Appendix

Appendix List

Appendix 6.1: List of IBAs in Sri Lanka

No.	Name	No.	Name
1	Jafna Lagoon	36	Kithulgala
2	Araly South-Punalai	37	Gilimale-Eratna
3	Kayts Island-Mandathive	38	Bambarabotuwa
4	Amaipaddukkai	39	Dotalugala/Rassagala
5	Periyakalapuwa mouth	40	Delmella
6	Giants Tank	41	Ayagama
7	Usgala Siyambalanduwa	42	Karawita
8	Seguwantive mudflats	43	Waratalgoda
9	Periyakadawela	44	Udawalawa
10	Mundel Lake	45	Delgoda/Kudumiriya/Kobahadukanda
11	Anaiwilundawa complex	46	Delwela/Panilkanda/Walankanda
12	Neugalkanda	47	Sinharaja
13	Padaviya	48	Rammalkanda
14	Anuradhapura	49	Namunukula
15	Minneriya/Girithale/Kaudulla	50	Tangamalai
16	Kumbuk Wewa	51	Haputale
17	Polonnaruwa	52	Muturajawela
18	Wasgomuwa	53	Bellanwila-Attidiya
19	Pimburettewa Tank	54	Labugama
20	Kantale Tank	55	Bodhinagala
21	Rugam Tank	56	Morapitiya-Runakanda
22	Madura Oya	57	Kalugala
23	Ampara	58	Yagirala
24	Senanayake Samudraya/Nilgala	59	Beraliya-Kudagala
25	Sigiriya	60	Haycock/Habarakada
26	Knuckles	61	Malambure
27	Udawattakele	62	Kombala-Kottawa
28	Kandapola-Seethaeliya/Pedro	63	Beraliya-Akurassa
29	Nuwara Eliya	64	Nakiyadeniya/Kanneliya/Dediyagala
30	Hakgala/Meepilimana	65	Dellawa/Diyadawa
31	Dikoya	66	Welihena
32	Agrapatana-Bopaththalawa	67	Mulatiyana
33	Horton plains / Ohiya / Pattipola-Ambewela	68	Bundala complex
34	Peak Wilderness	69	Wirawila
35	Amanawala	70	Yala

Appendix 7.1　Participant List of SHM-1

(個人情報につき省略)

Appendix 7.2　Participant List of SHM-2

(個人情報につき省略)

Appendix 7.3　Participant List of SHM-3

(個人情報につき省略)

Development Planning on Optimal Power Generation for Peak Power Demand

(1st Stakeholders Meeting)

June 27, 2013

CEYLON ELECTRICITY BOARD Enrich Life through Power

JICA

J-POWER

Contents

1. Introduction

- Purpose of the Study
  - to make Development Planning on optimal power generation for Peak Power Demand
- Purpose of Stakeholders Meeting
  - to reflect stakeholders comments to the Planning through dialogues
- Stakeholders Meetings (SHMs)
  - 1st SHM (June 27, 2013) : Proposal of Optimal Power Generation for Peak Power Demand
  - 2nd SHM (November 2013)
  - 3rd SHM (April 2014)

2. Purposes of the 1st Stakeholders Meeting

Purposes of Discussion in the1st Stakeholder Meeting

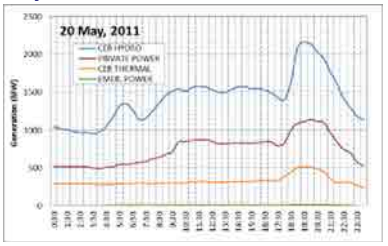
§ I Power Generation for Peak Power Demand

§ II Optimization Process of Planning of Pumped Storage Power Plant

§ III Scoping of Strategic Environmental Assessment (SEA) for Development of Pumped Storage Power Plant

3. Present Daily Load Curve

3.1 Rainy Season



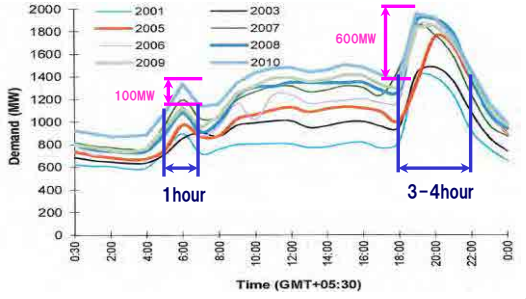
During the peak power demand period, CEB Hydro, CEB Thermal and Private Power Producers supply power.

3.2 Dry Season

During the peak power demand period, CEB Hydro supplies power. CEB Thermal & Private Power Producer are almost at their full capacities.

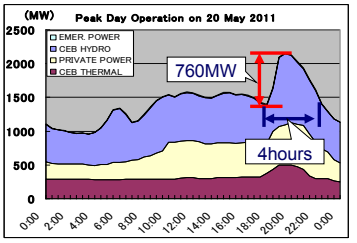
4. Demand Forecast

4.1 Peak Load – Present situation



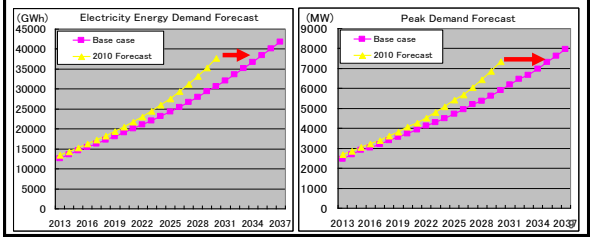
4.2 Peak Load on 20 May 2011

- Peak load was 760 MW. The peak period was around 4 hours.
- Peak load rapidly increased to 760MW within 1 and half hours.
- The minimum load was 959MW at 3:30. It is 44% of the peak demand (2,163MW).



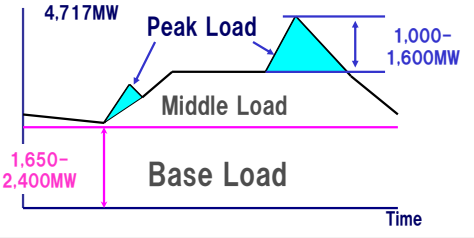
4.3 Demand Forecast of LTGEP2013-32

- The energy demand forecast shows 4-5 years' delay from the 2010 forecast. The peak demand in 2025 is 4,717MW. It is 700MW lower than the last one.
- Load Factor is 58.8%, which is almost as same as the 2010.



4.4 Demand Forecast in 2025

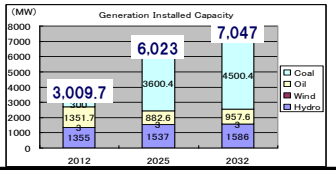
- Generation energy is assumed at 24,284 GWh.
- Peak demand is 4,717MW.



5. Necessity of Peak Power Supply

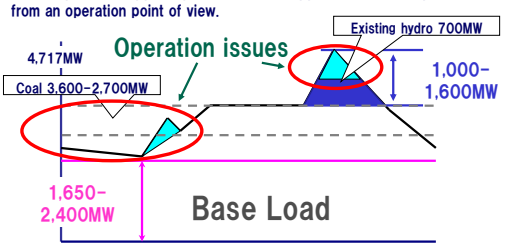
5.1 LTGEP 2013-2032

- The share of Coal thermal capacity becomes 60% and 64% of Generation Installed Capacity in 2025 and 2032.
- The forecasted load factor is less than 60%.
- Coal thermal plant's minimum operation output is 75%.
- The existing hydro could supply around 700MW at the peak power demand period in 2011. In 2025, the supply capacity is assumed to be 700MW.



5.2 Operation issues in 2025

- Peak Load would be 1,000-1,600MW (20-35% of peak demand).
- Peaking supply was 760MW in 2011. The existing hydro may supply 700MW in 2025.
- Lack of peaking supply capacity and oversupply from the coal plants are issues from an operation point of view.



5.3 Countermeasures to the Operation Issue

- **Options of Peak Power Generation**
  - Hydropower Plant (New Construction)
  - Hydropower Plant (Expansion)
  - Pumped Storage Power Plant
  - Coal-Fired Thermal Power Plant
  - LNG Integrated Gas Combined Cycle Power Plant
  - Gas Turbine Plant
  - Diesel Plant
  - Renewable Energy
- **Other options for Peak Power Generation**
  - Independent Power Producer
  - Demand Side Management
  - Inter Connection with Indian System

13

6. Options of Peak Power Generation

6.1 Hydropower Plant (New Construction)

The hydro potential in Sri Lanka has already been developed to a great extent.

Broadlands	35 MW	Committed, Run-of River Type
Uma Oya	120 MW	Committed, Multipurpose
Moragolla	27 MW	Multipurpose
Gin Ganga	49 MW	Run-of River Type
Total	231 MW	(reference: LTGEP 2013-2032)

Multipurpose and Run-of River Types are not suitable for peak power generation.

14

6.2 Hydropower Plant (Expansion)

Smanarawewa	120 MW	for peaking duty, environmental issues
Wimalasurendra	-	upgrading
New Laxapana	-	upgrading
Old Laxapana	-	upgrading
Victoria	228 MW	for peaking duty, irrigation intake issue
Kotmale	-	30m dam raising, 20% energy to be increased
Total	348 MW	

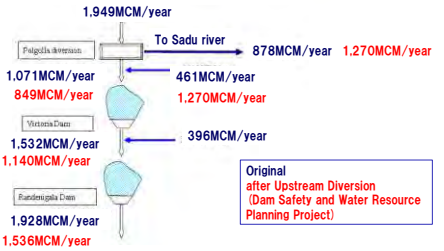
(reference: LTGEP 2013-2032)

These projects are not included in the Base Case Plan (2013-2032).

The irrigation issue of Victoria should be resolved as early as possible.

15

Expansion of Victoria HPP, Irrigation Diversion



16

A. Basic

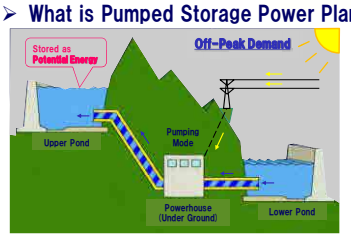
	unit	Existing	After Expansion	
Installed Cap.	MW	210	438	
Annual Energy	GWh	704.6	715.9	
-Firm	GWh	229.8	468.2	
-Secondary	GWh	474.9	247.7	▲69.2GWh
95% Dependable	MW	210	393	
B. After U/S Diversion of DSWRPP (878 → 1,270MCM/yr)				
Installed Cap.	MW	210	438	
Annual Energy	GWh	572	572	
-Firm	GWh	227	399	
-Secondary	GWh	346	173	▲41MW
95% Dependable	MW	207	352	

Source: Victoria Expansion Feasibility Study Report in 2009, JICA

17

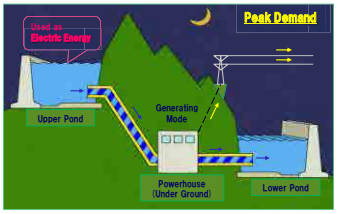
6.3 Pumped Storage Power Plant

- **What is Pumped Storage Power Plant?**



During the off-peak time, electric energy generated mainly by base load power stations is stored in Upper Pond as Potential energy.

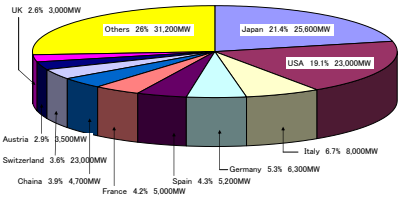
18



During the peak time, power is generated using stored energy in Upper Pond as a peak power station.

➢ Technical Maturity

1904	Ruppoldingen PSPP in Switzerland: 1st PSPP in the world.
1963	Taum Sauk PSPP in U.S: the first large scale pump-turbine.
-present	Total 86,100 MW in the world. (Total of Euro 26,800 MW excluding UK)



One of the options for Peak Power Generation in combination with Coal Thermal Power Plant and Renewable Energy Power Plant

6.4 Coal-Fired Thermal Power Plant

Comparatively Low Fuel Cost

Mainly used for Base Load Power Generation

Puttalam	300MW x 3unts	2nd and 3rd units are under construction
Trincomalee	250MW x 4units	Not committed
New Site	300MW x 6units	Expected up to 2025

6.5 LNG Integrated Gas Combined Cycle Power Plant

Generally used for Middle Peak Load or Base Load

Relatively expensive for utilized for Peak Load

6.6 Gas Turbine Plant

Short Start-up time

Good response to Load Fluctuation

Relatively low Efficiency

Short Life and High Fuel Cost

6.7 Diesel Plant

No construction since 1999

Not for Peak Load Power Plant from anti-oil policy

Small Scale and High Fuel Cost

6.8 Renewable Energy

Micro Hydropower (Economically feasible potential 400MW)

Wind (Feasible potential 200MW among meteorological potential)

Solar (Substantial potential in dry zone)

Bio (Fuel wood, municipal waste, industrial w., agricultural w.)

7. Other Options for Peak Power Generation

7.1 IPP

Current Total Capacity: 804.5 MW (small D:371.5MW, CC:433MW)

They are used for Middle Peak Load and Peak Load.

PPA with IPP will not be extended, as a CEB policy.

7.2 Demand Side Management

Introduction of energy-saving equipment, hourly varied tariff

Necessary activity but uncertainty of effect in Peak Demand

7.3 Inter Connection with Indian System

Inter connection makes Sri Lankan System Stable

India has the same daily load curve as Sri Lanka

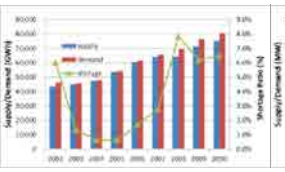
1) Study Progress

- The study was initiated in 2006.
- 500MW connection as the first stage would be expanded to 1,000MW.
- MOU was signed between CEB and PGCIL for a feasibility study.

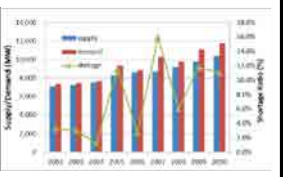
Transmission interconnection could be a countermeasure for Peak Power Supply?
…considering following situation in INDIA

2) Situation in INDIA

- Shortage of the power supply capability has not been improved.
- It is forecasted that the demand keeps growing rapidly (e.g. Peak demand in 2016 will be 1.6 times from 2010).
- Achievement of power development was 51.5% (in 2002-2006).



Balance GWh Basis in Tamil Nadu



Balance MW Basis in Tamil Nadu

8. Characteristics Required for Peak Power Generation (Screening 1)

➢ Requirements for Peak Power Generation

Options	Power Control Range	Power Variation	Start-up Time	Ability to Adapt
Hydropower	25-100%	50%/min	1-2 min	Very good
PSPP	25-100%	50%/min	1-2 min	Very good
Thermal Power (Oil)	30-100%	3%/min	3-5 hr	Fair
Thermal Power (Coal)	30-100%	1%/min	3-5 hr	Poor
Thermal Power (LNG)	20-100%	3%/min	3-5 hr	Fair
LNG IGCC	20-100%	10%/min	1 hr	Good
Gas Turbine	-	-	15-20 min	Good

9. Evaluation of Options from Various Angles (Screening 2)

	Hydropower (Expansion)	PSPP	LNG IGCC	Gas Turbine
Construction Period	Good	Fair	Good	Very good
Potential Capacity	Fair-Good	Very good	Very good	Fair
Procurement of Fuel	- (Very good)	-	Fair	Good
Life	Fair	Very good	Good	Fair
External Restriction	Fair	Very Good	Fair	Fair
Economical Efficiency	Very good	Good (to be studied)	Good (to be studied)	Fair

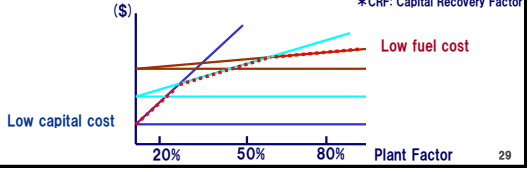
9.1 Economic Characteristics of the generators

➢ Generation unit cost ($/kWh) = Capital cost + Energy cost

$$\text{Capital cost} = \frac{\text{Construction unit cost} \times \text{CRF}^{*}}{\text{Plant Factor} \times 8760\,(\text{hour})}$$

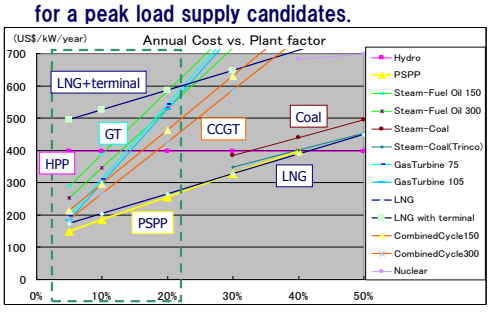
$$\text{Energy cost} = \frac{\text{Fuel unit cost}\,(\$/\text{kcal}) \times 860\,(\text{kWh/kcal})}{\text{Thermal Efficiency}}$$

*CRF: Capital Recovery Factor

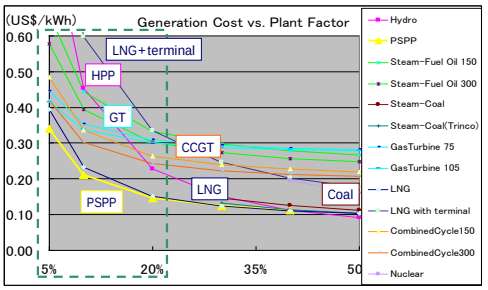


➢ LTGEP 2013-2032

✓ GT, CCGT, LNG and PSPP are the least annual cost for a peak load supply candidates.



✓ PSPP is one of the most economical generators for the peak load use.



31

9.2 Environmental and Social Considerations

➢ 10 environmental and social aspects

(1) air pollution;
(2) water pollution;
(3) greenhouse gas emissions;
(4) impacts on ecosystems;
(5) impacts caused by resettlement;
(6) impacts on water right / water resources;
(7) impacts on agriculture;
(8) impacts on fishery;
(9) impacts on tourism; and,
(10) impacts on human health

32

(1) Air pollution

Power Generation Option	SO_2 (t SO_2/TWh)	NOx (t NOx/TWh)	Particulate Matter (t/TWh)	Rating
Hydro capacity expansion	Less than New hydro PP	Less than New hydro PP	Less than New hydro PP	1
Pumped storage PP	More than New hydro PP	More than New hydro PP	More than New hydro PP	2
Gas combined cycle thermal PP	4 to 15,000+	13+ to 1,500	1 to 10+	2
Gas turbine thermal PP	N/A	N/A	N/A	2
Diesel PP	84 to 1,550	316+ to 12,300	122 to 213+	3
Transmission interconnection	Depending on the situation in the Indian side.			2
Demand side management	Nil	Nil	Nil	0

33

(2) Water pollution

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	· Alternation of the water temperature · Prolongation of turbid water discharging	Low	Low	1
Pumped storage PP	· Alternation of the water temperature · Prolongation of turbid water discharging	Low	Low	1
Gas combined cycle thermal PP	· Change of the water temperature due to heated effluent · Boiler blowdown · Boiler cleaning wastes	Low	Low	1
Gas turbine thermal PP	· Change of the water temperature due to heated effluent · Boiler blowdown · Boiler cleaning wastes	Low	Low	1
Diesel PP	· Boiler cleaning wastes	Low	Low	1
Transmission interconnection	Depending on the situation in the Indian side.			1
Demand side management	Nil	Nil	Nil	0

34

(3) Greenhouse gas emissions

Power Generation Option	Greenhouse Gas Emissions (kt eq. CO_2/TWh)	Rating
Hydro capacity expansion	Less than New hydro PP	1
Pumped storage PP	More than New hydro PP	2
Gas combined cycle thermal PP	389 to 511	2
Gas turbine thermal PP	Similar to Gas combined cycle thermal PP.	2
Diesel PP	555 to 883	3
Transmission interconnection	Depending on the situation in the Indian side.	2
Demand side management	Nil	0

35

(4) Impacts on ecosystems

Power Generation Option	Impacts	Local and regional ecosystems	Biomass	Genetic diversity at the world level	Rating
Hydro capacity expansion	Nil	Nil	Nil	Nil	0
Pumped storage PP	· Barriers to migratory fish · Loss of terrestrial habitats · Change in water quality · Modification of water flow · Climate change · Acid precipitation	x x x x x x	x	x	2
Gas combined cycle thermal PP	· Climate change · Acid precipitation · Loss of coastal habitats · Change of the water temperature due to heated effluent	x x x x	x	x	3
Gas turbine thermal PP	· Climate change · Acid precipitation · Loss of coastal habitats · Change of the water temperature due to heated effluent	x x x x	x	x	3
Diesel PP*	· Climate change · Acid precipitation	x x	x	x	2
Transmission interconnection	· Loss of terrestrial habitats · Loss of marine substrates	x x			1
Demand side management	Nil	Nil	Nil	Nil	0

36

(5) Impacts caused by resettlement

Power Generation Option	Land Requirements (km²/TWh/y)	Severity of impacts with mitigation	Rating
Hydro capacity expansion	Nil	Nil	0
Pumped storage PP	Less than New hydro PP	High to Low	2
Gas combined cycle thermal PP	Small	Medium to Low	2
Gas turbine thermal PP	Small	Medium to Low	2
Diesel PP	Small	Low	1
Transmission interconnection	Small	Low	1
Demand side management	Nil	Nil	0

37

(6) Impacts on water right/water resources

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	Nil	Nil	Nil	0
Pumped storage PP	· Change in the flow pattern	Low	Low	1
Gas combined cycle thermal PP	· Change of the water temperature due to heated effluent	Low	Low	1
Gas turbine thermal PP	· Change of the water temperature due to heated effluent	Low	Low	1
Diesel PP	Nil	Nil	Nil	0
Transmission interconnection	Nil	Nil	Nil	0
Demand side management	Nil	Nil	Nil	0

38

(7) Impacts on agriculture

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	Nil	Nil	Nil	0
Pumped storage PP	· Loss of land · Degradation of water quality · Change in the flow pattern	Low	Low	1
Gas combined cycle thermal PP	· Loss of land · Degradation of air quality	Low	Low	1
Gas turbine thermal PP	· Loss of land · Degradation of air quality	Low	Low	1
Diesel PP	· Loss of land · Degradation of air quality	Low	Low	1
Transmission interconnection	· Loss of land	Low	Low	1
Demand side management	Nil	Nil	Nil	0

39

(8) Impacts on fishery

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	Nil	Nil	Nil	0
Pumped storage PP	· Change in the flow pattern	Low	Low	1
Gas combined cycle thermal PP	· Change in water quality · Loss of coastal habitats · Change of the water temperature due to heated effluent · Degradation on substrate	Medium	Low	2
Gas turbine thermal PP	· Change in water quality · Loss of coastal habitats · Change of the water temperature due to heated effluent · Degradation on substrate	Medium	Low	2
Diesel PP	Nil	Nil	Nil	0
Transmission interconnection	· Degradation on substrate	Low	Low	1
Demand side management	Nil	Nil	Nil	0

40

(9) Impacts on tourism

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	Nil	Nil	Nil	0
Pumped storage PP	· Change in the flow pattern	Low	Low	1
Gas combined cycle thermal PP	· Impacts on sport / leisure · Impacts on landscape	Low	Low	1
Gas turbine thermal PP	· Impacts on sport / leisure · Impacts on landscape	Low	Low	1
Diesel PP	· Impacts on sport / leisure · Impacts on landscape	Low	Low	1
Transmission interconnection	· Impacts on landscape	Low	Low	1
Demand side management	Nil	Nil	Nil	0

41

(10) Impacts on human health

Power Generation Option	Impacts	Probability of occurrence	Severity of impacts with mitigation	Rating
Hydro capacity expansion	· Risks from water-borne diseases, particularly when there is irrigation · Dam break	Low	Low	1
Pumped storage PP	· Dam break · Climate change · Acid precipitation	High to Low	Low	2
Gas combined cycle thermal PP	· Climate change · Acid precipitation · Photochemical smog · Fire · Explosion	High to Low	Medium	2
Gas turbine thermal PP	· Climate change · Acid precipitation · Photochemical smog · Fire · Explosion	High to Low	Medium	2
Diesel PP	· Climate change · Acid precipitation · Photochemical smog · Particulate matter · Fire	High to Low	Medium	2
Transmission interconnection	· Electromagnetic wave	High	Low	2
Demand side management	Nil	Nil	Nil	0

42

➢ Result of assessment

POWER GENERATION OPTION	Air pollution	Water pollution	Greenhouse gas emissions	Impacts on ecosystems	Impacts caused by resettlement	Impacts on water right/ water resources	Impacts on agriculture	Impacts on fishery	Impacts on tourism	Impacts on human health	TOTAL
Hydro capacity expansion	1	1	1	0	0	0	0	0	0	1	**4**
Pumped storage PP	2	1	2	2	2	1	1	1	1	2	**15**
Gas combined cycle thermal PP	2	1	2	3	2	1	1	2	1	2	**17**
Gas turbine thermal PP	2	1	2	3	2	1	1	2	1	2	**17**
Diesel thermal PP	3	1	3	2	1	0	1	0	1	2	**14**
Transmission interconnection	2	1	2	1	1	0	1	1	1	2	**12**
Demand side management	0	0	0	0	0	0	0	0	0	0	**0**

43

➢ Result

- ✓Demand side management is the lowest score and has no negative impacts.
- ✓Hydro capacity expansion has the second, and Transmission interconnection has the third lowest score.
- ✓The rest of the options are not very different in the aspects of environmental and social considerations.

44

➢ Second Screening: Result

Power Generation Options / Evaluation Point	Hydropower (Expansion)	PSPP	LNG IGCC	Gas Turbine
Technical aspect	Good	Very good – Good	Good	Good
Economical aspect	Very good	Good	Good	Fair
Environmental aspect	Very good	Good	Good	Good
OVERALL EVALUATION	Very good	Very good – Good	Good	Good

45

10. Special Considerations on Possible Options

➢ Hydropower Expansion

The Victoria expansion is the most possible option. It is almost ready for construction, but the intake for the irrigation project is not determined.

➢ PSPP

It is free from draught risk, but it may be affected by fuel supply for pumping power from base load power plants.

➢ LNG IGCC

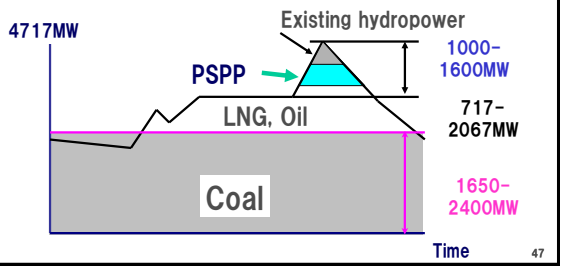
The JICA Study for Energy Diversification Enhancement Project (E/S) for the Construction of LNG Thermal is ongoing.

46

11. Combination of peaking supply in 2025

➢ (1) PSPP and Existing hydropower

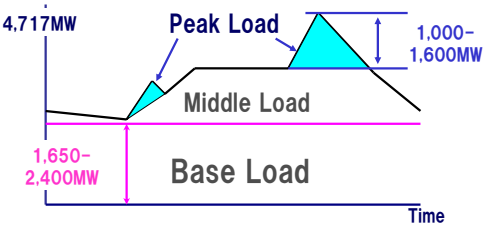
➢ (2) PSPP and LNG Combined Cycle



47

➢ Generation energy is assumed at 24,284 GWh.

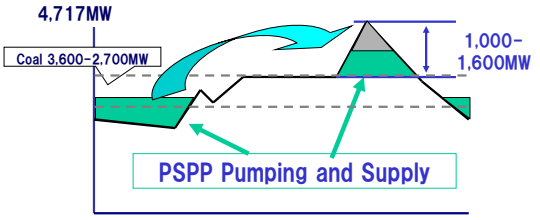
➢ Peak demand would be 4,717MW.



48

12 Additional values of PSPP

- PSPP has functions for peak power supply.
- It improves efficiency of base power supply.



49

- A variable speed PSPP can improve off-peak system stability. It can absorb system turbulence, during pumping operation by changing its pumping speed.
- PSPP can absorb surplus supply from unstable power sources such as wind and solar power generators.

50

13. Conclusions on Power Generation for Peak Power Demand

- Pumped Storage Power Plant (PSPP) is one of the suitable options to solve the peak power demand in 2025.
- The JICA Study Team hereafter starts site selection PSPP and its optimization.
- Combination Development of PSPP with Hydropower Expansion will contribute to stable supply of electricity and sustainable development in Sri Lanka.

51

14. Optimization Policy of Pumped Storage Power Project -Steps of Project

Project Stage	Environmental Consideration
MASTER PLAN	SEA
FEASIBILITY STUDY	EIA
DETAILED DESIGN	EMP
CONSTRUCTION	MONIRORING/ FOLLOW-UP
OPERATION	

52

14.1 Study stages

Stage1	・Selection of Suitable Power Generation Option for Peak Power Demand (1st SHM)
Stage2	・Study on 10 Candidate Sites of PSPP ・Review of Long Term Power Development Plan
Stage 3	・Selection of 3 Promising Sites (2nd SHM) ・Study on the 3 Candidates ・Selection of the Most Promising Site (3rd SHM)

53

14.2 Policy

(1) Procedure

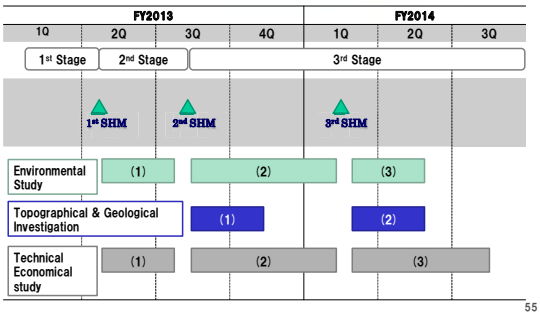
- To proceed to the next stage by forming consents to the results of the previous study in each SHM.

(2) Methodology

- To respect the Sri Lankan Laws and Regulations as well as the JICA's Guidelines.
- To examine the candidate sites from 1) Environmental aspects, 2) Technical Aspect, and 3) Economical aspects.
- To deepen the study level by a step-by-step approach.

54

14.3 General Schedule

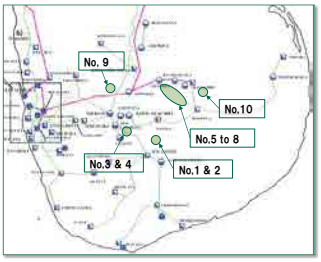


14.4 Criteria for Project Evaluation

Preliminary Design (main structure layout, reservoir capacity, acquired potential head, etc.) are identified on topographical maps (scale 1:50,000 or 1:10,000)) will be carried out and then the ranking study will be conducted from the following aspects:

Environmental Aspects	Laws and regulations Social environmental impacts Natural environmental impacts	→ Later explained
Technical Aspects	Topographical condition, Geological condition Hydrological Condition (Design Flood, Sedimentation) Construction Condition (Access, Temporary facility, etc.) Others (Operation, Distance from demand area, Project scale, relation to Transmission lines and substations, etc.)	
Economical Aspects	Construction cost per kW Benefit/Cost Economic IRR, Financial IRR	

14.5 Candidate Sites: (1) Location



NO.1 No.2	Kiriketi (2 candidates)
No.3 No.4	Maussakelle (2 candidates)
No.5 No.6 No.7 No.8	Halgran (4 candidates)
No.9	Maha (1 candidate)
No.10	Loggal (1 candidate)

Source: Study Formation Report by JICA in 2012

14.5 Candidate Sites: (2) General features

	Name	P (MW)	H (m)	Upper Pond V (MCM) A (km²)	Lower Pond V (MCM) A (km²)
NO.1 No.2	Kiriketi	500	780 -700	1.8-2.0 0.17-0.05	2.1-2.4 0.08-0.10
No.3 No.4	Maussakelle	500	490	3.4 0.4	3.9-4.3 0.24-0.25
No.5 No.6 No.7 No.8	Halgran	500	620 -870	2.0-3.9 0.13-0.22	2.3-5.9 0.13-0.25
No.9	Maha	500	500	2.0 0.18	5.0 0.20
No.10	Loggal	500	780	3.2 0.20	13.1 0.85

Source: Study Formation Report by JICA in 2012

Reference: Performance of PSPP as "Battery Device"

Item	Pumped Storage	Sodium-sulfur (NaS)	Redox Flow	Li-ion
Capacity	500 – 2,100MW (6-8hrs)	1MW (10hrs)	6MW (10hrs)	0.003MW (8hrs)
Efficiency	70 %	70 % (total)	70 % (total)	85 %
Cost	~1,000 USD/kW	2,000 USD/kW	2,500 USD/kW	–
Life Span	50 years	15 years	10 years	10 years
Merits	Large scale Technical maturity Long lifespan Cost	Dispersed placement Flexibility in charging and discharging	Dispersed placement Flexibility in charging and discharging	High efficiency Compactness Dispersed Placement Flexibility of charging and discharging
Demerits	Inflexibility in operation Depending on topological conditions	Temperature control (400℃) and sodium control are required.	Temperature control is required.	Using Li (rare metal) Expensive Complexity in control

15. Draft scoping items for the site selection

Strategic Environmental Assessment (SEA)

➢ SEA at the site selection stages.

➢ The important considerations are:

i. To equally consider environmental, social and economic aspects of the project;
ii. To conduct comparison examination of sites; and,
iii. To disclose information in a participatory manner.

➢ SEA steps at the site selection stage

2nd stage	2nd SEA: Site selection (10 sites)	July – Oct. 2013
	3rd SEA: Site selection (best 3 sites out of 10)	Nov. 2013 – Apr. 2014
	Last SEA: Site selection （the best site out of 3)	May – Jun. 2014

➢ Comments from SHM participants

Comments from SHM participants are collected as absolute requirements and/or priority requirements.

The followings are examples:

"XX site should be excluded because of the previous land disputes"

"a development plan is not allowed in an area where it is likely that endangered species occur"

"a development plan along XX road needs to be given high priority"

➢ Initial environmental study

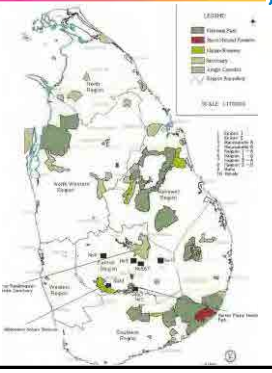
	Candidate site	Name of DS division
Jun. 11	Loggal	Meegahakiula
Jun. 12	Halgran	Walapane
Jun. 13	Maha	Ganga Ihala Korale Aranayaka
Jun. 18	Kiriketi	Imbulpe
Jun 19	Maussakelle	Ambagamuwa

Maussakelle / Ambagamuwa DS Division, June 19

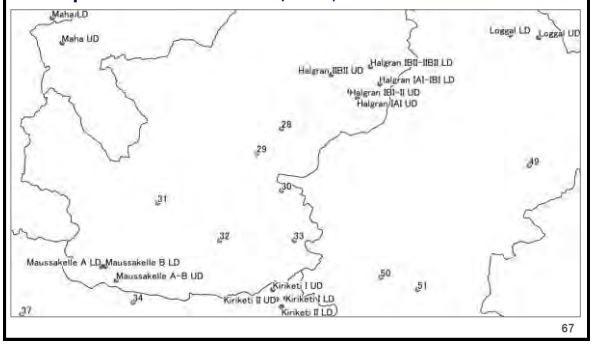
Candidate site	Present situation
Loggal (Kekale)	- Under construction of mini-hydropower plant - Mini-hydropower plan - No protected area - Tea plantation
Halgran	- Prone to landslides - Paddy cultivation - Tea plantation - Settlements - Shortage of water for paddies during dry season
Maha	- Tea plantation - Rock outcrops - Existing mini-hydropower plants
Kiriketi	- Water shortage during dry season - Natural forest - Tea plantation
Maussakelle	- Big waterfalls - Natural forest - Tea plantation

Natural environment	Impacts on fauna and flora	Inundated forest area
		Impacts on protected areas
		Impacts on endangered species (especially fish and other aquatic species)
Social environment	Impacts on local communities	Number of those who to be resettled
		Area of land to be appropriated
		Impacts on water utilization (e.g. drinking water)
		Impacts on utilization of forest and grassland
		Impacts on public facilities (e.g. school)
	Impacts on industries	Agriculture
		Forestry
		Tourism
	Impacts on cultural heritages	Religious and/or cultural facilities
		Impacts on landscape

Protected areas



Important Bird Areas (IBAs) and Candidate sites



67

Ramsar wetlands & Biosphere reserves and Candidate sites

68

Impacts on agriculture

Irrigation

Paddies

Tea plantation

69

Cultural heritages

Site	Properties	Registered year
1. Sacred City of Anuradhapura	Cultural heritage	1982
2. Ancient City of Polonnaruwa	Cultural heritage	1982
3. Ancient City of Sigiriya	Cultural heritage	1982
4. Sinharaja Forest Reserve	Natural heritage	1988
5. Sacred City of Kandy	Cultural heritage	1988
6. Old Town of Galle and its Fortifications	Cultural heritage	1988
7. Golden Temple of Dambulla	Cultural heritage	1991
8. Central Highlands of Sri Lanka	Natural heritage	2010

Source: UNESCO. 2012. http://whc.unesco.org/en/statesparties/lk (Accessed on 1 May 2012)

70

Are there any comments or suggestions for the scoping items?

1. …
2. …
3. …

E-mail address: cegp@ceb.lk, and Katsu_Hagihara@jpower.co.jp

71

Development Planning on Optimal Power Generation for Peak Power Demand

(Stake Holders Meeting- 2)

November 21, 2013

CEYLON ELECTRICITY BOARD Enrich Life through Power

JICA

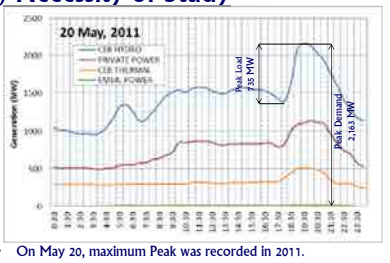
J-POWER

CONTENTS

Session I Introduction

1. Briefing of the Project
2. Present Progress of the Project
3. Points of Stake Holders Meeting-2

1-(1) Necessity of Study



- On May 20, maximum Peak was recorded in 2011.
- Peak Load was around 735MW.
- It was supplied by the Power Source of CEB Thermal (180 MW) Private Power (130 MW) and CEB Hydro (420 MW).

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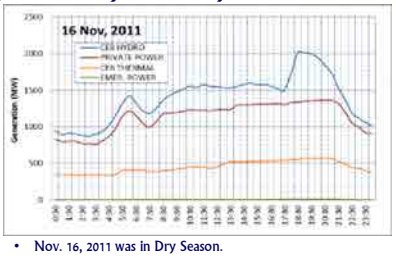
1-(1) Necessity of Study



- Nov. 16, 2011 was in Dry Season.
- CEB Thermal and Private Power was almost full capacity.
- CEB Hydro was 514MW for Peak Power Demand.

1-(2) Outline of Study

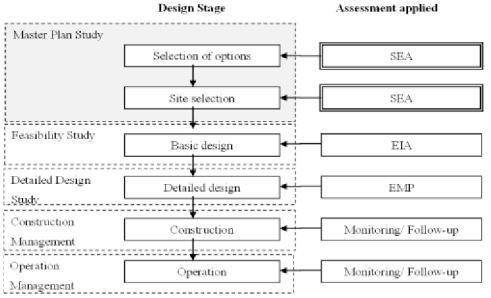
Stage 1: Initial Evaluation Stage
- March 2013 to June 2013
- JCC1: Inception Presentation
- Seminar: Pumped Storage
- SHM1: Option for Peak Power Demand

Stage 2: Formation of Power Development Plan for Peak Demand
- July 2013 to October 2013
- JCC2: Confirmation of Criteria for Site Selection
- Interim Report

Stage 3: Investigation on Candidate Sites for Peak Load Power Plants
- November 2013 to October 2014
- SHM2: Confirmation of Identified 3 Sites
- JCC3: Confirmation of Most Promising Site
- SHM3:Confirmation of Most Promising Site
- Pre-DF/R, DF/R and Final Report

1-(3) SEA Procedure for Master Plan Study

Strategic Environment Assessment



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1-(3) SEA Procedure for Master Plan Study

Key Points of SEA

- To equally consider environmental, social and economic aspects of the Project
- To conduct comparison examination of possible options
- To share information of the project in a participatory manner

2-(1) Progress of the Study

- March 2013: Commencement of the Study
- March 28, 2013: First Joint Coordinating Committee (JCC-1)@MOPE
  - Confirmation of scope and schedule of the Study
- April 9, 2013: Seminar on Power Generation for Peak Demand
  - Explanation on power generation for peak demand

Continued on the Next Page

2-(1) Progress of the Study

- June 27, 2013: First Stake Holders Meting (SHM-1)
  - Explanation on power generation options for peak power demand and forming consensus that Pumped Storage Power Plant is the optimal option
  - Screening method for from 11candidate sites for Pumped Storage Power Plant to 3 suitable sites
- September 25, 2013: JCC-2@MOPE
  - Forming Consensus on Evaluation Criteria

2-(2) Daily Load Curve Projection

As of 2011

- Peak Load (Ave) : 514 MW (28% of Peak Demand)
- Peak Load Period: 4 hours
- Minimum Demand: 1,000 MW (44% of Peak Demand) at 3:30

From LTGEP (2013 to 2032)

- Share of Coal thermal capacity: 60% of Generation Installed Capacity in 2025
- Minimum Operation Output of Coal Thermal Plant: 75%.
- Supply Capacity of CEB Hydro in 2025: 570 MW (420 MW + 150 MW UKHP)
- Generation Energy in 2025: 24,284 GWh.
- Peak Demand in 2025: 4,717MW

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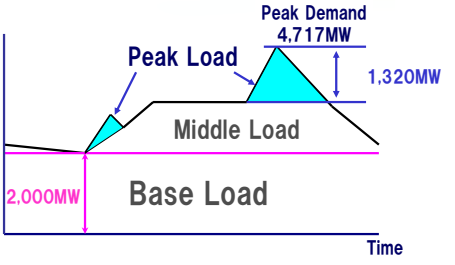
2-(2) Daily Load Curve Projection



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2-(2) Daily Load Curve Projection

Expected Power Generation for Peak Load

- Supposedly 1,320 MW (Average)
- Existing 570 MW + Victoria Expansion 228 MW + New Power Generation for Peak Load 522 MW

Expected Power Generation for Middle Load

- Supposedly 1,400 MW (Average)
- CEB Oil Fired Thermal + IPP + LNG CC

Expected Power Generation for Base Load

- Supposedly 2,000 MW (Average)
- CEB Coal Fired Thermal

13

2-(3) Options for Peak Power Demand

Options of Peak Power Generation

- Hydropower Plant (New Construction)
- Hydropower Plant (Expansion)
- Pumped Storage Power Plant
- Coal-Fired Thermal Power Plant
- LNG Combined Cycle Power Plant
- Gas Turbine Plant
- Diesel Plant
- Renewable Energy

Other Options for Peak Demand

- Independent Power Producer
- Demand Side Management
- Inter Connection with Indian System

Continued on the Next Page

14

2-(3) Options for Peak Power Demand

By Screening of Options in Sheet 14, Following Options are suitable for Peak Power Demand.

- Hydro Power Expansion
- Pumped Storage Power Plant
- LNG CC
- Demand Side Management
- Inter Connection with Indian System

Screening was done by considering perspective of;

- Adaptability to Load Change
- Economical Efficiency
- Environmental Aspect

15

2-(4) Most Practical Power Generation

Special Comment on Suitable Options for Determination of Most Practical Power Generation for Peak Power Demand

i. Hydro Power Expansion

- Victoria Expansion is an Option of Hydro Power Expansion.
- Its F/S and EIA have already prepared and are ready to implement.
- However, its Capacity is not enough for Peak Load in 2025.

ii. Pumped Storage Power Plant

- Sri Lanka has many Suitable Sites for PSPP.
- It can have big enough capacity for Peak Load in 2025.

Continued on the Next Page

16

2-(4) Most Practical Power Generation

iii. LNG CC

- Available for Peak Power Load
- For its Economic Efficiency, It should be used for Middle Load
- Its Development Schedule has still uncertainty

iv. Demand Side Management

- Peak Demand comes from Domestic Use that cannot be shifted except introducing Battery System
- Hourly Electricity Tariff may not be applied

v. Inter Connection with Indian System

- No merit for Peak Power Load because of Same Peak in India
- Substantial merit for power stability

Continued on the Next Page

17

2-(4) Most Practical Power Generation

As a result of Selection of Options

Optimal Power Generation for Peak Power Demand is:

Combination of Victoria Expansion and Pumped Storage Power Plant

- Victoria Expansion (228MW) for Demand in 2020
- Pumped Storage Power Plant for Demand in 2025

18

2-(5) Special Merits of Pumped Storage Power Plant

- Free from Drought Risk
- Enabling coal fired power plants to operate continuously at high efficiency level
- Absorption of Surplus Supply from Unstable Power Sources such as Wind and Solar Power Generators.
- Improvement of Off-peak System Stability in case a Variable Speed PSPP Applied.

19

2-(6) Outline of PSPP Planning

- 11 Candidates Sites
- Plant Capacity 600 MW
- Generating hours per day 6 hours

and

- Unit Capacity 200 MW * 3 units (as Base Plan)
- Unit Capacity 150 MW * 4 units (additonal Plan)

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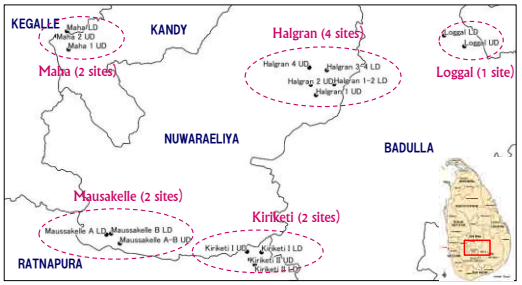
20

2-(6) Outline of PSPP Planning
Location of 11 candidates sites



21

2-(6) Outline of PSPP Planning
General Features of 11 Candidates Sites

		Kir 1	Kir 2	Mau A	Mau B	Hal 1	Hal 2
UD reservoir capa.	MCM	1.9	0.9	3.6	3.7	2.8	2.3
LD reseroivr capa.	MCM	1.5	0.7	3.7	3.5	2.9	2.3
Discharge (generating)	m³/s	108	98	156	155	125	106
Gross Head	m	700	770	474	488	606	715
Installed capa.	MW	600	600	600	600	600	600
Generating hours	hrs	3.80	2.52	6.42	6.28	6.19	6.11
Upper Dam H*L	m	40*250	85*300 +S200	40*1200 +S1,000	40*1200	85*250	120*500
Lower Dam H*L	m	95*320	75*270	60*300	55*350	85*420	85*420
Waterway Length	m	2,830	1,630	3,290	2,540	4,370	4,460

Kir; Kiriketi, Mau; Mausakelle, Hal; Halgran, S; Saddle Dam

Continued on the Next Page

22

2-(6) Outline of PSPP Planning
General Features of 11 Candidates Sites

		Hal 3	Hal 4	Mah 1	Mah 2	Log
UD reservoir capa.	MCM	2.4	3.4	3.7	3.7	3.1
LD reservoir capa.	MCM	2.5	3.4	3.4	3.6	2.8
Discharge (generating)	m³/s	110	155	155	166	128
Gross Head	m	692	490	489	458	591
Installed capa.	MW	600	600	600	600	600
Generating hours	hrs	6.05	6.10	6.03	6.09	6.16
Upper Dam H*L	m	60*200	90*550	55*200	80*310	45*220
Lower Dam H*L	m	70*220	75*290	80*360	80*360	80*540
Waterway Length	m	4,790	3,360	3,360	2,410	4,090

Hal; Halgran, Mah; Maha, Log; Loggal

23

2-(7) Criteria for Civil Works

- **Geological conditions**
  for example;
  - strength of foundation rock
  - water tightness
  - major faults
  - thickness depositions on river beds at dams' axises
  - slope stability around reservoirs

  …etc.

So far, no serious geological problems are identified in candidates sites

24

2-(7) Criteria for Civil Works

- **Ease of construction works**

evaluated by accessibility to candidates site

So far, following sites have accessibility problems

- *Kiriketi 1 Upper Dam*
- *Kiriketi 2 Upper Dam*
- *Mausakelle A, B Upper Dam*
- *Halgran 1 Upper Dam*
- *Halgran 4 Upper Dam*

Continued on the Next Page

25

2-(7) Criteria for Civil Works

- **Drawdown depth of reservoirs**

- Water level moves from Maximum water level to minimum water level basically once a day
- Large drawdown depth may induce slope instability around reservoir
- Generally, maximum drawdown level is set within around 30 m

Identified problems in terms of Drawdown depth:

Kiriketi 2 Upper Dam 38 m

Halgran 4 Upper Dam 52 m

26

2-(8) Criteria for Electromechanical Works

- **Manufacturing Limitation Pump-Turbines**

Due to stability of the power grid system in case of unit trip, …etc.

unit capacity (MW) limited to ***less than 200 MW per unit***

Generally

- high head and small discharge → small turbine
- low head and large discharge → large turbine

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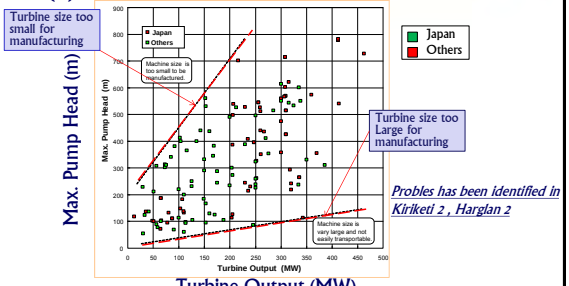
27

2-(8) Criteria for Electromechanical Works



Turbine Output (MW)

In actual study, Dimension of Turbine, Specific pump speed, etc. are studied at every candidates

28

2-(9) Economic Evaluation

Project cost calculation

- JICA Hydropower Development Guide Manual 2011
- Layout on 1:10,000 topographic map
- Civil Works: unit prices of similar works in Sri Lanka (Upper Kotmale HPP, Umaoya HPP, etc. Some of items referring from other countries)
- Electro-mechanical Works: international prices

Including land acquisition and compensation, environmental mitigation, design and engineering services, contingency, etc. and all of those are on standard basis

Economy of every project is evaluated by "Cost per kW"

29

2-(10) Environmental Study

The following table was presented at the 1st SHM, and the Environmental Study (1) has been conducted to study these items at the 11 candidate sites.

Natural environment	Impacts on fauna and flora	Inundated forest area
		Impacts on protected areas
		Impacts on endangered species (especially fish and other aquatic species)
		Risk of landslide*
Social environment	Impacts on local communities	Number of those who to be resettled
		Area of land to be acquired
		Impacts on water utilization (e.g. drinking water, irrigation)
		Impacts on utilization of forest and grassland
		Impacts on public facilities (e.g. school)
	Impacts on industries	Agriculture
		Forestry
		Tourism
	Impacts on cultural heritages	Religious, cultural and/or archeological facilities
		Impacts on landscape

Continued on the Next Page

30

2-(10) Environmental Study

The survey items requested by the participants of the 1st SHM.

1) Protected areas

The candidate sites within the protected area are excluded.

2) Aquatic species (e.g. fresh-water crabs and fresh-water fishes)

They have been surveyed.

3) Transmission lines

It will be considered in the next stage.

Continued on the Next Page

31

2-(10) Environmental Study

1) Environmental Study (1) was undertaken at the 11 candidate sites to collect information on the scoping items.

2) The Environmental Study (1) was conducted by the University of Peradeniya, headed by Prof. Hennayake.

3) Draft Final Report of the study was submitted by end of September 2013, and the findings in the Environmental Study (1) was briefly reported by Prof. Hennayake at CEB.

Continued on the Next Page

32

2-(10) Environmental Study

(2) Methodology

a) Based on the information (existing data, and collected data by brief site surveys), firstly the Sri Lankan experts examined the scale of expected impacts and gave ratings.

b) The following ratings were given to each point:

0: No negative impact, 1: small negative impacts, 2: medium negative impacts, and 3: large negative impacts.

c) Finally the JICA Study Team examined the results.

33

2-(11) Summary of Project Evaluation

sample form of project evaluation

Criteria		Rating	Allocation	Score
1. Technical Evaluation sub-total				
1.1	Geological Aspect			
1.2	Ease of construction works			
1.3	Manufacturing Limitation			
2. Economical Evaluation sub-total				
3. Environmental Evaluation sub-total				
3.1	Impact on fauna and flora			
3.2	Impact on local communities			
3.3	Impact on industries			
3.4	Impact on cultural heritages			
Total Score				

34

3 Points of Stake Holders Meeting-2

- Confirmation of 3 Promising Candidate Sites
  - Hearing of Opinions about 3 Promising Sites
  - Hearing of Weighing Method for Evaluation
- Selection of Most Promising Candidate Site
  - Hearing of Evaluation Method
  - Hearing of Priority and/or absolute Condition for site selection

35

Section II

4. Primary Screening Result (from 11 sites to 3 promising sites)

1) First screening
2) Evaluation from Geological Aspects
3) Evaluation from Ease of construction works
4) Manufacturing Limitation of Pump Turbine
5) Construction cost
6) Evaluation from Natural and Social Environmental Aspect

---

7) Ranking of Candidate sites by even evaluation
8) Ranking of Candidates sites by Environment weighed evaluation
9) Selection of 3 Promising sites
10) Discussion

5. Briefing of 3 sites

36

1) First Screening

◆ Pumped Storage Planning

- 11 Candidates Sites
- Plant Capacity 600 MW
- Generating hours per day 6 hours

and

- Unit Capacity 200 MW * 3 units (as Base Plan)
- Unit Capacity 150 MW * 4 units (additional Plan)

37

1) First Screening

Evaluated by two issues

1. "Out of manufacturing limit for 200 MW/unit pump-turbine",
2. Location related with "Sanctuary"

Eliminating candidates sites having applied two issues

Because if a candidate site falls into these two issues, it cannot be realized.

38

1) First Screening

"Out of manufacturing limit for 200 MW/unit pump-turbine"

Power System stability in 2025 → 150 MW/unit applicable
Power System stability in 2031 → 200 MW/unit applicable

↓

Examining manufacturing limitation of Pump Turbine; for 150 MW /unit and 200 MW/unit

↓

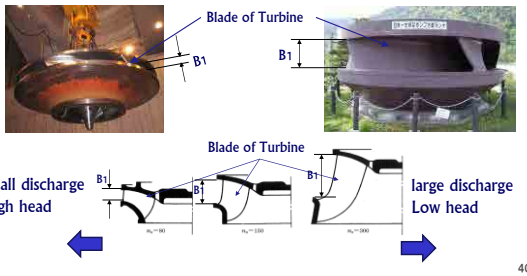
Kitiketi 2 (770m*) and Halgran 2 (715m*) → "out of manufacturing limitation" (*: Gross head)

Refer to the slide 28

39

1) First Screening

manufacturing limitation of Pump-turbine



40

1) First Screening

◆ **Location related with Sanctuary**

Development actions are not permitted within sanctuaries.

Candidate sites having their Upper and/or Lower reservoirs in sanctuaries.

→Kiriketi 1, Kiriketi 2, Maussakelle A, Maussakelle B

41

1) First Screening

Results

Candidate sites to be eliminated 4 sites

◆Out of Manufacturing Limitation of Pump-turbine
- Kiriketi 2
- Halgran 2

◆Located within Sanctuary
- Kiriketi 1 (Peak Wildness Sanctuary)
- Kiriketi 2 (Peak Wildness Sanctuary)
- Maussakelle A (Peak Wildness Sanctuary)
- Maussakelle B (Peak Wildness Sanctuary)

Halgran 1, Halgran 3, Halgran 4, Maha 1, Maha 2, and Loggal, total six candidate sites → Selecting → Three promising candidates sites

42

2) Evaluation from Geological aspects

Rating
- A Not likely to have major problems or limited, if any
- B Likely to have some problems
- C Expected to have some major problems

	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Logal
Strength	B	B	A	B	B	A
Impermeability	A	B	B	B	B	A
Faults	B	B	B	B	B	A
Riverbed Deposit	A	A	A	A	A	B
Slope	B	A	B	B	B	A
Overall evaluation	B	B	B	B	B	B

Evaluation were done by literatures, site reconnaissance, etc.

43

3) Evaluation from Ease of Construction aspects

Rating
- A Not likely to have major problems or limited, if any
- B Likely to have some problems
- C Expected to have some major problems

	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Logal
Access to Upper Dam	C	B	C	A	A	A
Access to Lower Dam	B	B	B	A	A	B
Temporary Yards	C	A	C	A	A	A
Others						
(Drawdown depth)			C			
(Access Tun. to PH)				A		
Overall Evaluation	C	B	C	A	A	B

44

4) Manufacturing limitation of Pump-turbine

Rating
- A 150 MW/unit and 200 MW/unit applicable
- B Only 200 MW/unit applicable
- C 200 MW/unit not applicable

	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Logal
Overall Evaluation	B	B	A	A	A	A

45

5) Evaluation from Construction cost

Rating
- A Less than 1,200 USD/kW
- B 1,200 – 1,400 USD/kW
- C More than 1,400 USD/kW

	unit	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Loggal
Construction Cost	USD/kW	1,335	1,042	1,414	1,094	1,216	1,280
Evaluation		B	A	C	A	B	B

Note;
- Cost for 600MW Pumped Storage Projects (for example, 800 -1,000 USD/kW for more than 1,000 kW class PSPP in South-west & South-east Asian countries)
- Interest during construction cost not included
- Construction Cost for Transmission lines not included
- Calculated based on JICA Hydropower Development Manual
- Level of construction costs would be less than conventional hydropower plants because of their scale merits, …etc.

46

5) Evaluation from Construction cost

Reference

$$P(kw) = g(m/s^2) \times \eta t \times \eta g \times Q(m^3/s) \times H(m)$$

	Conventional Hydro	Pumped Storage Power
Q	Large river flow preferable; - Broad catchment area (downstream area) - Plenty of precipitation	Large river flow not needed (determined by only capacities of upper/lower reservoir)
H	High potential energy is preferable - steep riverbed (upstream area), or - a long waterway or a high dam	Same or rather sever than the conventional; however, - (comparatively) easier to use a high potential between two different basins
(storage)	for annual regulation; a large dam and reservoir	For daily operation; two small dams

Flexibility for pumped storage projects planning makes large output (kW) easier than conventional hydropower projects, which contributes to find cost effective projects ; lower cost/kW.

47

4-6) Evaluation from Natural and Social Environmental Aspects

Site / Evaluation Items	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Loggal
Impacts on fauna and flora	B	B	B	B	B	B
Impacts on local communities	B	B	B	C	B	B
Impacts on industries	B	B	B	B	B	B
Impacts on culture and landscape	A	A	A	A	A	B

48

4-6) Evaluation from Natural and Social Environmental Aspects

Natural environment: Impacts on fauna and flora

- All sites are similar to each other. Ratings are all "B".
- Biodiversity and species richness are low to high.
- Several upper and/or lower dams have a few endangered species.

49

4-6) Evaluation from Natural and Social Environmental Aspects

Social environment: Impacts on local communities

- All sites are similar to each other (Rating "B") except for Maha 1.
- Maha 1

  There are 76 houses in the upper dam/reservoir site of Maha 1 (Rating "C").

50

4-6) Evaluation from Natural and Social Environmental Aspects

Social environment: Impacts on industries

- All sites are similar to each other (Rating "B").
- Agriculture is mainly considered.

  Tea plantations, home gardens and paddy fields. The biggest area is 50 ha (tea plantation at Maha 1 upper). Others are less than 30 ha.

51

4-6) Evaluation from Natural and Social Environmental Aspects

Social environment: Impacts on culture and landscape

- All sites are similar to each other (Rating "A") except for Loggal.
- Loggal

  There is a Buddhist temple in each upper and lower reservoir (Rating "B").

52

4-6) Evaluation from Natural and Social Environmental Aspects

Site / Evaluation Items	Halgran 1	Halgran 3	Halgran 4	Maha 1	Maha 2	Loggal
Impacts on fauna and flora	B	B	B	B	B	B
Impacts on local communities	B	B	B	C	B	B
Impacts on industries	B	B	B	B	B	B
Impacts on culture and landscape	A	A	A	A	A	B

53

Sample form of score calculation
…Before ranking of candidate sites

Criteria		Rating	Score allocation	Score
1. Technical Evaluation sub-total		--	25	15.75
1.1	Geological Aspect	A (1.0)	7.5	7.5
1.2	Ease of construction works	C (0.3)	7.5	2.25
1.3	Manufacturing Limitation	B (0.6)	10	6
2. Economical Evaluation sub-total		B (0.6)	25	15
3. Environmental Evaluation sub-total		--	50	37.2
3.1	Impact on fauna and flora	B (0.6)	12	7.2
3.2	Impact on local communities	B (0.6)	20	12
3.3	Impact on industries	A (1.0)	9	9
3.4	Impact on cultural and landscape	A (1.0)	9	9
Total Score		--	100	67.95

54

7) Ranking of Candidate Sites (Even evaluation case)

Criteria	Score allocation	Halgran 1		Halgran 3		Halgran 4		Maha 1		Maha 2		Loggal	
		Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score
1. Technical Evaluation	25		12.75		15.00		16.75		22.00		22.00		19.00
1.1 Geological aspects	7.5	B	4.50	B	4.50	B	4.50	B	4.50	B	4.50	B	4.50
1.2 Ease of construction works	7.5	C	2.25	B	4.50	C	2.25	A	7.50	A	7.50	B	4.50
1.3 Manufacturing Limitation	10	B	6.00	B	6.00	A	10.00	A	10.00	A	10.00	A	10.00
2. Economical Evaluation	25	B	15.00	A	25.00	C	7.50	A	25.00	B	15.00	B	15.00
3. Environmental Evaluation	50		33.60		33.60		33.60		27.60		33.60		30.00
3.1 Impact on Fauna and Flora	12	B	7.20	B	7.20	B	7.20	B	7.20	B	7.20	B	7.20
3.2 Impact on local communities	20	B	12.00	B	12.00	B	12.00	C	6.00	B	12.00	B	12.00
3.3 Impact on industries	9	B	5.40	B	5.40	B	5.40	B	5.40	B	5.40	B	5.40
3.4 impact on cultural heritages	9	A	9.00	A	9.00	A	9.00	A	9.00	A	9.00	B	5.40
Total	100		61.35		73.60		57.85		74.60		70.60		64.00
Rank			5		2		6		1		3		4

55

7) Ranking of Candidate Sites (Even evaluation case 2)

Criteria	Score allocation	Halgran 1		Halgran 3		Halgran 4		Maha 1		Maha 2		Loggal	
		Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score
1. Technical Evaluation	25		12.75		15.00		16.75		22.00		22.00		19.00
1.1 Geological aspects	7.5	B	4.50	B	4.50	B	4.50	B	4.50	B	4.50	B	4.50
1.2 Ease of construction works	7.5	C	2.25	B	4.50	C	2.25	A	7.50	A	7.50	B	4.50
1.3 Manufacturing Limitation	10	B	6.00	B	6.00	A	10.00	A	10.00	A	10.00	A	10.00
2. Economical Evaluation	25	B	15.00	A	25.00	C	7.50	A	25.00	B	15.00	B	15.00
3. Environmental Evaluation	50		32.80		32.80		32.80		27.40		32.80		30.00
3.1 Impact on Fauna and Flora	18	B	10.80	B	10.80	B	10.80	B	10.80	B	10.80	B	10.80
3.2 Impact on local communities	18	B	10.80	B	10.80	B	10.80	C	5.40	B	10.80	B	10.80
3.3 Impact on industries	7	B	4.20	B	4.20	B	4.20	B	4.20	B	4.20	B	4.20
3.4 impact on culture and landscape	7	A	7.00	A	7.00	A	7.00	A	7.00	A	7.00	B	4.20
Total	100		60.55		72.80		57.05		74.40		69.80		64.00
Rank			5		2		6		1		3		4

56

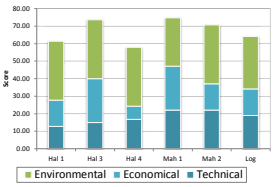
8) Ranking of Candidate Sites (Env. weighed case)

Criteria	Score allocation	Halgran 1		Halgran 3		Halgran 4		Maha 1		Maha 2		Loggal	
		Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score	Eva	Score
1. Technical Evaluation	15		7.65		9.00		10.05		13.20		13.20		11.40
1.1 Geological aspects	4.5	B	2.70	B	2.70	B	2.70	B	2.70	B	2.70	B	2.70
1.2 Ease of construction works	4.5	C	1.35	B	2.70	C	1.35	A	4.50	A	4.50	B	2.70
1.3 Manufacturing Limitation	6	B	3.60	B	3.60	A	6.00	A	6.00	A	6.00	A	6.00
2. Economical Evaluation	15	B	9.00	A	15.00	C	4.50	A	15.00	B	9.00	B	9.00
3. Environmental Evaluation	70		46.80		46.80		46.80		37.80		46.80		42.00
3.1 Impact on Fauna and Flora	16	B	9.60	B	9.60	B	9.60	B	9.60	B	9.60	B	9.60
3.2 Impact on local communities	30	B	18.00	B	18.00	B	18.00	C	9.00	B	18.00	B	18.00
3.3 Impact on industries	12	B	7.20	B	7.20	B	7.20	B	7.20	B	7.20	B	7.20
3.4 impact on culture and landscape	12	A	12.00	A	12.00	A	12.00	A	12.00	A	12.00	B	7.20
Total	100		63.45		70.80		61.35		66.00		69.00		62.40
Rank			4		1		6		3		2		5

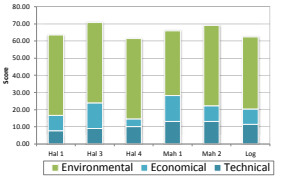
57

8) Ranking of Candidate Sites

Even case



Environment weighed case



58

9) Selection of Three promising sites

One site from one region, because…

- to avoid concentrating candidate site in one region
- if one is selected, others cannot be developed due to common reservoirs with neighboring sites (Halgran 3 and Halgran 4, Maha 1 and Maha 2)

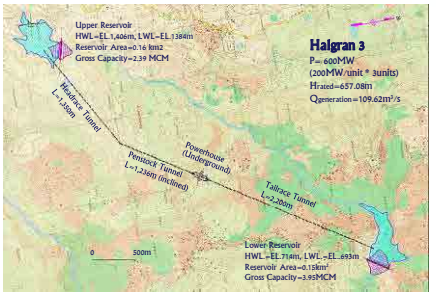
Sites Selection

- Halgran 3 is the best in Halgran region.
- Maha 1 is ascendant in the even evaluation; however it is reversed in the environmental weighed case. In Maha 1's upper reservoir area, the number of inundated houses is 76 houses; the largest in 6 candidate sites. Maha 2 is selected; ranking 3 in even case.
- Loggal is selected because …
  1) one candidate site from one region
  2) score difference to Halgran 1 is limited

Halgran 3, Maha 2, and Loggal is selected as three promising sites

59

5. Briefing of Promising Three Candidate Sites



60

5-1) Environments of Halgran 3

Upper dam/reservoir

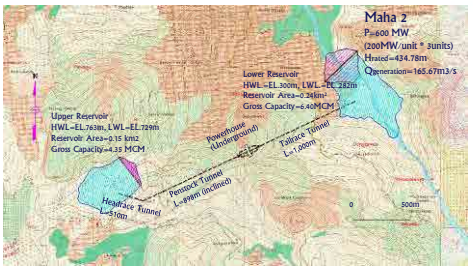

61

5-1) Environments of Halgran 3

Lower dam/reservoir


62

5. Briefing of Promising Three Candidate Sites



63

5-2) Environments of Maha 2

Upper dam/reservoir

64

5-2) Environments of Maha 2

Lower dam/reservoir


65

5. Briefing of Promising Three Candidate Sites

66

5-3) Environments of Loggal

Upper dam/reservoir


5-3) Environments of Loggal

Lower dam/reservoir


Section III

4. Methodology of Secondary Screening
(from 3 promising sites to the most promising sites)

1) Technical and Economical Aspects

2) Environmental Aspects from Results of Detailed Sites Survey

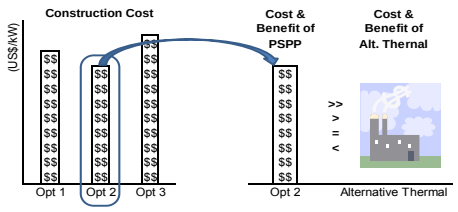
2) Assessment from Economic Aspects

By local Consultants,

- ◆Topographical survey in three candidates sites
- ◆Geological survey on the ground surface

For making three candidate sites
more accurate and attractive

1) Assessment from Economic Aspects



Step 1: Select lowest cost option among candidate sites

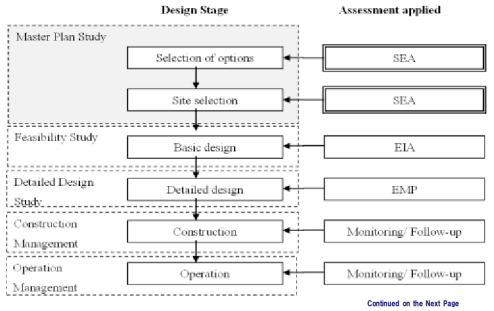
Step 2: Confirm economic efficieicy of selected PSPP over alternative thermal power

2) Economic Aspects
Cost-Benefit Analysis

- **Cost**
  - Capital cost: Construction, engineering, environment, land acquisition, compensation
  - OM cost
  - Electricity cost for pump-up by coal power
- **Benefit (Avoidable cost of thermal power)**
  - Capital cost of gas-turbine
  - OM cost
  - Fuel cost for generation

=> Assessment of economic efficiency by B-C, B/C, IRR

6-1) SEA Procedure for Master Plan Study

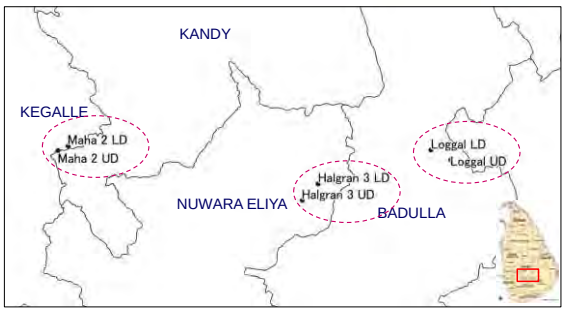


6-1) SEA Procedure for Master Plan Study

Key Points of SEA

- To equally consider environmental, social and economic aspects of the Project
- To conduct comparison examination of options
- To disclose information of the project in a participatory manner

6-1) Locations of the three promising sites



6-1) Hearings from GN Divisions

Date	Name of site	Name of GN Division	Divisional Secretariat	District
11th Nov.	Loggal Upper	Pitamaruwa	Meegahakiula	Badulla
	Loggal Lower	Kalugahakandura		
12th Nov.	Halgran 3 Upper	Morabedda Mantreehena	Walapane	Nuwara Eliya
	Halgran 3 Lower	Dambagolla Puranakumbura Denamure Hagama		
13th Nov.	Maha 2 Upper	Podape Narangala Pathithalawa	Aranayake	Kegalle
			Ganga Ihala Korale	Kandy
	Maha 2 Lower	Arama Deiyanwela	Aranayake	Kegalle
		Uduwella Watakedenya	Ganga Ihala Korale	Kandy

6-1) Hearings from GN Divisions

	Halgran 3 (5 GNs)	Maha 2 (6 GNs)	Loggal (2 GNs)
Opinions and concerns for the proposed project	➢ Request to hold consultation meetings when it is realized at the site with local authorities and communities ➢ Afraid of landslide. The local people have never experienced it, though.	➢ Request to hold consultation meetings when it is realized at the site with local authorities and communities. ➢ Compensation should be properly negotiated (lower). ➢ Afraid of landslide. They said that some small stones fell from the mountain (lower).	➢ The monk of Pitamadura (upper) suggested to hold consultation meetings with the local people. ➢ The local people basically do not like to relocate the Buddhist temple, because it is only the one in the area (lower).

6-1) Scoping for the three promising sites

Natural environment	Impacts on fauna and flora	Inundated forest area (including natural, secondary, plantation forests, and home garden)
		Impacts on faunal endangered species (including aquatic species)
		Impacts on floral endangered species (including aquatic species)
		Impacts on ecosystems
Social environment	Impacts on local communities	Number of those who to be resettled
		Area of land to be acquired
		Number of those who to be affected by losing livelihood
		Impacts on public facilities (e.g. school, road)
		Impacts on the poor people and minority
		Impacts on water utilization (e.g. drinking water, bathing, washing, irrigation, mini-hydropower plant) of rivers and wells
	Impacts on industries	Agriculture (including tree & rubber plantation)
		Tourism (e.g. water fall)
	Impacts on culture and landscape	Religious, and/or cultural facilities, burial ground
		Impacts on landscape

6-1) Environmental Study (2)

1) Environmental Study (2) will be conducted at the three promising sites to collect information on the scoping items by the University of Peradeniya.
2) The Study will start in December 2013 and finish in May 2014.

79

6-1) Information collection to identify one site from the environmental point of view

(1) Objective

To collect information on the three promising sites from the environmental aspects to identify the most promising site with less impacts on the environments.

(2) Methodology

a) Based on the information (existing data, and collected data by the field surveys), firstly the Sri Lankan experts examine the scale of expected impacts.

b) Secondly the JICA Study Team examines the results with other aspects (technical and economic aspects).

80

Opinions, comments or suggestions we need,

- Confirmation of 3 Promising Candidate Sites
  - about 3 promising sites
  - about applied method for evaluation and selection
- Selection of Most Promising Candidate Site
  - Evaluation Method
  - Priority and/or absolute Condition for site selection

81

Are there any comments or suggestions

1. …
2. …
3. …

E-mail address: cegp@ceb.lk, and
Katsu_Hagihara@jpower.co.jp

82

Development Planning on Optimal Power Generation for Peak Power Demand

(Stake Holders Meeting- 3)

May 27, 2014

CEYLON ELECTRICITY BOARD Enrich Life through Power

JICA

J-POWER

1

CONTENTS

2

Session I Review of the Study

1. Necessity of the Study
2. Progress of the Study to date
3. Review of Prior Stakeholders Meetings
4. Briefing of 3 Promising Sites of PSPP
5. Integrated Development of PSPP with CST & LNGCC

Notes
PSPP: Pumped Storage Power Plant
CST: Coal Steam Thermal
LNGCC: LNG Combined Cycle

3

I-1 Necessity of the Study

- On May 20, maximum Peak was recorded in 2011.
- Peak Load was around 735MW.
- It was supplied by the Power Source of CEB Thermal (180 MW) Private Power (130 MW) and CEB Hydro (420 MW).

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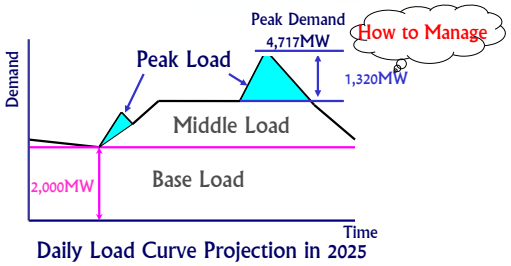
4

I-1 Necessity of the Study



Daily Load Curve Projection in 2025

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5

I-1 Necessity of the Study

Peak Load was supplied by;

a) Thermal Power ⇨ Expensive because of high price of petroleum fuel
b) Hydropower ⇨ Uncertain under the influence of precipitation level

Current Studies in practice in Energy Sector:

a) Reduction in Electricity Tariff ⇨ Coal Fired Steam Thermal
b) Diversification of Fuel to generate power ⇨ LNG Combined Cycle
c) Reliable and Economical Power for Peak Load ⇨ Pumped Storage

6

I-2 Progress of the Study to date

Stage 1: Initial Evaluation Stage
- March 2013 to June 2013
- JCC1: Inception Presentation
- Seminar: Pumped Storage
- SHM1: Option for Peak Power Demand

Stage 2: Formation of Power Development Plan for Peak Demand
- July 2013 to October 2013
- JCC2: Confirmation of Criteria for Site Selection
- Interim Report

Stage 3: Investigation on Candidate Sites for Peak Load Power Plants
- November 2013 to October 2014
- SHM2: Confirmation of Identified 3 Sites
- JCC3: Confirmation of Criteria for Most Promising Site Selection
- SHM3:Confirmation of Most Promising Site
- Pre-DF/R, DF/R and Final Report

Continued on the Next Page

7

I-2 Progress of the Study to date

Project Stage		Time Scale
Master Plan Stage	Selection of Options	June 27, 2013 SHM - 1
	Site Selection	May 27, 2014 SHM - 3
Feasibility Study Stage	Basic Design	2015 to 2017
Detailed Design Stage	Detailed Design	2018 to 2020
Construction Stage	Construction	2019 to 2025
Operation Stage	Operation	from 2025

8

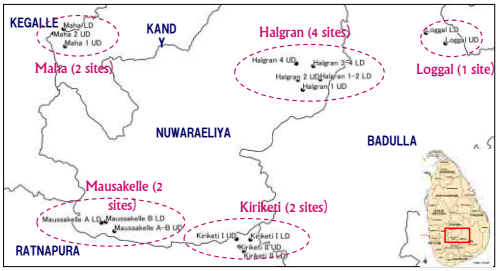
I-3 Review of Prior Stakeholders Meetings

- June 27, 2013: First Stakeholders Meting (SHM-1)
  - Among power generation options for peak power demand, it was confirmed that Pumped Storage Power Plant is the optimal option.
  - Selection method of 3 Promising Sites from 11 candidate sites for Pumped Storage Power Plant was accepted.
- November 21, 2013: Second Stakeholders Meeting (SHM-2)
  - Halgran 3, Maha 2, and Loggal were selected as 3 promising sites among 11 candidate sites from the environmental, technical & economical point of view.

9

I-4 Briefing of 3 Promising Sites of PSPP

Location of 11 candidates sites



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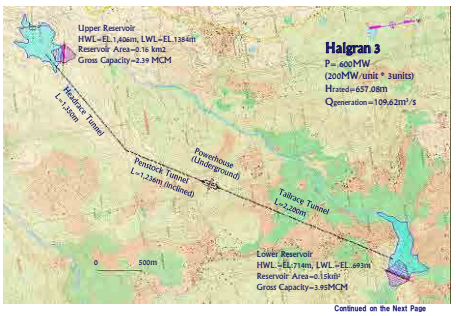
10

I-4 Briefing of 3 Promising Sites of PSPP



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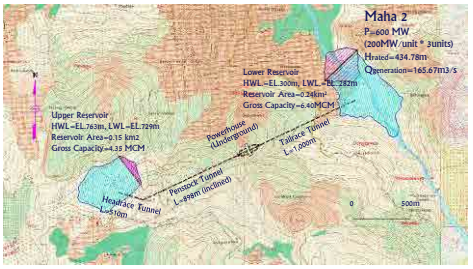
11

I-4 Briefing of 3 Promising Sites of PSPP



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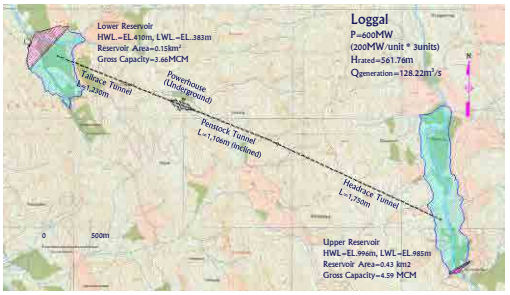
12

I-4 Briefing of 3 Promising Sites of PSPP



I-5 Integrated Development of PSPP with CST & LNGCC

- March 27, 2014, Joint Coordinating Committee Held at MOPE
  - Explained & confirmed on the criterion for the site selection.
  - MOPE requested to check the PSPP feasibility for other scenario of coal restricted cases.
- Study Team selected following cases in addition to Revised Base Case
  - Case 9: Coal limited around 60% from Total Generation
    (Plant Mix up to 2025)
    Coal; 2,600 MW, LNG; 750 MW (New Plants)
  - Case 7: No coal plants permitted after Trincomalee Development
    Coal; 2,000 MW, LNG; 1,250 MW (New Plants)

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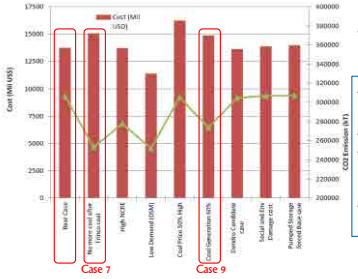
I-5 Integrated Development of PSPP with CST & LNGCC



This Figure is quoted from LTGEP 2013-2032.

Among Base case and LNG scenario cases in LTGEP;

- Base Case is least PV cost.
- Case 7 is highest PV cost, but lowest CO_2 emission case.
- Case 9 is high PV cost, but low CO_2 emission case.

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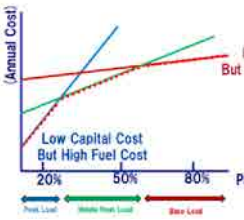
I-5 Integrated Development of PSPP with CST & LNGCC

- Conceptual Explanation of Best Mix of Power Sources



In General
PSPP & Gas Turbine for Peak Load
Combined Cycle for Middle Load
Coal Thermal for Base Load

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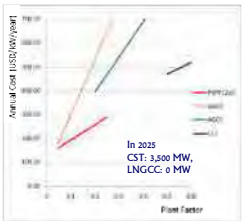
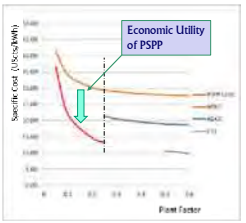
I-5 Integrated Development of PSPP with CST & LNGCC

- Annual Cost and Specific Cost in LTGEP Scenario Revised Base Case





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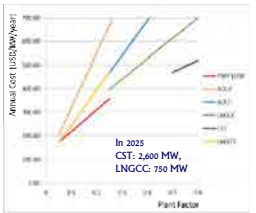
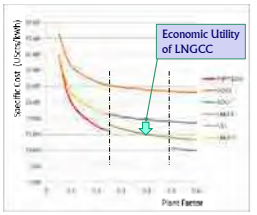
I-5 Integrated Development of PSPP with CST & LNGCC

- Annual Cost and Specific Cost in LNGCC Scenario Case 9
  (Coal Limited around 60% from Total Generation)





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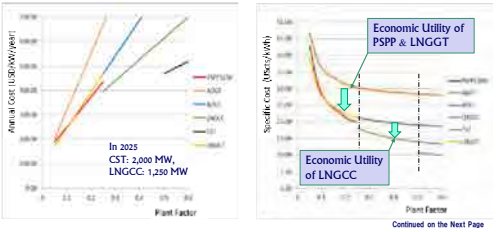
I-5 Integrated Development of PSPP with CST & LNGCC

- Annual Cost and Specific Cost in LNGCC Scenario Case 7
  (No Coal Plants permitted after Trinco Coal Case)



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19

I-5 Integrated Development of PSPP with CST & LNGCC

- Superiority of PSPP compared with other options for Peak Power Generation
  - Better Economical Efficiency as Peak Load Generation even in coal restricted cases
  - Stable Peak Power Generation free from Drought
  - Contribution to efficiency improvement of Base Load Generation
  - Contribution to Stability of Power System
  - Facilitation of Renewable Energy Development
  - Suitable as Stand-by Generator when system major outage

20

I-5 Integrated Development of PSPP with CST & LNGCC

Three Studies for New Power Generation using Japanese ODA Scheme are Ongoing:

- Coal Steam Thermal PP as a base load generation project for reduction of electricity tariff
- Pumped Storage PP as an optimal peak power generation for reduction of electricity tariff & stable electric system
- LNG Combined Cycle PP with LNG terminal for energy security, best mix of power sources & reduction of CO_2 emission in future

Continued on the Next Page

21

Development Planning on Optimal Power Generation for Peak Power Demand

Stake Holders Meeting- 3

Session II, III, IV

May 27, 2014

CEYLON ELECTRICITY BOARD Enrich Life through Power

JICA

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1

CONTENTS

2

II-1 Technical/Economic Evaluations

- Topographic and Geological Survey*1 (by Local Consultants)
- Review of Pumped Storage Project Planning
- Evaluation from Geological Aspects, Manufacturing Limitations
- Transmission Planning & Power System Analysis

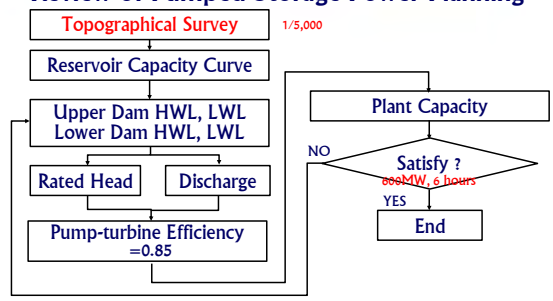
II-2 Environmental Evaluations

- Detailed Environmental Survey *2(by Local Consultants)
- Evaluations of 3 Promising Sites by the results of "Detailed Survey"

Note *1, *2;) In ***Loggal*** site, both of the survey works was suspended for a certain period due to protesting of local people, so that the topographic & geological surveys were canceled and some parts of the environmental surveys were also canceled.
In ***Maha 2 Upper dam*** site, some parts of the environmental surveys were canceled due to similar reasons.

3

Review of Pumped Storage Power Planning



4

Three Promising Candidate Sites

	Halgran 3	Maha 2		Maha 3		Loggal	
Location	Nuwara Eliya	Kandy, Kegalle		Kandy, Kegalle		Badulla	
Installed Capacity	600 MW	600 MW		600 MW		600 MW	
Unit Numbers	3	3	4	3	4	3	4
Unit Capacity	200 MW	200 MW	150 MW	200 MW	150 MW	200 MW	150 MW
Generating Hours	6 hours	6 hours		6 hour		6 hours	
Upper Dam	H70m*L210m	H80m*L250m		H61m*L275m		H42m*L220m	
Lower Dam	H75m*L280m	H71m*L350m		H68m*L350m		H76m*L540m	
Headrace Tun.	D4.9m*L1,350m	D6.0m*510m		D5.7m*L1,100m		D5.3m*1,750m	
Penstock Tun.	D3.8m*L1,212m	D4.7m*L885m		D4.4m*L979m		D4.1m*L1,106m	
Tailrace Tun.	D5.40*2,200m	D6.6m*1,000m		D6.2m*500m		D5.8m*L1,230m	

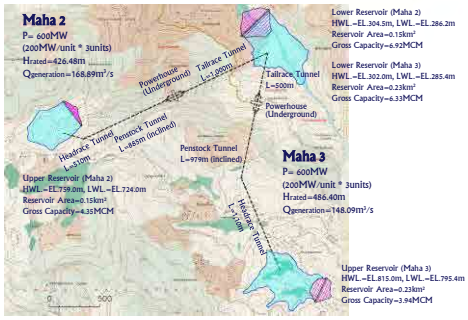
5

Three Promising Candidate Sites Location

6

Session II-1

Reviewed Maha Sites



7

Session II-1

Technical Evaluation

(1) Geological Aspect

Evaluated by results of *Geological survey (1)*

(2) Ease of Construction Works

Evaluate the ease of construction works on main civil works (Upper dam, Lower dam, Intake/Outlet structures, waterways, Powerhouse, etc.

8

Session II-1

Technical Criteria (cont.)

(3) Limitation of Pump-turbine Manufacturing

- Reviewed by revised specifications
- Applicability of 200 MW/unit 150MW/unit

(4) Stability of Power System

- Evaluated by Power System Analysis

9

Session II-1

Geological Aspects

Excellent, Good, Fair, Poor: A, B, C, D

Items	Halgran 3			Maha 2			Maha 3			Loggal		
	UD	LD	Route	UD	LD	Route	UD	LD	Route	UD	LD	Route
Rock Quality	B	C	B	A	B	B	B	B	B	A	B	B
Impermeability	C	C		B	B		B	B		B	B	
Faults	B	B	C	A	C	B	A	C	A	A	A	B
River bed Deposit	A	B		A	A		A	A		A	C	
Slope Sliding	A	C		A	C		B	C		A	B	
Direction			C			A			C			A
Overall Evaluation	C			A			B			C		

Evaluation on Loggal is made by the data of previous stage.

10

Session II-1

Evaluation from Ease of Construction Aspects

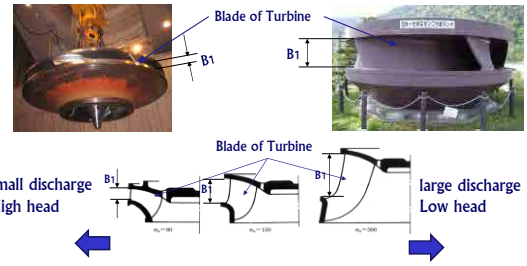
Easiness of works; A>B>C>D
Construction Cost; D>C>B>A

	Halgran 3	Maha 2	Maha 3	Loggal
Access to Upper Dam	C	B	A	B
Access to Lower Dam	B	B	B	C
Temporary Yards	B	B	B	B
Length of Access to PH	C	B	A	C
Drawdown depth	B	C	B	B
Overall Evaluation	C	B	A	C

11

Session II-1

Manufacturing limitation of Pump-turbine



12

Session II-1

Manufacturing limitation of Pump-turbine

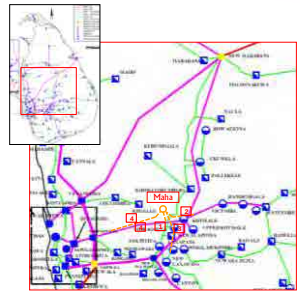
- Margin to the criteria; A>B>C, not applicable; D,
- for "Overall Evaluation" A; both applicable, C; only 200 MW applicable, D; both not applicable)

	Halgran 3	Maha 2	Maha 3	Loggal
200 MW/unit	B	A	A	A
150 MW/unit	D	A	A	B
Overall Evaluation	C	A	A	B

13

Session II-1

Transmission Line; Maha2 and Maha 3



1 To "Kotomale – Kirindiwela T/L" (PI Connection)

2 To "Kotomale PS"

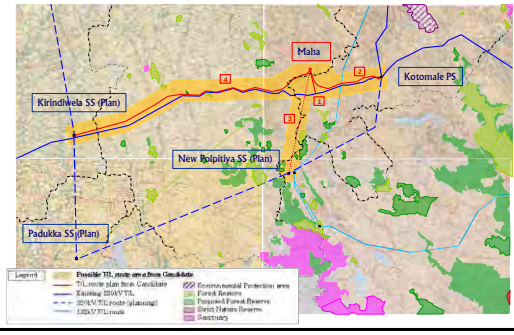
3 To "New Polpitiya SS"

4 To "Kirindiwela SS"

14

Session II-1

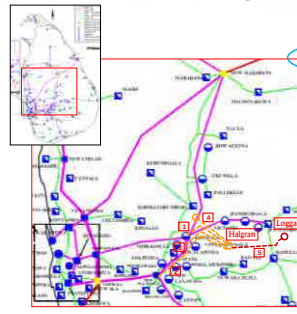
Transmission Line; Maha 2 and Maha 3



15

Session II-1

Transmission Line; Halgran 3 and Loggal



From "Halgran"

1 To "Kotomale PS"

2 To "New Polpitiya SS"

3 To "Existing T/L" near Kotomale PS (PI Connection)

4 To "New GS" near Kotomale PS

From "Loggal"

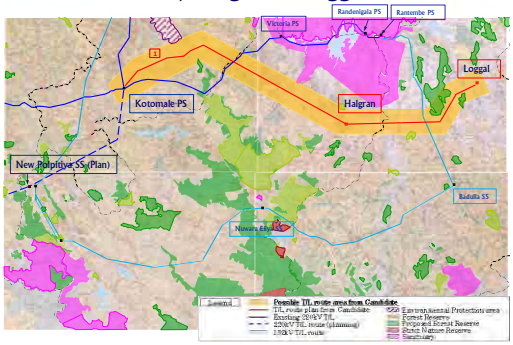
5 To "Kotomale PS" through "Halgran area" (T or PI Connection)

As for "Halgran area" to each connecting point, T/L routes are same as 1 to 4 of "Halgran" as above.

16

Session II-1

Transmission Line; Halgran 3 Loggal

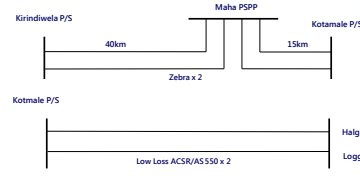


17

Session II-1

Power System Analysis; Conditions

Transmission Line



Generating & Loading Scenario

- Hydro Maximum Night Peak – Generating Operation
- Thermal Maximum Night Peak – Generating Operation
- Off Peak – Pumping Operation

18

Power System Analysis; Results

Margin for the criteria; A>B>C, less than the criteria: D

Items	Halgran 3	Maha 2	Maha 3	Loggal
Power Fault Analysis	A	B	B	A
Short Circuit Currents Analysis	A	A	A	A
Stability to 3-phase line fault	A	A	A	D
200 MW unit Trip	B	B	B	B
Overall Evaluation	A	B	B	D

Power fault analysis: No thermal criteria violation in N-1 but Maha 2 and Maha 3 margins are smaller Halgran and Loggal
Stability to 3-phase line fault: Unstable and Step out in Loggal due to rather long transmission line
200 MW unit Trip in off-peak: Stable and within 49.0 to 51.0 Hz

Economic Evaluation
Construction Cost

Power Plants: *1/5,000 topographic maps* → Review of PSPP Planning

Transmission Line: *1/50,000 maps* → Technical / Environmental → T/L routes → Distance of T/L

Review of PSPP Planning + Distance of T/L → Construction Cost

5) Evaluation from Construction cost

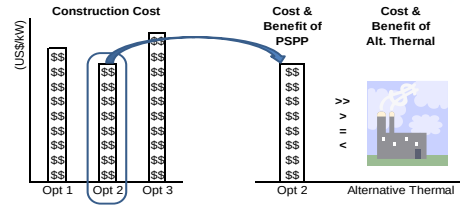
Rating

A Less than 1,200 USD/kW
B 1,200 - 1,300 USD/kW
C 1,300 – 1,400 USD/kW
D More than 1,400 USD/kW

	Unit	Halgran 3	Maha 2	Maha 3	Loggal
Construction Cost	MUSD	725	750	672	855
	USD/kW	1,209	1,251	1,120	1,425
Evaluation		B	B	A	D

Note;
- Cost for 600MW Pumped Storage Projects (for example, 800 -1,000 USD/kW for more than 1,000 kW class PSPP in South-west & South-east Asian countries)
- Interest during construction included
- Construction Cost for Transmission lines included
- Calculated based on JICA Hydropower Development Manual

Economic Analysis (for reference)



Step 1: Select lowest cost option among candidate sites

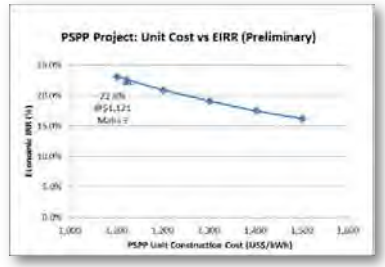
Step 2: Confirm economic efficieicy of selected PSPP over alternative thermal power

2) Economic Aspects
Cost-Benefit Analysis

- **Cost**
  - Capital cost: Construction, engineering, environment, land acquisition, compensation
  - OM cost
  - Electricity cost for pump-up by coal power
- **Benefit (Avoidable cost of thermal power)**
  - Capital cost of gas-turbine
  - OM cost
  - Fuel cost for generation

=> Assessment of economic efficiency by IRR

Economic Analysis (reference)



Session II-2

Environmental Evaluations

1) The Environmental Study (2) has been was conducted at the three (3) promising sites to collect information on the scoping items. The scoping items were presented at the 2nd SHM and agreed among the participants.
2) The Study has been undertaken by the University of Peradeniya, headed by Prof. Hennayake.
3) The results have been utilized by the JICA Study Team to compare the three candidate sites to select the most promising site.

25

Session II-2

Environmental Study (2); 3 Promising Sites

The following scoping table was presented at the 2nd SHM, and the Study has been conducted.

Natural environment	Impacts on fauna and flora	Inundated forest area (including natural, secondary, plantation forests, and home garden)
		Impacts on faunal endangered species (including aquatic species)
		Impacts on floral endangered species (including aquatic species)
		Impacts on ecosystems
Social environment	Impacts on local communities	Number of those who to be resettled
		Area of land to be acquired
		Number of those who to be affected by losing livelihood
		Impacts on public facilities (e.g. school, road)
		Impacts on the poor people and minority
		Impacts on water utilization (e.g. drinking water, bathing, washing, irrigation, mini-hydropower plant) of rivers and wells
	Impacts on industries	Agriculture (including tree & rubber plantation)
		Tourism (e.g. water fall)
	Impacts on culture and landscape	Religious, and/or cultural facilities, burial ground
		Impacts on landscape

26

Session II-2

Environmental Study (2); Transmission Line

An assessment on **the transmission lines** is conducted as part of the Study.

1) Alternative routes with buffer zones are selected by CEB and the transmission experts considering the following points.
   - To connect to the existing and planned facilities
   - To avoid major barriers (populated areas, major public facilities, cultural heritages)
   - To avoid protected areas, forest reserves and IBAs
2) The routes are assessed by the Study.

27

Session II-2

Evaluation from Environmental Aspects

Site / Evaluation Items		Halgran	Maha 2	Maha 3	Loggal
Impacts on fauna and flora	Forest area	C	D	D	C
	Endangered species (fauna)	D	D	D	D
	Endangered species (flora)	D	C	C	D
	Ecosystem	D	C	C	C
Impacts on local communities	Resettlement	B	D	C	C
	Acquired land	B	C	C	D
	Losing livelihood	D	D	C	C
	Public facilities	A	A	A	C
	Water utilization	C	D	D	D
Impacts on industries	Agriculture	A	C	C	D
	Tourism	A	A	A	A
Impacts on culture and landscape	Religious and cultural sites	A	C	C	C
	Landscape	A	B	B	A

28

Session II-2

Evaluation from Environmental Aspects

Natural environment

- Area of inundated forest at each site is relatively small.
- All sites have some endangered species. Halgran site has two Critically Endangered species.
- Biodiversity and species richness are moderate to high.
- All sites are outside of the protected areas (e.g. reserved forests and national parks).

29

Session II-2

Evaluation from Environmental Aspects

Social environment: Impacts on local communities

- Families to be resettled

  Halgran: 4 families; Maha 2: 45 families; Maha 3: 39 families; and 25 families
- Area to be acquired

  Halgran: 30 ha; Maha 2: 38 ha; Maha 3: 46 ha; and Loggal: 53 ha

30

Evaluation from Environmental Aspects

Social environment: Impacts on industries

- Agriculture land to be inundated

  Halgran: 19 ha; Maha 2: 32 ha; Maha 3: 39 ha; and Loggal 48 ha.

4-6) Evaluation from Environmental Aspects

Social environment: Impacts on culture and landscape

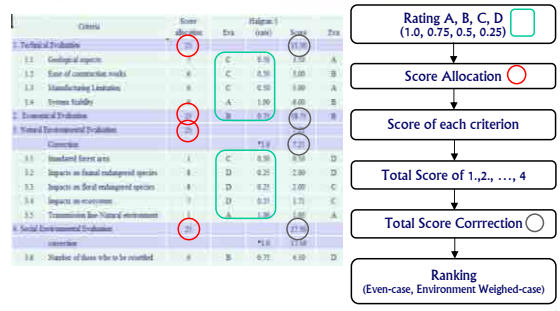
- All clusters have religious temples. They are not registered religious temples, but they are important for the local people.

4-6) Evaluation from Environmental Aspects

Transmission lines

- There are no major problems on their routes / buffer zones.

Overall Evaluation and Ranking for the Most Promising Site



7) Ranking of Candidate Sites

- Even case Tech. Econo.(1+2) : Env.(3+4)=50 : 50

	Score Allocation	Halgran 3	Maha 2	Maha 3	Loggal
1. Technical Evaluation	25.00	15.50	22.00	21.75	12.50
2. Economic Evaluation	25.00	18.75	18.75	25.00	6.25
3. Natural Environment	25.00	7.25	9.68	10.75	7.20
4. Social Environment	25.00	17.50	10.35	13.75	9.40
Total	100.00	59.00	60.78	71.25	35.35
Rank		**3**	**2**	**1**	**4**

7) Ranking of Candidate Sites

- Environmental weighed case (1+2) : (3+4)=30 : 70

	Score Allocation	Halgran 3	Maha 2	Maha 3	Loggal
1. Technical Evaluation	15.00	9.30	13.20	13.05	7.50
2. Economic Evaluation	15.00	11.25	11.25	15.00	3.75
3. Natural Environment	35.00	10.15	13.55	15.05	10.08
4. Social Environment	35.00	24.50	14.49	19.25	13.16
Total	100.00	55.20	52.49	62.35	34.49
Rank		**2**	**3**	**1**	**4**

Session III-1

8) Ranking of Candidate Sites, Environment Aspects

Environmental Evaluation-Even Natural : Social = 50 : 50

	Score Allocation	Halgran 3	Maha 2	Maha 3	Loggal
3. Natural Environment	25.00	7.25	9.68	10.75	7.20
4. Social Environment	25.00	17.50	10.35	13.75	9.40
Total	50.00	24.75	20.03	24.50	16.60
Rank		1	3	2	4

Environmental Evaluation - Natural : Social = 70:30

	Score Allocation	Halgran 3	Maha 2	Maha 3	Loggal
3. Natural Environment	35.00	10.15	13.55	15.05	10.08
4. Social Environment	15.00	10.50	6.21	8.25	5.64
Total	50.00	20.65	19.76	23.30	15.72
Rank		2	3	1	4

37

Session III-1

Environments of Maha 3 – upper site

38

Session III-1

Environments Maha 3 – upper site

39

Session III-1

Environments Maha 3 – lower site

40

Session III-1

Environments of Maha 2-3 – lower site

41

Session III-1

Environments of Maha 2-3 – lower site

42

Session III-2

…Next Phase of the Study

For the Most Promising Site,

1. Topographic Survey; Dams Area (1:1,000)
2. Geological Survey (Drilling Investigations at Upper dam and Lower dam)
3. Preliminary design by 1 to 1,000 topographic map
4. PI preparations
5. Draft Final Report (on August by the initial schedule)
6. Final Report (on October by the initial schedule)

43

Session IV

Overall Discussion & Conclusion

- Selection of Most Promising Candidate Site
  - Evaluation method applied
  - Evaluation results, etc.
- Confirmation of the Most Promising Site
- Suggestions for the next phase study

44

Session IV

Are there any comments or suggestions

1. …
2. …
3. …

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Katsu_Hagihara@jpower.co.jp

45

Trial Calculation of Contribution to Greenhouse Gas Reduction by Pumped Storage Power Project

1. Since Pumped Storage Power Plant (PSPP) needs power sources for pumping, the emission amount of CO_2 from PSPP is expressed as the summation of that by itself and by power plants for pumping energy. Consequently, the concept of life cycle CO_2 emission as eigenvalue index, which is commonly used for power generation option, seems unfit for PSPP, because CO_2 emission from PSPP is subject to the lineup of power plant of whole power supply system.

2. CO_2 emission from PSPP is expressed as follows;
(CO_2 emission of pumping energy) × (1/70%) + (indirect CO_2 emission from PSPP) – (contribution of PSPP to decreasing CO_2 emission)

3. The component of energy sources in 2025 (as a year for trial computation) is as following table from LTGEP 2013-2032;

Power Source	Annual Energy（GWh）	Component Ratio（%）
Major Hydro	4,692	19.3
Coal Thermal	17,731	73.0
Oil Thermal	233	1.0
Wind	869	3.6
Solar	153	0.6
Mini-hydro & Dendro	604	2.5
Total	24,282	100.0

4. Life Cycle CO_2 emission from each power source is tabulated as follows (source: CRIEPI News No. 468, August 2010);

Power Source	Direct Emission ($g\text{-}CO_2$/kWh)	Indirect Emission ($g\text{-}CO_2$/kWh)	Total ($g\text{-}CO_2$/kWh)
Hydro	0	11	11
Coal Thermal	864	79	943
Oil Thermal	695	43	738
Wind	0	25	25
Solar	0	53	53
LNG CC	376	98	474

5. Weighted average of CO_2 emission from whole power supply system can be calculated as 699 $g\text{-}CO_2$/kwh (assuming CO_2 emission from mini-hydro and dendro is same as hydro) from the tables in the Clause 3 and 4.

6. Assuming indirect emission of PSPP is same as hydro;
699 $g\text{-}CO_2$/kWh × 1/70% ＋ 11 $g\text{-}CO_2$/kWh － (contribution of PSPP to decreasing CO_2 emission)
= 1,010 $g\text{-}CO_2$/kWh － (contribution of PSPP to decreasing CO_2 emission)

7. That is, CO_2 emission of PSPP is evaluated as being equivalent or more than that of Coal Fired Thermal, in case that contribution of PSPP to decreasing CO_2 is not considered.

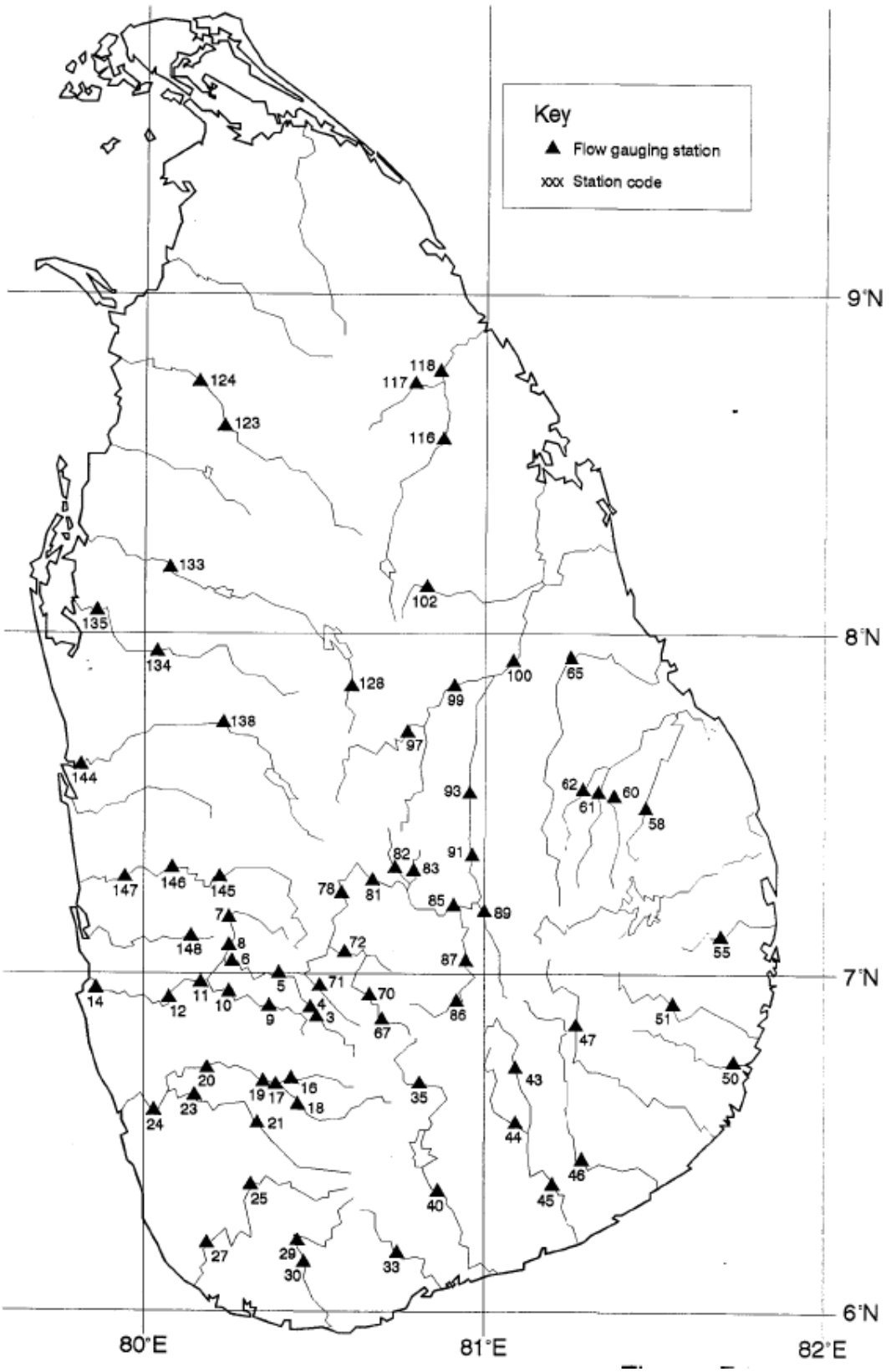
8. As contribution of PSPP to decreasing CO_2 emission, increment of wind power development by PSPP installation is considered, under the assumption that energy generated by wind power increment can replace that by coal thermal plant. CO_2 emission reduction is calculated as follows;
   1) Critical condition for wind power development is whether long period output fluctuation (zero-full) cause by wind power particularly in off-peak demand duration can be absorbed or not. In case of isolated Sri Lankan power system, it is usually contemplated that maximum capacity of wind powers installation is around 10% of the total system capacity.
   2) If PPSP is installed, long period output fluctuation having adverse impact to the power system as mentioned in the Clause 1) is absorbed by PPSP operation during off-peak demand.
   3) That is, if 600MW PSPP is installed, 600MW of wind powers can be developed other than 10% of the power system capacity.
   4) If the off peak power system capacity in 2025 is assumed as 2,000MW, maximum capacity of wind powers to be installed is 800MW (2,000MW×10%＋600MW). Since wind power capacity planned already is 310MW according to the table in the Clause 3, another 490 MW wind powers can be developed.
   5) Assuming plant factor of wind power as 20% and that of coal thermal 80%, 490MW wind power is equivalent to 122MW (490MW × 20% / 80%) coal thermal in respect of energy generation. This means the 600MW PSPP can replace 122MW coal thermal with 490 MW wind power in 2025.
   6) Deduction of CO_2 emission by this replacement can be considered as contribution of PSPP to decreasing CO_2 emission which is expressed as follows (assuming plant factor of PSPP as 25%);.

   (943 g-CO_2/kWh × 122MW×80% – 25 g-CO_2/kWh × 490MW × 20%) / (600 MW × 25 %) = 597 g-CO_2/kWh

9. Hence, CO_2 emission is calculated again by the formula in the Clause 2;
   699 g-CO_2/kWh × (1/ 70%) + 11 g-CO_2/kWh – 597 g-CO_2/kWh = 413 g-CO_2/kWh

10. If the value calculated in the Clause 9 can be regarded as basic unit of CO_2 emission in 2025, it is judged that CO_2 emission by PPSP is equivalent to that of LNG CC (474 g-CO_2/kWh) as a quantitative evaluation result including contribution of PSPP to decreasing CO_2 emission.

River Flow Gauging Stations in Sri Lanka



Station code	Name	No. years	Latitude (°N)	Longitude (°E)	MAF (m^3/s)	AREA (km^2)	AAR (mm)
SRI003	Maskeli Oya at Mausakele	19	06:52:30	80:31:30	347	122	2820
SRI004	Maskeli Oya at Laxapana	12	06:53:10	80:31:05	274	154	3170
SRI005	Kelani Ganga at Kitulgala	40	06:59:30	80:24:45	706	383	3670
SRI006	Kelani Ganga at Matiyadola	33	07:01:34	80:16:26	802	606	3930
SRI007	Gurugoda Oya at Holombuwa	18	07:11:35	80:15:45	224	155	3330
SRI008	Gurugoda Oya at Imbulanala	26	07:03:47	80:15:40	343	329	3420
SRI009	Sitawaka Ganga at Deraniyagala	28	06:55:15	80:20:40	332	154	4950
SRI010	Sitawaka Ganga at Algoda	16	06:56:55	80:15:40	634	344	4620
SRI011	Kelani Ganga at Glencourse	39	06:58:30	80:10:51	1708	1463	4060
SRI012	Kelani Ganga at Hanwella	14	06:54:36	80:05:00	1603	1782	3840
SRI014	Kelani Ganga at Nagalagam Street	33	06:57:30	79:52:30	1314	2085	3940
SRI016	Kalu Ganga at Malwala	24	06:41:15	80:25:24	759	329	4420
SRI017	Kalu Ganga at Ratnapura	12	06:40:36	80:24:18	407	604	3420
SRI018	Wey Ganga at Dela	31	06:37:20	80:27:10	133	220	2720
SRI019	Kalu Ganga at Nambapana	22	06:41:11	80:23:05	499	629	3740
SRI020	Kalu Ganga at Ellagawa	32	06:43:52	80:13:00	674	1393	4010
SRI021	Kukule Ganga at Kukulegama	9	06:33:48	80:19:48	403	334	3280
SRI023	Kuda Ganga at Millakanda	27	06:37:25	80:10:25	438	769	4230
SRI024	Kalu Ganga at Putupaula	41	06:36:40	80:03:55	1073	2598	3970
SRI025	Gin Ganga at Tawalama	13	06:20:30	80:19:48	726	377	3910
SRI027	Gin Ganga at Agaliya	53	06:11:15	80:11:45	369	681	3850
SRI029	Nilwala Ganga at Pitabeddhara	14	06:12:42	80:29:00	208	333	3400
SRI030	Nilwala Ganga at Bopagoda	44	06:09:20	80:29:05	328	411	3360
SRI033	Urubokka Oya at Julampitiya	11	06:11:10	80:44:40	73	141	2510
SRI035	Walawe Ganga at Samanalawewa	18	06:40:30	80:48:05	527	337	2860
SRI040	Walawe Ganga at Embilipitiya	22	06:20:40	80:53:55	892	1580	2190
SRI043	Kirindi Oya at Wellawewa	29	06:43:55	81:06:25	140	159	2300
SRI044	Kuda Oya at Kuda Oya	21	06:31:30	81:07:24	543	291	1780
SRI045	Kirindi Oya at Lunuganwehera	25	06:21:40	81:13:10	560	913	1830
SRI046	Menik Ganga at Kataragama	37	06:25:25	81:19:45	335	787	1710
SRI047	Kumbukkan Oya at Nakkala	14	06:53:18	81:17:48	99	216	1390
SRI050	Wila Oya at Wedagama	9	06:45:42	81:44:36	221	404	1730
SRI051	Heda Oya at Siyambalanduwa	28	06:54:20	81:32:40	148	295	2080
SRI055	Pannal Oya at Thottama	13	07:06:30	81:41:25	168	95	1880
SRI058	Magalavadavan Aru at Periya Aru	32	07:30:05	81:29:20	268	119	2060
SRI060	Rambukkan Oya at Nilobe	30	07:30:40	81:22:40	126	161	2150
SRI061	Maha Oya at Maha Oya	11	07:31:54	81:26:36	282	300	2150
SRI062	Galodai Aru at Weragoda	35	07:33:35	81:19:50	156	224	2140

Station code	Name	No. years	Latitude (°N)	Longitude (°E)	MAF (m^3/s)	AREA (km^2)	AAR (mm)
SRI065	Maduru Oya at Welikanda	29	07:56:10	81:15:15	754	1062	2100
SRI067	Agra Oya at Holbrook	16	06:52:52	80:41:40	103	121	2390
SRI070	Kotmale Oya at Talawakele	23	06:56:25	80:39:45	269	290	2390
SRI071	Mahaweli Ganga at Watawala	18	06:56:50	80:32:10	72	65	3950
SRI072	Kotmale Oya at Morape (Nedeco)	31	07:03:40	80:37:20	481	531	2760
SRI078	Mahaweli Ganga at Peradeniya	37	07:15:42	80:35:30	1264	1189	2970
SRI081	Mahaweli Ganga at Gurudeniya	33	07:16:30	80:40:30	1412	1417	2810
SRI082	Hulu Ganga at Teldeniya	23	07:17:48	80:45:54	252	161	3560
SRI083	Galmal Oya at Moragahamula	16	07:16:57	80:48:26	161	73	3670
SRI085	Mahaweli Ganga at Randenigala (Nedeco)	24	07:12:10	80:56:10	1251	2370	2760
SRI086	Uma Oya at Welimada	17	06:54:15	80:54:30	167	179	2010
SRI087	Uma Oya at Talawakanda	19	07:00:30	80:58:25	262	505	1890
SRI089	Badulu Oya at Kandeketiya	15	07:10:30	81:00:24	209	387	2100
SRI091	Mahaweli Ganga at Weragantota (Nedeco)	35	07:19:02	80:59:10	2447	4040	2500
SRI093	Mahaweli Ganga at Hembarawa	10	07:31:35	80:58:20	1385	4530	2580
SRI097	Amban Ganga at Elahera (Nedeco)	33	07:40:45	80:45:25	421	772	2520
SRI099	Amban Ganga at Anagamedilla (Nedeco)	13	07:51:12	80:55:00	691	1435	2350
SRI100	Mahaweli Ganga at Manampitiya (Nedeco)	28	07:54:40	81:05:10	1666	7343	2500
SRI102	Gal Oya at Gal Oya	12	08:09:12	80:50:20	321	199	1590
SRI116	Yan Oya at Horowupotana	34	08:34:36	80:52:42	390	948	1520
SRI117	Yan Oya at Wahalkada	18	08:43:36	80:51:05	81	91	1620
SRI118	Yan Oya at Pangurugaswena	33	08:44:55	80:52:45	689	1311	1710
SRI123	Aruvi Oya at Kappachchi	35	08:35:45	80:16:30	690	2121	1450
SRI124	Malwathu Oya at Tekkam	11	08:44:30	80:11:00	1492	3072	1430
SRI128	Kala Oya at Dambulla	12	07:51:00	80:37:00	38	189	1780
SRI133	Kala Oya at Kala Oya	26	08:12:00	80:05:48	614	1948	1520
SRI134	Mi Oya at Mahauswewa	16	07:57:50	80:04:08	187	588	1450
SRI135	Mi Oya at Tabbowa	17	08:02:50	79:55:05	140	1077	1380
SRI138	Deduru Oya at Ridibandi Ela	18	07:43:42	80:15:48	746	1370	1940
SRI144	Deduru Oya at Chilaw	19	07:40:00	79:48:58	612	2611	1790
SRI145	Maha Oya at Alawwa	20	07:17:30	80:14:26	973	803	2450
SRI146	Maha Oya at Giriulla	26	07:19:30	80:06:55	815	1191	2480
SRI147	Maha Oya at Badalgama	31	07:18:10	79:58:50	860	1360	2380
SRI148	Attanagola Oya at Karasnagala	17	07:06:30	80:10:30	508	53	3170

Rain Gauge Stations Functioning

District Wise

Amparai District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01AM001E	ADDALACHENAI	7.23 N	81.85 E	0	10/1/2002
2	01AM001C	AKKARAIPATTU	7.22 N	81.85 E	16	4/1/1993
3	01AM0012	AMPARAI TANK	7.28 N	81.67 E	27.4	1879-01-01
4	01AM126C	GALMADUWA	0.00 N	0.00 E	0	1/1/2010
5	01AM0182	IRAKKAMAN	7.25 N	81.73 E	12.2	1869-01-01
6	01AM257A	KUDASIGIRIYA	7.68 N	81.13 E	0	1/1/1993
7	01AM368B	NAVATKIRI ARU TANK	7.47 N	81.72 E	16	1/1/1941
8	01AM373A	NEETHTHA	0.00 N	0.00 E	0	8/1/2009
9	43999	POTTUVIL	6.88 N	81.83 E	3.6	1868-01-01
10	01AM0459	SAGAMAM TANK	7.13 N	81.80 E	16	1879-01-01
11	01AM459A	SAMANTHURAI	7.37 N	81.68 E	0	10/1/2002
12	01AM493B	THIRUKKOVIL	7.07 N	81.82 E	5	6/8/2006
13	01AM509B	UHANA COCONUT	7.37 N	81.62 E	16	12/1/1991

Anuradhapura District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	43421	ANURADHAPURA	8.35 N	80.38 E	92.5	1870-05-08
2	01AN104A	EHETUGASWEWA	8.97 N	80.83 E	1,111.00	3/1/1990
3	01AN105B	ELAYAPATHTHUWA	8.40 N	80.32 E	16	12/1/1978
4	01AN109B	ELAYAPATHUWA-NLDB FARM	8.42 N	80.25 E	0	1/1/2004
5	01AN112A	EPPAWALA WATER SUPPLY	8.13 N	80.40 E	0	1/1/1994
6	01AN141A	HABARANA LODGE	8.05 N	80.77 E	0	4/1/2001
7	01AN172C	HOROWUPATANA,AGA OFFICE	8.55 N	80.15 E	16	10/1/1977
8	01AN174A	HURULUWEWA	8.22 N	80.72 E	16	1/1/1948
9	01AN193A	KAHATAGASDIGILIYA W/S	8.42 N	80.68 E	0	1/1/1994
10	01AN197A	KALAWEWA COCONUT	8.02 N	80.53 E	16	5/1/1993
11	01AN0197	KALAWEWA TANK	8.00 N	80.53 E	122	1888-12-01
12	01AN227A	KEBITHIGOLLEWA W/S	8.63 N	80.67 E	0	2/1/1995
13	01AN233A	KEKIRAWA WATER SUPPLY	8.03 N	80.58 E	0	1/1/1994
14	43422	MAHA ILLUPPALLAMA	8.12 N	80.47 E	117.2	1868-01-01
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Badulla District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01BD0006	ALUTHNUWARA	7.32 N	81.00 E	92	1899-10-01
2	43479	BADULLA	6.98 N	81.05 E	669.6	1868-09-01
3	01BD0034	BANDARA ELIYA ESTATE	6.78 N	81.02 E	0	1/1/1935
4	143476	BANDARAWELA	6.82 N	80.97 E	1,225.30	8/20/1990
5	01BD0036	BANDARAWELA-IRRIGATION	6.83 N	80.98 E	1,219.50	4/1/1947
6	01BD048B	BOGAHAMADITTA	6.97 N	81.05 E	111	4/1/1991
7	01BD058A	CANAWARELLA GROUP	6.90 N	81.12 E	1,237.80	1/1/1941
8	01BD074D	DAMBATENNE	6.78 N	81.00 E	1,566.00	8/1/1996
9	01BD0079	DEBEDDE ESTATE	6.95 N	81.12 E	16	11/1/1925
10	01BD093A	DIYATALAWA-SURVEY CAMP	6.82 N	80.97 E	111	10/1/1990
11	01BD0102	DYRABBA ESTATE	6.88 N	80.93 E	1,299.50	3/1/1914
12	01BD126A	GALOOLA ESTATE	7.07 N	81.15 E	16	4/1/1972
13	01BD127A	GALPURAYAYA - G/KOTTE	7.45 N	81.02 E	125	12/1/2002
14	01BD134E	GIRADURUKOTTE	7.45 N	81.02 E	80	3/1/2006
15	01BD134C	GIRANDURUKOTTE W/S	7.45 N	81.08 E	0	6/1/1995
16	01BD135A	GLEN ALPIN ESTATE	6.95 N	81.08 E	0	1/1/1993
17	01BD131A	GLENANORE	6.77 N	80.92 E	1,392.00	8/1/1996
18	01BD139B	GONAMOTAVA	6.78 N	80.98 E	1,348.00	8/1/1996
19	01BD152A	HAPUTALE FACTORY	6.77 N	80.95 E	1,418.00	8/1/1996
20	01BD159B	HILPANKANDURA ESTATE	7.52 N	80.15 E	16	4/1/1992
21	01BD193B	KAHAGALLA ESTATE	6.78 N	80.97 E	0	8/1/1996
22	01BD0207	KANDAKETIYA	7.17 N	81.02 E	16	4/1/1947
23	01BD0247	KIRKLEES ESTATE	6.98 N	80.93 E	1,432.90	2/1/1934
24	01BD0271	LEDGERWATTE ESTATE	7.03 N	81.02 E	16	1893-11-01
25	01BD0277	LOWER SPRING VALLEY	6.92 N	81.10 E	16	1884-08-01
26	01BD0290	MAHADOWA ESTATE	7.02 N	81.17 E	16	2/1/1902
27	01BD310A	MAPAKADAWEWA	7.27 N	81.03 E	16	1/1/1941
28	01BD330C	MICKLEFIELD FARM	6.85 N	80.88 E	0	1/1/1993
29	01BD368D	NAYABEDDE	6.80 N	80.00 E	0	8/1/1996
30	01BD411B	PASSARA TEA SHAKTHI	6.95 N	81.20 E	0	10/1/2005
31	02BD0025	PASSARA,AGMET	6.92 N	81.13 E	96	1/1/1990
32	01BD424C	PITARAT MALAI ESTATE	6.78 N	80.98 E	1,524.00	8/1/1996
33	01BD428F	POONAGALA GROUP, FACTORY	6.77 N	81.03 E	0	1/7/1997
34	01BD317Q	RANTEMBE	7.20 N	80.93 E	0	4/1/1997
35	01BD452A	RIDIMALIYADDA	7.22 N	80.12 E	200	6/27/2008
36	01BD473C	ST.CATHERINE DIVISION	6.78 N	81.02 E	0	8/1/1996
37	01BD501B	TISSAPURA	7.30 N	81.08 E	150	6/27/2008
38	01BD0539	WELIMADA GROUP	6.90 N	80.90 E	16	1/1/1941
39	01BD0541	WEST HAPUTALE-UDAVERIYA	6.78 N	80.83 E	1,707.00	4/1/1925
40	01BD0545	WEWESSA ESTATE	6.97 N	81.10 E	16	8/1/1913
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Batticaloa District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	43436	BATTICALOA	7.72 N	81.70 E	7.8	1869-02-01
2	01BT197B	KALKUDAH	7.88 N	81.55 E	0	7/1/1996
3	01BT0357	MYLAMBAVELLY ESTATE	7.77 N	81.63 E	16	4/1/1935
4	01BT410B	PASSIKUDA	7.93 N	81.55 E	5	4/29/2005
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Colombo District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01CB0016	ANGODA MENTAL HOSPITAL	6.93 N	79.92 E	15.2	4/1/1930
2	01CB0025	AVISSAWELLA ESTATE	6.92 N	80.18 E	228.7	1897-01-01
3	01CB0026	AVISSAWELLA HOSPITAL	6.95 N	80.22 E	30.5	1879-01-01
4	01CB0038B	BATTARAMULLA	6.90 N	79.92 E	15	4/5/2007
5	01CB469B	COLOMBO PORT	6.93 N	79.85 E	0	1/1/1993
6	2043466	COLOMBO, AGROMET	6.90 N	79.87 E	7.3	1/1/1976
7	01CB068A	CINNAMON LAKE SIDE HOTEL	6.92 N	79.83 E	0	1/1/1993
8	01CB0080	DEHIWALA ZOO	6.85 N	79.87 E	16	9/10/1936
9	01CB109A	ELSTON	6.93 N	80.17 E	16	1/1/1984
10	01CB0150	HANWELLA GROUP	6.88 N	80.12 E	16	6/1/1932
11	01CB166A	HOMAGAMA	6.83 N	80.02 E	11	11/1/1990
12	01CB0179	INDIKADE	6.88 N	80.15 E	16	1/1/1941
13	01CB0268	LABUGAMA TANK	6.83 N	80.18 E	16	1879-07-08
14	01CB369A	MEEGODA-NAWALAMULLA	6.87 N	80.03 E	0	6/3/2002
15	01CB0390	ORUWALA	6.88 N	80.00 E	16	2/1/1967
16	01CB393A	PADUKKA ESTATE	6.82 N	80.12 E	0	9/1/1993
17	43467	RATMALANA	6.82 N	79.88 E	5	1868-01-01
18	01CB469B	SRI LANKA PORT AUTHORITY	6.93N	79.85E		
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Galle District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01GL0030	BADDEGAMA ESTATE	6.18 N	80.18 E	15.2	10/1/1908
2	01GL0041	BEAUSEJOUR(LOWER)	6.15 N	80.33 E	61	1/1/1905
3	01GL041C	BENTOTA ESTATE	6.35 N	80.17 E	400	7/1/2007
4	01GL087C	DEVITURAI ESTATE	6.25 N	80.15 E	0	1/1/1994
5	43495	GALLE	6.03 N	80.22 E	12.5	1869-01-01
6	01GL164A	HINIDUMA	6.30 N	80.32 E	0	1/1/1994
7	01GL0165	HIYARE	6.07 N	80.32 E	100.6	1/1/1910
8	01GL0267	LABUDUWA	6.07 N	80.23 E	16	9/1/1928
9	01GL501A	TITAGALLA, HANDUNGODA	6.02 N	80.35 E	0	11/20/1996
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Gampaha District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01GM0011	AMBEPUSSA GOVT FARM	7.28 N	80.17 E	54.9	5/1/1927
2	01GM0158	HENARATHGODA BOT GRDNS	7.10 N	79.98 E	9.1	1891-01-01
3	43450	KATUNAYAKA	7.17 N	79.88 E	8.5	1868-01-01
4	01GM221B	KATUNAYAKE AIR FORCE	7.18 N	79.88 E	0	9/18/1996
5	01GM234A	KELEPITIMULLA	7.23 N	79.95 E	0	5/1/1996
6	01GM246A	KIRINDIWELA (COCONUT)	7.03 N	80.12 E	16	4/1/1992
7	01GM0373	NEGOMBO	7.22 N	79.83 E	3.1	1879-01-01
8	01GM378A	NITTAMBUWA	7.13 N	80.10 E	16	1/1/1993
9	01GM0412	PASYALA	7.15 N	80.13 E	16	10/1/1945
10	01GM487B	THAMMITA	7.10 N	79.95 E	0	5/1/1996
11	01GM0528	WALPITA	7.27 N	80.05 E	16	2/1/1941
12	01GM538B	WELISARA-NAVY	7.02 N	79.90 E	0	8/7/1997
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Hambanthota District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01HT0008	AMBALANTOTA GOVT. FARM	6.12 N	81.02 E	6.1	10/1/1921
2	01HT008A	AMBALANTOTA PADDY RESEAR	6.12 N	81.02 E	0	7/1/1995
3	01HT005A	ANGUNAKOLAPELESSA	6.17 N	80.88 E	16	4/1/1969
4	01HT028A	BADAGIRIYA TANK	6.23 N	81.15 E	16	3/1/1955
5	01HT0037	BATA ATA	6.10 N	80.92 E	24.4	10/1/1926
6	01HT037A	BATAATA	6.08 N	80.90 E	85	3/18/2006
7	01HT0053	BUNDALA LEWAYA	6.20 N	81.25 E	16	7/1/1947
8	43497	HAMBANTOTA	6.12 N	81.13 E	15.5	1869-01-01
9	01HT141C	HANDUNE_GALA	6.20 N	80.62 E	850	9/24/2008
10	01HT0244C	KEKIRIOBADA TANK	6.22 N	80.67 E	122	1879-01-01
11	01HT0276	LIYANGAHATOTA	6.23 N	80.93 E	16	2/1/1913
12	01HT280A	LUNUGAMWEHERA	6.33 N	81.20 E	16	5/1/1983
13	01HT0292	MAHA LEWAYA (HAMBANTOTA)	6.13 N	81.13 E	16	1/1/1937
14	01HT0303	MAMADOLA	6.13 N	80.97 E	16	1894-07-01
15	01HT356C	MURUTHAWELA WEWA	6.20 N	80.73 E	0	5/1/1995
16	01HT0396	PALATUPANA SALTERN	6.25 N	81.38 E	16	1/1/1932
17	01HT449C	RANMALA KANDA	6.23 N	80.63 E	87	10/23/2008
18	01HT0453	RIDIYAGAMA IRRIGATION	6.22 N	80.98 E	16	3/1/1923
19	01HT453A	RIDIYAGAMA IRRIGATION	6.18 N	80.97 E	0	1/1/1994
20	01HT460B	SAPUTHANTHRI KANDA	6.23 N	80.63 E	1,350.00	10/1/2008
21	01ht481a	SURIYAWEWA	6.32 N	80.00 E	200	1/1/1965
22	01HT484A	THALAPATH KANDA	6.22 N	80.62 E	1,100.00	9/1/2008
23	01HT0501	TISSAMAHARAMA IRRIGATION	6.28 N	81.30 E	16	1879-01-01
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Jaffna District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01JF062A	CHAVAKACHCHERI	9.67 N	80.17 E	16	1893-11-01
2	43404	JAFFNA	9.68 N	80.03 E	3.1	1871-01-14
3	01JF251A	KONDAVIL	9.70 N	80.03 E	16	1/1/1968
4	01JF0258	KUDATHANAI	9.73 N	80.27 E	16	6/1/1967
5	01JF360A	NAINATIVU	9.60 N	79.77 E	16	4/1/1956
6	01JF0425	POINT PEDRO	9.83 N	80.23 E	16	1891-03-01
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Kalutara District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01KT021A	ARAMANAGOLLA	6.73 N	80.05 E	0	2/1/1984
2	01KT0035	BANDARAGAMA	6.72 N	80.00 E	16	10/1/1921
3	01KT0066	CLYDE ESTATE	6.58 N	80.03 E	24.4	7/1/1952
4	01KT073A	DELKEITH	6.57 N	80.20 E	95	7/22/2006
5	01KE0120	FROCESTER ESTATE	6.67 N	80.12 E	15.2	7/1/1952
6	01KT0132	GEEKIYANAKANDA ESTATE	6.60 N	80.12 E	106.7	1872-04-01
7	01KT0145	HALWATURA	6.72 N	80.20 E	137.2	3/1/1929
8	01KT169A	HORAGODA ESTATE	6.50 N	80.25 E	16	12/1/1954
9	01KT0171	HORANA	6.75 N	80.07 E	30.5	1/1/1941
10	01KT524A	KALUTARA, VOGAN GROUP	6.53 N	80.10 E	0	1/1/1994
11	01KT0200	KALUTARA-P.W.D.	6.58 N	79.95 E	3	1879-01-01
12	01KT253C	KOROSDUWA	6.65 N	79.95 E	18	3/16/2006
13	01KT359B	NAGODA	6.57 N	80.00 E	16	1/1/1944
14	01KT400C	PALLEGODA ESTATE	6.47 N	80.05 E	0	9/1/1998
15	01KT414B	PELAWATTE	6.42 N	80.22 E	16	1/1/1959
16	01KT0450	RAYIGAMA	6.77 N	80.18 E	16	1897-05-01
17	01KT0467	SIRIKANDURA ESTATE	6.50 N	80.15 E	16	3/1/1920
18	01KT478B	ST.VINCENTS GROUP	6.52 N	80.00 E	16	1/1/1955
19	01KT513A	USK VALLEY S.P.	6.57 N	80.23 E	16	10/1/1954
20	01KT474B	YATADOLA (MATUGAMA DIV)	6.52 N	80.05 E	210	3/16/2006
21	01KT474A	YATADOLA(BOPITIYA)	6.50 N	80.08 E	100	3/16/2006
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Kandy District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01KY082E	DELTA ESTATE,EAST DIV	7.12 N	80.67 E	0	1/1/1996
2	01KY082D	DELTA ESTATE,SOUTH DIV	7.10 N	80.65 E	0	1/1/1996
3	01KY082F	DELTA NORTH DEVISION	0.00 N	0.00 E	0	9/26/2006
4	01KY0099	DUCKWARI ESTATE	7.35 N	80.78 E	1,006.10	1888-04-01
5	01KY0127	GALPHELE, WATTEGAMA	7.35 N	80.70 E	701.2	1898-01-01
6	01KY132A	GIDDAWA	7.42 N	80.73 E	480	1/29/2008
7	01KY147B	HANDESSA- DAULAGALA	7.23 N	80.57 E	16	6/1/1987
8	01KY0211	KANDY-KINGS PAVILION	7.30 N	80.63 E	510.4	8/1/1922
9	43444	KATUGASTOTA	7.33 N	80.63 E	417.1	1868-01-01
10	01KY317L	KOTHMALE POWER STATION	7.12 N	80.57 E	0	1/1/1996
11	01KY317I	KOTHMALE POWER STN -D/S	7.02 N	80.58 E	0	1/1/1990
12	01KY317N	KOTHMALE RESERVOIR	7.02 N	80.58 E	0	1/1/1998
13	01KY0262	KUNDASALE FARM	7.27 N	80.68 E	492	10/1/1947
14	01KY286B	MADULKEIE	7.37 N	80.73 E	750	2/1/2003
15	01KY286A	MAHABERIYATENNA	7.27 N	80.77 E	16	1/1/1989
16	01KY328A	MELFORT	7.12 N	80.63 E	16	4/1/1991
17	01KY0370	NAWALAPITIYA	7.07 N	80.53 E	16	7/1/1937
18	01KY0374	NEW FOREST	7.15 N	80.68 E	16	1/1/1901
19	01KY389B	OVALA RATTOTA	7.52 N	80.15 E	16	3/1/1992
20	01KY401A	PALLEKELE	7.28 N	80.72 E	470	11/16/2007
21	01KY407B	PANVILATENIYA	7.15 N	80.62 E	760	2/25/2006
22	01KY0418	PERADENIYA BOT.GARDENS	7.27 N	80.60 E	16	1883-07-01
23	01KY317O	POLGOLLA	7.32 N	80.62 E	440.8	6/1/1996
24	01KY0471	SOGAMA ESTATE	7.12 N	80.62 E	16	1884-11-01
25	01KY317P	VICTORIA	7.25 N	80.78 E	0	5/1/1994
26	01KY536B	WELIGALLA	7.18 N	80.43 E	540	11/14/2009
27	01KY0547	WOODSIDE ESTATE	7.27 N	80.83 E	950	1897-10-01
28	143444	KANDY, OLD MET	**	**	16	1868-01-01
29	01KY317K	BADULLA	**	**	0	1/1/1994
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Kegalle District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01KE009B	AMBANPITIYA ESTATE	7.23 N	80.32 E	201.2	3/1/2003
2	01KE0021	ARANAYAKE GOVT. HOSPITAL	7.18 N	80.47 E	16	8/1/1905
3	01KE021B	ARANAYAKE MINI HYDRO PRO	7.13 N	80.47 E	0	10/1/2004
4	01KE0064	CHESTERFORD	7.07 N	80.18 E	198.2	9/1/1949
5	01KE079B	DEDIGAMA	7.22 N	80.25 E	100	6/1/2003
6	01KE0089	DIGALLA ESTATE	6.95 N	80.30 E	122	1886-03-01
7	01KE0100	DUNEDIN ESTATE	7.03 N	80.28 E	122	1882-11-01
8	01KE104C	EILA ESTATE	6.98 N	80.33 E	220	11/1/2000
9	01KE0113	ERAMINIGOLLA	7.30 N	80.38 E	16	11/1/1938
10	01KE113B	ERAMINIGOLLA (COCONUT)	7.30 N	80.37 E	16	1/1/1993
11	01KE152C	HAIMATTA	7.07 N	80.25 E	50	10/5/2006
12	01KE141D	HAKBELLAWAKA	6.98 N	80.35 E	200	2/24/2010
13	301	MALIBODA	6.88 N	80.43 E	274.4	8/1/1913
14	01KE345B	MORALIOYA	7.02 N	80.22 E	90	10/1/2006
15	01KY356A	MURUTALAWA,SURIYAGODA	7.32 N	80.40 E	16	8/1/1991
16	01KE0458	RUWANWELLA REST HOUSE	7.05 N	80.25 E	16	7/1/1910
17	01KE104D	UDABAGE	6.97 N	80.35 E	440	6/24/2005
18	01KE0503	UNDUGODA	7.13 N	80.37 E	16	1/1/1950
19	01KE0523	VINCIT ESTATE	7.08 N	80.22 E	16	9/18/1925
20	01KE0526	WAGOLLA	7.30 N	80.38 E	16	11/1/1949
21	01KE530A	WARAKAPOLA(NIYADURUPOLA)	7.15 N	80.22 E	280	5/26/2003
22	01KE0544	WEWELTALAWA ESTATE	7.05 N	80.38 E	16	1/1/1944
23	01KE319A	MATHEMAGODA (COCONUT)	**	**	16	1/1/1993
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Kilinochchi District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01KI001B	AKKARAYANKULAM	9.30 N	80.35 E	31.1	12/1/1961
2	01KI0183	IRANAMADU TANK	9.35 N	80.40 E	30.5	6/1/1910
3	01KI220B	KARIYALAINAGAPODUWAN	9.27 N	80.17 E	0	3/1/1998
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Kurunegala District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01KG014A	ANDIGAMA FARM	7.37 N	80.12 E	16	5/1/1967
2	01KG024A	ATHARAGALLA	7.92 N	80.28 E	0	1/1/1957
3	01KE0038	BATALAGODA TANK	7.52 N	80.45 E	16	1897-01-01
4	01KG049A	BOPITIYA	7.32 N	80.07 E	50	6/15/2007
5	01KG074C	DAMPELLASSA - NARAMMALA	7.42 N	80.20 E	16	3/1/1993
6	01KG082C	DELHENA	7.52 N	80.55 E	111	7/1/1988
7	01KG092B	DODANGASLANDA	7.57 N	80.53 E	165	6/1/1987
8	01KG0103	EGODAGAMA ELA	7.43 N	80.42 E	16	3/1/1941
9	01KG0253	HAKWATUNA-OYA	7.65 N	80.38 E	16	1/1/1991
10	01KG159D	HETTIPOLA	7.58 N	80.67 E	50	11/16/2007
11	159C	HINDAWA ESTATE				
12	01PU169B	HORAGASAGARA	7.57 N	79.95 E	16	1/1/1989
13	01KG175A	IBBAGAMUWA	7.52 N	80.42 E	140	11/16/2007
14	01KG0201	KAMALASRAM (UDUBADDAWA)	7.48 N	79.98 E	16	6/1/1950
15	01KG0256	KOULWEWA	7.53 N	79.93 E	16	3/1/1978
16	01KG258D	KULIYAPITIYA	7.45 N	80.08 E	60	10/4/2002
17	43441	KURUNEGALA	7.47 N	80.37 E	116.1	1885-06-01
18	01KG290A	MAHAGALKADAWLA,GALGAMUWA	8.07 N	80.28 E	111	11/1/1987
19	01KE300B	MAKANDURA	7.32 N	79.98 E	26	3/28/2007
20	01ke312A	MARANDAWILA FARM	7.63 N	79.95 E	0	1/1/1993
21	01KG0326	MEDIYAWA TANK	7.88 N	80.28 E	16	1/1/1905
22	01KG301B	MELCIRI PURA	7.63 N	80.60 E	170	11/16/2007
23	01KG0329	MELLAWA ESTATE	7.32 N	79.95 E	16	8/1/1978
24	01KG0377	NIKAWERATIYA	7.75 N	80.12 E	16	1/1/1941
25	01KG404A	PANDUWASNUWARA	7.60 N	80.12 E	1	3/1/1990
26	01KG407A	PANNALA VIRIDIYAWA EST	7.33 N	80.03 E	0	4/1/1996
27	01KG426A	POLGAHAWELA (COCONUT)	7.32 N	80.30 E	16	12/1/1992
28	01KG427A	POLONTALAWA	7.72 N	80.00 E	16	10/1/1953
29	01KG0452	RIDIBENDI ELA	7.73 N	80.25 E	16	6/1/1937
30	01KG469A	SIYAMBALANGAMUWA	7.95 N	80.45 E	16	12/1/1953
31	01KG0470	SIYAMBALAWEWA ESTATE	7.65 N	79.97 E	16	5/15/1936
32	01KG0532	WARIYAPOLA EXPTL.STATION	7.63 N	80.25 E	16	4/1/1930
33	01KG540C	WELLEWA	6.55 N	80.35 E	100	5/1/2007
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Mannar District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01MN220A	KARUKKAIKULAM	8.92 N	80.02 E	16	1/1/1941
2	43413	MANNAR	8.98 N	79.92 E	3.6	1870-05-01
3	01MN0356	MURUNKAN	8.83 N	80.05 E	16	1/1/1901
4	01mu0356	MURUNKAN	0.13 N	80.05 E	40	1/1/1901
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Matale District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01ML317M	BOWATENNA	7.65 N	80.65 E	0	6/1/1996
2	01ML0072	CRYSTAL HILL ESTATE	7.50 N	80.65 E	426.8	1880-07-01
3	01ML107A	ELKADUWA ESTATE	7.42 N	80.68 E	762	12/1/1999
4	01ML150A	HAPPUWIDDE DIV (ELKADUWA	7.42 N	80.68 E	1,068.00	1999-12-91
5	01ML0177	ILLUKKUMBURA	7.55 N	80.77 E	1,219.50	6/1/1936
6	01ML0208	KANDALAMA	7.87 N	80.68 E	16	5/25/1952
7	01ML277A	LOOLKADE DIVISION	7.65 N	80.55 E	0	1/1/1989
8	01ML0318	MATALE-P.W.D.	7.47 N	80.62 E	16	1879-01-01
9	01ML324A	MEDAPEELLA	7.70 N	80.73 E	200	5/1/2008
10	01ML0337	MILLAWANA ESTATE	7.67 N	80.55 E	16	11/1/1937
11	01ML0361	NALANDA EXPER.STATION	7.67 N	80.63 E	16	11/1/1922
12	01ML389B	OWELLA - RATTOTA	7.52 N	80.65 E	16	9/1/1990
13	01ML0416	PELWEHERA	7.90 N	80.68 E	16	10/1/1929
14	01ML317J	UKUWELA	7.40 N	80.65 E	16	1/1/1993
15	01ML0531	WARIYAPOLA ESTATE	7.47 N	80.63 E	16	1887-01-01
16	01ML540D	WELLEWALA	7.67 N	80.82 E	160	5/1/2008
17	01ML544A	WEWELMADA	7.48 N	80.68 E	833.8	10/1/2003
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Matara District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01MT0018	ANNINGKANDA ESTATE	6.35 N	80.62 E	533.5	1884-06-01
2	01MT074B	DAMPAHALA TEA FACTORY	6.27 N	80.63 E	176	12/1/1992
3	01MT0076	DANDENIYA TANK	6.00 N	80.65 E	16	1880-01-15
4	01HT079C	DEHIGAHAHENA	6.20 N	80.62 E	300	10/23/2008
5	01MT0085	DENAGAMA	6.10 N	80.65 E	16	1879-01-01
6	01MT085B	DENIYAYA, WILLIE GROUP	6.33 N	80.55 E	0	11/20/1996
7	01MT232A	KEKANADURA FARM	5.97 N	80.57 E	11	1/1/1989
8	01MT0232	KEKENADURA (MATARA)	5.97 N	80.57 E	48.8	1879-02-01
9	01MT0311	MAPALANA	6.07 N	80.57 E	16	5/1/1941
10	01MT0322	MAWARELLA ESTATE	6.20 N	80.58 E	16	3/1/1925
11	01MT0400	PALLEGAMA,RATHNAYAKE GP	6.35 N	80.53 E	16	1/1/1989
12	01MT404B	PANETIYANA	6.03 N	80.45 E	200	7/1/2003
13	01MT484A	TALAPATH KANDA	6.22 N	80.62 E	1,100.00	9/3/2008
14	01MT537A	WELIGAMA (COCONUT)	5.98 N	80.40 E	16	4/1/1993
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Monaragala District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01MG044A	BIBLE AGRI,TRAINING CEN	7.15 N	81.22 E	820	6/1/2000
2	01MG055C	BUTTALA - KONKETIYA	6.65 N	81.27 E	0	6/1/2004
3	01MG141B	HANDAPANAGALA	6.65 N	81.12 E	150	11/16/2007
4	01MG260A	KUMBUKKANA	6.77 N	80.28 E	440	3/10/2006
5	00043MMM	MONARAGALA	6.50 N	81.30 E	165	3/1/2009
6	01MG343B	MONARAGALA WATER SUPPLY	6.87 N	81.35 E	475	6/1/2000
7	01MG0385	OKKAMPITIYA	6.75 N	81.30 E	16	1/1/1941
8	01MG488A	TANAMALWILA WATER SUPPLY	6.47 N	81.12 E	250	6/1/2000
9	01MG501B	TISSAPURA	7.30 N	81.08 E	150	6/27/2008
10	01MG538A	WELIPITIYA COCONUT	7.15 N	81.25 E	16	1/1/1992
11	01MG540A	WELLAWAYA	6.73 N	81.10 E	16	10/1/1983
12	01MG540B	WELLAWAYA WATER SUPPLY	6.72 N	81.08 E	300	6/1/2000
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Mullaitivu District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01MU0216	KANNUKKENI TANK	9.20 N	80.80 E	30.5	3/1/1905
2	01MU357A	MUTU IYANKADDU	9.22 N	80.65 E	16	5/1/1978
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Nuwara Eliya District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01NE0010	AMBEWELA	6.88 N	80.80 E	1,828.40	1/1/1952
2	01NE0017	ANNFIELD ESTATE	6.87 N	80.63 E	1,311.00	1887-11-01
3	01NE033A	BAMBRAKELLY - LINDULA	6.88 N	80.65 E	0	9/1/1995
4	01BD042B	BEAUVAIS ESTATE	6.78 N	80.90 E	0	8/1/1996
5	01NE0049	BOPATTHALAWA	6.83 N	80.72 E	1,539.60	11/1/1941
6	01NE0058	CAMPION ESTATE	6.78 N	80.70 E	1,820.30	1885-08-01
7	01NE317A	CANYON	6.88 N	80.53 E	16	1/1/1983
8	01NE317B	CASTLEREIGH	6.87 N	80.57 E	16	1/1/1983
9	01NE098A	DRAYTON	6.92 N	80.62 E	0	4/1/1996
10	01NE140B	GAURAVILLA ESTATE	6.78 N	80.60 E	1,443.00	10/1/1999
11	01NE138A	GOONAPITIYA	7.05 N	80.80 E	0	3/1/1996
12	01NE0142	HAKGALA BOTANICAL GDNS	6.92 N	80.82 E	1,701.20	1883-07-01
13	01ne0153	HATTUN ROSITA	6.92 N	80.60 E	1,311.00	6/1/1978
14	01NE0156	HELBODDE ESTATE	7.08 N	80.67 E	834.1	1885-01-01
15	01NE0157	HELBODDE NORTH	7.08 N	80.68 E	1,493.90	4/15/1929
16	01NE159A	HIGH FOREST ESTATE	7.07 N	80.83 E	16	3/1/1986
17	01NE157B	HOLLY ROOD ESTATE	6.95 N	80.67 E	0	4/1/1996
18	01NE0166	HOLMWOOD ESTATE	6.85 N	80.72 E	1,685.00	1881-08-01
19	01NE0167	HOPE ESTATE	7.10 N	80.75 E	1,432.90	1885-10-01
20	01NE0236	KENILWORTH (STRATHELLIE)	7.00 N	80.48 E	762.2	1/1/1912
21	01NE236A	KENILWORTH ESTATE	6.08 N	80.48 E	520	9/27/2006
22	01NE0264	KURUNDU OYA	7.07 N	80.83 E	16	1882-07-01
23	01NE0266	LABUKELLE	7.02 N	80.72 E	16	1/1/1941
24	01NE317D	LAXAPANA	6.90 N	80.52 E	16	1/1/1983
25	01NE0274	LIDDES DALE	7.02 N	80.85 E	1,570.00	1/1/1923
26	01NE277C	LOOLECONDERA ESTATE	7.12 N	80.70 E	1,080.00	1/1/2003
27	01NE315A	MARIGOLD FACTORY	7.07 N	80.82 E	0	4/1/1996
28	01NE0316	MASKELIYA HOSPITAL	6.83 N	80.57 E	16	1882-08-01
29	01NE317F	MAUSSAKELLE	6.85 N	80.55 E	16	1/1/1983
30	01NE317E	NORTON	6.92 N	80.52 E	16	4/1/1984
31	01NE317G	SAMANALA POWER STATION	6.98 N	80.47 E	16	1/1/1989
32	01NE0460	SANDRINGHAM ESTATE	6.85 N	80.75 E	16	1881-07-01
33	01NE464A	SHANNON ESTATE	6.90 N	80.57 E	0	4/1/1996
34	01NE467B	SITA ELIYA	6.93 N	80.80 E	0	1/1/1966
35	01NE467C	SITAELIYA GOVT FARM	6.95 N	80.78 E	0	11/19/1996
36	01NE485D	ST. CLAIR	6.93 N	80.65 E	0	11/18/1996
37	01NE362A	SUMMERSET	6.93 N	80.70 E	0	11/18/1996
38	01NE166B	SUTTON DIVISON HOLMWOOD	6.85 N	80.70 E	1,440.00	9/28/2006
39	01NE506B	UDARADELLA	6.97 N	80.82 E	16	1/1/1989
40	01NE0534	WATAWALA	6.97 N	80.52 E	16	4/1/1910
41	01NE534B	WATAWALA, MOUNT JEAN	6.95 N	80.52 E	0	11/19/1996
42	01NE534A	WATAWALA,RAILWAY STATION	6.97 N	80.52 E	16	1/1/1993
43	01NE317H	WIMALASURENDRA POWER ST	6.90 N	80.53 E	16	1/1/1983
44						

Polonnaruwa District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01PL0015	ANGAMEDILLA	7.85 N	80.92 E	16	1/1/1941
2	01PL020A	ARALAGANWILA	7.80 N	81.15 E	60	3/1/2003
3	01PL0031	BAKAMUNA	7.77 N	80.82 E	16	1/1/1941
4	01PL092A	DIYABEDUMA	7.93 N	80.87 E	16	1/1/1960
5	01PL093B	DIYASENAPURA	8.12 N	81.02 E	0	1/1/1993
6	01PL104B	ELAHERA	7.68 N	80.82 E	16	6/1/1991
7	01PL134A	GIRITALE	8.00 N	80.93 E	16	7/1/1953
8	01PL134D	GIRITALE (Wild Life)	8.00 N	80.93 E	16	1/1/2004
9	01PL141A	HABARANA LODGE	8.03 N	80.75 E	0	4/1/2001
10	01PL0162	HINGURAKGODA-AGRICULTURE	8.05 N	80.95 E	39.6	1/1/1941
11	01PL224A	KAUDULLA WEWA	8.13 N	80.93 E	16	5/1/1953
12	01PL0340	MINNERIYA TANK	8.05 N	80.90 E	16	1899-03-01
13	00043PPP	POLONNARUWA	7.87 N	81.05 E	43	2/1/2009
14	01PL0427	POLONNARUWA AGRI.STATION	7.92 N	81.03 E	16	1/1/1940
15	01PL0538C	WELIKANDA (SINGHAPURA)	8.00 N	81.22 E	40	1/1/2002
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Puttalam District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01PU0013	ANAMADUWA DISPENSARY	7.88 N	80.00 E	76.3	5/1/1933
2	01PU040A	BATTULUOYA	7.72 N	79.82 E	5	1/1/2005
3	01PU0065	CHILAW-P.W.D	7.58 N	79.78 E	3	11/1/1911
4	01PU307A	DEVISIPURA	7.85 N	79.82 E	130	1/1/2005
5	01PU099A	DUMMALASOORIYA	6.00 N	80.85 E	260	11/1/2005
6	02PU0013	ELUVANKULAMA,AGMET	8.27 N	79.85 E	100	9/29/1975
7	01PU0170	HORAKELLE ESTATE	7.45 N	79.85 E	15.2	1868-10-01
8	01PU201A	KAMANDALUWA	7.77 N	80.00 E	0	4/1/1999
9	01PU216A	KARANDIPOOVAL	8.15 N	79.85 E	0	4/1/1999
10	01PU0221	KARUKKUWA ESTATE	7.50 N	79.83 E	16	5/1/1911
11	01PU256A	KOTTUKACHCHIYA	7.92 N	79.97 E	16	6/1/1939
12	01PU0281	LUNUWILA (BANDIRIPPUWA)	7.33 N	79.87 E	16	8/1/1950
13	01PU313A	MARAWILA	7.40 N	79.83 E	0	7/1/1995
14	353E	MUNDALAMA				
15	01PU282C	NORACHOLAI	8.05 N	79.82 E	3	11/8/2006
16	01PU0397	PALAVI SALTERN	7.98 N	79.83 E	16	4/1/1919
17	01PU353D	PALMGROVE ESTATE	7.77 N	79.82 E	0	1/1/2005
18	01PU0402	PALUGASWEWA ESTATE	7.65 N	79.87 E	16	1/1/1910
19	01PU428B	POOTTWALA ESTATE	7.65 N	79.88 E	16	11/1/1992
20	43424	PUTTALAM	8.03 N	79.83 E	2.1	1869-01-01
21	2043424	PUTTALAM, AGMET	8.03 N	79.83 E	2.1	2/9/1993
22	01PU0449	RATHMALAGARA AGMET	7.55 N	79.90 E	28	7/1/1938
23	01PU473B	ST. ANNES ESTATE, DALUWA	8.08 N	79.75 E	0	12/1/1990
24	01PU0483	TABBOWA AGRICULTURE	8.05 N	79.95 E	16	8/1/1938
25	01PU514B	VANATHAWILLU	0.00 N	0.00 E	0	11/8/2006
26						
27						
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Ratnapura District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01RT0005	ALUPOLLA GROUP	6.72 N	80.58 E	762.5	12/1/1931
2	01KE016A	ANHETIGAMA ESTATE	6.93 N	80.37 E	11	6/1/1990
3	01RT0032	BALANGODA POST OFFICE	6.65 N	80.70 E	527.4	7/1/1922
4	01RT042C	BELIHULOYA	6.72 N	80.77 E	670	6/7/2006
5	01RT050C	BELIHULOYA UPPER DIV	6.77 N	80.80 E	0	11/16/1996
6	01RT050B	BRAMPTON	6.75 N	80.82 E	0	4/1/1996
7	01RT0086	DEPEDENA GROUP	6.47 N	80.55 E	16	1/1/1942
8	01RT0087	DETANAGALLA	6.73 N	80.68 E	16	9/1/1912
9	01RT0104	EHELIYAGODA S.P.	6.85 N	80.27 E	225.6	3/1/1916
10	01RT0111C	EMBILIPITIYA,COCONUT	6.32 N	80.85 E	76.2	7/1/1930
11	01RT120A	GALABODA ESTATE	6.70 N	80.47 E	1	8/1/1990
12	01RT0124	GALATURA ESTATE	6.70 N	80.28 E	16	12/1/1936
13	01RT128A	GANGEYAYA	6.37 N	80.83 E	0	5/1/1995
14	01RT140D	GURULUWANA	6.75 N	80.43 E	0	10/1/2004
15	01RT0151	HAPUGASTENNA ESTATE	6.72 N	80.52 E	594.5	1/1/1944
16	01RT177B	ILLUBULUWA ESTATE	6.68 N	80.32 E	90	1/16/2007
17	01RT0195	KALATUWAWA	6.85 N	80.20 E	16	1/1/1941
18	01RT196A	KALAWANA	6.48 N	80.38 E	0	11/1/2005
19	01RT0237	KERAGALA	6.78 N	80.35 E	121.9	9/1/1912
20	01RT258A	KUDAWA	6.43 N	80.42 E	16	1/1/1980
21	01RT264A	KUTTIGALA,CHANDRIKAWEWA	6.25 N	80.90 E	16	1/1/1989
22	01RT269B	LANDSDOWN,MIDDLE DIV	6.67 N	80.47 E	0	4/1/1996
23	01RT271A	LELLOPITIYA ESTATE	6.68 N	80.50 E	16	12/1/1954
24	01RT345A	MORAHELA	6.67 N	80.67 E	0	7/1/1995
25	01NE0360	NAGRAK ESTATE	6.77 N	80.78 E	16	10/1/1933
26	01RT382B	NON PAREIL (BELIHULOYA)	6.75 N	80.78 E	0	4/1/1996
27	01RT0435	PUSSELLA S.P.	6.80 N	80.35 E	16	11/1/1951
28	43486	RATNAPURA	6.68 N	80.40 E	34.4	1869-09-01
29	01RT481B	SOORIYAKANDA	6.43 N	80.63 E	884	7/1/2003
30	01RT539A	WELLANDURA ESTATE	6.53 N	80.57 E	16	1/1/1955
31	01RT539B	WELLANDURA TEA FACTORY	6.55 N	80.57 E	0	1/1/1993
32	01RT111C	EMBILIPITIYA,COCONUT NUR	**	**	16	1/1/1992
33						
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Vavuniya District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01VA414A	PAVATKULAM	8.68 N	80.43 E	16	11/1/1955
2	43415	VAVUNIYA	8.75 N	80.50 E	97.5	1880-09-01
3	01VA0517	VAVUNIYA AGRICULTURE	8.77 N	80.48 E	16	4/1/1927
4	01VA0518	VAVUNIYA P.W.D.	8.75 N	80.50 E	16	1879-01-01
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Trincomalee District

	STN-ID	STN-NAME	LAT	LON	ELEVATION	BEGIN-DATE
1	01TC0004	ALLAI TANK	8.40 N	81.32 E	6.1	1879-03-01
2	01TC0194	KAL AAR	8.30 N	81.27 E	12.2	1/1/1941
3	01TC0215	KANTALAI TANK	8.35 N	80.98 E	76.2	1879-01-01
4	01TC0395	PALAMPODDAR,THAMBALAGAMU	8.55 N	81.07 E	16	2/1/1944
5	43418	TRINCOMALEE	8.58 N	81.25 E	23.9	1869-01-01
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7						
8						
9						
10						

Kelani Ganga at Glencourse

Water Year	Flood Peaks in Cumecs	Date
70/71	2038.79	1971.09.23
71/72	1399.26	1972.05.13
72/73	826.00	1973.08.01
73/74	3120.49	1974.07.28
74/75	2981.79	1975.05.23
75/76	1322.95	1975.11.03
76/77	1380.43	1977.05.25
77/78	1680.53	1978.05.14
78/79	4219.17	1978.11.25
79/80	573.41	1979.11.11
80/81	2695.06	1981.09.17
81/82	1973.66	1982.06.09
82/83	1060.60	1983.08.20
83/84	4285.71	1984.07.12
84/85	2095.73	1985.06.06
85/86	1766.53	1985.10.05
86/87	781.25	1986.10.13
87/88	1585.73	1987.10.27
88/89	3500.00	1989.06.04
89/90	831.00	1989.11.01
90/91	1146.00	1990.11.03
91/92	1318.28	1992.06.03
92/93	1346.17	1992.10.14
93/94	1519.46	1993.10.08
94/95	660.00	1995.06.04
95/96	1361.18	1995.10.08
96/97	1550.00	1997.09.16
97/98	787.00	1997.11.04
98/99	1407.00	1999.04.20
99/00	810.58	2000.09.20
00/01	491.93	2001.02.04
01/02	595.97	2002.06.07
02/03	561.29	2003.05.17
03/04	516.70	2004.09.24
04/05	810.51	2004.11.02
05/06	1134.20	2006.06.20
06/07	1009.34	2006.11.11
07/08	1733.30	2008.04.29
08/09	921.43	2009.08.17
09/10	516.70	2010.05.20
10/11	1690.25	2011.05.27
11/12	380.24	2012.07.09

Kelani Ganga at Kithulgala

Water Year	Flood Peaks in Cumecs	Date
84/85	925.00	15-07-85
85/86	497.00	12-11-85
86/87	268.00	01-10-86
87/88	808.00	04-08-88
88/89	2157.00	30-05-89
89/90	704.00	17-05-90
90/91	247.00	02-11-90
91/92	886.00	03-06-92
92/93	853.00	28-06-93
93/94	577.00	08-10-93
94/95	704.00	17-06-95
95/96	727.00	08-10-95
96/97	337.00	16-09-97
97/98	406.00	29-09-98
98/99	726.00	19-05-99
99/00	288.00	04-05-00
00/01	228.00	27-07-01
01/02	365.00	12-06-02
02/03	503.00	06-05-03
03/04	178.00	27-05-04
04/05	439.00	05-10-05
05/06	379.00	06-11-05
06/07	244.00	15-06-07
07/08	704.00	28-04-08
08/09	403.00	20-05-09
09/10	403.00	02-10-09
10/11	288.00	02-05-11
11/12	269.00	09-07-12

Gurugoda Oya at Holombuwa

Water Year	Flood Peaks in Cumecs	Date
85/86	431.76	04-10-85
86/87	174.12	02-06-87
87/88	484.18	26-10-87
88/89	644.11	03-06-89
89/90	248.15	18-11-89
90/91	193.00	02-11-90
91/92	280.00	03-06-92
92/93	475.00	13-10-92
93/94	316.73	08-10-93
94/95	228.00	09-05-95
95/96	192.94	08-10-95
96/97	525.00	20-07-97
97/98	204.70	24-07-98
98/99	246.89	20-04-99
99/00	137.82	24-09-00
00/01	179.03	30-07-01
01/02	190.44	21-04-02
02/03	102.82	17-05-03
03/04	175.66	03-11-03
04/05	279.35	02-11-04
05/06	172.29	22-10-05
06/07	297.67	12-11-06
07/08	329.24	19-07-08
08/09	173.13	17-08-09
09/10	241.54	30-04-10
10/11	456.40	27-05-11
11/12	189.23	23-10-11

Seethawaka Ganga at Daraniyagala

Water Year	Flood Peaks in Cumecs	Date
84/85	2312.60	31-.5-85
85/86	654.44	12-11-85
86/87	932.83	15-10-86
87/88	701.42	03-06-88
88/89		03-06-89
89/90	2079.00	17-05-90
90/91	509.00	02-11-90
91/92	1476.00	03.06.92
92/93	1708.00	13-10-92
93/94	954.16	08-10-93
94/95	540.00	04-06-95
95/96	656.00	22-09-96
96/97	644.00	21-07-97
97/98	462.00	24-07-98
98/99	362.00	20-04-99
99/00	282.00	20-09-00
00/01	368.00	18-05-01
01/02	497.00	12-06-02
02/03	508.00	06-05-03
03/04	266.00	27-05-04
04/05	426.00	05-09-05
05/06	458.00	20-06-06
06/07	601.00	12-05-07
07/08	920.00	28-04-08
08/09	572.00	16-08-09
09/10	416.00	15-08-10
10/11	580.00	27-05-11
11/12	278.00	26-05-12

Kalu Ganga at Rathnapura

Water Year	Flood Peaks in Cumecs	Date
77/78	370.94	27-09-78
78/79	520.31	24-11-78
79/80	349.71	12-07-80
80/81	453.06	17-09-81
81/82	579.15	08-06-82
82/83	339.14	28-11-82
83/84	506.58	12-07-84
84/85	472.59	24-05-85
85/86	513.48	04-10-85
86/87	395.43	01-10-86
87/88	531.00	02-06-86
88/89	764.54	31-05-89
89/90	492.78	07-05-90
90/91	370.99	02-06-91
91/92	446.05	03-06-92
92/93	458.79	31-05-93
93/94	589.06	08-10-93
94/95	360.37	04-06-95
95/96	477.90	08-10-95
96/97	463.04	21-07-97
97/98	419.00	29-09-98
98/99	552.00	20-04-99
99/00	320.00	01-06-00
00/01	268.00	29-09-01
01/02	392.00	12-06-02
02/03	686.88	18-05-03
03/04	350.00	30-05-04
04/05	459.00	05-09-05
05/06	356.68	20-06-06
06/07	322.02	01-09-07
07/08	547.27	28-04-08
08/09	355.20	30-06-08
09/10	368.45	19-05-10
10/11	395.33	29-04-11
11/12		

Kalu Ganga at Ellagawa

Water Year	Flood Peaks in Cumecs	Date
68/69	597.68	30-05-69
69/70	495.54	31-03-70
70/71	930.48	23-09-71
71/72	861.67	15-05-72
72/73	577.66	06-10-72
73/74	770.21	29-07-74
74/75	1113.41	08-05-75
75/76	679.31	25-10-75
76/77	529.10	05-06-77
77/78	1336.54	15-05-78
78/79	670.37	26-11-78
79/80	663.17	03-06-80
80/81	809.85	19-09-81
81/82	1387.51	10-06-82
82/83	641.09	29-11-82
83/84	1005.24	14-07-84
84/85	889.14	25-05-85
85/86	852.33	06-10-85
86/87	815.52	02-10-86
87/88	1042.05	04-06-88
88/89	1121.34	06-06-89
89/90	745.00	09-05-90
90/91	824.01	03-06-91
91/92	883.60	05-06-92
92/93	1081.69	01-06-93
93/94	1047.86	10-10-93
94/95	668.36	05-06-95
95/96	1222.50	09-10-95
96/97	1005.00	17-09-97
97/98	1000.00	05-11-97
98/99	1860.00	22-04-99
99/00	680.00	21-09-00
00/01	432.00	26-09-01
01/02	360.00	23-10-01
02/03	2620.00	19-05-03
03/04	548.00	24-09-04
04/05	690.00	06-09-05
05/06	750.00	22-06-06
06/07	710.00	01-09-07
07/08	1680.00	01-06-08
08/09	691.20	02-07-09
09/10	1100.00	21-05-10
10/11	880.00	30-04-11
11/12	246.50	10-07-12

Badulu Oya at Taldena

Water Year	Flood Peaks in Cumecs	Date
95/96	42.18	05-02-96
96/97	78.72	28-11-96
97/98	258.38	09-03-98
98/99	32.08	03-03-99
99/00	309.23	29-02-00
00/01	56.81	29-01-01
01/02	26.31	07-12-01
02/03	32.08	19-12-02
03/04	21.26	11-01-04
04/05	73.33	16-12-04
05/06	49.96	14-01-06
06/07	258.38	20-12-06
07/08	730.22	13-03-08
08/09	198.85	29-11-08
09/10	295.96	12-12-09
10/11	585.17	02-02-11
11/12	309.23	25-11-11

Attanagalu Oya at Dunamale		
Water Year	**Flood Peaks in Cumecs**	**Date**
05/06	36.44	22-11-05
06/07	48.70	26-10-06
07/08	58.66	31-05-08
08/09	36.44	21-10-08
09/10	50.88	01-05-10
10/11	41.32	02-10-10
11/12	31.33	24-10-11

Mahaweli Ganga at Nawalapitiya		
Water Year	**Flood Peaks in Cumecs**	**Date**
89/90	238.00	06-08-90
90/91	199.40	31-07-91
91/92	294.80	03-06-92
92/93	360.27	28-06-93
93/94	218.60	01-08-94
94/95	262.50	17-06-95
95/96	266.40	20-09-96
96/97	238.64	21-07-97
97/98	259.25	29-09-98
98/99	250.00	20-04-99
99/00	112.00	01-06-00
00/01	154.60	27-07-01
01/02	199.07	09-08-02
02/03	187.00	10-07-03
03/04	166.00	27-05-04
04/05	187.00	31-08-05
05/06	130.00	20-06-06
06/07	145.00	03-11-06
07/08	212.04	23-09 -09
08/09	205.80	20-05-09
09/10	190.60	15-08-10
10/11		
11/12		

COLOMBO MET

Monthly Mean Pan Evaporation - (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	4.10	4.76	5.39	3.13	4.31	4.66	4.53	4.78	4.35	4.14	3.98	4.57
1982	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1983	N/A	N/A	N/A	N/A	N/A	N/A	3.91	1.97	N/A	4.57	4.25	3.34
1984	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1985	4.33	4.10	4.76	4.46	4.28	N/A	4.06	3.99	3.86	4.12	3.35	3.48
1986	3.07	4.36	3.78	3.90	4.10	4.17	2.93	3.58	3.38	2.89	3.44	3.23
1987	3.70	4.58	5.33	3.99	4.21	3.86	4.42	2.45	4.18	3.12	2.73	3.37
1988	5.70	4.06	3.18	3.98	3.73	3.89	3.45	3.75	N/A	N/A	N/A	N/A
1989	3.48	4.39	5.07	4.27	3.49	3.16	3.05	3.86	4.18	3.93	3.67	4.02
1990	3.47	4.58	4.41	4.32	3.53	3.42	3.27	3.33	4.14	3.53	N/A	2.66
1991	3.40	4.07	4.75	4.07	4.23	3.73	3.85	4.27	4.13	2.99	3.35	N/A
1992	3.93	4.47	5.07	4.88	3.74	3.77	3.47	3.87	4.04	3.48	2.94	3.13
1993	3.79	4.66	4.14	4.68	3.82	3.75	3.42	3.76	4.38	3.74	2.69	2.63
1994	3.03	3.50	4.26	4.26	3.85	3.80	3.78	3.71	3.86	2.82	2.72	3.55
1995	3.54	3.95	4.65	3.83	3.71	3.34	3.65	3.70	4.11	3.77	3.48	3.70
1996	3.81	3.69	4.79	3.29	3.78	2.81	3.37	4.14	3.18	3.42	3.80	2.84
1997	4.17	3.49	3.88	4.02	3.17	3.33	3.20	4.33	3.06	3.00	2.89	2.42
1998	3.06	4.12	4.90	4.40	3.37	3.36	3.13	3.03	3.50	3.07	2.75	2.59
1999	3.03	3.22	3.72	3.26	3.21	3.51	3.31	3.23	3.04	2.22	2.70	3.03
2000	3.01	3.32	3.85	3.71	3.35	3.15	3.80	3.43	3.18	3.47	3.07	3.22
2001	2.92	3.67	4.32	3.55	3.41	3.60	3.48	4.59	4.45	3.42	3.23	3.59
2002	3.64	4.11	4.47	3.87	3.30	3.68	4.02	4.24	4.72	3.13	2.68	2.61
2003	3.40	3.18	3.62	3.64	3.42	3.12	3.07	3.42	3.52	3.36	2.45	3.62
2004	4.39	4.61	4.30	4.06	2.94	3.24	3.08	3.53	2.72	2.68	2.24	2.98
2005	3.69	4.37	4.54	3.98	3.49	3.28	3.34	4.00	3.72	2.85	2.63	3.03
2006	3.38	3.91	3.73	3.81	3.28	3.14	3.39	3.27	3.42	3.41	2.99	2.87
2007	3.60	4.21	4.44	3.75	3.58	3.31	3.20	3.34	3.30	2.76	3.40	2.97
2008	3.22	3.78	3.22	3.47	3.47	3.33	2.97	3.34	4.04	3.41	2.70	3.40
2009	3.92	4.49	3.89	3.60	3.65	3.16	3.53	3.53	3.49	3.44	2.15	4.24
2010	4.25	4.33	4.19	3.64	3.14	3.27	3.17	3.44	3.29	3.35	2.49	2.19
Average	3.67	4.07	4.32	3.92	3.61	3.49	3.49	3.64	3.74	3.34	3.03	3.20

Monthly Mean Wind Run - (km/h)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	3.3	3.4	3.3	3.8	4.1	5.6	5.1	5.3	4.9	3.2	3.7	3.3
1982	3.8	3.4	3.3	3.5	3.7	5.5	4.9	4.8	4.2	2.9	2.3	3.5
1983	3.9	3.2	3.2	3.5	3.8	3.6	3.4	3.8	2.9	3.0	3.0	3.1
1984	3.0	3.1	N/A	2.8	5.5	4.1	3.9	4.2	3.8	3.3	2.9	4.0
1985	3.5	3.0	4.6	5.4	6.9	7.2	6.7	6.7	5.8	5.2	5.2	5.3
1986	7.0	5.5	4.6	4.7	5.7	6.8	7.6	6.2	6.6	5.0	5.4	5.1
1987	6.7	6.2	5.5	4.9	5.1	7.3	5.9	5.8	5.1	3.9	7.0	6.0
1988	7.6	5.7	4.8	4.5	6.4	5.7	5.8	5.5	5.6	5.3	N/A	N/A
1989	6.2	5.5	4.7	4.9	6.4	7.0	N/A	N/A	6.5	4.5	4.1	4.4
1990	5.0	4.9	4.4	4.8	6.5	7.3	5.8	6.9	6.3	4.5	4.2	3.9
1991	4.3	4.7	4.4	4.9	4.9	8.0	7.1	7.6	6.3	4.8	3.8	4.3
1992	5.9	4.6	4.9	5.3	5.5	7.3	6.1	7.3	5.8	5.1	3.4	4.5
1993	4.8	5.1	4.5	4.3	5.6	7.8	7.3	6.9	6.2	5.2	3.5	3.5
1994	4.3	3.9	4.8	4.4	4.2	5.6	6.3	6.2	5.4	2.6	3.4	5.4
1995	4.7	4.4	4.6	4.3	6.6	6.3	6.2	6.7	5.7	4.5	2.6	4.1
1996	4.1	3.0	4.3	4.1	5.9	5.5	5.8	6.8	6.4	4.6	3.8	3.2
1997	4.4	4.5	4.1	4.1	4.5	4.5	6.0	6.7	4.4	2.4	2.0	2.3
1998	3.7	4.3	4.6	4.3	5.1	6.1	6.8	5.8	6.8	4.9	2.3	3.2
1999	4.2	3.7	3.6	5.5	6.0	6.4	6.5	5.8	4.8	3.8	2.9	3.4
2000	3.8	3.5	3.6	4.8	5.1	6.5	6.6	6.5	4.2	4.2	2.8	4.9
2001	3.9	3.2	4.3	3.1	4.8	5.9	5.5	7.0	5.8	5.0	3.3	4.8
2002	5.0	4.3	4.0	3.3	4.8	5.8	6.0	5.5	5.8	3.5	3.5	4.5
2003	4.4	3.1	3.4	3.6	6.1	5.7	5.7	6.2	5.7	4.8	3.4	5.7
2004	6.4	5.7	4.9	4.7	5.9	6.3	6.1	6.2	4.8	3.0	3.8	4.7
2005	5.4	4.9	4.1	3.4	4.8	6.6	5.7	5.5	6.0	4.3	4.7	8.3
2006	5.6	5.1	4.1	4.6	5.5	5.4	6.0	4.9	5.7	4.4	3.4	5.4
2007	5.8	5.2	4.7	3.8	6.0	5.6	5.6	5.5	6.3	4.5	4.6	4.8
2008	5.1	4.2	3.8	4.4	7.4	5.2	6.2	6.1	5.1	3.8	4.6	5.0
2009	5.6	5.2	4.1	5.0	7.1	6.7	5.4	6.4	7.0	4.5	2.3	3.3
2010	6.0	5.4	4.2	3.5	5.4	1.4	5.2	6.4	5.0	6.1	3.9	4.9
Average	4.9	4.4	4.3	4.3	5.5	6.0	5.9	6.0	5.5	4.2	3.6	4.4

RATNAPURA TRI

Monthly Mean Pan Evaporation - (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	4.30	5.30	4.90	4.00	3.40	3.60	3.30	3.30	3.10	3.70	3.80	2.90
1982	3.53	4.03	4.21	3.94	3.70	3.51	3.50	2.98	3.54	2.39	3.48	2.94
1983	3.50	5.06	5.74	4.90	4.28	3.74	3.57	3.49	2.55	3.73	3.71	2.28
1984	3.00	3.24	3.37	3.01	3.65	3.82	2.89	4.25	4.34	3.67	3.58	3.47
1985	3.16	4.00	4.58	4.01	3.63	2.76	3.39	3.43	3.42	3.81	3.83	3.02
1986	3.42	4.41	3.73	4.09	3.59	4.40	3.23	3.83	2.81	3.63	3.39	3.39
1987	3.72	5.36	5.55	4.87	4.12	4.05	4.46	3.03	4.17	2.79	3.64	3.80
1988	3.86	4.42	4.40	3.78	3.07	**	3.02	3.54	4.05	4.51	4.34	3.43
1989	3.54	4.90	5.50	4.20	**	2.84	3.35	**	**	4.03	4.25	3.44
1990	4.32	5.10	4.59	3.87	3.96	3.15	3.23	3.47	3.69	3.12	**	3.83
1991	3.62	4.56	4.38	3.34	4.29	**	4.25	**	3.97	**	3.76	3.38
1992	3.70	5.53	6.21	4.97	**	**	3.61	3.47	**	**	**	2.89
1993	3.93	4.67	3.91	4.43	**	**	3.00	3.21	3.24	3.15	3.23	2.63
1994	2.77	3.84	4.11	3.98	**	3.54	3.32	3.40	3.04	3.58	**	2.83
1995	2.94	3.60	3.13	**	3.75	3.00	3.31	2.40	3.63	3.19	3.15	3.14
1996	2.95	2.98	5.09	3.39	4.08	3.02	3.01	3.19	***	3.24	3.10	3.16
1997	4.39	4.66	4.10	3.86	3.01	3.90	2.75	3.39	2.82	3.91	2.73	2.70
1998	3.32	4.33	4.73	4.17	3.28	2.93	3.81	3.01	2.93	3.14	4.52	1.40
1999	3.21	3.58	4.42	3.18	3.19	4.16	3.82	3.66	3.42	2.97	3.33	3.55
2000	2.74	3.55	3.67	4.01	4.10	2.90	4.10	2.58	3.10	3.77	2.40	2.74
2001	2.40	3.73	4.50	3.38	2.91	4.00	3.01	2.99	3.01	***	3.55	2.82
2002	2.84	3.17	3.53	2.79	2.64	3.34	2.48	2.97	3.71	2.15	2.83	2.07
2003	3.07	3.40	3.58	3.40	2.61	2.86	2.70	2.90	3.16	2.10	1.94	3.36
2004	3.24	3.46	3.43	2.79	2.84	3.20	2.41	2.81	3.01	2.77	2.48	2.62
2005	2.27	3.58	3.13	3.23	3.75	3.03	2.85	2.92	3.39	3.23	2.72	2.65
2006	2.40	2.66	2.74	2.61	2.67	2.65	2.62	2.82	2.36	2.66	2.07	2.05
2007	2.70	3.10	3.41	3.10	3.09	2.81	2.15	1.75	1.71	1.45	2.18	1.91
2008	1.92	1.94	1.16	0.75			0.95	1.51	2.80	2.36	2.19	2.33
2009	3.13	3.88	2.77	2.28	2.31	1.93	2.45	1.80	2.33	2.92	1.40	1.35
2010	2.86	3.08	2.97	2.13	2.97	2.06	2.43	2.26	2.10	2.53	1.62	1.71
Avearge	3.22	3.97	4.05	3.53	3.40	3.25	3.10	3.01	3.16	3.13	3.08	2.79

Monthly Mean Wind Run - (km/h)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	2.3	2.6	2.3	2.4	2.5	4.0	3.8	3.6	2.6	2.5	2.6	1.6
1982	1.7	2.9	1.8	1.9	1.4	2.3	2.3	2.8	2.4	0.9	0.7	0.7
1983	2.2	3.5	3.7	3.5	3.6	4.1	4.2	4.3	3.2	4.1	3.5	3.8
1984	2.6	2.7	3.4	3.0	3.3	4.8	4.3	5.3	4.3	***	3.3	3.1
1985	2.3	2.3	2.9	3.1	3.8	4.6	4.1	4.1	3.3	3.3	2.9	2.0
1986	2.8	2.8	2.3	2.8	3.1	4.5	4.3	3.8	3.3	2.5	2.4	1.7
1987	2.0	2.6	2.7	2.4	2.3	4.5	3.7	2.6	2.6	1.9	2.1	2.5
1988	1.7	2.1	2.2	2.2	1.6	1.8	2.6	2.4	2.2	2.4	2.0	1.6
1989	5.3	8.0	7.7	7.1	4.3	2.2	2.3	2.6	1.7	2.1	3.2	2.4
1990	2.1	2.3	2.3	2.3	2.5	2.9	2.6	3.6	2.6	2.1	2.2	1.4
1991	1.6	1.9	2.0	2.0	2.0	2.1	2.4	2.9	2.7	2.4	1.7	1.5
1992	1.5	2.6	2.7	2.3	2.0	3.2	2.1	2.7	2.4	2.2	1.8	1.4
1993	1.4	2.1	2.0	1.8	1.8	2.7	3.0	2.4	2.0	1.8	1.4	1.5
1994	1.2	1.6	2.0	1.9	1.9	2.9	2.6	2.4	1.9	1.5	1.8	1.3
1995	1.6	1.9	2.2	2.3	2.6	2.5	3.8	2.7	3.1	2.2	2.4	1.7
1996	1.8	2.1	2.5	2.5	2.6	3.9	3.2	3.0	2.3	2.3	2.5	2.0
1997	2.1	2.5	2.3	2.9	2.1	2.3	2.5	3.1	2.1	1.7	1.9	1.4
1998	1.4	1.8	1.8	1.8	1.9	2.6	3.1	2.4	2.5	2.2	2.3	1.6
1999	1.5	1.8	1.7	1.6	1.9	2.3	2.7	2.0	1.8	1.8	1.8	1.7
2000	1.2	1.6	1.7	1.6	1.9	2.3	2.8	2.6	1.3	1.3	1.0	1.1
2001	0.9	1.1	1.3	0.9	1.5	1.9	1.9	2.0	1.7	1.7	1.4	1.1
2002	1.0	1.4	1.5	1.4	1.6	2.0	1.8	2.0	1.9	1.2	1.1	0.8
2003	0.9	1.0	1.1	1.2	1.7	1.3	1.5	1.5	1.3	1.1	0.9	1.0
2004	0.9	1.2	1.3	1.4	1.5	2.2	1.8	1.9	0.9	1.0	0.7	0.6
2005	0.8	0.9	0.9	0.8	1.1	1.4	1.7	1.8	1.7	1.0	1.1	1.2
2006	0.7	0.7	1.2	1.4	1.0	1.2	1.6	0.9	0.7	0.5	0.4	0.2
2007	***	***	***	***	***	***	***	***	***	***	***	***
2008	0.3	0.3	0.4	***	***	***	***	***	***	0.9	0.8	0.8
2009	0.72	1.16	1.00	1.10	1.17	1.21	2.08	1.43	1.64	1.49	0.92	0.76
2010	0.73	0.81	1.13	1.00	1.13	1.69	2.10	2.24	1.51	2.03	1.09	1.32
Average	1.62	2.07	2.14	2.16	2.13	2.70	2.74	2.68	2.20	1.86	1.79	1.51

Bandarawela

EVAPORATION - Monthly Mean (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	2.70	3.20	3.00	2.50	2.80	3.90	3.40	4.50	3.20	2.50	2.30	1.90
1982	2.60	3.90	3.40	3.20	2.30	3.70	3.70	3.90	3.70	1.30	1.30	2.00
1983	2.40	4.70	4.70	4.30	3.30	4.00	4.10	3.70	3.80	3.30	2.30	1.30
1984	2.70	3.60	3.40	2.40	2.80	3.40	3.90	4.20	2.90	2.80	2.20	1.90
1985	1.70	3.10	2.70	3.10	3.40	3.60	3.20	2.90	3.40	3.70	2.50	2.90
1986	2.80	2.80	2.70	2.80	3.20	3.90	3.90	3.20	3.40	2.70	2.70	1.90
1987	2.10	3.20	2.90	2.90	2.90	4.20	4.20	2.90	4.20	XXX	2.40	2.10
1988	2.10	3.50	3.30	2.00	2.90	4.10	3.30	3.00	2.80	2.30	XXX	XXX
1989	XXX	3.69	3.89	3.21	2.76	3.21	2.41	3.69	2.81	2.70	2.30	2.01
1990	3.00	2.78	3.06	2.98	3.54	3.82	3.67	3.84	2.94	2.82	2.11	1.50
1991	1.63	3.00	3.12	2.62	2.44	3.29	3.45	4.08	2.80	2.42	1.94	1.35
1992	1.98	3.53	4.49	3.30	2.54	4.65	3.33	3.38	2.68	2.80	1.60	1.40
1993	2.34	2.90	2.95	3.61	2.73	3.03	3.70	3.89	2.93	2.23	1.40	1.21
1994	1.66	2.37	2.91	2.65	2.72	3.86	3.22	3.35	2.26	1.65	1.25	1.44
1995	1.78	2.89	2.85	2.67	2.98	3.34	3.54	3.43	3.19	2.28	2.03	2.01
1996	1.72	2.19	3.05	2.17	3.54	3.02	2.69	3.10	2.64	2.64	2.15	1.98
1997	2.80	2.98	3.86	2.76	2.54	3.06	3.46	3.93	2.54	2.23	1.87	1.46
1998	2.07	2.81	3.20	2.89	2.73	3.15	3.11	2.39	3.15	2.34	1.96	1.28
1999	1.77	1.81	2.63	2.48	2.80	2.91	3.77	3.69	2.93	1.79	1.65	1.75
2000	1.43	1.93	2.69	2.52	2.74	2.99	3.63	2.81	2.52	2.00	1.65	1.14
2001	1.57	3.05	3.52	2.51	3.18	3.91	3.28	3.78	2.83	2.59	2.26	2.17
2002	2.24	2.76	3.67	3.11	3.59	3.66	4.22	3.56	3.76	2.62	2.01	1.69
2003	2.40	3.00	3.40	3.31	3.38	3.35	2.81	3.42	3.19	3.37	1.40	2.92
2004	2.38	2.91	3.70	3.10	3.06	3.86	3.46	3.67	2.29	2.05	1.36	1.84
2005	1.92	4.25	3.33	3.03	3.10	3.78	3.77	3.79	2.97	1.97	1.76	2.43
2006	1.84	2.42	2.77	2.87	2.68	3.35	3.47	3.55	3.36	2.25	2.23	1.33
2007	2.07	2.66	3.93	2.43	3.16	2.54	3.35	3.27	3.07	2.10	2.33	1.67
2008	1.83	2.62	2.06	2.62	2.88	2.81	3.41	2.94	3.34	1.99	1.62	2.10
2009	2.48	3.33	3.04	2.46	2.86	3.86	3.54	3.27	2.94	2.95	1.76	1.62
2010	2.40	3.18	3.18	2.77	2.59	2.79	2.69	2.81	2.46	2.98	1.76	1.61
Average	2.60	3.14	3.04	2.89	3.22	3.48	3.46	3.25	2.75	2.20	1.86	1.79

WIND SPEED - Monthly Mean (km/h)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	3.5	3.3	3.6	3.4	3.3	5.2	4.7	6.3	3.8	2.6	1.9	2.6
1982	3.2	3.0	3.0	2.5	3.2	5.0	5.5	3.7	3.7	1.6	2.0	1.9
1983	2.4	2.6	2.9	2.8	1.8	3.0	3.6	4.1	4.9	1.9	0.9	1.7
1984	1.4	2.0	1.2	0.9	0.8	4.6	3.7	2.6	1.4	1.5	1.4	1.0
1985	1.5	2.2	2.7	2.0	2.9	5.6	4.2	3.9	4.8	3.3	3.2	2.9
1986	2.9	3.1	3.2	2.7	3.4	6.1	6.5	4.9	4.0	2.0	2.6	3.0
1987	3.6	3.4	3.4	3.2	3.1	6.6	4.5	5.4	5.3	2.7	2.7	3.3
1988	3.2	2.1	0.9	0.8	0.8	3.1	2.4	2.5	2.3	0.5	NA	NA
1989	1.1	1.2	1.4	1.6	1.8	2.4	3.1	2.2	2.0	0.6	0.4	0.6
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	3.8	3.8	8.5	6.6	6.2	4.8	5.4	3.9	4.0
1992	4.5	4.5	5.0	4.4	4.6	8.0	6.0	6.4	4.2	4.6	3.6	2.8
1993	2.7	1.9	2.4	1.8	1.6	2.7	4.4	2.8	2.9	2.4	1.7	1.4
1994	1.3	1.5	1.8	1.5	2.5	3.2	3.3	2.5	2.4	1.4	0.7	0.7
1995	0.7	0.9	1.1	0.9	2.0	2.8	1.6	1.7	1.4	0.6	0.3	0.5
1996	0.4	0.5	0.6	0.2	0.6	4.1	2.7	0.9	2.4	0.9	0.2	0.3
1997	17.7	0.9	2.5	2.6	2.7	4.1	4.4	4.9	4.1	2.4	3.0	2.7
1998	3.4	3.6	3.5	3.2	3.4	6.0	5.5	3.7	4.7	3.6	2.8	2.8
1999	3.3	3.2	3.3	3.5	4.8	4.6	5.7	5.8	4.6	3.1	2.8	3.3
2000	3.4	3.1	3.4	3.0	3.2	5.6	6.5	6.5	3.7	3.2	3.2	3.4
2001	3.4	3.4	3.7	3.3	3.5	5.4	4.5	5.0	4.1	2.9	2.5	2.9
2002	3.1	3.5	3.7	3.2	3.9	5.2	5.5	5.6	4.4	3.3	2.8	3.5
2003	3.5	3.8	3.5	3.4	4.0	5.3	4.8	5.2	4.3	5.3	3.4	3.7
2004	4.0	3.8	4.0	3.4	5.4	6.5	5.2	5.6	4.0	3.3	3.1	3.4
2005	3.4	4.2	3.4	3.4	3.0	5.1	5.9	4.7	4.9	3.2	3.2	3.1
2006	3.7	3.9	3.5	3.1	3.9	4.4	5.4	5.3	6.3	3.4	2.8	3.4
2007	3.9	3.5	3.9	3.0	3.5	4.8	4.5	5.1	4.9	3.7	2.8	3.4
2008	3.0	3.4	3.6	NA	3.0	4.1	5.4	4.9	4.2	3.5	3.1	3.2
2009	3.8	3.7	3.4	3.1	3.9	5.4	5.4	4.8	4.5	3.9	3.3	3.0
2010	3.4	3.3	3.5	2.9	3.2	4.8	5.3	4.7	3.3	4.0	1.0	4.2
Average	3.4	2.8	2.9	2.6	3.0	4.9	4.7	4.4	3.9	2.8	2.3	2.6

Sitaeliya

EVAPORATION - Monthly Mean (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	3.22	4.17	3.33	3.76	4.28	XXX	XXX	2.70	XXX	XXX	XXX	XXX
1982	2.44	4.99	3.96	4.22	XXX	XXX	XXX	3.50	2.97	2.72	XXX	XXX
1983	2.60	5.10	5.00	5.10	2.90	3.10	3.79	2.86	2.87	3.60	2.60	2.20
1984	XXX	XXX	XXX	XXX	XXX	XXX	XXX	3.89	XXX	XXX	2.57	3.00
1985	3.03	4.09	3.86	3.79	3.82	1.81	2.56	2.59	2.80	3.77	2.73	4.02
1986	2.70	2.78	3.60	2.50	3.43	3.45	3.15	3.77	2.07	2.87	3.43	2.90
1987	2.54	3.31	4.26	3.78	3.71	4.30	3.86	3.79	3.73	2.60	2.38	1.95
1988	2.66	3.38	3.46	3.87	3.26	3.05	2.72	2.44	3.59	3.00	3.08	2.60
1989	3.75	3.70	3.99	3.17	3.04	3.27	2.61	3.36	2.77	2.69	2.20	2.55
1990	3.61	2.05	2.75	3.29	2.93	2.48	2.70	2.89	2.78	XXX	2.97	XXX
1991	3.17	3.71	3.78	3.12	3.22	2.41	2.37	2.53	2.57	2.31	2.31	1.97
1992	2.63	4.51	5.29	4.21	2.93	2.67	2.05	2.65	2.32	2.98	2.43	2.29
1993	3.22	4.12	4.56	4.96	3.65	3.39	2.57	XXX	XXX	1.69	1.74	0.85
1994	1.71	2.88	3.71	XXX	2.78	2.28	2.08	2.15	2.03	1.91	1.74	0.85
1995	2.13	2.62	3.82	2.58	XXX	1.70	2.26	2.27	2.40	2.31	2.43	2.73
1996	XXX	XXX	4.11	2.54	3.51	2.65	1.77	1.61	2.08	2.98	1.66	1.93
1997	2.52	3.22	3.80	2.37	2.41	2.17	1.67	2.10	2.10	1.90	1.54	1.51
1998	1.83	2.86	4.31	3.65	2.71	1.98	1.73	1.92	1.74	1.75	1.66	1.54
1999	2.14	1.94	3.73	1.94	1.90	2.12	2.17	2.21	2.49	1.13	1.80	1.94
2000	1.84	2.03	3.23	2.94	2.50	1.56	2.46	1.51	2.09	2.13	2.02	1.21
2001	1.80	4.01	5.00	2.35	3.06	2.08	2.22	1.94	2.24	1.48	1.80	1.56
2002	2.36	2.78	4.06	2.73	2.83	2.70	2.20	2.18	3.18	2.01	1.99	1.67
2003	XXX	XXX	2.95	2.92	3.09	2.24	2.68	3.17	3.03	3.70	2.09	3.11
2004	2.74	3.22	3.95	3.53	2.91	2.74	2.65	3.35	2.52	2.63	1.92	2.20
2005	1.90	4.00	3.64	3.02	2.81	2.26	2.19	2.80	2.66	1.78	1.68	1.90
2006	2.45	2.87	3.29	3.02	2.09	3.09	2.52	2.49	2.37	2.45	1.97	1.64
2007	2.40	3.16	5.07	2.60	2.95	2.30	2.14	2.25	2.22	1.57	1.90	2.01
2008	2.53	2.83	2.18	3.00	2.69	1.93	2.26	2.21	3.07	2.08	1.99	2.03
2009	2.71	3.73	3.30	2.51	2.55	2.19	2.09	1.85	2.14	2.85	1.58	1.86
2010	2.86	4.07	4.18	2.76	3.77	3.26	**	**	**	**	**	1.30
Average	2.57	3.41	3.87	3.22	3.03	2.56	2.44	2.61	2.57	2.42	2.16	2.05

WIND SPEED - Monthly Mean (km/h)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	4.6	4.7	5.1	3.9	7.5	24.1	23.1	18.4	15.7	2.8	2.8	6.8
1983	6.2	5.2	5.0	5.8	6.8	17.1	16.5	21.3	18.7	10.2	7.1	5.3
1984	6.4	8.1	7.4	7.1	10.2	29.5	20.2	16.3	16.8	14.1	8.0	5.8
1997	5.9	5.9	6.6	4.5	6.4	9.4	16.9	16.7	10.2	4.9	5.1	7.0
1998	7.2	5.6	6.2	5.6	9.3	21.0	16.8	12.7	17.6	13.0	7.5	7.1
1999	8.1	7.5	7.0	11.5	16.6	17.1	21.0	15.7	12.5	13.0	6.2	7.1
2000	8.6	5.9	6.4	6.1	9.7	21.6	17.6	20.6	9.9	10.7	7.5	7.2
2001	6.9	6.9	6.5	5.2	11.8	21.7	15.7	18.0	13.8	11.0	5.9	6.9
2002	7.0	8.0	7.6	6.1	15.7	19.2	17.3	18.1	13.0	8.4	6.2	8.9
2003	7.1	7.5	6.2	5.4	10.7	14.3	15.1	16.0	14.2	13.0	9.5	6.9
2004	6.8	5.9	6.7	4.9	17.6	21.7	17.7	15.6	10.4	9.8	8.8	8.5
2005	6.3	8.8	4.9	7.4	7.2	17.7	5.1	12.5	17.4	10.1	6.2	6.8
2006	9.6	7.7	6.1	5.3	11.6	15.1	18.2	14.1	14.0	8.6	6.2	9.3
2007	10.2	5.7	7.9	5.9	9.0	16.1	15.7	14.4	16.9	12.3	4.3	7.2
2008	6.7	5.7	5.8	5.0	7.7	16.8	15.3	11.5	11.1	7.8	6.9	5.2
2009	7.2	6.0	6.2	6.1	14.0	17.2	16.6	12.6	15.2	8.6	5.6	6.0
2010	5.9	6.8	7.6	5.2	7.6	14.3	15.5	14.5	9.7	16.3	na	na
Average	7.4	6.7	6.5	6.0	11.1	17.4	16.0	15.2	13.3	10.5	6.6	7.2

N

Waterway (Underground)

Kiriketi 1 Upper Dam
HWL. EL.1,954m
LWL. EL.1,934m

Kumburutheniwela

Nagaracwatta

Kiriketi 1

Powerhouse
(Underground)

Kiriketi 1 Lower Dam
HWL. EL.1,263m
LWL. EL.1,257m

NONPAREIL ESTATE

DUGALDOWA ESTATE

Nonpareilwatta

Belihuloya

Maddehiniwela

Yakdehiwala

Kiriketi2
Upper Dam
HWL. EL.1,731m
LWL. EL.1,725m

Waterway (Underground)

Powerhouse
(Underground)

Kiriketi 2

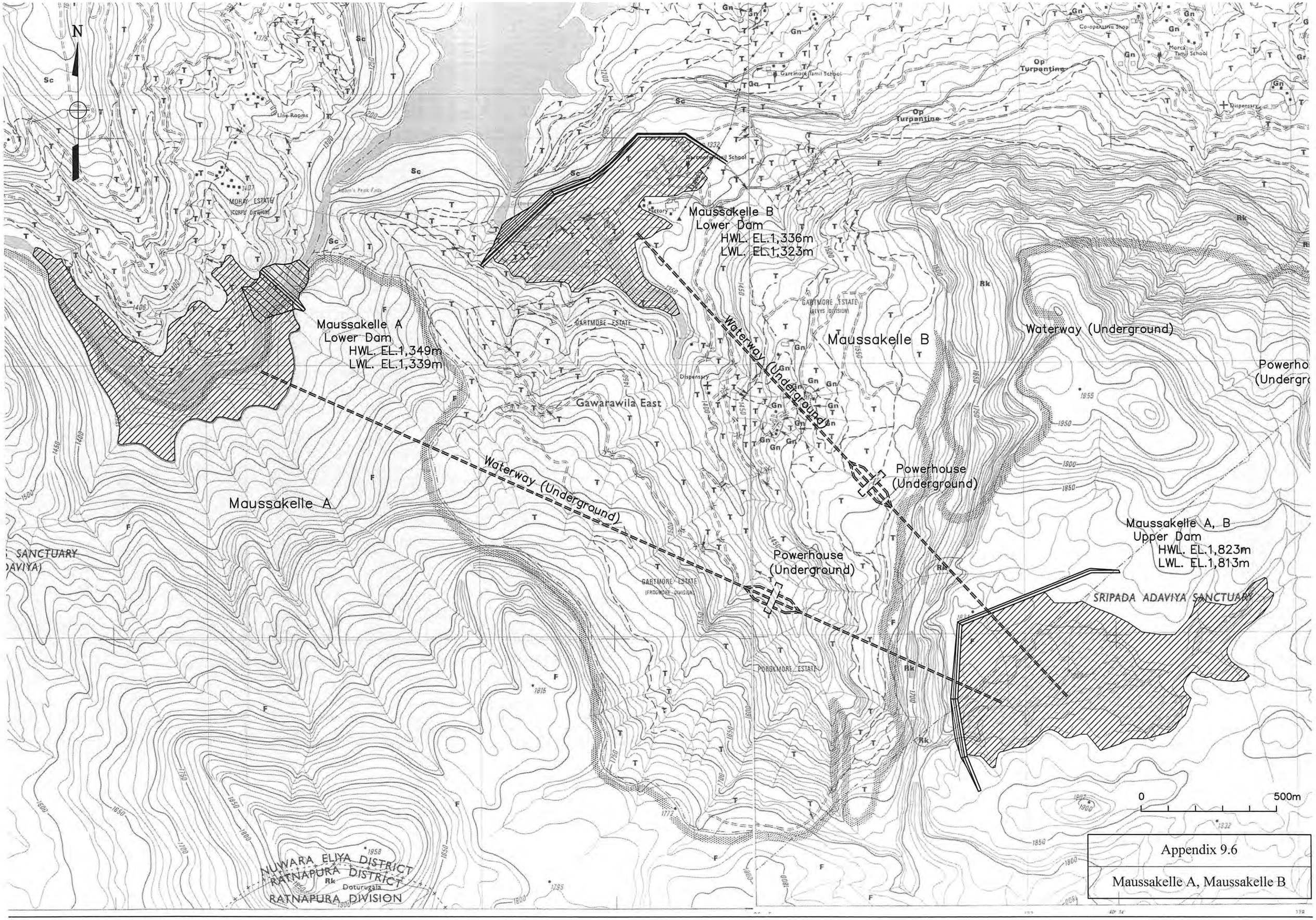
I M B U L P E D

Kiriketi 2 Lower Dam
HWL. EL.946m
LWL. EL.934m

0 500m

Appendix 9.5

Kiriketi 1, Kiriketi 2


N
Maussakelle B
Lower Dam
HWL. EL.1,336m
LWL. EL.1,323m
Maussakelle A
Lower Dam
HWL. EL.1,349m
LWL. EL.1,339m
Waterway (Underground)
Maussakelle B
Waterway (Underground)
Gawarawila East
Maussakelle A
Powerhouse
(Underground)
Powerhouse
(Underground)
Maussakelle A, B
Upper Dam
HWL. EL.1,823m
LWL. EL.1,813m
SRIPADA ADAVIYA SANCTUARY
SANCTUARY
(AVIYA)
NUWARA ELIYA DISTRICT
RATNAPURA DISTRICT
RATNAPURA DIVISION
Doturugala
MORAY ESTATE
(CORFU Division)
GARTMORE ESTATE
(ELVYS DIVISION)
GARTMORE ESTATE
(FROGMORE DIVISION)
PORDEMORE ESTATE
Co-operative Shop
Morca Tamil School
Garthmore Tamil School
Dispensary
Op Turpentine
Line Rooms
Factory
0
500m
Appendix 9.6
Maussakelle A, Maussakelle B

Halgran 2

Halgran 1

Powerhouse
(Underground)

Waterway (Underground)

Powerhouse
(Underground)

Waterway (Underground)

Halgran 2 Upper Dam
HWL. EL.1,375m
LWL. EL.1,343m

Halgran 1 Lower Dam
HWL. EL.655m
LWL. EL.642m

Halgran 2 Lower Dam
HWL. EL.653m
LOW. EL.642m

Halgran1 Upper Dam
HWL. EL.1,264m
LWL. EL.1,243m

Kumbukwela
Tobacco
Netugaha
Palugama
Pallewela
Ilukpelessa
Rupaha
Amunupitiya
Mathetilla
Maliyedda
Elahetanna
Gonabokka
Manthritenna
Pedigama
Ilukpatana
Embulanpaha
Kurupanawela
Wattekumbura
Ambaliyadda
Dambagolla
St. Leonards (Medawatta)
Thennewatta
Watulanda
JWALAPANE DIVERSION

N

0 500m

Appendix 9.7

Halgran 1, Hargran 2

Halgran 4 Upper Dam
HWL. EL.1,218m
LWL. EL.1,166m

Halgran 4

Powerhouse
(Underground)

Waterway (Underground)

Halgran 3 Lower Dam
HWL. EL.714m
LWL. EL.693m
Halgran 4 Lower Dam
HWL EL.726m
LWL. EL.720m

Halgran 3 Upper Dam
HWL. EL.1,406m
LWL. EL.1,384m

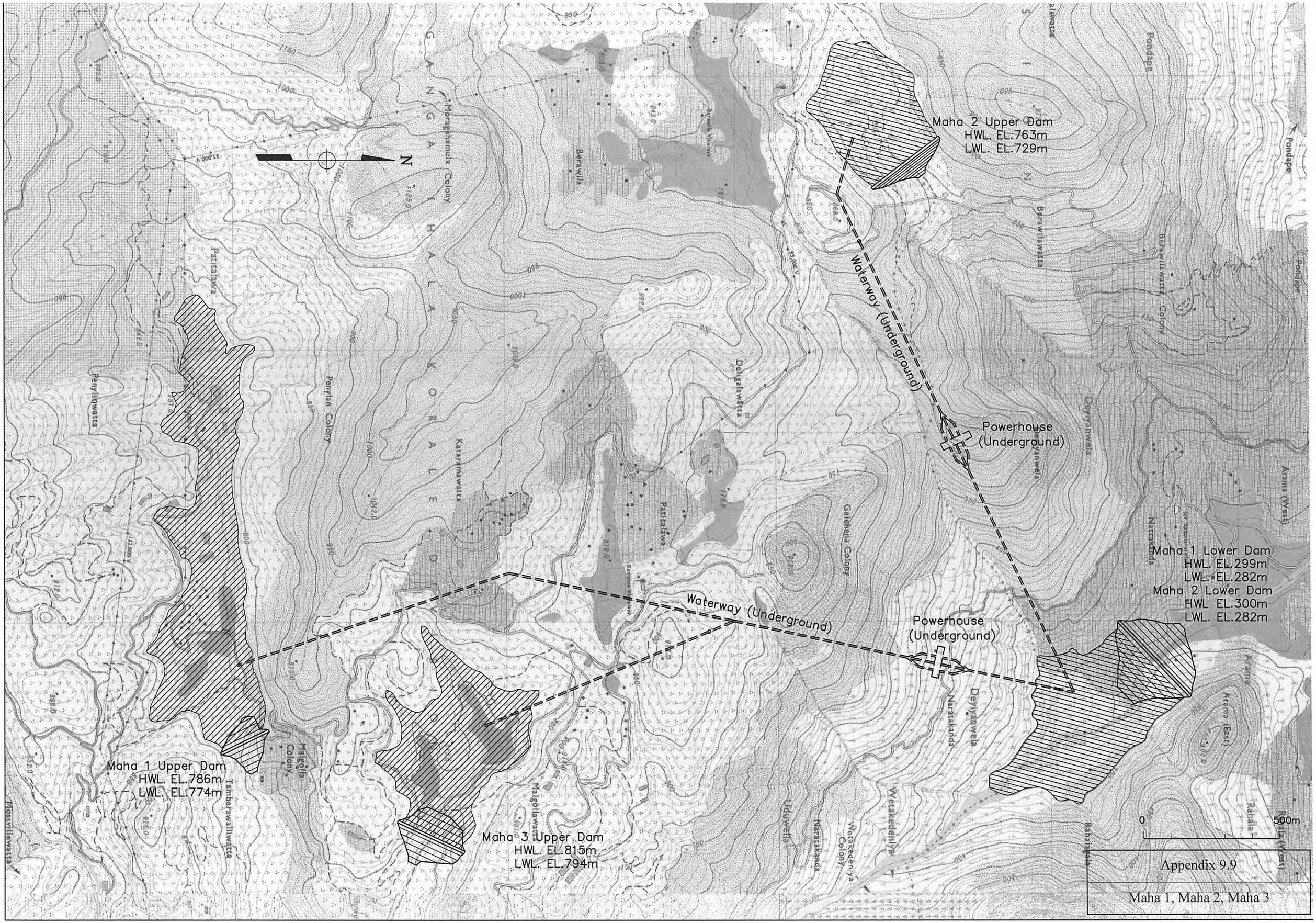
Halgran 3

Powerhouse
(Underground)

0 500m

Appendix 9.8

Halgran 3, Hargran 4


Maha 2 Upper Dam
HWL. EL.763m
LWL. EL.729m
Waterway (Underground)
Powerhouse
(Underground)
Maha 1 Lower Dam
HWL. EL.299m
LWL. EL.282m
Maha 2 Lower Dam
HWL. EL.300m
LWL. EL.282m
Waterway (Underground)
Powerhouse
(Underground)
Maha 1 Upper Dam
HWL. EL.786m
LWL. EL.774m
Maha 3 Upper Dam
HWL. EL.815m
LWL. EL.794m
N
0
500m
Appendix 9.9
Maha 1, Maha 2, Maha 3

N

Loggal Lower Dam
HWL. EL.410m
LWL. EL.383m

Powerhouse
(Underground)

Waterway (Underground)

Loggal Upper Dam
HWL. EL.996m
LWL. EL.983m

0 500m

Kolalawatta
Polwatta
Watagammana
Uda-Ellegama
Kalugahakandora
Pitamaruwa
Kolgoda
Wattegedara
Wewathenna
Siyambalagaslanda
Ellalanda
Kendeththemankada
Siyambalagahalanda
Sooriyagolla
Kudagala

Appendix 9.10

Loggal