

Mangrove Management Plan for Fiji

2013



**A report prepared for the National Mangrove
Management Committee (MMC).**

The Mangrove Management Plan of Fiji-2013 was prepared for the National Mangrove Management Committee (MMC) by Dr Dick Watling. This report was funded through the MESCAL Fiji project* housed under the Department of Environment.

© 2013 Mangrove Management Committee, Republic of Fiji.

Reproduction of this publication for educational and non- commercial purposes is authorized without prior written permission from the copyright holder, provided that the source is fully acknowledged.

Reproduction of any part of this publication for resale or other commercial purposes is prohibited without prior written consent from the copyright owner

Photographic credits: MESCAL Fiji Project

**MESCAL Fiji project is funded by the Federal Republic of Germany through International Union of Conservation of Nature - Oceania Regional Office, under the Pacific Mangrove Initiative.*

Table of Contents

1	Introduction.....	1
1.1	Background to the Report.....	1
1.2	Mangrove Management Plan Phase 1 & Phase 2	2
1.3	Scope of the Mangrove Management Plan for Fiji - 2013	2
2	Lessons Learned from the 1985 Mangrove Management Plan	4
2.1	Context of the MMP 1985/86	4
2.2	Mangrove Management Plan 1985/86	5
2.2.1	Overview of the Plan	5
2.2.2	Export of Mangrove Benefits and Regional Cumulative Impact	6
2.2.3	Mangrove Management Committee.....	7
2.3	Use of the Mangrove Management Plan 85.....	9
2.3.1	1985-1993.....	9
2.3.2	Post 1993.....	9
2.4	Criticisms of the Mangrove Management Plan 85/86	10
2.5	Lessons Learned and Issues Emerging	10
2.5.1	Recommendations of the MMP85	10
2.5.2	Current Status of Issues Identified in MMP85.....	11
2.5.3	Additional issues – 2013.....	12
2.5.4	Impact of Dredging spoil Disposal in Mangroves	13
2.5.5	Mangroves and Carbon Sequestration.....	14
2.5.6	Lessons Learned from the Mangrove Management Plan 85/86.....	15
3	National Mangrove Resource.....	17
3.1	MMP85 and Literature Figures.....	17
3.2	Forests Department Estimate	17
3.3	SPC-SOPAC GIS&RS Unit Estimate and Rate of Mangrove Loss	18
3.3.1	Mangrove Area Estimate	18
3.3.2	Mangrove Loss.....	18
3.4	Recommendation.....	19
4	Mangrove management – Implementation Arrangements.....	20
4.1	Current Legislative Arrangements	20
4.2	Communities and Mangroves	21

4.3	Department of Lands has Primary Responsibility	22
4.4	Department of Environment and the Environmental Management Act	22
4.5	National Environment Council	23
4.6	A Declining Role for Forests Department	23
4.7	Protected Mangrove Areas	24
4.7.1	Mangrove Trust Fund	25
4.8	Mangrove-Management: On-the-Ground Implementation	25
4.9	Recommendation	32
5	Policy	33
5.1	Requirement and Related Work	33
5.2	Existing Policy Statements Relating to Mangroves	33
5.2.1	Fiji Forest Policy 2007	33
5.2.2	Mangrove Management Plan Phase 1 1985.....	34
5.3	Recommendation – Mangrove Policy	34
6	The Role of the Mangrove Management Committee	35
6.1	Background	35
6.2	Changes to the Mangrove Management Committee	35
6.2.1	Mangrove Management Technical Committee.....	36
6.2.2	Wider Stakeholder Forum for Mangrove Issues.....	36
7	Guidelines for Environmental Impact Assessment, Review and Monitoring of Mangrove-impacting Developments	38
7.1	Introduction	38
7.1.1	Environmental Management Act 2005	38
7.1.2	Guidelines	38
7.2	Terms of Reference	39
7.3	Project Description	39
7.3.1	Avoidance and Minimisation of Impacts to Mangroves.....	40
7.4	Physical Processes	40
7.4.1	Coastal Processes	40
7.4.2	Dredging	41
7.5	Mangrove Description	41
7.5.1	Ecological Description.....	41
7.5.2	Timber Value.....	42

7.6	Regional Calibration and Cumulative Impact	43
7.7	Consultation	44
7.7.1	General Public.....	44
7.7.2	TFRO Consultation and Consent.....	45
7.8	Mangrove Offsets.....	45
7.9	Cost-benefit Analysis.....	47
7.10	Review Procedure	47
7.10.1	Use of MMP85 Mangrove Management Zonation Plans	48
7.11	Monitoring of EIA Compliance	48
7.11.1	Current.....	48
7.11.2	Construction Environmental Management Plan	48
7.11.3	Mangrove Mapping	49
7.11.4	Mangrove Monitoring Transects	49
7.11.5	Mangrove Monitoring Plots.....	49
8	Mangrove Conversion Approval Procedure	51
8.1	Background.....	51
8.2	Proposed Approval Procedure	51
9	Climate Change	53
9.1	Climate Change – What Does It Mean for Fiji ?	53
9.2	How Does Climate Change Affect Mangroves ?	53
9.3	The Wider Effects of Mangrove Response to Climate Change.....	54
9.4	Managing Mangroves for Climate Change	55
9.4.1	Government Response For Climate Change Management	55
9.4.2	Mangrove Conservation & Enhancement – A Valuable Climate Change Adaptation Measure	56
9.5	Recommendations	57
10	Valuing Mangroves.....	58
10.1	Mangroves and Ecosystem Linkage	58
10.2	What Can Be Valued ?	59
10.3	Valuing Mangrove-related Fisheries.....	60
10.4	Compensation for Loss of Fishing Rights.....	61
10.5	Recommendations on Valuing Mangroves and Compensation for Traditional Fishing Rights Owners.	61

11	Mangroves and Traditional Fishing Rights Owners.....	63
11.1	Overview	63
11.2	Usufruct Rights.....	64
11.3	Untapped Conservation Potential	64
11.4	Traditional Fishing Rights Owners' Consent.....	64
12	Mangrove forestry	67
12.1	Background.....	67
12.2	Department of Forests Policy and Position.....	67
12.3	Fuelwood Plantations.....	68
12.4	Recommendation.....	68
13	Urban & Development 'hot spot' mangrove plans	70
13.1	Background.....	70
13.2	Preparing Urban or Hot Spot Mangrove Plans	70
13.2.1	Outline	70
13.3	Process	71
13.3.1	Purpose.....	71
13.3.2	Boundary Definition:	71
13.3.3	Loss of Mangroves to Date	71
13.3.4	Identification of 'Development Areas' of Mangrove.....	72
13.3.5	Survey of Ecological Health of Existing Mangroves.....	72
13.3.6	Plan Preparation	72
13.4	Issues Arising	72
14	Mangrove Management Action Plan.....	74
	References.....	77
	Attachment 1: Satellite Imagery of Mangrove Fatality in the Labasa and Rewa deltas	79

LIST OF TABLES

Table 1:	Mangrove Zonation in the Mangrove Management Plan 1985/86	6
Table 2:	Area of Mangroves on 7 Fijian Islands (Source: DoF 2008).....	17
Table 3:	Loss of Mangrove (Viti Levu, Vanua Levu, Taveuni and Kadavu only) between 1991-2007 (Source: SPC-SOPAC GIS&RS Unit Status October 2013)	18
Table 4:	Preliminary Analysis of On-the-Ground Mangrove Management Requirements.	30

Table 5: Role of Mangrove Management Technical Committee in a Mangrove EIA process 37

Table 6: Mangrove Description Methodology 42

Table 7: Ecosystem Services of Mangroves Which Can be Valued 60

Table 8: Mangrove Management Action Plan..... 76

LIST OF FIGURES

Figure 3: Ecosystem Connectivity and Impacts on Ecosystem Services. (Source: Figure from Silvestri & Kershaw, 2010)..... 58

Figure 4: Estimated Annual Ecosystem Benefits for Coastal Ecosystems.(Source: Figure from Silvestri & Kershaw, 2010 based on TEEB 2009)) 59

ABBREVIATIONS AND ACRONYMS

CBA	Cost-benefit Analysis
CCU	Climate Change Unit
CEMP	Construction Environment Management Plan
DoEnv	Department of Environment
DoF	Department of Forests
DoL	Department of Lands

DTCP	Department of Town & Country Planning
ECF	Environment Consultants Fiji
EIA	Environmental Impact Assessment
EMA	Environmental Management Act 2005
FAO	Food and Agriculture Organisation (of the United Nations)
FLMMA	Fiji Locally Managed Marine Areas
ICMC	Integrated Coastal Management Committee
iTLTB	iTaukei Land Trust Board
MESCAL	Mangrove Eco Systems for Climate Change Adaptation and Livelihood project
MC	Municipal Councils
MiTA	Ministry of iTaukei Affairs
MMC	Mangrove Management Committee
MMTC	Mangrove Management Technical Committee
MMP85	Mangrove Management Plan 1985/86 Phases 1 & 2
MPI	Ministry of Primary Industries
NCCCC	National Climate Change Coordinating Committee
NEC	National Environment Council
NGO	Non-government organisation
NT	National Trust
SOP	Standard Operating Procedure
SPREP	Secretariat of the Pacific Regional Environment Programme
TFRO	Traditional Fishing Rights Owners
ToRs	Terms of Reference

1 INTRODUCTION

1.1 BACKGROUND TO THE REPORT

This report, the Mangrove Management Plan 2013 (MMP2013), has been prepared by Dr Dick Watling, Environment Consultants Fiji (ECF) for the Department of the Environment (DoEnv) as the focal point for the Mangrove Eco Systems for Climate Change Adaptation and Livelihood project Project (MESCAL).

A draft of the report was circulated to members of the Mangrove Management Committee (MMC) and other stakeholders prior to a workshop being held to discuss the draft. A report on the workshop was prepared by Department of Environment (DoEnv 2013), and findings considered by the consultant and included in the final.

The MESCAL project, a German Federal Ministry for Environment, Nature Conservation and Nuclear Safety funded project is administered through the International Union for the Conservation of Nature Oceania Regional Office (IUCN ORO) in collaboration with the government of Fiji, as one of the five countries included in the project. The project, is part of the broader Pacific Mangroves Initiative with the key goal *“to assist the Pacific Island countries and territories to implement sound practices and capacity building in mangrove management, including raising awareness of and maintaining high biodiversity values and ecosystem goods and services that can sustain or even improve the livelihoods and wellbeing of the local population depending off these coastal ecosystems”*.

The MMP2013 complements other MESCAL projects being undertaken in Fiji which include:

1. Review of legislation and policies relating to the use and management of mangrove ecosystems in Fiji Islands
2. Baseline biodiversity data/information on the MESCAL demonstration site - the Rewa Delta
3. Carbon assessment of the Rewa Delta.
4. Technical training of Government stakeholders
 - a. Mangrove long plot surveys
 - b. Shoreline video assessments
 - c. Fisheries surveys (net surveys)

- d. Carbon assessments (measuring, processing, packaging and import of soil samples; aboveground biomass sampling)
5. National Mangrove Media Awareness Campaign (partnering with WWF, Ministry of Lands, Department of Environment).

In particular the MMP recognises that the *Review of legislation and policies relating to the use and management of mangrove ecosystems in Fiji Islands* provides a comprehensive analysis which is drawn on in the development of this plan. While duplication of the review and analysis has been avoided, certain issues, recommendations and conclusions of that report underlie subjects specifically addressed in this plan.

1.2 MANGROVE MANAGEMENT PLAN PHASE 1 & PHASE 2

In 1985-6 a Mangrove Management Plan (MMP85) was prepared as a project of the South Pacific Commission with the Department of Fisheries. MMP85 complemented the establishment of the Mangrove Management Committee (MMC) as an advisory committee to the Department of Lands (DoL) as the government agency responsible for foreshore as Crown/State Land.

The MMC was active until approximately 1993 and during this period the MMP85 was a key tool for DoL mangrove management. With the dissolution of the MMC, use of the MMP85 declined to virtual non-existence for regulatory purposes amongst all the mangrove regulatory authorities. Nonetheless, MMP85 has been widely discussed over the past decade in development, regulatory and conservation fora relating to mangroves. The need for a review and revival in its use is recommended in numerous reports and is incorporated in certain sectoral policies (i.e. Fiji Forest Policy Statement, 2007; DoEnv 2004, 2011). Lack of funding combined with confusion in the review objectives prevented its implementation until the MESCAL project responded to DoEnv requests for its inclusion as a priority.

1.3 SCOPE OF THE MANGROVE MANAGEMENT PLAN FOR FIJI - 2013

The purpose of the current plan (henceforth MMP2013) is to prepare a document *“The Mangrove Management Plan will act as a tool to administer, manage, facilitate and control development and management of mangroves within Fiji..... intended for a range of audiences, including the Mangrove Management Regulatory bodies, Project Proponent/ Developers, Non-Government agencies, Mangrove Management Committee, Integrated*

Coastal Management Committee, Resource owners and the Fiji Government” (Project Terms of Reference, 2012).

A ‘lessons learned’ review of the MMP85 is included in this report which relies heavily on the author’s personal experience based on his:

- Preparation of MMP85;
- Membership of the MMC until its dissolution (1985-c.1994);
- Role as a consultant preparing Environmental Impact Assessments of developments in coastal and mangrove areas (1982-ongoing); and,
- *Ad hoc* input into mangrove management discussions and fora (recent years following dissolution of former MMC).

MMP2013 will not review or update the maps produced by MMP85. Revising or preparing new mangrove zonation maps will require extensive additional mangrove survey and appropriate consultation with the qoliqoli owners. This would be a lengthy process and, reaching widespread consensus, an unlikely outcome. In 2013 with the Environment Management Act in place, the approach adopted is to put in place a rigorous Environmental Impact Assessment (EIA) procedure in place ensuring consultation will be undertaken to address each situation on a case by case basis, as developments are planned or proposed. MMP2013 develops an approach and EIA guidelines for this purpose. However, it is recognised that there is a need for spatial (or scheme) plans in ‘high development pressure’ areas and MMP2013 provides guidelines for how these should be prepared.

2 LESSONS LEARNED FROM THE 1985 MANGROVE MANAGEMENT PLAN

2.1 CONTEXT OF THE MMP 1985/86

Prior to 1975 Fiji's mangroves were constituted as Forest Reserve and were managed by the Forestry Department. Following a Cabinet Decision in 1974 all mangrove Forest Reserves were dereserved following which they came under the jurisdiction of the Lands & Survey Department in line with all other 'foreshore'. The same cabinet paper (CP 74(204)) instituted the right of Traditional Fishing Rights Owners (TFRO) to receive recompense for the loss of fishing rights. This remains the sole basis for Fishing Rights Compensation today.



Mangrove land reclamation at Lami, Fiji

There followed a period of major mangrove conversion or plans for conversion including:

- Raviravi (Ba) for sugar cane, Dreketi (Macuata) for rice, Waidamu (Rewa) for agriculture;
- Denarau, Vulani* (Sabeto River), Saweni* (Nadi Bay) for tourism;
- Rokobili (Suva Harbour), Saru & Namoli (Lautoka), Vakamasuasua (Labasa) for industry;
- Sewage treatment oxidation ponds – Lautoka, Labasa, Ba and Sigatoka;
- Substantial but undocumented losses to dredging;

- World Bank funded ‘Seawall Rehabilitation Programme’ part of Sugar Cane Development Project; and,
- Seawall construction¹ in the Navua-Toquru area and Rewa Delta.

Following widespread concern within Government and an outcry of public concern, the Fisheries Department held a seminal workshop in 1983 (Lal 1983). It was appreciated that DoL since its inheritance of the responsibility for Fiji’s mangroves had not acquired expertise in mangrove management or developed good communications or working relationships with the various agencies involved with mangroves. Recommendations from the workshop were subsequently endorsed by Cabinet. One of these was for the preparation of a Mangrove Management Plan, and another institutionalised the establishment of the Mangrove Management Committee.

2.2 MANGROVE MANAGEMENT PLAN 1985/86

2.2.1 Overview of the Plan

Due to funding constraints for the preparation of the plan, it was decided to address the largest blocks of mangrove:

- Phase 1 – Rewa, Ba, Labasa Deltas (1985; this plan with the National Policy was endorsed by Cabinet);

During preparation of Phase 1, it was realised that these large areas were not the areas under most threat; as such further funding was sought and found for two specific areas were looked at:

- Phase 2 – i) Nadi Bay; ii) Suva to Navua (1986; presented to Cabinet who requested it be re-presented along with Phase 1 for them to be considered together. Phase 1 was subsequently submitted again but the two were not taken back to Cabinet).

Together these plans comprised over 15,000 ha or about 35% of Fiji’s mangroves. Maps were prepared of the mangrove resource with the mangroves allocated to alliances (dominant species’ associations which characterised the mangroves of the area and their assumed productivity). Separate maps were then prepared with a zonation overlay. A

¹ Seawalls constructed which cut off large areas of mangrove from the influence of salt water. The mangroves can survive for a long time but the habitat as such is ultimately doomed.

* Foreshore lease approved....not yet developed (2013)

hierarchical designation of zones was proposed so as to allow a degree of flexibility with the ‘Managed’ and ‘Development’ designated zones whilst affording maximum protection for the majority of the resource (Table 1 and Figure 2).

Designation	Zone
Primary – Mangrove Reserve	Resource Reserve
	National Reserve
Secondary – Managed Resource	Traditional Use
	Wood Production
	Shoreline Protection
	Sewage Treatment Effluent Processing
Tertiary – Development Zone	Urban Development
	Tourism Development
	Agriculture Development

Table 1: Mangrove Zonation in the Mangrove Management Plan 1985/86

Basis: Used aerial photographs as basis for mapping – for which there was good coverage;

- Zone; Minister for Managed Resource; and, ultimately the Cabinet for Mangrove Reserve);
- Existing “approved conversions” were zoned Development Zone irrespective of productivity status; and,
- There was no consultation with Traditional Fishing Rights Owners (TFRO);
- There were no restrictions at all on traditional rights or utilisation in all zones.

2.2.2 Export of Mangrove Benefits and Regional Cumulative Impact

MMP85 recognised that a major proportion of the benefits of mangroves are exported and provide public benefits, as such mangrove management requires a wider remit than just the traditional fishing rights owners. Thus any development assessment impacting a mangrove area needed to compare the area and ‘zonation’ of the area being considered for conversion within the local mangrove setting, with the amount of similar mangroves remaining in the local/sub-regional area. The MMP defined ‘Mangrove Locales’ as local/sub-regional areas within which comparisons would be made and these units could also be used to measure the regional cumulative impact of loss of mangroves. 14 locales were identified on Viti Levu

as an example (refer **Error! Reference source not found.**), with locales on other islands to be gradually developed. This was not done.

2.2.3 Mangrove Management Committee

The advisory Mangrove Management Committee was formed in 1983 and subsequently institutionalised by Cabinet Decision. Initially it comprised ‘senior level’ representatives from:

- Department of Lands;
- Department of Town & Country Planning;
- Ministry of Forestry;
- Division of Drainage and Irrigation;
- Ministry of Fijian Affairs & Rural Development (Native Lands and Fisheries Commission); and,
- National Trust of Fiji

At the time there was no DoEnv. Subsequently expertise from University of the South Pacific and other technical experts were invited to serve on the MMC.

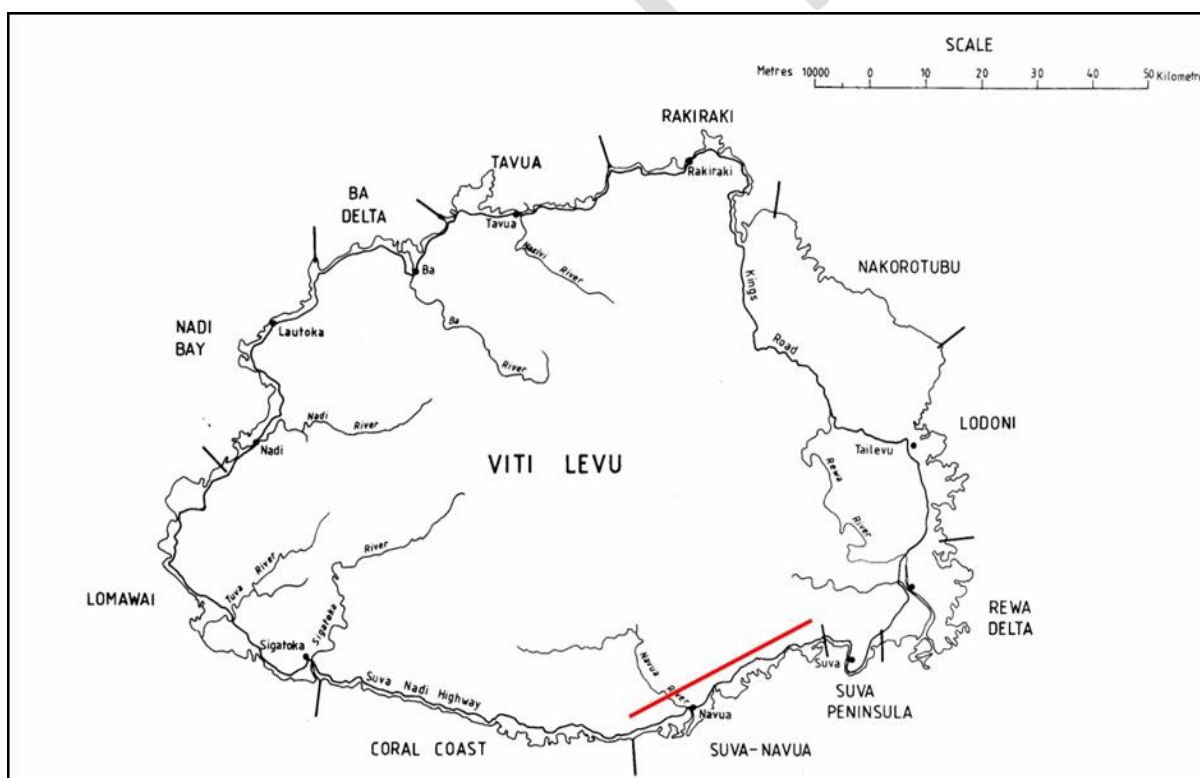


Figure 1: Mangrove Locales with the Suva-Navua Mangrove Locale shown (MMP85)

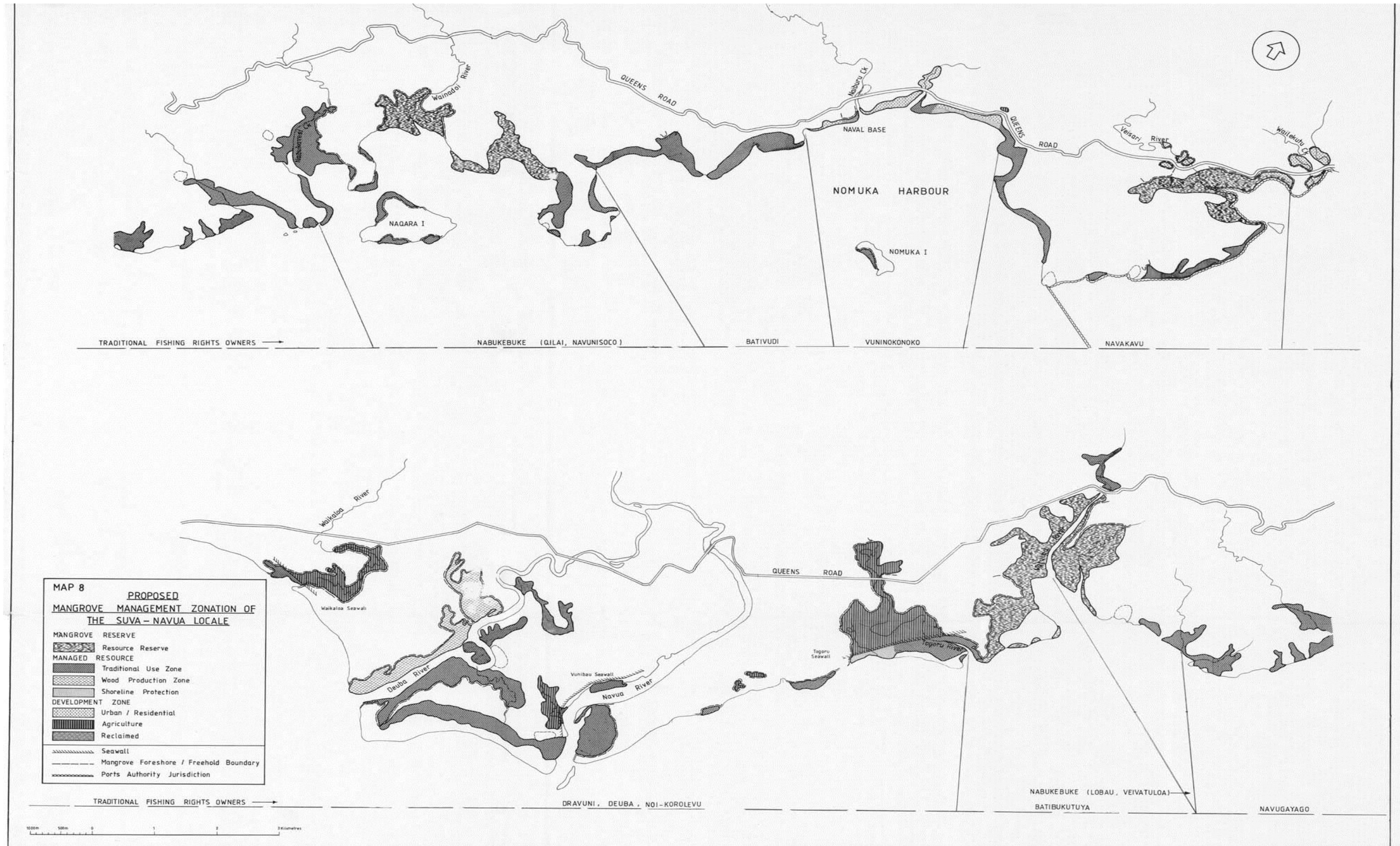


Figure 2: MMP85 - Mangrove Zonation of the Suva-Navua Mangrove Locale

2.3 USE OF THE MANGROVE MANAGEMENT PLAN 85

2.3.1 1985-1993

The overall purpose of the plan and the zoned maps was to provide MMC and DoL with a framework for decision-making when development applications were received or when departmental licensing for specific purposes i.e. mangrove harvesting for timber. The maps were also shown to developers to focus their attention on the need or not to convert mangroves, and/or direct their attention to more suitable sites.

Under the chairmanship of Mohammed Jaffar, the Assistant Director DoL at the time, the MMC was very active and often met once a month. It was responsible for commissioning through FAO the extremely detailed '*Environmental Guidelines for Dredging and River Improvement in Fiji*' (Tortell *et al.* 1992). There is little doubt that the combined influence of the MMP85 together with the MMC and a greater general awareness of the value of mangroves within Government departments resulted in a significant decrease in development applications and approvals in the period 1985-90 in comparison with the previous decade. The MMC provided a forum whereby *ad hoc* environmental assessments were made because all the relevant agencies were present and there was usually additional expertise from USP or others present. In the early 1990s the MMC met less regularly but MMP85 was referred to by the National Environment Management Project and the new Department of Environment. However, with the retirement of Mohammed Jaffar from DoL, the MMC quite quickly stopped meeting on a regular basis. The last meeting of the MMC of that era was in 1993.

2.3.2 Post 1993

It is difficult to judge the use of the MMP85 after 1993 but in general it appeared to be used only when convenient to do so. The MMC did not meet until it was resurrected by DoEnv initiative after several mangrove fora/workshops called for its reinstatement. However, it is clear that DoEnv itself has not as a matter of course, if at all, integrated the MMP85 into the Terms of Reference for EIAs for containing mangroves. At least one consultant has continued to prepare 'Mangrove Conversion Analyses' which assesses the regional and cumulative impacts in specified mangrove locales as part of EIAs, in accordance with the MMP85, but most do not.

The Forests Department does not appear to use the plan – of 11 mangrove licenses whose location is known (DoF 2013 information) within the Suva-Navua or Rewa Delta locales – none are in Wood Production Zones of MMP85, four are in Resource Reserves, three in Traditional Use Zones, two in Sewage Processing Zones and one in a Development Zone.

MMP85 highlighted the damage to mangroves caused by dredging and the need for proper assessments and management. Based on the recent river dredging in the Labasa and Rewa deltas (2010-2012), spoil disposal from dredging is clearly causing more damage to mangroves than it was before both MMP85 and the Environmental Guidelines for Dredging were prepared by Tortell *et al.* (1992; refer section 2.5.4).

2.4 CRITICISMS OF THE MANGROVE MANAGEMENT PLAN 85/86

A frequently raised criticism of MMP85 was that there was no consultation with either the general public or the TFRO during the preparation of the plan. This was not an oversight. Given the resources available it would not have been possible to undertake the consultation properly, even if it was considered necessary. In the event, the plan does not introduce any changes to TFRO access or traditional activities in respect of mangroves.

2.5 LESSONS LEARNED AND ISSUES EMERGING

2.5.1 Recommendations of the MMP85

MMP85 made some specific recommendations in relation to the development of the plan. These are listed below with the status of the recommendations at present.

1. Preparation of zoned plans for additional ‘high-pressure’ localities i.e. urban-periurban or tourism development sites

2013 – No additional mangrove areas have been assessed and zoned. Loss of urban and peri-urban mangroves remains the single most conspicuous and contentious mangrove issue to the general public.

2. Reclamation guidelines to be prepared

2013 – No reclamation guidelines have been prepared, but very detailed environmental management guidelines for dredging and river improvement have

been prepared (Tortell et al. 1992) but are apparently not used either by DoEnv or LWRM.

3. Review of the Fishing Rights Compensation procedure needed

2013 – At the time of MMP85 there was a procedure in place with the Agricultural Tribunal assessing compensation quantum for TFROs. It was not considered very satisfactory at the time – hence the need for a review. No review has been undertaken and now there is no procedure in place. Compensation payments today lack transparency, appear totally arbitrary and act as an incentive to mangrove conversion rather than providing equitable compensation to current and future generations for loss of traditional fishing rights.

4. Review of mangrove management for fuelwood with regard to issue of licenses; on site management and control; prosecution of offenders; royalties etc. and beneficiaries.

2013 – No comprehensive review has been reported. But the detailed Forestry Policy 2007 recommends the phasing out of commercial mangrove harvesting.

2.5.2 Current Status of Issues Identified in MMP85

MMP85 identified certain significant threats to mangroves, these are listed below with observations on the current status of the threats:

1. Lack of enforcement of regulations (mangrove felling for commercial purposes).
2013 - Common current observation/recommendation – the absence of an effective implementing agency for mangrove management and the MMP is a fundamental constraint to sustainable management of Fiji’s mangroves.
2. Poorly executed (and perhaps conceived) large-scale agricultural reclamations i.e. Raviravi, Ba.

2013 – Nothing similar since that time. However, such plans still emerge i.e. the 1997 proposal by the Ba Delta Development Corporation which proposed the reclamation of 20,000 acres of the Ba Delta. The US Embassy supported a feasibility study of this development. However, one poorly conceived and executed major mangrove loss to tourism development has occurred (Fantasy Island) and at least one or two more large schemes are in the application stage in

the same Denarau-Fantasy Island area. Others have been proposed for the last remaining mangrove areas in the Suva-Lami area.

3. Lack of defined policy in urban and peri-urban reclamations, resulting in illogical piece-meal development and incremental loss of urban mangroves

2013 – Serious continuing issue

4. Increased squatting in mangrove areas

2013 – Serious continuing issue

5. A conflict in the 'evolution' of traditional uses into commercial uses i.e. mangrove wood

2013 – Linked to 1 above - continuing

6. Pollution in mangrove areas

2013 – Remains a serious issue in urban and peri-urban areas

7. Estuarine dredging and the disposal of spoil in mangrove areas

2013 – No change, despite introduction of Environmental Management Act, EIAs and detailed Environmental Guidelines for dredging (refer Attachment 1 and section 2.5.4). Dredging is planned and overseen by LWRM, a government agency. Current plans for LWRM include the opening of two completely new channels in the Ba mangrove, several kilometres long and 50 m wide, for flood mitigation purposes. The EIA for the development is deeply flawed but has been approved.

2.5.3 Additional issues – 2013

Recently DoL has announced a review in its mangrove management-related procedures. In so doing it has indicated that prior to making any management decisions it will initiate its own assessments relying on Departments of Fisheries and Forestry to undertake independent valuations. This in addition to the EIAs prepared under the Environmental Management Act. It would appear that DoL cannot rely on EIAs and the advice of DoEnv in respect of the required assessments of mangrove conversion applications.

2.5.4 Impact of Dredging spoil Disposal in Mangroves

2.5.4.1 Recent Dredge-associated Mangrove Fatality in the Labasa and Rewa Deltas

Mangroves are vulnerable to excessive sedimentation. Some mangroves such as Dogo *Bruguiera gymnorhiza* are extremely susceptible to having their pneumatophores (breathing roots) covered by sediment (or dredge spoil) – if this happens then the tree dies.

Recent dredging in the Labasa and Rewa deltas have been highly damaging to mangroves. In Labasa, 15-20 ha of highly productive mangrove appear to have been killed by uncontained spoil disposal direct into the mangroves² (refer Attachment 1). Similar extensive mangrove fatality has occurred in the Rewa delta as a result of dredge spoil disposal. There appears to have been little or no attempt in either location to:

- Dispose of dredge spoil away from mangrove areas; or,
- To contain and manage dredge spoil so as to stop it spreading through the mangroves;

According to DoEnv no recent EIA for dredging in the Labasa delta has been undertaken. An EIA was prepared for the Rewa Delta dredging in 2010. The only EIA prepared for dredging in the Labasa delta was prepared in 1999 (Sinclair Knight Merz 1999). Although the EIA is deficient in that it lacks adequate hydrological information and provides only a superficial assessment of the expected benefits or the effects of the dredging³, the EIA is otherwise a well-prepared document and clearly indicates where and how dredge spoil should be deposited (refer plan in Attachment 1). The EIA is explicit in:

- Stating that no dredge spoil should be deposited in the mangrove;

² Dogo *Bruguiera gymnorhiza* 'breathes' through fist-sized pneumatophores roots which protrude above the mangrove mud. If these are covered by sediment, then the tree cannot 'breathe' and dies immediately. Tiri *Rhizophora* spp are more resilient but still succumb to excessive covering by sediment.

³ Like all EIAs of dredging undertaken in Fiji, Sinclair Knight (1999) does little more than assume that dredging will be beneficial. There is no analysis quantitatively or qualitatively of the benefit to be expected from undertaking the dredging. Best practice EIAs would require for these studies to assess a dredge design incorporating a hydrodynamic model of the river system concerned modeling flood levels and flows for the baseline situation, calibrated to specific storm events. This would enable a quantitative assessment of the benefits of dredging to be made, and as such a justification of the major expense of public funds which are incurred in dredging. Currently the benefits of dredging are largely anecdotal.

- Detailing how dredge spoil should be carefully placed on surveyed and prepared locations;
- How dredge spoil sites should be drained through sediment ponds;
- How dredge spoil sites should be retained at the side to stop any spread through adjacent mangroves, and,
- The sites where dredge spoil should be placed – all of which avoid mangroves

2.5.4.2 Management Failure

The Labasa EIA (Sinclair Knight Merz 1999), like the Fiji dredging guidelines of Tortell *et al.* (1992) are professionally prepared documents reflecting best practice of 15-20 years ago. That they are completely ignored and that extensive dredge spoil disposal direct into the mangroves has happened in 2011-12 demonstrates a significant management failure.

It is recommended that an enquiry be undertaken to report to the National Environment Council (NEC), to determine whether the management failure in respect of the Rewa and Labasa dredge disposal is a result of the following:

- Deficiencies in the EIA;
- Deficiencies in the dredging design;
- Deficiencies in the dredging contract;
- Contractor mis-management and lack of regulatory supervision; or,
- A combination of the above.

This enquiry should be completed and referred to the NEC before any further estuarine flood mitigation dredging is undertaken, and specifically that in the Ba Delta, despite the existence of an approved EIA⁴.

2.5.5 Mangroves and Carbon Sequestration

Recent research has shown that mangroves are among the most carbon-rich forests in the tropics, containing on average 1,023 Mg carbon per hectare. Much, if not most of

⁴ *Current dredging plans in the Ba Delta include the opening of two completely new channels in the Ba mangrove, several kilometres long and 50 m wide, for flood mitigation purposes. The EIA for the development is considered deeply flawed but it has been approved by Dept of Environment.*

the carbon storage (49-98%) is in the organic mangrove-rich soils. As such loss (deforestation) of mangroves contributes an order of magnitude more carbon emissions than terrestrial tropical forest (Donato *et al.* 2011).

Mangroves are included within the definition of forest as defined for Fiji's REDD-plus Policy.



MESCAL Fiji project team and Department of Forestry survey team doing mangrove below ground carbon assessment in Lami.

2.5.6 Lessons Learned from the Mangrove Management Plan 85/86

In reviewing the status of mangrove management in 2013 in comparison with 1985, the overall conclusion is the similarity of prevalent issues affecting mangroves at both times with no obvious improvement in any issue, and even deterioration in one or two.

1. The similarity of prevalent issues – all the issues identified as serious in 1985 remain serious in 2013

2. None of the recommendations made and priorities for progress with the plan identified in MMP85 have eventuated
3. There was a period (1985-93) when MMP85 appeared to work well. This can be attributed to the interest in and the attention given to mangroves at the time by the Assistant Director Lands as Chairman of MMC (Mohammed Jaffar). His interest and use of the both the MMC and MMP85 resulted in a benign period of mangrove management. However, none of the major reviews and recommendations of MMP85 were addressed or implemented.
4. Subsequent Directors of Lands did not see the value of the MMC and DoL gradually lost touch with 'mangrove management expertise' and the relevant agencies, eventually reverting to making 'in-house' decisions or unwarranted reliance on approved EIAs of dubious quality.
5. The Environmental Management Act (2005) and its EIA Regulations (2007) appear to have had no positive impact at all on sustainable management of the mangrove resource, rather poor EIA preparation and review has enabled unsustainable mangrove management.
6. Loss of small areas of highly conspicuous mangrove in urban and peri-urban areas to squatting and ill-conceived reclamations continues and galvanises public concern
7. National level mangrove losses to ill-conceived and executed developments continue (Fantasy Island; Rewa and Labasa dredge disposal) and more are being considered (Nadi Bay mangroves)
8. The issue of recompense to TFROs has clearly deteriorated. In 1985, the Agricultural Tribunal provided an independent recompense figure. This was not considered satisfactory by many at the time, and as lawyers became involved the recompense figures increased. Currently, one-off windfall payments attractive to the current generation of TFROs are made, but the quantum of which conceal a mangrove conversion subsidy (refer section 10.4) that represents the antithesis of sustainable resource management.

3 NATIONAL MANGROVE RESOURCE

3.1 MMP85 AND LITERATURE FIGURES

Fiji has the third largest mangrove resource in the island Pacific after Papua New Guinea (372,770 ha) and the Solomon Islands (64,200 ha) with Fiji's mangrove area variously reported in the literature ranging from 33,000 ha to 52,000 ha.

MMP85 undertook approximate mangrove area measurements from aerial photographs of approximately 30% of the resource. It found considerable variation – both overestimate and underestimate when compared to the Lands & Survey Department's measurements based on the 1:50,000 map series of the time. It concluded that *“it would be best to retain the Lands & Survey Departments official figure of 45,288 ha with the knowledge that it was only very approximate and did not include mangroves on those islands which were not covered in the 1:50,000 map series”*.

Aerial photographs used in this map series dated back to the early 1970s.

To date no figure has been reported which is known to include a detailed analysis of the mangroves of the Lau Group and a figure for this is long overdue.

3.2 FORESTS DEPARTMENT ESTIMATE

DoF have provided a figure for the seven islands covered by the National Forest Inventory using satellite imagery from 2000 (DoF 2008). It reveals an area of 48,317 ha.

Islands	Mangrove Area (ha)
Viti Levu	28,243
Vanua Levu	18,444
Taveuni	152
Kadavu	1,184
Ovalau	139
Gau	154
Koro	0
TOTAL	48,317

Table 2: Area of Mangroves on 7 Fijian Islands (Source: DoF 2008)

3.3 SPC-SOPAC GIS&RS UNIT ESTIMATE AND RATE OF MANGROVE LOSS

3.3.1 Mangrove Area Estimate

SPC-SOPAC have recently undertaken an analysis of the area of mangroves of Viti Levu, Vanua Levu, Taveuni, Ovalau and Kadavu in 1991, 2001 and 2007, and calculated the mangrove loss between these years. In total providing a figure for cumulative loss over a 16 year interval⁵.

The total area of mangroves on the five islands in 2007 was 43,405 ha, broken down as follows:

- Area of mangrove Viti Levu, Kadavu & Ovalau 27,136 ha
- Area of mangrove Vanua Levu & Taveuni 16,269 ha
- Total 43,405 ha**

3.3.2 Mangrove Loss

Table 3 provides an estimate of mangrove loss during the period 1991-2007. The median rate of mangrove loss during this period was 0.5%/annum or about 217 ha /year. According to the analysis 40% of this loss was in the Rewa delta-Suva area.

Mangrove loss 1991-2001		Mangrove loss 2001-2007		Summary: Mangrove loss 1991-2007	
Mangrove loss (ha) in 10 yrs	2,593	Mangrove loss (ha) in 6 years	871	Mangrove loss (ha) in 16 years	3,464
Average loss per year (ha)	259	Average loss per year (ha)	145	Average loss per year (ha)	217
% of 1991 resource lost in 10 yrs	5.5%	% of 2001 resource lost in 6 yrs	2.0%	% of 1991 resource lost in 16 yrs	7.4%
% loss/yr	0.6%	% loss/yr	0.3%	% loss/yr	0.5%

Table 3: Loss of Mangrove (Viti Levu, Vanua Levu, Taveuni and Kadavu only) between 1991-2007 (Source: SPC-SOPAC GIS&RS Unit Status October 2013)

⁵ The figures are provisional as the analysis has not been subject to ground-truthing. Satellite imagery date is 2000.

3.4 RECOMMENDATION

The difference between the DoF and the SPC-SOPAC area estimate for Fijian mangroves is over 10% which is not acceptable for management purposes. The SPC-SOPAC estimate is preliminary and it should be finalised. If the difference is still large, the two organisations should work together to provide a mutually agreed figure. It is recommended that:

1. For management purposes DoL needs to have access to a reliable and readily updatable capability for assessing mangrove area and conversion.
2. A reliable figure for Fiji's mangrove resource is needed and the resource in the Lau Group, hitherto unmeasured, needs to be assessed.

Draft Final

4 MANGROVE MANAGEMENT – IMPLEMENTATION ARRANGEMENTS

4.1 CURRENT LEGISLATIVE ARRANGEMENTS

As noted (section 2.1) prior to 1975 Fiji's mangroves were constituted as Forest Reserve and were managed solely by the Forestry Department. Following a Cabinet Decision in 1974 all mangrove Forest Reserves were deproclaimed following which they came under the immediate jurisdiction of the Lands & Survey Department in line with all other 'foreshore'. This remains unchanged today.

A detailed description of the legal framework covering mangroves is provided by Lumelume & Parkinson (2013). In brief:

- Under the Crown Lands Act (Cap 132) all mangrove as 'foreshore' is owned by the State and the Department of Lands (DoL) regulates the use of all State land – all applications for use, conversion or development are decided on by DoL;
- Under the Environmental Management Act (2005) any development proposal which impacts mangroves requires an Environmental Impact Assessment (EIA). DoEnv manages the EIA process, and delivers the decision and, if approved with or without conditions which is then conveyed to DoL. DoL are not bound to act on the advice of DoEnv except if the EIA is rejected. The EMA is a modern law which binds all government departments;
- Under EMA, DoEnv is also charged with monitoring the conditions of approval of EIAs, prevention of dumping and pollution, and monitoring the status of mangrove as a natural resource;
- Under the Forest Decree (1992) mangroves are 'forest' and the Forests Dept regulates the utilisation and management of all forest resources, but they only do so after DoL have approved an application for mangrove harvesting and they only regulate harvesting. They do not have a continual monitoring role or presence;
- The Fisheries Act (Cap 158) regulates a wide range of activities pertaining to fishing and marine life within Fiji's waters and as such is relevant to mangroves; and,

- Cabinet paper (CP 74(204)) instituted the right of Traditional Fishing Rights Owners (TFRO) to receive recompense for the loss of fishing rights which remains the sole basis for fishing rights compensation today.

4.2 COMMUNITIES AND MANGROVES

Despite having no ownership rights to mangrove or its resources, coastal village communities have considerable independence over the manner in which they use them, and as a generalisation they have been relied upon to be the unpaid custodians of the nation's mangrove resource. Unlike a large proportion of Fiji's forests, the mangrove has, in large, been used sustainably by communities for over three thousand years, and many mangrove-adjacent communities have a very deep understanding of mangrove ecology and utilisation. In the main this has not changed though the broader social and economic context of rural communities have changed greatly. A subsistence life-style has had to integrate increasingly with a commercial imperative and the cash economy, and mangroves have proven very important in supporting rural communities in this respect (Thaman 1998).

In contrast, communities have witnessed mangroves themselves being impacted by the degradation of catchment areas, pollution and outright loss through conversion. The last 40 years has witnessed by far the greatest loss of mangroves since the beginning of the twentieth century when large 'back of the mangrove' areas were converted through sea-wall construction for sugar cane cultivation. To a large degree village communities have been silent witness to these changes, but it would be surprising if it was not precipitating a change in the interaction of villagers and mangroves and that this will increase progressively and to the detriment of the mangrove resource. Incidents of unsustainable exploitation by TFRO communities have occurred and the willingness with which many TFROs apparently consent to large ill-conceived mangrove conversions is evidence of changing attitudes (though see section 11.4).

All the indications at the village level are that there is a need for new initiatives for the conservation, protection and where necessary reforestation of mangroves. Villagers will remain the key to such initiatives which will need to be designed to appreciate and reward community conservation management rather than the expectation hitherto of community support 'in their own interests'.

4.3 DEPARTMENT OF LANDS HAS PRIMARY RESPONSIBILITY

DoL is the custodian of crown/state land and bears primary responsibility for its management. A decade after it assumed responsibility following the de-reservation of mangroves, there was a public outcry over the mounting conversion of mangroves which led to the MMC and the MMP85. A decade or so after the demise of the MMC and effective demise of the MMP85, there has been another public outcry at the continuing conversion of mangroves. Analyses following both public outcries have pointed to the absence of appropriate experience and expertise within DoL to pursue a policy of sustainable mangrove management and ineffective relationships with government and other agencies which could assist. The absence of any real attempt to undertake any of the important reviews or recommendations of MMP85 (refer section 2.5) may reflect political sensitivity or an inability to address serious issues. There would seem to be little point in repeating the expectation in MMP2013.

4.4 DEPARTMENT OF ENVIRONMENT AND THE ENVIRONMENTAL MANAGEMENT ACT

There are great expectations in many quarters for a significant proactive role to be played by DoEnv on the the back of EMA, a modern legislation with significant penalties. However, to date DoEnv has not shown that it has the ability to use the legislation to ensure good environment outcomes. This may be either through a lack of resolve or a lack of either technical or financial resources. The record with mangrove-related development especially dredging clearly demonstrates this (refer 2.5.4.2), despite mangrove management being directly related to one of the two Purposes of the act – *'application of the principles of sustainable use and development of natural resources'*. A well-prepared and reviewed EIA reflecting the requirements of adopted Government policy is the key to sustainable mangrove management in the modern era. In carrying out this task, DoEnv would be expected to reject certain development proposals, and without an approved EIA, the proposals could not legally proceed. More importantly, the conditions of approval of accepted EIAs would also have to reflect the policy as well as best-practice mitigation measures. A good EIA by itself ensures nothing, if as now, there is no ability to monitor and resolutely enforce the conditions of approval.

There is clearly a major need to upgrade DoEnv's EIA capability and the provision of technical EIA guidelines for mangrove projects if strictly required of all consultants and

appropriately reviewed by DoEnv (and the MMTC) would be a major step forward (section 7). However, DoEnv also requires to work cooperatively with other agencies to monitor projects for compliance with conditions it has set, as it does not have the capacity to undertake this as yet, and very likely never will.

EMA has significant legislative requirements of DoEnv which apply to mangroves, additional to EIA, in particular the prevention of dumping and pollution, and the monitoring of natural resources and regular reporting on their status .

4.5 NATIONAL ENVIRONMENT COUNCIL

The National Environment Council (NEC) is appointed under the EMA and comprises CEOs (or their equivalent) of all the natural resource related ministries and other regulating agencies as well as NGO, academic, business and commercial interests. Issues relating to management of natural resources are a key component of its function. The National Environment Council '*...may appoint any technical committee necessary to advise it on matters affecting environmental protection and resource management (sub-section 8.2).may appoint a committee for coastal zone management to prepare a coastal zone management plan'* (sub-section 8.3).

With respect to mangrove management, the recommended Mangrove Management Technical Committee (refer section 8.3) should report direct to the NEC, and most importantly the NEC should have primary oversight in ensuring that DoL implements a NEC-endorsed MMP2013. It would be appropriate for DoL to approve conversion of mangrove only on the advice of NEC (refer section 8.2).

4.6 A DECLINING ROLE FOR FORESTS DEPARTMENT

In 1952, DoF supervised the harvesting of over 50,000 m³ and the major delta mangrove stands (Rewa, Ba, Labasa) were subdivided into working coups. Today, the only managed mangrove wood concessions are in the southern division and between 2008-2012, 16 licensees produced between 256-956 m³/yr and 0-651 lm/yr with total revenue received between \$2,181-\$5,836/yr. DoF does not have a boat to supervise the harvesting and such revenues are most unlikely to be covering DoF costs of management. DoF's ability to manage the resource is questionable given that it is

suspected that illegal mangrove felling for fuelwood in the southern division may be ~50% of recorded production.

While Forests have the traditional role for on-the-ground management of mangrove and specifically its harvesting, it is difficult to envisage that its shrinking role and concomitant shrinking resources could or should be the basis for such management in the future, especially with the Forests Department wishing to implement their policy and move to prohibit all commercial harvesting of mangrove (section 5.2.1). This apart, the role will be completely different from their traditional role, henceforth more relating to active conservation than to harvesting control.

4.7 PROTECTED MANGROVE AREAS

The need for certain mangrove areas to be fully protected was first proposed by the National Trust for Fiji in 1980 (Dunlap & Singh 1980). MMP85 identified three sites that were worthy of National Reserve status based on their stature. Nasoata Island was originally considered as Fiji's first RAMSAR site. It was then dropped because of ownership issues but these have apparently been resolved and it is being considered as Fiji's second RAMSAR site, as it is a remarkable example of unmodified mangrove (Thaman *et al.* 2005). More recently FLMMA have established permanent protected mangrove areas (refer section 11.3). MMP2013 also identifies the need for protected mangrove areas as a designation for mangrove offsets (refer section 7.8). There is also a need for a legal designation and a managing authority for mangrove protected areas in envisaged Urban Mangrove Plans (refer 13.4). Each of these initiatives have or is facing the same problem – a lack of appropriate legal designation for mangrove sites as protected area. Lumelume & Parkinson (2013) examines the legal mechanisms for conservation and there are none which are readily suitable at the present time. The same issue also effects potential marine and terrestrial 'protected areas'.

Protected area legislation is currently scheduled for preparation, at least in part, under the GEF-PAS project⁶. It is clearly a national priority and the specific requirements of mangrove protected areas need to be included.

⁶ Focus point – Dept of Forestry/National Trust for Fiji and the Protected Areas Committee

4.7.1 Mangrove Trust Fund

Consideration should be given to establishing a Trust Fund for mangrove management, especially for the management of Protected Mangrove Areas. The following could be used to endow the fund:

1. The annual foreshore rental for converted mangrove — the non-TFRO compensation component due for loss of ecosystem services which should be charged (refer section 10.5);
2. Biodiversity offset payments for offsets where equivalent habitat cannot be preserved (refer section 7.8); and,
3. If commercial harvesting of mangrove is permitted (although not recommended in this plan), then a portion of the Licence/Royalty fees should be used for the Trust Fund (refer section 12.4).

4.8 MANGROVE-MANAGEMENT: ON-THE-GROUND IMPLEMENTATION

It is now 40 years since the dereservation of Mangrove Forest Reserves and direct oversight by DoF, in favour of 'passive' management/protection through DoL oversight. It is a period which has seen steady but not precipitous conversion of mangroves, an unimplemented mangrove management plan, and two outbreaks of serious public concern over the loss of mangroves.

Many workshops and fora, on or related to mangrove management over the last decade, have discussed or concluded on 'the absence of an effective on-the-ground mangrove management capability', but there appear to have been no clear ideas or recommendations on how this can be progressed i.e. DoEnv (2004, 2011). There has been little or no analysis of what management is actually required, what is happening or what is likely to be required in the current context and in an increasingly climate change-impacted future. Table 4 provides a preliminary overview of on-the-ground mangrove management requirements.

While DoL maintains oversight and ultimate responsibility for the mangrove, it is not equipped to undertake any of the 'on-the-ground' management requirements. Apart from technical suitability, it does not have a field presence. It clearly has to rely on other

agencies to undertake this role, though it needs to improve its own ability to react to mangrove issues and use its statutory powers when needs be.

DoF undertakes its statutory forestry regulation role but it does not have a monitoring capability with its current resources and is unlikely to be meeting its costs given the current licensing system. Illegal commercial harvesting is occurring and this is likely to increase when, if as recommended here in MMP2013, commercial harvesting is phased out and DoF withdraw further from mangrove management.

Under EMA, DoEnv have considerable mangrove management responsibilities, but its current capacity precludes the ability to address this except in the most superficial manner. EMA has strong provisions for enforcement of many of the illegal activities which points to a greater role to be played by DoEnv. However, DoEnv's ability to use its legislation for enforcement purposes remains poorly developed.



Mangrove loss due to reclamation for development at the peri-urban Lami area.

Mangrove-related Activity	Comment on Issues and Management Requirements
Legal Activities	
Traditional use by TFROs	<p>Monitoring is required to ensure that traditional use does not become a commercial use; and/or becomes unsustainable. There is no doubt that the trend is for mangrove-fisheries and other traditional uses (bark for dyes etc) to become a small-scale commercial use (refer Thaman 1998). Community monitoring and management is clearly the most appropriate response to this. It requires a formal reporting framework probably through the Provincial Office, especially if issues emerge and cannot be resolved internally. TFROs require a licence for commercial fisheries like any other. A definition of 'commercial' fisheries becomes ever more important. Communities will be more effective in managing this than government agencies.</p>
Conversion for any purpose including wharves, jetties, boat channels, sea walls; industry; resorts etc.	<p>Requires an approved EIA with compensation for loss of fishing rights payable to TFROs. Issues:</p> <ol style="list-style-type: none"> 1) Have the EIA, TFRO consent etc. been undertaken in accordance with MMP2013 ? Note - EMA binds government and so government developments require EIAs 2) Monitoring of EIA compliance (CEMPs) and development approval issues. This is where there are serious concerns at the moment. A combination of 'on-the-ground eyes' and environmental/engineering expertise is required. How to deliver this has to be resolved. Leaving it just to community wardens, provincial office etc. will not deliver the required expertise on the ground or the ability to enforce which is essential. DoEnv & DoL have to find a solution here.

Mangrove-related Activity	Comment on Issues and Management Requirements
Commercial mangrove harvesting	<p>Continuing but at a low level. Not occurring in zones identified for Wood Production in MMP85. EIAs not being undertaken and mostly undertaken by non-TFROs. Management costs of Forestry unlikely met by revenues (refer section 12.1).</p> <p>Under MMP2013, this will be phased out in line with the policy of the DoF (refer section 5.2.1).</p>
Commercial fisheries	<p>Legal provided a permit has been issued through provisions of the Fisheries Act. Monitoring required and community wardens are clearly the most appropriate but legal enforcement capacity is lacking. Needs resolution by Fisheries Dept.</p>
Mangrove reforestation/afforestation	<p>These may be required as a component of climate change adaptation measures. Irrespective, major projects involving the alteration of land levels or hydraulic regimes should require an EIA.</p>
Community Managed Marine Areas	<p>A significant number of these have been established in mangrove areas (refer section 11.3). They suffer from lack of formal recognition and so are unenforceable by community wardens. Formal recognition will need to go hand-in-hand with management standards</p>
Illegal Activities	
Commercial fishing or fishing by non-TFROs	<p>Utilising community monitors/wardens is by far the most efficient way of detecting this, but as yet the system is informal with no enforcement powers. Slow reaction from police or Fisheries is often raised as the reason for this system failing. Fines are too low and/or Fisheries/police are reluctant to prosecute.</p>

Mangrove-related Activity	Comment on Issues and Management Requirements
Commercial mangrove harvesting	There is significant illegal harvesting of mangrove, more likely to be undertaken by TFROs than outsiders. Readily detectable utilising community monitors/wardens. Mobilising DoF to deal with such an issue may be difficult if commercial harvesting is phased out and their resources are directed elsewhere.
Excessive domestic firewood collection and collection by non TFROs	Often raised as an issue which causes degradation of mangroves, especially in the drier western areas where mangroves are less productive and more stressed at the accessible landward edge. Domestic firewood collection by non TFROs is usually considered a basic right, though can cause disputes. Requires community monitoring and resolution through the provincial office.
Illegal conversion	Readily detectable by community wardens. Needs to be resolved by DoL, but in association with DoEnv as the provisions of EMA enable restoration activities to be required and heavy fines are applicable.
Squatting	In certain urban areas this has become a problem where it is clearly an issue which DoL alone has the responsibility to address.
Pollution, dumping of waste	Unfortunately, the example of nearly all the municipal councils to utilise mangrove areas for their rubbish dumps has provided a bad example which many now follow. Dumping in mangroves, as with other places, will remain an issue until properly addressed by government in general and DoEnv in particular. Awareness is no longer the issue, enforcement of existing legislation is (Litter Decree and EMA).

Mangrove-related Activity	Comment on Issues and Management Requirements
	Pollution by industry through discharges into mangrove areas is a significant issue in certain places, as yet DoEnv's administration of the Waste Disposal Regulations appears to be having little effect.
Dumping of dredge disposal	Dumping dredge disposal directly in mangroves is unwarranted under any condition. It is contrary to the River Dredging Guidelines produced for Fiji and should never be permitted in an EIA (refer section 2.5.4).
Required Activities	
Protected Mangrove Areas	<p>No appropriate legislation exists for this (Lumelume & Parkinson 2013)</p> <p>MMP85 identified 3 sites as potential National Mangrove Reserves</p> <p>MMP2013 (this report) identifies 4 separate requirements for legally gazetted Protected Mangrove Areas (4.7)</p> <p>Legislation is required for this purpose but as, if not more important will be the management arrangements for the sites.</p>

Table 4: Preliminary Analysis of On-the-Ground Mangrove Management Requirements.

Fisheries have a clear role in respect of commercial fisheries which applies to mangrove produce, but its application is often compromised by issues relating to the rights of TFROs and difficulties working with resource owners.

Communities have developed a close relationship with their adjacent mangroves and have, over the years, largely provided conservative custodianship over the resource. Today, they provide the only mangrove monitoring agency, and are the only 'eyes and ears' on the ground. In effect, government, the resource owner, is completely reliant on this free service. There is no doubt that it is also in the communities' own interest to provide this custodianship. However, times are changing and subsistence reliance on mangroves by communities is giving way to their commercial needs. As a result the continued sustainable use of, even the need for, mangroves by communities is diminishing – especially near urban centres (Thaman 1998).



Mangrove are cleared to make recreational park in Suva.

Communities will largely continue to determine the sustainability of use of their mangroves. Government needs to recognise this and to harness the energy and positive mangrove management abilities of communities to ensure that wider environmental

services of mangroves which benefit the nation are not only maintained but enhanced. With climate change effects increasing this is even more crucial and pressing.

Business as usual – no ? There is a need to acknowledge the trends and the momentum, and to recognise that the hitherto free mangrove monitoring service by communities is the key to on-the-ground mangrove management. The service will need to be formalised and communities will need to be beneficiaries of the formalisation. If they are not then on-the-ground mangrove management will likely deteriorate at a greater rate than at present. Enabling this formalisation will be a challenge but it will be a challenge in line with the cross-sectoral, multi-stakeholder requirements of climate change adaptation. One significant step is the work done by FLMMA and other NGOs with coastal communities to introduce formal conservation and sustainable use management. These initiatives need to be built upon and to move towards national recognition and standardisation.

4.9 RECOMMENDATION

Establishing a functioning, on-the-ground, management capability is crucial to the future of mangrove management as a whole. While NGOs and FLMMA, in particular, have long recognised this, government has been slow to acknowledge its importance⁷. A traditional command and obey approach is very unlikely to be effective. The role of the communities, traditional custodians of the mangrove resource is now and will be the key. Progress on this issue is fundamental to mangrove management under any scenario but with the added complications of climate change adaptations, it is even more important.

A well-resourced review of establishing an on-the-ground mangrove management capability is required and it may well need to be a component of, or run in parallel with other reviews recommended in this plan.

⁷ The Forest Policy highlights the importance of this approach (section 5.2.1), however, government has yet to initiate the wide consultation proposed “with a view to introduce an effective mangrove regulatory and management framework”.

5 POLICY

5.1 REQUIREMENT AND RELATED WORK

A concise policy for mangrove management reflecting Government's existing commitment to sustainable management of natural resources (as established in the Environmental Management Act 2005) is a prerequisite for a national mangrove management plan.

Currently MESCAL is conducting a study 'Review of legislation and policies relating to the use and management of mangrove ecosystems in Fiji Islands'. This should provide, at the very least the background for a new policy.

5.2 EXISTING POLICY STATEMENTS RELATING TO MANGROVES

Subject to section 5.1 above, there are two existing policy statements relating directly to mangroves which have been approved by Cabinet:

- Fiji Forest Policy 2007 (in which mangroves are defined as a separate category in view of its ecological, economical and social importance).
- Mangrove Management Policy (1985 in the MMP85 Phase 1)

5.2.1 Fiji Forest Policy 2007

Section 5.1.5 of the Fiji Forest Policy refers to mangroves.....

The Government will consult with its departments and agencies involved in mangrove management and with qoliqoli owners and other stakeholders with a view to introduce an effective mangrove regulatory and management framework. The Government will consult widely and draw up guidelines or a plan to replace the current Mangrove Management Plan for Fiji (Phases 1 & 2 – 1985, 1986).

Actions

- 1. FD (Forests Dept.) will contribute actively to a Government review of mangrove management and will undertake the role assigned to it following the review.***
- 2. FD will advocate permanent conservation of mangroves to provide for sustainable customary uses, the sustenance of coastal fisheries, the protection of shorelines, and as an adaptation measure against climate change impacts. Commercial harvesting of mangrove trees will be prohibited.***

5.2.2 Mangrove Management Plan Phase 1 1985

MMP85 Phase 1 contained a policy statement for mangrove management and this was approved with the document by Cabinet (July 1986 CP (86) 184).

Mangroves are an important national asset.

Primarily, as a resource base for capture fisheries.

Secondarily, as a renewable source of products which contribute significantly to the quality of life of associated coastal communities.

Recognising this:

The natural processes of the ecosystem should be preserved wherever possible thereby allowing the sustained harvesting of its renewable products and the preservation of future development options. Conversion activities should be minimised and permitted only in the national interest and after detailed socio-economic comparison with the expected loss to the capture fisheries and other renewable uses.

The MMP85 policy, nominally still in effect today, is clearly outdated in the modern context with the greatly improved knowledge of the ecosystem services which mangroves provide, and which will be compounded as climate change intensifies.

5.3 RECOMMENDATION – MANGROVE POLICY

In view of a continuing loss of mangroves to conversion and alternative uses since MMP85 and weak implementation of that plan, combined with the improved understanding of the ecosystem services provided by mangroves, mangrove management requires a policy more in tune with the modern context. The policy needs a more balanced recognition of the value of mangroves' ecosystem services to the nation as a whole, as well their potential role for climate change adaptation, and in consequence, the policy needs to adopt a more conservative approach to mangrove conversion. Preparation of the policy should be a priority and should include the intent of the mangrove components of the Forest Policy (2007), Climate Change Policy (2010) and the REDD-plus Policy (2012).

6 THE ROLE OF THE MANGROVE MANAGEMENT COMMITTEE

6.1 BACKGROUND

There is a need for a Mangrove Management Committee (MMC) as a technical committee bridging the regulatory requirements of DoL in its role as custodian of state foreshore, and DoEnv in its role of ensuring sustainable management of natural resources. The key forum in this respect is the National Environment Council formed under EMA (refer section 4.5). The MMC should therefore be appointed by the NEC and report to it.

The Mangrove Management Committee (MMC) was revived in 2011 and Terms of Reference have been drawn up for it. The mandate derived from these ToRs clearly recognises the need for the MMC to be a technical advisory committee to the NEC and regulatory authorities. This is a sufficient mandate which covers all the other functions/activities – some of which have been recognised and listed as functions. These are by no means all the functions or activities to be expected of the MMC and so it is better not to just list a few...rather these should be converted to immediate activities.

The current role of the MMC is, however, compromised by

1. Its large membership developed as a forum to ensure multi-stakeholder representation; and
2. 'new' departmental advisory committees drawn up by both DoEnv and DoL to advise the departments independently on mangrove issues.

6.2 CHANGES TO THE MANGROVE MANAGEMENT COMMITTEE

There is a need to distinguish a technical committee which provides expert, technical advice to government, and a forum at which disparate stakeholders are able to raise and discuss mangrove-related issues directly with fellow stakeholders and the regulators. This was discussed and widely agreed at the Draft MMP2013 Workshop (refer section 1.1).

6.2.1 Mangrove Management Technical Committee

A technical committee is required to advise both MoL and DoEnv and its role should be distinguished from that of the Mangrove Management Forum. The MMTC should be restricted to members directly related to the management of mangroves, regulatory authorities and additional members with technical expertise, and should play a key technical role in the Mangrove EIA Guidelines. The following membership is recommended⁸:

1. Department of Lands (Chair);
2. Department of Environment;
3. Department of Forests;
4. Ministry of iTaukei Affairs;
5. Department of Fisheries;
6. National Trust of Fiji;
7. NGO Representative; and,
8. Academic/mangrove specialist

6.2.2 Wider Stakeholder Forum for Mangrove Issues

There is a need for a wider forum for mangrove stakeholders, including but not confined to those members on the current Mangrove Management Committee who are not members of the proposed Mangrove Management Technical Committee. In current circumstances, establishing another committee or forum would be considered the likely solution. This seems unwarranted; there appear to be too many committees taking up too much time of government and non-government members. This is an issue the MMTC would need to advise DoL on. Forming a chapter of the Integrated Coastal Management Committee might be an option worth considering.

⁸ The Land & Water Resources Management Division (MPI) provides no regulatory function in respect of mangroves, rather it is a major proponent of activities potentially (and currently actually) damaging to mangroves. Dredging is a development activity which requires the same consents (EMA, DTCP, ITLTB, DOL) as applicable, as other developers.

7 GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENT, REVIEW AND MONITORING OF MANGROVE-IMPACTING DEVELOPMENTS

7.1 INTRODUCTION

7.1.1 Environmental Management Act 2005

Application of the principles of sustainable use and development of natural resources is one of two ‘purposes’ of Fiji’s Environmental Management Act 2005 (refer section 4.1). In this respect, the legislation identifies that any development affecting mangroves requires an Environmental Impact Assessment which has to be reviewed by the DoEnv rather than any other Approving Authority (Section (o) Part 1 of Schedule 2 of EMA⁹).

EMA also specifically provides for the adoption of Guidelines for EIA preparation, procedures for processing development proposals and procedures for undertaking the monitoring of compliance.

On the basis of these provisions, the EIA process under EMA provides the logical and most appropriate forum for multi-stakeholder assessment of any development affecting mangroves. As such MMP2013 draws up Guidelines for environmental impact assessment, review and monitoring of mangrove-impacting developments

7.1.2 Guidelines

The objective in this chapter is to provide rationale for components of guidelines for a single rigorous Environmental Impact Assessment which incorporates the requirements of all the different regulatory agencies, TFROs and public interests. With such a document, DoL is in a position to discharge its overall management responsibility for state foreshore in a transparent manner without the need for additional assessments or expertise.

The Guidelines will follow the format of DoEnv’s current Environmental Impact Assessment Guidelines and will be presented as standalone Guidelines in the Final Report, once the specific issues (presented here) have been discussed and comments/opinions provided.

The issues which the guidelines specifically address are:

⁹ Specifically the EIA Administrator. In practice, the EIA Administrator is the Director of the Department of Environment, who may delegate tasks (s59, EMA), but retains overall responsibility.

1. Terms of reference
2. Project description
3. Physical Processes
4. Mangrove ecological description
5. Regional calibration and cumulative impact
6. Consultation – public and traditional fishing rights owners
7. Mangrove offsets
8. Cost Benefit Analysis
9. EIA Review procedure
10. Monitoring of EIA compliance

7.2 TERMS OF REFERENCE

Professionally prepared Terms of Reference (ToRs) are an essential component of the guidelines and will reflect the requirements of the guidelines. The guidelines themselves must be specifically referred to in the Terms of Reference as constituting the methodology to be used by the EIA consultant.

An appropriately advanced level of preliminary design including any necessary physical assessment (coastal processes, hydraulic modelling etc.) should be required in the guidelines (refer section 7.3), and should be a requirement for specific mention in the ToRs as well. If the only project description provided by the proponent is a sketchy conceptual plan, then issuing of the ToRs should be deferred until there is sufficient detail available for the project to be properly screened – a requirement of EMA. If there is only minimal project detail available at the time of the setting of the ToRs, DoEnv and the MMC will have to decide whether to issue ToRs with full explanation of the project description requirements (as per the Guidelines) or not to issue them pending further development of the project design, engineering etc.

The MMTC will assist DoEnv with the Terms of Reference for a mangrove EIA by either drafting the ToRs, or commenting on Draft ToRs prepared by a consultant or DoEnv.

7.3 PROJECT DESCRIPTION

A project proposal involving mangroves for which an EIA is being undertaken must be at the Feasibility Stage in a normal development project cycle. As such, preliminary

engineering and construction designs, costings etc should have been prepared and must be available for and included in the assessment. Notably, full coastal process and/or river hydraulic assessments will be required in dredging or mangrove-associated EIAs which will require at least preliminary design of proposals. EIAs of proposals lacking appropriate plans, engineering etc. will be rejected automatically – this needs to be made clear in the ToRs.

Development proponents often try to justify lack of design, preliminary engineering, masterplanning etc. by indicating that EIA project approval is required to enable budget allocation or funding for the necessary design work and project development. This is completely untenable for mangroves as it is for all other projects. Consideration and then approval of EIAs with inadequate project descriptions including design, preliminary engineering, masterplanning etc. is one of the most widespread and significant weaknesses of EIAs in Fiji today.

7.3.1 Avoidance and Minimisation of Impacts to Mangroves

The project description must be explicit in detailing how the hierarchy of project planning has been followed in respect of impacts to mangroves:

1. Avoidance;
2. Minimisation;
3. Offsets (refer section 7.8)

7.4 PHYSICAL PROCESSES

7.4.1 Coastal Processes

Any development which may affect coastal processes in or near mangroves should have a detailed coastal processes analysis. This may require modelling. Lack of technical skills for this in Fiji is not a reason for it not to be done. Modelling is relatively inexpensive, the more expensive part of the work is obtaining the baseline data and this, in most cases, can be organised and undertaken locally.

Coastal process analyses need to be complemented by appropriate coastal process engineering and design. There is no point undertaking a coastal processes analysis and then not designing a structure to complement the findings.

7.4.2 Dredging

No hydrodynamic modeling is undertaken for dredging work in Fiji which is extremely surprising in 2013. River dredging is a very high cost exercise which needs to be justified by using well-established methodologies including modeling. At present dredging gives the impression of being reactive to the serious flooding issues we are experiencing, on the assumption that it is beneficial. Such an assumption is unwarranted. Terms of Reference for dredging should require hydrodynamic modeling informed by adequate site description and hydrology.



Dredging at the Rewa River.

7.5 MANGROVE DESCRIPTION

7.5.1 Ecological Description

The requirement in the EIA is to provide an adequate level of detail of the mangroves under consideration to characterise their ecological significance with respect to *in situ*

values and the wider 'regional' context. This will require information on their extent, species (associations), zonation, approximate biomass and ecological health. The level of detail collected must be sufficient to inform economic valuation of *in situ* mangrove.

Methodology to be used is presented in Table 6

Mangrove Component	Objective	Methodology
Extent, area	Area/extent of mangrove and associated habitats (mudflat, other foreshore)	Satellite imagery, aerial photos or survey
Species and/ or 'species-association' zones	Characterise flora of mangroves	As per descriptions in MMP85 or better
Approximate mangrove biomass present (as a gross estimate of their productivity)	Data on representative height and stem diameters of different zones.	A combination of Level 1: Transect-based survey and Level 2; Plot-based survey (Ellison et al. 2012 <i>Manual for Mangrove Monitoring in the Pacific Islands</i>)
Ecological health	Amount of regeneration, unhealthy mangroves, die back etc	Recorded observations as per Ellison et al. (2012)
Impacts/pressures	Amount of garbage and other pollution, felling, cultural uses (bark stripping), alteration of drainage, sedimentation etc	Recorded observations as per Ellison et al. (2012)

Table 6: Mangrove Description Methodology

7.5.2 Timber Value

The description of mangrove type combined with mensural data from the plots will be sufficient to provide the timber value of the mangroves under consideration. Forestry Dept. requirements in terms of number of plot replications would need to be adhered to but the methodology is straight forward and does not have to be undertaken by Forestry Dept, it could be carried out by approved consultants.

7.6 REGIONAL CALIBRATION AND CUMULATIVE IMPACT

Mangrove distribution within Fiji is not uniform and the mangrove vegetation itself varies from one locality to another. This is most marked between the mangroves of the dry, leeward coasts and those of the wetter, windward coasts. Recognising these locational differences and understanding that mangrove benefits are a combination of both *in situ* (fishery, timber, sediment trapping, shoreline protection etc.) and those exported to adjacent inshore areas (nutrients, fishery etc.), mangrove management must consider a proposal in its 'regional' context.

For example a 5 ha loss of mangrove in the 10,500 ha of the Ba delta could be considered an ecologically minor loss. However, a 5 ha loss along the Coral Coast (approximately 200 ha of mangrove) should be considered a considerable ecological loss. Thus it is important that any mangrove conversion proposal considers:

- the area of the mangrove to be lost in the context of the extent of mangroves in the 'region' where it is situated; and,
- the 'cumulative impact' – the extent of mangroves already converted in that locale – what is and what will be the proportion of mangroves lost before and after the project.

MMP85 introduced the concept of 'mangrove locales' and at the time provided for a fixed definition of locales on Viti Levu, approximating to the coastlines represented in the 1:50,000 map series, with specific locales representing the Ba and Rewa deltas. The length of coastline represented in these locales was between 30-80 km . A rigid definition such as these locales may be useful for those areas in the centre of the locale as opposed to those near the boundaries where obvious inaccuracies are evident. Today, satellite imagery and mapping technology enable quick area estimation off mangroves over any selected length of coastline. It would be more ecologically appropriate to adopt rolling of smaller lengths of coastline....for instance 20 km i.e. 10 km each side of the project site. At the same time obvious coastal features should be adopted – Ba, Rewa, Labasa deltas, Nadi-Sabeto Bay, Savusavu Bay etc.

Responsible mangrove management will enable mangrove conversion in certain well-considered cases of clear national benefit. However, clear guidelines need to be adopted to ensure that the extent of conversion in a particular location does not exceed a fixed

proportion of the mangroves in the immediate area at any one time and on a cumulative basis. This ensures that in areas where mangroves are naturally rare, only very small areas of conversion might be approved.

MMP2013 will have to adopt the length of a coastline for a locale as well as specific other locales (deltas, bays etc.).

Pending a review of these guidelines by the MMTC, it is recommended that:

- The mangrove locale be identified in the Terms of Reference for an EIA of any mangrove-related proposal, and either be a natural, fixed locale (delta, bay etc.) or a 20 km coastline i.e. 10 km either side of the mangroves under consideration.
- That no more than 10% of any locale be converted on a cumulative basis.

For this to be put into practice, DoL will need to prepare an easily accessible database of all mangrove conversion. Lal (1983) provides a listing of conversions undertaken during the peak modern pressure period between 1980 and 1983 and then also prior to 1980 – the majority of which were old CSR reclamations. Some of these are unlikely to have been all mangrove, rather low-lying flood-prone land. 1980 would be the sensible cutoff date for the database.

7.7 CONSULTATION

There are three components of consultation in respect of mangrove conversion or development impact:

- General public;
- Traditional Fishing Rights Owners;
- Usufruct rights

7.7.1 General Public

There is widespread interest and concern about mangroves. The general public are stakeholders and have a rightful interest in ensuring the sustainable management of the mangrove resource. As such all EIAs where mangroves are removed and/or affected by a development proposal should be subject Public Review as is required by EMA but only happens occasionally in practice.

7.7.2 TFRO Consultation and Consent

The Ministry of iTaukei Affairs has no specified procedure for determining the consent or otherwise of TFROs in respect of loss of or impact to mangroves (or foreshore in general), this readily leads to abuse and disenfranchisement. There is also an issue of the distinction between TFRO communities living distant from a project site and those in the same TFRO living adjacent to the site and who use it on a regular basis (refer section 11).

The consultation process in an EIA will need to determine who the actual users of the area of mangrove under consideration are, where they are from, approximate numbers and nature of usage of the site. In so doing the EIA can provide an assessment of its significance to the actual users. How this is considered in the review of the EIA is unclear and will need to be considered by government.

7.8 MANGROVE OFFSETS

Biodiversity offsetting is now a very widely accepted method of providing conservation benefits as a result of activities designed to compensate for significant and unavoidable impacts on biodiversity. Many countries now have defined Biodiversity Offset policies or legislation. Queensland has, for instance, a well-developed policy¹⁰ which applies “*where residual impacts from development on an area possessing state significant biodiversity values cannot be avoided or minimised*”. Under the Queensland Biodiversity Offset Policy, development activities that might trigger the requirement for a biodiversity offset include developments in the coastal zone managed under the Coastal Protection and Management Act 1995. A mangrove offset package was required of BHPBilliton for dredging and upgrading development at their Finucane Island port¹¹. More recently, federal Environment Minister Tony Burke introduced the requirement “*I’d like us to provide quite specific offsets for seagrass protection wherever seagrass is under threat*” (The Australian 18 September 2012).

One of the best-established system of biodiversity offsets is found in the United States, where federal and state laws require “no net loss” of wetlands and the conservation of endangered species. Regulations require both public and private developers to

¹⁰ <http://www.ehp.qld.gov.au/management/environmental-offsets/biodiversity-offsets.html>

¹¹ Environmental Protection Authority 2008. Report 1304. Perth, Western Australia

compensate or mitigate the loss of natural habitat, when adverse impacts are considered unavoidable, by financing the creation, restoration and/or protection of comparable habitat. In such cases compensation for environmental damage may be undertaken off-site and/or involve the purchase of “mitigation credits” (Bishop 2007).

How can Biodiversity offsets apply to mangroves in Fiji ? It is proposed that a National Biodiversity Offset Scheme is introduced whereby the destruction of mangroves by any proponent (TFRO, government included), if approved, would then require the proponent to:

1. Identify an appropriate area of mangroves and arrange for their permanent protection as a Mangrove Reserve;
2. Contribute to a Mangrove Trust Fund which would be used for the establishment and management of a National Mangrove Reserve System or similar; or,
3. A package comprising a combination of the two.

Mangrove biodiversity offsets have already been agreed by the proponents of two major Fijian projects – a Naisoso Island and the Vulani Island developments. The approved EIAs of both projects include protection for identified areas of adjacent mangrove. It is not known whether DoEnv has followed up on the conditions of approval for these EIAs (noted that the Vulani development has not proceeded to date).

It is important to ensure that the introduction of such a scheme be drawn up and managed advisedly, such that it does not give developers the right to “trash mangroves” in exchange for cash, but only as a last resort to be utilized when the project is of national importance and the loss of mangrove cannot be avoided and is minimized by careful project planning.

A National Biodiversity Offset Scheme would not apply solely to mangroves but be applicable to other habitats and species with high national biodiversity values. Biodiversity offsets are particularly applicable to mining developments. Such a scheme could be introduced as a Regulation under the Environmental Management Act.

In developing a National Biodiversity Offset Scheme, Government should consider aligning itself with a recognised international offset standard such as that recently

introduced by the Business & Biodiversity Offset Programme¹² which can be independently certified.

7.9 COST-BENEFIT ANALYSIS

Cost-benefit analysis (CBA) is a tool which decision-makers use to choose between alternative courses of action and in deciding whether a proposed project should go ahead or not. Cost-benefit analysis is undertaken to weigh the costs of proceeding with a project against the benefits that would arise from it. Cost-benefit analyses are not currently required for EIAs in Fiji, however, where significant areas of the public estate (mangrove) are to be converted to private ownership or lost in other ways then there is good reason for a CBA to be undertaken as part of the justification for the project. Preparation of a detailed and accurate CBA is also a good indicator of a detailed feasibility study with appropriate level of design.

The CBAs prepared for projects involving mangrove destruction would need to include a value for the permanent loss of the various ecosystem services provided by the mangroves.

7.10 REVIEW PROCEDURE

Following a brief review of six EIAs involving mangroves, it is clear that DoEnv's review of such EIAs is weak to extremely weak. Every EIA examined, with one possible exception, had serious fundamental flaws which were grounds for outright rejection but each one was approved. Weak review of EIAs undermines the whole EIA procedure and only leads to more sub-standard EIAs. There is very little purpose in undertaking EIAs if they are not reviewed to reflect the intentions of the legislation. The MMP2013 will include three provisions relating to the review of EIAs and subsequent monitoring of engineering/dredging/construction activities:

1. All EIAs covering loss of mangrove or potential impact on mangroves are to be made available for public review;
2. The MMTC will form the core Review Committee for any EIA that involves the conversion of, or significant impact to, any area of mangroves. The primary

¹² <http://bbop.forest-trends.org/>

purpose of this is to ensure that each of the principal regulatory agencies is satisfied that the MMP2013 Assessment Guidelines are fully adhered to; and,

3. In addition, DoEnv (on the advice of the MMTC) will appoint¹³ a consultant with experience of EIA review and mangroves to review independently the EIA of major mangrove-related developments for the MMTC and DoEnv.

7.10.1 Use of MMP85 Mangrove Management Zonation Plans

MMP85 Mangrove Management Zonation Plans (for example Figure 2) provide useful information for mangrove EIA assessment or prospective development planning purposes and it is recommended that they are retained for these purposes. Given the need for a more conservative approach to mangrove conversion (refer section 9.5) it would be appropriate to classify all Resource Reserve and National Reserve zones as prohibited for conversion consideration.

7.11 MONITORING OF EIA COMPLIANCE

7.11.1 Current

Although Construction Environmental Management Plans are required by EMA and are regularly produced, their quality is highly variable, more significantly compliance monitoring is absent or extremely weak. Lack of resources is the principal reason why DoEnv are effectively unable to undertake compliance monitoring of project implementation following EIA approval. The MMTC should have a role in compliance monitoring but DoEnv are to utilise the provisions of EMA in appointing an EIA review consultant to review compliance of large mangrove-related developments.

7.11.2 Construction Environmental Management Plan

The CEMP of a Mangrove EIA will need to include a monitoring section to assist in the management of potential impacts on mangrove vegetation associations which will consist of:

- mangrove mapping;
- mangrove monitoring transects; and ,
- mangrove monitoring plots

¹³ Section 30 of EMA relates to the 'Reviewing of EIA Reports'

7.11.3 Mangrove Mapping

Aerial photography/satellite imagery used in the EIA, prior to the start of the project, will form the basis of the mapping requirements of the CEMP which relate to determination of mangrove cover and distribution. The location and number of Mangrove Monitoring Transects and Plots (sections 7.11.4, 7.11.5) are to be detailed for approval in the CEMP.

7.11.4 Mangrove Monitoring Transects

Mangrove monitoring transects will be set up as per Ellison *et al.* (2012) Level 1 Monitoring). The transects will be established prior to construction starting and surveys along these transects will be undertaken at least monthly in an effort to ensure that any negative impacts are detected as soon as possible. The surveys will monitor mangrove ecological health/condition based on visual assessment of mangrove ecological health, sedimentation and altered tidal flow.

7.11.5 Mangrove Monitoring Plots

Mangrove monitoring plots will be established prior to the commencement of construction activities in accordance with Ellison *et al.* (2012) Level 2 Monitoring with addition of sedimentation monitoring Ellison *et al.* (2012) Level 3 Monitoring. The number of sites to be established will be determined by the size of the construction activities, but sites must be established in all the adjacent mangrove vegetation associations with sufficient replications to ensure rigorous monitoring. The plots are established for monitoring of any sediment accumulation within mangrove vegetation associations, altered tidal flow and more detailed mangrove ecological health checks.

The following parameters should be measured in each monitoring plot

- the mangrove species present;
- the number of trees present;
- the number of dead limbs;
- height of trees
- the number of stems per tree;
- stem diameters;
- ecological health status of trees;

- sedimentation monitoring; and,
- evidence of altered tidal flow

Classification of the ecological health status of mangrove trees will be as follows:

1. Healthy: Leaves green, no visible signs of sickness <10% dead, yellowing or wilting leaves;
2. Sick: Yellow, wilting leaves Low foliage cover 10-50% dead, yellowing or wilting leaves;
3. Dead: Plant dead >50% dead/ yellow wilting leaves > 50% dead stems, plant beyond recovery/almost dead

Sedimentation will be monitored in the plots to provide an early warning of any potential impacts. Sedimentation monitoring will be undertaken at the same monitoring and reference sites used in the mangrove health surveys. The detection of sedimentation is only possible at a relatively coarse scale - >3-5cm.

8 MANGROVE CONVERSION APPROVAL PROCEDURE

8.1 BACKGROUND

Under current legislation, as state land, mangroves may be converted to other uses by the DoL under the Crown Lands Act. Before it can issue a development or other lease for mangrove conversion, DoL has to ensure that an EIA of the conversion proposal has been approved by the DoEnv under the Environmental Management Act. The conversion of mangrove in the absence of an EIA is an offence even if a foreshore lease has been granted, and/or the mangrove is included in a freehold title. DoL also have to satisfy the requirement for public notification of the proposal and recompense to the TFROs for loss of fishing rights which result from a Cabinet decision (refer section 2.1)

MMP85 recommended a staggered mangrove management approval procedure based on the zonation of any particular site. This was never implemented and should not be considered again.

8.2 PROPOSED APPROVAL PROCEDURE

The last 30 years have seen the best and the worst of mangrove conversion – Denarau has clearly been a great success, Raviravi in Ba, a complete disaster. Government needs to have the option of conversion, likewise the public and mangrove stakeholders have the right to insist that such a decision is only made after a comprehensive ecological, economic and social assessment has been undertaken and professionally reviewed.

As noted, it is recommended that in view of the requirements of climate change and the values mangrove have for adaptation purposes, that Government adopts a policy with a more conservative attitude to mangrove conversion than was adopted for MMP85.

No legislative changes are required, there appear to be sufficient checks and balances available in existing legislation provided they are properly applied and a procedure adopted and endorsed by Cabinet. The procedure is as follows:

1. The comprehensive ecological, economic and social assessment with all sectoral regulatory authority input (forestry, fisheries, provincial council etc.) and other stakeholders' interests (TFROs, NGOs, public, ICMC etc.) should be included in the EIA process (refer EIA guidelines section 7). There should be no additional assessment, information consideration etc. after the EIA process. DoL needs to

be part of the review process of the EIA and to be confident that it has been properly conducted and reviewed, and that it is then furnished with the best possible advice.

2. If the EIA is rejected then further consideration of the proposal ceases. DoL should not consider or issue a foreshore lease for a proposal which is unable to proceed because of the lack of an approved EIA.
3. If an EIA for mangrove conversion is approved, it can then be the basis for a sound application for a foreshore lease from DoL. DoL is not in any way bound to grant the application even if it has an approved EIA.
4. An approved EIA for mangrove conversion should be considered by the National Environment Council, to ensure that due EIA process has been undertaken, provide for further high-level multi-stakeholder discussion, and that the conversion is consistent with the Environment Management Act (refer section 4.5).
5. DoL should only proceed with the issuing of a foreshore lease or dredging license involving mangrove conversion **on the advice of the** National Environment Council.

The procedure in Item 5 above would not be a legal requirement and this is not envisaged at the present time. However, it should be considered as a requirement, as such it must have cabinet endorsement.

9 CLIMATE CHANGE

9.1 CLIMATE CHANGE – WHAT DOES IT MEAN FOR FIJI ?

The impact of climate change on Fiji over the course of the 21st century is projected as follows (extracted direct from Australian Bureau of Meteorology and CSIRO, 2011)¹⁴:

- Surface air temperature and sea-surface temperature are projected to continue to increase (*very high confidence*).
- Wet season rainfall is projected to increase (*moderate confidence*).
- Dry season rainfall is projected to decrease (*moderate confidence*).
- Little change is projected in annual mean rainfall (*low confidence*).
- The intensity and frequency of days of extreme heat are projected to increase (*very high confidence*).
- The intensity and frequency of days of extreme rainfall are projected to increase (*high confidence*).
- Little change is projected in the incidence of drought (*low confidence*).
- Tropical cyclone numbers are projected to decline in the south-east Pacific Ocean basin (0–40°S, 170°E– 130°W) (*moderate confidence*).
- Ocean acidification is projected to continue (*very high confidence*).
- Mean sea-level rise is projected to continue (*very high confidence*). (Note: The mean sea level at the Lautoka Tide Gauge is changing at a rate of 4.6mm/year over the 1993 to 2010 period. However, the satellite observations indicate that the sea level is changing at a faster rate of 6mm/year over the same period in the Fiji region).

9.2 HOW DOES CLIMATE CHANGE AFFECT MANGROVES ?

It is well established that mangroves are affected by climate change (Ellison 2012; Nicholls & Cazanave, 2010; Nicholls *et al.*, 2007), and the effects can be either positive or negative. Increases and the direct effects of CO² increases are likely to be mostly beneficial, increasing mangrove productivity. Rainfall changes are of greater significance to mangroves, particularly reduced rainfall, which decreases productivity and

¹⁴ See also Annex 1 of the National Climate Change Policy which reviews projected climate change effects in greater detail

biodiversity, while increased occurrence of cyclones can physically damage mangroves and reduce productivity.

However, global sea level rise as one of the more certain outcomes of climate change is the primary driver of concern with varied impacts which can directly affect key mangrove processes including (Ellison 2012):

- Mangrove health;
- Mangrove productivity;
- Recruitment;
- Inundation period; and,
- Sedimentation rates

Mangroves occur in many different coastal and estuarine locations with differing exposure and responses to sea level rise, however, the key exposure factors relating to the vulnerability of mangroves to sea level rise are tidal range and relative sea level change.

“For example, sea level rise will have a greater impact on intertidal systems in microtidal areas than in macrotidal areas because the tidal zone relocation will be more complete. Global sea level rise will also have a greater impact on areas that already suffer from relative sea level rise due to deltaic subsidence” (Ellison 2012).

Fiji is on the upper border of microtidal classification with a tidal amplitude of 1.3 m (Spring Tides). On the other hand subsidence of deltaic mangroves may be widespread, it has, for instance, been demonstrated at Tikina Wai, Nadroga (Ellison 2012).

9.3 THE WIDER EFFECTS OF MANGROVE RESPONSE TO CLIMATE CHANGE

The effects noted above (section 9.2) may result in mangrove mortality but overall mangroves migrate landward as a natural response to rising sea level. In small island countries such as Fiji landward migration is likely to be obstructed by existing valued land uses and development, these will tend to promote action to resist mangrove creep and the migration of saline conditions.

Many of the largest areas of mangrove in Fiji, especially in deltaic areas, are now bordered internally by seawalls constructed by government and these will prevent

gradual and natural migration of mangroves landward in response to climate change. Overall it is difficult to envisage anything other than a reduction in the area of mangroves and nearshore terrestrial coastal habitats. A reduction in the extent and health of these habitats will likely have a knock-on effect as coral reefs, mangroves, seagrasses and nearshore terrestrial habitats are highly interconnected by their physical and biological dependence on each other (Figure 1). The importance of this interdependence to ecosystem function and service provision is becoming increasingly recognised, particularly in the context of the disruptive impacts of human drivers of change (Silvestri & Kershaw, 2010).

As such, a reduction of Fiji's mangroves as a result of increasing global sea-level rise should not be viewed in isolation but as a key component in the overall reduction in the extent and productivity of adjacent inshore marine and nearshore terrestrial coastal habitats. It will be a significant challenge to manage proactively for this in the future, if the experience of mangrove management over the past thirty years is considered.

9.4 MANAGING MANGROVES FOR CLIMATE CHANGE

9.4.1 Government Response For Climate Change Management

Under any scenario managing mangroves for climate change is a very small component of a much larger and more difficult challenge - that of managing the effects of climate change on Fiji's natural resources as well as mainstreaming it into development planning.

Fiji has moved to address the challenge of climate change management by appointing the Ministry of Foreign Affairs and International Cooperation (MFAIC) as the national focal point for United Nations Framework Convention on Climate Change (UNFCCC) which it ratified in 1993. Appointing the Permanent Secretary of MFAIC as the designated national focal point for the UNFCCC and relocating the Climate Change Unit (CCU) from the DoEnv to MFAIC was a strategic move to strengthen political and national support for climate change activities in Fiji. A National Climate Change Coordinating Committee (NCCCC) has been created which serves as the body to coordinate climate change activities and projects of different government agencies. The NCCCC also provides direction and guidance to the Climate Change Unit which is responsible for facilitating the implementation of the National Climate Change Policy.

Within this national framework, the National Climate Change Policy has three objectives, all of which have direct relevance for mangrove management:

- Environmental protection, sustainable management and utilization of natural resources;
- Strengthening institutional capacity for environmental management; and
- Strengthening food security.

Hitherto, Fiji's response to climate change has been largely donor driven, and largely uncoordinated because of its cross-sectoral nature and the multiple players, including national government agencies, development partners, regional organisations and non-governmental organisations usually working in isolation or having only limited connectivity with each other's programmes. The new institutional framework is clearly positive high level endorsement of the intent to rectify this and to mainstream climate change response in development planning.

9.4.2 Mangrove Conservation & Enhancement – A Valuable Climate Change Adaptation Measure

Even the best-case scenarios indicate that climate change will be a reality for centuries to come and unless an appropriate response is agreed and implemented, a loss of mangrove with its associated negative effects on adjacent habitats can be expected. These are likely to be serious for a small island country such as Fiji which has a high reliance, especially for the subsistence sector, on the productivity of inshore marine habitats (refer Section 10.1; Figure 1). In addition, mangroves act to reduce coastal erosion and storm surge damages and their retention or restoration may be a cost-effective solution in certain circumstances as shown by the recent detailed study in Lami (Rao *et al.* 2012). Combined, these attributes of mangroves have resulted in mangrove conservation, restoration and planting as well as planning for landward migration as being valuable climate change adaptation measures.

Enabling mangrove migration landward in response to climate change is the immediately obvious option but is greatly constrained, as noted above, by the presence of valued land use, land-ownership and widespread construction by government of sea-walls at the back of mangroves, many of which double as access roads and flood defences. Government's current policy with regard to sea level is to maintain a 30m

setback of any development from the high water mark. This appears to be a guideline only though, as it has never been enacted, this is probably because of the land ownership implications of any formalized 30m setback. Formalization of the 30m setback provision to enable mangrove migration where appropriate would be helpful, but is likely an inadequate response to the actual need.

9.5 RECOMMENDATIONS

Recognising, the seemingly inevitable future loss of mangrove in Fiji as a result of rising sea levels and the inability or great difficulties which will be faced in providing at an appropriate scale for landward migration of mangroves, the priority climate change adaptation policy measures for mangroves are:

1. To minimise on-going conversion of mangroves in all situations – a more conservative policy towards mangrove conversion is a pre-requisite;
2. To maximise the retention of ‘back of the mangrove-flood prone habitats’ in their natural state to allow for future mangrove migration;
3. To encourage well-planned mangrove re-forestation as a valuable climate change adaptation measure¹⁵; and,
4. For the CCU and NCCCC to recognise the critical need of addressing the underlying domestic issues of mangrove management raised in this plan which have nothing to do with climate change *per se* but are fundamental to an effective mangrove management capacity.

¹⁵ In this respect, a priority pilot project should be to determine the feasibility and cost of converting saline mud flats at the back or the centre of large stands of mangrove into productive mangrove habitat.

10 VALUING MANGROVES

10.1 MANGROVES AND ECOSYSTEM LINKAGE

Mangroves cannot be viewed in isolation, they are a component of an interlinking set of terrestrial and marine habitats or ecosystems including coral reefs, seagrass beds and ‘back of the mangrove’ terrestrial or wetland habitats. The interdependence of the linkages is becoming increasingly recognised. Silvestri & Kershaw (2010) provide an innovative approach which helps understand and value ecosystem services across linked habitats (refer Figure 1).

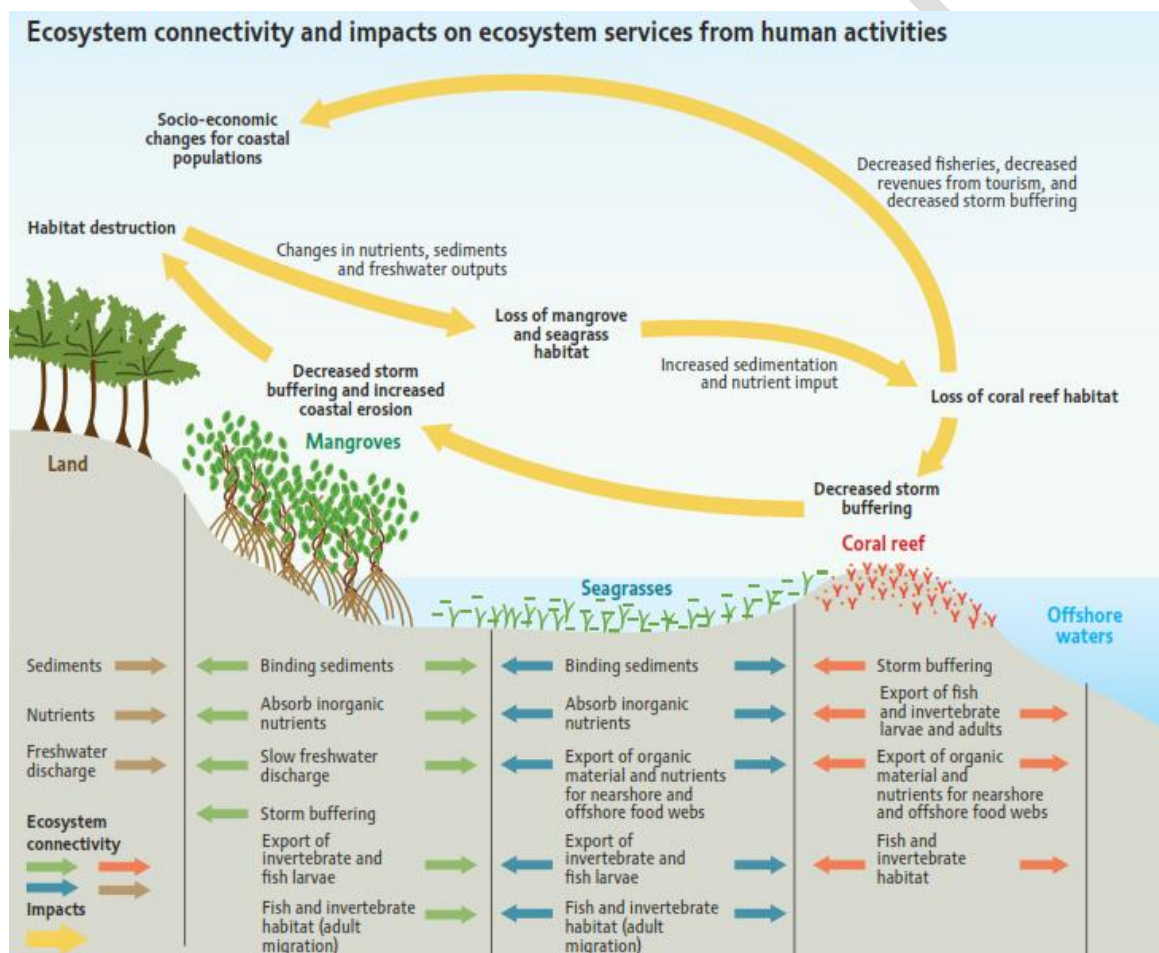


Figure 1: Ecosystem Connectivity and Impacts on Ecosystem Services. (Source: Figure from Silvestri & Kershaw, 2010)

For small islands where the areas of different coastal habitats and ecosystems are relatively small, the risk of breaking these linkages through human activity is high, and the resultant impacts on largely subsistence or subsistence + community livelihoods

likely to be highly significant. Even though mangroves may have a lower intrinsic ‘value’ than its neighbouring ecosystems, it nonetheless provides a vital link which helps sustains those ecosystems as well as providing unique ecosystem services.

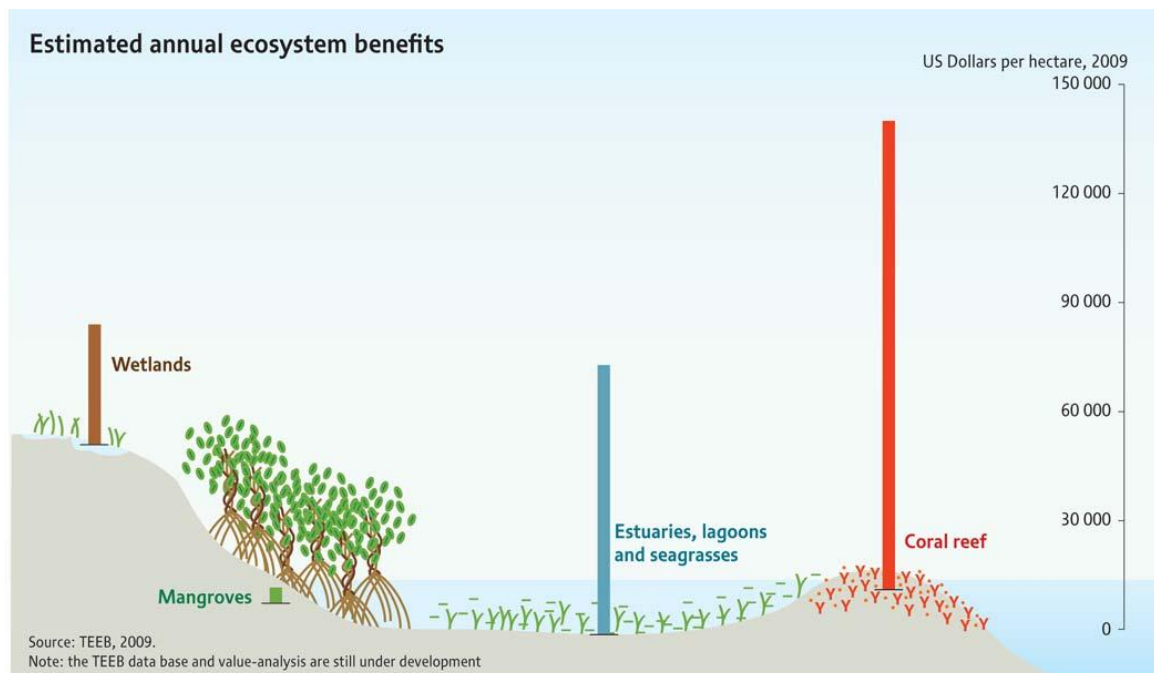


Figure 2: Estimated Annual Ecosystem Benefits for Coastal Ecosystems.(Source: Figure from Silvestri & Kershaw, 2010 based on TEEB 2009))

10.2 WHAT CAN BE VALUED ?

The link between mangroves and coastal fisheries has long been recognised as important and it was amongst the first such link that attracted the attention of emerging environmental economists. It was also a significant component of the seminal 1983 workshop which arrested the viewpoint prevalent in Fiji at the time, that mangroves were only useful if they could be converted to other uses (Lal 1983). Thereafter the Agricultural Tribunal relied on a ‘Fisheries Report’ to assist it in making a compensation payment to TFROs for the loss of mangroves. Since that time up to and including recent examples of the conversion of mangroves, a ‘fishery report’ has been regarded as the essential ‘valuation’ document for mangrove management.

However, environmental economics and the valuation of ecosystem services has moved on a great deal and fisheries is only one of at least 10 important ecosystem services which mangroves provide directly and indirectly (refer Table 7).

Ecosystem Value	Description
Fisheries	the value of fish and shellfish supported by mangrove forests, including support as nursery and breeding grounds
Forestry	includes timber, fuel wood, charcoal, and other forestry products
Recreation	includes tourism and research expenditures
Storm protection	coastal protection and stabilization
Carbon sequestration	a recent estimate is that mangrove deforestation generates as much as 10% of emissions from deforestation globally, despite accounting for just 0.7% of tropical forest area
Non-use values	including option, bequest and existence values, or 'willingness to pay'
Purification	water and air purification as well as waste assimilation
Nutrient	nutrient retention and recycling
Biodiversity	habitat value for species – marine and arboreal
Traditional/cultural uses	reflects cultural uses

Table 7: Ecosystem Services of Mangroves Which Can be Valued

10.3 VALUING MANGROVE-RELATED FISHERIES

Not all inshore fisheries are attributable to mangrove. There remains great uncertainty as to the contribution of mangroves to coastal fisheries, for instance UNEP (2011) refers to eight studies providing a global overview of estimates of mangrove's contribution to on and offshore fishery, with the estimated contribution varying between 10-20% to 90%. For the purpose of their study site in Gazi Bay, Kenya which supports 624 ha of mangrove with a fishery yield of 69.8 t/annum they used the results of Aburto-Oropeza (2008) which calculated that 31.7% of the capture production is attributable to the mangroves, because it was 'based on accurate baseline research'.

A single, one-off, poorly-resourced survey of fisheries at any one site as currently undertaken to determine compensation for TFROs does not constitute 'accurate baseline research' and lacks scientific credibility for its purpose.

10.4 COMPENSATION FOR LOSS OF FISHING RIGHTS

The issue of compensation for loss of fishing rights is beyond the scope of MMP2013, as it was in 1985 for MMP85. Even at that time it was quite evident that there needed to be a review of the Compensation Procedure which was one of the recommendations of the plan. This was not done and the situation has deteriorated such that compensation payments for foreshore developments today lack transparency, appear totally arbitrary and act as an incentive to mangrove conversion rather than providing equitable compensation to current and future generations for loss of traditional fishing rights. Agrawala *et al* (2003) have shown how an apparently large but one-off compensation payment for mangrove removal in Fiji – in this case \$400,000 for a 70 ha area of mangroves, actually represents a subsidy for mangrove conversion¹⁶ under a variety of valuation scenarios including the valuation of mangroves as undertaken in 1992 for the State of Environment Report (GoF 1992), and subsequently used in the National Biodiversity Strategy and Action Plan (GoF 2003).

Key to this issue is that currently compensation is paid as a single one-off payment which is undoubtedly attractive as a windfall payment to the current generation of TFROs. However, the loss of fishing rights represents a loss in perpetuity and should be paid annually commensurate with the value at the time so that future generations are not disadvantaged. The annual sums that reflect fisheries attributable to mangroves (refer section 10.3) are very small by comparison with the windfall one-off payments, and will be much less attractive to the current generation of TFROs (though they are equitable to present and future generations), and are readily assimilated into the rental currently paid to Government for a foreshore lease.

10.5 RECOMMENDATIONS ON VALUING MANGROVES AND COMPENSATION FOR TRADITIONAL FISHING RIGHTS OWNERS.

In its present form – the absence of a policy on equitable compensation for loss of fishing rights is one of the fundamental constraints to the sustainable management of the national mangrove resource. As such the recommendation for Government to

¹⁶ Agrawala *et al*. (2003) calculate that compensation paid by the Dept of Lands was only a fraction (as low as 1/20th) of the values assessed by other groups through economic valuation studies that take into account various mangrove services, including by the World Bank, and Fiji's own Biodiversity Strategy Action Plan (2003) (note – the valuation was actually carried out for Fiji: National State of the Environment Report (GoF 1992))

review this issue remains as a priority. The following are contextual statements for the review:

1. Large one-off, windfall compensation payments without valid scientific or economic valuation basis should cease as they provide an incentive to consent by TFRO for immediate gain at the expense of future generations of TFRO;
2. Compensation payments for mangrove-associated fisheries would be due in perpetuity, as such they should be a component of the annual rental charged by Government for the foreshore lease;
3. In line with the current basis for compensation of loss of fishing rights, compensation payments for loss of fishing rights should reflect potential fishery losses attributable to mangroves and nothing else;
4. Until such time as scientifically valid data are gathered in Fiji¹⁷, there are many studies from around the world providing fishery value of mangroves which can provide guidance (see for example Aburto-Oropeza (2008) or Salem & Mercer (2012) an analysis of 73 studies encompassing 352 observations of mangrove ecosystem service valuations);
5. Government should review the potential for statutory foreshore values for different habitats in line with current land valuation methodology to facilitate administration and reduce the potential for legal challenges;
6. Annual 'compensation-rental' payments should be paid to a TFRO Trust Fund;
7. Also due in perpetuity would be another component of the annual rental charged by Government representing compensation for the remaining 'ecosystem services' (total less fisheries) which should be paid into a Mangrove Management Trust Fund (refer section 4.7.1).
8. Annual 'compensation-rental' should be linked to a Cost of Living or Inflation Index or periodic review of the value of the 'fisheries', as appropriate.

¹⁷ MESCAL Rewa Delta project will be reporting on mangrove valuation....

11 MANGROVES AND TRADITIONAL FISHING RIGHTS OWNERS

11.1 OVERVIEW

The TFRO communities living close to mangroves have developed the deepest knowledge and appreciation of the use of mangroves, and are generally located such that they potentially receive the greatest benefit from the diverse values of mangroves (Thaman 1998). On the other hand and as a generalisation, TFROs have shown that they readily consent to mangrove conversion. There are various reasons for this including the need for village expansion, the protection of villages and agriculture and benefits of development projects, but the attraction of large windfall payments as 'compensation for loss of fishing rights' is likely the greatest incentive.

Currently, there are several issues involving Traditional Fishing Rights Owners and mangroves which have repercussions for mangrove management:

- Mangroves are often attributed to 'landowners' in the press (even in statements reportedly from Government). Apart from being incorrect this is misleading for the general public, the legal arrangement is that mangroves being located on foreshore¹⁸ belong to the public of Fiji with their management entrusted to the state;
- Currently by cabinet decision but not in law, TFROs have the right to recompense if their right to fish in their mangrove area is impacted. Other than customary access and uses, TFROs have no other rights and their consent or otherwise is not the determinant of whether an area of mangroves is converted or a project goes ahead;
- TFROs have no active role in the conservation of mangroves, rather the prevalent attitude is that as traditional owners they have a responsibility to conserve mangroves (FLMMA-managed mangrove areas receive no national recognition or support);
- Ministry of iTaukei Affairs has no specified procedure for determining the consent or otherwise of TFROs in respect of loss of or impact to mangroves (or foreshore in general) and this leaves it open to abuse (refer 7.7.2);

¹⁸ This excludes some small areas of mangrove which occur within freehold titles.

- Large, one-off windfall compensation payments for mangrove conversion are an incentive for TFROs to agree to a conversion, but in financial terms they are actually a subsidy for mangrove conversion (refer section 10.4).

11.2 USUFRUCT RIGHTS

The registration of Traditional Fishing Rights Ownership in Fiji does not distinguish between those who traditionally use a given area of mangrove and foreshore (*usus fructus* or usufruct rights holders) and those who live far away and never use the site. The extent of the distinction is largely based on the size of TFRO areas. Both groups are TFROs, but those with usufruct rights will suffer a loss of *in situ* resources when an area of mangrove is converted, while the others will not, although they may suffer losses as a result of a reduction of exported benefits. Both, however, are potential equal recipients of compensation payments due in the case of mangrove conversion. As noted (refer section 7.7.2), this anomaly poses an issue for the equitable EIA assessment, and it needs to be a component of the review of compensation for TFROs (refer section 10.5).

11.3 UNTAPPED CONSERVATION POTENTIAL

The rapid establishment of community managed marine areas (FLMMA) and the more recent move to incorporate mangrove areas represents a major opportunity that exist for all mangrove areas in Fiji, the use of local custodians to play an active role in the day to day management of mangroves. Currently FLMMA areas cover 12.5% of Fiji's mangrove (FLMMA *in litt.*).

At the moment Government provides no legal recognition for FLMMA areas and has no applicable protected area for mangroves. Moving to rectify either of these would provide a mechanism to harness the huge potential, energy and interest of local communities for mangrove protection and management.

11.4 TRADITIONAL FISHING RIGHTS OWNERS' CONSENT

Ministry of iTaukei Affairs has no specified procedure for determining the consent or otherwise of TFROs in respect of loss of or impact to mangroves (or foreshore in general). Occasionally, the Provincial Office provides leadership to ensure that appropriate consultation is undertaken but this may be rare. More commonly, private agents and/or consultants liaise with a wide variety of committees, task forces, trusts or

other bodies purportedly representing the TFROs to determine consent or otherwise with the process then adopted by the Provincial Office¹⁹.

The adoption of an appropriate transparent and auditable Standard Operating Procedure (SOP) for Traditional Fishing Rights Owner Consultation is essential for the purposes of due and equitable process. Such a process is as much to do with intra TFRO governance as wider public transparency. The process needs to be completed and assessed by the EIA and not be a separate parallel process. An example of a potentially appropriate SOP is provided in Box 1.

BOX 1: Draft Standard Operating Procedure for Traditional Fishing Rights Ownership Consultation & Consent

1. Provincial Office calls a meeting of all Turaga ni Yavusa of TFRO of the project location
2. At the meeting the EIA consultant or proponent explains the project in as much detail as possible and leaves a description as reported at the meeting in writing with the Provincial Office to be circulated with the Turaga ni Yavusa, and included in the final report. If necessary government departments should make presentations at the meeting describing the national significance of the proposed project.
3. Turaga ni Yavusa are to hold meetings with representative gatherings of all the mataqali of the Yavusa. Good records of the meetings need to be prepared with an account of the discussion topics and any decisions made, together with the names of all attendants with their mataqali and village etc. If necessary, meetings will need to be held in urban locations or wherever large numbers of the yavusa members are present.
4. When completed, the Provincial Office calls another meeting of the Turaga ni Yavusa at which meeting, each presents the results of the meetings held and presents the written records of the meetings.
5. The Provincial Office will then need to present the results of the consultation process, an account of the discussion at the final meeting, and any decisions made in a report which is available for inclusion in the proponent's EIA report. The report needs to provide the accounts with details as a record of all the yavusa meetings held.

¹⁹ As clearly illustrated in the recent Draunibota Bay case

There are obvious issues relating to the SOP drafted in Box 1. The most significant of these relates to the difference, where it arises which is in large Qoliqoli areas, between TFROs as a whole and that subsection of the TFROs who live close to and actually use ‘a project site’, and may be termed as having ‘usufruct rights’. These two groups can be expected to have opposing and divergent views on the project – the former lose their rights and nothing more, but the latter lose not only their rights but their actual and productive use of the site (refer section 11.2).



Local communities using the mangrove for fishing at the Rewa Province.

12 MANGROVE FORESTRY

12.1 BACKGROUND

Sustainable mangrove management systems were introduced well before sustainable terrestrial forest management systems were developed. Fiji had a sophisticated mangrove management system documented in the early 1950s (Marshall undated). Formerly mangroves were of major importance as a source of fuelwood. In 1952, over 50,000 m³ was harvested and processed by the DoF who drew up Working Plans based on principles of sustained yield. However the demand for fuelwood declined dramatically with the availability and convenience of imported fuel oil. The decline in the 1950s and 1960s stabilised at a fluctuating level around 5,000 m³ per year after 1967 and the managed fuelwood industry effectively disappeared. Today, the only managed mangrove wood concessions are in the southern division and between 2008-2012, 16 licensees produced between 256-956 m³/yr and 0-651 lm/yr with total revenue received between \$2,181-5,836/yr. Such revenues would be unlikely to be covering DoF costs of management. Forestry suspect that illegal mangrove felling for fuelwood in the southern division may be ~ 50% of recorded production. There is, in addition, the traditional use of mangrove wood as it is a favoured species for domestic use.

EIAs are not being conducted for commercial mangrove harvesting, these are required by EMA, and so technically they are illegal. It is doubtful, given the size of the current operations, that any of them could sustain the cost of a properly conducted EIA.

Mangrove, specifically Dogo, has very high energy content and so it is sought after for certain purposes – cremation, lovo and boiler fuel, but overall the use of mangroves for fuelwood today is not a significant industry. Those business houses which still do use it are taking advantage of a 'freely available' source of wood which they have not propagated and do not replant. The royalties they pay have not been set to reflect DoF management costs and loss of ecosystem services including (but by no means confined to) loss of traditional fishing rights.

12.2 DEPARTMENT OF FORESTS POLICY AND POSITION

The Fiji Forest Policy Statement (2007) provides explicit requirements in respect of mangroves with priority to be given to the management of mangroves to maintain its

ecological values and a consultative process to be undertaken with a view to introduce an effective mangrove regulatory and management framework. The drawing up of guidelines or a plan to replace the Mangrove Management Plan for Fiji (Phase I&II 1985/1986) was also highlighted in the policy statement. One of the two actions identified as part of mangrove management is that ***“the Forestry Department will advocate permanent conservation of mangroves to provide for sustainable customary uses, the sustenance of coastal fisheries, the protection of shorelines and as an adaptation measure against climate change impacts. Commercial harvesting of mangrove trees will be prohibited”***.

During consultation for this review, DoF representatives confirmed that the DoF wishes to see commercial harvesting of mangroves being phased out in the short term and thereafter to be prohibited.

12.3 FUELWOOD PLANTATIONS

If the current supply of mangrove fuelwood (legal and illegal) in the southern division is 2,000 m³/yr (see above section 12.1 and it is probably less) this amount of ‘green’ fuelwood could be produced annually by a 60 ha modern fuelwood plantation at a cost of \$5.00/m³ (2007 prices; Richardson *et. al.* 2007).

There is a vast amount of underutilised land in Fiji where fuelwood can be readily grown, and there is rapid international development of fast growing hybrid species for fuelwood. As such there seems very little logic in allowing commercial timber extraction from mangroves which at present are managed by the state as a cheap and convenient source of fuelwood at a price which does not cover DoF management costs or the loss of the mangroves’ ecosystem services.

12.4 RECOMMENDATION

Currently, commercial mangrove harvesting is:

1. largely occurring outside of sites identified for wood production in MMP85;
2. technically illegal as permit-holders are operating without EIAs required under EMA; and,
3. unlikely to be covering the management costs of DoF.

In accordance with DoF current policy - commercial mangrove harvesting should be prohibited. In practice it could be phased out over a period of 5 years with DoF providing assistance to any potentially commercial fuelwood grower for 5 or 10 years. Assistance should include advice on site selection and preparation, initial provision of seedlings and advice on maintenance.

It is very likely that the phasing out of legal commercial mangrove harvesting will result in an increase in the illegal harvesting and DoL will need to plan for this eventuality.

If there are valid requirements for mangrove wood as opposed to any other species which Government believes should be met and as such, decides not to phase it out completely, then commercial harvesting of mangroves should be subject to the following:

1. Mangroves should only be harvested from designated Wood Production Zones as per the MMP85, and preferably in those areas designated as Development Zone, i.e. where mangroves persist landward of seawalls;
2. EIAs be undertaken in accordance with the legal requirements of the Environment Management Act;
3. Mangrove harvesting costs should be reviewed and of the order of:

Department of Forests Management Costs	\$ 30 /m ³
Licence/Royalty	\$70/m ³
Total	\$100/ m³

4. Licence/Royalty Fees for mangrove harvesting should be paid into a Mangrove Trust Fund (refer section 4.7.1).

13 URBAN & DEVELOPMENT 'HOT SPOT' MANGROVE PLANS

13.1 BACKGROUND

One of the major lessons learned during MMP85 was that different areas of mangrove were under different threats and that the largest areas of mangroves (i.e. Rewa, Ba and Labasa deltas) were not necessarily under the greatest threat. Nearly all mangroves near urban areas were more threatened and there were some development "hot spot" areas which were under pressure. As such Phase 2 of MMP85 addressed the mangroves of Nadi Bay and those of Suva to Navua.

Urban mangroves in particular need to be distinguished from the national resource. The pressures are incremental and pressing (through conversion and/or degradation) but involve relatively small areas in relation to the national resource, though proportional losses have been far greater. They are in conspicuous locations and attract a lot of attention from the public. They are, in the main, the cause of the public outcries against mangrove conversion which erupted in 1983-4 and then again in recent years. Their management is a landscape issue not a national mangrove resource issue. In contrast, dredging damage currently being done to mangroves (Labasa, Rewa and potentially Ba) is an issue relating to the national mangrove resource.

Nadi Bay was a development pressure or hot spot for MMP85 and a zoned plan was prepared as part of the plan. However, approvals for conversion of mangroves in Nadi Bay have proceeded with MMP85 proving ineffective. It remains a pressure spot and a new spatial plan for it was recommended by DoEnv (2011).

Other pressure spots emerging include Momi, Natadola and the Coral Lagoon proposal. The mangroves of the proposed Caudua resort (Ocean Pacific at Nabukavesi) and residential development were removed but the project has failed. Such activities should have recoverable bonds.

13.2 PREPARING URBAN OR HOT SPOT MANGROVE PLANS

13.2.1 Outline

There are three components of Urban or Hot Spot Mangrove Plans

- Developing Foreshore Structural Plans which are essentially permanent with respect to mangroves

- Consultation Process – public as for urban structural plans; qoliqoli owners
- Protected Mangrove Areas – will require specific management responsibility

13.3 PROCESS

13.3.1 Purpose

In urban areas the overall purpose of the plan recognises that some areas of mangrove – soft coastal/estuarine borders should be retained as a landscape-open space-natural feature of a town-city rather than complete foreshore conversion to buildings-hardscape.

For ‘hot-spot’ areas the need is to provide a plan which serves several functions including:

- ensure that conversion of mangroves if and when it is permitted occurs in a planned and not an ad hoc manner;
- to minimise loss of mangrove and their ecosystem services to the national resource;
- to ensure that some mangroves are retained as a natural-landscape feature; and,
- to ensure that early developments are not impacted by late developments;

13.3.2 Boundary Definition:

For urban mangroves, the extent of the plan will need to be decided and it is likely that it should extend beyond city/town boundaries to appropriate natural/landscape boundaries. Similarly definition of ‘hot spot’ mangrove plans would require appropriate boundaries to be selected – defined as a combination of extent of pressure and natural boundaries.

13.3.3 Loss of Mangroves to Date

For both types of plans, the area of mangrove lost to date will need to be determined to provide clear understanding of the extent of loss. A specific time frame would need to be set – probably determined by appropriate aerial photographic cover – post 1950....perhaps into the 1960s.

13.3.4 Identification of 'Development Areas' of Mangrove

Development mangrove areas would be those which a survey of ecological health reveal have little or no likelihood of survival, and included would be those sites for which conversion has already been approved by DoL.

13.3.5 Survey of Ecological Health of Existing Mangroves

In both areas a survey of the mangroves would be required, in particular to determine the state of ecological health of the mangroves. Identification of areas of mangrove which for a variety of reasons have little or no likelihood of survival and minimal restoration potential would lead to their being designated as development zones. Other areas would be identified for restoration and permanent protection.

13.3.6 Plan Preparation

The plan would be prepared in the normal process undertaken by Department of Town & Country Planning in the preparation of zoned plans as per town planning schemes, local area advisory plans, centre plans, urban growth management plans etc.

This would require preparation of an initial draft plan and then iterative revisions following internal comment, regulatory authorities comment and finally public comment.

Public consultation would be held in a similar manner to scheme plans – but with emphasis on greater media coverage and with some public discussion meetings held. At the same time the views of private/commercial interests would be sought.

Fishing Rights Owners would need to be consulted through the Provincial Office. Areas of mangroves to be converted would need to go through the normal process for compensation for Loss of Fishing Rights, organised through the Provincial Office. Retained Mangrove Parks/Reserves – Fishing Rights Ownership issues will need to be determined and will depend on the status of these mangroves and access or otherwise for traditional fishing uses.

13.4 ISSUES ARISING

Issues which urban plans will have to address in addition to identifying Mangrove Park/Reserve areas:

1. **Boundary definition** – likely to be somewhat controversial

2. ***Fate of mangrove areas identified for conversion*** – how will the end use be determined – to what degree will ‘public good’ be incorporated. Should this be part of the Urban Mangrove Plan ?
3. ***Mangrove Parks/Reserves***: These will need to be actively managed. Passive management as at present is not tenable and will just result in business as usual – gradual conversion or degradation. The vision must be to have fully demarcated areas safe from squatters, rubbish dumpers, industry discharge polluters and, at least, non-traditional forms of use.
 - a. Under what legislation will they be protected ?
 - b. Who will be responsible for their protection ?
 - c. Will they be fully protected i.e. fishing rights ownership issues settled ?
 - d. What ‘development’ uses would be allowed – i.e. for conservation education – board walks, interpretive centre, restoration activities etc.

14 MANGROVE MANAGEMENT ACTION PLAN

Table 8 provides the recommendations of Mangrove Management Plan 2013 in the form of an action plan.

Objective	Activity/Strategy	Report Section	Timeframe/Responsibility
Addressing Fundamental Constraints to Sustainable Mangrove Management			
A modern policy for mangrove management adopted	<ul style="list-style-type: none"> • MESCAL Policy Review (Lumelume & Parkinson 2013) provides background • Stakeholder consultation • Integration with Forests, Climate Change and REDD –plus Policies • A more conservative approach to mangrove conversion is required in view of climate change impacts and adaptation values • Needs to provide for explicit conservation/protection requirements • Approval by NEC and Cabinet 	# 5.3 #2.5.5, #9.4	<u>2014</u> DoL MMTC,ICMC
Effective on-the-ground implementation capacity for mangrove management, monitoring, enforcement etc. is in place	<ul style="list-style-type: none"> • Well-resourced review required (as identified in Forests Policy 2007) • Formalising community custodianship of mangroves will likely be the key • May need to be a component of, or run in parallel with other reviews recommended in this plan • The review will be key to climate change adaptation requirements of mangroves 	# 4.9 # 10.5 #9.4.2, #9.5	<u>2015</u> DoL MMTC,ICMC,NGOs
Value of mangrove ecosystem services standardised with equitable procedure for compensation for TFROs adopted for mangrove conversion	<ul style="list-style-type: none"> • Review of the TFRO Compensation Procedure • Value of fisheries attributable to mangrove needs to be defined for Fiji • Move from large one-off windfall payments to annual fisheries value-only annual payments recovered as a component of DoL foreshore rental and paid to TFRO Trust Fund • Non-fisheries ecosystem services also valued and paid as annual rental to a Mangrove Management Trust Fund 	Contextual statements for review provided in # 10.5. #4.7.1	<u>2015</u> DoL
DoL provided with specialist advice on technical and management matters	<ul style="list-style-type: none"> • Mangrove Management Technical Committee established 	Composition # 6.2.1	<u>2014</u> DoL, MMTC
Consistent and transparent TFROs consent procedure in use	<ul style="list-style-type: none"> • Standard Operating Procedure for Traditional Fishing Rights Ownership Consent drawn up and adopted and used 	# 11.4	<u>2014</u> DoL, MiTA

Objective	Activity/Strategy	Report Section	Timeframe/Responsibility
Addressing <u>Important Constraints to Sustainable Mangrove Management</u>			
Legislation for Mangrove Protected Areas enacted	<ul style="list-style-type: none"> • MESCAL Mangrove Legislation Review • Protected Areas Legislation in preparation (?) (National Protected Areas Committee – GEF-PAS Project) • Legal protected area management status is required in four situations envisaged in MMP2013 – 1/ mangrove offsets; 2/ Urban Mangrove Reserves; 3/ FLMMA community managed marine areas; & 4/ National Mangrove Reserves i.e. RAMSAR sites 	#11.3 See 1: #7.8; 2: #13.3.6; 3: #11.3; 4: #4.7	<u>2015</u> DoEnv; NT
Commercial mangrove timber harvesting phased out	<ul style="list-style-type: none"> • In line with Forestry Policy (2007); • Prepare a phase out plan. • DoF providing assistance to any potentially commercial fuelwood grower. 	#12.2 #12.3	<u>2014</u> DoF
EIA Guidelines for Mangrove conversion/impacting activities adopted with cumulative impact provision agreed.	<ul style="list-style-type: none"> • DoEnv review guidelines as prepared in this plan and with MMTC refine for adoption • Prepare stand-alone guideline document • Procedures for determination of cumulative impact reviewed with SOPAC-SPC, MMTC & Forestry to determine feasibility and details of procedure. • Enquiry into environmental management failure of dredging projects • Retention of the MMP85 Zonation Plans for mangrove EIA assessment and prospective development planning purposes. Appropriate to classify all Resource Reserve and National Reserve zones as prohibited for conversion consideration. 	#7.1.2 #7.6 #2.5.4.2, Attachment 1 Figure 2 #7.10.1	<u>2014</u> DoEnv MMTC
Accurate database of converted mangroves prepared	<ul style="list-style-type: none"> • Required for understanding of cumulative impact of mangroves at any one location – an important requirement for consideration of conversion applications 	#7.6	<u>2014</u> DoL
Mangrove conversion approval by DoL only on the advice of the National Environment Council	<ul style="list-style-type: none"> • A formal mangrove conversion approval procedure requiring DoL to act on the advice of the National Environment Council • Endorsement by Cabinet required 	#8.2	<u>2014</u> DoL NEC

Procedure for adoption of Mangrove Management Spatial/Scheme Plans for urban/peri-urban and development 'hot spots' in place.	<ul style="list-style-type: none"> • In consultation with DTCP and Municipal Councils refine the methodology outlined in this report to draw up an agreed procedure; • ? Consistent with Scheme Plans under the Town Planning Act; • Draw up a priority list of localities starting with Suva-Lami as the pilot; • Legal establishment of Protected Mangrove Areas with designated management authority a key requirement 	#13 #13.3.6	<u>2014</u> DoL, DTCP MCs, MiTA
Mangrove Management Scheme Plan endorsed for Suva and Nadi Bay	<ul style="list-style-type: none"> • Plans for the two localities drawn up in accordance with adopted procedure 		<u>2015</u> DoL, DTCP, MCs, MiTA
Biodiversity Offsets legislation enacted and applying to mangroves	<ul style="list-style-type: none"> • Draft Biodiversity Offset Legislation and ensure it applies to mangroves • Enact as a Regulation of Environmental Management Act 2005 • Incorporate Mangrove Management Trust Fund 	#7.8 #4.7.1	<u>2016</u> DoEnv, NT
Climate change adaptation measures integrated into mangrove management	<ul style="list-style-type: none"> • Incorporate into Mangrove policy • Identify opportunities for enabling landward migration of mangroves • Encourage well-planned mangrove re-forestation 	Climate Change recommendations #9.5	<u>2014</u> DoL; NCCCC; CCU MMTC;ICMC
A definitive figure for the area of Fiji's mangrove resource is available and rate of loss confirmed 1991-2007	<ul style="list-style-type: none"> • Complete coverage of Lau Group & Koro not included in the 2007 coverage of SPC-SOPAC study • Ground-truth SPC-SOPAC study to confirm rate of loss over 1991-2007 period 	#3.3 #3.3.2	<u>2015</u> DoL DoF; SPC-SOPAC

Table 8: Mangrove Management Action Plan

Key: Timeframe – To be completed by the end of the year indicated

Primary Responsibility – Left justified; Secondary Responsibility – Right justified.

CCU	Climate Change Unit	MiTA	Ministry of iTaukei Affairs
DoEnv	Department of Environment	MMTC	Mangrove Management Technical Committee
DoF	Department of Forests	MMP85	Mangrove Management Plan 1985/86 Phases 1 & 2
DoL	Department of Lands	NCCCC	National Climate Change Coordinating Committee
DTCP	Department of Town & Country Planning	NEC	National Environment Council
FLMMA	Fiji Locally Managed Marine Areas	NT	National Trust
ICMC	Integrated Coastal Management Committee	SOP	Standard Operating Procedure
MCs	Municipal Councils		

REFERENCES

- Aburto-Oropeza, O 2008. Mangroves in the Gulf of California increase fishery yields, PNSA Vol. 150 no. 30.
- Agrawala S, T Ota, J Risbey, M Hagenstad, J Smith, M van Aalst, K Koshy, B Prasad. 2003. *Development and Climate Change in Fiji: Focus on Coastal Mangroves*. Organisation for Economic Co-operation and Development, Paris.
- Australian Bureau of Meteorology and CSIRO, 2011. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.
- Bishop J. 2007. Trading habitat: the potential of biodiversity offsets. Av 33, IUCN.
- DoEnv. 2013. *Draft Mangrove Management Plan, and The Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji Report. Stakeholder Consultation Workshop, 20th September, 2013. Tappoo City Conference Room, Suva*. Unpublished report. Ms Neema Nand (Compiler) Mangrove Management Committee. MESCAL-Department of the Environment Suva. Fiji
- DoEnv. 2011. *The Integrated Coastal Management Framework of the Republic of Fiji*. Unpublished report, Patrina Dumaru for the National Integrated Coastal Management Committee and the Department of Environment. Suva, Fiji
- DoEnv. 2004. *Mangrove Management Stakeholder Consultative Meeting Report, Tanoa Plaza, 11 June 2004*. Unpublished report, International Waters Program. Suva, Fiji
- DoF 2008. 2008 National Forest Inventory Report. Unpublished report, Department of Forests, Suva, Fiji.
- Donato DC, JB Kauffman, D Murdiyarso, S Kurnianto, M Stidham and M Kanninen. 2011. Mangroves among the most carbon-rich forests in the tropics. *Nature Geoscience* 4:293-294. DOI: 10.1038/NGEO1123
- Dunlap, R. & Singh. B. 1980. A National Parks and Reserves System for Fiji. National Trust-World Wildlife Fund, Suva
- Ellison JC. 2012. Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems. Washington, DC: World Wildlife Fund (WWF).
- Ellison JC, V Jungblut, P Anderson, and C.Slaven 2012. *Manual for mangrove monitoring in the Pacific Islands region*. Secretariat of the Pacific Regional Environment Programme, Apia Samoa.
- GoF 1992. State of the Environment Report. Government of Fiji – IUCN Consultants, Suva.
- GoF 2003. National Biodiversity Strategy and Action Plan. Government of Fiji – Department of the Environment, Suva.
- Hills T, A Brooks, J Atherton, N Rao and R James. 2011. *Pacific Island Biodiversity. Ecosystems and climate change adaptation: Building on nature's resilience*. Apia, Samoa: SPREP.
- Lal, P (ed) 1983. *Mangrove Resource Management*. Proceedings of an Interdepartmental Workshop Held on 24th February, 1983, MAF HQ Conference Room, Suva. Technical Report No 5, Fisheries Division, MAF, Fiji
- Lumelume R & P Parkinson. 2013. Review of legislation and policies relating to the use and management of mangrove ecosystems in the Fiji Islands. (DRAFT). Unpublished Report, MESCAL-Department of Environment, Suva, Fiji

- Marshall undated – c.1955. Sustained Yield Management of The Mangrove Salt Water Swamp Forest of Fiji. Department of Forestry, Government Press, Suva
- Mataki M, G Solo, P Donohue, D Alele, L Sikajajaka 2013. *Choiseul Province climate change vulnerability and adaptation assessment report: securing the future of Lauru now*. Secretariat of the Pacific Community, Deutsche Gesellschaft für Internationale Zusammenarbeit and Secretariat of the Pacific Regional Environment Programme. Apia, Samoa
- Nicholls R J, PP Wong, VR Burkett, JO Codignotto, JE Hay, RF McLean, S Ragoonaden, CD Woodroffe. 2007. Coastal systems and low-lying areas. In ML Parry, OF Canziani, JP Palutikof, PJ van der Linden & CE Hanson (Eds.), *Climate change 2007: Impacts, adaptation and vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press, 315–356.
- Nicholls RJ & A Cazanave. 2010. Sea-level rise and its impact of coastal zones. *Science* 328, 1517–1520.
- Rao NS, TJB Carruthers, P Anderson, L Sivo, T Saxby, T Durbin, V Jungblut, T Hills, S Chape. 2012. *A comparative analysis of ecosystem-based adaptation and engineering options for Lami Town, Fiji*. Secretariat of the Pacific Regional Environment Programme, Apia, Samoa
- Richardson K, D Fayolle, D Watling 2007. *Study of the feasibility of a reforestation project*. National Adaptation Strategy for Sugar in Fiji. Suva.
- Salem ME & DE Mercer. 2012. The Economic Value of Mangroves: A Meta-Analysis. *Sustainability* 4, 359-383. doi:10.3390/su-4030359
- Silvestri S & F Kershaw (eds.). 2010. *Framing the flow: Innovative Approaches to Understand, Protect and Value Ecosystem Services across Linked Habitats*. UNEP World Conservation Monitoring Centre, Cambridge, UK
- Sinclair Knight Merz. 1999. Environmental Impact Assessment of the Qawa, Labasa and Wailevu Dredging Project. Prepared for the Ministry of Agriculture, Fisheries and Forests, Suva
- TEEB 2009. The Economics of Ecosystems and Biodiversity for National and International Policy Makers, TEEB Climate Issues Update. September, 2009
- Thaman B. 1998. Community utilisation and valuation of mangrove resources in Fiji: Case studies of Sawa, Daku and Nadoria Villages and Kinoya and Tamavua-i-wai urban settlements, Viti Levu, Fiji. M.S. Thesis, James Cook University of North Queensland, Townsville, Australia
- Thaman RR, A Naikatini, G Keppel, B Thaman, D Watling, N Bolaqace, B Thaman, E Sekinoco, T Gaunavinaka, & M Masere. 2005. Nasoata Mangrove Island, the PABITRA Coastal Study Site for Viti Levu, Fiji Islands. *Pacific Science*, vol. 59, no. 2:193–204
- Tortell P, D Collins, R Dubois, D Gwyther and O Sedlak. 1992. *Environmental Guidelines for Dredging and River Improvement in Fiji*. Food & Agriculture Organisation of the United Nations, Rome.
- UNEP 2011. Economic Analysis of Mangrove Forests: A case study in Gazi Bay, Kenya, UNEP, iii+42 pp.

**ATTACHMENT 1: SATELLITE IMAGERY OF MANGROVE FATALITY IN THE
LABASA AND REWA DELTAS**

(Source: Google Earth – free download version)

Draft Final

**MAY 2012 IMAGERY FROM
GOOGLE EARTH SHOWING
MANGROVE FATALITY IN THE
LABASA DELTA**





**MAY 2012 IMAGERY FROM
GOOGLE EARTH SHOWING
MANGROVE FATALITY IN THE
LABASA DELTA**



**MAY 2012 IMAGERY FROM
GOOGLE EARTH SHOWING
MANGROVE FATALITY IN THE
LABASA DELTA**

**With dredge barge initiating
a new disposal site in
mangrove**



**MAY 2012 IMAGERY
FROM GOOGLE EARTH
SHOWING MANGROVE
FATALITY IN THE LABASA
DELTA**



**MAY 2012 IMAGERY FROM
GOOGLE EARTH SHOWING
MANGROVE FATALITY IN THE
LABASA DELTA**

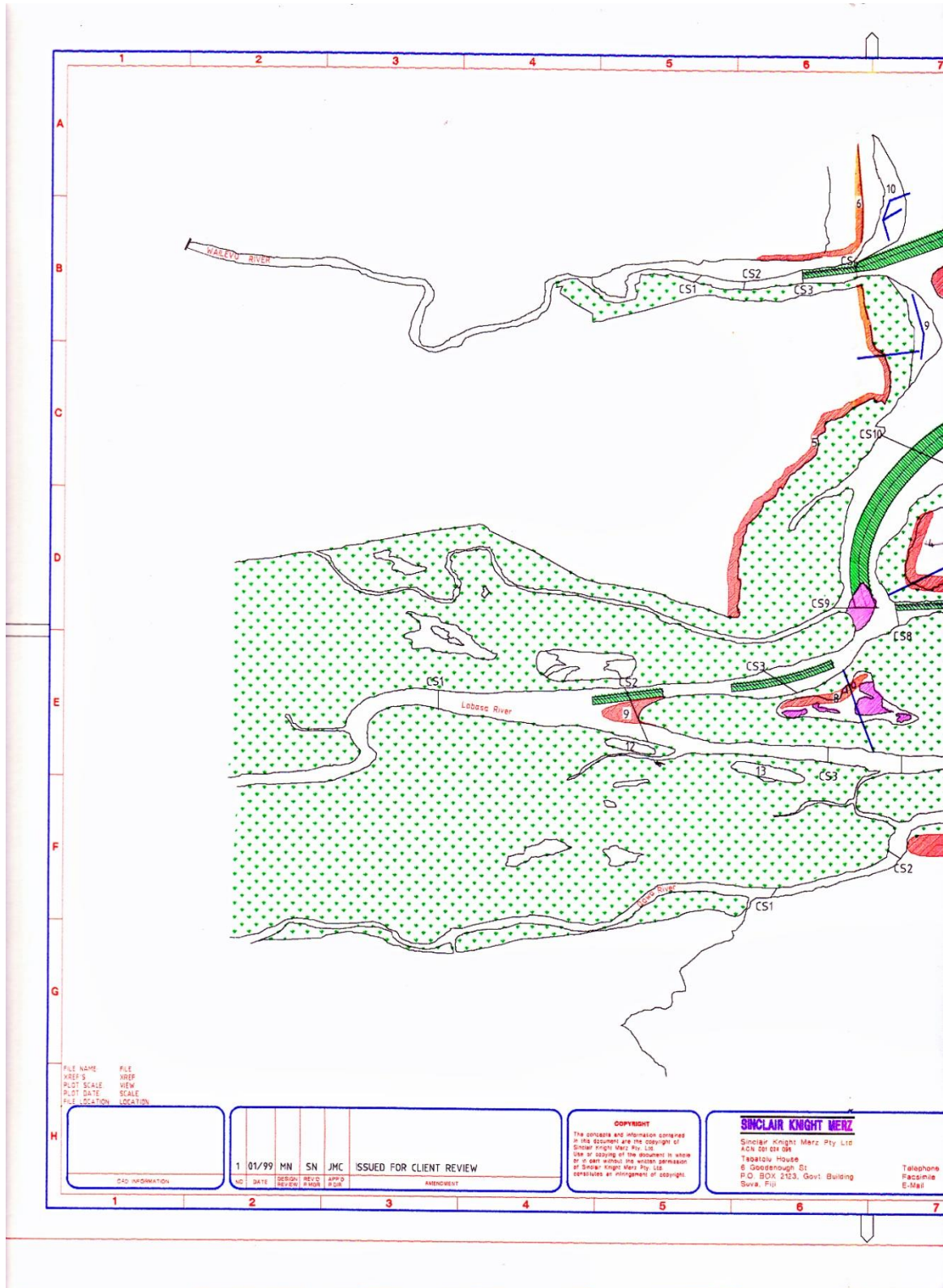


Figure (1 of 2) from SKM 1999 EIA of the Qawa, Labasa and Wailevu Rivers, Dredging Project – disposal sites for dredge illustrated in red – all avoid mangroves

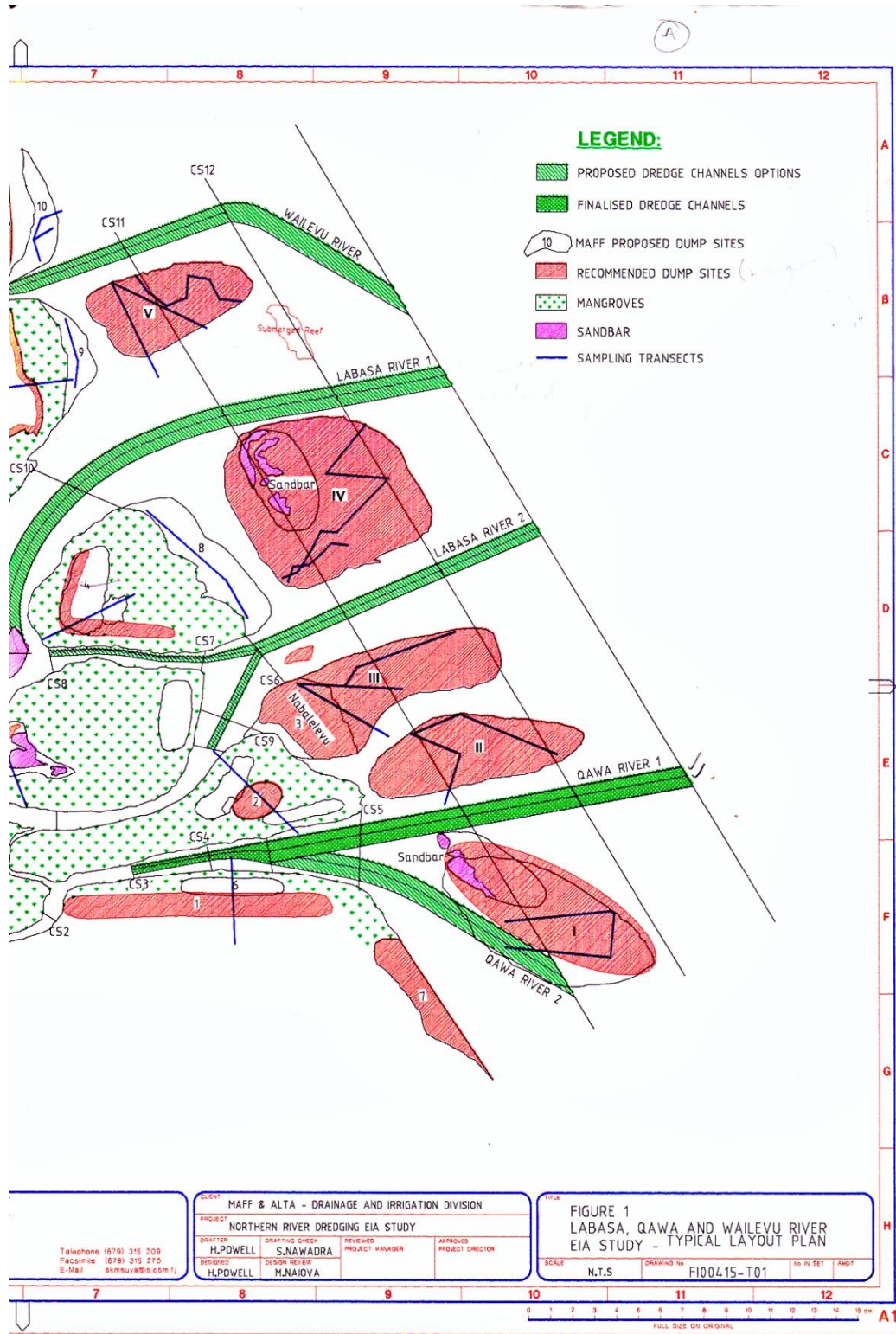


Figure (2 of 2) from SKM 1999 EIA of the Qawa, Labasa and Wailevu Rivers, Dredging Project – disposal sites for dredge illustrated in red – all avoid mangroves

REWA DELTA IMAGERY DATE 12 SEPTEMBER 2011 (GOOGLE EARTH) ILLUSTRATING EXTENT OF MANGROVE MORTALITY DUE TO DREDGE DISPOSAL



Draft Final