Ministry of Works, Transport & Infrastructure

ADAPTATION FUND FOR CLIMATE CHANGE

REVIEW OF NATIONAL ROAD STANDARDS IN SAMOA

Draft Final Report

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IPA

'Engineering & Management Consultants'

In association with:

JMConsult

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ACRONYMS AND ABBREVIATIONS

ACC	Accident Compensation Corporation
AS	Australian Standard
AustRoads	Australian Roads Transport and Traffic Agency
CBR	California Bearing Ratio
CIR	Cross Island Road
CRS	Crash Reduction Study
DFAT	Department of Foreign Affairs and Trade (Australia)
ESA	Equivalent Standard Axel
IPA	Isikuki Punivalu & Asscoiates Ltd
ISO	International Organization for Standards
JMC	James Matamu Consultant
LHD	Left Hand Drive vehicle
LTA	Land Transport Authority
MOTSAM	Manual of Traffic Signs and Manual
MWTI	Ministry of Works Transport and Infrastructure
NZ	New Zealand
NZTA	New Zealand Transport Agency
RHD	Right Hand Drive vehicle
SAMS	Samoa Asset Management System
SHGDM	State Highway Geometric Design Manual
SMEC	Snowy Mountain Engineering Corporation
TISRSS	Transport Infrastructure Sector Reform and Strengthening Strategy
TOR	Terms of Reference
UK	United Kingdom
UK TRRL	United Kingdom Road Research Laboratory
WB	World Bank

EXECUTIVE SUMMARY

Our town and our villages have progressively evolved over the years. So should our transportation system. As the growth of imported vehicles and their significance to the growing community increases, the transportation network is also proving increasingly important to our countries economic and agricultural developments. The transportation system connects people, towns, villages, jobs and businesses to places and each other. Most importantly, it enables farmers to connect and work on their plantations located further inland. Equally important is a transport network that is resilient to the rising natural disasters.

Generally, Road Standards are necessary in the design and construction of a superior, long lasting and safe transportation system for our people. A review of Samoa's National Road Standards was therefore prompted by MWTI to consider their effectiveness in the design and construction of our roads, and provide recommendations on the compatibility of the standards with the needs of our growing community. However, design standards were not available at the commencement of this service therefore it shifted the approach to more of a research basis to find out whether there any local design standards existed. As a result, consultations with relevant stakeholders were undertaken in which confirmed that Samoa does not have National Road Standards as a guide in the design and construction of national roads. It became evident that, over the years the standards and methods used for the design and construction of our road infrastructure depended on how projects were funded. Overseas standards were referred to when it is a World Bank or donor funded project. The main referenced overseas standards were the Australian Road Standards (Austroads), New Zealand Standards (Transit NZ aka NZTA) and the UK road Standards in the design of Road Geometrics, Road Safety and Traffic Engineering and Pavement Designs.

On the other hand, locally funded projects relied on a mixture of Austroads, Transit NZ and UK road standards. It was noted during consultation that for locally funded projects, there was a combination or mixture of Austroads, NZTA and UK standards and methods to design and construct public roads. In some instances, quick fix decisions were used to solve issues immediately on hand or to suit local conditions.

This report will provide an assessment on the effectiveness and reliability of these overseas standards and existing applied local processes as a guide for the design and construction of our public roads. The road infrastructure consists of a number of interlinking areas; however the timeframe provided was not sufficient to review every aspect of the road network. Therefore, for the purposes of this assignment three core areas were examined. These areas should be sufficient to ascertain the effectiveness and reliability of the overseas and applied local standards. They are: Road Geometrics, Road Safety/Traffic Engineering and Pavement Technology.

The assessment involved consultation with relevant stakeholders and conducting onsite assessments of the existing facilities and road furniture on our national roads. The main underlying finding from the onsite assessments highlighted that applied local processes and the mix application of Austroad, NZTA and UK in the design and construction of our national roads is unreliable and unsound. Also, some of the overseas standards and methods used do not suit our local conditions. It was therefore recommended that a comprehensive National Road Standards uniquely Samoa should be established by primarily adopting Austroads standards and provide supplementary or companion document that modifies the standards to suit Samoa's local conditions.

Furthermore, this report will provide an assessment of other factors that have contributed to the failure of our road infrastructure. They are: Budget constraints, Planning, Limited Capacity. The Government must address these factors as a matter of priority to ensure the successful operation and regulation of Samoa's national roads. These factors will be examined thoroughly later in this report.

Lastly, given the recommendation to develop National Road Standards for Samoa this report will provide a draft process for the development of a National Road Standard for the design and construction of our public roads.

1. INTRODUCTION

1.1 Background

Isikuki Punivalu & Associates Ltd (IPA) and James Moeono Consultants (JM Consult) partnered up to submit a proposal for this assignment. The local experience of the two company principals within road design and construction provides the consultants with a very experienced team to review all design construction standards for Samoa roads.

The Client, the Ministry of Works, Transport & Infrastructure (MWTI), hired the consultant team for this review in August 2016. The observation made by the consultants from their years of local experience in undertaking road design and construction is that Samoa's roads have been designed and constructed according to Australian and New Zealand standards. As most engineers received their qualifications from overseas institutions, it became easy for Samoa to utilize Australian and New Zealand standards for their roads. Despite these acceptable standards, there appears to be concerns raised by the public and Government in regards to the quality of local roads. That is, the local roads seem to fail in some way not long after construction which has raised questions and concerns from the general public and Government about why Samoa doesn't have local road standards. That is, the perception created is that the lack of quality roads is misconstrued as a lack of standards for road design and road construction. Political leaders have questioned MWTI and the Land Transport Authority (LTA) about the lack of existence of these standards. In addition to the lack of standards for locally funded roads, those roads which were funded under Samoa's Development Partners (World Bank (WB) and Department of Foreign Affairs and Trade (DFAT)) appear to be more durable and to have been constructed properly. These two perceptions are part of the main reasons behind the need for this consultancy.

1.2 Scope of Services

The objective of this assignment is to review road design standards currently used in Samoa. The consultants are to look at the standards currently being used by the LTA and the engineering and contracting industry in Samoa and come up with recommendations for their suitability and appropriateness for Samoa. The consultants' review should include cross drainage structures, pavement designs and construction standards for earthworks, aggregates, gravel and any other material for pavement. The consultant is to review what kind of sealing works is appropriate for Samoa (like bitumen sealing's with chip seals and asphalt surfacing), review the standard of road surfacing and delineations, road construction and maintenance methodology along with testing standards for road construction. The consultant should provide clear recommendations for the upgrade or update of any existing standards or propose recommendations for developing new standards for Samoa's road design and construction. Furthermore, the consultant is to come up with a draft terms of reference for further technical assistance to develop the recommendations.

1.3 Purpose of the Review of National Standards

The purpose of the review of national standards is to come up with a 'draft process' that recommends the approach to undertake for the development of Samoa National Road Design and Construction Standards. The work is to examine what has been adopted already by Samoa as its road standards for geometric and pavement design and then come up with a recommendation for a standard to be adopted for Samoa's roads. It is also good to note here that existing design materials from AustRoads and New Zealand Transport Agency (NZTA) were used in the past and shall continue to be used in the

future for Samoa. What will be more transparent shall be road speeds to be used for design national standards and what kind of delineation to be used by Samoa for road safety purposes. There needs to be more certainty of what can be utilized in Samoa as far as road design and construction is concerned. From there, lessons can be learnt and adoptions made on what is best for local roads for the future. A Table of Contents and Terms of Reference are the main deliverables of this Consultancy work, with the technical assistance consultant (hired via the TOR produced) will expand and develop the documents for future engineering design and construction of roads. It is hoped that these standards can be used both by MWTI and LTA and any other developer or individual that will be involved with road construction in Samoa. These documents will also lead to official documents to be used as reference for future road developments in Samoa.

1.4 Existing Standards

Design standards for review were not available at the commencement of this service therefore, consultation with LTA was necessary to discuss and validate the existence of design standards and if none existed, to find out what was/is currently adopted to guide the design and development of roads and its facilities for Samoa national roads. The Consultants were however given specifications for road construction by the LTA. This was the only document that was handed over for review. The lack of a design standard document for review did not mean that Samoa's roads were not designed properly, only that there is an absence of local road design standards. After almost 4 weeks of consultations with relevant stakeholders it was confirmed that Samoa used AustRoads and NZTA Design Standards for the design of local roads. That is, there was never a document which was compiled for Samoa's Road Design Standards. The review of past road design reports (e.g. Vaitele Street and other roads) and road onsite assessments constituted as part of the review undertaken by the Consultants for this assignment. In regards to construction standards, the feedback from consultations with the LTA and local engineers and contractors were taken on board as part of this review.

2. DESIGN STANDARDS ASSESSMENT

A consultation meeting with LTA technical staff confirmed three issues: (1) as mentioned above, there were no documented local design standards for Samoa. The only locally developed document that sits with LTA were the 4-volumes of technical specifications. Technical specifications and design standards are not the same because both have different purposes in relation to the construction of roads. For example: The technical specification specifies the installation of marking and signage which relates to material types and application methods. However, design standards govern the layout of paint markings, sign types, setouts and other road furniture. According to LTA, national roads are being designed using these technical specifications. It must be noted that because technical specifications are different from design standards they are not a reliable guide for design purposes. (2) the NZTA Manual of Traffic Signs and Markings (MOTSAM)had been the main referenced document for the design of road signs and line markings on national roads. (3) In practice, design consultants who had been engaged on World Bank funding projects have been referring to Austroads and NZ Transport Agency (previously Transit NZ) standards for design purposes. For example, the Apia Road Network and Traffic Management Study Phase II (Contract No B4.01) project in 2005 which includes the design of the Vaitele Street 4-lane road between Maluafou to Vailoa was referring to Austroads, NZ and UK design standards.

The practice of referencing to overseas standards depended on the background and preference of the engineers involved, such as their educational background and work experience. However, one must bear in mind that the road standards and methods of these overseas countries were tested and established based on their own experience and research with the performance of their materials and environmental conditions.

Given that there are currently no comprehensive local design standards to guide the construction of local roads, it is essential to conduct onsite assessments to check the reliability of the existing facilities and road furniture on national roads. Focus was also directed at the impact on road users of the interchangeable use of Austroads and NZTA standards to design World Bank funded projects and other roads in Samoa.

During consultation with LTA, discussions and questions were directed on the following design areas:

(i) Road Safety design standards on the following road safety areas:
   a. Crash database and treatments of crash locations;
   b. Pedestrian Facilities (footpaths and crossings);
   c. Pavement Marking; and
   d. Traffic Signage.
(ii) Geometric design standards; and
(iii) Pavement design standards.

2.1 Road Safety Design Standard Findings

2.1.1. Pedestrian Facilities (footpaths and crossings)

No records of pedestrian injuries on national roads **-**The number of pedestrian injuries while using footpaths and crossings on national roads is one of the most reliable indicators as to the effectiveness and safety of Samoa's national roads. This data is significant because it would enable road designers and decision makers to verify whether the pedestrian facilities on national roads are operating properly. However, consultation with relevant members of the Road Safety Committee confirmed that there is no system for reporting and recording pedestrian injuries, therefore there are no recorded data of pedestrian injuries on national roads.

Inconsistent Markings **-** There is an obvious inconsistency in the color of paint and the patterns of crossing bars on pedestrian crossings identified on Samoa Road Network. There is also an inconsistency in the markings of 'limit lines' and 'no stopping lines' around these pedestrian crossings. There is great danger in having different colored pedestrian crossings and markings around the crossings as this is highly likely to cause confusion amongst drivers and pedestrians.

During the onsite assessment, two types of pedestrian crossings were observed on two separate road projects that were both funded by the World Bank. One is on a two-lane two-way road (shown in Photo 1) and the other one is on a four-lane two-way road (shown in Photo 2). Both crossings were designed to Austroads and NZTA Standards and both look very different from one another in terms of color, size, patterns and markings. The obvious differences are the yellow and white marked crossing bars. In photo

1, the pedestrian crossing is painted with white crossing bars on a flat surface, whilst in photo 2 the pedestrian crossing is painted with parallel yellow crossing bars on a raised surface.

The pedestrian crossing in photo 2 has 'limit lines' and 'no stopping lines' on road edges. Photo 2 also has white diamond markings on each side to warn motorists of the pedestrian crossing ahead. However, the pedestrian crossing in photo 1 does not have 'limit lines', no 'stopping lines' and no white diamond markings. The "limit lines" are important to inform drivers on safe distance to STOP at a pedestrian crossing to allow pedestrians to cross safely. The "no-stopping lines" at edges of seal are to inform drivers that they are not allowed to park or stop at all times along these sections of the road.
Photo 3 shows the 3rd type of pedestrian crossing in existence in Samoa. This is an in-house design by LTA. The crossing bars are yellow zig zag patterns on a raised surface with no limit lines. There are no "limit lines" and "stopping lines". There were also no other markings and signs around the crossing as per NZTA standard. When LTA technical staff was asked to provide comments on existing design standards for pedestrian facilities on national roads, they responded by saying that there were a range of mixed standards that LTA referred to but their application on each project depends on what is most suitable to Samoa local conditions. They were not able to elaborate further on this statement in relation to suitable local conditions.

Photo 1 – Pedestrian Crossing with parallel white crossing bars on flat surface - designed and constructed using Austroads & NZTA Stds, WB funded project

Photo 2 – Pedestrian Crossing with parallel yellow crossing bars on raised platform with white limit lines etc. – designed & constructed using Austroads & NZTA Stds, WB funded project

Photo 3 – Pedestrian Crossing with zig zag yellow crossing bars on raised platform – LTA in house design

Lack of pedestrian facilities in school zones - There are quite a number of schools situated in urban and suburban congested traffic zones with inappropriate or lack of pedestrian facilities to ensure safety for school pupils. The most critical is the narrow widths of road shoulders for school pupils and pedestrians to walk on. This is a safety issue that requires road improvements to avoid serious injuries and fatalities. It is noted that Austroads and NZTA Standards place great emphasis on pedestrian safety in school zones. For example, NZTA standards use clear warning signs to mark the beginning and ending of school zones and flashing road signs to indicate the reduction of speed limit as safe speed to drive within a school zone.

Substandard Pedestrian crossings v speed humps - The most common types of pedestrian crossings and speed humps identified on the Samoa network are the facilities with raised platforms with crossing bars painted yellow. It is observed with interest that all pedestrian crossings on Samoa's national roads look very similar to speed humps. These pedestrian crossings and speed humps had not been designed in accordance with either the NZTA or Austroad standards. It is widely understood that pedestrian crossings and speed humps serve different purposes. To state the obvious, pedestrian crossings were

designed to stop ongoing traffic and to give the priority to the pedestrian to cross to the other side of the road safely while speed humps were designed to reduce vehicle speed.

During the onsite assessment, it was observed that there was a great variation in the sizes of pedestrian crossings on the road network, making them look more like speed humps. It was also noticed that both the pedestrian crossings and speed humps have parallel crossing bars which were painted in yellow, and both facilities have the same marking patterns making them look identical to each other; thus obscuring their different purposes and further confusing and misinforming the road users. The inability of road users to differentiate between pedestrian crossings and speed humps is a real concern because of the safety issue arising from the lack of appropriate differentiation between the two facilities through color, size and marking patterns. In this case, the failure to follow appropriate design standards makes it difficult for road users to identify the difference between a speed hump and a pedestrian crossing. For example, it was observed that in some locations motorists driving towards a pedestrian crossing had no tendency to stop to give way to pedestrians because the pedestrian crossing looked like a speed hump, while on the other hand pedestrians would continue to walk across a speed hump despite ongoing traffic thinking it was a pedestrian crossing. The safety issue in this situation is very important because road users need to be able to differentiate between a pedestrian crossing and a speed hump in order for them to make well informed decisions on how to cross the road safely. Motorists on the other hand need to be able to make a distinction between a pedestrian crossing and a speed hump in order for them to discern when to stop the vehicle in order for pedestrians to cross the road safely.

Furthermore, it was observed that on some roads there was either a lack of or insufficient line markings and road signs to provide prior warning to motorists of pedestrian crossings up ahead. The concern here is again the safety issue. Accidents are highly likely if motorists are taken by surprise as to the existence of a pedestrian crossing up ahead without prior warning. The risk is high especially around school zones and residential areas where the behaviors of young children are unpredictable.

2.1.2. Traffic Signage

No traffic sign design standards - Technical staff of LTA advised that NZTA Manual of Traffic Signs and Markings (MOTSAM) "*Part I – Signs"* had been the main referenced document for the design of road signs on national roads.

An onsite assessment was carried out to confirm the reliability of traffic signs and whether the design requirements, policy and location of traffic signs as specified in the NZTA MOTSAM standard were met.

Unfortunately, the assessment revealed that all traffic signs on the Samoa road network do not meet the requirements of the NZTA design standards as specified. Some of the obvious issues that were identified onsite were as follows:

(i) Most of the roads do not have any traffic signs at all, especially regulatory speed limit signs. This is a safety issue as lack of regulatory speed limit signs provides motorists with the freedom or excuse to speed on low speed environment zones or around school/residential areas. It also provides motorists with the freedom to drive very slowly on high speed environment zones. It was observed

that taxi drivers had the great tendency to drive very slowly while looking around for passengers while a queue of cars is forming from behind;

(ii) The regulatory speed limit signs all along Vaitele Street 4 lanes were not designed according to MOTSAM standard. Photo 4(a) shows an example of a speed limit sign currently on Vaitele Street. Photo 4(c) shows an example of a speed limit sign found on other roads in Samoa. The MOTSAM speed limit regulatory standard dictates that traffic signs must have black legend, have background that is reflectorized white and the border is reflectorized red. Photo 4(b) is an example of a regulatory sign which complies with MOTSAM standard. By comparing all three speed limit signs on the photos provided, it is apparent that the speed limit signs on Vaitele Street: photo 4(a) and the sign on other roads: 4(c) do not comply with MOTSAM. The regulatory speed limit sign as shown on photo 4(b) could not be found anywhere on the road network.

(iii) The speed limit signs currently used on the road network posts two sets of speed limits: refer to Photos 4(a) and 4(c). The speed limit on one single sign shows both the metric and imperial units. According to NZTA and Austroads, this is a safety issue because too much information on a single sign often confuses motorists. There are too many information to take in by a motorist who is concentrating on driving the vehicle. A comparison of photos 4(a), 4(b) and 4(c) below shows that the NZTA MOTSAM speed limit regulatory sign is much easier to read, less confusing and can clearly be seen by drivers as opposed to the two signs in photos 4(a) and 4(c).

In addition, these signs have been checked during nighttime and it is found that they are not retro reflective. Retro-reflectivity occurs at night and is an interaction between the driver, vehicle headlights and a road sign.

It should be noted that after the road switch on September 2009, Samoa is no longer using the American system. Photos 4(a) and 4(c) shows current examples of signs which are still showing miles per hour (mph). Prior to the road switch, most left hand drive (LHD) vehicles imported into Samoa were from the United States or American Samoa. The speedometers for all LHD vehicles' are measured in Miles Per Hour (MPH) while Right Hand Drive (RHD) vehicles speedometers are measured in Kilometers Per Hour (KPH). However, after the road switch only Right Hand Drive (RHD) vehicles were allowed to be imported into Samoa and the importation of LHD vehicles were prohibited. Therefore, it makes no sense at all posting mph on signs all over Samoa's national roads given that LHD vehicles are prohibited from entering Samoa and all RHD vehicles' speedometers are measured in KPH. The letters 'mph' posted on regulatory speed limit signs should be removed to reflect Samoa's current road system. Removing mph would alleviate having too much unnecessary information posted on signs, avoid providing misinformation to motorists and would be a step closer to complying with the NZTA MOTSAM regulatory speed limit standard.

Photo 4(a)–Speed Limit Regulatory Signs on Vaitele St

Photo 4(b) – NZTA MOTSAM Speed Limit Regulatory Sign for 50kph

Photo 4(c) – Speed Limit Regulatory Signs on other roads

(iv) Consultation with LTA divulged that some of the speed limit signs were being manufactured and supplied locally. Given that most or all of the speed limit signs as mentioned above do not meet NZTA MOTSAM standard, it was very important to discern what specifications were used to manufacture these signs, who was responsible for the quality assurance to ensure they meet the specifications and why these signs were not designed to MOTSAM standards?

(v) Neglected road signs -There is a lack of maintenance of road signs, and at some places they serve no purpose or meaning to motorists. In some roads, there are road signs to warn motorists of speed-humps up ahead but in actual fact there are no speed-humps (refer to Photo 5(a)). Photo 5(a) shows a speed hump road sign obscured by overgrown hedges, however in traveling further ahead no speed hump was found. The speed hump was either removed leaving the sign behind or the sign was placed there by an oversight of contractors. This could be seen as misinforming or misleading road users, and it is advisable to take them down rather than leaving them standing idle on road reserve.

(vi) There were signs on some roads that were damaged and vandalized (refer to Photo 5(b)) but were still left standing there instead of replacing them with new signs. The sign in photo 5(b) is obscured by writings making it impossible for motorists to determine the message on the sign. Some were seen hidden behind overgrown hedges and trees thus also obscuring the information on the sign (refer to Photos 5(a) and 5(c) below).

These are all safety issues because if these signs were not properly maintained drivers would have no idea of the hazards awaiting them up ahead. This can also be a legal issue against the Government, especially when a driver accidentally hits a pedestrian on a crossing because he/she did not know there was a crossing up ahead. Motorists could argue that there were no proper signs or lack of clear signs to warn of the pedestrian crossing up ahead.

Photo 5(a)– Inappropriate sign no longer needed & covered with overgrown hedges

Photo 5(b) – Vandalized warning sign

Photo 5(c) – Regulatory sign behind overgrown hedges

2.1.3. Pavement Markings

Double standards - Technical staff of LTA advised that NZTA Manual of Traffic Signs and Markings (MOTSAM) "*Part II – Markings" was* the main referenced document for the design of line markings on Samoa national roads.

An onsite assessment was carried out to confirm the reliability of current pavement markings and whether the design requirements of pavement markings as specified in the NZTA MOTSAM standard were met.

There are currently no policies or standards for the design requirements of the 3 classes of roads such as class 1: primary, class 2: secondary and class 3: tertiary. Therefore, it was difficult to determine why some roads have marked edges and some do not. For example, photos 6a, 6b, 7a and 7b are photos of four different class 1 roads. It was noted that despite these roads all being class 1 roads, the markings on the edges of each road all differs. This can be further clarified below:

- Photos 6a below shows Papaseea Class 1 road with an asphaltic sealed surface and marked edge-lines.
- Photo 6b shows Maugafolau Class 1 road with a chipseal surface and no edge-lines.
- Photo 7a and 7b shows both Talimatau Road and Vaitele Street as 4-lane roads, and both are class 1 roads however, Talimatau Road have no edge lines and Vaitele Street does.

Photo 6a –Papasesea Road (Class 1)

Photo 6b –Maugafolau Road (Class 1)

Photo 7a – Talimatau 4-lane Road (Class 1)

Photo 7b – Vaitele Street 4-lane Road (Class 1)

LTA was asked to provide reasons for these differences however they were unable to explain. It can however be inferred that due to the lack of design standards for the 3 classes of roads, the marking of the road edges was left to the discretion of the contractors and/or the LTA project manager.

This lack of standards is another major concern for road users given that the "pavement markings and other delineation devices on the road surface and adjacent to the roadway contribute to the overall operational efficiency of a roadway[1]". It is noted that "pavement marking can increase traffic capacity, improve safety and contribute to the orderly use of design paths by drivers, particularly at critical points in the road system…" Furthermore, "roadside markings and delineation devices assist drivers in their assessment of changes in the road alignment, particularly at night. Roadside markings also highlight the position of features within the road system that may be geometrically substandard or constitute a hazard to the motorist."[2]

2.2 Geometric Design Standards:

Samoa Road Classification and Hierarchy - Prior to the review of local standards that are currently being used by LTA and the engineering industry in Samoa for road geometric designs, it is crucial to understand the classifications of Samoa national roads with regards to their assigned purposes and functions in the network. Equally important is the need to identify if there are any policies in place to guide the management and design of various classes of national roads.

No policy document to define Samoa Road Classification - It was unsuccessful to obtain any approved policy document that provided detailed criteria and definitions of the existing classifications of Samoa national roads. The designation of a roadway in a particular hierarchy category is useful only when there are complimentary management policies to implement the designation.

The Samoa Road Sector Plan Update Report[3] by SMEC which contains the Samoa national road program (2007-2011) has stated the resumption of the Samoa Asset Management System (SAMS) in 2006 where MWTI introduced a modified road hierarchy. According to SMEC, the previous classification of roads in Samoa was based on the volumes of traffic, and was divided into four functional levels. They were: Highways, Strategic routes, Distributor roads and Local roads (including access roads). The modified road hierarchy by SMEC in 2006 is the current one which consists of 3 classes of roads, namely: Class 1-

[1] NZTA MOTSAM Part II - Markings
[2] Ibid
[3] Report document no.54012.020 - Prepared by Snowy Mountains Engineering Corporation (SMEC), April 2007 for the Government of Samoa through the Ministry of Works, Transport and Infrastructure under the project: Transport and Infrastructure Sector Reform and Strengthening Services (TISRSS)

Primary roads, Class 2-Secondary roads and Class 3-Tertiary roads. Class 1 is the highest class in the hierarchy and Class 3 is the lowest class. SMEC report did not produce any management policies for their modified classification of roads however they referenced a couple of tables from the 20th Australian Road Research Board (ARRB) Conference in Melbourne in 2001 as a recommended approach to establishing a road hierarchy framework that is suitable for Samoa.

No local geometric design standard - It was confirmed at the consultation meeting with LTA technical staff that there are no local geometric design standards or approved set of procedures in place for the geometric designs of Samoa national roads. There are a whole lot of reasons why geometric design is not a required task for local funding projects. For instance, the limited budget and time restrictions for each road project. However, when it came to donor funded road projects, geometric design is very important and all the required steps in a geometric design process must be carried through. For example: Vaitele Street 4-laning, West Coast road widening and Cross Island road widening were all World Bank funded road projects and were all geometrically designed.

The design consultants who were engaged on donor funding projects have been referencing the following geometric design standards: *NZTA 2000 State Highway Geometric Design Manual (SHGDM) and the Austroad 2003 A Guide to the Geometric Design of Rural Roads*.

NZTA (previously TNZ) published their Draft State Highway Geometric Design Manual (SHGDM) in the year 2000. Amendments from time to time were made on this document. NZ was unsure whether this document would become a fully published Guide for NZ Geometric road designs, or whether the Austroad publication would become the main reference for NZ with a NZ Supplement where practice in NZ varied from that in Australia. It is not confirmed at this stage whether NZ have developed a NZ Supplement of the Austroad publication or are still using their Draft SHGDM 2000.

The 2003 Austroad publication for Geometric Design standard for rural roads has been updated and is now part of the Austroad Guide to Road Design "Part 3 - Geometric Design" 2016 publication.

2.3 Pavement Design Standards:

No local pavement design standards – Again there is no Samoan pavement design standard per se. In the absence of Samoan local standards for pavement design, design consultants hired on World Bank donor funding projects have reviewed the appropriateness of standards from other countries, principally New Zealand *(the NZ National Road Board (NRB) – Pavement Design and Rehabilitation Manual 1998") ,* Australia *(the Austroads Pavement Design Guide 2004")* and the United Kingdom *(the Transport and Road Research Laboratory United Kingdom Road Note 31 (TRRL road Note 31 – A Guide to the Structural Design of Bitumen Surfaced Roads in Tropical and Sub-Tropical Countries").*
In accordance to Design Reports by Beca NZ for the "Apia Road Network and Traffic Management Study Phase II, 2005 (Contract No B4.01)", the Austroads Pavement Design Manual was primarily used for the pavement designs and then compared with the pavement configurations obtained from using the TRRL road note 31. Beca NZ noted some differences in results between the two design standards when they

were applied to the pavement design of the Vaitele Street. For example: The design depths recommended by TRRL road Note 31 were greater than those given in Austroads for the same loading. It implies that both standards are applicable to our local conditions but needs to be cross checked to each other with regards to their design methods for better results and pavement options.

3. CONSTRUCTION STANDARDS ASSESSMENT

3.1 Volume One – General Specifications

Volume One deals with the General Provisions of a contract/construction project. The following sections are covered in detail:

3.1.1. G1 General Provision

- Contract Scope of works;
- Site access parameters;
- Survey information for the works;
- Setting out of the works. The contractor shall be provided with adequate survey points either on or off site from which to base his setting on;
- Services that are affected and works in proximity to the services;
- Site Offices and Storage conditions;
- Materials to be used, supply and disposal;
- Record keeping of personnel, plant, inspections and testing;
- Reporting requirements ;
- Meetings requirements for the project;
- Construction program and cash flow information;
- Standards to be used for the contract;
- Project Identification sign requirement for the works;
- Temporary Access Bridge;
- Construction loading on bridges;
- Construction loading on culverts;
- Stream flow and flooding;
- Inclusion of costs;
- Limits of accuracy;
- Progress payments;
- Requirements of other authorities;
- Report on contract administration personnel;

Review Outcome:

- *The above general provisions are required for any contract that is undertaken for the construction of roads. While there are many general provisions, this review concludes that there are no sections within the general provision which are recommended for removal or amendment as all are applicable in terms of Samoa's context.*

3.1.2. G2 - Contract Management Plan

The contract management plans that are required for project implementation consist of 'Environmental Management Plan'; 'Quality Plan'; 'Occupational Health and Safety Plan'; 'Traffic Management Plan'; 'Durability and Life Assurance Plan' and 'Procedures and Maintenance Procedures' for the Defect Liability Period. The following sections are part of this contract management plan:

- Submissions and approval – this talks about the approval for the use of land not in the contract site, pits and quarries, cartage over existing roads, traffic diversions and detours;
- Environmental Management Plan – the EMP shall be according to Samoan legislation and guidelines *(not Australia Standards)* deals with site meetings, noise, archaeological, botanical and heritage features, artifacts, protection of works, topsoil, runoff, hazardous materials, site quarantine, lighting of fires, blasting and structurally damaging processes;
- Quality – a quality system must be in place and must follow the performance requirement of the contract and Australian Standards ISO9001.
- Occupational Health and Safety – these plans are for the health and safety of the work place and to make sure it is well covered in regard to heath, safety, hazards, risk and safety management plan. If there are any incidents, the contractor is obliged to notify the engineer within 7 days of the incident/accident.
- Traffic Management – they are required for directing the traffic during construction and it needs prior approval before the works begin.
- Public contact – issue to do with public contact.
- Durability and Life Assurance Plan and Procedures.
- Maintenance Procedures.

Review Outcome:
- *The above contract provision is to be part of the construction specifications. The EMP requirement should be Samoan legislation and guidelines (not Australian Standards).*

3.1.3. G4–Compaction Assessment

This specification is for methods required for assessment of compaction of material for the road. The specification has the following sections:

- Definition of terms;
- Test methods that are relevant to the specifications;
- Calculations;
- Acceptance Criteria;
- Control Charts;
- Reduction in road works testing frequency;
- Conduct and Reporting of Roller Trial;

Review Outcome:
- *The above assessments are all necessary for carrying out compaction assessment for road construction.*

3.1.4. G5 – Descriptive Terms in Geomechanics

These are the notes to summarise the terminology used for boreholes and excavation logs. While this specification may not be in used all the time, it is still a requirement for road construction. The specification has the following sections:

- Soil Description;
- Rock Description;
- Interpretation and presentation of seismic information;
- Terms and Test Methods used in Pavement Investigation;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.1.5. G6 – Quarried Materials

This specification sets out the minimum requirements for assessment of the source of rock to be used for the construction of the roads. It shall be a quality control classification into durability grades. The specification has the following sections:

- Objectives – it has the specifications for aggregate strength and durability that are to be supplied to LTA contracts for the construction of the roads.
- Contractors Responsibility;
- References – it refer to Australian Standard references to be used for Quarried materials
- Definitions – refer to AS2758 definitions of source of rock, material type, durability grade, and reference specimen;
- Source rock assessment;
- Frequency of testing;
- Durability grades;
- Quality Assurance;
- Appendix 1 – explanatory notes: These notes are to ensure that stone and aggregates supplied to the Principal have the specified aggregate strength and durability requirements and that the quality of the product is both uniform and verifiable. To achieve the above, the specification defines the minimum requirements for assessment of the rock source and production quality control.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2 Volume Two – Road Construction Standards

The current LTA Roads Construction Standards is a replica of the Department of Infrastructure, Energy and Resources, Tasmania Roadworks Specifications. These must have been put together by an engineer from Tasmania during Public Works time and later adopted by MWTI/LTA. The following work details are covered under this Volume Two:

3.2.1. R21 – Clearing and Grubbing

The specification covers the removal and disposal of trees, brush, logs, roots and other deleterious matter resting on the original ground surface of the road. It covers the following:

- Extent of Work
- Removal of Material
- Removal of Incidental Structures
- Preserved Areas
- Restoration of Cleared Site

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.2. R22 – Earthworks

The specification sets out the requirements for the excavation of cuttings, construction of embankments and sound mounds, disposal of surplus and unsuitable materials and treatment of local existing pavement failure areas. It covers the following:

- General – Tolerances; Geo-textile Separation Layer; Drainage Blankets; Treatment at Joints with Existing Roads; Stockpile Sites
- Excavation – Description of Works; Classification of Material to be Excavated; Over-Excavation; Excavated Material; Imported Embankment Material; Imported Embankment Material; Local Existing Pavement Failures Areas; Treatment of Redundant Road
- Embankments – Embankment foundation; embankment construction and sound attenuation mounds
- Treatment of Batters and Top Soiling – Earth Excavation Batter Treatment; Embankment Batter Treatment; Top soiling

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.3. R23 – Subgrade Zone

This specification is missing from LTA's specifications. It should be the specification that sets the requirement for the sub-grade zone in ordinary excavations and on embankments. This is the 200mm layer immediately below the design formation level.

Review Outcome:
- *The R23 should be developed as part of National Road Standards Specification.*

3.2.4. R24 – Geotextiles

This specification provides a classification of geo-textiles for use in road and bridge works. It covers the following:

- Material;
- Definitions of terms;
- Geo-textile classification;
- Handling and storage;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.5. R31 – Open Drains and Channels

The specification covers the construction of open drains associated with roadwork's and storm water facilities in permanent materials, and of open channels for permanent stream diversions. It covers the following:

- Open Drains
  - Surface Drains
  - Table Drains and Median Drains
  - Batter Drains
- Open Channels
  - Culvert Inlet and Oulet Channels
  - Open Channels for Steam Diversions
  - Excavations
- Lining of Drains and Channels
  - Rock Lining
  - Concrete Lining of Open Drain

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.6. R32 – Drainage: Culverts, Pipelines and Structures

This specification outlines the requirements for the construction of drainage culverts, pipelines and structures. The purpose of the specification is to ensure that road drainage infrastructure is constructed to appropriate standards using acceptable materials and that it continues to function as intended after construction is completed. The specification covers the following sections:

- References of Australia Standards for pipes, culverts, seals, tests for elastormers and code of practice for UPVC pipes
- Materials to be used as concrete pipes and fittings, PVC pipes and Fittings; Rubber Rings and External Rubber Bands; according to AS
- Access Chambers
- Precast Concrete Units
- Pipe Bedding and Support
- Setting Out
- Excavation
- Trench Base
- Intersecting Services
- Removal of Existing Pipeworks
- Bedding
- Pipe Laying and Jointing

- Trench Backfilling
- Miscellaneous Drainage Structures

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.7. R33 – Subsoil Drains

The specification describes the construction of subsoil drains, including excavation and backfilling of trenches, supply and installation of all materials and provision of markers. The specification covers the following sections:

- Materials used in subsoil drains consist of perforated drainage pipe; filter material; geotextile filter
- Installation of trenches; laying drains; backfilling and compaction; geotextile lining; outlets; flush points;
- Drain markers;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.8. R36 – Kerb and Gutter

The specification describes the construction of concrete kerbs, kerbs and gutters, v-gutters, edge strips, kerb ramps and gutter crossing at the location shown on the drawings and to the detailed dimensions shown on the standard drawings. The specification covers the following sections:

- Materials – concrete and pavement materials;
- Foundation preparation – kerb, kerb and gutter, kerb ramps and gutter crossings for new pavement and existing pavement;
- V-gutters and Edge Strips;
- M3 Mountable Kerb and B3 Barrier Kerb;
- Construction – in situ form construction; machine extrusion construction and joints; temporary installation of precast units; M3 mountable kerb- permanent installation; v-gutter and edge strips; tolerances; curing and protection;
- Removal of existing kerbs and related units.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.9. R40 – Pavement Base and Sub-base

This specification sets out the requirement for materials used as base and sub-base. The objective is to make sure the material provides a durable structure under a specified strength. The following sections are covered under this specification:

- Reference of Australian Standard used for testing the materials;
- The definitions of terms used for this specifications;
- The nomination of material;
- Material quality which specifies the grading ratio limits; target grading limits; and material quality requirements;
- And Construction requirements;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.10. R41 – Unsealed Pavement Base

This specification sets out the requirements for materials and procedures to be used for the construction of base course on unsealed roads and unsealed shoulders. The objective of the specifications is to makes sure the road will be durable under traffic load and the weather. The specification includes the following sections:

- References for Australian Standards that are used for sampling and testing the materials;
- Definitions of terms used for this work like course aggregates, fine aggregates, etc.;
- Nomination of material;
- Material quality;
- And Construction responsibilities;

Samoa has a number of unsealed roads and this specification is very important for those roads

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.11. R42 Stabilization

This specification covers the requirements for the insitu stabilization of pavement layers by addition of cement, lime or other specified pozzolanic material. The requirements relate to preparation of existing pavement materials, quality of additive, construction plant, and spreading, mixing and compaction procedures.

Review Outcome:
- *Samoa doesn't have a specification for stabilization yet of the roads. This is a specification that needs to be developed for the construction of roads in this country. This stabilization method has recently been used for Vaitele St under the World Bank funded project.*

3.2.12. R51 Sprayed Bituminous Surfacing

The specifications set out the bituminous surfacing for various class of surfacing of Samoa's roads. The objective of the specification is to make sure that it is compatible with the underlying surface

and the expected future traffic and that it is constructed with durable and appropriate materials. The following sections covered with regards to this specification include:

- References to adhere to. The references nominated are NAASRA, AusRoads, APRG Technical Notes and Australian Standards. There are too many references and copies of these standards may not be available at all to contractors;
- Definition of terms used in this specifications;
- Material and Testings;
- Contractors Contract Management Plan;
- Design requirements;
- Procedures to follow;

Review Outcome:

- *This is a very technical area which has too many references and procedures to follow. It is an area which needs close revision and to make sure that all contractors with bituminous spray trucks follow closely.*

3.2.13. R55 Dense Graded Asphalt

The specification is for laying asphalt surfacing on the road pavement and footpaths. The specification covers the following sections:

- Materials use for the work;
- Mix requirements;
- Storage and delivery of the mix – what to do;
- Acceptance of asphalt supplied;
- Preparation of pavement;
- Spreading;
- Compaction;
- Acceptance of asphalt placed;
- Footpaths asphalts;
- Bridge Deck Joints;
- Protection of Services;

Review Outcome:

- *This is a very important specification and it needs to be looked into more closely. It is important that the user of the specifications monitors that the usage of this specification is adhered to at all times by contractors to ensure quality of asphalt for road pavements and footpaths.*

3.2.14. R56 Open Graded Asphalt

This specification sets out the requirements for the supply and laying of open graded asphalt as a surface wearing course. The following sections covered with regards to this specification include:

- Materials to be used for the work;
- Mix Requirements;
- Storage and Delivery of Mix - what to do;
- Temperatures of Binder, Aggregate and Asphalt;
- Acceptance of Asphalt Supplied;
- Placing and Compacting Asphalt;
- And Acceptance of Asphalt Placed;

Review Outcome:
- *Similar to R55 Dense Graded Asphalt specifications.*

3.2.15. R57 Bituminous Slurry Surfacing

This specification outlines the requirement for manufacturing and placement of bituminous slurry for use on road pavements. The following sections covered with regards to this specification include:

- Materials to use for this work
- Mix Design
- Provision of Plant
- Field Application
- Sampling and Testing
- Defective Work and Materials – the responsibility of the contractor

Review Outcome:
- *Similar to R55 Dense Graded Asphalt specifications.*

3.2.16. R61 Road Safety Barrier Systems

This specification outlines the requirements for the supply and installation of Road Safety Barrier Systems for the roads. The following sections covered with regards to this specification includes:

- References for this specification is from Australian Standards;
- Barrier Types;
- Materials to be used;
- Removal of Existing Barrier;
- And Installation;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.17. R62 Guide Posts and Delineator

This specification sets out the requirement for guideposts and delineators. The aim is to make sure that pedestrians and traffic are safe through a clear delineation of the road for all users, for all

weather conditions during the day and night. The following sections covered with regards to this specification include:

- References are to be Australian Standards;
- Performance Criteria of Posts and Delineators;
- Installation;
- Removal of Existing Guide Posts;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.18. R63 Signs

This specification sets out the requirements for the fabrication and installation of new signs and the removal and relocation of existing signs. The following sections covered with regards to this specification includes:

- References are from Australian Standards;
- Materials to be used for the signs;
- Preparations of sign panels;
- Sign facing;
- Stiffening of signs;
- Identification marks;
- Installation of signs;
- Removal of existing signs;
- And compliance;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.19. R64 Pavement Marking

This specification sets out the requirements for the supply, application and removal of pavement marking, materials, glass beads, aggregates, reflective raised pavement markers and temporary pavement tape. The following sections covered with regards to this specification include:

- References are from Australian Standards;
- Material used for marking;
- Contractors quality control records;
- Application;
- Tolerances;
- Workmanship;
- Protection of Works;
- Evidence of Compliance;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.2.20. R 81 – Minor Concrete Structures

This specification covers minor concrete structures on the road. The purpose of the specifications is to make sure that minor concrete structures are durable. The following sections covered with regards to this specification include:

- References are from Australian Standards;
- Definition of terms used;
- Materials;
- Construction;
- Testing of concrete;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3 Volume Four – Road Maintenance

These are the specifications that are used by Road Contractors for the maintenance of Samoa's roads.

3.3.1. MG1 General Provision

This specification sets out the general requirements for carrying out maintenance works on roads and bridges. The following sections covered with regards to this specification include:

- Definitions of terms used for the specification;
- Contractor's operation procedures;
- Emergency contacts;
- Request form third parties;
- Interaction with police;
- Information supplied by principal;
- Performance criteria;
- Extraordinary events;
- Health and safety;
- Bridgeworks – environmental requirements;
- Use of appropriate plant and equipment;
- Services;
- Detailing of maintenance operations;
- Annexure MG1 – A: Details of Emergency Contacts; this should list out the names and position of contractors' names and position for contact for notification of emergency works;

- Annexure MG1 – B: Inspection and Report Schedule. During the first week of the contract period. The contractor shall conduct a full inspection of the network in conjunction with the engineer.
- Annexure MG1 – C: Intervention Levels and Response Times for Routine Maintenance. The interventions are very detailed and it references the response time in days for 3 classes of roads and what intervention level to carry out. If these interventions are followed closely by Engineers (Client) and Contractors, there should be no problem with condition of roads. The interventions are for (1) Pavement and Paved Areas ;(2) Shoulders and Verges; (3) Drainages; (4) Traffic Facilities; (5) Landscaping and Litter; and (6) Bridge Maintenance.
- Annexure MG1 – D: Details of Office and Maintenance Depots. These are the details for contractor depots that are away from their main office. While the specification allows for this, however most contractors operate from their main Office in Apia/Salelologa and maintenance crew are dispatched daily from those main depots.
- Annexure MG1- E: Methods of Assessing Service Quality for Pavement; Structures; Drainage Systems; Signaling and Road Safety. These are the methods of assessing whether the contractor has performed their duties and responsibilities under the correct service quality. It defines the kind of pavement, structures, drainage system, signals and road safety; the service quality and measurements or detection of faults.
- Annexure MG1 – F – Productivity Estimates. This is the information pertaining to each contract. If this form is being filled by contractors, there should be sufficient data collected for the cost of maintenance each year. This will help with budget setting and budget estimates for maintenance cost of each road.
- Road Sweeping;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.2. MG11 – Repair of Potholes in Sealed Roads

This specification sets out the requirements for the repair of potholes in sealed roads. The following sections covered with regards to this specification include:

- Definition of pothole;
- Requirements for conforming;
- Preparation and repair;
- Performance criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.3. MG12 – Repairs of Edge Defects in Sealed Roads

This specification sets out the requirements for the repair of edge defects in sealed pavements. The following sections covered with regards to this specification include:

- Definition of defects;
- Requirements for specs;
- Preparation and Repair;
- Performance Criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.4. MR13 – Crack Treatment in Sealed Roads

This specification sets out the requirement for the repair of cracks in sealed surfaces. The following sections covered with regards to this specification include:

- Definitions of cracks;
- Requirement for specs;
- Performance criteria;

Review Outcome:
- *It is recommended to include photographs for the various types of cracks, to assist the contractor in the identification on cracks so that their proposed method of treatment is effective.*

3.3.5. MR14 – Deformation in Sealed Roads.

This specification sets out the requirements for the repair of deformations in sealed roads. The following sections covered with regards to this specification include:

- Definitions of deformations
- Requirements for deformations
- Performance criteria

Review Outcome:
- *It is recommended to include photographs for the various types of deformation to assist the contractor in determining the most effective form of treatment.*

3.3.6. MR15 – Grading and Maintenance of Unsealed Shoulders and Verges

This specification sets out the requirements for grading, re-sheeting, compaction and maintenance of unsealed shoulders and verges of sealed pavements. The following sections covered with regards to this specification include:

- Specification requirements;
- Performance criteria;

Review Outcome:

- *The maintenance of some of the shoulders and verges have created problems such as no road shoulders that can be used safely by vehicles to pull over on the side of the road due to the fact that these shoulders have been over graded by contractors for the removal of grassed areas to improve the flow of water from the pavement. It is recommended that this specification be amended to take into account the above concern.*
- *The above information are all a necessary part of national road standard specifications.*

3.3.7. MR16 – Reconstruction Patches

This specification sets out the requirements for Patches in sealed roads. The following sections covered with regards to this specification include:

- Definition of Patches
- Requirements by the contractors
- Performance Criteria

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.8. MR17 – Repair of Potholes in Unsealed Surfaces

This specification sets out the requirements for the repair of potholes in unsealed surfaces. The following sections covered with regards to this specification include:

- Definition of pothole;
- Materials;
- Preparations and Repair;
- Performance Criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.9. MR18 – Grading and Re-sheeting of Unsealed Roads

This specification sets out the requirements for maintenance grading and re-sheeting of unsealed road pavements and associate works. It contains the followings sections:

- Definitions of terms used;
- Requirements;
- Performance criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.10. MR20 – Bituminous Cold and Hot Mixes

This specification sets out the requirements for the manufacturing of sizes 7, 10, 14 and 20 dense graded and open graded bituminous cold and hot mixes. The following sections covered with regards to this specification include:

- Definitions;
- Requirements to conform in regards to aggregates, filler, bituminous materials, mix requirements;
- Binder quality;
- Mixing and mixing temperatures;
- Bituminous cold or hot mix recycled from reclaimed asphalt pavement;
- Frequency of inspection and testing at the mixing plant;
- Preparation of the surface;
- Tack coat;
- Gritting of cold mix;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.11. MR21 – Culverts, Pits, Endwalls and Dissipaters

This specification sets out the requirements for the clearing, maintenance and if required replacement of storm water drainage structures. The following sections covered with regards to this specification include:

- Requirements for contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.12. MR22 – Open Drains and Channels

This specification sets out the requirements for the maintenance of surface drains, table drains, kerb and gutter, and inlet/outlet channels. The following sections covered with regards to this specification include:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.13. MR23 – Subsoil Drains

This specification sets out the requirements for the maintenance of subsoil drains. The following sections covered with regards to this specification include:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.14. MR31 – Guide Posts

This specification sets out the requirement for the maintenance of guideposts including repair or replacement of existing posts and delineators. The following sections are covered with regards to this section:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.15. MR32 – Steel Beam Guard Fence

This specification sets out the requirements for the maintenance of guard fences including repairs to existing damaged components. The following sections are covered with regards to this section:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.16. MR33 – Standard Post and Cable Guard Fence

This specification sets out the requirements for the maintenance of Post and Cable Guard Fence including repair and replacement of non-salvageable components. The following sections are covered with regards to this specification:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.17. MR34 – Signs

This specification sets out the requirements for the maintenance of signs including cleaning, repairs, replacements, relocation and straightening of signs, posts and/or its components and the removal of illegal signs. The following sections are covered with regards to this specification:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.18. MR35 – Pre-stressed Wire Rope Safety Fence

This specification sets out the requirements for the replacement of posts and caps/reflection for pre-stressed wire rope safety fencing. The following sections are covered with regards to this specification:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.19. MR36 – Kerb and Gutter

This specification describes the construction and maintenance of concrete kerbs, kerb and gutters, V-gutters, edge strips, kerb ramps and gutter crossing at the location shown on the drawings and to the detailed dimensions shown on the standard drawings. The following sections are covered with regards to this specification:

- Material to be used;
- Foundation preparation;
- Construction requirements;
- Removal of existing kerbs and related units;
- Maintenance of kerb and gutter;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.20. MR41 – Vegetation Control

This specification sets out the requirements for the control of vegetation within the road reservation by mowing, verge maintenance, tree maintenance, herbicide spraying and requirements when dealing with protected areas. The following sections are covered with regards to this specification:

- Work Categories;
- Requirements by the contractors;
- Performance Criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.21. MR42 – Herbicide Spraying of Vegetation

This specification sets out the requirements for the herbicide spraying of vegetation within the road reservation for the purpose of general growth control, maintaining visibility of and clearance around roadside structures and facilities and control and/or eradication of noxious, secondary and other weeds. The following sections are covered with regards to this specification:

- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.22. MR43 – Landscaped Area Maintenance

This specification sets out the requirements for maintenance of landscaped areas within the road reservation. The following sections are covered with regards to this specification:

- Work Categories;
- Requirements for the contractors; and
- Performance criteria.

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

3.3.23. MR53 – Emergency Requirements

This specification sets out the requirements for urgent maintenance works due to emergency situations. The following sections are covered with regards to this specification:

- Definitions of terms used;
- Description of the kind of emergencies;
- Notification of work;
- General;
- Specific requirements;
- Rectification works;

- Performance criteria;

Review Outcome:
- *The above information are all a necessary part of national road standard specifications.*

4. STAKEHOLDER CONSULTATIONS

Consultation with relevant stakeholders provided us with very valuable information. This information assisted our report as we were able to identify issues and come up with solutions to enable a safe and durable road infrastructure. Below are findings from the stakeholder comments. See Appendix E for Stakeholder Consultation Summary.

4.1 Comments from Road Safety Committee (RSC) Members

4.1.1. Crash database and treatments of crash locations

Consultations with LTA, ACC, Police and National Health confirmed that there is no reliable crash data or a proper system in place that records quality information on all crashes occurring on national roads. ACC and Police do have their own crash databases which are separate from each other that record reported crashes. Regrettably both databases are limited with technical details and quality information which are needed by road and traffic engineers for their crash reduction studies and implementations of safety improvements of road crash sites.

During the consultation meetings with the stakeholders it was found that there is no coordinated system that allows the sharing of crash data information. Additionally, there is no process in place that allows road safety and traffic engineers to carry out their crash reduction studies at crash locations aiming at providing measures to remedy the risks and improve the safety of road users at all crash locations within the network.

Take for example the Cross Island Road (CIR) at the top of Tiavi. There have been quite a number of crashes over the years on CIR at Tiavi which has cost lives and serious injuries to some unfortunate road users. Photos 8 and 9 are the most recent crashes which occurred this year 2016 at about the same location on CIR at Tiavi. The bus accident resulted in the loss of one life and many serious injuries. The truck accident was fortunate in that it luckily, only resulted in minor injuries. It raises concerns in terms of safety due to the high number of accidents reoccurring at these locations. The questions are:

- Have all these crashes been reported, investigated and recorded in a database that captures all the details, technical information and contributing factors to the crashes?
- Was there any crash reduction study carried out at these crash sites using the recorded technical information from the database to analyse the causes of each crash?
- Were there any safety improvement measures implemented at these crash sites to avoid future accidents from reoccurring?

Unfortunately the answer to these questions is “NO” based on the information gathered from the consultation meetings with LTA, ACC, Police and NHS. There is no inclusive database of crashes on Samoa road network, and there is no system in pace that provides assessments and safety improvements at crash locations of the network.

Photo 8 – The remains of the bus that crashed at Tiavi in late July 2016

Photo 9 – The very recent truck accident at Tiavi in early October 2016

4.2 Comments from Engineering Consultants

Consultancy firms have conveyed their agreement to the development of Samoa's own local Design Standard that is suitable to our local conditions. It was further suggested rather than re-inventing the wheel, refer to overseas standards that have been referenced in the past in the design of Samoa roads and pick and choose what is relevant and suitable to Samoa.

4.3 Comments from Contractors about existing Standards

The contractors have expressed positive reviews about the construction and maintenance specifications. They were of the opinion that there was little to nothing wrong with the specifications, and that the current quality and requirement of the LTA road construction specifications are quite adequate for Samoa's roads. If the specifications are followed closely by every stakeholder involved, it will result in better road quality for Samoa.

However, the contractors expressed their concern over the application of these same specifications. It starts from the stage of the tendering system. That is, most contractors expressed concern with the quality of their work not being up to the specifications, due to cost being the determining factor towards the delivery of better quality roads, which they felt was an issue not being considered properly by the LTA.

The available funds for work dictate the decision at the end and not necessarily the quality roads from specification. The cost of construction and maintenance contracts now are so low that it cannot deliver the roads according to the specifications.

In addition, the LTA doesn't have sufficient staff to manage and supervise the contractors properly. This results in very little of the contracts being administered properly and in accordance with the specifications. Feedbacks during consultations were that the supervision of contracts by the LTA do not seem to be according to their own specifications and the quality of supervision is vastly different between two officers and two different contractors as well.

According to contractors, unless they lower their prices to match the LTA's budget, they just can't compete at all. Therefore, their survival depends on continuous availability of work so that they can continue to employ their staff andequipment. So contractors lower their cost to get some work and then they work on what they can provide with the budget approved. It means everybody compromises the quality of roads.

The contractors would like to provide better quality roads. They don't want to continue with the status quo of doing things. These were some of the suggestions they provided:

- Roads construction/maintenance should be estimated properly by the LTA so that proper budget is made available for the specification given;
- Contracts should be supervised properly and should have the same standards for all roads. It is better if supervision is outsourced out from LTA;
- The annual budget cycle was too short for allowing contractors to look after areas on a long term basis. When contractors refer to long term, they meant about 3-5 years' contract agreements for maintenance contracts. That will allow the contractor to make investments on the road as part of their work for at least three years and allow them the flexibility to plan their maintenance program well going forward to minimize their cost and that of government.
- Government should start a resealing program instead of patching potholes on top of other potholes. Contractors said most of the roads lack attention at the right time. The current roads have passed their resealing timetable, with most of the roads at reconstruction stage in order to get the quality that it deserves. LTA should have a policy for the roads according to how many potholes at a section of the road to start reconstruction instead of continue with pothole patching. For example, if a 100m stretch of road has more than 20 potholes, that road section should be reconstructed instead of continuing to fill the potholes.
- Every contractor should be forced to follow the construction and maintenance specifications.

5. CONCLUSION

5.1 Design Standards

5.1.1. No crash database for Samoa and no Crash Reduction Study (CRS) Process

It is concluded that Samoa does not have a comprehensive crash database that records all injuries (both minor and serious) and fatalities on Samoa road network. There is also no process in place that allows road safety and traffic engineers to carry out crash reduction studies at crash locations aiming at providing measures to remedy the risks and improve the safety of road users at all crash locations within the network. Refer to recommendation in Section 6.1.1

5.1.2. Inconsistent design standards for pedestrian crossings

Given the findings and as illustrated in the three photos 1, 2 and 3 in Section 2.1.1 *Pedestrian facilities*, it is evident that there are at least three different types of pedestrian crossings in existence on Samoa's national roads. This means that road users have to be aware of the colorful pedestrian crossings with varying color, sizes, patterns and markings on the roads. The issues arising here are the inconsistencies in pedestrian crossing, confusion and therefore lack of pedestrian safety. It also concluded that there are safety issues due to the limited consideration of pedestrian facilities in design and construction of road networks in school zones. Refer to recommendations in Section 6.1.2 and 6.1.3.

5.1.3. Substandard design and constructions of pedestrian crossings and speed-humps

It is concluded that there are safety issues due to the great variation in the sizes of pedestrian crossings on the road network, making them look more like speed humps. Refer to recommendation in Section 6.1.4.

5.1.4. No design standards for traffic signs

It is concluded that the NZTA Manual of Traffic Signs and Markings (MOTSAM) "*Part I – Signs"* had been the main referenced document for the design of road signs on national roads. An onsite assessment was carried out to confirm the reliability of traffic signs and whether the design requirements, policy and location of traffic signs as specified in the NZTA MOTSAM standard were met. Unfortunately, the assessment revealed that all traffic signs on the Samoa road network do not meet the requirements of the NZTA design standards as specified. Refer to recommendation in Section 6.1.5.

5.1.5. No design standards for road markings

It is concluded that NZTA Manual of Traffic Signs and Markings (MOTSAM) "*Part II – Markings"* had been the main referenced document for the design of road markings on Samoa national roads. An onsite assessment was carried out to confirm the reliability of current pavement markings and whether the design requirements of pavement markings as specified in the NZTA MOTSAM standard were met. It was found that there are no policies or standards for the design requirements of the existing 3 classes of roads such as class 1: primary, class 2: secondary and class 3: tertiary and it was difficult to determine why some type of markings appeared on some roads and nowhere to seen on other roads of the same classes of roads. For example: road edges. Refer to recommendation in Section 6.1.6.

5.1.6. No policy document to define Samoa road classification

It had been unsuccessful to obtain any approved policy document that provided detailed criteria and definitions of the existing classifications of Samoa national roads. The designation of a roadway in a particular hierarchy category is useful only when there are complimentary management policies to implement the designation. Refer to recommendation in Section 6.1.7.

5.1.7. No local geometric design standard for Samoa

It is concluded after consultation meetings with LTA that there are no local geometric design standards or approved set of procedures in place for the geometric designs of Samoa national roads. Refer to recommendation in Section 6.1.8.

5.1.8. No local pavement design standards

It is concluded that there is no local pavement design standard for Samoa. In the absence of Samoan local standards for pavement design, design consultants hired on World Bank donor funding projects have reviewed the appropriateness of standards from other countries, principally:

- New Zealand *(the NZ National Road Board (NRB) – Pavement Design and Rehabilitation Manual 1998";*
- Australia *(the Austroads Pavement Design Guide 2004");* and
- United Kingdom *(the Transport and Road Research Laboratory United Kingdom Road Note 31 (TRRL road Note 31 – A Guide to the Structural Design of Bitumen Surfaced Roads in Tropical and Sub-Tropical Countries").*

Refer to recommendation in Section 6.1.9.

5.2 Construction Standards/Specifications

While most of these specifications were put together based on the Tasmania Roadworks Specifications, it is still relevant to Samoa and its legislation. There were lots of terminologies used in the standards that need to be explained properly so that users of the standards understand the correct meaning of such terms. These definitions can clarify any issues that may create conflicts within the standards. The standards also reference different staff positions which need to be defined in the Samoan context. This will provide clarity on which title of the person is being made reference to within the standards.

The construction road standards are very well accepted by engineers and contractors alike. Feedback during consultations was that the requirement of the standards was usually overlooked during the administration of contracts. While the standards are very well accepted, it appears that the detailed understanding of the content of the standards was lacking amongst the contractors. Perhaps it is an area where LTA can assist by conducting a workshop to assist the user with understanding how the standards can be utilized properly.

It is concluded that whilst the construction standard specification for Samoa is still applicable, with most of the standard in use and accepted by the engineering and contracting industry, recommendation 6.2 details where improvements/amendments/clarifications can be made to ensure a more comprehensive and applicable document for Samoa's roads.

6. RECOMMENDATIONS

Samoa should establish a comprehensive set of National Road Standards based on their own available resources such as materials, plant/equipment and environmental conditions. Austroad already has a complete set of Road Standards. We have had a thorough look at Austroads standards that have been used on Samoa road designs and instead of reinventing the wheel which can be time consuming and costly, Samoa could easily pick and choose what is relevant and suitable for Samoa's conditions.

6.1 Design Standards

6.1.1. Develop Crash Database and a process for Crash Reduction Studies (CRS)

This report recommends that a comprehensive **Samoa National Roads Crash Database** that records all reported crashes and all accidents on Samoa national roads be developed. To assist with the development of a Crash database, a Traffic Crash Report format must be prepared to capture all relevant information needed for crash reduction studies. Appendices A, B and C are recommended to be used as a guide. They are as follows:

- Appendix A –NZ Traffic Crash Report format is recommended to be used as a guide for developing a format of a Traffic Crash Report suitable for Samoa;
- Appendix B – Draft Crash Reduction Study is recommended to be used as a guide for carrying out Crash Reduction Studies at crash sites/locations;
- Appendix C – Content of Crash Reduction Study Report is recommended to be used as a guide in preparing CRS reports.

Additionally, the following Austroad and NZ guides are recommended to be referenced as a guide:

- A New Zealand Guide to the treatment of crash locations, December 2004 (which is a companion document to the *Austroads Guide to Traffic Engineering Practice Part 4);* and
- Austroads Guide to Traffic Engineering Practice Part 5 – Treatment of Crash Locations, 2003.

6.1.2. Develop design standards for pedestrian facilities

This report recommends standardizing pedestrian crossings to ensure that all crossings throughout Samoa are of the same design in terms of colour, cross-bar pattern, markings and signs. There should be a policy that sets out criteria for design and management purposes of all pedestrian crossings on Samoa national road network. NZTA MOTSAM Part II Markings – Section 4.02 for Pedestrian Crossing Markings is recommended to be referenced for developing a set of design policies for Samoa national road standards but to modify to suit local conditions. Given the varying design and colour of crossings and given that LTA appears to be well versed with the NZTA, it is recommended that NZTA should be adopted but modified to suit local conditions.

The following must be considered in the policy document for pedestrian crossings:

- Criteria for pedestrian crossings on raised platforms;
- Criteria for pedestrian crossings on flat road surfaces;
- A policy for all pedestrian cross bars to be marked with white reflectorized paint;
- Criteria for all cross bars to be marked parallel to the direction of approaching traffic;
- Criteria that determine the difference between pedestrian crossings on 2-lane roads, 4-lane roads separated by a double centerline and wider 4-lane roads separated by a median.

6.1.3. Include designs and constructions of pedestrian facilities in school zones

Given the danger faced by school students (primary, secondary, tertiary), this report recommends for the following on roads near schools:

- Recommend that all pedestrian facilities near schools to install appropriate signs and markings in all school zones (identify points of start and end of zones) in the designs and constructions of roads;
- Recommend to set a policy that considers all national roads within a certain radius (suggesting 0.5km – 1km) from all schools to at least provide the following as minimum safety requirements for school pupils:
  (i). Where roads in the school zones do not provide footpaths, it is recommended to widen the road shoulders to at least 1.5m from the road edge of seal on both sides to provide sufficient walking path and to allow a safe separation of pedestrians from travelling vehicles;
  (ii). All edges of sealed roads within the set radius to be marked with yellow dashed paint for no stopping to avoid vehicles stopping/parking on road shoulders, and to allow a clear pedestrian walking path;
  (iii). Install adequate warning road signs (with correct positioning from the road and distances from the school); and
  (iv). Install adequate pedestrian crossings near entry/exit ways to school compounds.

6.1.4. Standardise the design and construction of pedestrian crossings and speed-humps

This report recommends standardizing pedestrian crossings and speed-humps across the whole Samoa road network. The new standard should provide distinct design patterns of markings to differentiate speed-humps from pedestrian crossings on raised platforms to eliminate confusion.
For instance: all pedestrian crossings bars should be marked parallel to the direction of approaching traffic and should use the reflectorized white paint not yellow paint (as per recommendation 6.1.2 above). The speed-humps should only be painted yellow to differentiate a crossing from a speed hump.

- The design standard should indicate how many line markings and road signs that is considered sufficient to pre warn motorists of pedestrian crossing ahead;
- The design standard should provide a set of criteria so designers and decision makers would be able to determine when/where a pedestrian crossing needs to be installed on Samoa national roads.

6.1.5. Develop design standards for traffic signs

(i). This report recommends standardizing traffic signs and policies around speed signs such as location and maintenance to avoid confusion. Signs sitting idle on road reserve should also be removed to avoid having too many objects on road reserves.
(ii). Government should formally approve the adoption of MOTSAM Part I –"Signs" but modify it to suit the local conditions. Prior to using MOTSAM, Government should seek the approval of the New Zealand Transport Agency (NZTA) first, and satisfy any legal requirements for the use of their standards.
(iii). The most relevant Sections of MOTSAM to consider for Samoa national roads are Sections 2, 5 and 6. These sections needs to be reviewed and modified to suit the Samoa local conditions.
  - NZTA MOTSAM Part I Section 2: Regulatory Road Signs;
  - NZTA MOTSAM Part I Section 5: Temporary Warning Road Signs;
  - NZTA MOTSAM Part I Section 6: Permanent Warning Road Signs.

(iv). The Samoa local design standard for traffic signs must have policies that set out the following:

- All signs must be maintained in good condition to be effective;

- There should be technical people in government (or engage traffic engineers) with expertise in signs to be responsible for checking the reflectorisation of signs. Poorly maintained signs lose effectiveness at night and encourage noncompliance;
- There should be regular day and night inspections on road signs to identify poor performance;
- Remove inappropriate signs such as those that are no longer needed because the hazard has been eliminated. Do not just leave them idle on the road because it defeats the purpose of road signs on our national roads.
- Make sure that signs continue to do their job and their performance has not been adversely affected by:
  - vandalism and damage;
  - specular reflection from street lights;
  - impact of roadside hedges, trees and advertising;
  - Erection of other signs or public utilities.
- Ensure that signs do not restrict sight distances on bends or near intersections and driveways;
- All road signs when approved to be used on national roads needs to be regulated by including them into the Traffic Regulations and the Road Code;
- The Road Code must be revised to include all approved road signs to be used and must clearly define the meaning of all road signs in a language that is self-explanatory to all road users.

6.1.6. Develop design standards for road markings signs

This report recommends the following for Government to consider:

(i). Formally approve the adoption of MOTSAM Part II –"Markings" but modify to suit local conditions. Prior to using MOTSAM, Government should seek the approval of the New Zealand Transport Agency (NZTA) first, and satisfy any legal requirements for the use of their standards.

(ii). Modify the NZTA MOTSAM part II to suit local conditions. Include the development of a design and management policies for pavement markings, and make it a part of the overall standard which can be included into the traffic regulations and road code. For example: the policy shall be set to require all 4-lane roads and all Class 1 and Class 2 roads to be marked with white edge lines. Edge lines delineate the edge of the traffic lane and in situations where the shoulder is paved edge lines, separate the shoulder from the traffic lane. They provide a useful guide to motorists at night and in misty conditions. Where roadway shoulders are unsealed, the provision of edge lines not only enhances road safety but can reduce wear and maintenance of the shoulder.

6.1.7. Develop a Road Hierarchy Framework for Samoa

This report recommends the following for Government to consider:

(i). Review the existing classifications of national roads and provide management and design policies to form a logical basis for the planning, design and administration of Samoa national roads and road systems. The fundamental classification from the viewpoint of traffic network planning is a functional classification, i.e. according to the traffic carrying purpose of the road.

(ii). The policy shall have allocation systems for road planning, design and operations. The following shall be included:

- the allocation of priority of one road over another when installing traffic control devices;
- the setting of design standards for proposed roads in new development/sub-divisions;
- the degree of frontage access control to be exerted along a road;
- treatments of 4-lane roads and the designations of outside lanes to be slow lanes on 4-lane roads;

- the allocations of speed environments and operating/design speeds throughout the whole network; and
- Any other factor that may be considered important for the planning, design and operations of the Samoa road network.

(iii). Refer to Appendix D – Road Hierarchy Framework as recommended in the SMEC report[4] is to be used as guidance for developing Samoa's Road Hierarchy Framework.

6.1.8. Develop Geometric design standard for Samoa

This report recommends the following for Government to consider:

(i). Since the NZTA 2000 SHGDM is still in a draft form, Government should refer to Austroad Guide to Road Design "Part 3 – Geometric Design" 2016 publication and develop a Samoa Supplement by picking and choosing what is relevant and applicable to Samoa national road conditions and practice.

(ii). In the absence of data/information in the Austroad Guide for Samoa road conditions, NZTA 2000 SHGDM is then recommended to be referenced if the data/information is relevant and applicable.

(iii). Then Government should document and approve a geometric design process that can be considered as the "Samoa Geometric Design Standard" referencing relevant sections of the Austroad Guide to Road Design "Part 3 – Geometric Design" 2016 publication and/or NZTA SHGDM 2000.

6.1.9. Develop Pavement design standard for Samoa

This report recommends the following overseas standards to be formally adopted for the design of Samoa road pavements but provide a supplementary document of sections that requires modifications to suit local Samoan conditions:

(i). Government should formally approve the adoption of both: the "Austroads Pavement Design Guide" and the "UK TRRL Road Note 31 – A Guide to the Structural Design of Bitumen Surfaced Roads in Tropical and Sub-Tropical Countries" as guidance documents to the development of Samoa's National Road Pavement Design Standard for Flexible Bituminous bound and unbound granular pavements.

(ii). Government should formally approve the adoption of: the "Austroads Pavement Design Guide" and the Cement and Concrete Association of Australian publication "Road Note 27 – Concrete Roundabout Pavements, November 1987 or later version" as a guidance document for the development of Samoa's National Road Pavement Design Standard for Rigid concrete pavements.

The following should be used as minimum in the pavement design process that recommends to be considered on all national road pavement designs:

1. Design the type and thickness of pavement layers required with due regard to subgrade strengths and local availability of construction materials;
2. All class 1 and class 2 road pavements shall be designed for the expected traffic loading based on a minimum pavement design life of 20 years;
3. No pavement shall be designed for less than $1x10^5$ equivalent standard axles (ESA's) where a standard axle is defined as a dual tyred single axle loaded to 8.2 tonnes;
4. Must carry out a review of the existing data regarding the in-situ pavement materials (if any) and determine if the material can be reused. California Bearing Ratio (CBR) must be used as a parameter to describe the strength of the subgrade layer. In broad terms, the subgrade

[4] Report document no.54012.020 - Prepared by Snowy Mountains Engineering Corporation (SMEC), April 2007 for the Government of Samoa through the Ministry of Works, Transport and Infrastructure under the project: Transport and Infrastructure Sector Reform and Strengthening Services (TISRSS)

quality can be defined as: soft if CBR is less than 4 (or in elasticity modulus value of 40MPa) and consider firm if the CBR is more than 4. In comparison to NZ, better subgrades would have CBRs in the order of 5 to 7.

5. The following are some typical subgrade tests to be considered:
   - California Bearing Ratio (CBR): soaked and unsoaked condition method with test application either a laboratory test or in-situ on all soils fine and coarse (<19mm);
   - Dynamic Cone Penetrometer (Scalar): Indirect CBR test of in-situ on fine grained cohesive and cohesionless soils;
   - Shear Strength (Shear Vane): Indirect CBR test on in-situ or laboratory on fines grained cohesive soils;
   - Clegg Hammer (impact resilience): Indirect CBR test on in-situ or laboratory on all soils fine and coarse (<19mm); and
   - Deflection/Curvature measurements: modulus of elasticity test on all in-situ soils.
6. Must conduct a materials search to ensure that there is adequate quantity of suitable pavement gravels available to conform to the design specification. The standard specifications for an unbound material shall look at and test for the following properties:
   - Grading;
   - Plasticity of the fines in the aggregate;
   - Hardness;
   - Weathering Resistance and the
   - California Bearing Ratio (CBR)

   (Note: LTA laboratory capability must be reviewed and assessed against NZ or Australian laboratory compliance requirements.)
7. Design the pavement so that it is suitable for the climate and drainage conditions which could cause saturation of the subgrade or pavement materials.
8. Provide details of sub-surface drains and porous drainage layers required for the control of pavement drainages.

6.2 Construction Standards/Specifications

In review of the General Specifications, Road Construction Standards and Maintenance Standards, the following recommendations were made throughout the report:

6.2.1. Volume 1 – General Specification

- G1.9.3.1 As -Constructed Drawings – drawings are not microfilmed at LTA. They are usually scanned and then filed digitally. Specifications need to be amended to reflect this.
- G1.10 Standards – there is a list of organizations that is made reference here that needs to be reviewed for relevancy.
- G2.3.1 Environment Management: General – This should be changed to Samoan requirements under Government of Samoa legislation.
- G2.3.4 Archaeological, Botanical and Heritage Features – this is made reference to Specification R75. But Samoa doesn't have a R75 specification. R75 is known as Environmental Protection. Introduce a new Specification R75 – Environmental Protection.
- G2.3.12 Blasting and Structurally Damaging Processes – reference is made to forms supplied in Annexure G2.3 or similar, however, there is no such annexure to the Standards. It is recommended to create an Annexure G2.3 for Volume 1 – General Specifications.
- G2.4.2 General – reference is made to Annexure G2.1 but there is no such annex. It is recommended to create an Annexure G2.1 for Volume 1 – General Specifications. G2.6.8.1 Standard of Side Tracks – reference is made to AS1742.3 sidetracks, and for sidetracks to be

designed according to AUSTROADS Rural Road Design Guide 1989. It is recommended to review this standard and its reference and determine whether it is the most recent standard to be used.

6.2.2. Volume 2 – Road Construction Specifications

- R21.2.1 Extent of Work – reference is made to sob specific specifications in accordance with Clause G1.5.4, however, there is not such clause. Specification R21.2.1 needs to be reviewed to determine what is relevant Clause for insertion.
- R23 Subgrade Zone – reference to this specification is made several time, however, there is none within the specifications. This specification needs to be introduced to the Samoa Road Construction standards.
- R24 Contents Page – The numbering of the standards within the contents page is incorrect. This needs to be amended.
- R40.1 SCOPE – The scope appears to be missing from the contents page for specifications R40. Update contents page to include R40.1 Scope, as it is present within the body of the R40 specifications document.
- R40 Pavement Notes – this specification is missing. These notes explain the background and reasoning behind Specification R40.
- R42 Stabilisation – In-situ Stabilisation with Cementitious materials – Samoa just had Vaitele Street stabilised. This specification needs to be introduced to Samoa Road Standards.
- R55.2.2 Binder – the DRT Test T61 doesn't have any reference referral.
- R61 – Road Safety Barrier Systems – this specification is the supply of Road Safety Barrier Systems and this must be reviewed together with the design standards to be used on the road. The design standards must support the road safety barrier system.
- R62 Guide Posts and Delineators – the design standards for Guide Posts and Delineators should support this construction specification.
- R63 Signs – the design standards for Signs should support this construction specification.
- R64 Pavement Markings – the design standards should support this construction specification.
- R72 Fencing – this specification is missing from Samoa Road Standards. There has been a lot of fences erected as part of road construction. There ought to be a specification for the fence.
- R75 Environment Protection – the environmental requirements of road construction as part of PUMA environment checks for Environmental Management Plans is now part of the MNRE process. Therefore, there ought to be a road construction specification for Environmental protection.
- R91 Property Access & G-Turns – as part of road construction nowadays, there has been more and more construction of private access and G-Turns to properties at locations shown on the drawings. Samoa doesn't have a construction specification on this. This needs to be developed and included as part of specifications.
- R92 Underground Services facilities – there are more and more underground services to be constructed as part of road construction. Samoa doesn't have a specification on this area. This needs to be developed and included as part of specifications.

6.2.3. Volume 4 – Road Maintenance Specifications

- MG1 General Provisions – (iv) Emergency Works – Group 2 hazards include: Oil Spills on Tasman Bridge. There is no Tasman Bridge in Samoa. This needs to be removed from the standards or amended to reflect current bridges in Samoa.
- Hazard Group 3 – (ix) Defects – it says all defects shall be as defined in: "A Guide to the Visual Assessment of Pavement Condition – 1987" etc.. This reference document cannot be found

anywhere within the specifications. It needs to be provided as part of specifications or at least review for relevance in terms of Samoa's context.

To enable the above recommendations for the General Specifications, Construction Standards and Road Maintenance Standards, a Terms of Reference has been produced for the hiring of a Technical Assistance Consultant to expand on the current standards and specifications and develop the documents for future construction of roads. See Appendix F (to be submitted after receipt of comments for Draft Final Report).

7. OTHER CONTRIBUTING FACTORS TO FAILURE OF ROAD INFRASTRUCTURES

7.1 Factors

7.1.1. Budget Constraints

The LTA's budget process for each year is reviewed around about February and then submission is given to government for funding of different maintenance works and new capital works program for that year. Financial year budget approval is to start 1 July to 30 June the following year. So the budget year covers 6 months of two calendar years.

The budget ceiling from year to year seems to be dictated by spending on previous years. Although the justification of each budget submission has to be well put together by LTA, the final amount however, is always limited by government from sector to sector. Therefore, there is an expectation of the money given to do everything that is to be undertaken from year to year.

While LTA has their own expectations of the spending of the budget given their annual program, there are always other reasons outside emergency works that takes precedence in spending the funds. Therefore, some of the works that were planned for infrastructure maintenance that year by the LTA ends up being spent on other works that were not planned by the LTA. Most of these extra works spending program are village roads to be upgraded from gravel to sealed roads. These new upgraded roads program is always dictated by government Ministers for the purpose of making them as priority works from a political point of view and not usually technical as far as LTA is concerned. These unplanned additional works upsets an existing program by LTA and results in the status of roads today (instead of maintaining existing roads with limited available funds, these funds are stretched in undertaking new works).

The amount of money given by government for roads, bridges, seawalls and other associate works like drainages are never enough to upkeep an existing infrastructure to some reasonable standard. The consequence of these delays in maintenance is significant and the quality of roads deteriorates. For example, the roads show signs of fatigue in the pavement after a few years of new pavement. In order to preserve that payment, resealing of the same roads need to take place immediately.

However, because failure of the pavement might only be small hair line cracks and not that visible (compared to other roads), the resealing program is delayed further and other new works starts. This cycle continues from year to year and this delay in maintenance amounts up and roads are being patched on top of other existing patches which not only looks very bad, but they are also very rough for riding and continue to show bad management overall.

Unless the LTA dictates its own program and holds themselves accountable for the same, the current status of roads cannot be improved. There ought to be policy rationale for roads maintenance and new capital works. Otherwise the current status will continue as it is.

7.1.2. Works Program

It is normal for any organization to plan out their annual program for the year. Government agencies like the LTA do this every year. This same program allows LTA to plan out the money and resources for the coming year program. These programs are usually worked out as part of the normal asset management program for infrastructure currently under LTA responsibility. Technical reasons for maintenance of LTA assets are usually the means to choose which roads to maintain from year to

year. The capital works programs are normally dictated by government as part of its strategic government program.

Budgets are derived from these programs. The basis of the programs is mostly technical and strategic as far as rural villages are concerned. It has been seen in the past that most part of the country infrastructure will at least be addressed (district wise) within the government five-year tenure. LTA bases its program through technical assessments of the assets and government adds its priority because of its strategic way of addressing rural needs at the district levels. The technical and strategic ways of programming are often at odds with each other in many occasions. Despite its shortcomings, the two have been the normal part of getting funds from government for each financial year.

It has been observed in the past that the preparation given by the LTA for its program has not been seen as thorough or well prepared from year to year. There is a lack of analysis given to each project to properly appraise a project before it funded. There is no feasibility design prepared for these projects to assess benefits versus cost to such a community. The lack of analysis has led to many existing rural access roads built and still undeveloped by the community or even farmed by the community. When you inspect past works at rural communities both at Upolu and Savaii, you will always find the examples of roads being nicely tar sealed, but no plantations or any houses are located on such roads. This is the result of bad programming and lack of preparation works for each project under the budget from year to year. The money that funded those roads could be used to maintain the existing infrastructure and prolong the lives of roads and bridges.

The programming lacks thorough investigations of where resources could be obtained for the construction of new roads. The lack of investigations leads to bad estimation of budget for the cost of each project and results in bad decision making in time of tendering. It is the same results seen on maintenance contracts that are now dished out by government. The comments and feedback from contractors were not favorable towards the LTA. According to the contractors, the specification given for tender of works by the LTA is never followed and the results show with the current quality of road maintenance. The LTA pick the lowest price and award the contract to that contractor. However, those costs cannot pay for the quality dictated by the given specification. The contractors do very minimum work when they do carry out the work and LTA supervision hardly, if ever enforces the specifications under their supervision. The results always are evidenced by bad quality roads. The contractor wants LTA to estimate projects thoroughly and allow adequate funds to deliver quality roads. Don't award contracts to the lowest cost but should be awarded according to proper estimates pre-determined by LTA. An allowable percentage of higher or lower from that estimate should form as one of the main criteria for awards of contract and not the lowest cost. That will lead to quality roads for the future.

7.1.3. Maintenance Contracts

The maintenance contracts for the country road infrastructure have been divided into different zones. There are also different contractors that maintain drainages and road shoulder at district levels. So at one piece of road, three different contractors are responsible for the maintenance of the same asset. These three different contractors often run into each other's area of work and responsibilities. For example, the drainage contractor often grades the shoulders to maintain its drainage. The result of over grading can be unsafe for pull out vehicles as there is no road shoulders anymore left from grading roads. Road potholes and edges are often a problem area because of bad maintenance drainages and water can't run off the road.

The issues that comes out of maintenance contractors and results in bad quality roads are several.

Some of these issues are discussed as follow:

- One contractor should be responsible for the same piece of road and its responsibility covers the maintenance of the sealed road, road shoulders and associated drainages. There are too many contractors that work on the same area and often create problems in areas of responsibilities. The lack of supervision of contractors because of too many contracts could be eliminated if only a few contractors are hired for road maintenance works.
- Road specifications – the specifications of all road works are the same for all roads. If that is the case, then all road quality should be the same. However, the applications of these specifications to different roads are widely different and results in different standards. There is nothing wrong with the specification. However, the cost that was approved to deliver the specification never matches each other. It is impossible to deliver the quality against the approved cost. Proper road investigation and appraisal should happen before works are tendered out under the current specifications. Perhaps an agreement with government of acceptable quality against each class of roads.
- Supervision – there are far too many contracts that are looked after by only a few LTA staff. As a result, the proper inspection of roads according to specifications seldom happens. The result of the lack of supervision is different quality roads. The information called for under LTA specifications for maintenance contractors are never gathered. The issues raised by contractors are never looked into and no proper record of supervision from month to month is recorded for future references. Overall, LTA can't handle the number of contracts that it administers and this also contributes to the lack of quality roads.
- Insufficient Funding for new works and maintenance work is an issue with maintenance contracts.

7.2 Recommendations of other contributing factors

There has to be better utilization of limited financial resources for the future in regard to maintenance of the road network. The system at the moment is not being managed properly. There is no systematic guideline to follow in order to manage the limited budget given. The funds allocated for road maintenance must not be mixed up with other capital works budget. It seems the maintenance budget is insufficient already for the amount of work to be done each year. So when these scarce funds are directed to other work, then the whole network will suffer. The approval for the level of budget each year and the works program for the financial year should be an agreement between LTA and the Minister. That same program will form the basis of any budget submission to MOF. Whatever the approval amount given, then another submission should be agreed between LTA and the Minister for the final works program for that financial year. There should be a minimum budget for maintenance of existing infrastructures before any new works is to be approved. If additional work comes up during the financial year and not accounted for within the budget, a decision has to be made for additional funds for those new works. This is the only way to manage going forward. There is too much at stake in regards to quality roads because of too many parties involved with the decision making in terms of which roads to maintain or build which impacts on LTAs primary responsibility of maintaining road infrastructure of Samoa. Unless LTA controls its own work programming each year, no amount of standards will solve the existing bad quality roads. If we allow the engineers to do their work, they can probably come up with a better system to manage the limited budget it receives each financial year. If we can also rationalize the decision of which work to cover under the LTA budget, then the LTA can focus on those responsibilities and carry out their work properly.

The LTA should also strongly consider outsourcing the supervision of contracts to the private sector. LTA has been supervising the maintenance contractors and some capital works contractors so far and it appears that it is not working. Therefore, a change might be in order. To achieve this supervision by outside consultants, LTA needs to put aside 10% of the budget they have now for supervision. The contractor ought to be supervised properly which would thus force them to deliver better quality roads. If they are forced to work within the specifications, then the result will be better road. It is like making a lot of laws and no police to police those laws. That is what is happening now with road works with the blame mistakenly laid towards lack of design and construction standards. That has not been the case, but other issues seem to contribute more to bad quality roads. When everybody works together, the outcome will be better quality roads.

8. WAY FORWARD: WHERE TO FROM HERE?

As noted in the report above, it is recommended that a comprehensive National Road Standard for Samoa similar to that of Australia be developed. This is an expensive and lengthy process; therefore much thought is needed before the development of these standards. If the Government is serious about developing National Road Standards, their full cooperation and support is vital to ensure that the National Road Standards are successfully developed and applied in the most practical and cost effective way. There are two factors that must be met. These are: (i) technical capacity; and (ii) the process to guide the formulation of the standards. These factors are further explained below.

8.1 Technical Capacity

National Road Standards must be used and applied once they are developed. It is absurd and a waste of Government money to draft a complete set of National Road Standards only to have them sitting idle on office shelves because Government officials lack the technical capacity to understand and apply the standards. Therefore, to ensure that this is not the case, it is vital that technical officers must possess the knowledge to be able to apply the standards. The consultant(s) to be identified in the process below will be in a better position to recommend the types of qualifications and/or experience technical officers must possess in order for them to be able to understand and apply these standards.

LTA plays an operational role in the supervision and inspection of road constructions to ensure that the works are carried out in accordance to design and construction standards. Therefore, it is crucial for LTA to have sufficient technical personnel with the right qualifications and experiences in road supervisions and inspections.
The consultant hired to draft the proposed process will be able to suggest the number of technical officers required and the type of qualifications and/or experience they will need to have.

According to MWTI website[5] their mission is "to strengthen the Ministry's administration and regulatory roles in ensuring a safe, secure and viable Transportation modes and Infrastructure Regime, to improve Samoa's quality of life." Given their mission, it is both mandatory and important for MWTI to have technical staff both qualified and experienced and who are able to understand and can apply the proposed National Road Standards.

8.2 Draft process for developing the Samoa National Road Design Standards:

There is an obvious need to establish a clear process to guide the development of National Road Standards in Samoa. This process is elaborated in Appendix G.

[5] http://www.mwti.gov.ws/index.html

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10. APPENDICES

Appendix A –Traffic Crash Report

APPENDIX A

NZ Traffic Crash Report

TRAFFIC CRASH REPORT

Page 1 — Send white top copy pages to New Zealand Transport Agency Regional Office — POL 565 11/12

1 Local Body: Rangitikei

Locality or suburb: Porewa

Crash road: SH 1N

At | Intsn with | OR 350 | Metres | Km | N E S W

Side road: Putorino Road

GPS: ____ / ____

Fatal crash | serious injury crash | Minor injury crash | Non-injury crash

2 Crash date: 6 : 5 : 2009 Crash time: 1115 (24 HOUR CLOCK)

Sun 1 | Mon 2 | Tue 3 | Wed 4 | Thu 5 | Fri 6 | Sat 7

CODE: 1V

Officer arrival time: 1125 — Didn't attend

SCNSTN: C R U R A L — SECTOR CODE

Where Stationed: B C P

Reporting Member Initials/Reg No.: M Q 7 9 8 7

3 CHECKED BY: (Supervisor) Rank/Name: Sgt Smith — Det./Sen./Sgt./Const. — Initials: A L — Reg. No.: 5 3 0 1 — Signature — Date — (Minuting Member)

4 VEHICLE 1 — Reg No.: AB5678 — T.S.L. No.:

Car/wagon | SUV/4x4 | Taxi | Van/ute | Truck | Bus | School bus | Motor cycle | MoPed | Other

Towing: Boat | Caravan | Trailer | Semi-trailer | A train | B train | Other

Make & Model: Holden Commodore

Year: 1990 — CC rating: 3800

WOF or COF: (Yes) | No — Expiry date: 12 : 10 : 2009

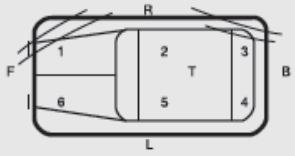
Speed before crash: 100 km/h — Parked | Reversing | Stationary

Too fast for conditions: (Yes) | No | Uncertain

Total passengers: Front: 1 Rear: 2 Other: (Not Drivers)

Damage severity: Fire | Overturn | (Extensive) | Minor/moderate | Nil

DAMAGE LOCATION



D.Loc	Role	FAC	FAC	FAC	CODER	DAY	MONTH

5 DRIVER 1 — Owns veh. | Not owned | Rental | Unknown

Name: FORE NAMES: Michael — SURNAME: Sheppard

Address: RD3 Makerua

Phone Nos: 06 843 2198

DOB: 16 : 5 : 1947 — (Male) | Female

Ethnicity: (European) | (NZ Maori) | Samoan | Fijian | Tongan | Cook Islander | Niuean | Tokelauan | Other Pacific Island | Asian | Other (Specify)

Occupation: Sharemilker

Licence No: A5543218

Licence status: Learner | Restricted | (Full) | Never held | ForBidden | Wrong class | Disqualified | Overseas | unKnown | Expired

If driver holds Overseas licence

Overseas Driver Country of Origin:

Overseas Driver Status: Student | imMigrant | Visitor | unKnown

Restraint worn: Uncertain | (Yes) | No | NOt Avail.

Injuries: (in detail) Broken ribs, Lacerations whiplash

Fatal | (Serious) | Minor | Nil

Hospitalised at: P North

Alcohol: Unknown | Not suspected | (Suspected) | Research (250-400) | Screen + / − | Evidential Blood 95

6 DRIVER INTERVIEW NOTES:

I was driving north towards Taihape. As I crossed the bridge, the car began to twitch. I braked and the car just shot across the road. I tried to control it but lost it on the shoulder. I ended up in the ditch on the other side of the road. I've only had two cans of beer.

Driver 1 signature

7 ION/TON Nos: — OFFENCE/PREC CODE: — DRIVER:

ION/TON Nos: — OFFENCE/PREC CODE: — DRIVER:

CARD EVENT No.: P 0 0 2 7 1 8 3 6 3 — DOCLOC CASE No.: 0 8 6 1 4 5 0 2 1 6 2

OCCURRENCE ID:

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8 VEHICLE 2 Reg No. BZ6173 T.S.L. No.

Owns veh. | (Not owned) | Rental | Unknown

Car/wagon | SUV/4x4 | Taxi | (Ute) | Truck | Bus

School bus | Motor cycle | MoPed | Other

Towing: Boat | Caravan | Trailer | Semi-trailer | A train | B train | Other

Make & Model: Toyota hilux

Year: 1968 CC rating: 2000

WOF or COF: Yes | (No) Expiry date 3 : 7 : 2009

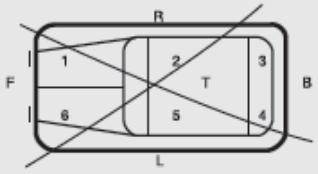
Speed before crash: ? km/h | Parked | Reversing | Stationary

Too fast for conditions: Yes | (No) | Uncertain

Total passengers: (Not Drivers) Front: Rear: Other:

Damage severity: Fire | (Overturn) | Extensive | Minor/moderate | Nil

DAMAGE LOCATION



DJ.oc	Role	FAC	FAC	FAC

9 DRIVER 2

Name: (FORE NAMES) Shane Lewis (SURNAME) Cooper

Address: 11 Barker Grove

Mapua

Phone Nos: 073782463

DOB: 2 : 7 : 1963 | (Male) | Female

Ethnicity: (European) | NZ Maori | Samoan | Fijian | Tongan | Cook Islander | Niuean | Tokelauan | Other Pacific Island | Asian | Other (specify)

Occupation: signwriter

Licence No: CSZ738000

Licence status: Learner | Restricted | (Full) | Never lic'd | ForBidden | Wrong class | Disqualified | Overseas | UnKnown | Expired

If driver holds Overseas licence

Overseas Driver Country of Origin:

Overseas Driver Status: Student | Immigrant | Visitor | unKnown

Restraint worn: Uncertain | (Yes) | No | NOt Avail.

Injuries: *(in detail)*

bruising shock

Fatal | Serious | (Minor) | Nil

Hospitalised at: P North

Alcohol Unknown | (Not suspected) | Suspected | Research (250-400) | Screen + − | Evidential Blood

10 DRIVER INTERVIEW NOTES:

I was going south as I came round the bend I saw the green car spinning across the road. I swerved and braked to avoid him. I think the trailer must have jackknifed because next thing I knew I was upside down.

Driver 2 signature S Cooper

11 If there is no further Police action, please state reason(s):

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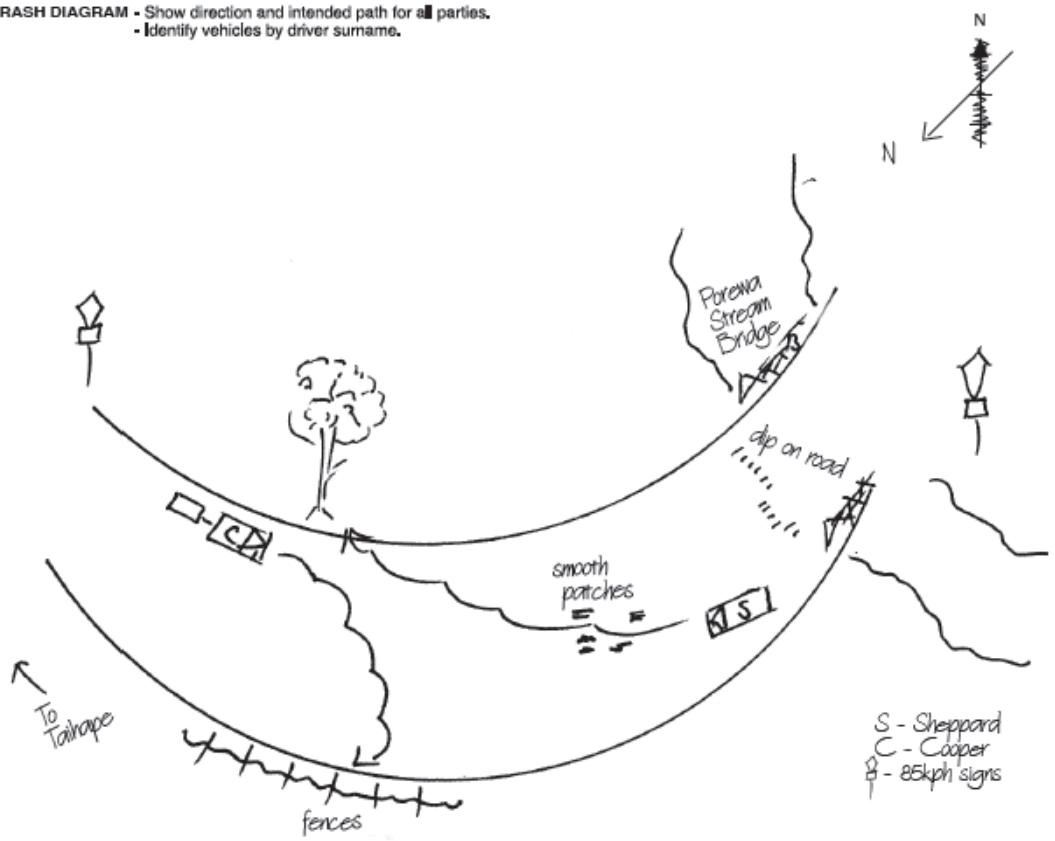
12 CRASH DIAGRAM - Show direction and intended path for all parties.
- Identify vehicles by driver surname.



(NOT TO SCALE)

13 WHAT HAPPENED

Sheppard travelling north lost control on the wet road coming off the bridge into a right hand bend (85kmph advisory). He overcorrected and slid into the opposing lane and then off the road into a culvert and tree. Affected by alcohol. Cooper travelling south saw Sheppard out of control and took evasive action but his ute/trailer combo rolled and went upside down against a fence on the western side of the road.

14 OBJECTS HIT: Culvert, tree, fence

OBJ						MVMT		1	D	S	2	3	4	FAC		FAC			FAC		

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15 WHY CRASH HAPPENED

Road and Roadside factors (eg no barriers, no shoulder, large trees, limited visibility etc)

Wet and slippery patches just north of bridge

Large tree just north of bridge

Rumble strips each side of road

Road User factors (eg impairment, fatigue, distraction, dark clothing etc)

Sheppard lost control and overcorrected possibly entered curve too fast.

Had been drinking alcohol.

Vehicle factors (eg brakes, steering, tyres etc)

Cooper's vehicle had expired WOF. Trailer heavily loaded.

Speed factors (eg speed too great for conditions, too great for corner etc)

Sheppard too fast through corner.

16 DETAILS

Speed limit: 100 | Advisory speed: 85 | Temp. speed limit:

CURVATURE	StRaight	Easy	(Moderate)	Severe	MARKINGS	Ped. Xing	Raised isld	Paint isld	No Pass Line	(Centre Line)	Nil
SURFACE	(Sealed)	Unsealed			TYPE	(Bridge)	Mway Ramp	Rly Xing	(Flat rd.)	Hill rd.
SURFACE	(Wet)	Dry	Ice or snow		JUNCTION	Driveway	Roundabout	X	T	Y	Multileg
LIGHT	Bright sun	(Overcast)	Twilight	Dark	CONTROL	Traf. signals	Stop	Give way	Sch Patrol/warden	Nil
STREET LIGHTS	On	oFf	(None)		WEATHER	Fine	Mist/fog	(Light rain)	Hvy rain	Snow	Frost	Str. wind

ROAD: 1-way | (2-way) | Off rd.

TOTAL LANES: 0 | 1 | (2) | 3 | 4 | 5 | 6

17 OTHER PERSONS INVOLVED EXCLUDING DRIVERS

	Forenames / Surname	Cyclist, Pedestrian, Passenger with	DOB	Sex	Ethnicity	Injury	NZTA Use: Causation	Office Use
1. Name:	Jemma Sheppard	Sheppard	1/8/92	M (F)	M	Fatal Serious Minor (Nil)		
Address:	RD 3 Makerua							
Injuries:	nil							
2. Name:	Thomas John Atkinson	"	2/10/40	(M) F	E	Fatal Serious (Minor) Nil		
Address:	15 Park Avenue, Foxton							
Injuries:	bump on head							
3. Name:	Michael Sheppard	"	2/7/99	(M) F	M	Fatal Serious Minor (Nil)		
Address:	RD 3 Makerua							
Injuries:	nil							
4. Name:				M F		Fatal Serious Minor Nil		
Address:								
Injuries:								
5. Name:				M F		Fatal Serious Minor Nil		
Address:								
Injuries:								
6. Name:				M F		Fatal Serious Minor Nil		
Address:								
Injuries:								

European	NZ Maori	Samoan	Fijian	Tongan	Cook IslandeR	Niuean
ToKelauan	Other Pacific Island		Asian	Other .... (Specify)		

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18 **INDEPENDENT WITNESSES OR OTHER NOTES**

Name: Forenames: Allan John Surname: Turner

Residential Address: 581 Fox St, Levin Phone: 03 471 9864

Business Address: Phone:

Following ute and trailer - saw it suddenly wobble and go off to the right.
Was approaching bridge. Didn't notice other car until got closer.

Signature: A Turner

Name: Forenames Surname

Residential Address: Phone:

Business Address: Phone:

Signature:

Name: Forenames Surname

Residential Address: Phone:

Business Address: Phone:

Signature:

19 Next of kin notified (when, where, by whom)

20 **SPECIAL PROJECTS:** *Office Use*

1. Project Name

2. Project Name:

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Appendix B – Draft Crash Reduction Study Process

APPENDIX B

Draft Crash Reduction Study (CRS) Process

PRE-STUDY STAGE	
STEPS	RESPONSIBILITY
1. Determine the need for study by analyzing crash data of the crash site. The crash data should be the updated extract from the Samoa National Road Crash Database	Road Safety Committee (MWTI, LTA, Police, ACC, Health) in conjunction with MWTI and/or LTA
2. Programme the study funding	Road Safety Committee (MWTI, LTA, Police, ACC, Health) in conjunction with MWTI and/or LTA
TYPICAL CRASH STUDY SCOPE	
STEPS	RESPONSIBILITY
1. **Initiate Study** (Various in-house, or consultant arrangements used. Short and long term CRS contracts)	Road Safety Committee (MWTI, LTA, Police, ACC, Health) in conjunction with MWTI and/or LTA
2. **Identify crash locations** (This may be undertaken prior to initiating the study or by the CRS team. The CRS initiation may be in response to a specific crash)	Road Safety Committee (MWTI, LTA, Police, ACC, Health) in conjunction with MWTI and/or LTA
3. **Form a Team** (Team member skills specific to the crash problems and environment. Study team may identify crash locations)	MWTI and/or LTA with the recruited Road /Traffic Engineer Consultant (s)
4. **Data Collection** (Traffic volumes, aerial photos, maps, road data, collision diagram etc)	Recruited Road /Traffic Engineer Consultant (s)
5. **Preliminary Diagnosis** (undertaken prior to site inspections)	Recruited Road /Traffic Engineer Consultant (s)
6. **Field Inspections and follow-up inspections** (Drive-over, inconspicuous observations, and any follow-up investigations required	Recruited Road /Traffic Engineer Consultant (s)
7. **Identify Problems** (Play detective and identify problems by thoroughly investigating both data and location	Recruited Road /Traffic Engineer Consultant (s)
8. **Develop Solutions** (countermeasures targeted to safety problems identified. Follow-up visits and measurements may be required)	Recruited Road /Traffic Engineer Consultant (s)
9. **Estimate/economics** (Economics dependent on funding sources and requirements)	Recruited Road /Traffic Engineer Consultant (s)
10. **Reporting** (Draft report prepared and reviewed by MWTI and/or LTA. Final draft may be sent to the RSC for comment. Final report to include monitoring setup Forms for LTA.	Recruited Road /Traffic Engineer Consultant (s)
11. **Monitoring Forms** (Site problem and recommendation forms)	Recruited Road /Traffic Engineer Consultant (s)

POST STUDY	
STEPS	RESPONSIBILITY
1. **Design, Construction and Implementation** (Timing, responsibility dependent on contractual arrangements and funding source. May or may not form part of the CRS)	LTA with the recruited Road /Traffic Engineer Consultant (s) and the Contractor.
2. **Safety Audit** (Check that improvement works will achieve the crash savings stated in report)	Independent Consultant
3. **Monitoring** (Implementation forms completed by the RCA or consultant and returned to LTA.	Independent Consultant

Appendix C – Content of Crash Reduction Study Report

APPENDIX C

Content of a Crash Reduction Study Report

Section	Description
1. Title page	• The authority undertaking the study • Study name and parameters • Study period
2. Introduction	An overview of the study area, crash history, study team and organisations, study process etc
3. Summary of recommendations	An executive summary of the recommendations for inclusion in the annual roading plan or minor safety projects list. It should include crash savings, cost estimates, BCRs (where applicable) for the locations covered in the study. For a multiple location study, this information is normally tabulated. The recommendation summary needs to clearly identify any recommendations pertaining to education and enforcement so that those can be forwarded onto the appropriate agencies.
4. Crash location summary sheets (One sheet for each crash location. Refer to Appendix C).	• Location name and location • Location description • Crash history (highlighting common factors) • Recent changes • Problem(s) • Solution(s) • Potential crash savings • Cost and economics (where applicable) • Recommendations for treating the location or other improvements • Crash listing • Collision diagram • Remedial works diagram • Photographs of the location
5. Appendices	• Map of network with study locations identified • Monitoring forms with location data and crashes entered • Other data relating to the study that may be appropriate such as the full crash listing and preliminary analysis, site selection, etc

Appendix D – Sample of Road Hierarchy Framework

Road Hierarchy Levels and Objectives

LEVEL 1: PURPOSE

ROAD	STREET
• to carry through traffic	• to provide local property access • to collect local traffic

LEVEL 2: FUNCTION

ARTERIAL ROAD	SUB ARTERIAL ROAD	COLLECTOR STREET	LOCAL STREET
• through traffic movements • longer distance traffic movements • line haul public transport task • primary freight and dangerous goods routes • regional cycle movements (off road)	• connections between local areas and arterial roads • connections for through traffic between arterial roads • access to public transport • through movement of public transport • regional – local cycle movements (off road) • pedestrian movements	• carry traffic having a trip end within the specific area • direct access to properties • access to public transport • pedestrian movements • local cycle movements	• direct access to properties • pedestrian movements • local cycle movements

LEVEL 3: MANAGEMENT

Highway	Arterial	Arterial Main Street	Traffic Distributor	Controlled Distributor	Sub Arterial Main Street	Major Collector	Minor Collector	Access Street	Access Place
The aim of management policies for these categories will be to facilitate:									
• longer distance traffic movements • regionally and nationally significant movements	• longer distance traffic movements	• longer distance traffic movements • access to commercial properties	• connection of local areas to arterial roads	• connection of local areas to arterial roads • access to properties (certain existing cases). *Treatment may control some aspects of traffic operation to ameliorate impacts*	• connection of local areas to arterial roads • access to commercial properties. *Treatment may involve preservation of aspects of local amenity in balance with traffic operation*	• connection of residential streets with traffic carrying roads • access to grouped/ commercial properties and community facilities	• connection of residential streets with traffic carrying roads • access to individual adjacent properties	• access to individual adjacent properties • access to local area	• access to individual adjacent properties

LEVEL 4: DESIGN

- according to relevant guidelines and codes including Council subdivision guidelines, AUSTROADS Guides, Queensland Streets, AMCORD, Australian Standards

Source: Eppell, V A T; McClurg, B A & Bunker J M (2001) A Four Level Road Hierarchy for Network Planning and Management (in Proceedings 20th ARRB Conference, Melbourne)

Road Hierarchy Desirable Performance Criteria – Urban Areas (Example Only)

Criterion	ROAD						STREET			
	ARTERIAL ROAD			SUB ARTERIAL ROAD			COLLECTOR STREET		LOCAL STREET	
	Highway	Arterial	Arterial Main Street	Traffic Distributor	Controlled Distributor	Sub Arterial Main Street	Major Collector	Minor Collector	Access Street	Access Place
Functional Characteristics										
Dominant linkage	Regional	Metropolitan	Metropolitan/sites	Specific area	Specific area	Specific area/sites	Environmental cell	Environmental cell	Sites	Sites
Traffic carrying function	Volumes not restricted	Volumes not restricted	<20,000vpd	Volumes not restricted	<10,000vpd	<10,000vpd	<6,000vpd	<3,000vpd	<750vpd	<300vpd
Residential access function	Nil	Nil	Nil	Nil desirable, accept consolidated	Nil desirable, accept consolidated	Site specific	Consolidated	Individual	Individual	Individual
Commercial access function	Nil	Nil	Site specific	Consolidated	Consolidated	Site specific	Direct possible for large sites	Individual	Individual	Individual
Industrial access function	Nil	Nil	Nil	Nil	Nil	Nil	Direct possible for large sites	Individual	Individual	Individual
Traffic speed environment	>=100km/h	70-80km/h	40-50km/h	60-80km/h	May be controlled to 50-70km/h	40-50km/h	60km/h	40km/h	<=40km/h	<=40km/h
Heavy vehicle movement	Primary freight routes	Primary/secondary freight routes	Should bypass except for access	Secondary routes	Should bypass except for access	Should bypass except for access	Access only	Access only	Access only	Access only
Dangerous goods movement	Primary routes	Nominated routes only	Inappropriate except for access	Nominated routes only	Nominated routes only	Inappropriate except for access	Inappropriate except for access	Inappropriate except for access	Inappropriate except for access	Inappropriate except for access
Public transport facilities	Line haul, priority treatments	Line haul, priority treatments	Bus route	Bus route	Bus route	Bus route	Bus route	Bus route	Nil	Nil
Cycle facilities	Trunk Routes, off carriageway	Trunk Routes, off carriageway	Trunk/District routes, cycle lanes on road	Trunk/District routes cycle lanes on road	Trunk/District routes cycle lanes on road	Trunk/District routes cycle lanes on road	District/Neighbourhood routes, cycle lanes on road	District/Neighbourhood routes, marked lanes not req'd	Neighbourhood routes, shared road space with cars	Neighbourhood routes, shared road space with cars
Pedestrian movement facilities	Only where linkage required, separate from road	Only where linkage required, pathways	Pathways both sides	Only where linkage required, pathways	Pathways both sides	Pathways both sides	Pathways both sides	Pathways one or both sides	Depends on network planning	Depends on network planning
Frictional Characteristics										
Access control	No access	No access	Selective access control	Selective access control	Selective access control	Selective access control	Combined site access	Individual sites	Individual sites	Individual sites
Parking provision	Nil	Nil	Keep clear of through lanes	Nil	Keep clear of through lanes	Keep clear of through lanes	Nil	Kerbside	No specific provision	No specific provision
Bus stopping provision	None on road	Indented bays where appropriate	Indented bays where appropriate	Indented bays where appropriate	Indented bays where appropriate	Indented bays where appropriate	Indented bays where appropriate	Kerbside	No provision	No provision
Pedestrian crossings	Grade separated	Signalised	Controlled points	Controlled points	Controlled points	Controlled points	Some controlled points	Some controlled points	No specific provision	No specific provision
Intersection spacing	1-2km highway >=2km motorway	500-1000m	Site specific	300m	300m	Site specific	100m	60m	40m	Nil
Intersection treatments	Grade separated	Grade separated/ signal/ roundabout	Signal/roundabout	Signal/roundabout/priority T	Signal/roundabout/priority T	Signal/roundabout/priority T	Roundabout/ priority	Roundabout/ priority	Priority	Priority
Cross section	Volume driven, divided	Volume driven, could be divided	4 or 2 lanes, could be divided	Volume driven, could be divided	4 or 2 lanes, could be divided	Generally 2 lanes	2 lanes, could be divided	2 lanes	2 lanes	1 or 2 lanes
Impact Characteristics										
Abutting land use types	Non sensitive to traffic	Non sensitive, vehicle associated	Retail/commercial	Non sensitive to traffic	Preferably non sensitive to traffic	Retail/commercial	As specified under zoning	As specified under zoning	As specified under zoning	As specified under zoning
Land use impact amelioration	Barriers/buffers/ setbacks	Buffers/streetscaping/setbacks	Streetscaping	Streetscaping/setbacks	Streetscaping	Traffic management/ streetscaping	LATM/ streetscaping	LATM/ streetscaping	LATM/ streetscaping	LATM/streetscaping

Source: Eppell, V A T; McClurg, B A & Bunker J M (2001) A Four Level Road Hierarchy for Network Planning and Management (in Proceedings 20th ARRB Conference, Melbourne)

Appendix E – Stakeholder Consultation Summary

APPENDIX E

Stakeholder Consultation Summary

(Note here for information – the only candidates that we did not interview were the politician – PM and Cabinet)

Candidate	Problems	Possible Solutions
Prime Minister and Cabinet (through second hand comments from client)	• Very bad status of roads! • Do we have any engineers? • Engineers are failing to look after our roads. • Very bad road standards.	• Provide sufficient funding for road programs. • Any roads not in the program can only be done if additional budget is given by Cabinet.
MWTI	• Are there any road standards? A possiblelack of road standards might be contributingto the bad quality roads. • The current MWTI legislation doesn't reflect the role the Ministry should provide for regulating roads in Samoa. There was already a consultancy undertaken to look at MWTI and LTA roles' and responsibilities' which identified areas that needed to be addressed. This ought to be implemented and requires Cabinet approval and change in existing legislation. • As a member of the Tenders Board, the current complaint from PM and Tenders Board members were the bad quality roads and what our engineerswere doing about it. • We are not involved with planning and approval of works program for road transport planning in	• Find out if there are any road standards (design and constrution). If there any, review the standards and make recommendations. • Amend the current MWTI legislations to allow a role for MWTI to support better roads in Samoa. A study has already determined the changes in the legislation. Possible solution is to implement the outcome of the study as soon as possible. Allow MWTI to review current road planning and programs for all Samoa roads. MWTI assist LTA to get funding to implement the agreed program. LTA can limit its work on that agreed program and any additional works will have to be funded differently (additional budgets to LTA before it is undertaken. A user pay system or community obligation systems by government).

	regard to the current system. MWTI should be involved and will support LTA budget submission and program for given funds from government. • The current legislation is not the same as the way the other transport sectors is being regulated, like the marine and air transport.	
LTA	• There is not enough money given to LTA each year to address all road maintenance works and any additional upgrade or capital works. • The system doesn't allow them to follow their own program and approved budget but seems to be dictated from the government (Ministers and Cabinet). • There are too many roads under their system to be looked after. The amount of work to be done annually and the available budget doesn't correlate. The constant interference with additional work to be done outside their normal maintenance works takes away money that is needed to maintain existing infrastructures. • LTA programs of maintenance capital works are not fully funded under government given annual budgets. • The budgets is limited (and grossly cut after	• LTA is funded sufficiently for its maintenance works and capital works program. Budget submission to government are based on agreed programs with LTA (and MWTI) against clear sets of deliverables. • The final annual budget given by government is aligned against clear agreed deliverables. LTA is to prepare this program and deliverables immediately after known funds for the coming budget year. This budget and program is given to MWTI, Minister of Works (and Cabinet) and LTA Board of Directors as agreed commitment by LTA (and MWTI). o The progress of this program is tracked monthly by MWTI, Minister of Works (Cabinet and CDC), LTA Board of Directors through monthly progress report that measures progress and spending. Same report is for everybody to get for their monitoring. o Through these monthly monitoring is a report for costing of any additional works program from government. Budgets for additional program is

	budget submission for funding from government) and the expectation for the same amount of work remains the same after budget submission • LTA have to stretch the available budget to cover all aspects of maintenance works and any new capital works dictated by government to be done. • Contracts preparations are limited and depends on the available budget. • Too many contracts to manage and not enough qualified engineering staff to support and supervise these contracts.	given (or promised) before actions is taken. • LTA is to rationalise the supervision of current contracts to improve quality roads. Some of these supervision can be outsourced and some can be retained within LTA staff. • LTA to extend annual maintenance contracts to 3 years' contract to allow flexibility of contracts for long term benefits. • LTA to prepare contracts properly before they are tendered out. This includes proper design and construction specification of each road. Provide a budget estimate of each road project and reveal the estimated cost to the Tenders Board before tenders are opened. Winning bidders are based on technical ability to do the work and *conforming bidders* can only be considered if bids are within 20% plus or minus of estimated cost of project. • LTA is looking into limiting road contracts for maintenance of roads. Review the effective delivery of contracts with the current system and make further recommendations for improvement. The aim of the review is to provide better quality roads for Samoa and not for any other reasons. • LTA registration of contracts has to be reinforced and to match future contracts against available contractor resources.

Appendix F - Terms of Reference Technical Assistance Consultant

Appendix G – Draft Process for Developing the Samoa NRD Standard

APPENDIX G

Draft process for developing the Samoa National Roads Design (NRD) Standard

Step1:Seek endorsement from Austroad:

Prior to anything else Government mustformerly seek endorsement from Austroad to permit Samoa to adopt the application of Austroad standards for the design of national roads for Samoa. Refer to Austroads Publications License Agreement attached in Appendix H.

It is important to note that the Austroad organisation has various standards used to guide the whole spectrum of land transportation. One of these guides is the Road Design Guide.These are listed below:

IMPORTANT NOTES:

- Austroads list of guides for the Transportation Network:

  - ✓ Guide to Bridge Technology;
  - ✓ Guide to Pavement Technology;
  - ✓ Guide to Project Evaluation;
  - ✓ Guide to Transport Planning;
  - ✓ Guide to Project Delivery; and
  - ✓ Guide to Road Design.
  - ✓ Guide to Asset Management;
  - ✓ Guide to Traffic Management; and
  - ✓ Guide to Road Safety

- The Guide to Road Design has eight (8) parts and they are as follows:

GUIDE TO ROAD DESIGN

AGRD01 2010 – Austroad Guide to Road Design Part 1 -	Introduction to Road Design
AGRD02 2006 – Austroad Guide to Road Design Part 2 -	Design Consideration
AGRD03 2010 – Austroad Guide to Road Design Part 3 -	Geometric Design
AGRD04 2009 – Austroad Guide to Road Design Part 4 -	Intersections and Crossings General
AGRD04A 2010 – Austroad Guide to Road Design Part 4A-	Unsigalised and Signalised Intersectio
AGRD04B 2011 – Austroad Guide to Road Design Part 4B-	Roundabouts
AGRD04C 2009 – Austroad Guide to Road Design Part 4C-	Interchanges
AGRD05 2010 – Austroad Guide to Road Design Part 5 –	Drainage Design
AGRD06A 2009 – Austroad Guide to Road Design Part 6A-	Pedestrian & Cyclist Paths
AGRD08 2009 – Austroad Guide to Road Design Part 8-	Process and Documentation

Step2: Seek assistance from Austroad Road Design Reference Panel:

It is highly recommended for the Government seek assistance/direction from any of the following **Austroads Road Design Reference Panel.** This panel consists of key experts responsible for providing much of the useful information and guided the authors in the preparation of the Austroad Guide to Road Design. They will be able to advice Government on the applicability and relevancy of the Terms of Reference (TOR) for the proposed engagement of an Individual Consultant or a Firm. Engaging a Consultant or Firm will be discussed furtherbelow.The**Austroads Road Design Reference Panel**arelisted below:

AUSTROADS ROAD DESIGN REFERENCE PANEL:	
Mr Pat Kenny	Roads and Traffic Authority, New South Wales
Mr David Barton	Roads Corporation, Victoria
Dr Owen Arndt	Department of Transport and Main Roads, Queensland
Mr Rob Grove	Main Roads Western Australia
Mr Noel O'Callaghan	Department for Transport, Energy and Infrastructure, South Australia
Mr Graeme Nichols	Department of Infrastructure, Energy and Resources, Tasmania
Mr Peter Toll	Department of Planning and Infrastructure, Northern Territory
Mr Ken Marshall	ACT Department of Territory and Municipal Services
Mr Peter Aumann	Australian Local Government Association
Mr James Hughes	NZ Transport Agency
Mr Tom Brock	The Association of Consulting Engineers Australia
Mr Anthony Barton	Australian Bicycle Council
Mr Michael Tziotis	ARRB Group Ltd

Step3:Develop Terms of Reference to engage a Consultant or Firm

Develop a comprehensive Terms of Reference that clearly outlines the scope of services, qualifications and experiences required from a knowledgeable Roading or Traffic Engineering Consultant or Firm. The Consultant or Firm will have a proven excellent knowledge of Austroad and a great understanding of their overall operation and processes. It is recommended that the Consultant or Firm has a proven sound and relevant track record of their involvement in the development of National Road Design Standards or similar in the past.

Step4:Engagement of a Competent Individual Consultant or Firm

Engage a Competent Individual Consultant or a Firm to develop a national road design (NRD) standard for Samoa. The NRD standards for Samoa will consist of the Austroad guide to road design and a companion supplementary document. The Consultant or Firm will be responsible for developing this companion supplementary document. The companion supplementary document will consist of amended sections of the *Austroad Guide to Road design* that suit Samoa's local condition.

The following eight Parts of the *Austroads Guide to Road Design*that the Consultant or Firm needs to reference in the development of the companion supplementary document for Samoa NRD standard.

Parts of the Guide to Road Design[1]

Part 1 – *Introduction to Road Design* is an overview of road design that briefly describes the scope of the *Guide to Road Design*, the context of the road design process, the philosophy and principles on which good design is based, and the design considerations that may be required. The use of each part, the relationships between them and their relationships to the design process are also covered. Part 1 is particularly useful to designers who are new to road design or are using the *Guide to Road Design* for the first time.

Part 2 – *Design Considerations*provides guidance on the range of influences, information, data, criteria, and other considerations that may have to be considered in developing a road project. These design considerations must be determined at an early stage of the design process, to properly define the task the road is to perform and the relevant constraints. Part 2 describes the basis of the guidelines and the context in which they should be applied. It also provides links to other Austroads Guides and resources that give further guidance on design inputs.

Part 3 – *Geometric Design*provides the detailed information necessary to enable designers to develop coordinated road alignments, as well as adequate cross-sections, sight distances and other features that allow safe operation of the design traffic at the required speed.

Part 4 – *Intersections*Appropriate design of these facilities is important because they are locations at which a high percentage of crashes occur. This part provides guidance to enable road designers to develop geometric designs for intersections and interchanges that will result in safe and efficient operation. It covers both rural and urban situations. Part 4A includes unsignalised and signalised intersections, Part 4B covers roundabouts, and Part 4C covers interchanges.

Part 5 – *Drainage Design.*This part provides information required to design effective road drainage systems that are safe for road users, take account of environmental factors including the treatment of stormwater runoff, and meet the requirements of the local planning authorities e.g. PUMA.

Part 6 – *Roadside Design,* *Safety and Barriers.* This part includes everything that relates to the areas between the outside edge of the shoulder or kerb and the road reservation boundary such as the accommodation of median strips, road furniture, utilities, roadway lighting, landscaping, etc. Part 6A covers pedestrian and cyclist paths and Part 6B is focused on the roadside environment.

Part 7 – *Geotechnical Investigation and Design*describes the geotechnical information likely to be required for road design and provides advice on how the information should be used. Aspects addressed include geotechnical investigations, earthworks design, construction materials and environmental issues.

Part 8 – *Process and Documentation*is the means by which designs are produced in an efficient manner, and ensures that all factors that should influence the desired outcome are taken into account. Documentation enables the decision making process to be retraced should this be necessary, and is the basis for quality management. This part describes requirements for quality of documentation and presentation.

[1]**GUIDE TO ROAD DESIGN PART 1: INTRODUCTION TO ROAD DESIGN**

Appendix H – Austroads Publications License Agreement

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