1. Purpose

In Victoria, every year there are over 440 crashes involving utility poles. Approximately 65% of these crashes occur in the Melbourne metropolitan area. More than one third (39%) of metropolitan pole crashes occur at intersections¹.

Pole crashes represent approximately 4% of all casualty crashes in Victoria. However, fatal pole crashes represent 7% of all fatal crashes.

In the metropolitan area, while pole crashes represent 6% of all casualty crashes, they represent approximately 9% of fatal casualty crashes.

As part of the implementation of the Road Management Act (2004), the Code of Practice for Management of Road Infrastructure in Road Reserves (2008) has been developed. The purpose of the Code is to provide practical guidance and identify benchmarks of good practice for utilities and road authorities, who are expected to work together cooperatively to facilitate the installation, maintenance and operation of road and non-road infrastructure within road reserves.

This Road Design Note (RDN) for dealing with roadside poles will supplement the Code and provide detailed guidance with respect to managing the location of utility poles in terms of road safety issues. It is produced in a form suitable for use by designers and those who install utility infrastructure.

2. Clear zone concept

The clear zone concept involved the provision of a recovery area that is sufficient for most errant drivers who leave the carriageway to stop safely or regain control. The VicRoads Supplement to the Austroads Guide to Road Design (VRS) - Part 6: Roadside Design, Safety and Barriers, Figure V4.1 shows the clear zone for different speeds for a higher volume straight road (reproduced in Appendix A). Note that traffic volume, road curvature and batter slope will also influence the clear zone requirements.

Ideally no pole (or any other roadside hazard) should be placed within the clear zone. In practice, particularly in urban areas, it has been difficult to satisfy this requirement due to constraints such as the location of poles amongst all of the other services within the road reserve, insufficient road reserve width and cost implications.

3. Risk assessment

The following risk analysis is based on the risk associated with individual poles. It refers to the risk that motorists are exposed to should they lose control of their vehicles and leave the road and relates to an individual event; it is not a tool for rating a length of road for the purposes of comparing roads.

3.1 Pole risk score

The pole risk score is the product of five risk factors:

\[ \text{Pole risk score} = \text{Daily traffic volume} \times \text{Offset factor} \times \text{Road factor} \times \text{Curve factor} \times \text{Severity Factor} \]

Daily traffic volume²

This is the total 2-way traffic (AADT) that passes the pole, in vehicles per day. At intersections, traffic on both cross roads should be considered because all traffic is exposed to the risk associated with a hazard on the corner.

The most appropriate daily traffic volume estimate is the Annual Average Daily Traffic (AADT). To facilitate quick "ballpark" estimation of pole risk, the 'Traffic Volume Data for Victoria', released on November 2012, contains the traffic volumes for freeways and arterial roads in Victoria and can be used to find the AADT. This article can be found on the VicRoads website. These figures are conservative and will generally result in higher risk estimation. They should only be used for preliminary estimation and actual traffic volumes should be obtained if the analysis suggests that the outcome would be dependent on accurate traffic volume data.

¹ Crash data between 2008 and 2012 (VicRoads CrashStats)

² The Pole Risk Score is calculated using a 2-way AADT Daily Traffic Volume and a Road Factor which reflects the crash rates for different cross sections. Refer to VicRoads Supplement to the Austroads Guide to Road Design - Part 6: Roadside Design, Safety and Barriers Section 4: use 1-way AADTs.
Offset factor

The offset of a pole is measured from edge of the nearest traffic lane (not parking lane).

Road factor

The relative risk of driving on a road varies depending on the road standard and cross-section (for example divided roads have a lower risk because generally there are limited interactions between vehicles travelling in opposite directions). The following factors are from information provided in the ARRB Road Safety Risk Manager and are based on crash rates for divided and undivided roads.

Road factor
= 1.0 for undivided road
= 0.60 for divided road
= 1.0 for poles in median.

Curve factor

This factor allows for the higher risk associated with poles located on curves.

Although crash risk is more specifically related to curve radius, curve safe speed is used in the graph below because it is easier to estimate in practice.

The curve safe speed is defined by the curve warning sign if one is present. If there is no curve warning sign, an estimate should be made or a measurement should be taken.

Roads without curves (straights) shall have a Curve Factor of 1.0.

Severity factor

This factor allows for the increase in crash severity as speed increases and is based on the fact that energy increases in proportion to speed squared.

Severity factor
= 0.7 for 50 km/h operating speed limit or below
= 1.0 for 60 km/h operating speed limit
= 1.4 for 70 km/h operating speed limit
= 1.8 for 80 km/h operating speed limit
= 2.3 for 90 km/h operating speed limit
= 2.8 for 100 km/h operating speed limit
= 3.7 for 110 km/h operating speed limit

Operating speeds are determined as follows:
- Urban Road: Operating Speed = Posted Speed Limit
- Rural Road: Operating Speed = Posted Speed Limit + 10 km/h

3.2 Relationship between risk score and crashes

The graph on the following page can be used to estimate the likely crash record that could result from a given Risk Score.

The graph shows that the higher the Risk Score, the higher the chances of having a crash involving a utility pole. Therefore efforts should be made to minimise the risk score as much as possible taking into account the physical constraints and the cost effectiveness of the approach.

4. New installations and counter measures for existing installations/situations

From a road safety point of view, the preferred approach to locating or treating poles is firstly to eliminate them by undergrounding the services, if possible; then to move them (preferably outside the clear zone); and lastly protect motorists by installing barrier systems. Other treatments can also be considered to ensure drivers are aware of the presence of a hazard. Such treatments include audible edgeline, increased delineation etc.

4.1 Undergrounding

If the services are placed underground, the hazard is completely removed. However, there may be other roadside hazards nearby so crashes with objects may not be totally eliminated and may reduce the likely effectiveness of the treatment. For example a crash reduction factor of 95% can be used when poles are removed and there are no other hazards such as trees remaining but where other hazards remain then the figure should be varied proportionally to suit (e.g. if there are equal numbers of poles and trees along the roadside then removal of poles would reduce crashes into roadside hazards by 50%).

Refer: Balance between Harm eduction and Mobility in Setting Speed Limits: a Feasibility Study by Brian Fildes, Jim Langford, Dale Andrea, and Jim Scully, MUARC June 2005
4.2 Moving outside the clear zone

If the location of a utility pole can be moved just outside the clear zone, 85% of errant drivers will have room to recover control and a crash reduction factor can be determined from the Offset Factor graph above depending on the hazards initial offset and the distance it is moved, assuming there are no other hazards in the clear zone. If there are other hazards a reduced value should be used as suggested in 4.1 above.

4.3 Barriers and hazard reduction

If the location of a pole remains within the clear zone, a barrier should be installed as per VRS Part 6 - Section 6.0, and considered in other circumstances. Wire Rope Barriers are the preferred type of barrier because they are the most forgiving in terms of road trauma and have been shown to reduce casualty crashes by 90%.

If there are constraints prohibiting the use of Wire Rope Barriers then Steel Beam Guardrail can be expected to reduce casualty crashes by up to 50%.

Note that the crash reduction factor for a barrier is a result of a reduction in the severity of the crash compared to that of a crash with a solid object such as a pole.

Desirably barriers should be located as far away as practicable from the road edge to allow vehicles to stop clear of the carriageway, to provide a recovery area for vehicles that leave the roadway and to reduce the likelihood of crashes into the barrier.

If a barrier is to be installed it is important to consider the impacts it may have on site — a poorly designed/installed barrier may be more hazardous than an isolated hazard. Offset from the traffic lane, deflection of the barrier type, required length of need and Sight Distance implications (particularly at intersections) should all be considered.

An on/road safety treatment that warrants consideration is use of audible edge lines. Raised thermoplastic strips are placed along the traffic edge line. When motorists travel over the strips they are alerted through noise and vibration that the vehicle has departed the traffic lane. Audible edge lines provide opportunity for drivers to take corrective action when they have inadvertently began to leave the roadway. Research has shown that audible edgelines are effective in reducing the likelihood of an errant vehicle leaving the road, and therefore installation should be considered in front of, and on the approach of, hazards — particularly in areas where installation of barrier is not possible or feasible and the hazards are within the clearzone.

4.4 Moving within the clear zone

If the location of a pole can be moved but it is still located within the clear zone, then a barrier system should be considered to protect motorists — refer to Section 4.3. However, if a barrier is not feasible, but significant improvement in offset can be achieved, then the following factors may influence justification for the cost of moving the pole.

The basis of these factors is explained in Appendix B.

<table>
<thead>
<tr>
<th>Urban 60 km/h environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offset (m)</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
4.5 Cost-effectiveness of treatments

A road safety improvement treatment is considered cost-effective when the treatment’s Benefit Cost Ratio (BCR) is greater than 1. Appendix C provides more explanation on Benefit Cost Analysis. However, often due to budget constraints, the funding is only available when the treatment/proposal has a BCR of 2 or sometimes 3 or higher. Once a BCR is set, the cost-effectiveness of different treatments can be calculated. Appendix D shows examples of how to determine when a treatment is cost-effective.

Different treatment options to reduce the pole risk score should be considered and BCR calculated for each option. A decision is then made on the appropriate option depending on the availability of funding or other factors.

5. Procedure for assessment of poles

The following procedure should be followed to ensure optimal road safety outcomes are achieved whenever new or existing pole installations are being considered.

5.1 New installations/road projects

Where new urban development is planned and new utility poles are to be erected or where a road project will redevelop an existing road reserve, the ideal situation is to provide sufficient road reserve width to allow poles to be located outside the clear zone.

If insufficient road reserve width has been set aside for poles to be located outside the clear zone, then a risk assessment should be carried out. If the Risk Score is high then services should be placed underground if technically possible. The lower costs involved in a green fields site are more likely to make this cost effective.

In a new greenfields situation or road project, if poles were to be placed within the clear zone and undergrounding is not warranted, appropriate safety barriers should be installed to protect motorists.

5.2 Existing poles

In every case where a pole is to be replaced or modified, relocating it to a position outside the Clear zone should be considered.

If this is not possible, a risk assessment should be carried out and the feasibility and cost-effectiveness of alternative treatments assessed.

Benefit cost ratios comparable to those obtained in road safety programs are likely to be obtained (assuming the treatment is feasible) by:

- moving the pole as far as possible when the risk score is low;
- installing a safety barrier system when the risk score is average;
- undergrounding the service when the risk score is high.

The flowchart on the next page illustrates the procedure proposed for the assessment of the safety of roadside poles.

5.3 Case studies

A number of real life case studies are presented in Appendix E. In the flow chart on page 5 “low cost” for maintenance/replacement means that the cost of improvements is a small percentage of the total cost of the project and can be funded as part of the project.

References

Supersedes RDN 06-03 (July 2010)

Approved by

Andrew Wall
DIRECTOR NETWORK POLICY AND STANDARDS
VicRoads

Daniel Cassar
MANAGER ROAD STANDARDS & TRAFFIC
VicRoads

Contact

For further information please contact:
VicRoads Technical Services
3 Prospect Hill Road Camberwell Vic 3124
Telephone: (03) 9811 8355
Email: technicalconsulting@roads.vic.gov.au

Road Design Notes are subject to periodic review and may be superseded.
Assessment of safety of roadside poles

**New installation**
(Green Fields / Road Projects)

- Can Clear zone be achieved?
  - Yes
  - No
    - Proceed

**Existing installation**
(Maintenance / Replacement)

- Can low cost improvements be made or the pole moved outside the clear zone or the pole modified?
  - Yes
  - No
    - No
      - Yes
      - No
      - Proceed

**Can alternative route be used?**
Can additional land be acquired?

- Yes
  - Proceed

- No
  - No
    - Proceed

**Carry out risk assessment**
Preferred order of treatment:
- Undergrounding
- Move beyond Clear zone
- Install Barrier

1. Assess Undergrounding when risk score is high
2. If above not practical, consider installation of Barrier System or move beyond Clear Zone.
3. If above not practical, locate to lowest risk location.*

*Lowest risk location may be the current location
Appendix A: VicRoads Supplement to AGRD Part 6 - Clear Zone Guidelines

Clear zone widths on straights (VicRoads Supplement Figure V4.1)

Adjustment factors for clear zones on curves (Austroads table 4.2)

<table>
<thead>
<tr>
<th>Radius (m)</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
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<td>1.1</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>600</td>
<td>1.1</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
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<td>1.2</td>
<td>1.3</td>
<td>1.3</td>
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<td>1.2</td>
<td>1.3</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
</tr>
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<td>400</td>
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<td>1.2</td>
<td>1.3</td>
<td>1.3</td>
<td>1.4</td>
<td>-</td>
</tr>
<tr>
<td>350</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>300</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.5</td>
<td>-</td>
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<td>250</td>
<td>1.3</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>200</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>150</td>
<td>1.4</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Appendix B: Crash reduction factors

The following curve is derived from the current clear zone guidelines, which state that in a rural 100 km/h situation 85% of errant vehicles will recover and not strike a hazard 9m from the road and from Fox, Goode & Joubert’s analysis of the form of the relationship.

Proportion of errant vehicles recovering before reaching a roadside hazard

<table>
<thead>
<tr>
<th>Offset (m)</th>
<th>Crash reduction factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>94%</td>
</tr>
<tr>
<td>13</td>
<td>91%</td>
</tr>
<tr>
<td>11</td>
<td>87%</td>
</tr>
<tr>
<td>9</td>
<td>85%</td>
</tr>
<tr>
<td>8</td>
<td>81%</td>
</tr>
<tr>
<td>7</td>
<td>76%</td>
</tr>
<tr>
<td>6</td>
<td>68%</td>
</tr>
<tr>
<td>5</td>
<td>60%</td>
</tr>
<tr>
<td>4</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td>38%</td>
</tr>
<tr>
<td>2</td>
<td>25%</td>
</tr>
<tr>
<td>1</td>
<td>12%</td>
</tr>
</tbody>
</table>

This curve implies that for instance, 60% of errant vehicles would not reach a hazard that is 5m from the roadway. Therefore the crash reduction in moving a pole from the back of kerb to a point 5m from the edge of traffic lane would be 60%. In this way the following table can be constructed.
Appendix C: Benefit Cost Analysis

The Benefit Cost Ratio (BCR) is the ratio of Present Worth of Benefits (PWB)/Present Worth of Costs (PWC).

\[
\text{BCR} = \frac{\text{PWB}}{\text{PWC}}
\]

\[
\text{PWB} = \frac{\text{Number of Casualty Crashes (CC) saved /yr}}{\text{cost of countermeasure (C)}} \times \text{weighted unit cost of casualty crashes (SCC)} \times \text{Crash Reduction Factor (CRF)} \times \text{Present worth factor (PWF)}.
\]

\[
\text{PWC} = \frac{\text{cost of countermeasure (C)}}{\text{cost of treatment (C)}}
\]

For Crash Reduction Factors refer to section 4.4.

**NOTE:** Updated costs and values are available from Road Safety and Network Access.

### Weighted Casualty Crash Costs (as of June 2005)

<table>
<thead>
<tr>
<th>Speed limit</th>
<th>Weighted CC cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 km/h and less</td>
<td>$153,000</td>
</tr>
<tr>
<td>70, 80, 90 km/h</td>
<td>$194,000</td>
</tr>
<tr>
<td>100, 110 km/h</td>
<td>$295,000</td>
</tr>
</tbody>
</table>

### Present Worth Factor

The uniform series present worth factor is given by the following formula.

\[
\text{PWF} = \frac{1 - (1+i)^{-n}}{i(1+i)^n} \text{ where } i = \text{annual discount rate} = 6.5\% \text{ and } n = \text{number of years}
\]

<table>
<thead>
<tr>
<th>n years</th>
<th>PWF</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.13</td>
</tr>
<tr>
<td>10</td>
<td>7.18</td>
</tr>
<tr>
<td>15</td>
<td>9.40</td>
</tr>
<tr>
<td>20</td>
<td>11.01</td>
</tr>
<tr>
<td>25</td>
<td>12.19</td>
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<td>30</td>
<td>13.05</td>
</tr>
<tr>
<td>40</td>
<td>14.14</td>
</tr>
<tr>
<td>50</td>
<td>14.72</td>
</tr>
</tbody>
</table>

Example: A utility pole is located with a 1m offset on a 60 km/h bend on an undivided road carrying 15,000 veh/day with an 80 km/h speed limit. It has experienced 1 casualty crash in the last 5 years. The cost to install guard fence would be $5,000.

\[
\text{BCR} = \frac{1/5 \times $194,000 \times 50\% \times 11.01}{5,000} = 41
\]

Original Risk Score = 15,000 * 0.9 * 1 * 2.3 * 1.8 = 54,000

### Appendix D: Cost-effectiveness

#### When is a barrier cost-effective?

As an example, if in a Road Safety Program, cost-effectiveness is defined as having a BCR of 2. A barrier around a single pole costs around $5,000, (30m of barrier at $100/m plus a contingency cost).

\[
\text{BCR} = \frac{\text{CC/yr} \times \text{SCC} \times \text{CRF} \times \text{PWF}}{\text{C}}
\]

\[
2 = \frac{\text{CC/yr} \times $153,000 \times 50\% \times 11.01}{5,000}
\]

where

- \( \text{CC} = \) the number of Casualty Crashes
- \( \text{SCC} = \) weighted unit Cost of Casualty crashes
- \( \text{CRF} = \) Crash Reduction Factor
- \( \text{PWF} = \) Present Worth Factor
- \( \text{C} = \) Cost of treatment

Refer to Appendix C for an explanation of Benefit Cost Analysis.

Therefore, \( \text{CC/yr} = 0.011 \).

The graph in section 3.2 indicates that this is equivalent to a risk score of approximately 7,000.

Therefore, in this case, a guardrail barrier system is almost certainly going to be cost-effective whenever the risk score is greater than 7,000. A Wire Rope Barrier may be cost effective at much lower risk scores because of its higher crash reduction factor.

#### When is undergrounding cost-effective?

The utility companies have advised that the cost of undergrounding can vary from $1,000 per metre in greenfields sites where there are few constraints to two or three times this figure in urban areas where there are constraints in the road reserve. In a situation where there are few constraints the cost is estimated at $1000/m for a total cost of $100,000 for 100m.

\[
\text{BCR} = \frac{\text{CC/yr} \times \text{SCC} \times \text{CRF} \times \text{PWF}}{\text{C}}
\]

\[
2 = \frac{\text{CC/yr} \times $153,000 \times 95\% \times 14.72}{100,000}
\]

Therefore, \( \text{CC/yr} = 0.093 \).

The graph in section 3.2 indicates that this is equivalent to a risk score of around 55,000.

Therefore, in this case, undergrounding could be cost-effective when the risk score is greater than 55,000.
Appendix E: Case studies

A. Outer Suburban intersection

The crash history at this intersection shows 2 casualty crashes in the last 5 years.

Daily Traffic Volume = 15,000
Offset of poles is 1 m (assumed) therefore Offset Factor = 0.8
Road Factor = 1.0 for undivided road
Curve Factor = 1.0 for straight road
Severity Factor = 1.8 for 80 km/h speed limit (assume)

Therefore Pole Risk Score = 15,000 * 0.8 * 1.0 * 1.0 * 1.8 = 21,600

Treatment 1: Barriers

Install barriers at the intersection at a cost of $60,000 and a life of 20 years for the treatment.

The benefit cost ratio is:

BCR = \( \frac{CC}{yr} \times \$CC \times CRF \times PWF}{C} \)

= 2/5 * $194,000 * 50% * 11.01 / $60,000
= 7.1

CC = the number of Casualty Crashes
$CC = weighted unit Cost of Casualty crashes
CRF = Crash Reduction Factor
PWF = Present Worth Factor
C = Cost of treatment

Treatment 2: Undergrounding

If it was not possible for practical reason to install barriers (e.g. due to property access requirements) and given the high BCR, then undergrounding the services should be considered. In this case the cost of undergrounding is estimated at $2,000/m for a total cost of $600,000 the BCR would be as follows.

BCR = 2/5 * $194,000 * 95% * 14.72 / $600,000
= 1.8

A BCR of 2 or better is currently considered to be a worthwhile investment of road safety funds.

B. Outer suburban arterial

Crashes = 3 CC/5years
Daily Traffic Volume = 40,000
Offset of poles is 0.5 m (assume) therefore Offset Factor = 0.9
Road Factor = 1.0 for undivided road
Curve Factor = 1.0 for straight road
Severity Factor = 1.0 for 60 km/h speed limit

Therefore Pole Risk = 40,000 * 0.9 * 1.0 * 1.0 * 1.0
= 36,000

Treatment: Given the high number of crashes and the frequency of property access, the preferred option would be to underground the services. Assume a CRF of 75% due to the presence of trees which would not be removed. (This assumes that 75% of current pole crashes would be prevented, 25% of current collisions would be transferred to collisions with trees and the current crashes with trees continue but do not come into this equation.)

The length in question is 500m and the cost of undergrounding $2,000/m.

BCR = \( \frac{3/5 \times $153,000 \times 75\% \times 14.72}{$1,000,000} \)
= 1.0

This project is marginal, so it would be desirable to identify more accurately the actual poles involved in crashes to see if a shorter length of undergrounding would be worthwhile.

C. Inner suburban intersection

Existing pole on south-east corner approx 0.2m from traffic in Road A and 3m from crossroad Road B. There were 3 casualty crashes involving poles at the intersection in the previous 5 years.

Assume traffic volumes: 60,000 vpd in Road A & 20,000 vpd in Road B.

Risk = 60,000*1*0.8*1*1 + 20,000*0.4*0.9*1*1
= 48,000 + 7,200
= 55,200

Option 1: Move pole into Road B with offsets of 4m to Road A and 2m to Road B.

Risk = 60,000*0.3*0.8*1*1 + 20,000*0.5*0.9*1*1
= 10,800 + 9,000
= 19,800

After services were located accurately it was found that this option was not feasible.

Option 2: The only feasible place to relocate the pole was to a location in Road A with a 1.5m offset 4m south of Road B.

Risk = 60,000*0.65*0.8*1*1 + 20,000*0.25*0.9*1*1
= 31,200 + 4,500
= 35,700 (Significant but relatively small change in risk)

Option 3: Consider removing the pole and placing the power lines underground.

100m of undergrounding will be required. The cost of undergrounding is normally in the order of $1,000 per metre for greenfields sites. Assume the cost will be three times this due to the difficult site conditions and traffic management requirements. Estimated cost therefore is $300,000.

BCR = \( \frac{3/5 \times $153,000 \times 95\% \times 14.72}{$300,000} \)
= 4.2, a very worthwhile project that would compete strongly for funding.
D. Rural road

A new power line is proposed in Road A from the intersection with Road B.

Pole 1 is proposed to be located at the intersection 10m away from the edge of traffic lane. As this is outside the Clear zone, there is no issue with the first pole.

Pole 2 is proposed to be located south-west of the intersection on the west side of the road with an offset of 7m from edge of traffic lane. The reason for crossing the road is that there is a significant stand of trees on the south side of the road. This pole would be within the clear zone of 9m so requires assessment. It cannot be placed any closer to the road reserve boundary because it will require a stay on the boundary side. Under the Clear Zone Guidelines it requires a safety barrier.

Pole 3 is located on the east side of the road in order to avoid another stand of trees. It is located as close as possible to the boundary and is more than 9m from the edge of traffic lane so there is no issue with it. The remaining poles are on the west side but are also outside the clear zone.

Conclusion: Provided all low cost alternatives have been considered, this proposal should be accepted subject to the use of a safety barrier for Pole 2.

E. Outer suburban arterial

A new 66kV power line is proposed to be taken from Road B south along Road A basically using existing poles. Road A is also currently being duplicated.

The duplication is bringing the kerb on the east side right up to the poles so the offset will be about 0.2m. Assume a traffic volume of about 60,000 vpd. The speed limit is 80 km/h.

Risk = 60,000*1*0.6*1*1.8
     = 65,000

Option 1: Barriers

There is insufficient room to install barriers.

Option 2: Underground

Length of power line is 300m at say $1,500/m = $450,000
Weighted casualty crash cost in 80 km/h zone = $194,000
Therefore a BCR of 2 or more would be achieved if 5 casualty crashes were saved in 20 years. This would be very likely on a busy road such as this.

Other options that could be considered are: (i) using modified poles that reduce the severity of impact. (ii) Lowering the speed limit to 60 km/h would lower the risk to almost half but would still constitute a high risk situation.

Conclusion: Undergrounding should be considered.

There are also poles on the west side of Road A and in the central median to the north which need to be assessed.

F. Outer suburban arterial

Initially a new power line was proposed to be placed adjacent to the existing two lane two way pavement. When it was discovered that there was a future proposal to duplicate this road with service roads, negotiations were entered into with the land owners and the poles were located between the service roads and the property boundaries, well away from the main carriageway.

This example is included to illustrate that there are circumstances where an almost perfect solution can be found.

For further information please phone 13 11 71 or visit vicroads.vic.gov.au