ROADS INVESTMENT STRATEGY AND PROJECT PRIORITISATION

A SOUTHROC PROJECT UNDER THE QUEENSLAND ROADS ALLIANCE

AUTHORS

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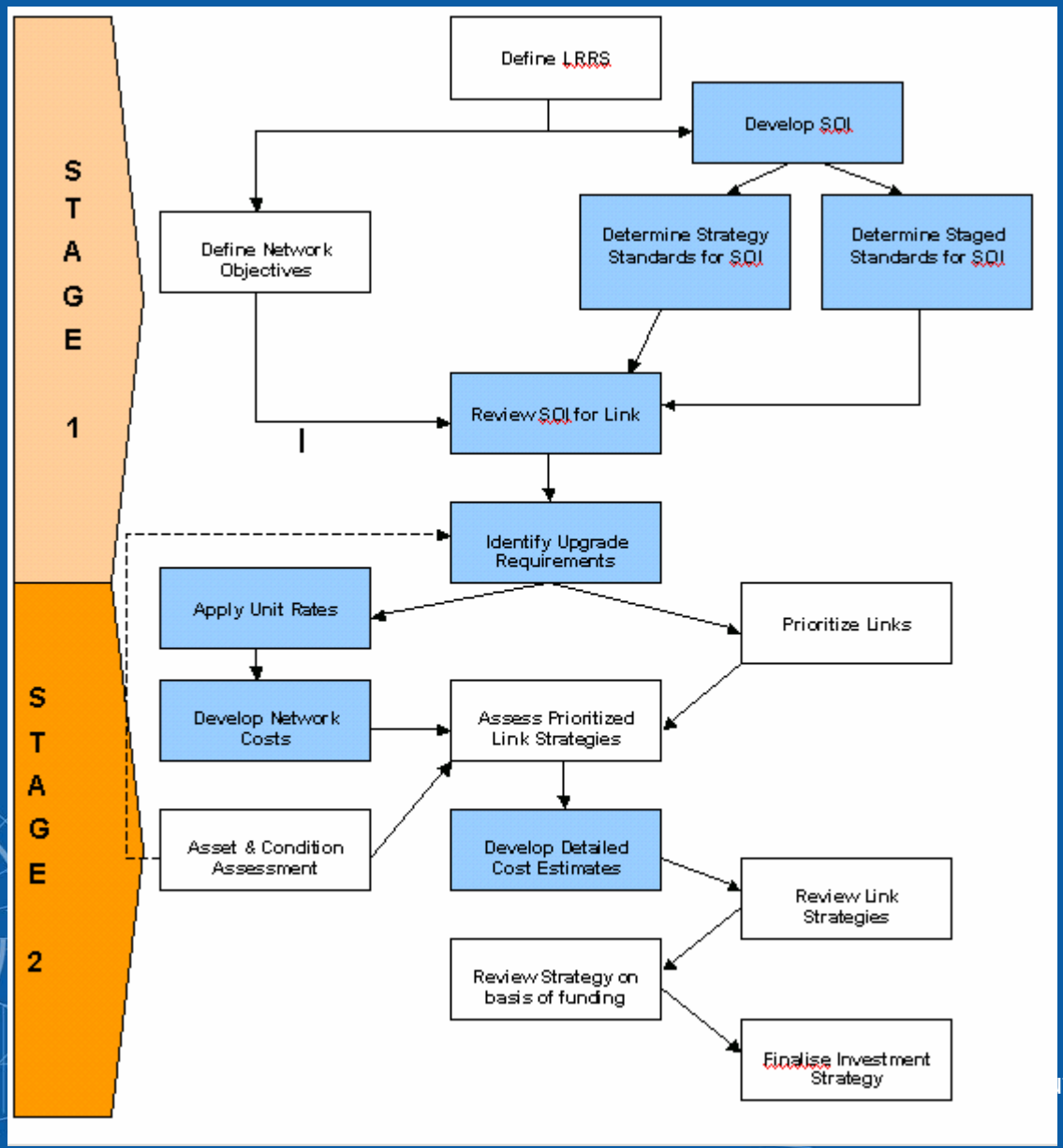
PROJECT INITIATION

- Alliance Guidelines and Program Development Kit
- Complexity of the road network for the SouthROC Area
- Alliance support to develop a model to generate preliminary Roads Investment Strategy
- GHD engaged to develop model
- Extended to include Project Prioritisation Methodology
- Projects of benefit to all RRG's in Queensland

Framework Flow Chart



Network Objectives

- Economic:
  - Eg. Efficient freight movement, commuting, service industry, residential growth.
- Social:
  - Eg. Flood immunity, community access, Public transport, visual amenity.
- **Environmental:**
  - Eg. Noise, Air pollution, Flora and Fauna.
- **Safety:**
  - Eg. Accident prevention, Forgiving road environment, Roughness.

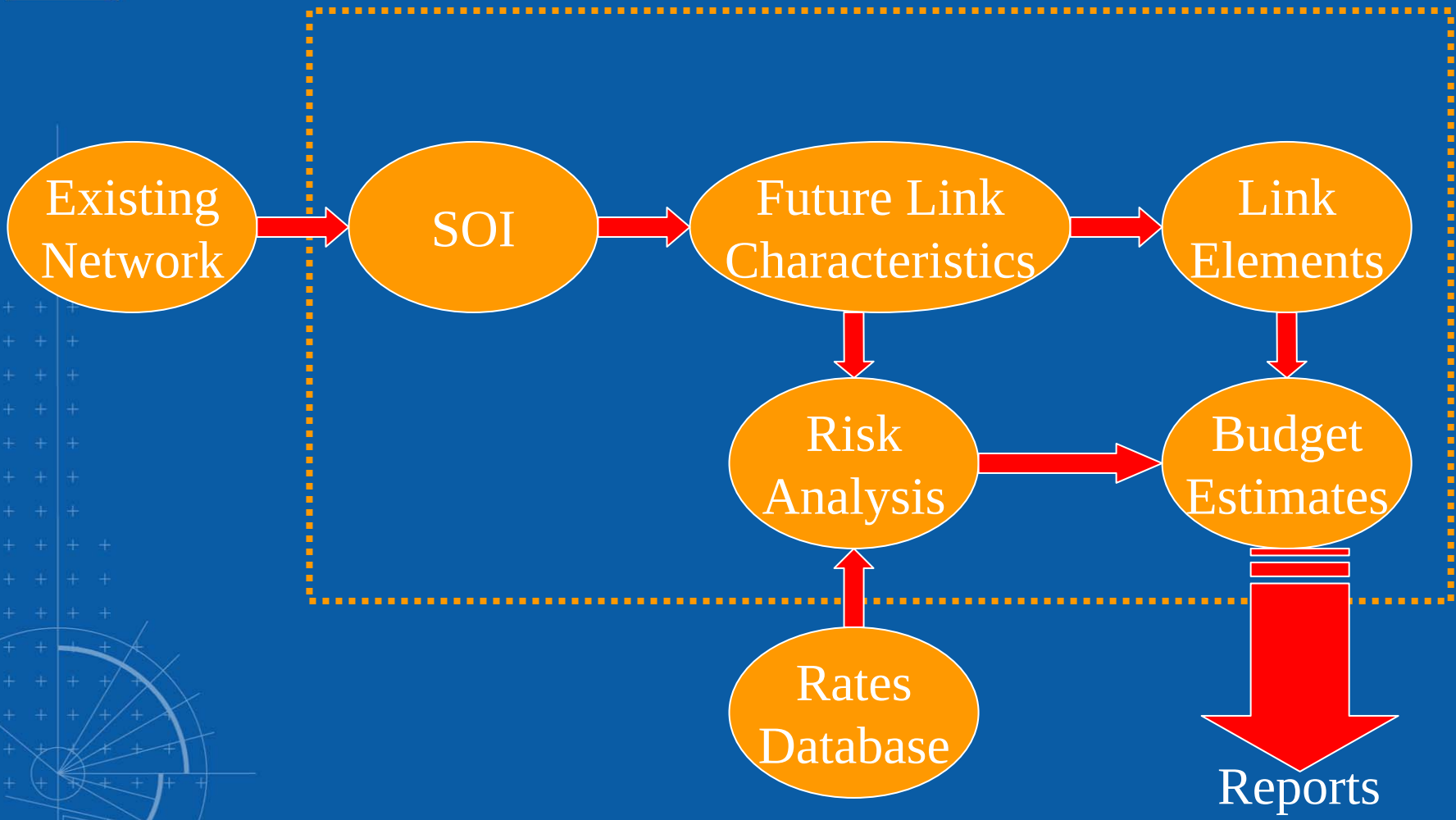
Statements of Intent

- Statements of Intent (SOI) are used to define the ultimate function of the road/link at the planning horizon
- The SOI's for SouthROC have been broken into two main classes:
  - Rural
  - Urban
- Within these classes there are sub-classes of roads based on the functional hierarchy of the road/link:
  - Rural Arterial
  - Rural Collector
  - Urban Arterial
  - Urban Collector

SOI Cont'd

- Within each of these subclasses of road there are different functional specifications defined by the role and vehicles (car, bus, cyclists, parking, etc) that the link must accommodate
- The functional elements that are proposed to define the SOI include:
  - AADT in 20 years
  - Regional Movement Hierarchy
  - Tourist Routes
  - Freight Movement / Efficiency
  - Inclusion of:
    - Transit Lanes
    - Bike Lanes
    - Parking Lanes
    - Dual Purpose Lanes

Estimating Model Structure



Infrastructure Cost Elements

- Earthworks
- Pavements
- Structures
- Drainage
- Project management
- Services
- Traffic Management
- Other Elements

PROJECT PRIORITISATION METHODOLOGY

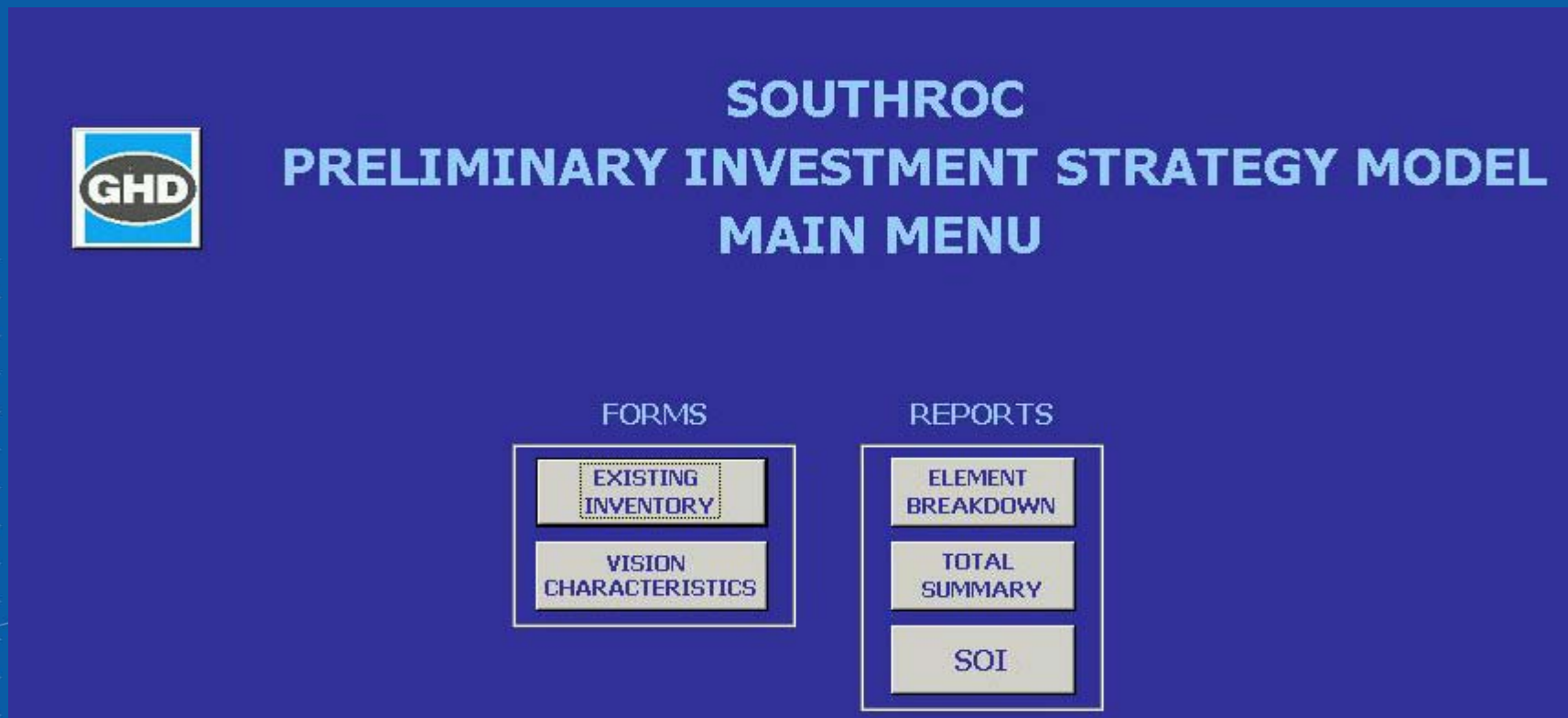
- Draft Methodology issued under Alliance Guidelines
- SouthROC offered to review and test
- Extension of Investment Strategy work by GHD
- Benefits - Best practice utilised
  - Spreadsheet tool for ease of use
  - User set parameters/weightings
  - Consistent uniform data across the Region
  - Priorities less open to challenge

Approach to Develop Preferred Methodology

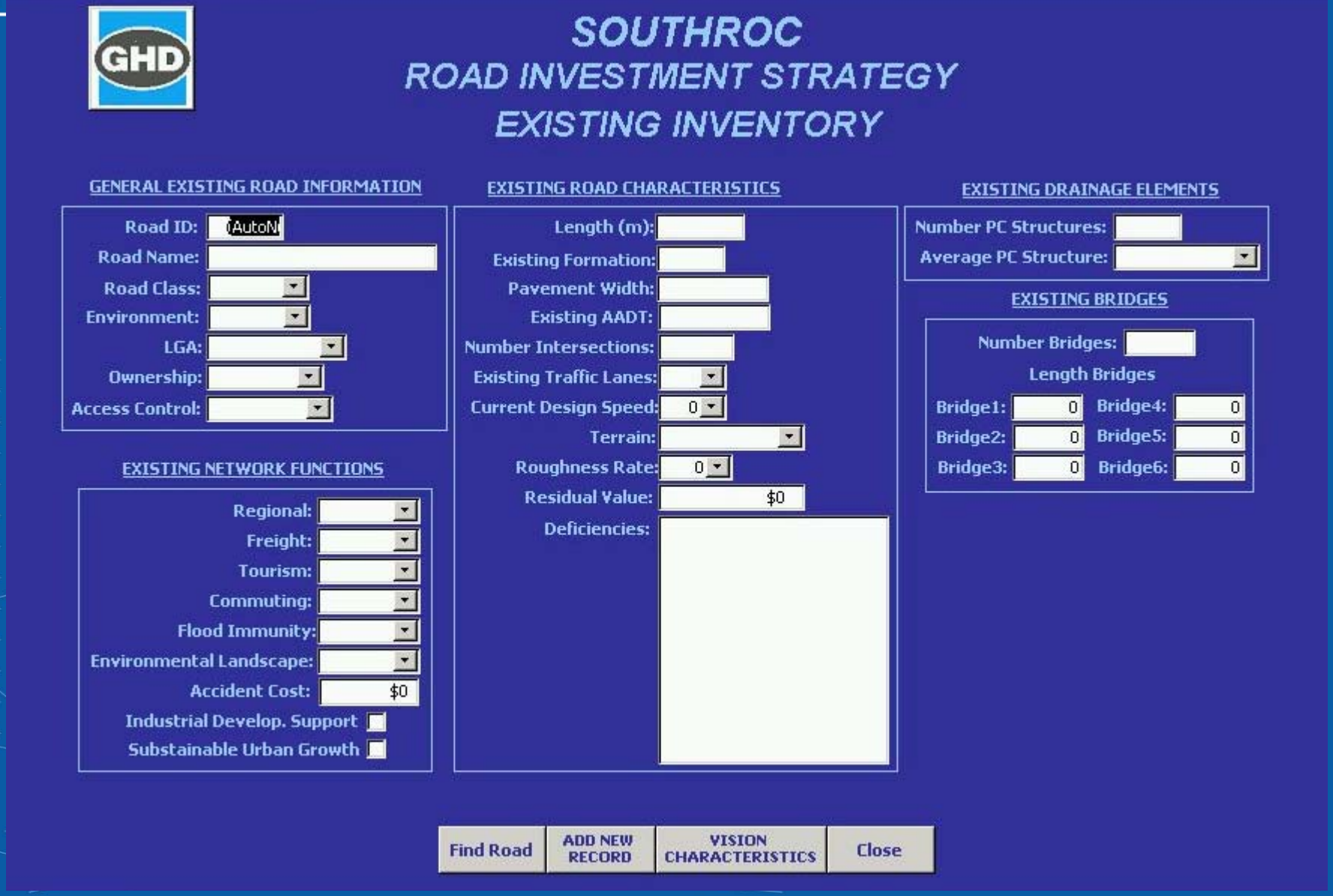
- Research conducted suggested that the Program Development Kit was a reasonably strong approach
- Concluded that:
  - The MCA component and the Risk Analysis be amended slightly
  - A Cost Effectiveness Analysis should be added to the methodology to reflect economic benefits
- Suggested weightings:

Cost Effectiveness Analysis	=	30%
Multi-Criteria Analysis	=	40%
Risk Analysis	=	30%

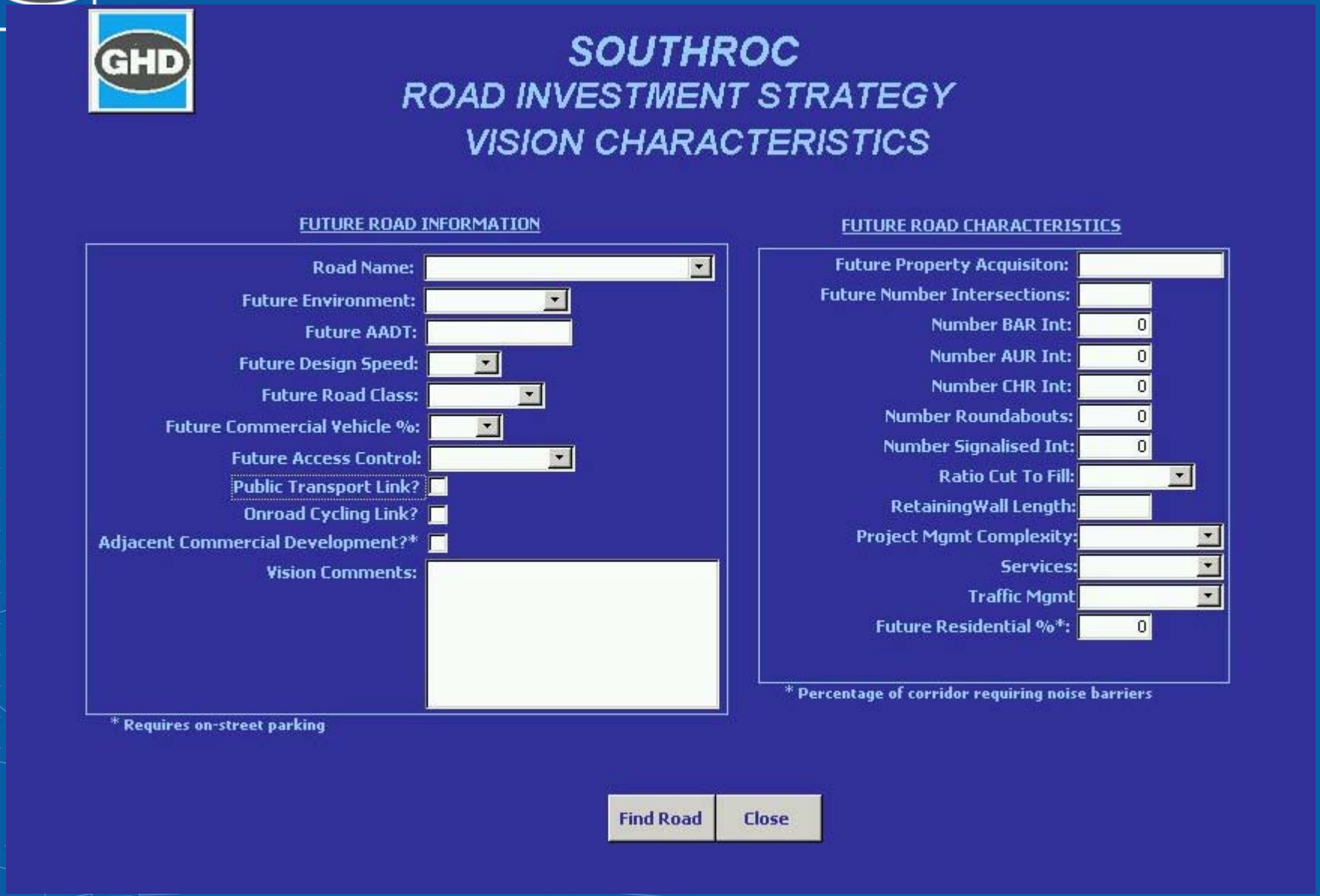
Preliminary Investment Strategy Model Interface



Model Inputs



Future Characteristics



Model Outputs

- Totals for:
  - Region
  - LGA
  - Responsible authority (LGA/DMR)
  - Road environment (Rural/Urban)
  - Road hierarchy (Arterial/Collector)
- Total costs by each element:
  - Earthworks
  - Pavements
  - Drainage
  - Project Mgt

PROJECT PRIORITISATION METHODOLOGY

- 3 Components
  - Cost effectiveness analysis
  - Multi criteria analysis
  - Risk analysis

Cost Effectiveness Analysis

- A more ‘user-friendly’ variation of traditional Cost Benefit Analysis

- Recommended that CEA be based on two components:
  - travel time cost savings
  - vehicle operating cost savings

- CEA is basically an assessment of the indirect costs to the community of traveling the road section with future traffic and existing road conditions, compared to the costs with future traffic and upgraded road conditions (over the life of the project)

Cost Effectiveness Analysis (2)

- CEA is measured by

$$\frac{(\textit{total travel time cost savings due to the project} + \underline{\textit{total vehicle operating cost savings due to the project}})}{\textit{total project cost}}$$

- Measurement of CEA relies heavily on the theoretical information within the *Austroads (Part 2)*, *Highway Capacity Manual 2000* and *Highway Development and Management – 4 (HDM-4)*
- Also relies on reasonable amount of road owner information – the majority of which will have already been collected for the Preliminary Roads Investment Strategy database

Multi-Criteria Analysis

- Could also be referred to as a “Regional Worthiness’ evaluation
- Based on a Quadruple-Bottom Line Assessment:
  - Economic = 25%
  - Social = 25%
  - Environmental = 25%
  - Safety = 25%
- Each of these components contain sub-components, as identified in Table 1 of LRRS Preliminary Roads Investment Strategy Report
- Vitally important that we use weightings that are agreed by members of the RRG

Multi-Criteria Analysis (6)

- Non-dimensionalised Scaling
  - Used to standardise values
  - Provides an element ‘score’ between 0 and 1
  - Useful when scoring ranges are inconsistent
  - Where a smaller score is undesirable, rating equals:

$$\frac{\textit{actual outcome} - \textit{worst outcome}}{\textit{best outcome} - \textit{worst outcome}}$$

- To obtain a score for an element, the ratings are ‘non-dimensionalised’, multiplied by their respective weightings and a score between 0 and 1 is achieved

Multi-Criteria Analysis (7)

- The identified multi-criteria scores are summed

- This total score is then multiplied by the weighting attributed to MCA to gain the ***Multi-Criteria Analysis Weighted Score***

Risk Analysis

- Research concluded that the ‘likelihood and consequence’ approach suggested within the Program Development Kit was widely accepted as ‘best practice’ risk assessment

- Likelihood:
  - Based on condition
  - The Roads Alliance ‘Road and Bridge Asset Management Kit’ had a Condition Rating Scale
    - From 1 (good condition) to 5 (unsafe)

Risk Analysis (2)

- Likelihood
  - Currently based upon a Condition Rating Scale

Rating	State	Description
1	Good	Free of defects
2	Fair	Structural performance is ok
3	Poor	Defects requiring monitoring
4	V.Poor	Defects requiring urgent action
5	Unsafe	Asset must be closed

Risk Analysis (3)

- Consequence:
  - Essentially recommend utilising the Consequence Rating Criteria within the Program Development Kit
  - "People" and "Local Community" have been amended to "People – Safety" and "People – Efficiency"
  - Based on a 1 (Insignificant) to 5 (Catastrophic) scale
  - Criteria are:
    - Risk to People – Safety
    - Risk to People – Efficiency
    - Delay Penalty Risk
    - Road Agency Risk
    - Local Economy Risk
    - Local Environment Risk

Risk Analysis (4)

- Overall Risk Rating & Score:
  - Rating to be determined based upon the matrix from Table 2.3.5 from the Program Development Kit
  - However, these ratings have been amended to exaggerate the score as the risk likelihood and consequence increases:

Likelihood					
5 – Near Certain	5.35	7.58	8.70	9.37	10.00
4 – Highly Likely	3.69	5.84	7.58	9.04	9.69
3 – Likely	2.39	4.28	6.75	7.97	9.37
2 – Unlikely	0.87	2.39	4.83	6.75	8.34
1 – Rare	0.00	1.66	3.06	5.35	7.18
Consequence	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic

Risk Analysis (5)

- The identified risk rating is then normalised
  - Based on 0 being the worst outcome (in terms of project priority) and 10 being the best outcome
- This score is then multiplied by the weighting attributed to risk to gain the ***Risk Analysis Weighted Score***

Overall Project Score

- Is the weighted sum of the CEA score, the MCA score and the Risk Analysis score
- Allows objective assessment of upgrades with rehabilitation/maintenance improvements.

Overall Project Score Calculation

- Currently a weighted sum, based on

CEA	=	30%
MCA	=	40%
Risk	=	30%

- Could possibly be a hierarchal or ‘sieving’ process, based on:

  MCA ranks ***all*** projects based on “regional worthiness”

  CEA then ranks the top ***x*** number of projects based on “value for money”

  Risk Analysis then ranks the top ***y*** projects based on “lowest risk”

CONCLUSION

- The two projects have delivered good software packages that can generate Investment Strategies for all potential road crossections
- Statements of Intent and Project Prioritisation uses consistent data across the region
- Cost estimates for all projects are developed from a uniform set of parameters
- Weightings can be set by the users but must be agreed by all across the region
- GHD have done an excellent job and added value to the process
- The tools are available for use by all RRG's and are of value to any road authority