



FIJI INTEGRATED WATER RESOURCES MANAGEMENT PLAN

2026

Executive Summary

The Integrated Water Resources Management (IWRM) Plan for Fiji, first identified in the National Development Plan (NDP) 2017–2021, has been prioritised alongside the development of the National Water Resources Management and Sanitation Policy (NWRMSP) and the National Groundwater Resources Development and Management Policy (GRDMP). Collectively, these frameworks strengthen the Government of Fiji’s capacity to sustainably manage water resources, ensuring reliable access for essential social needs while supporting economic development.

Building on this foundation, the new Fiji NDP 2025–2029 sets ambitious targets to accelerate universal access to safe water and sanitation, enhance climate-resilient infrastructure, and expand service coverage in rural, remote, and maritime communities. These priorities emphasise stronger integration of water, sanitation and hygiene (WASH) and climate considerations, improved service delivery, and more equitable access for vulnerable populations.

The IWRM Plan directly supports these national objectives by providing a comprehensive and practical framework for managing water resources into the future. It complements ongoing efforts to extend safe water and sanitation services while safeguarding resilience, public wellbeing, and sustainable development.

Surface water and groundwater must be managed in a consistent and prudent manner, despite being subject to different conditions and requiring distinct technical approaches. Both resources are critical to Fiji’s economy and the wellbeing of its people. Accordingly, the strategic directions outlined in the GRDMP are fully reflected in the IWRM Plan.

While previous reviews of Fiji’s water sector have recommended comprehensive water resources legislation, the Plan does not consolidate all water-related laws into a single statute. Instead, it builds on existing legal frameworks and introduces targeted reforms. These include modernising surface water allocation under the Rivers and Streams Act (1882) and establishing new legislation for groundwater management, as identified in the GRDMP.

The IWRM Plan aligns with the Government’s climate change policy by recognising that water resources will be increasingly affected by more extreme wet and dry conditions. Key response measures include strengthening water information systems through improved streamflow monitoring and data management; identifying priority planning programmes over the ten-year period; and introducing Water Resources Adaptation Plans to model extreme hydrological scenarios and guide response strategies.

Flood risk remains a critical concern for Fiji, with frequent loss and damage occurring in major river catchments. The Plan promotes an integrated flood risk management (IFRM) approach, which combines structural and non-structural measures to reduce flood hazards and minimise exposure. Currently, development control in high-risk flood areas is limited, resulting in increasing vulnerability. To address this, amendments to the Town Planning Act are proposed to enable the consideration of flood risk in development approvals. In parallel, flood studies and hazard mapping will be undertaken in high-risk areas.

The IWRM Plan is a ten-year strategic framework designed to strengthen public sector capacity in water resources management. It outlines nine key programmes covering water information systems, planning, allocation, flood and drought management, water quality, environmental protection, and watershed management.

Watershed conditions in many parts of Fiji have deteriorated, affecting streamflow and water quality. While initiatives such as Ridge to Reef (R2R) are addressing these challenges, the IWRM Plan introduces additional approaches at the river basin scale. These include establishing community-based watershed committees, strengthening inclusive local participation, integrating indigenous knowledge, and enhancing climate resilience.

The Plan also sets out a series of priority legal reforms to be implemented over the ten-year period, including:

- (a) amendments to the Rivers and Streams Act (1882) to support a surface water licensing system;
- (b) introduction of groundwater management legislation to regulate abstraction and drilling activities;
- (c) amendments to the Town Planning Act (1946) to incorporate flood risk considerations and establish flood zoning;
- (d) legislation to mandate compliance with the Fiji National Building Code, including flood-related standards; and
- (e) amendments to the Drainage Act (1961) to incorporate flood management works.

Legal reform will be supported by strengthened technical capacity and improved data systems. The Plan prioritises upgrading surface water monitoring networks, enhancing data coordination across agencies, and improving public access to water resources information.

A national programme of flood studies will be undertaken for urban “hotspot” areas, with each study followed by an integrated flood risk management plan to identify mitigation measures and infrastructure requirements, while ensuring that future development does not increase exposure to flood risk.

The Plan also recognises the need to strengthen regulation of activities that may pollute water resources. In particular, it highlights challenges associated with self-monitoring of wastewater discharges and proposes a review of regulatory and compliance mechanisms.

Given its broad scope, the IWRM Plan requires coordinated implementation across multiple ministries and agencies, representing a significant step forward in integrated water resources management in Fiji.

Implementation progress will be monitored through annual reporting to Government, supported by a mid-term review after five years and a final evaluation to inform future actions.

Foreword

A key priority of the Government is to ensure that Fiji's freshwater resources are safeguarded and sustainably managed, so they continue to benefit society, the economy, and the environment. The Integrated Water Resources Management (IWRM) Plan provides a strategic framework to guide the sustainable development, management, and protection of Fiji's water resources over the next ten years. The Plan is designed to be implemented progressively through existing institutional arrangements and resources during its initial stages and therefore does not create significant additional financial implications at the commencement of implementation. Future investments and funding requirements will be identified and prioritised as implementation progresses.

The implementation of this Plan will be guided by the principles of Gender Equality, Disability and Social Inclusion (GEDSI), ensuring that the needs and perspectives of women, men, persons with disabilities, vulnerable groups, and all communities are considered in water resources planning and decision-making. The Plan also promotes the application of environmental and social safeguards to minimise adverse impacts, protect ecosystems, strengthen climate resilience, and support sustainable development outcomes.

Looking ahead, the challenges are greater than ever, with more frequent and severe climate and weather extremes expected to intensify floods and droughts. To meet these challenges, Fiji must strengthen planning, improve the quality and availability of information, deepen understanding of water systems, and adopt more effective approaches for protecting and equitably sharing water resources.

This IWRM Plan is a guide for improving our ability to manage the freshwater resources of Fiji. It is a roadmap for strengthening the Government's ability to better deal with the potential scarcity of water and to limit the danger and destruction caused by water in locations where it may cause harm.

The IWRM Plan commits the Government to make changes in important areas. First, there will be schemes for regulating the groundwater and surface water that is taken for use. Until now, Fiji has allowed enterprises, buildings, and construction projects to take the water they require without comprehensively considering how much can be taken sustainably and how water sources may be depleted or affected. The IWRM Plan identifies a new groundwater permit scheme and a surface water licensing scheme, to be introduced during the life of the Plan, so that larger water users do not restrict others' access to water. Their right to take water will be defined and, for their protection, they will also receive a legal entitlement to the water they are approved to take.

With respect to flooding, the Government will introduce flood maps and flood management plans for priority settlement areas across Fiji. These will be developed by the National Disaster Risk Management Office. Quantifying flood risk will help communities and developers clearly understand which areas are suitable for construction and which areas pose higher risks. The flood management plans will establish guidelines to prevent the escalation of flood hazards and ensure that the design of new buildings and infrastructure appropriately accounts for flood risk, thereby reducing vulnerability to damage and loss.

The IWRM Plan also identifies areas where the Government needs to strengthen its water-related information and technology. In particular, the Fiji Meteorological and Hydrological Services will be strengthened in hydrology to improve understanding of streams, rivers, and seasonal flow patterns. This will be important for assessing water availability, supporting sustainable development, monitoring water quality, and understanding threats to the environment and society from water pollution.

I am confident that, over the ten-year implementation period of the IWRM Plan, Fiji will see a noticeable strengthening of its water management capabilities, resulting in more sustainable, resilient, and equitable use of water resources for all Fijians. At the same time, the Plan aims to enhance protection against the adverse impacts of water-related disasters, which we anticipate will continue to pose significant risks in the future.

A handwritten signature in blue ink, appearing to read 'Ro Filipe Tuisawau'.

Ro Filipe Tuisawau

Minister for Public Works, Meteorological Services and Transport

Table of Contents

Executive Summary	ii
Foreword.....	iv
Abbreviations	xii
Definitions.....	xv
Introduction.....	1
Nature and Scope of the Plan	1
The Water Resources of Fiji	1
Water Resource Development	2
Climate Change.....	3
<i>Understanding of Climate Change Impacts</i>	<i>3</i>
<i>Climate Change Predictions for Fiji.....</i>	<i>3</i>
<i>Approaches to Adaptation.....</i>	<i>4</i>
<i>Sustainable Development and Water Resources</i>	<i>4</i>
Integrated Water Resources Management	4
<i>Water Services and Water Resources Management.....</i>	<i>4</i>
<i>Definition of Integrated Water Resources Management.....</i>	<i>5</i>
<i>Safety and Protection from Harm</i>	<i>6</i>
IWRM Plan Vision and Mission	6
Vision.....	6
Mission.....	6
Integration and Coordination	6
Background.....	7
Principles	7
Gender Equality, Disability and Social Inclusion (GEDSI).....	7
Consistency with Plans and Policies	9
United Nations Sustainable Development Goals	9
National Policies and Plans.....	11
<i>Water Resources Risk Assessment</i>	<i>12</i>
<i>Action Focus</i>	<i>14</i>
IWRM Plan Programs.....	14
<i>Program Output Indicators.....</i>	<i>15</i>
Program 1 Water Resources Information and Data	17
Background.....	17
Streamflow Data	17
<i>The Issues.....</i>	<i>17</i>
<i>Strategies</i>	<i>18</i>
<i>Water Resources Data Quality</i>	<i>18</i>

<i>Access to Data</i>	18
<i>Access to Streamflow and Groundwater Data</i>	19
<i>Combined Use of Meteorological and Streamflow Data</i>	19
Program 1.1 Surface Water Information.....	19
<i>Outcomes</i>	20
Program 1.2 Groundwater Data and Information.....	20
<i>The Issues</i>	20
<i>Strategies</i>	21
<i>Groundwater Baseline Survey</i>	21
<i>Groundwater Data Quality Review</i>	21
<i>Groundwater Database</i>	21
<i>Drillers' Licences and Related Information</i>	21
<i>Outcomes</i>	22
Program 1.3 Water Quality Information and Data.....	22
<i>The Issues</i>	22
<i>Ambient Water Quality Reporting</i>	24
<i>Wastewater Monitoring</i>	24
<i>Groundwater Quality Monitoring</i>	25
<i>Outcomes</i>	26
Program 1.4 Data Exchange and Access.....	26
<i>The Issue</i>	26
<i>Spatial Data and Data Coordinator</i>	26
<i>Information and Confidentiality</i>	26
<i>Data Exchange Protocols</i>	27
<i>Water Resources Information Outcomes</i>	27
Program 2 Water Resources Planning	28
Planning in Water Resources Management	28
Planning Scale.....	28
Plan Categories	28
Surface Water Assessments	29
Program 2.1 Water Resources Assessment.....	29
<i>Aquifer Management Plans</i>	29
<i>Conjunctive Use Plans</i>	30
Program 2.2 Water Resources Adaptation Plans	30
<i>Water Allocation Plans</i>	30
<i>Water Quality Management Plans</i>	31
<i>Watershed Management Plans</i>	31
<i>Outcome</i>	32

Program 3 Water Allocation	33
<i>Background</i>	33
<i>General Objective</i>	34
<i>Planned Outcome</i>	34
<i>Current Responsibilities</i>	34
<i>Introduction of Water Allocation Schemes</i>	35
<i>Legal Program</i>	35
<i>Principles Applicable to Water Allocation</i>	35
<i>Introduction of Water Allocation</i>	35
Program 3.1 Surface Water Allocation	37
<i>Outcomes</i>	39
Program 3.2 Groundwater Allocation and Regulation.....	39
<i>Outcomes</i>	41
Program 4 Integrated Flood Risk Management	42
What is Integrated Flood Risk Management?	42
<i>IFRM Response Requirements</i>	46
Program 4.1 Integrated Flood Risk Management Framework.....	47
<i>Identification of Ten-Year Flood Study Program</i>	47
<i>Watershed Management and IFM Planning</i>	47
<i>Hydrological Flood Studies</i>	48
<i>Flood Mapping</i>	48
<i>Flood Control Schemes and Associated Measures</i>	49
<i>Flood Operation</i>	49
<i>Integrated Flood Risk Management Planning</i>	50
<i>Outcome</i>	51
Program 4.2 Flood Control and Operation.....	51
<i>Outcome</i>	52
Program 4.3 Planning and Development for Flood Risk	52
<i>Control of Development</i>	52
<i>Flood Zones</i>	52
<i>Outcomes</i>	54
Program 4.4 Flooding and Infrastructure	54
<i>The Issue</i>	54
<i>Flood Design Criteria</i>	54
<i>Referral Procedures</i>	55
<i>Outcome</i>	55
Program 4.5 Flood and Drainage	55
<i>Drainage in Fiji</i>	55

<i>Estuarine Drainage</i>	56
<i>Linking Flood and Drainage Measures</i>	56
<i>Outcome</i>	57
Program 5 Drought Management	58
Background.....	58
Program 5.1 Drought Management.....	59
<i>Outcomes</i>	59
Program 6 Water Quality Management	60
Background.....	60
Identified Gaps.....	62
<i>Sewage Effluent</i>	62
<i>Excavation</i>	63
<i>Intensive Agriculture</i>	63
<i>Groundwater Pollution</i>	63
<i>Outcomes</i>	64
Program 7 Freshwater Environment	65
Background.....	65
<i>Outcome</i>	65
Program 8 Watershed Management	66
Background.....	66
<i>Watershed Issues</i>	66
<i>Phases in Watershed Management</i>	66
<i>Watershed Threats and Solutions</i>	68
<i>Watershed Management Effectiveness</i>	68
<i>Watershed Threats</i>	69
<i>Experience in Fiji</i>	70
<i>River Basin Management Plans</i>	71
<i>Administrative Arrangements for River Basins</i>	71
<i>Approval of Watershed Plans</i>	72
<i>Traditional Land Ownership</i>	72
<i>The Watershed Management Framework</i>	72
Watershed Management Strategy	73
Rural Watershed Policy	74
Protected Areas	74
Program 8 Watershed Management.....	75
<i>Outcomes</i>	76
Background.....	77
Coordination	77

<i>National Coordination for IWRM</i>	77
<i>Thematic Coordination</i>	79
River Basin Organisation and Coordination	80
<i>Coordination and Watershed Management</i>	80
<i>River Basin Organisations</i>	80
<i>Nature and Role of River Basin Coordination</i>	81
<i>Role in Consultation and Representation</i>	81
<i>Support and Leadership</i>	82
<i>Conclusion on Watershed Committees</i>	82
10 Implementation and Monitoring	83
Functions and Responsibilities.....	83
Monitoring and Reporting Schedule	84
IWRM Plan Performance Indicators.....	85

Tables

Table 1: Elements in the Definition of IWRM.....	5
Table 2: Gender Equality, Disability and Social Inclusion mechanisms	8
Table 3 Sustainable Development Goal 6: Targets and Indicators	9
Table 4 Sustainable Development Goal 13 - Climate Change	11
Table 5 Sustainable Development Goal 6 Targets and Indicators	11
Table 6 Strengths, Weaknesses, Opportunities and Threats	12
Table 7 IWRM Programs.....	14
Table 8 Program Output Indicators.....	15
Table 9 Program 1.1 Surface Water Information.....	19
Table 10 Program 1.2 Groundwater Information.....	22
Table 11 Water Quality Sampling and Recording	23
Table 12 SDG Ambient Water Quality Parameters	24
Table 13 Program 1.3 Water Quality Monitoring Program	25
Table 14 Program 1.4 Water Data Exchange and Access.....	27
Table 15 Program 2.1 Water Resources Planning.....	31
Table 16 Responsibilities Related to Water Allocation	34
Table 17 Activities in Water Allocation	36
Table 18 Program 3.1 Surface Water Allocation.....	38
Table 19 Program 3.2 Groundwater Allocation.....	40
Table 20 Measures to Counteract Flood Hazard, Exposure and Vulnerability	43
Table 21 Elements in Integrated Flood Risk Management	45
Table 22 Program 4.1 Integrated Flood Risk Policy and Planning	50
Table 23 Program 4.2 IFRM – Flood Control and Operation.....	51

Table 24 Program 4.3 Development Planning for Flood Risk	53
Table 25 Program 4.4 Flooding and Infrastructure	55
Table 26 Program 4.5 Flood and Drainage	56
Table 27 Program 5.1 Drought Management.....	59
Table 28 Sources of Water Pollution	60
Table 29 Pollution Sources and Management Measures	61
Table 30 Program 6 Water Quality Management	63
Table 31 Program 7 Freshwater Environment	65
Table 32 Watershed Threats and Solutions.....	68
Table 33 Program 8 Watershed Management.....	75
Table 34: Surface Water Mandates and Functions.....	78
Table 35 Thematic Coordination Centres	79
Table 36 Coordination Program.....	82
Table 37: Functions and Responsibilities	83
Table 38 Monitoring and Reporting Schedule	84
Table 39 Performance Indicators	85

Figures

Figure 1: Water Use by Sector	2
Figure 2: Outline of integrated Flood Risk Management	43
Figure 3 Relationship Between Flood-Related Plans.....	48
Figure 4: Phases in Watershed Management	67

Abbreviations

ADB	Asian Development Bank
AEP	Annual Exceedance Probability
AIFFP	Australian Infrastructure Financing Facility for the Pacific
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Aus)
DKRZ	Deutsches Klimarechenzentrum
MECC	Ministry of Environment and Climate Change
DRR	Disaster Risk Reduction
DTCP	Department of Town and Country Planning
DWS	Department of Water and Sewerage
EC	Electrical Conductivity
EFL	Energy Fiji Limited
EMA	Environment Management Act
ENSO	El Niño Southern Oscillation
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FMP	Flood Management Plan
FMS	Fiji Meteorological Services
FMSHD	Fiji Meteorological Services Hydrology Division
FNBC	Fiji National Building Code
FRA	Fiji Roads Authority
FZ	Flood zone
GCC	Government Commercial Company
GCM	Global Circulation Model
GEDSI	Gender Equality Disability and Social Inclusion
GIS	Geographic Information System
GRDMP	National Groundwater Resources Development and Management Policy
GWP	Global Water Partnership
IFMP	Integrated Flood Management Plan
IFRM	Integrated Flood Risk Management
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
LSIO	Land Subject to Inundation Overlay

MAWSI	Ministry of Agriculture, Waterways and Sugar Industry
MCBD	Ministry of Commerce and Business Development
MECC	Ministry of Environment and Climate Change
MHMS	Ministry of Health and Medical Services
MITACHA	Ministry of iTaukei Affairs, Culture, Heritage and Arts
MLMR	Ministry of Lands and Mineral Resources
MPWMST	Ministry of Public Works, Meteorological Services and Transport
MOU	Memorandum of Understanding
NAP	National Adaptation Plan
NBCC	Nadi Basin Catchment Committee
NDRMO	National Disaster Management Office
NDP	National Development Plan
NFAP	Nadi Flood Alleviation Project
NGO	Non-Government Organisation
NWRMSP	National Water Resources Management and Sanitation Policy
R2R	Ridge to Reef Program
RBO	River Basin Organisation
REDD+	Reduce Emissions from Deforestation and Forest Degradation Program
RRCMP	Rewa River Catchment Management Plan
RWP	Rural Watershed Policy
SDG	Sustainable Development Goals
SOP	Standard Operating Procedure
SPCZ	South Pacific Convergence Zone
STP	Sewage Treatment Plant
SWOT	Strength, Weakness, Opportunity and Threat Analysis
TLTB	iTaukei Land Trust Board
TPA	Town Planning Act
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEP	United Nations Environment Program
WAF	Water Authority of Fiji
Waterways	Ministry of Agriculture, Waterways and Sugar Industry

WB	World Bank
WRCIMP	Waimanu River Catchment Integrated Management Plan
WRMU	Water Resources Management Unit
WRM	Water Resource Management
WSS	Water Supply and Sanitation
WTP	Water Treatment Plant
WWF	Worldwide Fund for Nature

Definitions

Aquifer	A naturally occurring underground water reserve
Beneficial Use	The use of a water resource that provides a benefit to human life, wellbeing, economy, or to the environment
Borehole	A narrow shaft bored into the ground, to find and extract water
Climate Change	The long-term trend in global temperature change that affects weather patterns, precipitation, and runoff into rivers and streams
Desalination	A process that removes salt or other minerals from water
Developer	A person or company that created a new parcel of land that required a separate water and/or sewerage connection
Drinking Water Quality Standard	A level for a water constituent which does not result in significant human health risk, and which ensures the water is acceptable for drinking and domestic use
GEDSI	Gender Equality Disability and Social Inclusion refers to the systematic consideration of the different needs, capacities and experiences of women, men, persons with disabilities and vulnerable or marginalised groups to ensure equitable participation in decision-making and equal access to the benefits of water resources management, water services and climate resilience initiatives.
Government	Government of the Republic of Fiji
IWRM	Integrated Water Resources Management, is a process which promotes the coordinated development and management of water, land and related resources to maximize the resultant economic and social welfare in an equitable and sustainable manner
Rainwater Harvesting	Accumulating and storing rainwater for use
Rural	All areas outside of metered urban and peri-urban water reticulation systems
Safe Water	Water that meets the National Drinking Water Quality Standard systems
Sanitation	The provision of facilities and services for the safe disposal of human excreta and domestic wastes
Sewage	Human waste from domestic and commercial premises including faeces, urine, waste from kitchens, showers, baths, domestic laundries etc
Sewer	A conduit used for the conveyance of wastewater
Sewerage	The management and operation of drainage by sewers

Surface Water	Water found on the land surface in rivers, streams, lakes, lagoons and impounded behind dams in reservoirs
Take Water	To withdraw water from a water body in nature, by diversion, pumping or other means, for human or environment use
Urban	The central business district of a city or town, along with its suburban developed areas
Vanua GIS	Web based Property/Land Information application developed and managed by the Ministry of Land and Mineral Resources. This is used by Ministries and stakeholders to view Government Spatial Assets and data
Water Committee	Committee established consisting of members of the community responsible for the operations and maintenance of rural water and sanitation schemes. This is a requirement of the RWSP.
Water Service Regulator	The organisation responsible for regulating, monitoring and evaluating the performance of water service providers in Fiji
Water Services	Water supplies for domestic, commercial and industrial uses, and sanitation, meaning the disposal of wastewater and sewage
Water Source	A source of surface water or groundwater from which water may be taken for beneficial use

Introduction

Nature and Scope of the Plan

The Integrated Water Resources Management (IWRM) Plan sets out the roadmap for advancing IWRM in Fiji. It outlines the key components of the national water resources management framework and defines the strategies and programs needed to strengthen Fiji's capacity to manage its water resources effectively. This framework brings together the relevant laws, policies, plans, ministerial and administrative functions, as well as the technical, professional, and managerial expertise within government institutions responsible for ensuring that water resources are developed, utilized, and safeguarded in a sustainable manner.

The Water Resources of Fiji

The freshwater resources of Fiji primarily comprise of surface water flowing in streams and rivers, springs and wetland and groundwater. Rainfall may be harvested in some instances. Fiji's topography is highly variable because Fiji possesses larger islands with mountainous landscapes, as well as numerous small and low-lying islands without permanent surface water.

The water resources of Fiji are influenced by the size and topography of the islands. The two main islands, Viti Levu and Vanua Levu, have elevated mountainous regions and steep slopes, rising to over 1,300 metres. They generate rainfall from the predominantly Southeast Trade wind. This results in wet tropical conditions in the eastern parts of the main islands and causes a rain shadow effect for the western divisions of both major islands. The wet seasons are caused by the southerly movement of the South Pacific Convergence Zone (SPCZ), which brings moisture from the west pacific atmospheric warm pool.

Annual precipitation rises from 2000-3000 mm in lowland areas, and up to 6,000 mm in higher elevations. These results in rivers, which are short in length by international comparison, but have significant flow, which can increase rapidly due to prolonged heavy rain and usually result in significant flooding. In the Western Division, the rain shadow effect can cause drought conditions, and is contributed by the weakening of the SPCZ. This results in El Niño Southern Oscillation (ENSO) conditions, which may cause serious drought to the nation.

Total renewable surface water resources are estimated at 28,550 GL/year. The renewable groundwater resources are estimated at about 5,273 GL /year, which are entirely drained by the surface water network (overlap).¹ The total annual renewable water resources in the country are estimated at 28, 550 GL.²

Fiji is composed of some hundreds of smaller islands, which have limited surface water or maybe absent altogether. These islands rely on rainwater harvesting and/or fresh groundwater and are vulnerable to climatic variability. Many islands have potential of groundwater availability with fresh groundwater lenses that are situated above saline water. These groundwater resources are however subject to depletion or contamination if over-abstracted.

Groundwater is present in voids and spaces of hard rock and consolidated materials aquifers (saturated zones), in the mountainous and hilly islands, feeding springs, as well as being available for abstraction through bores and wells. In low-lying areas, superficial and unconsolidated alluvial deposits contain groundwater also. These are all readily recharged and may be connected to the fluvial system. Groundwater levels fluctuate according to climatic patterns and conditions.

¹ Food and Agriculture Organisation (FAO) Country Profile – Fiji, 2016 (FAO, 2016) [p4]

² FAO, 2016

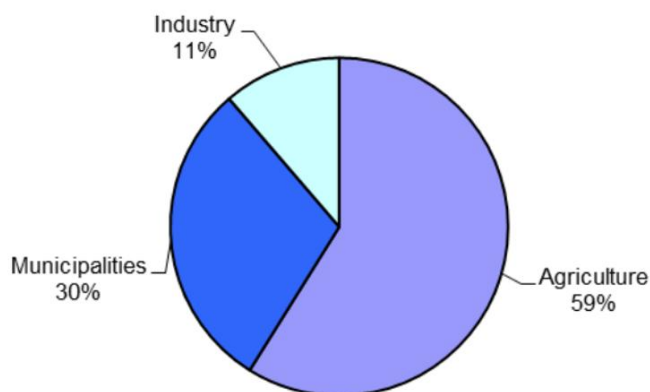
As a result of the contrasting geographical and water resource circumstances across Fiji, differential management approaches are required. Surface water management concerns include flood and drought, both of which have had serious impacts in Fiji. Further, watershed degradation is of significant concern to water suppliers and water users, both where storage dams are operated and where water offtake works may be threatened by instream activities or land degradation.

Freshwater pollution is also a concern, through sewage discharge and industrial wastes. Groundwater contamination is a serious issue on both large and small islands. Limitations of storage and disposal of polluting materials, limiting activities that apply chemicals and other potential pollutants to land surrounding boreholes, and requiring a safe distance for latrines and organic from domestic supply installations must be introduced. Contamination of groundwater is a potential issue on small islands, where domestic wastes are disposed without considering their potential to pollute the groundwater used for drinking water supply. Both point sources and diffuse sources of pollution are potentially problematic in different contexts and are almost impossible to remediate.

Water Resource Development

Until now, the volumes of water taken for use have been mainly for urban water use and agriculture, with agriculture being the largest user by volume. There is irrigation from both surface water and groundwater sources. In 2005 total water withdrawal was estimated at 84.9 GL, of which 50 GL (59 percent) was for agriculture, 25.3 GL (30 percent) for municipalities and 9.6 GL (11 percent) for industries, as shown in Figure 1.³

Figure 1: Water Use by Sector



Irrigation water withdrawal was 50 million m³ of which 90 percent was irrigated by surface water and the remaining 10 percent by groundwater. Of a total area of 4,000 ha, around 3,000 ha. or 75 percent was dedicated to rice. The remaining 1,000 ha. or 25 percent were upland crops, the majority of which were irrigated by sprinkler systems using both surface water and groundwater resources. It is estimated that all the area equipped for irrigation is irrigated.⁴

In 2015, total dam capacity in the country was estimated at 133 million m³, which mainly comprised water storage for electricity generation and urban water supply.

³ FAO, 2016

⁴ FAO, 2016

Climate Change

Understanding of Climate Change Impacts

The climate of Fiji is generally categorized as an oceanic tropical climate in which the dry season is from May to October and rainy season from November to April. Fiji's location has a strong influence on both seasonal and inter-annual variations in climate, particularly rainfall where the south easterly Trade winds carry moist air into the islands. Fiji is also prone to El Niño events and tropical cyclones relative to the positioning of the SPCZ.

During an ENSO event, conditions drier and hotter than normal can be expected from June to August. ENSO events are typically initiated and sustained by changes in the amount of heat in the waters below the surface of the tropical Pacific Ocean. Significant changes in the deeper ocean ensure that the surface waters stay warm or cool even when the atmosphere above might try to push the system back towards neutral, and in that way the Ocean sustains or leads an ENSO event.

During the November to April wet season Fiji is normally traversed by tropical cyclones as it lies directly in their normal path.

Climate Change Predictions for Fiji

The effects of climate change on water resources depend on the Global Circulation Model (GCM) used. Climate change predictions from two GCMs have been developed for the zone in which Fiji lies. The Australian Commonwealth Scientific, Industrial Research Organisation (CSIRO) scenario indicates an increase in maximum and minimum stream flows. Alternatively, the German Climate Computing Center (DKRZ) climate model predicts the converse. It is possible that, because of climate change, extremes will be intensified. Rivers will experience extreme low flow events and periods, while high flows will increase in volume, leading to the risk of more severe droughts and floods.

Predicted global and local warming is expected to affect water resources via the impact on atmospheric moisture and precipitation, as well as oceanic warming on wind patterns and cloud cover. Further, global warming may rise in sea levels, which in turn affect the quality of groundwater for human consumption through salt-water intrusion in low-lying coastal areas and small islands. An important instance is periodic salinity levels in the Waimanu River, where water supply for Suva is sourced. Small island groundwater resources be threatened by sea-level rise.

Therefore, the focus for future water resources planning and management must be the expectation that the variability of precipitation patterns will fluctuate more extremely and therefore low and high flow events will become more pronounced also. The impacts are expected to be:

- More extended dry periods, which will result in more severe drought, particularly in western rain shadow areas, and on small islands, thus affecting basic water supply; and
- More intense and concentrated precipitation events, resulting in rapid rise in river levels and flow, flooding, upland erosion, siltation and river channel degradation.

Inland flooding, when combined with storm surges and rising sea levels, poses serious risks to low-lying estuarine and coastal zones. Many of these impacts are already visible, as these areas have been heavily developed due to their suitability for tourism and related enterprises. In addition, climate mitigation co-benefits will be pursued through integrated water resources management, including watershed rehabilitation, reforestation and the protection of carbon-rich ecosystems. This makes them especially vulnerable to future shifts in climate and water dynamics.

Approaches to Adaptation

Water resources management adaptation to predicted climate change and global climate models means preparing for the greater extremes and their on-ground impacts. These will be addressed in three areas:

- **Integrated Flood Risk Management** is the coordinated design and application of flood-control measures to cope with extreme high-rainfall events, include such measures as retarding basins and dams, with flood management planning and measures to restrict development in areas of high flood risk, and require flood-resistant structural design and material to be used;
- **Drought Management:** measures include planning for alternative sources and greater drought predictive capacity. Water use efficiency is also an important element; and

Watershed Management: since watersheds are expected to be subjected to two destructive forces, which are (i) deforestation and vegetation loss human activity and (ii) more extreme precipitation, erosion, siltation, stream channel degeneration and soil loss. Solutions are reforestation, land-use controls, protection of wetlands and soil conservation. The Plan further promotes ecosystem-based adaptation approaches, including mangrove restoration, wetland protection, and ridge-to-reef management to enhance climate resilience and biodiversity conservation.

In addition, the IWRM Plan introduces Water Resources Adaptation Planning, which involves modelling and understanding the implications of theoretical high and low precipitation and flow conditions that are greater than historically recorded extremes.

Sustainable Development and Water Resources

A core principle of climate change adaptation is the sustainable management of natural resources. Applying this principle to water resource development is essential, not only to prevent degradation and depletion, but also to strengthen resilience against increasing variability and extremes in rainfall, temperature, streamflow, and groundwater recharge. Achieving sustainable development requires effective information systems, robust planning, ongoing capacity development, and equitable allocation mechanisms.

Integrated Water Resources Management

Water Services and Water Resources Management

A clear distinction exists between water services and water resource management. The IWRM Plan focuses primarily on the integrated management of water resources, while water services refer to the provision of water supply and sanitation (WSS) by the Government to support the wellbeing of all Fijians. These services include the abstraction, treatment, and distribution of water to consumers. In Fiji, the Water Authority of Fiji (WAF) is the primary service provider, delivering water across all urban areas and beyond. Most major water users rely on sources supplied by WAF.

Some water users draw directly from surface or groundwater sources. While they consume water in the same way as the Water Authority of Fiji (WAF), they are not considered water resources managers. For example, the Mineral Resources Department (MRD), under the Ministry of Lands and Mineral Resources, develops groundwater sources to supply rural schools and communities, functioning as a water services provider. At the same time, MRD also carries responsibilities in groundwater management.

Water resources management encompasses activities that sustain, allocate, protect, and oversee both surface and groundwater resources. Surface water bodies include rivers, streams, wetlands, and other systems where water flows or accumulates, while groundwater is stored in aquifers,

which may be isolated or interconnected as larger aquifer systems. Managing activities related to these sources and water bodies falls under water resources management. Nevertheless, there are strong interconnections between public water services (WSS) and the broader management of water as a resource.

Definition of Integrated Water Resources Management

Integrated Water Resources Management (IWRM) originated from the need to manage international rivers, requiring coordination and cooperation on water use, allocation, quality, pollution control, and flood management. The hydrological basin was identified as the logical unit of management for rivers.

The hydrologic or hydrogeological unit has come to be recognized as the optimal scale for water resource management. However, challenges arise because many river basins and aquifer systems extend across national, provincial, and district boundaries, leading to fragmented and often inconsistent management practices. In Fiji's case, its relatively small geographic size enables much of this management to be carried out effectively at the national level.

The IWRM approach is based in the Dublin Principles which were adopted at the 1992 Dublin Conference on Water and endorsed at the Rio de Janeiro Summit on Sustainable Development. The Dublin principles state that:

1. Water is a finite and vulnerable resource, essential to sustain life, development and the environment;
2. Water development and management should be based on a participatory approach, involving users, planners and policymakers, at all levels;
3. Women play a central part in the provision, management and safeguarding of water;
4. Water has an economic value in all its competing uses and should be recognised as an economic good.

In 1999, the Global Water Partnership (GWP) was formed to promote integrated water resources management worldwide. It promotes IWRM and has defined it as:

“a process which promotes the coordinated development and management of water, land and related resources to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment.”

The elements of the definition have been expanded in table 1 below.

Table 1: Elements in the Definition of IWRM

Definition	Explanation
IWRM is a process	IWRM is ongoing because water resources and related natural resources continue to vary naturally, and human activities constantly affect and change the dynamics of water in society and nature.
IWRM promotes coordinated development and management	Coordination of all efforts to develop and manage water resources is important because of the mutual impacts they have on one another and on the water resources as well. Therefore, coordination is a key principle of IWRM.

Definition	Explanation
IWRM involves water, land and related resources	Water resources include surface water, groundwater and other sources such as desalinated seawater and captured rainfall. Water bodies above and below the surface of the ground need complementary management action to prevent pollution and diminution of the water resource.
IWRM aims to maximise economic and social welfare	The development and use of water resources should cater for the basic water needs of society to provide secure and safe water for living, as well as enabling economic development and the orderly use of water for all sectors.
Avoiding compromise of ecosystems and environmental sustainability	The management of water resources should consider the water needs of the environment and ecosystems, and must ensure sustainable limits to water abstraction, to ensure that water sources remain viable for future generations

Safety and Protection from Harm

This plan also addresses protection from the risks posed by floods and droughts. The water management framework must consider potential loss of life and property from flooding, as well as the damage to agriculture and livelihoods that can result from prolonged droughts.

IWRM Plan Vision and Mission

The vision of the IWRM Plan defines the intended outcomes for water resources. The mission of the Plan describes the means for reaching the Vision, which involves strengthening the management framework for water resources in Fiji.

Vision

To ensure that, in the face of climate change, Fiji's water resources are sustainably developed and managed in a balanced and coordinated manner, supporting the wellbeing of all Fijians while safeguarding the integrity of aquatic ecosystems

Mission

To achieve the IWRM vision by developing a comprehensive, effective and professional governmental framework for the management of water resources through law, policy, communication and organisation.

Integration and Coordination

Coordination is a fundamental principle for IWRM. This results from the understanding that water resources occur in and across river basins (surface water) and aquifers or linked aquifer systems (groundwater) and that, they need to be managed in harmony with their geographical boundaries. It also results from the understanding that water resources are affected by the decisions of numerous government and private organisations. For these reasons, IWRM approaches include coordinating bodies and communication mechanisms.

Background

The Fiji Integrated Water Resources Management (IWRM) Plan for Fiji is a ten-year strategic initiative designed to establish a comprehensive and effective framework for managing water resources. The framework encompasses relevant laws, policies, plans, institutional roles and responsibilities, organizational capacity, and technological support. It also outlines the coordination and communication mechanisms necessary for efficient water management and related activities.

The Fiji IWRM Plan has been identified in the National Development Plan as an action to be accomplished for the water sector. It builds upon the National Water Resources Management and Sanitation Policy (NWRMSP) and is consistent with the National Groundwater Resources Development and Management Policy (GRDMP) that has been endorsed by Cabinet. They set the direction for establishing and strengthening national capacity to control the use of water and to make effective arrangements for its protection from pollution and exhaustion.

Principles

The IWRM Plan is based on the principle that the Fijian Government has a duty to all Fijians to encourage the use and development of water resources, while ensuring that they are sustainably used and protected from harm. The principles guiding the Fiji IWRM Plan are:

- planning must consider changing climatic conditions that will affect Fiji's water resources into the future;
- consistent with the internationally supported Sustainable Development Goals (SDGs) Fiji must endeavour to provide clean, safe and reliable water and sanitation to all Fijians at reasonable cost;
- the rational development of water resources for all beneficial uses should be consistent with sustainable withdrawal of water from sources in nature;
- there are measures that can be taken to limit or avoid damage and loss caused by flooding and flood risk can and should be reduced through flood risk management efforts;
- decision-making should be based on adequate and reliable information about Fiji's water resources;
- the rights of landowners must be balanced against the needs of society for water services; and
- the quality of land and vegetation affects the quality and quantity of water in streams and rivers and needs to be protected and managed sustainably.

Adaptation to climate change is a fundamental feature of the IWRM Plan. The Fijian Government places great importance on both measures to reduce global warming and to respond to the effects of warming seas and atmosphere.

Gender Equality, Disability and Social Inclusion (GEDSI)

The principles of this Plan also promote gender equality, disability inclusion and broader social inclusion to ensure that water, sanitation and climate adaptation actions are equitable, inclusive and responsive to the needs of women, persons with disabilities, and other vulnerable or marginalised groups. The Plan recognises that experiences of water insecurity vary according to gender, age, disability, location and socio-economic circumstances, and that these factors may intersect to compound disadvantage. In this context, GEDSI is treated not merely as an aspirational principle, but as an operational requirement to be integrated across the planning, implementation, monitoring and governance of all programs under this IWRM Plan. GEDSI will be mainstreamed throughout the implementation of the Plan, including via the measures in table 2.

Table 2: Gender Equality, Disability and Social Inclusion mechanisms

Aspect	GEDSI mechanisms
Climate adaptation	Water resources planning and water allocation, integrated flood risk management, drought management and watershed management plans shall take into account the differing impacts of climate change and water-related hazards on women, children, older persons, and persons with disabilities, as well as the circumstances of rural, remote, maritime, and informal settlement communities, including those with limited access to reliable water sources. These planning processes shall also recognise the gendered dimensions of disaster preparedness, response and recovery, including equitable access to early warning information, safe evacuation and shelter, and support for recovery and resilience.
Design and service delivery	Water and sanitation facilities shall comply with universal accessibility standards so that they are usable by persons of all genders, ages and abilities, and their design shall address the safety, privacy and dignity of users, including provision for menstrual hygiene management. Sanitation services shall remain accessible and functional during and after climate-related emergencies. Service delivery shall also take into account affordability, distance, and the appropriateness and acceptability of technologies, so that interventions do not place a disproportionate burden on women, low-income households or remote communities. Design and service delivery shall further recognise affordability and protection from gender-based violence as key considerations in ensuring accessibility, safety and wellbeing.
Participation and decision-making	Women, persons with disabilities, youth, older persons and other vulnerable groups shall be meaningfully involved in water and climate decision-making, and tokenistic participation shall be avoided. Participation shall include representation in consultation bodies, water resources management decisions, planning forums, and river basin or watershed coordination arrangements, and shall support the effective voice and leadership of women and other under-represented groups. Community consultation processes shall be designed and conducted so as to enable meaningful participation by women, persons with disabilities, youth, rural and maritime communities, and other under-represented groups, taking into account relevant cultural and social contexts, including iTaukei land ownership and traditional (vanua) decision-making structures. Inclusion mechanisms may include minimum representation requirements for women on basin and watershed committees, dedicated consultation processes for women and persons with disabilities, and accessible meeting formats, times and locations.

Aspect	GEDSI mechanisms
Safety and avoid unintended harm	Water resources management projects shall be designed and implemented so as not to create or increase risks to the personal safety of water users, including risks associated with the collection of water, the use of sanitation facilities, and conditions during water-related disasters. Agencies and implementing partners shall apply a "do no harm" approach, anticipating and mitigating any unintended adverse consequences, including increased burden on, or backlash against, women and marginalised groups that may arise from interventions under this IWRM Plan.
Analysis and evidence informed policy and practice	GEDSI analysis and risk-assessment guideline shall be adopted to inform program design, clear functional responsibility for GEDSI shall be assigned within the implementing institutions, and progress shall be monitored using sex-disaggregated and, where feasible, disability-disaggregated data, with reporting against the Plan to include GEDSI outcomes and any unintended impacts.

Consistency with Plans and Policies

The Fiji IWRM Plan for Fiji is consistent national policies and plans that the Fijian Government has made, as well as the international and regional agreements and protocols to which Fiji is a signatory. In particular, the Sustainable Development Goals (SDGs) of the United Nations (UN) are an important influence on the IWRM Plan.

United Nations Sustainable Development Goals

The Fijian Government has a signatory to the UN Sustainable Development Goals (SDGs). SDG 6 is entitled ‘*Ensure availability and sustainable management of water and sanitation for all.*’ Its targets cover both public water services (WSS) as well as targets related to managing water resources.

Table 3 shows the performance indicators most relevant to IWRM.

Table 3 Sustainable Development Goal 6: Targets and Indicators

SDG 6: Ensure Availability and Sustainable Management of Water and Sanitation for All

Target	Indicator
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	<i>6.1.1 Proportion of population using safely managed drinking water services</i>
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women	<i>6.2.1 Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water.</i>

Target	Indicator
and girls and those in vulnerable situations	
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	<i>6.3.1 Proportion of domestic and industrial wastewater flows safely treated</i> <i>6.3.2 Proportion of bodies of water with good ambient water quality</i>
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	<i>6.4.1 Change in water-use efficiency over time</i> <i>6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources</i>
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	<i>6.5.1 Degree of integrated water resources management</i> <i>6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation {not applicable}</i>
6.6 By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes 6.6.1 Change in the extent of water-related ecosystems over time	<i>6.6.1 Change in the extent of water-related ecosystems over time</i>
6.a By 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	<i>6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government coordinated spending plan</i>
6.b Support and strengthen the participation of local communities in improving water and sanitation management	<i>6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management</i>

Sustainable Development Goal 13 is also relevant to water resources management, as shown in Table 4, which deals with disaster risk and flooding.

Table 4 Sustainable Development Goal 13 - Climate Change

SDG 13 Take Urgent Action to Combat Climate Change and its Impacts

Target	Indicator
13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	<i>13.1.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population.</i> <i>13.1.2 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030</i> <i>13.1.3 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies.</i>

Indicators 13.1.2 and 13.1.3 are related to the behaviour of water and measures to reduce flood hazard, exposure and vulnerability. Measures to deal with flood response (apart from warning and flood control), and recovery are outside the scope of IWRM planning, but they must be closely coordinated with water resource-related measures.

National Policies and Plans

The IWRM Plan is consistent with the National Development Plan (NDP) 2025-2029 where it is listed as a task. It is consistent with the National Adaptation Plan (NAP) for climate change and the Green Growth Framework, see Table 5.

Table 5 Sustainable Development Goal 6 Targets and Indicators

Plan or Policy	Details
National Adaptation Plan (NAP)	<i>The National Adaptation Plan identifies climate change adaptation requirements for Fiji</i>
The National Climate Change Policy 2018-2030	<i>The Policy establishes the framework for climate change response. Objective 3.3, Strategy 2 and Objective 5.1 strategies 2, 4 and 6 are specifically addressed in the IWRM Plan</i>
Green Growth Framework	<i>The Green Growth Framework</i> <i>Thematic Area 1: Building Resilience to Climate Change and Disasters</i> <i>Thematic Area 2: Waste Management</i> <i>Thematic Area 6: Freshwater Resources and Sanitation Management</i>

Plan or Policy	Details
Rural Water and Sanitation Policy	<i>The Rural Water and Sanitation Policy (RWSP) promote the extension of water supply and sanitation services to rural and remote areas and sets out the procedures for establishing the mutual obligations of government and rural communities in operating and maintaining water systems in rural areas.</i>
National Water Resources Management and Sanitation Policy	<i>The NWRMSP has been prepared for approved by the Government. Its sets out policy principles for managing all-important aspects of water resources. It also describes programs that will be required to put the principles into practice.</i>
National Groundwater Resources Development and Management Policy	<i>The GRDMP deals exclusively with groundwater and its management. It follows similar principles as are found in the NWRMSP. The two policies are consistent and complementary.</i>

Water Resources Risk Assessment

An analysis of strengths, weaknesses, opportunities and threats (SWOT) was undertaken. The SWOT analysis is shown in Table 6. It identifies the water resources challenges as well as the factors that affect success or otherwise in overcoming current and likely future problems with water resources.

Table 6 Strengths, Weaknesses, Opportunities and Threats

Strengths	Weaknesses
(a) Abundant rainfall and surface water in most situations (b) Considerable good quality groundwater and active recharge (c) Proactive policy on flood and drought warning being developed by NDRMO (d) High level of awareness of climate change trends (e) National GIS system (Lands) (f) Important development of groundwater management framework (g) Draft policies for WRM and Groundwater management has been endorsed by Cabinet (h) Administration with limited governmental 'layers'	(a) Gaps in the legal framework (b) Important administrative responsibilities not assigned or functioning (c) No clear leadership or coordinating focus for surface water management (d) Operational functions taking precedence over management responsibilities (e) Watershed management efforts failing (f) Financing difficulties for some functions (g) Degradation of watershed land not being controlled (h) Lack of professional staff and difficulty retaining well-qualified staff in Government

Strengths	Weaknesses
(i) Rural water and sanitation programs (j) Separation of responsibility for water services and water management being initiated	(i) Lack of power to control development in face of flood hazard – to limit exposure (j) Inadequacy of surface water information for planning (k) Incomplete regulatory framework for government commercial companies (l) Lack of communication resulting from incomplete regulation

Opportunities	Threats
(a) Increasing understanding of the need for active management of water resources (b) High level of donor interest in developing WSS, WRM, climate change and environmental programs (c) Groundwater expertise and management capacity being developed (d) Support for upgrading water information systems (e) SDG and IWRM Plan reporting can ensure progress in implementation (f) Concern about flood damage and need to limit exposure (g) Awareness of climate change impacts and need for action (h) Reporting on SDGs turning attention to goals (i) Support for water service regulation and need for accountability in WSS (j) Research and modelling to make predictions or forecast of degree of impact of various climate change and human activity scenarios	(a) Climate change impacts on freshwater resources and safety (b) Difficulty in developing legislation (c) Continuing watershed deterioration not easily reversed (d) Active leadership for watershed management not readily identifiable (e) Monitoring and enforcement of rules requires resources and proactive stances (f) Vulnerability of groundwater on low-lying islands and coastal aquifers (g) Upland degradation by rural communities continuing (h) Lack of planning control over flood-prone development (i) Increasing flood threat due to climate trends (j) Potential for qoliqoli issues not to be resolved

To summarise, the strengths lie in the relative health of water resources, but threats lie in increasing danger from flooding and the vulnerability of some water resources. Weaknesses have to do with deficiencies in the legal framework as to water allocation and the ability to prevent development in the path of likely floods. In addition, thereby increase exposure to flood loss and damage. Other weaknesses are related to the incomplete information base and the fact that there is no identified responsibility for managing surface water resources.

Significant threats lie in the condition of watersheds, which are deteriorating significantly and, in some cases, affecting water supplies. A threat also lies in predicted increasing severity of drought conditions. A serious threat also lies in the incapacity of development planning law and administration to prevent increasing exposure to flood through new development.

Action Focus

The action focus of the IWRM plan is to strengthen the governance framework in Fiji as it relates to the management of water resources and preparation for climate change impacts, which are expected to lead to greater extremes of wet and dry conditions than in the past. There is a strong focus on information and planning, but also on the need for legislative development. The IWRM Plan identifies actions and programs in the categories shown below.

IWRM Plan Programs

The IWRM Plan identifies nine program areas for the integrated management of water resources. Climate change is a vital consideration in all aspect of water resources; it does not have its own key performance area. That is because climate change is to be considered in all areas of performance, and it is built into the whole of the Plan.

There are nine programs to develop the IWRM framework and provide development in Fiji as outlined in Table 7. Brief outlines are given below.

Table 7 IWRM Programs

Program	Departmental Involvement
1. Water Resources Information & data	
1.1 Surface Water information	FMS Hydrology Division
1.2 Groundwater information	MRD
1.3 Water quality monitoring	MECC, DWS, MHMS, MRD, WAF
1.4 Data exchange and access	MRD, FMS, MLMR, DWS, MHMS, MECC, WAF
2. Water Resources Planning	
2.1 Water resources planning	MAWSI, MRD, FMS, NDRMO (National Coordinating Authority), with relevant agencies
3. Water Resources Allocation	
3.1 Surface water allocation	MLMR, MAWSI, FMS
3.2 Groundwater allocation	MRD
4. Integrated Flood Risk Management	
4.1 IFRM	NDRMO in coordination with FMS, MAWSI, DTCP, MLMS, TLTB, Local government

Program	Departmental Involvement
4.2 IFRM and flood operation	NDRMO, MAWSI
4.3 IFRM and development planning	NDRMO, DTCP
4.4 IFRM and infrastructure	NDRMO, GCCS, DTCP
4.5 Flooding and drainage	MAWSI
5. Drought Management	
5.1 Drought planning and strategy	NDRMO (in consultation with relevant agencies)
6. Water Quality Management	
6.1 Water quality management	MECC, DWS, MRD, MHMS, MLMR, WAF
7. Water and Environment	
7.1 Water and environment	MECC, MRD, MLMR
8. Watershed Management	
8.1 Rural Watershed Policy	MITACHA Forestry, TLTB, MRD, DTCP, NDRMO, DWS, MLMR, WAF, MAWSI, others
8.2 Watershed Coordination	MAWSI, TLTB, MRD, MLMR, Forestry, DTCP, MECCC, NDRMO, WAF, MECC, others
9. Coordination and Communication	
9.1 Coordination and communication	DWS, All

Program Output Indicators

Output indicators for the IWRM Plan are listed in Table 8.

Table 8 Program Output Indicators

Program	Indicator
Water resources information and data	<i>Comprehensive, long-term reliable and quality assured data and information available for analysis and exchangeable for public and private uses</i>
Water Resources Planning	<i>Plans based on good understanding of water resource availability, quality, and sustainable limits, and development is consistent with maintaining water sources for all beneficial purposes</i>

Program		Indicator
Water Allocation	Resources	<i>A legally based and enforced system of water rights that maintains a sustainable water resources while encouraging beneficial uses in a harmonious manner</i>
Integrated Flood Management	Risk	<i>Flood schemes and measures based on understanding of flood risk, reducing flood hazard and loss while preventing added flood exposure in all key flood hotspots</i>
Drought Management		<i>Improved predictive understanding of drought and planning to provide for continuing access to basic water services and water for agriculture and enterprise</i>
Water Management	Quality	<i>Effective regulation of pollutants in wastewater and other sources to maintain ambient water quality in water sources</i>
Water and Environment		<i>Inventory of important water-based environmental values and ecosystems for protection</i>
Watershed Management		<i>Effective coordination and planning measures for river basins, with strengthened regulation of degradation sources and self-managing upland watershed plans and practices</i>
Coordination and communication	and	<i>The national multi-stakeholder National Water Resources Management Coordination Committee has been established</i> <i>Coordination arrangements at thematic and basin levels are useful, effective and provide forums for essential inclusion of society and enterprise to influence water management.</i>

The indicators in Table 8 will be used to monitor progress by ministries and departments in implementing the programs.

Program 1 Water Resources Information and Data

Background

Reliable long-term data is essential for understanding water, its occurrence, movement, and behaviour. Water behaves dynamically in nature, with its flow direction, rate, and availability fluctuating over time. Surface water typically follows seasonal patterns, though longer-term trends and year-to-year variability in flow also occur. Therefore, it is critical not only to measure flow during representative seasonal periods but also to collect continuous time-series data that captures trends in volume and the speed at which flow conditions change.

Important markers for surface water are the extremes of high and low flow and their likely occurrence, frequency and duration. This is because, as shown in Program 2, water resources adaptation planning requires knowledge of likely or possible extremes of flow to design effective measures for water security and hazard minimisation.

Groundwater, though not subject to the same degree of movement as surface water, also flows under the ground. At a very slow rate. Water table levels and fluctuations pressure are two indicators of the occurrence, abundance and variability of groundwater. Some aquifers are recharged in significant volumes while in other situations there may be little or negligible recharge. Shallow, mainly porous alluvial strata may be subject to considerable fluctuation in groundwater volume and water table level and may inter-connect actively with surface water bodies.

It is important to have the capability to understand the occurrence and behaviour of surface water and groundwater. Reliable historical and current data is critical for water resources planning, water allocation and the assessment of flood risk.

In addition to the occurrence, quantity and behaviour of water resources, it is important to understand the quality of water, both surface water and groundwater. Water quality is covered in Program 6, but data aspects are considered in this section.

The IWRM Plan has identified measures to develop the water resources data functions in Fiji for both surface water and groundwater separately. Responsibility for surface water data is assigned to the Hydrology Division of FMS (FMSHD). Responsibility for groundwater data is assigned to MRD. The IWRM Plan therefore covers water resource information in four areas:

1. Streamflow data;
2. Groundwater data;
3. Water quality information and data; and
4. Data coordination.

Rainfall data is also an important contribution to water resources information, but this is not the subject of this IWRM Plan, as no significant recommendations are being made for the development of the weather and climate functions of FMS.

Streamflow Data

The Issues

The national streamflow gauging function was transferred from the former Water and Sewerage Department to the Water Authority of Fiji (WAF), because most, but not all, of the data was related to WAF's water intakes. However, it was not considered appropriate for WAF as a Government Commercial Company (GCC) to maintain a national surface water information system. Therefore, it was transferred again to FMS, but WAF necessarily continued to conduct streamflow monitoring for its own important sites such as upstream of dams and major river intake works. These data are held by the Water Resources Management Unit (WRMU) of WAF.

Investment in the streamflow gauging function is now a priority because its effectiveness over time has degraded. FMSHD has focused mainly on flood warning by monitoring water levels and communicating these in real time to NDRMO and others for flood response. Given that freshwater flooding can be categorised as flash flooding, rapid data transmission is critical.

At the same time, the broader purposes for surface water data may have not been given priority. This is partly because no agency has had a clear mandate for water resources planning or assessment and therefore demand for data has been inconsistent. A key step in the IWRM Plan is to broaden the mandate of FMSHD to include data for water resources planning and assessment, which will include flood studies as well as hydrologic studies to identify water resource availability.

It is also considered important to upgrade the database function of FMSHD to provide more immediate access to data.

Strategies

The NWRMSP identifies the following strategies for surface water information:

- a) Perform a major upgrade of the capacity of the Hydrology Division of the Fiji Meteorological Services (FMS), to re-establish flow discharge calibration;
- b) Conduct a review of national key sites for river gauging;
- c) Undertake a quality review of historical streamflow data and establish, as far as possible an unbroken and reliable time-series;
- d) Upgrade data storage and archiving, to improve capacity to interact and analyse
- e) Provide FMS with the power to obtain streamflow data from public and private organisations where necessary to improve the national database;
- f) Conduct a national review of the need for real-time streamflow data for flood warning purposes, and plan to upgrade river gauging capacity in relevant locations; and
- g) Establish a surface water quality database for Fiji, using sampling data from all sources.

Water Resources Data Quality

Data quality should not be mistaken for water quality, which concerns the chemical and biological composition of water. Instead, data quality relates to the reliability of recorded information whether it is consistent, accurate, and properly documented so that it reflects actual conditions. A data quality review examines records to confirm that unusual data points are reasonable or explainable, and that the information remains consistent over time. The purpose of such a review is to identify and eliminate potentially inaccurate records, thereby strengthening the overall dataset. Conducting a scoping assessment of streamflow records is essential to determine whether significant issues of consistency or reliability exist and if necessary, to make appropriate corrections.

Access to Data

Comprehensive data provide important benefits for planning and assessment of water resources. Urban water data collected by WAF and independent scheme monitoring will be available to FMSHD through the Water Service Regulator, DWS. These data will be evaluated and, where appropriate, incorporated into the national streamflow database.

Access to Streamflow and Groundwater Data

An issue is the public and private use of streamflow data, which should be generally available for beneficial purposes. For instance, developers should have access to streamflow data to determine whether the water they seek to take will be available. WAF streamflow data are archived by the Water Resources Management Unit and provided to FMS with internal approval

Access rules and protocols are necessary and will form part of the general water resources data and information exchange and access scheme. It may be necessary to consider how to obtain surface water data from private water users, for the surface water database.

Combined Use of Meteorological and Streamflow Data

There are advantages in the combined use and understanding of weather and climate information along with streamflow, which is a product, for the most part, of weather events and long-term climatic trends. It is desirable to investigate ways in which meteorological data and streamflow data records in FMS can be compared with a view to use in modelling and assessment of streamflow and river basin behaviour and variability at various catchment scales. Modelled information would be of significant use for WSS as WAF understands of surface water availability and behaviour. The degree to which analytical work can or should be carried by FMS in the field of hydrology should be reviewed. The review should be conducted with WAF's and DWS's requirements in mind among other objectives.

Program 1.1 Surface Water Information

The program for surface water information is shown in Table 8. A four-year program is envisaged in which the initial steps are (1) to review and confirm the scope and purposes for which surface water data and information is being generated and provided, and (2) to undertake a scoping study of the capacity and future development of FMSHD. Following the scoping study, the programs shown in Table 9 will be undertaken. A data sharing MOU between WAF and FMS is being negotiated. The data sharing arrangement raises the question of common data standards for streamflow and related information. FMS, as the national hydrology agency should ultimately determine the appropriate data standards and data quality requirements for the national database.

Table 9 Program 1.1 Surface Water Information

Program element	Definition	FMSHD
Confirm objectives for FMSHD information	<i>Broaden scope of activity and priority and confirm scope of FMS Hydrology Division</i>	
Conduct scoping study for streamflow data	<i>Review data collection, including key sites, data transmission</i> <i>Identify requirements for discharge measurement at source</i> <i>Provide terms of reference for IT and database/storage development</i> <i>Identify need for data quality review. Focusing on accuracy and consistency of data</i> <i>Scope management requirements</i>	
Develop key site calibration	<i>Establish discharge rating at key sites for discharge data at all levels of flow</i>	

Program element	Definition	FMSHD
Undertake data quality review	<i>Subject to scoping study recommendation</i>	
Upgrade hydrological database	<i>Database to allow for interactive access</i>	
Data accessibility	<i>Investigate need for legal power to obtain data and develop data exchange agreements.</i>	
Review management arrangements	<i>Staffing and organisation requirements</i>	
FMS meteorological and water data	<i>Investigate opportunities for comparison between weather information and streamflow to improve overall understanding</i>	
Introduce flood modelling	<i>Create hydrodynamic flood models linking with meteorological forecasting, to generate more reliable flood warning information</i>	

Outcomes

The expected outcome will be FMSHD:

- Providing reliable time-series streamflow data at key sites in Viti Levu, Vanua Levu and possibly other sites;
- Update discharge rating to maintain flow records in addition to water levels
- Operating effective data archive for planning and assessment of surface water resources;
- Inter-connection between streamflow information and weather, groundwater and related information; and
- Provision of more timely and accurate flood warning by linking meteorological and hydrological models for key catchments.

Program 1.2 Groundwater Data and Information

The Issues

Groundwater data is derived from bores and wells, initial pumping test and ongoing abstraction information and mid long-term monitoring. Groundwater data provides information on water table levels and groundwater pressures, which in turn indicate probable volumes, behaviour and capacity of an aquifer. Loss of pressure or drawdown of the water table, for instance indicate that groundwater is being abstracted or lost at a greater rate than it is being replenished or recharged.

MRD is responsible for groundwater information, but to date has only had access to data from its own drillers and projects. However, MRD will be able to obtain data in the future from those groundwater users who are required to obtain a permit. The GRDMP proposes that legislation be introduced to require groundwater use to be subject to permits and data on usage provided to MRD, as the permit authority. There are numerous groundwater users whose data is not available to MRD. From a monitoring perspective their data need to be included in the MRD database. A National Groundwater Inventory project is being implemented from 2025-2026 to survey all boreholes and collate baseline hydrogeological data

Databases for groundwater in Fiji are already developed within MRD, but they need enhancing in important respects.

The key areas for enhancement are:

- **Data coverage:** data has not been available from private water users, and this is to be made available through the proposed legislation, to add to information from bores drilled by MRD, along with monitoring bores;
- **Baseline information:** there is a need to conduct a baseline survey to review the adequacy of existing data, its coverage and priorities for enhancement.
- **Database capacity:** greater complexity of data is expected, given that all drilling data will be collected and groundwater quality will be included.
- **Data accessibility and configuration:** the proposed inclusion of groundwater information in a coordinated data scheme will require review of technical standards and consistency with broader water resources data recording.

Strategies

The following will be undertaken in respect of groundwater data and information:

- a) Develop and expand the data and information base for groundwater and obtain all relevant data to increase understanding of groundwater resources and their behaviour;
- b) Conduct a baseline survey of groundwater in Fiji, including all categories and scales of groundwater occurrence and types of aquifer;
- c) Develop a national groundwater mapping database and include groundwater information in the *Vanua GIS*, for public access to groundwater information; and
- d) Analyse groundwater data to identify long-term trends and national implications of climate change for groundwater.

Groundwater Baseline Survey

The baseline survey for groundwater data will identify the adequacy of existing data and where further data should be available. It will confirm the existing national monitoring bore program and recommend change or improvement.

Groundwater Data Quality Review

Historical groundwater data will be reviewed to assess its accuracy, consistency and quality. Recommendation will be made for maintaining data quality in future.

Groundwater Database

A review of the existing databases in MRD will be undertaken. An issue for investigation is how best to incorporate new data from authorised water users, which might be useful for groundwater assessment purposes, but which is also needed to monitor groundwater use and ensure that permit conditions are not breached.

Drillers' Licences and Related Information

The regulatory unit will construct a database for licensed drillers, which will include information on licences, inspections, compliance with licence conditions, reporting on bore installation, including bore construction standards and materials, pump test information. This database will link with the national groundwater information records via automated data transfer.

Groundwater Information and Data

MRD is developing an active groundwater management role and therefore must expand and deepen its data records. The purpose of the groundwater information and data program is to generate national data on groundwater occurrence, quality, behaviour and the impact of recharge and abstraction to better manage the resource.

Table 10 Program 1.2 Groundwater Information

Program element	Definition	MRD
Groundwater baseline survey	<i>Review of existing groundwater and identification of required data for management purposes</i>	
Groundwater data quality review	<i>In tandem with the baseline survey a review of historical data quality will identify data reliability and recommend changes to ensure future data quality.</i>	
Groundwater database review	<i>Database configuration, technology and incorporation of water user data</i>	
Groundwater permit and Drillers' licensing database	<i>Create data archive on drillers licences, reporting and compliance with licence conditions, provision of bore pump tests and related information</i>	

Outcomes

- Comprehensive and updated data on groundwater status from all significant groundwater users including private groundwater users;
- updated baseline information for groundwater management and allocation;
- database capable of improved interrogation and access to data; and
- public access to information on groundwater resources through the data management policy.

Program 1.3 Water Quality Information and Data**The Issues**

The management of data on the quality of water is more complicated than for water quantity. No single department is responsible for, or has developed, a national water quality database. Comprehensive water quality information is costly to obtain, depending on the parameters being monitored. Water quality data can be collected from various sources, in particular instream surface water instream, groundwater, drinking water schemes and wastewater.

A distinction is made between monitoring the quality of water in nature – ambient water – and water for drinking in water supply schemes. Many rural water supply schemes do not have any form of water treatment, so that the quality of the groundwater or surface water from which they draw is critical to the community's health. The Ministry of Health and Medical Services (MHMS) is responsible for ensuring that rural water supplies satisfy drinking water quality standards and therefore monitors drinking water in supply schemes. DWS monitors rural water supply schemes and takes samples from sewage generated in rural sewerage schemes. WAF monitors its own in-scheme water before and after treatment and tests water quality at some of its water intake works. Therefore, there are several reasons for monitoring the quality of water, including environmental water monitoring.

Water quality data is not consistently or comprehensively collected and held. The organisations with a role in water quality sampling and analysis, for various purposes, are shown in Table 11.

Table 11 Water Quality Sampling and Recording

Organisation	Purpose of monitoring data
MECC	• <i>Quality of wastewater discharge under EMA permits. Water quality information obtained by DoE pursuant to discharge licences is currently confidential and not available for water management purposes.</i>
MRD	• <i>Groundwater monitoring well program</i> • <i>Quality data from all bore installation [proposed]</i>
DWS	• <i>Quality of effluent discharged by rural sanitation system</i> • <i>WAF WTP and WWTP discharges and treatment processes</i> • <i>Rural water and sanitation schemes</i>
MHMS	• <i>Rural scheme drinking water supply (where health issues identified)</i>
WAF	• <i>Instream quality upstream and downstream of water intakes</i> • <i>WWTP wastewater discharges</i> • <i>WAF water quality for WTP</i> • <i>WAF WWTP outlet monitoring</i>

MRD proposes to extend its monitoring activity to include water quality in water supply bores and possibly investigative monitoring of sources of groundwater contamination, to protect water supplies and other uses of groundwater.

There is a need to monitor instream water quality in catchment areas close to or downstream of activities such as intensive agriculture, mining, excavation, timber harvesting and similar undertakings. There is no comprehensive or consistent program for monitoring watershed water quality. Within river and stream channels, some activities are problematic, such as excavation leading to turbidity and the release of chemicals into streams. However, a nation-wide water quality-monitoring program to pick up all such activities is not practical because of the cost and resources required. The monitoring programs shown in Table 11 have the potential for actual or possible overlap.

In Fiji, drinking water quality is monitored by multiple stakeholders, raising the need to assess the establishment of a centralized water quality database. Consideration should be given to how data from various monitoring programmes can be collated, shared, validated, and effectively utilised to ensure reliability and consistency. Strengthening and systematically reporting ambient (surface) water quality monitoring is recommended, alongside the development of a comprehensive database on wastewater discharge volumes and quality. Strengthening regulatory enforcement will be aligned with existing environmental legislation, including the Environment Management Act and its subsidiary regulations, to ensure effective control of wastewater discharge, agricultural runoff, and sedimentation. Additionally, opportunities to rationalise existing monitoring programmes should be explored to maximise efficiency and overall benefits.

Ambient Water Quality Reporting

The quality of water in nature is known as ambient water quality. It involves sampling water in streams, rivers and groundwater. SDG Target 6.3 requires countries to report on ambient water quality (surface water and groundwater). However, this requires a nationally consistent water quality-monitoring program. The United Nations Environment Program (UNEP) provides a methodology for SDG ambient water quality monitoring that comprises the five parameters as shown in Table 12.

Table 12 SDG Ambient Water Quality Parameters

Water Quality Parameter	Application
Dissolved oxygen (DO)	Surface water
Electrical conductivity (EC)	Surface water and groundwater
Nitrogen/nitrate (N/N03)	Surface water and groundwater
Phosphorus (P)	Surface water
Acidity/alkalinity (pH)	Surface water and groundwater

An ambient water quality program will be developed to sample the parameters shown in Table 12 and possibly others. The location of the program is to be decided, but it will require not only a sampling regime but also water quality laboratory testing.

WAF collects water quality data upstream, downstream and near its water intakes, which includes analysis of 21 sample parameters, including turbidity, salinity (EC) and mineral content. These data provide information on instream water quality at those locations and could be of broader interest for ambient water quality monitoring and understanding of watershed conditions.

There has been an assumption that surface water quality in Fiji is of high quality in general. Some threats to the quality of surface waters are turbidity (such as is increasingly resulting from erosion and in-channel activity and disposal of wastewater and industrial chemicals mainly but not exclusively affecting lowland and coastal areas. Given that trends are important to identify, a national program needs to be developed, representative sites identified, and consistent sampling techniques applied. Responsibility for the program is to be determined.

Wastewater Monitoring

A major contributor to water quality in surface water bodies and with implications for some groundwater is the discharge of sewage and other wastewater to the environment by WAF and businesses with independent water supplies such as industrial and tourist enterprises. Discharge permits issued under the Environment Management Act (EMA), which requires quality standards to be maintained, control the discharge of wastewater to the environment. Monitoring and enforcement of discharge permits is required to ensure that water bodies are not polluted beyond acceptable limits.

In respect of sewage discharge, the proposed water services regulator will have the power to require sewage treatments plants (STPs) and discharges to comply with the standards in discharge permits. A scheme is required, to coordinate all discharge monitoring and enforcement, including

those of independently supplied enterprises. Currently, DWS collects and analyses discharge quality samples from urban sewage treatment plants and rural sewage treatment systems that have been funded under the RWSP.

Groundwater Quality Monitoring

Groundwater is not specifically included in reporting on SDG 6.3. However, MRD will include water quality parameters in its national database. Data is generally collected through drilling, pumping tests, and monitoring, as most bores are for domestic or urban water supply or, in the case of bottled water, must have a high level of purity and comply with Fiji National Drinking Water Quality Standard (FNDWQS) and the WHO guidelines. Borehole water is collected for analysis during groundwater evaluation and bore assessment or monitoring.

Groundwater resources, where present, has the potential to provide alternative water sources/supply to rural communities, schools, as well as for commercial water bottling. An issue for MRD is obtaining the data from private drilling operators, which will be possible under the proposed groundwater management law. Ongoing monitoring data will also be obtained under the legislation.

MRD's database will include water quality information from pumping tests and all drilling operations.

Program 1.3 Water Quality Monitoring

The water quality-monitoring program will involve several ministries and departments. Agencies currently undertaking some water quality monitoring include the MHMS, MAWSI, WAF, and DWS.

Table 13 Program 1.3 Water Quality Monitoring Program

Program element	Purpose	Facilitator
Review of current water quality monitoring programs (all categories)	<i>To identify extent and characteristics of current water quality sampling efforts and recommend consolidated programs and national water quality database responsibility</i>	DWS
Ambient water quality monitoring (surface water)	<i>Design ambient water quality program sampling, analysis and database</i>	DWS/MECC
Create coordinated discharge quality monitoring and enforcement program	<i>Establish comprehensive monitoring scheme and database for discharges, including rural and independent schemes</i>	
Groundwater quality monitoring program	<i>Identify enhancement for groundwater data collection and database</i>	MRD
Watershed monitoring	<i>Under watershed planning, local monitoring of streams should be included in national database</i>	
Discharge monitoring	<i>Compilation of data from all points sources of sewage and industrial discharge and create database</i>	MECC

Outcomes

The program will create national water quality sampling and analysis for databases on ambient water quality and groundwater quality, with the possibility of identifying quality trends – deterioration or improvement. It will enable Fiji to report with confidence on SDG 6.3 ambient water quality.

Discharge monitoring data will identify areas where action needs to be taken for pollution control and enhancement. The links between groundwater and discharge of liquid wastes will be better identified.

Program 1.4 Data Exchange and Access

The Issue

It is desirable to create information exchange arrangements for technical data in natural resources fields and for water-related data. To achieve a rational and effective data coordination system, several roles are necessary. Data managers are organisations that manage the primary data for a field or category of data and information, such as FMS (rainfall, surface water, streamflow), MRD (groundwater quantity and groundwater quality). For data, exchange to be meaningful there must be technical compatibility between databases. The data coordinator is the organisation that organises the data exchange system.

Much data is most useful when mapped, which means spatially configured such as via a GIS system. Combined data is often required for hydrological and hydrogeological studies, to indicate the condition of water, its movement and behaviour and its quality. These characteristics interact and provide a better understanding of how water is behaving and what trends are occurring over time. Comparison of data sets allows more sharp analysis of the water resource and indicators or those factors that are affecting the condition of water.

Spatial Data and Data Coordinator

The *Vanua GIS* of the Department of Lands contains the cadastral mapping base for Fiji. It is the ideal spatial mapping framework for including spatial mapped data relating to water resources. As such, it may become a data hub for all-important categories of water-related information, including flood maps and the location of water licences and permits. In that role, the Vanua GIS would be linked to the relevant databases in MRD, Ministry of Agriculture and Waterways and others.

A fully developed water resources, or natural resources, data coordination system requires an organisation to adopt the role of data coordinator. The coordinator is responsible for setting technical standards for data exchange and protocols for data publication and access. The data coordinator is not identified. The IWRM Plan includes a program to develop the data coordination scheme and identify the data coordinator. Indicative data categories include:

- Surface water availability (hydrographs);
- Groundwater occurrence;
- Groundwater levels;
- Aquifer type;
- Surface water ambient quality (based on national program);
- Groundwater quality;
- Flood risk maps; and
- Discharge point data.

Information and Confidentiality

Clear guidelines will be established on which categories of information will be made publicly accessible. Currently, private companies such as water bottlers keep water use data confidential.

Under future water allocation schemes for both surface and groundwater, licence and permit conditions will require disclosure of water abstraction information. The data policy will define the parameters for public access to this information.

Data Exchange Protocols

Agreements on data exchange are already being made between government departments. For instance, MRD and FMS are concluding a data sharing agreement on meteorological data. The IWRM Plan promotes a more general data exchange system, which would include general protocols for data transfer between databases. New data categories will be created through water allocation schemes, and it will be necessary to decide what information should be exchanged and allowed public access.

Policy and agreement on data exchange and access will be developed, to provide guidelines for data access as well as the technical details for database transfers. Issues to be considered in the policy include:

Program 1.4 Water Data Exchange

The program will bring together a coordinated group comprising FMS, MRD, Department of Lands, DWS, WAF, and NDRMO, with potential involvement from the Ministry of Agriculture, Waterways and Sugar Industry, and the Ministry of Environment and Climate Change. A key consideration will be identifying the data coordination role to ensure an effective information hub is established and maintained. This responsibility could be assigned to a technical committee, but it would require clear leadership.

Table 14 Program 1.4 Water Data Exchange and Access

Program element	Purpose	FMSHD
Scoping study to Identify data sets, managers and recommend data coordinator	<i>Review of data capacity and confirmation of national data sets and enhancement requirements</i>	FMSHD (leading)
Develop general data exchange protocol	<i>To enable data exchange and access rules</i>	FMSHD
Develop mapping hub	<i>Lands Department Vanua GIS as geographic information system (GIS) hub to include water resource-related layers</i>	MLMR

Water Resources Information Outcomes

The following outcomes for water resources information and data are identified, which will improve the information base by which to understand and manage freshwater resources in Fiji:

- Increase in reliability of streamflow and discharge information for analysis and assessment;
- Expansion of groundwater monitoring data to achieve comprehensive information for groundwater management;
- Mapped flood information to identify location and severity of flood risk;
- A spatial data hub in the Department of Lands with key water resources GIS layers for water resource monitoring, allocation, flood risk and other data for public information;
- Standardised data configuration for data transfer between agencies; and
- Data protocols for water resources data exchange.

Program 2 Water Resources Planning

Planning in Water Resources Management

The IWRM Plan deals with technical planning in the water sector but with emphasis on the management of water resources. The main areas for planning are:

- surface water resources assessment planning, which identifies the amounts of water available for development, but which should also indicate annual and inter-annual variability in water availability;
- groundwater resources assessment planning or aquifer management planning;
- planning for water quality management and water resources protection against pollution and degradation; and
- flood risk planning, which may be undertaken on a floodplain or wider basis, to reduce or minimise flood hazard and risk.

The program also emphasises the development of Water Resources Adaptation Plans to address climate variability and change. Through the IWRM planning process, consideration has been given to establishing these plans as statutory instruments, supported by appropriate legal and regulatory powers, to ensure effective implementation, compliance, and enforcement in Fiji.

Planning Scale

Fiji consists of both large islands and small, low-lying inhabited islands, requiring different approaches to water resources planning. On low-lying islands, planning must focus on the characteristics of limited and fragile groundwater reserves, along with measures to safeguard them from depletion. In contrast, planning for rivers and major streams involves broader-scale assessments and interventions that engage multiple sectors, enterprises, communities, and settlements. Within larger river basins, both large-scale and localized plans may need to be applied simultaneously.

Plan Categories

The IWRM Plan refers to the following categories of water resource plan:

1. **Surface water assessment and quantity management:** plans to identify the surface water availability in a catchment and identify development and use priorities;
2. **Groundwater management:** these plans may also be described as aquifer management plans;
3. **Conjunctive use and management:** investigating and planning for the interactions between rainfall, streamflow and groundwater;
4. **Water resources adaptation:** plans to identify possible extremes of high and low surface water flow, combined with groundwater impacts, and measures to prepare and respond to extreme circumstances;
5. **Integrated Flood and floodplain management:** plans made to coordinate flood control measures with development controls, and, where relevant, operation decision-making immediately before and during flood events;
6. **Water quality management:** plans to control land-based activity and to coordinate disposal of liquid wastes in order to protect surface water and groundwater sources; and
7. **Watershed management:** plans are major basin and local scales to improve the impacts on water sources from land condition and human activity.

Surface Water Assessments

A program is proposed to assess development potential at the sub-catchment level. This will require a surface water survey of all major rivers and streams, with primary focus on the larger islands. While hydrological and climate data may reveal additional opportunities, it is essential that (i) sub-catchment water resources are incorporated into a broader water assessment to evaluate the impacts of developing significant portions of upstream flow, and (ii) planning is recognized as a critical component of effective water resource management. Various types of plans may be prepared for different purposes, and the planning approaches relevant to IWRM in Fiji are outlined below.

Program 2.1 Water Resources Assessment

Some planning is guided by investigations into the occurrence and variability of water resources. Understanding the volume of water likely to be available, as well as seasonal and year-to-year fluctuations, is critical for making informed decisions on current and future development and water use. Surface water investigations combine hydrological analysis of streamflow data with meteorological information on precipitation and the runoff characteristics of catchments and river basins. Groundwater investigations involve hydrogeological analysis of data from exploratory and production wells, assessing water table levels, pressures, and other indicators. These analyses provide estimates of groundwater volume, spatial extent, recharge, flow direction, and likely abstraction capacity.

A surface water assessment program is proposed for the larger islands to evaluate development potential at the sub-catchment level of tributaries and rivers, particularly in rural areas. However, this must also account for the cumulative impacts of extracting water from multiple minor upland streams and incorporate analysis of the frequency and severity of low-precipitation and low-flow periods.

Responsible agency

Groundwater resources assessment will be undertaken in connection with (i) investigation of major groundwater abstraction and setting conditions for groundwater pumping, and (ii) the basis for aquifer management plans. MRD will undertake groundwater assessments.

Aquifer Management Plans

Aquifer management plans are plans that identify the key management issues for an aquifer or aquifer system, meaning linked groundwater systems. Aquifer management implies consideration of volumetric questions as well as sources of groundwater contamination, with the development of measures to manage potential difficulties, while aiming to maximise water use benefits within a sustainable framework.

Aquifer management plans apply to the territory of an aquifer as whole and would guide the allocation of groundwater (for instance by establishing total allowable groundwater abstraction) and identifying pollutions threats and response measures. Local management plans may be attached to groundwater permits, as conditions of permit, requiring the permit holder to maintain appropriate conditions and measures to protect a borehole from contamination (applicable only to land owned by, or under the control of, the permit holder).

Aquifer management plans are likely to be important for shallow and vulnerable groundwater in low-lying islands and coastal aquifers, where there are no permanent surface water sources and where, in some cases, fresh groundwater lies above seawater and is in danger of exhaustion or contamination if over-abstracted. In such cases, there will be local groundwater or aquifer management plans that set strict limits to the volumes and manner of pumping for all uses, including domestic use. Such plans also need to be integrated with conjunctive use plans, where all water sources are considered.

MRD will develop aquifer management plans, in selected areas, in response to significant issues. No specific program has been identified because aquifer management planning is a responsive program.

Conjunctive Use Plans

Conjunctive use applies mainly to common and harmonised use of surface water with groundwater. Drought periods, such as experienced in the Western Division, have led to the expansion of groundwater abstraction through sinking of new bores to replace streamflow. These activities have been unplanned and haphazard in the past. It is desirable to make plans that provide clear strategies for developing and using alternative sources in a coordinated way. Sources should include rainwater harvesting infrastructure and desalinisation (in limited areas). The main objectives of conjunctive use plan will be to provide for continuing domestic water supply for schemes independent of WAF systems. However, other uses, including irrigation and commerce may be included in these plans.

There is overlap between conjunctive use planning, which focuses on the supply of water for consumption and plans that focus on the management of water as a resource, such as aquifer management plans and water resource adaptation plans.

Program 2.2 Water Resources Adaptation Plans

The NAP identifies adaptation planning as important for Fiji, because climate change impacts are expected to be significant. The major impacts on water resources are expected to be (i) more frequent and severe dry periods (reduction in precipitation) and (ii) more severe storm, cyclone and precipitation events. Leading to more frequent and severe flood events possibilities as identified by the Global Circulation Models (GCM).

The effects of climate change on water resources depend on the Global Circulation Model (GCM) used. The CSIRO scenario indicates an increase in maximum and minimum stream flows, while the DKRZ model suggests the converse. It is possible that, because of climate change, extremes will be intensified. That is, low river flows will become lower and high flows will increase in volume, which implies higher risks of droughts and floods

Most attention on climate change for Pacific territories has been given to the effects of likely sea level rise and coastal zone impacts. However, hydrologic extremes (low and high flow) due in turn to climatic events need to be evaluated. Water resources adaptation plans will assume that historic extremes may be exceeded in the future, and that responsive measures need to be developed in advance.

Water resources adaptation plans will cover a specific area, which may be a river basin but may equally be designed around major settlement. This is because responses to extreme flood events will be a feature of the plans.

The water resources adaptation plan program will be developed identifying hotspot areas. They are intended to be in tandem with flood mapping and flood management plans.

Water Allocation Plans

A water allocation plan sets out the rules for water abstraction from a water source. Global limits may be imposed on abstraction from water sources to protect them from the consequences of over-development. If it becomes necessary to prevent further development of a water source surface water or groundwater source, a plan for that source becomes critically important.

Groundwater allocation plans may be part of an aquifer management plan. Surface water allocation plans currently are not envisaged, except for the Sigatoka River where irrigation and urban water supply are in some competition. Keiyasi Water Level Station (FMS) located in the

upper Sigatoka River (FMS Station) can be used to analyse flow and compare it to WAF daily extraction and irrigation demand.

Water Quality Management Plans

Water quality management plans at various scales are likely to be required to limit and control the disposal of contaminants and wastes into water bodies. Water quality management will form part of watershed management planning.

Watershed Management Plans

Planning is central of watershed management, because the condition of land, vegetation and water resources depends on the mutual health of each. Watershed management in Fiji will involve three types of approach:

1. Land reserved for limited activity to protect the quality of land, vegetation and water;
2. Major catchment areas where the threats are largely due to public or private enterprises within and outside river and stream channels; and
3. The effects of rural settlement and agriculture on land and vegetation, particularly in upland areas, which have led to degradation.

The details of watershed management planning are given in Program 8. This program contains disparate elements, involving surface water and groundwater and some of the plans are more properly included in other Programs. Planning schemes in this Program are shown in Table 15.

Table 15 Program 2.1 Water Resources Planning

Program element	Purpose
Program 1: Water resources information	
1. Surface water resources assessments	<i>To identify the scope for future development of surface water</i>
Program 3 Water allocation	
2. Aquifer management plans	<i>To identify management rules and action to maintain groundwater quantity and quality</i>
3. Surface water allocation plans	<i>To identify sustainable limits for water sources and the water withdrawals rules that should apply</i>
4. Water resources adaptation plans	<i>To identify strategies and actions for extreme low and high flow conditions and for groundwater impacts (based on modelled greater than historical extremes)</i>
Program 4 Integrated flood risk management	
5. Integrated flood management plans	<i>To develop a flood management regime that minimises the impact of flood hazard, limits exposure to flood risk, and provides for community resilience</i>
6. Flood operation plans	<i>To develop operational rules that result in optimal reduction of flood hazard</i>

Program element	Purpose
Program 5 Drought Management	
7. Drought management plans	<i>To identify potential drought frequency and severity and develop response strategies to provide for water security and use</i>
Program 8 Watershed Management	
8. Watershed whole-of-catchment plans	<i>Plans to identify the threats to water quantity and quality in river basin and sub-basin areas, and provide measures to counteract the effects of land degradation and sources of pollution in watercourses</i>
9. Upland watershed plans	<i>Plans made by watershed committees and implemented by agreement with the watershed agency to protect and remediate land, vegetation and natural values.</i>
10. Protected area plans	<i>Plans made by utilities and other agencies for protected land in river basins, to maintain and improve water quality and quantity</i>

Outcome

- Programs for water-related planning with a hydrological and hydrogeological base, to provide for the objectives in the program areas listed in Table 15.
- Water resource planning in the program areas listed in 15 integrates GEDSI considerations and includes women, persons with disabilities, and other vulnerable groups meaningfully in decision-making.

Program 3 Water Allocation

Background

Water allocation is the control of where, how much, and in what way, water is taken from surface water and groundwater sources for beneficial use. It also includes providing for the environment and social benefits by ensuring that streamflow and groundwater are not depleted beyond reasonable and sustainable limits. The issue of legally recognised rights to take water from water sources accomplishes water allocation. Fiji has not established a comprehensive water allocation scheme to date, but parallel water allocation schemes for surface water and groundwater are to be developed. The reasons for creating formal rights to take water are:

- firstly, to provide the holder of a water right with legal certainty; and
- secondly, to provide the government administration with the ability to manage water resources within sustainable limits.

To date, conflicts in Fiji over the right to take water or the impact of water users on each other or on water resources have not given rise to serious consideration at government level. However, it is noteworthy that as far back as 1882 the former colonial government saw fit to create a legislative basis for issuing special rights to water from rivers and streams in the *Rivers and Streams Act*. A reason must have been that water rights might be required to allow some water users to take water without interference from other claimants. It is also likely that public water supplies were in mind.

No water licences have been issued under the Rivers and Streams Act so far. However, in 2016, the WAF proposal to take water from the Rewa River at Viria led to an application for a water licence. The application arose when due diligence for the scheme, identified the need for legal security for the right to take the water. In other words, WAF needs to have confidence that no upstream development or other action will be allowed to reduce the water available to its intake works. That confidence can be provided by a water licence, which will require the government administration to ensure that any future development proposal upstream of the licenced location will not reduce water availability to WAF's intake works at Viria.

The second reason for developing water allocation schemes is to control, and in some circumstances limit, water being taken from water bodies, to maintain sustainable limits. Water licences and permits specify the location, extent and manner of taking water. At present, enterprises requiring significant volumes of water from rivers or groundwater sources may do so without being accountable for their ongoing abstraction. Water licences and permits allow the government to control how and where water is taken from nature and in that, way to provide for all types of water use and to minimise conflict, as well as ensure that water is made available for important environmental objectives.

Water licences and permits normally specify the location where water may be taken, the works used to take it, the amounts allowed to be taken, the measuring or metering requirements and, where relevant, conditions relating to timing of water abstraction and other matters may be included. Impacts of water use are also managed through licences and permits (in some countries, water rights may be transferrable from location to location within management rules, but for Fiji, such a scheme would not be appropriate at this time.)

Features of an effective water allocation scheme are:

- a. **Comprehensive:** covering all locations and types of water use at all scales;
- b. **Appropriately applied:** allowing for minor uses to proceed without requiring detailed assessment or formal approval, while defining larger withdrawals appropriately;
- c. **Monitored:** information about water withdrawal is available and can be analysed to enable reasonable responses to existing and new water use proposals;
- d. **Flexible:** although legal rights are involved, the conditions placed on those rights do not restrict reasonable changes to water withdrawal; and

- e. **Enforced:** conditions in licences and permits are enforced and sanctions are applied for breach of licence or permit.

General Objective

Comprehensive and effective water allocation schemes for surface water and groundwater resources in all the Fiji Islands. Establish an effective legal, administrative and technical basis for water allocation.

Planned Outcome

Water allocation schemes that:

1. Clearly define and legally enforce the rights of authorised water users taking water from surface water and groundwater sources;
2. Limit water withdrawals within sustainable limits, to prevent exhaustion or depletion of water sources;
3. Prevent or resolve conflicts among water users and between water users and other beneficiaries of water resources; and
4. Adequately and appropriately, cover all types and scales of water use, while minimising costs and regulation.

Current Responsibilities

The Department of Lands and MRD are responsible for surface water allocation and groundwater management respectively. There is no proposal to amalgamate the two areas of responsibility for the following reasons;

- The current legislation is administered by the Department of Lands, and this is not proposed to be changed; and
- Groundwater expertise is with MRD, and it is the appropriate department to develop the groundwater allocation scheme.

The proposed activities of ministries and departments are shown in Table 16. Note that the primary responsibility for surface water licensing remains with the Department of Lands.

Table 16 Responsibilities Related to Water Allocation

	Department	Activity
Surface water	MLMR	<i>Issue of water licences pursuant to the Rivers and Streams Act, monitoring and enforcement</i>
	Fiji Meteorological Service	<i>Provision of hydrological data and related meteorological information⁵</i>
	Ministry of Agriculture, Waterways and Sugar Industry	<i>Hydrological assessment of licence applications where required</i>
Groundwater	Mineral Resources Department	<i>All aspects of groundwater permit assessment and issue, monitoring and enforcement of permit</i>

⁵ Including incorporating WRMU data from WAF

Introduction of Water Allocation Schemes

There will be separate but parallel allocation schemes for surface water and groundwater. This is chiefly because both the law and administration for surface water and groundwater are separate. Water allocation must be based on law. At present, the legal situation is that:

- The Rivers and Streams Act provide for the issue of special surface water rights; and
- There is no law currently, but the GRDMP states that a groundwater management statute will provide similar legal powers as exist for surface water, along with necessary procedural and decision-making provisions.

Legal Program

No change is required to the right of the Government to allocate surface water by licence. However, the law leaves open an assumed right of others to take water without formal authorisation – at least it has been interpreted that way, where land ownership and leases alongside rivers are concerned. That assumption should be altered to expect that all major water users would require a water licence to take water, in addition to land lease or ownership.

The proposed groundwater management act will require all major users of groundwater to obtain a permit that authorises their abstraction. To date they have been able to take water without specific authorisation or limit. No explicit rights will be affected by the introduction of the permit requirement.

Principles Applicable to Water Allocation

Several principles will be followed in the development of water allocation schemes for surface water and groundwater. These are stated in the GRDMP and the NWRMSP, and are summarised as follows:

- Water is a basic human need, and therefore water for domestic use will receive priority;
- Water will be allocated
 - within an ecologically sustainable development framework;
 - regarding the precautionary principle; and
 - considering known climate change impacts;
- water will be managed and allocated on the basis of the hydrological unit (river catchment or sub-catchment and the hydrogeological unit (aquifer);
- a participatory approach will be taken, allowing the concerns of potentially affected persons and interests to be heard and where necessary acted upon; and
- legal security for water users is an important feature of water allocation schemes.

Introduction of Water Allocation

The approach known as ‘grandfathering’ will be taken on the introduction of water allocation for both surface water and groundwater. Grandfathering is where existing water uses are recognised as valid and incorporated into licences and permits. It is considered reasonable to formalise existing uses unless there are serious questions about the impact of water abstraction.

Surface water licences and groundwater permits are referred to as water allocation instruments and there are several concepts that apply to them in common. The instrument will contain a water entitlement, which is the annual amount of water authorised to be taken. All entitlements taken together must be limited to the sustainable level of water abstraction from each water source. There may be conditions where the entitlement must be restricted, such as when there is very low flow in a river (normally dry season May to October).

The objective is to establish a water allocation framework that creates equitable, sustainable and harmonious access to freshwater (surface water) for the benefit of all sectors of Fijian society and economy.

The target is a functional water allocation scheme, and the creation of legally recognized water rights that encourage beneficial uses and give priority to domestic water supply. The outcome is to establish administrative responsibility for the functions shown in Table 17, noting that not all the activities need be undertaken by the same organisation.

In line with international practice and community and business expectations, an independent body will be established, in time, to hear and decide appeals by authorised objectors, or the applicant for a licence or permit, where the applicant or an objector is not satisfied with the departmental decision. The intention is that it will be convened ad hoc and comprise three members, chaired by a person with judicial qualifications and experience.

Table 17 Activities in Water Allocation

Activity	Surface water	Groundwater
Receiving and registering applications for a water licence or permit	MLMR	MRD
Conducting investigations and other scientific assessments on the impact of granting the application to take water	FMS/ MAWSI	MRD
Considering and balancing the social and economic factors that the application raises	MLMR	MRD
Publishing the proposal to grant the application for the water right	MLMR	MRD
Receiving and dealing with objections (with technical input if necessary)	MLMR/ MAWSI	MRD
Making a water abstraction determination and issuing the water licence accordingly, with appropriate conditions	MLMR	MRD
Monitoring water abstraction by the licence/permit holder and taking other management responsibilities for the water licence	MLMR	MRD
Informing water licence/permit holders of requirements to limit or reduce the abstraction rate at times of low flow or water scarcity	MLMR	MRD
Imposing penalties or sanctions on the licence/permit holder if necessary	MLMR	MRD
Dealing with matters arising from an appeal by the applicant or by an objector	MLMR	MRD
Developing water abstraction rules for water bodies, where necessary, that define the limits to allowable water abstraction	FMS/MAWSI	MRD
Identifying ecological values to be protected from excessive water abstraction	MECC	MECC

Activity	Surface water	Groundwater
Monitoring the status of water bodies and making plans or rules to reflect their changing condition and changes in water uses	FMS/ MLMR / MAWSI	MRD
Record and map existing minor water uses that do not require a water right	MLMR	MRD
Promote water use efficiency and water saving by water users through the water allocation scheme	DWS/ MLMR /WAF	MRD/WAF
Develop policy on water rights and qoliqoli	MLMR	N/A
Conduct independent review on appeal of licence/permit determination	Judicial Department	Judicial Department

Table 17 shows that groundwater allocation is almost exclusively undertaken by MRD, which possesses the technical expertise as well as management responsibility for groundwater permits. The MLMR has legal responsibility but does not have technical expertise in surface water, and it is not proposed that this be developed in the Department. FMS and possibly the Ministry of Agriculture, Waterways and Sugar Industry must be responsible for assessing water availability and the impact of water abstraction and will advise the decision-makers in the MLMR.

Program 3.1 Surface Water Allocation

The surface water allocation scheme for Fiji will be developed and administered by the MLMR. It will be based on the powers in the *Rivers and Streams Act*, which provide that the water in rivers and streams is possessed by the State. The Act [S7] also provides for the issue of special water rights to draw off water from a river or stream. That power is the basis for establishing a comprehensive water allocation scheme.

The *Rivers and Streams Act* confirms that the State of Fiji has the right to the freshwater in rivers and streams and may issue special rights to take it. In the past, this power has not been used but it will be required in the future, firstly because major water users need to have certainty that their right will not be interfered with or reduced by newer entrants taking water from the same water source, and secondly because it is expected that demand for water will increase, so that competition for water in some locations could create problems.

Because the law is silent on the procedures to be followed, the matters to be considered and other features such as right of objection and appeal, it will be necessary to amend the law to include those elements. The *Rivers and Streams Act* does not give legal guidance on how special water rights should be issued or what should be contained in them. Therefore, the *Act* needs to be amended to provide for the assessment and management of water rights and indicate what must be considered and how all interests are to be managed. Amendments to the *Rivers and Streams Act* will include a provision that requires all relevant water users to obtain a licence. At present, the law provides for issuing a licence but does not require a licence to be obtained.

A surface water allocation policy will be developed as the first step in establishing the scheme. Although a water licence will be issued in the meantime for WAF on the Rewa River, the policy is not expected to affect that licence. Issues to be addressed in the policy will include the scale of water uses to be licensed, matters to be considered when determining a water licence, how

extremes of low flow will be managed and procedural requirements. The implementation program for surface water allocation is in Table 18.

The MLMR is the administrator of water rights and licences but will not have technical expertise for assessing water availability or the impact of taking water from a water body. Hydrological assessment of water licence applications will be undertaken by the Ministry of Agriculture, Waterways and Sugar Industry.

Table 18 Program 3.1 Surface Water Allocation

Program element	Definition	MLMR
1. Develop surface water allocation policy	<i>The surface water allocation policy will resolve licensing issues including the introduction of the scheme, its scope, application, issues relating to conflict resolution, priority of water use and important water allocation elements.</i>	MLMR
2. Develop policy and procedures for determination of qoliqoli rights and surface water use	<i>The rights of traditional landowners include qoliqoli as it applies to water benefits. An accepted and clear policy on the treatment of qoliqoli is important.</i>	MLMR
3. Amend Rivers and Streams Act [Cap 136]	<i>Amendment will introduce objectives, procedures, decision-making criteria, objection and appeal rights within legally defined bounds, monitoring and enforcement provisions.</i>	MLMR
4. Establish procedures for FMS and Waterways involvement in determining licences	<i>The Department of Lands will not establish its own technical staff but will rely on FMS and Waterways to advice on water entitlement, restriction, and resolution and so on.</i>	MLMR
5. Design and establish administrative unit, staffing and resources in Department of Lands	<i>A licensing unit will be established in the Department of Lands. The unit will be minimal on commencement but may increase over time</i>	MLMR
6. Training and development program	<i>The Department of Lands will require training in licensing functions, including investigation, conflict resolution and monitoring</i>	MLMR
7. Establish field operation	<i>Field activities may be integrated with existing staff responsibilities</i>	MLMR
8. Create water licence records and database	<i>The record of water licences and water use will form a part of the scheme. Some data may be incorporated into the Lands Department Vanua GIS</i>	MLMR
9. Initiate licensing of major water users	<i>A grandfathering approach will be taken where existing use is authorised, subject to there being no significant conflicts or resource impact problems</i>	MLMR
10. Establish appeal mechanism	<i>Create ad hoc tribunal system with minimal administrative complexity</i>	Judicial Department

Program element	Definition	MLMR
11. Water allocation framework for Sigatoka River	<i>Sigatoka River is where conflict has been evident between irrigation and urban water supply. An initial investigation will determine whether a plan is required.</i>	MLMR

Outcomes

The outcomes for Program 3.1 Surface Water Allocation will be:

- An effective surface water licensing scheme that ensures orderly and harmonious development of water uses into the future;
- Priority for drinking water in water scarcity conditions;
- Measures to provide for surface water ecological values and maintain water use within sustainable limits; and
- Protection of licensed water users from interference by unauthorised and authorised water abstraction.

Program 3.2 Groundwater Allocation and Regulation

The Government has a duty to ensure that groundwater, as a natural resource of Fiji, is managed, maintained, used and protected for the benefit of Fijians, now and into the future and groundwater use must be kept within sustainable limits and there should be equitable access to groundwater by all types of users. Further, groundwater uses rights need to be clearly established in law, to protect groundwater users and to enable sustainable limits to be maintained.

Further, the government has a duty to ensure that bores installed for basic and essential water supply are adequately and properly constructed and that they do not fail or result in contaminated water. Program 3.2 includes both the issue of permits for groundwater abstraction, as well as the regulation of groundwater drilling. Companies and organisations installing bores for domestic water supply must be held to technical standards to ensure the reliability and quality of drinking water. These two arms of groundwater management are included in Program 3.2.

Water allocation is a central part of the management of a water resource. The National Groundwater Resources Development and Management Policy (GRDMP) outline the proposed groundwater allocation scheme:

“Groundwater allocation means deciding where and how much groundwater all groundwater users may abstract. At present, there is no comprehensive water allocation regime in Fiji, but it will be required in order to ensure that groundwater development is equitable and sustainable. Rural and urban water supply should be based on demonstrated requirements and sustainability of the resource. For high-volume groundwater abstraction, such as commercial and industrial uses, hydrogeological studies will be required to ascertain the properties of the aquifer, and the water balance of the catchment.”

A groundwater permit scheme is to be introduced for high-volume groundwater users. Minor uses taking no more than 36m³ per day for basic domestic and household use will not require a permit, but their details will be registered and entered in a groundwater database (see Program 1.2).

As shown in Table 17, MRD has the professional expertise to conduct hydrogeological investigation and generate estimates of groundwater availability, as well as assess the impact on groundwater reserves of groundwater abstraction.

Groundwater use rights need to be clearly established in law, to protect groundwater users and to enable sustainable limits to be maintained. The environmental values supported by groundwater will be recognized and the predicted effects of climate change will be considered through water resources adaptation plans (Program 2.4). Priority will be given to making groundwater available for domestic use.

The right to take groundwater will be governed by a Groundwater Management Act, to:

- apply groundwater allocation measures, regulating all major groundwater uses by issuing permits that define the groundwater that may be taken and used;
- create statutory rules for groundwater drawdown and other criteria to ensure good quality groundwater remains sustainable and available;
- Develop policy and practice guidelines for the use and protection of vulnerable groundwater reserves on small islands; and
- encourage, and where necessary mandate, conjunctive use of groundwater and other supply sources, such as surface water, rainwater, with aquifer recharge measures.

The legislation will also mandate groundwater drilling standards for drilling companies and others, about sinking and installing bores for groundwater extraction. Licensing will specify the construction methods, materials and drilling standards to apply to bores installed; with a view to ensuring domestic groundwater supplies are safe and permanent. The appeal body for water licences will also hear appeals against groundwater permit decisions.

Program 3.2 Groundwater Allocation and Regulation

The groundwater management program includes both groundwater permit to establish the right to take groundwater in large quantities, and the regulation of drilling activity for groundwater production.

Table 19 Program 3.2 Groundwater Allocation

Program element	Definition	MRD
Groundwater Allocation		
1. Introduce Groundwater Management Act	<i>Drafting and passage of law to create formal groundwater use rights</i>	
2. Review mining abstraction and groundwater disposal conditions	<i>Review legislation and mining operation conditions, develop regime to limit impact on groundwater</i>	
3. Develop technical and procedural and rules for groundwater permits	<i>Develop policy with decision-making criteria to balance social, economic and environmental factors in the determination of permits, including program for existing users, technical procedures</i>	
4. Establish regulatory unit in MRD	<i>Review structure and establish regulatory unit to administer groundwater permits and drilling company bore drilling (also applies to drillers' licensing)</i>	
5. Training program for MRD staff	<i>Training for professional, administrative and field staff in permit management and drilling regulation</i>	

Program element	Definition	MRD
6. Create groundwater use database	<i>Records of water abstraction to include all categories of groundwater use</i>	
7. Groundwater protection guidelines for small islands	<i>Develop technical and management framework for small island groundwater abstraction and protection</i>	
8. Establish aquifer management plan framework	<i>Identify priority program for aquifer management planning and undertake initial plan</i>	
9. Issue permits to existing high-volume groundwater users	<i>Undertake permit issue program on a 'grandfathering' basis, and procedures for applications to increase abstraction rates and volumes</i>	
Regulation of groundwater drilling		
10. Introduce legislation (see 1 above)	<i>Create groundwater drilling licence scheme in Groundwater Management Act</i>	
11. Establish drilling licence function in regulatory unit	<i>Regulatory unit to include both groundwater use permits and drilling operators licensing</i>	
12. Establish drilling protocols and reporting rules	<i>It is necessary to maintain open reporting, including on MRD drilling operations</i>	
13. Training program (see 5 above)	<i>Provide training in licensing of drilling operations and field monitoring.</i>	

Outcomes

- well-managed groundwater, accessible for safe urban and rural water supply, equitably shared for all productive purposes and protected from contamination and harm; and
- ensuring that bores installed for domestic water supply are properly constructed and will provide a reliable and safe water supply.

Program 4 Integrated Flood Risk Management

What is Integrated Flood Risk Management?

The Pacific region experiences spatially and temporally fluctuating atmospheric conditions, the El Nino Southern Oscillation (ENSO) phenomenon. Flooding is a consequence of the natural variation when atmospheric moisture becomes temporarily abundant. Rivers and streams respond to the natural variation in surface water flow, and at times, their channels are no longer adequate to contain the discharge that results. Floods occur during those occasions when surface water is abnormally abundant.

For the purposes of Integrated Flood Risk Management under this Plan, NDRMO shall be recognised as the national coordinating authority for disaster risk management, in accordance with the National Disaster Risk Management Act 2024. All flood risk management, preparedness, response coordination, and disaster risk reduction measures under the IWRM framework shall be undertaken in alignment with the coordinating role of NDRMO.

Flooding is a serious disaster issue in Fiji. Apart from cyclones, Fiji experiences serious river flooding and the major towns in Viti Levu and Vanua Levu are subject to periodic flooding. Although not all riverine floods are life threatening, there have been losses of life and severe damage to dwellings and livelihoods in several coastal towns.

NDRMO is responsible for all forms of disaster preparation, response and recovery. In respect of flooding, NDRMO promotes awareness of flood risk and supports communities to make flood response plans that include evacuation strategies. NDRMO is involved in coordination and communication of flood warning, which combines weather forecasting and, immediately before floods reach exposed area, river level trigger warnings. As is explained below, there are elements of flood prediction and preparation that will be developed as part of IWRM and its application in Fiji.

Ideally, Fijian society would free of the serious flood risk. Flood control is a common historical approach to prevent flooding, although it has not been used in Fiji, except for the construction of minor works, such as low-level banks and drains. The term flood control is used to describe reliance on structural (meaning physical) flood management works and measures. It implies a belief that the natural occurrence of floods can be controlled through physical intervention, but in practice complete control of flooding is neither practically nor economically feasible because the natural availability of surface water varies enormously.

Management of the risk associated with human occupation and use of floodplains is the core of flood management, which is really the management of the risk of the destruction that results from flooding. When flood response is seen as the management of risk, certain conclusions result.

Human settlement and activity are located on flood plains, which are the naturally formed lowlands adjacent to river channels, where past flood events have laid down alluvium and created high quality soils. Further, towns and villages are commonly located next to rivers as crossing points and therefore convenient for travel and communication. This means that most coastal cities and towns are located in the downstream area, where flooding is likely.

Integrated flood risk management (IFRM) is a recent approach, developed to be consistent with IWRM principles. It takes a comprehensive approach, acknowledging the interrelationships between socio-economic development, environmental sustainability and the management of flood-risk. It attempts to create a beneficial balance between these objectives. The term integrated flood management (IFM) is also used. A visual way of depicting IFRM is shown in Figure 2.

Figure 2: Outline of integrated Flood Risk Management



IFRM involves a ‘whole-of-catchment’ approach that considers watershed management, flood mitigation and development planning and controls, to achieve the optimum outcomes for the three key flood considerations, which are flood hazard mitigation and reduction, limiting exposure to flood loss and damage, and strengthening resilience by reducing vulnerability to flood impacts.

Three aspects of flood can be identified, all of which must be addressed to obtain the best possible flood protection. They are, as adapted from the definitions provided by the

United Nations Office of Disaster Risk Reduction (UNDRR):

- **Flood hazard**, which is the physical impact and danger imposed by floodwaters entering and inundating an area;
- **Flood exposure**, which is the degree to which people, housing, production capacities and other tangible human assets lie in the path of, or are exposed to the impact of, floodwaters and will be subject to danger and damage; and
- **Flood vulnerability**, which means the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

To understand flood risk management, is essential to understand how the various measures contribute to these three aspects of flooding. This is shown in Table 20.

Table 20 Measures to Counteract Flood Hazard, Exposure and Vulnerability

Element of flood risk	Counter-measures
Flood hazard	• <i>Watershed management to reduce rapid runoff, frequency, velocity and volume of flood flow</i> • <i>Civil flood control works to prevent floodwater from inundating vulnerable areas</i> • <i>Detention and re-routing works and measures to reduce or avoid flood peak flow (including increasing river channel capacity)</i>
Flood exposure	• <i>Flood risk maps to inform communities of location and frequency of flood risk</i> • <i>Prevention of new development in path of highest flood hazard</i> • <i>Re-location of structure and property away from areas of flood hazard</i>

Element of flood risk	Counter-measures
	• <i>Retrofitting existing structures to withstand current and forecasted flood hazard levels</i>
Flood vulnerability	• <i>Pre-planning for flood response</i> • <i>Evacuation and flood response plans</i> • <i>Level of awareness in the community</i> • <i>Effective flood warning</i> • <i>Improved drainage consistent with flood discharge. Normal drainage capacities are not likely to have a significant impact on inundation from flooding, because the floodwater volumes involved in anything, but mild flood events are far too great.</i> • <i>Flood maps (as above for flood exposure)</i> • <i>Building and structural design and materials to withstand inundation</i>
All elements	• <i>Comprehensive flood alleviation schemes</i> • <i>Flood management planning</i> • <i>Comprehensive watershed management planning</i> • <i>Water resources adaptation plans</i>

Flood risk results from a combination of hazard, exposure and vulnerability, all of which are subject to change. Flood risk, as with all water resources issues, is affected by nature on the one hand and by the activity of human society on the other. When assessing flood risk, three categories can be identified:

1. **Present risk**, which is the risk presently experienced in any location;
2. **Future risk**, which is the risk that will occur, if further development increases exposure to flood hazard, if climate change trends occur as predicted, or if the level of hazard increases; and
3. **Residual risk**, which is the risk remaining after all flood management measures have been introduced.

Present risk is the assessed risk based on analysis of likely flood frequency and severity, combined with today's location and level of development and the various activities that lie in the path of floods. Hydrologic analysis can provide flood modelling that predict likely flood discharge and its frequency, based on historic river flow data, combined with weather and climate information.

Two issues affect future risk. The first is the increase in hazard that may occur, such as deterioration in catchment condition, leading to worsening of flow conditions. This is a matter of serious concern in Fiji. Future hazard will also be influenced by climate change, where we must expect more extreme meteorological events and higher and more rapid runoff on land. Another possible reason for future increase in exposure and therefore in risk, is new building or activity in the flood path. Even when the hazard level does not increase, exposure will increase the risk of loss and damage if development continues in locations of high flood risk, or other factors that either increase or decrease vulnerability to the overall risk to persons and communities to flood hazards. Other factors may include changes to land surfaces, as well as climatological changes.

Residual risk is the risk that remains after all flood control and protection measures have been introduced. Although a flood scheme may be designed to protect against a flood event that is predicted to occur no more frequently than once in 100 years (a statistical measure), there remains the possibility that a greater flood may occur. It is common for communities to assume that they

are ‘safe’ from flooding after flood control works such as dykes and levees have been built to protect them. However, there always remains a residual risk, and experience shows that when a greater flood occurs than schemes are designed for; the outcome is likely to be catastrophic.

Flooding is managed in Fiji within broader disaster risk reduction objectives, as expressed, for instance in the Sendai Framework 2015-2030. The Sendai Framework is a disaster risk reduction (DRR) framework, which aims to improve resilience to disaster in participating countries, and reduce deaths, losses and damage over a ten-year period. The general goal expressed in paragraph 17 of the Sendai Framework stresses integration, coordination and a comprehensive approach, namely to:

“Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.”

The Priorities for Action in the Sendai Framework are:

Priority 1: Understanding disaster risk;

Priority 2: Strengthening disaster risk governance to manage disaster risk;

Priority 3: Investing in disaster risk reduction for resilience; and

Priority 4: Enhancing disaster preparedness for effective response.

IFRM focuses on priorities 1-3, which are the preparation stages for flood disaster mitigation and alleviation. It has a very strong focus on the understanding and management of risk. Elements relevant to in IFRM in Fiji are shown in Table 21.

Table 21 Elements in Integrated Flood Risk Management

Elements	Goal
Watershed planning and management	<i>Good quality watershed conditions lead to continuous and greater absorption of rainfall, stable streamflow with less rapid runoff and fewer and lesser flood peaking events</i>
Flood studies (hydrological modelling)	<i>Hydrologic models and analysis provide predictions of likely flood frequency, duration, severity and geo-location, to help design preparation and alleviation measures</i>
Flood mapping	<i>Flood maps show flood return periods and location with associated information about depth and duration, to guide development planning and livelihood activity</i>
Works for flood control	<i>Flood control works are traditional measures to prevent floodwaters from inundating land, property and livelihoods including agriculture. These should be designed based on flood studies</i>
Flood diversion and detention measures and works	<i>Land may be set aside for the purpose of temporarily diverting or detaining floodwaters to reduce or eliminate flood peak flow. The allocation of land for these purposes could be an important issue.</i>

Elements	Goal
Flood operation	<i>Where flood works and other hydraulic works, such as dams, have operable features, it is necessary to develop protocols for pre-flood and in-flood operation</i>
Integrated flood management plans	<i>Plans are necessary to combine action on watershed management, flood operation and development controls, building design and resilience criteria, and retrofitting for reduced exposure and vulnerability</i>
Development planning rules and powers to limit exposure	<i>Development plans and approval procedures need to have regard to flood risk information to prevent building and construction in locations of high flood frequency and risk</i>
Building codes requiring appropriate design and materials in flood-risk areas	<i>Where building and construction is permitted in flood-risk locations, it is essential that they comply with design and materials standards suited to the possibility of inundation (currently the Fiji National Building Code is being reviewed)</i>
Infrastructure design and condition	<i>Public infrastructure review for resilience to ensure that predicted flood events cause minimal damage, and that flood flow is not impeded or diverted in a damaging manner for example, locations now subject to increased flood risk due to recent infrastructure development include Wailotua No.1 in Tailevu and Waciwaci village in Lakeba</i>
Water resources adaptation plans	<i>Plans will analyse extreme possibilities considering climate change and design response plans for flood residual risk</i>

The elements shown in Table 21 will be developed in Fiji, within an IFRM framework, as part of IWRM. To date, no major flood control scheme has been constructed. The Asian Development bank (ADB) has approved funding for a Nadi Flood Alleviation Project (NFAP)⁶, which would include flood control works, levees, along with other measures to reduce flood impacts in Nadi township. The NFAP, when completed, will protect Nadi township to a design flood level, but it will be important to prevent development from being extended into unprotected areas and to provide for response measures in case of extreme flooding. In other Fiji locations, flood control in the form of major levees may not be required, or may take the form of detention basins or measures to divert floodwaters.

IFRM Response Requirements

Program 4 of the IWRM Plan introduces an IFRM approach with focus on the water resources elements of flood mitigation and hazard reduction. Two key areas are:

⁶ Asian Development Bank

1. Measures to minimise the hazard imposed by the passage of flood flow and inundation, through a combination of flood control works, flood diversion measures and flood/high flow impedance mechanisms; and
2. The limiting of exposure to flood damage by exercising control over the location and design of development in flood prone areas.

Elements of IFRM in Fiji will include development in legislation, policy, planning and technical performance, which will involve some administrative development.

A flood control and alleviation scheme would need to be accompanied by maps indicating flood return periods to guide development away from areas of highest flood risk and planning policies and legislative provisions that mandate development in areas of low flood risk only and planning instruments that empower planners to require development to comply with flood risk criteria.

The link between town and country planning and hydrologic analysis needs to be established, so that town planning decisions are consistent with actual flood hazard. Flood detention or diversion measures cannot be installed and operated at present because of the lack of legislative mechanisms in the *Town Planning Act*, to create flood zones for such purposes.

Technical development of flood management involves hydrology-based flood studies to produce flood risk maps and flood return information to indicate the level of flood risk in critical flood-prone areas. Key areas for development are (i) flood control works operation and maintenance, (ii) flood hydrology, (iii) flood mapping and (iv) Integrated flood risk management planning (floodplain planning).

The NDRMO must take a leading role in the planning elements of IFRM as a component of DRR. It is proposed that NDRMO be the leading coordinator for the integrated flood management plans (IFMPs) and water resources adaptation plans.

Program 4.1 Integrated Flood Risk Management Framework

The IFRM program 4.1 does not include reference to the design, construction and operation of flood control works and schemes. These are included in Program 4.2. However, they are central to IWRM in relevant locations. IFRM plans will lead to flood control schemes, where flood studies show that control works are the most effective measure, when combined with the related measures shown under IFRM. Program 4.1 is outlined in Table 22. Flood warning systems are being reviewed under Program 1.1 (see Table 8).

Identification of Ten-Year Flood Study Program

The initial program element will confirm the locations where a ten-year program of flood studies and plans will apply. Other areas must also receive attention, but the major program will involve hydrologic investigation and resulting plans for flood management.

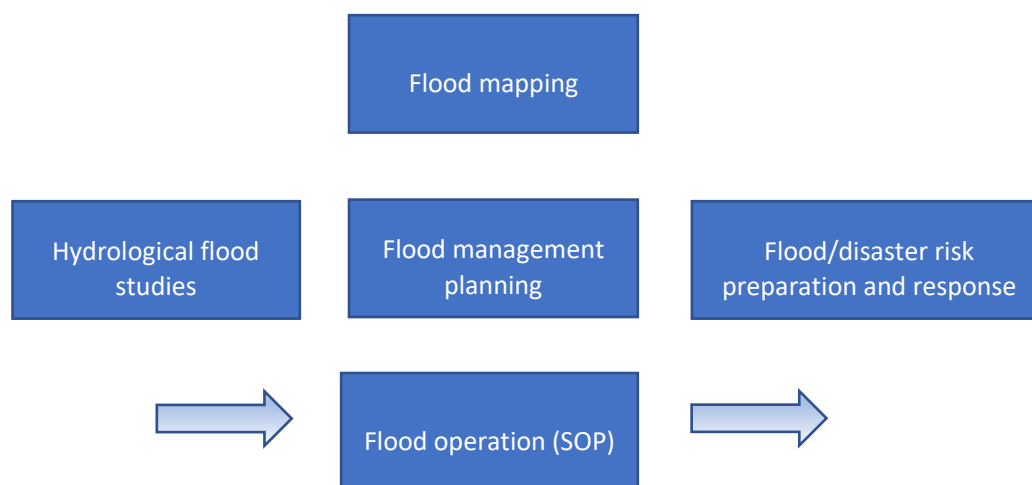
Watershed Management and IFM Planning

While watershed management and planning are important for flood mitigation, this subject is covered in Program 7. Planning that needs to be undertaken for areas subject to frequent or severe flooding is:

- Watershed management plans;
- Floodplain or flood risk management plans; and
- Water resources adaptation plans.

These plans will be linked to relevant watershed management plans as shown in Figure 3.

Figure 3 Relationship Between Flood-Related Plans



An IFMP or floodplain management plan is a plan configured to include all or most of a floodplain area and to combine all relevant factors relating to the threat and occurrence of flooding in that area. It is based on a flood study and a hydrologic flood model that identifies the flood characteristics of the area. Based on the model information, decisions are made about (i) the activities that are carried in the flood plain area, (ii) measures to reduce flood hazard risk, and (iii) measures to prepare for and respond to flood events. The measures in (iii) may include operation of flood works or other hydraulic works if they will have an influence of flood flow.

A water resources adaptation plan, as defined in the Fiji IWRM Plan for Fiji, is a plan that investigates theoretical extreme high flow and low flow/precipitation events, beyond the scope of historically recorded events. In other words, recorded meteorological and hydrological extremes will be extended for a further 5%, 10% and 15% beyond the most extreme known circumstances, and the modelled consequences analysed. Based on model outputs, strategies will be developed for such theoretical events, as possible DRR responses. The reason for conducting such modelling and strategy is to be prepared for greater than historical extremes that could result from climate changes.

Hydrological Flood Studies

A ten-year flood study program is to be conducted for the key flood-risk areas in Fiji. These are the locations where the greatest flood risk exists, due to population and property with businesses and livelihoods. Flood risk includes both the likelihood of inundation and the scale of likely loss and damage. Urban and peri-urban areas are therefore classed as high risk, due to the severity of the damage and loss that flooding will cause. NDRMO will oversee the flood and the flood study program. Flood studies will result in flood maps and will provide the information basis for IFMPs, consistent with the JICA Mainstreaming DRR Program

Flood Mapping

Flood maps will be made for the key flood risk areas, based on flood studies. A flood mapping policy is important to consult and resolve issues that could arise when technical assessment creates flood return maps, which show the flood return periods for specific locations. Flood return periods are calculated based on historical data, which is modelled to show the likely frequency of flood occurring at a particular location. Issues that may arise include impacts on the property values and the cost of insurance, where flood maps indicate a short flood return period. It is not that the flood

hazard has been changed by mapping, but knowledge of the level of flood risk can cause a re-evaluation of the value and safety of properties and livelihoods.

The flood maps are intended to become a planning guideline to prevent further exposure to flood risk. For use as planning guidelines, flood maps must be formally certified as the instrument that defines the level of flood risk, meaning the modelled frequency. Certification will be the responsibility of NDRMO. Once, certified, a flood map will become the formal guideline for town planners who will use it to determine whether development should be allowed and if so under what flood-related conditions such as elevation, structural design and materials. The certification process is important, as certified flood maps will become a guideline for development under the *Town Planning Act*.

Flood Control Schemes and Associated Measures

Hydrologic flood studies will identify the need or otherwise for structural schemes for flood control and associated measures such as flood detention or flood ways, which are areas of land allowed to be flooded to divert flood flow away from an urban or settled area. The location and details of any flood scheme beyond the NFAP cannot be identified until the necessary flood study has been undertaken and recommendations adopted. However, flood control schemes are included in the IWRM Plan, as they will have a significant impact on water management, if adopted.

The adoption of flood detention areas and flood ways will require town-planning measures yet to be introduced. These are specified in Program 4.2. The legal status of flood works requires legislative recognition. The proposal is to amend the Drainage Act to provide the Ministry of Agriculture and Waterways with the power to maintain and protect works for flood purposes in the same way and drainage works and other hydraulic works constructed by the Department.

Flood Operation

To date in Fiji flood control schemes have not been constructed with operational components requiring hydrologic information for flood mitigation, nor have any other hydraulic works, such as dams, been subject to operational rules for flood management purposes. The operation of flood schemes is the responsibility of the Ministry of Agriculture and Waterways. The operation of flood works may include decisions for structures such as dry dams and the opening of intake gates to flood detention areas or flood ways. The exact timing of operations will affect floodwaters and, in some cases, will affect land. Therefore, operational plans are likely to be required, where all community and public interest that will be affected are given a voice in the way in which such actions are decided. Operational protocols will be required for decisions such as when to open and close the gates on a dry dam, for instance. Operational plans can be made as stand-alone plans or may be part of a flood management plan.

Operational planning and protocols will generally be decided through an integrated flood management planning procedure, because issues of land use and inundation are likely to arise.

Flood warning systems are being reviewed under Program 1.1. There are advantages in the combined use and understanding of weather and climate information along with streamflow, which is a product, for the most part, of weather events and long-term climatic trends. It is desirable to investigate ways in which meteorological data and streamflow data records in FMS can be compared with a view to use in modelling and assessment of streamflow and river basin behaviour and variability at various catchment scales. Modelled information would be of significant use for WSS, WAF's understanding of surface water availability and behaviour. The degree to which analytical work can or should be carried by FMS in the field of hydrology should be reviewed. A professional review is to be undertaken.

Integrated Flood Risk Management Planning

Integrated flood management plans (IFMPs) will be made for the locations included in the ten-year flood program. They will be based on flood studies and will include all development planning issues related to flooding, as well as specific flood measures. IFMPs will link to any relevant watershed or catchment plans. NDRMO will be responsible for flood management planning that incorporates development planning and community activity. FMS and the Ministry of Agriculture and Waterways will provide meteorological and hydrological information and analysis.

Table 22 Program 4.1 Integrated Flood Risk Policy and Planning

Program items	Definition	NDRMO
1. Formally confirm key flood locations for attention	<i>Priority urban and settled areas in need of flood attention will be listed for the ten-year program</i>	With DTCP
a. Update and improve existing datasets	<i>Obtain and configure flood risk data for publication</i>	NDRMO
b. Conduct flood studies for key locations	<i>Ten-year program of flood modelling for the nominated key locations to generate flood information</i>	FMS, NDRMO
c. Generate flood maps for key locations	<i>Flood maps with flood return periods to be made and certified for use as flood management guidelines in nominated locations</i>	NDRMO
d. Certify flood maps	<i>Formal certification of a flood map will establish its status as a formal guideline for development planning.</i>	NDRMO
2. Make Flood Management Policy	<i>Covering all hydrology-related aspects of flooding</i>	NDRMO leading with DTCP and others
a. Develop policy on use of flood maps	<i>Public consultation on issues arising from flood return maps and use for development planning and flood alleviation, disaster planning</i>	NDRMO
b. Develop IFRM plan guidelines	<i>Establish IWRM plan framework, scope and planned outcomes in policy document</i>	NDRMO
c. Develop procedures for including flood risk criteria in development plans	<i>Linking technically assessed level of flood risk to be reflected in town and country planning policies, provisions and, where necessary, legislation or regulation</i>	NDRMO
3. Make IFRM plans for key locations	<i>Ten-year program of IFRM plans, based on flood studies, for key locations, covering flood mitigation measures, development guidelines, consultation, communication and flood warning, disaster planning. Where relevant, include operational protocols for flood and</i>	NDRMO (with others)

Program items	Definition	NDRMO
	<i>hydraulic works before and during flood events</i>	

Outcome

- Provision of reliable information on flood risk and planned response measures; and
- Adequate consultation on flood control decision-making and flood-related development policies and conditions.

Program 4.2 Flood Control and Operation

The Ministry of Agriculture, Waterways and Sugar Industry is responsible for schemes involving flood control works. No major scheme has been constructed in Fiji, but a Nadi Flood Alleviation Project (NFAP) is being considered for the lower Nadi River basin area, including Nadi township and environs. Structures proposed for the NFAP include levees, detention basins, and possible river widening and/or dry dams. The Ministry of Agriculture and Waterways controls and has the power to act to protect works for irrigation and drainage, under the relevant legislation, but flood works are not included.

It is particularly important to ensure that the Department can act to protect flood works, because the deterioration or damage to works such as flood levees will reduce the effectiveness of the works to protect from inundation. Therefore, the law must be clear that the MAWSI have the power to control and manage the works.

The MAWSI must also operate flood works that have operable features. They may include opening and closing the valves in a dry dam to retain and release streamflow and opening and closing gates that lead into and out of a flood detention area. The potential liability that accompanies such operational decisions needs to be resolved. This is because such operational decisions will cause water to be retained or not retained or diverted with consequences for the location and severity of flood. Two measures are required: (i) standard operating procedures (SOPs) for the works in a flood event, and (ii) legal protection for the operator if SOPs are properly followed.

SOPs for flood operation need to be developed, considering the various hydrological conditions that may arise, and with respect to the degree of change that will occur and the amount of loss or damage that may be incurred or avoided. SOPs must be developed in consultation with planning authorities as well as community and business representatives, as appropriate.

Table 23 Program 4.2 IFRM – Flood Control and Operation

Program element	Definition	
1. Legislate for flood works ownership and protection	<i>Amend Drainage Act to include works for flood control and related hydrological works</i>	MAWSI
2. Provide legal protection for flood operation	<i>Include provision in amended Drainage Act referring to right to operate flood works</i>	MAWSI
3. Develop flood operation guidelines	<i>Technical guidelines for use in developing SOP for flood operation</i>	MAWSI NDRMO

Program element	Definition	
4. Develop SOPs for Nadi Flood Alleviation Project	<i>When NFAP completed, NDRMO flood management planning group to develop trigger conditions for flood works operation, with appropriate consultation.</i>	NDRMO, FMS MAWSI

Note that element 4 can be developed as part of a flood management plan (under Program 2.3).

Outcome

- Effective management of flood control works to maintain protection from flood hazard and operation prior to, during and post-flood events.

Program 4.3 Planning and Development for Flood Risk

Reduction and limiting of flood exposure (to prevent an increase in flood risk) is the responsibility of the Department of Town and Country Planning (DTCP). Similarly, there is a need to create flood zones under the Town Planning Act, to enable flood detention and flood ways, where they are needed to complete a flood control scheme.

Control of Development

To limit flood exposure, it is necessary to prohibit or restrict new development in locations of high flood hazard. Flood mapping will identify such areas, and a policy will be required in each case to respond to the flood hazard information, such as identified return periods and predicted flood depths and duration, if such information is included in maps based on hydrologic flood studies. Other factors such as elevation, structural design and materials would also apply to buildings and structures where flooding is predicted to occur.

Regarding the planning legislation, flood hazard will be introduced as a matter to be taken into consideration, in the review of the *Town and Country Planning Act* (Cap 139). The law should also specify that certified flood hazard maps would be used to identify levels of flood hazard and considered in the town planning schemes and development approvals. A *Land Subject to Inundation Overlay* (LSIO) mapping layer will become the guideline for identifying flood hazard. The information in flood hazard maps will be inserted into the Department of Lands' *Vanua GIS* database and provided to local council offices and DTCP planning offices.

The *General Provisions* under the *Town Planning Act* need to be amended to incorporate flood-related guidelines. They will also introduce flood-related criteria, and guidelines defining activities that may or may not be permitted in a FZ and on land identified as subject to inundation.

A project to develop the *General Provisions* flood guidelines and related advice to town planners will be accompanied by training for town planners in flood-related policy and development, to assist them to decide where development applications may be approved, where applications must comply with specific conditions and where applications may not proceed.

Development should comply with the *Fiji National Building Code*, which is being amended to include flood-related standards. It is important that the *Code* be mandatory and not voluntary as at present. Therefore, legislative amendment or reference will be required to ensure that its provisions must be adhered to. Program 4.3 is shown in Table 24.

Flood Zones

Program 4.2 includes amendment of the *Town Planning Act* [cap139] to provide for creating a flood zone (FZ). The proposed flood zone is land allocated for the purpose of flood detention or flood passage in connection with a flood control or alleviation scheme. Land in a flood zone would

be prohibited from development that would obstruct floodwater or that would suffer significant damage. However, activities that do not obstruct flood flow or that incur temporary damage only would be allowed. For instance, pasture and some types of agriculture could be permitted.

The purpose of a flood zone is to allow flood flow in a river or other channel to be detained or to travel away from the area of greatest risk of damage and loss. Internationally, floodways' and detention basins have been established to diminish or divert flood peak flow. Similar proposals have been discussed as part of mitigation measures for Nadi township and surrounding area. Inundation of land in a flood zone would be controlled by inlet and outlet works, which would be operated by the organisation responsible for the flood management scheme or plan.

The procedure for designing and applying a flood zone would be (i) a flood study and IFRM plan, with consultation, (ii) approval of the flood scheme by the Government, and (iii) creation of the flood zone under the *Town Planning Act*.

Table 24 Program 4.3 Development Planning for Flood Risk

Program element	Definition	Local Government Councils
1. Contribute to Flood Management Policy	<i>Develop the planning and development elements of the Flood Management Policy to be developed by NDRMO</i>	
2. Develop protocols for use of flood risk maps and technical studies	<i>Develop internal rules and guidelines for town planners to refer to certified flood maps and associated flood risk information</i>	
3. Amend <i>Town Planning Act</i> to consider flood hazard and creation of Flood Zones	<i>Amendments to Town Planning Act to refer to flood and use of certified flood maps to allow or disallow development applications; ability to establish flood zones</i>	
4. Conduct policy review for LSIO and Building Code	<i>Conduct policy program and public consultation on flood map guidelines and Code implications</i>	
5. Introduce LSIO guidelines	<i>Based on flood maps, identify Land Subject to Inundation (LSIO) as planning guideline and applicable conditions</i>	
6. Add LSIO to national database	<i>Include LSIO in Department of Lands Vanua GIS</i>	
7. Add flood management to <i>General Provisions</i> under <i>Town Planning Act</i>	<i>Conduct policy discussion for staff and develop schedules under the General Provisions</i>	DTCP
8. Training program for town planners	<i>Conduct training program for town planning staff for planning decisions in different risk area.</i>	DTCP
9. Update Fiji National Building Code to	<i>Legislative amendment to mandate building code provisions including flood-related standards</i>	

Program element	Definition	Local Government Councils
include flood resilience standards		
10. Mandate Fiji National Building Code	<i>Legislate to make relevant elements of FNBC mandatory for building and construction, and to be applied by town and country planners</i>	MPWMST

Outcomes

- Provision of greater understanding of flood characteristics and trends in major settled areas of Fiji;
- Enable management of major flood schemes with significant flood protection works;
- Development of effective strategies for reducing flood hazard, loss and damage, and improving flood response through planning based on flood information;
- Empower DTCP to prevent increase in flood exposure by inappropriately sited development; and
- Ensuring that development in flood-prone areas is designed and constructed to better withstand inundation.

Program 4.4 Flooding and Infrastructure

The Issue

Public infrastructure developers in Fiji can have a significant influence on flood flow in areas adjacent to public works such as roads, transport and energy links, and major structures. Where infrastructure crosses natural drainage lines, there is the potential for floodwaters to back up behind or alongside civil works. Recent cases indicate that sufficient attention has not always been given to the flood impacts of infrastructure. For instance, there are cases where local flooding has been caused by new or upgraded roadways.

Design standards for the passage of major flood and local flooding need to be applied in such a way that infrastructure does not cause flood events, as identified by flood studies, to inundate areas not previously flooded, or cause the excessive back-up of floodwaters.

Several Fijian infrastructure agencies have been commercialised and therefore are not subject to planning regulation, as their status grants them organisational independence. For instance, the Fiji Roads Authority (FRA) has not been required to confer with DTCP on the potential flood impacts of roadways, or to inform the planning authorities of transport proposals. A similar situation exists in the case of Energy Fiji Limited (EFL), which may design and construct major works without reference to planning authorities.

It is therefore necessary to develop procedures and protocols that ensure that the potential flood impacts of infrastructure are subject to external review, and that applicable flood design guidelines to apply to all infrastructure projects.

Flood Design Criteria

Standard flood design criteria need to be established for all development proposals, including engineering and structural projects that can intercept or divert floodwaters on land where flood

risk is identified. Flood risk will be established through the flood-mapping program, where flooding and drainage reach the risk criteria established through the Flood Management Policy.

Referral Procedures

Infrastructure projects should be subject to review under the Flood Management Policy, which will establish protocols for referral to planning authorities and for evaluation of potential flood impacts.

Table 25 Program 4.4 Flooding and Infrastructure

Program element	Definition	
1. Develop infrastructure referral procedures for flood risk	<i>Referral guidelines and mandatory review to be developed in consultation with all infrastructure agencies</i>	MPWMST DTCP NDRMO
2. Establish flood design criteria for civil works	<i>Design criteria will ensure best practice to minimise the impact of engineering works on flood flow and drainage</i>	MPWMST DTCP NDRMO MAWSI

Outcome

- Infrastructure design adequately recognises flood impact, and the impounding or diversion of flood flow is avoided or allowed only to a reasonable degree.

Program 4.5 Flood and Drainage

Drainage in Fiji

Drainage is defined as the channelling of water through structures to remove it from land, which it would otherwise inundate. A distinction may be made between floodwater and what is known as stormwater. Floodwater is generally considered flow from a stream or river that overflows onto adjacent land. Stormwater is the local flow that results from precipitation, runs off land and artificial surfaces and discharges through drainage works.

Drainage may be urban or rural and normally comprises channels and pipelines that draw water away from occupied land into a water body or the sea. Urban drainage in Fiji is the responsibility of local government, city and town councils. Rural drainage may be installed to take water from irrigated areas or to prevent water from flowing onto agricultural land.

The inadequacy of drainage in Fiji to remove local flooding has been identified as a problem. Difficulties are (i) the intensity and sudden onset of precipitation events that cause large volumes of water to require removal in a short space of time, (ii) the interaction of stormwater drainage with sewers, (iii) the design capacity of stormwater drains in general, and (iv) the limited funds available to local governments for drainage works construction. Added to that, stormwater volumes often increase over time in locations where built-up areas expand and cause precipitation to run off more quickly, overwhelming older drainage lines.

In tropical and sub-tropical zones, stormwater drains must have greater flow capacities in general than in temperate latitudes, because of the frequency and intensity of heavy rainfall events, which may not be persistent, but which may contribute large volumes of water to run off. Ideally, the design and capacity of drainage works should reflect the annual exceedance probability (AEP) for rainfall in the relevant location.

The demarcation of floodwaters and drainage systems may also be unclear. Normally, works for flood control or diversion are constructed to protect land from river flow, whether the floodwaters are given impetus by marine storm surge, while drainage works relate more to local precipitation, although this distinction does not apply in all circumstances. Often the scale of the flow and the works cause them to be categorised as flood or drainage water.

Estuarine Drainage

Emphasis has been placed on drainage in particular estuarine areas, to facilitate navigation and alleviate flooding. The theory has been that dredging will deepen and open estuaries, to achieve these objectives, where estuarine areas are regularly silting up. It is a moot point whether estuaries fall into the category of freshwater, but the condition of an estuary can have an upstream impact on the behaviour of floodwater. The major dynamics are the slowing of river and estuarine discharge, so that over-bank flooding takes longer to drain away, and the water level upstream of an estuary may be raised for a longer period.

Dredging is an ongoing activity of the MAWSI, to maintain estuarine channels and alleviate flooding. However, it is not always clear that dredging, as undertaken in Fiji, does in fact have a material effect in reducing the duration and height of inundation from riverine floodwaters or the overflow of flood water onto floodplain areas. Dredging is constantly required, because deepened channels tend to fill readily with new suspended material brought down from catchment areas, by both normal flow and flood flow.

The IWRM Plan does not propose that the dredging program of the MAWSI be stopped, but there should be a review of the effectiveness of current dredging operations and a hydro-geomorphic study of the estuaries where dredging is most frequently undertaken.

Linking Flood and Drainage Measures

Both flood and drainage projects should be closely linked to urban plans, recognising existing and planned future development. A formal procedure is desirable to ensure that drainage design is included as part of urban planning or is developed in consultation with urban planners at DTCP. Similarly, WAF sewer lines, stormwater drainage lines and development areas need to be designed and developed in concert. Sewage lines cannot be kept completely isolated from stormwater and floodwater, and for that reason, they include relief valves that allow sewer flow escape to prevent sewage back up in buildings and dwellings. The interaction between sewers and stormwater drains is therefore important.

Table 26 Program 4.5 Flood and Drainage

Program element	Definition	MAWSI
1. Establish national drainage review program	<i>Develop ten-year program to identify funding priorities for drainage schemes</i>	MAWSI
2. Conduct evaluation of dredging operations	<i>Hydro-geomorphological modelling of selected estuarine areas, to identify the persistence and effectiveness of changes brought about by dredging operations</i>	MAWSI
3. Establish damage and loss assessment criteria	<i>Damage and loss assessment should determine how and where new drainage works are installed and whether existing works require modification</i>	MAWSI

Program element	Definition	MAWSI
4. Link drainage projects with urban plans	<i>Ensure that augmentation and refurbishment projects for urban drainage are designed in accordance with the complete urban planning scheme and not in isolation</i>	DTCP, FRA EFL, MAWSI
5. Local flooding database	<i>Develop a monitoring database for local flooding events in urban areas for planning and maintenance purposes</i>	Councils, MAWSI

Outcome

- limiting of local flooding in urban and rural areas through effective drainage, to limit local flooding and contamination of stormwater in urban and rural areas.

Implementation of the above measures shall be coordinated at the national level by NDRMO, in line with its statutory mandate for disaster risk management coordination.

Program 5 Drought Management

Background

Drought is a natural phenomenon. It is a temporary, negative and severe deviation for a period from average precipitation (a rainfall deficit), which may lead to meteorological, agricultural, hydrological, and socio-economic drought, depending on its severity and duration. Drought is a disaster management issue, but it is also a water resources management issue.

Drought may be defined as:

- **Meteorological drought:** Deviation of precipitation from normal status over some period;
- **Hydrological drought:** Deficiency of water reserves in groundwater and surface water bodies;
- **Socio-economic drought:** Associated with an imbalance between water demand and water supply and having an impact on society and the economy; and
- **Agricultural drought:** Expressed in terms of the soil moisture required by a particular crop at a particular time.

It is useful to distinguish the type and level of drought and to develop criteria for plans and criteria. Drought is part of disaster management in Fiji. Droughts have been experienced in the main islands and in small islands, due to lack of rainfall. The Western Division is particularly subject to drought because it lies in the rain shadow of the central ranges of Viti Levu.

Best practice drought management involves the following elements:

- Structural arrangements that include an authority for coordinating drought risk assessment, warning and response strategies;
- Drought status monitoring;
- Trigger criteria for introducing drought warning and declarations;
- Established and widely promulgated drought response strategies; and
- Planning that guides action.

The outline for these elements is being put in place in Fiji. Drought management is an element of disaster management, governed by the National Disaster Management Act. It comes under the disaster management organisational structure. The National Disaster Management Council and the NDRMO maintain two committees that have a role in drought management, which are the Drought and Early Warning Committee and the Risk Assessment Committee. NDRMO and these committees work with divisional, provincial, district and village-level disaster management committees under the structures established in Fiji.

The Early Warning Committee is responsible for validating triggering scores, which will activate emergency response plans.

The draft drought management plan identifies four indicators of drought or non-drought situation, based on triggering scores, as follows:

1. Normal: less than 10% of triggering score;
2. Watch/Prepare: 20-36% of triggering score;
3. Alert/Early action: 40-57% triggering score; and
4. Crisis/Emergency response: greater than 57% of the triggering score.

The triggering score is based on a few factors that must be monitored regularly, including ENSO forecasts, vegetation health indices, agriculture stress indices and price indicators.

NDRMO works closely with FMS on long-term and short-term climate and weather indicators. Also relevant are streamflow data, and monitoring of low-flow conditions, by the Hydrology Division of FMS. Similarly, NDRMO must work closely with the MAWSI, Ministry of iTaukei Affairs, Culture, Heritage and Arts and local communities to monitor conditions on the ground.

The drought management plan identifies the mechanisms and communication channels for declaring Watch, Alert and Crisis conditions and the actions that must follow. Drought planning and response coordination under this Program shall be led at the national level by NDRMO, consistent with its mandate under the National Disaster Risk Management Act 2024.

The planning and policy phase for drought management in Fiji, is near completion, through the drought management plan. Therefore, the IWRM Plan does not propose additional actions, but confirms the directions in planning already undertaken.

The NDRMO has drafted a National Drought Management Plan that follows international best practice. The Plan is to be put to Cabinet for approval. Following approval, drought management mechanisms will be established as indicated in Table 26.

Program 5.1 Drought Management

Table 27 Program 5.1 Drought Management

Program element	Definition	NDRMO
1. Identify drought management authority	<i>Drought management authority is NDRMO</i>	
2. Establish drought management structure	<i>Introduce drought management arrangements under disaster management framework including Risk Assessment Committee and Monitoring and Drought Early Warning Committee</i>	
3. Drought management planning and strategy	<i>Draft drought management plan identifies roles and responsibilities and actions required to assess, warn and respond to drought conditions</i>	
4. Initiate triggering criteria and monitoring mechanisms	<i>Draft outline of water management issues and inputs to drought management plan</i>	
5. Emergency planning	<i>Location-based emergency plans to be developed</i>	

Outcomes

- Improved predictive ability based on meteorological and hydrological modelling;
- Clearer trigger signs for drought declarations and drought responses; and
- Alternative water source planning and preparation.

Program 6 Water Quality Management

Background

Water quality management in Fiji is complex. The freshwater resources of Fiji are believed to be of general high quality, although threats to water quality exist in inland and upland areas, in urban areas and on small low-lying islands.

Elements of water quality management are included in other programs, for instance:

Issue	Program
Ambient water quality monitoring program	Program 1: Water resources information
Database and reporting on sewage discharge quality	Program 1: Water resources information
Water quality management plans	Program 2: Water resources planning
Diffuse pollution source management	Program 8: Watershed management

The quality of water is critical for human uses. Drinking water must be free of harmful substances. To date, in Fiji, water quality in both rural and urban areas has not been comprehensively managed. Groundwater contamination is known to be occurring in some rural cases, where waste disposal close to drinking water bores is contaminating the water sources. Similarly, surface water sources in some cases may be polluted by sewage disposal and discharge from sewage treatment facilities. Sources of contaminants are shown in Table 28.

Table 28 Sources of Water Pollution

Pollution source	Definition
Naturally occurring contaminants	<i>Minerals and naturally occurring substances on and under the ground that enter waterways and groundwater naturally</i>
Point source discharges to surface water	<i>Point sources are wastewater discharges from STPs and industrial or commercial discharges via pipes, drains, canals and the like. They require a discharge permit under the EMA.</i>
Surface water diffuses sources of pollution	<i>Diffuse sources include soils via erosion; agricultural chemicals applied to land and human wastes that drain indirectly to a stream or river. Diffuse sources may also affect groundwater in recharge areas and into superficial unconsolidated strata from the surface of the ground</i>
Groundwater bores and wells	<i>Waste disposal adjacent to bores and wells causing contamination of the groundwater and the installations. Pollutants may include domestic</i>

Pollution source	Definition
	<i>wastes and industrial wastes and discharges as well as solid wastes.</i>
Indirect waste disposal	<i>Industrial wastes discharged into WAF sewers and drains and into council drains, which then discharges to the environment. WAF controls the discharge of industrial wastewater into its sewers</i>

Mechanisms exist to manage and control the entry of pollutants into the aquatic environment, comprising freshwater streams and rivers and groundwater. Measures are shown in Table 29.

Table 29 Pollution Sources and Management Measures

Pollution source	Control and management measures
Turbidity resulting from erosion and rapid runoff	Removal of forest and other vegetation exposes land to the direct impact of precipitation and runoff. Revegetation, reforestation, land forming and appropriate farming methods are required to prevent rapid runoff. These are positive measures that rely significantly on local practices
Naturally occurring contaminants	Mining, waterways excavation and possibly excavation into superficial aquifers are the chief causes. Controls exist in the Mining Act and the administration of the Rivers and Streams Act which authorises excavation in river channels
Point source discharges to surface water	These are controlled through discharge permits issued under the EMA by the Department of Environment, which is responsible for monitoring and sanctioning for breach of discharge standards.
Surface water diffuses sources	Intensive activities, including intensive agriculture is not controlled as to diffuse discharge and runoff. Watershed planning identifies pollution sources and designs measures to prevent contaminated runoff and land degradation
Groundwater bores and wells	No controls exist at present, but the proposed Groundwater Management Act will empower MRD to create groundwater protection zones where pollutants will be prohibited from disposal. MRD will also be empowered to prevent domestic waste disposal adjacent to water supply bores.
Indirect waste disposal	WAF has the legal power to control discharge into its sewers. Other discharges into stormwater systems not owned by WAF cannot be controlled.

Identified Gaps

Two situations can be addressed to improve the quality of water resources:

- Where the government has no legal power to limit or prevent a polluting activity and
- Where powers exist but monitoring and enforcement is inadequate.

Some activities that are not authorised may continue because there is no mechanism to ensure that they either are stopped or obtain authorisation. Regulatory measures will be strengthened in alignment with existing environmental legislation to improve control of pollution sources affecting water quality.

Self-reporting and self-monitoring schemes are employed in various situations, including WAF's STP discharges, (WAF monitors its discharge quality) and excavation in waterways authorised by the MLMR, which have been investigated by the MECC and MAWSI. Mining has the potential to pollute water resources in several ways including the use of water in mining operations, which carries minerals and other substances into streams and rivers, and the disposal of tailings and use of tailing dams, which have the potential to release pollutants. The extent of mining discharges and water quality impacts needs to be studied, and measures identified, if it is found that contaminants are percolating into groundwater or draining into streams and rivers. The most significant gap is the diffuse activities of rural settlements, rural agriculture and other enterprises in land that drains to rivers.

Watershed planning and management can be divided into three categories:

1. Whole-of-river-basin planning and management;
2. Rural upland-based planning and management; and
3. Protected areas.

These activities are covered in Program 8 Watershed Management

Some of the more common water quality and degradation causes are:

- In-channel excavation (beds and banks);
- Intensive agricultural activity;
- Sewage disposal; and
- domestic waste disposal.

Sewage Effluent

STPs are a widespread source of water pollution. WAF's STPs must hold a discharge permit issued pursuant to the Environment Management Act (EMA). However, WAF self-monitors the quality of wastewater discharged from its facilities. Independent overview of treated wastewater needs to be introduced, to ensure transparency and effective treatment before discharge. Following the approval of the *Water and Sewerage Services Bill*, DWS will conduct a review of all WAF STP discharges and jointly develop an upgrade program, to include review of operational practice.

Rural schemes with locally owned and operated STPs must also be regulated in the same manner as WAF. DWS is responsible for ensuring that rural schemes comply with operating standards, which include sewage treatment. DWS will conduct an overview of rural schemes to identify where they are not performing to standards and will introduce measures to prevent surface water or groundwater contamination resulting from disposal of untreated or poorly treated sewage and domestic wastes.

Excavation

The Waimanu River Catchment Integrated Management Plan (WRCIMP) indicates that self-monitoring by excavators in river channels is problematic. In-river problems are not so much a result of the regulatory conditions as a failure of enforcement. It is noted that four agencies have a role in approving excavation in river channels (Department of Environment, Department of Lands, iTaukei Land Trust Board and Mineral Resources Department. Further, the Ministry of Agriculture and Waterways may have the geomorphological expertise to evaluate the impact of excavation). This activity has caused and is still causing damage to streams and rivers.

Intensive Agriculture

Intensive agriculture may include dairying, animal husbandry and the use of chemicals on irrigated crops. Runoff from these activities enters streams and rivers and may percolate to groundwater. There is little monitoring of the actual impacts on water of agricultural activity. Irrigation drainage is also a factor in some areas, where pesticides, fertilizer may be added to salinized water that runs into rivers or streams. Measures to control these impacts include barriers to runoff and recycling and re-use.

Groundwater Pollution

MRD has identified the contamination of bore water as an important issue. That problem arises partly where drinking water bores are sited inappropriately close to waste disposal areas, latrines and so on. The regulation of drilling companies and operations will prevent improper siting when the groundwater legislation is introduced. For existing boreholes measures to control or move, waste disposal may be a solution. The proposed groundwater legislation will enable MRD to create groundwater protection zones where activities that lead to groundwater pollution will be prohibited.

Table 30 Program 6 Water Quality Management

Program element	Definition	
1. Monitoring of discharges to water bodies	<i>Review effectiveness of self-monitoring and self-regulation and develop effective regulatory regime</i>	MECC
2. WAF STP review and upgrade program	<i>Program to upgrade and improve operation of sewage treatment plants and facilities of WAF and rural schemes, to include discharge quality monitoring review</i>	DWS
3. Rural sewage disposal program	<i>Investigate effectiveness of rural sewage treatment facilities and remediate under RWSP</i>	DWS
4. Bore contamination program	<i>Establishment of zones to prevent pollution of bore water as part of registration process</i>	MRD
5. Review of in-channel excavation	<i>Review current enforcement of excavation</i>	
6. Review of mining activity and impact on water resources	<i>Review existing regulatory framework and develop mechanism to control mining discharges and waste disposal</i>	MRD/MECC
7. National database on discharge quality	<i>Create coordinated wastewater discharge information to support investigation of</i>	DWS

Program element	Definition	
8. National ambient water quality monitoring program	<i>Establish national ambient water quality monitoring program for SDG reporting and water management</i>	
9. Agricultural water uses efficiency and water quality program	<i>Review of agricultural practices and development of mandatory and voluntary rules and practice guidelines</i>	MAWSI

Outcomes

- Improved understanding of ambient water quality and pollution sources;
- Reduction of river channel degradation caused by excavation and mining;
- Improved agricultural practices and water use efficiency;
- Upgraded STP performance;
- Removal of groundwater pollution sources adjacent to bores; and
- Reduction in diffuse pollution from intensive activity.

Program 7 Freshwater Environment

Background

Environmental features of freshwater streams and rivers in Fiji have not been the focus of major attention. It has been assumed, perhaps with justification that the quality of water in streams and rivers is of good quality for the most part. At the same time, the condition of river catchments is known to be deteriorating because of rural agriculture and harvesting. This issue is covered in Program 8: Watershed management, but it has a close relationship to environmental values for aquatic ecosystems.

To date there is no formal inventory of native flora or fauna of high value in Fiji that either rely on water or live in rivers or streams. Similarly, there is no formal plan to protect instream and water-dependent ecosystems, including groundwater-dependent ecosystems. The most prominent Fijian fauna set is freshwater fish, but these have received considerably less attention than marine fisheries, which are very important to the economy and culture of Fiji. Knowledge of freshwater aquatic species appears limited because of a lack of study.

Because water allocation must consider environmental impacts, it is important to undertake a survey of environmental values supported by freshwater resources, both surface water and groundwater. Although all environmental impacts on flora and fauna are routinely investigated as part of environmental impact assessment (EIA) for developments including those that take water in significant amounts, it will be useful to identify significant environmental values associated with the major rivers of Fiji.

Possible effects of water abstraction are (i) reduction of flow in rivers and streams, (ii) increases salinization in lower reaches of rivers, (iii) lowering of water table to deprive vegetation of water, (iv) disturbance to local habitat conditions. The departments administering the water allocation schemes for surface water and groundwater need to have a guide to potential environmental effects of water abstraction.

A survey of ecosystem values is proposed that will identify (i) any freshwater bodies considered to have significant environmental value and (ii) aquatic and water-dependent flora and fauna species considered important to natural ecosystems. The survey will recommend those items and species that need to be considered in water allocation and water resources management activity.

Table 31 Program 7 Freshwater Environment

Program element	Definition	MECC
1. Survey of freshwater ecosystem values	<i>Survey to identify locations, water bodies, with flora and fauna of significance and concern for the aquatic environment</i>	
2. Guideline for recognition of water-related environmental values	<i>Recommended approach to identifying ecosystem issues for development, water allocation and water resources management activity.</i>	

Outcome

- Improved knowledge of ecosystem requirements to ensure environmental protection.

Program 8 Watershed Management

Background

Watershed Issues

Watershed management is the activity that attempts to halt or reverse land and vegetation destruction and degradation to retain or improve soils and water on land bounded by a watershed. The terms watershed and catchment can be used almost interchangeably. However, watershed management is the term generally in use in Fiji.

Watershed management is of serious concern to natural resource managers in Fiji, because deteriorating catchment land is being observed, with consequent implications for water resources. Native vegetation in the form of forests and ground cover is being removed in significant amounts in some areas, and, over time, the condition of some upland areas has degraded with visible consequences. WAF is concerned about the protection of their dam catchments as well as the catchments draining to water intake works, where water of good or reasonable quality is vital for urban and domestic water supply.

The climate and precipitation of Fiji support the robust growth of native forest, but human intervention, apart from managed timber product harvesting, is causing the quality of vegetation to reduce and in some locations to be eliminated. The short-term gains from local harvesting can cause long-term problems for water resources.

The dynamics of watershed deterioration are well known. Exposing the ground leads to a combination of erosion and rapid runoff, which causes turbidity in streams, as well as a higher rise and fall in streamflow. It can cause flood discharges to increase more rapidly and to rise to higher levels. Water is not captured and absorbed into the soil by vegetation, which means that precipitation runs off and leaves streamflow to reduce to lower levels and more rapidly, also reducing infiltration to groundwater.

The second major watershed issue is contaminants entering streams and rivers from diffuse sources, which result from human settlement and enterprises. It includes excavation in riverbeds and banks which is authorised by the Director of Lands, but which involves self-monitoring of the impact, which are mainly turbidity, erosion, and siltation and may include bank instability. Other activities include mining, dairying and intensive animal production or processing. Agricultural chemicals also cause river pollution. The location of these sources of water degradation can be identified, and the issue is whether they are, or can be, conducted in such a way that they no longer cause the deterioration of water resources.

Phases in Watershed Management

Watershed management requires planning at the scale of the river basin or sub-basin (catchment or watershed). Planning involves investigating sources of pollution and disruption to streams and rivers and devising solutions in consultation with the people in the catchment area. However, planning is the initial phase of watershed management. The important second phase is the application of plan recommendations and projects on the ground. This phase may include two types of solution: those that involve ‘once-off’ projects and those that require ongoing changes. The phases of watershed management are shown in Figure 4.

Figure 4: Phases in Watershed Management

Planning Phase			Implementation Phase		
Make watershed plan			Implement watershed management		
Investigate catchment	Identify responses	Negotiate solutions	Development projects	Rules for activities	Ongoing monitoring
Analyse sources of degradation	Develop strategies	Final plan	Completed within the short term	Continuing	Continuing
	Plan may be reviewed periodically			Continuing management of catchment	
Organisation and coordination for plan-making			Organisation and coordination for managing the watershed		

Therefore, as Figure 4 indicates, watershed management can be said to have phases, which involves various types of activity and organisation:

1. Planning
 - a. investigating, analysing and obtaining knowledge of watershed conditions, interactions, development and activity;
 - b. designing, negotiating and recommending strategies;
2. Management
 - a. introducing works, measures and ways of undertaking activity;
 - b. implementing changes to the way activities are undertaken and continuing to monitor them.

While watershed management committees or working groups are commonly established to undertake 1a and 1b, it is critical to have an arrangement for overseeing or organising 2a and 2b. This requires an agency to be responsible either for implementing the watershed management actions or for ensuring that others implement them. Watershed management needs to be embedded, meaning to become part of the ongoing activities of organisations or communities, and responsibility needs to be structured in such a way that responsibility is taken by those who have the power to act.

The greatest difficulty is in establishing an arrangement to perform and coordinate the second phase, following the making of the catchment plan. It requires a structure or arrangement that continues beyond the plan-making period in order to apply the recommendations in the plan.

In some countries, catchment management bodies have been created to undertake water resource protection and amelioration works and measures. Within the European Union (EU), the Water Framework Directive provides for establishing river basin organisations financed from a fund created with fees levied on water users, which pay a volumetric fee for water taken from freshwater sources (streams, rivers, lakes). A similar financing scheme cannot apply in Fiji, due to cost structures and the fact that a large proportion of total water withdrawal is taken by WAF as the national utility providing basic services to the Fijian community.

Watershed Threats and Solutions

The types of threat to water in watersheds may be classified, to identify suitable responses. Catchment and watershed dynamics are well known. The task for catchment planning is to identify the threats and their location, severity and impacts in any catchment area.

Table 32 Watershed Threats and Solutions

Category of threat	Potential solutions
Instream excavation	<i>Identify acceptable limits and enforce approval rules for excavation</i>
Other excavation, mining	<i>Apply criteria for acceptable limits and enforce</i>
Intensive agricultural runoff and discharge (diffuse)	<i>Develop guidelines and apply (enforce or engage in measures to reduce runoff, limit chemical application and related practices</i>
Loss of forest and native vegetation	<i>Outside protected areas, develop mechanisms to limit vegetation stripping by various actors</i>
	<i>Develop rules shaping shifting agriculture, local vegetation harvesting and timber cutting</i>
	<i>Infrastructure rules to minimise impact and oversight of infrastructure management</i>
Point source discharge and pollution	<i>Issue license to pollute under EMA and enforce end-of-pipe or ambient standards</i>
Domestic waste disposal	<i>Introduce sewage treatment, appropriate safeguards and disposal methods, hygiene rules</i>
Groundwater contamination	<i>Apply bore siting and protection rules, waste disposal rules,</i>

The solutions to the major watershed threats identified in Table 32 are complex and involve numerous authorities and organisations, public and private, as well as rural communities and landowners. Some threats can be dealt with by introducing rules and regulation, while others require individual attention to land and locations, which means slow and resource-intensive programs.

Watershed Management Effectiveness

Three factors determine the effectiveness of watershed management (or catchment management) plans and projects. They are: (i) whether there is an organisation with a clear and accepted coordinating role to ensure that all ministries and departments follow the recommendations made in management plans, (ii) whether the need for controls can be met by existing law, policy, organisations, capacities and actions, and (iii) whether new control and positive protection measures are needed.

In theory, there could be a standard template for watershed management in Fiji, which identifies the threats and proposes approaches to resolve them, in all major river catchments. On the large islands, the types of activity that occur in one watershed require similar solutions to those that occur in other watersheds, for the most part, because they have similar land, forest and vegetation characteristics, as well as rural settlement similarities. Therefore, the solutions are a matter of identifying the watershed problems and applying similar approaches apply to the same causes of degradation elsewhere.

Surveys of forest resources soils, other vegetation, and topography and water resources provide an understanding of what needs to be done in any catchment or watershed. However, the success of planning depends on the actions that are taken, following planning, to remedy the causes of degradation. The success of watershed planning is an institutional matter. It depends more on an effective institutional framework than on a high degree of technical investigation and assessment. Therefore, the IWRM Plan focuses on institutional options for watershed management.

Careful consideration is also required between forest, water, eco-system services, and people ad livelihoods as forests capture, store water, and play an important role in providing drinking water for the people of Fiji. Forests help maintain high water quality, influence the volume of available water and regulates surface and groundwater flows. The diversity of plant species and trees, provide many essential benefits that may or may not be widely recognized and valued in terms of land use decision making. Undisturbed, naturally occurring trees and forests near rivers and streams act as natural filtration mechanisms, freely available with intrinsic water filtration ecosystem services. The difference in benefits to forest-based communities compared to those living in degraded or unsustainable land management practices is apparent. These benefits are identified as ecosystem goods and services. These include provision of water and healthy food, prevention of landslides, flood control and water purification.

In addition to these healthy forest ecosystems support healthy watersheds, which in turn contributes to communities' livelihoods and reduces cost of living. Degrading a healthy forest ecosystem degrades a healthy watershed. This increases reliance on monetary sourcing of goods and services to help sustain healthy living. These ecosystem services are a natural capital to which its monetary value is not widely locally recognized and valued against other land use options. Payments for ecosystem services is a scheme, which recognizes the measured monetary value of ecosystem services through a payment transaction.

Watershed Threats

Environmental management and controls are weak. In some cases, policies are outdated or fail to address current and emerging issues and there is serious need to review existing regulations and law enforcement relating to forests, water use and the different land uses and conservation practices in freshwater management.

Increasing development projects (gravel extraction, road expansion) which involves the removal and clearance of land areas and forest to support infrastructure.

Lack of conservation practices in freshwater management. Freshwater bodies are affected by logging, deforestation, reforestation, poor agricultural practices, and poor land management practices. Insufficient community education, awareness and participation especially on water rights issues and implications on customary land ownership

The unsustainable forestry and agricultural practices have often resulted in heavy soil erosion, causing degradation of Fiji's freshwater ecosystems, and downstream marine ecosystems; siltation leading to the riverbeds and estuaries. By minimizing soil erosion, reducing sediment and absorbing polluting chemicals, healthy forest ecosystems maintain and improve water quality. Forest understory plants, leaf litter, and tree roots, trap sediments and keep them from moving downslope and into waterways.

Experience in Fiji

The Nadi Basin Coordinating Committee

Watershed or catchment planning has been undertaken in Fiji. The Nadi Basin Coordinating Committee (NBCC) project undertook modelling of the Nadi River and surveys of threats to water resources. While it operated, the NBCC provided coordination in several important areas for water resources. The reasons for the impermanence of the NBCC are relevant to watershed management (Program 8) and coordination (Program 9). They can be summarised as follows:

- The NBCC was a project-based organisation, funded by the EU through the (then) South Pacific Geoscience Commission (SOPAC). When the project ended, the NBCC's funding also concluded, and it ceased to operate;
- The NBCC was not integrated with the administrative structure of any ministry or department and was not an arm or office of any administrative body of the Fijian Government and therefore did not have governmental status in that regard;
- Given that there is no agency in the Government with a mandate for water resources management, there was no obvious location for the NBCC or its functions; and
- The watershed/catchment management responsibility in the Government is not sufficiently developed with resources to take up the work of the NBCC.

Much watershed management activity is project-based. This means that when the project concludes the management terminates. This was the case with the NBCC. When the project concluded, the NBCC ceased to exist, regardless of its usefulness while the project continued. The NBCC was not an agency of any ministry or department of the Fijian Government and had no funding base outside the project. The NBCC was not necessarily a failure. Its termination simply indicates that it had not been fitted into any administration of the Fijian government.

Part C of the Nadi Flood Alleviation Project

The Nadi Flood Alleviation Project (NFAP) is a flood scheme to reduce the level of hazard in the lower Nadi River basin. The Australian Infrastructure Financing Facility for the Pacific (AIFFP) approved funding for essential catchment management and upstream flood mitigation work for the NFAP, to provide assessments of watershed condition in the upper Nadi catchment, and to assist the development of flood models, which can inform land management practices and assist with disaster preparedness and management. The AIFFP also funded a draft watershed management legislation draft, which has not been adopted to date.

Waimanu River Catchment Integrated Management Plan

A Waimanu River Catchment Integrated Management Plan (WRCIMP) was published in 2021, for the Waimanu River catchment, a tributary of the Rewa River. The WRCIMP comes under the Ridge to Reef (R2R) program, which has also been applied in the Waimanu River valley. WAF has two water intakes on that river.

The WRCIMP was undertaken for the Department of Environment with the iTaukei Affairs Board and support from the Worldwide Fund for Nature (WWF). The plan identifies seven strategies that could also be applied in other watersheds on the islands of Viti Levu and Vanua Levu. The plan indicates that the Department of Environment will provide a coordination platform.

Rewa River Catchment Management Plan

Most Recently, WAF has been taking the initiative in making the Rewa River Catchment Management Plan (RRCMP) project, to identify the threats to its water supply. Its focus is water quantity and quality at Viria on the Rewa River and at Waila and Tamavua on the Waimanu River. Some threats will be diffused and widespread, as well as some that are concentrated on commercial activities or intensive settlement in particular locations.

WAF cannot exercise control over commercial entities or rural activity and must therefore rely on other authorities and communities to act. Therefore, a mechanism is required to organise the policies and programs of the other authorities to fall in line with the proposals in the RRCMP.

River Basin Management Plans

It is proposed that river basin management plans be made for the major rivers of Fiji, according to a priority scheme that reflects the severity and urgency of the water protection and management needs in the basins. Plans will have regard to surface water and groundwater as well as forests and other vegetation values, soils, environmental and ecological values, social impacts and well-being and economic opportunity. River basin management plans will have the following elements:

- A survey of the water resources and dependent natural resources and environmental values of the river basin;
- An assessment of the trends in climate, water and related natural resources in the basin and the threats to water quantity and quality;
- An outline summary of the economic and social opportunities and values provided by the water resources to the communities in the basin;
- The status and role of water in threatening life and property and as a source of disaster and flooding;
- Proposals for improving or maintaining the value of water and related natural resources in the basin;
- Programs under the ministries and other stakeholders; and
- A monitoring and evaluation program over the life of the plan.

The Government will seek donor interest to support river basin planning, as well as ongoing support to implement the management programs that the plans identify.

Administrative Arrangements for River Basins

The IWRM Plan confirms administrative arrangements for watershed planning and management as outlined below. Watersheds are deemed to include river basins and areas defined as catchments, in the planning as well as plan implementation or management phases.

Three mechanisms are being established to manage the catchment/watershed activities, where the RRCMP is the current initiative. They are:

1. A **Steering Committee** that includes representatives of related ministries, chaired by the Permanent Secretary for Public Works, Meteorological Services and Transport;
2. A **Memorandum of Understanding (MOU)** between Steering Committee members which commits them to cooperate and participate in the planning process and apply their powers and mandates to perform the identified catchment management programs and activities; and
3. A **Secretariat** to support the Steering Committee, located in the Ministry of Agriculture and Waterways.

The RRCMP MOU (as approved and signed by the Permanent Secretary for Public Works, Meteorological Services and Transport covers data availability and exchange for the purpose of making the plan and commits steering committee members to apply policies and programs within their mandates for the purpose of implementing the RRCMP's recommendations.

The Ministry of Agriculture, Waterways and Sugar Industry is responsible for watershed management in rural areas, which is considered to include major watersheds or river basins, of which the Rewa River Basin is the most extensive example in Fiji. The MAWSI will establish a watershed management secretariat whose responsibilities will include:

- Provide support for meetings of the catchment/watershed Steering Committee under the direction of the Steering Committee chair;

- Organise consultation with catchment/watershed stakeholders;
- Record and promulgate catchment plans, when agreed by the Steering Committee;
- Record the programs and objectives for watershed plans, and the roles of ministries, agencies and other stakeholders;
- Monitor progress in plans, implementation and the contributions of ministries, agencies and other stakeholders; and
- Facilitate the provision of resources and funding for plans and implementation programs.

The Secretariat in the MAWSI will convene the Steering Committee at such times as the Chair of the Committee considers warranted to consider watershed issues that require attention after the plan is approved.

Approval of Watershed Plans

The catchment or watershed plan for a major river basin will involve the programs and activities of several ministries and may include recommendations for the regulation of activities in the interests of improving or maintaining the quantity and quality of water in the catchment or river basin. Such plans will require approval at a high level for their recommendations to be applied, and for all government agencies to be required to follow the recommended actions.

This raises the key question for watershed or catchment planning in Fiji – the need for the long-term application of proposals identified in plans, and the mechanisms required to see their implementation leads to successful outcomes. In this case, the questions are whether the steering committee should continue after the plan is made, and whether the steering committee will be the appropriate mechanism for maintaining watershed and catchment management improvement and protection activities.

Traditional Land Ownership

It is important to recognise that in Fiji, the rights and positive participation of iTaukei landowners are critical to the success of watershed management programs. Causes of degradation that directly affect the activities and rights of landowners require a combination of positive measures as well as potential changes in land practices. These are mainly to do with sources of income from harvesting and farming and there have to be measures that the landowners themselves agree to follow improvement that involve their livelihoods. Therefore, rural communities must actively participate in those aspects of watershed management that involve land-based activity. They must also have a positive attitude to changes that watershed plans identify. The rural watershed policy and program (Program items 4-6, Table 33) provide a framework for this approach.

The Watershed Management Framework

The arrangements required for watershed improvement require (i) coordination for long-term implementation of catchment management plans, (ii) control or appropriate management of activities that contribute to the deterioration of water resources, and (iii) the participation of the community level to obtain support for healthy catchment practices.

1. Long-Term Implementation

Coordination for the long-term implementation of watershed management requires:

- an official mandate for watershed management that provides it with the authority to undertake that role;
- active leadership;
- the resources to organise projects and activities and to coordinate; and
- Inclusion of all the organisations and authorities with related responsibility for natural resources or impacts on natural resources.

At the same time, there is a demand in rural areas and elsewhere to develop water resources within sustainable limits. At this time, it is not possible to identify a ministry or agency that has the resources to adopt the role explained above. Therefore, a strategy needs to be developed, where the responsibilities and arrangements are agreed.

2. Control of Activities and Impacts

The control or appropriate management of activities that contribute to the deterioration of water resources is complex because many sectors are included in this category. Work has been done to identify the key threats to water in catchments. The Waimanu planning investigations identified threats that are common in all major river basins of Fiji.

Current approaches are the difficulty in ensuring that actions are taken by the numerous governments, non-government organisation (NGO), private sector and community organisations. Given the commonality of most, if not all, of the problems affecting catchment health, there should be a review of the legal and institutional approaches that need to be taken. These will include recommendations for changes to law or regulations, the way land-related approvals and authorisations are made, the way in which monitoring, oversight, control and regulation are undertaken or not undertaken. This is recommended in the WRBCMP and is proposed as part of the Watershed Management Strategy in the IWRM Plan.

3. Community-Level Participation

Community participation is important at every level, but where the community has the greatest influence over the condition of land and water, it is necessary to create a program that puts the community in the driving seat and obtains the agreement and support of local people on all matters that affect the quantity and quality of water. This applies to rural uplands, whether developed or undeveloped, which contribute to the health of streams and rivers. A Rural Watershed Policy is proposed, that will provide Water Committees with a similar role to the programs established under the Rural Water and Sanitation Policy.

Watershed Management Strategy

Because the issues described above cannot be fully resolved in the IWRM Plan, a Watershed (or Catchment) Management Strategy is proposed, which will investigate and negotiate the following:

- the leadership responsibility for watershed management in Fiji, with the definition of the responsibilities, resources and procedures, and the legislative requirements, if any, to implement it;
- the coordinating mechanism to be establish and applied:
 - for planning and deciding watershed programs and practices; and
 - the means for ensuring that authorities and partners continue to follow watershed planning guidelines after the planning stage.
- a regulatory review to recommend to the Government the changes to law and practice required to protect and enhance watershed land and water resources;
- a review of development planning guidelines in rural areas, to consider watershed conditions; and
- sources of finance for watershed management programs.

The watershed management strategy will also survey the most critical watershed protection areas and develop a program for tackling priority locations over a five-year period and beyond. The strategy will be a comprehensive investigation and negotiation between the ministries and departments with watershed-related mandates, along with economic sectors and rural communities. It is expected to be a major program.

Rural Watershed Policy

A rural watershed policy is proposed, based on the model included in the NWRMSP. It involves creating a watershed committee comprising local representatives and a plan developed with the assistance of a technical working group. The watershed committee is responsible for implementing the agreed plan and will sign a watershed agreement to obtain funds for plan implementation and related local benefits.

Consultation is needed to develop the model, which will apply to areas where the watershed quality issues are governed by local activity. The watershed committee will have oversight of watershed management in the nominated area and will ensure that rural communities follow the terms and rules in the plan.

This model allows for plan development with the support of donors and external expertise, in addition to the technical working group of related ministry and department officials. The model will be piloted before being evaluated and, if considered, effective, rolled out more widely. It will complement the Ridge 2 Reef (R2R) program, which is already being implemented in some locations. It will differ from R2R in (i) being in a limited area, not from 'top-to-bottom' of a catchment, and (ii) relying on a Watershed Committee of rural representatives which enters into a binding agreement to put the watershed plan into practice.

Protected Areas

The need for protected land arises from the impacts of human activities on land that drains to water infrastructure that relies on water of a good quality. WAF is the central agency with protected area arrangements to protect the land that drains to its dams and water intakes. A major concern is siltation of dams, which occurs when land is exposed through removal of vegetation and forests. Energy Fiji Limited (EFL) has a similar need on behalf of its hydropower dams. Siltation of dam storage diminishes its usefulness. Further, the addition of nitrogen-based fertilizers causes eutrophication of still water and the water weed growth, and in extreme cases, deoxygenation.

Dam storages are some of the very few areas of still (non-flowing) water in Fiji as there are no lakes and few wetland areas, except in coastal areas where they are generally brackish. Dam storage water may therefore exhibit characteristics that are uncommon in Fiji, such as eutrophication and deoxygenation (creating 'dead water'). This will be facilitated by the entry of nitrogen and phosphorus for the most part. The land draining to dam storage waters is of particular importance for protecting both the quantity and the quality of the water resource.

The difficulty for land protection is the conflict between the interests of landowners who wish to exert traditional rights include harvesting natural vegetation, mainly timber, and conducting agricultural activity. Both activities can threaten the quantity and quality of water entering a dam or arriving at water intake works. Fiji has not seen fit to date to create complete exclusion areas except in limited circumstances. Compensation arrangements for landowners may be significant.

Several government agencies have a desire to increase the boundaries and the levels of protection for land in watershed areas. These include WAF and the Ministry of Forestry, which has forest diversity and protection goals.

Program 8 Watershed Management

The watershed management program includes activities that may be described as catchment management and river basin management. The term 'watershed' is used to cover all scales of activity.

Table 33 Program 8 Watershed Management

Program element	Definition	
1. Establish Watershed Coordination	<i>Provide services and resources for watershed/catchment coordinating committees for the purposes of protecting water quality and quantity and dependent values</i>	MAWSI
a. Establish coordinating committees	<i>Establish Rewa River coordination in the first instance with resources for committee operation</i>	
b. Identify critical watershed areas	<i>Conduct discussion to identify locations of greatest need for attention and develop long-term program</i>	
2. Regulatory review of watershed issues	<i>Conduct regulatory review based on issues already identified in watershed reviews</i>	MAWSI
a. Government enterprise activities	<i>Review guidelines and implementation of public agency activities (Forestry, infrastructure, WAF, EFL)</i>	
b. Private enterprise activities	<i>Review rules and enforcement relating to intensive activities, instream activity and sources of degradation in watersheds</i>	
c. Rewa River Catchment Management Plan implementation	<i>Following the catchment plan, implementation for matters identified in the plan will require multiple agencies and participants to take action</i>	
d. NFAP watershed management program	<i>AIFFP funded activities to survey catchment condition and design watershed protection and improvement works and measures</i>	
3. Rural Watershed Policy (RWP)	<i>Draft RWP to establish watershed committees at local level and make plan and agreement for funding of village benefits.</i>	MITACHA
a. Engage with Water Committees in pilot watersheds	<i>Pilot RWP program to implement rural watershed policy with plans and financing arrangements</i>	

Program element	Definition	
b. Implement RWP program	<i>Review pilot effectiveness and continue RWP program</i>	

Outcomes

Outcomes for Program 8 will be:

- Established leadership in watershed management.
- Movement towards regulating sources of pollution in watersheds; and
- Effective rural watershed plans being followed by rural communities.

Program 9 Coordination and Communication

Background

Coordination is a central principle in IWRM. Water resources management in its modern form became prominent because of the need to coordinate across rivers basins and later, by extension, across groundwater aquifers and between surface water and groundwater. Further water is influenced by other natural resources and in turn affects them. The possible levels of coordination become complex when fully considered.

International IWRM organisations such as the GWP and related international agencies (UN, World Bank, ADB) have promoted projects and policies designed to establish coordinating bodies for water resources management. It has been seen as desirable to have two types of coordinating body: at national and river basin scales.

National water councils or coordinating bodies are established to coordinate the water management issues that various ministries and departments are responsible for. This need has been identified where water-related ministerial responsibilities and programs are not conducted cooperatively, or with common knowledge. The second main type of coordinating body promoted for IWRM is the river basin organisation (RBO). Many RBOs have been established internationally, for several different purposes.

Because coordination is such a central issue for IWRM, it is necessary for the IWRM Plan to consider whether the two most common types of coordinating body should be established in Fiji for water resources management, which are a National Water Resources Management Coordination Committee and river basin organisations (RBOs).

The coordination issues covered by the IWRM Plan are:

- National coordination for IWRM;
- Coordination at the river basin scale;
- Coordination for groundwater management;
- Coordination for flood management and IFRM planning; and
- Coordination as means for consultation.

There are several general types of coordinating body that can exist in the water sector. They can be classified as (i) permanent with legislative backing, (ii) authorised by government decision but not in legislation, and ad hoc or for a temporary purpose.

Coordination

National Coordination for IWRM

In Fiji, ad hoc national coordination has been convened, in the form of working groups or committees from time to time. The coordinating arrangements have considered ideas and proposals for water resources management but have not been maintained permanently. In 2008, a national council was established, comprising permanent secretaries, to coordinate water resources issues. It did not continue, because (i) there was not a ministry or department with the clear leadership role in water resources management, (ii) the council did not have sufficient issues to resolve that could not be resolved in other ways, and (iii) it did not have a dedicated administrative support unit.

A national coordinating arrangement for water resources must be linked to administrative leadership in the water sector. In Fiji, the leadership and management role of groundwater is clearly assigned to MRD. For surface water, the administrative responsibilities have been divided, and there has not been a leading organisation for surface water resources management.

In matters relating to disaster risk management, including flood and drought risk, the NDRMO shall serve as the national coordinating authority, ensuring alignment of water resource management actions with national disaster risk reduction frameworks.

Without an organisational mandate for managing water resources, it is not possible to establish an effective national coordination arrangement for surface water. Department mandates and functions relating to surface water resources are shown in Table 34, which outlines both water resources management and water services functions.

Table 34: Surface Water Mandates and Functions

Surface water resources	Agency	Notes
Streamflow and meteorological information	FMS	Hydrology mandate is officially assigned
Surface water assessment	MAWSI	Requiring professional expertise to be available
Surface water planning	MAWSI WAF	Hydrological analysis is with Waterways, but others have roles
Surface water allocation	MLMR	Legal responsibility, function to be developed
Flood management	NDRMO, FMS, MAWSI	NDRMO has flood policy and planning. Waterways have flood scheme construction and operation
Drought management	NDRMO, FMS	Department of Agriculture and Department of Lands, TLTB have an interest also
Surface water quality management	Various	Including Environment, DWS, MHMS, WAF
Environmental management	MECC	Environment
Water services (WSS)		
Urban water services	WAF	
Regulation of urban and rural WSS	DWS	This role will be legislated via Water and Sewerage Services Bill
Water quality impacts	Various	MECC, MHMS, DWS, WAF

The new National Water Resources Management and Sanitation Policy (2026) tasks DWS with establishing a National Water Resources Management Coordination Committee which will be a national multi-stakeholder body to provide strategic oversight, coordination, and advisory support, ensuring integrated delivery of outcomes aligned with national priorities for water resource management and water service provision

Coordination at national level should deal with policy, major programs and issues that require cooperation between ministries. It should not become involved with technical matters or local issues.

Table 34 indicates that presently there is no central responsibility for surface water as a resource, in a way that is equivalent to the functions of MRD in respect of groundwater. Therefore, a new National Water Resources Management Coordination Committee has the potential to take on that responsibility. In addition, water resources coordination at the national level should include both surface water and groundwater, so MRD will need to have a key role on the Coordination Committee. Likewise, Waterways will need to play a key role.

The membership, terms of reference and chairing arrangement of the of the National Water Resources Management Coordination Committee remain to be determined. However, as IWRM efforts normally require creating a national water resource coordinating body, the new National Water Resources Management Coordination Committee once established can provide that formal and permanent national coordinating body for the IWRM Plan. The IWRM Plan itself provides a framework for developing functions and activities related to important aspects of water resources and this is the current focus of attention in the period before the Coordination Committee is established.

As the details of the National Coordination Committee are developed a working group for IWRM Plan implementation will be established and chaired by DWS and or Waterways, which is responsible for the initial implementation of the Plan. The working group will represent all-important functions related to both surface water and groundwater management, as shown in Table 34, with MRD for all groundwater management issues.

Thematic Coordination

Thematic coordination is joint working on programs and responsibilities that need to be related and jointly managed. The thematic coordination centres identified by the IWRM Plan are shown in Table 34.

Table 35 Thematic Coordination Centres

Coordination responsibility	Lead agency	Issue and Participants
Water resources information	FMS and MRD	<i>FMS and MRD share responsibility for surface water and groundwater information. The data exchange review will include water quality and environmental data, spatial mapping and a data hub for which an agency must be responsible.</i>
Water allocation	MLMR	<i>MRD and Lands will coordination on aspects of water allocation such as planning for and investigating conjunctive use. Technical responsibility related to water allocation will be with FMS and Waterways. DWS will have supporting role</i>
Integrated Flood Risk Management	NDRMO	<i>NDRMO will lead development of flood management policy that will cover the technical basis for flood risk, all aspects of planning, policy and coordination. Participating</i>

Coordination responsibility	Lead agency	Issue and Participants
		<i>agencies will be FMS, DTCP, Waterways, MRD and WAF. Other agencies will participate in policy and planning</i>

River Basin Organisation and Coordination

Coordination and Watershed Management

The term ‘river basin’ is used in this Plan to describe what is also called ‘catchment’ or ‘watershed’.

Coordination arrangements may be established for watershed management, as discussed in Program 8. Important questions to consider when deciding whether to establish a permanent coordinating body for IWRM are firstly whether the body is needed for tasks that cannot be accomplished in another way and secondly whether the coordinating body will have sufficient work to warrant a permanent existence.

River Basin Organisations

River basin organisation and coordination is a key feature of IWRM. It attempts to manage water resources across administrative boundaries in line with the boundaries of the hydrological unit. A distinction can be made between organisation and coordination. River basin organisations (RBOs) have been established internationally for numerous rivers, and they are the chief mechanisms for coordinating water resources management between nation states. Within a single country, RBOs may be set up to manage the water resources of a river basin or tributary basin. Organisation implies an ongoing or permanent administrative structure. There are prerequisites for useful and effective river basin organisation. They include active leadership, an organisational structure and an ongoing source of funding. Effective coordination also requires administrative support and funding. These requirements must be considered when considering what form river basin coordination should take in Fiji.

As well as geographical coordination, based on the river basin or sub-basin/ catchment/watershed, there is coordination between levels of government and levels within community structures. That is because water resources management efforts need to take place at different scales. There are important water management activities and programs that must involve the residents in local areas, and in Fiji mataqali and village community. These important participants need to be involved at the basin scale (assuming large river basins) as well as locally.

River basin organisations, of the type commonly promoted in IWRM frameworks internationally are not recommended for adoption in Fiji now. The resources to establish and maintain them are not available. Their practical activities and outcomes do not warrant the creation of new organisations, and it is not clear which ministry, or department should be responsible for them.

Coordination at river basin scale has been attempted in Fiji. The NBCC was established through a European Union (EU) funded project to coordinate water management in the Nadi River basin, but it lapsed when project funding ended. Catchment management plans have also recommended coordination arrangements, but to date not in detail. The Rewa River catchment plan project may also recommend a coordinating group, but its role may be limited to the planning project. The Waimanu River Catchment Integrated Management Plan proposes that the Department of

Environment will provide the coordinating platform for implementing the recommendations in the Plan

Nature and Role of River Basin Coordination

It has been recommended that a coordinating committee be established for all the major river basin in Fiji to perform similar functions as the former NBCC. The questions that remain are:

- Which ministry would host and support the committees?
- What funding sources would apply?
- Whether the committee would have any influence beyond providing advice and negotiating the agreement of members to perform actions or tasks.

The activities that river basin committees may undertake include:

- **Water resources planning:** planning can address several different water resources issues, but a hydro-meteorological model for the river basin would provide information on surface water availability and behaviour. Such modelling would be commissioned by a department such as FMS, Waterways or WAF, rather than by the committee.
Note also that WAF is not a resource management agency but a water utility, therefore WAF's interest in water resources planning will always be limited to its water supply and sanitation provision. For instance, the Rewa River catchment plan will not investigate flood issues downstream of WAF's facilities;
- **Applying policies in the basin:** the committee may have a monitoring role or may promote policy and negotiate the support of its member organisations to pursue a policy direction;
- **Conflict resolution:** where an intractable conflict over water access occurs, the committee could have a useful role;
- **Developing coordinated programs:** the committee could help to develop joint programs which involve several sectors, such as in the field of flood risk management; and
- **Promoting conjunctive plans and programs:** the committee would consider surface water and groundwater interactions where these could be important for instance in drought planning, alternative water sources. MRD can coordinate with other agencies without the need for the committee, but it might help to highlight an issue.

Role in Consultation and Representation

River basin organisations and coordinating committees normally have a role in consulting with and listening to sectoral and community groups and interests. This is in keeping with the principles of transparency and subsidiarity (Subsidiarity is the principle that decision-making should be made at the lowest practical level) that IWRM promotes. It promotes inclusion and consultation on matters that will affect commercial and individual interests. For instance, IFRM plans affect individuals directly by designing or redesigning the flood risk pattern and levels of risk, which may affect some adversely. Consultation is vital for such plans to be accepted and followed.

River basin committees may include sectors and interests by:

- Including representatives on the committee; or
- Creating a consultation or reference group to engage with, separately from the committee itself.

A difficulty with including community and sector representatives on the committee is that the committee becomes enlarged and potentially subject to strongly felt views that can distract the committee from its main tasks. The committee must have a consultation group if representatives are not included in the committee itself. Managing a consultation group as a regular activity involves administrative time, resources and costs.

Support and Leadership

A river basin committee has inter-ministry representation, but a particular ministry must support it to have status as a governmental entity and it must have a source of funds to operate, which would be supplied through the ministry in question. The ministerial responsibility for river basin organisation and coordination in Fiji remains to be decided. It is possible to establish different river basin committees under different ministries or departments, but that would result in greater complexity, if committees were established under different ministries or departments.

There are two options for the leadership or chairing of a river basin committee. The first is an officer from the supporting ministry or department. The second is a chair who is independent of all the represented agencies. In either case, an effective leader must commit time to the role. A manager is also required, to undertake all the administrative work of the committee.

Conclusion on Watershed Committees

River basin committees can be established as a matter of policy, but the committees will only be useful in river basins where there are known issues or conflicts that cannot readily be resolved in other ways.

To be decided is whether river basin committees are warranted for all the major rivers in Fiji. Further decisions are (i) which ministry or department will be responsible for the committees, (ii) who will chair them, (iii) will they have a consultation group, and (iv) what will be their terms of reference? It is not recommended that legislation be introduced for this purpose.

To be decided also is whether a program of comprehensive river basin planning should be rolled out over all the major river basins on the main islands. Comprehensive basin planning, as referred to here, would be based on hydrologic modelling of the surface water system with accompanying groundwater modelling, and would have a technical base. It would address water allocation and flood management as well as watershed quality. There is a proposal for flood modelling in all the major flood-risk locations, which may coincide with all the major rivers.

Table 36 Coordination Program

Program element	Definition
1. National coordination for water resources	<i>Interim arrangement limited to oversight of IWRM Plan, under coordination of DWS</i>
2. River basin committee review	<i>Review of desirability of river basin committees, coordinated by DWS and MRD</i>

10 Implementation and Monitoring

Functions and Responsibilities

The IWRM Plan identifies functions related to IWRM that have not been clearly expressed or have not been assigned to ministries and departments to date. Implementation of the Plan will be aligned with national climate change policies, including the National Adaptation Plan, and relevant Sustainable Development Goals. Climate-related indicators will be incorporated into monitoring and reporting frameworks to assess progress in resilience-building efforts. The Plan is designed to be implemented progressively through existing institutional arrangements and resources during its initial stages and therefore does not create significant additional financial implications at the commencement of implementation. Future investments and funding requirements will be identified and prioritised as implementation progresses. Broad functions that the IWRM Plan has identified are shown in Table 37.

Table 37: Functions and Responsibilities

Function and Responsibility		Description
Surface water resources assessment	MAWSI	Existing practice, which must become more active
Surface water allocation	MLMR	Based on existing powers, development of surface water licensing scheme
Groundwater allocation and management	MLMR	Continuing role, to be applied through proposed Groundwater Management legislation, to include groundwater permit scheme. Groundwater drilling will also be regulated.
Flood risk management (clarification)	NDRMO	The policy and planning aspects of flood management including the hydrologic approaches and related planning – as part of Disaster Risk Reduction (DRR)
Development planning and flood risk	DTCP	Existing responsibility enhanced to adopt rules and development criteria that limit flood risk exposure and increase resilience
Flood works design, construction and operation	MAWSI	Responsibility for major flood schemes, assuming they are constructed, including operation where relevant. However, associated planning will be the responsibility of NDRMO.
Rural Watershed Planning	MAWSI/ MRDM	Waterways to manage design and funding of rural watershed planning and implementation through Water Committee with other agency support

Function and Responsibility		Description
Regulation of urban and rural WSS	DWS	After the Water and Sewerage Services Act, a regulatory role will be adopted for all water supply and sanitation service provision
IWRM Plan monitoring	DWS/MAWSI	Coordination role in monitoring and reporting on implementation of the IWRM Plan
Watershed planning at river basin scale	MAWSI coordination	Waterways to coordinate ministry and other inputs and provide secretariat support
Water resources information coordination	FMS water resources data coordinator	FMS will develop national surface water data and coordination mechanism for related water datasets

The functions and responsibilities identified in Table 37 involve the development of new programs and the enhancement of existing programs. In particular, the Department of Lands and Mineral Resources Department will introduce water licensing and permits schemes for major water users. Responsibilities agreed while developing the MWR Plan include an active policy and planning role for NDRMO for flood management, including hydrologic aspects (excluding professional hydrological analysis), and management responsibility for the proposed rural watershed scheme by TLTB. Further, streamflow gauging is to receive major upgrading within FMS, but this is not included in the table, because it does not involve any change in responsibility and because the streamflow function of FMS is already recognised.

At this draft stage, two matters remain unresolved:

- The coordinating role for water resources data exchange and responsibility for the program to developed coordinating arrangements; and
- The leading role, if any is to be adopted, for catchment (watershed) management in river basins.

Monitoring and Reporting Schedule

The IWRM Plan is a ten-year strategic plan for integrated water resources management. It will commence when approved by the Fijian Cabinet. Implementation of the programs in the Plan is to be monitored and reported as shown in Table 38. DWS is responsible for compiling the reports and conducting the reviews.

Table 38 Monitoring and Reporting Schedule

Report	
Annual report	Annual report to Ministers on implementation of all programs in the IWRM Plan; commentary on programs experiencing difficulty or delay
Mid-term review	Fifth-year review of IWRM Plan to evaluate its effectiveness and recommend adjustment

Report	
Final review	Tenth-year review to report complete progress in implementation, evaluate continuation of the plan and necessary changes for future IWRM development

A Monitoring Group for IWRM Plan monitoring and reporting will be established, to be chaired by DWS and or Waterways. The Monitoring Group will represent all ministries and departments identified in the IWRM Plan as having roles in the programs. It will report, according to the schedule, to the Ministry for Public Works, Meteorological Services and Transport.

IWRM Plan Performance Indicators

Table 39 Performance Indicators

IWRM Program	Indicator	Agency
Program 1 Water resources information	Quality of surface water information (parameters to be defined)	FMS
	Quality of groundwater information (parameters to be defined)	MRD
	Water data availability	FMS, MLMR, WAF
	Water quality information database	MLMR, DWS, MHMS, MECC, WAF
Program 2 Water resources planning	River basin models	MAWSI
	Water resources adaptation plans	NDRMO, MAWSI
Program 3 Water resources allocation	Surface water allocation scheme (elements to be itemised)	MLMR
	Groundwater allocation scheme (elements to be itemised)	MLMR
Program 4 Integrated flood risk management	Flood study program implementation	MAWSI
	IFRM strategies designed and adopted	MAWSI
	Production of flood maps for all hotspots	MAWSI
	FMPs completed	NDRMO, MAWSI, DTCP, and relevant agencies
	Flood-related development controls introduced	DTCP

IWRM Program	Indicator	Agency
	Flood zones able to be established	DTCP
	Fiji National Building Code mandated	DTCP, DBGA
Program 5 Drought management	Drought management has incorporated water resource planning, alternative sourcing and trigger conditions for declaring all categories of drought	NDRMO, FMS, others
Program 6 Water Quality Management	STPs of WAF and rural schemes meeting wastewater discharge standards for water quality	DWS, WAF, MECC
	Ambient water quality understanding is improved	
	Control is gained over the impacts of excavation in streams and rivers	
Program 7 Freshwater environment	Identified environmental values to assist planning and water allocation	MECC
Program 8 Watershed Management	Establishment of coordinating arrangements for all major river basin catchments	Multiple
	Regulatory framework for diffuse sources of pollution is tightened to limit pollution of waterways	Multiple, MRD, MAWSI
	Watershed Committees are ensuring that local areas are meeting best practice land and water management practices	Multiple, TLTB MAWSI
Program 9 Coordination	National coordination provided through the IWRM Plan Working group, the IWRM Monitoring Group and the National Water Resources Management Coordination Committee when established	DWS, Multiple MAWSI
	Assessment of GEDSI inclusion for each program	DWS, agencies leading each program