DEPARTMENT OF WORKS

River Training Manual

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PREFACE

This document is a Design Manual prepared for the Department of Works, Papua New Guinea by Agonia Binnie Consultants, Port Moresby and Binnie and Partners Pty. Ltd., Melbourne, Australia using sub-consultants: B.A. Anderson of Lidstone and Anderson, Fort Collins, Colorado, USA; and J.W. Tilleard of Ian Drummond and Associates Pty. Ltd., Wangaratta, Victoria, Australia.

The procedures and techniques presented in this manual are based on the experience and judgement of the authors and their colleagues, or on information from reference material. Design and construction of appropriate erosion protection works relies heavily on the judgement of the designer about site conditions and on decisions made during construction. As a consequence neither the authors and their firms nor the Government of Papua New Guinea can accept responsibility for the performance of specific works designed by readers of this document, whether or not those works are designed in apparent accordance with this manual.

SUMMARY

Rivers in Papua New Guinea are numerous. Many are steep and unstable, subject to sudden flooding and carrying high sediment loads. These rivers threaten roads, bridges and other assets by erosion.

The most common problem is undermining and failure of bridge abutments by scour of the bed adjacent to the abutment. Whilst scour is inevitable in streams with high sediment mobility, the problem is exacerbated where natural channels are severely constricted by bridge crossings.

Incompatible bridge and river alignments also contribute to erosion and abutment problems.

Favoured techniques for dealing with these problems include:

- for upper bank protection:
  - rock riprap;
  - gabion mattress; or
  - gabion baskets;
- for lower bank protection:
  - rock riprap;
  - gabion baskets protected against abrasion;
  - sheet piling; or
  - pile and panel wall;
- for alignment training:
  - permeable retards.

In severe cases, relocation or lengthening of bridges must be considered.

Any of these works must be designed with an understanding of the dominant river processes and giving particular attention to the likelihood of scour of the bed during floods.

Sufficient detail is given in the manual to allow design of these works by a competent engineer. However the procedures are not intended to be "cookbook". Their successful implementation relies on the sound judgement and accumulated experience of the designer. It is to be expected that details of some techniques may be usefully refined as experience of their application in PNG accumulates.

Construction, monitoring and maintenance guidelines are given to ensure that design principles are carried over to the construction phase.

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1. INTRODUCTION

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The Road and Bridge Section of The Department of Works has recognised that increasing road and bridge standards in Papua New Guinea demand a greater level of road and bridge protection from river related damage. In the Terms of Reference for preparation of this manual, the Principal Engineer, Roads and Bridges stated:

> *Over the last few years a significant proportion of the design work for Roads and Bridges section has been diverted to the task of river protection works for roads and more particularly bridges. As the provincial works maintenance resources are stretched thinner over increasing road networks, the economics of permanent works rather than the usual periodic reinstatement works becomes more apparent.*

Rivers in Papua New Guinea provide a major restraint on transport. The island's young geomorphology including high elevations and high relief, together with its location within the tropics ensuring some of the highest annual rainfalls in the world, makes river related problems in Papua New Guinea of unusual significance.

1.1 OBJECTIVES

The objective of work on this manual has been to:

- develop and document standard river training and abutment treatment concepts applicable to the range of river related road and bridge problems in Papua New Guinea; and
- document guidelines to allow these concepts to be adapted and applied by Departmental staff and consultants to specific problems at specific sites.

The manual is not intended to be a rigorous theoretical treatment, but aims to:

- give guidelines for recognising and understanding river related problems and their treatment;
- describe options for treating problems;
- assist in choosing appropriate options for a given site;
- describe basic design principles for each option;
- give sufficient detail to allow design of appropriate remedial or preventative measures; and

- outline construction, monitoring and maintenance requirements.

In preparation of this manual it has become abundantly clear that "river training" does not readily lend itself to a "cookbook" type of manual. Experience, common sense and judgement will always be an important part of successful design. This manual therefore provides guidelines for selection, design and implementation of works rather than foolproof step-by-step procedures.

1.2 SCOPE OF THE MANUAL

Consideration is limited to river problems as they relate to roads and bridges - in particular:

- river training upstream and downstream of bridges;
- protection of bridge abutments; and
- river related erosion of the road formation or other asset.

The manual aims to generalise river problems and their solution. It gives emphasis to procedures for the design, construction and maintenance of works which resolve the most commonly observed problems. Special problems will exist which defy simple solution or where consequences of failure of the works are severe. These problems are beyond the scope of this manual and should be the subject of special investigation and design.

The material presented in this manual is directed toward the road and bridge engineer with basic engineering and construction skills. It is intended that the procedures given in the manual can be directly incorporated into standard road and bridge design processes. Whilst recognising the importance of experience in successful implementation, no previous specific experience in river training and protection works is assumed.

Sophisticated theoretical design approaches which rely on detailed data bases or detailed data gathering programs are not currently appropriate to road and bridge related river problems in PNG. The design procedures presented in this manual recognise limited data availability. More sophisticated approaches can be incorporated in future updates of the manual.

Costing of design alternatives is obviously a vital part of evaluating alternative treatment options. However, whilst the manual will address costs as part of the process of evaluating alternatives, it will not attempt to assign unit costs to labour, equipment or materials. This avoids the need for constant revision and problems with variability in unit costs throughout Papua New Guinea.

1.3 PROCEDURE FOR USING THE MANUAL

The manual is presented in logical order of topics. The following chart is intended to assist the designer who wishes to refer to the manual during the design process.

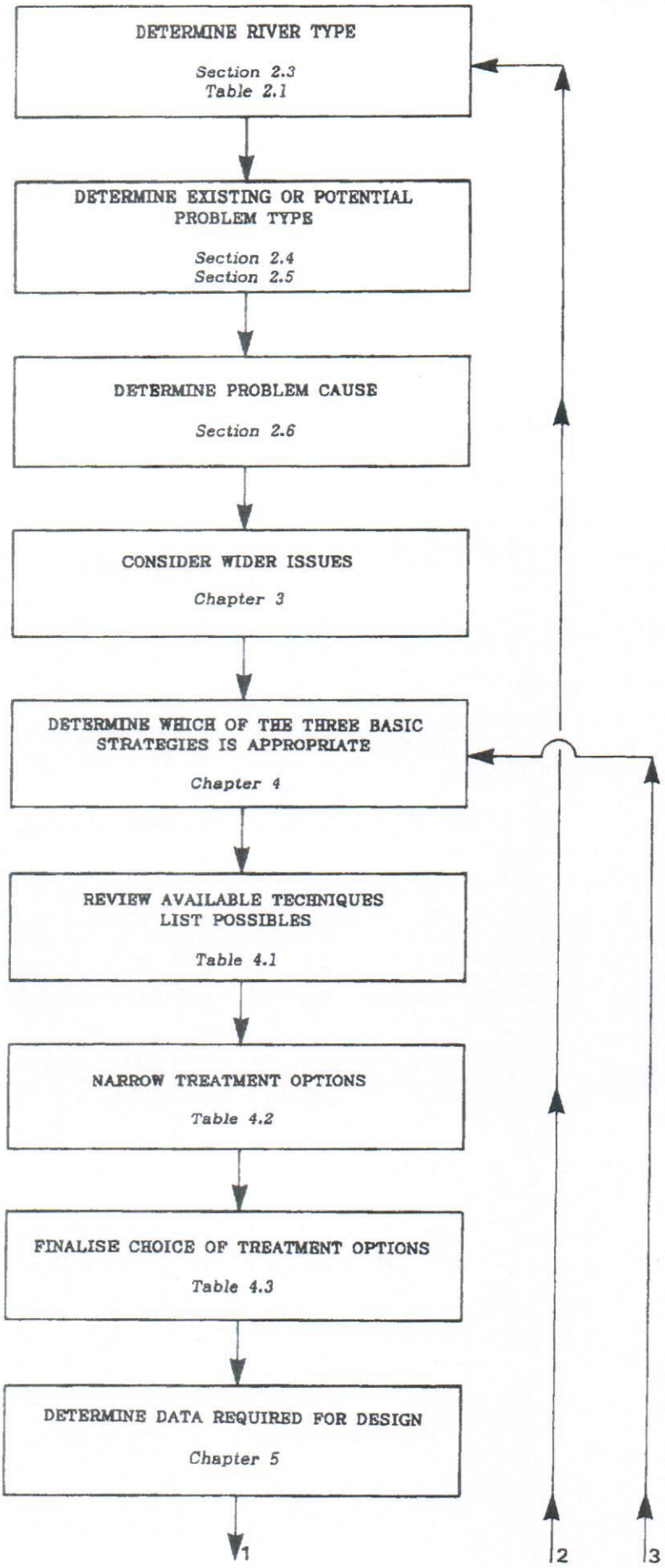

FIGURE 1.1 PROCEDURE FOR USING THE

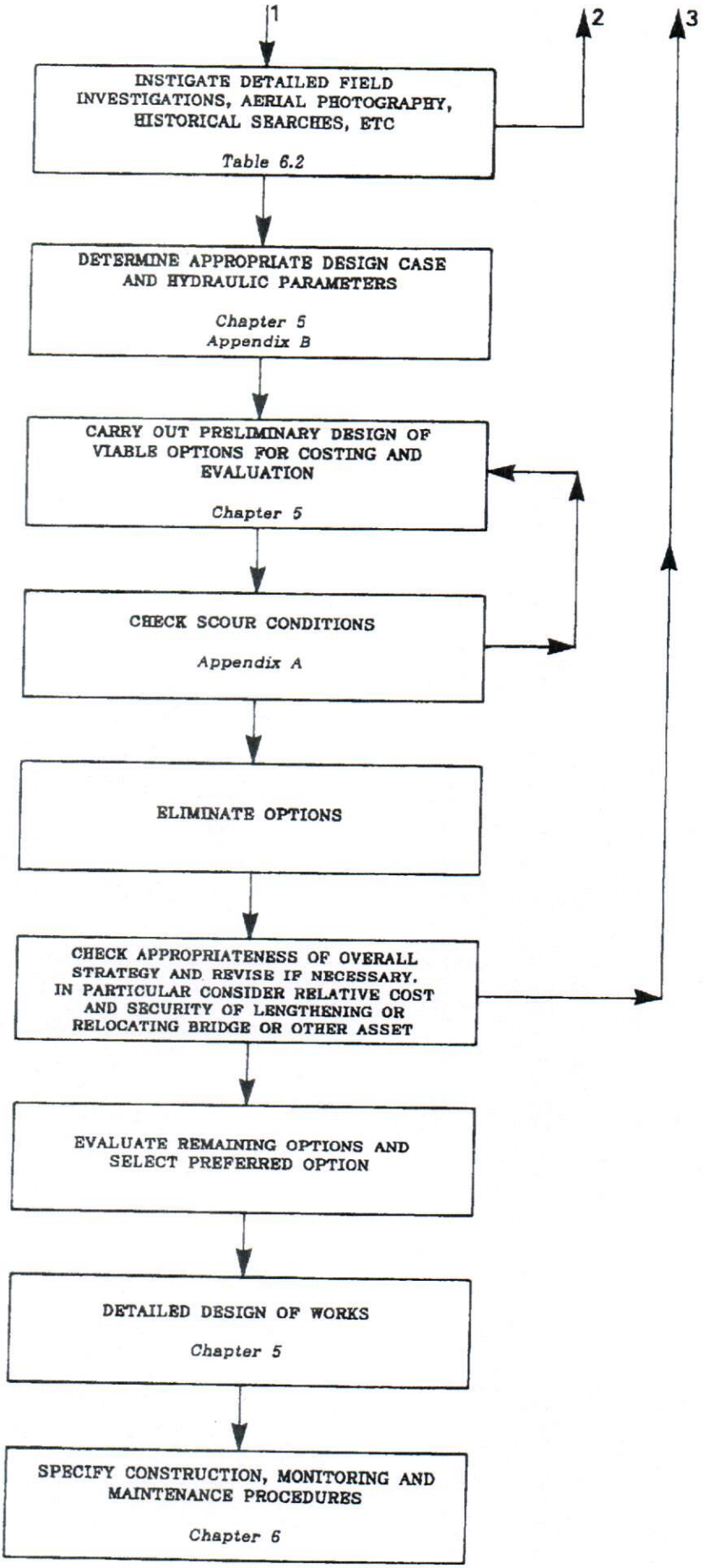

FIGURE 1.1 (Cont.) PROCEDURE FOR USING THE MANUAL