



M.J. & A.R. Bamford
CONSULTING ECOLOGISTS
23 Plover Way,
Kingsley, WA, 6026
ph: 08 9309 3671 fx: 08 9409 2710
eml: bamford.consulting@iinet.net.au
ABN 84 926 103 081

17th March 2014

Keane Road Strategic Link (KRSL)

The role of proposed underpasses in maintaining fauna diversity

Mike Bamford

BACKGROUND

Public submissions on the Keane Road Strategic Link (KRSL) Public Environmental Review (PER) included concerns about the potential impact of the proposed road upon large mammals (primarily the Western Grey Kangaroo but also the Brush Wallaby). The main concern was that if these species are present, the road could isolate small populations and potentially lead to local extinction, thereby resulting in a loss of biodiversity within Bush Forever site 342, through which the KRSL passes.

The City of Armadale proposed seven wildlife underpasses in the KRSL PER, each 450mm high and 1200mm wide, and these were to be spaced so that each of the main fauna habitat types had an underpass. The road was to be fenced to ensure that fauna would be guided to the underpasses and to reduce the risk of roadkill. In response to concerns about the adequacy of these underpasses, the city has now proposed to install seven underpasses as follows:

- One 1200 x 1200mm
- Two 600 x 1200mm
- Four 450 x 1200mm

These underpasses will be 18.4m long and will be located in areas where they will not be inundated by surface water (based upon hydrological modelling). It is intended that the increased number and size of some of the underpasses will ensure that even large fauna species present in the bushland either side of the KRSL will be able to pass under the road.

THE ROLE OF UNDERPASSES FOR FAUNA ALONG THE KRSL

The fauna underpasses are intended to facilitate movement of fauna north and south across the KRSL without risk of roadkill, and to prevent population fragmentation. Underpasses (and fencing) were proposed because the report prepared by Bamford and Turpin (2009) identified roadkill and fragmentation as significant potential impacts for fauna that could result from the construction and operation of the KRSL. The most significant potential impact from roadkill is for large species that may occur in small populations that are sensitive to increased mortality and to genetic isolation.

The fencing proposed is to be to the specification of Department of Parks and Wildlife (DPaW) and includes 1.8 m high chainmail, with a fine mesh at the bottom to ensure smaller species cannot pass through. While some individuals of small species may be able to climb over the fine mesh section of the fence, the fence will reduce the risk of roadkill to a high proportion of the terrestrial vertebrate assemblage, with the underpasses required to allow fauna movement underneath the road. Movement through underpasses can also be important for dispersal of young animals if faced with intra-specific aggression, such as young male Grey Kangaroos and Quendas that may be displaced by adult males. Male Brush Wallabies are very intolerant of each other and therefore if this species is present, access to as much land as possible is needed to allow males to avoid each other.

To be effective, the underpasses need to be used regularly by target species such as large lizards (the goannas *Varanus gouldii*, *Varanus rosenbergi*, and the Bobtail *Tiliqua rugosa*) and mammals (Quenda *Isoodon obesulus*, Grey Kangaroo and Brush Wallaby). Non-flying birds, such as ducklings, will also use underpasses. There is an extensive literature on the use of underpasses by fauna (Harris and Bamford 2013), but recent unpublished work by the University of Western Australia (Chacelle *et al.* undated) studying underpasses along the Roe Highway is especially relevant to the KRSL project, as the fauna assemblage at Roe Highway is very similar to that of the KRSL. This study concluded that underpasses could help solve the problem of habitat fragmentation in urban areas, and provided records of underpass use by Bobtails, Grey Kangaroo, a duck with ducklings, possums, Quenda, cats, foxes, rats, Bluetongues *Tiliqua occipitalis* and Dugite *Pseudonaja affinis* (Chambers *et al.* undated).

Smaller species may also use the underpasses and as stated above, the DPaW fencing specification includes a fine mesh at the bottom to prevent smaller species from passing through the fence onto the road. It should also be noted that smaller species of lizards, frogs and mammals are likely to be present in higher absolute numbers than the larger reptiles and mammals, and thus due to higher numbers will be less sensitive to any increase in mortality and less sensitive to fragmentation. Absolute densities of lizards are difficult to determine, but Bamford and Calver (in prep.) have found densities of small lizards (all species pooled) as high as 428.9/ha and 958.3/ha at two sites north of Perth.

LOCATIONS OF UNDERPASSES FOR FAUNA ALONG THE KRSL

Underpasses are to be spaced approximately evenly along the KRSL but across the range of vegetation types; this is to maximise the number of species and individuals that can access them. The highest underpass (1200mm in height) is restricted in placement to where the land surface is high enough above the water table to ensure that flooding does not occur. High underpasses where the ground surface is low would require a wider road footprint, resulting in greater loss of vegetation and longer underpasses.

THE STATUS OF THE WESTERN GREY KANGAROO AND BRUSH WALLABY; BUSH FOREVER SITE 342

The Western Grey Kangaroo was recorded during the September 2008 site inspection – although individuals were not sighted, tracks and scats were recorded from the survey area (Turpin and Bamford 2013). While the density of the population was unknown, it was suggested the population might not be viable in the long-term due to surrounding development. The Brush Wallaby was not recorded but it was concluded that the species might be present, as nearby populations are known. A survey is soon to be undertaken to check for the presence of both species and to estimate population size with results expected to be available early in April 2014.

It was suggested in the previous report (Turpin and Bamford 2013) that the Kangaroo population may be at an un-naturally high density because the area could provide extensive grazing (paddocks and other cleared areas) and low levels of predation; in other areas of bushland around Perth, Grey Kangaroos can occur at densities of $>1/\text{ha}$ (Cottonwood Crescent in Dianella, Whiteman Park, several golf courses; Bamford Consulting records). The natural density is likely to be $<1/\text{km}^2$ (Short *et al.* 1983), and a natural density for the Western Grey Kangaroo of $1.44/\text{km}^2$ has also been calculated (Poole 1995). The very high un-natural densities that can develop in urban bushland can lead to degradation of the bushland, although the presence of pasture can result in much less grazing pressure on bushland than might be expected. Rafferty and Lamont (2005) found that Western Grey Kangaroos grazed heavily on weeds and even had a controlling effect on these, “without detriment to native vegetation so long as populations did not exceed carrying capacities for the [Whiteman] Park.”

Estimates of the home range area of Grey Kangaroos vary widely: Arnold *et al.* (1992) calculated a range of 39-70 ha in Wandoo remnants and farmland near Bakers Hill, while Priddel *et al.* (1988) gave an average of 692 ha in western New South Wales. In urban remnants with abundant grazing, home range areas are likely to be smaller. For example, Cottonwood Crescent reserve in Duncraig has supported a group of around 15 Grey Kangaroos for many years in an area of $<5\text{ha}$ (Bamford Consulting records). Arnold *et al.* (1992) noted that home range areas overlapped which is to be expected as Grey Kangaroos live in loose groups of females, usually with a dominant male (Poole 1995). These sorts of observations suggest that Bush Forever Site 342 could potentially support a small mob of Grey Kangaroos indefinitely, although management by the Bush Forever Site responsible authority (DPaW) would be needed.

It is not known if the Brush Wallaby is present in Bush Forever Site 342, or if it is locally extinct. Brush Wallabies in Whiteman Park occur at a density of $0.16/\text{ha}$, with a home range area of 5.3 ha for females and 9.9 ha for males (Bamford and Bamford 1999). Unlike Grey Kangaroos, Brush Wallabies are solitary and there is little overlap between home ranges, while males are reported (by wildlife carers) to be very intolerant of each other. The Bush Forever site thus may be able to support a small wallaby population.

Populations of both the Grey Kangaroo and Brush Wallaby (if present) would require management in Bush Forever Site 342. Small populations can be vulnerable to local extinction, and with expanding urban development the risk of dog attack is likely to be high. In one golf course Kangaroo population, the main source of mortality was domestic dogs (Bamford Consulting records). In addition, reports have been received by the City of Armadale from local community that kangaroos have been shot as “game” and hit by off road vehicles within the site (pers. comm. James Robinson).

Conversely, small populations in restricted areas can experience over-population if predators are effectively excluded. In-breeding is also a risk. Mills and Allendorf (1996) suggest that inbreeding can be counteracted by a small number of immigrants per generation, but this is a complex topic and depends on factors such as population size.

Therefore if populations of Grey Kangaroo and/or Brush Wallaby occur within Bush Forever Site 342 they will likely require management by the responsible authority for the site (DPaW) to ensure the population is viable in the long term and manage issues such as:

- Off road vehicle access to the site
- Shooting
- Inbreeding
- Dog attack
- Possible over population and grazing pressure leading to degradation of native vegetation within the Bush Forever site.

These management issues will exist within Bush Forever Site 342 regardless of whether KRSL is approved and constructed or not. Therefore, management of these issues is a separate matter which would need to be addressed by the authority responsible for the site (DPaW), regardless of whether or not the KRSL is constructed.

The key management issues for the KRSL road alignment regarding kangaroo and wallaby are to ensure that the road if constructed does not lead to local extinction, thereby resulting in a loss of biodiversity within Bush Forever site 342 through which the KRSL passes. This requires the management of the following issues by the City of Armadale:

- Preventing the road causing genetic and habitat based isolation of small populations; and
- Preventing road kill.

THE USE OF UNDERPASSES BY THE WESTERN GREY KANGAROO AND BRUSH WALLABY

With a small population of the Grey Kangaroo and an uncertain (but even smaller if present) population of the Brush Wallaby, both species could be adversely affected by the KRSL. If the road formed a complete barrier, as it would due to fencing, the population could be divided by the road or isolated into a smaller habitat on one side of the road. This could result in smaller and/or more isolated populations even more vulnerable to risks such as local extinction and in-breeding. However, Chacelle *et al.* (undated), working with underpasses at Roe Highway, concluded that effective underpasses could allow divided populations to continue to function as a single population in urban bushland, even for animals the size of the Grey Kangaroo.

Chacelle *et al.* (undated) recorded Grey Kangaroos regularly using underpasses as low as 600mm, although this was a small female (R. Bencini pers. comm.) with a weight of about 25kg and a height at the hip when moving quadrupedally of about 500mm – Plate 1. However, the study concluded that underpasses with a height of 1200mm would allow for the movement of all animals in a kangaroo population (including adult males). The underpasses at Roe Highway have lengths of up to 45m which is much longer than the 18.4 m underpasses proposed by KRSL. This means that in Bush Forever Site 342, even when divided by the KRSL, the proposed underpasses would allow for movement of adult female, juvenile male and even adult male Grey Kangaroos, so could be

expected to offset the potential adverse impacts of the KRSL on the Grey Kangaroos in Bush Forever Site 342. It is expected that one 1200mm high underpass and two 600mm high underpasses at KRSL should be sufficient for the small kangaroo population likely to be present given:

- Larger individuals will learn the location of the 1200mm high underpass for movement underneath the road, as has been the case regarding learning of underpass locations at Roe Hwy;
- Smaller females will be able to use the 1200 mm high underpass as well as the two 600mm high underpasses, as has been the case at Roe Hwy, giving them the option of three locations to pass underneath the road;
- Young males are likely to use the underpasses if displaced by an older male. Conversely if a mature male dies naturally, a young male can come into the territory of the deceased male by using the underpasses;
- Fencing of the road and vegetation growth at underpass entrances will prevent road kill and guide animals into the underpasses;
- The underpasses will be placed in locations where they will not become inundated by water (using the project hydrology model) – although it should be noted that Kangaroos will move through water and this is more of a benefit to other fauna species.

Brush Wallabies were not present in the Chambers *et al.* (undated) study area, but the species is likely to readily use all seven proposed underpasses (with heights of 450mm to 1200mm), as they have been seen to use a 400mm diameter pipe (about 5m long; M. Bamford pers. obs) and naturally hop low through very dense vegetation. Harris and Bencini (2010) did note that usage of underpasses by fauna can lead to increased predation levels, but monitoring and control of feral predators, and the construction/planting of shelter, can reduce this impact (Harris and Bamford 2013). The City of Armadale has made commitments to such monitoring and management of underpasses as outlined within the KRSL PER.



Plate 1: 600mm high underpass being utilised by female Western Grey Kangaroo at Roe Hwy (Chacelle *et al.* (undated))

CONCLUSION

The underpasses proposed for the KRSL by the City of Armadale should allow for movement of all fauna that might be adversely affected by fragmentation caused by the road itself. This includes Grey Kangaroos that can be expected to readily use the 1200mm high underpass, with some usage by smaller females of the smaller (600mm high) underpasses. The proposed underpasses should thus mitigate the risk that might otherwise be imposed upon fauna populations by the KRSL.

It should be recognised, however, that existing risks may remain for kangaroos and wallabies (if present) within Bush Forever Site 342. For example, the populations will be small because the Bush Forever Site 342 has an area of <300ha of native vegetation, and has reduced connectivity with other areas of native vegetation. To be conserved, such small and isolated or partly-isolated populations will require some ongoing management irrespective of the KRSL. Therefore populations of the Grey Kangaroo and Brush Wallaby (if present) within Bush Forever Site 342 will require management by the responsible authority for the site (DPaW) to ensure they are viable in the long term. Issues to be managed are:

- Off road vehicle access to the site
- Shooting
- Inbreeding
- Dog attack
- Possible over-population and grazing pressure leading to degradation of native vegetation within the Bush Forever site.

REFERENCES

- Arnold G. W., Steven D. E., Grassia A. and Weeldenburg J. (1992) . Home-Range Size and Fidelity of Western Grey Kangaroos (*Macropus fuliginosus*) Living in Remnants of Wandoo Woodland and Adjacent Farmland, Wildlife Research, Volume 19, pp 137–143.
- Bamford, M.J. and Bamford, A.R. (1999). A study of the Brush or Black-gloved Wallaby *Macropus irma* (Jourdan 1837) in Whiteman Park. Whiteman Park Technical Report Series No. 1. Dept of Planning, Perth.
- Bamford, M.J. and Calver, M.C. (in prep.) A comparison of measures of abundance of reptiles in Kwongan vegetation of the South-West of Australia, determined through systematic searching and pitfall trapping.
- Chachelle, P.D., Chambers, B.K., Bencini, R., Ottewell, K. and. (undated). Home range and the use of underpasses by Western Grey Kangaroos on the Swan Coastal Plain. Unpubl. Report by the Faculty of Natural and Agricultural Sciences, University of Western Australia.
- Harris, I. and Bamford, M. (2013). Roads and Wildlife; a review of purpose-built fauna underpasses. Unpubl. report to the City of Armadale by Bamford Consulting Ecologists, Kingsley.
- Harris I.M., Mills H.R. and Bencini R. (2010). Multiple individual southern brown bandicoots (*Isodon obesulus fusciventer*) and foxes (*Vulpes vulpes*) use underpasses installed at a new highway in Perth, Western Australia. Wildlife Research. 37, 127-133
- Mills, L.S. and Allendorf, F.W. (1996). The one-migrant-per-generation rule in conservation and management. Conservation Biology 10: 1509-1518.
- Poole, W.E. (1995). In: the Mammals of Australia. Ed. R. Strahan. Australian Museum and Reed New Holland, Sydney.
- Priddel D., Shepherd N. and Wellard G. (1988) Home Ranges of Sympatric Red Kangaroos *Macropus rufus*, and Western Grey Kangaroos *Macropus fuliginosus*, in Western New-South-Wales, Australian Wildlife Research, Volume 15, pp 405–411.
- Rafferty, C. and Lamont, B.B. (2005). Selective feeding by macropods on vegetation regenerating following fire. J. Roy. Soc. WA. 88: 155-165.
- Short, J., Caughley, G., Grice, D. and Brown, B. (1983). The distribution and abundance of kangaroos in relation to environment in Western Australia. Aust. Wildl. Res. 10: 435-51.
- Turpin, J. and Bamford, M. (2013). Keane Road Strategic Link, Armadale. Fauna Assessment. Unpubl. Report to Enviroworks Consulting by Bamford Consulting Ecologists, Kingsley.