Chapter 4

Design Development Process
# Manual Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>Planning and Design Framework</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Pre-Project Planning</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Business Requirements</td>
</tr>
<tr>
<td><strong>Chapter 4</strong></td>
<td>Design Development Process</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Project Scoping</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Design Management</td>
</tr>
</tbody>
</table>
# Table of Contents

4.1 Concept Planning and Design Environment 4-1  
4.1.1 General 4-1  
4.1.2 Overall Process 4-1  
4.1.3 Process Elements 4-5  

4.2 Community Engagement and Consultation 4-5  

4.3 The Design Development Process 4-7  
4.3.1 What is Design Development? 4-7  
4.3.2 Project Scope 4-8  
4.3.3 Pre-Design 4-8  
4.3.4 Design Development 4-8  
4.3.5 Developing the Design 4-21  

4.4 Project Delivery 4-26  
4.4.1 Project Proposal 4-26  
4.4.2 Options Analysis 4-27  
4.4.3 Business Case 4-30  
4.4.4 Preliminary Design 4-33  
4.4.5 Detailed Design 4-34  

4.5 Whole of Life Considerations 4-39  
4.5.1 General 4-39  
4.5.2 Staging 4-40  
4.5.3 Materials 4-40  
4.5.4 Maintenance Needs 4-41  
4.5.5 Landscaping 4-41  
4.5.6 Public Utility Plant 4-41  
4.5.7 Rehabilitation 4-41  
4.5.8 Road User Costs 4-41  
4.5.9 Crime Prevention Through Environmental Design 4-42  

References 4-42  

Relationship to Other Chapters 4-43  

Appendix 4A: Procedure for Evaluating Project Planning (Solution) Options 4-44
# Chapter 4 Amendments - June 2005

## Revision Register

<table>
<thead>
<tr>
<th>Issue/Rev No.</th>
<th>Reference Section</th>
<th>Description of Revision</th>
<th>Authorised by</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>First Release</td>
<td>D. Hicks/ R.Guppy</td>
<td>Mar 2003</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>General updates following feedback</td>
<td>D. Hicks</td>
<td>Jan 2004</td>
</tr>
<tr>
<td>3</td>
<td>Chapter 4 - Planning and Design Processes</td>
<td>Totally new Chapter 4 - Planning &amp; Design Processes, following the incorporation of the original chapter 4 - The Concept Phase into the new Chapter 3.</td>
<td>D. Hicks</td>
<td>Feb 2005</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>First Edition Release</td>
<td>D. Hicks</td>
<td>June 2005</td>
</tr>
</tbody>
</table>
4.1 Concept Planning and Design Environment

4.1.1 General

The framework for planning and design in Main Roads is described in Chapter 1. This framework provides the basis of the environment within which planning and design is undertaken.

In the first instance, planning and design has to be in harmony with the strategic directions of the Department and the obligations of the Chief Executive described in the relevant Acts. These are described in Chapter 1 and are manifested in the Road Network Strategy, the Investment Strategies and the Roads Implementation Program. This manual is intended to provide the detailed knowledge required to implement the requirements of these over-arching documents.

4.1.2 Overall Process

The overall planning and delivery process is illustrated in Figure 4.1, which shows the relationship between the various steps in that process. This Chapter discusses the pre-project process from early planning of the project to its inclusion on the RIP. This Chapter deals with the Road Planning Process. Each succeeding phase relies on the results of its predecessor and must apply those results to retain the integrity of the process.

Figure 4.1 shows the desirable flow of activities throughout the process but at any given time, all activities may be in some stage of review. Further, the boundaries between the phases of the project are not precise and activities may fall on one side or other of these boundaries depending on the particular elements of the project.

Scoping (including the road planning process) represents the first step in the project planning process and occurs within the context of the overarching strategies described in Chapter 1. Figure 4.2 illustrates a typical approach to the road planning process and shows how the various elements interact to produce the planning report on which the future decisions will be made. The elements of this process are discussed in detail in following sections.

It is essential that the cost of projects be kept under strict control throughout the process. The Project Cost Estimating Manual provides guidance on the management and control of projects and should be consulted to help plan a project. These project management procedures should be introduced at the earliest phases of the project because:

- the decisions made in the early stages of a project have the biggest impact on the success or failure of the project; and

Manuals covering Environmental Management, Noise Management, Landscape Design, Pavement Design, Drainage Design and Structural Design are separate publications and these have been referred to as necessary throughout.

Where approvals will be required from other government departments or agencies (e.g. Department of Natural Resources and Mines, Wet Tropics), they should be approached early in the process to avoid rework and disharmony as the project developed.

Figure 4.1 shows the desirable flow of activities throughout the process but at any given time, all activities may be in some stage of review. Further, the boundaries between the phases of the project are not precise and activities may fall on one side or other of these boundaries depending on the particular elements of the project.

Scoping (including the road planning process) represents the first step in the project planning process and occurs within the context of the overarching strategies described in Chapter 1. Figure 4.2 illustrates a typical approach to the road planning process and shows how the various elements interact to produce the planning report on which the future decisions will be made. The elements of this process are discussed in detail in following sections.

It is essential that the cost of projects be kept under strict control throughout the process. The Project Cost Estimating Manual provides guidance on the management and control of projects and should be consulted to help plan a project. These project management procedures should be introduced at the earliest phases of the project because:

- the decisions made in the early stages of a project have the biggest impact on the success or failure of the project; and
Figure 4.1 Overall Preconstruction Processes
Review existing and future land use L.G. Strategic Plans

Determine existing traffic flow and review accident data

Undertake inventory of existing corridor with respect to geometric design, road and shoulder widths, pavement surface conditions, flood immunity and vehicle access

Assess existing conditions against standards and identify deficiencies

Review existing and proposed major utilities

Define future travel and develop corridor options

Undertake impact assessment on options, including a Review of Environmental Factors and Cultural Heritage

Define long term road network and access locations to corridor and establish long term functional needs of corridor and junctions, including public transport and other transport considerations (pedestrians, equestrians, cyclists)

Prepare preliminary concept and feasibility

Prepare draft access management strategy

Consult with affected property owners

Public consultation

Revise layouts and access management strategy following consultation

Undertake staging strategy

Review overall concept

Prepare final report including costs, staging and implementation program

Figure 4.2 Typical Road Planning Process
Figure 4.3 Estimated Costs Allocation over the Various Phases of Project Life Cycle
• the potential for cost reduction decreases as the project matures.

Appropriate risk management studies are essential to identify all risks associated with the execution of the project at the various stages of the life cycle of the project. This will allow appropriate estimates of the costs of the project at the various stages with proper allowances for the unknowns identified in the risk assessment. Figure 4.3 illustrates the approach to be taken.

4.1.3 Process Elements

Following from the Road Network Strategy and the various Investment Strategies, specific implementation plans must be developed. The complexity of these plans will depend on the location and scale of the projects envisaged and will range from simple rural road developments to complex urban motorway projects. The level of complexity will determine the detail of the processes required.

The essential elements of the process are:
• Land use/transport planning (including environmental impact assessment);
• Community engagement;
• Project proposal (problem, required outcomes, budget to deliver it);
• Business case (e.g. business case and the brief);
• Planning and preliminary design; and
• Detailed design.

Each of these elements is discussed in the sections below.

4.2 Community Engagement and Consultation

The planning process is a community driven one and an important element at every stage of the process is consultation with stakeholders. Stakeholders include affected and adjoining landowners, relevant statutory authorities (local government, other government departments, public utility authorities), industry bodies and users of the facility. The involvement of stakeholders throughout the planning process will help to ensure that all issues and needs are identified and considered and will lead to outcomes with a high degree of support and ownership.

Community consultation is therefore an essential part of all planning and design activities. To get the best results, it is necessary to start with a “clean sheet” and develop the project as the input from the consultation process unfolds. If this is not done, the consultation process will suffer from a perception that the Department has made up its mind and is in the process of selling the proposal. Figure 4.4 outlines the consultation project cycle.

The “clean sheet” approach is particularly applicable to route location proposals and “green field” sites. Some modification to the process may be justified when the proposal is an upgrading of an existing facility. The initial consultation will require information on the need for upgrading and the general concept considered to apply. This will allow the stakeholders to understand the intent of the project and to make more informed comments.

However, it is desirable that alternative proposals for the project be developed after the initial input so that they can be developed in the knowledge of the range of community concerns. The second phase of consultation will then have more specific proposals to consider and may result in additional issues arising. This approach retains the essential elements of the “clean sheet” approach and avoids settling on preferred alternatives too early in the process.

The Department has accepted the definition of Community Consultation as “the two way information exchange/s between the Departments of Main Roads and Transport and their publics before decisions are made. It is an open and accountable process whereby individuals and groups can participate in decision making processes and influence the outcomes of a policy or decision”.
THE CONSULTATION PROJECT CYCLE

STAGE ONE
ANALYSE THE ISSUES
- describe the issue and the context
- identify stakeholders
- 'reality test' with stakeholders
- assess the risk
- decide whether to proceed
- decide whether an 'advisory' group needed

SIGN OFF

STAGE TWO
DEVELOP A CONSULTATION/COMMUNICATION PLAN
- form stakeholder/subject groups for workshops to determine problem
- and possible solutions
- work with stakeholders to develop consultation/communication plan
- seek stakeholder feedback
- review stakeholder register
- develop a broad project brief

SIGN OFF

STAGE THREE
IMPLEMENT THE CONSULTATION/COMMUNICATION PLAN
- monitor and report on consultation/communication plan
- keep track of any issues
- feed info into the project decision-making cycle
- develop draft consultation activities report

SIGN OFF

STAGE FOUR
ONGOING CONSULTATION AND COMMUNICATION
- develop an ongoing consultation/communication plan
- keep track of issues
- monitor and report on the success of each activity
- feed info into the project decision-making cycle
- provide stakeholder feedback
- evaluate with stakeholder input

SIGN OFF

STAGE FIVE
EVALUATE
- carry out comprehensive evaluation
- write evaluation report
- feedback to stakeholders

SIGN OFF

Always review previous stages before proceeding.

Figure 4.4 The Consultation Project Cycle
The consultation program should be designed in accordance with the following publications:

- Community Consultation Policy, Standards and Guidelines;
- How to Gain Broader Participation in Consultation; and
- Consultation Planner.

Main Roads and Queensland Transport produce all of these.

Further guidance for specific communities is provided by the following publications produced by the Department of Families, Youth and Community Care:

- Protocols for Consultation and Negotiation with Aboriginal People; and
- Proper Communication with Torres Strait Islander People.

4.3 The Design Development Process

4.3.1 What is Design Development?

Design development is the process of:

- Developing a clear and common understanding of the need/problem with the project sponsor,
- Understanding the required outcomes specified in the functional specification,
- Identifying the solution options to satisfy the needs/problem articulated in the project proposal/functional specification,
- Selecting the preferred solution option that satisfies the needs and specified outcomes,
- Developing the preferred option through to the completion of detailed design, and
- Establishing a construction contract.

The design development process is a continuum that relies on proper planning to ensure that all of the necessary data, information and considerations are available when required to maximise the efficiency of the process, and to avoid or at least minimise the potential for rework. Most projects will require community (or at least targeted) engagement and consultation, data and information collection, special purpose studies, and investigations to be carried out in order to deliver a quality outcome with stakeholder approval. Some investigations and studies may identify further investigation and studies for specific purposes, e.g. for rare and endangered species. This is mainly associated with major projects but when required it could result in unavoidable rework.

Standard inputs to the design development process are:

- The Project Proposal (R1001),
- Relevant pre-project information, including known risks,
- Technical design details - Design Development Report (Form M4211 or M4212),
- Functional Specification or Brief,
- Engineering survey, and
- Reports from consultation, investigations and studies.

Standard Design Development Process Deliverables are:

- Options Analysis Report, including Templates R1002 or R1004 or R1005, as appropriate
- Business Case Report, including Template R1003 or R1004 or R1005, as appropriate, including Project Proposal Report for National Highways
- A Project Planning Report
- Detailed Design Report
- Scheme Prototype
- Completed Design Development Report (Form M4211 or M4212)
4.3.2 Project Scope

The project scope can only be defined to the level of available information, e.g. at the project proposal stage (refer 4.5.1) of a project the scope is defined at a very high level in the form of a comprehensive understanding of the need or problem to be solved together available background information from pre-project activities and the location of the need. The functional specification will specify the functional outcomes required to be achieved by the completed and in-service road infrastructure.

As the project moves through the design development process the scope becomes more and more defined. The process has built in progressive deliverables, i.e. Options Analysis (refer Section 4.4.2), Business Case (refer Section 4.4.3), Preliminary Design (refer Section 4.4.4) and Detailed Design (refer Section 4.4.5) that are designed to require the scope to be progressed to the extent necessary to allow these deliverables to be achieved. The extent necessary is governed by the ability to achieve a project cost estimate accuracy specified in the Main Roads Project Cost Estimating Manual using a risk management approach. The concept of a management reserve is not acceptable as all risk are to be managed using a probability approach to calculate a contingency amount to cover the cost of a risk should it eventuate during construction.

For further details on project scoping refer to Chapter 5.

4.3.3 Pre-Design

The Road Network Strategy, the Investment Strategies and Link Strategies in combination with consultation with Federal, State and local government and the community establish the projects necessary to meet the requirements of the Department's stewardship of the road network. Having identified the problems and needs, individual project proposals are developed and prioritised. The approval of a project proposal will authorise:

- A major planning project to be included on the RIP for the development of the options analysis report and the development of a business case, or
- The preparation of an options analysis and the development of a business case.

The approval of planning projects (900 series jobs) and business cases collectively form a significant input to the RIP development process.

4.3.4 Design Development

A generic framework for delivering a RIP project (Design Development Process) is shown in Figure 4.5.

The design development process commences with an approved project proposal. The information from pre-project activities (Network Planning) may assist in the identification of all plausible solution options. The development of options will require the consideration of the same issues that are necessary for the full development of the preferred option through to detailed design. The intensity of the available information will grow with time as the results from studies, investigations, and consultations become available. The activities described in this section should be seen as a listing of the issues that need to be addressed over the whole design development process, including the development of options.

At the outset, the criteria on which the project is to be judged must be developed. Some of these will flow from the various overarching strategies, which will define the overall objectives. More detailed criteria will be required to satisfy the needs of the stakeholders in the consultation process. These criteria should ideally be developed in conjunction with the stakeholders so that they can accept ownership of them.

Planning should start with the development of solution options for the project consistent with the Road Network and relevant Investment Strategies.
Figure 4.5 – Generic Framework for the Delivery of RIP Projects

(Note: The work activities described under work management columns vary from a consideration check for Type 3 projects to delivering comprehensive work packages for Type 3 projects)

**AM = Asset Management and PM = Project Management**

<table>
<thead>
<tr>
<th>Phase Deliverables</th>
<th>PRE-PROJECT Network Planning</th>
<th>CONCEPT</th>
<th>DEVELOPMENT</th>
<th>CONSTRUCTION</th>
<th>IMPLEMENTATION</th>
<th>HANDOVER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM Phases</strong> 1, 2, 3 &amp; 4</td>
<td>Project and Program Management</td>
<td>Work Management</td>
<td>Deliverables from Business Case</td>
<td>Deliverables from Business Case</td>
<td>Deliverables from Business Case</td>
<td>Close-Out</td>
</tr>
<tr>
<td><strong>PM Phases</strong> A, B &amp; C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DELIVERABLES</strong></td>
<td>Project Stage (1) RIP Review and submit for Network Approval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consultant Contact Form (R1005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONCEPT</strong></td>
<td>Delivers to Project Stage (2) RIP Review and submit for Network Approval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consultant Contact Form (R1005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DEVELOPMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONSTRUCTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IMPLEMENTATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HANDOVER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Input:**
- Whole of Government Strategic Plan
- Asset Management System
- Corporate Plans
- Strategic Programs
- Budget Plan
- Portfolio Planning
- Business Case
- Business Case Approval
- Projections/Options Analysis
- Preliminary Design
- Detailed Design

**Outputs:**
- Business Case
- Business Case Approval
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**AM Phases 1, 2, 3 & 4**

**Project Stage (1) RIP Review and submit for Network Approval**

1. **Network Review**
2. **Project Stage (1) RIP Review and submit for Network Approval**
3. Consultant Contact Form (R1005)

---

**PM Phases A, B & C**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**CONCEPT**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**DEVELOPMENT**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**CONSTRUCTION**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**IMPLEMENTATION**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

---

**HANDOVER**

**Deliverables:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)

**Activities:**
- Project Stage (1) RIP Review and submit for Network Approval
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
- Consultant Contact Form (R1005)
together with the need specified in the project proposal, the functional outcome specified in the functional specification and the required technical specifications (Form M4211 or M4212). Developing options is an acquired creative skill producing a range of alternative solutions that will satisfy the goals of the project. The initial development of options should be done with as few constraints as possible so that creative ideas are not ignored. All viable options can then be compared with the criteria outlined at the outset to determine the one best meeting (or exceeding) those criteria.

Developing appropriate solution options requires the designer to be sensitive to the environment of the area through which the road passes. To do this, the designer must be aware of the physical context and location of the proposed facility. This may need a comprehensive data gathering exercise involving site visits and discussions with local people. This is important as it allows the designer to identify any physical constraints early in the process.

US Dept of Transportation (1997) suggests the following questions to be asked:

- Physical characteristics of the corridor - urban, suburban or rural?
- How is the corridor being used (other than for vehicular traffic)? Are there destination points requiring safe access for pedestrians to cross? Do bicycles or other non-motorised vehicles travel along the road? (An additional question is: "Would they be likely to use the road if appropriate facilities were provided?")
- What is the vegetation along the corridor, e.g. sparse or dense; special plants or trees, etc.
- Are there important views from the road?
- What is the size of the existing road and how does it fit into the surroundings?
- Are there historic or especially sensitive environmental features (such as wetlands or endangered species) along the roadway?
- How does the road compare to other roads in the area?
- Are there particular features or characteristics of the area that the community wants to preserve (e.g. rural character, neighbourhood atmosphere, or main street) or change (e.g. overhead electrical wires, congested main street)?
- Is there more than one community group in the area? Are different groups interested in different features/characteristics? Are different groups affected differently by possible solutions?
- Are there concentrations of children, the elderly, or disabled individuals with special design and access needs (e.g. pedestrian cross walks, kerb ramps, audible traffic signals, median refuge areas)?

Understanding these issues will place the designer in a good position to develop solution options appropriate to the area.

Careful consideration of the following activities is required to produce a comprehensive and rigorous design development process. The full extent of these activities may not always be required for preparing the deliverables from the design development process (e.g. a business case) but they will have to be completed at some stage in the process. For less complex projects, these activities will more readily fit in with the preliminary design step.

**Economic Evaluation**

Where options have differing economic impact, the Cost Benefit Analysis Manual for Road Infrastructure Investment (Main Roads, 1999a) should be used to evaluate the merits of each option. The evaluation should include an assessment of:

- Industry demands (such as freight movements);
- Economic trade (including tourism, agriculture, mining, manufacturing, wholesale/retail);
- Regional development;
- Export industries;
- Improved efficiency within the network.
For significant projects the solution options analysis process should include an economic evaluation using a whole of life approach. The project economic evaluation (BCR) is always conducted in the preparation of the business case.

**Environmental Analysis**

Decisions on the form of project taken at the options analysis and business case of the process will have the most significant effect on the environmental impacts. It is therefore important that all of the potential impacts are identified at this early stage to minimise the impacts and any required amelioration works thereby minimising the cost of the project.

The detailed requirements for the assessment of environmental effects are described in the Road Project Environmental Management Processes Manual (Main Roads, 1998b). The first step is the Review of Environmental Factors (REF), the outcome of which will be one of the following:

- The project has minimal adverse impacts on the environment and concept planning may proceed without the need for an Environmental Impact Study (EIS); or
- The REF requires additional work to determine more appropriately the effect on a particular environmental factor; or
- A more detailed environmental analysis is required (i.e. an EIS) to determine more accurately the effect on the environment; or
- The project has an unacceptable impact on the environment and will not be considered as an option.

If the result of the REF is that an EIS is required, then that process must be undertaken.

**Cultural Heritage**

Cultural Heritage (both Indigenous and European) issues must be identified and appropriate consideration and arrangements made to accommodate them in the overall delivery process, i.e. during planning, design and construction.

Refer to the Cultural Heritage Manual for guidance on the processes required.

**Native Title**

All Native Title issues must be identified and appropriate actions taken during the concept planning process. Where Native Title is affected by the project in any way engagement and consultation with the original owners should be undertaken to ensure a smooth overall delivery process. The required notifications should be prepared and submitted at the same time as Land Resumption Requests are made to minimise delays in acquiring the right-of-way.

**Topography**

For new alignments, the location of a route will be affected by the topography of the area through which it passes. As part of the environmental analysis, or in conjunction with it, the topographical controls and influences should be determined and taken into account during the process. Detailed information on the topography can be obtained through a variety of means, depending on the accuracy required at that stage of the planning process (topographic maps, aerial photography, orthophoto maps, ground survey).

**Community Consultation**

See Section 4.2 Community Engagement and Consultation.

**Land Acquisition**

A range of issues concerned with land acquisition can affect the planning and design of a road project:

- Native Title - this is a significant consideration and should be dealt with early in the process. Consultation with the appropriate aboriginal communities is an essential component of the approach to be taken (Dept of Families, Youth and Community Care 1997a, 1997b);
- Heritage Listings - advice from the Environmental Protection Agency must be sought where there is any possibility of an impact on a heritage listed site;
• Vegetation Protection Orders (By-Laws) and Green Areas - Local Governments may have tree preservation orders and/or rare tree listings and these may have a significant effect on the planning and design of the project;

• Acquisition Costs - Property Services Branch of the Department can provide the appropriate advice (injurious affection may be a significant cost);

• Type of property - communities have concerns for the residents of low cost housing being able to relocate, and for local producers being able to re-establish;

• Number of People affected - this may be more important than the number of properties;

• Property Values - there are often concerns that the value of property will be adversely affected by the project -
  - increase in traffic volumes and noise;
  - property access limited;
  - adverse effect on personal privacy due to loss of entertainment and recreation area;
  - future dwelling extensions prevented;
  - loss of neighbourhood parks

• Severance of Farming Properties - this may require accommodation works to provide for:
  - animal and machinery access e.g. cattle creeps;
  - relocation of farm infrastructure;
  - maintenance of access to irrigation, dams, bores, streams etc;
  - restoration of fencing (including dingo and rabbit fences where applicable); and
  - construction or relocation of grids.

• Mining Leases - consultation with the Department of Mines and Energy is required;

• Quarry Leases - consultation with the Local Government is required;

• Town Plan - respect for the town plan and its objectives is essential. Consultation with the Local Government can assist in locating a new road to reinforce the objectives of the plan rather than be in conflict with it (refer to Section 4.2 Land Use/Transport Planning).

Effect of Options on Adjacent Land Users

• Property Values - properties not required for acquisition may be affected by the options in different ways and may be an issue in deciding between alternatives. Costs of amelioration works may also be a consideration.

• Community severance - may require special consideration of pedestrian and cyclist facilities, together with provisions for local traffic movement.

• Local Government and State Owned Land - the future use of adjacent land owned by government authorities may have a significant effect on the development of the road proposal. Considerations may include -
  - Access requirements (may need incorporation of additional lanes, channelisation and traffic signals);
  - Service roads;
  - Contributions by others to the infrastructure;
  - Special needs for education, police, hospitals, day care centres, libraries, etc.

• Emergency Services - the project may adversely affect the level of service provided by the various services (ambulance, fire brigade, and police) and access requirements should be considered. For example, traffic signals may be required to allow rapid access to the road for a fire brigade.

• Educational Institutions - the requirements for pedestrians, cyclists, drop off zones, parking and bus stops must be considered.

• Airport Clearances - projects in the vicinity of airports have to consider the effect of structures and poles on the air space around the airport. Further, road lighting in the vicinity of the airport may be confusing or distracting for
pilots at night (Refer to Civil Aviation Authority publication "Lighting in the Vicinity of Airports - Advice to Designers").

- Other Institutions - the following should be considered:
  - Institutions/war memorials;
  - Hospitals;
  - Retirement Villages;
  - Vibration sensitive industries
  - Ports (clearance heights and shipping manoeuvre clearances)

**Public Utility Plant**

Alterations and/or relocations of Public Utility Plant (PUP) can be one of the most expensive components of a road construction project. The location and size of all such services must be determined early in the process to allow appropriate adjustments in the proposals to minimise the costs involved. The relevant authorities must be consulted to obtain accurate information in addition to what can be ascertained from ground survey. Future proposals for upgrading the installations should also be determined. Services include:

- **Telecommunications**
  - Telephone exchanges
  - High band width communication conduits - fibre optic cables, co-axial cables
  - Low band width communications - local connections
  - Cables
  - Satellite communication facilities
  - High band width communication towers

- **Water**
  - Large reticulation systems
  - Pressure mains
  - Water towers, storage tanks
  - Pump stations
  - Waste Water and Sewerage

- **Electricity**
  - Towers
  - High voltage overhead lines
  - Substations
  - Power pole mounted transformers
  - High voltage underground cables

- **Gas**
  - major gas mains

- **Oil Pipelines**

**Drainage**

**Major Drainage Structures**

Design calculations should be undertaken on major drainage structures to obtain approximate structure sizes for inclusion in the business case costings. A major drainage structure is one where the cost of the structure has a significant effect on the total estimate and includes structures over rivers or creeks.

In some rural schemes without major drainage crossings, the drainage costs may only be a very small part of the overall cost. In this case, very few calculations will be required to determine the drainage requirements and cost. However, in some cases in urban situations, drainage costs are a substantial part of the overall cost and planning of the drainage system will need to be more exact.

Design for major drainage structures includes obtaining topographic maps or contour plans of the catchment areas surrounding the alignment to determine major drainage paths. Approximate flows may be determined from the rational method based on assumed values of run-off coefficient, intensity, and area. Future upstream development should be considered in the calculation of the drainage flows. Any possible drainage reserves or easements that are required should also be considered.
Cross Drainage

For cross drainage, an approximate waterway area may be calculated by assuming a velocity and using the formula \( Q = V \times A \), or calculated by assuming inlet control only. Once an approximate waterway area is determined, an approximate type and size of culvert may be determined from the preliminary vertical alignment and natural surface. Any possible adverse effects of the resultant upstream headwater level should be considered. If it is suspected that tailwater levels may have a dominant effect (i.e. in low-lying flat areas), then the design calculations assuming outlet control and a tailwater level should be considered.

If a floodway is to be considered on a National Highway, flood immunity requirements can be obtained from the reference "Standards and Guidelines for the Construction of National Highways". For other roads, the flood immunity requirements are defined in the Road Network Strategy and the Link Strategies for that road.

Methods of floodway design are contained in the Road Drainage Design Manual.

Longitudinal Drainage

The location of the outlets of longitudinal drains may affect the quantity of water to be carried in some of the culverts and therefore can have a major bearing on culvert sizes and lengths. In some cases, the boundaries of the catchments may be affected by the distribution of the water from the longitudinal drainage system - this should be avoided. The water level at the outlet is also a major consideration. Refer to the Road Drainage Design Manual for design methods.

Complex Hydraulic Analysis

Where the major drainage structure is on a waterway that requires more precise analysis than the rational method can provide, specialist advice should be sought on the flood immunity and the type and size of structure required. Complex hydraulic analysis is generally required on the following waterway types:

a) waterways on large catchments;
b) waterways on complex catchments, e.g. multi stream systems peaking at different times during the design flood;
c) streams with unsteady flows;
d) flood plains;
e) waterways downstream from dams, weirs and reservoirs;
f) waterways with tidal flow;
g) waterways with significant local storage;

Minor Drainage Structures

There is generally no requirement to undertake any design calculations for minor drainage systems. A nominal cost is usually sufficient to allow for minor drainage systems. Cross drainage culverts can be located by visual inspection of topographic maps or contour plans.

For urban minor longitudinal drainage, pits may be placed at a nominal spacing along the roadway and a nominal number of pits may be allowed for at each intersection.

Geotechnical (Ground) Conditions

Geotechnical conditions for any particular option may have a significant influence on its feasibility and cost. In extreme cases, natural hazards may preclude some options altogether while the presence of land slips, swamps, rock outcrop and the nature and depth of structure foundations will invariably influence the adoption of some options.

As these conditions occur below the ground surface, some level of geotechnical investigation will normally be required at the development and comparison of options stage to allow the development of preliminary geotechnical models to assist in the assessment of the possible options.

The level of investigation will vary from a simple collation of existing data confirmed by visual assessment, to some level of sampling, testing and analysis. A competent engineering geologist or geotechnical engineer should undertake such investigations. The geotechnical models can be
progressively developed through the design development process.

Ground conditions which have a significant influence on the feasibility of any particular option include:

- Conditions of natural slopes including evidence of potential land instability, erosion, nature of materials and groundwater seepage.
- Occurrence of hard rock in cuts and the impact on excavation techniques and slope stability (and hence resumptions), stabilisation measures and drainage requirements.
- Presence of soft and swampy ground under embankments and implications for settlement, stability, need for ground improvements, construction programming and investigation requirements and timing.
- Subgrade soil conditions that will influence pavement design and drainage.
- Presence of acid sulphate soils.
- Presence of sodic soils.
- Usability of excavated materials and implication on earthworks balance, disposal of unsuitable material and selective winning and usage of suitable materials.
- Presence of underground openings (caves, old mine workings, etc.) causing potential short and long term subsidence problems for both road and structures.
- Presence of services, adjacent structures (embankments, retaining walls, and bridges) and/or need to construct under traffic restricting the range of alternatives.
- Presence of problem materials such as spoiled fill, refuse, contaminated land and other unsuitable material requiring specific improvement techniques or remove and replace.

**Major Structures**

Chapter 22 of the Road Planning and Design Manual discusses the requirements of major structures and their impact on road and project development.

**Road Design Considerations**

All of the factors to be considered are detailed in the Road Planning and Design manual:

- Traffic Parameters and Human Factors (Chapter 5);
- Speed Parameters (Chapter 6);
- Cross Section (Chapters 7 and 8);
- Sight Distance (Chapter 9);
- Alignment Design (Chapters 10, 11 and 12);
- Intersections (Chapters 13 and 14);
- Auxiliary Lanes (Chapter 15);
- Interchanges (Chapter 16);
- Transit Lanes (Chapters 2 and 7).

**Pedestrians and Cyclists**

Transportation corridors provide a medium for all modes of transport. In urban environments, cyclists and pedestrians form a significant proportion of transport corridor users. Cycling facilities (paths and terminus facilities) and pedestrian provisions must be considered for inclusion in all new projects. Many Local Governments are actively encouraging increased walking and cycling. Therefore, high quality, convenient, connected, safe and attractive routes for cycling and walking need to be incorporated into road designs at the planning stage to encourage use of these modes and to ensure the safety of these 'unprotected road users'.

Providing for pedestrians and cyclists is a major function of Local Government. It is therefore necessary to ensure that Main Roads proposals are compatible with the Local Government's responsibilities, and vice versa. This may involve sharing costs between the Local Government and Main Roads, both for construction and for maintenance. The responsibilities and cost sharing arrangements are set out in Main Roads et al (2000).
The planning and design of new road infrastructure must consider the inclusion of bicycle and/or pedestrian facilities. Where bicycle and/or pedestrian facilities are incorporated into a project the planning must take into consideration how bicycle and/or pedestrian operations can be safety accommodated in the traffic management plan for construction.

The following questions should be answered in the planning stage:

• Cyclists

1. Bicycle facilities or wider road shoulders must be considered on main roads (urban motorways will require separated provision for cycling to be built into the project due to the higher traffic volumes and speeds). Provision for cycling increases the safety of all road users and avoids the slowing effect created by having cycling in the general traffic lanes. Planners and designers need to consult with the Local Government to ensure that installation of the bicycle facility conforms with the local authority bike plan. Regional cycling strategies, including the Queensland Cycle Strategy, Integrated Regional Cycle Network Plan for South-East Queensland (IRCNP) on internet site http://www.transport.qld.gov.au/qt/tpSite.nsf/index/ircnp and Cycle Southeast are additional references when considering provisions for cyclist. If no bike plan is in place, consultation with local authority staff and local bicycle users will be necessary. Refer to Chapter 5 of the Road Planning and Design Manual and as a secondary reference Part 14 (Austroads, 1999) for guidance on provision of bicycle facilities.

2. When providing a bicycle facility, consider whether an on- or off-carriageway facility is required. Off-carriageway facilities may increase land resumption and increase the estimate of the cost, and must be taken into account. In rural areas, it may be less costly to provide for the bicycles on an off road facility as the cost of the construction will be less than the cost of widening the road pavement (extra land would rarely be required in these cases.) The most appropriate type of facility will depend on speed and volume of traffic, surrounding land uses and the types of user expected on the facility. Refer to Chapter 5 and Austroads, 1999.

3. How many potential bicycle/motor-vehicle conflict points require special treatment? Special intersection treatments such as advanced stop lines, storage bays, bike lanes or bike crossing signals, may be required and the cost included in the estimates. The planning process should pay particular attention to bicycle trip generators (e.g. schools and shopping centres). Any need for the use of grade separated structures should be identified at this early stage.

• Pedestrians

1. Provision for pedestrians will be required on all main roads in built up areas except those such as motorways where separate provision will need to be built into the project. The planning stage should involve consultation with the Local Government and community groups to confirm the requirements for pedestrians. Refer also to Chapter 5 of the Road Planning and Design Manual.

2. If a footpath is required, what width is needed? The width necessary for the installation of Public Utility Plant must be taken into account. Footpath width will affect the land acquisition requirements (See Chapters 5 and 7 of the Road Planning and Design Manual).

3. How many potential pedestrian/motor-vehicle conflict points are there? Special intersection treatments may be needed and the costs to the project of providing the necessary facilities must be taken into account. (See Chapter 13 of the Road Planning and Design Manual and Austroads, 1995).

4. Note that all pedestrian facilities provided must be in accordance with design standards for people with disabilities.

• Combined Pedestrian and Cycling Facilities

- It is important to note that Austroads Part 14 (Austroads, 1999) outlines design requirements for joint pedestrian/cycling
facilities which are also designed to a standard suitable for people with disabilities.

**Local Government Involvement**

All proposals will impact on the responsibilities of Local Government in some way. Consultation with the relevant Local Government/s at all stages of the process is therefore essential. Agreement must be reached on the details of the project and in particular, any requirements for changes to Local Government infrastructure or for Local Government input into the project.

It is also necessary to reach agreement on the cost sharing arrangements if applicable. Main Roads et al (2000) sets out the agreement between the Local Government Association and Queensland Main Roads on responsibilities and cost sharing and must be applied in discussions with the relevant Local Government on these matters.

**Passenger Transport Modes**

The information on bus routes given in this section is taken from Main Roads et al (2000). Refer to this reference for any additional information required above what is given in this section.

In any community there is a demand for "public" transport to and between work, shopping, education, leisure activities and residential areas.

The level and nature of demand for these transport services are determined by such factors as density of development, spatial distribution of activities and the age structure and socio-economic characteristics of an area. The extent to which public transport can meet the potential demand is influenced not only by these factors, but also by the road layout, hierarchy and geometry in the service area.

In major urban areas, trains often provide a major public transport service. It is important that good quality access to railway stations for all modes (walking, cycling, buses, private car) be provided where required. Facilities could include:

- Pedestrian and cyclist under- or overpasses;
- On- and/or off-road pedestrian and cycle lanes;
- Bus priority measures;
- "Kiss and Ride" facilities;
- Bike storage facilities;
- Bus stops.

In rural areas well removed from urban communities, the major public transport requirement is for school buses. Providing access to the road system for this service is usually the dominant public transport issue. However, some long distance services require some level of access and these must also be considered.

**Land Use Planning and Bus Routing**

The general philosophy of land use planning for efficient public transport servicing is that which best combines:

- provision of direct routes between major activity centres such as retail centres, industrial estates, commercial centres, large schools, and significant leisure centres and the patronage source (the residential areas);
- provision of appropriate density of residential developments along such routes, within "convenient" walking distance to bus stops;
- provision of appropriate and convenient pedestrian facilities, accessible for people with disabilities, giving access to all bus stop locations;
- location of lesser activity centres such as smaller schools, local shops or commercial centres, post offices or public buildings on, or very close to, the routes between the major activity centres;
- placement of residential centres such that residents have a choice of major activity centres, in either direction on the bus route;
- progressive coordinated development of land parcels which enable new or extension bus service to be implemented efficiently or which "fill-in" gaps in existing route catchments;
opportunities for intermodal trips by providing safe and convenient bicycle access to public transport interchanges.

Bus Routing and Road Planning Options

The role that public transport should perform on various classes of road are as outlined below:

- **Arterial Roads**

  Bus usage of arterial roads should be restricted to trunk express or limited stop services. Wherever bus stops occur, passengers should be isolated as far as practicable from the arterial road traffic by providing stopping areas clear of the main carriageway (preferably on service roads) and walk/access facilities segregated from the arterial road vehicles (grade separation desirably, pedestrian signals as a minimum).

- **Sub-arterial and Collector Roads**

  Principal pedestrian access to, facilities for, and routes of major bus services are best suited to sub-arterial and collector roads.

- **Local Roads**

  Local roads should be restricted to residential traffic only and are not suitable for use as bus routes.

Ease of bus movements between the various road types must be considered in the design of the road layout and intersection control.

In particular, buses should not be expected to cross or make uncontrolled right turns onto arterial roads through "Stop" or "Give Way" control. Channelisation, roundabout or traffic signal control should be introduced to assist bus access to the arterial system or alternative bus priority measures implemented. Wherever possible, T-junctions rather than 4 way intersections should be used as these significantly improve safety and accessibility.

At any location where significant bus delays are expected, introducing some form of bus priority should be considered. (See also Section 4.2.5.)

Regional Commercial and other Major Developments and Bus Access

Where a large commercial development, such as a shopping centre, office park, college or hospital is planned for an area away from the central city area, the needs of, and demands on public transport should be carefully assessed.

Particular factors to be considered include:

- Bus access/egress and stop facilities should not be intermixed with normal car parking or affected by private vehicle queues;
- Route diversions off the sub-arterial or collector roads through the centre should be as short as possible, in both distance and time;
- Bus stop facilities should be as close as possible to the pedestrian access of the centre;
- Colleges and hospitals should be located adjacent to major transport routes and have good pedestrian access between bus stop and facility, desirably including bus shelter and even covered walkways for very high volume routes;
- Intermodal transport: people travel by car, bicycle and walking to public transport. Appropriate facilities are required for all user types to allow intermodal trips.

Consultation with Local Government and other stakeholders is essential.

Other Route Planning

Bus routes should not be allocated to streets which have:

- speed bumps;
- deep drainage invert channels;
- short sharp vertical changes in grade;
- tight horizontal alignment.

Queensland State Transport Regulations provides for single deck buses to a height of 4.3 metres and double deck buses to a height of 4.4 metres. Structures on bus routes (overpasses, tunnels etc.)
and within bus interchange areas should provide adequate clearance for these vehicles - a minimum of 4.5 metres is desirable.

Additional care must be taken for roads under a structure on a sag curve, as this effectively increases the height clearance requirements of a bus.

To maintain an acceptable speed differential between buses and other vehicles, gradients on bus routes should not exceed 10%.

Options Analysis of Identified Solutions

The evaluation process must include an assessment of each option's ability to fulfil the purpose or need outlined in the project proposal and functional specification.

Considerations that should be assessed are listed below but not all of these considerations would necessarily be assessed for any one project. Some aspects may not be able to be quantified and therefore a qualitative comparison must be made. Documentation of the evaluation considerations should be included in the planning report.

To assist in determining the preferred solution an option analysis procedure for evaluating project planning (solution) options is included in Appendix 4A.

Consideration of Quantifiable Construction Costs

Concept estimates for large projects have a demonstrated likelihood to be below cost because unforeseen factors are revealed during the design and construction phases. To ensure this occurrence is minimised sufficient upstream work must be undertaken to ensure the concept estimate is consistently within ± 20% of the final total project cost. In this respect, the extent of upstream work must be appropriate for the identification of all significant project risks and to allow the calculation of a contingency amount (dollar value) to cover the cost of any risk should it eventuate. The preparation of an estimate for planning projects should concentrate on the major cost items. Time and effort will be wasted in trying to determine the cost of every minor item at the business case stage. When estimating project costs it is important to understand market forces and to provide due allowance in project cost estimate unit rates.

However, it is more often than not that the concept estimates are below final costs because unforeseen factors are revealed during the design and construction phase. For this reason, a contingency amount is to be included in the project cost estimates to cover the cost of any risk should it eventuate. This contingency amount is calculated using a risk management approach based on the probability of each individual risk occurring. (refer to The Project Cost Estimating Manual, Main Roads, 2004).

Consideration of Quantifiable Operating Costs

Operating costs are the ongoing costs occurring after completion of the project. These costs include:

- Pavement and road maintenance (See Pavement Design Manual for whole of life analysis for pavements. For heavy duty pavements, Main Roads (1998d) should be considered).
- Road user costs e.g. vehicle operating costs, delays (particularly commercial vehicles).
- Accident costs

The department's "Cost Benefit Analysis Manual" (Main Roads, 1999a) provides the details for estimating these costs.

Consideration of Non-Quantifiable Issues

Non-quantifiable issues are those that can not be measured or are difficult to measure and include varying degrees of subjectivity (referred to as externalities). These include:

- Some environmental impacts;
- Impact on the community (health impacts, convenience of access, quality of life);
- Level of service.
Additional Benefits

For each option any additional benefits over and above those assumed at the concept stage should be identified and included in the planning report.

Anticipated Risks

During the design development process, additional risks may be identified for various options. Such risks may include:

- Susceptibility to cost over runs due to wet weather;
- Additional costs that may be identified from geotechnical investigations or construction techniques; and
- Using a unique construction method or new materials;
- Design failing to consider all road user needs;
- Radical changes in road use requirements after construction;
- Increased safety risks to vulnerable road users from increased traffic speeds and volumes, and reduced crossing opportunities.

These risks should be assessed as to their influence on the project viability.

4.3.5 Developing the Design

The following discussion is intended to cover all of the considerations and inputs, regardless of the project type. The design input considerations will serve as a mind jogger with the designer taking full responsibility for determining the relevance and degree of impact of any consideration to the project. Some considerations may be applicable more than once during the process and the designer must be vigilant so as not to overlook these occurrences.

It is very important for the designer not to lose sight of the project objectives as the design develops because scope and cost, and outcomes may change if these requirement are overlooked or not clearly understood. Project objectives as specified in the Project Proposal and must be reviewed at the start of each phase step, i.e. options analysis, business case, preliminary design and detailed design. The process requires succeeding steps to build on previous steps not to rework them as so often happens, i.e. “I can do it better thinking”.

The design process has mandatory hold points for review, justification and approval purposes. The designer will have to determine the level of detail required to suit the accuracy required of the various mandated project cost estimates, i.e. concept, preliminary design and detailed design.

To commence the design development process the following are required:

- An approved project proposal,
- A Functional Specification,
- A clear and common understanding of the requirements with the sponsor, and
- An understanding of pre-project data and/or information that could assist in the development of the preferred solution, and
- A budget to deliver an options analysis and the business case.

It is a requirement that these details be kept under review during the whole design development process. Sometimes studies and investigations will require further but usually more specific studies and investigations. As the results of these studies and investigations become available they may dictate a revisit to earlier conclusions. As issues change and develop and some of the conclusions reached at the earlier phase may move out of alignment with the new requirements. In these circumstances rework maybe necessary to account for this newer information.

All of the following elements have to be determined and addressed during this phase.

Environmental Assessment

The environmental assessment activities must be continued in this phase at a higher level of detail.
If the Concept REF identified the need for an EIS, it will be necessary to undertake it at this stage.

Otherwise, a Planning REF will be required. An Environmental Management Plan (Planning) (EMP Planning) must be prepared in either case.

The Road Project Environmental Processes Manual (Main Roads, 1998b) defines the requirements for the preparation of the Planning REF and the EMP (Planning).

**Cultural Heritage**

Cultural Heritage (both Indigenous and European) issues must be identified and suitable arrangements made to accommodate them in this phase of the process.

Refer to the Cultural Heritage Manual for guidance on the processes required.

**Native Title**

All Native Title issues must be identified and appropriate actions taken in this phase of the process. The required notifications should be prepared and submitted at the same time as Land Resumption Requests are made to minimise delays in obtaining right-of-way.

**Design Traffic Volume**

Predicted traffic volume on the road in question is the basis for many aspects of the design. The traffic parameters to be used are discussed in Chapter 5 of this manual.

**Road Geometry**

The road geometry has to be designed in accordance with the requirements set out in this manual, namely:

- Horizontal Alignment;
- Vertical Alignment;
- Coordination of the horizontal and vertical alignments;
- Cross Section (including Transit lanes if required).

**Structures**

- Flood immunity required for bridges is defined in the Department's Road Drainage Design Manual.
- Types of bridges are discussed in Chapter 22 of the Road Planning and Design Manual.
- Cross section requirements for bridges are discussed in Chapter 7 of the Road Planning and Design Manual.
- Bridges for Interchanges are discussed in Chapter 16 of the Road Planning and Design Manual.
- Public Utility Plant on Bridges:
  - Requirements should be determined early in the planning process
  - Utilities inside closed cells of bridges can pose a serious hazard - water and sewer lines can leak and proper drainage is required; gas mains should not be placed inside closed cells because of the risk of explosion;
  - High pressure gas mains present a serious explosion hazard if ruptured and should not be placed on bridges without special precautions;
  - High voltage electrical cables may have a significant heat output and may require ventilation;
  - PUP Authorities may have restrictions on the location of their service with respect to other services;
  - Electrical cable ducting for street lighting is to be provided on bridges where required for present or future lighting;
  - PUP may be provided for in the footway/bikeway, or suspended from the side of prestressed units, or under the deck in girder bridges as permitted by the PUP Authority.

**Intersections**

Details of intersection requirements are included in Chapter 13 (Intersections at Grade) and
Chapter 14 (Roundabouts) in the Road Planning and Design Manual.

**Drainage**

The relevant Local Government should be contacted to obtain details of any Strategic or Master drainage schemes it may have. The drainage design of the road should fit in with these schemes where possible.

Existing drainage networks can also be obtained from the relevant Local Government and from previous departmental documents.

Major drainage structures may require the approval of the Department of Natural Resources.

During this phase of the design, it will be necessary to undertake a more detailed examination of the requirements of major drainage structures if the following circumstances occur:

- cultural heritage issues arise;
- native title issues arise;
- the size and shape of the structure affects the land acquisition required;
- environmental impacts may be significant;
- the vertical distance from the base of the drainage path to the bottom of the pavement is critical;
- the height of the upstream head may cause flooding problems; and
- the proposed drainage structure may conflict with services or other structures thereby affecting size, shape and location.

These structures will need to be adequately designed to determine their type, shape and size so as to ensure that major changes are not required at the detailed design stage. This may require a detailed hydraulic analysis to be undertaken in the project proposal phase. If complex hydraulic analysis is required, specialists should undertake it.

If additional property is required for drainage reasons, it should be determined at this stage.

There is no need to undertake calculations for minor drainage requirements at this stage since the details are not likely to affect the land required or the size and placement of other features. Enough detail can be determined from the cross sections and layouts to give sufficient confidence in the estimates required at this stage.

**Geotechnical Investigations**

Additional geotechnical investigations should focus on the critical geotechnical aspects of the selected option. This progressive development of the geotechnical model will also facilitate the development of a program of geotechnical investigation to be completed and utilised in the project proposal phase to ensure appropriate design parameters are adopted as well as identifying any constraints on the construction process.

**Pedestrians and Cyclists**

The needs of pedestrians and cyclists must be incorporated into the process and included in the relevant parts of the elements described in preceding sections. The basic parameters for assessing these requirements are described in Chapter 5 of the Road Planning and Design Manual. Special features will often be required to accommodate their needs.

In some cases, an overall strategy is in place to provide a network of cycle ways and pathways and these strategies form the basis of the decisions required for the facilities to be included. Planners and designers should ascertain the strategies in place for the area in question and incorporate the necessary features into the project.

**Public Utility Plant**

A more detailed assessment of utility services relocation requirements must be undertaken at the preliminary design stage. It is necessary to determine the extent of the work and to assess whether early relocation may be advantageous to facilitate the construction process. The various Authorities should be advised early in the
preliminary design stage of the proposals so that any affected services can be identified.

Where possible, relocation of services should be minimised by judicious adjustment to the design. Minor changes to the layout can often be made without compromising the standard of the design and major savings can be achieved.

If stage construction is involved, services should be placed in their final locations if possible.

Chapter 7 of the Road Planning and Design Manual provides guidance on the clearances required for services (overhead and underground) as well as desired locations for services in the road reserve.

**Stage Construction**

The potential for developing the project in stages has to be determined at the preliminary design phase. Appropriate staging will require a detailed analysis of the traffic impacts of the staging and the likely life of the stages proposed.

Proper attention must be given to the design to ensure that future construction of the next stages can be achieved without undue disruption to the road users and the adjacent property owners. This can affect various aspects of the design and can have a significant effect on the detail of the design adopted. Some features affected include:

- width of medians;
- location of carriageway in the road reserve;
- length of overpass bridges;
- grading of the carriageway to facilitate future grade separation;
- location of intersections;
- location of property accesses;
- provision for pedestrians and cyclists;
- transit lanes;
- depth of pavement;
- clearance to overpass structures;
- extent of works to facilitate temporary connections and their removal.

**Traffic Diversion During Construction and Construction Sequencing**

Preliminary design must ensure that the project can be constructed in an economical manner and that business, traffic and pedestrians are not unduly disrupted in the process. This may require changes to the design and some additional works to ensure that a satisfactory outcome is achieved. Issues to be addressed include:

- maintenance of access to property and business - this does not only include direct access to adjacent property but must consider the wider effect on customer access to established businesses;
- pedestrian and cyclist movements - special pathways and protective devices may be required to ensure adequate pedestrian and cyclist movement through the site. All pedestrian treatments must consider the needs of people with disabilities;
- traffic movements - considerable attention must be given to the safety of traffic movement and the management of traffic through the project. This may include -
  - lane closure
  - traffic diversion via another route
  - construction of side tracks, paved and sealed, or other temporary roadways;
- bus routes - maintenance of bus stops and service to the community is essential.

Important data for this stage includes traffic volume, percentage of heavy vehicles, traffic speeds, and intersection capacity and delay.

The preliminary design must examine the sequencing of the works to determine the feasibility of the project and to determine the temporary works required to manage the construction process. This has to be documented even though the contractor may adopt a different approach during the project.
Sequencing of the construction process is different from the staging of the project and requires a different approach. The sequencing is the set of activities required to ensure that the project is constructed economically while minimising disruption. Staging defines the works to be carried out over an extended time to achieve some "ultimate" goal for the standard of the road.

**Pavements**

Pavements can be the most expensive part of a project and considerable attention to the design of the pavement is required at the preliminary design stage to obtain a reasonable estimate of the cost of the works. The type of pavement affects the cross section and both need to be designed in conjunction with each other.

Details of the approach to pavement design can be found in the Pavement Design Manual. For special pavements (e.g. heavy-duty motorway pavements), specialist assistance should be obtained.

**Roadside Furniture**

The elements of roadside furniture to be considered and dealt with elsewhere in this manual are:

- Signs - refer to the Manual of Uniform Traffic Control Devices (MUTCD) for warrants and design requirements;
- Pavement markings - refer to the MUTCD and the Guide to Pavement Markings manual;
- Lighting - includes route and intersection lighting - refer to Chapter 17 of the Road Planning and Design Manual;
- Roadside barriers - refer to Chapter 8 of the Road Planning and Design Manual;
- Fencing - refer to Chapter 8 of the Road Planning and Design Manual.

**Additional Safety Considerations**

- School zones - speed limits will apply in school zones (refer to MUTCD)
- High rainfall areas - special attention to pavement surfacing is required, particularly where alignments are winding, steep or heavily trafficked;
- Aquaplaning;
- Areas of fog - good delineation is required;
- Roadside hazards - particular attention to the presence of potential hazards is required. Such hazards should be removed or protected with barrier - refer to Chapter 8 the Road Planning and Design Manual;
- Runaway vehicle facilities - refer to Chapter 15 the Road Planning and Design Manual;
- Crossfall - there are limitations on the amount of crossfall on curves because of the adverse effect on vehicles with a high centre of gravity - refer to Chapter 7 of the Road Planning and Design Manual.

**Special Works**

- Cattle Creeps may be required where a new road severs a rural property - usually placed where the vertical alignment affords the opportunity but it may be necessary to adjust the design to accommodate the crossing to make it convenient to use;
- Fauna crossings - refer to Chapter 3 of the Road Planning and Design Manual;
- Grids are installed for the convenience of the landholder to avoid the need for fencing. If the traffic volume exceeds 700vpd, grids are not suitable and the road should be fenced to ensure adequate safety for the traffic. Grids are only installed where a written request is received from the landholder and an agreement has been signed absolving the Department from the responsibility for fencing the road boundaries;
- Open Level Rail Crossings are dealt with in Chapter 21 of the Road Planning and Design Manual.
Rest Areas

Rest areas are established in accordance with the departmental policy on location of these facilities. They are off road stopping places providing safe parking, toilet facilities, shelter shed, picnic table/s, rubbish bins, fireplace and drinking water where possible. Access to the rest area must be properly designed with attention to the required acceleration and deceleration lanes and turning facilities (refer to Chapters 13 and 20 of the Road Planning and Design Manual).

Service Centres

Service Centres are major facilities provided by private enterprise on major roads with full access control. Acquisition of land for Service Centres is the responsibility of the developer. The requirements for Service Centres are described in Chapter 20 of the Road Planning and Design Manual.

Land Acquisition

Land required for the project should be determined at the Preliminary Design stage and Resumption plans prepared in accordance with the Drafting and Design Presentation Manual.

Land required should be determined from the clearance requirements defined in Chapter 7 of the Road Planning and Design Manual. In addition, any land for environmental amelioration must be identified at this stage and allowed for in the resumption plans. This land may be required for such things as noise mounds, sedimentation ponds, gross filter traps and buffer zones.

Where future development of the road will require property in addition to that required for the current project, it is desirable that it be acquired at the same time. This will avoid undue disruption to property owners in the future and provide a secure basis for future planning by the Department.

Stock Routes

Stock Routes are managed by the Department of Natural Resources from a central office in Brisbane (General Manager (Stock Routes)). Where Limited Access declarations may impact on a Stock Route, the General Manager (Stock Routes) must be consulted before finalising the plans.

Proposals are to be forwarded to the General Manager in the first instance and he/she will coordinate with the local officers of the Department of Natural Resources.

4.4 Project Delivery

The relationship between the deliverables from the Concept Phase (Project Proposal, Options Analysis and Business Case) and the Development Phase (Preliminary Design and Detailed Design) in the context of the design development process is shown in Figure 4.6. The design development process is shown in Figure 4.7 - Design Development Flowchart for Road Infrastructure Projects.

4.4.1 Project Proposal

Preparing the project proposal is a pre-project activity and it is only when it is approved that a project is created and the cost of preparation transferred to the cost of the project. This phase step is an output from the pre-project activities of network planning.

The first step in the preparation of a project proposal is to:

- Understand and define the problem arising from network planning, including the current situation together with the current road Functionality as it may have changed since original design,
- Identify the functional outcome required to be achieved by the completed and operational infrastructure. This is a key requirement when developing solutions to the problem, i.e. the required functionality to be achieved by this project may be different to the current functionality,
- Define the scope of the project deliverables and outcomes (Functional Specification),
• Link the project to the strategic business plans, e.g. confirming strategic fit,

• Prepare a budget (planning) to deliver the options analysis and the business case based on:
  - Information from pre-project activities, e.g., link studies, analysis of environmental constraints/opportunities based on Road Corridor Environmental Assessment data, and
  - An assessment of likely work packages, e.g. environmental study, together with the cost of consultancies to deliver them,

• Validate application of the PPP policy to the project,

• Identify risks to the project (external and internal),

• Prepare a proposal report (all projects) by completing Template R1001 to:
  - Secure funding for delivering the next stages (e.g. for the Options Analysis and the Business Case);
  - Seek approval to proceed to the next stage (i.e. the Options Analysis) with assignment of appropriate resources; and
  - Seek approval to proceed as a planning project on the RIP, if applicable.

Outputs Summary

• A Project Proposal (need), Template R1001 (Mandated),

• Functional Specification (required outcomes),

• Briefs for work packages (consultancy requirements),

• Identified Risks to the Project,

• A plan to deliver the Options Analysis and the Business Case,

• A budget to deliver the Options Analysis and the Business Case.

4.4.2 Options Analysis

When preparing a solution options analysis the first step is to review the project proposal to understand the need and required functional outcomes. Developing this clear understanding of the requirements with the sponsor will assist in the management of the project scope by not allowing it to drift to include non imperative design 'niceties'. Refer Chapter 6 for information on scoping a project.

After developing a clear and common understanding of the requirements the first step in the development of the options analysis is to:

• Examine any relevant pre-project acquired data and/or information that could assist in the development of the preferred solution,

• Identify all plausible problem solution options (technical and non-technical) using a risk management approach that will satisfy the specified requirement(s) (options could include alternative alignments, different layouts, coordination of traffic signals, or public transport schemes),

• Identify required work packages, e.g. for consultations, studies or investigations, prepare relevant briefs and engage consultants to deliver them,

The identification and development of options includes the development of all the plausible solution options to the extent necessary for realistically conducting an options analysis to select the preferred option. This process includes addressing all of the issues identified in the Design Development Process- Refer Section 4.3. The extent of consideration will range from a thought process for straightforward low risk projects (Type 3 Project) to fully explored and well documented options for complex and/or high risk and/or major projects (Type 1 Project). The selected option for major and/or more complex and/or high risk projects will require Regional Executive Director approval whilst straightforward projects would normally be approved by the District Director (refer Figure 4.7). However, regional procedures will specify the local
Figure 4.6 Planning and Design Process - Design Development Deliverables
Infrastructure Strategy (e.g. Road Network Strategy) approved
Regional Strategy approved

Figure 4.7 Design Development Flowchart

- **CONCEPT PHASE**
  - Project Proposal (R1001)
    - Clear understanding of the problem
    - Preferred Functional Outcome
    - Planning Budget
    - Work for Options Analysis
    - Contract to deliver Options Analysis
    - Potential as PPP
    - Seek Federal Stage 1 approval

- **PREFERRED INFRASTRUCTURE OPTION**
  - Options Analysis (R1002, R1004 or R1005)
    - Develop options identifying impacts, benefits and cost to a level of detail that enables an effective comparative evaluation process to select the preferred option
    - Preferred option confirmed against need & functional outcome
    - Review strategic fit
    - Brief to deliver Business Case
    - Contract to deliver Business Case and/or further phases

- **DEVELOPMENT PHASE**
  - Business Case (R1003 or R1004 or R1005)
    - Developed preferred option identifying impacts, benefits and cost to a level of detail that enables the project scope and risks to be accurately defined
    - Solution re-confirmed against need & functional outcome
    - Confirm strategic fit
    - Concept SOT Estimate = Project Budget
    - Contract to deliver next phase/stage and/or further phases
    - Seek Federal Stage 2 approval

- **CONTRACT TO DELIVER**
  - Brief for Options Analysis (TP)
    - Prepare PPR & Stage 2 as a planning project, if appropriate
    - Develop Preliminary Design
    - Review Business Case, including:
      - Project Proposal
      - Concept SOT Estimate
      - Strategic fit
      - Delivery method
      - Review and confirm Project Plan
      - Develop Sub-Solutions, e.g.
        - Pavement Types
        - Culvert Types
        - Planning Report
        - Determine and document ROW requirements
        - Contract to deliver Detailed Design and/or further stages

- **SOLUTION**
    - Finalise Design
    - Scheme Prototype (Construction Drawings, schedules, Specifications and Conditions of Contract)
    - Solution confirmed against need & functional outcome
    - Detailed SOT Estimate

- **PREFERRED TENDERER**
  - Tender Analysis
    - Conduct Review and modify CSA Tool - Tender
    - Award Contract

- **PROJECT CONSTRUCTION**
  - Establish Construction Contract
    - Prepare Tender Documents
    - Call Tenders
  - Preconstruction Processes Manual
    - Establish Construction Contract
  - Preconstruction Processes Manual
  - Federal Stage 3B Approval

**NOTES:**
2. Budgets:
   - A - For routine Projects the Concept Phase is delivered by the network planning budget with the balance of the preconstruction activities delivered by the project budget.
   - B - For significant projects only the Project Proposal is delivered by the network planning budget with the balance of the preconstruction activities delivered by the project budget.
requirements in this respect. The preferred option (adopted solution) during its development for business case purposes starts to establish the tangible scope of the project.

The development and assessment of solution options must utilise a Value Management approach (refer Section 3.3 in Chapter 3) that assesses impacts, benefits and cost to a level of detail that enables a comparative evaluation to clearly determine the preferred option, including conducting Road Safety Audit (Feasibility) for each option, where relevant. (It is important that the 'do nothing' option is considered as part of this analysis to provide a baseline against which the costs and benefits can be measured). The process must ensure the options are within the defined scope of the project.

The process must also ensure project environmental sustainability through appropriate environmental assessment and management (refer to the Road Project Environmental Manual for guidance).

Preparing the Options Analysis report and completing Template R1002 for Type 1 Projects, Template R1004 for Type 2 Projects and Template R1005 for Type 3 Projects to:

- Seek approval of the preferred option,
- Seek approval to proceed to the next stage, i.e. the Business Case,
- Confirm planning budget requirements.

The following discussion is intended to cover all of the considerations, regardless of the project type, and the proponent will have to determine the level of detail required to suit the accuracy required of the various mandated project cost estimates.

It is required that the details of the Project Charter be kept under review during this phase of the process. Issues change and develop and some of the conclusions reached at the earlier phase may move out of alignment with the new requirements.

**Outputs Summary**

- An Options Analysis Report
- A completed Options Analysis Template (R1002, R1004 or R1005) (Mandated)
- Planning REF,
- Briefs for work packages (consultancy requirements)
- A plan and budget to deliver the Business Case,
- Design Development Report (Form M4211 or M4212)
- A Risk Management Record (Form M4213).

### 4.4.3 Business Case

When preparing a business case the first step is to review the project proposal and options analysis report to understand the need and required functional outcomes. Developing this clear understanding of the requirements will assist in the ongoing management of the project scope. Refer Chapter 6 for information on project scoping.

After developing a clear and common understanding of the requirements with the sponsor the first step in the development of the business case is to develop the preferred option to the extent necessary to reliably produce a project cost estimate (concept estimate) to within ± 20 of the total project cost (refer to the Project Cost Estimating Manual for guidance). This process includes addressing all of the issues identified in the design development process together with other issues that may come to light from time to time as the project develops, e.g. the discovery of rare and endangered species. For very large projects (Type 1) this requirement may take several years to develop and result in the development of the preferred option that approaches a preliminary design. Small routine projects may take less than a week to perform this activity. The development of the preferred option establishes a reasonably well defined scope of the project.

Once the concept estimate has been produced it is then necessary to justify the project through a two stage evaluation process (BCR and 2nd stage
evaluation). Should project evaluation fail to justify the project the planner/designer must seek an acceptable solution. This may require the scope of the preferred option to be modified or in extreme circumstances a revisit to the options analysis step or even the specified need may be necessary.

The development of the business case must be in accordance with the requirements of Section 4.4.3 together with any other requirements identified during the development process. The approval of the business case template authorises the project to be included in the RIP as a construction project and authorises expenditure to produce the development phase.

For Federally funded projects, it is necessary to prepare an additional report (Project Proposal Report (PPR) using the table of contents guide shown in Figure 4.8). This report must meet the Federal Government requirements specified in the "Australian Land Transport Development Program Administrative Procedures" (1992).

Preparing the Business Case Report and completing Template R1003 for Type 1 Projects, Template R1004 for Type 2 Projects and Template R1005 for Type 3 Projects to:

- Seek approval to include the project in RIP, and to proceed to the next stage, i.e. the Preliminary Design,
- Confirm Development Phase budget requirements.

**Outputs Summary**

- A Business Case Report, including a Concept Estimate,
- A completed Business Case Template (R1003, R1004 or R1005) (Mandated),
- A Project Proposal Report (National Highway Projects only)
- EIS if required,
- Briefs for work packages (consultancy requirements),
- A plan and budget to deliver the Preliminary Design and the Detailed Design,
- Design Development Report (Form M4211 or M4212)
- A Risk Management Record (Form M4213).

**Preferred Option Review**

The basic assumptions and criteria established at the beginning of the process should be reviewed to ensure that they are still valid. Issues that have arisen during the process should be resolved before proceeding. Any design changes required have to be identified and the impact of the changes assessed. Will the changes affect the viability of the project? Is the project still justified as planned or should a revised approach to the project be taken?

If a major change to the project is required, the process has to return to the earlier phases to resolve the issues.

If the review confirms the project, then the preliminary design can proceed.

The following discussion is intended to cover all of the considerations, regardless of the project size or complexity, and the proponent will have to determine the level of detail required to suit the accuracy required of the various mandated project cost estimates.

This phase may require further Work Packages identified from the Business Case process. These may be an extension to existing studies or new studies identified from the work done so far. The extent of these needs should have been identified when developing the solution options but the process of further detailing may reveal the need for additional information.

All items required for the project to function have to be explored in this stage. This will require detailed final calculations leading to the refining of the design of all elements and final decisions on the options available -

- Road Geometry - alignment and cross section;
- Structures;
Typical Project Proposal Report Contents Page
(Federal Stage 2 requirement for AusLink Projects)

1. Introduction
   1.1 Purpose
   (To provide the justification, cost, scope, nature and design features of the project and timeframe).

1.2 Design Statement
   (Outline the standards proposed for design and construction giving the maximum or minimum values where appropriate, in sufficient detail to enable the Commonwealth to be assured that adequate and appropriate standards are to be used)

2. Economic and Social Justification
   2.1 AusLink Justification
   (the justification and objectives of the project in relation to the AusLink strategy).
   2.2 Economic and Social Evaluation.
   (Findings and conclusions of economic and social evaluations).
   2.3 Traffic Projections
   (Traffic Estimates for 5, 10 and 20 years into the future disaggregated into truck and other traffic).
   2.4 Crash Information.
   (Traffic accident report on the crash history of vehicles on the section of road concerned).
   2.5 Design Consistency.
   (Assurance that standards are consistence with adjacent sections).
   2.6 Environmental Compliance.
   (Certification of compliance with Federal and State environmental legislation).
   2.7 Regional and Community Impacts
   (Relevant regional and/or community implications of the project).
   2.8 Project Completion
   (Estimated time for completion of the project).

3. Physical Details
   3.1 Project Location and Context
   (Maps showing location of the project in the road network, zoning and use of abutting land).
   3.2 Significant Project Components
   (Maps showing the position of bridges, intersections and interchanges, as relevant).
   3.3 Design Profiles
   (Drawings showing typical longitudinal and cross section with number and width of lanes, shoulder width, lateral clearance and right of way width).
   3.4 Pavement Design
   (Pavement construction details including design life).
   3.5 Design Standards
   (Design Information including confirmation that Standards and Guidelines for the Construction of National Highway will be met, or details and reasons of proposed departures from them).
   3.6 Staged Openings to Traffic
   (Staging proposals, for bringing segments of the route into use before construction of the full length is completed).
   3.7 Landscaping, Rest Areas and/or Service Areas
   (Brief notes on landscaping, rest areas and/or service areas proposed).

4. Cost and Timeframe
   4.1 Project Cost Estimate
   (Cost of the project with a break-up into appropriate sub-items (expressed in outturn dollars).
   4.2 Project Cost Estimate Accuracy
   (Basis and level of confidence of the cost estimate).
   4.3 Delivery Program
   (Estimated completion date and expected annual expenditure).

5. Appendices
   Attach relevant and supporting maps, drawings reports, etc.

Figure 4.8 Project Proposal Report
• Interchanges;
• Channelised intersections;
• Drainage - cross drainage, longitudinal drainage and pavement drainage;
• PUP relocations;
• Pavement design (notional);
• Safety barriers;
• Signing and marking;
• Lighting;
• Fencing;
• Accesses;
• Constructability;
• Construction sequencing; and
• Environmental management.

4.4.4 Preliminary Design

When preparing the Preliminary Design the first step is to review the project proposal, options analysis report, the business case report and to understand the need and required functional outcomes together with the approved design elements to date. Developing this clear understanding of the requirements will assist in the ongoing management of the project scope and allow further development of the preferred option to preliminary design stage without rework and within budget.

The further development of the preferred option is required to the extent necessary to reliably produce a project cost estimate (preliminary design estimate) to within ± 12 - 15% of the total project cost (refer to the Project Cost Estimating Manual for guidance). This process includes addressing all of the issues identified in the design development process together with other issues that may come to light from time to time, e.g. the discovery of cultural heritage artifacts. The development of the preferred option establishes a very well defined scope of the project.

Once the preliminary design estimate has been produced it is then necessary to confirm that the project is within budget and justification. Should the project fall outside the budget an acceptable solution must be sought. A review of the business case must be undertaken to confirm scope creep has not occurred during the preliminary design process. In extreme circumstances a review of the preferred option may be necessary in order to deliver a project within the budget approved in the business case.

If the review confirms the project, then the preliminary design can proceed.

The development of the Preliminary Design must be in accordance with the requirements of Section 4.4.4 together with any other requirements identified during the design development process. The approval of the preliminary design authorises the project to be included in firm year two of the RIP.

A Planning Report is required to be produced using the table of contents guide shown in Figure 4.9.

The proposed procurement strategy for delivering the project must be reviewed and confirmed.

Outputs Summary

• A Planning Report, including a Preliminary Design Estimate,
• Briefs for work packages (consultancy requirements),
• Approved alignments and layouts,
• Approved ROW requirements
• A plan and budget to deliver the Detailed Design,
• Updated Design Development Report (Form M4211 or M4212)
• Updated Risk Management Record (Form M4213).

Preliminary Design Review

The following discussion is intended to cover all of the considerations, regardless of the project size or complexity, and the proponent will have to
determine the level of detail required to suit the accuracy required of the various mandated project cost estimates.

This phase may require further minor work packages. The extent of these needs should have been identified at the business case stage but the process of further detailing may reveal the need for additional information.

All items required for the project to function have to be detailed in this phase. This will require detailed final calculations leading to the refining of the design of all elements and final decisions on the options available -

- Road Geometry - alignment and cross section;
- Structures;
- Intersections;
- Interchanges;
- Drainage - cross drainage, longitudinal drainage and pavement drainage;
- PUP relocations;
- Pavement design;
- Barriers;
- Signing and marking;
- Lighting;
- Fencing;
- Accesses;
- Constructability;
- Construction sequencing; and
- Environmental management.

4.4.5 Detailed Design

When preparing the Detailed Design the first step is to review the project proposal, options analysis report, the business case report, the preliminary design report and to understand the need and required functional outcomes together with the approved design elements to date. Developing this clear understanding of the requirements will assist in the ongoing management of the project scope and allow further development of the preferred option to the detailed design stage without rework and within budget. Figure 4.6 illustrates position of detailed design in the overall process.

The further development of the preferred option is required to the extent necessary to:

- reliably produce a project cost estimate (detailed design estimate) to within ± 10% of the total project cost (refer to the Project Cost Estimating Manual for guidance).
- provide appropriate construction information to allow construction to progress with minimum interpretation of the drawings and/or the electronic model.

This process includes addressing all of the issues identified in the design development process together with other issues that may come to light from time to time. The development of the preferred option to the completion of detailed design establishes a full and detailed scope of the project.

The development of the detailed design must be in accordance with the requirements of Section 3.4.5 together with any other requirements identified during the development process.

This part of the process finalises all of the details of the design within the limits of the project as defined in the project proposal and functional specification.

This is a process of refinement and confirmation of the details identified during the preliminary design stage. All of the issues identified in Sections 4.4.4 and 4.4.5 have to be revisited with additional detail to complete the design. Essential elements of the process are discussed below.
## Typical Planning Report Contents Page

**1.0** INTRODUCTION

**2.0** NEEDS ASSESSMENT
- 2.1 Population trends and Projects
- 2.2 Strategic Planning Review
- 2.3 Transportation Needs

**3.0** COMMUNITY CONSULTATION

**4.0** IMPACT ASSESSMENT
- 4.1 Traffic Analysis
- 4.2 Environmental Impact Assessment
- 4.3 Social Impact Assessment
- 4.4 Land Use Assessment
- 4.5 Local Government
- 4.6 Public Transport Study
- 4.7 Economic Evaluation
- 4.8 Visual Impact Assessment

**5.0** GENERAL DESIGN CONSIDERATIONS
- 5.1 Option A
- 5.2 Option B
- 5.3 Option C
- 5.4 Option D
- 5.5 Option E

**6.0** CONSTRUCTION COSTS AND STAGING
- 6.1 Option A
- 6.2 Option B
- 6.3 Option C
- 6.4 Option D
- 6.5 Option E

**7.0** SUMMARY AND RECOMMENDATIONS

**8.0** APPENDICES

---

*Figure 4.9 Typical Planning Report Contents Page*
• hydraulic analysis; and
• traffic assessment.

The extent of these needs should have been identified at the preliminary design stage but the process of further detailing may reveal the need for additional information.

All items required for the project to function have to be detailed in this phase. This will require detailed final calculations leading to the refining of the design of all elements and final decisions on the options available -

• Road Geometry - alignment and cross section;
• Structures;
• Interchanges;
• Channelised intersections;
• Drainage - cross drainage, longitudinal drainage and pavement drainage;
• PUP relocations;
• Pavement design;
• Safety barriers;
• Signing and marking;
• Lighting;
• Fencing;
• Accesses;
• Constructability;
• Construction sequencing; and
• Environmental management.

This is a process of refinement and confirmation of the details identified during the preliminary design stage. All of the issues identified in Sections 4.4.4 and 4.4.5 have to be revisited with additional detail to complete the design. Essential elements of the process are discussed below.

**Final Review**

The detailed design estimate of cost of the project will now be available and the final cost of the job will be known. It is necessary to review the cost of the job and assess its affordability before proceeding to finalise the documentation and call tenders. A decision will be required on the ability to proceed with the project as designed if the cost is excessive. The possible outcomes of the review are:

• Proceed with the project as designed with appropriate adjustments to the RIP;
• Proceed with the project but with a reduced length of job to more closely match the budget (the remaining parts of the job to be reprogrammed in the RIP);
• Proceed with the job but with reduced scope of works; or
• Defer the project.

**Outputs Summary**

• Detailed Design Report,
• Environmental Design Report,
• Verified and Certified Design,
• Scheme Prototype,
• Detailed Design Estimate,
• Completed Design Development Report (Form M4211 or M4212),
• Completed Risk Management Record (Form M4213),
• Contract Documents.

**Documentation**

**Contract Documents**

Contract documents are to be prepared in accordance with Main Roads standards. Supplementary Conditions of Contract and Supplementary Specifications may be required. These documents will include the certified design plans and specifications, which must be prepared
to high standards of accuracy and completeness (see Chapter 6 - Design Management).

**Detailed Design Report**

A Detailed Design report is required in order to:

- Demonstrate that the design has met all of the requirements of environmental and other impact management plans;
- Document any special features of the design that must not be varied in construction;
- Document particular features of the design that require specific maintenance procedures to be adopted;
- Document the assumptions made during the design; and
- Record the various reports and other inputs used in completing the design.

The Detailed Design Report should address at least the following issues:

- Designer's certification;
- Notes on design interface checks (essential that the interfaces between different design disciplines are thoroughly checked);
- Notes on sensitive environmental issues;
- Notes on sensitive community consultation issues;
- Notes on negotiations with adjacent property owners plus cross reference to any agreements;
- Notes on sensitive drainage issues;
- Justification for construction sequence plans (if required);
- Justification for provision for traffic requirements;
- Notes on sensitive landscaping issues;
- Methodology used to calculate the scheduled quantities (or the actual calculations) including assumptions made to assist the Superintendent certify quantities for payment - refer Section 2.2 of MRS11.01;
- Calculations for topsoil quantities including basis of assumptions;
- Notes on unusual design aspects or unique design aspects not to be amended in the field;
- Notes on any features of the design requiring particular maintenance procedures to be adopted;
- Notes on unusual specifications and the reasons for them;
- Cross reference geotechnical reports and highlight potential problem areas;
- Notes on all statutory approvals;
- Notes on any other issues which should be brought to the attention of the Administrator of the Construction Contract;
- Other issues (see below);
- Notes on Scheduled Items including (if ordered) items and unusual items;
- Annotated Cross Sections (if not included in the contract documents);
- Data on Principal's Materials or Works including Public Utility Plant works, Traffic Signals and Red Light Cameras, etc;
- Copy of estimate for the Local Government's Contribution and correspondence with the Local Government; and
- Notes on issues to be discussed at the pre-start meeting (refer Construction Administration System (CAS) Manual - Procedure P-003: Prestart Meeting and to the Standard Form SF-004: Prestart Meeting Agenda). Note: It is very important that the superintendent and the construction contractor clearly understand the intent of the overall design, the functions of the various design components and any unusual/special features of the design.
The following documents should be appended to the Report:

- Planning Report;
- All addenda prepared since the planning report was completed (Addenda to REF, EMP, Community Consultation Report, Geotechnical Reports, etc as applicable);
- Environmental Design Report (if not separately submitted);
- Agreements with property owners to construct Accesses;
- Agreements with property owners on types of fences along resumption boundaries;
- Any other agreements with property owners;
- Constructability Report;
- Construction Sequence Plans (if any and not included in the contract documents);
- Copy of all Statutory Approvals;
- Report on status of Public Utility Plant relocations including Drawings, Specifications, etc;
- Offers for relocation of Public Utility Plant;
- Agreement for Point of Supply for Lighting, Signals, etc;
- Written Offer for installation of Traffic Signals;
- Construction Traffic Management Report;
- Risk Analysis Report;
- Construction Programme;
- Resumption and Access Limited Plans.

As a guide to the content of the report, the following should be considered:

1. **Environmental Issues**

Highlight the most environmentally significant issues and their importance; detail any negotiated outcomes to be achieved; and cross-reference the relevant Sections of the Review of Environmental Factors, Environmental Management Plan (Planning), etc.

Any other documents that clarify these issues should be appended.

2. **Unusual Design Aspects or Unique Design Aspects**

These could include:

- timing of installations (fencing, noise barriers, drainage, high tide effects on the works, etc);
- retaining walls;
- new types of materials;
- alternative construction method/s.

3. **Statutory Approvals**

The Designer is usually required to obtain all statutory approvals that the Principal requires to effect the delivery of the project.

The Approval Conditions (on both the Designer and the Principal) must be included in the report to the Construction Contract Administrator.

4. **Other Issues**

The Designer should provide advice on all other issues that may affect the satisfactory delivery of the project.

These could include but are not limited to:

- Items of Cultural Heritage;
- Local events;
- Other local issues;
- Discussions with landowners affected by resumption;
- Advice of possible unexploded ordinance;
- Local Government Involvement.
5. Principal’s Obligations (Materials or Works or Contingencies)

For all Principal’s Materials, the Designer should include the following as applicable:

- For Public Utility Plant relocation works, provide the following:
  - Specifications and Plans including backfill treatments to all trenches;
  - details of limitations on access to the site;
  - provision for traffic requirements;
  - details of any special treatments, etc;
  - quotes for Relocation of Services (including itemised schedules for complex works);
  - any specific timing requirements;
  - name and other details of contact personnel within the Utility Service Providers;

- All other Principal’s Materials (Correspondence, Plans, Specifications and Estimate required for all items listed as Principal’s Materials or Works);

- Quotes for traffic signal and red light camera works (if applicable).

6. Issues to be Discussed at the Pre-start Meeting

These could include but are not limited to:

- Design Intent, including any unusual features of the design and design functionality issues for each design component;

- Environmental Issues;

- Reasons for working hour restrictions;

- Reasons for other working limitations (noise, vibration, road closure restrictions, etc); and

- Reasons for other specification requirements.

**Environmental Design Report**

The requirements for, and the rationale of, the Environmental Design Report are set out in the Road Project Environmental Management Processes Manual. This report is to be prepared after the completion of detailed design and must show the ways in which the environmental requirements of the EMP (Planning) have been incorporated into the design and contract documentation.

**Post Construction Review**

A review of the design must be undertaken in a post construction review. This should include:

- review of standards used and their appropriateness;
- construction difficulties encountered;
- elements that could have been constructed more economically with a different design;
- feedback from the construction team;
- feedback from users;
- feedback from adjacent residences, businesses and other institutions; and
- feedback from other stakeholders.

The learnings from this review should be documented in the “Consultant Performance Report” (Part B). The learning results should be considered for incorporation in this Manual as appropriate.

**4.5 Whole of Life Considerations**

**4.5.1 General**

When developing options and deciding between them, both the initial capital cost of the facility and the ongoing cost of operations and maintenance must be considered. Decisions on the form of the design, the materials used and the staging of the works can have an impact on the whole of life costs of a project. Adopting a cheap solution for the initial construction will not necessarily produce the minimum whole of life cost.
4.5.2 Staging

Whole of Life considerations would indicate that current works should provide for the future stages to be implemented with minimal effect on the current works. In addition, they should make for ease of construction of the future works. Hence, a pavement may be extended to provide a clean joining point for a future extension to the carriageway clear of the traffic using the first stage.

Other examples include:

- Providing space for piers for a future overpass;
- Designing for a future overpass rather than an underpass;
- Allowing space for future widening into the median;
- Allowing for duplication of a single carriageway in the same right of way;
- Providing for spoil to be placed on a future carriageway;
- Providing space for PUP clear of the carriageways;
- Locating PUP so that it does not have to be relocated for future stages of the road development;
- Minimising the temporary works required for future stages;
- Allocating corridor space to future on- or off-road bicycle facilities.

4.5.3 Materials

Selection of the materials to use for pavements, bridges, safety barriers and noise barriers can have a marked effect on both the initial cost and the long-term costs of a project.

Pavements

The choice of pavement material and style of pavement is one between low initial cost and high recurring costs of maintenance and rehabilitation, and high initial cost and low ongoing costs. The whole of life costs can be readily estimated and the decision can be made on economic grounds. In some cases, the volume of traffic will be the determining factor but availability of material is often the crucial issue.

Bridges

Concrete is the material of choice for long term low maintenance costs (assuming that the concrete is manufactured correctly with durable materials). Steel structures require ongoing maintenance (painting) that may negate any initial cost advantage they may have. In arid western areas, maintenance needs are significantly less and galvanized steel girders may represent an economical solution because the savings in transportation costs of girders to site, may more than adequately offset any maintenance costs. A further consideration is the availability of suitable maintenance personnel and the accessibility of the structure.

Safety Barriers

Choice of type of barrier involves considerations other than the material type since the circumstances prevailing may not allow all types to be used (see Chapter 8 of the Road Planning and Design Manual). However, if different types are suitable, the cost of replacement and ongoing maintenance is a consideration. Concrete barriers have the lowest ongoing costs since they are not usually damaged in a collision and there is little other maintenance required.

Noise Barriers

The lowest cost noise barriers are usually made of treated timber. However, timber is not as long lasting as concrete and other materials and it may require attention to prevent deterioration over its life. In addition, timber noise barriers are susceptible to damage by fire – a risk that should be assessed. The whole of life costs can readily be assessed and an appropriate decision reached.
4.5.4 Maintenance Needs

The ongoing maintenance costs of the various features of a design must be considered in the decision making process. Consider the maintenance requirements of the following:

- Pavements (see Section 4.5.3);
- Pavement edges – seal shoulders to reduce this;
- Outer wheel path pavement deformation – sealing shoulders reduces this if the depth is adequate;
- Batter slopes;
- Line marking – materials used have different durability;
- Flush seal pavements – require reseal every seven years on average;
- Debris removal from drainage inlets and outlets (affects size and type of opening, use of grates);
- Surface drainage features (natural materials, concrete lining, channel shapes, use of bicycle safe grates);
- Materials requiring painting;
- Safety barriers (see Section 4.5.3);
- Landscaping elements (see Section 4.5.5);
- Access for maintenance personnel and vehicles.

4.5.5 Landscaping

The whole of life costs of landscaping is heavily dependent on the type of treatments adopted and the standard of appearance desired - see Figure 4.7 and the Road Landscape Manual.

Issues to be considered include:

- Growth habit of trees and shrubs (know the expected size of trees and shrubs at maturity);
- Long term effects on sight distance;
- Impact of root growth – intrusion into drainage lines, heaving of pavements and footpaths;
- Watering costs;
- Mowing, pruning and weed control.

4.5.6 Public Utility Plant

The objective should be to reduce the need for future road openings to zero. This is an unlikely possibility but the fewer road openings, the lower the long term costs for the road. To minimise the number of road openings, careful attention to the location of the PUP in the first instance is essential. In addition, providing sufficient space in the area allocated to the individual services, and installing enough ducts to provide for future expansion will reduce the need for future openings. (See also Section 4.5.2 above.)

4.5.7 Rehabilitation

Various components of the road require periodic rehabilitation to maximise the service life of the component. In particular, road pavements other than concrete require rehabilitation at intervals depending on the type of pavement. The design should recognise this and make provision for this process to be carried out with as little disruption as possible.

Clearances to overhead structures should be provided to allow overlays to be done without breaching the requirements for that structure.

Where allowance is made for future overlays, the width of formation must also be adjusted so that this can be accommodated.

4.5.8 Road User Costs

Road user costs represent a significant part of the whole of life costs of a road. Benefit cost analyses account for these costs that are affected by the following:

- Road roughness;
- Grades;
- Length of travel;
• Accident rates;
• Delay, including delays caused by flooding.

In addition to the immediate impact of particular features of the design, planners and designers have to take account of the rate of change in that feature with time and usage. In particular, road roughness increases with time and usage, the rate of increase depending on the type of pavement and its durability.

Delay also may change with time as traffic volumes and congestion increase. Potential flooding delay remains constant for the road as long as the road levels remain constant.

### 4.5.9 Crime Prevention Through Environmental Design

Crime Prevention through Environmental Design (CPTED) is an important consideration in reducing the incidence of crime near or adjacent to roads. Detailed discussion with Police and Community groups is required to ensure that appropriate measures are taken.

### References


Bornhorst, Ward, Veitch: Guidelines to Planning and Design for Bus Public Transport in Regional Conurbations.


Department of Families, Youth and Community Care (1997a): Protocols for Consultation and Negotiation with Aboriginal People.

Department of Families, Youth and Community Care (1997b): Proper Communications with Torres Strait Islander People.


Queensland Departments of Main Roads and Transport (1997a): Public Consultation Policy, Standards and Guidelines.

Queensland Departments of Main Roads and Transport (1997b): How to Gain Broader Participation in Consultation.

Queensland Departments of Main Roads and Transport (1997c): Consultation Planner.


Queensland Department of Main Roads (1998a): Land Use Development and State Controlled Roads.


Queensland Department of Main Roads (1998c): Queensland Environmental Legislation Register.


Queensland Department of Main Roads (1999a): Cost Benefit Analysis Manual for Road Infrastructure Investment.

Queensland Department of Main Roads and Local Government Association of Queensland (2000): Agreement between Local Government Association of Queensland, Inc and Department of Main Roads for Cost Sharing based on responsibilities within State-controlled Roads.


**Relationship to Other Chapters**

- Logically follows and complements Chapters 1 and 2;
- Traffic forecasting and travel demand overview related to parts of Chapter 5 of the Road Planning and Design Manual; and
- Further details of pedestrians and cyclists follow in Chapter 5 of the Road Planning and Design Manual.
Appendix 4A: Procedure for Evaluating Project Planning (Solution) Options

Purpose and Scope

The purpose of this procedure is to provide a model for evaluating and selecting the most appropriate solution when more than one planning option exists. The model is based on a process using a Ranking Matrix.

Definitions

Feature: a feature is a distinctive or characteristic aspect of a project.

Attribute: an attribute is a characteristic quality appropriate to a feature used in the evaluation process.

Process

Features and Attributes

The first step in the process is to decide from the Concept Phase which features of the project will significantly impact planning decisions within the corridor. Examples of features are as follows:

- Earthworks Balance;
- Flood Immunity of Road/Bridge;
- Local Access;
- Environmental Issues such as noise and pollution;
- Staging of Construction;
- Resumptions;
- Effect on National Parks etc;
- Alignments.

When choosing features for the evaluation process keep it to a manageable number, say six or seven, and do not choose features that will have a common treatment for each option, eg ‘Design Speed’ would have the same value in each option, say 100 km/h. The number of features required in the matrix will depend on the complexity of the project. The ranking matrix should be completed early in the planning process preferably before being involved with any of the planning options. It is important to note that the cost estimate does not form part of the matrix at this stage of the process.

To complete the matrix it is advisable to establish a committee of say four (maybe more for complex projects) which is representative of all aspects of the project. This may well involve using a person from the community consultation process if warranted. The committee will then rank one feature against the other until all boxes are completed. This is a pair wise ranking such that two boxes are completed for each decision.

The process is effective if not too much time is spent on this. If the majority think one feature has greater impact it is scored as 2, and the other 0, whereas if there is a balance of opinion or any indecision do not spend time discussing the pros and cons but score them 1 each.

The scores for each feature are then tallied and ranked in order. This then allows you to assign % weights to each feature.

Example:

To assess whether ‘Environmental Effects’ were more important than the ‘Effect of Flooding on Adjacent Properties’, the committee was unanimous in its decision that the latter was more important, therefore a 2 is placed in the column under ‘Effect of Flooding’ and a 0 in the column under ‘Environmental Effects’. Similarly when comparing ‘Local Access’ with ‘Staging of Construction’ there was a balance of opinion so a 1 was placed in each column.

The next step in the process is to evaluate each option under the relevant features. Only personnel experienced in the particular feature should complete the option evaluation. Each feature may be scored directly or by breaking it into a number of attributes that may be weighted and scored individually as shown in the following example for ‘Horizontal and Vertical Alignment’.
### Attribute Weight

1. Horizontal Speed and Visibility 25%
2. Vertical Speed and Visibility 20%
3. Economy of Earthworks 25%
4. Coordination of Alignment 15%
5. Overtaking Opportunities 15%

The weightings in this section may be handled directly or by the matrix method.

Therefore in this example Option 3 (highest score) best accommodates the significant features of the project.

### Estimates

We now have to address the estimate of cost for each option. In most cases there will be a need to balance the benefits flowing from the particular treatment of a feature against the cost of the treatment. The aim is to determine which option is best value for money.

The example below illustrates how the cost of different treatments may be compared for various options.

**Example:**

*Option 1 has a comparative estimated cost of $3.6m and Option 3 a comparative estimate of $3.8m. We can now examine which attribute will change if we choose the cheaper option. From the tables above the difference occurs in the feature ‘Horizontal and Vertical Alignment’ under the attribute ‘Earthworks’. It may be that cost is reduced by an option which has less favourable cut and fill batters slopes. A decision is now required on whether the $200,000 cost saving balances the reduced quality of the final product. The final decision will be made by the District Director / Regional Director.*

For an actual evaluation the process may need to be iterative and the cost difference may be apportioned in part to several attributes. The evaluation team has the task of apportioning the cost difference and recommending a course of action to achieve best value for money.

### Final Evaluation

To complete the procedure it is important to check that the following points were adequately addressed:

- Appropriate features chosen for the Ranking Matrix;
- A representative committee to establish the rankings;
- Experienced personnel to rate each option under a particular feature;
- The selected option gives the best value for money.

This procedure needs only be an complex as the project being undertaken ie it may be reduced or expanded but it must provide an accountable process of selection based on the principle of value for money.