Developing a defendable approach to pavement defect repair
(or how to pick which defect to fix!)

Stuart Finlan
Tonkin & Taylor
This presentation provides an overview of methods developed to rank or prioritise pavement defects based upon engineering and safety grounds using an auditable approach thereby making funding applications more robust.

The number of defects inevitably exceeds available funding. This approach ensures the most needy sites are treated: defends the TA position with the public and councillors; and, in our increasingly litigious society, offers a defence against actions taken
The Problem
The Problem
The Problem
The Problem
Data Collection

- Location
- Geotechnical
- Safety
Location

- Site name
- Location (route position)
- Road classification
- Relationship to carriageway (left/right)
- On embankment, in cutting or at grade
- Description of defect
- Any current movement or activity
- Dimensions/sketches/photographs
- First thoughts on remedials
Geotechnical

- Influence of surface water (overland flow)
- Influence of groundwater (seepages?)
- Culverts (intact/size/blocked/damaged)
- Form and type of ground movement (slips/subgrade failure/surface deformation)
- Will there be further/continued failure (settlement/slippage)
- Perceived consequences of such failure (lane closure/road closure)
- Likely rate of such failure (slow/moderate/rapid/sudden)
Safety
Pavement roughness/deflection
Driveability
Alignment (horizontal and vertical)
Speed environment
Speed reduction due to defect
Sight distance
Decision sight distance
Details of current warning devices (signage)
Data Analysis

Risk Matrix
Simple matrix applying assessed criteria as ‘coarse sieve’

Spreadsheet
Score each element
Total score
E,H,L or N ranking applied to score bands
Total score gives E, H, L or N ranking
Simple matrix approach

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>A (Almost Certain</th>
<th>H</th>
<th>H</th>
<th>E</th>
<th>E</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>B ( Likely)</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>C (Possible)</td>
<td>N</td>
<td>L</td>
<td>H</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>D (Unlikely)</td>
<td>N</td>
<td>N</td>
<td>L</td>
<td>H</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>E (Rare)</td>
<td>N</td>
<td>N</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

1 (Insignificant) 2 (Minor) 3 (Moderate) 4 (Major) 5 (Critical)

N = Negligible, L = Low, H = High, E = Extreme

**Level** | **Descriptor** | **Description**
---|---|---
5 | Critical | Sever the highway and/or extreme risk to road users
4 | Major | Close the highway for more than 24 hours and/or major risk to road users
3 | Moderate | Close half the highway for more than 24 hours and/or unacceptable risk to road users
2 | Minor | Reduce available road width and/or low risk to road users
1 | Insignificant | Minor delays during clean-up and/or insignificant risk to road users

**Level** | **Descriptor** | **Description**
---|---|---
A | Almost certain | Expected to occur in most circumstances
B | Likely | Will probably occur in most circumstances
C | Possible | Might occur at sometime
D | Unlikely | Could occur at sometime
E | Rare | May occur only in exceptional circumstances
Further refinements

**Likelihood** includes consideration of:-
- Existing drainage: does it still work?
- Influence of surface/groundwater
- Weather impacts
- Traffic loading

**Consequence** includes consideration of:-
- Closure time/delay in travel time
- Road user hazard (sight and vertical deformation)
- Anticipated rate/depth of movement
## Preliminary Risk Assessment Fieldsheet - Shallow Slips

### Likelihood

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rating and Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of Instability</td>
<td>None</td>
</tr>
<tr>
<td>Recurrence Interval of Significant Failures</td>
<td>&gt;10 years</td>
</tr>
<tr>
<td>Annual Rainfall</td>
<td>&lt;400 mm</td>
</tr>
<tr>
<td>Groundwater</td>
<td>None</td>
</tr>
<tr>
<td>Slope Height</td>
<td>8-10 m</td>
</tr>
<tr>
<td>Slope Angle</td>
<td>&lt; 20 deg</td>
</tr>
</tbody>
</table>

### Consequence

<table>
<thead>
<tr>
<th>Potential road closure</th>
<th>Shoulder/Furrow</th>
<th>1/2 Lane</th>
<th>1 lane</th>
<th>2 Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Vehicle Risk</td>
<td>0-50%</td>
<td>50-60%</td>
<td>60-76%</td>
<td>70-100%</td>
</tr>
<tr>
<td>% of decision site distance</td>
<td>Adequate sight distance</td>
<td>Moderate sight distance</td>
<td>Limited sight distance</td>
<td>Very limited sight distance</td>
</tr>
<tr>
<td>Roadway width including paved shoulders</td>
<td>&gt;12 m</td>
<td>0-12 m</td>
<td>7.5-9 m</td>
<td>&lt;7.5 m</td>
</tr>
<tr>
<td>Quantity of debris per event</td>
<td>&lt;3 m³</td>
<td>3 - 10 m³</td>
<td>10 - 20 m³</td>
<td>&gt;20 m³</td>
</tr>
</tbody>
</table>

### Probability Score

- Likelihood Score: 50
- Consequence Score: 28
- Risk Level: High

### Notes

- SH: Street Name
- Area: Geographic Area
- Length: Length of Area
- RP: Road Project
- Date: Date of Assessment
Assessment of Strategies

- Can the current risk level be reduced using signage/barricading/smoothing?
- Deal to the remaining Extreme and High risk sites
- Monitor remaining sites and reassess their risk over time (add to database to give ongoing picture of deformation and deterioration to assist in planning)
- Not ideal as sites will continue to deteriorate over time/temporary measures can add to the problem over time (smoothing)
- Method of managing defects: in the short to medium term: defect will always require fixing in the end
Minimise
Isolate
Eliminate
Example

• Flood damage
• Slumping of lane
• High speed environment

An EXTREME site
• Mitigation options:
  − Minimise: smoothing and toe support
  − Isolate: barricade and temporary realignment
  − Eliminate: gabion basket wall

• Effectiveness:
  − Minimise: extreme ⇒ high
  − Isolate:
    extreme ⇒ high
  − Eliminate:
    extreme ⇒ negligible
Acknowledgements

MWH
Opus
Works Infrastructure
Transit New Zealand
PSMC002 Highways North