Breaking the Barriers: Engineering Solutions to Ecological Problems (May 2009)

Design for both Fauna Barrier Mitigation and Traffic Safety:

Juggling the various requirements in corridor landscape design

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- **Road Design Philosophy**
- **Road Landscape & Trees**
- **Clear Zones, Frangibility & Sight Lines**
- **Discouraging & Excluding Fauna**
- **Safety for Pedestrians, Cyclists and Maintenance**
- **Culverts and Fauna Underpasses/Overpasses**
- **'Fauna Friendly Roads'**
- **Other linear infrastructure**

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Fauna Barrier Mitigation & Safety

Transport Corridors & Fauna Movement

Animals need to move around:

- Especially in fragmented landscapes;
- Species differ widely, & at different times

Roads and railways are barriers:

- Gaps in suitable habitat;
- Linear bands of high noise, fast things & bright light
- Physical impediments (cuttings, steep embankments, fences); and
- A cause of fauna mortality through collisions.

Image Source: Bennet, A. F. 1991.

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Transport Corridors & Fauna Movement contd

In principle, wildlife could move across barriers if:

- Gap width is reduced, by retaining or replanting habitat close to the road and/or in the median ('natural permeability');
- Fauna underpasses or overpasses in suitable locations, supported by planting;
- Batter slopes & fencing reduced, and/or use fauna-friendly fencing; and
- Reduce traffic speed, especially at times when fauna are most mobile.

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Road Design Philosophy

- Move vehicles efficiently & safely
- Context-sensitive design that balances safety, mobility, community & environmental needs
- Risk assessment & management approach to prevention, mitigation, tolerance and recovery
- Consistent driver experience, but with some visual interest & focal points
- A ‘Self explaining road’ matching speed to alignment and cross-section - no sudden surprises
- If there is a change, forewarn & allow drivers to respond eg.Transitions, Signage, making changes obvious

It is inconsistent with this philosophy to:

- Change speed of traffic flow at fauna crossings
- Encourage large fauna to cross freely
- Put people at risk to manage fauna

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Road Landscape Planting

Multi-purpose:

- Stabilise, rehabilitate and revegetate;
- Control erosion and reduce siltation;
- Amenity and aesthetics;
- Screen the highway and acoustic barriers from view, and screen/filter headlights;
- Reduce wind and glare;
- Frame attractive views/guide attention to visual focal points;
- Buffer adjacent land uses;
- Habitat, wildlife movement & ecological succession;
- Provide visual cues and guidance.

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Trees in the Road Environment

- Trees close to road / in medians are attractive, and encourage fauna to cross, ie. help mitigate movement barriers
- BUT … trees are roadside hazards, accounting for a high proportion of 1-vehicle crashes and deaths
- AND … habitat connectivity across roads causes road kills, unless there is grade separation
- In general, motorists and ground-dwelling fauna are safest if trees are excluded from the clear zone
- The exception is tree canopy connectivity for arboreal mammals

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Trees in the Road Environment contd.

Risk management principles for a tree (or any structure) within the Clear Zone:

- remove it (occasionally relocation is feasible);
- re-design it or replace it with something frangible;
- shield it or reduce impact by a breakaway device; and/or
- warn & guide motorists around it.

NB: This applies to both existing & proposed trees; but greater liability (to designers) attaches to new landscape planting

Also: Planted trees take decades to replace habitat value lost in tree clearing; and severed tree canopy corridors may be better replaced by alternative movement opportunities

Trees in the Road Environment contd.

Retention / new planting of non-frangible trees in clear zones require Design Exemption:

- Assessed on merits;
- Environmental grounds may include current/projected faunal use (mainly arboreal mammals) eg. trees suitable for rope bridges;
- Trees needed for glider movement may be replaced by frangible glider poles;
- Shielded by barriers and/or breakaway devices, especially at ‘black spots’ or high-risk locations.

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Clear Zones & Frangible Landscape

- Clear zones allow a driver of an ‘errant vehicle’ to regain control, with minimum damage
- Clear zones increase the overall barrier width, for ground animals which require forested or wooded environments
- BUT they reduce risk of road kills:
  - less habitat,
  - better driver visibility & reaction time,
  - more escape opportunities for fauna

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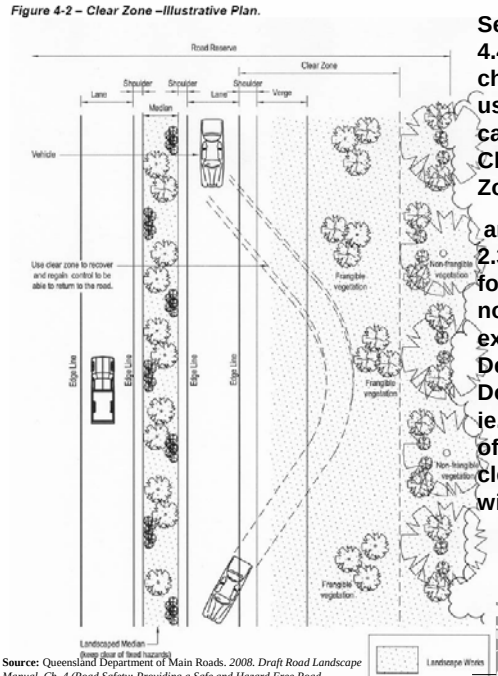
Clear Zones & Frangible Landscape contd

Figure 4-2 – Clear Zone –Illustrative Plan.



Source: Queensland Department of Main Roads. *2008. Draft Road Landscape Manual, Ch. 4 (Road Safety: Providing a Safe and Hazard Free Road Environment)*. Queensland Government. Queensland. p 5.

See Figure 4.4 for flow chart to use when calculating Clear Zones;

and Figure 2.3 (Ch 2) for the normal and extended Design Domains ie. a range of possible clear zone widths

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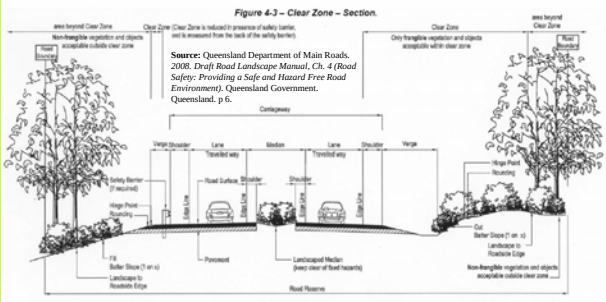
Clear Zones & Frangible Landscape contd

- Slopes:
  - < 1:4 'recoverable'
  - 1:3 to 1:4 are 'traversable' (if no obstructions)
  - > 1:3 are 'non-recoverable' & may cause overturning
- Free from non-frangible structures & planting (frangible species > 100mm trunk diameter);
- For unavoidable non-frangible structures (bridge abutments, retaining walls or significant vegetation), or sudden changes in level, use safety barriers for shielding.



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Clear Zones & Frangible Landscape contd

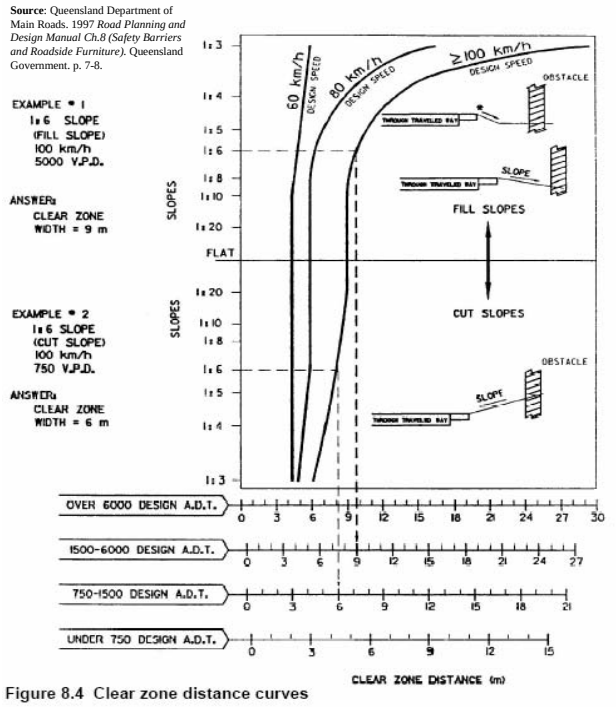

Figure 8.4 Clear zone distance curves

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Sight Line Considerations

- Road alignment (horizontal & vertical), landform (cuttings) and vegetation can restrict visibility.
- Line of sight essential for clear identification of potential hazards at a safe distance (reaction time)
- **Vertical curves:**
- trees adjacent to roads in ‘sags’ should not have overhanging canopies;
- Median planting may need to be taller to filter headlight glare;
- Sags may require roadway level to be raised (fauna underpass opportunity)
- Cuttings may be fauna overpass opportunities
- **Intersections and horizontal curves**: vegetation and landform should be set back; and/or low-growing ground covers.

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Sight Line Considerations contd

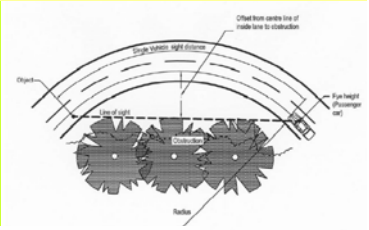
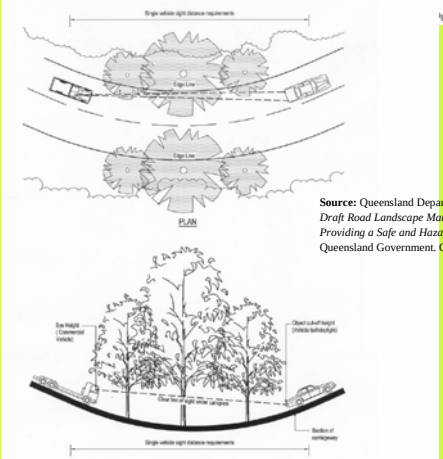


Figure 4-10 - Sag vertical curve restrictions on landscape treatments to sight distance – Plan/Section.



Source: Queensland Department of Main Roads. *2008. Draft Road Landscape Manual, Ch. 4 (Road Safety: Providing a Safe and Hazard Free Road Environment).* Queensland Government. Queensland. p 15 & 16

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DISCOURAGING & EXCLUDING FAUNA

Making roads less attractive and/or accessible to fauna:

- Fauna exclusion fencing, combined with ‘people-proof’ safety fencing;
- Reduction of grass, in favour of other groundcover plants;
- Reduction in the use of plants attractive / palatable to birds and bats;
- Light and sound – Reflectors and whistle devices mounted on vehicles

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SAFETY OF OTHER ROAD USERS

Pedestrians, Cyclists & Maintenance Crew

- Sight line distances apply to all pedestrian, cycle intersections & crossings;
- Pedestrian footpaths & cycle ways need barriers ie. not within the clear zone;
- Shouldn’t share fauna underpasses/overpasses;
- Road verge & median maintenance is dangerous – minimise pruning, trimming and mowing.

CULVERTS, UNDER & OVERPASSES

Adapting culverts - design parameters:

- Clearance height;
- Length and daylight penetration;
- Visibility from one side to another;
- Invert level (wet & dry routes);
- 'Furniture' and ground material
- Entry 'courts.

Image source: Harris, L.D. & Scheck, J. 1991.

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ROAD SUMMARY

Fauna-friendly roads can also be safe:

- Allow ground-dwelling, aquatic and arboreal fauna to move regularly from one side to another, in a way that avoids vehicle-animal collisions (under or over);
- Reduce vehicle-animal collisions by discouraging larger ground-dwelling fauna from attempting to cross;
- Direct fauna to suitable crossing points,
- Reduces speed and increases visibility, at certain places or times;
- Reduce the attractiveness of the roadside environment for grazing or feeding.

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DESIGN & MANAGEMENT CHALLENGES

Vegetation:

- A range of available plants with mature trunk diameters less than 100mm, but which provide shelter, habitat for some native fauna and are contextually appropriate

Structures

- Adapt the typical structures in infrastructure corridors for use by fauna

Management

- Maintain clear zones and easements as habitat for small, less mobile fauna

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OTHER TRANSPORT CORRIDORS

RAIL:

Similar considerations to highways but:

- 'People-proof' security fencing and steep embankments, more of a barrier to fauna, even though vehicle movements much less frequent
- Vertical alignment more uniform – greater opportunities for underpasses; less opportunity for overpasses due to overhead powerlines

OTHER LINEAR INFRASTRUCTURE

ELECTRICITY:

- Easements have habitat value for some fauna (grazing macropods, raptors)
- Maintenance slashing disrupts habitat, benefits some fauna
- Main public safety issue is bushfire
- Tall pylons can support lines over valley tree tops
- Possible low browse shrub habitat

GAS, WATER, SEWERAGE

- Habitat rehabilitation possible after construction, no safety issues associated with fauna use

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