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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF NATURAL RESOURCES (MNR)
SOLOMON ISLANDS ELECTRICITY AUTHORITY (SIEA)
THE SOLOMON ISLANDS

MASTER PLAN STUDY OF POWER DEVELOPMENT IN SOLOMON ISLANDS

FINAL REPORT

VOLUME Ⅱ MAIN REPORT

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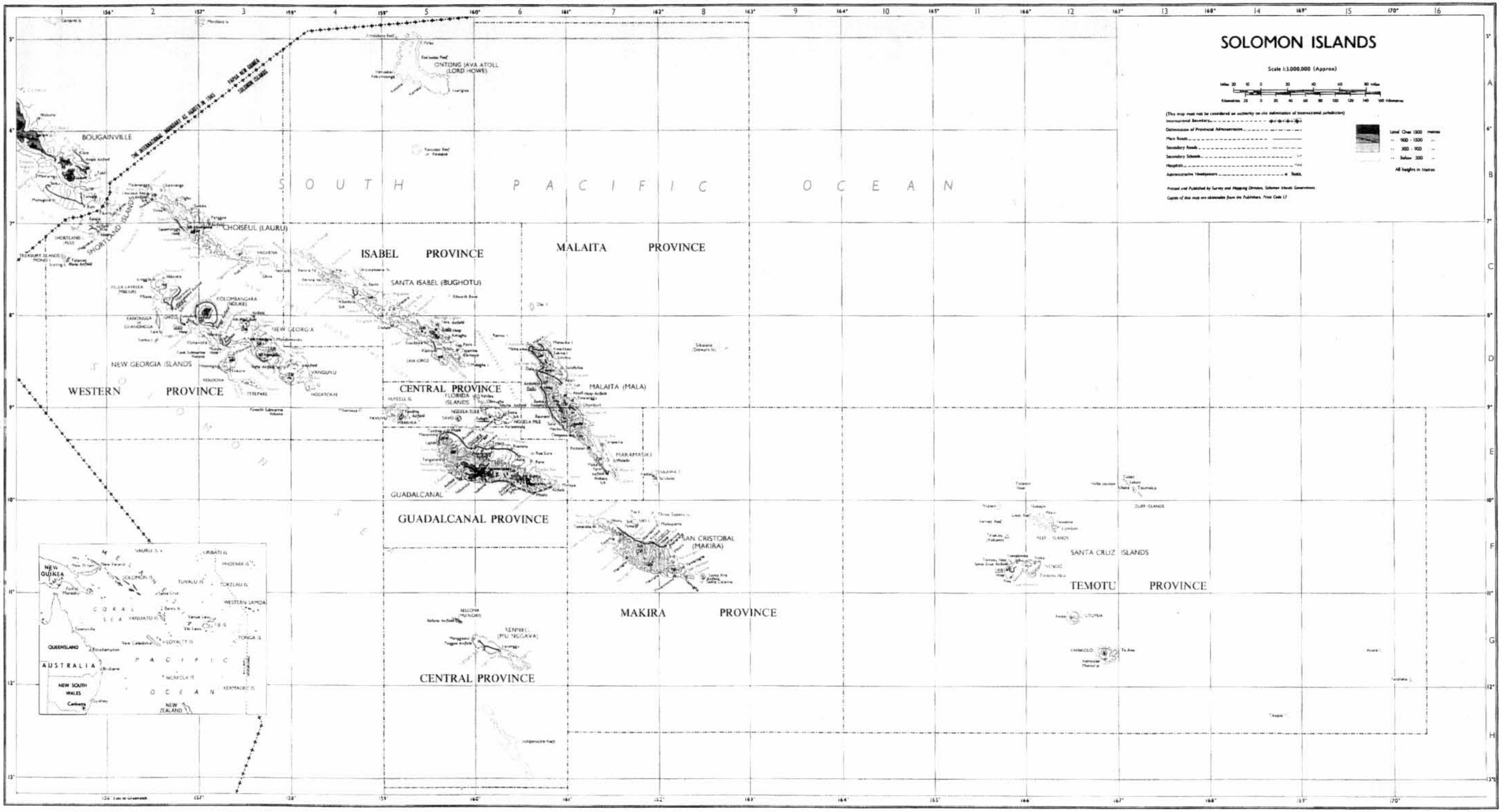

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Master Plan Study

of

Power Development

in

Solomon Islands

Draft Final Report

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ACRONYMS / ABBREVIATIONS

ADB	:	Asian Development Bank
AFPA	:	Automatic Fuel Price Adjustment
ANZ	:	Australia and New Zealand Banking Group Limited
APACE	:	Appropriate Technology Community and Environment, Sydney-based NGO
CAP	:	Chapter
CASO	:	Conservation Area Support Officer
CBSI	:	Central Bank of Solomon Islands
CEMA	:	Commodity Export Marketing Authority
CF	:	Conversion Factor
CI	:	Conservation International
CIF	:	Cost, Insurance and Freight
CO2	:	carbon dioxide
COD	:	Cash on Delivery
CRCD	:	Community Resource Conservation and Development
DB	:	Dry Battery
DBSI	:	Development Bank of Solomon Islands
E	:	east
EC	:	European Community.
ECD	:	Environment and Conservation Division
EDS	:	Every Day Stress
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EIS	:	Environmental Impact Statement
EL	:	elevation
ELR	:	Solomon Islands Environmental Legal Review
EO	:	Environment Officer
F/S	:	Feasibility Study
FIRR	:	Financial Internal Rate of Return
FOB	:	Free On Board
GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
GREA	:	Guadalcanal Rural Electrification Association
GTZ	:	Deutsche Gesellschaft fur Technische Zusammenarbeit
HRPI	:	Honiara Retail Price Index
ICSI	:	Investment Companies of Solomon Islands
ISFMT	:	Isabel Sustainable Forestry Management Trust
IUCN	:	International Union for Conservation of Nature and Natural
JICA	:	Japan International Cooperation Agency
Kr	:	kerosene, kerosine
LAR	:	Liquidity Asset Ratio
LRAIC	:	Long Run Average Incremental Cost
LRMC	:	Long Run Marginal Cost
M/P	:	Master Plan
MEMM	:	Ministry of Energy, Mines and Mineral Resources
MHP	:	Mini- Hydropower

ACRONYMS / ABBREVIATIONS

mil	: million
MNR	: Ministry of Natural Resources
MOF	: Ministry of Finance
MTDS	: Medium Term Development Strategy
N	: north
NBSI	: National Bank of Solomon Islands
NCP	: National Coalition Partners
NE	: northeast
NEMS	: Solomon Islands National Environmental Management Strategy
NGO(s)	: Non-Government Organization(s)
NNW	: north-northwest
NPF	: National Provident Fund
NW	: northwest
P/S	: Power Station
PAP	: People's Alliance Party
PEO	: Principal Environment Officer
PER	: Public Environmental Report
PPD's	: Project Preparation Documents
PS	: Power Station
PSIP	: Public Service Investment Program
PSRP	: Policy and Structure Reform Program
PV	: Photovoltaic
PVC	: polyvinyl chloride
REAC	: Rural Electrification Advisory Committee
RIPEL	: Russel Islands Plantation Enterprises
ROA	: Return on Asset
ROR	: Run of River
RTC	: Rural Training Center
S	: south
SCF	: Standard Conversion Factor
SDR	: Special Drawing Right
SE	: southeast
SELF	: Solar Electric Light Fund
SEO	: Senior Environment Officer
SHS	: Solar Home System
SIAC	: Solomon Islands Alliance for Change
SICHE	: Solomon Islands College of Higher Education
SIDT	: Solomon Islands Development Trust
SIEA	: Solomon Islands Electricity Authority
SIECD	: Solomon Islands Environment and Conservation Division
SIMS	: Solomon Islands Meteorological Service
SINURP	: Solomon Islands National Unity
SIPL	: Solomon Islands Plantation Limited
SIWA	: the Solomon Islands Water Authority
SMEC	: the Snowy Mountain Engineering Corporation
SOE	: State-Owned Enterprise

ACRONYMS / ABBREVIATIONS

SOPAC	:	South Pacific Commission
SPBCP	:	South Pacific Biodiversity Program
SPREP	:	the South Pacific Regional Environment Program
SSE	:	south-southeast
SW	:	southwest
T&D	:	Transmission and Distribution Line
TEPSCO	:	Tokyo Electric Power Services Co., Ltd.
UNICEF	:	the United Nations Children's Fund
UNIDO	:	United Nations Industrial Development Organization
W	:	west
WHO	:	World Health Organization
WTP	:	Willingness to Pay
WWF	:	World Wide Fund for Nature

UNIT

Prefixes

μ	:	micro-	=	10^{-6}
m	:	milli-	=	10^{-3}
c	:	centi-	=	10^{-2}
d	:	deci-	=	10^{-1}
da	:	deca-	=	10
h	:	hecto-	=	10^{2}
k	:	kilo-	=	10^{3}
M	:	mega-	=	10^{6}
G	:	giga-	=	10^{9}

Units of Length

m	:	meter
km	:	kilometer

Units of Area

m^2	:	square meter
km^2	:	square kilometer

Units of Volume

m^3	:	cubic meter
l	:	liter
kl	:	kiloliter

Units of Mass

kg	:	kilogram
t	:	ton (metric)
oz	:	ounce

Units of Energy

kWh	:	kilowatt-hour
MWh	:	megawatt-hour
MJ	:	megajoule

Units of Temperature

℃	:	degree Celsius or Centigrade

Units of Electricity

W	:	watt
kW	:	kilowatt
MW	:	megawatt
Ah	:	ampere hour
V	:	volt
kV	:	kilovolt
kVA	:	kilovolt ampere

Units of Flow Rate

l/s	:	liter per second
m^3/s	:	cubic meter per second

Units of Currency

SB$	:	Solomon Dollar
US$	:	US Dollar
¥	:	Japanese Yen
AUcent	:	Australian Cent

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and Recommendations

The Master Plan Study Team prepared the long term power supply plan and the rural electrification plan, for the use of renewable energy such as small hydro power and solar energy to be implemented until the year 2018, and also studied the institutional framework required for rural electrification.

The conclusion of this study is based on the identification of several plans for the power supply for demand centers in each province (refer to power supply and rural electrification plans mentioned in Chapter 10, section 10.3). Upon evaluation, the plans were examined and studied by screening based on essential conditions and finally selected as optimum supply plan for a demand center. The plans were evaluated on several aspects for reference.

In order to accelerate rural electrification by SHS in remote areas, the pilot scheme should be carried out, and the result of the pilot scheme shall be reflected in the nationwide scheme that was recommended in this chapter.

The optimum power supply plan and rural electrification plan by SHS for all provinces in Solomon Islands is presented in Section 1.1 and Section 1.2.

The study concluded that the optimum power supply development scheme and rural electrification plan by SHS in Solomon Islands shall be carried out.

On the other hand, it is also recommended that the rural electrification fund for SHS should be collected in addition to the present average electricity charge in order to accelerate the rural electrification plan by SHS and to disseminate SHS programs. It is also necessary the training of the provincial government engineers and the community people who will be in charge of the SHS system maintenance, in order to rise villager's consciousness and understanding and to maintain PV systems by community/villagers. For these reasons, the establishment of a PV training center (in REAC), for theory and practice training of PV systems, is recommended.

1 Conclusions

It is concluded in this study that the optimum power supply and the rural electrification plans by SHS would be feasible for realization. However, an amount of US$177 million for construction cost and an amount of US$142 million for operation and maintenance are needed for implementation of the optimum power supply development scheme until the year 2018. In order to implement this development scheme, the present average electricity charge must be increased about 21 %. This increased amount of 21 % includes the rural electrification fund by SHS.

Since the government development budget, which will be obtained from grant aid or loans by overseas donors, will not meet the above mentioned amount, electricity charges must be increased.

The organization and management of newly developed hydro power stations should be done by

SIEA, because SIEA has been operating successfully two hydropower stations (Buala and Malu'u).

With regard to the institutional framework for rural electrification by SHS, the Rural Electrification Advisory Committee (REAC) should be established and should perform as a key organization for rural electrification implementation and for coordination of activities among ECC, MNR, SIEA, training institutions, provincial governments, aid donors and villages/communities (including NGO/private sector), following the national energy policy and guidelines.

1.1 Optimum power supply plan by grid power and small hydropower

The optimum power supply plan by grid power and small hydropower for each demand center are shown below.

Province / Island / Demand center / Plan No. / Fiscal Year	Guadalcanal	Malaita	Isabel
	Guadalcanal	Malaita	Santa Isabel
	Honiara-Lungga	Auki-Malu'u	Buala
	3	3	2
1998	-	-	-
1999	Lungga diesel No.9 (3900kW) installed	-	-
2000	Lungga diesel No.10 (4200kW) install, Lungga diesel No.4 & No. 5 (1000kW*2) and Honiara diesel No. 5 & No. 6 (500kW*2) retire	Auki diesel 2 units (200kW*2) replace, Malu'u diesel 1 unit (83kW) install	-
2001	-	Bina diesel No.1 unit (1500kW) develop, existing diesel 1 unit (208kW) retire	-
2002	-	Bina diesel No.2 unit (1500kW) install	-
2003	Lungga diesel No.11 (5000kW) develop	Bina diesel No.3 unit (1500kW) install, Rori hydro (300kW) develop	-
2004	Lungga diesel No.12 (5000kW) develop, Lungga diesel No.7 (2300kW) retire	-	-
2005	-	-	New diesel No.2 (160kW) install
2006	-	-	-
2007	Lungga diesel No.13 (5000kW) install	-	-
2008	Lungga diesel No.8 (3600kW) retire	-	-
2009	-	Ruala'e hydro (200kW) develop	Kubolata hydro (80kW) develop
2010	Maotapuku 1 & 2 (1600kW, 1400kW) develop	-	-
2011	-	-	-
2012	Lungga diesel No.14 (5000kW) install	-	New diesel No.3 (160kW) install
2013	-	Silolo hydro (2100kW) develop	Existing old diesel (62kW) retire
2014	-	-	-
2015	-	-	-
2016	Lungga diesel No.15 (2000kW) install	-	-
2017	-	-	-
2018	-	-	-

Province / Island / Demand center / Plan No. / Fiscal Year	Makira	Temotu	Choiseul
	San Cristbal	Santa Cruz	Choiseul
	Kirakira	Lata	Taro & Choiseul
	2	2	1
1998	-	-	-
1999	-	-	-
2000	-	-	New diesel No.1 & 2 (20kW*2) develop in Taro Is.
2001	New diesel No.4 (200kW) install	-	-
2002	-	-	-
2003	-	-	Sorave hydro (70kW) develop in Main island
2004	New diesel No.5 (170kW) install	-	-
2005	-	New diesel No.4 (200kW) install	-
2006	-	-	-
2007	-	-	-
2008	-	-	-
2009	-	-	-
2010	-	-	-
2011	New diesel No.6 (170kW) install	-	-
2012	Existing old diesel No.1 (60kW) retire	New diesel No.5 (200kW) install	-
2013	Existing old diesel No.2 (50kW) retire	Existing old diesel No.1 (60kW) retire	-
2014	-	Existing old diesel No.2 (40kW) retire	-
2015	-	Existing old diesel No.3 (60kW) retire	-
2016	-	-	-
2017	-	-	-
2018	-	-	-

Province / Island / Demand center / Plan No. / Fiscal Year	Western		Central
	Gizo	New georgia	Tulagi
	Gizo	Noro-Munda	Tualgi
	2	2	2
1998	-	-	-
1999	-	-	-
2000	Gizo diesel 2 units (200kW*2) replace	-	-
2001	-	Noro new diesel No.4 & No.5 (2000kW*2) extend	-
2002	New diesel No.4 & No.5 (300kW*2) install	-	-
2003	Existing old diesel No.3 (170kW) retire	-	-
2004	-	-	-
2005	-	New diesel No.6 & No.7 (2000kW*2) extend	New diesel No.3 (60kW*1) extend
2006	New diesel No.6 (300kW*1) install	Existing old diesel No.1 (900kW) retire	-
2007	-	Existing old diesel No.2 (900kW) retire	-
2008	-	Existing old diesel No.3 (900kW) retire	-
2009	-	-	-
2010	-	New diesel No.8 & No.9 (2000kW*2) extend	-
2011	-	-	-
2012	-	-	-
2013	-	-	-
2014	-	-	-
2015	New diesel No.7 (300kW*1) install	-	-
2016	-	New diesel No.10 (2000kW*1) extend	-
2017	-	-	-
2018	-	-	-

1.2 Rural electrification by SHS

In order to implement the rural electrification plan by SHS, the pilot scheme structural organization should be established and the monitoring should be executed at the selected villages.

Then 270 sets of SHS for individual houses and 27 sets of SHS for public facilities should be installed every year from 2005 to 2018. About 4000 houses and 400 public facilities would be electrified by the year 2018.

The rural electrification plan by SHS is shown below.

Year \ Plan No.	Project name	Contents
1998	-	-
1999	-	-
2000	-	-
2001	Pilot scheme (1st year)	36Wp SHS 200 sets, 55Wp SHS 50 sets, 75Wp SHS 39sets
2002	Pilot scheme (2nd year)	
2003	Pilot scheme (3rd year)	
2004	-	-
2005	Nationwide scheme (1st year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2006	Nationwide scheme (2nd year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2007	Nationwide scheme (3rd year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2008	Nationwide scheme (4th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2009	Nationwide scheme (5th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2010	Nationwide scheme (6th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2011	Nationwide scheme (7th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2012	Nationwide scheme (8th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2013	Nationwide scheme (9th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2014	Nationwide scheme (10th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2015	Nationwide scheme (11th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2016	Nationwide scheme (12th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2017	Nationwide scheme (13th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets
2018	Nationwide scheme (14th year)	36Wp SHS 270 sets, 75Wp SHS 27 sets

2 Recommendations

2.1 Recommendation ss for the power supply plan

It is necessary to carry out the following tasks consciously before the power supply plan is implemented as explained in section 1.

(1) To review the power demand forecast for each province/island at least once a year.

(2) To carry out further surveys on the following topics before implementation or development of each hydro potential in each province or island.

- Guadalcanal Province: The possibility of an open channel shall be confirmed for Maotapuku 1 and Maotapuku 2. A leveling survey shall be carried out for confirmation of the effective head at Sasa.
- Malaita Province: Access roads and geology surveys shall be carried out at Silolo.
- Isabel Province: Discharge measurement shall be surveyed at Kubolata.
- Makira Province: Leveling survey and discharge measurement shall be carried out at Waimapuru.
- Choiseul Province: Leveling survey of the tailrace shall be carried out at Sorave.
- Temotu Province: Leveling survey and discharge measurement shall be carried out at Luembalele.

The output capacity and energy generation should be reviewed based upon these surveys.

(3) The power supply plans should be reviewed based on updated power demand forecasts.

The following environmental study shall be carried out before implementation or development of the optimum power supply plan:

- At planning stage
  - Location of the plant in relation to conservation areas.
  - Impacts on endemic or rare species of wildlife.
  - Large scale reshaping of the slopes and rivers which could cause artificial or intensified landslides of floods.
  - Land procurement and land ownership and written agreement for project implementation.
- At construction or operation stage
  - Disposal of excavated soil and sand in the construction of dams and water conveyance structures
  - Conflict between inflowing workers and surrounding communities in construction period
  - Adverse impacts on the surroundings and downstream ecosystem by a project not employing the project design which mimics the natural settings (e.g., access of large scale machinery and roads into upstream areas, change of natural dry season)
  - Water shortage downstream of a water intake, especially during dry season
  - Water shortage or pollution of the potable water supply source if it is located downstream
  - Disturbance of migration of fish, which could be a food source to nearby communities
  - Disturbances of agro-forestry production and landscape
  - Inflow of logging business into upstream areas through leftover access roads for the construction of electrification facilities

2.2 Recommendations for the rural electrification

2.2.1 Establishment of organization for rural electrification

REAC should be established in the Ministry of Natural Resources (MNR). REAC should act as the primary institution plan to coordinate and implement rural electrification by SHS. The energy division of MNR shall perform as secretariat and administration. The REAC is comprised by the Energy Division, Ministry of Education, Ministry of Health, Ministry of Finance, SIEA, NGO and aid donors.

The energy division should carry out: (1) to obtain the consent of related institutions for discussion and assistance, (2) to inform the related institutions regarding the rural electrification plan, (3) to implement recruiting man power for professional staff.

After establishment, REAC should have responsibility for the following work items:

1) Public relations for rural electrification plan
2) Establishment of a PV training center
3) Production of a PV training manual
4) Establishment of a revolving fund
5) Legislation of a regulatory framework
6) Evaluation and selection of petitions
7) Workshop at SHS installation villages

8) SHS procurement and installation
9) Provide aftercare service for SHS
10) Monitoring and evaluation

2.2.2 Rural electrification

The following environmental study shall be carried out before implementation and development.

1) Reduction in the use of dry cells and the amount of their disorderly disposal (positive impact)
2) Disposal of used batteries at the end of a lifecycle of SHS facilities (adverse impacts)
3) Disturbance of the surrounding landscape with distribution lines and SHS facilities (adverse impacts)
4) Safety issues of transmission lines and the like during cyclone and strong winds (adverse impacts)

The rural electrification plan shall be carried out by two schemes. Firstly, the pilot scheme shall be implemented, and then, the nationwide scheme shall be implemented. Any action to be taken from results of the pilot scheme should be evaluated, aiming to form a basis for the nationwide scheme.

The following organization is recommended:

A person to have responsibility of PV system operation and maintenance in a community/village should be commissioned as a basic organization. This person should take care of the daily operation in the village, and the provincial engineer should take care of any trouble that cannot be solved by the commissioned person.

The SIEA engineer should be in charge of maintenance back up and should be able to solve any major trouble.

The following points should be checked during the monitoring period.

(1) Technical issues such as number of members, service level, service items, maintenance cycle, training subject and training periods

(2) Management issues such as number of members, amount of charge for services, rate of charges collection, rate of delinquency

(3) Disposal of batteries

When a stock amount of batteries is reached, batteries to be processed should be conveyed to Brisbane in Australia, to be processed at a certain factory, taking provision that disposal and treatment of batteries do not affect the environment of Solomon Islands.

2.3 Establishment of rural electrification funds by SHS

The social basic infrastructure may not be developed in remote rural areas and in areas far from the urban zones, and the people living in such places will be forced to live with neither water, electricity nor gas. It is recommended that the rural electrification funds by SHS shall be collected in addition to the present electricity charges in order to provide such people the benefit of lighting. The increased amount by SHS electrification funds is stated in section 2.4.

2.4 Electricity charge

2.4.1 Electricity charge by optimum power supply plan

For implementation of the power supply plan by grid and small hydropower, the total amount of US$ 313 million, US$172 million for construction and US$142 million for operation and maintenance, is needed to implement the above scheme. In order to attain this, it would be necessary to increase the present average electricity charge from 79.18 SBC/kWh (0.1584 USC/kWh) to 94.03 SBC/kWh (0.1881 USC/kWh) as final average charge.

It is recommended that the best combination of funds for loan, grant and own fund should be applied to implement the above scheme. When the loan is applied, the government should ask the lowest interest and long term repayment loan.

2.4.2 Collection charge by rural electrification program

For implementation of rural electrification program by SHS, the total amount of US$ 6.2 million, US$0.37 million for the pilot scheme, US$5.2 million for construction and US$1.0 million for operation and maintenance on the nationwide scheme, is needed to implement the above rural electrification plan by SHS.

250 houses and 39 public facilities (school, church and clinic) would be electrified by the pilot scheme, and 270 houses and 27 public facilities would be electrified every year by the nationwide scheme. Consequently, about 4,000 houses and 400 public facilities would be electrified by the year 2018.

2.4.3 Total collection charge

It is recommended that the total increased amount be 16.67 SBC/kWh, which consists of two parts that correspond to the optimum power supply plan (increasing amount is 14.85 SBC/kWh) and rural electrification plan by SHS (increasing amount is 1.82 SBC/kWh), shall be carried out in order to implement the long term power supply master plan. This means that the rise of average electricity charge shall be from the present average charge of 79.18 SBC/kWh to 95.85 SBC/kWh as the final average electricity charge.

The collection of charges for the rural electrification fund by SHS should be transferred to the account in DBSI. REAC shall use this fund.

The number of electrified houses was 6,600 in 1998, however, the total number of electrified houses, to be electrified by grid or small hydropower and by SHS, would be about 16,100 by the year 2018.

The funding for the above development shall be obtained by grant for the pilot scheme and by loan for the nationwide scheme in principle. However, if the grant can be applied to the nationwide scheme, this fund would be useful as a revolving fund for rural electrification by SHS. Therefore the Solomon Government shall ask grant aid to donors. (Refer to Chapter 12, Table 12-4-3-1)

2.5 Funding

2.5.1 Fund for optimum power supply plan by grid or small hydropower

Total construction cost of US$ 172 million will be funded by US$ 100million of loan, US$ 29million of grant and US$ 43million of own fund. The loan should be long repayment term and lowest interest. Project costs over US$ 20million shall be procured by loan. Grant shall be applied only to small sized projects less than US$ 10million.

2.5.2 Fund for rural electrification plan by SHS

Total construction cost of US$ 0.37 million for the pilot scheme will be funded by grant aid, and the amount of US$ 5.2 million for nationwide scheme during the year 2005 to 2018 shall be funded by loan. However it is desirable to ask the grant for the nationwide scheme taking account the dissemination of SHS and rural electrification program by SHS.

2.6 Training for the formation of maintenance personnel

Engineers, who belong to the provincial government, should be trained on PV at the training center in Honiara. People from the communities to be in charge of maintenance of photovoltaic systems, should be trained by the provincial engineer. Details are presented in Section 7.13, Chapter 7.

2.7 Establishment of PV training center

Since at present there is no training center for PV in the Solomon Islands, such training center should be established in the Solomon Islands College Higher Education (SICHE) or Rural Training Center (RTC). It is recommended that provincial engineers and young apprentices, who come from rural areas to Honiara or to provincial capitals, should be trained and assigned as personnel in charge of photovoltaic maintenance.

2.8 Operational Improvement of SIEA

In order to improve the operational management of SIEA, the following objectives should be achieved.

(1) Improvement of collection rate of electricity tariff

- Promotion of ongoing "Cash Power 2000" installation

- Expansion of compulsory electricity disconnection to default users (especially to statutory organizations)

(2) Efficiency of generation and distribution of electricity

- Introduction of remote supervisory system for outstations' operation
- Improvement of maintenance work for generation and distribution facilities

(3) Strengthening of management capability

- Contract out of management; the Ministry of Finance is currently planning for tender
- Formulation of Corporate plan

(4) Increase of electricity tariff

- Increase of electricity charge to the reasonable level to produce operational profit

2.9 Electrification Measure for Low Income Communities

Technical and management organization, as well as the process of collection of charges from the village/communities selected to participate in the pilot scheme can be monitored.

On the other hand, it is recommended that the village or comunities that were not selected in these schemes, should be the object of some social development measure based on PV, to be taken by the Solomon Government.

CHAPTER 1

INTRODUCTION

Chapter 1 Introduction

1.1 Background

The Solomon Islands, located in the South Pacific at the northeast of Australia, has six main islands and about 100 small islands. The capital is Honiara, in Guadalcanal Island, which has a population of about 50 thousand people. The power supply for the public demand in the Solomon Islands is achieved, in Honiara, by two diesel power plants that use 33 kV, 11 kV and 415V/240V systems, and in the rest, almost by diesel power plants but hydropower is used in some places. Fuel costs from the diesel power plants have deteriorated the financial situation of Solomon Island Electricity Authority (SIEA). The Government of the Solomon Islands is seeking to increase the power supply around the municipal area by using diesel power, in the short-term, but on a middle and long-term basis, the Government is planning to promote development and rural electrification using renewable energy. There is a potential of renewable energy in the Solomon Islands, and in fact, some consultants from foreign aid organizations had reported their surveys and proposed projects, but none of these had become a reality due to the lack of technology and human resources needed to manage whole long-term programs.

Under these circumstances, the Government of the Solomon Islands requested the Government of Japan in November 1997 to conduct a study for a long-term Power Development Master Plan. In response to this request, the Government of Japan sent a Special Assistance Study Team for the Project Formation from February 12 to February 28, 1998, and then dispatched a Preliminary Study Team from August 30 to September 11, 1998. After these studies were completed, results were analyzed and the scope of work to form the Master Plan was defined. The JICA Master Plan Study Team (JICA M/P Team), formed by joint collaboration between TEPSCO and IC Net Limited, was commissioned to carry out this study, which started in December 18, 1998, and is to be completed at the end of January, 2001.

1.2 Master Plan Objectives and Geographical Scope

1.2.1 Objectives

The objectives of the Master Plan are:

- to formulate a long-term power supply implementation plan, to be completed by 2015, based on the utilization of renewable energy, and
- to provide recommendations on institutional organization to the electric power sector in the Solomon Islands.

1.2.2 Geographical scope

The Master Plan (M/P) covers the national territory of Solomon Islands. However, as it will be difficult to survey all islands of the country due to time constraints and limited human resources, the Master Plan is to be carried out based on the next methodology:

(1) Small hydro power development, geological investigation and transmission and distribution facilities

Potential sites on islands that could not be field surveyed, will be studied based on analysis of maps and will be considered in the report after consultation with the Energy Division of the Ministry of Natural Resources (MNR) and SIEA, Solomon Islands counterpart bodies.

(2) Solar energy generation development

Potential villages on islands that could not be field surveyed, will be approached and considered in the report after consultation with the Energy Division of the Ministry of Natural Resources (MNR) and SIEA, Solomon Islands counterpart bodies.

(3) Rural society study

After the social survey covers six proposed islands, with a total population equivalent to the 87 percent of the national population, it is expected that the survey will lead to a good comprehension of social aspects that approach a scenario representative of the Solomon Islands.

1.2.3 Target year

Generally, hydropower plants have an operation life of about 50 years, transmission and distribution line facilities about 30 years and solar energy systems about 20 years. However, the target year of the M/P Study has been settled to around 2015, based on the Scope of Work and the Meeting Minutes jointly agreed on the 10th September 1998 by the JICA Preliminary Study Team, MEMM (MNR) and SIEA.

1.2.4 M/P Study Contents

The M/P Study is to be achieved based on the Scope of Work and the Meeting Minutes jointly agreed in 10th September 1998 by the JICA Preliminary Study Team and MEMM and SIEA. The main study items are listed below:

(1) Analysis of power supply methods for each region

(2) Establishment of basic data collection system, to include rainfall, hydrologic, sunshine duration and solar irradiation data

(3) Field investigation

(4) Investigation of the power sector present situation and power demand forecast

(5) Rural society study and environmental study

(6) Economic and financial study

(7) Formulation of an optimum power supply plan

(8) Measures for an early realization of the implementation plan

(9) Recommendations on future organization of the electric power sector

1.3 Structure of the Interim Report

This report consists of 12 chapters. The background, study objectives, geographical scope, outline of the work in Japan and field work in the Solomon Islands are included in Chapter 1 and Chapter 2.

The main contents of this study are included in Chapters 3 to 12, as detailed below:

Chapter 3: Society, economics and present power situation in the Solomon Islands,

Chapter 4: Power demand forecast in demand centers,

Chapter 5: Study, development, layout, design and project cost carried out on 10 small hydropower potential sites (selected among six provinces, six islands),

Chapter 6: Transmission and distribution line facilities between the small hydropower potential sites, described in Chapter 5, to demand centers, based upon the optimum power supply plan described in Chapter 10, including costs,

Chapter 7: Solar Home System (SHS) standard systems specification, construction costs and monthly payments for public and domestic use in Solomon Islands communities not expected to be supplied with power from the existing distribution system or by power systems yet to be developed, within about 10 years, based upon 12 villages surveyed by the team,

Chapter 8: Present situation and issues on rural development by small hydropower (described in Chapter 5), transmission and distribution lines (Chapter 6) and solar energy generation systems (Chapter 7),

Chapter 9: Present regulations, public organization and expected environmental impact in connection with the adoption of small hydropower and solar energy generation, and measures which need to be considered,

Chapter 10: Power supply policy and power supply plans, including the proposal of the optimum power supply plan for the demand centers, currently assisted by SIEA, and based on demand forecasts,

Chapter 11: Present situation, policy and regulations of the power sector structure in Solomon Islands, together with issues on the SIEA privatization that have been discussed recently, and guidelines for the SHS dissemination,

Chapter 12: SIEA financial situation and electricity tariffs; economic and financial analysis of the optimum power supply plans based on the development of small-hydro power and solar energy systems, as well as financing and repayment plans,

Chapter 13: The optimum power supply and rural electrification plans, as well as the financing and repayment plans are recommended. The future structure and organization of the power sector, necessary for the implementation of rural electrification, are also recommended.

CHAPTER 2

OUTLINE OF THE M/P STUDY

Chapter 2 Outline of the M/P Study

2.1 Preparation Work in Japan

Relevant documents and existing reports were collected and studied as preparative activities in Japan. The following activities were studied carried out in this stage:

- Understanding of the present socio-economic situation
- Documents survey to analyze the power demand, supply structure and present situation
- Preparation of rural society investigations
- Preliminary map study for possible small hydropower potential sites
- Preparation of a questionnaire for MEMM, SIEA, NGO (APACE and GREA)
- Preparation and dispatch of the inception report
- Data collection regarding to solar energy and small hydropower generation

2.2 First Field Survey

The following activities were included in the first field survey:

- Explanation and discussion of the inception report, and signing of meeting minutes
- Data collection, review and analysis (including related documentation, rainfall, hydrology and weather data, codes and standards, laws and regulations, topographical and geological maps, generation, transmission and distribution data available from SIEA facilities, electric power usage, existing power development plans, etc.)
- Survey of the existing power supply in each region and village
  - Confirmation and evaluation of existing power supply facilities
  - Regional development plans (including those made by NGOs)
  - Specifications of demand centers served by the grid power and preliminary power demand forecast
  - Map study for the evaluation of hydropower potential sites
  - Evaluation and investigation of sites for electrification by SHS
- Confirmation of the present situation of basic data collection (rainfall, hydrology, weather, etc.)
- Survey of development assistance organizations and NGOs
- Preliminary field investigation of the main prospective sites for the second field survey
- Preliminary rural society and environment survey for development of power resources
- Confirmation of the present situation of the power sector, from both the economic and financial aspects
- Recommendations for the future improvement of the electric power sector, based on evaluation of the current situation of organizations and institutions
- Investigation of policies and projects concerning the power supply to national public facilities, such as schools, clinics and fisheries

- Purchase of computers and relevant equipment to support next stages survey activities

2.3 First Domestic Activities

The collected data, information and results from the first field survey were reviewed and analyzed. The main activities carried out in these first domestic activities are as follows:

- Study and analysis of collected data and identification of current problems
- Selection of power supply areas, according to grid power, independently isolated and individually installed type of power sources
- Selection of a total of 20 prospective sites, 10 for small hydropower and 10 for solar energy generation, chosen from the possible sites proposed in the first field survey, to be surveyed in detail in the second field
- Preparation for the acquisition in Japan of meteorological and water flow measurement
- Preparation of the progress report

2.4 Second Domestic Activities

The following measurement equipment and material was purchased and sent to Solomon Islands:

Staff gauge	30
Water flow meter	3
Water level recorder	1
Automatic rain gauge	1
Evaporation pan	1
Pyranometer	1
Sunshine duration meter	1

2.5 Second Field Survey

During the second field survey in the Solomon Islands, the following activities were carried out:

- Explanation and discussion of the progress report, and signing of meeting minutes
- Completion of the first seminar on technology transfer
- Detailed survey of areas served by the grid power
  - Present situation and evaluation of the existing power facility
  - Survey of distribution expansion plans
  - Power demand forecast
  - Field evaluation of small hydropower potential sites
  - Rural society survey of the areas surrounding the hydropower potential sites
  - Geological investigation
- Detailed survey of the sites supplied by independently isolated and individually installed

type of power sources

- Rural society survey
- Present operational situation of the existing power sources, and confirmation and evaluation of their maintenance and management organization
- Field survey of the potential hydropower sites
- Geological survey
- Survey of technical and economical factors for the implementation of SHS
- Survey of the methods and organizational issues for the dissemination of SHS
- Creation of a system for basic data collection (rainfall, hydrology, weather, etc.)

2.6 Third Domestic Activities

The collected data, information and results from the second filed survey were reviewed and analyzed. The main activities carried out in these third domestic activities are as follows:

- Study and analysis of collected data and information obtained from the second field survey
- Conceptual design of small hydropower plants
- Study and analysis of the SHS conceptual design and installation methods
- Evaluation of social impacts
- Study and analysis of the power sector organization and measures to be taken for the promotion of rural electrification
- Preparation and dispatch of the interim report

2.7 Third Field Survey

During the third field survey in the Solomon Islands, the following activities were carried out:

- Explanation and discussion of the interim report, and signing of meeting minutes
- Completion of the second seminar on technology transfer
- Basic data collection (rainfall, hydrology, weather, etc.)
    - Collection of basic data obtained from rainfall and sunshine measurement equipment
- Collection of data and information on construction materials and estimation of costs
    - Data for small hydro power design
    - Data and information for cost estimation of small hydro power construction
    - Data for transmission and distribution facilities design
    - Data and information for cost estimation of transmission and distribution facilities construction
    - Data for solar power generation (SHS) design
    - Data and information for cost estimation of solar power generation construction

2.8 Fourth Domestic Activities

The collected data, information and results from the third field survey were reviewed and analyzed. The main activities carried out in these fourth domestic activities are as follows:

- Study and analysis of collected data and information obtained from the third field survey
- Preparation of the optimum power supply plan for areas served by the grid power
- Preparation of an electrification plan for areas served by individually installed power sources such as SHS
- Preparation of an electrification plan for areas served by independently isolated power sources such as small hydro power
- Preliminary design and cost estimation of small hydro power systems
- Preliminary design and cost estimation of SHS
- Analysis of the situation of organizations and institutions of the power sector and recommendations
- Economic and financial analysis of optimum power supply plans, together with rural electrification plans based on dissemination of SHS
- Preparation of implementation and financing plans
- Preparation and issue of the draft final report

2.9 Fourth Field Survey

- The fourth field survey was cancelled due to the ethnic tension.
- JICA M/P study team sent the draft final report to Ministry of Natural Resources and Solomon Islands Electricity Authority that are counterparts in Solomon Islands in order to reflect their comment to the final report.

2.10 Final Report

The comment, which was no comment, was provided to the M/P study team from MNR and SIEA. Therefore the M/P study team reviewed and checked the report again for finalizing.

2.11 Members of the Master Plan Study Team

The institution and related person in Solomon Islands are shown below:

- MNR (Ministry of Natural Resources)
  Mr. John Gorosi, Director of Energy Division
  Mr. Moses K Biliki, Director of Environment and Conservation Division
- SIEA (Solomon Islands Electricity Authority)
  Mr. Bobby Kwanairara, General Manager
  Mr. Michael Nation, Deputy General Manager
- Ministry of National Planning
  Mr. Donald Kudu, Permanent Secretary

Mr. Shadrach Fanega, Under Secretary

- Ministry of Finance
- Department of Commerce, Employment and Tourism

  Mr. Stephen Oru, Project Officer
- Ministry of provincial government and rural development

  Mr. Japhet Waipora, Minister

  Mr. Anthony Seketa, Secretary
- Province

  Malaita Province Mr. David Oeta, Premier

  Isabel Province Mr. Jacob B. Pitu, Premier

  Western Province Mr. Noah Zala, Deputy Premier

  Mr. Nacily Pule, Provincial Secretary

  Makira Province Mr. John S. Saunana, Provincial Secretary

  Choiseul Province Mr. Andrew Malasa, Provincial Secretary

  Temotu Province Mr. Gabriel Teao, Premier

  Central province Mr. Mark Kemakeza, Premier

  Rennell and Bellona Province Mr. Stanley Kataha, Deputy Provincial Secretary
- APECE
- GREA (Guadacanal Rural Electrification Agency)

  Mr. S. Tovosia, Chairman

  Mr. Bradly, Project Officer
- Embassy of Japan

  M. Hideo Nomoto, Ambassador

  Mr. Yutaka Hirata, Ambassador

  Mr. Yousuke Miyamoto, Second Secretary and Vice Consul
- JICA/JOCV, Solomon Office

  Mr. Shinichi Hamada, Resident Representative

The Study Team consists of the following members:

1) M/P Study Team

Takahisa MURATA	Team Leader/Power supply planning
Tetsuo TEJIMA	Small hydropower development
Katsuhiro MUKAI	Solar energy generation planning
Yuuji TAKEUCHI	Geological investigation
Seiichiro HIRANO	Transmission and distribution facilities/Power system planning
Masahiko SUGINAGA	Rural society study
Tsuyoshi SASAKA	Environmental study
Naoya AZEGAMI	Institutional building for rural electrification

Takashi KAMO	Economic and financial analysis
Shinichi MOGI	Administrative assistance
Toshiyuki Kobayashi	Administrative assistance

2) Japan International Cooperation Agency (JICA)

Hirofumi HASEGAWA	Administration
Hiroyuki KOBAYASHI	
Yoshiki EHARA	

CHAPTER 3

GENERAL SITUATIONS OF SOLOMON ISLANDS

Chapter 3 General Situation of Solomon Islands

3.1 General Information

The Solomon Islands, which became an independent member of the British Commonwealth on 7 July 1978, is one of the islands country located in South Pacific Ocean. The capital city is Honiara. The total land area is 28,370 km^2 and the islands are located between 5 ° and 12 ° south latitude and 155 ° and 170 ° east longitude. The country consists of six major islands including Guadalcanal, Malaita, Santa Isabel, New Georgia, Choiseul and San Cristobal, and about 100 small islands and stretch in the form of double chains in the northeastern direction from the Bougainvillea Island of Papua New Guinea (see Table 3-1-1). With a number of steep mountain zones, most of the major islands are covered by the tropical rain forest. Although the country is located in a tropical zone, the normally severe tropical climate is eased by the trade wind blowing in southeastern direction from April to November and the trade wind blowing in northwestern direction from November to April. Consequently, the annual maximum and minimum mean temperature are 32.9 ^oC and 21.2 ^oC respectively. The humidity is from 60% to 90%, the highest humidity season is from November to April, which is the rainy season.

Table 3-1-1 Administrative Districts of Solomon Islands (1999)

	Province	Main Land	Capital	Large City	Area (km^2)	Population
1	Western	New Georgia, Gizo Vella Lavella, Kolombangara	Gizo	Noro, Munda	5,475	77,573
2	Choiseul	Choiseul	Taro		3,837	25,858
3	Isabel	Santa Isabel	Buala		4,136	24,474
4	Central	Tulagi (Florida Islands)	Tulagi		615	29,165
5	Rennell & Bellona	Rennell, Bellona	Tingoa		671	3,241
6	Guadalcanal	Guadalcanal			5,336	65,847
7	Honiara	--	--	--	22	49,817
8	Malaita	Malaita	Auki	Malu'u	4,225	112,505
9	Makira	San Cristobal	Kirakira		3,188	31,322
10	Temotu	Nendo(Santa Cruz Islands)	Lata		865	22,603
	Total				28,370	442,404

* Guadalcanal is not including Honiara.
* Population is estimated.
Source: Based on SOLOMON ISLANDS 1993 STATISTICAL YEARBOOK

3.1.1 Population and race structure

There is not any accurate population data after the census taken in 1970, 1976 and 1986. Recently, there has been completed the latest census in fiscal 1999[1], however it seems to take several time to be published the result of census[2]. According to the SOLOMON ISLANDS 1993 STATISTICAL YEAR BOOK, which was published by the Statistics Division in MOF,

1 Fiscal year in Solomon Islands is from January to December
2 According to statistics division, the result of census will be published after 2 to 3 years.

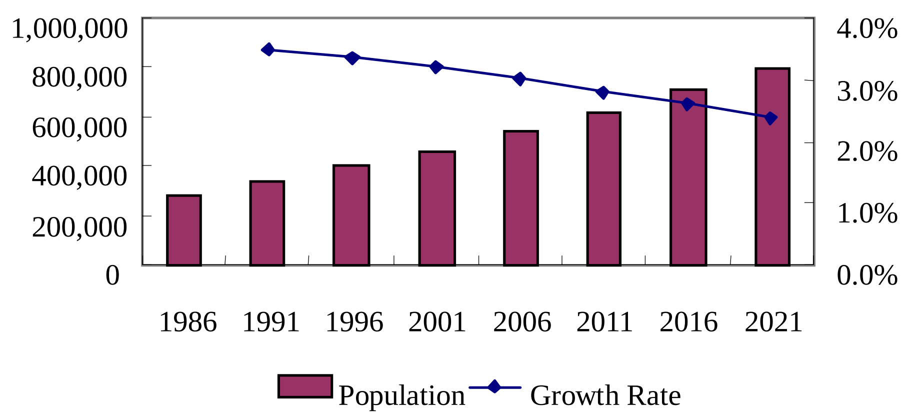
the total population in 1999 is estimated to be approximately 440,000, being 110,000 concentrated in Guadalcanal Island. In recent years, with rapid development of the currency economy, many people have migrated from rural villages to Guadalcanal Island, especially to Honiara, and consequently the population in Honiara City has reached around 50,000. The concentration of the population in the city area is a remarkable trend. According to this data, the growth rate of population from 1981 to date is about 3.5% to 3.8% in the whole country, and 4.5% to 6.3% in Honiara City. The estimated trend of population in each province is shown as follows.

Table 3-1-2 Trend of Population in each Province of Solomon Islands

	1993	1994	1995	1996	1997	1998	1999
Western	60,398	62,984	65,679	68,491	71,395	74,422	77,573
Choiseul	20,133	20,995	21,893	22,830	23,798	24,807	25,858
Isabel	19,442	20,197	20,980	21,795	22,653	23,546	24,474
Central	23,285	24,179	25,107	26,071	27,064	28,095	29,165
Rennell & Bellona	2,587	2,687	2,790	2,897	3,007	3,122	3,241
Guadalcanal	53,220	55,104	57,054	59,064	61,243	63,503	65,847
Honiara	37,896	39,722	41,637	43,643	45,610	47,667	49,817
Malaita	94,277	97,011	99,824	102,719	105,882	109,143	112,505
Makira	25,198	26,037	26,904	28,064	29,110	30,196	31,322
Temotu	18,558	19,175	19,813	20,472	21,159	21,869	22,603
Total	354,994	368,089	381,681	396,046	410,921	426,370	442,404

* Guadalcanal is not including Honiara.
Source: SOLOMON ISLANDS 1993 STASTICAL YEARBOOK

The growth rate of population in the long future until 2021 is estimated in the Medium Term Development Strategy 1999-2001 (hereinafter MTDS) issued in November 1998 by the government. According to this source, total population of the country will reach to 700,000 in 2016. The growth rate will decline gradually, and reach to around 2.6% in 2016. Regarding the race structure, population in the country consists of around 94% of Melanesian, 4% of Polynesian, 1% of Micronesian, and 1% of others including European and Chinese.



Source: Medium Term Development Strategy 1999-2001

Fig.3-1-1 Estimation of Population of Growth

3.1.2 Language and religion

About more than 80 different vernacular forms of speech are used, and almost every tribe has its own language. The most effective lingua franca is Pidgin English, which is the mixture of English and each vernacular. The official language is English. More than 98% of the inhabitants are Christian now.

3.1.3 Government and Administration

The Solomon Islands is a constitutional monarchy with the British Queen as Head of State. And the Governor-General (Solomon Islands' person) appointed by the Queen on the recommendation of the legislature every five years, will represent the British Queen. The present Governor-General is Fr. John Lapri, the former provincial governor of the Temotu Province, appointed in July 7, 1999. There is a single-chamber National Parliament composed of 50 elected members. The normal life of parliament is four years. Suffrage is given to all the residents more than 18 years old. The actual administrative power is on the hand of the Cabinet.

The government has been handled by the united Cabinet of SIAC headed by the former Prime Minister Ulfaal elected in August 1997. However in the 30th June 2000, due to the coup d'etat by the ethnic armed force, Mr. Ulfaal was forced to resign and Mr. Sogavare, the opposition leader was selected as the new Prime Minister. The political parties in the old government were as follows.

Government Party	Opposite Party
Salomon Islands Alliance for Change (SIAC)	Coalition for National Advancement
Solomon Islands Liberal Party	
Solomon Islands Labor Party	
United party	
National Party	
People's Alliance Party (PAP)	
Independent	

The former government has executed the restructuring of the government organizations from 15 to 10 ministries in order to reduce expenditures. The former ministries were as follows.

Office of the Prime Minister
Ministry of Justice, Legal Affairs and Police Security
Ministry of Commerce, Industries, Employment and Tourism
Ministry of Transport, Works, Communications and Aviation
Ministry of Natural Resources (MNR)
Ministry of Home Affairs, Provincial Government and Rural Development
Ministry of Education and Human Resources Development
Ministry of Health and Medical Services
Ministry of Finance and Development Planning
Ministry of Land, Agriculture and Fisheries

Local Government

The Solomon Islands are separated into nine provinces and one capital, and each province has its provincial government (see Table 3-1-1). Each provincial government executes necessary duties in each local district such as housing, health, education and promotion of the local enterprises. The provincial governments have special rights such as issue of permits for the production and sale of liquor and collection of corporation, commercial and sales taxes.

Ethnic Frictions

Activities of armed ethnic groups have occurred since 1998. This situation was caused by conflicts in land disputes and cases of injury compensation arising between Guadalcanal natives and Malaitan people since independence. An armed force called GRA was organized by a militant group of people in Guadalcanal, and since their formation many violent attacks, some including armed force, have occurred all over the country. A state of "National Emergency" was declared in June 1999 and Sitiveni Rabuka, the former Prime Minister of Fiji was sent as Special Commonwealth Envoy, and the "Honiara Peace Accord" was concluded. After this, the armed activities ceased, apparently, but confrontations started again in May 2000 and finally caused a coup d'etat. Mr. Ulfaal, the Prime Minister, was confined by an armed group and was forced to resign. The opposition leader, Mr. Mannesseh Sogavare, was selected as the new Prime Minister. The social agitation has not settled at present. The Malaitan people escaped from Guadalcanal islands, foreigners escaped to overseas and operation of the government and private companies were suspended. This situation caused serious social and economic impact on the whole country.

3.2 General Economic Situations

3.2.1 General

The characteristics of the economy of the Solomon Islands are 1) mixture of traditional self-supply economy and currency economy, 2) high proportion of primary industry, 3) high dependency on import products etc.

Although the currency economy has prevailed into the deep rural area, most of the rural people are still operating self-supply non-monetary agriculture and fishery. Primary products such as fish, log timber, copra, palm oil etc., constitute an important source of foreign currency. However, because the primary products are easily affected by weather conditions and international markets, the economy of the country is still on very weak foundations. Along with rapid westernizing of the life style, the country has come to depend heavily upon import products such as transportation vehicles, equipment and materials for industry, clothes, daily goods and foods, excluding some local agricultural products. Although around 30 years have passed since independence in 1978, infrastructure such as power utilities and roads have not been constructed sufficiently and almost all budget for such infrastructure development has been heavily dependent on loans and grant aids from foreign countries.

Since 1997, the government has aimed to restructure the economy. The Medium Term Development Strategy (MTDS) was prepared and the reform of the administration and economic structure was implemented. By the end of 1999, almost all accumulated arrears had been cleared. However, the recent ethnic tensions and change of government are having serious impacts on the national economy, and it is thought that further restructuring of the economic situation will become more difficult after 2000.

3.2.2 Gross Domestic Product (GDP)

According to the Annual Report 1999, issued by the Central Bank of Solomon Islands (CBSI), the growth rates of the real GDP were -0.9%, 1.3% and -0.5% in 1997, 1998 and 1999, respectively, and compared with the first years in the 90's, the growth rate has sharply dropped. The main reasons of these minus growth rates were the sharp fall in the international price of the log timber and the decline of the total value of exports. In 1999, the timber market was recovering and the export of gold also contributed to the total value of exports, however, due to impacts caused by ethnic tensions, the growth rate in 1999 declined to minus figures. The nominal GDP per capita is estimated to be around US$700 in 1997.

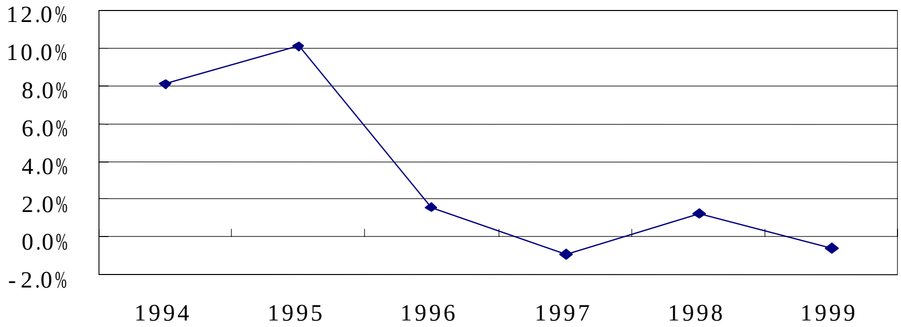


Fig.3-2-2 Real GDP growth

Estimation of the GDP future growth rate is difficult. MTDS predicted that around 4.0% growth would be achieved from 1999 to 2001, however, according to 1999 results, it has already fallen sharply. Although there were expectations of structural reform by the government, the ethnic tensions and the government change caused serious impact to the economy, and it is thought that the effects on the economic growth will become worse.

Table 3-2-2 GDP data

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Nominal GDP (SB$,mil)	598.3	763.1	901.2	1,052.5	1,249.9	1,461.5	1,612.1	1,728.1	1,738.7
Nomical GDP per Capita (US$)	666.6	763.8	798.7	873.9	968.1	1,050.0	1,065.1	853.7	790.5
Real GDP (at 1985 price, SB$)	248.5	276.7	281.4	304.1	334.8	340.1	337.0	341.3	339.4
Index of Real GDP (1985=100)	119.9	133.5	135.8	146.7	161.5	164.1	162.6	164.7	163.8
annual growth %	0.6%	11.4%	1.7%	8.1%	10.1%	1.6%	-0.9%	1.3%	-0.5%

Source: non-official data from Central Bank of Solomon Islands, May 2000

3.2.3 Industry

The main agricultural products are copra (dried coconut fruit), cocoa, palm oil and palm kernel, etc. The main export destinations are Europe and Japan. In the fishery industry, the main products are canned bonito and tuna, chilled foods and dried bonito for shaving which are exported by major companies such as Solomon Taiyo.

The log timber was a major industry of the country until 1996. Because of the sharp fall of the international log market, which was caused by the Asian currency crisis and decrease of demand for South Pacific timber in 1997, the volume of log export has decreased substantially. The export volume of timber was 830,000 m^3 at its peak in 1996, but decreased to 600,000 m^3 in 1998. In 1999, thanks to the recovery of the log market, the export volume slightly recovered to around 620,000 m^3.

Copra is mainly produced by RIPEL (Russel Islands Plantation Enterprises) and other small rural farmers. The production amount in 1999 was 23,000t, dropped from 28,000t in 1998. The main reason of this decrease was the close of the Tenal branch in Guadalcanal. The production of the coconut oil increased to 10,000t in 1999 from 5,300t in 1997. It reflected a national policy in which the copra will be gradually shifted to coconut oil as an export item. The Commodity Export Marketing Authority (CEMA) controls the production of coconut oil from copra in the whole country. CEMA is an important electric power consumer.

Almost all palm oil and kernel were produced by Solomon Islands Plantation Limited (SIPL), but this producer closed in June 1999 due to ethnic tensions, and all production since then has stopped.

In the mineral and mining industry, the gold mining in the Gold Ridge area, which is close to Honiara City, has been spotlighted in recent years. Ross Mining NL, an Australian company, obtained the mining right of the gold ore. It established Goldridge Mining Limited in August 1998 (100% owned by Ross Mining), and started operation. The reserve of gold in the ore is estimated to be 1,350,000 ounces (380,000 ton), and the company expects to produce 100,000 ounces (2,800kg) of gold per year in the future 10 years. In the first year of operation, the production of gold by the company was 126,000 ounces, and it plans to increase production. The current export price of gold is US$290 per ounce. According to the Annual Report 1999 by the company, the production cost is around US$170, this allowed a substantial profit. The power source of its operation is diesel power, which has a capacity of 11,000 kW (11 MW) and is owned by the company. Currently the operation is suspended due to ethnic tensions.

3.2.4 Employment and Wage

According to the statistics data, the number of official employee were 35,000 in 1998, which was esteemed around 10% to 20% share in all workable labors (15 to 59 years old). Other people were still engaging in traditional self-supplied economy. Although the number of graduated young generation people seeking to find jobs are increasing substantially, there are not enough employment opportunities that could absorb this demand. The unemployment is now a serious social problem in the whole country.

Table 3-2-4 Number of employees in each section

	1994	1995	1996	1997	1998
Agriculture	4,343	4,157	4,093	3,809	3,356
Forestry	4,040	3,964	3,313	2,709	2,658
Fishery	2,623	2,844	2,937	2,579	1,412
Mining	28	32	38	62	1,412
Manufacturing	1,284	1,471	1,612	1,665	4,348
Power, Water	531	631	703	650	387
Construction	1,221	1,474	1,925	1,638	1,187
Retail, Wholesale	3,890	3,921	4,066	3,844	4,641
Transportation	1,335	1,427	1,972	1,777	1,878
Financing	1,124	1,291	1,422	1,602	1,183
Government	6,909	6,244	6,198	1,016	4,261
Others	3,861	4,080	8,567	5,057	8,750
Total	31,189	31,536	36,846	26,408	35,473

Source: Annual Report 1999, Central Bank of Solomon Islands

The first salary for the new employee who has just graduated in the Solomon Islands College of Higher Education, the highest educational institution in the country, is estimated around SB$700 per month. The average salary for a government officer is estimated in the range of SB$700 to SB$2,000.

3.2.5 Tax System

The tax system in the Solomon Islands is shown below. The good tax and service tax are generally charged in the local market, and import duty and export tax are charged at the customs office. The government is planning to reduce the tax rate drastically for stimulating the development of the domestic industry and inviting more foreign investment.

Goods tax

Import goods: 15%, domestic product: 10%, rice: 5%

Medical goods, government related facilities, goods for charity or disabled people: no tax

Exported goods, property, intangible assets, second-hand goods: no tax

Sales tax

Telecommunications (local or international), service in restaurants, boarding ticket on the ship (local), rent fee for vehicle, airplane, ship, sales of property, beauty parlor, cleaning shop accounting, legal and other special services	10% for all above
Air ticket, boarding ticket for ship (international)	SB$10/ticket
Entrance fee for movie theater	SB$0.5/ticket
Rent fee for video cassette	SB$2.0/piece
Sales of petroleum goods	SB$0.1/liter

Taxation for individuals

PAYE (pay as you earn): the system of progressive taxation

It is charged on the total amount of taxable income separated as follows.

Expense for medicine, education, insurance, pension and loan interest for individual housing are exempted from the taxable income.

Under SB$5,200	tax exempted (to be raised to SB$7,800)
Under SB$15,000	11%
Under SB$15,000 – SB$30,000	12%
Under SB$30,000 – SB$60,000	35%
Over SB$60,000	47% (to be reduced to 40%)

Taxation for corporations

Resident corporation	for domestic income	35% (to be reduced to 30%)
Non-resident corporation	for income from outside	50% (to be reduced to 35%)

Import duty

Clothes, foods and daily goods	40% (to be reduced to 20%)
Mechanical equipment, generator, PV panel, battery, Processed foods, stationary etc.	20%
Construction material, cement and irons	10%
Chemical goods, rice	5%
Automobile	10%+SB$5,000-SB$10,000

Petroleum goods:	kerosene	SB$0.10/liter
	Gasoline	SB$0.13/liter
	Diesel oil	SB$0.22/liter
	Lubricant oil	40%

Export tax

Timber Logs	25%
Sawn timber	5%
Copra, Palm oil	7% (to be abolished in 2000)
Cocoa	4.5% (ditto)
Coconuts oil	no tax
Frozen fish	10% (no tax for canned fish)
Gold ore	15% (2.5% for Goldridge)

In general, tax will be exempted for the construction of infrastructure and development projects by the government.

3.2.6 Trading

Log timber, fish, coconut products and gold are the main export items. Log exports were in boom from 1993 to 1996, and reached between a 50% to 60% share of total exports. The international log market fell down sharply due to the Asian currency crisis, but recovered in 1999 and the share also recovered to around 30% of total exports. Gold mining operations have performed well since 1998 and had a 25 % share of total exports in 1999. Palm oil and kernel production stopped in June 1999 due to ethnic tensions. On the other hand, two thirds of the total imports have been shared by machinery, manufacturing and transportation facilities, and food carries a 15% share of imports.

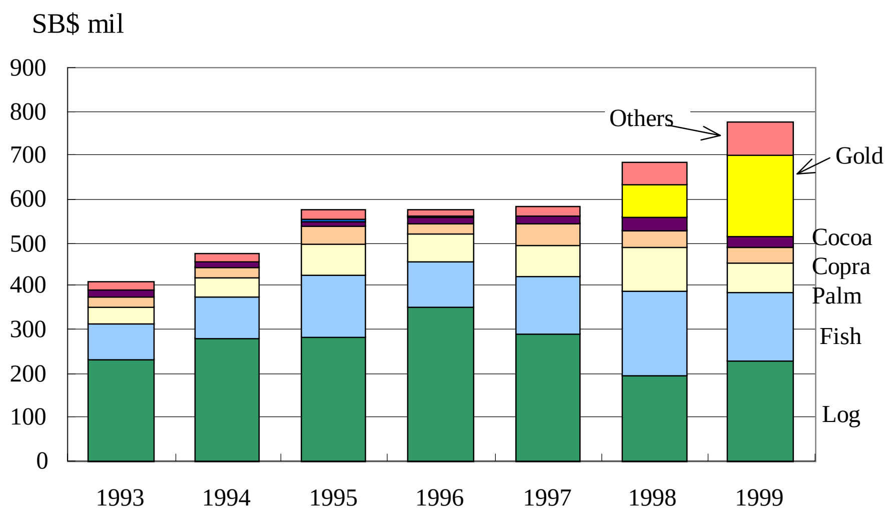


Fig. 3-2-6 Value of Export

Balance of trade has been in deficit since 1990 because of the high dependency on imports. In 1997 and 1998 the balance declined to a substantial deficit due to the sharp fall of the log market. A surplus is recovered in 1999 because of the decrease of imports (SB$770mil in 1998 to SB$409mil in 1999) originated by ethnic tensions.

The biggest export destination is Japan, which has a 40% share of the total exports, and the biggest import source is Australia, which has a 40% to 45% share of the import amount.

3.2.7 Exchange rate

The Solomon government has devalued the currency rate every year to maintain the competitive power of export and the amount of external reserve. However, this caused a currency inflation trend and became a main factor of the high inflation rate. In December 1997, the government made a 20% devaluation of the currency, however, the effect was offset by the poor performance of exports and the exchange rate has devalued again to SB$5.06/US$ in December 1999.

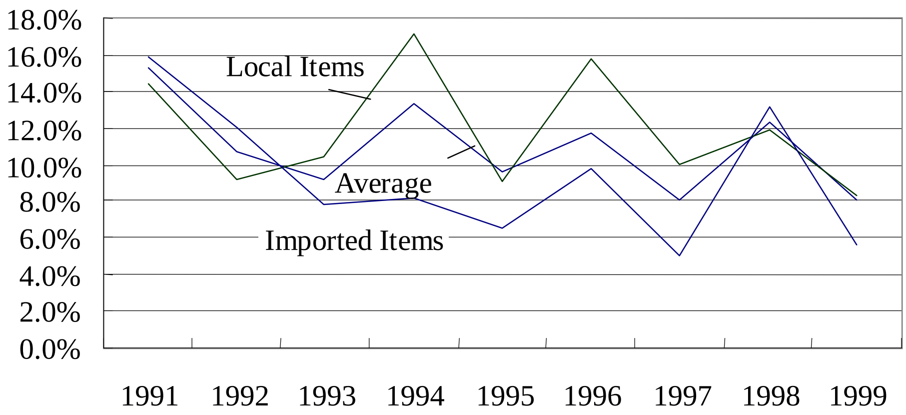
Table 3-2-7 Exchange Rate (annual average)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
SB$/US$	2.72	2.93	3.18	3.29	3.41	3.55	3.73	4.82	5.06
%		7.7%	8.5%	3.5%	3.6%	4.1%	5.1%	29.2%	5.0%

Source: Annual Report 1999, Central Bank of Solomon Islands

3.2.8 Inflation rate

During 1991 to 1998, the average annual inflation rate stayed at a high level of 10.3%. Exacerbated by the drastic devaluation of currency at the end of 1997, the price of import goods rose sharply. At the end of 1999, the inflation began slowing down to around 7.8% because of the gradual decrease in the price of import goods.



Source: Annual Report 1999, Central Bank of Solomon Islands

Fig. 3-2-8 Inflation Trend

3.2.9 Financial Sector and interest rate

There are several financial institutions in the country such as Central Bank of Solomon Islands (CBSI), three commercial banks (Westpac Bank, ANZ Bank, National Bank of Solomon Islands - NBSI), Development Bank of Solomon Islands (DBSI), and more than 100 different Credit Unions. Moreover, there are the National Pension Fund (NPF), Housing Financing Company (HFC), Investment Companies of Solomon Islands (ICSI)[3] and several insurance companies.

The Central Bank of Solomon Islands (CBSI) is the currency authority, which issues bank

[3] Investment Company of Solomon Islands (ICSI) : a state owned investment company, which owns the shares of Solomon Telecom and SIPL on behalf of government.

notes and controls the monetary market, interest rate and external reserve. The control of money supply is the main role of the CBSI. Money supply (M3) consists of the currency in circulation + demand deposit + saving deposit + time deposit, and reached SB$457mil at the end of 1999.

The control of the "Liquidity" (or liquid assets) of commercial banks is also an important role of the CBSI. Liquidity consists of till cash, deposits in CBSI (Call deposits), treasury bills and CBSI securities (Bocolo bill), and the "Free Liquidity" which consists of till cash and deposits in CBSI is required to exceed the Liquidity Asset Ratio (LAR) (currently 7.5%) decided by the government[4]. The exceeded amount of the Liquidity over LAR represents a free capital for investment to the private sector.

The government is keeping a tight monetary policy in order to control the inflation. The banks have been very cautious in new financing after the suspension of new issues of treasury bills in August 1995. The government tightened the interest rate and raised the call rate of the CBSI in April 1998 and also tightened recurrent expenditures. The average lending and deposit rates in September 1998 were 14-15% and 3.0-4.0% respectively, and the interest margin was around 10%.

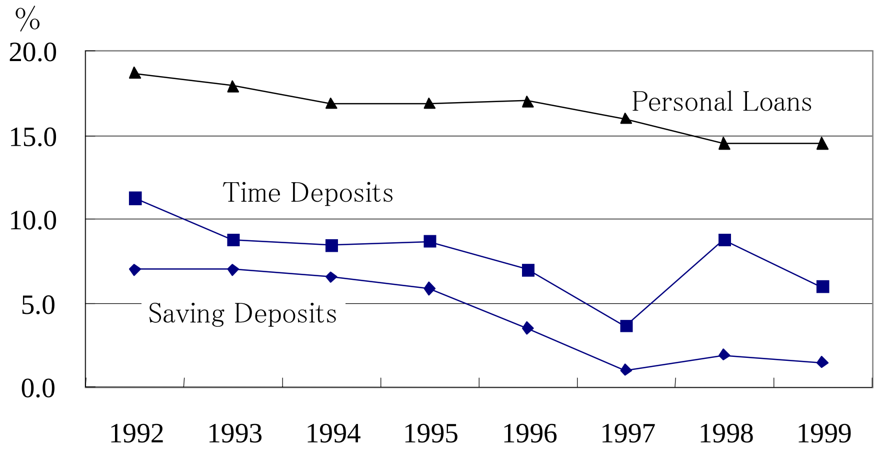


Fig. 3-2-9 Interest rate

3.2.10 Financial Situation of the Government

The characteristic of the financial situation of the Solomon government is a long term deficit and chronic debt accumulation based on the weak industrial background. Almost all tax revenue is spent for recurrent expenditures including the salary of government officers, and a main portion of the development expenditure depends on external debt and grant aid from foreign countries and institutions. Defaults in the interest payment both in external and domestic debts started happening with consequential accumulated arrears. The domestic

[4] LAR was adjusted to 7.5% from 40% because the treasury bill was excluded from the Liquidity in 1999.

finance should rely on the Treasury bond and Treasury bill, however, because of the default, the issuance of Treasury bills has been suspended since 1995.

According to the following table of the government budget, it can be seen that almost all debt service and development expenditure rely upon the external debt and grant aid. And it should be noticed that the figures since 1995 are estimated. The final settlement figure of each year was not obtained.

Table 3-2-10 Budget of Government (SB$ mil.)

	1993	1994	1995	1996	1997	1998	1999	2000
	Audited	Audited	Estimated	Estimated	Estimated	Estimated	Budget	Budget
Government Earnings	41.9	41.8	49.8	23.8	30.0	31.0	29.3	48.1
Taxation	179.8	236.9	269.5	291.7	289.2	311.2	351.5	362.6
Borrowing(domestic)	72.6	63.4	33.3	8.0	5.5	0.0	0.0	0.0
(external)	17.6	25.9	26.7	15.9	9.5	27.2	40.6	70.9
Cash Grants	43.9	39.7	36.4	34.5	31.8	50.9	61.7	111.4
Policy and Structural Reform						77.6	59.3	
Total Revenue	355.8	407.7	415.7	373.9	366.0	497.9	542.4	593.0
Recurrent Operations	229.6	269.3	266.2	286.1	284.0	304.0	314.6	347.5
Debt Service	48.1	55.4	64.1	43.1	24.8	36.4	44.4	49.2
Development Expenditure	78.1	82.9	85.4	67.4	58.1	80.0	124.1	196.2
Policy and Structural Reform	0.0	0.0	0.0	0.0	0.0	77.6	59.3	0.0
Total Expenditure	355.8	407.6	415.7	396.6	366.9	498.0	542.4	592.9

Table 3-2-11 Breakdown of the development Expenditure (SB$ mil.)

Development Expenditure		
Human Resources and Community	38.3	19.5%
Natural Resources	24.8	12.6%
Commerce, Industry and Finance	17.3	8.8%
Physical Infrastructure & Utilities	51.5	26.2%
Government and Security	64.3	32.8%
Total	196.2	100.0%

Source: The 2000 Budget Speech, 2nd December 1999

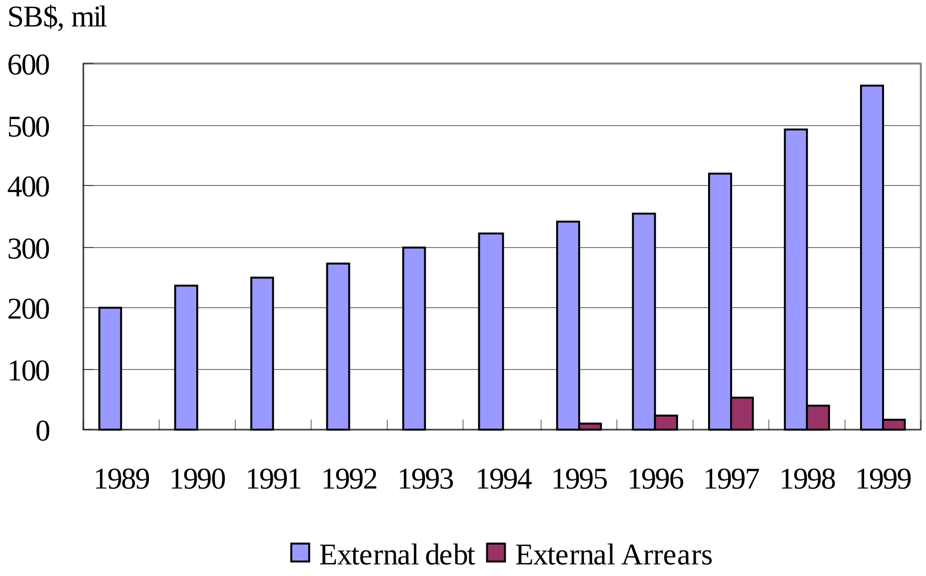
Table 3-2-12 Breakdown of development expenditure for the electricity (SB$ mil.)

Electrification Affairs & Services (2000)		Fund Source
Provincial Centers Electrification	3.0	ADB Loan
Bina Harbour - Malu'u Transmission Line	3.0	ADB Loan
Energy Master Plan	0.0	Japanese Grant
Komarindi/ Lungga Power Plant	0.5	Government
Wartsila Diesel Generator Installation	1.6	WB Loan
National Fuel Farm	1.0	ADB Loan
Total	9.1	

Source: Solomon Islands Government 2000 Draft Development Estimate

Government Debt

Total amount of the external and internal debt of the government were to be increased to SB$958.5mil (internal SB$378.0mil, external SB$56.5mil) at the end of 1999. ADB and World Bank will cover around 40% and 30% of external debt, respectively. The amount of amortized arrears has been decreasing since the peak in 1997, and the internal arrears will be expected to reduce to zero and the external arrears were expected to reduce to SB$17.0mil in 1999.



Source: Based on “2000 Budget Speech, 2nd December 1999”

Fig. 3-2-10 External Debt

3.2.11 Financial Situation of the Government

The former Ulfaal government announced the "Policy and Structure Reform Program (PSRP)" and implemented the reform in administration and economic situation. The government held a “National Summit” in November 1998, and published the "Medium Term Development Strategy (MTDS)" and the "Public Service Investment Program (PSIP)" based on PSRP. The summary of these programs is as follows.

1) Financial Reform

In terms of financial reform, several aspects were stressed such as reduction of financial deficit, maintaining a balanced budget, clearance of arrears, reduction of recurrent expenditure, reform of tax system, enhancement in budget control, etc. In 1998, reform of the ministries was implemented and in 1999, a large number of government staff was reduced. In 1998 and 1999, the special account of "Policy and Structure reform budget" was set in the budget and related expenditure has derived from this account. As a result of the program, the result of the balance was a slightly surplus in 1998 and 1999 and could clear the arrears. The credit in the domestic security market began to recover and the auction of Treasury Bill was restarted from 1999.

However, due to the ethnic tensions since 1999, serious effects incurred in the financial situation of Solomon Islands and it is thought that the resulting financial loss was around SB$30mil in 1999. Therefore, there is increased pressure for the new Prime Minister Mr. Sogavare to reform the financial structure and implement the reform itself.

2) State-Owned Enterprise ("SOE") Reform

In terms of SOE's reforms, privatization of SOE, minimization of subsidies and removal of special treatment for SOEs were mentioned as the final targets. Final liquidation of National Shipping Services Ltd. and Livestock Development Authority were started but the ethnic tensions caused this to be delayed. At the end of 1999, it was agreed to transfer the 48.1% share of Solomon Telecom' s stock to the NPF (National Provident Fund). The transfer amount of SB$48.3mil will offset the debt to be refunded to the NPF.

3) Private Sector Reform

In terms of the private sector reform, construction of infrastructure, invitation of foreign investment and development of tourism business, etc., were recommended. The development of Goldridge and Vagunu are pointed out as examples, but one of the consequences of the ethnic tensions was the close of the SIPL. The risk in business has begun to rise so that except for the timber and fishery, industrial business will be difficult to develop.

3.2.12 The situation of foreign assistance

In 2nd June 2000, a "Government - Development Partners Consultative Meeting" was held in Honiara, gathering representatives of the countries and institutions that provide several kinds of assistance to the Solomon Islands[5]. The following is the list of the members that were present. At this meeting, the implementation situation of PSRP was explained and the future promotion of the plan was discussed.

According to the report made for the meeting, the total amount of grant aid from all donor countries and institutions was estimated to be SB$680mil. However, the implementation period was not clear, but it is thought that the plan will be implemented within 10 years, the average amount for each year being estimated to be SB$50mil.

[5] The expense for preparing the report of PSRP and meeting itself were provided by ADB.

The member's list of attendance

Asian Development Bank (ADB)	Papua New Guinea
Australia	Republic of China (Taiwan)
Canada	SCFA
ESCAP	United Kingdom
European Commission (EC)	United Nation Development Program (UNDP)
FAO	UNICEF
Forum Secretariat	World Bank
International Monetary Fund(IMF)	WHO
Japan	
New Zealand	

Outline of assistance from each donor member is as follows.

Asian Development Bank (ADB)

The main assistance is loan aid for construction of infrastructure. It also assists and advises the direction of policy and structure reform program.

Australia

Assists the structure reform.

SI Bilateral Development Co-operation Program : A$13mil

Including funding for regional program : A$17mil

Australia agreed to support the following sectors; Forestry Management, Customs Administration, Lands Administration, Government Accounting Finance and National Auditor General's Office.

European Commission (EC)

Program Aid from European Commission comes under three main headings.

１） The National Indicative Program (NIP）

NIP is funded from European Development Fund (EDF).

Recent NIP for the grant was SB$102mil signed in March 1999.

２） STABEX Funds

STABEX Fund are made available to Government in order to compensate for losses incurred through income fluctuations on exports to the European Union. Since 1998, SB$52mil was granted under STABEX.

Structural Adjustment Funds

These funds are also grants in support of structural reform. Solomon Islands will benefit for the first time to an amount of SB$18.0mil during 1999-2000. They are programmed for transport infrastructure strengthening, road maintenance and primary education development.

Japan

Japanese assistance includes not only funding but also technical and cultural supports. Japan continue to support in the economic development with implementation of General Grant Aid, Grant Assistance for Grassroots Projects, Cultural Grant Aid and Technical Co-operation including acceptance of trainees, dispatch of experts, survey teams and volunteers, through JICA and JOCV.

United Kingdom

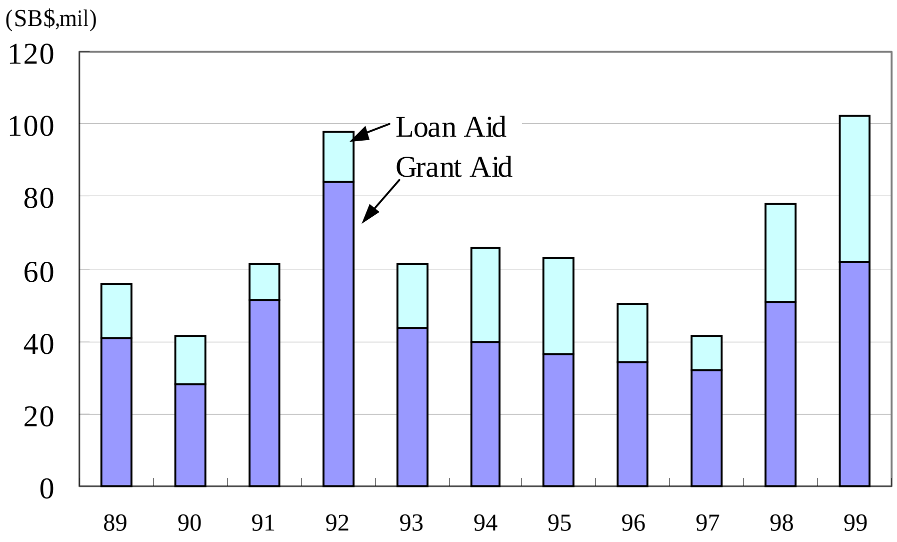
British Aid provides help and support in a variety of areas. There are over 30 volunteers working in 4 key areas that are education, health, rural infrastructure (roads, wharfs) and social development (legal sector support).

Republic of China (Taiwan)

It mainly supports small size project such as agriculture, hospitals and prisons, etc.

The Department of Development Planning of the Ministry of Finance and Development Planning is the main administrating section of the Solomon government. Several specialists from EU, Japan and other countries are commissioned to this department to advise in development planning.

According to the report prepared for the budget speech, the total amount of loan aid (low interest lending) and grant aid in each year are on average around SB$40mil and SB$50mil respectively, and share around 20% of total budget of the government.



Source: 2000 Budget Speech, 2nd December 1999

Fig. 3-2-12 Amount of Loan and Grant Aid (budget base)

3.3 Situation of power supply

Most of all power supply sources of Solomon Islands are diesel power, while two small hydropower are installed in Buala (Santa Isabel Island) and Malu'u (Malaita Island), and both diesel and hydro have been operating by SIEA. In addition, APACE, one of the NGO is now developing the micro hydropower in Western Province by support of Australia Aid, and GREA, also one of the NGO, installed SHS in Sukiki village, which is located in the south area of the Guadalcanal Island, and are operating it. Operating performance of the SIEA, which has a responsibility of power supply for the whole country, is in profit in Honiara-Lungga Grid and Noro-Munda Grid, and in loss in the other stations such as: Auki, Malu'u, Buala, Kirakira, Lata, Tulagi and Gizo.

The existing power stations as of November 1999 that were operated by SIEA are shown in Table 3-4-1, and the power situations from 1990 to 1998 by SIEA are shown in Table 3-4-2. According to these data, power supply sources are almost diesel power.
Initial cost for diesel power is lower and construction period is shorter than hydropower, but maintenance and fuel costs are higher than hydropower. Consequently, it is advantageous to develop hydropower compared to diesel power for a long-term view point.

3.3.1 Existing power stations

(1) Honiara-Lungga grid

The available rating of the Lungga power station is 14,000 kW (6 units), and that of the Honiara power station is 4,000 kW (5 units), being the total available rating 18,000 kW (11 units) in the Honiara-Lungga Grid. The peak demand in October 1999 was 10,550 kW. At present, the peak demand has dropped due to conflicts arisen from ethnic tensions.
Lungga No.7 unit, completed in 1987, had been in trouble for eight months from March to October in 1999. The No.7 unit got damaged because it was operating exceeding the possible continuos operating hours.
Now, peak demand did not grow so much compared to past records after the ethnic tensions in June 1999, and supply interruption has not been occurred since maintenance inspection of existing diesel generator in Honiara and Lungga has been done. However, if a big units under maintenance and next bigger unit has a problem, a supply interruption may occur. Therefore, necessary amount of budget for maintenance of diesel generators should be allocated to avoid problems, to ensure a longer lifetime of diesel generators and to keep supply capability.

(2) Auki

The available rating in Auki power station, which has been operated since 1991, is 624 kW (3 units) and the peak load was 280 kW in October 1999. One of three units is generally operating continuously, the other unit is operating for adjustment of peak load, and the other one is used in emergencies.

It seems that this station still has some available capacity for power supply, but all three units are not operating in good conditions. SIEA has plans to replace them by new generators.

(3) Malu'u

The available rating in Malu'u power station, which has been operated since 1984, is 30 kW (1 unit) and the peak load was 33 kW in October 1999, exceeding of the supply capacity. The power supply is stable for the time being, but an expansion plan is expected to be implemented as soon as possible, being the only matter funds for the implementation. The operation is now good.

(4) Buala

A hydropower station was installed in 1996, and at the same time, the old diesel power plant was moved to other station. The nominal rating is 150 kW (1 unit) for hydropower plus 62 kW (1 unit) for diesel power. The diesel power is used in case of emergency and together with hydropower during the five-month dry season. The peak load was 70 kW in October 1999. The capacity of power supply is enough in the rainy season, however, in the dry season, the diesel power is necessary to operate together since the power supply by hydropower is not stable because of the high dependency on the reservoir height.

(5) Kirakira

The available rating in Kirakira power station, which has been operated since 1992, is 170 kW (2 units) and the peak load was 61 kW in October 1999. Unit No.1 is operating in the peak time (17:00 – 24:00) and Unit No.2 is operating out of this time. According to Table 3-3-2 in Chapter 3, the peak load in 1990 was 81 kW and declined to 61 kW at present. The reason of this decline is that the fisheries center near the SIEA power station, which used to operate the refrigerator, has already stopped its operation.

It was time to overhaul Unit No.1 by the end of 1999, however, necessary spare parts which were requested to SIEA Head Office could not be dispatched. It was needed to take necessary action on this regard.

(6) Lata

The available rating in Lata power station, which has been operated since 1993, is 160 kW (3 units) and the peak load was 65kW in October 1999. It still has a certain space for power supply, and same as Gizo, one of three units normally is in full operation, the other unit is operating for adjustment of peak load, and the other one is in case of emergencies.

Since No.1 and No.2 units have not been overhauled after the commencement of operation in 1993, each unit should be overhauled. No.3 unit was in operation in 1995. This unit is now outage due to fuel pump trouble, and the outage shall be solved immediately.

(7) Gizo

The available rating in Gizo power station, which has been operated since 1991, is 510 kW

(3 units) and the peak load was 280 kW in October 1999, and there is still a certain space for power supply. One of three units is generally in continuous operation, the other unit is operating for adjustment of peak load, and the other one is used in case of emergencies. The station was located in the city before 1991, however, because of operation noise, it was moved to its present place far from the city area.

The operation is now good because maintenance of the three units has been carried out properly.

(8) Noro-Munda system

The two outstations in Noro and Munda were connected by an 11 kV underground transmission line in 1996, and the two diesel power units in Munda were transferred to the other station at the same time. The available rating of the Noro power station, which has been operated since 1987, is 2,700 kW (3 units), and the peak load was 1,790 kW in October 1999, therefore, there is still remaining a certain capacity for new demand.

No.1 unit, which began operation in 1991, has been in outage for more than two years from July 1997 to August 1999, because operated exceeding the possible continuous operating hours. Therefore, No.3 unit required overhaul and inspection, but the unit could not be stopped due to above reason. Now, No.3 unit is under outage because the generator stator got burned.

(9) Tulagi

No.1 diesel power unit was taken over to SIEA in December 1998. Since SIEA staff has not reported any monthly data or information to SIEA Head Office and Ranadi Engineering Office, SIEA should train the staff to submit reports monthly in order to get an efficient management.

(10) Diesel generating unit

The efficiency of diesel power generation will be about 38 % at the initial stage, however, even if normal inspection or detailed inspections are carried out, it is said that decline of efficiency by about 2 - 3 % per year can not be avoided.

The present efficiency of SIEA diesel generators are calculated based upon the collected data from SIEA.

Lungga - Honiara	29 % (34 %)	
Auki	24 % (25 %)	
Kirakira	22 % (22 %)	
Lata	21 % (30 %)	
Tulagi	N.A.	
Noro	23 % (20 %)	
Gizo	24 % (24 %)	Figures in brackets are theoretical.

The efficiency of Lungga - Honiara and Lata power station would be rather low from theoretical level. This comes from a lack of funds for maintenance budget.

3.3.2 Existing Transmission and Distribution (T&D) Lines

The construction of roads, which are the base of the development of the economy, is not implemented sufficiently in the country, and there is not any concrete plan for expansion of T&D lines, which is necessary for the efficient supply of the power. The existing facilities of T&D lines are shown as follows.

(1) Honiara-Lungga Grid

The power stations in Lungga and Honiara are connected by 33 kV and 11 kV overhead line and underground cable. In Honiara city, 11 kV distribution lines constitute the base grid, and the distribution to each user is provided by a 3 phase 4 wire distribution line after step down to 415 V by an 11 kV/415 V transformer.

(2) Auki

In Auki, the main city in the Malaita Province, 11 kV distribution lines constitute the base grid, and the distribution to each user is provided by a 3 phase 4 wire distribution line after step down to 415 V by a 11 kV/415 V transformer.

(3) Malu'u

In Malu'u, the second main city in Malaita Province, the power generated at 415 V is stepped up to 11 kV, and distributed to the each user by a 3 phase 4 wire distribution line after step down to 415 V by an 11 kV/415 V transformer.

(4) Buala

The generated power at 415 V in the hydropower station is distributed to each user in Buala, the main city of Isabel Province, and Jejevo city, near from Buala, directly by a 3 phase 4 wire distribution line without transformation.

(5) Kirakira

Because the city area is small in Kirakira, the main city of Makira Province, the generated power at 415 V is distributed to each user directly by a 3 phase 4 wire distribution line without transformation.

(6) Lata

Because city area is small in Lata, the main city of Temotu Province, the generated power at 415 V is distributed to each user directly by a 3 phase 4 wire distribution line without transformation.

(7) Gizo

In Gizo, one of the main cities in the Western Province, 11 kV distribution lines constitute the base grid, and the distribution to each user is provided by a 3 phase 4 wire distribution line after step down to 415 V by an 11 kV/415 V transformer.

(8) Noro-Munda system

The power stations in Noro and Munda were connected by 11 kV underground transmission line in 1996, and the two diesel power units in Munda were transferred to the other station at the same time. In both Noro and Munda, 11 kV distribution lines constitute the base grid, and the distribution to each user is provided by a 3 phase 4 wire distribution line after step down to 415 V by an 11 kV/415 V transformer.

(9) Tulagi

In Tulagi, the main city of Central Province, the generated power at 415 V is stepped up to 11 kV, and is distributed to each user by a 3 phase 4 wire distribution line after step down to 415 V by an 11 kV/415 V transformer.

Table 3-3-1 Existing generators (Provincial wise/Islands wise)

As of Jun. 2000

Name of Province/Island	Name of P/S	Type of P/S	Unit No.	Name plate Rating (kVA)	Name plate Rating (kW)	De-Rated (kW)	Installed Year	Remarks
Guadalcanal P. /Guadalcanal				27,270	24,540	18,000		
	Lungga			19,390	18,040	14,000		
		Diesel	4	1,900	1,900	1,000	1971	Mirrless-Blachstone
			5	1,900	1,900	1,000	1971	Mirrless-Blachstone
			6	2,840	2,840	2,200	1998	Mirrless-Blachstone
			7	3,000	3,000	2,300	1987	W.H.Allen
			8	4,500	4,200	3,600	1993	Wartsila
			9	5,250	4,200	3,900	1999	Mitsubishi
	Honiara			7,880	6,500	4,000		
		Diesel	1	1,875	1,500	1,000	1997	Perkins
			2	1,875	1,500	1,000	1997	Perkins
			3	1,875	1,500	1,000	1997	Perkins
			5	1,128	1,000	500	1984	Mirrless-Blachstone
			6	1,128	1,000	500	1984	Mirrless-Blachstone
Malaita P. /Malaita				818	818	654		
	Auki			780	780	624		
		Diesel	1	260	260	208	1991	Perkins
			2	260	260	208	1991	Perkins
			3	260	260	208	1991	Perkins
	Malu'u			37.5	37.5	30		
		Hydro	1	37.5	37.5	30	1984	
Isabel P. /Santa Isabel				310	238	212		
	Buala			310	238	212		
		Diesel	1	110	88	62	1993	Perkins
		Hydro	1	200	150	150	1996	
Makira P. /San Cristobal				294	235	170		
	Kirakira			294	235	170		
		Diesel	1	100	80	60	1992	Catepillar
			2	114	91	50	1993	Perkins
			3	80	64	60	Out of service	Lister
Temotu P. /Nendo				330	264	160		
	Lata			330	264	160		
		Diesel	1	110	88	60	1993	Perkins
			2	110	88	40	1993	Perkins
			3	110	88	60	1995	Perkins
Western P. /New Georgia				5,333	4,277	3,252		
	Gizo			780	624	510		
		Diesel	1	260	208	170	1991	Perkins
			2	260	208	170	1991	Perkins
			3	260	208	170	1991	Perkins
	Noro			4,500	3,600	2,700		
		Diesel	1	1,500	1,200	900	1987	W.H.Allen
			2	1,500	1,200	900	1987	W.H.Allen
			3	1,500	1,200	900	1987	W.H.Allen
	Munda			53	53	42		Interconnected with Noro by 11kV
		Diesel	1	53	53	42	Out of service	
Central P. /Tulagi				400	320	244		
	Tulagi			400	320	244		
		Diesel	1	150	120	84	1999	Catepillar
			2	250	200	160	1999	Perkins
Choiseul P. /Choiseul								Not applicable

Source: The data provided by SIEA at the general meeting during third field survey (May 17-June 2, 2000)

Table 3-3-2 Past electrical record 1990-1999 (Grid and Powerstation wise)

As of End of Oct. '99

Name of Grid	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Honiara (Guadalcanal)	D											1999-1990
Installed capacity	kW	11,190	11,190	11,190	11,190	15,390	13,062	13,000	13,000	13,000	24,540	11 units
Name plate capacity	kW	8,690	8,690	8,690	8,690	11,390	11,390	11,390	9,800	15,000	19,200	
Peak load	kW	6,100	6,500	7,030	7,800	8,850	9,400	9,740	9,650	10,450	10,550	
Generated energy	MWh	29,438,000	32,381,000	35,258,313	38,275,190	42,665,561	47,181,303	49,474,690	50,051,249	53,799,102	45,773,756	
Sold energy	MWh	26,108,000	29,416,683	31,822,019	34,759,553	35,759,553	42,798,420	44,556,611	44,537,995	44,940,027	38,107,758	
Total loss	%	11.3%	9.2%	9.7%	9.2%	16.2%	9.3%	9.9%	11.0%	16.5%	16.7%	
Nos. of consumers		4,625	4,863	4,975	5,124	5,239	5,556	5,793	5,957	6,194		
Growth of peak load	%		6.6%	8.2%	11.0%	13.5%	6.2%	3.6%	-0.9%	8.3%	1.0%	6.28%
Growth of Sold energy	%		12.7%	8.2%	9.2%	2.9%	19.7%	4.1%	0.0%	0.9%	-15.2%	4.29%
Auki (Malaita)	D											1999-1990
Installed capacity	kW	624	624	624	624	624	624	624	624	600	624	
Name plate capacity	kW	624	624	624	624	624	654	654	654	654	654	
Peak load	kW	176	181	185	180	230	320	260	260	240	280	
Generated energy	kWh	1,046,000	1,055,000	1,010,120	1,067,410	1,189,650	1,368,020	1,414,940	1,475,910	1,500,600	1,335,860	
Sold energy	kWh	874,000	924,642	931,349	985,141	1,031,470	1,231,040	1,374,541	1,651,473	1,587,815	1,419,361	
Total loss	%	16.4%	12.4%	7.8%	7.7%	13.3%	10.0%	2.9%	-11.9%	-5.8%	-6.3%	
Nos. of consumers		549	448	475	489	506	532	576	563	492	590	
Growth of peak load	%		2.8%	2.2%	-2.7%	27.8%	39.1%	-18.8%	0.0%	-7.7%	16.7%	5.29%
Growth of Sold energy	%		5.8%	0.7%	5.8%	4.7%	19.3%	11.7%	20.1%	-3.9%	-10.6%	5.54%
Malu'u (Malaita)	H											1999-1990
Installed capacity	kW	30	30	30	30	30	30	30	30	30	30	
Name plate capacity	kW	30	30	30	30	30	30	30	30	30	30	
Peak load	kW	10	10	14	15	19	22	25	28	29	33	
Generated energy	kWh	36,000	28,000	31,073	48,121	66,813	67,180		82,976	89,510	93,631	
Sold energy	kWh	32,000	27,236	24,774	38,663	56,270	58,820	79,771	73,281	81,718	83,743	
Total loss	%	11.1%	2.7%	20.3%	19.7%	15.8%	12.4%		11.7%	8.7%	10.6%	
Nos. of consumers		65	64	67	73	74	89	96	98	102	113	
Growth of peak load	%		0.0%	40.0%	7.1%	26.7%	15.8%	13.6%	12.0%	3.6%	13.8%	14.19%
Growth of Sold energy	%		-14.9%	-9.0%	56.1%	45.5%	4.5%	35.6%	-8.1%	11.5%	2.5%	11.28%
Buala (Isabel)	H/D											1999-1990
Installed capacity	kW			132	132	132	132	270	270	270	248	
Name plate capacity	kW							248	248	248	248	
Peak load	kW	29	30	32	32	44	59	62	47	70	70	
Generated energy	kWh	170,000	179,000	182,220	157,810	204,430	232,225	262,409	287,700	329,109	293,380	
Sold energy	kWh	146,000	161,677	160,157	160,760	182,370	224,890	246,837	247,139	289,836	252,057	
Total loss	%	14.1%	9.7%	12.1%	-1.9%	10.8%	3.2%	5.9%	14.1%	11.9%	14.1%	
Nos. of consumers		72	88	100	108	110	112	108	134	133	142	
Growth of peak load	%		3.4%	6.7%	0.0%	37.5%	34.1%	5.1%	-24.2%	48.9%	0.0%	10.29%
Growth of Sold energy	%		10.7%	-0.9%	0.4%	13.4%	23.3%	9.8%	0.1%	17.3%	-13.0%	6.26%
Kirakira (Makira)	D											1999-1990
Installed capacity	kW			192	192	192	215	300	300	300	262	
Name plate capacity	kW			171	171	171	171	171	171	171	171	
Peak load	kW	81	80	54	55	47	56	59	59	55	61	
Generated energy	kWh	216,000	254,000	236,880	241,530	226,890	255,600	274,980	289,710	300,780	242,500	
Sold energy	kWh	206,000	230,891	231,863	234,129	215,670	247,640	412,727	298,926	299,533	233,965	
Total loss	%	4.6%	9.1%	2.1%	3.1%	4.9%	3.1%	-50.1%	-3.2%	0.4%	3.5%	
Nos. of consumers		187	192	199	203	203	200	221	208	204	212	
Growth of peak load	%		-1.2%	-32.5%	1.9%	-14.5%	19.1%	5.4%	0.0%	-6.8%	10.9%	-3.10%
Growth of Sold energy	%		12.1%	0.4%	1.0%	-7.9%	14.8%	66.7%	-27.6%	0.2%	-21.9%	1.4%
Lata (Temotu)	D											1999-1990
Installed capacity	kW				176	176	176	176	176	450	187	
Name plate capacity	kW				186.6	186.6	186.6	186.6	186.6	186.6	186.6	
Peak load	kW	44	47	48	43	43	59	63	46	65	65	
Generated energy	kWh	197,000	198,000	195,000	161,441	216,961	248,970	252,441	194,420	127,731	127,793	
Sold energy	kWh	188,000	185,356	180,409	163,158	198,260	238,530	246,098	250,745	257,342	263,567	
Total loss	%	4.6%	6.4%	7.5%	-1.1%	8.6%	4.2%	2.5%	-29.0%	-101.5%	-106.2%	
Nos. of consumers		105	106	118	120	119	131	147	136	172	212	
Growth of peak load	%		6.8%	2.1%	-10.4%	0.0%	37.2%	6.8%	-27.0%	41.3%	0.0%	4.43%
Growth of Sold energy	%		-1.4%	-2.7%	-9.6%	21.5%	20.3%	3.2%	1.9%	2.6%	2.4%	3.83%

Name of Grid	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Gizo (Western)	D											1999-1990
Installed capacity	kW	624	624	624	624	624	624	624	624	624	624	
Name plate capacity	kW	624	624	624	624	624	624	624	624	624	624	
Peak load	kW	240	245	220	220	235	275	283	280	270	280	
Generated energy	kWh	1,214,000	1,100,000	1,171,964	1,188,470	1,293,849	1,490,570	1,501,386	1,531,180	1,583,960	1,319,375	
Sold energy	kWh	1,094,000	999,622	1,075,904	1,125,425	1,234,096	1,327,170	1,354,461	1,459,235	1,835,414	1,299,717	
Total loss	%	9.9%	9.1%	8.2%	5.3%	4.6%	11.0%	9.8%	4.7%	-15.9%	1.5%	
Nos. of consumers		468	463	475	460	486	509	554	520	490	583	
Growth of peak load	%		2.1%	-10.2%	0.0%	6.8%	17.0%	2.9%	-1.1%	-3.6%	3.7%	1.73%
Growth of Sold energy	%		-8.6%	7.6%	4.6%	9.7%	7.5%	2.1%	7.7%	25.8%	-29.2%	1.93%
Noro (Western)	D											1999-1990
Installed capacity	kW	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	3,600	
Name plate capacity	kW	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	
Peak load	kW	1,210	1,410	1,400	1,290	1,950	1,720	1,800	1,820	1,790	1,790	
Generated energy	kWh	5,970,000	7,280,000	7,055,637	7,602,966	8,556,809	10,246,780	9,952,864	9,639,904	10,269,313	8,321,334	
Sold energy	kWh	5,506,000	7,041,385	6,852,338	7,517,168	8,071,610	9,222,850	9,173,414	8,742,284	9,470,155	7,912,116	
Total loss	%	7.8%	3.3%	2.9%	1.1%	5.7%	10.0%	7.8%	9.3%	7.8%	4.9%	
Nos. of consumers		129	127	130	194	204	230	256	255	267	290	
Growth of peak load	%		16.5%	-0.7%	-7.9%	51.2%	-11.8%	4.7%	1.1%	-1.6%	0.0%	4.45%
Growth of Sold energy	%		27.9%	-2.7%	9.7%	7.4%	14.3%	-0.5%	-4.7%	8.3%	-16.5%	4.11%
Munda (Western)	D											1997-1990
Installed capacity	kW				106	106	106	(Decommissioned in 1996)				
Name plate capacity	kW											
Peak load	kW	41	45	46	47	56	66					
Generated energy	kWh	190,000	209,000	227,181	276,526	278,732	312,526	122,358	0	0	0	
Sold energy	kWh	174,000	191,595	200,546	218,460	242,160	267,670	294,451	328,150	368,507	0	
Total loss	%	8.4%	8.3%	11.7%	21.0%	13.1%	14.4%	-140.6%				
Nos. of consumers		99	111	115	121	126	137	157	160	182	208	
Growth of peak load	%		9.8%	2.2%	2.2%	19.1%	17.9%	-100.0%				0.02%
Growth of Sold energy			10.1%	4.7%	8.9%	10.8%	10.5%	10.0%	11.4%	12.3%	-100.0%	-100.00%
Tulagi (Central)	D											1999-1993
Installed capacity	kW									400	344	
Name plate capacity	kW									344	344	
Peak load	kW										49	
Generated energy	kWh											
Sold energy	kWh				73,783	96,158	166,970	198,468	215,627	157,960	683,515	
Total loss	%											
Nos. of consumers					30	31	32	34	35		190	
Growth of peak load	%											
Growth of Sold energy	%											44.92%
Solomon Islands												1999-1990
Installed capacity	kW	18,468	18,468	18,792	19,074	23,274	20,969	21,024	21,024	21,674	30,459	
Name plate capacity	kW	13,568	13,568	13,739	13,926	16,626	16,656	16,904	15,314	20,858	25,058	
Peak load	kW											
Generated energy	kWh	38,477,000	42,684,000	45,368,388	49,019,464	54,699,695	61,403,174	63,256,068	63,553,049	68,000,105	57,507,629	
Sold energy	kWh	34,328,000	39,179,087	41,479,359	45,276,240	47,087,617	55,784,000	57,937,379	57,913,791	59,388,149	50,355,641	
		34,328.0	39,179.1	41,479.4	45,276.2	47,087.6	55,784.0	57,937.4	57,913.8	59,388.1	50,355.6	
Total loss	%	10.8%	8.2%	8.6%	7.6%	13.9%	9.2%	8.4%	8.9%	12.7%	12.4%	
Nos. of consumers		6,299	6,462	6,654	6,922	7,098	7,528	7,942	8,066	8,236		
Growth of peak load	%											
Growth of Sold energy	%		10.9%	6.3%	8.0%	11.6%	12.3%	3.0%	0.5%	7.0%	-15.4%	4.35%

Source: SIEA Engineering Report Statistics Summary 1990-1997, and SIEA Engineering Report September, 1999
SIEA Head Quarter Data 1983-1998
SIEA Lungga P/S OIC statistical data 1983-1998
The figure in 1999 shows until the end of October.

CHAPTER 4

POWER DEMAND

Chapter 4 Power Demand

4.1 Power Demand Forecast Method

There are two methods for power demand forecast as shown below.

- Micro method: power demand estimation by analytical way
- Macro method: power demand estimation by

  Economic index

  Trend based upon past record

  Proportion between nation and projected area

  Comparison between other countries and projected nation/area

4.1.1 The method of power demand forecast for Solomon Islands

The preliminary power demand forecast in this progress report was carried out from information based on collected data and information during the first field survey (Table 3-3-2), from a number of consumers, their annual power consumption and growth rates. However, the power demand forecast in the interim report was made based on the number of consumers by electricity tariff category, each growth rate, annual power consumption per consumer by electricity tariff category, and its growth rate, for load centers that were supplied by SIEA power station over the past 10 years (1989 - 1999) (Table 4-1-1). The power supply planning will be considered by this power demand forecast.

4.1.2 The method of power demand forecast for the grid system

The power demand forecast (kWh) for the grid system of Honiara – Lungga is estimated based upon the annual power consumption per consumer by electricity tariff category, its increasing rate, the number of consumers by electricity tariff category, and its increasing rate derived from power usage for 10 years. The peak demand (kW) is estimated from the future power demand (kWh), future power constituent ratio and estimated future load factor which is assumed based upon the past records.

4.1.3 The method of power demand forecast for the areas served by independently isolated small hydro power sources

The power demand forecast (kWh) for provincial capitals is estimated in the same manner as in section 4.1.2.

4.1.4 The method of power demand forecast for the areas served by Solar Home Systems (SHS)

In other areas excluded from above sections 4.1.2 and 4.1.3, or in the area where there is not available any hydro potential site or is a remote area away from hydro potential site, the requirement of electricity has been confirmed from village society survey and photovoltaic potential site survey. The issue is the size of SHS and the possible amount that consumers can pay for the SHS. The outline of electrification plan by SHS in such areas is as follows:

For individual house and clinic: 7-11W 1-3 fluorescent lights 3-4 hours

6W 1 radio 1-2 hours

For church, community hall or secondary school:

9-11W 4 fluorescent lights 1-2 hours

Refer to Chapter 7 for details.

4.2 Estimated Condition of Power Demand Forecast

The estimated conditions of power demand forecast for areas served by existing grid power, existing independent isolated power source, or where future independent power source are planned, are shown below. The basic data is from SIEA as end of 1998.

4.2.1 The estimated condition of power demand forecast for areas served by existing grid power

(1) Honiara – Lungga grid (Guadalcanal Province, Guadalcanal Island) (refer to Appendix 4-2-1 for the area served by SIEA power station)

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	2,339				
Annual average growth rate (%)		3.3	2.8	2.3	2.0
Number of customers	4,879				
Annual average growth rate (%)		3.1	2.6	2.1	2.0
Commercial					
Annual power consumption per customer (kWh)	22,755				
Annual average growth rate (%)		4.0	3.5	3.0	2.5
Number of customers	981				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	34,185				
Annual average growth rate (%)		0.05	0.05	0.05	0.05
Number of customers	185				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	33,491				
Annual average growth rate (%)		8.5	6.5	4.5	4.0
Number of customers	149				
Annual average growth rate (%)		0.5	0.5	0.5	0.5

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

4.2.2 The estimated condition of power demand forecast for areas served by existing independent power sources

(1) Auki - Malu'u - Bina harbor (Malaita Province, Malaita Island) (refer to Appendix 4-2-2 for the areas served by SIEA powerstation)

Related officials of the Solomon Government stated that along with the development of the international harbor, a factory similar to the one existent in Noro is planned to be constructed at Bina Harbor in the near future. Therefore, from the power demand of this load center, which is estimated based upon this information, this center is considered to be a potential large customer.

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	1,095				
Annual average growth rate (%)		7.0	6.5	6.0	5.5
Number of customers	426				
Annual average growth rate (%)		1.2	1.5	1.5	1.5
Commercial					
Annual power consumption per customer (kWh)	3,924				
Annual average growth rate (%)		3.0	2.5	2.0	2.0
Number of customers	105				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	11,793				
Annual average growth rate (%)		6.0	5.5	5.0	4.5
Number of customers	50				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	15,522				
Annual average growth rate (%)		6.5	5.5	5.0	4.5
Number of customers	13				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customers owned diesel power generator		1			
Annual power consumption per customer (kWh)		9,198	18,396	18,396	27,594
Annual average growth rate (%)					

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(2) Buala (Isabel Province, Santa Isabel Island) (refer to Appendix 4-2-3 for the area served by SIEA powerstation)

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per one customer (kWh)	1,023				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customer	99				
Annual average growth rate (%)		6.0	5.0	4.5	4.0
Commercial					
Annual power consumption per one customer (kWh)	5,750				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customer	22				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per one customer (kWh)	5,418				
Annual average growth rate (%)		3.0	2.5	2.0	1.5
Number of customer	12				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per one customer (kWh)	0				
Annual average growth rate (%)		0.0	0.0	0.0	0.0
Number of customer	0				
Annual average growth rate (%)		0.0	0.0	0.0	0.0
Number of customer owned diesel power generator	0	0	0	1	1
Annual power consumption per one customer (kWh)				50,000	
Annual average growth rate (%)				0.0	0.0

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed constituent factor of number of customer.

(3) Kirakira (Makira Province, San Cristobal Island) (refer to Appendix 4-2-4 for the area served by SIEA powerstation)

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	726				
Annual average growth rate (%)		6.0	5.5	5.0	4.5
Number of customers	160				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Commercial					
Annual power consumption per customer (kWh)	4,063				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customers	18				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	4,217				
Annual average growth rate (%)		3.0	2.5	2.0	1.5
Number of customers	25				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	4,111				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customers	1				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Number of customers owned diesel power generator	0	0	0	1	1
Annual power consumption per customer (kWh)				50,000	
Annual average growth rate (%)				0.0	0.0

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(4) Lata (Temotu Province, Nendo Island) (refer to Appendix 4-2-5 for the area served by SIEA powerstation)

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	576				
Annual average growth rate (%)		5.5	5.0	4.5	4.0
Number of customers	119				
Annual average growth rate (%)		4.5	4.0	3.5	3.0
Commercial					
Annual power consumption per customer (kWh)	1,522				
Annual average growth rate (%)		3.0	2.5	2.0	1.5
Number of customers	36				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	6,714				
Annual average growth rate (%)		3.0	2.5	2.0	1.5
Number of customers	17				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	31,123				
Annual average growth rate (%)		5.0	4.5	4.5	4.0
Number of customers	1				
Annual average growth rate (%)		5.0	4.5	4.0	3.5

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(5) Gizo (Western Province, Gizo Island) (refer to Appendix 4-2-6 for the area served by SIEA powerstation)

Category \ Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	1,650				
Annual average growth rate (%)		2.5	2.0	1.5	1.0
Number of customers	357				
Annual average growth rate (%)		3.0	2.5	2.0	1.5
Commercial					
Annual power consumption per customer (kWh)	7,091				
Annual average growth rate (%)		1.0	1.0	1.0	1.0
Number of customers	85				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	16,391				
Annual average growth rate (%)		3	2.5	2.0	1.5
Number of customers	39				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	511				
Annual average growth rate (%)		12.0	10.0	8.0	6.0
Number of customers	9				
Annual average growth rate (%)		5.0	4.5	4.0	3.5

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(6) Noro – Munda (Western Province, New Georgia Island) (refer to Appendix 4-2-6 for the area served by SIEA powerstation)

Category / Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	1,647				
Annual average growth rate (%)		1.0	8.0	7.0	6.0
Number of customers	360				
Annual average growth rate (%)		10.0	8.0	6.0	5.5
Commercial					
Annual power consumption per customer (kWh)	24,879				
Annual average growth rate (%)		5.0	4.0	3.0	2.0
Number of customers	65				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	11,102				
Annual average growth rate (%)		4.5	4.0	3.5	3.0
Number of customers	22				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	3,768,835				
Annual average growth rate (%)		4.0	3.5	3.0	2.5
Number of customers	2				
Annual average growth rate (%)		5.0	4.5	4.0	3.5

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(5) Tulagi (Central Province, Tulagi Island)

Category / Year	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	64				
Annual average growth rate (%)		5.5	5.0	4.5	4.0
Number of customers	145				
Annual average growth rate (%)		5.0	4.5	4.0	3.5
Commercial					
Annual power consumption per customer (kWh)	5,945				
Annual average growth rate (%)		1.0	1.0	1.0	1.0
Number of customers	25				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	11				
Annual average growth rate (%)		2.0	1.5	1.0	1.0
Number of customers	20				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	0				
Annual average growth rate (%)		0.0	0.0	0.0	0
Number of customers	0				
Annual average growth rate (%)		0.0	0.0	0.0	0.0

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

4.2.3 The estimated condition of power demand forecast for areas served by future independent isolated power source

(1) Taro (Choiseul Province, Choiseul Island)

Year / Category	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	450				
Annual average growth rate (%)		2.5	2.0	1.5	1.0
Number of customers	70				
Annual average growth rate (%)		7.0	6.0	5.0	4.0
Commercial					
Annual power consumption per customer (kWh)	1,500				
Annual average growth rate (%)		5.0	4.0	3.0	2.0
Number of customers	0				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	3,000				
Annual average growth rate (%)		5.0	4.0	3.0	2.0
Number of customers	0				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	4,000				
Annual average growth rate (%)		4.0	3.0	2.0	1.0
Number of customers	0			1	
Annual average growth rate (%)		0.0	0.0	10.0	10.0
Number of customers owned diesel power generator	0	0	0	1	1
Annual power consumption per customer (kWh)				50,000	
Annual average growth rate (%)				0.0	0.0

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

(2) Rennnell and Bellona (rennenll and Bellona Province, Rennnell Islands)

Year / Category	1998	1998-2003	2004-2008	2009-2013	2014-2018
Residential					
Annual power consumption per customer (kWh)	300				
Annual average growth rate (%)		2.5	2.0	1.5	1.0
Number of customers	26				
Annual average growth rate (%)		7.0	6.0	5.0	4.0
Commercial					
Annual power consumption per customer (kWh)	500				
Annual average growth rate (%)		5.0	4.0	3.0	2.0
Number of customers	3				
Constituent factor *		*	*	*	*
Public (Government, Street lighting, others)					
Annual power consumption per customer (kWh)	2,000				
Annual average growth rate (%)		5.0	4.0	3.0	2.0
Number of customers	6				
Constituent factor *		*	*	*	*
Industry					
Annual power consumption per customer (kWh)	1,000				
Annual average growth rate (%)		4.0	3.0	2.0	1.0
Number of customers	1				
Annual average growth rate (%)		5.0	4.0	3.0	2.0

Note: ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER shall be refereed for the constituent factor of number of customers.

4.3 Result of Power Demand Forecast

The power demand forecast is shown below based upon the clause "4.2 Estimated condition of power demand forecast." Details for the whole country and for each demand center are shown in Table 4-3-1, and from Table 4-3-2 to Table 4-3-10.

4.3.1 Power demand forecast for areas served by existing grid power

The power demand forecast, expressed in kWh and kW, for the demand center of Honiara - Lungga grid is shown below.

- Power demand forecast in MWh

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Honiara-Lungga	45,048	47,841	50,274	52,834	56,289	59,990	63,299	66,805	70,522	74,462	78,639
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honiara-Lungga		84,487	88,567	92,598	96,971	101,557	105,851	110,330	115,004	119,880	124,968

- Power demand forecast in kW

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Honiara-Lungga	10,450	10,604	11,144	11,711	12,477	13,298	14,168	14,953	15,785	16,667	17,602
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honiara-Lungga		18,727	19,632	20,525	21,495	22,511	23,237	24,221	25,247	26,317	27,434

4.3.2 Power demand forecast for areas served by existing independent isolated power sources

The power demand forecast, expressed in kWh and kW, for the demand center of (1) Auki-Malu'u, (2) Buala, (3) Kirakira, (4) Lata, (5) Tulagi, (6) Gizo and (7) Noro-Munda are shown below.

- Power demand forecast in MWh

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Auki-Malu'u-Bina	1,670	1,885	2,014	2,152	11,499	11,660	21,072	21,248	21,438	21,641	21,859
Buala	293	339	375	414	458	506	551	601	655	714	778
Kirakira	299	313	343	376	413	454	493	537	584	635	692
Lata	269	319	340	363	387	413	437	462	489	518	548
Gizo	1,836	2,550	2,673	2,803	2,939	3,083	3,206	3,335	3,469	3,609	3,755
Noro-Munda	9,992	10,701	11,838	13,104	14,513	16,083	17,651	19,382	21,294	23,409	25,748
Tulagi	158	215	228	241	255	270	285	300	317	334	353
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Auki-Malu'u-Bina		22,074	22,304	22,550	22,813	23,094	23,371	32,863	33,176	33,510	33,866
Buala		891	958	1,031	1,110	1,195	1,275	1,360	1,452	1,551	1,656
Kirakira		796	855	918	986	1,060	1,130	1,204	1,284	1,370	1,462
Lata		575	604	635	667	701	730	761	794	828	865
Gizo		3,873	3,996	4,123	4,254	4,389	4,489	4,592	4,698	4,806	4,916
Noro-Munda		27,879	30,196	32,714	35,452	38,432	41,202	44,183	47,391	50,847	54,569
Tulagi		370	388	408	428	450	470	491	514	537	562

- Power demand forecast in kW

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Auki-Malu'u-Bina	470	487	481	478	2,387	2,164	3,538	3,578	3,622	3,668	3,717
Buala	70	81	89	98	108	119	129	139	151	164	177
Kirakira	55	69	76	84	92	101	110	120	131	143	155
Lata	65	66	70	75	80	86	91	96	102	108	115
Gizo	270	485	512	541	571	603	632	662	694	727	763
Noro-Munda	1,790	1,930	2,150	2,397	2,673	2,983	3,297	3,647	4,036	4,469	4,951
Tulagi	49	61	65	68	71	75	79	82	86	91	95
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Auki-Malu'u-Bina		3,765	3,816	3,871	3,929	3,990	4,051	5,715	5,788	5,866	5,948
Buala		202	216	231	247	265	281	298	316	336	357
Kirakira		179	193	207	223	240	256	274	292	312	334
Lata		121	128	134	141	149	156	163	170	178	186
Gizo		793	824	856	891	926	955	984	1,015	1,046	1,079
Noro-Munda		5,401	5,893	6,433	7,024	7,673	8,289	8,957	9,683	10,470	11,326
Tulagi		99	103	108	113	118	122	127	132	137	143

4.3.3 Power demand forecast for areas served by future independent isolated power source

The power demand forecast, expressed in kWh and kW, for the demand center of Chiseul and Bbellona are shown below.

- Power demand forecast in MWh

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Choiseul	32	74	82	91	101	112	123	134	146	159	174
Rennell	22	24	26	29	32	35	37	40	43	46	50
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Choiseul		243	257	273	290	308	322	338	354	372	390
Rennell		52	55	58	61	65	67	69	71	74	76

- Power demand forecast in kW

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Choiseul	14	19	21	23	25	28	30	32	35	38	41
Rennell	6	6	7	7	8	9	9	10	10	11	12
Name of Demand Center \ Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Choiseul		57	60	63	66	70	73	76	79	82	86
Rennell		12	13	13	14	15	15	16	16	16	17

Table 4-1-1 Past record of power consumption by category wise during 1989-1998 (Grid and Powerstation wise)

Name of Grid	Unit	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average or Growth Rate
Honiara (Guadalcanal)	D											
Power consumption		25,025	26,098	29,417	31,822	34,760	38,199	42,589	44,557	60,129	45,048	
Residential	MWh	6,084	6,244	6,604	7,348	8,140	8,755	9,679	10,303	10,547	11,411	
Commercial	MWh	6,925	10,166	14,261	15,887	16,812	18,128	21,758	22,293	38,430	22,323	
Industrial	MWh	3,041	3,522	4,354	4,360	5,281	4,483	4,573	4,663	4,743	4,990	
Government	MWh	7,221	5,252	3,426	3,377	3,714	5,833	5,444	6,195	4,731	5,154	
MIN/Charge	MWh	92	80	76	71	63	59	53	49	51	43	
Others	MWh	1,662	834	697	780	750	940	1,081	1,055	1,627	1,127	
Number of consumers		4,556	4,845	4,862	4,975	5,124	5,239	5,574	5,795	5,957	6,194	
Residential		3,651	3,682	3,828	3,908	4,105	4,137	4,375	4,531	4,670	4,879	
Commercial		447	843	707	770	706	813	930	964	971	981	
Industrial		194	69	153	141	137	139	108	135	144	149	
Government		102	153	82	71	103	75	75	94	81	87	
Others		162	98	92	85	73	75	86	71	91	98	
Unit annual power consumption		5,493	5,387	6,050	6,396	6,784	7,291	7,641	7,689	10,094	7,273	
Residential	kWh/y	1,666	1,696	1,725	1,880	1,983	2,116	2,212	2,274	2,258	2,339	
Commercial	kWh/y	15,492	12,059	20,171	20,633	23,813	22,298	23,396	23,125	39,577	22,755	
Industrial	kWh/y	15,675	51,043	28,456	30,918	38,548	32,253	42,347	34,539	32,936	33,491	
Government	kWh/y	70,794	34,327	41,779	47,559	36,056	77,771	72,588	65,904	58,411	59,246	
Others	kWh/y	10,827	9,327	8,398	10,007	11,131	13,329	13,190	15,544	18,442	11,938	
Auki (Malaita)	D											
Power consumption		738	884	935	833	985	1,031	1,231	1,375	1,651	1,588	
Residential	MWh	166	196	182	220	218	260	341	395	394	413	
Commercial	MWh	110	154	302	288	314	310	395	406	432	400	
Industrial	MWh	46	40	52	46	50	35	61	73	314	201	
Government	MWh	390	464	378	257	377	399	408	465	457	524	
MIN/Charge	MWh	0	0	0	0	0	12	10	11	11	11	
Others	MWh	26	30	21	23	26	16	16	24	43	38	
Number of consumers		443	549	448	475	489	506	532	576	553	492	
Residential		337	430	335	359	368	375	410	420	414	347	
Commercial		34	60	52	60	64	73	75	89	87	91	
Industrial		8	8	11	8	8	9	7	20	13	12	
Government		44	37	41	36	35	35	30	31	34	27	
Others		20	14	9	12	14	14	10	16	5	15	
Unit annual power consumption		1,666	1,610	2,086	1,754	2,015	2,038	2,314	2,386	2,986	3,228	
Residential	kWh/y	493	456	543	612	592	694	832	941	951	1,191	
Commercial	kWh/y	3,235	2,567	5,799	4,807	4,912	4,247	5,261	4,566	4,966	4,399	
Industrial	kWh/y	5,750	5,000	4,771	5,721	6,242	3,874	8,681	3,630	24,134	16,765	
Government	kWh/y	8,864	12,541	9,222	7,125	10,773	11,387	13,607	14,994	13,454	19,423	
Others	kWh/y	1,300	2,143	2,280	1,915	1,854	1,986	2,627	2,233	10,900	3,256	
Malu'u (Malaita)	H											
Power consumption		31	32	27	39	39	36	59	80	73	82	
Residential	MWh	12	10	11	13	24	10	38	55	44	53	
Commercial	MWh	7	8	5	16	3	12	8	8	12	12	
Industrial	MWh	0	0	0	0	0	0	0	0	1	1	
Government	MWh	7	8	9	7	8	10	8	12	11	11	
MIN/Charge	MWh	0	0	0	0	0	3	3	3	4	4	
Others	MWh	4	6	2	3	4	1	1	1	2	1	
Number of consumers		61	65	64	67	73	74	89	96	98	102	
Residential		46	52	54	53	58	59	71	77	77	79	
Commercial		0	0	3	4	7	7	10	13	13	14	
Industrial		8	7	0	0	0	0	1	1	1	1	
Government		3	3	4	7	6	6	5	4	4	4	
Others		4	3	3	3	2	2	2	1	3	4	
Unit annual power consumption		502	492	422	583	529	489	661	831	748	802	
Residential	kWh/y	257	192	201	238	421	174	535	713	565	672	
Commercial	kWh/y			1,718	4,074	368	1,710	833	630	956	834	
Industrial	kWh/y	0	0					0	275	770	599	
Government	kWh/y	2,400	2,667	2,165	987	1,345	1,708	1,630	3,086	2,862	2,800	
Others	kWh/y	1,100	2,000	792	1,083	1,779	1,850	2,165	4,055	1,704	1,300	
Buala (Isabel)	H/D											
Power consumption		110	146	162	160	161	134	225	247	247	294	

Table 4-1-1 Past record of power consumption by category wise during 1989-1998 (Grid and Powerstation wise)

Name of Grid	Unit	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average or Growth Rate
Residential	MWh	34	30	39	44	47	44	72	74	77	101	
Commercial	MWh	13	48	74	69	69	34	92	116	118	127	
Industrial	MWh	0	0	0	0	0	1	4	0	0	1	
Government	MWh	42	44	44	45	41	49	42	43	38	51	
MIN/Charge	MWh	0	0	0	0	0	2	3	2	2	2	
Others	MWh	21	24	5	3	3	4	12	12	11	11	
Number of consumers		77	72	88	100	108	110	112	108	134	133	
Residential		55	50	62	72	79	80	83	77	99	99	
Commercial		6	11	15	17	18	19	17	22	24	22	
Industrial		0	0	0	0	0	0	0	0	0	0	
Government		13	10	10	10	10	10	11	5	8	9	
Others		3	1	1	1	1	1	1	4	3	3	
Unit annual power consumption		1,429	2,028	1,837	1,602	1,489	1,222	2,008	2,286	1,844	2,207	
Residential	kWh/y	618	600	622	605	591	552	873	965	781	1,023	
Commercial	kWh/y	2,167	4,364	4,944	4,030	3,857	1,776	5,422	5,261	4,909	5,750	
Industrial	kWh/y											
Government	kWh/y	3,231	4,400	4,423	4,540	4,145	4,864	3,803	8,613	4,791	5,707	
Others	kWh/y	7,000	24,000	4,749	2,671	3,211	6,690	14,340	3,415	4,433	4,550	
Kirakira (Makira)	D											
Power consumption		190	204	231	232	234	207	248	413	306	299	
Residential	MWh	64	82	68	77	79	70	92	91	106	116	
Commercial	MWh	21	20	26	24	35	34	77	84	110	73	
Industrial	MWh	0	0	0	0	0	0	0	0	3	4	
Government	MWh	91	94	129	123	111	93	70	230	80	97	
MIN/Charge	MWh	0	0	0	0	0	8	8	7	6	7	
Others	MWh	14	8	8	8	10	1	1	1	1	1	
Number of consumers		186	187	192	199	203	203	200	221	208	204	
Residential		147	148	149	155	158	158	160	160	161	160	
Commercial		11	14	17	17	18	18	13	25	19	18	
Industrial		0	0	0	1	0	1	1	1	1	1	
Government		20	22	23	23	23	23	23	30	24	22	
Others		8	3	3	3	4	3	3	5	3	3	
Unit annual power consumption		1,021	1,091	1,203	1,166	1,153	1,018	1,238	1,868	1,473	1,465	
Residential	kWh/y	436	554	457	496	497	444	574	567	659	726	
Commercial	kWh/y	1,882	1,429	1,516	1,439	1,947	1,900	5,947	3,365	5,806	4,063	
Industrial	kWh/y						200	0	210	2,712	4,111	
Government	kWh/y	4,550	4,273	5,590	5,335	4,820	4,060	3,031	7,661	3,331	4,426	
Others	kWh/y	1,763	2,667	2,832	2,679	2,427	2,900	2,913	1,554	2,455	2,681	
Lata (Temotu)	D											
Power consumption		161	188	185	180	163	198	239	246	245	269	
Residential	MWh	27	32	39	48	45	51	56	67	67	69	
Commercial	MWh	22	24	15	17	24	34	57	51	59	55	
Industrial	MWh	0	0	0	0	0	0	0	0	5	31	
Government	MWh	91	82	85	73	56	67	80	81	57	61	
MIN/Charge	MWh	0	0	0	0	0	4	4	4	4	4	
Others	MWh	21	50	46	43	38	42	41	42	54	49	
Number of consumers		103	108	106	118	120	119	131	147	136	173	
Residential		77	80	79	85	87	87	91	98	86	119	
Commercial		5	11	13	19	19	20	26	34	34	36	
Industrial		0	0	0	0	0	0	0	1	1	1	
Government		17	12	12	11	11	9	11	9	10	12	
Others		4	5	2	3	3	3	3	5	5	5	
Unit annual power consumption		1,566	1,741	1,749	1,529	1,359	1,666	1,821	1,674	1,804	1,553	
Residential	kWh/y	352	400	498	559	522	590	616	687	777	576	
Commercial	kWh/y	4,420	2,182	1,147	891	1,265	1,724	2,199	1,508	1,748	1,522	
Industrial	kWh/y								0	4,546	31,123	
Government	kWh/y	5,335	6,833	7,116	6,672	5,106	7,476	7,233	9,012	5,657	5,064	
Others	kWh/y	5,350	10,000	22,857	14,177	12,503	15,063	15,240	9,274	11,598	10,672	
Gizo (Western)	D											
Power consumption		1,007	1,094	998	1,076	1,125	1,238	1,327	1,354	1,457	1,836	
Residential	MWh	205	214	210	240	258	220	327	360	365	589	
Commercial	MWh	261	354	347	406	403	443	424	477	577	603	

Table 4-1-1 Past record of power consumption by category wise during 1989-1998 (Grid and Powerstation wise)

Name of Grid	Unit	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average or Growth Rate
Industrial	MWh	6	8	7	4	7	11	10	7	4	5	
Government	MWh	368	310	346	333	329	463	472	379	415	432	
MIN/Charge	MWh	0	0	0	0	0	86	13	10	9	8	
Others	MWh	167	208	87	93	128	16	80	123	88	199	
Number of consumers		447	468	463	475	460	486	509	554	520	490	
Residential		337	328	337	355	351	360	388	394	401	357	
Commercial		35	63	34	35	55	69	76	82	72	85	
Industrial		32	52	58	61	10	9	9	20	9	9	
Government		6	9	10	10	32	33	23	23	24	24	
Others		37	16	24	14	12	15	13	35	14	15	
Unit annual power consumption		2,253	2,338	2,156	2,265	2,447	2,547	2,607	2,445	2,802	3,746	
Residential	kWh/y	608	652	624	675	736	610	843	913	909	1,650	
Commercial	kWh/y	7,457	5,619	10,212	11,604	7,328	6,419	5,572	5,816	8,008	7,091	
Industrial	kWh/y	188	154	114	65	695	1,222	1,166	328	433	511	
Government	kWh/y	61,333	34,444	34,647	33,343	10,283	14,018	20,538	16,457	17,285	18,004	
Others	kWh/y	4,514	13,000	3,645	6,619	10,662	6,785	7,209	3,792	6,948	13,810	
Noro (Western)	D											(Commissioned in 1989)
Power consumption		3,888	5,492	7,041	6,852	7,517	8,072	9,223	9,173	8,742	9,470	
Residential	MWh	45	80	118	129	175	299	422	381	423	497	
Commercial	MWh	28	8	128	455	799	964	1,157	1,461	1,448	1,431	
Industrial	MWh	3,784	5,306	6,792	6,266	6,541	6,800	7,636	7,315	6,842	7,511	
Government	MWh	28	88	0	0	0	0	0	0	0	0	
MIN/Charge	MWh	0	0	0	0	0	2	1	2	2	2	
Others	MWh	3	10	4	3	2	7	7	15	27	28	
Number of consumers		118	129	127	130	194	204	230	256	255	267	
Residential		111	115	108	109	168	174	197	220	217	225	
Commercial		2	12	16	17	20	24	25	32	29	33	
Industrial		5	2	2	2	2	2	2	2	2	2	
Government		0	0	0	0	0	0	2	2	2	3	
Others		0	0	1	2	4	4	4	0	5	4	
Unit annual power consumption		32,953	42,574	55,442	52,710	38,749	39,567	40,099	35,834	34,283	35,469	
Residential	kWh/y	404	696	1,089	1,179	1,041	1,719	2,142	1,734	1,948	2,208	
Commercial	kWh/y	14,150	667	7,980	26,777	39,954	40,175	46,281	45,641	49,927	43,378	
Industrial	kWh/y	756,880	2,653,000	3,396,106	3,132,972	3,270,722	3,399,785	3,817,806	3,657,383	3,421,242	3,755,722	
Government	kWh/y							0	0	0	0	
Others	kWh/y			3,665	1,312	506	2,185	2,070		5,862	7,588	
Munda (Western)												(Decommissioned in 1996)
Power consumption		154	172	192	201	218	242	268	298.421	328	522	
Residential	MWh	25	30	33	34	40	52	57	66	76	96	
Commercial	MWh	42	38	59	65	76	90	114	117	140	186	
Industrial	MWh	0	0	0	0	0	0	5	23	24	26	
Government	MWh	38	50	94	94	97	96	87	86	81	163	
MIN/Charge	MWh	0	0	0	0	0	4	5	4	4	4	
Others	MWh	50	54	5	8	5	0	0	1	3	47	
Number of consumers		99	99	111	115	121	126	137	157	160	182	
Residential		73	76	81	85	89	93	97	112	116	135	
Commercial		10	10	14	15	17	18	24	27	30	32	
Industrial		0	0	0	0	0	0	0	1	0	0	
Government		12	13	15	14	13	13	14	14	12	13	
Others		4	0	1	1	2	2	2	3	2	2	
Unit annual power consumption		1,554	1,737	1,726	1,744	1,805	1,922	1,955	1,901	2,051	2,868	
Residential	kWh/y	338	395	413	400	455	557	586	591	655	713	
Commercial	kWh/y	4,150	3,800	4,208	4,300	4,461	5,011	4,744	4,349	4,654	5,802	
Industrial	kWh/y								22,984			
Government	kWh/y	3,175	3,846	6,290	6,734	7,459	7,352	6,206	6,133	6,789	12,547	
Others	kWh/y	12,375		4,915	7,797	2,581	2,310	2,375	1,990	3,595	25,386	
Tulagi (Central)	D											
Power consumption						74	96	167	198	216	158	
Residential	MWh					12	11	10	11	10	9	
Commercial	MWh					48	79	157	187	206	149	
Industrial	MWh					13	6	0	0	0	0	
Government	MWh					0	0	0	0	0	0	

Table 4-1-1 Past record of power consumption by category wise during 1989-1998 (Grid and Powerstation wise)

Name of Grid	Unit	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average or Growth Rate
MIN/Charge	MWh					0	0	0	0	0	0	
Others	MWh					0	0	0	0	0	0	
Number of consumers						30	31	32	34	35	190	
Residential						23	23	23	25	24	145	
Commercial						7	6	7	7	9	25	
Industrial						0	0	0	0	0	0	
Government						0	0	0	0	0	9	
Others						0	2	2	2	2	11	
Unit annual power consumption						2,459	3,102	5,218	5,837	6,161	831	
Residential	kWh/y					542	475	431	430	409	64	
Commercial	kWh/y					6,825	13,206	22,421	26,779	22,841	5,945	
Industrial	kWh/y											
Government	kWh/y										0	
Others	kWh/y						121	50	141	130	11	
Solomon Islands												
Power consumption		31,304	34,310	39,187	41,396	45,276	49,454	55,575	57,941	73,396	59,565	
Residential	MWh	6,662	6,918	7,304	8,151	9,039	9,772	11,095	11,803	12,108	13,355	
Commercial	MWh	7,429	10,820	15,216	17,228	18,583	20,129	24,239	25,201	41,531	25,358	
Industrial	MWh	6,877	8,876	11,205	10,675	11,893	11,336	12,290	12,080	11,935	12,770	
Government	MWh	8,276	6,392	4,512	4,309	4,733	7,009	6,611	7,490	5,871	6,495	
MIN/Charge	MWh	92	80	76	71	63	180	101	93	93	85	
Others	MWh	1,968	1,224	875	962	965	1,027	1,240	1,274	1,857	1,502	
Number of consumers		6,090	6,522	6,461	6,654	6,922	7,098	7,546	7,944	8,056	8,427	
Residential		4,834	4,961	5,033	5,181	5,486	5,546	5,895	6,114	6,265	6,545	
Commercial		550	1,024	871	954	931	1,067	1,203	1,295	1,288	1,337	
Industrial		247	138	224	213	157	160	128	181	171	175	
Government		217	259	197	182	233	204	194	212	199	210	
Others		242	140	136	124	115	121	126	142	133	160	
Unit annual power consumption		5,140	5,261	6,065	6,221	6,541	6,967	7,365	7,294	9,111	7,068	
Residential	kWh/y	1,378	1,394	1,451	1,573	1,648	1,762	1,882	1,930	1,933	2,040	
Commercial	kWh/y	13,507	10,566	17,470	18,058	19,960	18,865	20,149	19,460	32,245	18,966	
Industrial	kWh/y	27,844	64,319	50,022	50,118	75,750	70,848	96,015	66,741	69,796	72,973	
Government	kWh/y	38,140	24,680	22,902	23,678	20,315	34,358	34,076	35,332	29,504	30,927	
Others	kWh/y	8,512	9,314	6,989	8,332	8,937	9,976	10,640	9,626	14,665	9,921	

Source: SIEA Engineering Report Statistics Summary 1990-1997, and SIEA Engineering Report September, 1999
SIEA Head Quarter Data 1983-1998
SIEA Lungga P/S OIC statistical data 1983-1998

Note: D or H in the box of Unit describe type of powerstation, D means Diesel powerstation and H means Hydro powerstation.

Table 4-3-1 Result of Power Demand Forecast for Solomon Islands

Power Demand Forecast (MWh)

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honiara	45,048	47,841	50,274	52,834	56,289	59,990	63,299	66,805	70,522	74,462	78,639	84,487	88,567	92,598	96,971	101,557	105,851	110,330	115,004	119,880	124,968
Auki-Malu'u	1,670	1,885	2,014	2,152	11,499	11,660	21,072	21,248	21,438	21,641	21,859	22,074	22,304	22,550	22,813	23,094	23,371	32,863	33,176	33,510	33,866
Buala	293	339	375	414	458	506	551	601	655	714	778	891	958	1,031	1,110	1,195	1,275	1,360	1,452	1,551	1,656
Kirakira	299	313	343	376	413	454	493	537	584	635	692	796	855	918	986	1,060	1,130	1,204	1,284	1,370	1,462
Lata	269	319	340	363	387	413	437	462	489	518	548	575	604	635	667	701	730	761	794	828	865
Gizo	1,836	2,550	2,673	2,803	2,939	3,083	3,206	3,335	3,469	3,609	3,755	3,873	3,996	4,123	4,254	4,389	4,489	4,592	4,698	4,806	4,916
Noro-Munda	9,992	10,701	11,838	13,104	14,513	16,083	17,651	19,382	21,294	23,409	25,748	27,879	30,196	32,714	35,452	38,432	41,202	44,183	47,391	50,847	54,569
Tulagi	158	215	228	241	255	270	285	300	317	334	353	370	388	408	428	450	470	491	514	537	562
Choiseul	32	74	82	91	101	112	123	134	146	159	174	243	257	273	290	308	322	338	354	372	390
Rennell and Bellona	22	24	26	29	32	35	37	40	43	46	50	52	55	58	61	65	67	69	71	74	76
Solomon Islands	59,618	64,260	68,193	72,407	86,887	92,606	107,155	112,844	118,957	125,527	132,595	141,241	148,180	155,306	163,032	171,251	178,907	196,192	204,739	213,774	223,330

Peak Demand Forecast (kW)

Name of Demand Center \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honiara	10,450	10,604	11,144	11,711	12,477	13,298	14,168	14,953	15,785	16,667	17,602	18,727	19,632	20,525	21,495	22,511	23,237	24,221	25,247	26,317	27,434
Auki-Malu'u	470	487	481	478	2,387	2,164	3,538	3,578	3,622	3,668	3,717	3,765	3,816	3,871	3,929	3,990	4,051	5,715	5,788	5,866	5,948
Buala	70	81	89	98	108	119	129	139	151	164	177	202	216	231	247	265	281	298	316	336	357
Kirakira	55	69	76	84	92	101	110	120	131	143	155	179	193	207	223	240	256	274	292	312	334
Lata	65	66	70	75	80	86	91	96	102	108	115	121	128	134	141	149	156	163	170	178	186
Gizo	270	485	512	541	571	603	632	662	694	727	763	793	824	856	891	926	955	984	1,015	1,046	1,079
Noro-Munda	1,790	1,930	2,150	2,397	2,673	2,983	3,297	3,647	4,036	4,469	4,951	5,401	5,893	6,433	7,024	7,673	8,289	8,957	9,683	10,470	11,326
Tulagi	49	61	65	68	71	75	79	82	86	91	95	99	103	108	113	118	122	127	132	137	143
Choiseul	14	19	21	23	25	28	30	32	35	38	41	57	60	63	66	70	73	76	79	82	86
Rennell and Bellona	6	6	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	16	16	17

Table 4-3-2 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: **Guadalcanal/Honiara-Lungga**

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	113,170	117,154	121,207	125,328	129,539	133,840	138,230	142,708	147,275	151,944	156,715	161,589	166,566	171,646	176,829	182,117	187,507	193,001	198,598	204,318	210,161
Growth Rate(%)	4.04	3.52	3.46	3.40	3.36	3.32	3.28	3.24	3.20	3.17	3.14	3.11	3.08	3.05	3.02	2.99	2.96	2.93	2.90	2.88	2.86
Elect. Ratio(%)	23.40	23.24	23.07	22.91	22.76	22.62	22.38	22.15	21.93	21.72	21.52	21.22	20.93	20.66	20.39	20.13	19.85	19.59	19.34	19.09	18.85
No.of family members	5.43	5.41	5.39	5.36	5.34	5.32	5.30	5.28	5.26	5.24	5.21	5.19	5.17	5.15	5.13	5.11	5.09	5.06	5.04	5.02	5.00
No.of Customers	4,879	5,035	5,191	5,352	5,518	5,689	5,837	5,989	6,145	6,304	6,468	6,604	6,743	6,884	7,029	7,177	7,320	7,467	7,616	7,768	7,923.53
Consump./Customer(kWh)	2,339	2,421	2,500	2,583	2,668	2,756	2,833	2,913	2,994	3,078	3,164	3,237	3,312	3,388	3,466	3,545	3,616	3,689	3,762	3,838	3,914
Energy Consum.(MWh)	11,411	12,188	12,981	13,825	14,724	15,681	16,539	17,444	18,399	19,406	20,468	21,379	22,330	23,323	24,360	25,444	26,472	27,541	28,654	29,812	31,016
Growth Rate(%)		6.81	6.50	6.50	6.50	6.50	5.47	5.47	5.47	5.47	5.47	4.45	4.45	4.45	4.45	4.45	4.04	4.04	4.04	4.04	4.04
Share to Total(%)	25.3	25.5	25.8	26.2	26.2	26.1	26.1	26.1	26.1	26.1	26.0	25.3	25.2	25.2	25.1	25.1	25.0	25.0	24.9	24.9	24.8
Commercial																					
No.of Customers	981	1,007	1,012	1,017	1,048	1,081	1,109	1,138	1,167	1,198	1,229	1,321	1,349	1,377	1,406	1,435	1,464	1,493	1,523	1,554	1,585
Constituent Ratio to Res.	0.20	0.20	0.195	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Consump./Customer(kWh)	22,755	23,665	24,612	25,596	26,620	27,685	28,654	29,657	30,695	31,769	32,881	33,867	34,883	35,930	37,008	38,118	39,071	40,048	41,049	42,075	43,127
Energy Consum.(MWh)	22,323	23,832	24,915	26,029	27,910	29,926	31,779	33,746	35,835	38,054	40,410	44,733	47,042	49,471	52,025	54,712	57,201	59,804	62,525	65,370	68,344
Growth Rate(%)		6.76	4.54	4.47	7.22	7.22	6.19	6.19	6.19	6.19	6.19	10.70	5.16	5.16	5.16	5.16	4.55	4.55	4.55	4.55	4.55
Share to Total(%)	49.6	49.8	49.6	49.3	49.6	49.9	50.2	50.5	50.8	51.1	51.4	52.9	53.1	53.4	53.7	53.9	54.0	54.2	54.4	54.5	54.7
Public & Others																					
No.of Customers	185	187	189	191	194	196	198	200	201	203	204	206	210	211	215	220	224	228	233	238	242
Constituent Ratio	0.032	0.031	0.0305	0.03	0.0295	0.029	0.0285	0.028	0.0275	0.027	0.0265	0.026	0.026	0.0255	0.0255	0.0255	0.0255	0.0255	0.0255	0.0255	0.0255
Consump./Cust.(kWh)	34,185	34,202	34,220	34,237	34,254	34,271	34,288	34,305	34,322	34,339	34,357	34,374	34,391	34,408	34,425	34,443	34,460	34,477	34,494	34,512	34,529
Energy Consum.(MWh)	6,324	6,406	6,475	6,542	6,635	6,729	6,788	6,846	6,902	6,956	7,008	7,083	7,235	7,249	7,404	7,564	7,719	7,877	8,039	8,204	8,372
Growth Rate(%)		1.30	1.06	1.04	1.43	1.40	0.88	0.85	0.82	0.78	0.75	1.07	2.15	0.19	2.15	2.15	2.05	2.05	2.05	2.05	2.05
Share to Total(%)	14.0	13.4	12.9	12.4	11.8	11.2	10.7	10.2	9.8	9.3	8.9	8.4	8.2	7.8	7.6	7.4	7.3	7.1	7.0	6.8	6.7
Industry																					
No.of Customers	149	149	150	150	151	152	153	154	154	155	156	157	157	158	159	160	161	161	162	163	164
Consump./Customer (kWh)	33,491	36,338	39,427	42,778	46,414	50,359	53,633	57,119	60,832	64,786	68,997	72,102	75,346	78,737	82,280	85,982	89,422	92,999	96,719	100,587	104,611
Energy Ind. Demand (MWh)	4,990	5,414	5,904	6,438	7,020	7,655	8,193	8,769	9,386	10,046	10,752	11,293	11,860	12,455	13,081	13,738	14,359	15,008	15,686	16,395	17,136
Energy Big Cust.(MWh): Gold Ridge	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452	67,452
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh): CEMA	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	4,990	5,414	5,904	6,438	7,020	7,655	8,193	8,769	9,386	10,046	10,752	11,293	11,960	12,555	13,181	13,838	14,459	15,108	15,786	16,495	17,236
Growth Rate(%)		8.50	9.04	9.04	9.04	9.04	6.57	6.57	6.57	6.57	6.57	4.78	5.58	4.74	4.75	4.75	4.29	4.30	4.30	4.30	4.30
Share to Total(%)	11.08	11.32	11.74	12.19	12.5	12.8	12.9	13.1	13.3	13.5	13.7	13.4	13.5	13.6	13.6	13.6	13.7	13.7	13.7	13.8	13.8
Total																					
No.of Customers	6,194	6,379	6,543	6,711	5519.5	5690.6	5838.6	5990.4	6146.1	6305.9	6469.9	6605.8	6744.5	6886.1	7030.8	7178.4	7322.0	7468.4	7617.8	7770.1	7925.5
Energy Consumption (MWh)	45,048	47,841	50,274	52,834	56,289	59,990	63,299	66,805	70,522	74,462	78,639	84,487	88,567	92,598	96,971	101,557	105,851	110,330	115,004	119,880	124,968
Growth Rate(%)		6.20	5.09	5.09	6.54	6.58	5.52	5.54	5.56	5.59	5.61	7.44	4.83	4.55	4.72	4.73	4.23	4.23	4.24	4.24	4.24
T & D Losses(%)	16.3	16.2	16.0	15.9	15.8	15.7	15.6	15.5	15.4	15.2	15.1	15.0	14.9	14.8	14.7	14.6	14.5	14.3	14.2	14.1	14.0
Energy Sent Out(MWh)	52,185	57,399	60,234	63,213	67,252	71,575	75,417	79,484	83,790	88,348	93,175	99,966	104,649	109,261	114,264	119,503	124,384	129,470	134,770	140,292	146,047
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	53,799	59,174	62,097	65,168	69,332	73,789	77,750	81,943	86,381	91,081	96,057	103,057	107,885	112,640	117,798	123,199	128,231	133,474	138,938	144,631	150,564
Load Fcator (%)	49.21	51.50	51.50	51.50	51.50	51.50	51.0	51.0	51.0	51.0	51.0	51.50	51.50	51.50	51.50	51.50	52.0	52.0	52.0	52.0	52.0
Peak Load (kW)	10,450	10,604	11,144	11,711	12,477	13,298	14,168	14,953	15,785	16,667	17,602	18,727	19,632	20,525	21,495	22,511	23,237	24,221	25,247	26,317	27,434

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-3 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Malaita/Auki-Malu'u-Bina Harbour

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	109,143	112,035	115,004	118,052	121,174	124,373	127,651	131,008	134,447	137,969	141,577	145,272	149,057	152,932	156,908	160,988	165,174	169,468	173,874	178,395	183,033
Growth Rate(%)	3.08	2.65	2.65	2.65	2.65	2.64	2.64	2.63	2.63	2.62	2.62	2.61	2.61	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Elect. Ratio(%)	2.22	2.26	2.22	2.18	2.14	2.10	2.07	2.04	2.00	1.97	1.94	1.91	1.88	1.86	1.83	1.80	1.77	1.75	1.72	1.69	1.67
No.of family members	5.69	5.66	5.64	5.62	5.59	5.57	5.54	5.52	5.49	5.47	5.44	5.42	5.40	5.37	5.35	5.32	5.30	5.27	5.25	5.22	5.20
No.of Customers	426	447	453	458	464	469	476	483	491	498	505	513	521	529	536	544	553	561	569	578	587
Consump./Customer(kWh)	1,095	1,100	1,177	1,260	1,348	1,442	1,536	1,636	1,742	1,856	1,976	2,095	2,220	2,354	2,495	2,645	2,790	2,943	3,105	3,276	3,456
Energy Consum.(MWh)	466	492	533	577	625	677	731	791	855	924	999	1,075	1,156	1,244	1,338	1,440	1,542	1,651	1,768	1,893	2,027
Growth Rate(%)		5.52	8.28	8.28	8.28	8.28	8.10	8.10	8.10	8.10	8.10	7.59	7.59	7.59	7.59	7.59	7.08	7.08	7.08	7.08	7.08
Share to Total(%)	27.9	26.1	26.5	26.8	5.4	5.8	3.5	3.7	4.0	4.3	4.6	4.9	5.2	5.5	5.9	6.2	6.6	5.0	5.3	5.6	6.0
Commercial																					
No.of Customers	105	109	109	110	110	110	111	111	112	112	113	113	114	114	115	115	116	116	117	117	117
Constituent Ratio to Res.	0.25	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.2
Consump./Customer(kWh)	3,924	4,041	4,163	4,287	4,416	4,549	4,662	4,779	4,898	5,021	5,146	5,249	5,354	5,461	5,570	5,682	5,796	5,911	6,030	6,150	6,273
Energy Consum.(MWh)	412	441	456	470	486	501	516	532	548	564	581	595	609	624	639	655	670	686	703	719	736
Growth Rate(%)		7.14	3.24	3.23	3.22	3.21	3.01	3.00	2.99	2.98	2.97	2.45	2.44	2.43	2.42	2.40	2.39	2.38	2.37	2.35	2.34
Share to Total(%)	24.7	23.4	22.6	21.9	4.2	4.3	2.5	2.5	2.6	2.6	2.7	2.7	2.7	2.8	2.8	2.8	2.9	2.1	2.1	2.1	2.2
Public & Others																					
No.of Customers	50	62	62	62	63	63	64	64	64	65	65	66	66	67	67	68	68	69	69	70	70
Constituent Ratio	0.112	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Consump./Cust.(kWh)	11,793	11,911	12,626	13,383	14,186	15,038	15,865	16,737	17,658	18,629	19,653	20,636	21,668	22,751	23,889	25,083	26,212	27,392	28,624	29,912	31,258
Energy Consum.(MWh)	590	737	785	836	890	948	1,008	1,071	1,139	1,210	1,286	1,361	1,439	1,523	1,610	1,703	1,793	1,887	1,986	2,091	2,200
Growth Rate(%)		24.95	6.51	6.50	6.50	6.50	6.30	6.30	6.30	6.29	6.29	5.78	5.78	5.78	5.77	5.77	5.26	5.26	5.25	5.25	5.24
Share to Total(%)	35.3	39.1	39.0	38.8	7.7	8.1	4.8	5.0	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.7	5.7	6.0	6.2	6.5
Industry																					
No.of Customers	13	13	14	14	15	16	17	17	18	19	20	20	21	22	23	24	25	26	27	27	28
Consump./Customer (kWh)	15,522	16,530	17,605	18,749	19,968	21,266	22,435	23,669	24,971	26,345	27,794	29,183	30,642	32,175	33,783	35,472	37,069	38,737	40,480	42,302	44,205
Energy Ind. Demand (MWh)	202	215	240	269	300	336	370	408	450	496	547	598	653	713	778	850	919	994	1,075	1,163	1,258
Energy Big Cust.(MWh): Bina Habour	0	0	0	0	9,198	9,198	18,396	18,396	18,396	18,396	18,396	18,396	18,396	18,396	18,396	18,396	18,396	27,594	27,594	27,594	27,594
Big Cust.(Bina) Takeover (MWh)	0	0	0	0	9,198	9,198	18396	18396	18396	18396	18396	18396	18396	18396	18396	18396	18396	27594	27594	27594	27,594
Captive Power (MWh): CEMA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	202	215	240	269	9,498	9,534	18,817	18,855	18,897	18,943	18,994	19,044	19,099	19,159	19,225	19,296	19,365	28,638	28,720	28,807	28,902
Growth Rate(%)		6.50	11.83	11.83	3434.67	0.37	49.33	0.20	0.22	0.24	0.27	0.26	0.29	0.31	0.34	0.37	0.36	32.38	0.28	0.30	0.33
Share to Total(%)	12.08	11.40	11.93	12.49	82.6	81.8	89.3	88.7	88.1	87.5	86.9	86.3	85.6	85.0	84.3	83.6	82.9	87.1	86.6	86.0	85.3
Total																					
No.of Customers	594	631	638	645	463.8	469.3	476.4	483.5	490.8	498.1	505.6	513.2	520.9	528.7	536.6	544.7	552.9	561.1	569.6	578.1	586.8
Energy Consumption (MWh)	1,670	1,885	2,014	2,152	11,499	11,660	21,072	21,248	21,438	21,641	21,859	22,074	22,304	22,550	22,813	23,094	23,371	32,863	33,176	33,510	33,866
Growth Rate(%)		12.90	6.81	6.87	434.34	1.40	80.72	0.84	0.89	0.95	1.01	0.98	1.04	1.10	1.17	1.23	1.20	40.62	0.95	1.01	1.06
T & D Losses(%)	-5.0	5.0	5.3	5.7	6.0	6.1	6.3	6.4	6.5	6.6	6.8	6.9	7.0	7.1	7.3	7.4	7.5	7.6	7.8	7.9	8.0
Energy Sent Out(MWh)	1,542	1,988	2,131	2,286	12,257	12,446	22,523	22,743	22,977	23,227	23,494	23,758	24,039	24,337	24,655	24,994	25,329	35,667	36,057	36,471	36,910
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	1,590	2,049	2,197	2,356	12,636	12,831	23,220	23,446	23,688	23,946	24,221	24,493	24,782	25,090	25,418	25,767	26,112	36,770	37,172	37,599	38,051
Load Fcator (%)	40.6	44.2	47.8	51.4	55.0	61.5	68.0	67.8	67.6	67.4	67.1	66.9	66.7	66.5	66.3	66.1	65.9	65.6	65.4	65.2	65.0
Peak Load (kW)	470	487	481	478	2,387	2,164	3,538	3,578	3,622	3,668	3,717	3,765	3,816	3,871	3,929	3,990	4,051	5,715	5,788	5,866	5,948

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-4 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Isabel/Buala

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	23,546	24,316	25,106	25,915	26,741	27,586	28,448	29,330	30,231	31,153	32,094	33,053	34,035	35,039	36,066	37,111	38,180	39,272	40,390	41,533	42,700
Growth Rate(%)	3.33	3.27	3.25	3.22	3.19	3.16	3.13	3.10	3.07	3.05	3.02	2.99	2.97	2.95	2.93	2.90	2.88	2.86	2.85	2.83	2.81
Elect. Ratio(%)	2.25	2.34	2.40	2.45	2.51	2.57	2.61	2.65	2.69	2.73	2.78	2.81	2.84	2.87	2.91	2.94	2.96	2.99	3.01	3.03	3.06
No.of family members	5.35	5.33	5.31	5.29	5.28	5.26	5.24	5.23	5.21	5.19	5.17	5.16	5.14	5.12	5.10	5.09	5.07	5.05	5.03	5.02	5.00
No.of Customers	99	107	113	120	127	135	142	149	156	164	172	180	188	197	205	215	223	232	241	251	261
Consump./Customer(kWh)	1,023	1,074	1,128	1,184	1,244	1,306	1,365	1,426	1,490	1,557	1,627	1,692	1,760	1,830	1,904	1,980	2,049	2,121	2,195	2,272	2,351
Energy Consum.(MWh)	101	115	128	142	158	176	193	212	233	255	280	305	331	360	391	425	458	492	530	571	614
Growth Rate(%)		13.40	11.30	11.30	11.30	11.30	9.73	9.72	9.73	9.73	9.72	8.68	8.68	8.68	8.68	8.68	7.64	7.64	7.64	7.64	7.64
Share to Total(%)	34.6	33.9	34.1	34.4	34.6	34.8	35.1	35.3	35.6	35.8	36.0	34.2	34.6	34.9	35.2	35.6	35.9	36.2	36.5	36.8	37.1
Commercial																					
No.of Customers	22	24	25	26	28	30	31	32	34	36	37	39	40	42	44	46	47	49	51	53	55
Constituent Ratio to Res.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Consump./Customer(kWh)	5,750	6,038	6,339	6,656	6,989	7,339	7,669	8,014	8,375	8,752	9,145	9,511	9,892	10,287	10,699	11,127	11,516	11,919	12,336	12,768	13,215
Energy Consum.(MWh)	127	143	159	176	196	217	238	260	284	311	340	369	400	433	470	509	546	586	629	675	725
Growth Rate(%)		13.08	10.99	10.99	10.99	10.99	9.42	9.42	9.42	9.42	9.42	8.37	8.37	8.37	8.37	8.37	7.33	7.33	7.33	7.33	7.33
Share to Total(%)	43.2	42.2	42.4	42.6	42.7	42.9	43.1	43.3	43.4	43.6	43.7	41.4	41.7	42.0	42.3	42.6	42.9	43.1	43.3	43.5	43.8
Public & Others																					
No.of Customers	12	15	15	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32
Constituent Ratio	0.112	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Consump./Cust.(kWh)	5,418	5,580	5,747	5,920	6,097	6,280	6,437	6,598	6,763	6,932	7,106	7,248	7,393	7,541	7,691	7,845	7,963	8,082	8,204	8,327	8,452
Energy Consum.(MWh)	65	81	88	95	104	112	120	129	138	147	158	167	177	187	199	210	221	231	243	255	267
Growth Rate(%)		24.61	8.55	8.55	8.54	8.54	6.99	6.99	6.98	6.98	6.98	5.95	5.94	5.94	5.94	5.93	4.91	4.90	4.90	4.89	4.89
Share to Total(%)	22.2	23.9	23.5	23.1	22.6	22.2	21.8	21.4	21.0	20.6	20.2	18.7	18.5	18.2	17.9	17.6	17.3	17.0	16.7	16.4	16.1
Industry																					
No.of Customers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Consump./Customer (kWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy Ind. Demand (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh): CEMA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Share to Total(%)	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.2	4.9	4.5	4.2	3.9	3.7	3.5	3.2	3.0
Total																					
No.of Customers	133	145	154	163	127.4	135.0	141.8	148.9	156.3	164.1	172.3	180.1	188.2	196.7	205.5	214.8	223.4	232.3	241.6	251.2	261.3
Energy Consumption (MWh)	293	339	375	414	458	506	551	601	655	714	778	891	958	1,031	1,110	1,195	1,275	1,360	1,452	1,551	1,656
Growth Rate(%)		15.75	10.51	10.52	10.53	10.54	8.99	9.00	9.01	9.01	9.02	14.45	7.55	7.59	7.63	7.66	6.71	6.73	6.76	6.78	6.81
T & D Losses(%)	14.1	14.0	13.9	13.8	13.7	13.6	13.5	13.4	13.3	13.2	13.0	12.9	12.8	12.7	12.6	12.5	12.4	12.3	12.2	12.1	12.0
Energy Sent Out(MWh)	331	396	437	483	533	588	640	697	759	826	899	1,028	1,104	1,187	1,276	1,372	1,462	1,558	1,662	1,772	1,890
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	341	408	451	497	549	606	660	718	782	852	927	1,060	1,138	1,223	1,315	1,414	1,507	1,607	1,713	1,827	1,949
Load Fcator (%)	47.7	47.5	47.8	48.1	48.4	48.6	48.9	49.2	49.5	49.8	50.1	50.4	50.7	51.0	51.3	51.5	51.8	52.1	52.4	52.7	53.0
Peak Load (kW)	70	81	89	98	108	119	129	139	151	164	177	202	216	231	247	265	281	298	316	336	357

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-5 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Makira/Kirakira

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	30,196	31,132	32,094	33,083	34,096	35,133	36,200	37,291	38,409	39,562	40,749	41,966	43,214	44,495	45,810	47,161	48,553	49,973	51,428	52,920	54,454
Growth Rate(%)	3.12	3.10	3.09	3.08	3.06	3.04	3.04	3.01	3.00	3.00	3.00	2.99	2.98	2.96	2.96	2.95	2.95	2.93	2.91	2.90	2.90
Elect. Ratio(%)	3.12	3.26	3.31	3.36	3.41	3.47	3.50	3.54	3.58	3.62	3.66	3.68	3.71	3.73	3.76	3.78	3.79	3.80	3.80	3.81	3.82
No.of family members	5.90	5.88	5.86	5.84	5.82	5.80	5.78	5.76	5.74	5.72	5.70	5.68	5.66	5.64	5.62	5.60	5.58	5.56	5.54	5.52	5.50
No.of Customers	160	173	181	191	200	210	219	229	240	250	262	272	283	294	306	318	330	341	353	365	378
Consump./Customer(kWh)	726	770	816	865	917	972	1,025	1,082	1,141	1,204	1,270	1,334	1,400	1,470	1,544	1,621	1,694	1,770	1,850	1,933	2,020
Energy Consum.(MWh)	116	133	148	165	183	204	225	248	274	302	332	363	396	433	473	516	558	604	653	706	764
Growth Rate(%)		14.48	11.30	11.30	11.30	11.30	10.25	10.25	10.25	10.25	10.25	9.20	9.20	9.20	9.20	9.20	8.16	8.16	8.16	8.16	8.16
Share to Total(%)	38.9	42.6	43.2	43.8	44.4	45.0	45.6	46.2	46.8	47.5	48.1	45.6	46.4	47.2	47.9	48.7	49.4	50.1	50.9	51.6	52.3
Commercial																					
No.of Customers	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Constituent Ratio to Res.	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.1
Consump./Customer(kWh)	4,063	4,266	4,480	4,704	4,939	5,186	5,419	5,663	5,918	6,184	6,462	6,721	6,990	7,269	7,560	7,862	8,138	8,422	8,717	9,022	9,338
Energy Consum.(MWh)	73	82	90	99	109	119	129	140	152	166	180	193	208	223	240	258	275	293	312	332	353
Growth Rate(%)		12.77	9.63	9.63	9.63	9.62	8.58	8.57	8.57	8.57	8.56	7.52	7.52	7.52	7.51	7.51	6.47	6.47	6.47	6.46	6.46
Share to Total(%)	24.5	26.4	26.4	26.3	26.3	26.3	26.2	26.2	26.1	26.1	26.0	24.3	24.3	24.3	24.4	24.4	24.3	24.3	24.3	24.2	24.2
Public & Others																					
No.of Customers	25	21	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	38	39	40	42
Constituent Ratio	0.112	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Consump./Cust.(kWh)	4,217	4,344	4,474	4,608	4,746	4,889	5,011	5,136	5,265	5,396	5,531	5,642	5,755	5,870	5,987	6,107	6,199	6,292	6,386	6,482	6,579
Energy Consum.(MWh)	105	93	100	107	115	124	132	141	150	159	170	179	188	199	209	221	231	241	251	262	274
Growth Rate(%)		-12.02	7.52	7.52	7.51	7.51	6.47	6.47	6.47	6.47	6.46	5.43	5.43	5.43	5.42	5.42	4.39	4.39	4.39	4.38	4.38
Share to Total(%)	35.3	29.7	29.1	28.5	27.9	27.3	26.8	26.2	25.6	25.1	24.5	22.5	22.1	21.6	21.2	20.8	20.4	20.0	19.6	19.1	18.7
Industry																					
No.of Customers	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Consump./Customer (kWh)	4,111	4,317	4,532	4,759	4,997	5,247	5,483	5,730	5,987	6,257	6,538	6,800	7,072	7,355	7,649	7,955	8,233	8,522	8,820	9,129	9,448
Energy Ind. Demand (MWh)	4	4	5	5	6	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	21
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh): CEMA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	4	4	5	5	6	6	7	8	8	9	10	61	62	63	64	65	66	67	68	70	71
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	83.76	1.41	1.51	1.60	1.70	1.58	1.67	1.75	1.84	1.94
Share to Total(%)	1.38	1.38	1.39	1.39	1.4	1.4	1.4	1.4	1.4	1.4	1.4	7.7	7.2	6.8	6.5	6.1	5.8	5.6	5.3	5.1	4.9
Total																					
No.of Customers	204	214	225	236	200.1	210.1	219.5	229.4	239.7	250.5	261.8	272.3	283.2	294.5	306.3	318.5	329.7	341.2	353.2	365.5	378.3
Energy Consumption (MWh)	299	313	343	376	413	454	493	537	584	635	692	796	855	918	986	1,060	1,130	1,204	1,284	1,370	1,462
Growth Rate(%)		4.58	9.72	9.74	9.77	9.79	8.76	8.78	8.80	8.82	8.85	15.10	7.35	7.40	7.45	7.50	6.56	6.60	6.64	6.67	6.71
T & D Losses(%)	0.6	1.0	1.3	1.6	1.9	2.2	2.5	2.9	3.2	3.5	3.8	4.1	4.5	4.8	5.1	5.4	5.7	6.0	6.4	6.7	7.0
Energy Sent Out(MWh)	292	316	348	383	421	464	507	553	604	659	720	832	896	965	1,041	1,123	1,201	1,284	1,375	1,471	1,576
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	301	325	358	394	434	479	522	570	622	680	742	857	923	995	1,073	1,158	1,238	1,324	1,417	1,517	1,624
Load Fcator (%)	62.0	51.5	51.4	51.3	51.3	51.2	51.1	51.0	50.9	50.9	50.8	50.7	50.6	50.6	50.5	50.4	50.3	50.2	50.2	50.1	50.0
Peak Load (kW)	55	69	76	84	92	101	110	120	131	143	155	179	193	207	223	240	256	274	292	312	334

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-6 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Temotu/Lata

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	21,869	22,449	23,032	23,620	24,211	24,808	25,407	26,011	26,617	27,229	27,848	28,474	29,105	29,743	30,386	31,034	31,688	32,346	33,010	33,680	34,357
Growth Rate(%)	2.70	2.65	2.60	2.55	2.51	2.46	2.42	2.37	2.33	2.30	2.27	2.25	2.22	2.19	2.16	2.13	2.11	2.08	2.05	2.03	2.01
Elect. Ratio(%)	2.70	2.72	2.77	2.83	2.88	2.94	2.99	3.04	3.09	3.14	3.20	3.24	3.28	3.32	3.37	3.41	3.44	3.48	3.51	3.54	3.58
No.of family members	4.96	4.96	4.96	4.97	4.97	4.97	4.97	4.97	4.98	4.98	4.98	4.98	4.98	4.99	4.99	4.99	4.99	4.99	5.00	5.00	5.00
No.of Customers	119	123	129	134	141	147	153	159	165	172	179	185	191	198	205	212	219	225	232	239	246
Consump./Customer(kWh)	576	608	641	676	714	753	791	830	872	915	961	1,004	1,049	1,097	1,146	1,197	1,245	1,295	1,347	1,401	1,457
Energy Consum.(MWh)	69	75	83	91	100	111	121	132	144	157	172	186	201	217	235	254	272	292	312	335	358
Growth Rate(%)		9.19	10.25	10.25	10.25	10.25	9.20	9.20	9.20	9.20	9.20	8.16	8.16	8.16	8.16	8.16	7.12	7.12	7.12	7.12	7.12
Share to Total(%)	25.5	23.5	24.3	25.1	25.9	26.8	27.6	28.5	29.4	30.4	31.3	32.3	33.3	34.2	35.2	36.2	37.3	38.3	39.3	40.4	41.5
Commercial																					
No.of Customers	36	36	36	37	37	37	37	37	37	36	36	35	35	34	33	32	31	29	28	26	25
Constituent Ratio to Res.	0.30	0.29	0.28	0.27	0.26	0.25	0.24	0.23	0.22	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.1
Consump./Customer(kWh)	1,522	1,568	1,615	1,663	1,713	1,765	1,809	1,854	1,900	1,948	1,996	2,036	2,077	2,119	2,161	2,204	2,237	2,271	2,305	2,339	2,375
Energy Consum.(MWh)	55	56	59	61	63	65	67	68	70	71	72	72	72	72	71	70	69	67	64	62	58
Growth Rate(%)		3.03	3.91	3.77	3.63	3.48	2.31	2.14	1.94	1.73	1.49	0.26	-0.02	-0.34	-0.69	-1.08	-2.48	-2.99	-3.57	-4.26	-5.07
Share to Total(%)	20.4	17.7	17.2	16.8	16.3	15.8	15.3	14.8	14.2	13.7	13.1	12.5	11.9	11.3	10.7	10.0	9.4	8.8	8.1	7.4	6.8
Public & Others																					
No.of Customers	17	22	23	23	24	24	25	25	25	26	26	26	26	27	27	27	27	27	27	27	27
Constituent Ratio	0.143	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10
Consump./Cust.(kWh)	6,714	6,916	7,123	7,337	7,557	7,784	7,978	8,178	8,382	8,592	8,806	8,982	9,162	9,345	9,532	9,723	9,869	10,017	10,167	10,320	10,474
Energy Consum.(MWh)	114	155	163	171	180	189	197	205	213	221	230	236	243	249	256	263	267	271	275	280	283
Growth Rate(%)		35.75	5.16	5.13	5.10	5.07	4.02	3.99	3.95	3.91	3.87	2.83	2.79	2.75	2.71	2.66	1.62	1.57	1.52	1.47	1.42
Share to Total(%)	42.5	48.6	47.9	47.2	46.5	45.8	45.0	44.3	43.5	42.7	41.9	41.0	40.2	39.3	38.4	37.5	36.6	35.6	34.7	33.7	32.8
Industry																					
No.of Customers	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Consump./Customer (kWh)	31,123	32,679	34,313	36,029	37,830	39,722	41,509	43,377	45,329	47,369	49,500	51,728	54,056	56,488	59,030	61,687	64,154	66,720	69,389	72,165	75,051
Energy Ind. Demand (MWh)	31	33	36	40	44	48	53	58	63	69	75	81	89	96	105	114	122	132	142	153	164
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh):	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	31	33	36	40	44	48	53	58	63	69	75	81	89	96	105	114	122	132	142	153	164
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.99	7.99	7.99	7.99	7.99	7.10	7.10	7.10	7.10	7.10
Share to Total(%)	11.59	10.25	10.59	10.95	11.3	11.7	12.1	12.5	12.9	13.3	13.7	14.2	14.7	15.2	15.7	16.2	16.8	17.3	17.9	18.4	19.0
Total																					
No.of Customers	173	183	189	196	140.6	146.9	152.8	158.9	165.3	171.9	178.8	185.0	191.5	198.2	205.1	212.3	218.7	225.2	232.0	238.9	246.1
Energy Consumption (MWh)	269	319	340	363	387	413	437	462	489	518	548	575	604	635	667	701	730	761	794	828	865
Growth Rate(%)		18.73	6.66	6.68	6.71	6.74	5.74	5.77	5.81	5.84	5.87	4.96	5.01	5.05	5.09	5.14	4.18	4.23	4.28	4.33	4.39
T & D Losses(%)	-110.2	9.0	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	7.0
Energy Sent Out(MWh)	124	352	375	399	425	453	479	506	535	565	598	627	657	690	724	760	791	823	858	894	932
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	128	362	386	411	438	467	494	522	551	583	616	646	678	711	746	784	815	849	884	921	961
Load Fcator (%)	47.2	55.5	55.4	55.3	55.1	55.0	54.9	54.7	54.6	54.5	54.3	54.2	54.1	53.9	53.8	53.7	53.5	53.4	53.3	53.1	53.0
Peak Load (kW)	65	66	70	75	80	86	91	96	102	108	115	121	128	134	141	149	156	163	170	178	186

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-7 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Central/Tulagi

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	27,865	28,719	29,582	30,452	31,333	32,224	33,125	34,035	34,954	35,884	36,824	37,774	38,733	39,702	40,683	41,677	42,684	43,703	44,735	45,779	46,836
Growth Rate(%)	3.13	3.07	3.00	2.94	2.89	2.84	2.80	2.75	2.70	2.66	2.62	2.58	2.54	2.50	2.47	2.44	2.42	2.39	2.36	2.33	2.31
Elect. Ratio(%)	2.82	2.86	2.91	2.95	3.00	3.05	3.09	3.13	3.17	3.22	3.26	3.30	3.33	3.36	3.40	3.44	3.46	3.48	3.51	3.53	3.56
No.of family members	5.42	5.40	5.38	5.36	5.34	5.32	5.30	5.27	5.25	5.23	5.21	5.19	5.17	5.15	5.13	5.11	5.08	5.06	5.04	5.02	5.00
No.of Customers	145	152	160	168	176	185	193	202	211	221	231	240	249	259	270	281	290	301	311	322	333
Consump./Customer(kWh)	64	400	422	445	470	496	520	546	574	602	632	661	691	722	754	788	820	852	887	922	959
Energy Consum.(MWh)	9	61	67	75	83	92	101	110	121	133	146	159	172	187	203	221	238	256	276	297	320
Growth Rate(%)		561.24	10.78	10.78	10.78	10.78	9.73	9.72	9.72	9.72	9.73	8.68	8.68	8.68	8.68	8.68	7.64	7.64	7.64	7.64	7.64
Share to Total(%)	5.8	28.3	29.6	31.0	32.4	33.9	35.3	36.8	38.3	39.8	41.4	42.9	44.4	45.9	47.5	49.1	50.6	52.1	53.7	55.3	56.9
Commercial																					
No.of Customers	25	26	26	27	28	29	29	30	30	31	31	32	32	33	33	33	33	33	33	33	33
Constituent Ratio to Res.	0.17	0.17	0.17	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.12	0.11	0.11	0.11	0.10	0.1
Consump./Customer(kWh)	5,945	6,005	6,065	6,125	6,187	6,248	6,311	6,374	6,438	6,502	6,567	6,633	6,699	6,766	6,834	6,902	6,971	7,041	7,111	7,182	7,254
Energy Consum.(MWh)	149	154	160	166	172	178	184	189	195	201	206	211	215	220	224	229	232	235	237	240	242
Growth Rate(%)		3.81	3.78	3.73	3.67	3.62	3.07	3.01	2.95	2.88	2.81	2.25	2.17	2.09	2.01	1.92	1.33	1.23	1.12	1.01	0.88
Share to Total(%)	94.0	71.6	70.3	68.9	67.4	66.0	64.6	63.1	61.6	60.1	58.5	57.0	55.5	54.0	52.4	50.8	49.3	47.8	46.2	44.6	43.0
Public & Others																					
No.of Customers	20	24	25	26	27	27	28	29	30	30	31	32	32	33	34	34	35	35	36	36	37
Constituent Ratio	0.138	0.14	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10
Consump./Cust.(kWh)	11	11	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	14	15
Energy Consum.(MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Growth Rate(%)		23.43	5.28	5.26	5.24	5.21	4.17	4.15	4.13	4.10	4.07	3.04	3.01	2.98	2.95	2.92	2.39	2.36	2.33	2.29	2.25
Share to Total(%)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Industry																					
No.of Customers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Consump./Customer (kWh)	4,500	4,725	4,961	5,209	5,470	5,743	6,002	6,272	6,554	6,849	7,157	7,479	7,816	8,168	8,535	8,919	9,276	9,647	10,033	10,434	10,851
Energy Ind. Demand (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Share to Total(%)	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total																					
No.of Customers	190	202	211	221	176.3	185.1	193.4	202.1	211.2	220.7	230.7	239.9	249.5	259.5	269.9	280.7	290.5	300.6	311.2	322.0	333.3
Energy Consumption (MWh)	158	215	228	241	255	270	285	300	317	334	353	370	388	408	428	450	470	491	514	537	562
Growth Rate(%)		36.32	5.76	5.81	5.88	5.94	5.33	5.38	5.44	5.50	5.57	4.91	4.96	5.02	5.07	5.13	4.43	4.48	4.52	4.57	4.62
T & D Losses(%)	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.2	7.1	7.1	7.0	7.0
Energy Sent Out(MWh)	167	235	248	262	278	294	309	326	343	362	382	401	420	441	463	487	508	530	554	579	606
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	172	242	256	270	286	303	319	336	354	373	394	413	433	455	477	502	524	547	571	597	624
Load Fcator (%)	36.8	40.0	40.3	40.5	40.8	41.1	41.3	41.6	41.8	42.1	42.4	42.6	42.9	43.2	43.4	43.7	43.9	44.2	44.5	44.7	45.0
Peak Load (kW)	49	61	65	68	71	75	79	82	86	91	95	99	103	108	113	118	122	127	132	137	143

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-8 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Western/Gizo

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	3,102	3,210	3,319	3,430	3,543	3,658	3,774	3,893	4,014	4,137	4,262	4,389	4,518	4,649	4,782	4,918	5,056	5,197	5,340	5,485	5,633
Growth Rate(%)	3.53	3.46	3.40	3.34	3.29	3.24	3.20	3.15	3.10	3.06	3.02	2.98	2.94	2.90	2.87	2.84	2.81	2.78	2.75	2.73	2.70
Elect. Ratio(%)	69.23	84.62	83.92	83.29	82.69	82.14	81.22	80.36	79.54	78.75	78.01	76.92	75.87	74.87	73.90	72.96	71.70	70.48	69.30	68.16	67.04
No.of family members	6.02	5.99	5.96	5.94	5.91	5.89	5.86	5.84	5.81	5.78	5.76	5.73	5.71	5.68	5.65	5.63	5.60	5.58	5.55	5.53	5.50
No.of Customers	357	453	467	481	495	510	523	536	550	563	577	589	601	613	625	637	647	657	667	677	687
Consump./Customer(kWh)	1,650	1,651	1,692	1,735	1,778	1,823	1,859	1,896	1,934	1,973	2,012	2,042	2,073	2,104	2,136	2,168	2,189	2,211	2,233	2,256	2,278
Energy Consum.(MWh)	589	749	790	834	881	930	972	1,017	1,063	1,111	1,162	1,203	1,245	1,289	1,335	1,382	1,417	1,452	1,489	1,526	1,565
Growth Rate(%)		27.06	5.58	5.57	5.58	5.57	4.55	4.55	4.55	4.55	4.55	3.53	3.53	3.53	3.53	3.53	2.52	2.51	2.52	2.52	2.51
Share to Total(%)	32.1	29.4	29.6	29.8	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.3	31.4	31.5	31.6	31.6	31.7	31.8	31.8
Commercial																					
No.of Customers	85	107	109	112	114	117	119	121	122	124	126	128	129	131	132	134	134	135	136	137	137
Constituent Ratio to Res.	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.2
Consump./Customer(kWh)	7,091	7,162	7,233	7,306	7,379	7,453	7,527	7,602	7,678	7,755	7,833	7,911	7,990	8,070	8,151	8,232	8,315	8,398	8,482	8,567	8,652
Energy Consum.(MWh)	603	767	791	817	843	869	892	916	940	965	991	1,012	1,033	1,055	1,077	1,100	1,117	1,135	1,152	1,170	1,188
Growth Rate(%)		27.25	3.19	3.18	3.18	3.17	2.66	2.65	2.65	2.64	2.63	2.12	2.12	2.11	2.10	2.09	1.58	1.57	1.57	1.56	1.55
Share to Total(%)	32.8	30.1	29.6	29.1	28.7	28.2	27.8	27.5	27.1	26.7	26.4	26.1	25.9	25.6	25.3	25.1	24.9	24.7	24.5	24.4	24.2
Public & Others																					
No.of Customers	39	61	62	64	65	67	68	70	71	72	74	75	76	77	78	79	80	80	81	82	82
Constituent Ratio	0.109	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Consump./Cust.(kWh)	16,391	16,882	17,389	17,911	18,448	19,001	19,476	19,963	20,462	20,974	21,498	21,928	22,367	22,814	23,270	23,736	24,092	24,453	24,820	25,192	25,570
Energy Consum.(MWh)	639	1,029	1,085	1,145	1,207	1,273	1,330	1,389	1,451	1,515	1,583	1,637	1,693	1,751	1,810	1,872	1,917	1,963	2,010	2,058	2,107
Growth Rate(%)		60.96	5.48	5.48	5.47	5.47	4.45	4.45	4.44	4.44	4.44	3.42	3.42	3.42	3.41	3.41	2.40	2.40	2.39	2.39	2.39
Share to Total(%)	34.8	40.4	40.6	40.8	41.1	41.3	41.5	41.7	41.8	42.0	42.2	42.3	42.4	42.5	42.6	42.7	42.7	42.7	42.8	42.8	42.9
Industry																					
No.of Customers	9	9	9	10	10	11	11	12	12	13	14	14	15	15	16	17	17	18	18	19	20
Consump./Customer (kWh)	511	573	642	719	805	901	991	1,091	1,200	1,320	1,452	1,568	1,693	1,829	1,975	2,133	2,261	2,397	2,540	2,693	2,854
Energy Ind. Demand (MWh)	5	5	6	7	8	10	11	13	15	17	20	22	25	28	31	35	39	43	47	51	56
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	5	5	6	7	8	10	11	13	15	17	20	22	25	28	31	35	39	43	47	51	56
Growth Rate(%)		12.00	17.60	17.60	17.60	17.60	13.01	13.01	13.01	13.01	13.01	10.97	10.97	10.97	10.97	10.97	8.85	8.85	8.85	8.85	8.85
Share to Total(%)	0.25	0.20	0.23	0.25	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1
Total																					
No.of Customers	490	630	648	667	495.6	510.5	523.3	536.3	549.7	563.5	577.6	589.1	600.9	612.9	625.2	637.7	647.2	656.9	666.8	676.8	686.9
Energy Consumption (MWh)	1,836	2,550	2,673	2,803	2,939	3,083	3,206	3,335	3,469	3,609	3,755	3,873	3,996	4,123	4,254	4,389	4,489	4,592	4,698	4,806	4,916
Growth Rate(%)		38.89	4.84	4.85	4.87	4.88	4.01	4.02	4.02	4.03	4.04	3.16	3.16	3.17	3.17	3.18	2.29	2.29	2.30	2.30	2.30
T & D Losses(%)	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0
Energy Sent Out(MWh)	1,875	2,692	2,825	2,965	3,113	3,268	3,403	3,544	3,690	3,843	4,003	4,134	4,269	4,409	4,554	4,704	4,817	4,933	5,052	5,174	5,299
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	1,933	2,775	2,912	3,057	3,209	3,369	3,508	3,653	3,804	3,962	4,127	4,262	4,401	4,546	4,695	4,850	4,966	5,086	5,208	5,334	5,462
Load Fcator (%)	77.6	60.0	59.6	59.2	58.7	58.3	57.9	57.5	57.1	56.6	56.2	55.8	55.4	54.9	54.5	54.1	53.7	53.3	52.8	52.4	52.0
Peak Load (kW)	270	485	512	541	571	603	632	662	694	727	763	793	824	856	891	926	955	984	1,015	1,046	1,079

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-9 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Western/Noro-Munda

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	22,545	23,326	24,120	24,926	25,746	26,581	27,431	28,294	29,171	30,064	30,972	31,895	32,833	33,785	34,754	35,741	36,746	37,767	38,806	39,864	40,941
Growth Rate(%)	3.53	3.46	3.40	3.34	3.29	3.24	3.20	3.15	3.10	3.06	3.02	2.98	2.94	2.90	2.87	2.84	2.81	2.78	2.75	2.73	2.70
Elect. Ratio(%)	9.61	10.17	10.77	11.42	12.10	12.84	13.38	13.95	14.55	15.17	15.84	16.23	16.64	17.06	17.50	17.95	18.34	18.74	19.15	19.58	20.02
No.of family members	6.02	5.99	5.96	5.94	5.91	5.89	5.86	5.84	5.81	5.78	5.76	5.73	5.71	5.68	5.65	5.63	5.60	5.58	5.55	5.53	5.50
No.of Customers	360	396	436	479	527	580	626	676	730	789	852	903	957	1,015	1,075	1,140	1,203	1,269	1,339	1,412	1,490
Consump./Customer(kWh)	1,647	1,664	1,681	1,697	1,714	1,731	1,870	2,020	2,181	2,356	2,544	2,722	2,913	3,117	3,335	3,568	3,782	4,009	4,250	4,505	4,775
Energy Consum.(MWh)	593	659	732	813	904	1,004	1,171	1,366	1,593	1,858	2,167	2,458	2,788	3,162	3,587	4,068	4,549	5,087	5,689	6,362	7,115
Growth Rate(%)		11.10	11.10	11.10	11.10	11.10	16.64	16.64	16.64	16.64	16.64	13.42	13.42	13.42	13.42	13.42	11.83	11.83	11.83	11.83	11.83
Share to Total(%)	5.9	6.2	6.2	6.2	6.2	6.2	6.6	7.0	7.5	7.9	8.4	8.8	9.2	9.7	10.1	10.6	11.0	11.5	12.0	12.5	13.0
Commercial																					
No.of Customers	65	72	79	88	97	108	117	127	138	149	162	173	184	196	209	222	236	250	265	281	298
Constituent Ratio to Res.	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.2
Consump./Customer(kWh)	24,879	26,123	27,430	28,801	30,241	31,753	33,023	34,344	35,718	37,147	38,633	39,791	40,985	42,215	43,481	44,786	45,681	46,595	47,527	48,477	49,447
Energy Consum.(MWh)	1,617	1,878	2,181	2,532	2,940	3,414	3,854	4,352	4,913	5,547	6,262	6,872	7,541	8,275	9,080	9,963	10,775	11,652	12,601	13,626	14,735
Growth Rate(%)		16.12	16.12	16.12	16.11	16.11	12.91	12.91	12.90	12.90	12.90	9.74	9.74	9.73	9.73	9.73	8.15	8.14	8.14	8.14	8.14
Share to Total(%)	16.2	17.5	18.4	19.3	20.3	21.2	21.8	22.5	23.1	23.7	24.3	24.6	25.0	25.3	25.6	25.9	26.2	26.4	26.6	26.8	27.0
Public & Others																					
No.of Customers	22	28	30	32	35	38	40	42	44	46	49	50	52	53	55	57	58	59	60	61	63
Constituent Ratio	0.061	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Consump./Cust.(kWh)	11,102	11,601	12,123	12,669	13,239	13,835	14,388	14,964	15,562	16,185	16,832	17,421	18,031	18,662	19,315	19,991	20,591	21,209	21,845	22,501	23,176
Energy Consum.(MWh)	244	325	365	411	462	519	569	624	684	749	820	876	935	997	1,063	1,131	1,191	1,254	1,318	1,383	1,450
Growth Rate(%)		32.91	12.53	12.48	12.42	12.36	9.72	9.66	9.59	9.52	9.44	6.82	6.73	6.65	6.55	6.45	5.33	5.22	5.10	4.98	4.84
Share to Total(%)	2.4	3.0	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.0	3.0	2.9	2.9	2.8	2.8	2.7	2.7
Industry																					
No.of Customers	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
Consump./Customer (kWh)	3,768,835	3,919,588	4,076,372	4,239,427	4,409,004	4,585,364	4,745,852	4,911,957	5,083,875	5,261,811	5,445,974	5,609,353	5,777,634	5,950,963	6,129,492	6,313,377	6,471,211	6,632,991	6,798,816	6,968,786	7,143,006
Energy Ind. Demand (MWh)	7,538	7,839	8,560	9,348	10,208	11,147	12,056	13,040	14,104	15,254	16,498	17,673	18,932	20,279	21,723	23,270	24,687	26,189	27,784	29,475	31,269
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	7,538	7,839	8,560	9,348	10,208	11,147	12,056	13,040	14,104	15,254	16,498	17,673	18,932	20,279	21,723	23,270	24,687	26,189	27,784	29,475	31,269
Growth Rate(%)		4.00	9.20	9.20	9.20	9.20	7.54	7.54	7.54	7.54	7.54	6.65	6.65	6.65	6.65	6.65	5.74	5.74	5.74	5.74	5.74
Share to Total(%)	75.44	73.26	72.31	71.34	70.3	69.3	68.3	67.3	66.2	65.2	64.1	63.4	62.7	62.0	61.3	60.5	59.9	59.3	58.6	58.0	57.3
Total																					
No.of Customers	449	498	547	602	527.2	579.9	626.3	676.4	730.5	789.0	852.1	903.2	957.4	1014.9	1075.8	1140.3	1203.0	1269.2	1339.0	1412.6	1490.3
Energy Consumption (MWh)	9,992	10,701	11,838	13,104	14,513	16,083	17,651	19,382	21,294	23,409	25,748	27,879	30,196	32,714	35,452	38,432	41,202	44,183	47,391	50,847	54,569
Growth Rate(%)		7.09	10.63	10.69	10.75	10.82	9.75	9.81	9.87	9.93	9.99	8.28	8.31	8.34	8.37	8.40	7.21	7.23	7.26	7.29	7.32
T & D Losses(%)	2.7	3.2	3.6	4.1	4.6	5.0	5.5	6.0	6.4	6.9	7.3	7.8	8.3	8.7	9.2	9.7	10.1	10.6	11.1	11.5	12.0
Energy Sent Out(MWh)	9,961	11,061	12,298	13,682	15,229	16,962	18,710	20,649	22,803	25,197	27,859	30,322	33,014	35,955	39,172	42,690	46,012	49,606	53,496	57,709	62,273
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	10,269	11,404	12,679	14,105	15,700	17,487	19,288	21,288	23,508	25,976	28,721	31,260	34,035	37,067	40,383	44,010	47,435	51,140	55,151	59,494	64,199
Load Fcator (%)	63.7	63.3	62.9	62.4	62.0	61.5	61.1	60.7	60.2	59.8	59.4	58.9	58.5	58.1	57.6	57.2	56.7	56.3	55.9	55.4	55.0
Peak Load (kW)	1,790	1,930	2,150	2,397	2,673	2,983	3,297	3,647	4,036	4,469	4,951	5,401	5,893	6,433	7,024	7,673	8,289	8,957	9,683	10,470	11,326

The figure after the year 1999 is forecasted based upon the past actual data given by SIEA.

Table 4-3-10 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: Choiseul/Choiseul

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	25,287	26,165	27,054	27,955	28,878	29,816	30,764	31,733	32,717	33,721	34,736	35,772	36,820	37,887	38,979	40,082	41,204	42,347	43,512	44,695	45,902
Growth Rate(%)	3.53	3.47	3.40	3.33	3.30	3.25	3.18	3.15	3.10	3.07	3.01	2.98	2.93	2.90	2.88	2.83	2.80	2.78	2.75	2.72	2.70
Elect. Ratio(%)	1.75	1.80	1.86	1.92	1.98	2.04	2.09	2.14	2.19	2.24	2.29	2.33	2.37	2.40	2.44	2.48	2.50	2.52	2.54	2.56	2.58
No.of family members	6.33	6.30	6.28	6.25	6.22	6.20	6.17	6.15	6.12	6.09	6.07	6.04	6.01	5.99	5.96	5.93	5.91	5.88	5.85	5.83	5.80
No.of Customers	70	75	80	86	92	98	104	110	117	124	131	138	145	152	160	168	174	181	189	196	204
Consump./Customer(kWh)	450	461	473	485	497	509	519	530	540	551	562	571	579	588	597	606	612	618	624	630	636
Energy Consum.(MWh)	32	35	38	42	46	50	54	58	63	68	74	79	84	89	95	102	107	112	118	124	130
Growth Rate(%)		9.67	9.68	9.68	9.68	9.68	8.12	8.12	8.12	8.12	8.12	6.58	6.57	6.58	6.58	6.57	5.04	5.04	5.04	5.04	5.04
Share to Total(%)	100.0	46.7	46.2	45.6	45.1	44.5	44.1	43.7	43.3	42.8	42.4	32.4	32.6	32.8	32.9	33.0	33.1	33.2	33.2	33.3	33.3
Commercial																					
No.of Customers	0	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	18	19	20	20
Constituent Ratio to Res.	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.1
Consump./Customer(kWh)	1,500	1,575	1,654	1,736	1,823	1,914	1,991	2,071	2,153	2,240	2,329	2,399	2,471	2,545	2,622	2,700	2,754	2,809	2,865	2,923	2,981
Energy Consum.(MWh)	0	13	15	16	18	21	23	25	27	30	33	35	38	40	43	47	49	52	55	58	61
Growth Rate(%)			11.72	11.72	11.72	11.71	9.61	9.61	9.60	9.60	9.60	7.51	7.51	7.51	7.50	7.50	5.44	5.43	5.43	5.43	5.42
Share to Total(%)	0.0	17.8	18.0	18.1	18.2	18.3	18.4	18.5	18.5	18.6	18.7	14.4	14.6	14.8	15.0	15.2	15.3	15.4	15.4	15.5	15.6
Public & Others																					
No.of Customers	0	8	9	10	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	22	22
Constituent Ratio	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Consump./Cust.(kWh)	3,000	3,150	3,308	3,473	3,647	3,829	3,982	4,141	4,307	4,479	4,658	4,798	4,942	5,090	5,243	5,400	5,508	5,619	5,731	5,845	5,962
Energy Consum.(MWh)	0	26	29	33	37	42	46	51	56	61	68	73	79	86	92	100	106	112	119	126	134
Growth Rate(%)			12.29	12.29	12.29	12.29	10.18	10.18	10.18	10.18	10.18	8.09	8.09	8.09	8.09	8.09	6.02	6.02	6.02	6.02	6.02
Share to Total(%)	0.0	35.5	35.9	36.3	36.7	37.2	37.5	37.8	38.2	38.5	38.9	30.1	30.7	31.3	31.9	32.5	32.9	33.2	33.6	34.0	34.3
Industry																					
No.of Customers	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2
Consump./Customer (kWh)	4,000	4,160	4,326	4,499	4,679	4,867	5,013	5,163	5,318	5,477	5,642	5,755	5,870	5,987	6,107	6,229	6,291	6,354	6,418	6,482	6,547
Energy Ind. Demand (MWh)	0	0	0	0	0	0	0	0	0	0	0	6	6	7	8	9	10	11	13	14	15
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh): CEMA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	0	0	0	0	0	0	0	0	0	0	0	56	57	58	58	59	60	62	63	64	66
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	1.24	1.37	1.51	1.67	1.68	1.83	1.99	2.16	2.35
Share to Total(%)	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.1	22.1	21.1	20.2	19.3	18.7	18.2	17.7	17.3	16.8
Total																					
No.of Customers	70	92	98	105	91.8	98.2	104.1	110.3	117.0	124.0	131.4	138.0	144.9	152.1	159.7	167.7	174.4	181.4	188.7	196.2	204.1
Energy Consumption (MWh)	32	74	82	91	101	112	123	134	146	159	174	243	257	273	290	308	322	338	354	372	390
Growth Rate(%)		134.85	10.97	10.98	10.99	11.00	9.16	9.17	9.17	9.18	9.19	39.53	5.94	6.03	6.12	6.21	4.77	4.83	4.88	4.93	4.98
T & D Losses(%)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Energy Sent Out(MWh)	33	80	88	98	109	121	132	144	157	172	188	262	277	294	312	331	347	364	382	401	421
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	34	82	91	101	112	125	136	149	162	177	193	270	286	303	322	342	358	375	394	413	434
Load Fcator (%)	25.7	45.0	45.4	45.7	46.1	46.5	46.8	47.2	47.6	47.9	48.3	48.7	49.1	49.4	49.8	50.2	50.5	50.9	51.3	51.6	52.0
Peak Load (kW)	14	19	21	23	25	28	30	32	35	38	41	57	60	63	66	70	73	76	79	82	86

The figure is forecasted based upon the assumption shown in Chapter 4, there is no SIEA power supply facility until the year 1999.

Table 4-3-11 ENERGY & LOAD FORECAST BY CATEGORY WISE IN EACH LOAD CENTER

SIEA LOAD CENTER: **Rennell/Rennell and Bellone**

Fiscal Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential																					
Population	3,200	3,298	3,397	3,497	3,598	3,701	3,804	3,909	4,014	4,121	4,229	4,338	4,448	4,559	4,672	4,786	4,902	5,019	5,137	5,257	5,379
Growth Rate(%)	3.13	3.07	3.00	2.94	2.89	2.84	2.80	2.75	2.70	2.66	2.62	2.58	2.54	2.50	2.47	2.44	2.42	2.39	2.36	2.33	2.31
Elect. Ratio(%)	3.71	3.87	4.04	4.22	4.41	4.61	4.78	4.95	5.13	5.32	5.52	5.68	5.84	6.01	6.18	6.37	6.49	6.62	6.76	6.90	7.04
No.of family members	4.57	4.59	4.61	4.64	4.66	4.68	4.70	4.72	4.74	4.76	4.79	4.81	4.83	4.85	4.87	4.89	4.91	4.94	4.96	4.98	5.00
No.of Customers	26	28	30	32	34	36	39	41	43	46	49	51	54	56	59	62	65	67	70	73	76
Consump./Customer(kWh)	300	308	315	323	331	339	346	353	360	367	375	380	386	392	398	404	408	412	416	420	424
Energy Consum.(MWh)	8	9	9	10	11	12	13	14	16	17	18	19	21	22	24	25	26	28	29	31	32
Growth Rate(%)		9.67	9.68	9.67	9.68	9.68	8.12	8.12	8.12	8.12	8.12	6.57	6.58	6.57	6.58	6.58	5.04	5.04	5.04	5.04	5.04
Share to Total(%)	35.0	35.6	35.6	35.7	35.7	35.8	35.9	36.1	36.3	36.5	36.8	37.1	37.5	38.0	38.4	38.9	39.5	40.1	40.8	41.5	42.3
Commercial																					
No.of Customers	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8
Constituent Ratio to Res.	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.1
Consump./Customer(kWh)	500	525	551	579	608	638	664	690	718	747	776	800	824	848	874	900	918	936	955	974	994
Energy Consum.(MWh)	1.5	1.7	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	7	7	8
Growth Rate(%)		11.25	11.61	11.61	11.60	11.60	9.50	9.49	9.49	9.48	9.48	7.40	7.39	7.38	7.38	7.37	5.31	5.31	5.30	5.30	5.29
Share to Total(%)	6.7	7.0	7.1	7.2	7.3	7.5	7.6	7.7	7.9	8.0	8.2	8.3	8.5	8.6	8.8	9.0	9.2	9.3	9.5	9.7	9.9
Public & Others																					
No.of Customers	6	6	6	7	7	7	7	8	8	8	8	8	8	8	9	9	9	9	8	8	8
Constituent Ratio	0.20	0.20	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10
Consump./Cust.(kWh)	2,000	2,100	2,205	2,315	2,431	2,553	2,655	2,761	2,871	2,986	3,106	3,199	3,295	3,394	3,495	3,600	3,672	3,746	3,821	3,897	3,975
Energy Consum.(MWh)	12	13	14	15	17	18	19	21	22	24	25	26	27	29	30	31	31	32	32	33	33
Growth Rate(%)		5.78	9.40	9.32	9.24	9.16	7.02	6.93	6.83	6.72	6.61	4.47	4.35	4.22	4.07	3.92	1.77	1.59	1.40	1.19	0.96
Share to Total(%)	53.8	52.9	52.8	52.6	52.5	52.3	52.0	51.7	51.4	51.0	50.6	50.1	49.6	49.0	48.4	47.8	47.1	46.3	45.4	44.5	43.6
Industry																					
No.of Customers	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Consump./Customer (kWh)	1,000	1,040	1,082	1,125	1,170	1,217	1,253	1,291	1,329	1,369	1,410	1,439	1,467	1,497	1,527	1,557	1,573	1,589	1,604	1,620	1,637
Energy Ind. Demand (MWh)	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
Energy Big Cust.(MWh):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Cust. Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (MWh):	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Captive Takeover (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Share SIEA to Total(%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Consum.(MWh)	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
Growth Rate(%)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	4.82	4.82	4.82	4.82	2.93	2.93	2.93	2.93	2.93
Share to Total(%)	4.48	4.55	4.53	4.51	4.5	4.5	4.5	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Total																					
No.of Customers	36	38	41	43	34.1	36.5	38.7	41.0	43.4	46.1	48.8	51.3	53.8	56.5	59.3	62.3	64.8	67.4	70.1	72.9	75.8
Energy Consumption (MWh)	22	24	26	29	32	35	37	40	43	46	50	52	55	58	61	65	67	69	71	74	76
Growth Rate(%)		7.66	9.64	9.60	9.56	9.52	7.60	7.56	7.51	7.47	7.42	5.51	5.46	5.41	5.35	5.29	3.41	3.35	3.29	3.23	3.16
T & D Losses(%)	15.0	14.6	14.2	13.8	13.4	13.0	12.6	12.2	11.8	11.4	11.0	10.6	10.2	9.8	9.4	9.0	8.6	8.2	7.8	7.4	7.0
Energy Sent Out(MWh)	25	28	31	34	37	40	43	46	49	52	56	59	62	65	68	71	73	76	78	80	82
Plant Use(%)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (MWh)	26	29	32	35	38	41	44	47	51	54	58	61	64	67	70	74	76	78	80	82	85
Load Fcator (%)	44.0	45.0	45.4	45.7	46.1	46.5	46.8	47.2	47.6	47.9	48.3	48.7	49.1	49.4	49.8	50.2	50.5	50.9	51.3	51.6	52.0
Peak Load (kW)	6	6	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	16	16	17

The figure is forecasted based upon the assumption shown in Chapter 4, there is no SIEA power supply facility until the year 1999.

CHAPTER 5

SMALL HYDROPOWER GENERATION

Chapter 5 Small Hydropower Generation

5.1 Objective

The hydropower generation plan included in the Master Plan Study for Power Development in the Solomon Islands has two main objectives, which are:

(1) To quantify the hydropower potential in the Solomon Islands for water resource development,

(2) To select prospective hydropower sites to be developed within the next 15 years until 2015.

In order to achieve these objectives, the hydropower study was carried out to identify the hydro potential, and the possible sites, for power development in the Solomon Islands.

5.2 Methodology for the Small Hydropower Development

Hydropower planning requires several study and design steps, from data collection, hydrological analysis, map studies and field surveys to design of civil and electric-mechanical works. In the Master Plan Study, JICA Team implemented the planning works as follows:

(1) Data Collection

(2) Hydrological Analysis

(3) Map Study

(4) First Field Survey

(5) Site Selection for Second Field Survey

(6) Second Field Survey

(7) Conceptual Design of the Hydropower Plant

(8) Design and Construction Cost Estimate

(9) Master Plan

The flow chart included in Fig.5-2-1 shows the sequence of this planning study.

5.3 Data Collection

This section describes the collected data and includes the data analyses based on collected data and field information. The collected data used to study the natural conditions of the Solomon Islands covers topography, geology, meteorology, hydrology related data and past surveys and designs as well.

5.3.1 Topography

(1) Topographic maps

Collected maps cover the whole areas of the major islands, which are Guadalcanal, Malaita, Santa Isabel, New Georgia, San Cristbal, Choiseul and Santa Cruz Islands. These maps are in a series of 1:50,000 scale and compiled versions in 1:150,000 and 1:250,000 scales. 1:50,000 and 1:150,000 maps are general topographic maps, while 1:250,000 maps are physiographic region maps and catchment areas maps. The Land Resources Division of British Government's Overseas Development Administration published natural conditions and land-use reports with thematic sectional maps in 1973 to 1977. Maps collected for the present study, in 1:250,000 scale, correspond to these sectional maps.

(2) Physiography

The Solomon Islands is a complex island arc. Most of the territory belongs to the Solomon arc, which includes the six major islands. Temotu province including Santa Cruz Islands belongs to the Vanuatu arc. The Solomon arc arranged in an echelon double chain. This arc stretches in a NW-SE direction and the six major islands have the same long axes. Fig.5-3-1 to 5-3-6 show the six major islands physiography and drainage system.

(a) Guadalcanal

The island is 160 km long by 30 to 48 km wide, and has an area of 5,336 km^2. It is characterized by east-west beltlike regions, and the elevation decreases toward the north. There is a very dense drainage system. The rivers flow mainly northward or southward. In mountains there are many upper reaches in east-west direction. The Northwestern Volcanic Area has up to 1,000m in height, steeply dissected cones with well-developed radial drainage. North Plains are the alluvial zones. The Middle Central Hills and Northern Foothills are 40 to 1,000m in height. The Southern Mountains, that occupy one half of the island, are over 1,000m in height, with steep slopes in the southern coast. There is no large typical karst area, although parts of the outcrop of old and new limestone or calcareous rocks show some tendencies toward that kind of karstic pattern in the northwest area.

(b) Malaita

The island is 191 km long by 20 to 40 km wide, and has an area of 4,225 km^2. It is characterized by a NNW-SSE trend major axis with echelon ridge-bay arranges, and elevations are symmetrical toward both coasts. The drainage system shows right angles or parallel to the ridges. The Northern and Western Foothills to terraces are below 200 m in height. The Northern and Central to the Southern Hills and Mountains are 200 to 1,300m in height.

(c) Santa Isabel

The island is 200 km long by 20 to 30 km wide, and has an area of 4,136 km^2. It is characterized by NW-SE beltlike regions and symmetrical elevations toward both coasts. There is a dense drainage system. The rivers flow mainly northward or southward. In the north to central part of the island many rivers flow in east west direction. The North Hills and ridges are a series of low, parallel ridges and scarp slopes. The Central Ridges, Mountains or Plateaus are over 600 to 1,000m in height, long narrow spine. The South Ridges and Foothills have rounded ridge systems and low hills separated by wide valleys.

(d) New Georgia Group

The group area is 200 km long by 50 km wide, and has an area of 5,475 km^2, which consists of Vella Lavella, Kolombangara, New Georgia, Vangunu, Nggatokae, Rendova, Rannonga, Gizo, and Tetepare. These islands are divided into a north main volcanic chain[1] and a southern outer-arc of smaller islands[2]. The main volcanic chain is 700 to 1,800m in height, and consists of largely of composite volcanic cones, or their remnants.

(e) San Cristobal

The island is 139 km long by 25 to 40 km wide, and has an area of 3,188 km^2. It is characterised by an asymmetrical watershed near the southern coast, and northward running rivers have longer length. The Western Terraces and Hills, Northern Foothills and Plains are mainly below 200m in height and have an upraised reef coast. The Western Lowlands and Ridges are below 600m in height, characterized by close-spaced narrow steep valleys and gorges. The Central Uplands, Eastern Hills and Ridges are mountainous with deep valleys, and are close to the southern coast.

(f) Choiseul

The island is 161 km long by 20 to 35 km wide, and has an area of 3,537 km^2. It is characterized by transversal regions and symmetrical elevations toward both coasts. Northwest hills are below 400m in height, rolling hills with moderate to gentle slopes interspersed with rocky outcrops and gorge-like valleys. Central highlands, covering two thirds of the island, is a generally rugged region up to 1,000m in height with a dominant NW-SE to the angular, largely fault controlled drainage pattern. Three eastern regions, Eastern Lowlands, Eastern Ridges and Eastern Islands, are small lower areas. Choiseul has three typical karst areas[3] and two volcanic areas[4].

(g) Santa Cruz Islands

The island has another name Nendo Island, is 46 km long by 10 to 15 km wide, and has an area of 604 km^2. It is the principal island of dispersed Santa Cruz Islands. It is characterized by volcanic island capped and flanked in many areas by calcareous sediments, and the elevation decreases toward the coast. East and west sides of the island have flatlands. There is a common density drainage system. The rivers mainly flow on tree-like or lattice patterns. Central Ridges and Cuestas Area is ridges of the island, has up to 520m in height, steeply dissected. Eastern Plateau and Plains Area, 300 to 500m in height, is formed by high-level alluvial valleys among rocky karst and low volcanic ridges. Western Plateaux Area is extensive raised reef, has up to 160m in height, consist of level to gentry rolling land, and stepped limestone cliffs on seaward margins. There are several km-sized karst patterns in parts of the northern and western areas.

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[1] Vella Lavella, Kolombangara, New Georgia, Vangunu, Nggatokae and the northern part of Rendova
[2] Rannonga, Ghizo, Tetepare and the southern part of Rendova
[3] Mt. Talaevondo/ Paghpalio hill, Tiva ridge-Nunuliti hill and Manggo bay
[4] Mt. Maetambe and Kumboro peak

5.3.2 Geology

(1) Geological maps and reports

The collected maps cover nearly whole areas of the Solomon Islands for hydropower and other purposes. The collected maps are in a series of 1:50,000 scale, compiled versions in 1:100,000, 1:150,000, 1:200,000, 1:250,000 and 1:1,000,000. Compiled maps have different scales depending on the island. Collected reports consist of one publication list, geological reports and applied or engineering geology reports.

(2) General geology

The Solomon Islands and adjacent sea floor areas are tectonically complex, as shown in Fig.5-3-7 to -8. The region comprises the central portion of the Melanesian Borderlands, a system of island arcs of various ages. The Solomon arc consists of several island groups forming a double echelon chain. A major trench system occurs to the south of the Solomon Islands. At least two possible spreading centers[5] occur in the region. A discontinuous trench system lies in the Coral Sea on the southern side, and another poorly defined trenche in the Pacific on the northeast side. Most of the area is seismically active. The geology can be briefly described in terms of three structural/stratigraphic elements. And the geological provinces are divided by distinctive assemblage of rocks. The three elements are oceanic basement, calc-alkaline volcanics and older/younger sedimentary cover. Each island consists of two or three main elements in each composition.

(a) Structural/stratigraphic elements

- Oceanic basement

The basement is formed of basalt lava, cognate dolerite/gabbro intrusions and ultramafic bodies. They are of alkali basalt family that is generally considered as upraised ocean floor. In Guadalcanal, Florida, San Cristbal, Santa Isabel and Choiseul the basalt is fractured and metamorphosed. In contrast, Malaita has practically no deformation or metamorphism.

- Calc-alkaline volcanics

The volcanics consist of andesite lava, volcaniclastic rocks and diorite. The main development was in the Plio-Pleistocene in New Georgia. There are several small volcanic islands such as Savo, and other islands have limited volcanic areas such as Gold Ridge.

- Sedimentary cover

The sedimentary cover comprises very thick varied sediments that lie unconformable in the basement. The earliest sediments are thicker Cretaceous sandy successions, although there are extensive developments of Miocene and Pleistocene reef limestone. From the Pliocene onwards volcaniclastic sediments become an increasing component.

[5] Woodlark basin and New Heblides basin

(b) Geological provinces

- Central province has fractured, metamorphosed basement and complex geology.
- Pacific province has more stable un-metamorphosed, but folded basement and pelagic sedimentation.
- Volcanic province is the latest addition to the arc being a series of volcanic cones and still continuing fumarolic activity.
- Atoll province consists of upraised coral atolls[6].

(3) Regional geology

(a) Guadalcanal

There are three major series of rocks: the pre-Miocene basement, the Miocene to Pleistocene formations and the Pleistocene volcanics. The pre-Miocene basement predominates in the Southern Mountains. It comprises metabasics, dolerite, gabbro, diorite, volcanics and ultrabasics. The Miocene to Pleistocene formations are up to 6,000m thick, flat-lying to gently folded volcanic and sedimentary rocks. They include several limestone and calcareous formations. The Pleistocene volcanics in the northwest area occupy one fourth of the island, and consist of lava and volcaniclastics. There is a very complex geological structure, no dominant trend. There are three zones[7] of intense Quaternary faulting, and three linear zones[8] of Alpine type ultramafics.

(b) Malaita

Malaita is a major unit of the pacific province. There are two major series of rocks: the upper Mesozoic oceanic basalt basement and the Cretaceous to Pleistocene mainly calcareous and pelagic formations. The basement and overlying formations were extensively folded and faulted, and makes a continuous cascade arrangement of rocks.

(c) Santa Isabel

There are two geological terranes: Zabana province and Jajao province, these are separated by a major fault[9]. Zavana province covers 80% of the island on the northeast side, and comprises basement pillowed basalt overlain by old pelagic limestones and volcaniclastics. These pre-Miocene units are folded, faulted and overlain by younger reef limestone or siltstone along the shore. Central Ridges, Mountains or Plateaus mainly consist of basement or volcaniclastics. Jajao province covers one-third of the islands width on the southwest side, and consists of an ophiolitic assemblage of pillowed basalt, gabbro and ultramafics. It has a fault-bounded mosaic structure, which is overlain by old calcareous/ non-calcareous sediments and recent swamp deposits on the lowlands. The geological structure is dominated by major NW-SE oriented faults and sub-parallel folds.

6 for example, Ontong Java and Rennell
7 Northwest Volcanic Area, upper Lunnga watershed and Gold Ridge
8 Ghausava belt, Marau belt and Suta belt
9 Kaipito-Korighole fault

(d) New Georgia Group

There are two structural zones: a main zone and an outer-arc. The main volcanic chain of larger islands comprises a chain of twenty-three singles and coalesced volcanic cones fringed by an intricate system of coral reefs and lagoons. The outer-arc of the smaller islands consists of uplifted fore-arc sediments, submarine volcanics and partly fringed reefs or lagoons. The volcanic cones consist of porphyritic lava and volcaniclastics. These rocks have several groups of basalts, andesites and dacites. Present day activity is confined to offshore eruptions, dormant Simbo, and residual thermal activity. And most of the volcanic cones are considered to be extinct.

(e) San Cristobal

Most of the area is composed of altered and pillowed basaltic lava basement. In the Western Hills and the Northern Foothills there is older volcaniclastic sedimentary cover. Northern coasts have raised reef limestone. The basement and cover have abundant E-W and NE-SW faults and lesser N-S fractures.

(f) Choiseul

There are two major series of rocks: the pre-Miocene basement complex, the sedimentary and volcanic cover. The pre-Miocene basement predominates in the Central Highlands to eastern regions. It comprises mainly amphibolitised basaltic rocks, shist, ultramaites and microgabbro. The sedimentary and volcanic cover predominates in the Northwest Hills, both coast sides of the Central Highlands and along the shorelines. It consists of limestone, calcareous rocks, sandstone to mudstone, lava and tuff. There is a strongly deformed and faulted basement and a weakly tectonised cover. NW-SE and NE-SW trend fractures divide the basement into numerous rectilinear fault blocks. The cover has general NW-SE trend faulting and sub-parallel axis gentle folding.

(g) Santa Cruz Islands

There are three major series of rocks: the Lower Miocene basement, the Miocene to Pliocene beds and the Quaternary deposits. The Lower Miocene basement predominates in the Central Ridges. It comprises basaltic lava and volcaniclastics. The Miocene to Pliocene formations are up to 400m thick, flat-lying to partly gentle folded sedimentary beds and a basaltic andesite bed. They are including several limestone and calcareous formations. The Quaternary deposits are coral reef limestone, reef breccia and alluvium deposits. The geological structure is discrete fault block units and tilting. The dominant fault trends are north south and east west.

5.3.3 Meteorology and Hydrology

(1) Data Collection

(a) Meteorological Data

Ambient temperature, precipitation and evaporation meteorological data were collected mainly from the Solomon Islands Meteorological Service (SIMS) and from the Ministry of Natural Resources (MNR). Rainfall data from several other official sources are complied in the report "Rainfall data from the British Solomon Islands Protectorate to the end of 1973", which includes data from the Land Resources of British Solomon Islands Protectorate.

The report "Rainfall and Other Climatic Data for Forestry Stations to September 1986" was also obtained. SIMS has operated and maintained meteorological stations continuously all over the Solomon Islands, however most other government offices have stopped their observations or have not published recent climatological data reports. Some of these stations were only operated during particular projects and after project completion the records ended, such as in Lungga and Komarindi projects. The location maps of the meteorological stations show the observatories currently operating in the Solomon Islands, as detailed in Fig.5-3-9 to -14.

As the observatories are installed in the coastal area of each island, except in Guadalcanal, inland climatological is therefore not available. Temperature, evaporation and rainfall-collected data are included in Table 5-3-1 to -7.

(b) Hydrological Data

River flow data were collected from the Water Resource division of MNR that operates water level gauging and carries out flow measurement of the rivers for water resource development. The location of the water level gauging stations is shown in Fig.5-3-9 to -14. The Lungga Bridge gauging station was installed in 1965 at the Lungga Bridge, in Guadalcanal, where the catchment area is 377 km^2. The Lungga gauging station has the longest record of river flow data in the Solomon Islands. In 1985, installation of a data logger and more frequent river flow measurement improved data quality of this station.

The Lungga Gorge gauging station is located at the Lungga dam where a catchment area is 350 km^2. The station started their records in July 1977 and ended the observation in July 1992 due to vandalism damages.

The Charahi gauging station was installed in November 1986 for the feasibility study of the Komarindi Project and ended the observation in February 1993. The station site is located at the Komarindi intake that is 26 km from the north coast of Guadalcanal. Data collection involves the use of a helicopter, so that maintenance work is difficult and costs are high.

The Gwaidalo gauging station is located on the Kwaibala River, at the south of Auki in Malaita. The station was installed in September 1986 and ended the observation in

October 1996.

The Jejevo gauging station is located at the intake of Buala hydropower station in Santa Isabel. The station was installed in February 1987 and ended operation in October 1991 due to vandalism of the data logger.

The Kukundu gauging station is located in Kukundu, in Kolombangara Island. The station started operation in September 1989 and ended the observation in February 1990 due to land disputes.

The Pijaka gauging station is located at Mbatuna in Vangunu Island. The station commenced its operation in March 1988. The latest data obtained is up to May 1995.

The Huro gauging station is located at Waitetei, near Kirakira in San Cristbal. The station has been operating since the observations began in April 1987.

Although the water level gauging stations were installed and operated in many rivers in the Solomon Islands, operation and maintenance have not been carried out properly. Consequently, the discharge data from the existing gauging station often includes observation interruptions. The main causes for these problems are:

(a) Vandalism and land dispute with local people

(b) Lack of financial resources for maintenance and data collection when projects are completed

(c) Difficulty of acquisition of equipment spare parts

(d) Access difficulty due to the remoteness of the stations

These are also the reasons the MNR climatological stations in Guadalcanal have ceased to operate.

(2) Regional Climate

The Solomon Islands are situated in a tropical rain forest region with high humidity and temperature. The ambient temperature in the Solomon Islands is stable throughout the year. The mean monthly temperature at Honiara is approximately 27 ºC.

The weather is dominated by seasonal movement and development of the Intertropical Convergence Zone (ITCZ), where the trade winds meet to cause convection in an unstable atmosphere with a high moisture content from the ocean, as shown in Fig.5-3-15.

In January, the ITCZ is situated in the south of the Solomon Islands. The northwest trade winds dominate in the period from November to April, and bring heavy rainfall during the period. In July, the ITCZ moves to the Northern Hemisphere. The southeast winds prevail with rainfall on the windward side of the islands, during the period from May to October.

(3) Rainfall

An isohyetal map of the South Pacific Ocean, that includes Papua New Guinea and Solomon Islands, is shown in Fig.5-3-16. According to this map, the mean annual rainfall is 3,000 mm in the western part of the Solomon Islands and increases to 5,000 mm in the eastern part. In January, the monthly rain exceeds 350 mm over the entire country, while it slightly decreases in July.

Fig.5-3-17 indicates the available annual rainfall in the period from 1955 to 1997 for the stations in the major islands. The mean rainfall in the major islands varies from 2,000 mm to 5,000 mm as shown in Table 5-3-8. In the western Solomon, the annual rainfall is 3,375 mm at Taro in Choiseul, while it is 5,609 mm at Paeu in Santa Cruz Islands.

It is noted that the rainfall in Rove West, Honiara, Henderson and Tenaru are less than 2,200 mm, which is low when compared with other stations. They are located in the northern end of the coastal plain far from the mountains of Guadalcanal, therefore the trade winds cause only limited amounts of rain in the coastal plain because of an orographic effect of the island as illustrated in Fig.5-3-18. Heavy rainfall occurs near the crest of mountains, and rain in coastal areas depends on the distance from mountains.

Fluctuation of the monthly rainfall in the year 1993 shows the rainy season from November to April and the dry season from May to October in Guadalcanal, Malaita, Santa Isabel and New Georgia islands, as shown in Fig.5-3-19 to -20.

The eastern region, however, does not show a distinct dry period. San Cristbal and Santa Cruz Islands rainfall was steady throughout the year 1993.

Table 5-3-8 Annual Rainfall

Station (Islands)	Annual Rainfall (mm)	Data Period (including breaks)
Taro (Choiseul)	3,375	1975-1997, 20 years
Munda (New Georgia)	3,492	1956-1997, 42years
Buala (Santa Isabel)	3,860	1982-1997, 10years
Auki (Malaita)	3,109	1956-1997, 42 years
Honiara (Guadalcanal)	2,004	1954-1973,1979-1997, 37 years
Henderson (Gudalcanal)	1,813	1974-1997, 23 years
Kirakira (San Cristbal)	3,454	1965-1997, 33 years
Lata (Santa Cruz Islands)	4,271	1970- 1997, 27 years
Paeu (Santa Cruz Islands)	5,609	1933-1948, 1952-1954 1956-1967 , 26 years

(4) River Flow

Available river discharge data from the nine gauging stations are very limited, because of observation breaks and vandalism problems as mentioned in section "(2) Hydrological Data ". The Lungga water level gauging station at the Lungga Bridge in Guadalcanal has the longest records of river flow data in Solomon Islands. The Lungga Bridge station has been operated since 1965, however only 12 years of complete daily data are recorded. The Lungga Gorge station has seven years of data, and all the other stations have less than two years of flow data, as shown in Table 5-3-9 to -17.

The flow duration curves are derived from the data of Lungga Bridge, Lungga Gorge, Charahi (Komarindi) and Jejevo stations, as shown in Fig.5-3-21 to -24.

The mean annual discharge of the Lungga Bridge is 39 m^3/s from the catchment area of 377 km^2. The mean monthly discharge varies from 65 m^3/s in March to 17m^3/s in August that reflects the monthly fluctuation of the rainfall in northern Guadalcanal. Table 5-3-18 summarizes the mean annual discharge of the stations with complete years of observation.

Table 5-3-18 Mean Discharge

Station	Annual Discharge(m^3/s)	Catchment	Data Entries
Lungga Bridge(Guadalcanal)	39	377 km^2	12 years
Lungga Gorge (Gudalcanal)	29	350 km^2	7 years
Charahi(Guadalcanal)	11	133 km^2	1 year
Jejevo(Santa Isabel)	0.146	2.1 km^2	1 year

(5) Water Balance in Lungga Basin

In order to check the mean annual discharge of the Lungga Bridge data, run-off from the Lungga basin was derived by the water balance equation as shown below.

$R = P - E$

Where R: Annual run-off in depth (mm)

P: Annual precipitation in the basin (mm)

E: Annual evapotranspiration from the basin (mm)

(a) Annual Precipitation

The Lungga basin is situated in the northwestern region of the Guadalcanal Island. In the north, west and south, watersheds of the catchment are surrounded by the mountains and the river flows to the northeast to the coastal plains. The mean annual rainfall over the catchment area was estimated by weighted average of three sub-catchments of the Lungga Basin according to elevation, as shown in Fig.5-3-25. The correlation analysis was made to derive the annual rainfall at Komarindi (EL260m) and Mt. Chaunapaho (EL1, 250m) from the long-term data of Honiara, as shown in Fig.5-3-26 to -27. Based on the result of the correlation analysis, the average rainfall of the sub-catchments was estimated as follows:

Table 5-3-19 Average Rainfall in Lungga Basin

Elevation (m)	Catchment (km^2)	Rainfall (m)	Remarks
0-200	20	2,004	Honiara
200-1000	337	4,363	Komarindi
Over 1000	20	5,174	Chaunapaho
Total	377	4,281	Average

The average annual rainfall over the Lungga basin is estimated to be 4,300 mm approximately. This calculation reflects the fact that the rainfall increases from SIPL station (EL55m) in the coastal plain to the Gold Ridge station (EL290m) and Mt. Chaunapaho station (EL1,250m) in the mountainous area of Guadalcanal, as shown in Fig.5-3-28.

(b) Evapotranspiration

Table 5-3-2 shows Class A pan evaporation data. The annual Class A pan evaporation is 1,716 mm at Henderson in Guadalcanal and 1,377 mm at Taro in Choiseul. It is generally said that actual evapotranspiration is 70% to 80% of the pan observation data.

Evapotranspiration data for the water balance was estimated to be 964 mm to 1,373 mm by the above factor. Fig.5-3-29 shows the annual evapotranspiration prepared by Lvovitch. The map indicates the annual evapotranspiration in the coastal area of Papua New Guinea is 800 mm to 1,500 mm. This agrees with the estimated value of evapotranspiration.

(c) Run-off at Lungga Bridge

The annual run-off at the Lungga Bridge station for 377 km^2 is calculated by the water balance equation as follows:

- When evaporation is assumed to be 964 mm,

R = P – E = 4,281-964 = 3,317 mm

Mean annual discharge = Catchment × Run-off / time

= 3.317 × 377 × 10E6 / (24 × 3,600 × 365)

= 40 m^3/s

- When evaporation is assumed to be 1,373 mm,

R = P – E = 4,281-1,373 = 2,908 mm

Mean annual discharge = Catchment × Run-off / time

= 2.908 × 377 × 10E6 / (24 × 3600 × 365)

= 35 m^3/s

The discharge estimated by the water balance equation indicates that the mean annual discharge is between 35 m^3/s and 40 m^3/s, this agrees with the actual observed data of 39 m^3/s, therefore the discharge data at the Lungga bridge station is acceptable for further study. The result of the water balance study is summarized below:

- The annual rainfall over the Lungga basin is estimated to be approximately 4,300 mm based on recorded data.
- The annual run-off from the basin is 3,262 mm which corresponds to 39 m^3/s at the Lungga Bridge gauging station for the catchment area of 377 km^2.
- The annual evaporation from the basin is approximately 1,000 mm derived by water balance equation.

(6) Monitoring Equipment Installation

The meteorological and hydrological instruments were procured by JICA and installed by MNR to monitor and collect evaporation, rainfall and river flow discharge data for hydropower development. The following instruments have been operated by MNR.

Table 5-3-20 Monitoring Equipment Installation

Instrument	Type	Quantity	Installation
Evaporation Pan	Class A pan ISUZU, model 3-7000-01	1 set	Upper Air Observatory in Honiara
Rain Gauge	Automatic Rain Gauge YOKOKAWA, model B-432-00	1 set	Malu'u police station, in Malaita
Water Level Gauge	SUIKEN 62 type YOKOKAWA, model W-021-00-60	1 set	Rori River in Malaita
Current Meter	Price current meter, ISUZU, model 3-7080-02	2 sets	MNR
Current Meter	Hiroi current meter, ISUZU, model 3-7090-02	1 set	MNR
Staff Gauge	Steel type, YOKOKAWA, model W-871-01	30 sets	each project site

5.3.4 Previous Studies

This section presents the previous studies and reports about the hydropower development in the Solomon Islands in chronological order. The names of the reports are listed in Table 5-3-21(1) and (2) by various institutions.

(1) General

The Hydrometric Status Report was compiled by the Ministry of Natural Resources (MNR) to summarize collection data to be used for rural hydropower potential in Solomon Islands up to 1978. The report reviewed many hydro potential sites from all over the Solomon Islands consisting of the Eastern Outer Islands, San Cristobal, Malaita, Guadalcanal, Santa Isabel, Western Province, Choiseul, Shortland Islands and Santa Cruz Islands. (Ref. 1, all the reference numbers are in Table 5-3-21(1) and (2))

In 1984 the United Nations Department of Technical Co-operation mission visited and reviewed hydro potential sites for the Tenaru, Mataniko and Kohore rivers in Guadalcanal, Fiu and Kwaibala rivers in Malaita, and Huro and Puepue rivers in San Cristbal. (Ref. 2)

In 1986 the United Nations Industrial Development Organization (UNIDO) carried out the prefeasibility study for the hydro potential sites in Solomon Islands and gave recommendations on priorities. The report recommended implementation of a feasibility study for the Komarindi hydropower project and suggested further study for the Kwaibala and Fiu rivers in Malaita, the Jejevo river in Santa Isabel, and the Huro river in San Cristobal. (Ref. 3)

In 1988 the Deutsche Gesellschaft Fur Technishe Zusammenarbit (GTZ) of the Federal Republic of Germany, German Technical Assistance, implemented a prefeasibility study on the hydro potential sites in Haimatua in Guadalcanal, Pijaka in Vangunu, Kukundu in Kolombangara and Folotana in Malaita. (Ref. 5)

(2) Guadalcanal

In 1965 Sir William Harcrow submitted to the British Solomon Islands Protectorate a report called “Feasibility of Water Power in Guadalcanal”, which studied the Lungga, Mataniko, Tenaru, White, Tinahula, and Nglimbiu rivers. (Ref. 6)

After the first report by Sir William Harcrow in 1965, the assessment of Lungga Hydroelectric Scheme was reviewed by Snowy Mountain Engineering (SMEC) in 1975. (Ref. 7)

The feasibility study report on the Lungga Hydro Project was completed in 1977 by Preece Cardew and Rider in association with Cameron MacNamara and Partners.

Since then at least 6 other reports on the Lungga Hydropower were submitted (Ref. 8 to 13).

In 1986 a prefeasibility study report for the Haimatua Mini Hydropower Scheme was completed by the Walter and Power Consultancy Services Ltd. (Ref. 14)

In 1988 the feasibility study on the Komarindi Hydropower was made by Tonkin and Taylor. (Ref. 17)

Following the feasibility study, detailed design for the Komarindi Hydropower was completed by Tonkin and Taylor in 1991. (Ref.19)

Three additional reports were prepared for the Komarindi project up to 1996. (Ref. 20 to 22)

Although many reports were prepared for the hydropower development in Guadalcanal, none of these has been realized.

(3) Malaita

In 1975 the geologists from MNR and SMEC visited the Malu'u hydropower project site and submitted a report, the Malu'u Micro Hydro Project, to the British Solomon Islands Electric Authority (BSIEA). (Ref.23 to 25)

In 1976 the chief geologist of MNR submitted the report called "A Preliminary Report on the Manakwai River as a hydroelectric power source", which stated that the discharge of the Manakwai was measured 12 times from August 1975 to July 1976. (Ref. 26)

In 1978 the Hydrometric Status Report was prepared for the hydro potential sites in the Solomon Islands including Malaita. The report prepared by the hydrological section of MNR who visited Malu'u, Manawai, Eastern Malaita, Southern Malaita, Auki and west Kwara'ae. (Ref. 1)

In 1980 the ENEX of New Zealand submitted for the Department of Technical Co-operation of the United Nations, the Feasibility Study Report on Malu'u Mini-Hydro scheme. (Ref. 27)

In 1986 UNIDO visited and reviewed the hydro potential sites including the upper and lower Kwaibala, and Fiu rivers in Auki system. (Ref. 3)

In 1987 NICHIMEN corporation visited the hydro potential sites including Kwaibala and Fiu rivers. (Ref. 4)

In 1994 GTZ submitted a hydro potential study on Auki. (Ref.33)

In 1996 GTZ completed a pre-feasibility study for Fiu and Ruala'e Mini-Hydropower schemes. (Ref. 34 and 35)

In 1996 GTZ submitted a pre-feasibility report for the Power System Expansion Malu'u. (Ref.28)

Atoifi micro hydropower station (32 kW) has been run by the Seventh Day Adventist (SDA) mission since 1976.

In 1984 the Malu'u Hydropower Project (35 kW) was constructed.

In 1998 Appropriate Technology for Community and Environment (APACE), Australia based non government organization for rural electrification, constructed the Manawai hydropower station (32 kW).

(4) Santa Isabel

In 1976 MNR visited the Poporo river for a hydropower potential study. (Ref.29)

In 1978 "Hydrometric Status Report" reported an investigation on the Poporo, Jejevo, and Koloao rivers. (Ref. 1)

In 1979 The Geological division of MNR visited the Rifukoti, Kubolata, Koloao, Korosaba and Sogolego rivers and the Buala area. (Ref. 30)

In 1986 UNIDO studied and visited the hydro potential sites in the Solomon Islands including the Jejevo hydropower project site. (Ref. 3)

In 1987 NICHIMEN corporation visited the hydro potential sites in the Solomon Islands including the Jejevo river. (Ref. 4)

In 1994 GTZ visited the Rifukoti and Poporo rivers and completed the report that recommended early implementation of a hydropower plant on the Rifukoti or Jejevo rivers. (Ref. 31)

In 1995 GTZ submitted the Feasibility Study Report on Buala Mini Hydropower Scheme. (Ref. 32)

In 1996 SIEA constructed the Buala Mini Hydropower Station (150 kW).

(5) San Cristobal

In 1978 the Hydrometric Status Report stated that discharge measurements were carried out on the Puepue and Huro rivers in 1976. (Ref. 1)

In 1986 UNIDO studied the hydro potential sites in the Solomon Islands including Huro Hydropower Project. (Ref. 3)

In 1987 NICHIMEN Corporation visited the hydro potential sites in the Solomon Islands including Huro river. (Ref. 4)

In 1994 GTZ visited the Huro, Puepue and Bungiroto rivers. (Ref. 36)

In 1996 GTZ completed the Feasibility Study Report on the Kirakira Mini Hydropower Scheme (111 kW) on the Huro River. (Ref. 37)

Currently no hydropower station has been constructed in the San Cristobal Island.

(6) Western Province

In 1978 the Hydrometric Status Report analyzed the hydro potential sites in Kolombangara, and New Georgia Islands. (Ref. 1)

In 1988 GTZ completed the prefeasibility Study that reported the potential hydropower sites at Pijaka in Vangunu and Kukundu in Kolombangara Islands. (Ref. 5)

APACE constructed three micro hydropower stations in Kolombangara: Irir (5kW) commissioned in 1983, Vavanga (5kW) in 1993 and Ghatere (5kW) in 1995.

Currently operation of the Vavanga station was confirmed by JICA Team in February 1999, however MNR reported that Iriri and Ghatere are not being operated due to mechanical problems.

(7) Choiseul

In 1979 the Geological Division of MNR visited the Koropengge Falls in the Panggoe area, Tarapa river near Vuranggo, Pacho river near Chorovanga and Sorave Falls on the Sui river. (Ref. 41)

Currently no hydropower station has been constructed in the Choiseul Island.

(8) Santa Cruz Islands

In 1978 the Hydrometric Investigation Report stated that the hydropower sites were possible in the Luembalele and Luetombo rivers in Santa Cruz Island. (Ref. 38)

In 1979 the follow up survey was carried out on the Luesalo river around the Graciosa Bay area. (Ref. 39)

In 1994 GTZ submitted a report called “Hydro potential for the Electric Power Supply of the Provincial Capital Lata on the Solomon Island”. (Ref.40)

None of the hydropower stations have been constructed in Santa Cruz Islands.

5.4 Hydro Potential Study

5.4.1 Identification of Hydro Potential Sites

Potential hydropower sites are identified on the 1:50,000 scale maps to derive head between intake and tailrace levels, and to measure catchment areas for hydrological analysis to estimate river discharge.

The following points are considered for site selection.

(1) An intake site is selected to have a large catchment area to enable usage of sufficient river flow for power generation.

(2) As for a run-of-river type development, intake and tailrace sites are selected in a steep part of a river course to maximize head by a short headrace.

(3) As for a pondage type or a reservoir type layout, the dam site should be located at a narrow valley where a dam site requires less dam volume for construction.

In the Master Plan Study, the following categories of power plant size are adopted:

Micro Hydropower Plant : Installed capacity less than 100 kW

Mini Hydropower Plant : Installed capacity equal or more than 100 kW and less than 1,000 kW

Small Hydropower Plant : Installed capacity equal or more than 1,000 kW

5.4.2 River Flow Data

Hydropower projects generally require river flow data for at least 10 years to select plant size and to design civil works. In the Solomon Islands, however, long-term river flow data are scarce even in the major rivers except the Lungga river in Guadalcanal. Therefore long-term river data are necessary to be converted for each project site.

The Lungga Bridge station has more than 12 complete years of flow data, and therefore is suitable as a reference data source.

In order to estimate available discharge at a site, and to set up flow duration for a project, the Lungga discharge data is converted for each site by the following equation:

$$Q_{site} = Q_{Lungga} \times (CA_{site} / CA_{Lungga})$$

Where Q_{site} : discharge at site

Q_{Lungga} : Lungga Bridge discharge data

CA_{site} : catchment area of intake site

CA_{Lungga} : catchment area of Lungga Bridge gauging station, 377 km^2

River discharge for the hydro potential study is based on the discharge and duration curve from the Lungga Bridge station data. The specific discharge per 100 km^2 is 10.3 m^3/s and the discharge 90% equaled or exceeded (firm discharge) is 3.0 m^3/s as shown in the Fig.5-4-1.

5.4.3 Plant Sizing

Plant size or installed capacity of potential sites is derived from head and maximum turbine discharge by using the following equation.

$$P = 9.8 \times He \times Q \times \eta \quad (kW)$$

Where, P : installed capacity (kW)

He : effective head (m)

Q : maximum turbine discharge (m^3/s)

η : combined efficiency of turbine and generator (0.8)

The following assumptions are made for the potential study:

(1) Effective head

Effective head is assumed to be 95% of the gross head between intake and tailrace water levels.

(2) Maximum discharge

The maximum discharge of a plant is determined taking into account the type of power generation, plant size, and power supply system.

(a) Run-of-river type plant

Small Hydro

The maximum discharge of run-of-river type is set at 10 $m^3/s/100\ km^2$, which corresponds to a Flow Utilization Factor (FUF, refer to Fig.5-4-2) of 0.7 for non-grid system or small demand system, as shown in Fig.5-4-3. The FUF of 0.7 is the recommended value by the "Guide Manual for Development Aid Programs and Studies of Hydro Electric Power Projects" issued by the New Energy Foundation of Japan. The manual assumes that generated energy cannot be consumed fully through non-grid system or small demand system. The maximum discharge for a grid system is selected at 13 $m^3/s/100\ km^2$, which corresponds to FUF of 0.6, to supply power to higher demand area such as the Honiara system. It is assumed that generated power up to 40 MW can be consumed for base load in the Honiara system.

Mini/Micro Hydro

The maximum discharge for mini/micro hydro is set at 3.0 m^3/s / 100 km^2, which corresponds to a FUF of 0.96, based on a 90% of probability of occurrence of an equaled or exceeded flow duration, in order to utilize the power plant at a high rate throughout the year.

(b) Pondage type

The maximum discharge for pondage or reservoir type power plants is set at 18 m^3/s /100 km^2, which corresponds to FUF 0.45 as shown in Fig.5-4-3. This value of FUF 0.45 is based on similar projects in Japan that indicate the optimum value of FUF is generally between 0.4 to 0.5 for pondage type plants. The following table summarizes the maximum discharge of plants.

Table 5-4-1 Maximum Discharge of Plant

Type of Plant	Plant Size	Supply System	Max. Discharge	FUF (duration)
Run-of-river	Small Hydro	Non-grid	10 m^3/s/100 km^2	0.70 (124days)
Run-of-river	Small Hydro	Grid	13 m^3/s/100 km^2	0.60 (80days)
Run-of-river	Mini/Micro Hydro	Grid or Non Grid	3 m^3/s/100 km^2	0.96 (329days)
Pondage	Small Hydro	Grid	18 m^3/s/100 km^2	0.45 (35days)

(3) Turbine and Generator combined efficiency

Although a type of turbine is not determined for each site, overall turbine and generator combined efficiency is assumed to be 0.8.

5.4.4 Results of Map Study

The result of the map study is summarized in Table 5-4-2. A total of 130 potential hydropower sites are identified in the Solomon Islands, with a total hydro potential amount of 326 MW including Lungga and Komarindi hydropower projects and other previous studies, as give in Table 5-4-3 to -10. The location of each site is indicated in Appendix 5-1-1 to -7. Hydro potential in each island is summarized below.

Table 5-4-2 Result of Hydropower Map Study

	Islands	Number of Sites	Micro Hydro (kW)	Mini Hydro (kW)	Small Hydro (kW)	Total (kW)	Remarks kW / site
1	Guadalcanal	49		1,210	236,100	237,310	4,800
2	Malaita	23	90	2,700	28,000	30,790	1,300
3	Santa Isabel	6		610	4,100	4,710	800
4	New Georgia	23	320	4,840		5,160	200
5	San Cristobal	12	20	371	25,500	25,891	2,200
6	Choiseul	15	140	2,030	20,030	22,200	1,500
7	Santa Cruz	2	50	260		310	200
	Total	130				326,371	

(1) Guadalcanal

The hydro potential sites in Guadalcanal totals 237 MW that accounts for 73% of the country's hydro potential. The average capacity of each site shows 4,800 kW, the largest among the islands. Remoteness of the sites, however, makes project planning, survey, design and construction difficult. Improvement of access is indispensable for further hydropower development.

(2) Malaita

The hydro potential totals 30,790 kW, the second largest in the Solomon Islands.

The Malaita province has been expanding its road system that can accelerate the hydropower development. The north west area of the island shows the favorable conditions for hydropower development such as steep terrain with high rainfall and easy access from the provincial road. In this area the Rori, Silolo, Tamba, and Aero hydro projects are proposed to generate total 2,770 kW.

(3) Santa Isabel

Although in the Santa Isabel the hydro potential is limited to 4,710 kW, the Buala area has favorable conditions such as a steep slope creek with high rainfall. Further mini hydro development like the existing Buala hydro is possible in the Kubolata hydro site.

(4) New Georgia

The Western province comprises several islands where mini and micro hydro projects are possible. The average capacity of the hydro sites is small as 200 kW. Inland access to the hydro sites are very limited, therefore power supply area will be a isolated system.

(5) San Cristbal

The rivers in San Crirstbal have a large catchment with mild slope, consequently storage projects is possible layout. A large hydro scheme, however, makes immediate construction difficult, because of current small electricity demand in the island.

(6) Choiseul

The hydro potential sites are situated around the Central Highland, except the Sorave site in the north west of the island. The existing provincial road is available for 12 km in the south coast near Kolombangara River, therefore the logging roads are alternative access to the sites.

(7) Santa Cruz Islands

Although Lata situated in the far east islands needs stable hydropower supply, hydropower sites are limited. The advantages of the island are high rainfall, the existing provincial road and volcanic rocks for construction material.

5.5 Field Survey

The JICA Master Plan Team together with MNR and SIEA surveyed the hydropower sites in the major islands of the Solomon Islands in the periods from January to March, 1999 for the first field survey and from October to December, 1999 for the second field survey. The field survey was carried out to investigate and confirm topographic, hydrological and environmental conditions of the sites. Power supply and distribution facilities were also surveyed to evaluate the construction of transmission and distribution lines. Transport conditions including access routes, bridges, ports and other transport infrastructures were surveyed in connection with the construction works. The hydropower group, formed by T. Murata (team leader, power supply planing engineer), T. Tejima (small hydropower engineer), and S. Hirano (transmission lines and distribution facilities engineer), and Y. Takeuchi (Geologist), carried out the field survey of the proposed sites as follows:

5.5.1 First Field Survey

The first field survey was carried out to check and collect information regarding to the potential hydropower sites in all six major islands in the following terms:

(1) Guadalcanal : 15, 21 and 22 January and 10 February
(2) Malaita : from 25 to 29 January
(3) Santa Isabel : from 1 to 5 February
(4) New Georgia : from 14 to 19 February
(5) Choiseul : from 21 to 23 February
(6) Makira : from 26 February to 1 March

During the first field survey, JICA Team also visited the existing the Malu'u hydro (35kW) in Malaita and the Buala hydro (150kW) in Santa Isabel. Since these power stations are operated and maintained efficiently, JICA Team confirmed that the SIEA is capable to operate future hydro plants.

5.5.2 Site Selection

Based on the results of the map study and the first field survey, the hydro project sites were selected for the second field survey according to the following considerations:

(1) Hydropower sites are planned to supply power mainly for domestic consumption, government offices, hospitals and secondary schools. These premises require the use of electric appliances including telecommunication facilities for offices, medical equipment for hospitals and lighting facilities for studying activities in dormitories of secondary schools. Therefore these public and private facilities should be given a high priority for electric power supply.

(2) Hydropower sites in vicinity of the provincial capital and/or government (provincial) stations are selected, since power plant sites should be located near the load center to

minimize construction costs originated by access and transmission / distribution lines.

5.5.3 Second Field Survey

The survey team conducted a topographic survey, river flow measurement and geological investigation at each one of the selected sites.

(1) Malaita

Survey Site: Silolo, Rori and Kware'a

Duration : 25 October to 5 November, 1999

(2) Santa Isabel

Survey Site: Kubolata and Poporo

Duration : 8 November to 15 November, 1999

(3) Choiseul

Survey Site: Sorave

Duration : 19 November to 23 November, 1999

(4) San Cristbal

Survey Site: Waimapuru

Duration : 26 November to 1 December, 1999

(5) Santa Cruz

Survey Site: Luembalele

Duration : 8 December to 11 December, 1999

(6) Guadalcanal

The hydropower sites in Guadalcanal such as Maotapuku 1 and 2, and Sasa were not surveyed during the second field survey because of the security risks caused by the ethnic tensions breaking out in 1999. Further study of these sites are therefore based on the existing data and on results of the first field survey.

5.5.4 Third Field Survey

The survey team conducted the filed survey for the Rori hydropower site in the period from 25 to 28 May, 2000.

During the filed trip, the survey team confirmed the water level gauge that has been operated on the Rori Rive by MNR.

5.6 Design and Cost Estimation

5.6.1. Civil Design

(1) Dam

For a run-of-river type hydropower site, a concrete intake weir is selected to divert river flow to a headrace. The weir height shall be less than 15m and its downstream slope between 1:0.7 to 1:0.8 based on existing run-of- river type plants in Japan. For a pondage or a reservoir type hydropower site, a concrete gravity type dam is selected to create head on a storage reservoir. The downstream slope of the dam is adopted to be 1:0.8.

(2) Intake

(a) Side Intake

An intake is installed near the upstream of a weir to divert river flow to a sand trap. A screen with a bar interval of 5 to 10 cm is installed at the entrance of the intake to remove floating debris. At the screen the inflow velocity shall be 0.3 m/s to 1.0 m/s to reduce head loss. A regulating gate is also installed to control inflow to a waterway.

(b) Streambed Intake

A streambed intake is adopted at a project site where a catchment area is small. Although a mean annual discharge of the small catchment is low compared with a river in a large basin, the river flow from the small catchment area fluctuates largely with high amounts of sedimentation. A streambed intake is suitable for such river condition, and requires less concrete volume than that of a conventional weir and intake structure. A streambed intake consists of an intake weir with a screen and a channel embedded in an intake weir.

(3) Sand Trap

A Sand trap is installed in the downstream area of an intake to settle sediment. In order to remove sand settled in the bottom of the sand trap, a sand-flushing gutter is provided at its end. A manual scouring sluice gate is provided at one end of the gutter to release the sand to a river. The length of the settling basin structure is calculated by the following equation:

$$L \geqq (h / V_g) \times u$$

Where, L: Required minimum length of sand trap (m)

h: Water depth of sand trap (m)

u: Mean velocity in sand trap (0.3 m/s)

V_g: Critical settling velocity of the finest sand particles to be settled (0.1 m/s with grain size d=0.5 to 1.0 mm according to Fig.5-6-1)

In practice, the length of the sand trap should be twice the value obtained from the above formula by taking account a secondary flow effect. The water depth should be slightly deeper than the headrace, and the width should be determined in order that the average flow velocity shall be about 0.3 m/s. Bed slope of sand trap is to be about 1/15 to 1/50.

(4) Headrace

Either an open channel or embedded pipe is normally planned in mild topography of a valley where open excavation is feasible. A tunnel is adopted only when construction of an open channel is difficult because of the topography. The headrace slope adopted is to be 1/1,000. The cross-section for a headrace structure is derived from the average flow velocity to be about 1.0 to 3.0 m/s.

(5) Head tank

In order to determine the head tank dimensions, the head tank is to have a tank volume corresponding to 2 to 3 minutes use of the maximum plant discharge. At the inlet of the penstock a sufficient cover of water shall be provided to prevent air being drawn into the penstock. The cover depth is empirically given by the following formula:

H=2d

Where H : Water depth from the center of inlet to water surface (m)

D : Inside diameter of penstock (m)

For removing sediment and dirt, the bottom slope of the head tank is to be about 1/15 to 1/50 with a manual scouring sluice at the end of the gutter. A screen and a regulating gate are also provided at the inlet of the penstock. In a sudden decrease of load, spillway is provided to release surplus water safely to a river.

(6) Penstock

The diameter of a penstock is determined from the pipe flow velocity from 1.0 to 4.0 m/s that depends on effective head as shown in Table 5-6-1.

Table 5-6-1 Mean Flow Velocity of Penstock

Head, H (m)	Mean velocity in Pipe, V (m/s)
15 > H	V < 1.0
30 > H > 15	V < 2.0
100 > H > 30	V < 3.0
H > 100	V < 4.0

Anchor blocks are installed at both ends and bend points of a penstock. The straight sections between anchor blocks are supported by ring girders or concrete saddles.

(7) Powerhouse

A conventional surface type powerhouse is selected, except a semi underground powerhouse at Kware'a. Approximate dimensions of buildings are determined from the combinations of turbine type, output and effective head. The open channel type of tailrace is selected with a mean flow velocity of 1.0 to 2.0 m/s.

5.6.2 Mechanical Design

(1) Head loss

The head loss at an intake and a sand trap is assumed to be about 0.05m. The head loss at the turbine inlet, etc. is estimated to be (0.5m +Δh). Δh is within the range of +0.5m, and the head loss is expressed in multiples of 0.5m. Therefore, the total head loss is calculated from the following equation:

$H_L = 0.05 + (L1 \times 1/1{,}000) + (L2 \times 1/200) + (L3 \times 1/1{,}000) + (0.5 + \Delta h)$

Where, H_L: head loss (m)

L1: length of headrace (m)

L2: length of penstock (m)

L3: length of tailrace (m)

(2) Maximum Discharge

The maximum discharge of the hydropower plant is based on the previous discussion presented in section "5.4.3 Plant Sizing".

(3) Turbine Selection

When the effective head and maximum discharge are given, the turbine type is selected from Fig.5-6-2. The maximum combined efficiency is estimated by the turbine type, effective head, and maximum discharge. Maximum efficiencies of each turbine type considered in this preliminary design stage are shown as follows:

-Horizontal Francis Turbine	:0.84
-S-type tubular Turbine	:0.84
-Pelton Turbine	:0.72
-Cross Flow Turbine / Reverse Running Pump Turbine	:0.72〜0.75

(4) Annual Output Energy

Estimation of the annual output energy is based on the combination of the flow-duration curve and the turbine and generator efficiency as shown in Fig.5-6-3. The number of days for the flow duration curve is divided into several periods. The mean discharge at these periods is read on the flow duration curve, the corresponding combined efficiency is obtained and then the annual output energy (Ei) is obtained by summing up each Ei.

$E = \Sigma Ei = \Sigma (Pi \times ti)$

Where, E : Annual output energy (kWh)

Ei : Output energy at time interval (kWh)

Pi : Average power at time interval (kW)

ti : Time interval (hours)

5.6.3 Cost Estimation

(1) Conditions and Assumption

The construction cost estimate method was made on the basis of the conditions and assumptions described below.

(a) The cost estimate was made at a price level of June 2000 when the cost survey was carried out. The exchange rate is US$1.00=SB$0.20=105.00J.Yen.

(b) The unit prices were estimated based on the cost survey carried out during the third field survey and the similar hydro power projects in the Solomon Islands, the South Pacific countries, the South East Asian countries and Japan. Unit prices of labor wage, major construction materials and equipment in Solomon Islands are shown in Tables 5-6-1,-2 and -3.

(c) The project cost consists of civil works, equipment, and other expense as shown in Appendix 5-2.

(d) The procurement of main equipment and materials are shown in Table 5-6-5.

Table 5-6-5 Procurement of Main Equipment and Materials

Local Procurement	Procurement from other countries	Procurement from Japan
aggregate for concrete (gravel and sand)	cement	turbine and accessories
timber	reinforcement bar	generator
gasoline and kerosene		control panel
		transformers
		transmission and distribution lines
		gates, screens penstock
		other miscellaneous materials for civil works

(2) Cost Estimate Method

(a) Civil Works

The construction cost for civil works was estimated by the unit price estimate method.

① Quantity

The quantity is basically calculated from the preliminary design drawings.

② Transportation Cost

Port facilities for bulk transportation from Honiara to each project site are selected as shown in Table 5-6-6. Cost for Sea freight from Honiara to each province was estimated based on chartering a ship (normal capacity of 45 ton). Sea freight cost of SB$0.001/kg/km and inland transportation cost of SB$0.01/kg/km are applied to estimate on-site-costs for construction materials. These transportation costs are included in the unit prices.

Table 5-6-6 Distance from Capital to Each Site

Site	Port Facility	Distance from Honiara (km)
Maotapuku 1,2 and Sasa	Point Cruz at Honiara	0
Silolo and Rori	Malu'u	120
Kware'a	Auki	120
Kubolata	Buala	200
Waimapuru	Kaonasugh	260
Sorave	Jetty of the logging company near school	530
Luembalele	Lata	700

③ Excavation Cost

Unit prices for excavation were adopted from the existing hydro project cost in the Solomon Islands. Excavation of common soil is estimated at US$13/m^3, and excavation of rock is estimated at US$32/m^3. Excavation costs of each civil structure such as intake, sand trap, head tank, penstock and powerhouse were derived from combination of "Common Soil" and "Rock" excavation. Table 5-6-7 shows the unit price of excavation at each civil structure.

Table 5-6-7 Unit Price of Excavation at Each Civil Structure

Site	Excavation Ratio Soil: Rock	Adopted Unit Price
Intake and Sand Trap	10:90	US$30/m^3
Headrace (open channel)	80:20	US$16/m^3
Head Tank	60:40	US$20/m^3
Penstock and Spillway	80:20	US$16/m^3
Powerhouse and Tailrace	80:20	US$16/m^3

④ Concrete Unit Price

Unit prices for concrete were estimated based on the on-site-costs of materials such as cement, aggregates, reinforcement bar, and plywood. All materials are to be transported from Honiara. As for Maotapuku 1, 2, Sasa and Kware'a, a concrete plant would be prepared near the site, thus the unit price is based on ready-mixed-concrete. As for other sites, concrete is mixed on site. The unit price for concrete includes placement, reinforcement, formwork, and transport from Honiara to each site. The unit prices for concrete at each site are shown in Table 5-6-8.

Table 5-6-8 Basic Unit Price for Concrete

Site	Basic Unit Price
Maotapuku 1,2, Sasa, Kware'a	US$ 374/m^3
Silolo, Rori	US$ 426/m^3
Kubolata	US$ 462/m^3
Waimapuru	US$ 490/m^3
Sorave	US$ 610/m^3
Luembalele	US$ 688/m^3

⑤ Tunnel

The headrace tunnel work mainly consists of excavation and concrete lining. The unit price was estimated from similar hydropower projects in the Solomon Islands, the South East Asian countries and Japan. The headrace tunnel is a non-pressure type tunnel with a shape of vertical leg horseshoe with horizontal invert, 1.8m wide by 1.8m high, excluding concrete lining of 20cm. The minimum cross section was selected based on the machine excavation. The unit price of tunnel was estimated at US$6,600 per meter. The unit price includes excavation, blasting, mucking, erection of support, concrete lining, ventilation and dewatering of site.

⑥ Powerhouse Building

The Unit price for the powerhouse building is based on the volume of the building including a turbine foundation. The unit price of the powerhouse building is derived from the existing hydropower projects in Solomon Islands. Powerhouse Building cost is estimated at US$ 180 per cubic meters.

⑦ Access Road

The unit price for access construction in length was estimated at US$108 per meter from the similar hydro projects in the Solomon Islands.

⑧ Indirect Cost

The costs for temporary works, site supervisor and site expense are included in the indirect cost. The indirect cost was estimated at 30% of the direct cost based on the similar hydro projects in South Pacific countries.

(b) Equipment

① Metal Works

Metal works include supply and installation of penstock, gates and screens. The unit price estimating method was applied. The weight of steel structure was calculated based on its dimension, maximum discharge, and design hydraulic pressure. The unit prices of penstock, gates and screens were based on the similar JICA hydro projects.

-Penstock: US5, 200 per ton plus indirect cost.

-Gate: US10, 200 per ton plus indirect cost.

-Screen: US6, 700 per ton plus indirect cost.

The costs of installation, temporary work, packing and shipping, engineering assignment, site expense, overhead is included in the indirect cost. The indirect cost was estimated at 30% of direct cost based on similar hydro project in South Pacific countries.

② Turbine and Generator

The costs of turbine and generator were estimated based on effective head and installed capacity. The unit price includes equipment (turbine and generator, control panel, step-up transformer, provision of manual and spare parts), installation, temporary work, packing and shipping, engineering assignment, site expense, overhead.

③ Transmission and Distribution Line

The quantity and cost of transmission and distribution lines at each hydropower site are summarized in Table 5-6-9. The unit prices include supply of materials, erection of towers and poles, construction of foundations and installation of conductors as well as step-down transformers for distribution lines. Details of transmission and distribution lines are referred to Chapter 6.

Table 5-6-9 Quantity and Cost of Transmission and Distribution Lines

Site	Transmission Line				415V Distribution Line		
	Voltage & ckt	Length (km)	Unit Price	Cost	Length (km)	Unti Price	Cost
Maotapuku 1	33kV 2ckt 240	6.5	US$113,400	US$737,000			
Maotapuku 2	33kV 2ckt 240	32.5	US$113,400	US$3,686,000	6.0	US$50,500	US$303,000
Sasa	11kV 1ckt	15.0	US$53,900	US$809,000	2.0	US$50,500	US$101,000
Silolo	33kV 2ckt 160	8.0	US$99,000	US$792,000			
Rori	11kV 1ckt	20.0	US$53,900	US$1,078,000	9.0	US$50,500	US$455,000
Kware'a	33kV 1ckt 160	14.0	US$71,400	US$1,000,000			
Kubolata	11kV 1ckt	2.5	US$53,900	US$135,000	0.5	US$50,500	US$25,000
Waimapuru					2.0	US$50,500	US$101,000
Sorave	11kV 1ckt	6.0	US$53,900	US$323,000			
Luembalele	11kV 1ckt	22.0	US$53,900	US$1,186,000			

(c) Others

① Land Acquisition and Compensation

Land acquisition and compensation cost was estimated at 1% of the construction cost of the civil works and the equipment.

② Engineering Service

The cost for engineering service that comprises design and site supervision was estimated as shown in Table 5-6-10.

Table 5-6-10 Cost of Engineering Service

Output (kW)	Specification	Engineering Service
P ＞ 1,000	Small Hydro Power	10% of the construction cost
1,000 ≧ P ≧ 100	Mini Hydro Power	10% of the construction cost
100 ＞ P	Micro Hydro Power	US60,000, based on GTZ project

③ Contingency

The contingency required for the project consists of physical contingency to compensate for physical conditions unforeseeable at this stage. The contingency was estimated as shown in Table 5-6-11.

Table 5-6-11 Cost of Contingency

Output (kW)	Specification	Engineering Service
P ＞ 1,000	Small Hydro Power	10% of the construction cost
1,000 ≧ P ≧ 100	Mini Hydro Power	US940,000, based on similar hydro project
100 ＞ P	Micro Hydro Power	US156,000, based on similar hydro project

5.7 Small Hydropower Development

This chapter presents the study results of the small hydropower development for the selected hydropower sites that were surveyed during the second field survey, except the Poporo hydropower which was excluded from the further study as stated in Appendix 5-5.

The ten selected sites consist of:

-Guadalcanal

Maotapuku 1, Maotapuku 2 and Sasa projects,

-Malaita

Silolo, Rori and Kware'a projects,

-Santa Isabel

Kubolata project,

-San Cristobal

Waimapuru project,

-Choiseul

Sorave project,

-Temotu

Luembalele project.

The study results include the following for each project:

(1) General

This section presents the summary and project features of each project.

(2) Climate and Hydrology

Climatological and hydrological conditions of each project site are presented.

(3) Geology

Results of the geological investigation and the existing geological information are presented with a site geological map in 1/10,000 scale.

(4) Hydropower Planning

Head and maximum discharge of a hydro plant are discussed, as well as flow duration, installed capacity and annual generated energy are also presented.

(5) Layout and Design

A layout of a preliminary design is shown on a map scale of 1/10,000 enlarged from the existing 1/50,000 series maps. The design drawings are based on the investigation result including preliminary topographic survey.

(6) Access

Access shows current conditions such as the nearest port facility, the existing road and the proposal of a project access road for construction and maintenance.

(7) Environment

The findings of the environmental conditions for each project are presented. Environmental considerations for hydropower development are also presented in sections

9.4.1 and 9.4.2 of "Environmental Considerations".

Land acquisition and related issues such as landowners are summarized in Table 8-5-1 of "Rural Society".

(8) Project Cost

Project cost was estimated from work quantity derived from the drawings and the costs for civil works and electro-mechanical works surveyed in the Solomon Islands and Japan.

5.7.1 Maotapuku 1 Hydropower site

(1) General

The Maotapuku 1 hydropower site, situated at 28 km to the southeast of Honiara, is proposed on the Maotapuku River that is a tributary of the Matepono River in the central area of the Guadalcanal Island, as shown in Fig.5-7-1.

The project is aimed to exploit discharge from the catchment area of 10 km^2 and head of the steep river by a run-of-river hydro plant to generate 1,600 kW and 7,838 MWh per year, as shown in Table 5-7-1.

The project requires the construction of an intake weir, a waterway (sand trap, headrace, head tank and penstock) and a powerhouse as shown in Fig.5-7-2 (1). An access road of 3.5 km beyond the existing Gold Ridge mining road is required for construction and maintenance. The project also needs a 33 kV transmission line for 6.5 km from the Maotapuku 1 to the Maotapuku 2 powerhouse.

The project cost will be US$ 24.9 million and will cover civil works, electro-mechanical works, transmission line, land acquisition, engineering and contingency.

The principal parameters of this project are as follows:

Island	: Guadalcanal
Name of River	: Maotapuku River (a tributary of the Matepono River)
Catchment	: 10 km^2
River Flow	: 1.0 m^3/s (mean annual discharge)
Gross Head	: 155 m
Effective Head	: 150.5 m
Max. Plant Discharge	: 1.3 m^3/s
Installed Capacity	: 1,600 kW
Annual Energy Output	: 7,838 MWh
Intake Weir	: Height 3.9 m and crest length 15.0 m
Tunnel	: Width 1.8 m, height 1.8 m and length 1,620 m
Penstock	: Diameter 700 mm and length 531 m
Turbine type	: Francis turbine (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 6.5 km (33 kV 2ckt)

Access Road	: 3.5 km
Project Cost	: U$24.9 million (SB$=0.2US$, year 2000)

(2) Climate and Hydrology

The Matepono River originates on Mt. Chanapaho (EL1,250 m) situated in the central area of Guadalcanal Island, flows on the north slope of this mountainous region and farther down to the coastal plain, and finally drains to the sea at Iron Bottom Sound. The Maotapuku River, which is a tributary of the Matepono River, flows at the east of Gold Ridge in a mountainous area, where the river slope is as steep as 1/ 8, as shown in Photos 5-7-1 and 5-7-2. The catchment of the intake site is 10 km^2 in the upland at an elevation above EL 400 m where heavy rainfall occurs.

The long-term rainfall data has been collected at the Honiara station, where records over 37 years since 1954 give a mean annual rainfall of 2,004 mm. There is a seasonal pattern of rainfall during the year, being the wet period from December to March and the dry period from April to November, as shown in Fig.5-7-3. The highest mean monthly rainfall is 312 mm in March, and the lowest is 91 mm in July, as shown in Table 5-7-2. It is reported that the rainfall in Guadalcanal increases with elevation, therefore the rainfall in the Gold Ridge area should have a higher rainfall than that observed in Honiara, at the coastal plain. The annual rainfall in the Gold Ridge area is estimated to be about 4,300 mm, which is the result of rainfall in the 200 to 1,000m elevation section as shown in Table 5-3-19, from "Average Rainfall in Lungga Basin" of section 5.3.3 (5) "Water Balance in Lungga Basin", in this report.

There is no long-term river flow data available for the Maotapuku River. The most reliable river flow data is available from the Lungga Bridge gauging station that has been operating since 1965. The mean annual discharge of the Lungga Bridge is 39 m^3/s, derived from 12 years of complete data records, in a catchment area of 377 km^2. The river flow of the Maotapuku is derived by the catchment conversion method from the Lungga Bridge gauging station of 377 km^2 to the Maotapuku intake site catchment of 10 km^2. The mean annual discharge is estimated to be 1.0 m^3/s at the intake site.

(3) Geology

The project area is covered by a 1:50,000 geological map (1979) and aerophotographs (1986)[1]. The regional geology is shown in Fig.5-7-4.

(a) Topography and geology outline

The project area is located in the east side of Gold Ridge Mine, central Guadalcanal. The area consists of ridges ranging in 400-800m of altitude, and 250-450m riverbeds. Many collapses occur in the branches of the upper reaches. The riverbed may have thicker deposits, but the river shores are not wide. The Gold Ridge Volcanics covers the whole project site. The volcanics are mainly pyroclastics from the Neogene age,

[1] GOLD RIDGE, Guadalcanal Geological Map Sheet GU 9, and Aerophotographs C7801 F22-23.

that gradually dip north, and have many faults in several directions and partly altered zones.

(b) Project site engineering geology conditions

The intake site is located in a meandering part of the river, just after a branch junction. An old collapse is found in the right slope at 400m upstream from the intake site. The waterway route on the left bank is in a comparatively gentle slope. Surface deposits are assumed to cover the faulted basement rock. As there are neighboring mining activities with possible influences on the waterway, related information is important. The powerhouse site is to be located on the left tributary near a ridge end, in a meandering river characterized by faults.

(4) Hydropower Planning

In order to exploit the river flow originated from a heavy rainfall catchment of 10 km^2 and with a steep head section on the Maotapuku River, the intake site is selected at EL 420m, to the east of Gold Ridge. The powerhouse site is situated at 300m upstream from the confluence of three rivers, Maotapuku, Charivungo and Turupote. The available head will be 155m between the intake water level at EL 420 m and the tailrace water level at EL 265m. The maximum plant discharge is assumed to be 1.3 m^3/s, which corresponds to a flow utilization factor (FUF) of 0.6, or a flow duration of 22% (80 days flow), to supply power to the Honiara system, a high demand area, as shown in Fig.5-7-5.

The installed capacity is 1,600 kW by using a horizontal Francis turbine with a maximum discharge of 1.3 m^3/s at a gross head of 155m, with an estimated annual generated energy of 7,838 MWh.

(5) Layout and Design

The project layout and design are shown in Fig.5-7-2 (1) to (4).

The intake weir has been selected at the river confluence, at EL 420m, to collect available water. The intake and the sand trap are situated on the left bank immediately downstream from the weir.

The headrace conveys the maximum discharge of 1.3 m^3/s for 1,620 m along the tunnel gradient of 1/1,000. The headrace is a non-pressure type tunnel with the shape of a vertical leg horseshoe with a horizontal invert, 1.8m wide by 1.8m high excluding concrete lining of 20 cm thick.

The head tank has a storage capacity of about 280 m^3, measures 5.9m wide by 17.27m long and 6.6m high, and is situated at the north east edge of the Gold Ridge.

The penstock, 700 mm in diametre, will be laid on the surface for 531m from the head tank to the powerhouse located on the right bank of the Charivungo River, or at 300m upstream from the confluence of the rivers Charivungo and Maotapuku.

The powerhouse, a conventional surface type, accommodates a horizontal Francis turbine and a synchronous generator in a building 14m wide by 7m long and 8m high.

The tailrace is a concrete open channel for 5m long required for the discharge of water back to the river.

(6) Access

Point Cruz in Honiara is the nearest port facility for this project. From Honiara to the site, the provincial road and the access of the Gold Ridge mining are already constructed, with respective lengths of 31 km and 10 km. A new access road of 3.5 km, necessary for the construction and maintenance activities of the project, should run from the existing Gold Ridge road to the intake via the head tank, and to the powerhouse. Permanent bridges are already built over all the rivers from Honiara to the Gold Ridge, except at the Tinahulu River where a temporary wooden bridge is used for mining operation.

(7) Environment

The site survey for hydropower development has not yet been carried out for the Maotapuku 1 site, therefore, site survey including environmental investigation should be carried out before the next stage of the project. The environmental investigation should cover site survey and data collection of the environmental requirement set out by the mining operation.

(8) Project Cost

The project cost is estimated to be US$ 24,870,000 as follows. Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-3 Project Cost of Maotapuku 1

Item	Unit	Cost	Remarks
A. Civil Works	US$	16,093,000	Tunnel:1620m
B. Equipment			
Metal Works	US$	1,219,000	L:531m,D:0.7m
Turbine&Generator	US$	2,505,000	Francis
Transmission Line	US$	737,000	L:6.5km,33kV2ckt
Sub-total of item A & B	US$	20,554,000	
C. Others			
Land acqusition	US$	206,000	1% of sub-total
Engineering	US$	2,055,000	10% of sub-total
Contingency	US$	2,055,000	10%of sub-total
Total Project Cost	US$	24,870,000	

Note:SB$=0.2US$(year:2000)

5.7.2 Maotapuku 2 Hydropower Site

(1) General

The Maotapuku 2 hydropower site is proposed in the downstream area of the Maotapuku 1 powerhouse as shown in Fig.5-7-1. The project is aimed to exploit discharge from the catchment area of 22 km^2 and head of the steep river course, by a run-of-river hydro plant to generate 1,400 kW and 6,619 MWh per year.

The project requires the construction of an intake weir, a waterway and a powerhouse as shown in Fig.5-7-6 (1). An access road of 5.8 km from the existing Gold Ridge mining road is required for construction and maintenance. The project also needs a 33 kV transmission line for 32.5 km from the Maotapuku 2 to the Lungga Diesel power plant and a 415V distribution line for 6 km.

The project cost will be US$ 27.0 million for the civil works, electro-mechanical works, transmission and distribution lines, land acquisition, engineering and contingency.

The principal parameters of this project are as follows.

Island	: Guadalcanal
Name of River	: Maotapuku River (a tributary of the Matepono River)
Catchment	: 22 km^2
River Flow	: 2.2 m^3/s (mean annual discharge)
Gross Head	: 62m
Effective Head	: 58.5m
Max. Plant Discharge	: 2.9 m^3/s
Installed Capacity	: 1,400 kW
Annual Energy Output	: 6,619 MWh
Intake Weir	: Height 3.9m and crest length 15m
Tunnel	: Width 1.8m, height 1.8m, and length 1,400m
Penstock	: Diameter 1,200 mm and length 157m
Turbine	: Francis type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 32.5 km (33 kV 2ckt)
Distribution Line	: 6 km (415 V)
Access Road	: 5.8 km
Project Cost	: US$ 27.0 million (SB$=0.2US$:year2000)

(2) Climate and Hydrology

The climatological and hydrological conditions are presented in the Maotapuku 1 site, in the previous section.

The river flow of the Maotapuku 2 site is derived from the catchment conversion method from the Lungga Bridge gauging station of 377 km^2 to the Maotapuku 2 intake site catchment of 22 km^2. The mean annual discharge is estimated to be 2.2 m^3/s.

(3) Geology

The project area is covered by a 1:50,000 geological map (1979)[2]. The regional geology is shown in Fig.5-7-7.

(a) Topography and geology outline

The project area is located to the northeast of the Gold Ridge Mine, central Guadalcanal. The area consists of ridges ranging in 250-450m of altitude and 120-220m riverbeds. The Toni Conglomerate Member covers from the intake site to

[2] ditto GU 9.

the open channel route. The Mubetivatu Sandstone covers from the head tank to the powerhouse. These Neogene sedimentary rocks gradually dip north, and have gentle folding and faults.

(b) Project site engineering geology conditions

The intake site is located in a straight part of the river between steep slopes. The Chovohio fault is present in the right bank near the site. It is also a geological boundary.

The waterway route on the left bank is in a comparatively steep slope. The lower part has northwest trend faults and small dykes of volcanic breccia from the Chovohio Igneous Phase.

The powerhouse site is to be located in a river junction near a ridge end.

(4) Hydropower Planning

In order to exploit the river flow originated from a heavy rainfall catchment of 22 km^2 and with a steep head section on the Maotapuku River, the intake site is selected at EL 202m to the east of the Gold Ridge mining area. The powerhouse site is situated at the confluence of Maotapuku and Charinave to maximize available head. The available head will be 62m between the intake water level at EL 202m and the tailrace water level at EL 140m.

The maximum plant discharge is assumed to be 2.9 m^3/s, which corresponds to a flow utilization factor (FUF) of 0.6, or flow duration of 22% (80 days flow), as shown in Fig. 5-7-8.

The installed capacity is 1,400 kW by using a horizontal Francis turbine with a maximum discharge of 2.9 m^3/s at a gross head of 62m. The annual generated energy would be 6,619 MWh.

(5) Layout and Design

The project layout and design are shown in Figs.5-7-6 (1) to (4).

The intake weir is located at EL 202m. The sand trap is installed on the left bank immediately downstream after the intake.

The headrace conveys water for 1,400m along the tunnel gradient of 1/1,000, in the left bank of the valley. The headrace is a non-pressure type with the shape of a vertical leg horseshoe with a horizontal invert, 1.8m wide by 1.8m high excluding concrete lining of 20 cm thick.

The head tank has a storage capacity of about 380 m^3, measures 7m wide by 25.1m long and 4.8m high and is situated at the north slope of the ridge.

The penstock, 1,200 mm in diameter, leads water for 157m from the head tank to the powerhouse located at the confluence of the Maotapuku and Charinave Rivers.

The powerhouse, a conventional surface type, accommodates a horizontal Francis turbine and a synchronous generator in a building 14m wide by 7m long and 8m high.

The tailrace is made of a concrete open channel for 10m to release the discharge to the river.

(6) Access

The access from Honiara is to be referred to the Maotapuku 1 site.

An access road of 5.8 km is necessary for the construction and maintenance of this project, from the terminal point of the Maotapuku 1 powerhouse access to the intake, head tank and powerhouse of Maotapuku 2 site.

(7) Environment

The site survey for hydropower development has not yet been carried out for the Maotapuku 2, therefore, site survey including environmental investigation should be carried out before the next stage of the project.

The environmental investigation should cover site survey and data collection of the environmental requirement set out by the mining operation

(8) Project Cost

The project cost is estimated to be US$ 27,027,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-4 Project Cost of Maotapuku 2

Item	Unit	Cost	Remarks
A. Civil Works	US$	14,261,000	Tunnel:1400m
B. Equipment			
Metal Works	US$	967,000	D:1.2m,L:157m
Turbine &Generator	US$	3,120,000	Francis
Transmission Line	US$	3,988,000	L:32.5km,33kV2ckt
Sub-total of item A&B	US$	22,336,000	
C. Others			
Land acqusition	US$	223,000	1% of sub-total
Engineering	US$	2,234,000	10% of sub-total
Contingency	US$	2,234,000	10%of sub-total
Total Project Cost	US$	27,027,000	

Note:SB$=0.2US$(year:2000)

5.7.3 Sasa Hydropower Site

(1) General

The Sasa hydropower site is proposed on the Sasa River in the northwest area of Guadalcanal Island, as shown in Fig.5-7-9. The site is situated 27 km to the northwest of Honiara, at the east of Cape Esperance. The project is aimed to exploit the water resource of the Sasa River, with a discharge from a catchment area of 22 km^2 and river head, by using a run-of-river hydro plant that generates 280 kW and 2,396 MWh per year. The project requires the construction of an intake weir, a waterway and a powerhouse as shown in Fig.5-7-10 (1). An access road of 1.7 km from the existing provincial road is required for construction and maintenance activities of this project.

The project also requires an 11kV transmission line for 15 km from the powerhouse to Honiara and a 415V line of 2 km for local supply.

The project cost will be US$ 6.2 million for the civil works, electro-mechanichal equipment, transmission and distribution lines, land acquisition, engineering and contingency.

The principal parameters of this site are as follows.

Island	: Guadalcanal
Name of River	: Kotina River (a tributary of the Sasa River)
Catchment	: 22 km^2
River Flow	: 2.2 m^3/s (mean annual discharge)
Gross Head	: 62.5m
Effective Head	: 58.0m
Max. Plant Discharge	: 0.66 m^3/s
Installed Capacity	: 280 kW
Annual Energy Output	: 2,396 MWh
Intake Weir	: Height 3.5m, and crest length 10m.
Open Channel	: Width 0.95 m, height 0.95 m, and length 2,350 m
Penstock	: Diameter 600 mm and length 285 m
Turbine	:Cross Flow type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 15 km (11 kV, 1ckt)
Distribution Line	: 2 km (415V)
Access Road	: 1.7 km
Project Cost	: US$ 6.2 million

(2) Climate and Hydrology

The Kotina River, a tributary of the Sasa River, originates on Mt. Popori (EL 880m) situated in the northwest area of the Guadalcanal Island. The Kotina joins up with the Talangia and forms the Sasa River, which drains to the sea at Iron Bottom Sound. The catchment area of the intake site is 22 km^2 in the north east slope of the Mt. Popori.

The climatological conditions are referred to the Honiara station as stated in the Maotapuku 1 site.

There is no long-term river flow data available for the Sasa River basin. The river flow of the intake site is derived by the catchment conversion method from the Lungga Bridge gauging station of 377 km^2 to the intake site catchment of 22 km^2. The mean annual discharge is estimated at 2.2 m^3/s.

(3) Geology

The project area is covered by a 1:50,000 geological map (1989)[3]. The regional geology is shown in Fig.5-7-11.

3 CAPE ESPERANCE AND SAVO, Guadalcanal Geological Map Sheet GU 1, 2.

(a) Topography and geology outline

The project area is located in the east side of a volcanic area, in the northwest of Guadalcanal. The area consists of hills ranging in 40-200m of altitude, eroded by the Sasa River, that has 20-100m riverbeds. Hills are widely grassland, made of logging traces.

The Gallego Volcanics Group and talus deposits cover the slopes. The volcanic members continue intermittently and gradually dip to the coast. Two faults are present on the right bank hill. The flatland along the river is covered by gravel, sand or terrace deposits.

(b) Project site engineering geology conditions

The intake site is located in a wide gravelly riverbed. Both banks are low terraces, consisting of gravel and sand-mud mixture. An assumed fault is along the river. This site is the uppermost point of the river where volcanic mountain-foot deposits start, and where severe dry conditions would cause the river to flow undercurrent.

The waterway route is located in the right bank. There is a middle angle slope and partly steep cliff. It is covered by volcaniclastics, lavas and talus deposits.

The powerhouse site is to be located on the lower terrace.

(4) Hydropower Planning

In order to exploit the river flow originated from a heavy rainfall catchment of 22 km^2 and with a steep head section of the Kotina River, the intake site is selected at EL 82.5m to the east of Mt. Popori. The powerhouse site is situated at the right bank, on the opposite side of the Takamboro village. The available head will be 62.5m between the intake water level at EL 82.5m and the tailrace water level at EL 20m. The maximum plant discharge is assumed to be 0.66 m^3/s as a mini hydro category, which corresponds to a flow utilization factor (FUF) of 0.96 or flow duration of 90 % (329 days flow), to supply power to the Honiara system, a high demand area, as shown in Fig.5-7-12.

The installed capacity is 280 kW by using a cross flow turbine with a maximum discharge of 0.66 m^3/s at a gross head of 62.5m, with an estimated annual generated energy of 2,396 MWh.

(5) Layout and Design

The project layout and design drawings are shown in Figs.5-7-6 (1) to (4).

The intake weir is located at EL 82.5m to divert the river flow to the open channel, as shown in Photo5-7-3. In order to remove sand and gravel, the sand trap is installed on the right bank immediately downstream after the intake.

From the sand trap to the head tank, the open channel, a rectangle section of 0.95m wide by 0.95m high, conveys the maximum discharge 0.66 m^3/s for 2,350m along the channel gradient of 1/1,000 in the right bank of the valley, as shown in Photo5-7-4.

The head tank has a storage capacity of about 80 m^3, measures 4m wide by 14m long and

2.5 m high and is located at the north east end of the right bank ridge.

The penstock, 600 mm in diameter, leads water for 285m from the head tank to the powerhouse on the right bank of the Sasa River.

The powerhouse, a surface type, accommodates a cross flow turbine and a synchronous generator in a building 14m wide by 7m long and 5m high.

The tailrace is a concrete channel of 70m to release the discharge to the river.

(6) Access

The nearest port is located at Point Cruz in Honiara. From Honiara to the project site, the unpaved provincial road is available for about 29 km. An access road of 1.7 km is necessary for construction and maintenance, from the existing provincial road to the intake via the powerhouse. There are permanent bridges over the major rivers, such as the Mbonehe River, but several minor rivers have no bridges.

(7) Environment

According to hearing in the Takamboro village, the village people have to fetch water near the proposed intake site during the dry period, since the river sometimes dries up during the low flow period in the downstream area near the village.

Design should consider the tailrace water to be used for water supply for the village.

(8) Project Cost

The project cost is estimated to be US$ 6,211,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-5 Project Cost of Sasa Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	2,254,000	Open ch. 2350m
B. Equipment			
Metal Works	US$	482,000	D:0.6m,L:285m
Turbine &Generator	US$	1,103,000	Cross Flow
Transmission Line	US$	910,000	L:15km,11kV1ckt
Sub-total of item A&B	US$	4,749,000	
C. Others			
Land acqusition	US$	47,000	1% of sub-total
Engineering	US$	940,000	refer to Chapter 5.6.3
Contingency	US$	475,000	10%of sub-total
Total Project Cost	US$	6,211,000	

Note:SB$=0.2US$(year:2000)

5.7.4 Silolo Hydropower Site

(1) General

The Silolo hydropower site is proposed on the Silolo River, at the northwest of the Malaita Island as shown in Fig.5-7-13. The project site is situated at 44 km north of Auki, the provincial capital of the Malaita province. The project is proposed to exploit discharge from the catchment of 13 km^2, a head of the steep river course and the Talifu waterfall, by a run-of-river hydro plant that generates 2,100 kW and 10,495 MWh per year. The project requires the construction of an intake weir, a waterway and a powerhouse as shown in Fig.5-7-14 (1). An access road of 6.3 km is required for construction and maintenance.

The project also needs a 33 kV transmission line for 8 km from the powerhouse to the Fausande substation to supply its power to the Auki system.

The project cost will be US$ 28.3 million for the civil works, electro-mechanical equipment, transmission line and distribution lines, land acquisition, engineering and contingency.

The principal parameters of the project are as follows:

Island	: Malaita
Name of River	: Silolo River
Catchment	: 13 km^2
River Flow	: 1.3 m^3/s (mean annual discharge)
Gross Head	: 160m
Effective Head	: 155m
Max. Plant Discharge	: 1.7 m^3/s
Installed Capacity	: 2,100 kW
Annual Energy Output	: 10,495 MWh
Intake Weir	: Height 2.5m and crest length 19m
Tunnel	: Width 1.3m, height 1.55m and length 1,730m
Penstock	: Diameter 800 mm and length 570m
Turbine	: Horizontal Francis type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 8 km (33 kV, 2ckt)
Access Road	: 6.3 km
Project Cost	: US$ 28.3 million (SB$=US$0.2: year 2000)

(2) Climate and Hydrology

The Silolo River basin is situated in the northwest of the Malaita Island where the topography is a peninsula, the size of which is 15 km long and 10 km wide. The central part of the peninsula is formed by a mountainous area that includes the highest peak of the watershed at EL 780m.

The Silolo flows to the northwest for 5.5 km from the watershed and then turns to the north at EL 250m. Farther down the gorge, the Silolo River descends the ravine and drops for about 60m at the Talifu waterfall, as shown in Photo5-7-6. Beyond the waterfall the river flows onto the coastal plain, and finally drains to the Suafa Bay. The total length of the river course is 8.5 km from the watershed to the sea.

The rainfall data is available from the Auki meteorological station where the annual average rainfall recorded is 3,109 mm for 43 years of observation since 1956. There is a distinct seasonal pattern of rainfall during the year, being the wet period from December to March and the dry period from April to November, as shown in Fig.5-7-15. The highest mean monthly rainfall is 399 mm in March, while the lowest is 181 mm in June, as shown in Table5-7-6.

There is no long-term river flow data available for the Silolo nor the nearby rivers. The river flow data is estimated by the catchment conversion method from the Lungga Bridge gauging station of 377 km^2 to the Silolo intake site of 13 km^2. The mean annual discharge is estimated to be 1.3 m^3/s.

(3) Geology

General geology refers to a frontispiece map from a regional geological report (1995)[4]. Aerophotographs (1979)[5] cover the project area. The regional geology is shown in Fig.5-7-16.

(a) Topography and geology outline

The project area is located in the lower middle reaches of steep slopes in a V-shaped valley. The riverbed is narrow and gravelly, and wide river shores are rare except in reaches lower than the powerhouse. There are two large waterfalls and several outcropped rapid streams. A 1:50,000 topographic map[6] shows that northwest-southeast upper reaches are continuous to the lower ones, but the upper part is an isolated depression divided by a steep 20m cliff with a spring cave, up river from the intake site. This map is not correct near the cliff.

The boundary between the Alite Limestone Formation and the Haruta Limestone Formation is near to the river-dividing cliff. The Tertiary Haruta Limestone Formation almost covers the project area. A narrow belt of mountain-foot near the powerhouse corresponds to the Alite Limestone Formation. The Neogene Tomba Limestone Formation covers the coastal undulating hill.

(b) Project site engineering geology conditions

The intake site is located on a 6-8m width riverbed in an outcropped canyon. The stream direction follows the pattern of the rock joints. Both slopes are 75 degrees steep, with 2.5m rock walls in the lower parts. The site is formed by Haruta Limestone Formation, mainly white to pale brown calcisiltite, soft-rock or middle-hard rock, more than 80 degrees bedding, and has crossing joints spaced at more than 1 m. Non-calcareous layers are partly present. The riverbed is partly outcropped, has 0.2m thick sand and gravel deposits. Riverside rock walls have small cavities that are limited to shallow horizontal shapes. Partial seepage from these cavities is superficial and of small amount.

The waterway route is on the left bank. The Haruta Limestone Formation at the

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[4] Petterson, M. G. (1995) The Geology of North & Central Malaita, Solomon Islands, Geological Memoir No. 1/95, Water & Mineral Resources Div., Ministry of Energy, Water & Mineral Resources, Honiara, Solomon Islands.

[5] Aerophotographs 5438 C3-4, D6-7.

[6] MALAITA Sheet 8/160/7, Series X711 (D.O.S.456), Edition I-D.O.S. 1971.

underground part of the slope has middle to hard rocks mostly calcareous, but rock quality varies from place to place. These varieties are formed by distributions of springs or cavities. There are no records on large geological structures such as fault or folds. Large limestone boulders, 10m diameter, may occur in the slope deposits.

The powerhouse site is located on a gentle slope, cacao tree cultivated, and 5m higher than the left bank. Basement rock and surface deposits cover the site. The riverbank outcrop of Alite Limestone Formation is hard near the water, but the upper part is weathered rock with many cracks.

(4) Hydropower Planning

In order to exploit the discharge from the catchment area and a head of the gorge section and the waterfall of the Silolo River, the intake site is selected at EL 180 m in the gorge, as shown in Fig.5-7-14 (1) and Photo5-7-5. The powerhouse site is situated at 1.0 km upstream from the existing provincial road at the foot of the left bank slope. The available head will be 160m between the intake water level at EL 180m and the tailrace water level at EL 20m. Although there is no long term discharge data on the Silolo River, the maximum plant discharge is assumed to be 1.7 m^3/s as a small hydro, which corresponds to a flow utilization factor (FUF) of 0.6, or flow duration of 22 % (80 days flow), to supply its power to the Auki-Malu'u system. The installed capacity is 2,100 kW by using a horizontal Francis turbine with a maximum discharge of 1.7 m^3/s at a gross head of 160 m. The annual generated energy is estimated at 10,495 MWh derived from the duration curve, as shown in Fig.5-7-17.

(5) Layout and Design

The project layout and drawings are shown in Figs.5-7-14 (1) to (4).

The intake weir is located at EL 180m, where the narrow valley forms a pond below the gorge and the exposed rock exists in the riverbed, to divert the river flow to the headrace tunnel, as shown in Photo5-7-5. In order to remove sand and gravel, a sand trap is installed in the left bank immediately downstream of the intake.

The headrace conveys the maximum discharge of 1.7 m^3/s for 1,730m in the left bank ridge.

The headrace is a non-pressure tunnel type with the shape of a vertical leg horseshoe with a horizontal invert, of 1.8m wide by 1.8m high excluding concrete lining of 20 cm thick.

The head tank has a storage capacity of about 360 m^3 measuring 4 m wide by 17.3 m long and 6.6 m high, to be installed at EL 180m.

The penstock, 800 mm in diameter, leads water for 570m from the head tank to the powerhouse located 1.2 km upstream of the provincial road bridge.

The powerhouse, a surface type, accommodates the horizontal Francis turbine and the generator in a building of 14m wide by 7m long and 8m high.

(6) Access

The nearest port facility is located in Auki for unloading heavy equipment for the project. The provincial road is available for 83 km from Auki to the village of Silolo. Access preparation is necessary for 6.3 km from the provincial road to the powerhouse, penstock, head tank and to the intake weir. Permanent bridges are installed over the major rivers, such as the Fiu and Kwarea Rivers, but wooden bridges are used in the minor rivers along the provincial road.

(7) Environment

There is no installation for water supply above the powerhouse site.

The river water is diverted to the headrace tunnel for power generation, thus the river flow will be reduced between the intake and the tailrace. During the dry period, compensation water should be released for the scenic Talifu waterfall for tourism.

(8) Project Cost

The project cost is estimated to be US$ 28,261,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-7 Project Cost of Silolo Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	17,956,000	Tunnel L:1730m
B. Equipment			
Metal Works	US$	1,648,000	D:0.8m,L:570m
Turbine &Generator	US$	2,959,000	Francis
Transmission Line	US$	792,000	L:8km,33kV2ckt
Sub-total of item A&B	US$	23,355,000	
C. Others			
Land acqusition	US$	234,000	1% of sub-total
Engineering	US$	2,336,000	10% of sub-total
Contingency	US$	2,336,000	10%of sub-total
Total Project Cost	US$	28,261,000	

Note:SB$=0.2US$(year:2000)

5.7.5 Rori Hydropower Site

(1) General

The Rori hydropower site, situated at 47 km north of Auki, is proposed on the Rori River in the northwest of the Malaita Island, as shown in Fig.5-7-18. The project is to exploit discharge from the springs and head of the cascade, by a run-of-river hydro plant that generates 300 kW and 2,526 MWh per year. The project requires the construction of an intake weir, a waterway and a powerhouse as shown in Fig.5-7-19 (1). An access road of 900m is required for construction and maintenance.

The transmission line is rated at 11 kV with single circuit for 20 km from Malu'u to the Anda'ua village and the distribution line at 415V for 9 km for local supply.

The project cost will be US$ 6.0 million for the civil works, electro-mechanical equipment, transmission and distribution lines, land acquisition, engineering and contingency.

The principal parameters of the project are as follows.

Island	: Malaita
Name of River	: Rori River JICA Team confirmed that “Alithango” shown on the 1:50,000 map is locally called “Rori”
Catchment	: 2 km^2
River Flow	: 1.1 m^3/s (observed on 1 November 1999)
Gross Head	: 39.5m
Effective Head	: 37.0m
Max. Plant Discharge	: 1.1 m^3/s
Installed Capacity	: 300 kW
Annual Energy Output	: 2,526 MWh
Intake Weir	: Height 3.5m and crest length 11.4m
Open Channel	: Width 1.1m, height 1.1m and length 400m
Penstock	: Diameter 800 mm and length 304 m
Turbine	: Cross Flow type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 20km (11 kV, 2 ckt)
Distribution Line	: 9 km (415V)
Access Road	: 900m
Project Cost	: US$ 6.0 million (SB$=US$0.2:year 2000)

(2) Climate and Hydrology

The Rori River basin is situated in the northwest tip of the Malaita Island where the local topography is a 15 km long and 10 km wide peninsular area. The central part of the peninsula forms a plateau including the prominent peak “Mt. Fauiwane” (EL 714 m), where a number of springs occur in the surrounding flanks, such as the Manakwai River in Malu’u.

The Rori River has its source at two spring spots, one from the major spring at EL 55m and the other from the minor spring at the left bank tributary of the Rori, as shown in Photos5-7-7 and -8. The Rori River joins up with its left bank tributary at a confluence, at EL 45m, about 100m downstream from the major spring. Beyond the confluence the river flows to the northwest and then southwest in the cascade section, and finally drains to the sea at Indispensable Strait. The river course is short, having only 1.5 km approximately from the springs to the sea.

The rainfall data is referred to the Auki station as stated in the Silolo project.

There is no long-term river flow data available for the Rori and the nearby rivers. During the second field survey the river flow measurement of the Rori River indicated that the discharge was 1.1 m^3/s, on 1 November 1999. Judging from the topography the river course shows a stable flow condition; the flood marks of the Rori river at the provincial road bridge show only a small fluctuation of the water level. Flood discharge at the intake is presumably low, since the catchment area of the intake site of 2 km^2 is very small.

The JICA Team confirmed that the minor spring water is used for water supply to the Afufu village, a local village near the project. According to the villagers, these springs never dry up even in dry spells. It is assumed that the groundwater from the plateau with high rainfall supplies steady water to the Rori springs.

(3) Geology

General geology refers to a frontispiece map from a regional geological report (1995)[7], but it is found that the lower Rori has Quaternary deposits. Aerophotographs (1979)[8] cover the project area. The regional geology is as shown in Fig.5-7-20.

(a) Topography and geology outline

The project area is located in the lower reaches on gentle hills and terraces near the top end of the northwest peninsula of Malaita. The riverbed is gravelly and has several outcrops on the banks, and the river has comparatively higher gradients at the lower reaches. There are two springs, richer than the mainstream in water quantity, that are present at the end of the tributaries in the left bank, above the intake site. These springs breed from joint-based cavity of Alite Limestone Formation. A geographical map[9] shows that an area located 2 km away to the southeast is 'Karst-like Ridges and Hills', and it is presumable that groundwater currents from the southeast are, together with the geological structures, parallel to the island axis.

The Haruta Limestone Formation or Quaternary deposits cover the project area, lower than the spring area. They have poor outcrops and the distribution of geology is uncertain. The Haruta Limestone Formation is not identified in rock faces. The similarity to Quaternary sandstone near the powerhouse site and the presence of limestone block on the right bank at the intake site suggests a possibility that it is of younger formation.

(b) Project site engineering geology conditions

The intake site[10] is located on a narrow river with 2.5-6.0m height walls of calcareous sandstone containing small pebbles. The left bank is a very steep cliff. This pebbly sandstone, assumed to be a Haruta Limestone Formation, is pale brown, joint-poor massive, middle to coarse grained soft-rock, that has a relatively weak strength. The outcrop surfaces are weathered and weak, breakable by hammering. The riverbed is 4-5m width, 1-1.5m depth, and has thin pebbly deposits. There is some leakage of water from outcrop cracks, at river water level, on the right bank.

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[7] Petterson, M. G. (1995) ditto.

[8] Aerophotographs 5438 F2-3.

[9] Text map 10 LANDFORMS,, Volume 3 Malaita and Ulawa, Land Resources of the Solomon Islands, D.O.S., 1973.

The waterway route is on the left bank. The gentle slope is a cultivated field, and is covered by deposits of river terrace or talus. There is a raised reef cliff present on part of the right bank.

The powerhouse site is located in low land near the river on the left bank, beside a cacao tree field. The site is thinly covered by terrace and talus deposits. The riverbed near the site has several outcrops of Quaternary calcareous sandstone, weathered and scarcely consolidated, but underground conditions at the site are not clear.

(4) Hydropower Planning

In order to exploit discharge from the springs and head in the steep section of the Rori River, the intake site is selected at EL 42.5m in the downstream part from the confluence, as shown in Fig.5-7-19 (1) and Photo5-7-9. The powerhouse site is situated at the foot of the hill slope to maximize the available head. The available head will be 39.5m, between the intake water level at EL 42.5m and the tailrace water level at EL 3m. Although there is no long-term discharge data for the Rori River, the maximum plant discharge is assumed to be 1.1 m^3/s based on observed data and on the steady flow duration from the springs. It is also assumed that the maximum discharge of 1.1 m^3/s would be available during 329 days (90%) of the year, since the river flow measurement of the Rori River made in November could be a low flow, because it was prior to a wet period. The installed capacity is 300 kW by using a Cross Flow turbine with a discharge of 1.1 m^3/s at a gross head of 39.5m. The annual generated energy is estimated at 2,526 MWh derived from the duration curve, as shown in Fig.5-7-21.

(5) Layout and Design

The Project layout and design are shown in Figs.5-7-19 (1) to (4).

The intake weir is located at EL 42.5m, where the narrow valley and the exposed foundation rock exist, to divert the river flow to the open channel. The weir has dimensions of 3.5 m high and 11.4 m crest length. The sand trap is installed in the left bank immediately downstream of the intake site.

The open channel, a rectangle section of 1.1 m wide by 1.1 m high, conveys the maximum discharge of 1.1 m^3/s for 400m in the hilly area. The channel route follows an elevation along the channel slope of 1/1,000.

The head tank has a storage capacity of about 140 m^3 measuring 4m wide by 14m long, and 4.2m high.

The penstock, 800 mm in diameter, leads water for 304m from the head tank to the powerhouse that is located in the left bank at 100m upstream from the provincial road bridge, as shown in Photo5-7-10.

The powerhouse, a surface type, accommodates a Cross Flow turbine and a synchronous generator in a building of 14m wide by 7m long and 5m high.

[10] Local name：Fauran.

The tailrace is a concrete channel for about 10m to release discharge water back to the river.

(6) Access

The nearest port facility is located in Auki for unloading heavy equipment for the project. The provincial road is available for 68 km from Auki to the nearest village of the Rori project. Permanent bridges are installed over the major rivers such as Fiu and Kware'a Rivers, however wooden bridges are used in several minor rivers along the provincial road.

Preparation of a 900m access road is necessary for construction and maintenance activities, from the provincial road to the intake via the powerhouse, penstock and the open channel.

(7) Environment

The existing water supply facility was installed at the minor spring that is located in the upstream area of the proposed hydropower intake, therefore, the project will not obstruct the existing water supply facility.

On the other hand, the open channel and the penstock will be constructed in an existing farm field in the left bank of the Rori River, where land compensation will be needed.

(8) Project Cost

The project cost is estimated to be US$ 5,989,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-8 Project Cost of Rori Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	937,000	Open ch.:400m
B. Equipment			
Metal Works	US$	746,000	D:0.8m,L:304m
Turbine &Generator	US$	1,334,000	Cross Flow
Transmission Line	US$	1,532,000	L:22km,11kV
Sub-total of item A and B	US$	4,549,000	
C. Others			
Land acqusition	US$	45,000	1% of sub-total
Engineering	US$	940,000	refer to Chapter 5.6.3
Contingency	US$	455,000	10%of sub-total
Total Project Cost	US$	5,989,000	

Note:SB$=0.2US$(year:2000)

5.7.6 Kware'a Hydropower Site

(1) General

The Kware'a hydropower site is proposed on the Kware'a River, in the north of the Malaita Island as shown in Fig.5-7-22. The project site is situated near the Kware'a bridge, which is located at 14 km from the Dala village. The project is aimed to exploit discharge from a catchment of 28 km^2 and head created by the Kware'a dam, by a pondage type hydro plant to generate 600 kW and 2,541 MWh per year. The project requires construction of a dam, penstock and a powerhouse as shown in Fig.5-7-23 (1).

An access road of 1.1 km is required for construction and maintenance.

The project also needs a 33 kV transmission line for 14 km from the powerhouse to the Dala village.

The project cost will be US$ 18.2 million for the civil works, electro-mechanical equipment, land acquisition, project engineering and contingency.

The principal parameters of the project are as follows:

Island	: Malaita
Name of River	: Kware'a River
Catchment	: 28 km^2
River Flow	: 2.8 m^3/s (mean annual discharge)
Gross Head	: 16.5m
Effective Head	: 15.5m
Max. Plant Discharge	: 5.0 m^3/s
Installed Capacity	: 600 kW
Annual Energy Output	: 2,541 MWh
Dam	: Height 25m and crest length 63.4 m
Penstock	: Diameter 2 m and length 35 m
Turbine	: Tubular type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 14 km (33 kV, 1ckt)
Access Road	: 1.1 km
Project Cost	: US$ 18.2 (SB$=0.2US$:year2000)

(2) Climate and Hydrology

The Kware'a River basin lies in the mountainous region of the north central part of the Malaita Island, where the river flows in the deep valley in the tropical rainforest. The Kware'a River originates in the watershed in the central upland, about 9 km southeast of the Kware'a bridge. The catchment area of the dam site is 28 km^2. The Kware'a flows generally northwest in the upper reaches of the basin, and then turns to the north at the dam site. After joining with the large tributaries from the eastern part of the basin, the river goes northwest again, and finally drains into the Coleridge Bay on the west coast of the island. The total length of the river course is about 30 km from the watershed to the sea.

The climatological condition is referred to the Auki station as stated in the Silolo project.

There is no long-term river flow data available for the Kware'a and the nearby rivers, and therefore river flow data is estimated by the catchment conversion method from the Lungga Bridge gauging station of 377 km^2 to the Kware'a dam site of 28 km^2. The mean annual discharge is estimated at 2.8 m^3/s.

Flood discharge at the Kware'a dam site is estimated at 320 m^3/s based on the specific discharge of the Komarindi hydro, 13.5 $m^3/s/km^2$ for 200 years return period (refer to Appendix 5-3).

Specific sedimentation was assumed at 100 m^3/km^2/year, adopted from sedimentation data in Japan and other Asian rivers (refer to Appendix 5-4).

(3) Geology

General geology refers to a frontispiece map from a regional geological report (1995)[11], but a boundary near the area was confirmed by geological surveying. Aerophotographs (1979)[12] cover the project area. The regional geology is shown in Fig.5-7-24.

(a) Topography and geology outline

The project area is located in the middle reaches, 18 km from the mouth of Kware'a River. The drainage system is of lattice pattern. The area keeps within 50-100m-height range for valleys in both bank slopes. The riverbed has 10-15m width and 0.2-0.6m depth, is gravelly and flows slowly.

The Tertiary Haruta Limestone Formation is mainly limestone and partly mudstone interbeds. The upper reaches are covered by Pre-Miocene Maramasike Volcanic Formation and the Alote Limestone Formation. Northwest trend faults and fold axes cross the river, and joints are parallel to the river course. Both sides of the Kware'a bridge have limestone outcrops, and the right side has gullies and springs.

(b) Project site engineering geology conditions

The dam site has continuous outcrops in both banks, but the slopes are 40-60 degrees, covered by vegetation and talus deposits. Underground conditions of ridge slopes without outcrops were not identified. The bank at the left of the dam axis, 150m from the river, has a gently curved photolineament, which is assumed to be an open joint or rock sliding. The right tributary, at 50m downstream, make the dam axis ridge flatter. Basement rock depth in the riverbed is estimated to be more than 6 m in general, but about 3m depth at the narrowest point of 4m width riverbed, if there is no deep channel erosion along the joint.

The Haruta Limestone Formation is present as some cracked middle-hard rock, and bedding dips 40 degrees downstream. The joints of 1-1.5m spacing tend to be along the stream with a high dip angle. Some outcrops run out to the river, and their bedding and joints have become loose. The 3 leakage springs in the left bank breed a considerable amount of water from jointed outcrops at river water level. The reservoir area is covered by weathered soft Maramasike Volcanic Formation and lime-rich Alite Limestone Formation.

(4) Hydropower Planning

In order to exploit the discharge from the catchment area and the head created by the dam,

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[11] Petterson, M. G. (1995) ditto.

[12] Aerophotographs 5438 G5-8.

the dam site is selected at 200 m upstream from the existing provincial road bridge as shown in Fig.5-7-23 (1) and Photos 5-7-11 to 12.

The available head will be 16.5m between the intake water level at EL 100.5m and the tailrace water level at EL 84m. Although there is no long term discharge data for the Kware'a River, the maximum plant discharge is assumed to be 5.0 m^3/s, which corresponds to a flow utilization factor (FUF) of 0.45 or flow duration curve of 10% (35 days flow), as shown in Fig.5-7-25, considering it supplies power to the Auki system. The installed capacity is 600 kW by using a Tubular turbine with a maximum discharge of 5.0 m^3/s at a gross head of 16.5m. The annual generated energy is estimated at 2,541 MWh derived from the duration curve.

(5) Layout and Design

The project layout and design are shown in Figs.5-7-23 (1) to (4).

The dam site is located 200m upstream from the Kware'a bridge where the valley forms narrow V shapes suitable for construction of a dam, as shown in Photo5-7-12. The river width at the water level is about 8m on the dam axis. On both banks the side slopes are at 40 to 60 degrees and are covered with 4 to 5m of talus. In the riverbed the exposed rocks are found along both sides of the river course.

The dam has a shape of 25m high and 63.4m crest length with a non-gated spillway and a flushing way.

The gross storage is 650,000 m^3 with an active storage 110,000 m^3 that enables the power plant for six hours of peak operation (refer to Appendix 5-4).

The powerhouse is planned in a site immediately downstream from the dam on the left bank, since the riverbed slope is too flat to obtain head by a headrace tunnel or an open channel. The penstock, 2m in diameter, conveys the maximum discharge from the intake to the powerhouse for 35m.

The powerhouse is of semi-underground type that accommodates a tubular turbine and a synchronous generator in a building 7.5m wide by 19m long and 12m high.

(6) Access

Auki is the nearest port for unloading heavy equipment for the project. The provincial road is available for 37 km from Auki to the Kware'a bridge. The dam site is easily reached by construction of an access road from the left bank of the existing bridge. Preparation of this 1.1 km access road is necessary for construction and maintenance activities of this project.

(7) Environment

The proposed project is a pondage type power plant that requires impounding a reservoir area of 1 km^2 along the river course. Although there is no population in the upstream area of the reservoir, survey for flora and fauna including aquatic animals such as fish, shell and others should be carried out in the next stage of the project.

(8) Project Cost

The project cost is estimated to be US$ 18,185,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-9 Project Cost of Kware'a Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	10,766,000	Dam: 25,000m^3
B. Equipment			
Metal Works	US$	426,000	D:2.0m,L:35m
Turbine &Generator	US$	2,837,000	Tubular
Transmission Line	US$	1,000,000	L:14km,33kV
Sub-total of item A & B	US$	15,029,000	
C. Others			
Land acqusition	US$	150,000	1% of sub-total
Engeering	US$	1,503,000	10%of sub-total
Contingency	US$	1,503,000	10%of sub-total
Total Project Cost	US$	18,185,000	

Note:SB$=0.2US$(year:2000)

5.7.7 Kubolata Hydropower Site

(1) General

The Kubolata hydropower site is proposed on the Kubolata River, in the northeast coast of Santa Isabel Island, as shown in Fig.5-7-26. The site is situated 2 km to the northwest of Buala, the provincial capital of Isabel province. The project is aimed to exploit the spring water of the Kubolata River, discharge from the three springs and head of the creek, by a run-of-river hydro plant to generate 80 kW and 563 MWh per year. The project requires the construction of intake weirs, sand trap, penstock, and a powerhouse as shown in Fig.5-7-27 (1). An access road of 2.0 km from Buala to the powerhouse is required for construction and maintenance.

The project needs an 11 kV transmission line for 2.5 km from the powerhouse to the Buala hydropower plant and a 415V distribution line for 0.5 km.

The project cost will be US$ 1.6 million for the civil works, electro-mechanical equipment, land acquisition, engineering and contingency.

The principal parameters of the project are as follows.

Island	: Santa Isabel
Name of River	: Kubolata River
Catchment	: 1 km^2
River Flow	: 0.069 m^3/s (based on the Jejevo Gauging Station data)
Gross Head	: 234.0m
Effective Head	: 229.0m
Max. Plant Discharge	: 0.05 m^3/s
Installed Capacity	: 80 kW
Annual Energy Output	: 563 MWh
Intake	: Three streambed intakess

Headrace	:Diameter 200 mm and length 180m
Penstock	: Diameter 250 mm and length 917m
Turbine	: Pelton type (one unit)
Generator	: Synchronous (one unit)
Transmission Line	: 2.5 km (11 kV, 1 ckt)
Distribution Line	: 0.5 km (415 V)
Access Road	: 2.0 km
Project Cost	: US$ 1.6 million (SB$=0.2US$:year 2000)

(2) Climate and Hydrology

The Kubolata River originates on the north slope of Mt. Sasari (EL 1,200m) situated in the northeast coast of Santa Isabel Island. The source of the river comes from three springs located between EL 244m and EL 296m, and flows to the north on a steep valley to the Kubolata village in the coast of the Maringe Lagoon, as shown in Photos5-7-13 and -14. The river course is as steep as 1/5, with a 234m decrease of elevation at a course distance of about 1,000m. The catchment at the intake site is 1 km^2 but the springs discharge groundwater throughout the year.

The rainfall has been recorded at the Buala station for 16 years from 1982 including some breaks. The rainfall data shows that heavy rainfall occurs in the steep slope in the Buala area. The mean annual rainfall is 3,860 mm based on 10 years of complete data. The seasonal pattern of rainfall is not clear, but heavy rain occurs in the period from December to March, while monthly rainfall less than 100 mm occurs in the periods from April to June and from August to November, as shown in Fig.5-7-28. The highest mean monthly rainfall is 400 mm in March, while the lowest is 251 mm in August, as shown in Table 5-7-10.

There is no long-term river flow data available for the Kubolata River. The nearest river flow data is available from the Jejevo gauging station that began operation in 1987 and stopped in 1991. In 1988, when normal rainfall was observed in the Solomon Islands, the mean annual discharge of the Jejevo gauging station was 0.146 m^3/s at the catchment area of 2.1 km^2 as shown in Table 5-3-14. The river flow of the Kubolata is derived by the catchment conversion method from the Jejevo gauging station of 2.1 km^2 to the Kubolata intake site catchment of 1.0 km^2. The mean annual discharge is estimated at 0.069 m^3/s.

(3) Geology

General geology refers to a 1:250,000 geological map (1991)[13] of Santa Isabel Island. The regional geology is as shown in Fig.5-7-29.

(a) Topography and geology outline

The project area is located in the middle lower reaches of the 3 km long Kubolata River. The drainage system is from lattice to zigzag pattern. The valley maintains

13 1:200,000 SANTA ISABERA, unpublished, Manuscript photocopies.

10-40m slopes at both banks. Middle reaches have rapid streams and a waterfall. The riverbed has 5-10m width and shallow depth, and is gravelly. The upper reaches are in a gentle slope zone.

The springs are present at 3 points in the left bank around the intake site. The water breeds from open joints at small cliff outcrops. These joints are filled and covered up with talus deposits. The springs have several water supply pools and pipes. A bigger spring is present at water level on the left bank at the east of Kubolata village near the coast.

A geographical map[14] shows the southeast area beyond the line between Buala township and Mt. Sasari is a 'Karst' area. A nearby project site is a Karst underdeveloped area. Groundwater currents presumably come in part from mountainside Karst.

The Maruto Limestone Formation covers the steep slopes up to the coast. The bed generally strikes parallel to coastline and dips at middle to high angles, but measurements indicate that in general the dip is 20-40 degrees to the southeast.

(b) Project site engineering geology conditions

The intake site is located at the left bank, on a narrow flatland in front of small cliff outcrops. The site is covered by riverbed sand and gravel and by talus. The surrounding slope has relatively few outcrops. The Maruto Limestone Formation is stratified but shows as stuck hard rock. The joint has a spacing of 1m. The slope surface has open joints made by weathering, dissolving or tilting, and the joints have fillings.

The waterway route is on the left bank. The route is generally covered by talus deposits and red brown soil. Several outcrops in the steep slopes show shallow basement rocks. The route has repeated distribution of unconsolidated sediments and basement rock.

The powerhouse site is located in the south side of the Kubolata village. Riverbed and talus deposits cover this site.

(4) Hydropower Planning

In order to exploit the high head in the steep section of the Kubolata River and the spring water from the heavy rainy terrain of the Mt. Sasari, the intakes are selected at the three sites to collect the spring water. The head tank is to be installed at EL 244m, at the lowest spring site. The powerhouse site is situated at the foot of the slope in the Kubolata village, about 300m from the shore. The available head will be 234m between the intake water level at EL 244m and the tailrace water level at EL 10m.

The maximum plant discharge is assumed to be 0.05 m^3/s estimated from the maximum discharge of the Buala hydro plant of 0.09 m^3/s converted by the ratio of both catchments.

[14] Text map 14 LANDFORMS, Volume 5 Santa Isabel, Land Resources of the Solomon Islands, D.O.S., 1976.

The maximum discharge of 0.05 m^3/s corresponds to 215 days of flow (59%) or flow utilization factor (FUF) at 0.8, as shown in Fig.5-7-30.

The installed capacity is 80 kW by using a Pelton turbine with the maximum discharge of 0.05 m^3/s at a gross head of 234m, and the annual generated energy would be 563 MWh.

(5) Layout and Design

The project layout and design are shown in Figs.5-7-27 (1) to (5).

In order to collect the spring water, intake weirs are located at three sites, being the No. 1 intake at EL 296m, No. 2 intake at EL 291m and No. 3 intake at EL 244m. The sand trap is located immediately downstream after the intake No. 2. An embedded pipe will be installed from the No. 1 intake to the No. 3 intake via the sand trap at the No.2 intake.

The head tank is planned at the No. 3 intake to supply water to the powerhouse through the penstock. The penstock, 250 mm in diameter, will be embedded in the ground for 917 m in the left bank of the Kubolata River.

The powerhouse, located at the foot of the steep slope behind the village, accommodates a Pelton turbine and a synchronous generator in a building of 9.5m wide by 5.8m long and 3.8m high.

The tailrace is a concrete open channel to release water to the river.

(6) Access

A jetty is available in Buala for unloading heavy equipment for the project. Construction and/or upgrading of the provincial road is necessary for 2.0 km along the coast, from Buala to the Kubolata village.

Preparation of an access to the intake site is not possible, since the access route slope is too steep to construct a road. Therefore, alternative means for transportation during the construction works are required, such as a temporary cableway or a monorail.

(7) Environment

The proposed intake sites of the Kubolata are planned at the downstream sites of the existing water supply facilities, therefore the project will not affect the existing water supply.

However, in the downstream of the proposed intake No. 2 site, there is a garden that uses excessive water from the existing water supply intake, therefore, compensation water will be required during the dry period.

(8) Project Cost

The project cost is estimated to be US$ 1,649,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-11 Project Cost of Kubolata Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	463,000	Pipe,L:180m
B. Equipment			
Metal Works	US$	302,000	D:0.25m,L:917m
Turbine &Generator	US$	494,000	Pelton
Transmission Line	US$	160,000	L:2.5km,11kV
Sub-total of item A & B	US$	1,419,000	
C. Others			
Land acqusition	US$	14,000	1% of sub-total
Engineering	US$	156,000	refer to Chapter 5.6.3
Contingency	US$	60,000	refer to Chapter 5.6.3
Total Project Cost	US$	1,649,000	

Note:SB$=0.2US$(year:2000)

5.7.8 Waimapuru Hydropower Site

(1) General

The Waimapuru hydropower site, situated at 12 km to the west of Kirakira, is proposed on the Waimapuru River on the north coast of the San Cristobal Island, as shown in Fig. 5-7-31. The project is aimed to exploit the hydro potential of the Waimapuru River, head and discharge of the waterfalls, by using a run-of-river hydro plant that generates 20 kW and 170 MWh per year. The project requires the construction of an intake weir, a waterway, and a powerhouse as shown in Fig.5-7-32 (1). An access road of 2.0 km is required for the construction and maintenance activities of the project. The project also needs a 415V distribution line for 2.0 km from the powerhouse to the secondary school. The project cost will be US$0.9 million that covers civil works, electro-mechanical works, distribution line, land acquisition, engineering and contingency.

The principal parameters of the project are as follows.

Island	: San Cristobal
Name of River	: Waimapuru
Catchment	: 2.8 km^2
River Flow	: 0.1 m^3/s (observed on 29 November 1999)
Gross Head	: 32.0m
Effective Head	: 30.0m
Max. Plant Discharge	: 0.1 m^3/s
Installed Capacity	: 20 kW
Annual Energy Output	: 170 MWh
Intake Weir	: Height 2.2m and width 1.9m (Streambed Intake)
Penstock	: Diameter 0.3m, length 238.5m
Turbine	: Reverse running pump (one unit)
Generator	: Synchronous type (one unit)
Distribution Line	: 2.0 km (415V)
Access Road	: 2.0 km

Project Cost : US$0.9million (SB$=0.2US$: year2000)

(2) Climate and Hydrology

The Waimapuru River basin is situated in the north of the San Cristobal Island. The higher mountains surrounding the basin are covered with primary rain forest but a small flat land is found near the river mouth. The Waimapuru River emerges at an altitude of 600 m and flows in a north direction towards the sea. The Waimapuru River has two waterfalls at the middle reaches of the river, being the height of the first waterfall about 20m. The gentle gradient of the creek continues from the upland of the first waterfall to the basin of the second waterfall. The river course is short, having about 3.0 km from the second waterfall to the sea.

Rainfall data is available from the Kirakira meteorological station where a mean annual rainfall is 3,481 mm, recorded for 33 years since 1965.

There is no distinct seasonal distribution although June and the period from September to December appear to be the driest months, as shown in Fig.5-7-33. Rainfall is associated with the monsoon winds. The monsoon wind changes its direction due to the movement of ITCZ in winter and summer. Transitional period of monsoon winds are characterized by unstable weather, resulting in lower rainfall. However, monsoon winds cause a large amount of rainfall in other periods. The highest mean monthly rainfall is 349 mm in March, while the lowest is 236 mm in June, as shown in Table 5-7-12.

There is no long-term river flow data available for the Waimapuru River. During the second field survey the river flow measurement of the Waimapuru River indicated that the river discharge was $0.1m^3/s$ in 29 November 1999. The Huro River flows in the west of Kirakira and has been observed at Waitete village since 1987. The complete data from 1994 to 1995 indicates that the mean annual discharge is $0.38\ m^3/s$ at the catchment area of $6.2\ km^2$.

(3) Geology

A geological mapping project in San Cristobal Island is in progress. General geology refers to a 1:1,000,000 Solomon Islands geological map (1969)[15] and 1:50,000 geological maps of the northwest area (1975)[16]. The valley basement rock distribution is not correct. It was modified during a geological survey. The regional geology is as shown in Fig.5-7-34.

(a) Topography and geology outline

The project area is located in the lower middle reaches of dissected hills and steep valleys. The river has a narrow riverbed, two waterfalls and both banks have continuous outcrops. The lower reaches after the powerhouse site have some river shores.

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15 1:1,000,000 Geological Map of the British Solomon Islands, 2nd edition, D.O.S., 1969.

16 AROSI, San Cristbal Sheet SC 1 and ARSI-WEST BAURO, San Cristbal Sheet SC 2

The springs or seepage partly occur in the tributary ends and slopes in both banks. Basement rock depth is shallow, and surface deposits are made of relatively thin layers. Therefore, the water keeping ability of the slop is small, but groundwater level is high. After raining, the river outflow change is comparatively serious.

The Basic Igneous Rocks, mainly basaltic lava, widely cover the riverbank and slopes. The Arosi Beds, reef limestone, may cover the hilltop, but dissolved lime-attached basalt is partly observed in the riverbank. No limestone outcrops are found in the valley, and boulder stones are rare in the riverbed. The limestone has a limited distribution.

(b) Project site engineering geology conditions

The intake site is located on a 4-5m width pebbly riverbed in an outcropped valley. Both slopes are 30-60 degrees steep, having 1.5-4m rock walls. Basaltic lava, covering the site, is found as hard-rock, having relatively wide spacing joints. A talus slide collapse of 4m width, 7m height is found in the right bank.

The waterway route is in ridge end at the left bank. A deposit of thin talus and basalt with 1m thick weathered layer is present.

The powerhouse site is located on the lower slope in the left bank. No flatland is higher than the riverbank. The backside slope dips 40-45 degrees, and partly has outcrops and small collapses.

(4) Hydropower Planning

In order to exploit the discharge from the catchment and head from the waterfall, an intake site is selected at about 35m downstream from the second waterfall at EL 97.0m, as shown in Fig.5-7-32 and Photos 5-7-15 and 16.

The powerhouse site is situated at about 25m downstream from the first waterfall. The tailrace water level is set at EL 65.0m. The available head will be 32.0m between the intake water level of EL 97.0m and the tailrace level of EL 65.0m. The maximum discharge is determined to be 0.1 m^3/s based on the observed data and assumed duration curve from Huro River.

The installed capacity is 20 kW by using a reverse running pump turbine with discharge of 0.1 m^3/s at a gross head of 32m. The annual generated energy is estimated at 170 MWh derived from the duration curve, as shown in Fig.5-7-35.

(5) Layout and Design

The project layout and design are shown in Figs.5-7-32 (1) to (4). The intake weir is located at EL 97.0m, where the narrow ravine and the exposed foundation rock exist, to divert the river flow to the penstock. A sand trap is installed in the left bank immediately downstream after the intake. The penstock, 300 mm in diameter, leads the water for 238.5m from the sand trap to the powerhouse at 25m downstream from the first waterfall located in the left bank of the Waimapuru River. The powerhouse, a surface type, accommodates a pump reverse running turbine and a synchronous generator in a building of 9.5m wide by 5.8m long and 3.8m high. The tailrace is made of a concrete open channel for 5m long required to discharge water back to the river.

(6) Access

A jetty is situated in Kaonasughu from where the unpaved provincial road is available for 6 km to Waimapuru. Preparation of an access road is necessary for 2.0 km from the provincial road at Waimapuru secondary school to the powerhouse for construction and maintenance. Access between Kirakira and Waimapuru is difficult, since there is no bridge available over the major rivers, except over the Huro River.

(7) Environment

There is no water supply facility above the powerhouse site.

Diversion of water is only for 240m between the intake and the powerhouse by the penstock so that it will not cause negative impact on the environment.

(8) Project Cost

The project cost is estimated to be US$912,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-13 Project Cost of Waimapuru Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	387,000	
B. Equipment			
Metal Works	US$	77,000	D:0.3m,L:238.5m
Turbine &Generator	US$	124,000	Pump reverse running
Transmission Line	US$	101,000	L:2km,415V
Sub-total of item A & B	US$	689,000	
C. Others			
Land acqusition	US$	7,000	1% of sub-total
Engineering	US$	156,000	refer to Chapter 5.6.3
Contingency	US$	60,000	refer to Chapter 5.6.3
Total Project Cost	US$	912,000	

5.7.9 Sorave Hydropower Site

(1) General

The Sorave hydropower site is proposed at the Sorave waterfall on the Sorave River, a tributary of the Sui River in the northwest of the Choiseul Island, as shown in Fig.5-7-36. The project site is situated at 5 km east of the Taro Island in the mainland Choiseul. The project is aimed to exploit head and discharge of the Sorave waterfall, by using a run-of-river hydro plant to generate 70 kW and 592 MWh per year. The project requires the construction of an intake weir, sand trap, penstock and a powerhouse as shown in Fig.5-7-37 (1). An access road of 384m is required for construction and maintenance.

The project needs an 11kV transmission line for 6 km from the powerhouse to the secondary school.

The project cost will be US$ 1.9 million for the civil works, electro-mechanical equipment, land acquisition, engineering and contingency.

The principal parameters of the project are as follows.

Island	: Choiseul
Name of River	: Sorave River
Catchment	: 9.5 km^2
River Flow	: 0.99 –1.83 m^3/s (observed data since 1977)
Gross Head	: 10.0m
Effective Head	: 9.0m
Max. Plant Discharge	: 1.1 m^3/s
Installed Capacity	: 70 kW
Annual Energy Output	: 592 MWh
Intake Weir	: Height 3.5m, crest length 12m
Headrace	: Open channel, 1.1m wide, 1.1m high and 32m long
Penstock	: Diameter 1.2m and 81m long
Turbine	: Cross Flow type (one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 6 km (11 kV, 1ckt)
Access Road	: 384m
Project Cost	: US$ 1.9 million (SB$=0.2US$:year 2000)

(2) Climate and Hydrology

The Sorave Basin is situated in the northwest of the Choiseul Island. The Sorave River, a tributary of the Sui River, joins the Sui at the Sorave waterfall located at 4 km upstream from the river mouth. The Sorave River has its source at the foot of a Limestone Karst highland that lies in the south of the Sorave catchment area. The river flows in a natural channel made of limestone as shown in Photo 5-7-17. The river width is less than 2m at the top of the waterfall but becomes about 20m at the bottom, as shown in Photo 5-7-18. The height of the waterfall is about 10m.

The rainfall data is available from the Taro meteorological station where the mean annual rainfall is 3,375 mm for 23 years of observation since 1975. There are two seasons, the northwest monsoon period from November to March and the southeast monsoon period from April to October, as shown in Fig.5-7-38. The rainfall is related to the monsoon winds since heavy rainfall occurs in April caused by the northwest monsoon, while it occurs again in July caused by the southeast monsoon. The highest mean monthly rainfall is 348 mm in July, while the lowest is 186 mm in December, as shown in Table 5-7-14.

Though there is no long-term river flow data available for the Sorave River, river flow measurement of the Sorave has been carried out 7 times since 1977 including the JICA Team observation, that found a discharge of 1.15 m^3/s on 21 November 1999.

Date	Discharge
21 June 1977	1.69 m^3/s
22 June 1977	1.59 m^3/s
22 June 1977	1.83 m^3/s
31 August 1978	0.99 m^3/s
31 August 1978	1.10 m^3/s
4 September 1978	1.20 m^3/s
21 November 1999	1.15 m^3/s

Judging from the observed data, the river discharge mostly exceeds 1.1 m^3/s.

(3) Geology

The project area is covered by a 1:50,000 geological map (1977) [17]. The regional geology is as shown in Fig.5-7-39.

(a) Topography and geology outline

The project area is located in the lower reaches of the Sorave River, which is a left right tributary of the Sui River[18]. The junction of both rivers is a waterfall. The drainage system is linear with small meandering. The Sorave River is a shallow valley of rapid current on continuous outcrops in both banks and riverbed. It has a small amount of river deposits. The riverbanks have short sub-parallel fossil watercourses. A geographical map[19] shows this part as a 'Karstic Area' in contact with the southern 'Karst'. The uppermost part of the Sorave River has a cave without spring. Some springs are present on jointed outcrops in the left bank.

Swamp deposits widely cover the shoreline and the lower Sui River. Coral Limestone and Lagoon deposits cover the coastal zone. Basement rock is of the Pemba Formation. The Mbani Calcisiltite Member covers the lower area after the Sorave junction. The Sui Calcarenite Member covers the upper reaches.

(b) Project site engineering geology conditions

The intake site is located on a 2-5m width riverbed in an outcropped stream. Both banks are 1-3m vertical rock walls, and flat or gentle slopes are found at the top of the walls. The Sui Calcarenite Member is a relatively soft massive calcarenite with resistive sandy layer. The bedding dips less than 5 degrees to the downstream. The high angle joints trend parallel or crossing to the river, with seepage limited to the wall foot.

The waterway route is in the left bank, on a gentle slope covered by talus deposits and weathered rock.

The powerhouse site is located in the left bank of the Sui River below the junction. As

[17] CHOISEUL BAY, Choiseul Geological Map Sheet CH 1.

[18] CHOISEUL Sheet 6/156/10, Series X711 (D.O.S.456), Edition I-D.O.S. 1971 shows no watercourse of upper reaches in the northeast valley, but the geological map shows 2 waterways that are the northeastern Sui and the east-southeastern Sorave.

[19] Text map 16 LANDFORMS, Volume 6 Choiseul and the Shortland Islands, Land Resources of the Solomon Islands, D.O.S., 1977.

the bank is a 5-10m cliff with gentle slopes at the top, rock excavation will be necessary to build the powerhouse. The basement rock has a geological boundary, faults and related weathering or cavities.

(4) Hydropower Planning

In order to exploit the discharge from the Limestone Karst area and head of the Sorave waterfall, the intake site is selected at EL 18.4m, about 100m upstream from the waterfall. The powerhouse site is situated at 30m downstream from the waterfall. The tailrace water level is set at EL 8.4m to avoid flooding of the Sui River. The available head will be 10.0m between the intake water level at EL 18.4m and the tailrace water level at EL 8.4m.

Although there is no long-term discharge data of the Sorave River, the maximum plant discharge is assumed to be 1.1 m^3/s, based on the observed data and the steady flow duration from the Limestone Karst area in the heavy rainfall. It is also assumed that a maximum discharge of 1.1 m^3/s would be available during 329 days (90%) in the year, since the river flow measurement has indicated that the discharge mostly exceeds 1.1 m^3/s.

The installed capacity is 70 kW by using a Cross Flow turbine with the maximum discharge of 1.1 m^3/s under the gross head of 10.0 m. The annual generated energy is estimated at 592 MWh derived from the duration curve, as shown in Fig.5-7-40.

(5) Layout and Design

The project layout and design are shown in Figs.5-7-37 (1) to (3).

The intake weir is located at EL 18.4m, where the river course is on the exposed rocks.

The headrace open channel will be installed for 31.9m from the intake to the head tank.

A sand trap is omitted, because the sedimentation of the Sorave River is not significant and the head tank with a sand trap function is located only 31.9 m from the intake.

The head tank has a storage capacity of about 160 m^3, measuring 4.6m wide by 7.5m long and 1.5m high.

The penstock, 1,200 mm in diameter, leads water from the head tank to the powerhouse which is located at approximately 30 m downstream from the bottom of the Sorave fall.

The powerhouse, a surface type, accommodates a Cross Flow turbine and a synchronous generator in a building 10.5m wide by 7.5m long and 3.8m high.

The tailrace is a concrete open channel for 8m to release water to the Sui River.

(6) Access

A jetty is located near the secondary school at the end of the logging road.

From the jetty to the temporary bridge situated at 400m downstream from the powerhouse site, the unpaved logging road is available for 5 km. Preparation of an access road of 384m is necessary for the construction and maintenance activities of the project, from the existing logging road to the intake and powerhouse sites.

(7) Environment

The water of the Sorave River has been used for water supply to the secondary school and the logging company. The intakes for the water supply are located in the upstream sites of the proposed hydropower intake, therefore the project will not obstruct the existing water use.

In the downstream of the Sui River, crocodiles and fish exist along the river and its mangrove swamp area, thus river water quality should be maintained at the current level for these species during and after construction.

(8) Project Cost

The project cost is estimated to be US$ 1,859,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-15- Project Cost of Sorave Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	543,000	Open,L:31.9m
B. Equipment			
Metal Works	US$	329,000	D:1.2m,L:80.6m
Turbine &Generator	US$	432,000	Cross Flow
Transmission Line	US$	323,000	L:6km,11kV
Sub-total of item A & B	US$	1,627,000	
C. Others			
Land acqusition	US$	16,000	1% of sub-total
Engineering	US$	156,000	refer to Chapter 5.6.3
Contingency	US$	60,000	refer to Chapter 5.6.3
Total Project Cost	US$	1,859,000	

Note:SB$=0.2US$(year:2000)

5.7.10 Luembalele Hydropower Site

(1) General

The Luembalele hydropower site, situated at 9 km to the southeast of Lata, is proposed on the Luembalele River in Nendo Island in Santa Cruz Islands, as shown in Fig.5-7-41.

The project is aimed to exploit head and discharge from the cascade, by a run-of-river hydro plant to generate 50 kW and 432 MWh per year. The project requires the construction of an intake, a waterway and a powerhouse, as shown in Fig.5-7-42 (1). An access road of 2.8 km is required for construction and maintenance activities of the project. The project also needs an 11kV transmission line for 22.0 km from the powerhouse to Lata. The project cost will be US$4.1 million for civil works, electro-mechanical works, distribution line, land acquisition, engineering and contingency.

The principal parameters of the project are as follows.

Island	: Nendo Island, in Santa Cruz Islands
Name of River	: Luembalele
Catchment	: 2.4 km^2
River Flow	: 0.24 m^3/s
	(derived from annual rainfall data from 1971 to 1997)

Gross Head	: 35.0m
Effective Head	: 31.0m
Max. Plant Discharge	: 0.24 m^3/s
Installed Capacity	: 50 kW
Annual Energy Output	: 432 MWh
Intake Weir	: Height 1.4m, width 3.4m (Streambed Intake)
Open Channel	: Width 0.80m, height 0.80m and length 1,900m
Penstock	: Diameter 0.4m and length 198.97m
Turbine	: Reverse running pump type(one unit)
Generator	: Synchronous type (one unit)
Transmission Line	: 22.0 km (11kV 1ckt)
Access Road	: 2.8 km
Project Cost	: US$4.1million (SB$=0.2US$: year2000)

(2) Climate and Hydrology

The Luembalele River basin is situated in the west of the Nendo Island where topography is dominated by low mountains (with peaks of around 400m). The region towards the west coast of the mountains gives way to an extensive lowland. The basin of the Luembalele River is covered with rain forest. The Luembalele River emerges at an altitude of 300m and flows in a west direction towards the sea. One waterfall of 10m height is confirmed at the middle reaches, and after the waterfall the creek continues with a gentle gradient to the river mouth. The length of the river course is about 7.0 km from the waterfall to the sea.

The rainfall data is available from the Lata meteorological station where the mean annual rainfall is 4,271 mm for 28 years of observation since 1970. There is no distinct seasonal distribution although June and the period from November to December appear to be the driest months as shown in Fig.5-7-43. Rainfall is associated with the monsoon winds. The monsoon wind changes the direction due to the movement of ITCZ in winter and summer. Transitional period of monsoon winds is characterized by unstable weather, resulting in lower rainfall. However, monsoon winds cause a large amount of rainfall in other periods. The highest mean monthly rainfall is 422 mm in March, while the lowest is 292 mm in June as shown in Table.5-7-16.

Neither an existing river flow data nor a field survey flow measurement data is available in Santa Cruz Islands. The annual run-off at Luembalele for 2.4 km^2 is calculated by a water balance equation. Annual precipitation and evapotranspiration are to be 4,271 mm and 964 mm, respectively, in reference with section 5.3.3 in this report. Mean annual discharge is estimated to be 0.24 m^3/s that correspond to 10 $m^3/s/100\ km^2$.

(3) Geology

The area is covered by a 1:50,000 geological map (1975)[20]. The regional geology is as shown in Fig.5-7-44.

(a) Topography and geology outline

The project area is located in the upper reaches of the Luembalele River. The drainage system is tree-like.

The Mengalu Volcanics covers the center of western Nendo Island, and is present as volcanic breccia and lava near the volcano center. Tertiary Malue Beds are interbedded calcarenite and calcisiltite. The bedding is shown in part having 40-50 degrees and small foldings, but generally dips low angles surrounding the volcanics.

(b) Project site engineering geology conditions

The intake site is located in the downstream after the junction, where the upper reaches branch out into tributaries. The volcanics have many outcrops.

The waterway route is in the left bank on middle to gentle slopes. The route is covered by the Mengalu Volcanics in its upper part, then crosses a tributary river and heads to a small ridge covered by Malue Beds.

The powerhouse site is located in the alluvium left bank of a twisted part of the river. The basement rock is formed by Malue Beds.

(4) Hydropower Planning

In order to exploit discharge from the catchment and the head of the waterfall, the intake site is selected at the top the waterfall at EL 135.0m as shown in Fig.5-7-42 (1) and Photo 5-7-19. The powerhouse site is situated at about 2,100m downstream from the waterfall. The tailrace water level is set at EL 100.0 m to maximize the available head. The available head will be 35.0m between the intake water level of EL 135m and the tailrace level of EL 100m.

Taking into consideration the large amount of rainfall and small catchment area, a duration curve is estimated based on the Jejevo River duration curve. The maximum discharge is set at 0.24 m^3/s, which would be available during 329 days (90%) in the year.

The installed capacity is 50 kW by using a reverse running pump turbine with discharge of 0.24 m^3/s at a gross head of 35m. The annual generated energy is estimated at 432 MWh derived from the duration curve, as shown in Fig.5-7-45.

(5) Layout and Design

The project layout and design are shown in Fig.5-7-42 (1) to (4). The intake weir is located at the top of the waterfall, EL 135.0m, to divert the river flow to the headrace. The sand trap is installed in the left bank immediately downstream from the intake site. The headrace open channel will be installed for 1,900m at a gradient of 1/1,000. The head tank has a storage capacity of about 33 m^3, measuring 5.0m wide by 11.6m long and 1.9m

[20] WEST NENDO, Nendo Geological Map Sheet EOI 1.

high. The penstock, 400 mm in diameter, leads the water for 199 m from the head tank to the powerhouse located in the left bank of the Luembalele River. The powerhouse, a conventional surface type, accommodates a pump reverse running turbine and a synchronous generator in a building of 9.5m wide by 5.8m long and 3.8m high. The tailrace is a concrete open channel for 5m long required to discharge water back to the river.

(6) Access

A jetty is located at Lata for unloading heavy equipment for the project. From Lata to the project site, the existing road is available for 21 km. Preparation of an access is necessary for 2.8 km from the logging road to the intake and powerhouse sites for construction and maintenance.

(7) Environment

During the second field survey, a considerable amount of sediment and debris of wood logs were reported. The information from the local government also indicated that the river floods have caused large fluctuation of the water level. The intake weir should minimize accumulation of debris and sedimentation at the intake site.

(8) Project Cost

The project cost is estimated to be US$4,117,000 as follows.

Detailed work quantity and cost breakdown are shown in Appendix 5-2.

Table 5-7-17 Project Cost of Luembalele Hydropower

Item	Unit	Cost	Remarks
A. Civil Works	US$	2,250,000	Open, L:1900m
B. Equipment			
Metal works	US$	117,000	D:0.4m,L:203.0m
Turbine &Generator	US$	309,000	Reverse running pump
Transmission Line	US$	1,186,000	L:22km,11kV
Sub-total of item A & B	US$	3,862,000	
C. Others			
Land acqusition	US$	39,000	1% of sub-total
Engineering	US$	156,000	refer to Chapter 5.6.3
Contingency	US$	60,000	refer to Chapter 5.6.3
Total Project Cost	US$	4,117,000	

Note:SB$=0.2US$(year:2000)

5.7.11 Conclusion

The major conclusions reached as a result of the hydropower study for the Master Plan were given below. The location map for the proposed hydropower sites are shown in Fig.5-7-46.

(1) Guadalcanal

The Maotapuku 1 and 2, and Sasa hydropower sites are situated in an advantageous location to supply their power to the Honiara system that is currently supplied by the Lungga and Honiara diesel plants. The proposed run-of-river hydropower plants can supply base load energy that can reduce a considerable amount of fuel consumption from the diesel plants.

However, these project sites were not surveyed during the second field survey, therefore, site survey should be carried out before the next of the projects.

(a) Maotapuku 1 Hydropower

The project cost for the 1,600 kW plant, which generates 7,838 MWh/year, is US$ 24,870,000. The specific costs per kW and kWh are 15,544 US$/kW and 3.17 US$/kWh, respectively.

The project requires the construction of a tunnel for 1,620 m that accounts for 44% of the total project cost. Construction cost will be reduced considerably if an open channel is adopted, thus a site survey to study the possibility of construction of an open channel will be necessary.

(b) Maotapuku 2 Hydropower

The project cost for the 1,400 kW plant, which generates 6,619 MWh/year, is US$ 27,027,000. The specific costs per kW and kWh are 19,305 US$/kW and 4.08 US$/kWh, respectively.

The project requires the construction of a tunnel for 1,400m that accounts for 34% of the total project cost. The adoption of an open channel will reduce the project cost.

The Maotapuku 2 needs higher project cost than the Maotapuku 1, since the cost for the transmission line, that accounts for 15% of the total project cost, is included in the Maotapuku 2 project to send the power to the Honiara system.

(c) Sasa Hydropower

The project cost for the 280 kW plant, which generates 2,396 MWh/year, is US$ 6,211,000. The specific costs per kW and kWh are 22,182 US$/kW and 2.59 US$/kWh, respectively.

The site access condition is good and construction equipment can be transported to the site without much difficulty.

Leveling survey should be done to confirm the head between the intake and the tailrace water levels.

(2) Malaita

The northern part of the Malaita Island has favorable conditions for hydropower development, such as steep terrain and heavy rainfall, and also the provincial road allows easy access to each project site.

Several prospective hydropower sites, such as Silolo (2,100 kW), Rori (300 kW), Tamba (240 kW) and Aero (130 kW), exist around the Malu'u area.

Once transmission lines are installed in this area, all these hydro sites can be developed to supply their power not only to the local villages but also to Auki, the provincial capital.

(a) Silolo Hydropower

The project cost for the 2,100 kW plant, which generates 10,495 MWh/year, is US$ 28,261,000. The specific costs per kW and kWh are 13,458 US$/kW and 2.69 US$/kWh respectively.

The key issues for implementation of the project are the construction of a tunnel for 1,730m and an access road for 6.3 km in the mountainous terrain.

The tunnel requires US$11.4 million or 46% of the total project cost, and therefore a detailed study of the tunnel and open channel is needed.

The access to the intake site, head tank and penstock is also a technically difficult task since the topography of the access route is in the gorge covered with densely forested jungle.

In spite of these difficulties, the Silolo is considered to be an economical and powerful plant covered in the Master plan, which can supply 2,100 kW to the Auki system.

(b) Rori Hydropower

The project cost for the 300 kW plant, which generates 2,526 MWh/year, is US$ 5,989,000. The specific costs per kW and kWh are 19,963 US$/kW and 2.37 US$/kWh, respectively.

The project has several advantages for implementation such as:

-River flow duration is stable, because of spring fed river.

-Flood discharge is low, since the catchment is only 2 km^2.

-Short access road of only 900m, from the provincial road to the intake.

-Powerhouse site is only 100m from the provincial road.

-Construction of the waterway is easy in the hilly area.

-The water level gauging station has been operated to obtain the river flow data.

Judging from the above the project is ready for construction in the very near future.

(c) Kware'a Hydropower

The project cost for the 600 kW plant, which generates 2,541 MWh/year, is US$ 18,185,000. The specific costs per kW and kWh are 30,308 US$/kW and 7.16 US$/kWh respectively.

The project requires construction of a dam for storage.

Although site access is easy, the potential of the river cannot justify construction of the dam that requires a concrete volume of 25,000 m^3. Therefore, the hydropower generation is possible only if the dam is constructed for other purposes.

(3) Kubolata Hydropower

The project cost for the 80 kW power plant, which generates 563 MWh/year, is US$ 1,649,000. The specific costs per kW and kWh are 20,613US$/kW and 2.93US$/KWh, respectively.

The Kubolata project will be more economical if available water is more than the current maximum discharge of 0.05 m^3/s, because of a high head scheme. Any increase in plant discharge will directly increase the installed capacity and benefit the project, therefore, the detailed study of the hydrological analysis is essential for the project.

With regard to the project implementation, the Buala hydropower project will be an appropriate reference for design and construction of the Kubolata project. As for design, the embedded pipe can be adopted as a penstock. Labor based construction method can be applied to the intake, head tank and penstock construction.

(4) Waimapuru Hydropower

The project cost for the 20 kW plant, which generates 170 MWh/year, is US$ 912,000. The specific costs per kW and kWh are 45,600 US$/kW and 5.36 US$/kWh, respectively.

Although the project is not economical, the electricity demand in the Waimapuru is high. The national secondary school was once closed by water shortage caused by the diesel plant shut down, since the water supply system rellied totally on several electric pumps. Any increase in head and discharge will make the project more economical. Therefore, detailed investigations of leveling survey between the intake and tailrace, as well as flow measurement are essential to examine the size of the project.

(5) Sorave Hydropower

The project cost for the 70 kW plant, which generates 592 MWh/year, is US$ 1,859,000. The specific costs per kW and kWh are 26,557 US$/kW and 3.14 US$/kWh, respectively.

The Sorave hydropower is rated at 10m head with 1.1 m^3/s discharge, being a low head plant with relatively high discharge for a mini hydropower site.

The maximum discharge of 1.1 m^3/s requires a large size of the waterway structures that result in high cost of the headrace, head tank and penstock.

Since any increase in head will make the project more economical, a detailed study of the tailwater level of the Sui River is essential to determine the rated head of the turbine.

(6) Luembalele Hydropower

The project cost for the 50 kW plant, which generates 432 MWh/year, is US$ 4,117,000. The specific costs per kW and kWh are 82,340 US$/kW and 9.53 US$/kWh, respectively.

The project requires construction of an open channel for 1,900 m that accounts for 31% of the total proje ct cost. Moreover, 22 km of the 11 kV transmission line, which account for 29%, is also required. Although construction cost is not economical, the project would be more attractive if it is implemented with a water supply project, currently planned by USAID, for basic human needs. Since any increase in head and discharge will make the project more economical, a detailed survey of the leveling and discharge is essential to determine the size of the project.

SOLOMON ISLANDS METEOROLOGICAL SERVICE
CLIMATOLOGICAL DATA

Table 5-3-1 **Monthly Mean Tempterature (Degree Celsius)**

STATION : HONIARA **ISLAND: GUADALCANAL** **YEAR : 1951 - 1997**

LATITUDE: 09 25 'S **LONGITUDE: 160 03 'E** **ELEVATION : 7.9 M**

YEARS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	27.1	26.6	26.2	26.6	26.4	26.6	25.9	26.2	26.4	26.7	27.1	27.1
1952	27.2	27.3	26.9	26.4	26.9	26.5	26.1	26.5	26.4			
1953	27.1	26.7	26.3	26.0	25.8	26.3	25.7	25.7	26.1	26.5	26.8	26.7
1954	26.8	26.4	26.7	26.8	26.8	26.5	26.4	26.3	26.7	26.6	26.5	26.7
1955	27.0	26.9	26.2	26.7	26.7	26.4	26.2	26.3	26.1	26.7	26.4	25.9
1956	26.4	26.4	26.1	26.6	27.1	26.7	26.6	26.8	27.1	27.2	26.9	27.0
1957	26.8	26.3	26.3	26.8	26.5	26.0	26.1	26.5	26.5	26.6	26.7	27.0
1958	27.1	27.3	27.2	26.9	26.8	26.2	26.1	26.5	27.0	27.0	26.8	26.5
1959	26.9	26.7	26.8	26.8	26.8	26.5	26.2	25.9	25.8	26.6	26.8	26.9
1960	26.8	26.4	26.3	26.5	27.1	26.6	26.0	26.4	26.7	26.5	27.3	27.1
1961	27.2	27.2	26.9	27.0	27.0	26.7	26.0	26.4	26.4	26.4	26.5	27.0
1962	27.2	26.8	26.9	26.6	26.6	26.1	26.5	26.3	26.7	27.0	26.6	26.6
1963	26.9	26.7	26.6	26.7	26.7	26.8	26.1	26.5	26.3	26.1	26.2	26.6
1964	26.9	27.1	27.0	26.9	26.8	26.3	26.2	26.3	26.9	26.8	26.6	26.5
1965	26.6	26.7	26.3	26.4	26.2	25.6	25.2	25.3	26.2	26.2	26.2	26.8
1966	26.8	27.1	26.7	26.7	26.6	26.5	26.3	26.6	26.6	26.9	26.5	26.6
1967	26.5	26.4	26.4	26.5	26.7	26.7	26.2	26.2	26.5	26.2	26.2	27.0
1968	26.8	26.5	26.7	26.3	26.8	26.6	26.0	26.1	26.3	26.6	26.8	26.8
1969	26.8	26.9	27.1	27.4	27.4	26.8	26.3	26.2	26.7	27.0	27.2	26.8
1970	27.4	26.9	27.2	26.6	26.9	26.5	26.4	26.6	26.5	26.5	26.7	26.8
1971	26.6	26.7	26.0	26.5	26.6	26.3	26.0	26.3	26.6	26.5	26.8	26.5
1972	26.2	26.9	26.5	26.6	26.7	26.1	25.8	25.3	26.0	26.4	27.3	27.2
1973	27.5	27.0	27.2	27.0	26.6	27.0	26.2	26.5	26.9	26.6	26.9	26.8
1974	26.4	26.2	26.5	26.7	26.6	26.7	26.7	26.6	26.6			
1987			27.5	27.2	27.1	26.9	26.6	26.3	27.3	27.5	27.8	27.5
1988	27.4	27.5	28.1	27.4	27.9	27.2	26.8	26.9	27.0	27.0	27.0	26.6
1989	27.0	26.5	26.9	27.0	26.8	26.9	27.1	27.3	27.4	27.8	28.5	27.7
1990	27.9	27.7	27.8	27.6	27.8	27.3	27.0	27.3	27.2	28.0	27.9	27.7
1991	27.9	27.6	27.6	27.9	27.6	27.5	26.8	27.0	26.7	27.1	27.0	27.9
1992	27.7	27.1	27.3	27.2	27.3	27.2	26.7	27.0	26.9	27.0	26.9	27.6
1993	27.5	27.4	27.4	27.6	27.1	27.0	26.3	25.8	26.3	26.7	27.6	27.8
1994	27.7	27.4	27.6	27.5	27.3	26.6	26.4	26.8	26.6	27.1	27.4	27.5
1995	28.2	27.9	27.2	27.8	27.6	27.5	27.6	27.7	27.5	27.6	28.2	27.6
1996	27.5	27.8	27.5	27.8	27.4	27.2	27.4	27.3	27.6	27.5	27.5	27.6
1997	27.6	27.4	27.3	27.3	27.2	26.5	27.6	26.4	26.1	25.8	27.1	28.1
Aver	**27.1**	**27.0**	**26.9**	**26.9**	**26.9**	**26.6**	**26.4**	**26.5**	**26.6**	**26.8**	**27.0**	**27.0**
Lowest	**26.2**	**26.2**	**26.0**	**26.0**	**25.8**	**25.6**	**25.2**	**25.3**	**25.8**	**25.8**	**26.2**	**25.9**
Highest	**28.2**	**27.9**	**28.1**	**27.9**	**27.9**	**27.5**	**27.6**	**27.7**	**27.6**	**28.0**	**28.5**	**28.1**
Entries	**34**	**34**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**33**	**33**	**33**

(Source: Solomon Islands Meteorological Service)

Table 5-3-2 Class A Pan Evaporation Data

(unit : mm)

Site	Hend	Munda	Taro	Lata
Island	Guadalcanal	New Georgia	Choiseul	Santa Cruz
Year				
1980				
1981				
1982	Incomp			
1983	1,835	Incomp		
1984	1,710	1,513		
1985	1,615	1,488		
1986	1,811	1,554		
1987	1,796	1,565		
1988	1,682	1,647	Incomp	Incomp
1989	1,771	1,724	1,528	1,403
1990	1,775	1,662	1,605	1,459
1991	1,580	1,567	1,203	1,488
1992	1,736	1,746	1,316	1,445
1993	1,690	1,626	1,391	1,479
1994	1,702	1,431	1,302	Incomp
1995	1,707	1,551	1,297	
1996	1,608	1,595	Incomp	
1997		1,633	Incomp	
mean	1,716	1,593	1,377	1,455
standard deviation	78	88	142	33
standard deviation / mean	5	5	10	2
Entries	14	14	7	5

(Sources : Solomon Islands Meteorological Service)

Note, Blank : No data available

Incomp : Incomplete Data

Table 5-3-3 Rainfall Data (Guadalcanal)

island	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal
station	Tangarare	Visale	Komarindi	Rove West	Honiara	Mt Austen	Henderson	Ruavatu	SIPL	Goldridge
gographical coordinates	159° 39'E9° 35'S	159° 42'E9° 15'S	-----	159° 56'E9° 25'S	159° 58'E9° 25'S	159° 58'E9° 28'S	160° 03'E9° 25'S	160° 23'E9° 26'S	-----	-----
source	Land Resources *b	Land Resources *b	MEMM *e	Forestry Note *c	SIMS *a	Forestry Note *c	SIMS *a	Land Resources *b	MEMM *e	MEMM *e
	G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8	G-9	G-10
1921										
1922								2,622		
1923								2,795		
1924								2,599		
1925								2,654		
1926								2,203		
1927								2,292		
1928								2,631		
1929								3,095		
1930								2,076		
1931								2,432		
1932								2,683		
1933								3,312		
1934								4,069		
1935								2,321		
1936								3,216		
1937								2,361		
1938								3,551		
1939								3,139		
1940								3,958		
1941								incomp		
1942										
1943										
1944										
1945										
1946										
1947										
1948										
1949										
1950										
1951										
1952										
1953										
1954					incomp					
1955					2,142					
1956					1,845					
1957		incomp			1,834					
1958		1,742			2,150					
1959		2,743			2,550					
1960		2,264			2,317					
1961	incomp	2,511			1,991			incomp		
1962	3,451	2,009			2,300			2,448		
1963	3,144				2,041			2,014		
1964	3,545			1,517	1,586	1,832				
1965	3,998			2,546	2,387	2,944		incomp		
1966	2,465			1,543	1,547	incomp		1,607		
1967	3,265	3,099		2,883	2,916	2,117				
1968	incomp	2,260		1,737	2,045	1,793		incomp		
1969	2,469			1,838	2,087	1,756				
1970				2,148	2,530					
1971				2,318	2,327					
1972				2,798	2,863					
1973				incomp	1,797					
1974					incomp		incomp			
1975							1,937			
1976							2,845			
1977							2,132			
1978							1,272			
1979					incomp		1,896			
1980					1,908		1,695			
1981					1,312		1,446			
1982					2,257		2,346			
1983					1,673		1,675			
1984					1,996		2,028		incomp	incomp
1985					2,509		2,231		2,292	incomp
1986			incomp		1,969		2,124		incomp	incomp
1987			3,812		1,305		1,195		1,129	3,077
1988			3,632		2,631		2,639		incomp	4,614
1989			5,227		1,929		1,828		incomp	2,764
1990			4,613		1,688		1,542		incomp	incomp
1991			incomp		1,828		1,752		incomp	incomp
1992			incomp		1,361		1,174		incomp	incomp
1993			incomp		1,264		1,195		incomp	incomp
1994					1,841		1,671			
1995					1,552		1,323			
1996					2,190		2,169			
1997					1,693		1,591			
mean	3,191	2,375	4,321	2,148	2,004	2,088	1,813	2,731	1,711	3,485
standard deviation	563	454	739	522	421	499	458	619	822	990
standard deviation / mean	18	19	17	24	21	24	25	23	48	28
entries	7	7	4	9	37	5	23	22	2	3

Note a : Solomon Islands Meteorological Service
b : Rainfall data for the British Solomon Islands Protectorate to the end of 1973, P.G. Ash, J R D Wall, J. R. F. Hansell, vol2
Land Resources Division, Tolworth Tower, Surbition, Surrey, England, KT6 7DY
c : Forestry Note No.13-13/86, Rainfall and other climatic data for forestry station to september 1986,
d : Weather and climate, and the influence of the southern oscillation on the rainfall of the Solomon Islands,
Micah Ariki, Wellington, New Zealand, 1990
e : Ministry of Energy, Mine and Mineral Resources
Blank : No data available
incomp : incomplete data

Table 5-3-4 Rainfall Data (Guadalcanal)

(unit : mm)

island	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal	Guadalcanal
station	Mt. Chanapaho	Tenaru	Maraunia	Makina	Mbumbulake	Kakake	Leivasuvasu
gographical coordinates	-----	160° 05'E9° 25'S	160° 45'E9° 43'S	160° 49'E9° 50'S	-----	-----	-----
source	MEMM *e	Land Resources *b	Land Resources *b	Land Resources *b	MEMM *e	MEMM *e	MEMM *e
	G-11	G-12	G-13	G-14	G-15	G-16	G-17
1921							
1922		1,868	3,828				
1923		2,240	4,264				
1924		3,670	4,549				
1925		1,823	3,992				
1926		incomp	4,015				
1927		1,831	4,896				
1928		1,295	4,249				
1929		2,153					
1930		1,892					
1931		2,158					
1932		2,060					
1933		2,276					
1934		1,759					
1935		incomp					
1936							
1937							
1938							
1939							
1940							
1941							
1942							
1943							
1944							
1945							
1946							
1947							
1948							
1949							
1950							
1951							
1952							
1953							
1954							
1955							
1956							
1957							
1958							
1959							
1960							
1961				incomp			
1962				5,127			
1963		incomp		6,015			
1964				3,590			
1965				5,420			
1966				4,026			
1967				5,427			
1968				4,295			
1969				4,473			
1970							
1971				3,448			
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980							
1981							
1982							
1983							
1984	incomp				incomp		
1985	incomp				incomp	incomp	incomp
1986	incomp				incomp	incomp	incomp
1987	incomp				incomp	incomp	incomp
1988	incomp				3,056	incomp	incomp
1989	incomp				2,445	incomp	incomp
1990	incomp				1,890		incomp
1991	incomp				incomp		incomp
1992	incomp				incomp		incomp
1993	incomp				incomp		
1994					incomp		
1995							
1996							
1997							
mean	incomp	2,086	4,256	4,647	2,464	incomp	incomp
standard deviation	incomp	567	367	895	583	incomp	incomp
standard deviation / mean	incomp	27	9	19	24	incomp	incomp
entries	0	12	7	9	3	0	0

Note a : Solomon Islands Meteorological Service
b : Rainfall data for the British Solomon Islands Protectorate to the end of 1973, P.G. Ash, J R D Wall, J. R. F. Hansell, vol2
Land Resources Division, Tolworth Tower, Surbition, Surrey, England, KT6 7DY
c : Forestry Note No.13-13/86, Rainfall and other climatic data for forestry station to september 1986,
d : Weather and climate, and the influence of the southern oscillation on the rainfall of the Solomon Islands,
Micah Ariki, Wellington, New Zealand, 1990
e : Ministry of Energy, Mine and Mineral Resources
Blank : No data available
incomp : incomplete data

Table 5-3-5 Rainfall Data (Malaita / Santa Isabel)

(unit : mm)

island	Malaita	Malaita	Malaita	Malaita	Santa Isabel	Santa Isabel	Santa Isabel	Santa Isabel
station	Auki	Nafinua	Su'u	Afa'Alomae	Allardyce	Buala	Tasia	Jejevo
gographical coordinates	160° 44'E8° 47'S	160° 54'E8° 45'S	160° 55'E9° 10'S	-----	158° 40'E7° 46'S	159° 36'E8° 08'	159° 37'E8° 08'S	-----
source	SIMS *a	Land Resources *b	Land Resources *b	MEMM *e	Forestry Note *c	SIMS *a	Land Resources *b	MEMM *e
	ML-1	ML-2	ML-3	ML-4	SI-1	SI-2	SI-3	SI-4
1956	3,130 *d							
1957	2,576 *d						incomp	
1958	2,941 *d		3,348				incomp	
1959	3,047 *d		4,487				incomp	
1960	2,840 *c		3,560				4,505	
1961	3,528 *c	4,436	3,144				3,686	
1962	3,456	4,101	2,672				4,313	
1963	3,112	4,340					4,433	
1964	3,250	5,002					4,149	
1965	3,649	5,780			4,423		4,307	
1966	2,770				incomp		incomp	
1967	3,950				4,197		4,718	
1968	3,466				4,202		3,394	
1969	3,276				3,252			
1970	4,136				3,466		incomp	
1971	3,866				2,870			
1972	3,123							
1973	3,582							
1974	2,974							
1975	3,784							
1976	3,367							
1977	3,742							
1978	2,748							
1979	2,898							
1980	3,186							
1981	2,829							
1982	2,756					incomp		
1983	3,012					incomp		
1984	3,231					5,274		
1985	3,052					3,724		
1986	3,007			incomp		incomp		
1987	2,239			2,234		4,418		incomp
1988	3,269			4,130		incomp		4,391
1989	2,752			4,476		incomp		4,300
1990	2,630			incomp		3,750		4,732
1991	3,091			incomp		3,629		incomp
1992	2,486			incomp		incomp		
1993	2,637			incomp		2,761		
1994	2,601			incomp		3,739		
1995	2,756			incomp		3,770		
1996	3,444			incomp		4,910		
1997	2,394					2,629		
mean	3,109	4,732	3,442	3,613	3,735	3,860	4,188	4,474
standard deviation	440	673	670	1,207	626	833	440	228
standard deviation / mean	14	14	19	33	17	22	11	5
entries	42	5	5	3	6	10	8	3

Note a : Solomon Islands Meteorological Service

b : Rainfall data for the British Solomon Islands Protectorate to the end of 1973, P.G. Ash, J R D Wall, J. R. F. Hansell, vol2 Land Resources Division, Tolworth Tower, Surbition, Surrey, England, KT6 7DY

c : Forestry Note No.13-13/86, Rainfall and other climatic data for forestry station to september 1986,

d : Weather and climate, and the influence of the southern oscillation on the rainfall of the Solomon Islands, Micah Ariki, Wellington, New Zealand, 1990

e : Ministry of Energy, Mine and Mineral Resources

Blank : No data available

incomp : incomplete data

Table 5-3-6 Rainfall Data (New Georgia / Russell Is. / Florida Is.)

(unit : mm)

island	New Georgia Vella Lavella	New Georgia	New Georgia Kolombangara	New Georgia Kolombangara	New Georgia Kolombangara	New Georgia	New Georgia Rendova	New Georgia	Russell Is.	Russell Is.	Florida Is.
station	Unknown	Gizo	Monnga	Poitete	Ringi Cove	Munda	Rendova Harbour	Arara	Pepesala	Yandina	Tulagi
gographical coordinates	166° 44'E7° 20'S	156° 51'E8° 06'S	156° 58'E7° 54'S	157° 7'E7° 52'S	157° 09'E8° 07'S	157° 16'E8° 19'S	157° 20'E8° 24'S	157° 38'E8° 29'S	159° 07'E9° 00'S	159° 13'E9° 04'S	160° 12'E9° 06'S
source	Land Resources *b	SIMS *a	Forestry Note *c	Forestry Note *c	Forestry Note *c	SIMS *a	Land Resources *b	Forestry Note *c	Land Resources *b	Land Resources *b	Land Resources *b
	N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	R-1	R-2	F-1
1897											incomp
1898											3,742
1899											3,963
1900											2,091
1901											3,400
1902											3,625
1903											2,953
1904											2,811
1905											1,841
1906							incomp		incomp	incomp	2,430
1907							4,886		3,380	3,202	2,726
1908							4,813		3,794	4,254	3,540
1909							6,093		3,417	3,141	3,348
1910							4,990		3,040	2,862	3,437
1911							5,213		3,808	3,117	2,964
1912							4,596		2,388	2,107	2,295
1913							4,347		3,112	2,635	2,284
1914							2,840		2,312	2,355	1,547
1915							2,672		2,014	2,048	1,599
1916							3,983		3,948	3,615	4,283
1917							3,438		4,014	3,024	3,742
1918							4,322		3,120	3,006	3,033
1919							5,983		2,878	2,530	2,544
1920							5,222		2,628	2,504	2,036
1921							5,165		3,824	2,841	3,558
1922							4,088		4,843	3,473	5,889
1923							3,607		3,279	3,984	4,671
1924							4,811		3,329	3,433	4,649
1925							2,985		2,728	3,366	2,719
1926							3,313		2,478	2,385	2,444
1927							4,665		4,210	3,773	incomp
1928							3,539		2,975	1,999	2,591
1929							4,771		3,743	3,543	3,835
1930							2,989		3,165	2,221	2,603
1931	2,602						6,078		3,009	1,962	2,831
1932	3,301						5,717		4,091	2,836	3,256
1933	3,266						4,038		3,832	3,206	4,249
1934	2,686						4,604		3,802	2,776	3,418
1935	3,290						3,890		3,082	2,809	3,060
1936	3,930						3,268		4,275	2,460	3,194
1937	3,189						3,589		4,045	2,768	3,172
1938											
1939											
1940											
1941											
1942											
1943											
1944											
1945											
1946											
1947											
1948											
1949											
1950											
1951											
1952											
1953											
1954											
1955											
1956						3,019 *d					
1957						3,197 *d	incomp				
1958						3,337 *d	3,389				
1959						3,958 *d	4,293				
1960						3,196 *b	3,484		2,810	3,053	
1961		3,592 *c				3,914 *b	4,606			2,521	
1962		2,732 *c				3,714	3,597			3,590	
1963		2,576 *c				3,306	3,850			3,106	
1964		2,526 *c				3,106	3,457			2,725	
1965		3,663 *c	4,012			4,437	4,693			3,032	
1966		2,368 *c	2,819			3,347	3,461			2,388	
1967		incomp	3,318			4,193	4,933			3,561	
1968		3,087 *c	3,007		3,707	3,744	4,098			2,584	
1969		2,874 *c	3,093		3,122	3,946	4,505	3,861		2,279	
1970		2,893 *c	3,945		3,906	3,505	4,226	3,850		incomp	
1971		2,804 *c	3,201		3,218	3,208	3,116	4,059		3,180	
1972			3,059		3,626	3,949				2,998	
1973			3,349		3,346	3,325				3,318	
1974			2,476		2,613	2,805					
1975			3,160		2,793	3,644					
1976			3,500		3,578	4,074					
1977			3,888	3,246	3,907	4,045					
1978			2,618	3,183	1,942	3,580		3,351			
1979			3,491	incomp	3,517	3,933		3,454			
1980			3,429	3,597	3,948	4,123		3,630			
1981			3,243	3,626	4,236	3,417		2,806			
1982		incomp	incomp	incomp	4,599	3,885		incomp			
1983		2,332	3,046	3,352	3,172	3,180		2,566			
1984		2,816	2,774	3,614	incomp	2,849		incomp			
1985		3,235	3,313	3,383	3,680	3,252		3,492			
1986		2,604				2,885					
1987		2,476				2,591					
1988		2,670				3,688					
1989		2,232				2,766					
1990		3,389				4,054					
1991		incomp				3,591					
1992		incomp				3,303					
1993		2,841				3,376					
1994		incomp				3,287					
1995		2,811				3,771					
1996		2,421				4,058					
1997		1,378				2,112					
mean	3,181	2,742	3,237	3,429	3,465	3,492	4,227	3,452	3,355	2,922	3,184
standard deviation	442	494	412	184	634	493	879	492	658	543	939
tandard deviation / mea	14	18	13	5	18	14	21	14	20	19	29
entries	7	22	20	7	17	42	31	9	18	30	16

Note a : Solomon Islands Meteorological Service

b : Rainfall data for the British Solomon Islands Protectorate to the end of 1973, P.G. Ash, J R D Wall, J. R. F. Hansell, vol2
Land Resources Division, Tolworth Tower, Surbition, Surrey, England, KT6 7DY

c : Forestry Note No.13-13/86, Rainfall and other climatic data for forestry station to september 1986,

d : Weather and climate, and the influence of the southern oscillation on the rainfall of the Solomon Islands,
Micah Ariki, Wellington, New Zealand, 1990

e : Ministry of Energy, Mine and Mineral Resources

Blank : No data available

incomp : incomplete data

Table 5-3-7 Rainfall Data (San Cristobal / Choiseul / Shortland Is. / Santa Cruz Is.)

(unit : mm)

island	San Cristobal	San Cristobal	San Cristobal	San Cristobal	Choiseul	Choiseul	Shortland Is.	Santa Cruz	Santa Cruz
station	Kirakira	Three Sisters	Mwaniwowo	West Ridge	Taro	Sasamungga	Nila	Lata	Paeu
gographical coordinates	161° 55'E10° 25'S	161° 59'E10° 16'S	162° 11'E10° 49'S	-----	156° 24'E6° 24'S	156° 46'E7° 02'S	155° 45'E7° 00'S	165° 48'E10° 42'S	166° 50'E11° 41'S
source	SIMS *a	Land Resources *b	Land Resources *b	MEMM *b	SIMS *a	Land Resources *b	Forestry Note *c	SIMS *a	Land Resources *b
	SC-1	SC-2	SC-3	SC-4	CH-1	CH-2	SR-1	SZ-1	SZ-2
1920							3,746		
1921							3,668		
1922		4,473					3,537		
1923		4,678							
1924		3,824							
1925		3,518					3,869		
1926		3,758					3,437		
1927		5,305					incomp		
1928		4,729					3,157		
1929		incomp					3,615		
1930		5,023					2,990		
1931		5,838					3,643		incomp
1932		4,266					4,504		incomp
1933		6,561					3,540		6,107
1934		6,664					3,437		6,669
1935		4,967					3,630		4,382
1936		4,931					3,838		5,110
1937		5,474					4,037		6,031
1938		6,936							6,099
1939		5,573							5,939
1940		6,701							7,926
1941		1,898							4,606
1942									5,320
1943									4,919
1944									6,844
1945									5,499
1946									5,847
1947									incomp
1948									incomp
1949									
1950									
1951									
1952									incomp
1953									incomp
1954									6,700
1955									
1956									4,049
1957						incomp			5,503
1958						3,628			4,170
1959						3,779			5,075
1960						3,063			4,741
1961						4,022			6,711
1962						2,866			6,676
1963			incomp			2,744			5,562
1964			4,944			3,138			4,655
1965	4,988		8,018			4,294			5,935
1966	3,099		5,078			incomp			4,749
1967	4,685		7,153			incomp			incomp
1968	4,014		7,010			3,657			
1969	4,465		8,381			3,722			
1970	3,883		6,959			3,744		incomp	
1971	4,243		incomp			2,876		4,247	
1972	3,123					3,794		4,139	
1973	3,159							3,731	
1974	3,514							3,722	
1975	4,278				incomp			4,297	
1976	4,033				3,847			5,478	
1977	3,168				incomp			4,330	
1978	2,771				3,120			4,426	
1979	2,943				3,384			4,609	
1980	3,127				3,853			4,199	
1981	2,729				3,402			3,650	
1982	3,492				3,028			4,566	
1983	2,558				3,415			4,064	
1984	3,732				4,083			5,014	
1985	4,054				3,568			4,965	
1986	3,304				3,226			3,798	
1987	2,058			incomp	2,808			3,423	
1988	4,327			4,770	3,957			5,697	
1989	4,312			5,274	3,010			4,234	
1990	3,537			3,474	3,338			4,306	
1991	3,399			incomp	2,501			4,431	
1992	2,084			incomp	2,875			3,186	
1993	2,580			incomp	5,132			5,286	
1994	3,093			incomp	2,925			3,645	
1995	2,931			incomp	3,560			3,818	
1996	4,088			incomp	incomp			4,480	
1997	2,201				2,474			3,569	
mean	3,454	5,006	6,792	4,506	3,375	3,487		4,271	5,609
standard deviation	761	1,268	1,328	929	613	492		624	960
standard deviation / mean	22	25	20	21	18	14		15	17
entries	33	19	7	3	20	13		27	26

Note a : Solomon Islands Meteorological Service

b : Rainfall data for the British Solomon Islands Protectorate to the end of 1973, P.G. Ash, J R D Wall, J. R. F. Hansell, vol2
Land Resources Division, Tolworth Tower, Surbition, Surrey, England, KT6 7DY

c : Forestry Note No.13-13/86, Rainfall and other climatic data for forestry station to september 1986,

d : Weather and climate, and the influence of the southern oscillation on the rainfall of the Solomon Islands,
Micah Ariki, Wellington, New Zealand, 1990

e : Ministry of Energy, Mine and Mineral Resources

Blank : No data available

incomp : incomplete data

Table 5-3 -9 Discharge Data at Lungga Bridge Gauging Station

River:Lungga CA:377km2 unit:m3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1965										incomp	45	37	
1966	33	43	95	83	52	27	20	20	13	26	37	30	40
1967	81	58	120	76	63	27	29	29	48	61	52	32	56
1968	67	49	37	40	24	13	18	26	31	43	30	66	37
1969	40	105	46	38	23	16	17	10	incomp				
1970			incomp	38	15	18	21	22	28	42	52	64	
1971	82	53	115	59	33	39	32	15	15	34	24	97	50
1972	incomp	48	38	30	22	incomp							
1973													
1974													
1975	incomp	38	incomp	incomp	incomp	15	20	13	15	24	incomp		
1976											incomp	29	
1977	71	55	112	38	27	26	31	24	37	44	50	18	44
1978	31	64	38	31	17	14	12	10	14	13	16	32	24
1979	117	100	29	33	20	21	27	15	18	17	30	30	38
1980	23	103	60	23	incomp	13	17	21	35	incomp	incomp	36	
1981	39	incomp											
1982			incomp	incomp	incomp	incomp	22	37	23	26	12	22	
1983	47	55	42	34	18	17	13	18	26	26	36	incomp	
1984	incomp	24	incomp	incomp	32	15	21	14	13	25	42	56	
1985	incomp	incomp	137	29	18	10	19	17	23	45	53	51	
1986	47	59	30	38	132	15	12	18	28	13	53	19	39
1987	21	81	42	41	31	12	7	5	9	35	42	45	31
1988	56	66	32	38	21	16	16	11	9	21	42	88	35
1989	45	75	44	42	26	25	13	8	11	14	19	52	31
1990	72	45	incomp	51	30	19	14	11	28	incomp	incomp	44	
1991	29	71	incomp	incomp	39	28	32	23	23	51	31	14	
1992	34	121	70	32	27	10	16	18	8	10	22	incomp	
1993	incomp		incomp	incomp	incomp	33	incomp	9	14	10	14	incomp	
1994		incomp	61	54	37	24	25	19	11	incomp	incomp	7	
1995	incomp			incomp	14	9	incomp	incomp	16	44	13	29	
1996	32	25	82	61	45	24	17	19	21	25	39	140	44
1997	63	incomp	69	44	22	12	incomp	incomp	incomp	7	incomp		
mean	52	64	65	43	33	19	20	17	21	29	34	45	39
entry	20	21	20	22	24	26	24	25	25	23	22	23	12

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

CA:Catchment Area

Table 5-3 -10 Discharge Data at Lungga Gorge Gauging Station

River:Lungga CA:350km2 unit:m3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977							incomp	21	35	42	48	16	
1978	26	47	33	28	16	14	12	10	14	13	17	31	22
1979	76	79	28	31	18	21	27	14	16	17	30	31	32
1980	incomp												
1981													
1982													
1983					incomp	16	13	18	27	21	32	incomp	
1984	incomp	21	incomp	incomp	29	14	21	13	13	25	42	51	
1985	43	28	112	32	19	11	18	17	24	44	45	39	36
1986	39	49	27	38	107	15	10	10	21	9	43	16	32
1987	18	80	42	34	28	11	7	5	9	33	35	40	29
1988	50	57	29	34	20	16	14	10	10	20	35	62	30
1989	34	59	52	35	23	21	10	8	11	13	18	29	26
1990	40	37	incomp	41	25	16	14	11	21	incomp	incomp	incomp	
1991	28	66	incomp	incomp	28	22	22	15	18	27	17	9	
1992	20	84	54	18	17	7	incomp						
mean	37	55	47	32	30	15	15	13	18	24	33	32	29
entry	10	11	8	9	11	12	11	12	12	11	11	10	7

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

CA:Catchment Area

Table5-3 -11 Discharge Data at Charahi Gauging Station

River Mbetikama CA:133km2 unit:m3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1986											incomp	5	
1987	7	36	16	14	10	4	3	2	3	13	13	13	11
1988	20	25	10	17	9	6	incomp			incomp	9	incomp	
1989		27	14	17	9	9	incomp	incomp					
1990	incomp	19	incomp	16	11	8	7	3	10	incomp	incomp	incomp	
1991			incomp	13	incomp		incomp	incomp					
1992													
1993	12	incomp											
mean	13	27	13	15	10	7	5	3	7	13	11	9	11
entry	3	4	3	5	4	4	2	2	2	1	2	2	1

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

CA:Catchment Area

Table5-3 -12 Discharge Data at Hughotambu Gauging Station

River:Hughotambu unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1988							incomp	67	53	31	94	229	
1989	incomp	incomp	189	143	incomp	incomp	24	10	incomp	incomp		incomp	
1990	135	incomp		incomp	65	69	incomp					incomp	
1991	94	incomp									incomp	incomp	
1992													
1993	28	incomp											
1994						incomp	70	incomp		incomp			
mean	86		189	143	65	69	47	39	53	31	94	229	
entry	3		1	1	1	1	2	2	1	1	1	1	0

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table 5-3 -13 Discharge Data at Gwaidalo Gauging Station

River:Kwaibala unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1986									incomp	169	incomp		
1987	incomp	2399	1267	410	135	52	223	46	231	339	369	443	
1988	1603	1265	362	incomp		incomp	413	incomp	incomp	incomp		incomp	
1989	1063	incomp		incomp	531	incomp					incomp	incomp	
1990			incomp	402	453	incomp				incomp	626	630	
1991	incomp							incomp					
1992													
1993				incomp				incomp				incomp	
1994	904	1086	656	916	949	1670	1727	incomp	incomp	57	9	5	
1995	133	688	1143	680	828	258	incomp			incomp	174	332	
1996	incomp							incomp	580	incomp			
mean	926	1360	857	602	579	660	788	46	406	188	295	353	
entry	4	4	4	4	5	3	3	1	2	3	4	4	

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table5-3 -14 Discharge Data at Jejevo Gauging Station

River: Jejevo unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1987		incomp	109	57	9	9	97	19	16	102	64	132	
1988	98	68	68	88	62	100	149	216	214	224	262	197	146
1989	151	incomp	incomp	125	48	105	74	incomp	incomp	53	incomp	incomp	
1990				incomp			incomp	49	incomp		incomp	incomp	
1991			incomp	incomp		incomp	88	87	84	incomp			
mean	125	68	89	90	40	71	102	93	105	126	163	165	
entry	2	1	2	3	3	3	4	4	3	3	2	2	1

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table5-3 -15 Discharge Data at Kukudu Gauging Station

River:Kukudu unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1989									incomp	incomp	incomp	923	
1990	1831	incomp											
mean	1831											923	
entry	1	0	0	0	0	0	0	0	0	0	0	1	0

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table5-3 -16 Discharge Data at Pijaka Gauging Station

River:Mbatuna unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1988			incomp	17	incomp	14	28	19	18	30	23	28	
1989	20	33	27	incomp			incomp	22	incomp	incomp	incomp		
1990													
1991						incomp	32	31	29	incomp			
1992												incomp	
1993							incomp	11	incomp				
1994	incomp	incomp	incomp				incomp	incomp	incomp	incomp	incomp	incomp	
1995		incomp	19	27	incomp								
mean	20	33	23	22		14	30	21	24	30	23	28	
entry	1	1	2	2	0	1	2	4	2	1	1	1	0

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table5-3 -17 Discharge Data at Huro Gauging Station

River:Huro unit:litre/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1987				356	435	162	175	incomp	incomp	127	203	593	
1988	1010	1025	825	846	670	651	954	978	incomp			incomp	
1989	984	1035	incomp	incomp		incomp	incomp	incomp	incomp	158	96	135	
1990	incomp	334	286	428	804	324	214	159	incomp	184	183	600	
1991	355	incomp	incomp	491	494	479	incomp	incomp					
1992		incomp	341	262	310	148	incomp						
1993											incomp	521	
1994	incomp		incomp	517	1062	841	481	508	276	185	148	128	
1995	140	113	449	167			incomp	incomp			incomp	161	
1996	incomp			incomp									
mean	622	627	475	438	629	434	456	548	276	164	158	356	
entry	4	4	4	7	6	6	4	3	1	4	4	6	0

(Data source:Ministry of Energy, Mine and Mineral Resources.)

Note Blank: No data available

incomp: incomplete data

Table 5-3-21(1) List of Previous Reports (1)

Ref. No	title of report	date	form	check	expert original	JICA original	text	Publication Organization	category	remarks for library
1	Hydrometric Staus Report "A Summary of Data Collection for Evaluation of Rural Hydropower Potential" up to 1978	1978	report					MNR	JR・CR( )・SR	
2	Evaluation of Small Hydropower Sites in Solomon Islands, United Nations Department of Technical Co-operations for Development, April 1984	1984	report					UN	JR・CR( )・SR	
3	Prefeasibility Studies of Hydropower Projects in Solomon Islands and Recommendations on Priorities, UNIDO, July 1986	1986	report					GTZ	JR・CR( )・SR	
4	Mini-Hydropower Project in Solomon Islands Report of Survey, Nichimen Corporation, October 1987	1987	report					NICHIMEN	R・CR ( ) ・SR	
5	Prefeasibility Study Micro Hydropower Development for Rural Electrification Report, GTZ , January 1988	1988	report					GTZ	JR・CR( )・SR	
6	Feasibility Study of Water Power in Guadalcanal , Sir William Harcrow & Partners, February 1965	1965	report					British Solomn Islamds	JR・CR( )・SR	
7	Assessment of Lungga Hydroelectric Scheme, SMEC, April 1975	1975	report					SIEA	JR・CR( )・SR	
8	Report on Feasibility Study for Lungga Hydropower Project , Solomon Islands, Preece Cardew & Rider in association with Cameron MaCnamara & Partners, September 1977	1977	report					ADB	JR・CR( )・SR	
9	Lungga Hydropower Project , Solomon Islands, Preliminary Design Report Appendix 2 Geotechnical Report, Preece Cardew & Rider in association with Cameron MaCnamara & Partners, 1978	1978	report					Australian Developemnt Bureua	JR・CR( )・SR	
10	Lungga Hydroelectric Report- A Technical & Economic Review , SMEC, August 1979	1979	report					Australian Developemnt Bureua	JR・CR( )・SR	
11	Lungga Hydropower Project , Review of Project Alternatives, Cameron, MaCnamara & Preece & Cardew Internation, October 1981	1981	report						JR・CR( )・SR	
12	Solomon Islands, Lungga Hydropower Project, Economic and Financial Aspects, ADB, August 1981	1981	report					ADB	JR・CR( )・SR	
13	Lungga Hydro Power Report on Optimization Syudy, Cameron MaCnamara and Preece Cardew International, February 1982	1982	report					Solomn Islands Government	JR・CR( )・SR	
14	Haimatua Mini Hydro Power Scheme Final Report, Walter & Power Consultancy Service (India) Ltd., August 1986	1986	report					Commonwealth Fund	R・CR ( ) ・SR	
15	Komarindi Hydropower Proqject- Proposal for Engineering Consultancy Services, Tonkin & Taylor International Ltd., November 1987	1987	report					ADB	JR・CR( )・SR	
16	Engineering Geological Pre-feasibility Assesement of Tunnelling, Komarindi Hydropower Electric Scheme, Guadalcanal, Solomon Islands, B.W Riddolls for NZMOFA , 1987	1987	report					ADB	JR・CR( )・SR	
17	Komarindi Hydropower Project F/S Draft Final Report , Tonkin & Taylor International, September 1988	1988	report					ADB	JR・CR( )・SR	
18	Komarindi Hydropower Project Feasibility Study and Proposed Financial Scheme Final Report, Cameron and MaCnamara, 1989	1989	report						JR・CR( )・SR	
19	Komarindi Hydropower Project Detailed Design , Technical Report , Tonkin & Taylor, July 1991	1991	report					ADB	JR・CR( )・SR	
20	Komarindi Hydropower Project Detailed Design , Phase 2: Design Report Vol -I Project Evaluation Report, Tonkin & Taylor , July 1991Technical Report , Tonkin & Taylor, July 1991	1991	report					ADB	JR・CR( )・SR	

Table 5-3-21(2) List of Previous Reports (2)

Ref. No	title of report	date	form		expert original	JICA original	text	Publication Organization	category	remarks for library
21	Komarindi Hydroelectric Power Project, Environmental Impact Assesment Report, Summary EIA(SEIA) Report Final Draft , Tonkin & Taylor, August 1994	1994	report					ADB	JR・CR( )・SR	
22	Komarindi Catcment Area Conservation Area Solomon Islands Project Preparation Document, South Pacific Biodiversity Conservation Program, Marcch 1996	1996	report					World Bank	JR・CR( )・SR	
23	Reconnaissance Report, Malu'u Hydro Project, SMEC, Narch 1975	1975	report					MNR	R・CR ( ) ・SR	
24	Geological Report on the Malu'u Micro Hydrological Project, SMEC, April 1975	1975	report					MNR	R・CR ( ) ・SR	
25	Report on Malu'u Micro Hydro Project, SMEC, August 1975	1975	report					MNR	R・CR ( ) ・SR	
26	A Preliminary Report on the Manakwai River as a Hydroelectric Power Source, MNR, August1976	1976	report					MNR	R・CR ( ) ・SR	
27	Malu'u Mini-Hydro Scheme, Solomon Islands, Design Report, July 1980, ENEX of New Zealand Inc., July 1980	1980	report					New Zealnd Foreign Affairs	R・CR ( ) ・SR	
28	Prefeasibility Study Power System Expansion Malu'u , Malaita Province, Solomon Islands, SIEA, August 1996	1996	report					GTZ	R・CR ( ) ・SR	
29	A Preliminary Report on the Feasibility of Electric generation using Water Power in the Poporo River, Santa Isabel, MNR,1976	1976	report					MNR	R・CR ( ) ・SR	
30	Hydrometric Survey of the Rifukoti stream, Buala, Santa Isabel, Geological Division of MNR, November 1979	1979	report					MNR	R・CR ( ) ・SR	
31	Hydropower Potential for the Electricity Supply of the Provincial Capital Buala on the Solomon Islands, GTZ, February 1994	1994	report					GTZ	R・CR ( ) ・SR	
32	Feasibility Study Mini Hydropower Scheme Buala Isabel Province, GTZ, March 1995	1995	report					GTZ	R・CR ( ) ・SR	
33	Hydropower Potential for the Electricity Supply of the Provincial Capital Auki on the Solomon Islands, GTZ, February 1994	1994	report					GTZ	R・CR ( ) ・SR	
34	Pre-feasibility Study Mini Hydropower Scheme Fiu River, malaita Province , GTZ, 1996	1996	report					GTZ	JR・CR ( ) ・SR	
35	Pre-feasibility Study Mini Hydropower Scheme Ruala'e ,Auki System, Malaita Province , GTZ, 1996	1996	report					GTZ	R・CR ( ) ・SR	
36	Hydropower Potential for the Electricity Supply of the Provincial Capital Kirakira on the Solomon Islands, GTZ, February 1994	1994	report					GTZ	R・CR ( ) ・SR	
37	Feasibility Study Mini Hydropower Scheme Kirakira , Makira Ulawa Province , GTZ, 1996	1996	report					GTZ	R・CR ( ) ・SR	
38	Hydrometric Investigatuons at Santa Cruz, Geology Division of MNR, 1978	1978	report					MNR	R・CR ( ) ・SR	
39	Hydrometric Surveys Luesalo River, Garciosa Bay, Santa Cruz, Geology Division of MNR, September 1979	1979	report					MNR	R・CR ( ) ・SR	
40	Hydropower Potential for the Electricity Supply of the Provincial Capitl Lata on the Solomon Islands, GTZ, February 1994	1994	report					GTZ	R・CR ( ) ・SR	
41	Reconnaissance Hydrometric Investigations in North Choiseul, Geological Division of MNR, June 1979	1979	report					MNR	R・CR ( ) ・SR	

Table5-4-3 Small Hydropower Potential Sites
Guadalcanal (1)

Island: Guadalcanal

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Sasa	ROR	Mn	22	82.5	20	62.5	0.66	280
2	Kohove	ROR	Mn	14	280	160	120	0.4	380
3	Mataniko	ROR	Mn	34	80	60	20	1.0	150
4	Lungga	RES	Sl	346	80	40	40	63.0	20,300
5	Tuambule	ROR	Sl	34	420	320	100	4.4	3,300
6	Oha	ROR	Sl	19	320	160	160	2.5	2,900
7	Komarindi	ROR	Sl	133	220	140	80	11.1	6,600
8	Mbarona	ROR	Sl	20	260	120	140	2.6	2,700
9	Mbetisahata	ROR	Sl	39	290	190	100	5.1	3,800
10	Charive 1	ROR	Sl	12	560	280	280	1.6	3,300
11	Charikando	ROR	Mn	10	240	120	120	0.3	270
12	Charive 2	ROR	Sl	25	270	160	110	3.3	2,700
13	Itina 5	PON	Sl	144	180	100	80	25.9	15,400
14	Itina 4	ROR	Sl	76	260	190	70	9.9	5,200
15	Charima 2	RES	Sl	43	120	80	40	10.1	3,000
16	Itina 3	ROR	Sl	36	420	320	100	4.7	3,500
17	Charima 1	ROR	Sl	18	230	120	110	2.3	1,900
18	Itina 2	ROR	Sl	31	630	440	190	4.0	5,700
19	Itina 1	ROR	Sl	17	1000	680	320	2.2	5,300
20	Kolondoma	ROR	Sl	6	440	20	420	0.8	2,400
21	Ngalimbu	PON	Sl	127	200	120	80	23.5	14,000
22	Voraha	ROR	Sl	25	400	280	120	3.3	2,900
23	Mbiambe	PON	Sl	30	400	250	150	5.4	6,000
24	Kavarso	ROR	Sl	19	630	430	200	2.5	3,700
25	Maotapuku 1	ROR	Sl	10	420	265	155	1.3	1,600
		sub total							117,280

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW〜)
Mn (Mini Hydro 100〜1000kW)
Mr (Micro Hydro 〜100kW)

Table5-4-4 Small Hydropower Potential Sites
Guadalcanal (2)

Island: Guadalcanal

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
26	Maotapuku 2	ROR	Sl	22	202	140	62	2.9	1,400
27	Nuhu	PON	Sl	111	350	240	110	20.0	16,400
28	Kokalapa	PON	Sl	82	430	350	80	19.2	11,400
29	Viso	ROR	Sl	17	300	200	100	2.2	1,700
30	Sutakiki	ROR	Sl	24	590	430	160	3.1	3,700
31	Sutakama 2	ROR	Sl	43	510	430	80	5.6	3,300
32	Sutakama 1	ROR	Sl	33	640	510	130	4.29	4,200
33	Koma	ROR	Sl	26	180	80	100	3.4	2,500
34	Choha	PON	Sl	179	240	160	80	32.2	19,200
35	Kolokumaha	ROR	Sl	48	300	240	60	6.2	2,800
36	Manuhoho	ROR	Sl	67	242	157	85	8.7	5,500
37	Kolombolavu	ROR	Sl	26	240	140	100	3.4	2,500
38	Kombito	ROR	Sl	33	400	210	190	4.3	6,100
39	Asi	ROR	Sl	13	221	20	201	1.7	2,500
40	Mboloavu	ROR	Sl	18	240	40	200	2.3	3,500
41	Valasi	ROR	Sl	26	240	155	85	3.4	2,100
42	Kolohasiva	ROR	Sl	58	260	104	156	7.5	8,800
43	Koloula	ROR	Sl	21	420	320	100	2.7	2,000
44	Haimatua	ROR	Mn	2.6	---	---	48	0.4	130
45	Sambahalava	ROR	Sl	25	400	140	260	3.3	6,300
46	Sambaharihi	ROR	Sl	20	200	20	180	2.6	3,500
47	Simiu	PON	Sl	90	160	111	49	16.2	5,900
48	Kolovaghanela	ROR	Sl	49	80	20	60	6.4	2,900
49	Hanargga	ROR	Sl	37	106	60	46	4.8	1,700
		sub total							120,030
		total							237,310

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-5 Small Hydropower Potential Sites

Malaita

Island: Malaita

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Rori	ROR	Mn	2	42.5	3	39.5	1.1	300
2	Silolo	ROR	Sl	13	180	20	160	1.7	2,100
3	Tambaa	ROR	Mn	11	120	24	96	0.3	240
4	Takwea	ROR	Mn	7	160	30	130	0.2	200
5	Kwaimbaita	ROR	Mr	5	100	20	80	0.2	90
6	Areo	ROR	Mn	9	100	36	64	0.3	130
7	Kwainafala	ROR	Sl	9	520	30	490	0.9	3,300
8	Ataa	ROR	Mn	17	80	37	43	0.5	160
9	Kware'a	ROR	Mn	28	100.5	84	16.5	5.0	600
10	Lo'omae	ROR	Mn	34	80	19	61	1.0	460
11	Ngwanaa	ROR	Sl	12	200	74	126	1.2	1,100
12	Longana	ROR	Sl	29	80	17	63	2.9	1,400
13	Auluta	ROR	Sl	36	60	17	43	3.6	1,200
14	Akomare	ROR	Mn	11	100	19	81	0.3	200
15	Fiu	ROR	Sl	43	---	---	79	2.0	1,100
16	Ruala'e	ROR	Mn	---	---	---	200	0.1	180
17	A'arai	ROR	Mn	13	40	15	25	0.4	70
18	Ambitona	ROR	Sl	16	400	100	300	1.6	3,600
19	Fulo	ROR	Sl	18	200	43	157	1.8	2,100
20	Kwaimae	ROR	Sl	16	200	80	120	1.6	1,400
21	Kwariekwa	ROR	Sl	15	135	30	105	1.5	1,200
22	Wairaha	PON	Sl	355	40	20	20	63.9	9,500
23	Waitahu	ROR	Mn	13	70	16	54	0.4	160
		total							30,790
	Existing Plant								
EX1	Malu'u	ROR	Mr	---	---	---	21	0.2	30
EX2	Atoiri	ROR	Mr	---	---	---	---	---	30
EX3	Manawai	ROR	Mr	---	---	---	---	---	50
		total							110

Note: ROR-run of river, PON-run of river with pondage, RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-6 Small Hydropower Potential Sites

Santa Isabel

Island: Santa Isabel

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Kotova	ROR	Mn	24	71	22	49	0.7	260
2	Korighole	ROR	Sl	13	240	47	193	1.3	1,900
3	Skaleo	ROR	Mn	11	93	37	56	0.3	140
4	Poporo	ROR	Mn	10	86	26	60	0.3	130
5	Kubolata	ROR	Mn	1	244	10	234	0.05	80
6	Ghonoghano	ROR	Sl	30	200	104	96	3.0	2,200
		total							4,710
	Existing Plant								
EX1	Buala	ROR	Mn	2.1	---	---	242.7	0.90	150
		total							150

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-7 Small Hydropower Potential Sites

New Georgia

Island: Kolombangara, New Georgia, Rendova, Vangunu

No.	Site	Type of Plant	classification	Catchment Area (km^2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m^3/s)	Plant Output(kW)
	Kolombangara								
1	Lundumoe	ROR	Mr	16	40	18	22	0.5	80
2	Patupaele	ROR	Mn	12	80	17	63	0.4	170
3	Kukundu	ROR	Mn	17	60	19	41	0.5	160
4	Ghiza	ROR	Mr	13	40	14	26	0.4	80
	New Georgia								
5	Mase	ROR	Mn	13	80	30	50	0.4	150
6	Kumbukombu	ROR	Mn	11	120	66	54	0.3	130
7	Vaeimbu	ROR	Mn	14	58	23	35	0.40	110
8	Mbaeni	ROR	Mn	11	120	58	62	0.3	150
9	Sakambara	ROR	Mn	38	182	80	102	1.1	870
10	Utu	ROR	Mn	13	80	29	51	0.4	150
11	Tita	ROR	Mn	13	80	34	46	0.4	130
	Rendova								
12	Hazoari	ROR	Mn	21	70	36	34	0.6	160
	Vangugu								
13	Chocole	ROR	Mn	18	65	38	27	0.5	110
14	Nggevala	ROR	Mn	25	108	64	44	0.8	250
15	Pijaka	ROR	Mr	0.8	---	---	158	0.7	70
16	Sanggivi	ROR	Mn	14	80	32	48	0.4	150
	Vella Lavella								
17	Ereo	ROR	Mn	7	200	100	100	0.2	150
18	Kaso	ROR	Mn	14	100	40	60	0.4	190
19	Pakoi	ROR	Mn	7	280	140	140	0.2	230
20	Mundi-Mundi	ROR	Mn	14	385	95	290	0.4	920
21	Maesao	ROR	Mn	8	195	95	100	0.2	170
22	Kimbiri Point	ROR	Mn	8	350	90	260	0.3	490
23	Malasova	ROR	Mr	7	150	90	60	0.2	90
		Total							5,160
EX1	Iriri	ROR	---	---	---	---	---	---	5
EX2	Vavanga	ROR	---	---	---	---	---	---	5
EX3	Ghatere	ROR	---	---	---	---	---	---	5
EX4	Bulelawara	ROR	---	---	---	---	---	---	5
		Total							20

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-8 Small Hydropower Potential Sites
San Cristobal

Island: San Cristobal

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Wainari'i	ROR	Mn	13	120	29	91	0.4	260
2	Tarihu	PON	Sl	69	80	35	45	12.4	4,200
3	Waimakarima	PON	Sl	43	100	68	32	7.7	1,800
4	Waimapuru	ROR	Mr	2.8	97	65	32	0.1	20
5	Maepua	PON	Sl	59	120	80	40	10.6	3,200
6	Hao	PON	Sl	109	80	23	57	19.6	8,300
7	Kirakira	ROR	Mn	3.5	---	---	103	0.15	111
8	Maghoha 2	ROR	Sl	29	240	80	160	2.9	3,500
9	Maghoha 1	ROR	Sl	18	360	240	120	1.8	1,600
10	Houmapusi	PON	Sl	54	147	107	40	9.7	2,900
11	Ravoraha	PON	Sl	113	120	80	40	20.3	6,100
12	Warihito	PON	Sl	89	140	100	40	16.0	4,800
		total							25,891

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-9 <u>Small Hydropower Potential Sites</u>

Choiseul

Island: Choiseul

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Sorave	ROR	Mr	9.5	18.4	8.4	10	1.1	70
2	Vacho	PON	Sl	211	80	37	43	38.0	12,200
3	Visovaso	ROR	Mr	10	34	3	31	0.3	70
4	Kerava	ROR	Mn	19	120	52	68	0.6	290
5	Poro	ROR	Sl	26	160	55	105	2.6	2,030
6	Kolombangara 2	ROR	Mn	12	80	40	40	0.4	110
7	Kolombangara 1	ROR	Sl	54	100	38	62	5.40	2,500
8	Saloka	ROR	Mn	18	120	54	66	0.5	270
9	Komangga 1	ROR	Mn	35	98	34	64	1.1	500
10	Komangga 2	ROR	Mn	10	120	36	84	0.3	190
11	Maukana 1	ROR	Sl	19	160	80	80	1.9	1,100
12	Maukana 2	ROR	Mn	14	120	60	60	0.4	190
13	Kao	ROR	Mn	10	120	33	87	0.3	190
14	Manggo 1	ROR	Sl	24	160	40	120	2.4	2,200
15	Manggo 2	ROR	Mn	32	80	40	40	1.0	290
		total							22,200

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table5-4-10 Small Hydropower Potential Sites
Santa Cruz Islands

Island: Nendo Is. (Santa Cruz Islands)

No.	Site	Type of Plant	classification	Catchment Area(km2)	Intake WL(m)	Tailrace WL(m)	Gross Head(m)	Discharge (m3/s)	Plant Output(kW)
1	Luembalele	ROR	Mr	2.4	135	100	35	0.24	50
2	Luetombo	ROR	Mn	6	240	40	200	0.18	260
		total							310

Note : ROR-run of river,PON-run of river with pondage,RES-reservoir
Sl (Small Hydro 1000kW～)
Mn (Mini Hydro 100～1000kW)
Mr (Micro Hydro ～100kW)

Table 5-6-2 Labour Wage

Particular	Unit	SBD
Foreman	M.h	15.8
skilled labor	M.h	13.0
Casual labor	M.h	2.6
Carpenter	M.h	7.8
Reinforcing bar fixer	M.h	8.0
Equipment Operator, Driver	M.h	6.7

Table 5-6-3 Unit Price of Major Construction Materials

Materrials	specification	per unit	SBD
ready mixed concrete	21MP/20mm	m^3	550
	18MP/20mm	m^3	519
Portland cement	40kg bag price, paradise cement from NG	kg	37
coarse aggregate	20mm , Lunnga river	m^3	110
	10mm, Lunnga river	m^3	110
	6mm, Lunnga river	m^3	95
river fine sand	Lunnga river	m^3	103
Selected soil		m^3	87
Reinforcement bar	16mm*6m,deformed	no.	47
	12mm*6m,deformed	no.	26
	10mm*6m,deformed	no.	17
	6mm*6m,deformed	no.	5.3
Mesh wire	4.7*1.9m/sheet	no.	184
	4.7*1.9m/sheet	no.	127
	2.1*3.0m/sheet	no.	319
Concrete blocks	390*190*190mm	no.	5.8
	390*140*190mm	no.	4.1
	390*90*190mm	no.	3.5
PVC pipes	150mm, 6m/each	m	36
	100mm	m	20
	75mm	m	12
	50mm	m	6.0
Plywood for concrete forms	8ft*4ft, t=10mm	m^2	52
diesel oil		litter	1.8
gasoline		litter	2.1

Table 5-6-4 Hourly Cost of Major Construction Equipent

Equipment	specification	Unit	SBD
Air compressor	1.4m3/min	h	123
Water pump	40mm,5m	h	30
*Dump truck	10t	h	300
*Dump truck	4t	h	200
*Backhoe	0.25m^3	h	385
*Backhoe	0.05m^3	h	220
*bulldozer	6t	h	380
*Shipment ,charter,45t	within Solomon Islands	24h	5000

*Unit price includs operation fee

Table 5-7-1. Summary of Hydropower Planning

Site	Catchment (km^2)	Type of Plant	Effective Head (m)	Maximum Discharge (m^3/s)	Turbine Type	Installed Capacity (kW)	Energy Output (MWh)	Transmission Line (km) Voltage (kV)	Distribution Line (km) Voltage (kV)	Access Road (km)	Supply Area	Project Cost (million US$)
Maotapuku 1 (Guadalcanal)	10.0	ROR	150.5	1.3	H-F	1,600	7,838	6.5km/33kV (Maotapuku 1-Maotapuku2)		3.5	Honiara	24.870
Maotapuku 2 (Guadalcanal)	22.0	ROR	58.5	2.9	H-F	1,400	6,619	32.5km/33kV (Maotapuku2-Lungga P/S)	6.0km/415kV	5.8	Honiara	27.027
Sasa (Guadalcanal)	22.0	ROR	58.0	0.66	C	280	2,396	15.0km/11kV (Sasa-Honiara P/S)	2.0km/415kV	1.7	Honiara	6.211
Silolo (Malaita)	13.0	ROR	155.0	1.7	H-F	2,100	10,495	8.0km/33kV (Silolo-Fausande)		6.3	Malu'u-Auki	28.261
Rori (Malaita)	2.0	ROR	37.0	1.1	C	300	2,526	20.0km/11kV (Malu'u-Anda'ua)	9.0km/415kV	0.9	Malu'u-Auki	5.989
Kware'a (Malaita)	28.0	PON	15.5	5.0	ST	600	2,541	14.0km/33kV (Kware'a-Dala)		1.1	Dala-Auki	18.185
Kubolata (Santa Isabel)	1.0	ROR	229.0	0.05	P	80	563	2.5km/11kV (Kubolata-Buala)	0.5km/415kV	2.0	Buala	1.649
Waimapuru (San Cristobal)	2.8	ROR	30.0	0.1	R	20	170		2.0km/415kV (Waimapur-Secondary School)	2.0	Waimapuru Second School	0.912
Sorave (Choiseul)	9.5	ROR	9.0	1.1	R	70	592	6.0km/11kV (Sorave-Secondary School)		0.4	Secondary school	1.859
Luembalele (Lata)	2.4	ROR	31.0	0.24	R	50	432	22.0km/11kV (Luembalele-Lata)		2.8	Lata	4.117

Note, ROR=Run-of-River type
PON=Pondage type
H-F=Horizontal Francis
C=Cross-Fow
P=Pelton
ST=S Type Tubular
R=Rverse Running Pump Type

Table 5-7-2 Monthly Rainfall in Honiara (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1954	m	m	m	m	m	m	m	m	m	m	116.4	319.8
1955	125.7	131.1	607.6	115.8	174.8	77.8	41.6	6.9	76.0	69.4	136.0	578.8
1956	402.6	489.7	341.3	150.1	51.3	73.4	15.4	26.9	11.6	71.7	119.4	91.1
1957	141.6	369.1	313.1	112.8	186.6	62.2	54.2	87.1	79.9	171.7	97.1	159.0
1958	185.8	88.4	194.7	640.8	123.2	339.0	23.3	45.9	66.6	185.6	52.7	204.2
1959	371.4	241.3	306.0	290.0	129.8	59.2	94.7	194.4	211.2	97.5	158.8	395.2
1960	193.1	307.6	602.8	329.0	74.3	101.6	152.8	61.0	133.3	137.0	93.9	130.2
1961	162.5	174.1	316.2	174.4	106.8	63.3	213.3	123.3	142.6	147.6	245.4	121.4
1962	202.1	310.9	117.4	344.2	473.0	108.9	60.7	68.6	64.2	164.6	98.3	287.0
1963	182.8	206.1	406.0	187.1	40.8	36.8	95.2	142.2	189.7	274.9	115.1	164.5
1964	238.7	81.4	297.5	157.0	186.2	42.2	64.5	47.3	37.9	191.7	132.7	109.3
1965	375.2	396.4	373.9	113.7	150.3	108.8	306.2	120.5	67.8	116.6	88.4	168.8
1966	32.3	199.7	248.0	141.1	57.0	48.0	16.3	48.1	26.0	52.8	392.3	285.8
1967	565.3	304.3	635.6	180.6	215.0	87.7	113.2	138.9	67.2	377.1	167.6	63.9
1968	423.6	318.5	198.1	192.8	23.5	65.1	176.1	97.4	140.9	132.9	137.7	137.9
1969	289.4	362.1	215.3	181.3	135.4	153.0	96.2	94.6	79.9	95.8	108.1	276.3
1970	168.6	560.8	269.8	332.6	131.6	119.8	52.5	80.9	211.0	197.0	120.2	285.3
1971	236.4	109.7	455.9	328.2	96.3	109.5	88.5	82.2	85.3	157.6	130.3	447.2
1972	955.8	298.3	359.7	204.8	158.2	267.6	103.1	117.9	103.9	76.1	38.7	178.9
1973	82.1	218.7	363.9	107.9	84.4	70.4	90.3	128.1	30.7	245.8	130.1	244.6
1974	232.2	474.4	222.4	139.0	73.0	89.2	53.0	117.4	72.2	m	m	m
1975	m	m	m	m	m	m	m	m	m	m	m	m
1976	m	m	m	m	m	m	m	m	m	m	m	m
1977	m	m	m	m	m	m	m	m	m	m	m	m
1978	m	m	m	m	m	m	m	m	m	m	m	m
1979	m	m	m	m	m	m	m	35.6	75.6	35.8	201.2	200.4
1980	182.2	503.2	407.0	23.8	58.8	39.8	62.2	95.8	188.2	73.4	189.0	84.4
1981	361.0	266.2	66.0	92.6	24.0	9.8	95.6	89.2	64.0	84.4	27.2	132.2
1982	351.2	179.0	353.2	352.4	150.0	40.6	118.2	270.8	123.8	88.8	62.8	155.8
1983	152.8	323.2	211.2	99.0	127.8	35.8	91.4	72.8	178.0	96.0	83.8	201.2
1984	89.8	210.8	380.4	222.8	125.0	31.4	37.8	45.4	59.6	172.4	329.8	290.6
1985	304.2	170.6	557.2	143.6	113.0	53.0	154.2	270.4	77.8	142.6	340.4	182.2
1986	272.6	182.0	263.0	250.6	366.2	40.0	84.2	115.6	141.0	9.0	207.8	37.2
1987	93.6	231.2	113.8	84.2	60.2	0	66.2	30	62.6	98.4	165.6	299
1988	318.0	409.2	122.6	78.2	32.6	103.6	95.4	139.4	130.4	198.4	453.4	549.4
1989	243.6	483.0	151.8	247.4	206.8	145.6	34.4	35.8	72.4	65.4	71.2	171.2
1990	230.8	71.4	332.8	160.4	167.8	52.6	111.8	48.2	122.8	41.6	73.6	274.0
1991	273.8	274.8	235.4	151.0	189.4	139.6	144.2	154.0	138.8	75.4	35.0	16.4
1992	91.2	423.2	109.0	117.0	60.9	46.4	68.0	34.6	24.2	131.2	100.1	155.2
1993	61.6	232.8	131.0	187.8	60.2	112.3	97.8	96.1	32.9	41.1	42.5	168.3
1994	258.3	363.9	343.7	140.4	174	201.1	73.4	96.5	19.1	54.8	18.1	97.8
1995	m	m	m	m	m	m	m	m	m	m	m	m
1996	149	161.5	369.2	153.7	90.6	93	108.8	133.5	70.9	218.4	123.8	517.3
1997	185.4	241.5	564.4	185.7	13.8	26.7	13	83.3	147.64	38.6	54.8	36.6
mean	248.3	280.3	312.3	192.3	126.8	88.0	91.0	96.8	95.5	125.1	139.0	213.5
Max.	955.8	560.8	635.6	640.8	473	339	306.2	270.8	211.2	377.1	453.4	578.8
Min.	32.3	71.4	66	23.8	13.8	0	13	6.9	11.6	9	18.1	16.4
Entry	37	37	37	37	37	37	37	38	38	37	38	38

Note m: missing data or data not available
Source: Solomon Island Meteorological Service

Table5-7-6 Monthly Rainfall in Auki (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1962	253.8	535.3	451.0	258.6	206.3	112.1	196.8	191.3	213.8	192.2	264.0	580.9
1963	281.8	159.2	436.6	196.1	107.4	194.7	227.3	266.2	282.1	494.6	259.5	206.0
1964	481.1	481.8	451.7	320.8	97.0	156.1	244.4	179.9	185.9	235.0	222.9	193.7
1965	418.6	285.9	586.5	226.7	245.8	197.0	506.9	318.9	258.3	223.6	111.2	269.2
1966	118.9	338.9	392.4	133.6	247.9	195.1	131.8	165.6	136.6	204.3	349.8	355.5
1967	503.8	477.6	578.7	201.5	362.6	228.8	218.4	419.1	156.8	243.3	382.5	177.0
1968	735.2	519.3	348.4	130.6	158.1	136.3	376.4	149.4	234.8	155.7	197.1	324.8
1969	343.7	406.0	209.4	251.2	245.5	283.8	374.3	361.0	204.5	236.2	79.5	280.9
1970	186.9	538.2	510.5	540.3	257.0	146.8	207.5	169.9	235.3	371.6	245.4	726.5
1971	431.2	393.6	605.6	257.0	237.8	121.9	143.9	292.3	246.2	273.4	201.1	661.7
1972	677.2	178.9	348.8	155.1	431.9	396.3	205.6	116.5	149.9	141.7	144.6	176.1
1973	330.6	428.3	576.2	334.7	126.4	230.0	219.7	219.0	233.0	341.3	143.4	399.4
1974	434.0	361.2	465.4	215.4	110.2	252.0	298.8	97.2	117.6	271.4	232.6	117.8
1975	761.6	328.2	428.0	277.2	235.0	82.2	248.2	242.6	271.0	190.8	401.2	317.8
1976	718.6	517.4	302.4	354.4	149.6	97.2	222.4	180.6	70.2	258.0	165.8	330.6
1977	574.8	201.2	570.8	309.2	177.0	198.0	357.7	381.0	257.6	222.6	326.6	165.0
1978	298.8	396.4	260.6	283.4	184.4	138.4	211.6	153.2	163.0	129.6	279.4	249.6
1979	296.0	273.4	284.8	247.0	322.0	280.8	186.0	141.8	148.0	146.2	294.4	277.8
1980	342.8	522.2	417.1	139.8	112.4	296.2	73.4	332.0	255.4	190.2	280.8	223.8
1981	265.4	517.4	171.2	179.4	128.4	154.2	335.2	121.4	280.8	272.6	139.0	264.0
1982	375.8	247.8	346.2	432.1	192.2	57.2	213.6	316.9	161.2	221.6	26.0	174.2
1983	327.4	517.0	380.5	257.2	165.0	114.1	191.4	201.0	282.6	207.4	201.2	167.6
1984	193.6	182.6	632.8	325.5	223.7	160.6	347.0	232.8	186.6	193.0	273.0	280.0
1985	348.7	424.5	564.9	148.2	223.0	123.4	145.2	284.6	195.2	134.8	168.8	290.8
1986	223.8	392.2	369.3	246.0	624.6	106.2	79.2	148.8	382.6	119.4	203.8	110.6
1987	65.4	406.6	440.8	149.2	157.2	43.6	176.4	16.8	266.0	127.0	152.0	237.6
1988	388.2	397.6	246.2	248.4	117.2	162.2	210.4	334.0	213.6	265.4	169.0	517.2
1989	265.6	462.8	337.0	281.6	251.4	182.0	103.8	125.0	144.8	120.2	163.4	314.0
1990	372.6	98.0	287.2	192.0	231.8	235.0	269.2	111.2	149.8	216.6	228.0	238.8
1991	558.0	419.8	288.0	60.4	215.4	206.2	126.6	383.0	257.8	331.6	133.4	110.6
1992	167.6	496.0	213.4	225.8	60.0	29.0	248.8	199.3	149.4	115.0	271.9	309.9
1993	96.6	356.9	234.8	259.5	260.5	293.5	332.3	123.2	213.4	73.3	182.6	210.5
1994	310.7	311.6	224.1	294.9	191.3	411.4	295.5	266.9	27.4	124.3	89.6	53.6
1995	196.0	230.3	520.8	197.7	251.9	147.6	198.6	245.2	300.2	162.9	174.6	139.3
1996	283.2	210.5	528.9	351.0	266.7	209.2	155.6	233.4	177.3	140.8	285.1	602.2
1997	587.6	322.1	340.8	170.8	83.0	114.5	66.5	136.7	345.8	38.8	73.4	113.7
Mean	367.1	370.5	398.7	245.9	212.7	180.4	226.3	218.3	209.8	205.2	208.8	282.5
Max.	761.6	538.2	632.8	540.3	624.6	411.4	506.9	419.1	382.6	494.6	401.2	726.5
Min.	65.4	98.0	171.2	60.4	60.0	29.0	66.5	16.8	27.4	38.8	26.0	53.6
Entry	36	36	36	36	36	36	36	36	36	36	36	36

Note m:missing data or data not available
Source: Solomon Island Meteorological Service

Table 5-7-10 Month Rainfall in Buala (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1982	m	m	m	m	m	m	358.0	173.0	330.5	337.1	45.5	365.0
1983	235.9	514.9	418.2	373.2	355.0	349.7	350.1	185.5	406.0	m	329.5	m
1984	245.1	493.7	518.7	554.7	427.4	243.6	412.3	311.4	468.2	422.0	580.5	596.5
1985	318.5	240.0	419.2	279.3	143.5	136.5	407.5	351.3	301.8	454.6	314.8	356.5
1986	452.9	188.2	314.8	592.4	392.0	296.8	200.2	346.3	313.7	427.5	m	298.7
1987	372.0	444.5	518.0	387.1	361.0	303.5	333.7	98.0	354.9	333.7	421.7	489.5
1988	349.5	334.8	m	m	m	m	m	m	m	m	m	m
1989	698.8	239.0	390.8	235.3	70.5	111.5	382.6	206.8	418.5	m	m	m
1990	368.7	189.7	358.3	373.9	348.2	193.8	447.4	145.0	218.0	392.2	331.2	383.4
1991	300.4	268.2	220.0	179.0	602.4	374.4	160.9	358.0	542.2	423.2	91.6	108.4
1992	213.2	483.5	213.2	65.9	157.2	98.6	293.2	224.7	65.9	m	m	m
1993	180.5	306.1	296.3	296.6	262.6	328.6	249.8	164.9	202.8	65.5	195.4	211.6
1994	319.3	464.3	419.8	257.1	457.2	636.8	344.4	360.7	85.6	156.2	64.2	173.1
1995	274.6	308.0	364.4	248.4	475.6	340.4	339.8	332.6	156.4	467.5	242.1	240.2
1996	339.2	378.0	549.7	593.1	535.6	278.4	306.8	306.0	448.8	256.0	502.6	415.6
1997	311.8	340.2	597.6	301.4	145.0	168.5	159.9	122.0	95.2	40.8	160.0	186.5
Mean	332.0	346.2	399.9	338.4	338.1	275.8	316.4	245.7	293.9	314.7	273.3	318.8
Max.	698.8	514.9	597.6	593.1	602.4	636.8	447.4	360.7	542.2	467.5	580.5	596.5
Min.	180.5	188.2	213.2	65.9	70.5	98.6	159.9	98.0	65.9	40.8	45.5	108.4
Entry	15	15	14	14	14	14	15	15	15	12	12	12

Note m: missing or not available data

Source: Solomon Islands Meteorological Service

Table 5-7-12 Monthly Rainfall in Kirakira (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1965	416.0	344.6	394.9	208.4	396.2	500.5	743.3	514.8	307.4	422.8	130.1	609.4
1966	165.4	436.7	278.6	312.8	363.0	168.1	24.8	155.0	158.2	138.5	392.6	505.7
1967	498.9	297.3	668.4	212.3	367.4	378.9	182.0	708.0	220.2	532.0	236.3	383.6
1968	719.6	379.8	194.9	573.2	169.1	118.4	342.4	156.5	301.9	280.2	228.2	550.0
1969	515.8	389.4	435.1	679.2	259.8	450.8	496.1	462.3	m	314.1	116.3	240.8
1970	157.1	185.3	259.1	268.9	356.4	417.8	566.2	695.2	205.3	350.9	199.7	220.7
1971	448.8	289.3	765.5	589.0	170.2	243.2	193.4	343.3	370.2	160.8	240.2	429.4
1972	424.3	259.1	409.6	331.3	457.0	270.4	267.5	129.8	80.4	134.4	140.5	227.8
1973	112.8	120.4	532.8	328.2	105.3	183.6	195.4	299.4	379.9	332.1	247.2	321.9
1974	260.4	770.6	387.4	295.0	157.4	312.8	379.0	121.5	170.6	187.3	285.4	186.4
1975	549.6	342.0	467.2	173.7	218.0	183.6	447.0	251.8	421.0	304.6	534.4	385.5
1976	641.2	616.6	420.6	225.1	205.9	214.8	544.4	447.6	199.6	150.8	184.6	182.2
1977	289.8	327.4	372.0	149.6	204.2	265.4	406.2	412.8	216.7	152.2	265.6	106.0
1978	324.0	358.6	284.4	187.4	422.0	123.8	271.8	348.6	117.4	62.0	158.8	112.4
1979	484.6	370.6	111.8	192.6	197.8	291.0	245.8	106.6	170.7	154.8	325.2	291.8
1980	132.6	548.8	333.0	174.6	433.6	110.0	61.0	192.0	213.8	269.6	329.8	327.8
1981	249.0	277.8	71.6	131.2	137.6	97.4	401.6	313.4	432.2	267.0	153.6	196.2
1982	211.0	405.0	367.2	534.1	350.2	123.0	430.8	585.6	130.0	205.4	70.6	79.4
1983	207.8	172.8	209.1	172.0	229.0	109.1	248.6	175.6	359.8	183.0	268.9	221.8
1984	228.6	259.4	444.2	395.8	237.0	272.0	415.2	153.1	227.2	517.0	185.9	396.4
1985	358.2	210.8	695.8	242.8	488.6	239.4	383.9	705.6	m	262.6	294.2	172.0
1986	236.0	326.2	274.0	503.4	439.8	136.6	174.0	239.1	451.4	145.0	247.8	130.2
1987	77.4	m	238.8	233.7	267.2	48.2	250.0	31.0	210.4	153.0	171.8	376.4
1988	290.4	244.4	197.8	305.2	164.6	338.8	360.8	521.1	506.2	308.6	510.6	578.0
1989	527.6	432.0	394.0	585.6	592.4	405.6	291.2	190.2	457.0	111.0	m	225.0
1990	400.2	133.0	364.0	587.8	523.4	189.6	156.8	57.2	300.0	169.8	152.4	502.4
1991	296.8	274.6	216.6	212.6	222.4	242.2	186.8	509.8	542.4	477.6	150.0	67.0
1992	152.2	307.8	156.2	271.0	212.1	84.2	218.6	216.8	95.7	42.1	264.7	62.3
1993	196.7	213.6	313.0	188.1	297.5	185.8	106.6	47.0	159.9	149.9	192.6	529.6
1994	195.4	353.7	217.7	341.1	626.8	386.3	238.8	354.6	188.7	57.8	70.1	62.0
1995	134.5	76.5	426.8	106.4	320.5	122.5	338.6	433.7	285.2	507.4	59.7	119.1
1996	294.7	210.8	288.0	269.2	358.3	286.1	401.6	396.7	367.8	303.2	285.6	625.5
1997	209.9	272.9	318.9	404.0	134.8	280.9	41.8	124.3	206.3	9.1	113.1	84.5
mean	315.4	319.0	348.8	314.7	305.6	235.8	303.4	315.2	272.7	236.9	225.2	288.2
Max.	719.6	770.6	765.5	679.2	626.8	500.5	743.3	708.0	542.4	532.0	534.4	625.5
Min.	77.4	76.5	71.6	106.4	105.3	48.2	24.8	31.0	80.4	9.1	59.7	62.0
Entry	33	32	33	33	33	33	33	33	31	33	32	33

Note m: missing data or not available data
Source: Solomon Island Meteorological Service

Table 5-7-14 Monthly Rainfall in Taro (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1976	338.0	481.2	444.6	309.0	386.2	190.4	394.6	563.2	117.8	298.0	117.6	206.6
1977	215.6	233.8	206.4	457.0	161.8	354.6	224.1	448.0	306.2	m	m	115.4
1978	248.8	217.6	366.0	188.6	325.8	248.6	181.6	364.6	213.0	240.8	382.4	141.8
1979	145.8	288.6	311.6	360.8	264.0	225.0	482.8	379.6	257.6	212.8	294.2	161.0
1980	244.4	214.4	567.0	147.6	411.6	463.6	415.4	480.0	304.0	261.4	112.0	231.4
1981	332.6	481.4	101.6	206.4	214.6	241.9	402.6	265.8	230.2	356.8	m	368.8
1982	238.2	174.3	356.2	403.3	214.2	265.5	443.6	156.4	m	m	32.2	123.6
1983	102.2	395.8	310.7	291.4	299.2	247.8	352.0	257.1	503.6	237.0	210.0	207.8
1984	131.0	387.6	588.4	385.0	333.8	309.2	670.6	332.2	244.6	176.5	279.0	244.6
1985	344.8	224.6	447.8	584.4	261.4	177.0	373.4	249.2	290.2	226.8	162.4	226.2
1986	322.4	292.8	285.4	522.0	107.8	247.2	291.2	205.6	412.8	270.1	74.6	194.0
1987	98.0	458.7	113.3	292.9	222.0	112.6	344.6	136.2	152.4	318.0	279.6	279.4
1988	262.8	228.8	213.0	350.6	296.2	312.2	393.8	307.8	293.0	450.6	664.4	183.6
1989	247.2	375.2	340.8	371.4	251.4	170.2	148.4	293.8	206.4	251.4	154.4	199.2
1990	334.8	86.4	230.6	213.8	321.0	214.6	270.4	421.8	477.2	245.0	355.8	167.0
1991	303.0	143.0	61.8	232.4	304.0	321.7	223.6	257.4	338.8	134.6	155.0	25.4
1992	227.2	367.4	277.4	148.8	200.9	190.1	241.4	319.2	222.8	365.7	146.1	167.7
1993	408.2	719.0	278.0	410.6	627.9	752.3	642.7	291.9	213.4	230.0	m	257.1
1994	201.7	352.0	275.2	306.3	392.6	201.7	280.5	411.6	182.0	209.8	82.4	29.5
1995	382.1	237.6	239.7	236.8	236.6	220.9	232.8	285.9	502.3	372.5	372.2	240.6
1996	206.9	205.6	307.3	m	m	m	m	m	m	m	m	m
1997	m	m	254.4	m	214.3	152.7	295.4	m	m	m	m	131.0
mean	254.1	312.7	299.0	321.0	288.0	267.6	347.9	321.4	287.8	269.9	227.9	185.8
Max.	408.2	719.0	588.4	584.4	627.9	752.3	670.6	563.2	503.6	450.6	664.4	368.8
Min.	98.0	86.4	61.8	147.6	107.8	112.6	148.4	136.2	117.8	134.6	32.2	25.4
Entry	21	21	22	20	21	21	21	20	19	18	17	21

Note m:missing or not available data

Source: Solomon Island Meteorologocal Service

Table 5-7-16 Monthly Rainfall in Lata (mm)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1970	m	m	m	m	m	m	m	m	204.3	506.9	m	452.8
1971	505.8	433.7	569.4	352.8	158.3	246.7	260.3	478.7	335.9	233.5	281.8	390.3
1972	564.3	308.8	325.1	289.5	653.3	307.7	246.5	295.7	401.3	169.5	253.1	323.8
1973	323.3	329.9	449.6	363.7	306.1	213.7	271.6	337.2	281.7	297.6	278.8	278.0
1974	274.0	390.4	361.2	336.5	148.4	281.6	288.6	403.6	219.1	401.6	460.0	156.6
1975	664.8	286.6	383.6	269.4	231.0	234.7	373.6	346.4	487.0	309.2	495.8	215.0
1976	1008.2	572.6	656.6	340.8	218.6	269.0	390.4	382.6	333.6	350.8	431.4	523.4
1977	554.4	396.0	419.6	207.6	338.0	347.0	493.8	406.8	375.8	456.2	168.2	167.0
1978	231.8	460.0	300.2	323.2	611.4	338.0	277.0	517.7	324.6	477.2	223.4	341.0
1979	626.8	239.4	361.2	238.2	309.0	515.6	343.0	602.4	296.6	256.8	496.4	324.0
1980	291.6	415.8	385.2	158.0	194.0	524.8	506.0	267.0	561.8	261.8	235.2	397.4
1981	345.6	350.8	135.4	323.2	176.6	106.6	374.4	91.4	422.4	319.4	394.2	610.0
1982	344.2	304.2	765.6	106.4	446.6	408.2	615.4	600.4	299.0	470.0	83.0	123.2
1983	369.8	455.4	206.0	314.4	572.0	94.6	332.2	105.2	469.2	359.8	411.2	374.6
1984	516.4	313.1	753.4	464.4	414.4	403.0	343.4	129.6	269.8	538.8	594.0	273.5
1985	235.1	352.8	526.2	294.4	363.5	253.8	534.8	702.4	320.4	506.6	473.2	401.8
1986	168.2	312.4	394.8	471.9	660.8	154.4	153.4	177.0	381.8	235.6	378.2	309.8
1987	153.6	619.8	369.8	309.2	387.6	65.4	160.2	96.2	428.6	272.6	134.6	425.4
1988	523.6	497.4	255.6	465.6	275.2	333.6	620.8	416.0	509.1	453.8	581.2	764.6
1989	392.6	626.2	303.6	564.2	493.8	247.2	205.4	143.6	172.2	315.6	363.0	406.4
1990	366.8	312.0	657.0	168.8	329.0	229.8	262.0	236.2	693.4	212.8	307.6	530.2
1991	489.2	430.4	297.4	205.6	531.4	319.2	303.6	732.4	368.0	490.6	179.0	84.4
1992	104.4	471.4	119.8	491.0	338.6	207.9	687.8	308.2	145.0	30.8	111.6	169.8
1993	307.3	636.0	527.7	465.1	594.9	694.2	510.6	422.0	213.4	186.1	374.9	353.4
1994	319.2	362.2	494.4	482.6	390.3	215.1	161.3	181.7	115.4	489.0	236.3	197.6
1995	324.0	239.5	527.2	257.6	368.4	230.5	169.5	665.3	217.7	418.2	252.0	145.7
1996	367.5	286.4	400.5	362.5	417.0	348.4	409.2	398.3	399.1	611.9	270.5	208.6
1997	351.2	518.2	433.1	416.5	258.6	292.4	149.7	336.3	401.9	61.4	205.0	144.2
mean	397.2	404.5	421.5	334.9	377.3	292.0	349.8	362.2	349.8	340.3	321.2	320.0
Max.	1008.2	636.0	765.6	564.2	660.8	694.2	687.8	732.4	693.4	611.9	594.0	764.6
Min.	104.4	239.4	119.8	106.4	148.4	65.4	149.7	91.4	115.4	30.8	83.0	84.4
Entry	27	27	27	27	27	27	27	27	28	28	27	28

Note m:missing or not available data

Source: Solomon Island Meteorological Service