

**THE REPUBLIC OF FIJI
MINISTRY OF AGRICULTURE, RURAL AND
MARITIME DEVELOPMENT AND NATIONAL
DISASTER MANAGEMENT**

**THE PROJECT FOR
THE PLANNING OF
THE NADI RIVER FLOOD CONTROL
STRUCTURES**

**VOLUME II MAIN REPORT
PART I : MASTER PLAN STUDY**

JULY 2016

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

**YACHIYO ENGINEERING CO., LTD.
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THE REPUBLIC OF FIJI
THE PROJECT FOR THE PLANNING OF
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COMPOSITION OF FINAL REPORT

VOLUME I SUMMARY

VOLUME II MAIN REPORT

Part I MASTER PLAN STUDY

Part II FEASIBILITY STUDY

VOLUME I III DATA BOOK

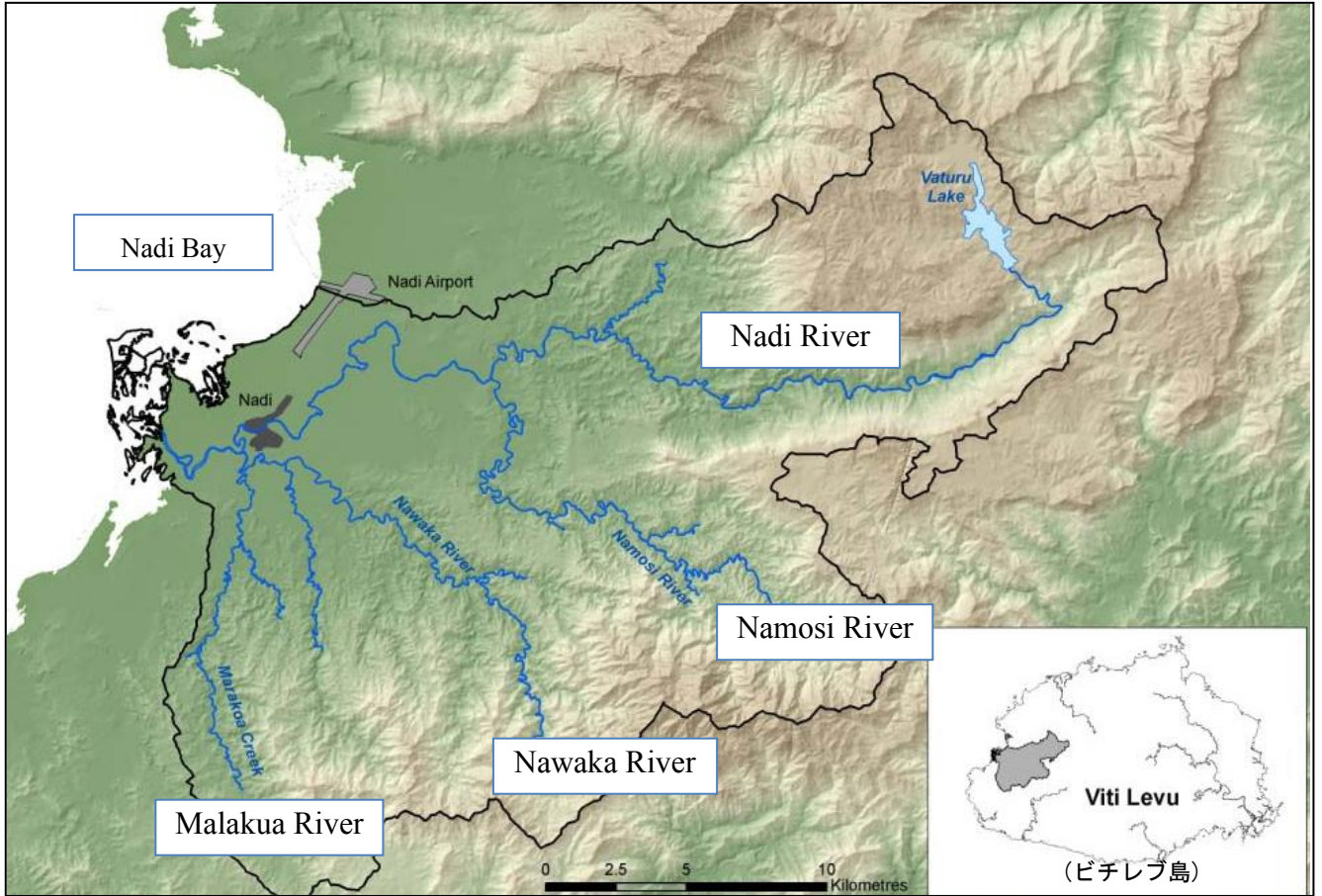
Part I DATA BOOK (1)

Part II DATA BOOK (2)

Exchange Rate: FJD 1 = JPY 54.5, 1 USD=FJD 2.17

(As of April, 2016)

<Map of Project Area>



(出典) Integrated Water Resource Management Demonstration Project

Photo



Photo-1 Inception Report Meeting

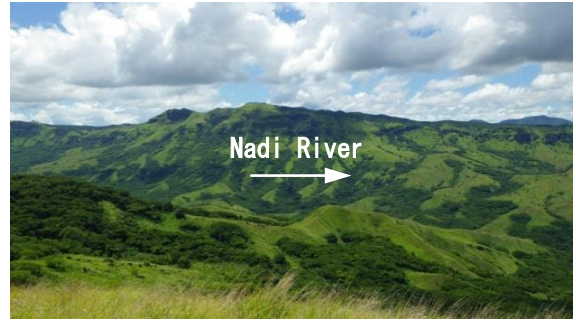


Photo-2 Nadi River Basin (Upstream)

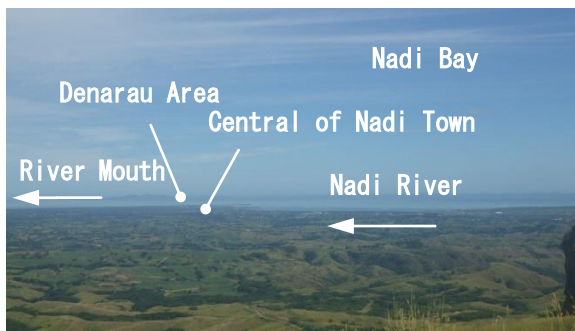


Photo-3 Nadi River Basin (Panoramic view)



Photo-4 Nadi River (River Mouth)



Photo-5 Central of Nadi Town



Photo-6 Nadi River (Middle Stream)



Photo-7 Nadi River (Upstream)



Photo-8 Vaturu Dam (Nadi River Upstream)



Photo-9 Nadi River (Nadi Town Bridge)



Photo-10 Nadi River (Nadi Town Bridge) during Flood



Photo-11 Nadi River (Old Queens Road Bridge)



Photo-12 Nadi River (Old Queens Road Bridge) during Flood



Photo-13 Nawaka River



Photo-14 Retention Dam (Nawaka River)



Photo-15 Counterpart Training in Japan



Photo-16 Seminar in Fiji

Executive Summary of Flood Control Master Plan and Priority Project in Nadi River Basin

1. Master Plan

【Basic Concept of Master Plan】

- In the Master Plan, based on the flood and river basin characteristics as well as properties in the upstream, midstream and downstream of the Nadi River, taking into account measures in an entire basin, comprehensive flood control plan consisting of dam, river improvement, retarding basins and ring dikes are proposed.
- Taking into account a long term and the large budget to complete the structural measures, and also taking into account the risk due to flood exceeding design scale, perfect protection measures for flood inundation are not feasible. Therefore, structural measures and non-structural measures such are proposed in the Master Plan..
- In the formulation of the Master Plan, it is an important to clarify priority protected areas from the view point of clarification on the contents of flood control plan and addressing a road map for the integration of short, middle and long term flood control plan. Therefore, Important Protected Area is set and it is prioritized to be mitigated from damage by flood.
- The Master Plan is formulated considering Environmental and Social Considerations and Social Acceptance for flood control

【Target Area of Master Plan】

Target area of Master Plan is Nadi River Basin with catchment area of 516 km².

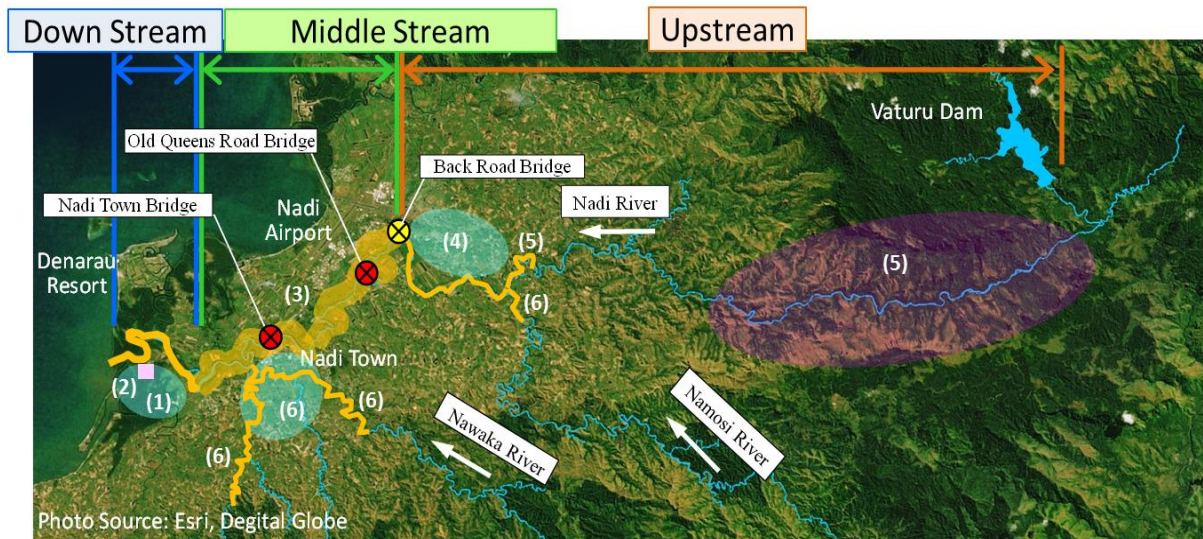
【Target Scale of Master Plan】

Design flood scale for Master Plan is set as 1/50 with regard to previous maximum flood event occurred in March 2012.

【Components of Master Plan】

(1) Structural Measures

Structural Measures as shown in Figure1 and Table1 are proposed in order to mitigate flood damage by targeted flood in Nadi River Basin.



(1)	Retarding Basin in downstream incl. surrounding dike of retarding basin in downstream
	River Improvement in downstream
(2)	Ring Dike
(3)	River Widening incl. Rebuilding of 2(two) bridges
(4)	Retarding Basin A,B in upstream
(5)	Dam
	River improvement in upstream
(6)	Retarding Basins in Tributaries incl. surrounding dike
	River Improvement in Tributaries incl. Rebuilding of 4(four) bridges

Figure 1 Components of Master Plan (Structural Measures)

Table 1 Components of Master Plan (Structural Measures)

	River, Location		Component of the Master Plan		Quantities	Remarks
Structural Measures	1. Nadi River	Downstream	(1)	Retarding Basin and River Improvement in downstream	A=725 ha V=9,715 千m3	—
			(2)	Ring Dike	L=1.8 km	—
		Middlestream	(3)	River Widening ²⁾	L=13 km	Including rebuilding of 2 (two) bridges
			(4)	Retarding Basin A	A=35 ha V=795 千m3	—
			Retarding Basin B	A=178 ha V=6,920 千m3		
		Upstream	(5)	Dam and River improvement in upstream	1	—
2. Tributaries	Nawaka Maralua Namosi River	(6)	River Improvement	L=21 km	Including rebuilding of 4 (four) bridges in tributaries	
			Retarding Basins (13 sites)	A=340 ha V=11,600 千m3		

(2) Non-Structural Measures

Non-Structural Measures as shown in Table2 are proposed in order to corroborate and complement structural measures and mitigate damage by targeted flood.

Table 2 Components of Master Plan (Non-Structural Measures)

	Effect of Measure (Large Classification)	Major components
Non-Structural Measures	(1) Understanding disaster risk and risk avoidance	1-1) Strengthening of understanding flood risk with flood hazard map 1-2) Strengthening flood forecasting technology
	(2) Enhancing disaster preparedness for effective response	2-1) Strengthening disaster management system
	(3) Disaster risk management, risk avoidance	3-1) Technical assistant for land-use regulation 3-2) Strengthening river basin management
	(4) Economic disaster risk management	4-1) Strengthening economic disaster risk management by regional BCP
	(5) Evaluation and feedback	5-1) Establishing a system of evaluation of Pre-disaster activity / existing measures and feedback

【Implementation Schedule of Master Plan】

Proposed entire implementation schedule of the Master Plan projects is shown in Table3. Target implementation period of Master Plan is proposed as 30 years from the project commencement.

Table 3 Components of Master Plan and Implementation Schedule (Proposed)

Work Item	20XX-20XX				20XX-20XX																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Study on M/P																															
Detailed Design																															
I. Structural Measures																															
I-A. Priority Project (Short Term Measures)																															
1 River channel widening works in midstream section																															
1) River channel widening works in midstream section, L=13km																															
2 Retarding basin works in upstream section																															
1) Retarding basin (A) works in right bank side in Nadi River, A=35ha																															
2) Retarding basin (B) works in left bank side in Nadi River, A=178ha																															
3 Ring dike																															
1) Ring dike, L=1.8km																															
4 Shortcut in tributaries / Surrounding dike works in Nadi River																															
1) Shortcut in tributaries, A=0.5km																															
2) Surrounding dike, L=4.5km																															
I-B. Middle Term Measures																															
1 Retarding Basin in downstream section (A=km2)																															
1) Retarding Basin in downstream section, A=725ha																															
2 River improvement in tributaries																															
1) Nawaka River, L=8.5km																															
2) Malakua River, L=8.5km																															
3) Namosi River, L=4.0km																															
I-C. Long Term Measures																															
1 Dam construction in upstream in Nadi River (H= m)																															
1) Dam construction in upstream in Nadi River																															
II. Non-structural Measures																															
1 Understanding disaster risk and risk avoidance																															
1-1) Strengthening of understanding flood risk with flood hazard map																															
1-2) Strengthening flood forecasting technology																															
2 Enhancing disaster preparedness for effective response																															
2-1) Strengthening disaster management system																															
2-2) Strengthening emergency assistance system																															
3 Disaster risk management, risk avoidance																															
3-1) Land use regulations																															
3-2) Strengthening river basin management																															
4 Economic disaster risk management																															
4-1) Strengthening economic disaster risk management by regional BCP																															
5 Establishing a system of evaluation of Pre-disaster activity / existing measures and feedback																															
5-1) Establishing a system of evaluation of Pre-disaster activity / existing measures and feedback																															

Note: *including loan agreement, EIA, land acquisition, procurement of consultant (D/D, C/S), detailed design, preparation of PQ and tender document and so on.

2. Priority Project

【Basic Concept for selection of Priority Project】

- Taking into account a long term and the large budget to complete the structural measures, and also taking into account the risk due to flood exceeding design scale, perfect protection measures for flood inundation are not feasible. Therefore, Priority Project is selected in order to protect important area and mitigate flood damage.
- Regarding structural measures of Priority Project, components which mitigate flood damage in Important Protected Area is selected after setting Important Protected Area.
- Regarding non-structural measures of Priority Project, protection of human lives, understanding of disaster risks and evacuation are considered as a top priority. Based on this concept, components for understanding of disaster risks and evacuation are selected as Priority Project.

【Components of Priority Project】

(1) Structural Measures

Structural Measures as shown in Figure 3 and Table 4 are proposed in order to mitigate flood damage in Important Protected Area (Figure 2).

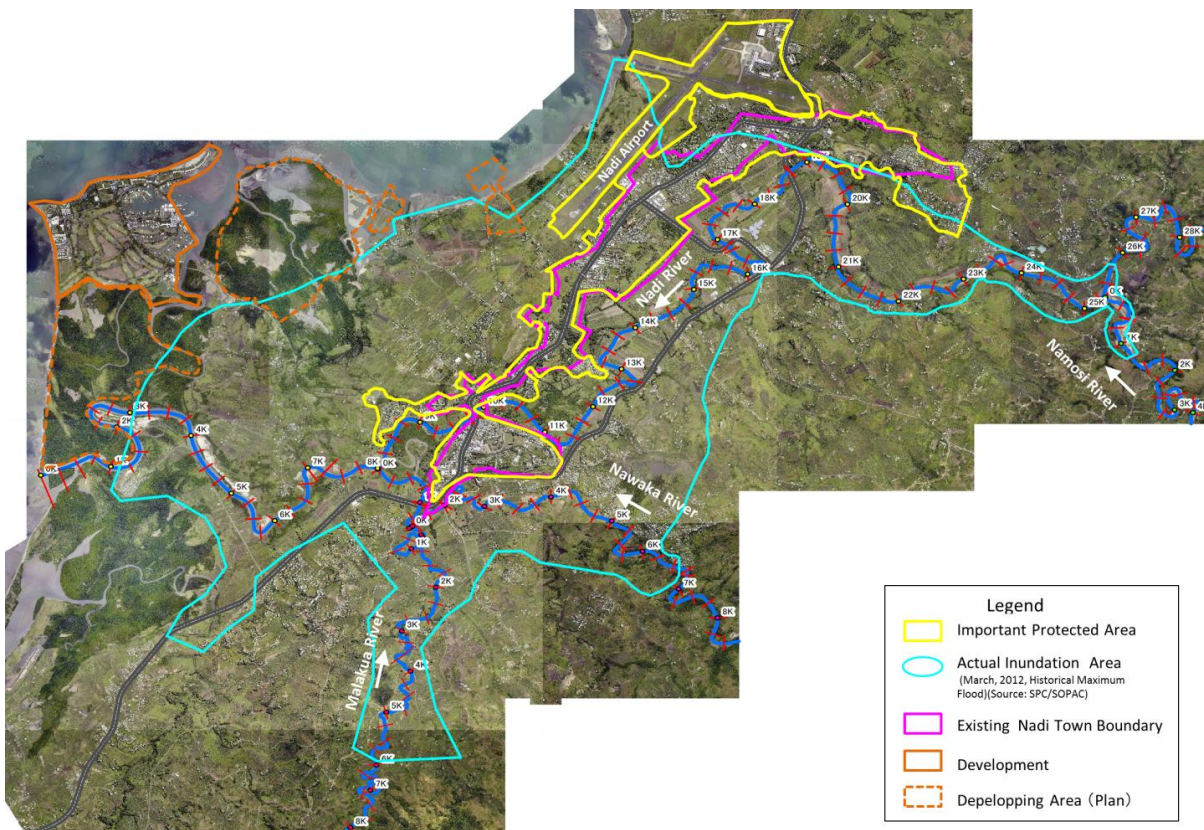


Figure 2 Important Protected Area

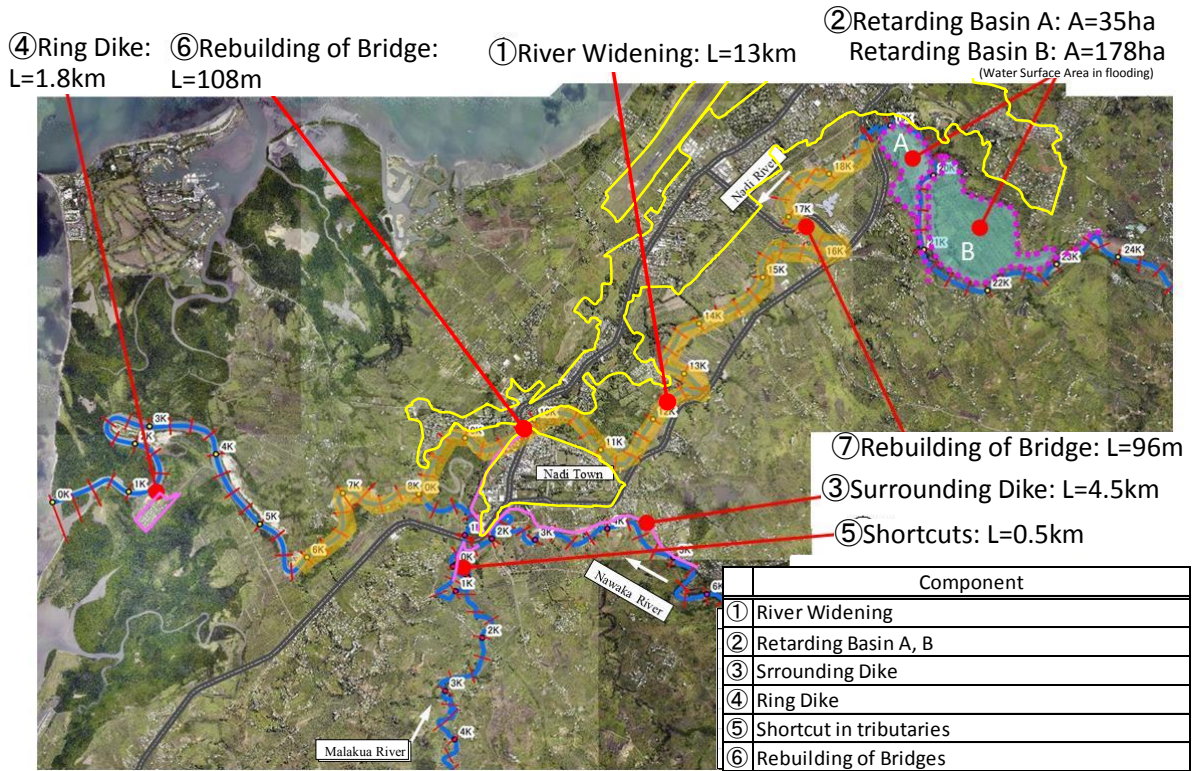


Figure 3 Components of Priority Project (Structural Measures)

Table 4 Components of Priority Project (Structural Measures)

	River, Location		Component of the Master Plan	Component of the Priority Project		Remarks
				Main Component	Quantities	
Structural Measures	1. Nadi River	Downstream	(1) Retarding Basin and River Improvement in downstream	—	—	—
			(2) Ring Dike	④ Ring Dike	L=1.8 km	—
		Middlestream	(3) River Widening ²⁾	① River Widening Rebuilding of Nadi Town Bridge Rebuilding of Old Queens Road Bridge	L=13 km L=108 m L= 96 m	—
			(4) Retarding Basin A	② Retarding Basin A	A=35 ha V=795 千m ³	—
			Retarding Basin B	② Retarding Basin B	A=178 ha V=6,920 千m ³	
	Upstream	(5) Dam and River improvement in upstream	—	—	—	
2. Tributaries	Nawaka Marakua Namosi River	(6) River Improvement	⑤ Shortcut of Tributaries ③-2 Surrounding Dike of Nadi Town	L=0.5 km L=4.5 km	Shortcut and Surrounding dike in tributaries are preceded to construction as part of the master plan	

(2) Non-Structural Measures

Protection of human lives, understanding of disaster risks and evacuation are considered as a top priority, under condition that the progress of structural measures project will be at initial phase. Therefore, activities accompanied with development and disclosure of hazard maps and development of hydrological devices for awareness of flood risks are proposed as Priority project. In addition, in order to evaluate the effect of non-structural measures in the past or priority projects, and in order to connect to “Better disaster prevention”, evaluation and feedback system on the past projects is also proposed as Priority Project.

Table 5 Components of Priority Project (Non-Structural Measures)

	Category	Measures
Non-structural Measures	Understanding disaster risk and risk avoidance	<ul style="list-style-type: none">• Strengthening of understanding flood risk with flood hazard map• Strengthening flood forecasting technology, such as expansion of rainfall gauge, water level gauge and introduction of real-time monitoring camera
	Better Disaster Prevention	<ul style="list-style-type: none">• Establishing a system of evaluation of Pre-disaster activity / existing measures and feedback

【Selection of Implementation Project】

Integrated flood control facilities considering whole river basin have not been installed yet in spite of effectiveness of structural measures and implementation of structural measures such as dam, retarding basin, and river are required urgently. Therefore, structural measures of Priority Project are selected as Implementation Project.

【Objective of Implementation Project】

Objective of Implementation Project is to improve of vulnerability to flood in Nadi River Basin, mitigate flood damage specially in Important Protected Area and contribute to improve living environment of residents by developing flood control facilities such as river widening and retarding basin in Nadi River Basin, which has been damaged by severe flood.

【Components of Implementation Project】

Components of Implementation Project is as shown in Figure 4 and Table 6, which are as same as structural measures of Priority Project.

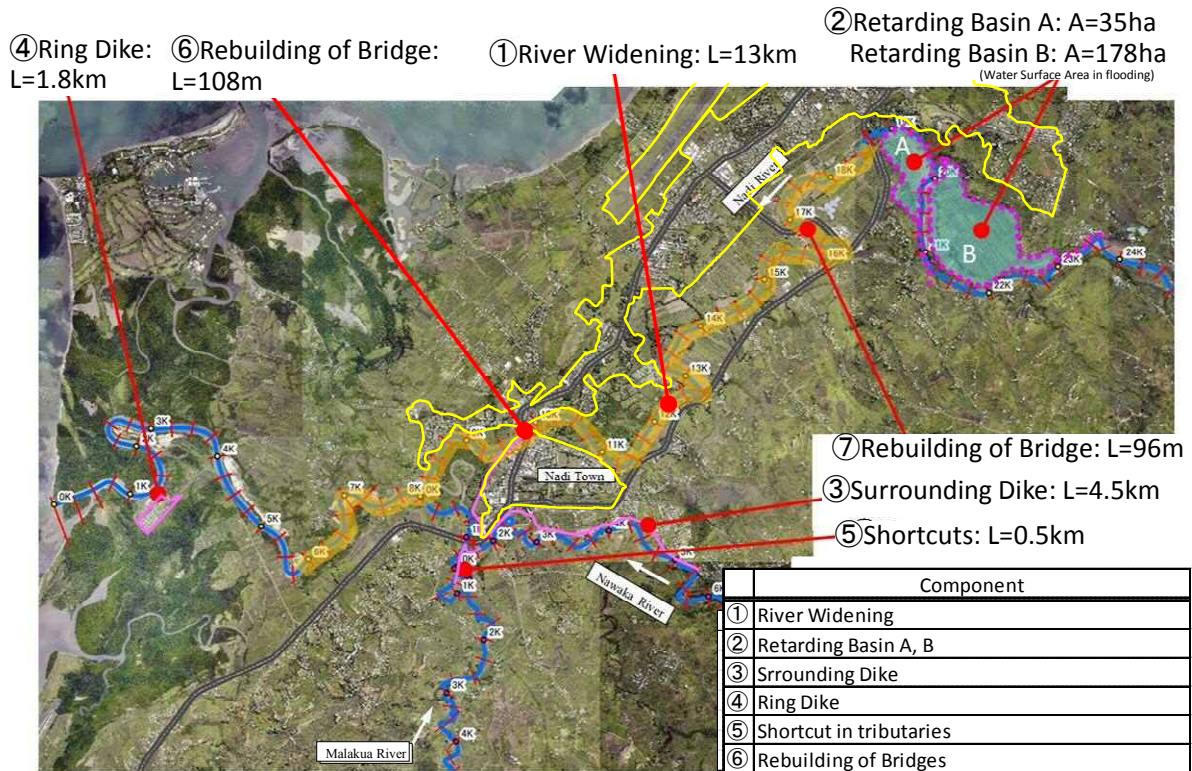


Figure 4 Components of Implementation Project (Structural Measures)

Table 6 Components of Implementation Project (Structural Measures)

	River, Location		Component of the Master Plan	Component of the Priority Project		Remarks
				Main Component	Quantities	
Structural Measures	1. Nadi River	Downstream	(1) Retarding Basin and River Improvement in downstream	—	—	—
			(2) Ring Dike	④ Ring Dike	L=1.8 km	—
		Middlestream	(3) River Widening ²⁾	① River Widening Rebuilding of Nadi Town Bridge Rebuilding of Old Queens Road Bridge	L=13 km L=108 m L= 96 m	—
			(4) Retarding Basin A	② Retarding Basin A	A=35 ha V=795 千m ³	—
		Retarding Basin B	② Retarding Basin B	A=178 ha V=6,920 千m ³		
	Upstream	(5) Dam and River improvement in upstream	—	—	—	
2. Tributaries	Nawaka Marahua Namosi River	(6) River Improvement	⑤ Shortcut of Tributaries ③-2 Surrounding Dike of Nadi Town	L=0.5 km L=4.5 km	Shortcut and Surrounding dike in tributaries are preceded to construction as part of the master plan	
		Retarding Basins (13 sites)	—	—	—	

【Implementation Schedule of Implementation Project】

Implementation Schedule of Implementation Project is as shown in Table 8.

【Implementation Project】

Implementation Project Cost is as shown in Table 9.

【Economic Feasibility of Implementation Project】

Total cost of the priority project is JPY21.0 billion (F\$385million) and the average annual benefit is JPY 1.88billion (F\$34.5million). These figures lead to EIRR 12.0%, B/C=1.2 and NPV JPY1.8billion (F\$33million) respectively. This economic valuation is beyond the target investment rate of 10% in Fiji and show the adequate economic effect.

Table 7 Result of Economic Evaluation

Economic indicator	Result	Evaluation
Economic internal rate of return (EIRR)	12.0%	Since EIRR is well over 10% which is applied to the development assistance project in Fiji, the economic effectiveness is high.
Benefit-cost (B/C) ratio	1.20	Since the B/C ratio is over 1.0, the cost-effectiveness is high.
Net present value (NPV)	JPY 1.8 billion (FJD33 million)	Since the value is plus, the cost-effectiveness is high.

Source: JICA study team

【Conclusion and Recommendation】

Implementation Project proposed as one of the Priority Project is evaluate appropriate since it could mitigate severe flood damage and it is feasible technically, economically, socially and environmentally. Therefore, next steps such as securing budget and request for technical assistance as follows are recommended to be conducted by Fiji Government as soon.

- (1) Implementation of the Priority Project and establishment of Implementation Structure
- (2) Formulation consensus of Government and residents for the Implementation
- (3) Commencement of loan procedure for project fund
- (4) Commencement of negotiation for land acquisition and compensation
- (5) Commencement of consultant procurement and environmental monitoring
- (6) Establishment of legislation of flood control
- (7) Preparation and consolidation of organization responsible for flood control and capacity building
- (8) Preparation of criteria and standard
- (9) Permanent securement of maintenance budget for flood control

Table 9 Project Cost of Implementation Project

(FC&Total: Million JPY, LC: Million FJD)

Item	Total			
	FC	LC	Total	
	million (Yen)	million (F\$)	million (Yen)	million (F\$)
A. ELIGIBLE PORTION				
I) Procurement / Construction	6,778	134	14,074	258
Package 1 River Widening, Rebuilding of Bridge	4,213	77	8,432	155
Package 2 Retarding Basin	1,281	19	2,299	42
Package 3 Ring Dike	40	1	76	1
Package 4 Surrounding Dike	392	5	657	12
Base cost for JICA financing	5,926	102	11,464	210
Price escalation	529	26	1,940	36
Physical contingency	323	6	670	12
II) Consulting services	933	18	1,893	35
Base cost	828	14	1,579	29
Price escalation	60	3	223	4
Physical contingency	44	1	90	2
Total (I + II)	7,711	151	15,967	293
B. NON ELIGIBLE PORTION				
a Procurement / Construction	0	0	0	0
Base cost for JICA financing	0	0	0	0
Price escalation	0	0	0	0
Physical contingency	0	0	0	0
b Land Acquisition	0	38	2,093	38
Base cost	0	34	1,845	34
Price escalation	0	3	148	3
Physical contingency	0	2	100	2
c Administration cost	0	17	903	17
d VAT	0	30	1,625	30
e Import Tax	0	0	0	0
Total (a+b+c+d+e)	0	85	4,621	85
TOTAL (A+B)	7,711	236	20,588	378
C. Interest during Construction				
Interest during Construction(Const.)	351	0	351	6
Interest during Construction (Consul.)	1	0	1	0
D. Front End Fee				
Front End Fee	32	0	32	1
GRAND TOTAL (A+B+C+D)	8,094	236	20,971	385
E. JICA finance portion (A)				
JICA finance portion (A)	7,711	151	15,967	293

US\$1=2.17 F\$, 1F\$= JPY 54.5

Abbreviation

ADB	Asian Development Bank	アジア開発銀行
ADRA	Adventist Development and Relief Agency	アドベンチスト開発救助機関
AusAID	Australian Agency for International Development	オーストラリア国際開発庁
BCP	Business Continuity Plan	事業継続計画
BOM	Bureau Of Meteorology	オーストラリア気象局
CBD	Convention on Biological Diversity	生物多様性条約
CCA	Climate Change Adaptation	気候変動適応
CCL	Climate Change Loan	気候変動対策円借款
CCM	Climate Change Mitigation	気候変動緩和
CHARM	Comprehensive Hazard And Risk Management	統合的ハザード・リスク管理
C/P	Counterpart	カウンターパート
CRED	Centre for the Research on the Epidemiology of Disaster	災害の疫学に関する研究センター
CWO	Commissioner Western Office	西部地域長官室
DEM	Digital Elevation Model	デジタル標高モデル
DF/R	Draft Final Report	ドラフトファイナルレポート
DIS	Drainage & Irrigation Section	排水・灌漑部門
DISMAC	Disaster Management Centre	災害管理センター
DMP	Disaster Management Plan	防災計画書
DOE	Department of Environment	環境局
DOFi	Department of Fishery	漁業局
DOF0	Department of Forest	森林局
DOL	Department of Lands	土地局
DO-N / DO	District Nadi Office / District Office	ナンディ地区事務所 / 地区事務所
DOW	Department of Works	公共事業局
DRCC	Disaster Ready Community Committee	災害自立型コミュニティ委員会
DRR	Disaster Risk Reduction	災害リスク軽減
DRRDM	Disaster Risk Reduction & Disaster Management	災害リスク軽減・災害管理
DTCP	Department of Town & Country Planning	都市 / 地方計画局
EDF	European Development Fund	ヨーロッパ開発基金
EIA	Environmental Impact Assessment	環境影響評価
EiE	Education in Emergencies	緊急時の教育
EOC	Emergency Operation Center	緊急対策室
EPGA	Environmental Programme Grant Aids	環境プログラム無償資金協力
EU	European Union	欧州連合
EWS	Early Warning System	早期警報システム
FBS	Fiji Bureau of Statistics	フィジー統計局
FMS	Fiji Meteorological Service	フィジー気象局
F/R	Final Report	ファイナルレポート

FRA	Fiji Road Authority	フィジー道路公社
F/S	Feasibility Study	フィジビリティ調査
FSC	Fiji Sugar Corporation	フィジー砂糖会社
GDP	Gross National Product	国民総生産
GEF	Global Environmental Facility	地球環境ファシリティ
GGP	Grant Assistance for Grassroots Human Security Projects	草根の無償／草の根・人間の安全保障 無償資金協力
GIS	Geographical Information System	地理情報システム
GNI	Gross National Income	国民総所得
HFA	Hyogo Framework for Action	兵庫行動枠組み
IC/R	Inception Report	インセプションレポート
IDA	Initial Damage Assessment	初期損害評価
IDD	Irrigation & Drainage Division	灌漑・排水部門
IDM	Introduction of Disaster Management	災害管理の導入
IEE	Initial Environmental Examination	初期環境調査
IRC	International Red Cross	国際赤十字
IT/R	Interim Report	インテリムレポート
IWRM	Integrated Water Resource Management	統合水資源管理
JCC	Joint Coordination Committee	合同調整委員会
JICA	Japan International Cooperation Agency	独立行政法人 国際協力機構
KP	Kyoto Protocol	京都議定書
LRPD	Department of Land Resource Planning & Development	土地資源計画・開発局
LWRM	Land & Water Resource Management	土地水資源管理部
MDGs	Millennium Development Goals	ミレニアム開発目標
MFA&IC	Ministry of Foreign Affairs & International Co-operation	外務・国際協力省
MFSPNDS	Ministry of Finance Strategic Planning, National Development & Statistics	財務戦略計画・国家開発・統計省
MLGUDHE	Ministry of Local Government, Urban Development, Housing & Environment	地方行政・都市開発・住宅・環境省
MLMR	Ministry of Lands & Mineral Resources	土地鉱物資源省
M/M	Minutes of Meeting	会議議事録
MOA	Ministry of Agriculture	農業省
MOU	Memorandum Of Understanding	覚書
M/P	Master Plan	基本計画
MP Radar	Multi Parameter Radar	マルチパラメータ気象レーダ
MRMSNDM	Ministry of Rural & Maritime Safety & National Disaster Management	地域・海上保安・国家災害管理省
MTCP	Ministry of Town and Country Planning	都市計画省
MWTPU	Ministry of Works, Transport & Public Utilities	公共事業・運輸・公益事業省
NBCC	Nadi Basin Catchment Committee	ナンディ流域委員会
NCCP	National Climate Change Policy	国家気候変動政策
NDMC	National Disaster Management Council	国家災害管理評議会

NDMO	National Disaster Management Office	国家災害管理室
NEOC	National Emergency Operation Centre	国家緊急オペレーション・センター
NIWA	The National Institute of Water and Atmospheric Research	水・大気研究国立機関
NTC	Nadi Town Council	ナンディ町議会
NZAID	New Zealand Agency for International Development	ニュージーランド国際開発庁
O&M	Operation and Maintenance	運用維持管理
OCHA	Office for the Coordination of Humanitarian Affairs	国連人道問題調整事務所
ODA	Official Development Assistance	政府開発援助
OJT	On the Job Training	実地訓練
PCIDRR	The Pacific Community-focused Integrated Disaster Risk Reduction	大洋州コミュニティ統合的災害リスク削減
PDM	Project Design Matrix	プロジェクトデザインマトリックス
PDN	Pacific Disaster Net	大洋州災害ネット
PDRMP	Pacific Disaster Risk Management (Training) Programme	大洋州災害リスク管理(研修)プログラム
PDRMPN	Pacific Disaster Risk Management Partnership Network	大洋州災害リスク管理パートナーシップ・ネットワーク
PHT	The Pacific Humanitarian Team	大洋州人道チーム
PIFACC	Pacific Islands Framework for Action on Climate Change	大洋州気候変動行動枠組み
PMO	Prime Minister Office	首相府
PMU	Project Management Unit	プロジェクト・マネジメント・ユニット
P/R	Progress Report	プログレスレポート
PRMS	Planning & Resource Management Section	計画・資源管理部門
PRSP	Poverty Reduction Strategy Paper	貧困削減戦略文書
PWD	Public Works Division	公共事業部
RAP	Resettlement Action Plan	住民移転計画
R/D	Record of Discussion	討論議事録
RES	River Engineering Section	河川エンジニアリング部門
SOP	Standard Operation Procedure	標準作業手順書
SOPAC	South Pacific Applied Geoscience Commission	太平洋諸島応用科学委員会
SPC	Secretariat for the Pacific Community	太平洋コミュニティ事務局
SPCZ	South Pacific Convergence Zone	南太平洋収束帯
SPREP	South Pacific Regional Environment Programme	大洋州環境プログラム事務局
TC	Tropical Cyclone	熱帯性サイクロン
TLTB	iTauke Land Trust Board	イ・タウケイ土地信託委員会
ToT	Training of Trainers	指導員研修
UNCCD	United Nations Convention to Combat Desertification	国連砂漠化防止条約
UNDP	United Nations Development Programme	国連開発計画
UNESCAP	United Nations Economic & Social Commission for Asia & the Pacific	国連アジア太平洋経済社会委員会
UNFCCC	United Nations Framework Convention on Climate Change	国連気候変動枠組条約
UNICEF	United Nations International Children's Emergency Fund	国連国際児童緊急基金
UNISDR	United Nations International Strategy for Disaster	国連国際防災戦略

	Reduction	
UNOCHA	United Nations Office for Coordination of Humanitarian Affairs	国連人道問題支援室
USAID	United State Agency for International Development	米国国際開発庁
WAF	Water Authority of Fiji	フィジー水公社
WB	World Bank	世界銀行(世銀)
WMO	World Meteorological Organization	世界気象機関
WMS	Watershed Management Section	流域管理部門

**THE REPUBLIC OF FIJI
THE PROJECT FOR THE PLANNING OF
THE NADI RIVER FLOOD CONTROL STRUCTURES**

**FINAL REPORT
VOLUME II MAIN REPORT**

Part I: Master Plan Study

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Map of Project Area

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Part II: Feasibility Study

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Chapter 1 Introduction

1.1 Background and Necessity of the Project

The Republic of Fiji (hereinafter refer to as “Fiji”) plays a central role in the development and economy of the Pacific Ocean Island Nations Region, having headquarters of regional international organizations such as Secretariat of PIF (Pacific Ocean Islands Forum). Stable and sustainable development of Fiji is important for the Pacific Ocean region as a whole.

Nadi Town, which is located in the target river basin (the Nadi River Basin) of the Project, is the third largest city of Fiji. Nadi Town is the commercial and sightseeing center of Fiji, not only because of its traditional sugar industry but also because of its prospering tourist business. About 700 thousand tourists visit Fiji every year through mainly Nadi International Airport, the main gateway to Fiji. On the other hand, the Nadi River Basin is vulnerable to flood disaster. Extensive flood damage has occurred in recent years (January 2009, and March and January 2012). However, systematic and comprehensive flood control planning and/or flood control projects have not been formulated yet, and the Nadi River Basin is facing a natural disaster risk.

Therefore, formulation of flood control master plan for the Nadi River Basin and implementation of flood control project(s) are urgently required, and they are expected to have a very large impact in the near future. Furthermore, the effectiveness of the master plan will contribute to other basin of Fiji and to the development of the Pacific region as a whole.

Considering the above conditions, JICA is dealing with strengthening of disaster prevention of the Pacific region, as disaster prevention program(s) and climate change adaptation program(s), through (1) Capacity Development of Disaster Management of the Government of Fiji (hereinafter referred as “GOF”); (2) Strengthening of Disaster Response Capacity of the Community”; and (3) Strengthening of Capacity of the Climate Observation and Weather Forecasting”. JICA implemented the development survey, “The Study on Watershed Management and Flood Control for the Four Major Viti Levu Rivers in the Republic of Fiji Islands” in 1996 to 1998. Nevertheless, no actual measures had been taken. In addition, together with the economic development of the target area, land utilization and asset situation have greatly changed in the last 16 years. The targeted flood and the expected amount of rainfall and its spatial distribution have also changed drastically. Other challenges such as improvement of hydraulic analysis, comprehensive sediment management, impact on coastal environment, capacity development of related organization and so on were also confirmed in the detailed planning survey conducted by JICA in 2014. In this study, considering the background and initiatives conducted by JICA so far, the results of the development survey will be reviewed without prejudice and with the latest technology and knowledge.



Figure 1-1 Basic Concepts of the Project

Considering the issues of Nadi River Basin, the whole perspective of the Project and the contents of technical specifications of the Project, 3 basic concepts of the Project implementation are proposed as follows: (1) **Formulation of Resilient Flood Control Plan**, (2) **Capacity Building leading to Improvement of Capability on Disaster Management**, and (3) **Introducing Japanese Technology, Experiences and Knowledge to Fiji**. Then, by reducing the flood damage of the Nadi River Basin and creating a virtuous cycle of social, environmental and economic condition of Fiji, this project will contribute to the sustainable development of Fiji and the Pacific region.

1.2 Framework of the Project

The project is conducted based on Minutes of Meeting (M/M) and Record of Discussion (R/D) which were agreed and signed between MOA and JICA on February 7, 2014 and March 31, 2014 respectively. The outline of these documents is shown below.

1.2.1 Objectives of the Project

Goal of the Proposed Plan:

The Master Plan and the results of the Feasibility Study will be approved by GOF

Goal, which will be attained by utilizing the Proposed Plan:

Flood damages in Nadi Town will be mitigated

1.2.2 Outputs of the Project

The outputs of the Project are as follows:

- 1) The Master Plan of the flood management of the Nadi River Basin
- 2) The Feasibility Study on urgent and/or priority project(s)
- 3) Technical transfer to C/P through the Project

1.2.3 Activities

The activities of the Project during the three (3) stages and entire period of the project are as follows:

Stage-1: Basic Study

Stage-2: Master Plan Study

Stage-3: Feasibility Study

Entire Period: Technical Transfer

1.2.4 Target Area of the Project

The Nadi River Basin (approx. 516km² in catchment area) and its coastal area

1.2.5 Implementing Agency

Land and Water Resources Management Division (hereinafter refer to as “LWRM”), Ministry of Agriculture (hereinafter refer to as “MOA”)

1.3 Outline of the Study

1.3.1 Objective of the Study

The objective of the Study is to contribute to the mitigation of the flood damage in the Nadi River Basin with formulating a flood control master plan and implementing a feasibility study.

1.3.2 Implementation Schedule

From July 22 2014 to July 29 2016 (about 24 months)

1.3.3 Implementation Schedule and Flow

The entire implementation schedule and flow are shown as Figure 1-2 and Figure 1-3 respectively. The entire implementation schedule has been modified from the version on IC/R together with the progress of Stage-1 in March, 2015 and it is shown below.

Work Schedule of the Project for the Planning of Nadi River Flood Control Structures in the Republic of Fiji

		2014							2015							2016													
		7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7			
Work Stage	Stage1	Basic Study																											
	Stage2																												
	Stage3																												
Committee	Committee for the Progress of the Study	IC/R	1st JCC					1st TWG				2nd JCC	3rd JCC		2nd TWG	4th JCC				3rd TWG			5th JCC	6th JCC	Seminar				
	Committee for the Disclosure Process	□	▲					◇				▲	▲		◇		▲			◇			▲	▲	★				
Report	IC/R																												
	P/R																												
	IT/R																												
	DF/R																												
	F/R																												

(*)This TWG will be held if necessary after discussions about situation and necessity with MOA

- | | |
|------------------------------------|---------------------------|
| [Meetings] | [Report] |
| IC/R : Inception Report Meeting | PC : Public Consultation |
| JCC : Joint Coordination Committee | SM : Stakeholder Meeting |
| TWG : Technical Working Group | |
| | IC/R : Inception Report |
| | P/R : Progress Report |
| | IT/R : Interim Report |
| | DF/R : Draft Final Report |
| | F/R : Final Report |

Figure 1-2 Implementation Schedule

In addition, implementation items and each schedule are shown in Figure 1-4.

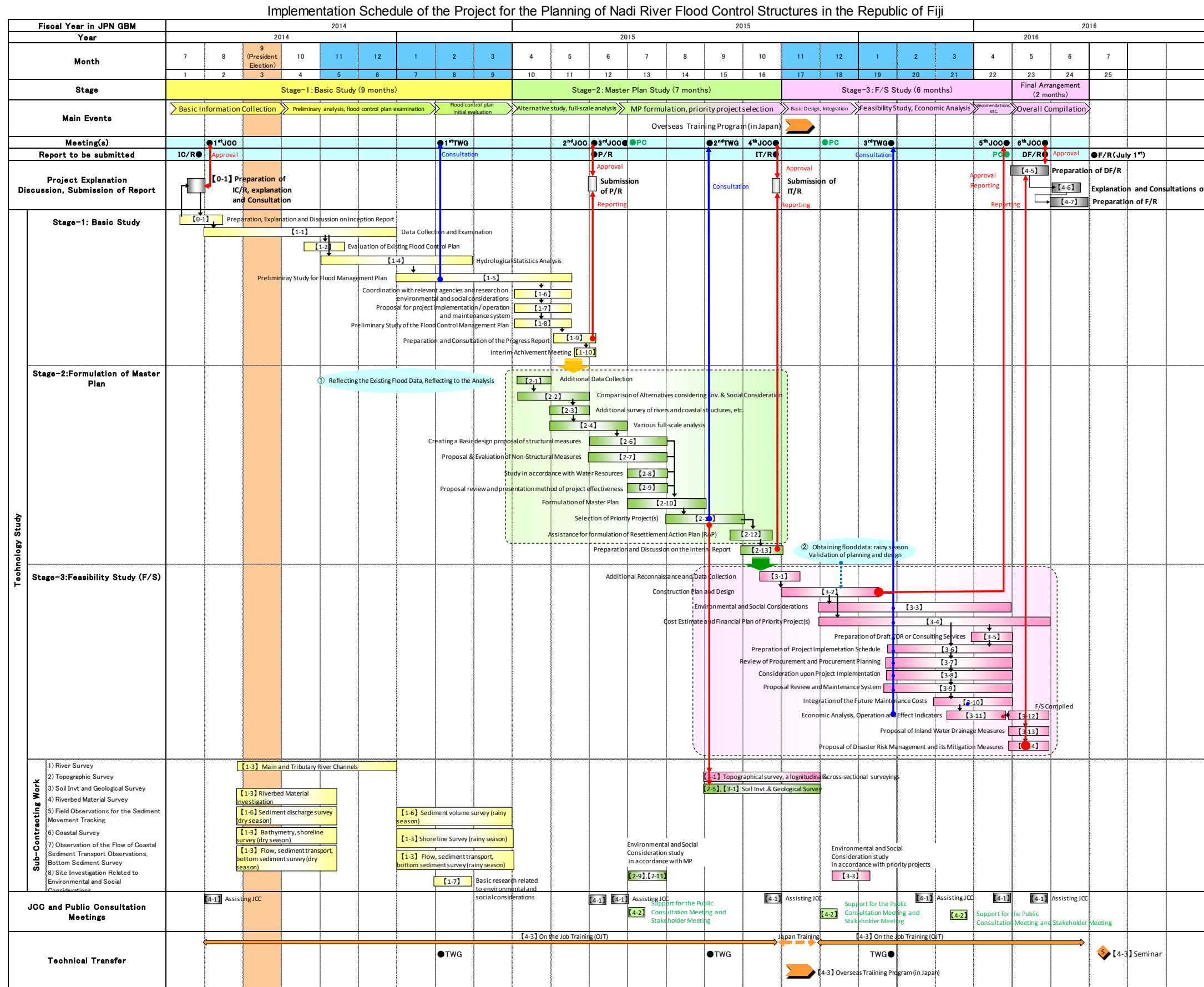


Figure 1-3 Implementation Flow

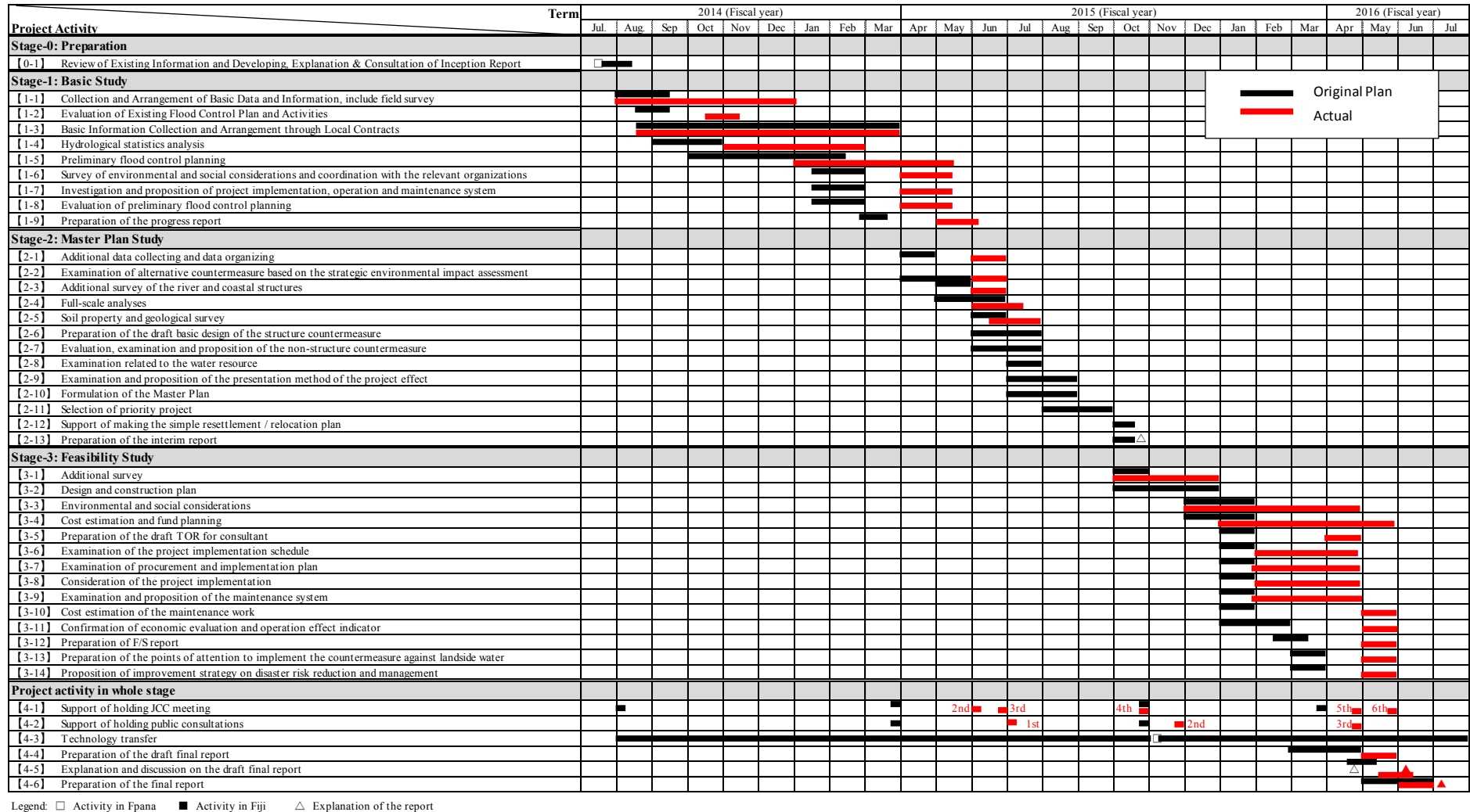


Figure 1-4 Implementation Items

1.3.4 Implementation Structure of the Study

The Implementation Structure of the Study is as shown in Figure 1-5. The Team is organized with core of project management group, and it will conduct the Study mainly based in Nadi and Suva. The Joint Coordination Committee (hereinafter referred to as "JCC") mentioned in R/D has been established in order to facilitate inter-organizational coordination, deliberate and make decisions on the project findings and results.

Technical Working Group (hereinafter referred to as "TWG") have been established in order to discuss the technical contents in detail for understanding of the technical issues.

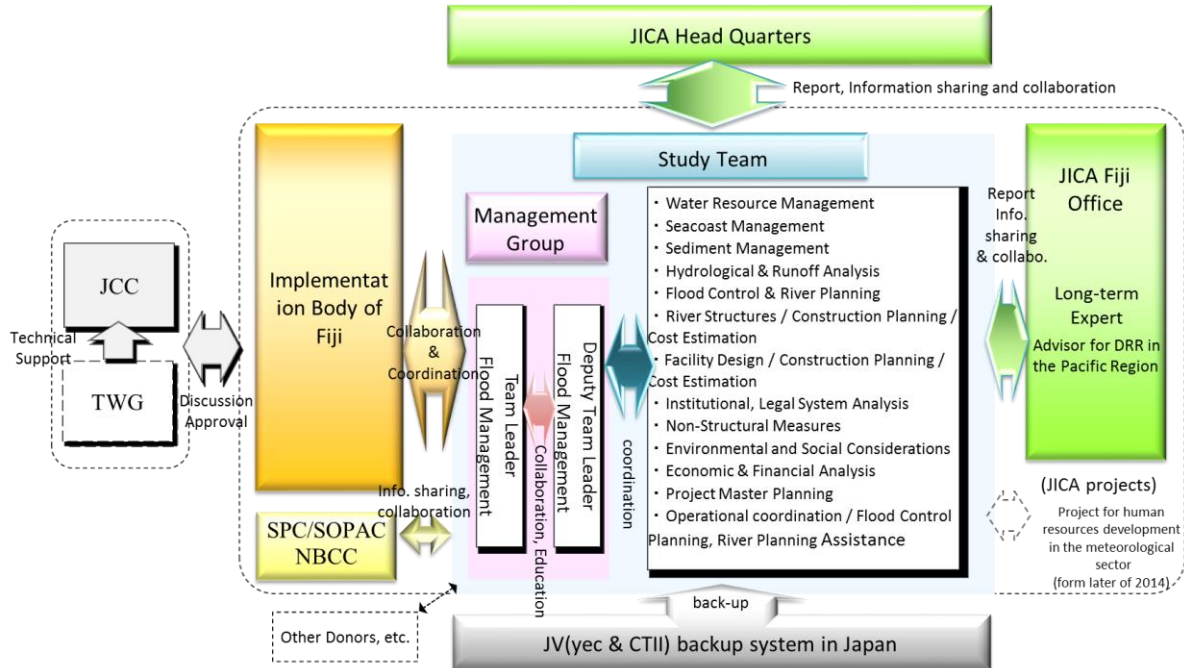


Figure 1-5 Implementation Structure

1.4 Main Activities of Stage-1

In Stage-1, for 11 months, the Team conducted the collection and analysis of basic information, sight inspection, surveys (through sub-contractors), initial examination of flood control measures, preparation and discussion of progress report, conferences, and technical transfer. The outline of each activity is described below.

1.4.1 Collection and Analysis of Basic Information

In Stage-1, the Team collected topography and survey data, hydro-meteorological data, information regarding historical flood damages, information regarding river and marine structures, natural, social and economic condition of the target area, upper level plan and flood control plan, institutional and legal situation and so on for the examinations. It took long time to collect the hydro-meteorological data but most of the data needed are collected. At the occasion of data collection from organizations, the Team held meetings to collect information.

Part of the documents such as past aerial photos, the details of Master Plan for drinking water by Water Authority of Fiji(WAF), design and construction standards, unit prices, construction project implementation and economic analysis, which needed in Stage-3(F/S Stage) are not in the hands of the Team. The Team will continue to collect such documents during Stage-2 (M/S Stage).

The results of collection and analysis of basic information are reported in Chapter 2.

1.4.2 Field Investigations

As the site investigation in Stage-1, the Team carried out the investigations of rivers, sediments and coasts.

In the rivers investigations, the Team conducted helicopter survey to see and take pictures of the Nadi River Basin. Also conducted the ground survey to grasp the characteristics of the basin, the Nadi River and its tributaries, inspect the river structures, confirm the hydraulic and run off analysis conditions, asses the possibility of flood control measures (structural measures), figure out the location of flow observation stations, etc.

In the sediments investigations, from the point of integrated sediment management, the Team conducted the ground inspections in rivers and coasts. Furthermore, the Team conducted the field inspection for identifying the locations to be surveyed by sub-contractors (River bed materials, Sediment transport and Discharge).

In the coasts investigation, the Team inspects the coastal areas to grasp the coastal topography, inspect the coastal structures and situation of coastal erosion. Furthermore, the Team conducted the field inspection for the locations for surveys by sub-contractors (Measurement of tidal current and sand drift and Sea bed materials).

The results of Field Investigations are reported in Chapter 3”Field Investigations”.

1.4.3 Surveys by Sub-Contractors

In Stage-1, the Team conducted the following surveys by sub-contractors.

(1) River Survey

Table 1-1 Quantities of Cross-Sections Survey and Longitudinal Leveling

River	Item	Quantities	Quantities in the TOR
Nadi River	Surveying range	28km	50km 250m and crossing structures
	No of cross-sections	more than 102	
	Survey interval	250m、 500m and crossing structures	
Namosi River	Surveying range	5km	50km 250m and crossing structures
	No of cross-sections	more than 17	
	Survey interval	250m、 500m and crossing structures	
Nawaka River	Surveying range	10km	50km 250m and crossing structures
	No of cross-sections	more than 37	
	Survey interval	250m、 500m and crossing structures	
Malakua River	Surveying range	7km	50km 250m and crossing structures
	No of cross-sections	more than 22	
	Survey interval	250m、 500m and crossing structures	

(2) River Bed Materials and Sediment Transport

Table 1-2 Quantities of River Bed Materials and Sediment Transport

Type	Items	Quantities	Quantities in the TOR
River Bed	Particle Size Distribution Analysis	13 sites	11sites
Materials	Surface gravel size survey	8 sites	
Sediment Transport	Water Sampling	7 sites	8sites
	Turbidity meter	2 sites	
	Discharge Measurement	4 sites	

(3) Coastal Survey, Measurement of tidal current and sand drift and Sea Bed materials

Table 1-3 Quantities of Coastal Survey

Area	Items	Quantities	Quantities in the TOR
Nadi river mouth coastal area	1)Bathymetric Survey		Along the coast 16km Along the coast 500m interval (250m interval for river mouth)
	Area of Survey	9.0km x 1.0km = 9.0km ²	
	Number of Sections	23 sections	
	Section interval	500m (in total 14 sections)	
		250m (in total 9 sections)	
	Length	1000m (14 sections)	
		2000m (9 sections)	
	2)Shoreline Survey		
	Area	9.0km	
South edge of survey	Sonaisali area		
North edge of survey	Denarau island		
Nadi Bay	1)Bathymetric Survey		
	Area of Survey	7.0km x 1.0km = 7.0km ²	
	Number of Sections	15 liens	
	Section interval	500m interval	
	2)Shoreline Survey		
	Area	7.0km	
	South edge of survey	Denarau marina	
	North edge of survey	Sabeto river mouth	

Table 1-4 Quantities of Measurement of Tidal Current and Sand Drift and Sea Bed Materials

Type	Area	Item	Quantities	Quantities in the TOR	
Measurement	Nadi river mouth coastal area	1)Wave	2 sites	Current and sand drift: 6 sites, Sea bed materials: 54 sites	
		2)Tidal Current	4 sites		
		3)Sand Drift	4 sites		
		4)Sea Bed Materials	General Sections		Measurement site 15sites Shore line 5 lines Shoreward: 3 sites
			River Mouth Sections		Measurement site 24sites Shore line 6 lines Shoreward: 3 - 5 sites
		5) River Mouth water level measurement	1 site		
			Nadi Bay		1)Wave
2)Tidal Current	2 sites				
3)Sand Drift	2 sites				
4)Sea Bed Materials	Measurement site 15sites Shore line 5 lines Shoreward: 3 sites				
2.Laboratory Tests			Sieve Test:8 samples Hydrometer:8 samples Gravity: 8 samples Moisture Content: 8 samples Ignition Loss: 8 samples LL/PL:8 samples	Modified from “Sieve Test 66 samples”, which is written on operational plan, to below: Sieve Test:8 samples Hydrometer:8 samples Gravity: 8 samples Moisture Content: 8 samples Ignition Loss: 8 samples LL/PL:8 samples	

(4) Survey for Environmental and Social Considerations

Table 1-5 Quantities of Environmental and Social Considerations Survey (Basic Study Stage, IEE level)

Survey items	Quantities	Quantities in the TOR
Legal and Institutional system of EIA	Lamp sum	Conduct if necessary
Items for Land Acquisition	Lamp sum	
Items for social Environment	Lamp sum	
Items for Natural Environment	Lamp sum	
Items for Pollutions	Lamp sum	

1.4.4 Preliminary examination of flood control measures

Details of primary examination of flood control measures are described in **Chapter 6** and **Chapter 7**.

1.4.5 Preparation and Discussion of Progress Report

The Team prepared the Progress Report with the results of Stage-1; also in response to the comments from JICA and JCC, the Team revised and finalized the Progress Report.

1.4.6 Technical Transfer in Stage-1

In the Study, discussions and opinion exchanges between the Team and C/P have been conducted through the daily surveys. At the time of the TWG, the Team and TWG members discussed on the technical issues for hydraulic analysis and examination of flood control measures intended to technical transfer from Japan side to Fiji side.

Furthermore, based on the request from the principal engineer of C/P, the Team performed the training on river discharge measurement for junior engineers of C/P. In addition, the Team and C/P performed joint field measurement.

1.5 Main Activities of Stage-2

In Stage-2, for 7 months, the Team conducted development and proposal of the Master plan and study on the contents of the Priority Project based on the basic information and the result of the initial examination of flood control measures, which were obtained from the activities of Stage-1. Moreover, preparation and discussion of the interim report, conferences, and technical transfer were conducted. The outline of each activity is described below.

1.5.1 Collection and Analysis of Additional Basic Information

In Stage-2, the Team collected additional information which is required for the study on the Master Plan and the F/S. Information regarding river and river basin condition, which are required for the detailed analysis and the selection of contents of the Master Plan and the Priority Project was collected through the field survey and so on. Moreover, information regarding environmental and social considerations; non-structural measures; design, cost estimation and construction of structural measures was collected. Procedures and issues for project implementation were also collected and examined aiming the implementation of F/S. Discussion with the C/P organizations was conducted along with data collection.

1.5.2 Detailed analyses

Run-off and inundation analysis, riverbed fluctuation analysis and analysis on change of the seashore line were implemented later in Stage-1. Therefore, detailed analyses were conducted considering the contents of the Master Plan and the Priority Project in Stage-2. The result of run-off and inundation analysis was utilized for examination of specification / basic design of flood control plan and facilities for the Master Plan and the Priority Project. It is also used for the study on the negative effects of the Priority Project. Effects of the selected Master Plan and Priority Project on geography were analyzed with riverbed fluctuation analysis and analysis on change of the seashore line. River widening was

selected as one of the contents of the Master Plan and the Priority Project instead of diversion channel, and it is found that the effects on configuration of sediment transportation and shoreline change are relatively small from the results of the analyses.

1.5.3 Strategic Environmental Assessment and Detailed analyses

Effects of flood control measures on natural environment, such as sea coast, and the effects on society, such as land acquisition and relocation, are examined and evaluated at the early stage of the study as a strategic environmental assessment. Examination and evaluation were conducted considering the “JICA Guidelines for Environmental and Social Considerations” and the procedure of environmental assessment in Fiji and based on the discussion with C/P organizations. Moreover, a monitoring plan was developed for the selected Priority Project.

1.5.4 Examination and Proposal of Non-Structural Measures

Current situation and issues related to non-structural measures in the Nadi River basin were clarified and organized based on the interview / discussion with the relevant C/P organizations, and non-structural measures for the Master Plan and the Priority Project were proposed.

Protection of human lives, understanding of disaster risks and evacuation are considered as a top priority, under condition that the progress of structural measures project will be at initial phase.

Therefore, activities accompanied with development and disclosure of hazard maps and development of hydrological devices for awareness of flood risks and so on were proposed as the contents of the non-structural measures for the Priority Project.

1.5.5 Determination of the Master Plan and the Priority Project for Flood Control

Contents and its optimized combination of the structural measures for the Master Plan and the Priority Project were examined based on the results of detailed analyses. It was explained and discussed at the JCC meetings, TWG meeting, individual meeting with the relevant C/P organizations and public consultation meeting, and it was determined through the JCC meeting considering the comments of the public and the stakeholder. As a result, river widening of middle-stream of the Nadi River instead of river diversion, which was proposed in the previous development survey in 1998, was adopted as a basic concept of the flood control in the Nadi River basin. Measures, which can preferentially-protect the important protection area / urban area (population / property concentration area) in the Nadi River basin, were selected as a priority project.

1.5.6 Development of Draft Basic Design of the Structural Measures

Basic design of the selected structural measures for the Master Plan was conducted. Flood control plan, project contents and its scale were crystallized.

1.5.7 Support of Development of the Abbreviated Resettlement Action Plan

The Abbreviated Resettlement Action Plan (RAP) for the Priority Project is formulated by the Fiji Government through Feasibility Study stage. In 2nd Study Stage, the outline of the plan, items to be examined, items for filed survey, etc. have been examined by JICA Study Team with relevant organization in Fiji Government. RAP will be finalized in F/S stage.

1.5.8 Preparation and Discussion for Interim Report

The team prepared the interim report including the results of the study conducted in Stage-2. The comments from JICA and the JCC were reflected on the report. Since the description of the interim report is based on the study conducted by the end of Stage-2, it will be reviewed and modified based on the additional information and study.

1.5.9 Technical Transfer in Stage-2

In the Study, discussions and opinion exchanges between the Team and C/P have been conducted through the daily surveys. At the time of the TWG, the Team and TWG members discussed on procedures, system and issues for implementation of the Priority Project and the Master Plan intended to technical transfer from Japan side to Fiji side.

Furthermore, based on the request from the Project Director of C/P, the Team demonstrated the run-off and inundation analysis and conducted the technical explanation on it.

1.6 Main Activities of Stage-3

In Stage-3, the Team implemented Feasibility Study for selected components through Stage-1 and Stage-2 and summarizes Draft Final Report. The outline of each activity is described below.

1.6.1 Additional Survey

Following additional surveys were implemented by sub-contract in Stage-3.

(1) Topographical Survey

Contents of topographical survey are as shown in Table 1-6.

Table 1-6 Quantities of Topographical Survey

Area		Item	Quantities	
			Unit	Quantities
River Area	South of Nadi Town	Topographical Survey	km2	0.100
	Retarding Basin	Topographical Survey	km2	0.200
Bridge Area	Nadi Town Bridge	Topographical Survey	km2	0.0175
		Longitudinal, Cross-sectional Survey	km	0.40
		Cross-sectional Survey	Nos	20
		Cross-sectional Survey	m	20
	Old Queens Road	Topographical Survey	km2	0.0175
		Longitudinal, Cross-sectional Survey	km	0.40
		Cross-sectional Survey	Nos	20
		Cross-sectional Survey	m	20

(2) Soil Investigation

Contents of soil investigations are as shown in Table 1-7 and Table 1-8.

Table 1-7 Quantities of Boring

Bor No	Depth		Site Location	
	Unit	Quantities		
No.1	m	20	Nadi River	1k000, Left Bank Side
No.2	m	20	Nadi River	8k500, Left Bank Side
No.3	m	20	Nawaka River	3k250, Right Bank Side
No.4	m	30	Nadi River	9k750, Right Bank Side
No.5	m	30	Nadi River	9k750, Left Bank Side
No.6	m	20	Nadi River	13k500, Left Bank Side
No.7	m	30	Nadi River	16k750, Right Bank Side
No.8	m	30	Nadi River	16k750, Left Bank Side
No.9	m	30	Nadi River	19k250, Left Bank Side
No.10	m	30	Nadi River	20k500, Left Bank Side
No.11	m	30	Nadi River	20k000, Right Bank Side
No.12	m	30	Nadi River	21k250, Right Bank Side
No.13	m	30	Nadi River	23k000, Right Bank Side
No.14	m	30	Nawaka River	2k500, Right Bank Side
No.15	m	30	Nawaka River	3k200, Right Bank Side
No.16	m	30	Nawaka River	4k750, Right Bank Side

Table 1-8 Quantities of Soil Test

Bor	Site Tests	Lab Tests Required					
	Permeability	Density	Moisture Content	PSD	Atterberg	UCS	Consolidation
No.1	1	2	10	6	3	2	2
No.2	1	3	10	6	3	3	3
No.3	1	3	10	6	3	3	3
No.4	1	4	10	6	3	2	1
No.5	1	2	10	6	3	2	2
No.6	1	3	10	6	3	3	3
No.7	1	1	10	6	3	1	1
No.8	1	1	10	6	2	1	1
No.9	1	1	10	6	3	1	1
No.10	1	1	10	6	3	1	1
No.11	1	2	10	6	3	2	2
No.12	1	3	10	6	3	0	0
No.13	1	3	10	6	3	1	1
No.14	1	3	10	3	3	1	0
No.15	1	3	10	6	3	3	3
No.16	1	3	10	6	3	2	3

(3) Environmental and Social Survey

Contents of Environmental and Social Survey are as shown in Table 1-9.

Table 1-9 Environmental and Social Survey

Survey Item	Initial	Additional	Remarks
1) Water Quality Survey	5 sites	7 sites	Parameter: Temperature, pH, Salinity, Dissolved Oxygen, Turbidity, Conductivity, Total Suspended Solids, Total Dissolved Solids, Total Phosphorus, Nitrate, BOD, COD
2) River Bed Soil Survey	5 sites	8 sites	Parameter: Organic matter Content, Dry matter content, Ash content, Moisture content, Mn, K, pH, T-N, pH, Heavy metals trace (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)
3) Biological Survey			
3-1) Flora and Fauna	22 selected environment along the Nadi River	8 selected environment along the Malakua & Nawaka River, and 1 environment in Moala village	Parameter: Plants, animals, insects, birds
3-1) Water ecology	7 sites	9 sites	Parameter: Macro-invertebrates, Fish, Algae & Macrophytes
4) Social Surveys	Randomly selected 122 households in the Project area		Interview survey

1.6.2 Preliminary Design and Construction Planning

Preliminary Design and Construction Planning for target components of the Feasibility Study were implemented. Target components of the Feasibility Study are as shown in Figure 1-6.

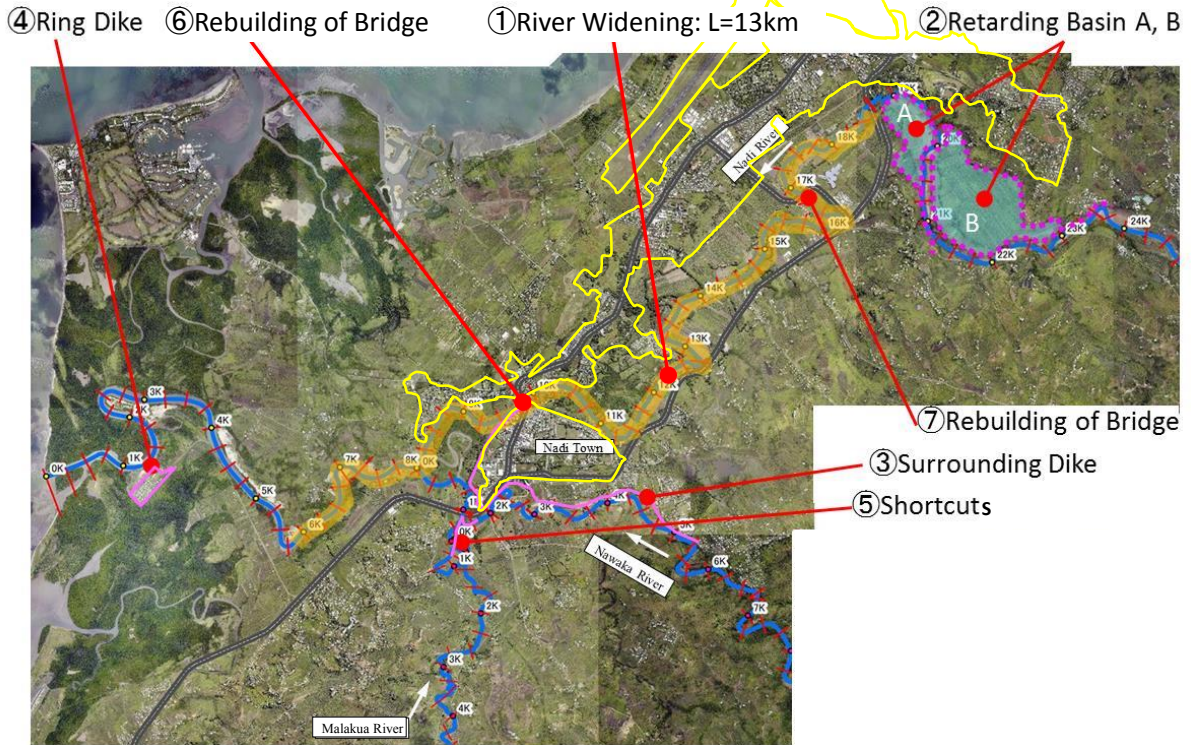


Figure 1-6 Target components of the Feasibility Study (Structural Measures)

1.6.3 Project Cost Estimation

Project cost for target components was estimated based on preliminary design. Estimated project cost is as shown in Table 1-10. Estimated project cost is 385 million FJD (21 billion JPY).

Table 1-10 Project Cost

Item	Total			
	FC	LC	Total	
	million (Yen)	million (F\$)	million (Yen)	million (F\$)
A. ELIGIBLE PORTION				
I) Procurement / Construction	6,778	134	14,074	258
Package 1 River Widening, Rebuilding of Bridge	4,213	77	8,432	155
Package 2 Retarding Basin	1,281	19	2,299	42
Package 3 Ring Dike	40	1	76	1
Package 4 Surrounding Dike	392	5	657	12
Base cost for JICA financing	5,926	102	11,464	210
Price escalation	529	26	1,940	36
Physical contingency	323	6	670	12
II) Consulting services	933	18	1,893	35
Base cost	828	14	1,579	29
Price escalation	60	3	223	4
Physical contingency	44	1	90	2
Total (I + II)	7,711	151	15,967	293
B. NON ELIGIBLE PORTION				
a Procurement / Construction	0	0	0	0
Base cost for JICA financing	0	0	0	0
Price escalation	0	0	0	0
Physical contingency	0	0	0	0
b Land Acquisition	0	38	2,093	38
Base cost	0	34	1,845	34
Price escalation	0	3	148	3
Physical contingency	0	2	100	2
c Administration cost	0	17	903	17
d VAT	0	30	1,625	30
e Import Tax	0	0	0	0
Total (a+b+c+d+e)	0	85	4,621	85
TOTAL (A+B)	7,711	236	20,588	378
C. Interest during Construction				
Interest during Construction (Const.)	351	0	351	6
Interest during Construction (Consul.)	1	0	1	0
D. Front End Fee				
GRAND TOTAL (A+B+C+D)	8,094	236	20,971	385
E. JICA finance portion (A)				
	7,711	151	15,967	293

US\$1=2.17 F\$, 1F\$= JPY 54.5

1.6.4 Project Implementation Planning

For project implementation planning, objective, outline, budget planning, implementation Schedule, contents of consulting services, procurement method of consultant and contractor, project implementing structure and so on was studied and proposed.

1.6.5 Economic Evaluation

Economic evaluation was implemented with project cost and benefit estimated from flood damage. Economic feasibility of the Priority Project is as shown in Table 1-11.

Table 1-11 Economic Evaluation of the Priority Project

Economic indicator	Result	Evaluation
Economic internal rate of return (EIRR)	12.0%	Since EIRR is well over 10% which is applied to the development assistance project in Fiji, the economic effectiveness is high.
Benefit-cost (B/C) ratio	1.20	Since the B/C ratio is over 1.0, the cost-effectiveness is high.
Net present value (NPV)	JPY 1.8 billion (FJD33 million)	Since the value is plus, the cost-effectiveness is high.

Source: JICA study team

1.6.6 Reporting of Feasibility Study

Result of Feasibility Study was summarized in Draft Final Report

1.6.7 Draft Final Report

All study results were summarized and compiled in Draft Final Report.

1.6.8 Technical Transfer in Stage-3

In the Stage-3, discussions and opinion exchanges between the Team and C/P have been conducted through the daily studies of feasibility studies. At the time of the TWG, the Team and TWG members discussed on technical matters of the Priority Project and at the time of JCC, the Team and JCC members discussed on procedures, system and issues for implementation of the Priority Project intended to technical transfer from Japan side to Fiji side.