species most commonly encountered on fences were gliding marsupials (Sugar Glider Petaurus bre- viceps and Squirrel Glider P. norfolcensis) (26 individuals), followed by birds (7 individuals). On a continental scale, species found entangled in barbed wire include gliding marsupials, flying-foxes, aquatic birds, night birds and birds of prey. Records were collected from a wide range of habitats and localities, including the urban-rural fringe, forests and woodlands, agricultural landscapes, semi- arid areas and around water bodies. All individuals were found entangled with barbed wire, and more than 95% of entanglements occurred on standard height farm fencing. Recommendations for alternatives to barbed wire fencing are discussed.*

The report includes a discussion of alternative fencing styles which could be adopted. It stresses that they must be of equal or greater benefit for stock management as they must keep stock from the road corridor as a priority. One example suggested is:

> *• Plain high-tensile fencing wire, if tensioned correctly, can contain most stock. When a fence is being constructed with new materials, consider using multiple strands of high tensile plain wire or plain wire and ringlock mesh (but beware using fine mesh which may also entrap animals or act as a barrier to movement).*

The project documents made no mention of the style of fencing to be used along the farm boundaries just as they do not define the nature of the regularly mentioned "fauna fencing". It seems that in stage 1 of the project the farmers were asked what sort of fencing they would like and that proved to be basic barbed wire farm fences. This became the standard for farm boundary fences along the boundary with stage 1. Our attempts to have even the top wire changed to plain from barbed have not yet been confirmed partly no doubt because this means a change to the approved design.

Recognition of the impact of barbed wire on fauna **MUST** be taken into account in the design stage of the

Foxground - Berry component of the project.

**RECOMMENDATION 3:**

**The lack of certainty of the design of "fauna fencing" and agricultural boundary fencing should be rectified so that both "types" of fencing are described in detail and their ability to perform their respective tasks with no risk to wildlife is proven.**

**Special effort should be made to reduce the use of barbed wire on agricultural boundary fences.**

**The use of exclusion fencing.**

As a matter of principle agricultural boundary fencing along the project corridor should be designed not only with cattle and other livestock in mind but with exclusion of native fauna from the road area as a shared primary concern.

We acknowledge that full "fauna fencing" along all of the agricultural boundary to the project would conflict with the objectives to retain "rural visual amenity", however this would be a great opportunity to look at modification of the traditional farm fencing to increase its ability to exclude some of the smaller native fauna species.

(See Attachment 2 for an example of alternative fauna friendly exclusion fencing)

**RECOMMENDATION 4:**

**That investigations be made into the design of agricultural fencing which has a greater exclusion capability for smaller native fauna species. Such fencing should equally well exclude farm stock, larger native fauna and if possible smaller native fauna from the road corridor.**

## SECTION 2

This part of the submission focusses on structures which can interfere with the opportunity of fauna which become trapped in the road corridor to exit the area safely.

**Concrete median barriers and noise walls.**

We note that the project description contains the following:

*"The project comprises the following key features:*

- *Construction of a four lane divided highway (two lanes in each direction) with median separation (wire rope barriers or **concrete barriers** where space is constrained, such as at bridge locations). "*

We are aware that in the Foxground - Berry Bypass section of the upgrade that such constraints are most likely to occur at bridges as the width of the corridor generally will allow for rope style central treatments.

Type F precast concrete median barriers (see Attachment 3) are currently in place on the Picton Road as a means of allowing smaller animals the option of moving across the road should they be trapped. Providing that the "fauna fencing" on the approaches to the proposed bridges are sufficiently long it would be expected that few individual animals would find their way onto the bridge. However to allow greater freedom of movement for any animals that do gain access to the bridge we request that Type F precast median barriers be used.

We also note references to noise walls in the Environmental Assessment documents. Pages 93-94 of the Environmental Assessment Vol 1 refer to:

> *"**The proposed North Street noise barrier** would be on the southern side of the project. It would extend from the western end of the bridge at Berry to the southern interchange for Berry and would be around four metres in height above the road surface. The barrier would likely consist of a precast concrete barrier with low level landscaping at the base of the barrier on the side of the project, where feasible. A landscaped embankment would be built close to the top of the barrier on the North Street side to minimise the visual impact.*
>
> ***The proposed Huntingdale Park Road noise barrier** would likely be located along the northbound off-ramp for the southern interchange for Berry and based on the proposed design, would be around four metres in height and around 200 metres long. The final details of height and length would be determined during detailed design. Noise barriers constructed as part of the project would be designed in accordance with the RMS 'Noise wall design guidelines: Design guidelines to improve the appearance of noise walls in NSW' (RTA, 2007)."*

The RMS (RTA, 2007) guidelines provide for the inclusion of a break in the wall (see 2.5 Continuity) designed in such a way as to retain the acoustic integrity of the structure. As there is no evidence that "fauna fencing" is being considered in the sections leading up to the noise walls, consideration should be given to the inclusion of a break with one way exit for larger animals which may find themselves trapped within the road corridor along the sound barrier sections. An example of one way exit gate structures is attached. (see Attachment 4)

**RECOMMENDATION 5:**

**That consideration be given to excluding fauna from the sections of the road corridor confined by the sound barriers. That where appropriate gaps with one way gates (see above) be included to facilitate the exit of fauna from the road corridor.**

## SECTION 3

This part of the submission is in support of a broader consideration of biodiversity corridors within the project area and our concern that the identification of important corridors relevant to the project may be less than adequate. (see references to biodiversity corridors in submission from Harvey Blue)

We note on page F-50 a reference to the broad corridor identified by the Southern Rivers CMA and Berry Landcare:

> *"A broader wildlife corridor has been identified by the Southern Rivers CMA. This corridor represents a long term restoration goal which would see a revegetated corridor extending east from the escarpment to the coast. It represents areas of interest for the Southern Rivers CMA and the Berry Landcare group in which efforts towards restoring the native landscape and improving connectivity should be focused. Within the study area, this corridor includes the section of the project between the proposed embankment at Broughton Creek bridge 1 and just east of Tindalls Lane interchange. It is mostly made up of cleared agricultural land and includes most of the wildlife corridors as shown in Figure 3.4. The assessment concentrates on connectivity impacts associated with the project. Therefore it focusses on the most vulnerable areas within this corridor which are located along creeks and ridgelines, and which have existing remnant vegetation."*

As we suggested in Section1 of the submission the lack of focus on the agricultural land is of concern. We feel that provision of fauna mitigation measures in the agricultural areas contained within this biodiversity corridor may be ignored and that over time, as plantings occur and the movement of fauna increases it will be difficult to retrofit fencing to prevent road kill and to direct fauna to specialised crossing points in the area.

The Environmental Assessment acknowledges that the identified corridor should be supported, however restricts its interest to the "most vulnerable areas". We believe that support should be extended to the areas currently "degraded" but which in the future will be vegetated and support fauna movements.

**RECOMMENDATION 6:**

**That consideration be given to providing fauna mitigation fencing and other structures within the agricultural component of the CMA identified corridor which support the future increase in fauna movements likely as the revegetation progresses.**

Thank you for the opportunity to comment on the Environmental Assessment for this project.


| | |
|---|---|
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# Barbed Wire Fencing as a Hazard for Wildlife

Rodney van der Ree[1]

**Abstract**
Anecdotal reports from landholders and biologists suggest that the entanglement and subsequent death of animals on barbed wire fences is widespread in Australia. In this report, I collate records of at least 62 species of wildlife that have become entangled on barbed wire fences in Australia. This paper is divided into two components; the first focuses on an area near Euroa in northern Victoria as a case study, and the second lists records from throughout Australia. In the Euroa study area, the species most commonly encountered on fences were gliding marsupials (Sugar Glider *Petaurus breviceps* and Squirrel Glider *P. norfolcensis*) (26 individuals), followed by birds (7 individuals). On a continental scale, species found entangled in barbed wire include gliding marsupials, flying-foxes, aquatic birds, night birds and birds of prey. Records were collected from a wide range of habitats and localities, including the urban-rural fringe, forests and woodlands, agricultural landscapes, semi-arid areas and around water bodies. All individuals were found entangled with barbed wire, and more than 95% of entanglements occurred on standard height farm fencing. Recommendations for alternatives to barbed wire fencing are discussed. (*The Victorian Naturalist* **116** (6), 1999, 210-217.)

## Introduction

During a study of the ecology of arboreal marsupials in a network of roadside and streamside vegetation near Euroa, Victoria, a number of Squirrel Glider *Petaurus norfolcensis* and Sugar Glider *P. breviceps* carcasses were discovered suspended from barbed wire fences (Fig. 1). There have been several incidental observations of such deaths for a range of species in Australia and overseas (Russell 1980; Allen and Ramirez 1990; Andrews 1990; Krake 1991; Nero 1993; Land for Wildlife 1994; Platt and Temby 1994; Johnson 1995; Anonymous 1996; Tischendorf and Johnson 1997; van der Ree 1997; Campbell 1998; Johnson and Thiriet 1998) but the extent of this problem is still relatively unknown. The aim of this study was to quantify the extent of the situation by collecting records from a range of sources and describing the actual event (e.g. species, fence type, which strand of wire, location).

## Study area and methods

### *Case study – Euroa, Victoria*

The study area lies within the northern plains of Victoria and is bounded by the towns of Euroa, Violet Town, Nagambie, Avenal and Murchison. Formerly dominated by open eucalypt woodland, there is now 3.6% remnant vegetation cover, approximately 85% of which occurs as linear strips along roads and streams (van der Ree, *unpubl. data*). The remaining 15% is made up of small patches of woodland. The major land use is agriculture, with extensive dryland cropping and grazing (Bennett *et al.* 1998).

Observations of animals caught on barbed wire fences were made opportunis-

**Fig. 1.** Dead Squirrel Glider *Petaurus norfolcensis* caught in a barbed wire fence. Photo by R. van der Ree.

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**Table 1.** Observations of wildlife entangled with barbed-wire fencing from the Euroa case study area. Species listed in taxonomic order according to Christidis and Boles (1994) (birds) and Menkhorst (1995) (mammals).

| Species | Scientific name | Number of individuals | Fence type | Wire type |
|---|---|---|---|---|
| **Mammals** | | | | |
| Squirrel Glider | *Petaurus norfolcensis* | 15 | f | b |
| Sugar or Squirrel Glider | *Petaurus* sp. | 11 | f | b |
| **Birds** | | | | |
| Spoonbill | *Platalea* sp. | 1 | f | b |
| Rock Dove | *Columba livia* | 1 | f | b |
| Galah | *Eolophus roseicapilla* | 1 | f | b |
| Southern Boobook | *Ninox novaeseelandiae* | 1 | f | b |
| Australian Magpie | *Gymnorhina tibicen* | 2 | f | b |
| White-winged Chough | *Corcorax melanorhamphos* | 1 | f | b |

Fence type: f = standard height farm fence. Wire type: b = barbed wire.

tically while undertaking fieldwork on the ecology of arboreal marsupials. Additional records were obtained from local landholders. There was no systematic searching to detect entangled animals, and consequently the results of this study are likely to underestimate the severity of the problem.

Whenever possible, the following parameters were obtained for each entanglement:

- date found;
- approximate time since death or entanglement;
- species, sex and approximate age (the approximate age of *Petaurus* species was determined using the level of upper incisor wear (refer Suckling 1984; Quin 1995);
- location (latitude and longitude), and description of site;
- the point of entanglement on the animal's body (e.g. wing, neck, tail, gliding membrane);
- the fence characteristics (fence type, barbed or plain wire strand, strand position in the fence).

### *Australia-wide Perspective*

This section is a preliminary report of records from a wide range of people across Australia and is intended to highlight the issue and present initial findings. I collated the same information as that collected for the Euroa study area, from sources including Field Naturalist groups, Landcare groups, landholders and biologists, between 1996 and the present. I also requested records from members of the Ecological Society of Australia, Australasian Wildlife Management Society, Field Naturalist Club of Victoria, and Birds Australia via their electronic mail discussion lists and newsletters. The wildlife atlas data-bases from Victoria and New South Wales were investigated, as was the Wildlife Information and Rescue Service (WIRES) data-base.

## Results

### *Euroa study area*

*Number and type of species entangled*

A total of 33 animals was recorded entangled on barbed wire between 1994 and 1998 in the Euroa study area (Table 1). Fifteen were positively identified as Squirrel Gliders and 11 gliders could not be reliably identified to species and are referred to as *Petaurus* sp. (this group includes only Sugar Gliders and Squirrel Gliders). Other species entangled with barbed wire fencing included the Australian Magpie *Gymnorhina tibicen* (2 individuals) (Fig. 2), and a single Rock

**Fig. 2.** Ausralian Magpie *Gymnorhina tibicen* caught on barbed wire fence. Photo by R. van der Ree.

**Table 2.** Point of entanglement of gliders found on barbed wire fences in the Euroa study area, 1994-1998. No. = number of gliders found.

| Point of entanglement | No. |
|---|---|
| Tail only | 11 |
| Tail and gliding membrane | 4 |
| Gliding membrane and leg | 2 |
| Unable to tell (decomposed too far) | 3 |
| Not recorded | 6 |
| **Total found** | **26** |

Dove (Feral Pigeon) *Columba livia*, Spoonbill *Platalea* species, Southern Boobook *Ninox novaeseelandiae,* White-winged Chough *Corcorax melanorhamphos* and Galah *Eolophus roseicapilla*.

*Fence characteristics*

All individuals were entangled with barbed wire on standard farm fences approximately one metre high. The apparent point of entanglement of the animal was with the barb on the wire. Where entanglement position was recorded (n=17), 12 entanglements occurred on the top strand of the fence, one occurred on the second strand from the top, and four occurred on the third strand from the top. Once caught on the barbed wire, it appeared that many gliders and birds became further entangled as they struggled to free themselves. On one occasion, the strand of wire was cut and the glider taken, with the wire *in-situ*, to a wildlife shelter for removal and rehabilitation. In the Euroa study area, all 33 records occurred where fences were positioned between cleared paddocks and vegetated roadsides.

*Carcass characteristics*

The advanced decomposition of many carcasses limited observations on the sex and age of the animals. Four female and one male Squirrel Glider were identified; the sex of 21 gliders and seven birds was not determined. Using the degree of tooth wear on the upper incisors of the gliders as an index of age, four individuals were identified as juvenile and four as adults. Age was not determined for the remaining 18 gliders or seven birds.

For gliders, the most common point of entanglement was the tail (11 records) (Table 2), followed by a combination of the tail and gliding membrane (four records) and the gliding membrane and leg (two records). Three gliders were too decomposed to determine the point of entanglement, and point of entanglement was not recorded for six individuals. Only two gliders were found alive and released, and these were entangled by the tail only. One magpie was entangled by a combination of wing and neck, and the feral pigeon was caught by its leg ring; the point of entanglement was not recorded for the remaining birds.

***Australia-wide perspective***

*Number and type of species entangled*

Sixty-two species of wildlife have been observed entangled with barbed wire fencing across Australia (Table 3). The types of species include gliding marsupials, bats, ground-dwelling birds, water birds, night birds and birds of prey. The most numerous group reported entangled with barbed wire fencing were flying foxes from northern Australia. The Little Red Flying-fox *Pteropus scapulatus* appears particularly susceptible to entanglement in north Queensland, with a published report of over 450 individuals entangled in one year (Johnson 1995), and another respondent reported 200 individuals on one fence at the same time (Jon Luly, *pers. comm.*). Many respondents reported observing numerous macropods (Black Wallaby *Wallabia bicolor*, Eastern Grey Kangaroo *Macropus giganteus,* Western Grey Kangaroo *M. fuliginosus*, and Red Kangaroo *M. rufus)* and Emus *Dromaius novaehollandieae* with their legs entangled in the top two strands of fences but could not give detailed information about specific incidents because of the regularity with which they were observed. This problem is not specifically related to barbed wire, as plain wire also entraps kangaroos and Emus by their legs as they attempt to jump the fence, and hence these records have not been included in Table 3.

Mesh fencing may pose a barrier to those species that are too large to pass through the mesh and unable to jump or climb over the fence. Certain species of reptile appear to be particularly susceptible because their rear facing scales and body shape allows them to place their heads through the tightly fitting mesh – but does not allow the rest

**Table 3.** Observations of wildlife entangled with barbed-wire fencing from across Australia (excluding the Euroa case study records) as reported by volunteer observers. Species listed in taxonomic order according to Christidis and Boles (1994) (birds) and Menkhorst (1995) and Strahan (1983) (mammals).

| Species | Scientific name | State (Number of individuals) | Fence type | Wire type |
|---|---|---|---|---|
| **Mammals** | | | | |
| Koala | *Phascolarctos cinerus* | NSW (2), QLD (4) | f | b, m |
| Greater Glider | *Petauroides volans* | Vic (2), NSW (6), Qld (4) | f | b |
| Yellow-bellied Glider | *Petaurus australis* | Vic (3), NSW (3), Qld (8) | f | b |
| Sugar Glider | *Petaurus breviceps* | Vic (25) NSW (9), Qld (44) | f, c | b |
| Squirrel Glider | *Petaurus norfolcensis* | Vic (24), NSW (12), Qld (5) | f | b |
| Sugar or Squirrel Glider | *Petaurus sp.* | Vic (12) NSW (1) | f | b |
| Mahogany Glider | *Petaurus gracilis* | Qld (5) | f | b |
| Brush-tailed Bettong | *Bettongia penicillata* | Qld (1) | f | b |
| Tasmanian Pademelon | *Thylogale billardierri* | Tas (1) | f | b |
| Grey-headed Flying-fox | *Pteropus poliocephalus* | Qld (4), NSW (3) | f, c | b |
| Little Red Flying-fox | *Pteropus scapulatus* | Qld (666^), NSW (5), NT (6), WA (1) | f, c | b |
| Black Flying-fox | *Pteropus alecto* | Qld (23), NSW (81), NT (20) | f, c | b |
| Spectacled Flying-fox | *Pteropus conspicullatus* | Qld (25) | f, c | b |
| Flying-fox | *Pteropus* sp. | NSW (4), Qld (2), NT (75) | f, c | b |
| Queensland Tube-nosed Bat | *Nyctimene robinsoni* | Qld (41) | f, c | b |
| Ghost Bat | *Macroderma gigas* | NT (1) | f | b |
| White-striped Freetail Bat | *Tadarida australis* | Vic (1) | f | b |
| Long-eared Bat | *Nyctiphilus* sp. | NSW (1) | f | b |
| Microchiropteran Bat | species unknown | NSW (1), Qld (2) | f | b |
| Grassland Melomys | *Melomys burtoni* | NSW (1) | f | b |
| Red Fox | *Vulpes vulpes* | Vic (1) | f | b |
| **Birds** | | | | |
| Southern Cassowary | *Casuarius casuarius* | Qld (1) | f | b |
| King Quail | *Coturnix chinensis* | NSW (2) | f | b |
| Australian Wood Duck | *Chenonetta jubata* | Qld (1) | f | b |
| Pacific Black Duck | *Anas superciliosa* | NSW (3), Qld (1) | f | b |
| Hoary-headed Grebe | *Poliocephalus poliocephalus* | Vic (1) | f | b |
| Short-tailed Shearwater | *Puffinus tenuirostris* | Vic (<5) | f | b |
| Australian Pelican | *Pelecanus conspicillatus* | Vic (1) | f | b |
| White-faced Heron | *Egretta novaehollandiae* | Vic (1), NSW (3) | f | b |
| White-necked (Pacific) Heron | *Ardea pacifica* | Vic (1) | f | b |
| Nankeen Night Heron | *Nycticorax caledonicus* | NSW (1) | f | b |
| Royal Spoonbill | *Platalea regia* | Qld (2) | f | b |
| Wedge-tailed Eagle | *Aquila audax* | Vic (1) | f | b |
| Brown Falcon | *Falco berigora* | NSW (1) | f | b |
| Australian Hobby | *Falco longipennis* | NSW (1), Vic (1) | f | b |
| Peregrine Falcon | *Falco peregrinus* | Vic (1) | f | b |
| Sarus Crane | *Girus antigone* | Qld (1) | f | b |
| Buff-banded Rail | *Gallirallus philippensis* | Qld (4) | f | b |
| Little Button-quail | *Turnix velox* | NSW (2) | f | b |
| Red-chested Button-quail | *Turnix pyrrhothorax* | NSW (1) | f | b |
| Lathams Snipe | *Gallinago hardwickii* | NSW (1) | f | b |
| Bush Stone-curlew | *Burhinus grallarius* | Qld (2) | f | b |
| Black-fronted Dotterel | *Charadrius melanops* | Vic (1) | f | b |
| Masked Lapwing | *Vanellus miles* | Vic (1), Qld (1) | f | b |
| Silver Gull | *Larus novaehollandiae* | Vic (<5) | f | b |
| Little Corella | *Cacatua sanguinea* | Qld (1) | f | b |
| Sulphur-crested Cockatoo | *Cacatua galerita* | Qld (1) | f | b |
| Red-rumped Parrot | *Psephotus haematonotus* | Vic (1) | f | b |
| Southern Boobook | *Ninox novaeseelandiae* | NSW (1), Qld (1), Vic (3) | f | b |
| Masked Owl | *Tyto novaehollandiae* | NSW (2) | f | b |
| Barn Owl | *Tyto alba* | NSW (2), Qld (1), Vic (3) | f | b |
| Grass Owl | *Tyto capensis* | Qld (1), SA (1) | f | b |
| Tawny Frogmouth | *Podargus strigoides* | Qld (2), SA (2), Vic (4) | f | b |
| Australian Owlet-nightjar | *Aegotheles cristatus* | Vic (1) | f | b |

**Table 3 continued.**

| Species | Scientific name | State (Number of individuals) | Fence type | Wire type |
|---|---|---|---|---|
| Laughing Kookaburra | *Dacelo novaeguineae* | NSW (2), Vic (1) | f | b |
| Dollarbird | *Eurystomus orientalis* | Qld (1) | f | b |
| Eastern Spinebill | *Acanthorhynchus tenuirostris* | NSW (1) | f | b |
| Magpie-lark | *Grallina cyanoleuca* | Vic (1) | f | b |
| Willie Wagtail | *Rhipidura leucophrys* | Qld (1) | f | b |
| Australian Magpie | *Gymnorhina tibicen* | ACT (1), Qld (2), SA (2), Vic (1) | f, c, na | b |
| Silvereye | *Zosterops lateralis* | Vic (1) | f | b |
| Common Starling | *Sturnus vulgaris* | Vic (1) | f | b |

^ = Includes records of 200 individuals (Jon Luly *pers. comm.*) and 450 individuals from Ravenshoe district, north Queensland Fence type: f = standard height farm fence, c = 6 to 8 foot cyclone wire mesh fence, na = not assessed Wire type: b = barbed wire, m = mesh.

of their bodies to pass through or retreat. Goats were reported to become entangled with mesh fencing as their horns prevent them from removing their heads from the wire mesh once pushed through. Electrified strands of wire too close to the ground may electrocute Short-beaked Echidnas *Tachyglossus aculeatus* if they attempt to push underneath the wire. Fatal collisions by various bird species with mesh fencing was frequently recorded.

Wildlife also became entangled with wire in non-fence situations; a Kookaburra *Dacelo novaeguineae* was found impaled on a protruding wire on a tree-guard, five White-throated Needletails *Hirundapus Caudacutus* and Black Swans *Cygnus atratus* were observed dead on overhead powerlines and a small insectivorous bat was impaled by a piece of wire on the top of a shed.

Records of fauna entangled with barbed wire were received from across the Australian continent. Wildlife were entangled with barbed wire fences in a wide range of habitats, including arid and semi-arid rangelands, temperate woodlands, forests, rainforest, wetlands, urban areas and the rural-urban interface.

## Discussion

### *A localised and widespread problem*

The most commonly encountered species entangled with barbed wire in the Euroa area was the Squirrel Glider. In parts of the study area, roadside vegetation supports high densities of the Squirrel Glider and other arboreal marsupials (van der Ree, *unpubl. data*). The total number of Squirrel Gliders that became entangled with barbed wire is probably much greater than that reported here because many carcasses could not be reliably identified. Moreover, this report only includes those individuals that have been found and reported. In Victoria, the Squirrel Glider is present in only a few large reserves (e.g. Chiltern National Park, Killawarra State Park) and is largely restricted to small patches of woodland habitat or linear reserves along roads and streams. This species has undergone a significant decline in abundance and in Victoria is classified as vulnerable to extinction (CNR 1995). The additional threat of mortality from barbed wire fences for small and isolated populations may be detrimental to their long-term persistence.

The records collated from across Australia indicate that the problem is widespread. Records were collected from all states of Australia, with most originating from the eastern mainland states. The absence of records from many areas may be due to a paucity of observers and entanglements going unreported rather than an absence of entanglements. As many entanglements undoubtedly go unobserved and unreported, the results of this study must be considered an underestimation. To realise the full extent of the problem, observations of entanglements need to be reported and systematically collated. Of the data-bases interrogated, only the New South Wales Wildlife Atlas was able to easily retrieve records of wildlife entangled with fences. It would be useful for other data-bases to include a specific code for records that originate from such entanglement so that in future the extent of the situation can be accurately described.

***Wildlife behavior***

In the Euroa area, 85% of remnant vegetation occurs along roads and streams, and the remaining 15% as small patches. The practice of fencing on both sides of roads, streams and around patches places wildlife at risk of encountering a fence. The movement patterns and behaviour of Squirrel Gliders (as revealed by radiotelemetry) in the Euroa area (van der Ree, *unpubl. data*) may increase the risk of becoming entangled with barbed wire fences. Squirrel Gliders, and probably other gliders, risk entanglement with barbed wire fencing when gliding to and from woodland vegetation in paddocks and along roads and streams. Gliders also glide diagonally across corners at 90° intersections to minimise travel distance and energy demands. These behaviours require the glider to regularly cross fencelines. The potential for entanglement also increases as gliding distance increases; the longer the glide, the lower the animal will land on its target tree and the closer it is to the height of the barbed wire fence.

The placement of barbed wire fences in activity paths of other species may also increase the rate of entanglement. In north Queensland, barbed wire fences in fruit bat flight paths regularly cause the entanglement and mortality of at least five species of fruit bat. Removal of bats from barbed wire fences may place humans at risk of infection with bat viruses, and extreme care should be taken when removing these animals[1]. New fencing erected in existing wildlife travel paths can cause the entanglement and death of many individuals. Many respondents reported that kangaroos appear to be highly susceptible to entanglement in new fencing, and that consideration to wildlife movements when designing fences can minimise the problem.

There were insufficient data to determine whether mortality by collision and entanglement with barbed wire is specific to age or sex in any group of species.

[1] Guidelines on how to handle bats are given at the following web address: http://www.bushnet.qld.edu.au/~melissa/ffnff/

***Management implications***

Habitat restoration and revegetation is a goal of many government agencies, conservation groups and landholders. Fencing is essential to control stock access in order to protect native vegetation and allow for natural regeneration of palatable species. Wildlife populations in many rural areas have already undergone considerable declines, and often exist in small isolated patches of habitat. The loss of individuals by entanglement with fencing is an avoidable and unnecessary additional threat. All fencing that utilises barbed wire to conserve or protect vegetation may conceivably place the fauna using that habitat at risk of local extinction.

*High risk areas*

It appears from these results that areas of potentially high risk can be identified:

- Highly fragmented areas where animals must regularly cross barbed wire fences to reach different parts of their habitat. This is particularly apparent in the Euroa study area and is probably true for many agricultural areas.
- Regular flight paths for bats and birds, and movement paths for mammals that may include areas of fragmented and continuous habitat.
- Areas with high density populations of species vulnerable to entanglement such as marsupial gliders in the Euroa case study and fruit bats in north Queensland.
- Wetland areas where barbed wire is exposed above the water level.

*Fencing alternatives*

For an alternative fencing style to be adopted, it must be of equal or greater benefit for stock management. Depending on the farming enterprise, a number of alternatives to barbed wire are available:

- Plain high-tensile fencing wire, if tensioned correctly, can contain most stock. When a fence is being constructed with new materials, consider using multiple strands of high tensile plain wire or plain wire and ringlock mesh (but beware using fine mesh which may also entrap animals or act as a barrier to movement).
- If additional security is required, investigate the option of electric fencing instead of barbed wire. However, beware of the potential risk of electrocution of wildlife.

- If using existing fenceposts, consider removing the existing strands of barbed wire and replacing them with plain wire. In addition, consider adding an electrified strand to the fence for increased security.
- If a plain wire or ringlock mesh option does not offer sufficient security, an electrified strand is not feasible, and the use of barbed wire can not be avoided, then consider avoiding barbed wire on the top two or three strands of the fence – this will reduce, but not eliminate the risk. In high-risk areas, use plain wire or sheath the barbed wire inside poly-pipe to protect animals from the barbs.
- Design the fence to avoid right angles where marsupial gliders may cross diagonally across the corner (Fig. 3), such as at the intersection of two road reserves. This would benefit other wildlife by creating extra habitat as well as reducing fencing costs.

Future investigation should consider:

- Documenting the extent of the problem more fully by government agencies and wildlife rehabilitation organisations through wildlife databases by specifically including 'entanglement with barbed wire' as the cause of death.
- Investigating alternative fence designs that contain stock, are cost-effective to erect and maintain, and do not pose a threat to wildlife.
- Education programs to ensure land managers are aware of the potential risk to wildlife and are able to identify high risk areas or 'hot spots'.

Government agencies and other bodies providing funds for fencing and revegetation projects should consider these findings and encourage the use of non-barbed wire alternatives as a condition for receiving funding. This will reduce the amount of barbed wire fencing being erected, and as old fences are gradually replaced with non-barbed wire alternatives, the loss of fauna to barbed wire fencing will be greatly reduced.

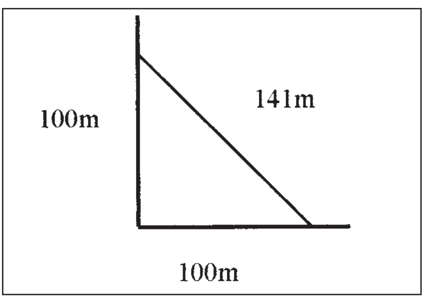


**Fig. 3.** Fencing diagonally at a 90° corner reduces the amount of fencing materials required, provides additional habitat for wildlife, and potentially minimises the risk of entanglement by wildlife.

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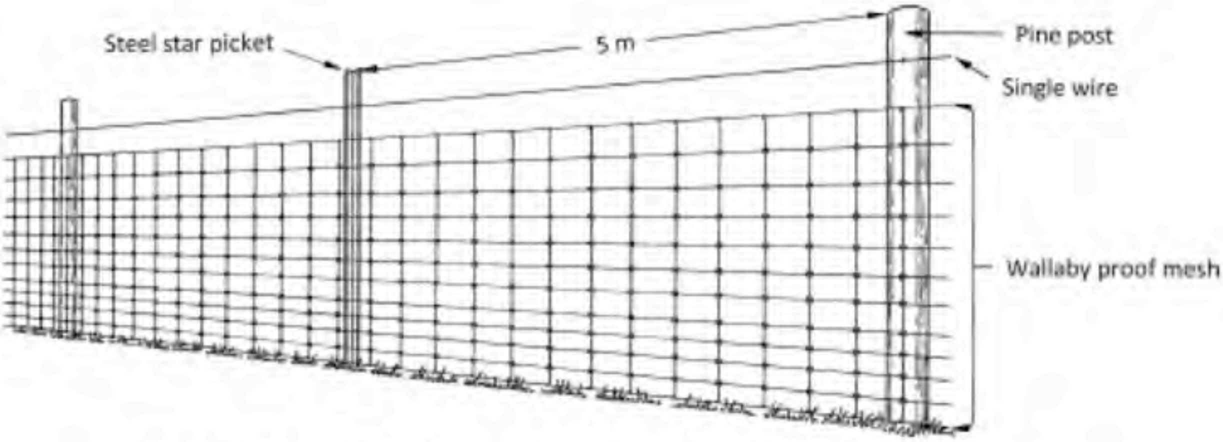
ATTACHMENT 2 One option for ALTERNATIVE EXCLUSION FENCING




**Typical wallaby proof fence, posts are often either alternating pine and star posts or all star posts except for corners and ends.**


Mesh with knot A is rigid and the knot does not move. The vertical wires, running the depth of the fence give good support, particularly when animals are trying to push under. It is more expensive than other mesh designs but the rigidity means that a wider post spacing can be used than with other mesh types.

# ATTACHMENT 3 F TYPE CONCRETE MEDIAN BARRIER

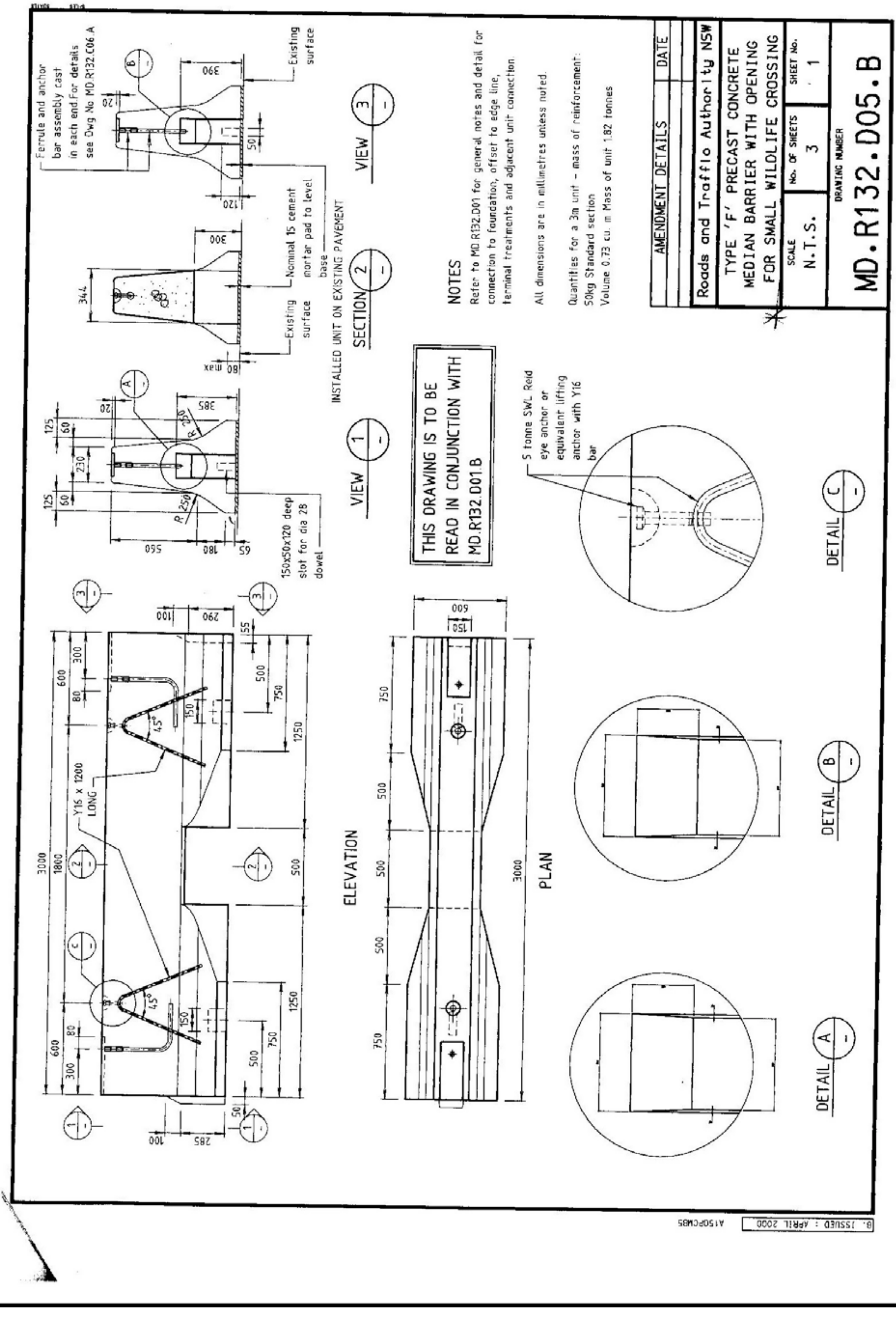


Figure 4. One-way gate designed for moose and deer

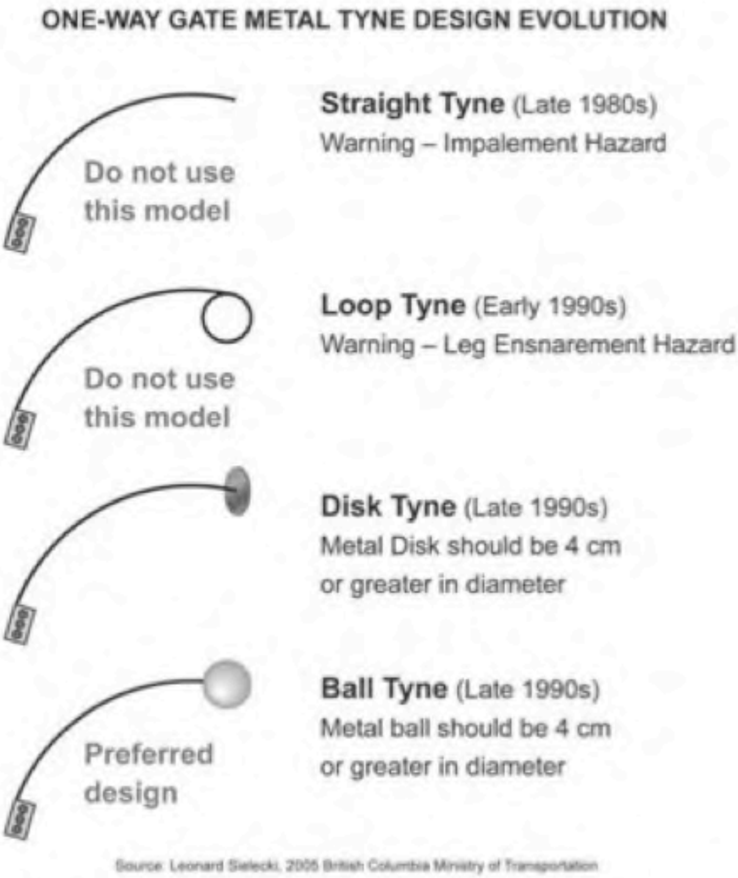



Figure 5. One-way gate metal tyne design evolution