Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries

National Integrated Water Resource Management Diagnostic Report

Samoa

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GLOBAL ENVIRONMENT FACILITY

UNDP

SOPAC

UNEP

ACRONYMS (INCOMPLETE)

ADB	Asian Development Bank
ADM	Aid Coordination and Loan Management
CHARM	Comprehensive Hazard and Risk Management
DEC	Division of Environment and Conservation (MNRE)
EHD	Environmental Health Department
EIAs	Environmental Impact Assessments
EPC	Electric Power Cooperation
EPPD	Economic Policy and Planning Department
GEF	Global Environment Facility
GWP	Global Water Partnership
HPPSD	Health Promotion and Prevention Services Department (within EHD)
ISP	Institutional Strengthening Project
IWP	International Waters Programme
IWRM	Integrated Water Resource Management
LMD	Land Management Division (MNRE)
l/p/d	Litres per person per day
MAFF	Ministry of Agriculture, Forests and Fisheries??
MDGs	Millennium Development Goals
MESC	Ministry of Education, Sports and Culture
MET	Meteorology Division (MNRE)
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finance
MOH	Ministry of Health
MWCSD	Ministry of Women, Community Services and Development
MWTI	Ministry of Works, Transport and Infrastructure
NAPA	National Adaptation Programme of Action to Climate Change
NEMS	National Environment and Development Management Strategies
NGOs	Non Governmental Organisations
NOAA	National Oceanic and Atmospheric Administration
NRW	Non Revenue Water
NUS	National University of Samoa
NWRMS	National Water Resource Management Strategy
NWSMC	National Watershed Management Committee
PEARs	Preliminary Environmental Assessment Reports
PUBS	Public Utility Billing System
PUMA	Planning and Urban Management Agency

RDIS	Research and Development Institute of Samoa
RWSCP	Rural Water Supply Consolidation Project
SOE	State of the Environment Report
SOEs	State Owned Enterprises
SOPAC	Secretariat of the Pacific Applied Science Commission
SPREP	Secretariat of the Pacific Region Environment Programme
SUNGO	Samoa Umbrella of NGOs
SWA	Samoa Water Authority
UFW	Unaccounted For Water
UNDP	United Nations Development Programme
USP	University of the South Pacific
WaSSP	Water Sector Strengthening Programme
WRD	Water Resources Division
WSMU	Water Sector Management Unit (Ministry of Finance)
WSSC	Water Sector Steering Committee
WSTEC	?? to do with land corporation?

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EXECUTIVE SUMMARY

Sustainable development necessitates a balance be maintained between the needs of economic development, public health and environmental protection. Inevitably these three pillars of sustainability create competing and sometimes opposing pressures and demands upon the limited land and water resources of countries. In Small Island Developing States (SIDS) in particular, with limited land mass and even more limited natural water resources, these pressures are a present day reality.

Whilst many SIDS have made great progress to realising sustainable development and achieving the Millennium Development Goals and targets, such endeavour has been generally made through sectoral approaches. In doing so the competitive demands of different sectors are difficult to manage, and the result is a continued increase in population growth, land use and water usage. For some SIDS this demand is now close to exceeding the natural carrying capacity of the islands and watersheds, especially those hosting the country capital.

Samoa is no different to many other Pacific SIDS in having to address these challenges at this time, whilst recognising that it, like other SIDS, has limited human and financial resources, and does not have the benefits of the economies of scale that larger countries can utilise.

Samoa consists of two main islands and seven islets. It is rugged and mountainous, with about 40 percent of Upolu and 50 percent of Savaii characterized by steep slopes descending from volcanic crests. The interior of both main islands is still covered with montane forests, and in the case of the highest altitudes on Savaii, cloud forest. These areas also contain volcanic peaks with the Upolu crestal ridge rising to 1,100 m. Savaii has more and younger volcanic cones with the highest peak reaching 1,848 m at Mt. Silisili. West Savaii and north-west Upolu are almost devoid of surface streams and their associated incised river channels, with uniform terrain and gentler slopes, allowing rapid rainfall infiltration and the development of fresh groundwater lenses.

Of the population of 180,000 people, approximately two thirds live on Upolu, and of them approximately 40,000 live in the capital Apia. The country as a whole has a population density of 63.5 persons/square kilometre, whereas that of Apia has a population density of 570 persons/square kilometre. Not surprisingly the land use in and around Apia is greatly modified from its natural state, with urban development in the coastal plain and low foothills, and peri-urban development and commercial agriculture in the watersheds.

Water supply in northern, eastern and southern Upolu and eastern Savaii is from surface water intakes, where as that for western Upolu and rest of Savaii is from groundwater. Water shortages are reported during the dry season, especially during extended dry periods associated with the ENSO, in the Apia area on Upolu (served by surface water intakes) and in the Falealupo Peninsula on Savaii (where groundwater is often brackish saline and the population relies upon rainwater harvesting). The Vaisagano Catchment behind Apia provides water for 3 of the 5 hydropower plants in the country.

Comment: 'behind' north-east of Apia??? Where, behind not v. geographic

The lack of natural water storage results in these catchments reaching low flow levels within several weeks. Conversely the lack of storage also results in rapid flooding events, with times to peak estimated at less than 3 hours for cyclone and tropical storm associated rainfall events. Flooding in Apia is a recurrent problem.

Water and energy demand is increasing with population wealth, and despite considerable effort in water demand management measures, including metering, leakage detection and repair, tariff incentives and conservation awareness campaigns, per capita consumption of water and power are predicted to rise.

With increasing population and landuse pressures, especially around the capital area, land degradation in the catchments is a concern. Inadequate wastewater management and solid waste management in the lower catchments, and increasing vegetation clearance due to urban expansion and cash cropping in the upper catchments not only reduces low flows and increases

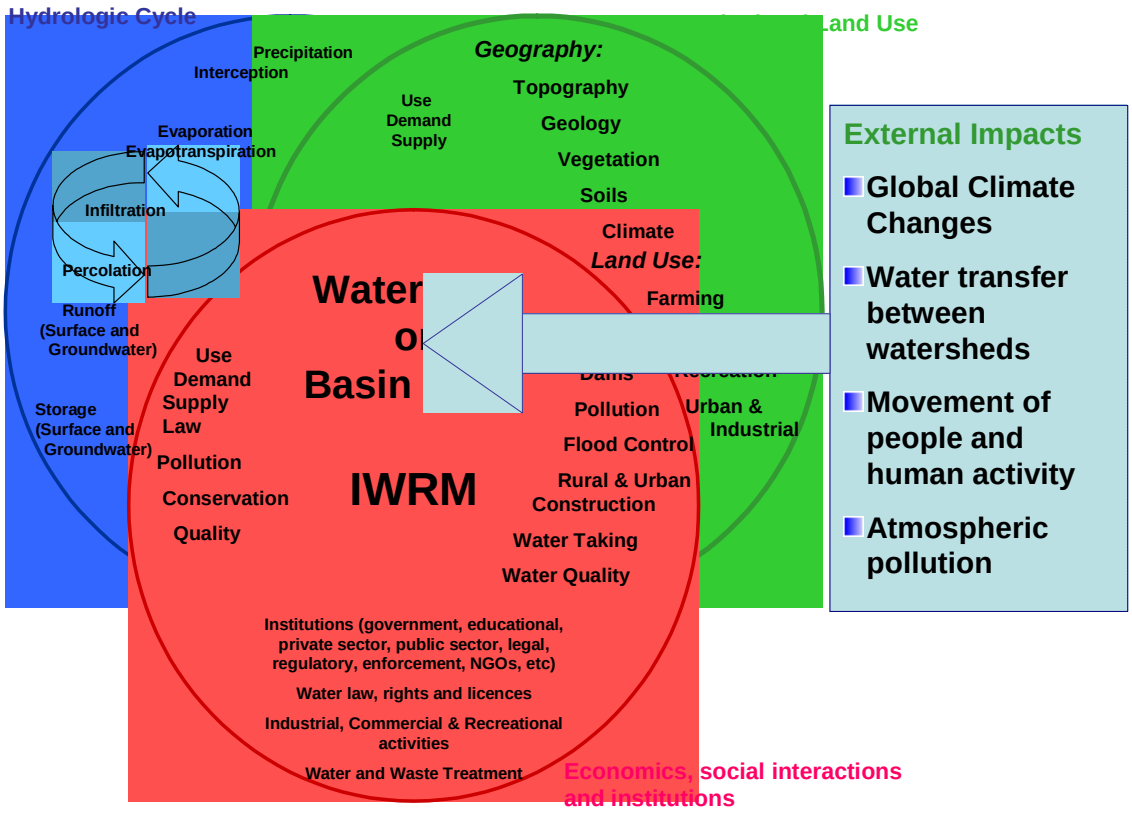
flash run-off, but also is resulting in perceived increases in erosion, sediment loading and nutrient enrichment of the water courses.

In Savaii logging and forestry are common economic activities in the uplands, whilst in Upolu the northern slopes are continuing to serve the economic expansion of Apia, whilst the southern coastal area is enjoying an expansion of the tourism industry.

Collectively these increasing pressures are perceived to be impacting upon public water quality, public health and causing degradation of environmental habitat.

Samoa therefore recognises the benefits to be gained by adopting more integrated water resources management approaches. Many of the programmes currently being undertaken demonstrate a commitment to the fundamental IWRM principles.

Figure 1: Summary Diagram of Integrated Water Resources Management



This diagnostic report has allowed a more systematic analysis of the water sector and its linkages to the environment, health, land use, industry and other sectors to be undertaken. The diagnostic outcomes include areas identified requiring institutional strengthening, and a proposed coherent IWRM approach to plan the implementation of these tasks. The ethos of this approach is to build on the activities undertaken to date but to improve the coordinated and integrated planning and management of these activities, moving away from sectoral and institutional delivery, to more effective and efficient collaborative implementation.

ACKNOWLEDGEMENTS

This IWRM report has been prepared, reviewed and amended by the Samoan stakeholders as part of larger water and wastewater reforms on-going within the country. The report draws upon interviews and consultations held with government ministries, civil society representatives and development agency personnel over the last six months, between October 2006 and April 2007.

The main facilitators of this dialogue and consultation are the two leading water agencies in Samoa, namely the Water Resources Division of Ministry of Natural Resources and Environment (MNRE) and the Samoa Water Authority. The senior officers of these two agencies wish to formally recognise the contribution of all the other stakeholders involved in these consultations, meetings and workshops.

This IWRM review has value beyond the GEF pdf-B development process, and the outcomes will be integrated themselves into the ongoing water sector reform, strategic planning and institutional strengthening initiatives.

1. INTRODUCTION

1.1 Justification for IWRM in Pacific Small Island Developing States

The Water Needs of Small Island Developing States

The economic and social wellbeing of Pacific Island Countries are dependent upon the quality and quantity of their freshwater. Constrained by their relative small size, natural vulnerability, and limited human and financial resource base, Pacific Small Island Developing States face specific challenges to effectively manage their water resources.

They can be categorised into three broad thematic areas which were also identified as broad challenges at the Kyoto Consultations for Small Island Developing Countries on Water Resources during the Third World Water Forum (2003**)**:

1) Small island countries have uniquely fragile water resources due to their small size, lack of natural storage and competing land use, vulnerability to natural and anthropogenic hazards, including drought, cyclones and urban pollution. This requires detailed water resources monitoring and management and improving collaboration with meteorological forecasting services;

2) Water service providers face challenging constraints to sustaining water and wastewater provision due to the lack of resources including human and financial resource bases, which restrict the availability of experienced staff and investment, and effectiveness of cost-recovery. Future action is required in human resources development, water demand management and improving cost-recovery; and

3) Water governance is highly complex due to the specific socio-political and cultural structures relating to traditional community, tribal and inter-island practices, rights and interests, which are all interwoven with colonial and 'modern' practices and instruments. These require programmes such as awareness, advocacy, and political will, at community; institution and government levels to create a framework for integrated water resources management.

Water and Pacific Small Island Developing States

The Pacific Islands regional needs for both water and sanitation are well articulated in the Pacific Regional Action Plan (RAP) on Sustainable Water Management. Endorsed by 18 countries, 14 at Heads of State level, the Pacific RAP provides a coordinated and holistic approach to water resources management and has significantly pushed water up the national and regional agenda.

The development of the Pacific RAP, which was a critical precursor for the Third World Water Forum convened in Kyoto Japan in 2003, articulates the following six thematic action areas:

- Water Resources Management (assessment, monitoring, pollution)
- Island Vulnerability (climatic and other natural hazards)
- Awareness (community participation, political will)
- Technologies (appropriate technology, capacity building, leakage reduction)
- Institutional Arrangements (policies, planning, legislation, regulation)
- Financing (cost recovery, economic value of water)

The Pacific RAP has a strong focus on integrated water resources management.

Integrated Water Resources Management – a global definition

Integrated water resources planning and management aims to take appropriate account of important physical, social, economic and cultural linkages within a water resources system, such as:

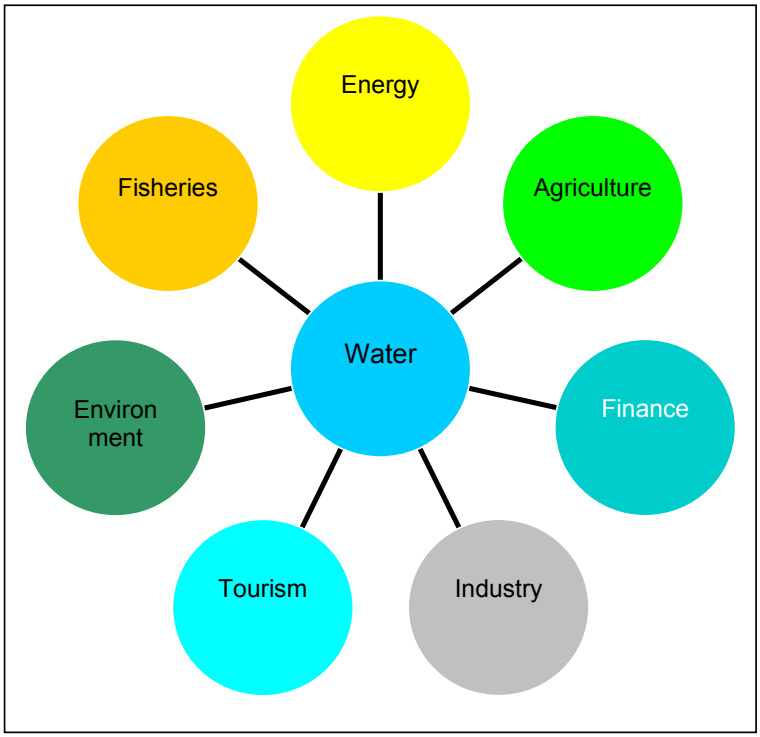
- physical linkages between landuse and surface and groundwater quantity and quality,

- economic linkages between various, and sometimes competing, water uses,
- social linkages between water development schemes and potential beneficiaries or those adversely affected, and
- institutional linkages, both horizontally and vertically, among various formal and non-formal stakeholder institutions.

IWRM thus looks to manage both water and land resources through improved sectoral collaboration and partnership between the government functions and civil society.

The Global Water Partnership (GWP), one of the foremost global advocates of IWRM, describes IWRM as: '….. a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.'

Figure 2: IWRM physical, social, economic and cultural linkages within a water resources system



IWRM in the Pacific

IWRM is a relatively new "brand" in the Pacific Islands. However, the concept and the approaches it embodies - namely, the need to take a holistic approach to ensure the socio-cultural, technical, economic and environmental factors are taken into account in the development and management of water resources - has been practised at a traditional level for centuries in the Pacific Islands. The concept that all activities affect each other, given the very small landmasses involved in the Pacific, is well understood by people living in the islands. The concept of competing land pressures, the choice of whether to use precious land for a plantation, a water reserve, a school or recreation area, are appreciated at the household, village and community level. In particular, every coastal village community understands the

connection between activities on the land and in the sea, as they impact on freshwater, fisheries stock and coral reefs.

The formal development of the IWRM management approach within governance structures at the national level has not been a widespread reality. This has largely been a function of inherited colonial government structures with their inherent line ministries and poor inter-ministerial liaison and collaboration, with a general tendency for government administrations to be inadequately resourced and weak compared to local and traditional governance structures. This has been a persistent constraint that water is everybody's business and therefore no ones responsibility.

Basin and transboundary IWRM, the scale at which IWRM first took hold and was seen to be of value, are not issues in the Pacific. Basins or catchments are generally too small to manage individually except at the community level, and with no international land borders in the region, transboundary in the Pacific refers to marine pollution and migratory fish stocks.

Growing recognition since the late 1990's and into the new millennium that sustainable water resources management was not being achieved in the PICs started to focus water stakeholders on identifying the causes. It was increasingly understood that competing activities in watersheds had to be tackled together if the water resources of the catchments were to be managed adequately.

Cyclone and drought events, to which the PICs are especially vulnerable (due to the small size of the catchments and aquifers and therefore the lack of natural storage) affected all water users, whether they be urban or rural water supplies, commercial forestry and agriculture, subsistence agriculture, and of course the fisheries/reefs and tourist developments. The need for drought and disaster preparedness plans became two forms of climatic extreme water resources management, recognised as national priorities in many PICs. Additional mounting evidence was suggesting that pollution on land from inadequate wastewater disposal, increased sediment erosion and industrial discharges were impacting upon coastal water quality and fisheries stock which sustain the entire island populations.

This has led the islands to looking at managing water resources not only within the watershed but also the receiving coastal waters. In the Pacific this management concept is referred to as "Ridge to Reef". In the Caribbean it is known as "White Water to Blue Water". Whilst demonstration schemes have been occasionally tried in the Pacific, the small size of the countries really necessitates a national approach to capacity building and awareness to address this issue. In the Pacific this has been called "Island System Management" (ISM) and in the Caribbean "Integrated Watershed and Coastal Area Management" (IWCAM).

Recent progress has been made in many countries, both in terms of the recognition of the need for all government stakeholders to be involved in water resources management such as attempts to introduce either formal or informal inter-ministry/departmental partnership mechanisms e.g. the national Water for Life consultations in Samoa (2002-2004), the fledgling National Water Sector Steering Committee, as well as the integrated municipal scale Sustainable Management Planning process.

IWRM whilst being synonymous with partnership is also closely linked to legislation in other parts of the world. In the Pacific where government administrations are relatively weak and under resourced, traditional/custom land and water ownership rights are strong, and internal country communications and access difficult, the significance of legislation is often over stated. The reality that legislation cannot be regulated or enforced has put the emphasis upon awareness and education of local communities to improve their water management. Examples of participatory catchment management initiatives involving local communities monitoring their own impact upon the water resources as well as commercial activities in the catchments include the IWP supported community initiatives in Apolima and Lepa and agro-forestry sustainable community livelihood projects in neighbouring catchments.

These demonstrate an island adaptation of IWRM concepts to the needs and realities of the Pacific, and confirm a proactive and dynamic baseline to which the GEF project can build and strengthen.

1.2 Objectives of the "Sustainable Integrated Water Resources and Wastewater Management Project in PIC's"

The Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries (SIWRWMPIC) proposal coordinated by SOPAC evolved from the Strategic Action Programme (SAP) for the International Waters of the Pacific Small Island Developing States carried out in August 1997. The SAP identifies the priority concerns, imminent threats and root causes, and provides solutions and the proposed activity areas to implement those solutions. The goal of this SAP was to develop a strategy for the integrated sustainable development and management of International Waters in the region. The priority transboundary concerns for Pacific Island International Waters were defined as arising from imminent threats to the health of those waters:

1. Pollution of marine and freshwater (including groundwater) from land-based activities
2. Physical, ecological and hydrological modification of critical habitats
3. Unsustainable exploitation of living and nonliving resources.

The root causes of these threats lie within management and institutional deficiencies, particularly those of a lack of effective governance, as well as the lack of information and understanding at all levels together with a narrow sectoral focus. The SAP provides the regional framework within which actions are identified, developed and implemented. Targeted actions within the SAP are envisaged in two complementary, linked consultative contexts: Integrated Coastal and Watershed Management (ICWM) and Oceanic Fisheries Management (OFM). Through the ICWM and OFM approaches, the SAP sets out a path for the transition of the Pacific Islands from sectoral to integrated management of International Waters as a whole. The regional SIWRWMPIC proposal is addressed specifically to the Integrated Coastal and Watershed Management context.

The Global International Water Assessment (GIWA) undertaken in the Pacific in 2002 reconfirms the major concern for the Pacific to be freshwater shortages. In detail these freshwater shortages were identified as:

- Reductions in useable surface water due to reducing low flows and increasing sediment loadings;
- Increasing pollution of water supplies; and
- Increasing salinisation of groundwater.

Aim of the SIWRWMPIC

The overall aim of the regional SIWRWMPIC is to assist Pacific Island countries (PICs) achieve sustainable, equitable, safe and efficient management of water resources and wastewater through the use of Integrated Water Resource and Sanitation Management (IWRM) and improved Water Use Efficiency (WUE) approaches, using a combination of national demonstration projects - to address key critical priority concerns and demonstrate tangible economic, social and environmental benefits, supported by regional IWRM capacity building programmes.

This GEF funded project will operate in parallel with a European Union IWRM governance programme, which will itself concentrate on IWRM and WUE planning. The GEF project is therefore seen to provide the means to implement priority issues within the country IWRM planning and management process and in doing so provide credibility to the longer term IWRM governance reform within the country and across the sectors as a whole.

1.3 Scope of the Report

This report uses the thematic structure of the Pacific Regional Action Plan on Sustainable Water Management, as well as making linkages to the primary economic, social and environmental sectors, to provide a country status assessment of the extent of integration in water resources and wastewater management in Samoa.

The report specifically identifies what IWRM activities are occurring and on-going, highlights the main issues and concerns preventing further IWRM implementation, and describes what additional requirements are needed to ensure IWRM becomes a fundamental approach in the sustainable development of the country as a whole.

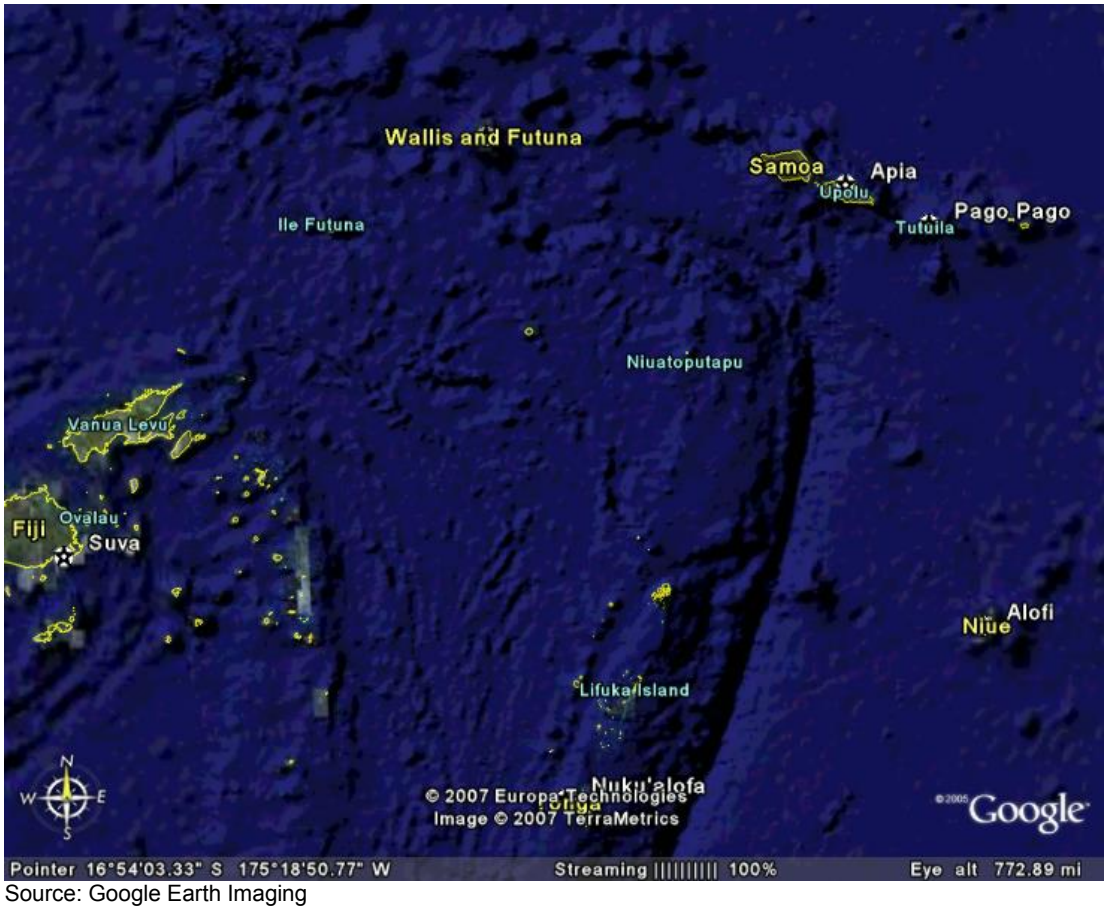
2. GENERAL OVERVIEW

2.1 Country Background Information

2.1.1 Location

As the larger and western part of the Samoan Archipelago, Samoa (formerly Western Samoa) lies in the south-west Pacific between 13º 25' and 14º 05' south of the equator, and between 171º 23' and 172º 48' west longitudes. It comprises two main islands, seven smaller islands, and islets and rocks. Its total land area is about 2,820 sq km, with the two main islands of Upolu and Savaii containing 1,115 and 1,700 sq km respectively. The capital Apia is located about midway on the north coast of Upolu, and lies about 130 km from Pago Pago, American Samoa, 3,000 km from Auckland, New Zealand, and 4,500 km from Sydney, Australia.

Figure 3: General Location of Samoa in the South Pacific (with reference to Fiji, Tonga and Niue)



Source: Google Earth Imaging

2.1.2 Topography

The topography of Western Samoa is rugged and mountainous, with about 40 percent of Upolu and 50 percent of Savaii characterized by steep slopes descending from volcanic crests. The interior of both main islands is still covered with montane forests, and in the case of the highest altitudes on Savaii, cloud forest. These areas also contain volcanic peaks with the Upolu crestal ridge rising to 1,100 m. Savaii has more and younger volcanic cones with the highest peak reaching 1,848 m at Mt. Silisili. West Savaii and north-west Upolu are almost devoid of

surface streams and their associated incised river channels, with uniform terrain and gentler slopes.

2.1.3 Geology

The Samoan islands are composed almost wholly of basic volcanic rocks such as olivine basalt, picrite basalt, and olivine dolerite of the alkaline basalt suite. The main volcanic formations are: Fagaloa; Salani; Mulifanua; Lefaga; Puapua; Aopo; and the Vini tuffs, which are summarized in Appendix 1 (Kear and Wood 1959). The younger vulcanicity is on Savaii, with the Aopo volcanics erupting in 1760, and more local eruptions as recent as 1902 to 1911.

Comment: Not in references

A coral reef exists off much of the Samoan coastline, its presence and absence depending on the age of the coastal volcanics. More ancient coral reefs are known to exist below the Puapua basalts.

2.1.4 Soils

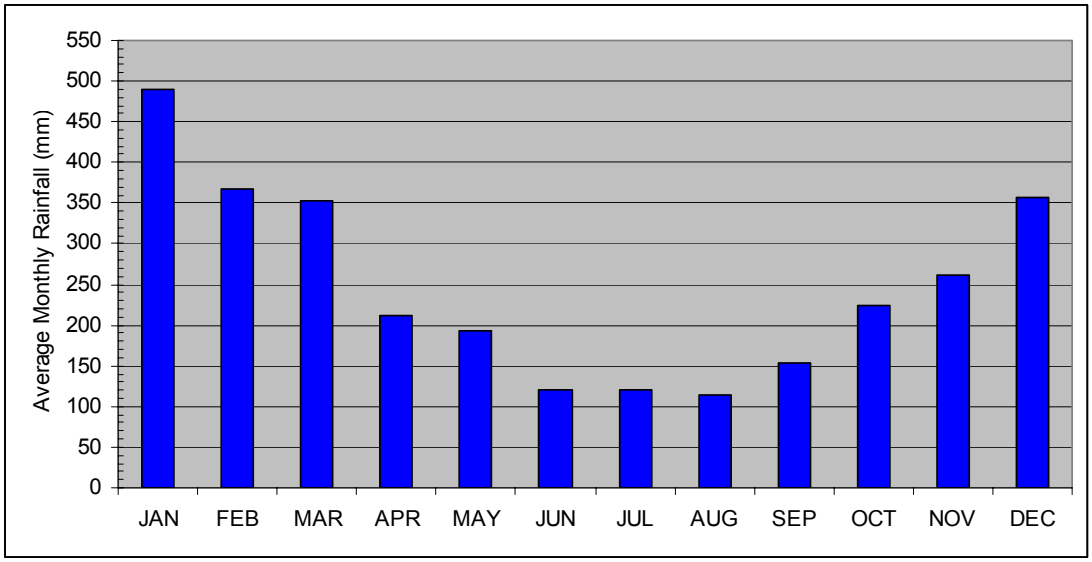
The older volcanics are extensively weathered to form clayey soils, resulting in rapid surface water run-off, whilst the younger volcanics have poorly developed or no soils and allow rapid infiltration. Alluvium is not common, restricted to the floodplain of a few of the larger river valleys, but forms the parent material for the most versatile soils. Present day beaches are commonly composed of coral sand, with rarer stretches of coral and basalt gravel.

2.1.5 Climate

The climate is generally hot and wet, marked by a distinct wet season (November to April) and dry season (May to October). However, due to its equatorial location, Western Samoa has only small variations in temperature. The average annual temperature is 26.5ºC in coastal areas, with a decrease in temperature as the land rises inland. Cloudiness and relative humidity are higher inland than at the coast, with the average figures for Apia of 5.3 cloud cover and 83 percent humidity respectively.

Due to the predominance of moisture-bearing, south-easterly trade winds (more than 80 and 50 percent of the time during the dry and wet seasons respectively), the north-west parts of the main islands as well as the south-east side of Savaii are rainshadow areas, receiving about half the rainfall of the highland areas. The annual rainfall is about 3,000 mm (varying from 2,500 mm in the north-west parts of the main islands to over 6,000 mm in the highlands of Savaii) with about 75 percent of the precipitation occurring during November-January.

Figure 4: Rainfall data for Apia (1971 – 2000)



Source: Samoa Meteorology Division

Storm patterns affecting Samoa originate from three main sources: tropical easterlies cause winds from the south-east; cold fronts from Australian systems cause cold air flows and rain; and storms from the south-west Pacific generate cyclones at the contact zones of the easterlies and westerlies. Air pressures are relatively stable with a maximum in August of 1,012 mbs and a minimum in January of 1,008 mbs.

2.1.6 Natural Disasters

Samoa has a history of natural disasters, particularly volcanic eruptions (the most recent being in 1911), earthquakes and tropical cyclones. The latter have had the most widespread impact on both the population and biodiversity and are relatively frequent though Samoa is not on the main cyclone path. Between 1972 and 1998 four named cyclones affected the group (Pauga and Lefale 1988). However, the two that struck in 1990 and 1991 were the most destructive this century. Cyclone Ofa in February 1990 affected the group for three days with winds gusting to 130 miles/hour. Cyclone Val in December 1991 had winds averaging 104 miles/hour and gusts up to 150 miles/hour over four consecutive days.

A tsunami warning was last issued in May 2006, although proved to be precautionary only.

2.1.7 Vegetation

Whistler (1992c) divided the vegetation of Samoa into 20 plant communities which belong to five broad categories: (1) littoral, (2) wetland, (3) rainforest, (4) volcanic, and (5) disturbed vegetation.

The littoral zone vegetation comprises four plant communities: herbaceous strand or beach; littoral shrubland; *Pandanus* scrub; and littoral forest. The best remaining littoral vegetation in Samoa is found on the Aleipata islands (Nuutele, Nuulua, Namua and Fanuatapu), and the south-central coasts of both Upolu and Savaii. Littoral vegetation, though low in species diversity, is important for many birds and for coastal protection.

Wetland vegetation comprises coastal marsh, consisting of herbaceous wetland situated on the coast; montane or mountain marsh, occurring in montane craters and depressions; mangrove scrub, dominated by 'togo fafine' (*Rhizophora mangle*) which are small sized trees; mangrove forest, dominated by 'togo tane' (*Bruguiera gymnorrhiza*) which are large trees forming closed-canopy forests; and swamp forest, occurring where freshwater saturates the soil. Wetland vegetation, except for the swamp forest, is generally low in plant species diversity. Mangrove communities are dominated by salt-tolerant trees and are important in erosion control and the maintenance of inshore fisheries.

Rainforest vegetation is divided into the following five plant communities: coastal forest; lowland forest; ridge forest; montane forest; and cloud forest. Coastal forest is restricted to coastal areas, mostly on tuff cones (a particular type of volcanic rock), and is found on the Aleipata islands and Apolima. Lowland forest once covered most of Samoa from sea level to 400-600 m elevation. Remaining areas of lowland forest, although extensively damaged in the 1990 and 1991 cyclones, are also located at Tafua and Falealupo villages on Savaii.

Montane forest occurs on both Upolu and Savaii. It extends from 400-600 m to over 1,000 m elevation, with a transitional zone containing elements of both communities, and has probably the greatest diversity of flora of any community in Samoa. Cloud forest occurs at the highest elevation of Savaii. These rainforest ecosystems are now of critical importance for the vast majority of native plants and animal species.

Volcanic vegetation comprises two communities: lowland volcanic scrub (below 650 m); and upland volcanic scrub (above 1,200 m elevation). Recent lava flows will only support a few colonising plant species. However, as the soil develops, a greater variety of species can become established.

Disturbed vegetation is a consequence of human activities or climatic factors. It comprises the following four communities: managed land used for human activity (for example, plantations and

roads); secondary scrub, dominated by weeds, shrubs and vines; secondary forest, developed when secondary scrub is left for long periods; and fernlands, dominated by 'asaua' (*Dicranopteris linearis*) which occurs only at Luatunuu on north-central Upolu, and Amaile at east Upolu.

2.1.8 Land Use (Agriculture and Forestry)

Much technical information has been collected nationally relating to land use capability. Article 101 of the Constitution divides land in Samoa into three categories: customary, freehold and public. Two reports give a fuller explanation of these three categories of land (Government of Western Samoa 1975a and Government of Western Samoa 1992).

Slightly over 80 percent of land in Samoa is held according to Samoan custom. Exactly what "Samoan custom" means in relation to land ownership is a matter of interpretation. O'Meara claims the traditional view of customary tenure – where land pertained to a *matai* title, the holder of which exercised *pule* or authority over the land – is in eclipse. A new form of ownership is emerging where the person who clears the land is claiming ownership, for him and his descendants. As much as 60 percent of village customary land may be held in this manner (Government of Western Samoa 1993b; O'Meara 1987).

Control over land under customary ownership can be influenced by the lending policies of financial institutions such as the Development Bank of Samoa (DBS) or the government's agricultural policies such as subsidies on herbicides. There appears to be a growing recognition of the income to be made in the form of export earnings from cash crops, and anecdotal evidence of recent increases in cropping activity. Compulsory acquisition of customary land under the Taking of Land Act 1964 is legally possible, but in most cases an unrealistic and unenforceable option.

Government has direct influence over public land, (either through the Land Board, WSTEC, or Samoa Land Corporation). Free-hold land is mostly restricted to urban areas.

Comment: Request acronym

Deforestation has undoubtedly changed the vegetation cover in Samoa. There are two man made causes of deforestation: agricultural clearing, and (on Savaii only) commercial logging. There is also cyclone associated damage, and El Nino associated dry period bush fires (notably in Savaii in 2003) which can be made worse by anthropogenic activities.

The problem of agricultural clearing is largely attributable to sustained economic growth and the desire for an increase in exports. Moreover, Samoa's increasing population puts pressure on families to clear land for more food and to meet ever-increasing cash needs. Land once used for subsistence needs is largely being converted for more large-scale agricultural purposes. A catalyst in this process is the recognition that the person clearing new land will gain title to it (UNDP 1990:67).

Deforestation due to logging occurs only on Savaii. There is a huge overcapacity in the logging industry relative to the forestry resource. Between 1977 and 1992, 47 percent of the merchantable forest of Savaii was cleared. Approximately 40 percent was due to logging and 60 percent was due to agricultural and other clearance (Government of Western Samoa 1993b).

2.1.9 Water Resources

The surface water and groundwater resources of Samoa are fundamentally controlled by the geology. The older volcanic terrain of the Fagaloa and Salani volcanic are most weathered and eroded, and the resulting clay cover results in effectively impermeable strata with rapid run-off from the steep catchments (up to 92 %) with significant sediment loads in peak flow periods (RKL 1996). These older volcanics and associated surface water courses are located on the eastern half of Upolu and some of the eastern half of Savaii.

Conversely, the younger volcanics of the Mulifanua, Lefaga, Puapua and historical Aopo lava flows, have little or no soil cover and allow the infiltration of nearly all rainfall. These lavas are also highly permeable, with former lava tubes enabling rapid groundwater flow to the sea. Coastal springs exist along the north-west Upolu and much of Savaii, coinciding with the distribution of the younger volcanics, and were historically used for water supply.

Ironically the rainfall is greatest in the south-east of each island over the surface water catchments, resulting in common flooding, especially in Apia, and at its lowest in the north-west of each island in the groundwater provinces, resulting in saline intrusion and up-coning, especially in the Falealupo Peninsula in north-west Savaii.

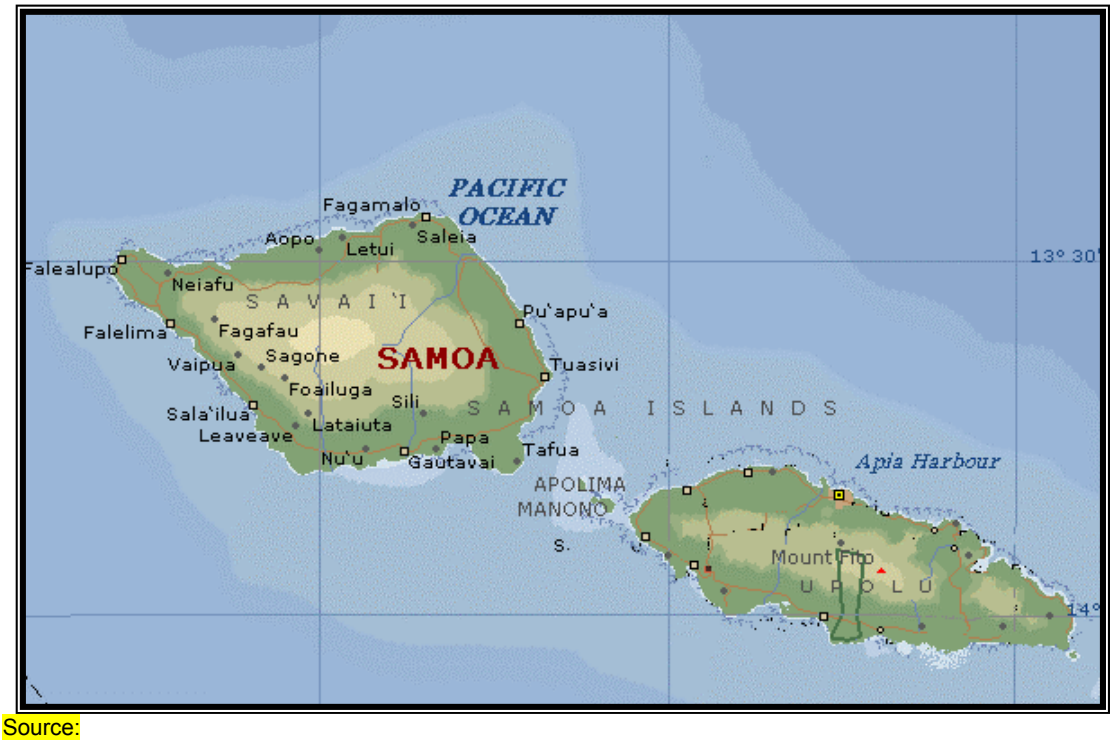
2.1.10 Demography

Samoa has a population (in 2005) of approximately 185,000 people (UNESCAP 2003). 40% are under 14 years old and 56% between 14-65 years old, and 4% older than 65 years old.

The rural population is estimated at 78% (UNESCAP 2003). The country as a whole has a population density of 63.5 persons/square kilometre (UNESCAP 2003).

SPC estimate two-thirds of the population live in Upolu, with 30% in urban Apia, which itself has a population density of 570 persons/square kilometre. The population growth rate is estimated at 0.9% per annum (UNESCAP 2003).

Figure 5: Map of Samoa, with locations of main towns



Source:

2.1.11 Socio-Economic Issues

The two main islands are well served by ring and cross-island roads. The completion of the current roads improvement programme should see all the main roads upgraded and tar-sealed. The main international port is Apia with an inter-island ferry service operating between Mulifanua at north-west Upolu, and Salelologa at south-east Savaii. Faleolo is the only international airport in the country.

Like many of the small Pacific Island nations, Samoa since independence has endeavoured to develop a modern economy from traditional subsistence agriculture. Agricultural and related primary sector activities support around 75 percent of the total population including almost the entire rural population (Fairbarn 1993). The significance of the primary sector to the national economy is indicated by the fact that related activities account for 50 percent of Gross Domestic

Product (GDP); 60 percent of the workforce, and about 80 percent of export earnings (World Bank 1991).

The economy is also dominated by external aid and by remittances from Samoans working overseas. While remittances from overseas workers have been a very important source of foreign exchange, there has been growing concern that very little of the remitted capital goes back into productive investment but is spent mainly on consumption and social infrastructure (Shankman 1976; ADB 1985; Ahlburg and Levin 1990).

The manufacturing sector mainly processes agricultural products. One factory in the Foreign Trade Zone employs 3,000 people to make automobile electrical harnesses for an assembly plant in Australia. Tourism is an expanding sector, accounting for 25% of GDP; about 100,000 tourists visited the islands in 2005 (CIA World Fact Book 2006).

Comment: Not in references – online resource?

3. INTEGRATED WATER RESOURCES MANAGEMENT SITUATION FOR SAMOA

3.1 Water Resources Management

3.1.1 Types of freshwater resources

The annual rainfall is approximately 3,000 mm (varying from 2,500 mm in the north-west parts of the main islands to over 6,000 mm in the highlands of Savaii) with about 75 percent of the precipitation occurring during November-January.

Conventional water resources including surface water and groundwater exist across almost the entire country, although are quite noticeably separate in their distribution.

The surface water and groundwater resources of Samoa are fundamentally controlled by the geology. The older volcanic terrain of the Fagaloa and Salani volcanic are most weathered and eroded, and the resulting clay cover results in effectively impermeable strata with rapid run-off from the steep catchments (up to 92 % of rainfall) with significant sediment loads in peak flow periods (RKL 1996). These older volcanics and associated deeply incised surface water courses are located on the eastern half of Upolu and specific areas of the southern and north-eastern parts of Savaii.

Catchment sizes are small, and slope gradients steep, resulting in rapid responses to rainfall events, and low flows in dry periods. The catchments south of Apia are known to have caused severe flooding in 1939, 1974, 1990 and 2001, with a further 6 moderate flooding events since 1975. The Vaisagano River has recently been hydrologically modelled (SOPAC 2006) and found to have a 'time to peak' (time from rainfall to peak flood flow) of approximately 3 hours.

Low flows in these streams are significant enough to cause problems for the urban Apia water supply system. As recently as October 2006, low flows (associated with the weak-moderate El Nino) were resulting in water shortages, despite above average rainfall recorded for August and September 2006.

Conversely, the younger volcanics of the Mulifanua, Lefaga, Puapua and historical Aopo lava flows, have little or no soil cover and allow the infiltration of nearly all effective rainfall. These lavas are also highly permeable, with former lava tubes enabling rapid groundwater flow to the sea. Only limited hydrogeological investigations have been undertaken in Samoa, although these consistently identify highly permeable aquifers, with low groundwater levels responding to tidal influences. Coastal springs exist along the north-west Upolu and much of Savaii, coinciding with the distribution of the younger volcanics, and were historically used for water supply. The groundwater resources in these areas are now exploited using boreholes. Some saline up-coning is reported to occur in Sataua and Matavai in Savaii. Freshwater submarine springs are also known to exist.

Groundwater is generally exploited below the 50 m ground level contour height, partly because of the coastal location of communities historically reliant upon coastal freshwater springs, and partly because of the expense of deeper drilling.

There are some high elevation springs presumably perched on lower permeability strata or overflowing from vertical dyke bounded systems. These are important locally, and include Lefaga on Upolu and Apolima.

Ironically the rainfall is greatest in the south-east of each island over the surface water catchments, resulting in common flooding, especially in Apia, and at its lowest in the north-west of each island in the groundwater provinces, resulting in saline intrusion and up-coning, especially in the Falealupo Peninsula in north-west Savaii.

Comment: Exact same para in 2.1.9

Rainwater harvesting has only been reported to be practiced to any extent in the Falealupo Peninsula of north-west Savaii, where a combination of the highly permeable Puapua volcanics and the relatively isolated geographic peninsula appear to result in saline groundwater and no

surface water courses, giving the local populace no alternative but to use rainwater harvesting. This has been practiced since 1993.

There is no known use of unconventional sources, although locally produced bottled water is available.

3.1.2 Types of freshwater uses

*Drinking Water Supply.*Surface water and groundwater are used for all types of water supply. Some are operated by the Samoa Water Authority (SWA), others by the villages and are known as independent water schemes.

Surface water provides approximately 65% of the water supply and groundwater 35%.

SWA currently operates 38 surface water intakes used for public water supply, 36 in Upolu (including 4 springs) and 2 in Savaii. There are 40 borehole supplies, 20 each on Savaii and Upolu.

In addition there are 19 independent water schemes in Upolu and 5 in Savaii.

Commercial, industrial and tourism uses are limited in Samoa, and rely for the most part on the urban water supply.

The largest commercial activities are the brewery, coconut factory and approximately 7 bottled water companies. 'Le Vai', one of the bottled water companies and the airport are understood to have their own borehole supplies.

Irrigation. There is no irrigation for agriculture in Samoa. All crop and cattle are rain fed. However the newly developed Penina Golf Course has an irrigation system fed from a borehole.

Hydropower. Surface water is also used for power generation. There are five micro-power stations all in Upolu, at Afulilo, Lalomauga, Samasoni, Faleolefee and Alaoa, the latter three locations are all within the same Vaisagano watershed. Only Afulilo is supplied by a dam. All other stations have headponds fed by the water course.

The five power stations have a combined generation output of 7.25 mega watts, which typically provides 40% of the national demand. During the wet season hydropower can provide up to 70% but this can reduce to 20% in the dry season.

Future power demand is estimated to be increasing by 5% per annum. Electric Power Cooperation (EPC) advise they hope to meet this increase partially through upgrading Afulilo and bringing on line a diversion to Afulilo from the Tiavea River and a new hydropower project in the Sili Basin in Savaii. Some of these proposals are contentious with local land owners.

3.1.3 Majors issues and concerns

3.1.3.1. Extent to which groundwater and surface water resources are used and alternative sources.

Surface water and groundwater are the only sources of water used for water supply provision, with the exception of rainwater harvesting practiced widely in the Falealupo Peninsula and in otherwise isolated and rural households. Piped water supply access is estimated at between 90-95% of the population.

Surface water resources in three catchments (Vaisiagano, Afulilo and Falefa) also provide hydropower which can meet up to 70% of the country's energy demand.

3.1.3.2. The various and relative demands placed on watersheds/water resources.

There has been no national assessment to date on the stress put upon the individual catchments and aquifers. This work will be undertaken as part of an on-going EU funded water sector support programme (WaSSP).

Limited historical surface water monitoring, and a lack of raw water abstraction metering, to date prevents accurate assessment of water withdrawal against low flow yields.

There has been no systematic groundwater resources assessment in the country to date.

A qualitative assessment of water resources demands can however be made. The urban water supply for greater Apia (whose population is estimated at approximately 60,000) is supplied almost entirely from surface water intakes from the Vaisigano and Fuluasou rivers.

All four water treatment plants in Upolu are fed by these two rivers, three of these plants supplying urban Apia. Production estimates from the four plants fed by these streams are 34,000 m³/d (i.e. 400 l/s). Naturalised low flow estimates are difficult to make given the ungauged abstraction from them, but minimum flows are estimated at between 500-600 l/s (RKL 1996).

If accurate, this suggests between 65-80% of the surface water low flows in these catchments are used for water supply. In addition, the Vaisigano has three on-stream hydropower plants, which while non-consumptive, clearly rely on certain minimum flow requirements.

At this time it is not known if any of the other 40+ other surface water catchments suffer this degree of over-abstraction, but given the rural population density this is considered to be unlikely.

It is also worth noting that the Afulilo Dam, which truncates one of the headwater streams of the Sopoaga River (which flows to the south coast), transfers its water through flow to an adjacent catchment which flows north-east to Taelefaga, and thus is a catchment-to-catchment transfer of unknown volume.

As stated earlier, there has been no attempt to date to quantify the groundwater resources in the country.

3.1.3.3 Competing uses of water and priority uses.

The competition for water resources appears only noticeable for the Fuluasou and Vaisigano water catchments around Apia, where both public water supply and public energy supply are provided by the same river systems. Hydropower operations in Fuluasou river catchment is now non-operational due to insufficient water quality and complete infilling of the intake reservoir with sediment.

This competition and interaction is complex however, as at Faleolefee EPC and SWA share the same intake, whilst at Alaoa SWA abstracts from the EPC discharge channels, and at other locations, EPC intakes are located above SWA intakes whilst the water returns are located below the SWA intakes. Thus in some locations EPC taking water removes it from SWA but in others EPC using water provides it to SWA.

From consultations held with EPC and SWA, it appears that during periods of low flow, public health considerations are given priority, given the infrastructure back-up EPC maintains by way of diesel powered generation capacity.

There are also known to be two village water supply intakes upstream of the Lalomauga hydropower plant on the Falefa River, and village water supply intakes below the Afulilo Dam discharge.

Consultations with the Division of Environment and Conservation (DEC) of MNRE confirmed there has been no assessment of the requirement for ecological environmental flows to protect habitats. There are therefore no environmental low flow requirements for any surface water or groundwater system.

3.1.3.4 Sources of pollution of surface water, groundwater and coastal waters.

The DEC advised it does not undertake any water quality monitoring. To date neither has the newly formed Water Resources Division (WRD) of the Ministry of Natural Resources and Environment, or its predecessor the hydrology section of the Meteorology Division.

SWA does have a laboratory capacity and routinely samples raw and treated waters. Much of this work focuses on microbiology, the adequacy of chlorination of treated waters, and turbidity of raw and treated waters.

More generic assessments of the Pacific region, notably the Global Programme for Action for the protection of the Marine Environment from Land based Pollution (GPA) and the Global International Waters Assessment, concluded the main threats to water quality in the Pacific were inadequate sanitation (creating nutrient enrichment in all waters), sediment erosion and transport in surface waters and over-abstraction (salinisation) of aquifers.

There is no known water quality monitoring for wastewater associated pollution. An on-going Asian Development Bank (ADB) funded Apia wastewater and drainage project is presently in the design phase and is about to commence baseline monitoring. There is however ample visual evidence of wastewater contamination of streams around the urban Apia area. Solid waste disposal is also a problem within the low-lying populated areas, with obvious uncontrolled tipping into valleys.

Sediment erosion is the most visible surface water pollutant within the catchments. SWA operate a three stage filtration process, but during periods of heavy rainfall, these are frequently overwhelmed. Perhaps the most stark reminder of sedimentation in the watersheds is the complete infilling of the now abandoned Fuluasou Hydropower Dam reservoir.

A number of studies have been undertaken on sediment loading (FAO et al), which unsurprisingly confirm a relationship with rainfall. Cyclone associated rainfall can be devastating (Terry et al, SOPAC et al) resulting in not only heavily laden sediment flood run-off but also landslides. Direct relationships to land use were difficult to demonstrate (FAO et al) but increased sediment run-off is associated with commercial forestry and cultivation practices according to government officials.

Comment: Request full details

Comment: Follow up refs.

Salinisation is known to occur at some boreholes in Savaii, although this is generally thought to be saline up-coning (i.e. over-pumping of an individual borehole) rather than saline intrusion (over-abstraction from the aquifer as a whole). The possible exception appears to be the Falealupo Peninsula, which might be prone to saline intrusion. However a lack of systematic monitoring and groundwater investigation prevent further assessment.

No water quality monitoring of coastal waters is understood to occur in Samoa. However it is logical to assume that sediment loads and nutrient enrichment associated with inadequate wastewater treatment are likely to be issues.

3.1.3.5 Information exchange systems on water resources.

There are no operational water resources information systems on water resources. There is a MAPSERVER available to all government departments and the Forestry Department operates a GIS based land classification/forestry management system known as SAMFRIS, which contains information highly relevant to watershed management.

A GIS based system has been proposed as part of the WaSSP, which is intended to capture all water resources and quality monitoring data, abstractions, and in the future controlled discharges, with the intention of being developed into a management tool. However it is not clear at this stage whether such a system will be procured under the programme.

3.1.4 Measures to manage impacts and concerns (IWRM approaches)

3.1.4.1 The National Hydrological Network for water resources assessment and monitoring.

The National Hydrological Network has recently been transferred from the Meteorological Division to the Water Resources Division. Meteorological, climatological and geophysical/seismic monitoring remains the responsibility of the Meteorology Division (Met).

The Meteorology Division maintains 28 manual monthly rain gauges in Upolu and a further 28 gauges in Savaii, with 1 on Apolima. There are also two tipping bucket gauges measured daily (coast and highland) on Upolu. There are eight weather stations, two operated by the Meteorology Division, and six fully automated operated by NOAA using satellite linkages. A further three NOAA automated weather systems (AWS) are presently awaiting delivery. The Meteorology Division owns two hyetographs (rainfall intensity) but neither is operational.

The national hydrological network itself has almost completely collapsed. Historically 19 sites (18 on Upolu) have been instrumented for surface water flow gauging. Only two sites on Upolu are presently gauged. Whilst several of these historic sites have been lost due to hydropower construction, most have been destroyed by cyclone damage.

WRD owns 2 current flowmeters and has the technical capacity to carry out flow gauging. It continues to maintain fortnightly gauging at the two existing gauging stations, and has recently been carrying out spot gauging on numerous streams as part of the WaSSP and concerns over low flows in the last dry season (September to October 2006).

It is expected that at least part of (perhaps 50%) the historic hydrological network will be reinstated as part of the WaSSP with associated training, equipment and vehicle support.

However, to date there is no groundwater monitoring whatsoever. SWA monitors salinity and abstraction at its supply boreholes, but there are no dedicated observation wells. A borehole inventory is presently being undertaken under the WaSSP and a national groundwater monitoring programme (including boreholes) proposed. Whether it will be funded under the WaSSP is unclear at this stage.

3.1.4.2 The status of water resources quality including existing monitoring programmes and community-based monitoring.

There is no existing national water resources quality monitoring programmes. At this time the WRD, Meteorology Division or DEC conduct baseline water quality surveys. SWA have some information on suspended solids/turbidity of raw feed water into treatment plants and salinity from their production boreholes.

The Environmental Health Department of the Ministry of Health presently has no capacity to undertake water quality monitoring. It is intended under the WaSSP to equip them to undertake microbiological field analysis of rural water supplies.

The International Water Programme of SPREP (Secretariat of the Pacific Regional Environment Programme) has been carrying out community based watershed management projects on the island of Apolima and the Lepa catchment on Upolu for the last five years. Water sampling and testing has been used to demonstrate the impact of changes to land use on community water supplies.

It is understood the ADB wastewater and drainage project is likely to undertake baseline studies of water quality in the urban Apia area and local coastal environs, although no specific details are known at this time.

WRD are also aware of a Japanese research project in the Letogo Catchment, which includes instrumentation measuring suspended solids and other parameters.

The WaSSP intends to equip WRD to carry out selective in-field water quality analysis of water resources (e.g. salinity, turbidity, nitrate, ammonia, phosphate).

3.1.4.3 Water conservation and reuse attitude and applications.

Considerable efforts have been made by SWA to introduce water demand management into their operations. Water consumption before the AusAID supported Institutional Strengthening Project (ISP) was of the order of 900-1000 l/p/d, however through universal metering of the Apia area, the consumption rates fell to approximately 300 l/p/d. More recent estimates from SWA metering records (Dorsch and KEW Consult 2004a) suggest per capita consumption to presently be 230 l/p/d.

However the water demand remains high and production figures from the treatment plant of approximately 34,000 m³/d are not only 30% above treatment plant capacity, but compared to customer metering shows at least 41% unaccounted for water. A recent World Bank report states these losses could be as high as 55%.

Comment: How recent? 2005?

Accordingly SWA is continuing to make efforts to address unaccounted for water (UFW) and the WaSSP includes resources to make improvements to the leakage detection and water demand management capability of the Authority, including the testing and recalibration of water meters.

Since June 2003 the SWA had also introduced a tariff structure which penalises excessive water usage. Water is free below 500 l/household/day, at a fixed rate up to 2200 l/hh/d, and a higher rate thereafter. Recent estimates suggest only 20% of the connections enter this highest rate. However, it is worth noting that this upper band equates (for a 7 person household) to >300 l/p/d, which does not create much incentive to curb water usage.

There are no thoughts of water reuse at this time.

There appears to be no legislation to limit water abstractions from a water resource.

3.1.4.4 Prevention measures of pollution: buffer zones, water reserves, water safety plans.

There is a draft of protection measures developed within the broad suite of legislation. However the capacity to enforce such legislation is very limited, and in reality the right to access let alone interfere with customary owned land is non-existent.

Conventional environmental governance approaches rely upon enforcement of legislation which determines acceptable and unacceptable environmental impacts. Recent legislation (Planning and Urban Management Agency (PUMA) Act 2004) indicates this is being pursued. However PUMA does not have the capacity to enforce the legislation, nor does any other division within MNRE.

The following legislative tools are available:

- Sustainable Management Plans (SMPs) – an integrated area plan. None have been implemented to date, although an advisory SMP on catchment flooding prevention exists;
- Preliminary Environmental Assessment Reports (PEARs) – an impact screening process;
- Environmental Impact Assessment (EIAs);
- Development Consent Process (DCP) – places conditions on a development e.g. a discharge consent limiting effluent quantity and quality;
- Watershed Management Plans (WMP) – defined under the Watershed Management Regulations 1991 include the protection of land from specific activities for 5 years;
- Water Act 1965 and the Lands, Survey & Environment Act 1989 – define the offence to pollute waters, control on aggregate extraction, landfilling, reclamation;
- The Land Act states all rivers, streams etc belong to the government, including importantly a barrier of 10 m each side of the water course for ‘set-aside’. In reality this barrier is not enforced;
- The Land Act also allows re-course to rehabilitate damaged land, but the powers have never been tested.
- Health Ordinance 1969 – offence to discharge wastewater;
- Forestry – forestry planning and licensing of logging activities and enforcement of the Logging Code
- National Parks and Reserve Act – enables land to be classified as land as park or reserve but it has to be state owned;
- Right of Compulsory Land purchase - under the Taking of Land Act 1964
- Compliance Monitoring of DCP, WMP, Logging, and many other activities
- Formalised engagement of communities – Internal Affairs Act and the Village Fono Act

To date there are no effective buffer zones (other than those introduced to the communities directly), water reserves, or water safety plans (although the latter are being introduced into Samoa as a regional programme by SOPAC and WHO).

The lack of enforcement capacity and the rights of customary landowners has instead led the Watershed Management Section of WRD, Environment and Forestry departments and others to adopt community engagement strategies.

3.2 Island Vulnerability

3.2.1 Types of disasters

Samoa has a history of natural disasters, particularly volcanic eruptions (the most recent being in 1911), earthquakes and tropical cyclones. The latter have had the most widespread impact on both the population and biodiversity and are relatively frequent though Samoa is not on the main cyclone path. Between 1972 and 1998 four named cyclones affected the group (Pauga and Lefale 1988). However, the two that struck in 1990 and 1991 were the most destructive. Cyclone Ofa in February 1990 affected the group for three days with winds gusting to 130 miles/hour. Cyclone Val in December 1991 had winds averaging 104 miles/hour and gusts up to 150 miles/hour over four consecutive days. Cyclone Heta in 2004 passed 100 km west of Samoa but still brought destructive storm force winds and sea flooding.

Flooding associated with cyclones, tropical storms and other periods of heavy rains are regular events. Catchment sizes are small, and slope gradients steep, resulting in rapid responses to rainfall events, and low flows in dry periods. The catchments south of Apia are known to have caused severe flooding in 1939, 1974, 1990 and 2001, with a further six moderate flooding events since 1975. The Vaisagano River has recently been hydrologically modelled (SOPAC 2006) and found to have a 'time to peak' (time from rainfall to peak flood flow) of approximately 3 hours.

Low flows in these streams are significant enough to cause water supply problems for the urban Apia water supply system. As recently as October 2006, low flows (associated with the weak-moderate El Nino) were resulting in water shortages. What is alarming for Samoa is that the Meteorology Division reported that August and September rainfall were 32% and 41% above average, whilst October rainfall was 57% below average. This appears to demonstrate that one dry month is sufficient to bring the surface water catchments supplying Apia to significantly low flows.

Storm surges associated with tropical storms can cause minor damage to coastal infrastructure. Cyclone Heta passing 100 km west of Samoa produced a storm surge of 30 cm above the predicted tide, enough to cause coastal flooding.

Seismic activity is regularly reported by the Meteorology Division and a tsunami warning was last issued in May 2006, although proved to be precautionary only. The highest magnitude ever recorded was of 7.2 on the Richter scale in 1996 (Nelson 2005). Generally, whilst acknowledged as present, seismic risks are perceived to be moderately low compared with Tonga and Fiji.

Comment: Not in references

3.2.1.1 Sea level rise and /or horizontal land movement (subsidence or isostatic rebound).

Samoa is part of the Pacific Sea Level Rise project, and had a SEAFRAME gauge installed in Apia in 1993. Absolute average sea level rise on the gauge to date is +3.6 mm/yr; although a nearby gauge (in American Samoa) monitoring over a longer period but with less precision reports +1.46 mm/yr. Given the relatively short term placement of the SEAFRAME gauge, the older gauge (in American Samoa) may be more accurate of the long term trend.

The Pacific Sea Level Rise project (AusAID June 2005) has identified mean sea level and temperature variance associated with both seasonal changes and the El Nino, and also detected a 30 cm tsunami wave from a magnitude Mw 8.4 earthquake off Peru in 2001. SEAFRAME contributes to the Pacific tsunami early warning system.

Comment: Mercalli

The wharf itself is reported to be sinking at approximately 1mm/yr.

3.2.1.2 Incidences of flood and/or drought impact on watershed and coastal management.

The impact of flooding and drought on watersheds and the coastal waters largely depends on the infrastructure and population affected and the ability to observe the impacts, as well as the impacts caused due to modifications to the catchments.

Consultations with WRD, suggested that flooding was only considered a significant issue in the greater Apia area. This is partly because of the size of the catchments involved, but more significantly because of the development both in the catchment and most importantly in the low-lying coastal plain and floodplains of the watersheds.

It is anticipated that when the Vaisigano and Fuluasou Rivers are in flood so are most of the rivers in the east of Upolu, and probably Savaii. Indeed the destruction of the gauging stations and weirs at Ti'avea and elsewhere, and the sediment infilling of the Fuluasou reservoir are demonstrable of these unseen and unreported events.

Occasional flash floods are reported especially for the catchments draining south on Upolu, and when there has been the tragic loss of life, typically at road crossings.

However Apia, with its suburban hinterland, urban coastal floodplains, and exploited watershed (for water supply and power generation) is clearly reported as the catchment most affected by these common flooding events (Yeo 2000; Lambrusco 2006). The speed of these floods (3 hours to peak) makes them particularly dangerous as it prevents the effective early warning of the populace within the catchments, unless associated with the slightly longer forecast period associated with cyclone warnings (typically 3-7 days).

Comment: Missing from ref.

Similarly the drought periods affect the Apia watersheds most because these are the most exploited. Whilst no catchment yield analysis has been carried out in detail on any other catchment to date, the lower population densities are expected to show the water supplies there are less prone to drought periods, because of the 'headboard' between the catchment demand and low flow yield.

The possible exception to this is the groundwater resources known to be prone to salinisation, most of which are in Savaii, and in particular the Falealupo Peninsula which appears to be highly prone to saline intrusion, forcing the local community to rely upon rainwater harvesting in the driest part of the entire country. The WaSSP has prioritised this area for water supply upgrade and is presently carrying out groundwater investigations in the area.

3.2.1.3 Historic data exist on floods and droughts at the national level.

The occurrence of flooding in the Vaisigano and Fuluasou rivers is known from historical visual observations and more recently (1974 onwards) from flow measurements or estimates. There have been nine major floods in the last 30 years, and 3 in the last 7 years.

There is less data to assess the impacts of droughts primarily because whilst the low flows in many of the river have been recorded, the water consumption has been increasing with time. As such the impact of the hydrological drought is becoming increasingly profound with time as the population continues to grow and per capita water and energy demand to increase. No attempt to date has been made to consider historic drought impact.

The recent low flows in October 2006 were possibly associated with a weak El Nino event, which brought about both water shortages and a recognition of an increase in diesel power generation. When compared to markedly more severe El Nino events in the past (such as the 1998/89 event) there are indications that Upolu, and Apia in particular, may well be now vulnerable to periods of prolonged drought.

The 1988/89 El Nino drought was very severe in that major water supply rationings were carried out. There were major bush fire events on the island of Savaii.

3.2.1.4 Economic costs of water-related disasters.

The more recent disasters (e.g. Cyclone Heta and February 2006 flooding) have well reported data on insurance losses, government clear-up costs and lost productivity (when compared to other years).

The World Bank (2005) has reported that over the last 50 years in the 12 'disaster years', the average economic losses in Samoa were nearly half of the countries GDP (GDP being US$ 400 million). The report goes on to state however that due to hazard management and climate adaptation procedures adopted during the 1990's, Samoa is estimated to have prevented up to US$165 million in damages from Cyclone Heta.

3.2.1.5 Development practices contributing to threats to life and property.

There can be little doubt that the Vaisigano River will continue to represent a major flooding risk to Apia. This situation has undoubtedly got worse in the last 50 years, with the expansion of the city and the continued urbanisation of the area, including construction within the natural floodplains and the removal and blockage of the remaining drainage system.

Historically there has been little attempt to either introduce landuse planning in recognition of the risks to these low-lying areas (i.e. flood risk zonation) nor retrospectively improve drainage and stormwater management. The ADB sanitation and drainage project presently in design is expected to help contribute to relieving some of the flooding in these areas. As part of this project flood zonation mapping is being undertaken in collaboration with SOPAC.

The ADB project will also go some way to addressing the complete lack of urban sanitation planning in Apia, which also represents a major threat to human and ecological life.

The continuing concentration of economic activity into the urban area of Apia is also creating pressures upon land use, resulting in deteriorating water quality, and increased vulnerability to drought, as the water demand rises.

As in all Small Island States, the populace tends to inhabit the costal fringe, and this continued concentration of the population in these low-lying areas inevitably exposes the people to the risks of storm surges, tsunamis and sea level rise.

3.2.1.6 ENSO relationship to climatic disasters.

The ENSO is known to have a significant impact on rainfall and as such will be linked to the frequency and duration of drought periods. The Meteorology Division use sea surface temperatures to provide a prediction of rainfall with a three month forecast. The weak El Nino in late 2006, may be associated with the below average rainfall in October 2006.

Flooding is more commonly associated with cyclonic rainfall. The relationship between cyclone frequency and ENSO is more complex because of a west to east shift in cyclone development activity. The Australian Bureau of Meteorology (BoM) report (Hastings 1990) that for the South Pacific, El Nino years have more frequent and more intense cyclones, whereas anti-El Nino years show decreases in frequency and some decrease in intensity.

Comment: Missing from ref.

3.2.2 Major issues and concerns

3.2.2.1 Lack or inundation of water resources.

Water demand and urban development mean that for the greater Apia area the risks of flooding and drought are both a major concern.

3.2.2.2 Water quality impacts caused by pollution.

Wastewater pollution appears to be the major concern for the town of Apia and its coastal waters, fisheries and recreational use. This will include the uncontrolled disposal of trade effluents and other potentially hazardous effluent disposal such as the hospital wastes.

In the upper catchments, where population densities are low, sediment mobilisation is perhaps of more importance, creating as it does problems for water supply and power generation further down the catchments, as well as land fertility damage to the hillside communities.

3.2.2.3 Saltwater intrusion and mitigation.

Saltwater intrusion appears to date to be limited to the Falealupo Peninsula in Savaii. Saline up-coning beneath supply boreholes is more common and occurs in northern and eastern Savaii.

Historically there have been no measures in place to address these problems.

An immediate response to both these problems under WaSSP is to investigate more optimal pumping techniques from the boreholes to minimise drawdown and thus reduce saline up-coning.

More strategically, and long term, WaSSP is expected to commit resources to a national groundwater monitoring programme as part of building capacity in hydrogeological assessment and management within WRD.

3.2.2.4 Extreme weather impacts on watersheds.

Both weather extremes have impacts on the watersheds. Heavy rainfall causes immediate flooding, but also extensive erosion, loss of terrestrial habitat, damage to agro-forestry activities as well as infrastructure damage in the urban areas. Sediment mobilisation latterly clogs parts of the rivers, damages water supplies and affects the marine habitats of the receiving coastal waters. Solid and liquid waste within the catchment is also mobilised and may also reach the coastal waters and habitats.

Dry periods result in low flows, water supply and power shortages, damage to aquatic habitat, and the concentration of land based contamination within the catchment, awaiting subsequent flushing with the return of the rains.

3.2.2.5 Impacts of sea level rise or storm surges on aquifers or watersheds.

Sea level rise of 1-3 mm/yr has no impact upon the watersheds and aquifers. Storm surges may result in some minor coastal damage, but are not significant enough to cause inundation of the aquifers.

3.2.3 Measures to manage impacts and concerns (IWRM approaches)

3.2.3.1 Disaster Preparedness and Climate Change Planning and Response.

- National Disaster Management Framework

The national disaster management framework was recently reviewed as part of the second phase of the World Bank funded Sustainable Infrastructure Asset Management Programme. This review included the development of disaster management legislation, review and development of a national disaster management plan, as well as other activities to build the capacity and strengthen the capability of the Disaster Management Office (DMO), the response agencies and other sectors of the community. Parliament has recently approved the passage of the Disaster and Emergency Management Bill 2007 into an Act. Cabinet in its capacity as the National Disaster Council approved the new National Disaster Management Plan (NDMP) in November 2006. Included as part of the National Disaster Management Plan are the response plans by response agencies and national hazard plans.

Comment: year/date?

To date, the DMO in collaboration with the Disaster Advisory Committee has developed the National Tsunami and Cyclone Plans and both plans have been approved. However more national hazards plans are required to be developed including plans to address a number of hazards listed in the NDMP that are likely to adversely affect Samoa.

The Disaster and Emergency Management Act 2007 requires the implementation of the activities to mitigate the impacts of, prepare for, respond to and recover from disasters and emergencies at both national and community level. It also provides for establishment of the national disaster management structure to oversee the application of the Act and implementation of the NDMP. The Act also requires the response agencies including educational institutions, villages, NGOs, and the business community to develop response plans to address their roles and responsibilities during response under the Act and the NDMP, business continuity, recovery from any disaster event as well as the safety and well being of their staff.

The National Disaster Management Plan details what is required to mitigate the impacts of, prepare for, respond to and recover from disasters. The Disaster Advisory Committee (DAC) member agencies are required under the NDMP to implement disaster risk reduction activities and to work with and encourage other sectors of the community to do likewise.

Comment: Who are they?

With reference to operational arrangements for preparedness, the NDMP requires the development and implementation of public awareness programmes at all levels of the country, putting in place an early warning system preferably with a multi-hazard focus, standard operational procedures, response and contingency plans, planning and implementation of trainings to build and strengthen the capacity of response agencies and all sectors of the community, and having simulations to tests relevant components of the national disaster management system.

In terms of response, the National Disaster Council provides strategic direction and makes decisions while DMO and the DAC forms the national focal point to coordinate response operations during any disaster or emergency event from the National Emergency Operations Centre (NEOC). This centre is currently housed together with the DMO at the MNRE Matautu-tai office building. The DMO/NEOC currently has both the conventional communication equipments (telephone, fax, email) as well as alternative communication systems such as UHFs and satellite telephones to ensure that communication with the response agencies and other sectors of the community (including the villages) can continue during any disaster or emergency event.

To date, alerting the response agencies, media and the public is done through radio and TV links around the country and also through direct telephone calls to the response agencies. In addition the NDMP also require the media to give first priority to airing or broadcasting public information relating to a disaster or emergency event. However this system is highly dependent on the populace listening to the broadcasted information and that transmission is still operational as most of these radio and TV stations cease broadcasting at midnight. The DMO is currently working with SamoaTel and Digicel to utilise the GSM network to alert the public, media and response agencies through SMS texting. However this system requires proper planning and testing before it is made available to the whole country.

- Arrangements to facilitate provision of warnings to the public (in relation to flooding, drought, cyclones)

The official sources of warnings are identified in the NDMP and the Meteorology Division is the designated official source for all weather related hazards including flooding, drought and cyclones. Operational procedures are in place to ensure the key personnel identified in these procedures are quickly informed and that approval is given immediately to issue warnings to the media, DMO and DAC members.

Samoa has received considerable support in the strengthening of its National Disaster Management Office, throughout the UN decade of disaster reduction, as well as the more recent SOPAC implemented regional CHARM (Comprehensive Hazard and Risk Management) programme (2000-2004).

These interventions include:

- The production of a preliminary seismic micro zonation map of Apia produced during an earthquake hazard quantification visit. The earthquake hazard quantification was the preliminary data-gathering step for the Pacific Cities Project in Samoa.
- Data on Samoa were gathered and collated where available, for the Pacific Cities Project - Samoa. This included the incorporation of existing database of roads, physical features and the water reticulation network, a detailed seismic micro zonation of the city and the survey of the structure of all buildings in the greater city area, the assembly of the borehole database, production of a coarse digital terrain model, and aerial photography and survey of control points in preparation for the production of a fine-scale working digital terrain model.

- The Global Environmental Vulnerability Index (EVI) has been developed and is now operational.
- A review and evaluation of the causes and effects of the April 2001 flood in Samoa. The results were detailed recommendations to enhance the levels of resistance for future floods provided in a report and made available to Samoa.
- High level advocacy to promote the mainstreaming of disaster risk management and the strengthening of the disaster management arrangements.
- A Public Safety and Disaster Risk Management planning capacity building to strengthen national capacity.
- The provision of funds to the Samoa National Disaster Management Office for their 2004 Public Awareness Campaign on Disaster Reduction.
- A review of the capacity of the Samoa Fire Service and the provision of ongoing institutional strengthening and training support to improve public safety in Apia
- Participation in the implementation planning phase of the World Bank disaster management capacity building support initiative.

Additionally Samoa has received technical support on advocating the need for and integrating the issues of climate change and climate adaptation into sustainable development planning. The first phase of the Pacific Adaptation to Climate Change (PACC) has been completed, essentially an advocacy and strategic vulnerability assessment, and the second phase of PACC including climate adaptation interventions in priority sectors, is in the design stage.

It is understood that Samoa has also identified activities in the Coastal Infrastructure Management Plans (CIMPs) to guide prioritisation of adaptation activities and sectors and villages of the community to focus on. Climate change issues and disaster risks are also key components of the risk assessment required for any development consent application. Proponents are required to provide all relevant information including development designs, specifications, site plans, and environmental impact assessment to facilitate risk assessment in addition to physical site inspection of any development. This process is provided for under the Planning and Urban Management Act 2004. The development consent process is similar to the CHARM process however there is no information which indicates that Samoa has attempted to adopt the latter.

3.3 Awareness

3.3.1 Type of awareness campaigns, advocacy initiatives currently being undertaken in the area of water resources management

3.3.1.1 Stakeholder consultation in national policy.

Following on from the national consultations held in Samoa as part of the preparation for the 'Water In Small Island Countries Meeting' in Fiji in 2002 and the subsequent 3rd World Water Forum, Samoa embarked on probably the largest national consultation on water ever undertaken in the Pacific.

The 'Water for Life' consultation, funded by the European Union, and coordinated by SWA, explored the development of holistic water sector policy, strategy and action for the country. It included both urban and communal water supplies, water resources, financing, coordination, institutional strengthening, community engagement, private sector involvement, monitoring and performance.

The document "Water for Life" sets out a sector plan and framework for action to address water sector development needs. It is based on a common vision for the future of the water sector and elaborates specific policies, programme priorities, and budgetary implications to help guide future investment to provide a tool to clarify how and where support is most needed and would have greatest impact.

At the time of drafting the document in 2005, over SAT$[1]100 million was to be invested to improve water supply, sanitation and resource management within the following 5 years or so. Adopting a "*business as usual*" approach in allocating these finances was not an option. The water sector was considered to be at a critical stage in its development and the available resources have to ensure a transformation toward a more independent and financially viable service provider.

Commitment to common action based on a unified sector-wide approach was considered necessary. The coordinators wrote 'The challenge for government, and indeed all stakeholders, is to consolidate the gains already made in the sector and to have a phased programme of improving service delivery and to set this within a sound water resource management framework'.

Comment: Request ref as quote.

This Water Sector Plan aims to respond to Samoa's development agenda and to provide a Framework for Action to guide and drive water sector reforms and to bring benefits to all Samoans.

The Water Sector Plan cannot be seen in isolation. The plan builds on a wealth of earlier assessments, studies, and documents, including:

- Review and consultation on the National Strategy for the Development of Samoa (SDS) the 2002-2004 and the emerging recommendations for the new SDS (2005-2007);
- Findings from the Rural Water Supply and Sanitation Study (2004) which provided an appraisal of options for the sustainable delivery of safe water supply and basic sanitation services;
- Recommendations from the SWA Institutional Strengthening Project (SWA/ISP);
- Evaluation of the Rural Water Supply Programme (RWSP*)* in north-western Upolu and south east Savaii;
- Pacific Region Action Plan on Sustainable Water Resource Management (2002) –in preparation for the 3rd World Water Forum held in Japan 2003 and politically endorsed through a Ministerial Declaration;
- Water Policy: Review and Reformulation (2003) – consultation workshop held in October 2003; and
- National Water Resource Master Plan Study (1996) a comprehensive assessment of water resource, challenges, and responses.

The framework aims to elaborate specific policies, programme priorities, and budgetary implications with enough clarity to guide the medium-term development of the sector, and to provide a vehicle to clarify how best the resources of Government, NGOs, private sector, community representatives, donor community and other stakeholders is best provided and would have greatest impact.

The plan is in-line with the Government's desire to shift to a sector-wide approach in water. It emphasises the desire to enhance local capacities to manage water supply and sanitation services within an overall water management framework and to adopt technology appropriate to our local circumstances.

Plan implementation would be monitored and evaluated from the current baseline conditions through a set of key indicators and milestones.

The format for the sector plan is based on guidelines issued by the Economic Policy and Planning Department (EPPD) under the Ministry of Finance (MoF).

[1] Samoan TALA

Further details on consultations and policy and strategy outcomes are provided in Section 5 below.

Community involvement has received increasing attention for both planning and implementation of water services and resource management. Government has progressively included NGOs/CSOs (Community Service Obligations) in consultative processes and in stakeholder consultation on policy decisions of its various ministries and corporations. In the water sector, NGOs and civil society have been actively involved in the definition phases for sector support as well as water policy dialogue and formulation. The NGO sector views these developments and trends as extremely positive in relations with Government.

Watershed management and water resources protection. Watershed Management section of WRD is involved in community watershed management activities. They are presently working with five communities, including two as part of the IWP SPREP regional programme. The team have reasonable experience and understand the process of developing a participatory catchment management plan. They use community engagement processes to develop the plans, and provide extension support through field technicians, during implementation. Watershed has a research nursery (at the Forestry nursery) where it focuses on developing agro-forestry and sustainable livelihood crops. They typically try to work with 2-3 communities per year. WRD has also formulated a Communications Strategy.

Rural Water Supplies – Independent Schemes. Around 15% of the population rely on independent or village/community managed water supply schemes; 18 in Upolu and 4 in Savaii. The quality of water supplied by small independent schemes is variable and none are treated. Most of the schemes were developed by the Public Works Department some years ago and most are coming to the end of their useful life. The village committees that operate the schemes do not collect income sufficient to rehabilitate the schemes and most do not have the technical knowledge to do so. Despite this, it is reported (KEW Consult 2004) that there are still strong desires by some communities to remain independent, perceived to be driven by uncertainty of the government to provide reliable supplies, a desire to remain free of government water charges, and reluctance for metered supplies. However it is further reported that this situation is not helped by a lack of community knowledge and advice on the health aspects of untreated water supplies.

In the majority of cases the water scheme is run by the village Water Committee; and the chairperson is generally the village mayor.

In rural areas, sanitation is rudimentary. Septic tanks are reported to be widely used but this term is often used to describe any tank which receives toilet waste and a sample survey in July 2004 indicated only 17% of such tanks could be considered as true septic facilities.

Comment: By whom?

3.3.2 Major issues and concerns

3.3.2.1 Social and cultural issues associated with water resource and wastewater management.

In summary the main social and cultural issues relevant to water resources and wastewater management are a village desire for independence, customary land ownership and dependence on the land for income, and a lack of village awareness of water and wastewater issues at the village and at larger scales.

Village independence is self-explanatory and requires no further discussion.

Land ownership remains a major issue in Samoa where more than 80% of the land is in customary ownership. In the more rural locations, subsistence cropping as well as land based incomes is vital to the communities. Attempts at introducing land use change have to recognise the dependence on these resources and the inability of statutory instruments to enforce any prescriptive measures forced on these communities.

A general lack of rural community knowledge and understanding of the consequences of inappropriate land use activities on the water resources, even their own water resources, remains.

In more urban catchments, knowledge levels are greater, but competition for land and income, result in inappropriate land use activities despite an understanding of the potential consequences.

3.3.2.2 Community participation and consultation.

Samoa has made clear strides to improving the linkages between the government governance apparatus and the traditional village governance arrangements. Most notably this includes the requirement for formalised engagement of the village communities as written into the Constitution of Samoa (fundamental rights and freedoms and recognises the institutions of traditional governance, customary (or chiefly) titles, as well as customary land ownership), Internal Affairs Act 1995 (established the Ministry of Women, Community and Social Development and makes provision for the recognition and organisation of village authority, which is to stand as a system of local government throughout Samoa) and the Village Fono Act 1990 (which empowers the Village Fono (or council of chiefs) to exercise authority within a village in accordance Samoan custom and tradition).

A lack of community participation and consultation is therefore not seen as a concern in Samoa.

Where these rules and procedures are not followed however, community engagement is ineffective.

3.3.2.3 Political will.

The government has continually prioritised the water sector in terms of the focus of external support into the country, and has through the 'Water for Life' consultations advocated for the involvement of the Samoan stakeholders in finding sustainable solutions for the water sector. There is strong political will throughout government to support this sector.

Any concerns relate more to the capacity of existing government departments to address the needs of the water sector, and to change from 'business as usual' to a more 'integrated' management approach.

3.3.2.4 Gender Issues.

The rights and roles of women in Samoan society are well represented at the national, ministerial and communal level, both formally and informally. The Ministry of Women, Community and Social Development (MWCSD) is the government department formally responsible for the rights and representation of women, as well as the mechanism by which the government apparatus liaises, engages and works with the traditional governance structure of the village communities.

A lack of gender consideration is not seen as being a concern or problem area.

3.3.3 Measures to manage impacts and concerns (IWRM approaches)

3.3.3.1 Community based monitoring programmes.

Community based monitoring schemes have been used in demonstration/pilot studies carried out to date (e.g. IWP). They have contributed towards education, awareness raising, and engaging with communities, providing communities with a means of measuring their own impacts upon their water resources, and developing their own mitigation plans.

This approach also reduces considerably the burden upon government departments to monitor water resources and community activities – and is seen as vital in the improvement of IWRM in the country.

3.3.3.2 Targeted education and awareness campaigns.

Improving civil society knowledge and education is widely recognised as being a contributor to informed decision making at many different levels. Whether specific groups should be targeted is a consideration.

There have been notable successes in other parts of the Pacific (e.g. Fiji, Solomon Islands, Vanuatu and Papua New Guinea), in integrating water sector issues into the school curriculum,

to enable water, sanitation and hygiene issues to be sustained rather than ad hoc campaigns. In this context, school children could be a target group.

3.3.3.3 High level advocacy initiatives.

The government is already a strong advocate of the water sector. The need now is for improved integration of the sector with other sectors. High level IWRM governance, including coordination and planning will require advocacy.

3.4 Technology

3.4.1 Types of water supply systems

3.4.1.1 Types of water supply systems.

BLANK presents only a partial, and perhaps misleading picture, of water supply provision in Samoa as it does not reflect access to "safe" water supply.

Comment: Missing beginning of sentence. Existing information presents…?

Table 1: Connections and services; sources of water supply

	Source of water supply per HH					
	Piped	Piped shared	Well/Spring	River/lake	Rain	Total
AUA	4,960	206	44	26	67	5,303
	93.5%	3.9%	0.8%	0.5%	1.3%	100.0%
NWU	5,682	771	92	43	381	6,969
	81.5%	11.1%	1.3%	0.6%	5.5%	100.0%
ROU	4,306	422	246	102	330	5,406
	79.7%	7.8%	4.6%	1.9%	6.1%	100.0%
Savaii	4,295	447	34	14	711	5,501
	78.1%	8.1%	0.6%	0.3%	12.9%	100.0%
Total	19,243	1,846	416	185	1,489	23,179
	83.0%	8.0%	1.8%	0.8%	6.4%	100.0%

NB: AUA: Apia Urban Area;, NWU: Northwest Upolu; ROU: Rest of Upolu
Source: 2001 Census

The above statistics have been used to state that 91% of the population have access to a piped water supply (columns 1 and 2) yet many piped supplies are intermittent and can be polluted.

In addition the Electric Power Corporation (EPC) operates five hydropower stations on Upolu. 3 of these schemes are run-of-the-river schemes on the Vaisigano River, one is a run-of-the-river scheme at Lalomanga on the Falefa River, and one a dam impoundment at Afulilo. EPC was not able to provide estimates of minimum flows it requires to operate the turbines.

There are no irrigation schemes for agriculture in Samoa.

3.4.1.2 Rural and urban (reticulated/non-reticulated).

The Samoan Water Authority (SWA) is the major service provider for water supply and sanitation and covers about 17.000 households (equivalent to about 70% of the population) on both main islands of Samoa. About 20 district-managed schemes deliver these services to mainly rural areas. The European Union has supported the sector with a major rural water supply project in NW Upolu and SE Savaii covering about 7,000 households in rural areas for the supply of drinking water during the period 2001 to 2003.

Completion of the schemes in Upolu and Savaii in 2003 has resulted in a significant increase in registered users including an increase of 48% in kilometres of pipe, two additional treatment plants, as well as an additional 20 new/replacement boreholes. Transferring customers to metered supply has also increased by 50% the number of meters. Current assets are:

Comment: Missing text…are listed in Table 2?

Apia urban area is supplied from gravity sources that have reliable yields higher than the current demand. However this demand is greater than the design capacity of the treatment works and

this then becomes the controlling factor. The area of supply through the treatment works is therefore adjusted to suit the maximum (overloaded) capacity of the treatment works.

Table 2: Samoa Water Authority Assets

Assets	June 2003	May 2004
River and spring intakes:	38	34
Water supply treatment plants	3	5
Reservoirs and tanks	55	113
Bore supply systems	44	62
Pipe length (kilometres)	627	1,207
Pipe size (diameter) range:	25-450mm	25-450mm
Control valves	388	450
Water meters:	6,000	9,016
Hydrants	334	852

In most other rural areas, however, the SWA has inherited aging and often poorly maintained water supply assets which deliver intermittent and untreated water supplies. Much of the Apia urban area also has aging assets. Depreciation is estimated at around $3.5 million per year for SWA.

Independent water supply schemes are water schemes that are operated by either one particular village or a number of villages in a district. The total number of independent schemes in Upolu is eighteen (18) while Savaii has four (4). The 18 in Upolu includes Sataoa, Lotofagā, Vavau, Aufaga, Saleapaga, Samamea, Ma'asina, Salimu, Sauano, Falevao, Lalomauga, Saoluafata, Eva, Solosolo, Luatuanu'u, Leusoalii, Laulii and Falelatai, while the four in Savaii are Sala'ilua, Matautu, Satupa'itea and Sili.

Table 3: Independent Schemes Assets

	Number	50 mm pipework (metres)	50mm < Ø < 100mm (metres)	Ø = 100mm and over (metres)
Intake	25			
Reticulation		9,696	11,081	61,085
Storage Tanks / BPT	13			

Source: ?

3.4.1.3 Water treatment systems.

Only one third of this population currently receive treated water and some 15% of samples from these treated supplies fail quality tests either through ineffective treatment or intermediate contamination. The potential for delivering treated metered water was significantly increased following the recent implementation of projects in NW Upolu and SE Savaii and a consolidation

phase to these projects will ensure the full benefits are realised. The remaining 32% of the population either receive water from independent village schemes or their own small sources.

The SWA operates five treatment plants (3 for Apia and one for NW Upolu and one for SE Savaii), namely:

- Alaoa capacity 9,125 m³/d, average production about 12,000 m³/d
- Fuluasou I for urban Apia, capacity 5,915 m³/d, average production about 11,000 m³/d (almost 200% of design)
- Fuluasou II for NW Upolu, capacity 8,640 m³/d (100 l/s)
- Malololelei 1,860 m³/d, average production 2,400 m³/d
- Faleata (Savaii), 5,184 m³/d (60 l/s)

The treatment steps are similar for all plants consisting of upstream roughing filters, sedimentation tanks, and slow sand filters. As a final step disinfection is installed using the application of calcium hypochlorite solution.

In addition there are some 15 SWA operational boreholes on Upolu and 27 in Savaii. Water from the Upolu boreholes is generally good quality at the bore, as is the water from the new Savaii boreholes. However the 20 old boreholes on Savaii are being overused and causing saline intrusion.

There is no treatment of any independent scheme and many are in a poor state of repair.

3.4.2 Types of wastewater /sanitation systems

3.4.2.1 Rural and urban (onsite and reticulated).

An extract from 2001 Census statistics for Samoa states: MISSING TEXT

Table 4: Samoa Sanitation - Extract from 2001 Census

	Sanitation facilities available in HH					
	Flush with septic	Flush shared	Pisikoa	Pisikoa shared	Pit	Total
AUA	4,238 79.9%	213 4.0%	576 10.9%	74 1.4%	202 3.8%	5,303 100.0%
NWU	3,906 56.0%	262 3.8%	1,565 22.5%	219 3.1%	1,017 14.6%	6,969 100.0%
ROU	2,661 50.2%	217 4.1%	1,641 30.9%	198 3.7%	589 11.1%	5,306 100.0%
Savaii	2,682 48.8%	157 2.9%	1,657 30.1%	173 3.1%	832 15.1%	5,501 100.0%
Total	13,487 58.2%	849 3.7%	5,439 23.5%	664 2.9%	2,640 11.4%	23,079 99.6%

NB: AUA: Apia Urban Area;, NWU: Northwest Upolu; ROU: Rest of Upolu
Source: 2001 Census

The Sanitation statistics above show over 60% of properties have access to a “flush” toilet inside the property. This percentage is reported as misleading as a measure of access to waterborne sanitation; flush toilets are preferred because they are seen as being most hygienic, and less likely to cause odour; they are also seen as a status symbol. A high proportion however are installed in properties with no piped water supply or intermittent supply only, and flushed by first filling the cistern with a bucket.

Similar misconceptions are reported regarding the numbers of properties with septic tanks. It is common practise throughout Samoa to refer to any tank that receives toilet waste as a ‘septic tank’, in fact most do not act as a septic tank at all. In a small survey carried out in July 2004 (Kew Consult) only 17% of tanks inspected were considered as proper septic tanks, no where near the 58% quoted in the 2001 Census.

3.4.2.2 Medium to large-scale collection and treatment.

There is no medium or large scale collection and treatment of wastewater at this time. The ADB funded Samoa Sanitation and Drainage project, which is presently in the detailed design stage, is expected to provide for a wastewater sewerage system for the Central Business District of Apia only.

The proposed Sanitation and Drainage Project, involving an ADB concessional loan of US$7.8 million, will also clean and widen drains, rehabilitate septic tanks for up to 500 households, and provide regular pump-out services for individual septic systems, which will include environment-safe methods of treatment and disposal. In addition, the project will build technical and administrative capacity for providing urban services and management.

The details of the design are yet to be finalised but are understood to include a wastewater treatment works, with cake and effluent disposal to the Division of Environment and Conservation operated landfill outside of Apia, i.e. no marine outfall is being considered.

3.4.2.3 Available mechanisms for handling and managing wastewater.

The existing mechanisms are all on-site wastewater disposals, i.e. septic tanks and pit latrines. Inadequate wastewater disposal is a major issue for urban Apia, where domestic and trade effluent is disposed directly into the urban drainage channels and culverts.

3.4.3 Major issues and concerns

3.4.3.1 Supply and demand balance.

Water demand appears to be readily met by the surface water and groundwater sources with some specific exceptions. However, it is estimated (Kew Consult 2004) that 50% of the SWA customers only receive untreated water and in many cases only receive an intermittent supply.

SWA estimates from its billing records being able to supply 230 litres per capita per day to its metered customers. There is however no metering of any sort for the rural and independent schemes. It is not possible to make any assessment of the adequacy of water supply to the rural schemes. However a lack of reported water scarcity (with the exception of Falealupo), and low population densities suggests this is not a significant problem.

However because of the large number of customers in the urban Apia area, it has been reported (Kew Consult 2004), that water demand is only met by restricting the supply area to that which can comfortably be supplied from the existing water treatment works.

Apia urban area is supplied from gravity sources that have reliable yields higher than the current demand. However this demand is greater than the design capacity of the treatment works and this then becomes the controlling factor. The area of supply through the Works is therefore adjusted to suit the maximum (overloaded) capacity of the treatment works.

It is further reported that in the rural areas of Upolu and Savaii, boreholes that supply the villages only operate for between 11 and 17 hours per day; these hours having been arrived at by balancing economy in electricity costs and demand. Because many areas do not have storage within the system; pumped hours are limited to hours of peak consumption, morning and evening.

In Savaii a scheme was installed by AusAID at Falealupo some 10 years ago and continued for about 5 years before the boreholes ran dry. The scheme was then abandoned and the area has had no piped water since. Attempts by SWA to provide tankered water to the area have been thwarted by over-abstraction at local boreholes resulting in saline intrusion.

The villages on the Falealupo Peninsula are reported to be successfully using rainwater harvesting.

3.4.3.2 Water shortages.

The reliance upon surface water sources in the greater Apia area means that during dry periods, stream low flows cannot readily yield the required abstractions. As recently as October

2006, water shortages were starting to occur in the Apia region due to a prolonged dry month. Field inspections at the time, however suggested additional water resources might be exploited if appropriate catchment analysis and existing user dependency could be further evaluated.

A lack of hydrological monitoring and a near absence of abstraction monitoring make detailed low flow analysis difficult at this time. No drought vulnerability assessment has been carried out to date, but is planned under the WaSSP.

As stated in the section above, in some rural areas on Savaii (notably Falealupo, but also other northern and eastern coast towns of Savaii), borehole water has become saline as over-abstraction has led to salt water intrusion. It is believed it may be possible to improve this situation with improved abstraction techniques. Further investigations are planned for the Falealupo region under the WaSSP.

3.4.3.3 Human Resources.

Within the recent past the SWA has been supported by numerous externally funded projects covering areas from technical assistance, public awareness campaigns, to institutional strengthening and engineers' supervision for investment programmes. These projects have achieved varying degrees of success and their impacts on the SWA performance continue to be investigated:

- AusAID funded ISP from 1998 to 2003
- KfW funded Apia Water Supply Consolidation Project from 1999 to 2001
- EU funded public awareness rising campaign (EUPA) from 1998 to 2000
- EU funded rural water supply project (EU-RWSP) NW Upolu and SE Savaii
- JICA funded assistance to establishment of the EBU and a wastewater section within SWA

As an example, referring to the final evaluation report for the EU-RWSP prepared by Hydro – R&D, Belgium, submitted in January 2004; the following comments can be used for illustration of where attention is still required on capacity building:

Comment: Consulting firm

- A rapid programme for training of operational staff of SWA is required in particular for the treatment plants
- Over pumping of coastal aquifers take place and should stop immediately
- Leak reduction requires higher priority
- Assets operated by SWA are not yet entered into GIS database
- Water meter coverage is far below target leading to an uncontrolled wastage of water and potential overburden of the installations
- Sanitation measures require higher attention and particularly for the rural areas should be implemented with water supply scheme simultaneously.

It needs to be recognised that in the last five years, SWA has seen an increase in its customer base by nearly 100% and a near doubling of its assets. Whilst these two factors should ideally enable the systems to be maintained, the reality of Samoa, as with most other Pacific states is that there is a shortage of appropriately skilled persons. The staffing of SWA had not doubled in this period, and as a result SWA is under considerable manpower pressures.

Independent water schemes, run by the villages have very little technical capacity. Only three independent schemes have qualified and experienced operators, which are ex-SWA or PWD employees. They have relevant knowledge in fixing leaks and pipe-laying but do not have the required skills and experience in operating the schemes and/or managing the water resource, intake protection etc. There are reports of villages using plastic telephone ducting to carry out repairs because of the lack of funds for proper spares.

It has been reported that the SWA has improved steadily and has had some successes, notably the Apia Water Supply Consolidation Project and the Rural Water Supply Consolidation Project. The Authority appears to have technically competent staff who are in need of management and supervisory development and who need to develop confidence through experience. The Authority has some good IT hardware but needs systems development.

3.4.3.4 Financial Resources.

The only source of income for the SWA at present is water sales. Sales presently generate less than half the required income to cover normal operating costs. Income is estimated at SAT$4.5 million against expenditure estimated at SAT$12 million. The difference is made up by Government of Samoa grants and subsidies. There is no reported attempt to cover the depreciation costs of SAT$3.5 million per year.

Income from water sales is dependent on the tariff and the number of customers, and it was proposed that the tariff did not increase for a further 4 years.

It has now been accepted that a tariff "freeze" would threaten the financial viability of the Authority and changes are being discussed. However there will be reliance on grants or subsidies from the Government of Samoa for some time to come. The issue of tariffs is discussed in a later section.

Previous reports (Kew Consult 2004) have summarised:

- The 230 l/c/d average metered consumption is very high and exceeds average consumption figures in the Pacific region.
- The low tariffs and free allowance contribute to this high consumption by giving little incentives for water conservation and reduction of wastage.
- In turn high consumption leads to overloads of treatment and distribution facilities and puts unnecessary stress on the available water resources.
- High consumption figures in turn also lead to higher projected demands for future schemes and increase capital expenditure on new infrastructure.
- The 'Free Allowance' designed to help the poor does not reach a large proportion of the rural population.

The EU funded Rural Water Supply Consolidation project will result in some 2400 new metered connections that will increase income by around SAT$0.6 million per year. The scheme will also allow the closing and reduced operation of some boreholes that will result in operational savings of SAT$0.1 million per year.

Financial viability in future will to some extent depend upon Government policies, especially on tariffs and support funding.

Independent water suppliers surveyed in 2004 were found to be generally not providing a good service, none provide treated water and many are operating old schemes that have had only breakdown maintenance over the last 20 years.

3.4.3.5 The threat of inadequate wastewater management to water resources, human health and ecosystem welfare.

The on-site sanitation systems presently have the effect of dissipating the effluent load and distributing across the land area. The lack of 'point loading' of effluent disposal has perhaps contributed to a lack of concern to date over the risk it may pose to the raw water resources.

Most of the raw water intakes are located sufficiently up catchment to not be significantly affected by wastewater returns. The populations are predominantly located along the coastline, with the exception of urban Apia, and as such wastewater disposal is of more concern to human health within the settlement areas and the coastal ecosystems.

The same cannot necessarily be said for agricultural effluent, where cattle grazing occurs in the upper catchment areas.

Wastewater disposal in the villages and greater Apia area does however represent a significant risk to human health in these areas, in terms of direct human contact, and disposal to near shore coastal waters and their associated use as both recreational waters and village fisheries.

The intermittency of water supplies in some areas introduces another pathway for contamination. As pipelines depressurise after water delivery they create negative pressures. This can suck in water from the ground around them. The Apia supply system is known to have water losses of 40% indicating that leakage occurs. Where the systems are not supplying water 24 hours a day, they have the potential to pull in contaminated shallow groundwater through the leaking pipework.

SWA carries out microbiological testing of its raw waters. But there is no facility for the monitoring of water from independent suppliers or from village pools, except by paying for SWA laboratory services.

It is understood that the proposed Apia CBD wastewater scheme, intends to dispose of treatment plant waste activated sludge in the drying bed at the Tafaigata landfill located inland of SWA's water supply standby boreholes at Malie and Vaitele-fou. The liquid effluent from the proposed plant is understood to be planned to be disposed through an infiltration gallery before seeping directly into the bay.

Trade effluent and in particular hazardous waste effluent, such as from the hospital, are significant concerns.

3.4.4 Measures to manage impacts and concerns (IWRM approaches)

3.4.4.1 Measures in place to prevent pollution from poorly managed wastewater treatment and/or discharges.

There are no wastewater treatment plants in Samoa at this time although a sewerage system is presently being designed for the CBD of Apia. All other sanitation is on-site only and may or may not use a septic tank system.

Pollution prevention is based largely on the upstream location of the raw surface water intakes, the natural attenuation properties of the underlying rocks, and for Apia water treatment. SWA treats approximately a third of the water it pumps into supply from five treatment plants, all of which are operating beyond capacity. The treatment steps are similar for all plants consisting of upstream roughing filters, sedimentation tanks, and slow sand filters. As a final step disinfection is installed using the application of calcium hypochlorite solution.

There is no disinfection of borehole supplies.

A study of the monthly Laboratory Water Quality reports (carried out in 2004) showed that chlorination is erratic with many periods without disinfection. The laboratory staff regularly highlights this problem.

Comment: By whom?

No independent water schemes have treatment.

3.4.4.2 Water conservation measures.

SWA has invested heavily in trying to reduce water consumption and water demand. The recent AWSCP during which the urban Apia area was converted to universal metering was successful in that water consumption was reduced from about 900-000 l/c/d to less than 300 l/c/d.

The 230 l/c/d average metered consumption remains relatively high for Pacific countries, but more importantly the unaccounted for water in urban Apia is reported as at least 41% of production, thus requiring approximately 500 l/c/d to supply these customers.

A considerable investment in unaccounted for water management was provided by AusAID under a previous Institutional Strengthening Programme (ISP), but it is understood most of the personnel trained have since left SWA. There is at present no active leakage detection within SWA. SWA recognise the problem and have a leakage control section.

A water demand management programme exists within the current EU funded WaSSP and it is hoped that it can build capacity in this area.

It has been concluded in reports that the SWA does not deliver sufficient quantity of treated water to many of its existing customers for a number of reasons:

- Continued high levels of leakage and a lack of leak detection activity.
- New properties and developments built higher than supply systems were designed to supply thus needing new infrastructure. This process has become worse since the cyclones and the movement of people inland.
- A lack of water storage in some systems, from construction, that means there is no balancing of demand and customers go without at peak periods.
- Attempts to control electricity costs by only using boreholes at peak times of day resulting in intermittent supplies. Especially in areas with no storage as above.
- Attempts to control the abstraction from boreholes to reduce the amount of salt water drawn into the system. A problem frequently commented on but not properly investigated because of lack of resources.

3.4.4.3 Appropriate technologies and methods.

Water scarcity and water quality are the main areas requiring attention. At this time SWA is not responsible for wastewater per se.

Water scarcity can be addressed by:

- appropriate assessment of surface water low flow yields (requiring hydrological monitoring and abstraction metering) and relocation of intakes;
- conjunctive use with groundwater resources (especially at times of low flow) once groundwater resources assessments have been completed;
- increase in storage to meet peak demands and enable reduction of borehole abstraction rates to lower levels thus reducing risk of saline up-coning;
- pro-active unaccounted for water monitoring and leakage remediation;
- flowmeter recalibration and replacement in the SWA system;
- changes to tariff system to provide incentive of water conservation; and
- public awareness campaigns on water conservation.

3.4.4.4 Water Resources/Catchment Management Geographical Information Systems (GIS).

There are a number of GIS systems operated by government departments which are of relevance to water resources and catchment management. Much of this information is stored on a MAPSERVER presently operated by the Meteorology Office, but this is about to be transferred to a private IT company. The MAPSERVER struggles to be effective because internet connectivity is not adequate to use it on line.

The SWA GIS apparently is used as an asset registry and has linkages to operation and maintenance and a hydraulics modelling tool.

Forestry Department of MNRE operates a GIS management system known as SAMFRIS, which includes all land use coverage, vegetation types, geology, topography, land ownership and logging concessions.

The Technical Services department of MNRE operates a number of GIS systems, and has copies of aerial photography, satellite imagery and topographic maps within its systems.

The ADB Sanitation and Drainage Project is known to have carried out some assessment on the stormwater generation possible within the Apia catchments, as has SOPAC as part of a risk reduction programme on flood forecasting.

Under the WaSSP it is hoped that all these datasets can be integrated within a GIS system operated by WRD, which would also capture hydrological and hydrogeological monitoring and assessment.

3.5 Institutional Arrangements

3.5.1 Types of Institutional Arrangements

3.5.1.1 National Water Vision.

The 2002-2004 Strategy for the Development of Samoa (SDS) is built on an over-riding objective to provide opportunities for all and to promote economic growth that is equitable and sustainable and improves the health, education and well-being of everyone. The next SDS (2005-2007) has built on these trends with a continued emphasis on good governance, a stable macro framework, efficient and effective service delivery, and sustainable natural resource management.

Comment: Which Ministry does this fall under?

Government accords a high priority to water supply and sanitation, wastewater and water management and this is reflected in the SDS 2005-2007. Addressing water sector needs under a single, sector-wide approach paves the way for a more focused and sustainable programme of water-related actions to support achievement of the overall country policies and strategies.

The Government's water policy and strategy supports implementation of the SDS and is guided by an overall goal: ***"To ensure community access to water of suitable quality and appropriate quantities to meet all reasonable health, environmental and economic development needs."***

3.5.1.2 National Water Committee.

At present, there is no Water Sector Apex Body that coordinates policy formulation and regulatory roles for all of the water functions. Due to the absence of an appropriate policy and legal framework, which would support the establishment of this type of administrative body, the control over the management of water resources is fragmented.

However due to the unprecedented level of activity in the water sector, the Ministry of Finance has set up a Water Sector Management Unit (WSMU) to coordinate internal and external funding support for the water sector.

The WMSU in turn reports to the Water Sector Steering Committee (WSSC), an informal and interim arrangement mechanism composed of the CEO's of relevant government departments, for the purposes of sector coordination. The WSSC includes CEOs from the Ministry of Finance; the Ministry of Natural resources and Environment; the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Women, Community Services and Development, Ministry of Health; Ministry of Works, Transport and Infrastructure (MWTI); Samoa Water Authority; Electric Power Cooperation and SUNGO.

It is anticipated that an Apex body mechanisms will be developed during the life of the WaSSP although the WaSSP is not specifically tasked to create such a mechanism. The IWRM process is expected to assist in the formulation of such a body.

The Watershed Management regulations created the formation of the National Watershed Management Committee (NWMSC), a committee of CEO level officials appointed to advise the Head of State on the formation of Watershed Management Plans. It is understood this committee is not presently operational, but may be an appropriate mechanism for the Apex body.

3.5.1.3 National Water Resources and National Water Services Policy.

In response to identified challenges, the Government has continued to develop and strengthen its policy in the water sector based on recognised good practice, and consistent with policies of the international development community. A National Water Resources Policy (NWRP) was endorsed by Cabinet in July 2001 and is currently being reviewed. More recent work has focused on establishing the complementary policy for water services. This resulted in

agreement on a National Water Services Policy (NWSP) which was to be endorsed by Cabinet in early-2005.

Building on the development of the water policies, a water sector Roadmap was developed during 2003/2004. The Roadmap provides key milestones and targets for sector development which are consistent with the policy framework.

Water Sector Organisation of Samoa

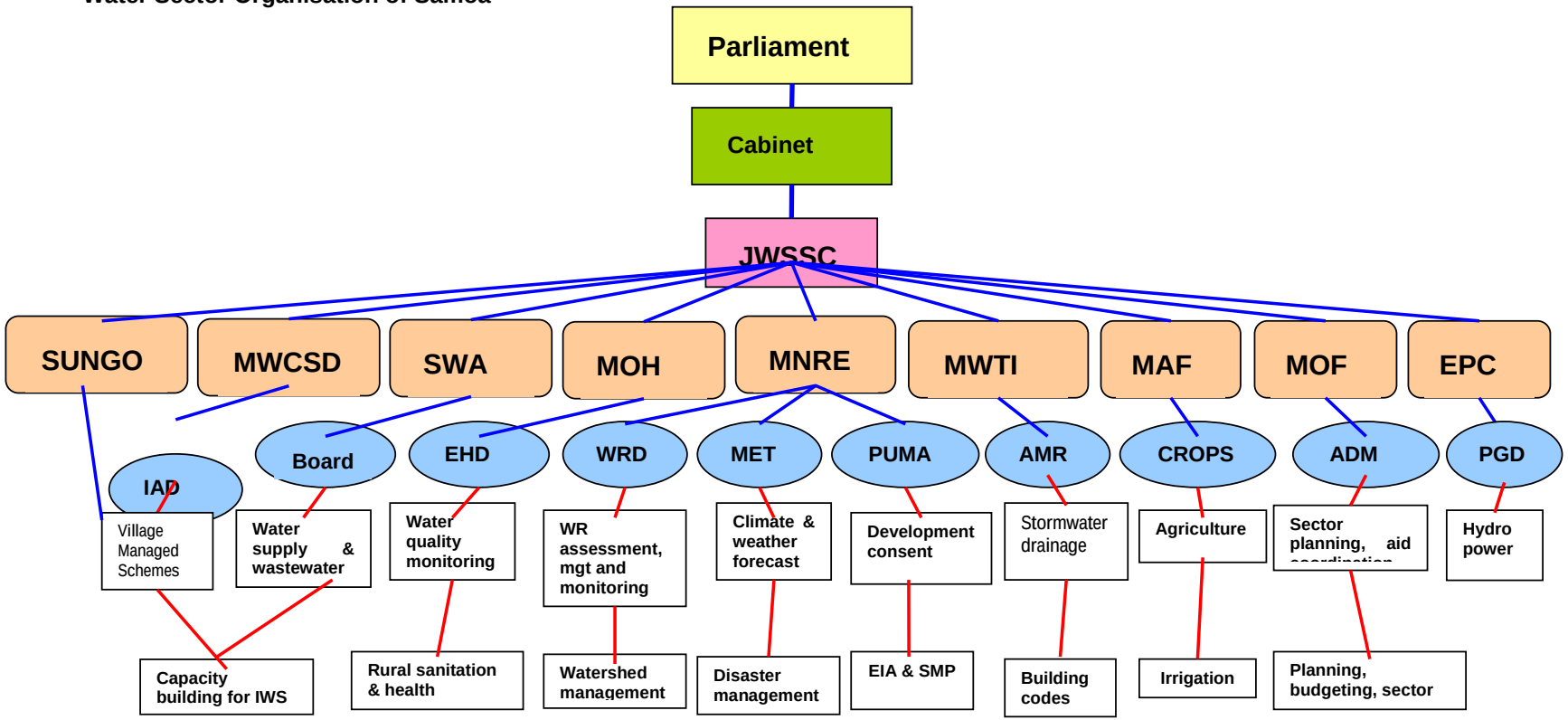


Figure 6: Samoa Water Sector Organisational and Responsibility Diagram

AMR (Asset Management Roads): CROPS (Crops Division); IAD (Internal Affairs Division); IWS (Independent Water Schemes); JWSSC (Joint Water Sector Steering Committee); PGD (Power Generation Division); SMP (Sustainable Management Plans)

The national water policy documents are mutually reinforcing and are intended to address priority concerns in the short- to medium-term. Expected benefits from policy implementation aim to secure sustainable delivery of water services and sustainable management of water resources and include:

Expected benefits of national water resource policy implementation	Expected benefits of national water service policy implementation
• Greater public awareness of water resources issues • Increased stakeholder involvement in protection of watershed shed areas • More community participation in the conservation of water sources • Protection of water bodies from adverse impacts of human activities • Equitable access to water • Efficient allocation of water to various users	• Improved public health through increased access to quality water-related services • Clear and appropriate standards of service • Improved levels of cost recovery and financial viability of service providers • Strengthened institutional capacity to sustain water services; • Improved levels of performance and higher system efficiencies • Increased stakeholder involvement in water service management and provision • Greater public awareness of responsible water management and use • More effective sector governance and oversight • Adoption of integrated water resources management principles and practice • Conservation and protection of water catchment areas and water sources;

The objectives of the national water resources policy are set out below:

Objectives	Comments
1. Create greater community awareness of water resources	Greater community awareness and better understanding of water resources matters are likely to lead to more public support for the sustainable management of water resources.
2. Improve knowledge and understanding of water resources	To develop suitable water resources management strategies, it is very important to have reliable information on all aspects of water including surface water, rainwater, re-charge and draw – off rates for underground water and water quality. Necessary to conduct on going data collection and scientific assessment.
3. Conserve water resources in partnerships with all stakeholders	The conservation of fresh water bodies and water system – rivers, springs, lakes, water

	catchment areas Underground water and water storage is the key to the sustainable utilisation of water. Greater stakeholder involvement in water resources management. Provide support for management programmes and activities.
4. Protect water resources from adverse impacts of human activities	The protection of water sources and catchment areas to be part of the planning process so that water quality and quantity are not adversely affected by development. Approve environmental impacts assessment procedures for such development programmes.
5. Develop mechanisms to control the allocation of water	At present access to water resources is free, only the cost of water supply to consumers is charged.
	There is no incentive for service providers to use water efficiently so there is urgent need to develop system for the equitable allocation of water to various users.
6. Promote partnerships to support the management of water resources	International partnerships provide opportunities to share experience and knowledge through skills and technology transfer. Strengthen relations with external development partners and secure financial assistance for water resources programmes.

The National Water Resources Policy states:

'The most pressing concerns affecting water resources are: (i) the degradation of water catchment areas as a result of uncontrolled clearance of land for agricultural purposes; and (ii) the inequitable allocation of water due to its free extraction by users. These are urgent priorities to be addressed to ensure the sustainability of water resources and therefore supplies'.'

And

'Water as a resource is limited and good quality water is insufficient to cater for the increase in demand with the continuing increase in population and also for use in development activities. There are critical management issues relating to the sustainable use and management of water resources in Samoa. These critical issues need to be fully addressed through a coordinated approached involving all stakeholders.'

A National Water Resources Management Strategy (NWRMS) is presently under-going consultation throughout the country as part of the EU funded WaSSP programme.

The NWRMS provides a national framework for the protection, conservation, development and management of Samoa's water resources as well as a platform for close collaboration and cooperation among all agencies and stakeholders with interests in water at the national and local level.

The overall goal of the strategy is "To ensure community access to water of suitable quality and appropriate quantities to meet all reasonable health, environmental and economic development needs". The strategy objectives are:

1. To strengthen the control, management and protection of water resources.
2. To improve knowledge and enhance understanding and management of water resources and their uses.
3. To develop and strengthen existing measures/mechanisms to protect the quality and sources of freshwater.
4. To build and strengthen capacity of WRD staff and stakeholders.
5. To create greater pubic awareness of water resources issues.
6. Promote partnerships to support the management of water resources.
7. To secure finances/resources for project implementation

The NWRMS will be submitted to Cabinet for approval by May of this year (2007).

3.5.1.4 Legislative and policy documents that provide the appropriate mandates for the institutions responsible for water resource and wastewater management.

A. Laws Relating Specifically to Water

Water Act 1965

The Water Act 1965 makes provision in relation to the conservation, supply and use of water, as well as protection of it from pollution:

- Right to *use* water in rivers, falls etc for the purpose of generating or storing electricity or other power OR supplying water for domestic, agricultural, pastoral, industrial or commercial use is vested in the Government;
- Minister may prohibit cutting or removal of bush or trees from banks of rivers or streams and prohibit cultivation – for the purpose of conserving the flow of water;
- It is an offence to allow any pollutant into any water or watershed being part of the water supply system, or to allow livestock to trespass on any waterworks;
- Director of Health and officers can take samples of water for analysis from any point of any water supply including private premises- if director certifies the water as polluted/ dangerous to health then water should cease to be supplied from that source;
- Regulations under this Act may be made to control streams and other waters, and also in relation to all lands, watersheds, catchment areas, reservations, dams etc.;

Note some operational provisions remain under this Act although all responsibility for this has been shifted to the Water Authority under its own Act. This Act also requires all payments for Government supplied water to be paid to the Director of Public Works and not the Water Authority.

Water Authority Act 2003 (repeals the Water Authority Act 1993/1994)

Continues the operation of the Samoa Water Authority under revised legislative provisions aimed at promoting its financial independence and its role as a provider of economically viable services. It has responsibilities and powers relating to the conservation and safeguarding of Samoa's water resources. Its functions include formulating and recommending to the Minister

national policies relating to the control and use of such resources. Under this Act, regulations can be made to prescribe water quality standards, conserve water resources, prevent pollution and to minimise any adverse effects on water resources, and ensuring a continuous supply of water as far as practicable and restricting the use of water resources in times of shortage or anticipated shortage.

The Samoa Water Authority was formed by the implementation of the Samoa Water Authority Bill 2002 and the functions of the Authority are set out in Section 9 of the Bill:

(a) to harvest, treat and reticulate water for supply to the people of Samoa;

(b) to set and to meet standards in relation to the supply of and quality of water supplied by the Authority;

(c) to create, operate and maintain systems for the provision of water in Samoa;

(d) to preserve the assets previously operated by Government in relation to the provision of water supplies;

(e) to provide other services as provided for by section 29;

(f) to provide relevant specialist advice and technical services;

(g) to progressively achieve economic viability in the provision of water supply services;

(h) to encourage and require the responsible use of Samoa's water resources;

(i) to be environmentally responsible in the performance of all its activities;

(j) to assist in protecting, managing and conserving Samoa's water resources;

(k) to identify new sources of water;

(l) to assist in the formulation of national policies relating to the use and control of Samoa's water resources;

(m) to provide assistance to the Board; and

(n) to be a responsible and fair employer.

There is no specific Water Resources Act at this time. As such there is no legal code to define abstraction entitlement and protection of entitlement from derogation.

B. Laws relating to Government and Administration.

<u>The Lands Surveys and Environment Act 1989</u>

This Act establishes the Department of Lands Surveys and Environment (now MNRE) and makes comprehensive provision in relation to land and the management of the environment. It is the principle law relating to the administration of land matters in Samoa and the management and protection of the environment.

- It makes provision for management plans prepared by the Director for the protection, conservation, management and control of Samoan waters ands water resources, and pollution. In the preparation of the management plan, regard shall be had (amongst other things) to the protection of the water catchment values of those areas within the plan, soil resources and erosion;
- It is an offence to pollute Samoan waters (includes underground water, river, streams, water course, reservoir, lake etc).

<u>The Agriculture, Forests and Fisheries Ordinance 1959</u>

This Ordinance establishes MAFF. Its various functions that relate to conservation and management of the environment (including promoting with MNRE, the conservation and development of the natural resources of Samoa- especially soil, water and forests).

<u>Ministry of Works Act 2002</u>

Reforms the law relating to public works. It has general powers relating to planning and urban management and comprehensive provision is made in relation to building regulation. Comprehensive provision is also made for the construction and management of bridges, drains and seawalls etc.

Planning and Urban Management Act 2004

Establishes the Planning and Urban Management Agency (PUMA) located within MNRE. The term 'environment' in this Act includes the social and economic aspects of development as well as the biophysical features of the environment, and also includes consideration of the impacts on the 'traditional social and cultural use of the environment from which the Samoan way of life has developed.

All development proposals are required to contribute to the achievement of the objectives for planning in Samoa which include:

- Providing for the sustainable use, development and management of land;
- Enabling landuse and development planning and policy to be integrated with environmental, social, economic, conservation and resource management policies at national, regional, district, village and site specific levels;
- Balancing the present and future interests of all Samoans.

PUMA will have a future role to play, issuing development consents- requiring EIAs etc.

C. Laws Relating to Environmental Protection

Watershed Protection and Management Regulations 1991

Makes provision for the coordinated approach to the protection and management of watershed areas. It establishes a Watershed Committee comprising officers of MNRE and MAFF, responsible for the formulation and implementation of watershed management plans. The Chief Forest Officer is principally responsible for the formulation of watershed management plans dealing, inter alia, with the treatment and proper disposal of waste in the watershed, the protection of the watershed from activities likely to cause damage to its soil and water, and monitoring water resources. It also provides that a management plan may provide for any land to be protected for up to 5 years- cultivation or disturbance of the soil can be prohibited for up to 5 years.

Police Offences Ordinance 1961

Certain offences prescribed by this Act relate to the protection of the environment, such as:

- throws or leaves any dead animal, animal remains or other offensive matter into any river, stream or other water
- removes any sand, boulders or stone from any foreshore or from the bed or bank of any stream
- pollution of water

Health Ordinance 1959

Includes certain provisions relating to pollution and to disease affecting land and rivers. Very broad powers are given to the Director General of Health including forbidding the discharge of sewerage and offensive matter in watercourses and rivers.

Forests Act 1967

The Forests Act provides for the conservation, protection and development of the soil, water and forests of Samoa.

D. Laws facilitating community involvement include.

The Constitution of Samoa

Samoa's Constitution deals with a wide range of matters including fundamental rights and freedoms and the system of government. Amongst other provisions it recognises the institutions of traditional governance, customary (or chiefly) titles, as well as customary land ownership.

Note the need to preserve culture and traditional values is therefore fundamental to Samoans approach to environmental issues.

Internal Affairs Act 1995

Established the Ministry of Internal Affairs (now part of the MWCSD). It makes provision for the recognition and organisation of village authority, which is to stand as a system of local government throughout Samoa. The functions of the Ministry include assisting village authorities with social, economic projects and village development; to advance local government through the development of village authority.

It creates executive committees which are to consult with village authorities concerning the implementation of government policies and projects, and to assist village authorities. Villages nominate a *Pulenuu* (almost like a Mayor), which is appointed by Cabinet upon the advice of the Minister. Government representatives known as *Sui-o-le-Malo* may also be appointed. The *Pulenuu* and *Sui-o-le-Malo* have extensive functions relating to maintenance of good order in the villages and liaison with government and assist Government in the implementation of its projects.

Village Fono Act 1990

The Village Fono Act 1990 empowers the Village Fono (or council of chiefs) to exercise authority within a village in accordance Samoan custom and tradition. A Village Fono may exercise authority over any person ordinarily resident in a village. Village Fonos have specific power to make rules for the maintenance of hygiene and development and use of village land for the village's economic betterment. This power includes requiring people ordinarily resident in the village to perform work relating to these activities. Village Fonos also have the authority to impose punishments including a fine in money, fine mats, animals or food or ordering an offender to undertake work on village land.

3.5.1.5 Water related legislative instruments.

Conventional environmental governance approaches rely upon enforcement of legislation which determines acceptable and unacceptable environmental impacts. Recent legislation (PUMA Act) indicates this is being pursued. However PUMA does not have the capacity to enforce the legislation, nor does any other division within MNRE.

The following legislative tools are available to enforce environmental protection:

- Sustainable Management Plans (SMPs) – includes an advisory SMP on catchment flooding prevention.
- Preliminary Environmental Assessment Reports
- Environmental Impact Assessment (EIAs)
- Development Consent Process – with conditions such as discharge consents
- Watershed Management Plans – regulations include protection of land from specific activities for 5 years
- Water Act and the Lands and Environment Act – offence to pollute, control on aggregate extraction, landfilling, reclamation
- Health Ordinance – offence to discharge wastewater
- Forestry – forestry planning and licensing of logging activities and enforcement of the Logging Code

- National Parks and Reserve Act – land has to be state owned to become park or reserve.
- Right of Compulsory Land purchase - under Taking of Land Act 1964
- Compliance Monitoring of DCP, WMP, logging, and many other activities
- Formalised engagement of communities – Internal Affairs Act and the Village Fono Act

There is no legislation on water allocation, water entitlement, protection of water entitlement (other than generically for SWA and EPC), nor a requirement to sustain environmental low flows.

There appears to be adequate legislation to protect the water environment with regards to pollution, but inadequate capacity to enforce the legislation.

The rights of the community appear adequately enshrined and protected by existing legislation. Communities readily engage with regulatory process when it protects their interests.

Legislation is a necessity to provide legal authority and legal rights, but alone is not enough for an effective management system.

The Advisory SMP is at a catchment or multi-catchment scale, and there is close similarity to a WMP, however a WMP is presently a conservation plan not a sustainable development plan.

An SMP is a guideline for integrated development to be enforced by PUMA, signed off by the Planning Board. There are no SMPs to date.

A WMP is a legal document, endorsed by the Head of State at the recommendation of the National Watershed Management Committee authorising certain activities and preventing others. There is allegedly one endorsed WMP for the Vaisigano. All others (Fuluasou, +1, Apolima and Lepa) are draft only.

Comment: Why is it alleged?

There is no actual spatial land planning or zoning as such.

3.5.1.6 Monitoring, enforcement and compliance arrangements.

The vast amount of legislation available to the government puts an extensive emphasis on enforcement. Consultations held with WRD, Forestry, PUMA, Environment, Lands all confirmed that the capacity to carry out any enforcement and compliance monitoring was minimal.

Each department has typically less than three enforcement officers, with many reporting a lack of vehicles, human resources and analytical equipment to fulfil these functions. There is particularly strong emphasis on the role of PUMA, a fledgling agency, which is trying to introduce new development planning and development control processes, tools and procedures.

Almost without exception, these departments not only recognise their limited human resources, but the ineffective role of regulation and enforcement when it came to dealing with customary land ownership and landuse. All have adopted various community engagement approaches for trying to influence behaviour on customary land, using awareness and education approaches with a particular focus on maintaining community livelihoods whilst attempting to change cropping patterns.

Forestry uses community awareness programmes (AusAID programme about to commence). They are focussing on trying to improve livelihoods of communities through agro-forestry approaches.

Watershed Section of WRD has considerable experience in community approaches. Presently they develop WMPs but at community level not catchment level. Process of WMP development is entirely participatory from scoping through to endorsement and implementation. The Watershed Section has a planning officer, and a community officer, and develops extension activities including awareness programmes. The Section's approach is to educate on watershed protection and attempt to change behaviour through advocating and demonstrating alternative

but sustainable livelihoods. They work closely with Forestry. Watershed use field technicians to demonstrate approaches to the communities and employ casuals to work with the communities on implementation.

DEC work with communities on conservation areas, which has to be fully participatory.

Land Administration Section runs sustainable land management programmes.

The Ministry of Health carries out sanitary surveys of villages but has to go through Ministry of Women.

Agriculture is understood to run sustainable farming community awareness programmes.

Of these Watershed and Forestry appear the most active and focussed. There is however no monitoring of the effectiveness of their initiatives, and the individual teams have very limited resources for community engagement. Furthermore there are no baseline surveys to enable impacts to be determined.

3.5.1.7 Multi-lateral and Environmental agreements (MEAs)

No.	INTERNATIONAL CONVENTIONS/AGREEMENTS	RATIFICATION YEAR	Status
1.	United Nations Convention to Combat Desertification (UNCCD)	1998	Acceded
2.	Convention on Biological Diversity	1994	Ratified
3.	United Nations Framework Convention on Climate Change (UNFCCC)	1994	Ratified
4.	United Nations Convention on Laws of the Sea (UNCLOS)	1995	Ratified
5.	Vienna Convention for the Protection of the Ozone Layer	1992	Acceded
6.	Montreal Protocol on Substance that depletes the Ozone Layer	1992	Acceded
7.	UNCLOS relating to the Convention and management of Straddling Fish Stocks and Highly Migratory Fish Stocks	1996	Ratified
8.	Kyoto Protocol	2000	Ratified
9.	World Heritage Convention	2001	Acceded
10.	Basel Convention for the control of Transboundary Movements of Hazardous Wastes and their disposal	2002	Acceded
11.	Cartagena Protocal on Biosafety	2003	Ratified
12.	Rotterdam Convention	2002	Acceded
13.	Stockholm Convention on Persistent Organic Pollutants	2002	Ratified
14.	Ramsar Convention on Wetlands	2004	Ratified
15.	Convention for the International Trade of Endangered Species of Wild Fauna and Flora (CITES)	2005	Ratified
16.	Convention on Migratory Species	2005	Ratified

17.	Comprehensive Test Ban Treaty Organisation (CTBTO)	2002	-
18.	World Forest Charter	1994	-
19.	International Convention for the Protection of Pollution from Ships (ICPPS - MARPOL)	2002	-
20.	World Meteorology Organisation (WMO)		
REGIONAL AGREEMENTS/CONVENTIONS			
21.	Apia Convention: Convention on the Conservation of Nature in the South Pacific	1976	Ratified
22.	Rarotonga Treaty South Pacific Nuclear Free Zone Treaty	1985	Ratified
23.	Protocol for the Prevention of Pollution in the South Pacific by Dumping	1986	Ratified
24.	Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region	1986	Ratified
25.	Wellington Convention: Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific Region	1989	Ratified
26.	SPREP/Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region	1990	Ratified
27.	Waigani Convention to Ban the importation and to control the Transboundary Movement of Hazardous and Radioactive Wastes in Forum Island Countries	2001	Ratified

3.5.2 MAJOR ISSUES AND CONCERNS

3.5.2.1 Capacity shortfalls in the context of the absence of appropriate institutional arrangements/bodies, human resources and equipment.

All the functions of water resources and water supply are adequately covered in terms of institutional bodies. Sanitation has not been addressed until recently and is now to fall under the remit of SWA within the urban Apia area. Responsibility for sanitation outside of Apia remains the responsibility of individuals and communities, with technical advice from SWA and the Ministry of Health.

The absence of an apex body mechanism prevents integrated water resources planning and management.

There are capacity shortfalls in every government department with respect to regulatory enforcement, compliance monitoring and community engagement. Relatively few human resources are compounded further by a lack of vehicles, equipment and other essentials. Basic water resources assessment and monitoring has been neglected and is now being addressed under the WaSSP.

Customary land ownership makes regulatory approaches ineffective without detailed and long term community engagement and dialogue.

3.5.3 Measures to manage impacts and concerns (IWRM approaches).

3.5.3.1 Institutional, policy and legislative.

Samoa has a broad policy framework for the waters sector, recognising the need to be inclusive of IWRM. There is a need for a coordinated planning and management mechanism to enable sectoral approaches to be planned and developed with optimum benefit to the people and environment of Samoa.

SMPs and WMPs represent approaches which have some application to IWRM planning, although neither is used at this time. The regulatory framework exists for both planning approaches, but the institutional coordination is presently lacking. There is even a cross-sectoral coordinating mechanism for WMPs although this appears to be dormant at this time, with no WMPs been drafted recently and the SMP yet to be used.

Comment: Perhaps specify level as earlier say local/community level they are drafted/used.

Neither of these planning approaches specifically is a strategic landuse planning approach which appears to be absent in Samoa.

The legislation on environmental and water quality protection is quite broad, but there is a lack of legislation on water abstraction, over-abstraction, abstraction entitlement and entitlement protection. Most countries adopt abstraction licensing systems, although this is also a regulatory tool and needs to run in parallel with public awareness and community education programmes.

3.5.3.2 Capacity building.

Capacity building is required across all government departments from water resources assessment and management, through environmental protection, to development consent, forestry logging, and land use and agricultural practices, and community engagement.

Measures include the need for training, equipment, consumables, and computers and so on.

3.6 Financing

3.6.1 Types of Financing Arrangements

3.6.1.1 Funding and revenue sources for water supply and wastewater management.

The primary source of income for the SWA is water sales and the simple fact is that current water sales generate less than half the required income to cover normal operating costs. Income is estimated at SAT$4.5 million against and expenditure estimated at SAT$12 million. The difference is partially made up by government grants and subsidies, but there is no attempt to cover the depreciation costs of SAT$3.5 million per year. Whilst some limited operational savings can be made through efficiency improvements it is evident that income from water sales, a function of tariff-level and the number of customers, will need to be increased if a more viable and independent SWA is to be realised.

It is reported (Dorsch and Kew Consult 2004) that current levels of cost recovery within SWA are inadequate to meet the gap between income and expenditure, even without depreciation costs. A relatively low tariff structure is in place and represents only 2% of the annual income (for the 70% of population earning < $10,000 per year), whereas 5% is generally accepted internationally. The supply of high quality potable water in the rural areas may never be a fully commercial operation, and therefore needs to be supplemented by Community Service Obligations (CSOs), but affordable increases in tariffs and increased willingness to pay are undoubtedly at the centre of increasing SWA's financial independence and viability.

Comment: Check what $ it is.

Likewise, independent schemes also grossly under charge and fail to attain sustainable operation, maintenance and depreciation cost levels.

Wastewater management is limited to on-site infrastructure and maintained (or not) by the individual householder.

3.6.1.2 Economic instruments and sources of external/ international funding.

Institutional strengthening projects at SWA have concentrated on trying to improve its financial performance through a combination of unaccounted for water reduction, improved system metering, customer metering, and improved billing and collection. Given the considerable imbalance in income versus expenditure this appears to have met with limited success.

The tariff system does have a logical structure and should be reviewed in the light of its' under performance.

As the income does not cover depreciation costs, it appears that capital investment remain reliant upon external support. The EU (2001-2004) funded a €20 million rural water supply project on a grant basis. This has now been supported by a €18 million water sector support programme focusing in part on rural water supply and sanitation infrastructure.

The ADB is presently funding the design of a wastewater treatment works for central Apia, at an estimated cost of US$10 million.

3.6.1.3 Tariff Structures and Cost Recovery.

Within Phase I of the ISP a public utility billing system (PUBS) was provided and has been in operation since mid 1999. In the early stages of phase II of the ISP some modifications and upgrades were provided for this system. These were needed because as an increasing number of meters were installed during the AWSCP, some errors in the package became obvious and required modifications.

Based on the customer database of the SWA the majority of metered customers are within the urban Apia region, only a small number of customers within the rural areas are metered (none in Savaii prior to July 2004) the majority remaining on a flat rate basis.

The following tariff was implemented in June 2003:

Table 5: Tariff structure of SWA

Tariff structure of SWA (implemented by ISP July 2003)			
Metered treated water			
		0 - 2,2 m³/d	> 2,2 m³/d
Domestic	SAT/m³	0.50	0.67
Commercial	SAT/m³	0.50	0.67
All domestic customers are entitled to 0.50 m³/d free of charge SWA is reimbursed by GoS at 0.50 SAT/m³ for this entitlement			
Unmetered treated water			
		SAT/d	SAT/month
Domestic		1.73	52.50
Commercial		7.60	231.17
Unmetered borehole pumped water			
		SAT/d	SAT/month
Domestic		0.7507	22.83
Commercial		0.7507	22.83
Unmetered raw water			
		SAT/d	SAT/month
Domestic		0.3945	12.00

The impact of this tariff has been for customers to have reduced their metered demand to around a third of previous amounts.

However revenue only meets a third of expenditure, excluding depreciation of asset value. With such a large imbalance, the tariff would have to be doubled or trebled to cover all operating costs, depreciation and remove the need for the CSO grant. It is apparent therefore that substantial increases are essential in the medium term.

Comment: What is this?

3.6.1.4 The economic value of water at the national level.

The true economic value of water is clearly not appreciated, judging by the financial performance of SWA and the lack of investment by villages in their water supplies. Whilst it is

recognised that this has direct consequences in terms of public health, no cost benefit analysis has been undertaken.

This is particularly surprising for Samoa who depend on hydropower for typically 40% of their energy needs, and who have to import diesel to generate power during times of low flow, when hydropower reduces to only 20%, although can reach 70% in wet periods.

Samoa is also highly prone to flood damage, especially in the Apia area, where economic losses associated with flood damage would be considerable.

A recent cost benefit analysis study for the Cook Islands on Economic Evaluation of Watershed Management in Rarotonga (CSIRO 2005) has estimated avoidable cost (savings) from improved watershed management at NZ$7.4 million per year (US$4.6 million), predominately through reduced healthcare costs, reduced water treatment costs and alternative supply augmentation and reduced tourism income losses. This amounts to US$1,780 per capita per year. This figure is the closest estimate available to date for the impact of IWRM in a Pacific country. Whilst this estimate clearly is specific to an island with a strong tourism sector, and might not therefore be appropriate for other countries, the Cooks are not reliant upon hydropower. If we use this estimate for Samoa, the value of IWRM to the country (as a proxy to water value) could be estimated at US$320 million per annum.

For comparison it is worth remembering Samoa's GDP was estimated at US$400 million in 2005. That is to say, the value of water directly and indirectly to the economy could be as much as 80%. Given the immediate links between water and health, food production and power generation, and their links to economic productivity, this is perhaps not surprising.

A related analysis by the World Bank advocates focusing on risk mitigation measures using climate change adaptation approaches to minimise the impacts on infrastructure and people. These include setting back infrastructure from vulnerable areas, better management of ecosystems and protection of water resources. All these objectives are consistent with IWRM objectives. The World Bank cites the example of Samoa, which is estimated to have saved US$ 165 million (€130 million) in damages due to hazard management procedures adopted in the 1990's. Thus in 'disaster years' the value of water resources management would be even greater.

3.6.1.5 State subsidies.

Although the approach of supporting the SWA by government subsidies (Government of Samoa reimburses SWA for the first 0.5 m³/d per connection) in order to ensure the poorer part of the population has access to safe drinking water is to be commended it is not selective in its application. A free allowance is given to all metered customers independent of the financial situation or the extent of their domestic plumbing system. With a more sophisticated public utility billing system in place it should be possible to include subsidies only for those customers that really cannot afford to pay high water bills, and charge high income class households for the full amount of water received. This would reduce the financial burden on the Government.

At present the free allowance does not reach all the poor population, only those who are metered. Some families paying fixed charges are paying more than metered families. Fixed allowance households are generally in the rural areas receiving untreated water. There are approximately 5000 flat rate customers but this is changing slowly with the implementation of the RWSCP. Of course these families have no restriction on the amount of water they can use (if it is available).

Comment: Is this in acronyms?

3.6.2 Major issues and concerns

3.6.2.1 Difficulties faced with the current financing arrangements.

The present collection rate for water billed is estimated at 70%, the actual figure is unclear because of the number of "non-active" customers and the fact that the public utility billing system does not produce a like for like comparison. SWA are making inroads into identifying actual and non-active customers and will eventually have to write off some of the debts lying in the system.

The cost of collection of water charges in rural areas has been estimated by the institutional strengthening programme (ISP) as sometimes being higher than the income received. This is especially important when further large rural supply schemes are being considered. At present the meter staff makes two visits, one to read the meter and one to deliver the bill. By comparison the Electricity Supply Corporation read the electricity meter and produces the bill on-site. This is possibly an area for outsourcing in future.

Measures to make bill payment easier and more convenient for poorer and very rural areas are being discussed by SWA and these could eventually lead to an improvement in the collection ratio. At present there is only one payment centre in Apia. In some cases the cost of transport to Apia is nearly as much as the bill itself.

Some customers refuse to pay the water bill because they receive such a poor service, or intermittent supply and very low pressures.

Clearly, the non-revenue water needs to be reduced, the billing recovery improved, and finally the tariff revisited.

Increasing tariffs is of course a highly political issue and one that will face many challenges.

If SWA do take responsibility for the new Apia CBD wastewater treatment works, then the tariff will have to be considered in the light of wastewater charges.

3.6.3 Measures to manage impacts and concerns (IWRM approaches)

3.6.3.1 Role of improved regulatory oversight in improving water supply financing.

The problems of adequate financing of the water sector stem from the high costs of delivering such services (and in fact all sector services) in small island states. Economies of scale are low, whilst costs of importation are high.

Regulatory oversight of the SWA may help to improve its financial performance, but is of little value to the independent schemes. Furthermore penalising SWA for inefficiencies only adds additional financial burden upon the organisation.

Other stakeholders like Health and Water Resources are even more under resourced and the ability of regulators to enforce compliance with regards to abstraction licences and discharge consents, let alone pollution events, is questionable at this time.

3.6.3.2 Funding and cost recovery systems.

Increase customer base. There have been many recommendations made to improving the tariff and cost recovery system for SWA. The present Rural Water Supply Consolidation project will alone result in some 2,400 new metered connections that will increase income by around SAT$0.6 million per year. The scheme will also allow the closing and reduced operation of some boreholes that will result in operational savings of SAT$0.1 million per year. These are small but significant improvements (although they will also increase the amount of water supplied free of charge).

Increase tariffs. Reported alternative tariff analyses have been proposed. With an average per capita consumption of 230 l/c/d and 7 person/household metered consumption results in an average monthly bill of about SAT$17/month including 500 l/HH/d water supplied free of charge. The income data presented in the census from 2001 shows about 70% of the population are in an annual income range of < $10.000 a year equivalent to about SAT$800 per month. These 70% therefore only pay 2% of their income for water supply services and this is well below the 5% norm used by the WHO and other organisations.

Comment: Check currency

The allowance of 0.5 m³/d per household of free water is reimbursed by the Government of Samoa as direct subsidy to the SWA and costs about SAT0.36 million $SAT in annual subsidies only for the domestic metered customers. Without this allowance the average customer bill would be about 25 $SAT/month, equivalent to 2.9% of the income, still well below the 5% mark.

Billing and payment. Recommendations have also been made (see section above) regarding improving the billing activities and ease of payment.

Hidden costs and savings: Costs associated with non-service provision, such as water resources management, environmental protection and tourism generation, environmental health monitoring and reduced health expenditure, flood prevention and reduced disaster clear-up costs, are not presently recognised at all. It will require a significant assessment of IWRM cost benefit to promote these linkages to the Treasury and Ministry of Finance, to justify reinvestment in these water sector functions.

Power generation. No assessment has been undertaken to date of the cost to EPC and therefore its own client base of: i) increased diesel generation as a result of low dry season flows; and ii) damage due to flood flows and increased maintenance due to sediment erosion etc.

3.6.3.3 Public Private Partnerships.

The private sector remains relatively under-developed in the Pacific. The large number of external development projects has resulted in a blossoming local water sector consultancy market, but otherwise opportunities appear to be limited.

Culturally and therefore politically it is unlikely to be acceptable for water provision to be put into the private sector.

There may be some merit however to considering the synergies that exist between power generation and water supply, for a combined utility to be formed, such as there is in American Samoa - the American Samoa Power Authority (ASPA). This may in turn be more attractive to foreign investment.

4. LINKAGES TO OTHER AREAS

4.1 Landuse and agriculture

4.1.1 Existing land-use policy with special emphasis on water resources, wastewater management and water source protection

There is no integrated national land-use policy for Samoa, nor any spatial planning policy.

The Lands Surveys and Environment Act (1989) established DLSE (now MNRE) and makes provision in relation to land and the management of the environment. It is the principle law relating to the administration of land matters in Samoa and the management and protection of the environment.

It makes provision for management plans prepared by the Director for the protection, conservation, management and control of Samoan waters ands water resources, and pollution. In the preparation of the management plan, regard shall be had (amongst other things) to the protection of the water catchment values of those areas within the plan, soil resources and erosion.

The Act also states it is an offence to pollute Samoan waters (includes underground waters, rivers, streams, water courses, reservoirs, lakes etc).

The Act also refers to ownership of water resources by the government, states a 10 m set aside from watercourses owned by the government, and has secondary legislation to regulate such landuse activities as sand mining, reclamation and logging licences (monitored by Forestry).

However, as with much legislation in the Pacific, the capacity or even acceptability of enforcing such regulatory approaches is very limited. No land management plans are known to have been developed to date.

Two specific pieces of legislation have direct relevance to land use management, these are Sustainable Management Plans (SMPs) authorised under the PUMA Act 2004 and Watershed Management Plans (WMPs) as authorised under the Watershed Management Regulations 1992.

Adequate legislation exists to develop WMPs, including powers to create National Parks and Reserves on state land and to force customary land to be Protected Land preventing certain activities, for 5 years. The WMP is effectively designed as an environmental protection tool, not a sustainable development tool.

A WMP is a legal document, endorsed by the Head of State at the recommendation of the National Watershed Management Committee authorising certain activities and preventing others. There is allegedly one endorsed WMP for the Vaisigano. This was drafted by the FAO in the late 1990s. There is no evidence that this WMP is in operation. There are three other WMPs known to exist, one for the Fuluasou catchment drafted again by FAO, and two community watershed plans drafted by the communities on Apolima and in the Lepa catchment as part of the IWP project. None of these have any legally binding endorsement. As far as it can be determined the NWSMC is not operational.

Comment: See S3.5.1.5

The IWP community watershed plans tend to focus on introducing sustainable livelihood approaches, whereby behavioural change is based upon the community responses to participatory education and awareness raising initiatives.

An SMP is a guideline for integrated development to be enforced by PUMA, signed off by the Planning Board. There have been no SMPs developed to date, resulting in some confusion as to their role in practice. The SMP was originally intended to improve integrated infrastructure planning, whilst ensuring adequate protection for the environment using development control procedures through the introduction of such regulatory mechanisms as environmental impact assessments, screening assessments, discharge consents, and so on.

An advisory SMP exists for flood management, but the lack of planning and regulatory control capacity seems to have prevented its operation. It is understood that the ADB Sanitation and Drainage Project will be subject to this development control process.

It is also unclear what land area an SMP could operate over. Originally intended for Apia, there is some reference now to applications from the site specific, to districts, to regions, to islands or even national planning.

Together the WMP should protect recharge areas and upstream watersheds from erosion and pollution, and the SMP should prevent uncontrolled discharge of pollutants, mitigate flooding and perhaps constrain water abstraction. To date these regulatory processes have been utterly ineffective.

It is also worth noting that there is potential for a WMP and SMP to be contradictory, given that the WMP is essentially an environmental protection tool, the SMP an economic development tool.

Conflicting land use pressures within watersheds

Conflicts in watersheds due to land use can be divided into conflicts relating to competing land uses and their impacts upon each other and specific conflicts and disputes relating to land ownership.

The former includes such examples as historic deforestation of most watersheds on Upolu and the now increased removal of secondary forest cover for subsistence and more commercial agricultural activities such as cash cropping and cattle grazing, as well as the continued urbanisation of the Apia hinterland.

All of these land use pressures are expected to contribute to increased run-off, sediment mobilisation and agricultural contamination (mostly from animal faeces) and reduction of low flow yields. However the lack of baseline surveys prevents any confirmation of these impacts.

Land use conflicts are more specific. The most obvious examples are conflicts over access and compensation associated with hydropower schemes, such as the proposed (and stalled) scheme in the Sili Basin in Savaii.

Whilst EPC has the authority to make compulsory purchase of any lands, customary land ownership ensures that such activities cannot occur without compensation. The communities around Alaoa for example receive free electricity as part of their compensation agreement.

A specific conflict is the reluctance for customary land owners to set their land aside for conservation or watershed protection areas. The Environment Department has had some success in establishing conservation areas to protect native species, but this can only be done on customary land with the full consultation and agreement of the community to a conservation strategy.

4.1.2 Land use impact on source protection

Most sources are located sufficiently upstream that they are above the areas where land use has developed to cause significant source protection problems. However a lack of water quality baseline surveying prevents confirmation of this.

Surface water courses have heavy sediment loads after rainfall events, and this is partly attributed to land use practice. Increased turbidity in the raw water feed, reduces the effectiveness of source treatment and thus reduces treated water quality.

Upland communities may provide some threat to water courses from wastewater disposal, if their septic tanks discharge effluent to the water course directly.

Other than filtering and chlorination, SWA provides no other treatment, implying that it perceives no pollution threat other than from sediment loads and microbiology.

A complete lack of groundwater resources characterisation means that it is difficult to quantify the risk of septic tank effluent disposal (and other wastes) into the groundwater regime. No

source protection zones have been established for the public or independent scheme boreholes.

4.1.3 Importance of irrigation with respect to water use at the national level

There is no irrigation. There are however five hydropower plants as discussed in earlier sections.

Measures are in place with respect to drainage linked to irrigation schemes

None (see response above).

A drainage project for the Apia urban area is presently in the design phase. This is intended to reduce stormwater flooding and has no irrigation aspects to it.

4.1.4 Distribution of rain-fed agriculture and irrigated agriculture

All agriculture is rain fed. There is no irrigation practised.

4.1.5 Plans to increase food production through irrigation or through rain-fed agriculture

None per se. There is a perceived increase in cash cropping activities due to increases in costs of living and a greater demand for income revenue for communities.

4.1.6 Affect of land-based pollution affecting watershed management

There is no effective watershed management at this time.

The Watershed Management Section of WRD is presently working with communities in two catchments to develop community catchment management initiatives. WRD are using water quality monitoring as a way of demonstrating how land use changes can impact upon drinking, washing and recreational water quality.

The problem of sediment erosion in particular is recognised by government (note the now sediment full Fuluasou Reservoir). The government is helping with the reforestation of parts of the Vailima and Fuluasou catchments to reduce sediment run-off.

High sediment loads are known to be causing problems for both SWA and EPC in their water supply and power generation infrastructure.

4.1.7 Main Sources of land-based pollution of watersheds

There is little data to confirm or deny pollution of the watersheds in Samoa.

A SPREP Inventory of Persistent Organic Pollutants (POPs) in 2004 reported up to 150 tonnes of non-fuel hydrocarbons may have been imported into Samoa. Between the 1960's and 1980's this included significant amounts of DDT for use on plantations, as well as timber treatment chemicals.

Pollution in the upper catchments is likely to be limited to sediment erosion. Where agricultural activity is more common associated agricultural waste run-off may be a localised concern, as will be any agro-chemical used on any plantations. Timber preservation activities in the forestry plantations are also a potential concern. There is of course the potential for accidents and oil spillages near the cross-island roadways.

The mid-level hills near Apia especially are becoming increasingly urbanised and primary pollution sources will be inadequate wastewater disposal as well as solid waste littering. Ironically the dispersed nature of the septic tanks discharges is likely to reduce the risk of water resources contamination.

In the low-lying coastal areas, where most communities are located, the increased population densities are expected to result in substantial increases in wastewater effluent disposal and solid waste littering. Whilst neither of these poses a threat to the water resources at these elevations, they clearly provide a significant threat to the estuarine and coastal waters, as does the high flow sediment loads.

Clearly these urban areas also pose a threat from hydrocarbons associated with fuel stations, car repairs and so on, plus the site specific risk of the diesel powered power generation plants.

The Port of Apia is entirely marine (as opposed to riverine) and as such is not specifically considered within a watershed. However, it will undoubtedly it contribute to near shore marine pollution.

Other commercial activities of note are the Vailima Brewery, which must have an effluent disposal requirement, the coconut milk factory, the airport and the industrial zone. These are all likely to store and discharge organic loading in their effluent and storm water run-off.

4.1.8 Impacts of deforestation and sedimentation on watersheds

Samoa has lost nearly all of its virgin forest vegetation. Secondary forest has replaced this and much of this is now being cleared for agriculture and urbanisation in an around the capital of Apia.

The deforestation of the watersheds has made them more vulnerable to cyclone associated damage. As a result it is perceived that flood events are more extreme, sediment loadings are greater and low flow retention within the catchments during periods of low rainfall are lower.

However, a lack of baseline data again makes it impossible to substantiate these comments with quantitative data.

Flooding is a common problem, especially in the urbanised and constrained catchments around Apia, where the hinterland is largely devoid of forest cover and the low-lying floodplains built upon and natural drainage channels removed, reduced, blocked and clogged. Flooding inevitably causes substantial damage to infrastructure, as well as pollution of the near shore marine environment.

Sedimentation loads cause persistent problems for SWA and EPC with the operation of their infrastructure, and this in turn causes drinking water quality problems and associated health issues. An extreme example of this is the Fulausou Reservoir which used to feed the Fulausou hydropower plant and is now completely full of sediment. The hydropower plant has been abandoned.

Reduced vegetation cover is associated with a reduced ability to retain water within catchments and this in turn leads to increased periods of lower flows. In the Apia area this is causing water shortages.

4.2 Habitats and ecosystems

4.2.1 Critical habitat types and associated threatened, endangered, charismatic and/or endemic species

Terrestrial ecosystems. Whistler (1992c) divided the vegetation of Samoa into 20 plant communities which belong to five broad categories: (1) littoral, (2) wetland, (3) rainforest, (4) volcanic, and (5) disturbed vegetation. A brief description of each category is as follows:

A. Littoral Vegetation

The littoral zone is that area just above the high tide mark where land vegetation first appears. This category comprises four plant communities:

- Herbaceous strand or beach;
- Littoral shrubland;
- *Pandanus* scrub;
- Littoral forest.

The plant communities are all situated on the seashore. The best remaining littoral vegetation in Samoa is found on the Aleipata islands (Nuutele, Nuulua, Namua and Fanuatapu), and the

south-central coasts of both Upolu and Savaii. Littoral vegetation, though low in species diversity, is important for many birds and for coastal protection.

B. Wetland vegetation

This category comprises the following five plant communities:

- Coastal marsh, consisting of herbaceous wetland situated on the coast;
- Montane or mountain marsh, occurring in montane craters and depressions;
- Mangrove scrub, dominated by 'togo fafine' (*Rhizophora mangle*) which are small sized trees;
- Mangrove forest, dominated by 'togo tane' (*Bruguiera gymnorrhiza*) which are large trees forming closed-canopy forests; and
- Swamp forest, occurring where fresh water saturates the soil.

Wetland vegetation, except for the swamp forest, is generally low in plant species diversity. Mangrove communities are dominated by salt-tolerant trees and are important in erosion control and the maintenance of inshore fisheries.

C. Rainforest vegetation

This vegetation category is divided into the following five plant communities:

- Coastal forest;
- Lowland forest;
- Ridge forest;
- Montane forest; and
- Cloud forest.

Coastal forest is restricted to coastal areas, mostly on tuff cones (a particular type of volcanic rock), and is found on the Aleipata islands and Apolima. Lowland forest once covered most of Samoa from sea level to 400-600 m elevation. Remaining areas of lowland forest, although extensively damaged in the 1990 and 1991 cyclones, are also located at Tafua and Falealupo villages on Savaii.

Montane forest occurs on both Upolu and Savaii and is the most poorly studied vegetation type in Samoa. It extends from 400-600 m to over 1,000 m elevation, with a transitional zone containing elements of both communities, and has probably the greatest diversity of flora of any community in Samoa. Cloud forest occurs at the highest elevation of Savaii. These rainforest ecosystems are now of critical importance for the vast majority of native plants and animal species.

D. Volcanic vegetation

Volcanic vegetation comprises two communities:

- Lowland volcanic scrub (below 650 m); and
- Upland volcanic scrub (above 1,200 m elevation).

Recent lava flows will only support a few colonising plant species. However, as the soil develops, a greater variety of species can become established.

E. Disturbed vegetation

Disturbed vegetation is a consequence of human activities or climatic factors. It comprises the following four communities:

- Managed land, used for human activity (for example, plantations and roads);
- Secondary scrub, dominated by weeds, shrubs and vines;

- Secondary forest, developed when secondary scrub is left for long periods; and
- Fernlands, dominated by 'asaua' (*Dicranopteris linearis*) which occurs only at Luatunuu on north-central Upolu, and Amaile at east Upolu.

Samoa supports more than 750 species of vascular plants (including 200 species of ferns); 33 land birds (10 are endemic); three species of mammals (all bats); 21 species of butterfly; eight land snails; seven species of lizard; and one species of snake (UNDP 1990). Recent studies of flora and fauna include: Pearsall and Whistler (1991), Whistler (1991), and Park et al. (1992).

The native flora of Samoa comprises 96 families, 298 genera, and nearly 500 species (Whistler 1992b), making it the most diverse flora in tropical Polynesia, except for Hawaii. Thirty two percent of the species and one genus, *Sacropygme* (*Rubiaceae,* 2 spp.) are endemic to the Samoan islands.

The largest families are:

- *Orchidaceae* (orchid family: about 100 native species),
- *Rubiaceae* (coffee family: 45),
- *Urticaceae* (nettle family: 24),
- *Fabaceae* (pea family: 20),
- *Myrtaceae* (myrtle family: 20) and
- *Euphorbiaceae* (spurge family: 19).

The largest genera are:

- *Psychotria* (*Rubiaceae:* 20 species)
- *Cyrtandra* (*Gesneriaceae:* 20)
- *Syzygium* (*Myrtaceae:* 16)
- *Elatostema* (*Urticaceae:* 12-14)
- *Dendrobium* (*Orchidaceae:* 12), and
- *Bulbobphyllum* (*Orchidaceae:* 11).

The native ferns comprise 21 families, 71 genera, and nearly 200 species (Whistler 1992a). The fern allies (*Psilotum, Selaginella, Lycopodium,* and *Tmesipteris*) comprise 14 species. The most diverse and interesting groups of plants are the orchids and ferns.

There are no 'designated' endangered or threatened plant species in Samoa. However, Dahl (1980) lists twelve rare or endangered plant species, while Whistler (1992a) proposes a list of 136 species that he considers potentially threatened or endangered.

Fauna

A large amount of collection and taxonomic study was carried out in the late 1800s and early 1900s but much of this work now needs to be updated. Land snails are a land invertebrate group that has been studied in some detail. Dahl (1986) has identified 21 butterfly species in Samoa – of which *Hypolimnas thompsoni* is found nowhere else (Taule'alo 1993). Little is known about freshwater invertebrates.

Brief surveys conducted as part of the Environmental Impact Assessment of the Afulilo Hydroelectric Power Project (Winders et al. 1987; Waugh et al. 1991) noted a relatively sparse insect fauna with some very common crustacea. Samoa has one species of freshwater shrimp (*Macrobrachium lar*) which is of some importance in the subsistence diet. There has not been a detailed study of the native freshwater fish, however, the EIA studies for the Afulilo project noted a relatively sparse fish fauna. Four species of freshwater fish have been introduced to Samoa.

The taxonomy of the native reptiles, birds and land mammals of Samoa is well known, and new species are unlikely to be found. No amphibians occur in Samoa. However, with the exception of a few studies, the detailed ecological knowledge vital to ensuring the long-term survival of many of these species is lacking.

Reptiles

Eight skinks, five geckos and one snake (the Pacific boa *Candoia bibroni*) have been recorded in Samoa. Most of the lizards appear reasonably abundant and only one (the Samoan skink *Emoia samoensis*) is endemic to the Samoan Archipelago.

Birds

Thirty-five species of land birds and 21 sea and shore birds have been recorded for Samoa. Ten of the land birds are endemic at the species or sub-species level, while four species have been introduced. One native species, the 'punae' or Samoan wood rail (*Pareudiastes pacificus*), is probably extinct. Further work is needed to determine the current status of many other species as 14 are listed as "rare or endangered" (Dahl 1986).

Pigeons are a traditional food source and play an important role in Samoan tradition and customs. Pigeon numbers have declined, primarily due to the destruction of habitat, and the decline has been significantly increased by the effects of the cyclones of 1990, 1991 and 2004. The government introduced a ban on hunting following the cyclones and in late 1993 it extended the ban for a further five years.

Mammals

There are 13 species of terrestrial mammals in Samoa and of these only three, all bats, are native: two flying foxes (or fruit bats), 'pea vao' the Samoan flying fox (*Pteropus samoensis*) and 'pea fai taulaga', the Tongan flying fox (*Pteropus tonganus*); and 'tagiti', the sheath-tailed bat (*Emballonura semicaudata*).

The flying foxes, like the pigeons, are a traditional food source and are also important for the long-term survival of the forest as they pollinate the flowers of many species and disperse seeds of eaten fruit. Population suffered a substantial decline from 1981 to 1988 due to an export industry to Guam. Government regulation stopped this industry in 1989. Flying fox populations declined further after Cyclone Val and traditional hunting was then temporarily banned. In late 1993 the government extended this ban for a further five years.

Of the introduced species, the early Polynesian voyagers brought 'imoa', the Polynesian rat (*Rattus exulans*), pigs and dogs to the islands. Cattle, horses, goats, cats, two more species of rats (*Rattus norvegicus* and *R. rattus*) and the house mouse (*Mus musculus*) arrived with the Europeans. In August 2004, the Samoan government imported 54 live sheep from Fiji for breeding purpose.

Marine ecosystems

In the marine sector, there are believed to be 991 species of fish, about 40 of which are found only in Samoa (Government of Western Samoa 1993a).

The marine domain can be divided into the inshore area, encompassing mangroves, coastal wetlands, the lagoon and reef, and the offshore area, i.e. the area beyond the reef.

The offshore area is notable for bottom fish (e.g. off the west coast of Falealupo) and highly migratory species, particularly tuna. This fishery is largely untapped and efforts have been made to encourage exploitation by local fishermen through such means as the alia (fishing vessel) subsidisation scheme; placement offshore of fish aggregating devices; and the introduction of long-line fishing (Peteru 1990). There has been talk of establishing a local tuna cannery.

Table 6: Samoan Biodiversity Species List including Number of Threatened Species

Species of:	Endemics	Native	Introduced	Threatened	Total

Flowering Plants	1 5	~500 -	~500 -	~136 -	~1, 00
Ferns	6	33	3	14	0
Land Birds	-	-	-	N/A	22
Sea Birds	8	4	11	4	0
Reptiles	-	-	N/A	N/A	35
Ants	1	16	4	-	21
Snails	-	19	-	1	14
Butterflies	-	25	4	-	59
Aquatic Fauna	2	-	-	-	20
Corals	-	-	-	4	21
Marine	-	-	-	14	29
Vertebrates	-	890	2	-	N/
Marine Invertebrates	- N / A				A 8 95 99 1
Fisheries					

Source: Schuster et al. 2001 pp61-65

4.2.2 Protected watershed and coastal areas

Samoa has one National Park, O le Pupu Pu'e (established 1978) and five Reserves: Stevenson Memorial Reserve (1958), Mt. Vaea Scenic Reserve (1958), Vailima Botanical Garden (1978), Togitogiga Recreation Reserve (1978), and Palolo Deep Marine Reserve (1979). The latter is Samoa's only Marine Reserve although a study has been completed for the Aleipata Islands (SPREP 1989a). The National Parks and Reserves Act 1974 applies only to public land. This raises the problem of dealing with land which is held under customary title (SPREP 1989b).

The Environment Department attempts to deal with the issue of conservation areas on customary land through the signing of Agreements between overseas donor organisations and local villages. Falealupo, Tafua, Faala and Salelologa villages have each entered into separate Agreements whereby each agrees to preserve for 50 years a given area of rainforest in return for limited development assistance.

4.2.3 Primary threats to habitats/ecosystems

Terrestrial habitats

Factors causing decline of biodiversity are reported to include: forest clearance, population growth, overexploitation of natural resources, non-sustainable developments, natural disasters, and spread of introduced species and/or suppression of local ones. These factors are discussed in more detail below.

Forest clearance: Deforestation has been identified as one of the key problems to be addressed by Samoa's National Environment and Development Management Strategies (NEMS). Approximately one third (23,885 ha) of the country's forests were cleared between 1977 and 1990 and the forest clearance rate in the last five years of 3% per annum is one of the highest in the world. At the current rate of clearance (50 ha/year on Upolu, where there are no commercial logging licenses, and 1,000 ha/year on Savaii) all merchantable forests will soon be gone. Lowland forests have been almost eliminated and the conservation of the remaining fragments is an urgent priority.

Population Growth: The increase of population and especially its concentration in Apia and in lowland coastal areas has increased and concentrated pressures on the islands' ecological resources. Reclamation of the coasts, widening of roads, development of production, service and consumer infrastructures in and around Apia have increased adverse environmental impacts of material and social services such as waste generation, air and land pollution, erosion and degradation of coastal areas. This trend is rapidly spreading to areas close to Apia – such as along the north coast from Apia to the country's international airport.

Overexploitation of natural resources: The overexploitation of natural resources has occurred in both the terrestrial and marine systems. Hunting of pigeons, doves and fruit bats has

apparently reached unsustainable levels, particularly in the immediate aftermath of the cyclones when they were easier to hunt. The numbers and average size of fish caught in the lagoons have declined dramatically and local populations of turtles have been reduced to apparent critically low numbers. Such hunting pressures are made worse by the demands of the increasing population. Furthermore, there has been a rapid expansion in the offshore areas with longline fishery and bottom fishing.

Non-sustainable developments: An increase in major developments will also pose a threat to the remaining areas of biological resources if such developments are non-sustainable or not adequately screened of environmental degradations. The Afulilo Hydro scheme indicates the difficulties of balancing conservation and development needs on small islands. Its construction resulted in the loss of a unique area of swamp forest that was recognised as one of the country's priority site in terms of global conservation (Pearsall and Whistler 1991). Furthermore, the ongoing reclamation of mangrove and lagoon areas at the edge of Apia and other areas is another obvious illustration of the same problem.

Natural disasters: Samoa has a history of natural disasters, particularly volcanic eruptions, earthquakes and tropical cyclones. The latter have had the most widespread impact on biodiversity and are relatively frequent though Samoa is not on the main cyclone path. Between 1972 and 1998 for example four named cyclones affected the group and the two that struck in 1990 and 1991 were the most destructive this century. Cyclone Ofa in February 1990 affected the group for three days with winds gusting to 130 miles/hour. Cyclone Val in December 1991 had winds averaging 104 miles/hour and gusts up to 150 miles/hour over four consecutive days. The impact of Cyclone Val on forests, birds and flying foxes was particularly severe (Lovegrove et al. 1992).

Comment: Think this is the third repeat of same para.

Spread of introduced species and/or suppression of local ones: Invasive species in Samoa have included mammals, plants, invertebrates, and amphibians. Suppression of local species has occurred in the marine environment and may occur more in future as a result of pollution and improper waste disposal, and also as a result of climate change and sea-level rise. These aspects are covered in more detail below:

Pollution and waste disposal: Urban waste, including sewage, and industrial wastes may pollute waterways, streams and ultimately the marine environment, particularly the lagoons. Pesticides used in agriculture can pose a threat to native biodiversity if incorrectly used. Mangrove forests have often been used as rubbish dumps in the past, and though the Apia municipal dump has been moved from the Vaitoloa mangroves, it will take years for the area to be rehabilitated. Atmospheric pollution from industry and fires used to burn rubbish, including grass, and for cooking, may pose a further threat.

Climate change and sea level rise: Potentially very serious impacts on biodiversity could result from changes in climate and sea levels associated with greenhouse gases and ozone depletion. An increased frequency of storms has been suggested and Samoa's coasts in low-lying flat areas are experiencing severe erosion from strong wave action, often compounded by water currents made acute by land reclamation and sand mining. Coral bleaching is a problem that may become more serious with increasing frequency of ENSO events as in 1977/78 when coral reefs were exposed for longer periods due to a lower than normal sea level.

Coastal waters. The increase in demand for fish, the introduction of new and very effective fishing techniques, the use of dynamite and poison for fishing, the advent of the cash economy in the village, export markets, the use of refrigerated storage, etc. have all acted to increase fishing pressure on inshore waters (Johannes 1982; Zann 1991).

Environmental degradation of inshore waters has added to the overfishing problem. Many mangrove swamps and marshes, important nurseries for many species of fish, have been drained and reclaimed. Soil erosion, a serious problem on land, has an effect on inshore reefs. Pollution, in the form of industrial discharges, petrocarbons, detergents, pesticides, heavy metals, and untreated sewage rich in nutrients and high in faecal bacteria now discharge directly via storm water drains, or indirectly via the water table into the shallow coastal lagoon off Apia (Zann 1991; Taylor 1991; Klinckhammers 1992).

Almost all of the wetlands in Samoa have been disturbed to some extent (Scott 1993). The inshore area also provides sand and coral deposits which are being mined in an unsustainable way (Observer 1991b).

Under the Constitution land seaward of the high water mark is vested in the State. No reference is made to the superjacent waters. In practice the inshore waters and their fisheries are under the control of each village Fono. In a move to protect the marine environment, a marine park (Palolo Deep) has been established in Apia.

4.3 Health and Hygiene

4.3.1 Major health concerns related to watershed and wastewater management

The major health concern is the impact of activities within the catchments (including wastewater disposal) on water quality, and its subsequent use for drinking water.

Around a third of the population of Samoa receive treated water and, even when treated, only 85% of samples taken by the SWA pass the relevant standards. These failures are caused by:

- Incorrect sand in slow sand filters, although this is being replaced;
- Low or negative pressures in the reticulation system causing ingress of contamination;
- Long reticulation systems with inadequate chlorination at source; and
- No disinfection of borehole supplies, resulting in occasional microbiological failures.

All independent schemes have no treatment although the schemes under the WaSSP programme rehabilitation are designed to include disinfection by chlorination at all sources, surface water and groundwater.

The Environmental Health Department (EHD) is responsible for monitoring the quality of water supplied throughout the country including all independent and non-SWA schemes. In areas where water is supplied by the SWA the EHD's role is of monitoring and checking. The EHD has not carried out sampling of independent schemes for over a year because of lack of resources and transport. Most village water committees have no idea as to the quality of the water in their village and rely on residents developing immunity to any local contamination.

There are also concerns about recreational use of waters in the Apia area and of course health concerns associated with flooding events.

4.3.2 Water borne, water-washed, and water-related diseases

At present 1 person in 60 each year, is affected by waterborne disease to the extent that they require a hospital visit.

The Health Promotion and Prevention Services Department (HPPSD) of the Environmental Health Department has been formed under the recent WaSSP programme. They will be tasked with investigation of all outbreaks of waterborne disease and to advise on possible causes and remedies. At this time the EHD has little resources to undertake this function, although this is to be addressed under the WaSSP.

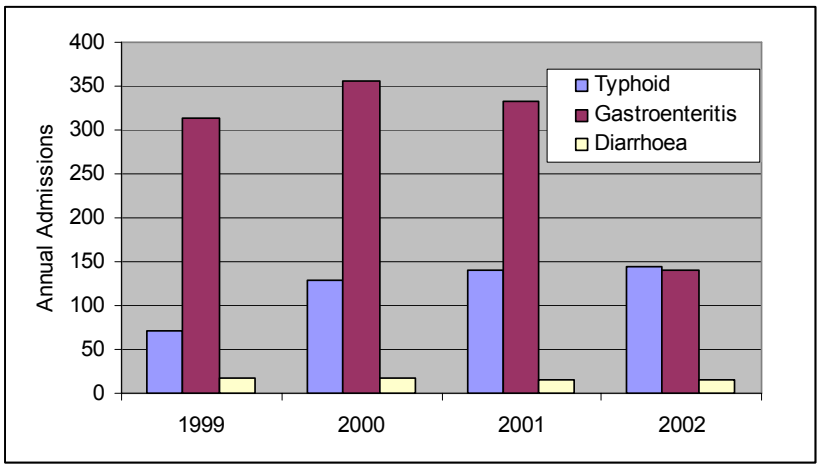
4.3.3 Major tourism concerns related to watershed and wastewater management

There are relatively few tourist resorts in Samoa. All resorts are located on the coast. The four main resorts are located on the south coast of Upolu and are therefore unaffected by the pressures which trouble Apia (i.e. flooding, water shortages and wastewater disposal).

Most tourist resorts are however reliant upon catchment water supplies, require electricity from EPC, and depend on the pristine nature of the coastal marine habitat, and in particular the coral reefs, as their main attraction.

Immediate concerns are therefore over water supply, although most resorts stock bottled water for drinking water, and have back-up generators for power supply. As such the resorts are not overly affected by water shortages, drinking water quality issues or power issues.

Figure 7: Annual Admissions for Water Related Diseases (1999-2002)



Source: Apia Hospital

Table 7: Extract from the Apia Hospital admissions statistics.

Comment: This is same info in graph, do we need both?

	1999	2000	2001	2002
Typhoid	72	129	141	144
Gastroenteritis	314	355	332	140
Diarrhoea	17	18	15	16

The main concern for the resorts is the coastal habitat. Fortunately on the south coast, the population densities are sufficiently low to make visual evidence of inadequate wastewater disposal a non-issue. As stated earlier this is little data on coastal water quality available to demonstrate specific wastewater impacts.

Sediment erosion however can cause substantial damage to reef life. If this was to affect the reefs near hotels, this would cause serious concerns over their ability to attract foreign interest. Few resorts are actually located near rivers however, as freshwater also causes stress to coral growth.

Tourism obviously contributes to heavy water demand and power demand per capita, especially compared to local levels of consumption. There is also a disproportionately high amount of wastewater, especially associated with cleaning and laundry activities. Water demand is likely to have the greatest impact on the watersheds, with wastewater discharged locally to the sea. As no resorts and few hotels are located in the watersheds, there is relatively little impact from them other than their excessive demand per capita on water supply.

4.4 Watershed and coastal management

4.4.1 The need to integrate watershed and coastal management in the context of IWRM

Clearly there is a close linkage between the surface water and groundwater flowing through the catchments on land and their discharge into the near shore environment.

Other than the freshwater flows, which may themselves support unusual freshwater/salt water ecosystems, the nutrient, sediment and contaminant load, including floodwater debris, is transported with the freshwater flows and ends up in the receiving waters that is the near shore coastal marine environment.

Along with the dependency of coastal communities upon the near shore environment for subsistence food sources, fishing incomes, as well as tourism opportunities, this had led to the recognition that the management of the watersheds impacts upon the near shore environment and economy. Furthermore, the reefs, mangroves and other habitats contribute to the protection of the terrestrial environment from storm waves, tsunamis and coastal erosion, and thus in no small part protect the coastal margin of the terrestrial catchments themselves.

This type of management approach has been referred to as 'Ridge to Reef' or 'White Water to Blue Water', i.e. an extension of catchment management to include the receiving coastal waters.

Clearly such a management approach requires a coordinated effort by all the sectors operating on the land within the catchments, all those interested in the use of water and disposal of effluent into the water resources, and all those interested in the near shore marine environment.

4.4.2 Existing sectoral linkages and requirements for a more integrated management approach

In Samoa there are very few existing sectoral linkages with respect to planning or management. In the past (1992), the National Watershed Management Committee (NWSMC) was created by legislation to bring together the various sectors to design and finalise watershed management plans.

In 2004, the PUMA Act created Sustainable Water Management Plans (which require approval from the Land Board) but these have yet to be tested. An advisory exists for flood management, but there has been no action upon it.

It is understood there is an intention to introduce Integrated Coastal Zone Management into Samoa.

There is also presently a Water Sector Steering Committee (WSSC), which is used to ensure that investments in the sector are coordinated and that all ministries are aware of these investments and programmes. The WSSC is supported by the Water Sector Management Unit (WSMU) within the Ministry of Finance.

The WaSSP programme in its high level advocacy role recognises the need for an apex body, although will stop short of specifically creating one. Evidently there is a requirement for an apex body, possibly using the existing powers of the NWSMC to be used to develop watershed planning, sustained exploitation, management and protection.

Such a body will perhaps require an integration of the plethora of legislation that exists at the moment, with WMPs, SMPs and perhaps coastal zone management plans, to provide the tools to enable such integrated planning and coordinated management and monitoring.

5. STAKEHOLDER ENGAGEMENT

The process and approach used to gather information for this analysis, including the institutions and individuals involved in the consultations, was not specific to the GEF pdf-B development process, but part of a larger national, holistic inclusive consultation process in Samoa, that has been on-going since 2002.

The formalised reporting of these more extensive consultations within this document specifically utilised the following:

- The national consultations in 2002 as part of the preparation for the Water In Small Island Countries consultations (SOPAC 2003);
- the Water for Life consultations (SWA 2005);
- the on-going water sector review as part of the Water Sector Support Programme (2006-2011) institutional strengthening (MWH 2006); and
- the on-going draft National Water Resources Strategy consultations (2006-2007)

The focal points for the GEF pdf-B consultation process are the Water Resources Division of MNRE and the Samoa Water Authority.

The following organisations (in alphabetical order) were involved in the Water for Life consultations in 2005:

- Asian Development Bank (ADB)
- Electric Power Corporation (EPC)
- EU Office in Samoa (EC)
- Faasao Savaii, Member of Samoa Umbrella of NGOs (SUNGO)
- Govt/EU Microprojects
- Hydro R&D/DIWI (HRD)
- Isikuki Punivalu & Associates (IPA)
- Kew Consult (KEW)
- Ministry of Agriculture, Forestry and Fisheries (MAFF)
- Ministry of Finance (MOF)
- Ministry of Natural Resources, Environment and Meteorology (MNRE&M)
- Ministry of Women Affairs, Community and Social Development (MWCSD)
- National Council Of Churches / President of the Board for OLSSI
- National University of Samoa (NUS)
- OSM Consult (OSM)
- Planning and Urban Management Agency (MWTI/PUMA)
- Samoa Water Authority (SWA)
- Pacific Islands Applied Geoscience Commission (SOPAC)
- South Pacific Regional Environment Programme (SPREP)
- United Nations Development Programme (UNDP)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- US Peace Corps

- World Health Organization (WHO)

The following named individuals (in chronological order of consultation) were involved in personal discussions with the authors during a review of water resources governance in October 2006:

Individual	Organisation	Ministry (where applicable)
Amataga Penaia	WRD	MNREM
Moefaauo Taputoa Titimaea	SWA	
Jude Kohlase	PUMA	MNREM
Ludo Prins	WSMU	MOF
Nadia Meredith	WSMU	MOF
Nigel Walmsley	WSMU	MOF
Russell Adams	WASSP	
Lameko Asora	WRD	MNREM
Iosefatu Eti	WRD	MNREM
Maturo Paniani	WRD	MNREM
Larissa Toelupe	WRD	MNREM
Hans Denker Thurstrup	UNESCO	
Thomas Offerer	EU	
Masina Ngau Chun	WRD	MNREM
Theresa Potoi	LEGAL	MNREM
Tuuu Ieti Taulealo (CEO)	CEO	MNREM
Kasandra Betham	EHD	MOH
Paulo Permita Seuseu	EHD	MOH
Frances Brown	WRD	MNREM
Leoo Polutea	TECSERV	MNREM
Mulipola Ausitalia Titimaea	MET	MNREM
Sala Sagato	MET	MNREM
Reema	MET	MNREM
Sahara Sesega Anae	SWA	MNREM
Rhonda Bower	SOPAC	
Malo Selefano	LANDS	MNREM
Tony Leulele	FORESTRY	MNREM
Pau Ioana	FORESTRY	MNREM
Tile Leia	EPC	
Sailimalo Faumuina Pati	ENVIRONMENT	MNREM
David Hunter	USP	
Ekiumeni Fauolo	SWA	
Brian Kouvelis	WASSP	
Ariel Latorre	ADB SDP	

The draft diagnostic report has been circulated by the IWRM Focal Points to all relevant stakeholders for peer review and comment in March 2007. The draft final report will undergo similar peer review prior to final approval.

A two day Hot Spot Analysis workshop was undertaken in March 2007 which again involved a multi-stakeholder consultation, facilitated by civil society stakeholders. ANNEX X for list of invitees.

Ama can you provide a list of attendees to the HSA – perhaps Latu kept one ?

6. OTHER PROGRAMMES, PROJECTS AND ACTIVITIES RELATED TO IWRM.

The following projects and activities contribute towards the implementation of IWRM in the country including water and wastewater management plans and strategies: Ama we need to get this circulated to DEC, Lands, Forestry, EPC *etc* for review and update.

Table 8: IWRM related national and regional projects and activities in the country

National Projects

Donor	Implementing Agency	Project Name	IWRM sub-sector	Objectives	Duration	Funding
EU	EU	Microprojects	water use	Improved rainwater harvesting and drought resilience	2003-2007	SAT4 million
JICA	JICA	Grassroots Grant Aid Projects	water use	Improved rainwater harvesting and drought resilience	1991-2006	-
ADB	ADB	Samoa Drainage and Sanitation Project	Wastewater and drainage	Improve the environment and public health of Apia's resident's; improving urban infrastructure for drainage and sanitation; improving capacity in urban management	2004-2008	SAT23.9 million
FAO	FAO	Low cost small scale irrigation	Agricultural water use	Establish low-cost small scale irrigation systems in critical areas of the country, and develop the capacity of MAFF to effectively carry out related activities in the future.	2003-2005	US$221,000
EU	EU	Rural Water Supply Consolidation Project	water use	Consolidate the impact and sustainability of benefits from newly improved water supply infrastructure in NW Upolu and SE Savaii	2004-2006	SAT5.6 million
NZAID/ AUSAID	NZAID/ AUSAID	Public Sector Improvement Facility (Samoa)	sector orientation		2005-2008	-
EU	EU	Water Sector Support Programme	sector orientation, water resources, water use, wastewater	Improve the quality of public health through the development, management and conservation of water resources and the disposal of waste water, in the framework of sustainable development of Samoa's economic and social environment	2005-2010	€ 19.09 million
Donor	**Implementing Agency**	**Project Name**	**IWRM sub-sector**	**Objectives**	**Duration**	**Funding**

GEF?	Lands Division MNRE	MSP on Capacity Building and Mainstreaming of Sustainable Land Management	Watershed Management	Mainstreaming of sustainable land management	3 years	US$500,000
GEF ?	Lands Division MNRE	MSP-Lowland and Upland Forests	Watershed Management	Habitat protection and sustainable rural livelihoods		US$1.5 million
World Bank	PUMA ?	Samoa Infrastructure and Asset Management Project (Phases 1 & 2	Climate Adaptation, Flood Management, Drainage, Coastal Management, Disaster Preparedness	Coastal Infrastructure Management Plans National Disaster Management Plans Samoa Drainage and Sanitation Cyclone Emergency Recovery Project for Cyclone Heta Sustainable Management Plans for Flood Prone Areas	5 years	tba
FAO/ AusAID	Forestry MNRE	Community Forest Programme	Watershed management	Sustainable Rural Livelihoods and Watershed Protection	5 years	AU$5 million
JICA	DEC MNRE	National Parks & Reserve Project	Watershed Management	Improved protection and management of national parks	5 years	US$100,000

Regional Projects

Donor	Implementing Agency	Project Name	IWRM sub-sector	Objectives	Duration	Funding
GEF	SPREP	International Waters Project (Regional)	water resources, environmental protection	Regional initiative to improve natural resources management and the environment	2000-2006	SAT 670,000

EU	SOPAC	Pacific Programme for Water Governance	water resources, water use, wastewater	Assist in achieving sustainable water resource management and provision of water services. Activities: Promote the application of effective water governance in institutions, systems, structures and processes (Fiji, Kiribati, Solomon Islands)	2002-2006	€ 150,000
NZAID	SOPAC/ SPREP/NIWA	Pacific Island Climate Update	water resources and climate adaptation	Improved decision-making through the use of climate information. Activities: Production and dissemination of Island Climate Update	2004-2006	NZ$300,000
ADB	SOPAC/ CPWC	Pacific Resource Centre on Water and Climate	water resources	Improve the capacity in water resources management to cope with the impacts of increasing variability of the world's climate. Activities: Establish a platform through which policymakers and water resource managers have better access to and make better use of information generated by climatologists and meteorologists	2005-2006	US$50,000
EU	SOPAC	Reducing Island Vulnerability Project (Regional)	water resources, flood management, disaster risk reduction	Flood forecasting and training	2005-2006	180.000 SAT
GPA	UNEP/SOPAC/ USP-IOI-SPREP	Regional Wastewater Training Course	wastewater	Capacity building in wastewater management. Activities: Development and provision of wastewater training course.	2005-2006	US$75,000
UNDESA	USP/IAS	Pacific Virtual Water Learning Centre	water resources	Capacity building in integrated water resources management. Activities: Establishment of virtual water learning centre and provision of distance learning course on IWRM	2005-2006	US$70,000
SOPAC?	SOPAC	Water & Sanitation Awareness	water and wastewater	Supply of awareness and education materials on water and sanitation	2006 ongoing	US$80,000 (2006 tbc.)
NZAID	SOPAC/ UNESCO/ WMO/NIWA	Pacific Hydrological Training Programme	water resources	Capacity building for hydrological technicians. Activities: 3-year course on groundwater and surface water hydrology	2005-2007	NZ$600,000

ADB	SOPAC	Coordination Unit Pacific Partnership on Sustainable Water Management	water resources	Assist facilitation of the Partnership. Activities: Newsletter, Website, Database, Pacific Water Action Matrix	2005-2008	US$55,000
AUSAID	SOPAC/WHO	Regional Water Safety Plans	water resources	Introduction of risk management in water supply. Activities: Promotion and establishment of Water Safety Plans in pilot countries.	2006-2007	AU$600,000
GEF	SOPAC	IWRM (PDF-B Stage)	water resources	Assist PICs in developing IWRM demonstration projects	2006-2007	US$600,000
ADB/WB AUSAID/ NZAID/ PIFS	ADB	Improving Delivery of Infrastructure Services	water use, wastewater	Establish information clearinghouse of country priorities, subsector strategies, programs and projects; a diagnostic analysis of service delivery; a feasibility study for a regional advisory unit; and a strategy and action plan	2006-2008	US$800,000
EU Water Fund	SOPAC	Pacific IWRM Planning Programme	sector orientation, water resources	Objectives: national IWRM policies and water efficiency strategies in place, endorsed by both government and civil society stakeholders, and integrated into the national SDSs	2007-2010	€ 2.8 million
EU Water Fund	SOPAC	Pacific IWRM WUE	water resources	Develop sustainable national IWRM policies and water efficiency strategies, endorsed by both government and civil society stakeholders, and integrated into the national sustainable development strategies. Activities: create and strengthen national and catchment water partnerships, and assist them develop IWRM policies and plans. Assist PICs in implementing applicable and effective Integrated Water Resource and Water Use Efficiency Plans.	2006-2009	€ 3.8 Million Euro (proposed)
EU WF	SOPAC/WMO	Pacific HYCOS (Regional)	water resources	Objectives: Improve management and protection of PICs freshwater resources. Activities: provision of appropriate water resources management systems to demonstrate sustainable catchment and aquifer management. Focus on carrying our activities like flood forecasting, water resources assessment in major rivers, water resource database, drought forecasting, groundwater and water quality monitoring and assessment	2006-2009	€ 3.2 million

NZAID	SOPAC/WHO/USP/IAS	Water Quality Monitoring	water resources	Objectives: Improved water quality monitoring. Activities: Establishment of sustainable regional capacity building programme in water quality monitoring	2006-2009	707.000 NZ$
NZAID	SOPAC/PWA	Water Demand Management Project	water use	Objectives: Improved Water Demand Management for Pacific Water Utilities. Activities: Development and implementation of WDM plans incl. leak detection; benchmarking etc	2006-2009	740,000 NZ$
SPC	Institute Pasteur	Water Quality Control	water resources	Objectives: Improve laboratories for water quality control in the Pacific with support to laboratories on utilities focusing on microbial analyses		-

7. CAPACITY DEVELOPMENT NEEDS FOR REMOVING THE BARRIERS

This section examines the capacity development needed in Samoa to reduce or remove key IWRM barriers identified in the country.

7.1 Water resources management – abstraction and protection

Surface water resources assessment – hydrological measurement capacity is adequate but monitoring network is inadequate as is data storage and management system. More advanced catchment low flow analysis, requiring gauging stations, equipment and a GIS system (and training) is needed.

Groundwater assessment – there is no hydrogeological capacity whatsoever, requiring basic groundwater training, field equipment and a national monitoring programme (necessitating a drilling programme).

Water resources water quality – no government departments are carrying out baseline surveys. Training and equipment is required for basic water quality analysis, but in a coordinated manner between WRD (water resources and watersheds), Environment (habitat and effluent monitoring), Environmental Health (rural supplies) and SWA (urban water supplies), with data capture and storage procedures for entry to a GIS system.

Watershed assessment – build capacity in watershed characterisation, data capture and linkages to other departments, and watershed analysis, to enable prioritisation of catchments requiring pro-active management.

7.2 Island vulnerability – flood and drought management

Comment: Shoul these be bulleted?

Flood analysis, risk assessment and prediction – need to build capacity in flood hydrology, flood prediction, flood plain definition, and establish capacity for close linkages between hydrology, disaster response planning and town planning agencies.

Capacity building for emergency water supply provision planning from water providers allowing for outage events (e.g. loss of power, loss of sources etc).

Capacity building in urban drainage requirements including land use planning for flood avoidance.

Drought preparedness – need to develop surface water low flow yield analysis and groundwater yield analysis (saline intrusion risk), develop understanding of conjunctive use approaches and maximising storage, and drought prediction capacity building, whilst building water conservation and demand management capacity using education programmes and improved supply system asset management (leakage reduction, increases in metering, appropriate tariffs, asset GIS etc)

Cost-benefit analysis capacity building of costs of disasters to economy.

Environmental capacity building to understand minimum low flows required to support habitats and eco-systems.

7.3 Awareness – Political advocacy and community engagement

Political advocacy capacity building for recognising economic value of water, and need for an improved integration of sectoral policies, plans and programmes, i.e. support for an apex body.

Increase in capacity building of all government departments to engage with communities on watershed management and water resources use and protection issues.

Capacity building in formal and informal public education programmes, including integrating water issues into the school curriculum, and awareness programme capacity building especially through NGOs and civil society structures.

Capacity building within communities to understand impacts of their land use and water use and pollution on themselves and on downstream catchment residents, including the identification of appropriate alternatives – i.e. sustainable livelihoods.

7.4 Technologies – Water demand management and water treatment

Capacity building of water service providers to improve asset management including abstraction metering, system and customer metering, leakage and illegal connection assessment and reduction, system operation and maintenance, system hydraulic analysis and redesign where appropriate.

Capacity building to improve water treatment including raw and treated water quality monitoring, system operation and maintenance, system chlorination analysis and redesign where appropriate.

Capacity in drought planning for low flow availability, including public awareness campaigns, water and energy conservation and demand reduction strategies, use of conjunctive use sources, and tariff setting to promote water and energy conservation.

Capacity building in disaster risk management to identify risks within systems, using water safety planning approach, as well as increasing delivery capacity to allow for 'outage events' e.g. temporary loss of sources, pipe networks or treatment plants.

Capacity building in integrated infrastructure planning between water supply and hydropower generation, and integration of water demand requirements between hydropower and water supply requirements, to optimise abstraction arrangements.

With the ADB project, wastewater management expertise will also have to be developed.

7.5 Institutional arrangements – Policies, legislation, planning and apex body

Building capacity to review complex legislative framework and try to simplify the regulatory regime.

Building of capacity to enforce the complex regulatory regime, most notably the development consent process (PUMA); sustainable management plans; and condition enforcement thereafter (e.g. discharge consents).

Capacity building for the development of watershed plans, their implementation and monitoring.

Capacity building for integrated land use planning (including WMPs and SMPs as appropriate).

Building of water resources, water quality and effluent quality monitoring capacity to ensure compliance with regulations.

Capacity building for a quantitative abstraction management legal mechanism to monitor and control water abstractions, e.g. a water abstraction licensing system.

Capacity building to develop inter-ministry, inter-agency, inter-sectoral, and government-civil society consultation and management partnerships, leading to the development of an apex body for IWRM.

Capacity building of government stakeholders to engage with civil society and in particular with communities.

7.5.1 Financing – cost recovery and economic cost benefits

For the service providers (both water supply and hydropower) capacity building is required to improve customer metering, improve asset management and maintenance, improve tariff structures, and improve billing and payments process, and the penalties for non-payment.

There has to be an eventual move away from relying upon external aid and government subsidies to replace, upgrade or expand capital infrastructure investment.

Budgetary support for the water resources management and environmental protection functions will require capacity building to recognise a realistic value of water resources and IWRM to the

national economy, both in terms of economic development and in terms of health care and disaster clear-up savings.

7.6 Land and agriculture – land uses and land management (including forestry)

Capacity building is required to promote sustainable community livelihoods which reduce watershed degradation whilst recognising the need for communities to have livelihoods and income streams. This includes community engagement skills, as well as best practice land use techniques.

Capacity building will be required for planning, but integrated with other sectors catchment uses and requirements, and may increasingly require the management of protected reserves.

Enforcement and compliance monitoring capacity building is also required. The SAMFRIS management system does however appear to be well used and in an integrated manner between Lands, Agriculture and Forestry.

7.7 Habitats and ecosystems – monitoring and protection

The Environment Department presently carries out no water quality monitoring and no habitat or ecosystem monitoring other than that for the single coastal water reserve. The department requires significant increases in capacity to identify vulnerable habitats, monitor their condition and the water quality received.

The Environment Department will also need to build capacity in waste management for its landfill operations, discharge consent compliance for trade effluent monitoring, and increase its knowledge of contaminant sources in the country.

7.8 Health and hygiene – water quality and public health costs

The Environmental Health Department presently has no capacity whatsoever to undertake rural water supply monitoring, and is reliant upon SWA laboratories. Capacity building is required in terms of planning, such as water safety plans, in-field testing, analysis, community engagement and education, transport and linkages to other agencies with relevant expertise in catchment and water resources management, water supply system design and operation and public health impacts.

7.9 Watershed and Coastal Management – integration of planning and management

Various agencies work in watershed management aspects as it relates to land use including WRD, Lands, Forestry, Agriculture and Environment. Additionally PUMA is the lead agency for SMPs and integrated infrastructure planning.

Capacity building is required in improving the linkages between these agencies and their sectoral responsibilities, in terms of planning, community consultations, and community support during interventions, monitoring and analysis.

The non-functional NWSMC could be rejuvenated and expanded to include coastal waters issues as far as they relate to and are impacted by watershed issues. This will require a coordinated approach to planning that appears not to exist at present, and capacity built to develop this process, including consultation with civil society.

8. INTRODUCING AN INTEGRATED APPROACH TOWARDS BARRIER REMOVAL

8.1 Diagnostic Report IWRM Measures

This section brings together all the measures to overcoming impacts and concerns into a coherent overall IWRM approach.

As a first step to collating the outcomes of the IWRM diagnostic report, the following list of **18** tasks has been identified from the thematic and linkages sections in this report:

1) Water resources management
2) Upper catchment watershed management
3) Flood and drought management
4) Public awareness and education
5) Community engagement and ownership
6) Sustainable rural livelihoods
7) Water demand management
8) Water quality management
9) Wastewater management
10) Hydropower generation
11) Lower catchment urban and coastal planning
12) IWRM partnership and planning
13) Legislative reform
14) Cost recovery and appropriate tariff setting
15) Regulatory/Management funding
16) Sustainable land management
17) Public health protection
18) Environmental protection

Nearly all of these activities, tasks and functions are being addressed to some extent in Samoa, but crucially from an IWRM perspective, most of these are being undertaken at either the institutional scale or the sectoral level. There is therefore relatively little integration of these functions between ministries, sectors, and between government and civil society stakeholders.

There are of course exceptions to this statement – two examples being: a recently undertaken flood risk management capacity building project (under the SOPAC Island Systems Management programme) which brought together stakeholders from Hydrology (WRD), Meteorology, PUMA and the NDMO; and the EU funded Water Sector Support Programme, which strengthens the inter-linkages between the different water sector stakeholders including most notably WRD, SWA, the Ministry of Health, and the independent village supplies, but also through its watershed management component with DEC, PUMA, Forestry, Lands and Agriculture.

Global Water Partnership Guidance to IWRM Frameworks

The Global Water Partnership (GWP) has promoted IWRM as a process for over ten years. It has developed useful guidance on how to develop an IWRM framework at the area, basin, country and regional level.

GWP recognises that water is required for people, food, nature and industry, and has developed an approach which is worth considering here when trying to develop a coherent overall IWRM approach for Samoa.

GWP identifies three main areas of action as part of what it refers to as its IWRM Toolbox. These are the:

- Enabling Environment – including national policies, the legislative framework and adequate water funding
- Institutional Roles – including well defined responsibilities, capacity building to undertake those functions, and coordination between these agencies; and
- Management Instruments – including water resources assessment, demand management, public awareness and education, water allocation mechanisms, regulations, EIA, risk assessment and management tools (e.g. flood and drought) economic tools (e.g. tariffs and subsidies) and information management and exchange.

A rapid comparison between the diagnostic report derived IWRM measures and the GWP checklist clearly shows that the national review identifies all of these IWRM issues.

The focus now therefore has to be to create and improve linkages across the sectors and scales (communities, watershed, islands, nation), and build capacity within and between the stakeholders in utilising the management instruments and tools. This is most likely to achieve political, institutional and general public support in the short term by addressing the most obvious pressing key priority issues.

A. Coherent Overall IWRM Approach for Samoa

The approach outlined below recognises that the policy, planning and management implementation of IWRM necessitates the improvement of inter-agency communication, coordination and work programme execution.

The approach does not therefore consider sectoral issues at all but rather only uses multi-agency activities, each of which is designed to further improve the integration of the various agencies and stakeholders, be it at the planning or activity level.

a) An IWRM Apex Body

The creation of an entity which improves coordination between sectors, government agencies, civil society and the private sector is fundamental to sustained IWRM. The Apex body's responsibilities should include the better coordination and harmonisation of: land use planning and consultation; policy and legislation; programme and project execution; management tasks; and knowledge and information transfer. The existing WSSC and the presently defunct NWSCC could both be used as an interim mechanism to fulfil this function, although in due course the existence of the apex body should become formalised.

b) Integrated Land Use Planning

Samoa has existing legislation which allows for watershed planning (WMP), integrated infrastructure planning (SMP) and coastal zone management. However to date these approaches have not taken a 'Ridge to Reef' approach and have not been effective due to limited inter-sectoral planning and enforcement capacity. This objective is to informally improve the integration of upper catchment and lower watershed land use planning by developing land use plans through a multi-sectoral mechanism.

c) Water Resources Assessment and Quality Monitoring

It is impossible to have effective IWRM without having a reasonable understanding of the water resources available for exploitation and protection. WRD has the mandate for water resource assessment, but like all agencies has very limited resources. This objective is to not only strengthen their technical capacity, but to integrate the resource monitoring burden across all stakeholders who should or do, undertake existing monitoring of water resources for their own reasons. Therefore rainfall, surface water flow, groundwater level, abstraction and water quality

data acquisition will be planned, executed and shared by WRD, Meteorology, SWA, EPC, Environmental Health, DEC, village water supplies, private abstractors etc. as part of the national hydrological network. This will include where necessary joint monitoring activities as well as data storage and sharing.

d) Watershed and Land Use Management

All water use and water pollution is a function of a land use activity. Planning and changing land use within the upper and lower catchments is critical to protecting the water resources. Samoa has a large range of legislation available to control land use as well as considerable expertise in engaging with communities to promote behavioural change. Planning in catchments in presently non-existent and community engagement whilst good is uncoordinated. The regulatory approach is recognised as being limited in value. The Apex body is seen as vital to improving the planning and coordination of these activities. However this objective is to integrate the activities of the principle agencies i.e. WRD, Forestry, Land Management, Agriculture and DEC by collaborating on the planning and execution of projects and tasks including watershed and land use inventory and characterisation, community engagement, education and awareness campaigns, research on rural livelihoods and soil stabilisation (including USP), water quality monitoring and regulatory enforcement, as well as coordinated agency capacity building and information management.

e) Demand Management and Water Use Efficiency

Where water shortages occur, conserving water and reducing demand are an important component of IWRM. SWA has spent considerable effort on reducing unaccounted for water from its systems and on customer awareness and education campaigns. Demand management however is applicable to all water uses, and these efforts can be improved and strengthened by including the human, financial and customer bases of the energy generation, tourism, private commercial abstractors, village supply systems and agricultural water usage stakeholders in water resources planning, water conservation and demand management activities. This will include awareness campaigns, asset management procedures and approaches (including leakage detection and repair), capacity building, infrastructure planning and appropriate technologies (e.g. conjunctive use schemes for water supply and power generation, drip irrigation, household rainwater harvesting), and financial incentives (i.e. tariffs and material subsidies).

f) Water Rights, Policies and Legislation

The IWRM review has confirmed there is no existing legal framework for the control, allocation and protection of existing and future water abstractions, either from flow derogation or from pollution. There is a need to amend this gap in the existing legislative framework, without which water resources management will be ineffective. This will need to be done as part of a more comprehensive review of the existing policy and legislative framework.

g) Water Resources Information and Management System

Effective IWRM will need the capture of water resource flow, quality, water allocation and use and land use data within an information system. A Geographical Information System, compatible with the land management SAMFRIS system, SWA and EPC asset management systems and national MAPSERVER, should be established at WRD to enable water resources availability, vulnerability and demand to be assessed. The management system would include future water resources planning (especially drought planning) and a water allocation scheme (licensing system). The management system would also be used to contribute to the future land use planning and decision making process (to minimise pollution of water resources) and enable informed PEAR and EIA preparation.

Priority Areas for Action

Such a holistic approach to achieve long term IWRM requires a medium term commitment by central government, the involved institutions and the public. Experience suggests this cannot be realised without demonstrating real and tangible economic, social and environmental benefits to

the stakeholders. In other words, given the increase in effort and expense to undertake IWRM, what do the Treasury, institutions and public get back in return? Some of these benefits, be they improved public health, improved tourism revenue, reduced environmental damage, increased hydropower generation, reduced flood damage, therefore have to be achieved in the short term.

This necessitates the need to identify critical key priority areas which can be addressed in the short term, and which can demonstrate a return on the IWRM investment. From the evidence presented in the diagnostic report such priority concerns might include:

- dry period/drought water shortages;
- flooding risks;
- deterioration in drinking water quality;
- competing water supply and hydropower demands;
- unsustainable land use practices;
- cyclone associated soil erosion; and/or
- localised saline intrusion.

Whilst these concerns are true for many catchments, the greatest land use and water demand pressures are undoubtedly in the catchments above the capital of Apia.

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9. ANNEXES

10.1 ANNEX I

Maps of the island/country showing the distribution of islands, watersheds, rivers, wetlands and major communities

The following maps are provided below:

A: Map of Upolu showing surface watersheds, groundwater areas (no surface water courses), rivers and supply infrastructure (except for Apia area)

B: Map of Upolu showing topography, water supply zones and typical demand rates

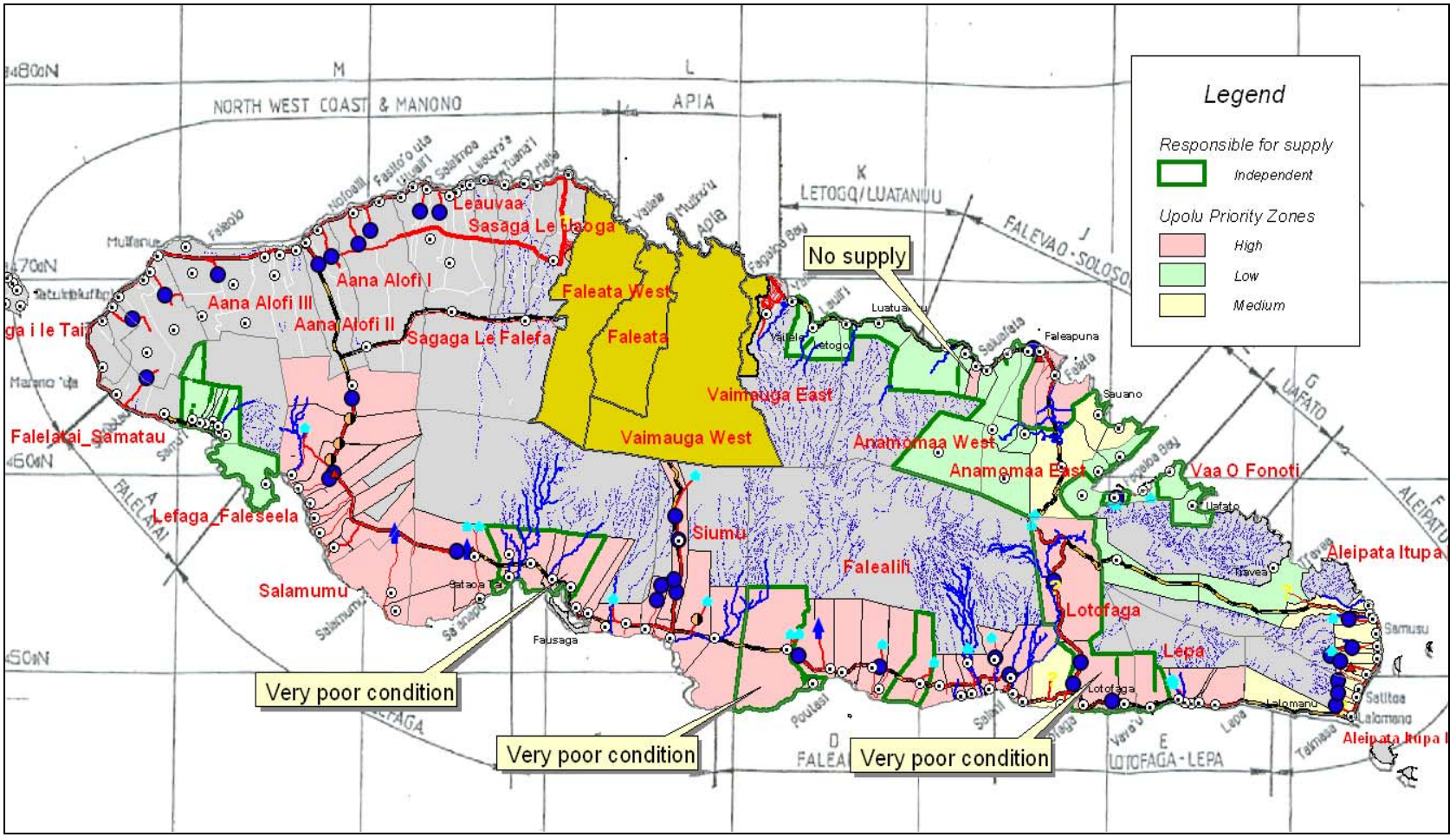
C: Map of Savaii showing surface watersheds, groundwater areas (no surface water courses), rivers and supply infrastructure

D: Map of Savaii showing topography, streams, borehole locations and water supply zones (except for east coast area)

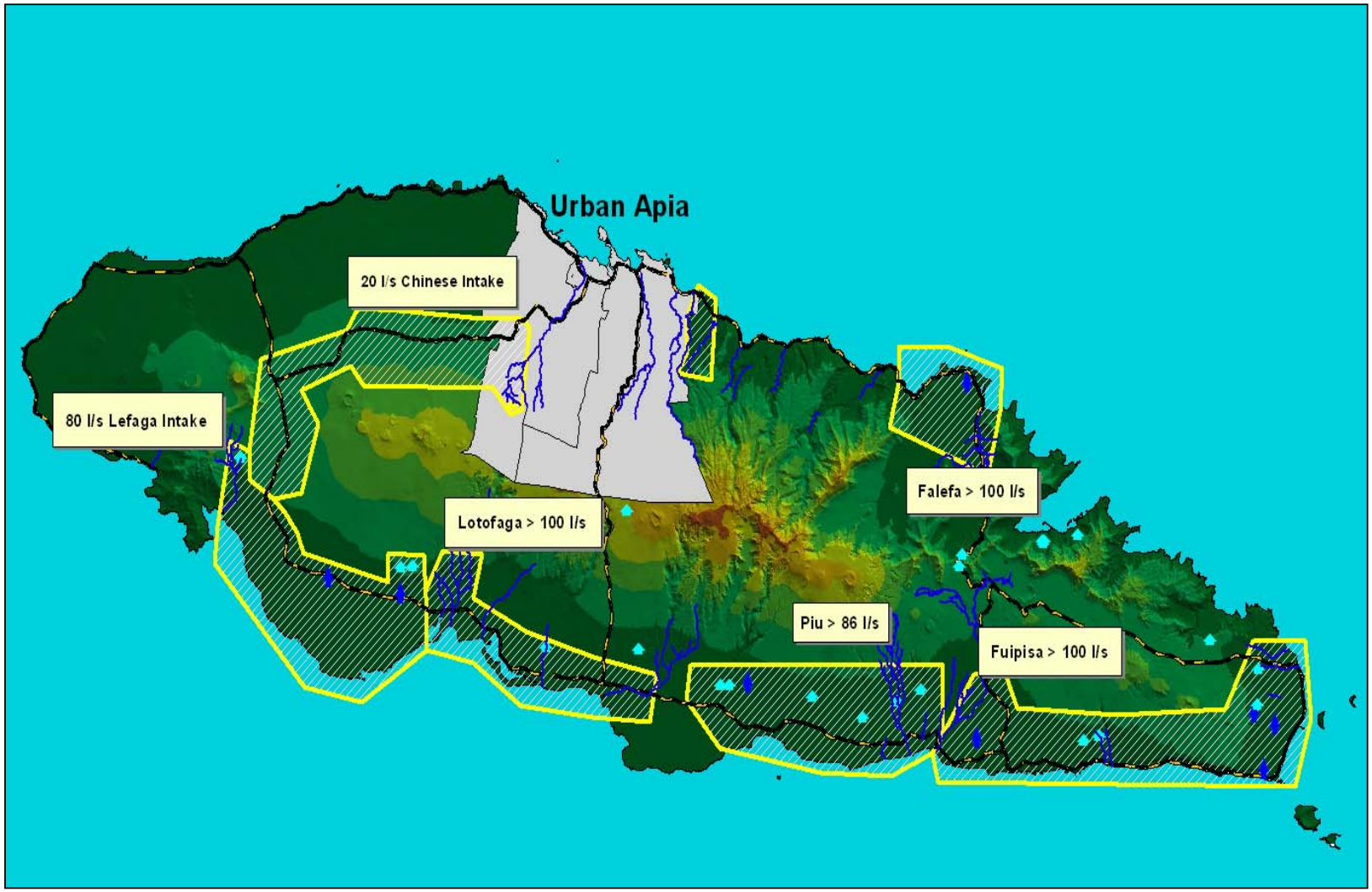
E: Geological Map of Samoa

There is no mapping data available on the locations of wetlands.

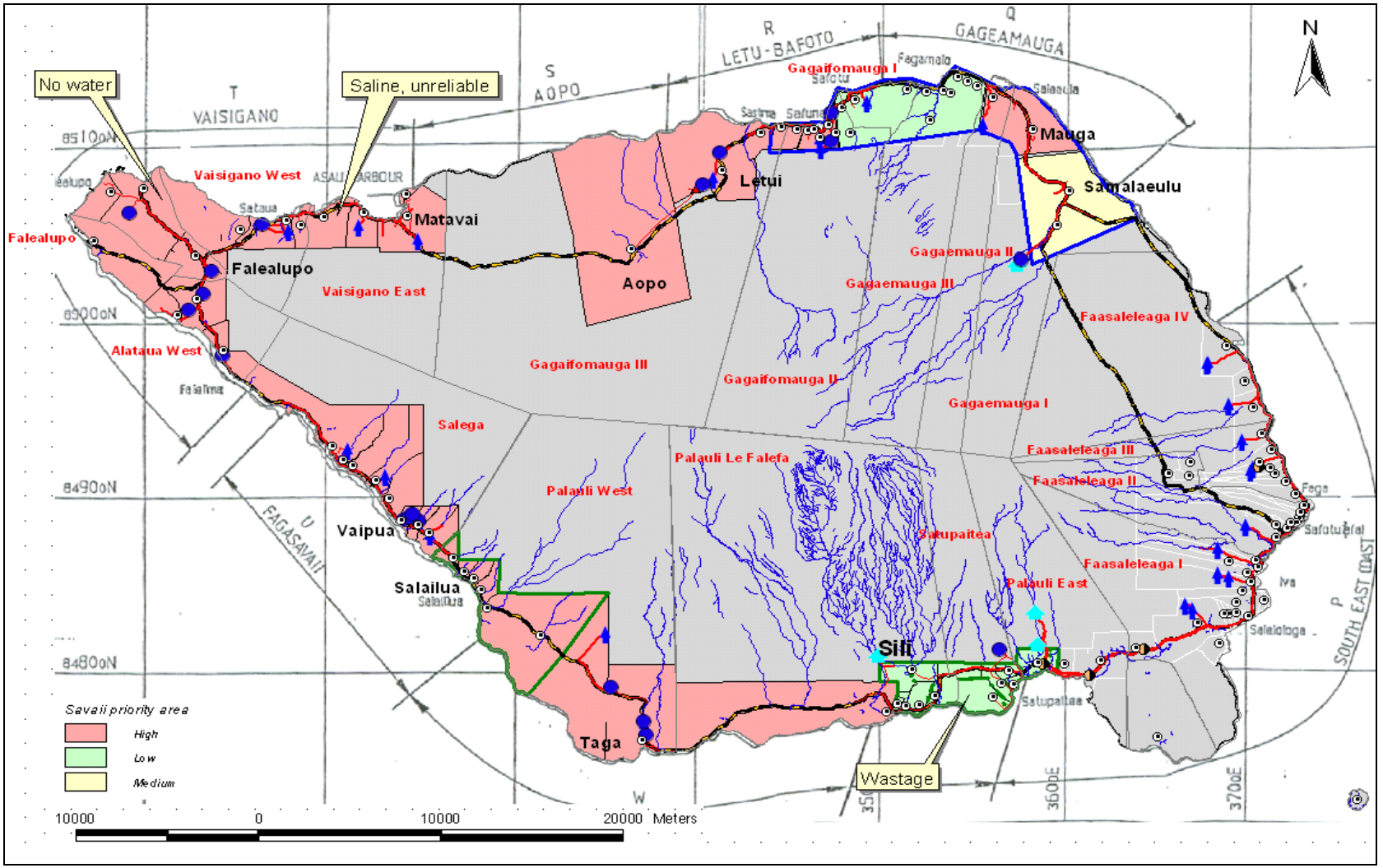
Ama could you check this with Lands and DEC please?



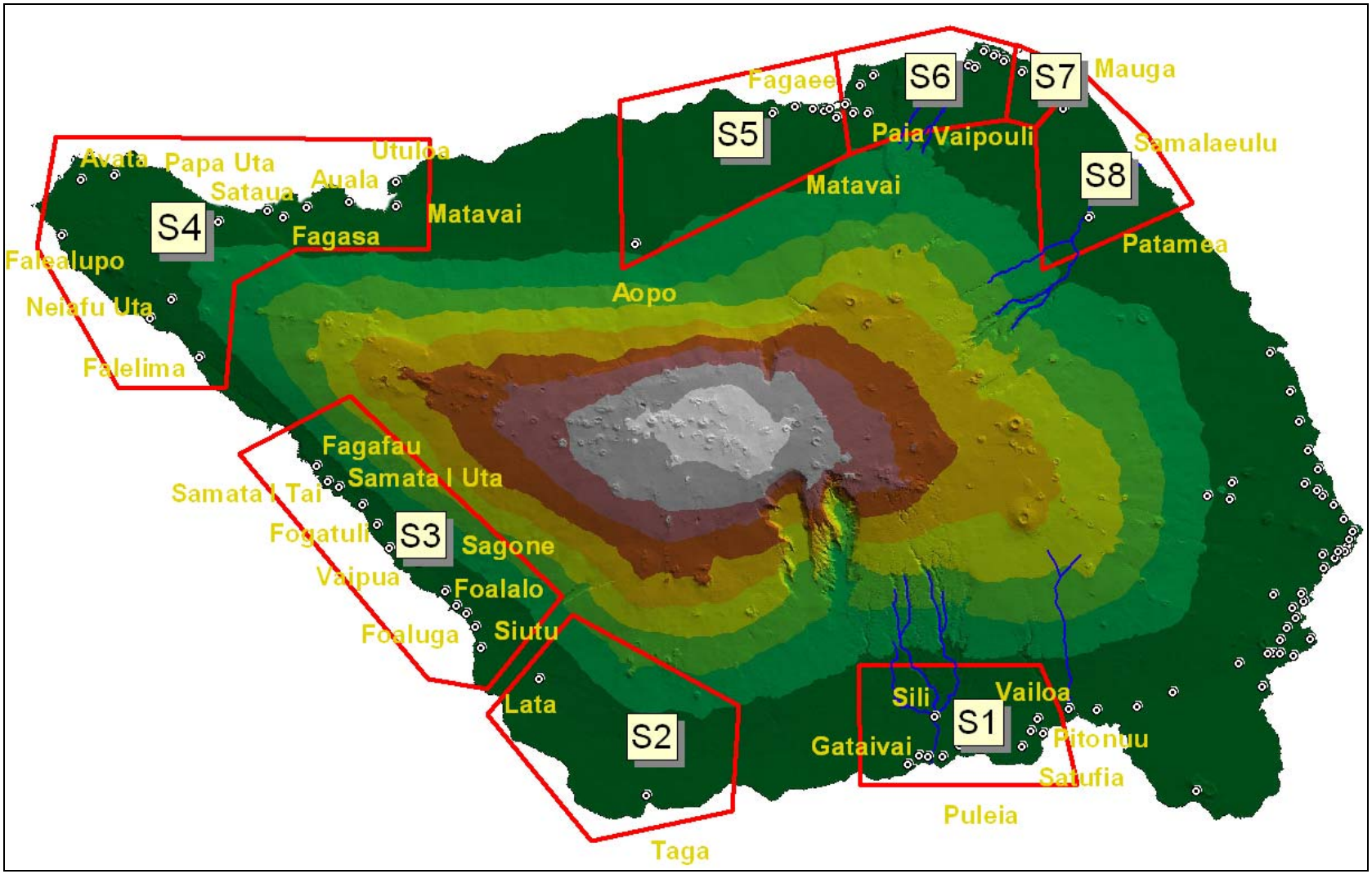
Map of Upolu showing surface watersheds, groundwater areas (no surface water courses), rivers and supply infrastructure (except for Apia)



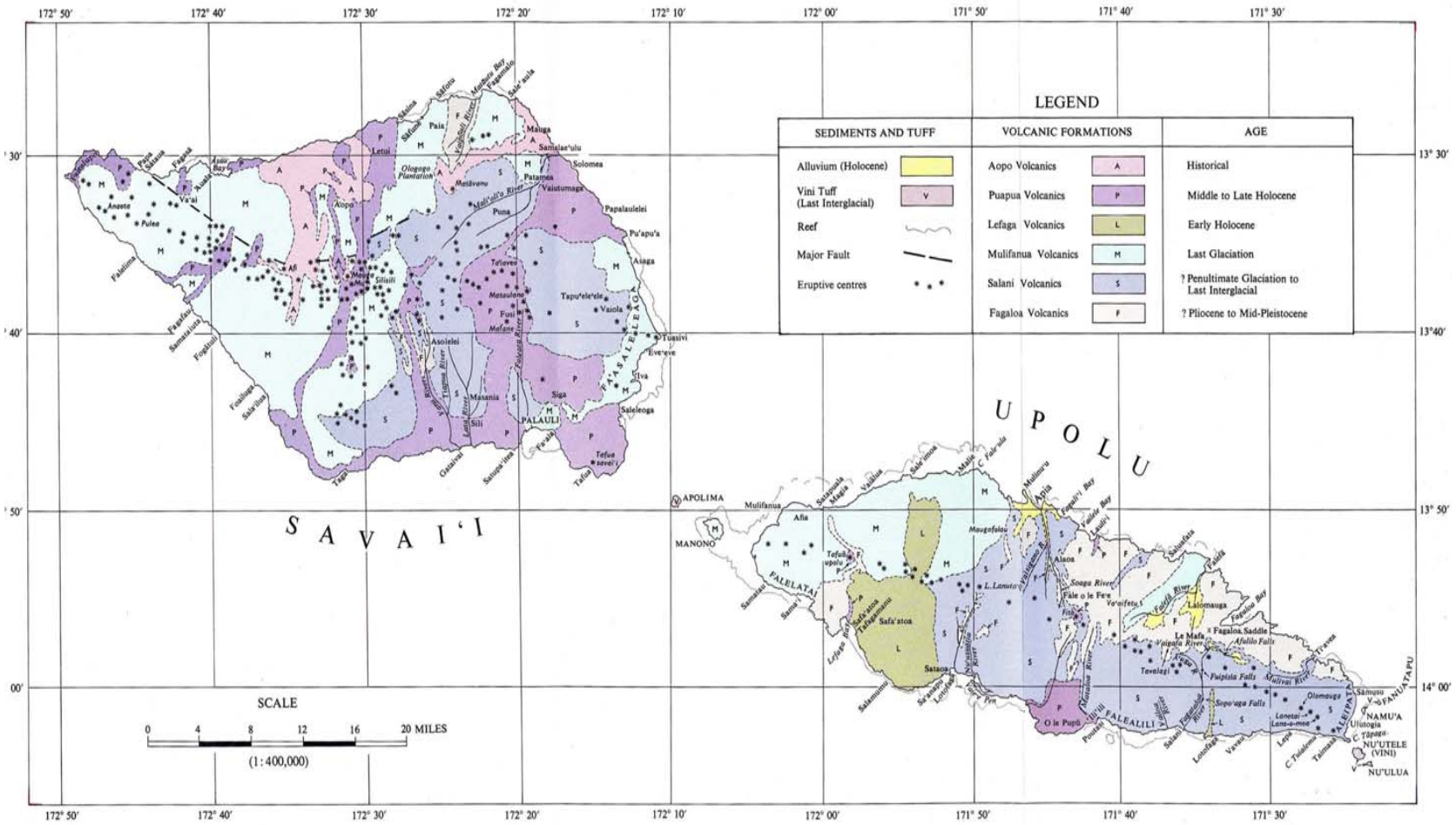
Map of Upolu showing topography, water supply zones and typical demand rates



Map of Savaii showing surface watersheds, groundwater areas (no surface water courses), rivers and supply infrastructure



Map of Savaii showing topography, streams, borehole locations and water supply zones (except for east coast)



Geological Map of Samoa (NZGS 1959)

(Note: the surface water courses are restricted to the older formations of the Fagaloa and Salani Volcanics)

10.2 ANNEX II

- A map of the island/country showing land use (including protected areas and areas planned for development

This still needs to be secured from Lands and Technical Services (Ama can you arrange please)

- A table giving average monthly rainfalls (1971-2000)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
489	368	352	211	193	121	121	113	154	224	262	358	2965

Ama can we get a table like this but for each year from Met, then we can include variability as well.

- A table giving average monthly water use by area

  There is no seasonal water demand data available.

10.3 List of Invitees; Catachment Coordination Committee

Hot Spot Analysis Meeting (?)

NAME	ORGANISATION	DESIGNATION	TELEPHONE	EMAIL
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