Sri Lanka® Carbon Crediting Scheme

Carbon Management Assessment (CMA)

Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project

Eagle Power (Pvt) Ltd
No: 9, Modarawila Industrial Zone, Panadura, 12500, Sri Lanka.
Tel: +94385593000 | +94701834108
Email: sithara@anunine.com | Web: www.anunine.com

Project Title	*Maduru oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project*
Version	*03*
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Project proponent/s	*Eagle Power (Pvt) Ltd*
Prepared By	*Sithara Sewwandi*
Contact	*No: 9, Modarawila Industrial Zone, Panadura, Sri Lanka.* *Tel: +94385593000* *Emai: sithara@anunine.com* *Web: www.anunine.com*

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1. Description of Project Activity

1.1. Introduction of Project Activity

The project activity titled 'Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project' is located in Polonnaruwa district, Dimbulagala Divisional Secretariat Division. The Maduru Oya Left Bank Irrigation System is fed by a lined main with several Brach Canals to release water for seasonal crops. Maduru Oya Reservoir is a major reservoir managed by Mahaweli Authority having a Project Manager and site level technical staff for Operation and Maintenance of the system. Proposed Project is located in the Left Bank Main Canal Regulator 09, at 24 + 140 taking into consideration of the available drop.

The purpose of the proposed project is to abate GHG emissions by generating clean electricity through the irrigation canal of an existing reservoir, Maduru Oya. The project supports Sri Lankan government policy which promotes the development of renewable energy technology. It also contributes to the decreased dependence on fossil fuel-based thermal power plants.

Location	Capacity	Costs of the Project
Regulator cum drop structure 9, at 24 + 140 of LB Main Canal	2000 kW	130 MSLRs

The project is technically feasible and economically viable. The Internal Rate of Return (IRR) for the project is more than 16% after paying a royalty (27%) to MASL.

The project will not cause any adverse environmental impacts as canal water is using for power generation. Due to proposed versatile equipment and automatics, there will be no interruptions to the canal flow and the water issue directive by the PM will be adhered.
Mahaweli Authority of Sri Lanka will have unfettered access to check the project during construction and operations on proper usage of the assets.

The project area is not environmentally sensitive since it already has been disturbed by human activities since the inception of the Mahaweli irrigation system. The environment of the area is a disturbed grassland and secondary forest vegetation. No unique flora or fauna exist in the area.

Maduru Oya drop 9 project is located at the 24+240 m location of the left bank main canal. Discharge of the location is approximately 22.0 m3/sec and a fixed head of 11.0 meters. Capacity of the project is 2.0 MW, and the output in average is 6009.36 MWh annually.

Existing drop structure is having 2 regulator gates for water level operations of the canal for a given discharge. LB canal is a well maintained concrete lined canal.

Parameters related to the power project

Hydrology

Maximum discharge observed	19.3	cumecs
Minimum discharge observed	1.01	cumecs
Average mean discharge	11.55	cumecs

Rainfall	1000 – 4000 mm

Canal regulator cum drop head

Maximum	11.5 m
Designed head	11.0 m
Outlet canal water level	78.0 m

Proposed power plant

Installed Capacity	2 MW (as proposed in LOI)
Expected Energy Output	6009.36 MWh annually
Type of the turbine	Dual operation Kaplan – Vertical Bulb turbine or K-tec.
Efficiency of the flow variation	60%
Generation	Synchronous/semi umbrella type
Generating Voltage	6.6 kV
Frequency	50 Hz
Line of connectivity and Voltage	500 m/ 33 kV

Cost and financial status

Total Project Cost	130 m SLRs
Equity of the Project Proponent	40 %
Lending Banks	60 %
Internal Rate of Return	> 18.46%
Royalty to MASL	27 % from generated power

Operational Conditions

Water operations - as per MASL seasonal operating plans/RPM sys 'B' directives

Parameter of Project and E & M equipment

Hydrology

Reservoir full supply level	96.0 m msl
Minimum operating level	84.5 m msl
Maximum observed discharge	36.11 m^3/sec
Designed discharge	22.0 m^3/sec
Head variation	18 ~ 6 m

Turbine Inlet valve

Type	Butterfly
Diameter	2.6 m

Turbine

Type	vertical shaft – Kaplan
Maximum net head	18.0 m
Minimum net head	06.0 m
Rated net head	16.0 m
Rated speed	350 rpm

Runaway speed	750 rpm
Power at rated head	2500 kW
Power at the maximum loading	3000 kW
Sense of rotation	anti clockwise

Generator

Phase	Three
Frequency	50 Hz
Rated Voltage	6600 V
Maximum output	3000 kVA
Power factor	0.9 lead or lag
Synchronous speed	350 rpm
Runaway speed	750 rpm

Main transformer

Frequency	50 Hz
Phase	three
Rated voltage	6.6 kV/33kV
Rated output	3000 kVA
Power factor	0.9 lead or lag
Off lo dap changer	- 10% to + 10% in steps of 5

Scope of work

Following items have been identified for the preparation of technical feasibility report. Each of these items has been prepared by experienced consultants to meet the objectives of the Projects.

Detailed field Survey

- Including access roads, physical situation of the terrain and other important features
- Contours at 0.5 meter interval and where necessary 0.25 meter interval to identify the area
- Incorporation of the project structural features after designs
- Comprehensive plan of the project area including all above at 1:1000 scale for the lease agreement

Detailed geological survey

- Foundation and sub-surface condition of all the proposed structures
- Geological analysis report on stability of structures and slopes
- Drilling and analyzing core samples where necessary
- Soil conservation and drainage protection measures
- Preparation of all geological drawings which will be based for designs

Detailed hydrological survey

- Computation of daily flow discharges at various sequences
- Flow duration curves for normal and critical flow variations
- Maximum and minimum flow discharges and its duration and variations

- Compute all required flow patterns for turbine designs to obtain the maximum energy output at the highest efficiency
- Flood and drought flow analysis

Selection of Electrical and Mechanical equipment

- Finalization of turbine/generator systems with hydrological information with head variations
- Other ancillary equipment
- All basic parameters and drawings for the commence of civil drawings
- Efficiency, protection systems, general specification standards for the acceptability to CEB regulations

Conceptual civil designs and drawings

- Designs of the Power House, inlet outlet canals and other features using above data 1, 2, 3 and loading systems
- Preparation of conceptual drawings considering the E & M components
- Computation of quantities
- Unit rate analysis considering the variation trends

Cost, financial and economic calculations and analysis

- Projected costs with price variations and dollar fluctuations
- Equity partnerships, banks loans, any other funding arrangements with interests, dividend and other arrangements
- IRR and Cost Benefit ratios for various situations and sensitivity analysis
- Analysis on sensitivity of debt service cover
- Analysis of tax benefits, insurance cover, royalties, discounted rates, bank rates and tariff rate variations
- Comprehensive financial report with economic benefits

Project Management with issuing guide lines, supervision and coordinating all consultancy works including analysis according to RFP and other state requirements and preparation of final reports

- Rate analysis for all civil works, taking out quantities for the preparation of cost estimates for structural components separately
- Preparation of contract documentations for out sourcing contracts with agreements
- Progress monitoring with quality control assurance of all the items of project
- Certification of payments cost variation, additional works identifications and project criticality analysis
- All co-ordination of activities with MASL, CEB, CEA, and other relevant organizations to perform the functions.

Irrigation water supply

Left Bank sluice provides water to an extent of 18,000 Ha of land at present for seasonal irrigational crops. Water provision is through a lengthy lined Main Canal and several sub canals to meet the gravity water supply to farm lands owned by farm families. At 24 + 140 km of the main canal, proposed project received water after distributing to several Branch Canals viz., LBL1, LBR1, LBL2, LBL3, and LBR2. Due consideration will be given not to interrupt the water supply to feed irrigation sub canal system.

Irrigation canal distribution system

There is a commitment by the MASL to provide timely irrigation water for seasonal crops agreed with farmer organizations. Seasonal water operational plans prepared by the Water Management Division of MASL with the concurrence of farmers and relevant officials will be strictly adhered to meet the economy and the livelihood of farm families. Traditionally there will be two irrigation seasons viz., Yala and Maha. Yala season prevails from April to August and Maha from October to March. These seasons are aligned with South West (April/June) and North East (November/February) monsoons. The average rainfall varies from 1000 mm to more than 5000 mm per year in the project area. Temperature is moderately high above 30 C and humid.

For last 20 years since completion the Project is in operation without any draw back supplying the required water for irrigation facilities. Water supply is assured for many years to come as the project is expanding to meet the irrigation facilities for 24,000 Ha at the full development. Reservoir water supply is assured, as in addition to the catchment water during monsoons, a firm diversion is made from Ulhitiya – Rathkinda reservoir to Maduru Oya through a link tunnel.

Hydrological and Power analysis

Maduru Oya LB canal is fed by Maduru Oya reservoir having a catchment area of 453 Km^2. The reservoir has an active storage reservoir volume of 473.5 mcm for irrigation water usage. In addition to the natural catchment, there is also a tunnel, which diverts water from the River Mahaweli Ganga, through Ulhitiya –Rathkinda to Maduru Oya Reservoir. This link tunnel has a maximum capacity of 34m^3/s. Total inflow to Maduru Oya is approximately 550 mcm for a year.

The Left Bank Canal has been designed to carry maximum of 56 m3/s of water to irrigate 27.000 Ha of existing and new land under the command of Maduru Oya LB canal. However, approximately 18000 Ha have been developed so far and water release are limited and not reached the maximum. As the records of the canal flow a maximum of 21.66 m^3/sec is being discharged for irrigation of the land from the proposed location and present average is 11.55 m^3/s.

Design Flow of the proposed location

The main purpose of the reservoir operation and canal flows are for irrigation. Therefore, water flow pattern and flow rates cannot be altered to suit electrical power generation. What is to be done is to optimize the proposed electrical power plant under the irrigation flow constraints.

Daily records of water flow through the Maduru Oya Left Bank Sluice were obtained from the Mahaweli Authority of Sri Lanka, the Mahaweli Water Management in Colombo. Daily flow records were available for the period January 1995 to October 2006.

During the field investigations the discharges, in Brach Canals were obtained from the RPM staff to analyse the balance water available at the proposed location. Observed that the canal water level has to be maintained at a desired head to divert water to Branch canals.

Irrigation facilities in LB Canal system

As per original designs, it was anticipated to provide water for 46,750 Ha of new lands and 3,750 Ha of existing lands for irrigation in System B of Mahaweli Project from Maduru Oya reservoir. At

present the LB irrigation development has been completed to a substantial amount and approximate irrigation development is 18,000 Ha. Several branch canals are off taking from the LB main canal to meet the water demand in farm lands owned by individual farm families. Water distribution in this intricate canal system is a complex one and the Project is managed by a Resident Project Manager and supporting staff for operation and maintenance purposes.

Zones	Zone centre	Br-Canals/Main Canal	Land under irrigation / Ha	Present situation
Zone 1	Ellawewa Dimbulagala	LB L1, LB L2, LB L3, LB L4	6100	Developed
Zone 2	Sevanapitiya Senapura	LB L 5	4600	Developed
Zone 3	Sinhapura	LB L 6	2900	Developed
Zone 4A	Aselapura Sapumalpura Ransaratenna	LB R5, LB R6 LB R7, LB L6	6800	Partly developed
Zone 4B	-		2100	Not developed
Zone 5	Damminna Vijayabapura	LB R1, LB R2, LB R3, LB R4	5500	Developed
			~28,000 Ha	~ 18,000 Ha

As per above schedule of irrigation infrastructure facilities, Project water requirement is not at full scale yet. At the full development and the present development water discharge parameters at the sluice are as follows; Observed minimum flows are for domestic purposes during the canal maintenance period.

MADURU OYA LB CANAL AT 24+140 AVERAGE WATER DISCHARGES

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Avg
Mean	19.88	20.03	12.1	15	30.6	29.89	29	22.58	7.31	9.67	19.3	19.8	19.6

LBR1, LBL1, LBL2, LBR2 &LBL3
canals water discharges

LBR1	1.24	1.34	1.45	0.5	2.64	3.54	2.47	2.3	1.01	0.28	1.97	1.16	1.7
LBL1	2.61	2.78	2.43	0.5	2.65	3.67	3.07	3.54	1.28	0.19	2.67	0.89	2.25
LBL2	1.51	1.41	1.42	0.1	0.83	1.08	1.22	0.54	0.23	0.08	1.78	0.74	0.98
LBR2	1.59	1.64	0.56	0.3	3.21	1.89	1.19	1.16	0.23	0.11	2.87	1.44	1.34
LBL3	1.24	2.14	4.04	0.1	1.98	2.17	3.44	2.13	0.62	0.27	2.36	1.04	1.78
Total	11.87	9.31	9.9	1.5	11.3	12.35	11.4	9.67	3.37	0.93	11.65	5.27	8.05

AVERAGE DISCHARGES AT 24+140

Drop 9	8.01	10.72	2.2	13	19.3	17.54	17.6	12.91	3.94	8.74	7.65	14.53	11.55

Characteristic flow values at the sluice for the period are as follows;

Mean monthly flow	19.55	m3/s
Highest monthly flow	36.11	m3/s

Minimum daily flow 1.06 m3/s

At the drop 24+140, flow is less on several Branch Canals are taking off water from main canal. Branch canals are LBR 1, LBL 1, LBL 2, LBR 2, LBL 3. In average 40% of the flow absorb by these canals.

Available mean monthly flow 11.55 m3/sec
Available maximum mean flows during (May, June, July) 18.14 m3/sec
Considering to obtain the proposed install capacity of Design flow is 17.20 m3/sec

Left Bank Main Canal at 24+140 water releases

LB Main Canal at 24+140 will discharge maximum of 33.69 m^3/sec and due to partial development of the irrigation system, it is observed that the maximum discharge so far delivered is 21.66 m^3/sec. Water releases form the sluice are made according to a seasonal operating plan prepared by the MASL to provide crop water requirements during Yala and Maha seasons. As paddy being cultivated to a greater extent with some other cash crops in a scattered manner, observed that the water releases are according to an established pattern related to paddy cultivation.

Yala and Maha seasons are in the months of April to September and October to March respectively. Water issue calendars are finalized with the concurrence of farmer organizations by RPM and water issues are made accordingly to crop water requirements. For paddy cultivation water requirements are varies from initial ploughing period, growing, flowering and riping periods. At the tail end of the cultivation season water issues are made on rotational basis. Each season end, there is a closure period for canal maintenance maximum of one month period. However domestic water requirements are made on farmer organizations requests during maintenance periods. It is expected to generate power as per water releases according to a seasonal operating plan prepared by the MASL.

Data of water issues during 2005/2006 as per Seasonal Operational Plan of MASL

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
LB issues mcm	46.2	55.1	n/a	18.2	88.2	88.5	86.2	78.8	17.7	22.1	6.3	67..0
Average In m^3/sec												
End storage In mcm	355.5	396.5	n/a	490.3	412.8	338.4	226.2	142.4	128.1	213.3	216.5	209.1
Rain fall In mm	494.5	155.3	68.6	123.0	76.4	29.0	-	62.0	167.9	276.8	324.3	60.7

Above table explains the water issues and reservoir storages during last Yala and Maha cultivation seasons. During North East monsoon the inflows are high and reasonable inflows expect during South West monsoon to the reservoir. In addition to the inflow from the Maduru Oya reservoir catchment, Mahaweli water divert from the Ulhitiya/Rathkinda reservoirs to Maduru Oya through a link tunnel. This amount is a substantial quantity to meet the irrigation water requirements in downstream. Mahaweli Authority reserves the right to change the water distribution patterns

according to the situations, such as unexpected rain may tend to reduce the canal flows to save water in the reservoir.

Water releases for last 10 years

Water issue data obtained from the WMS of MASL, EIC of Headworks division Maduru Oya Project was analyzed to check the maximum, minimum, mean and average flows for last 10 years. Flow pattern has been following to an established sequences and observed that From April, there is a steady increase in water releases reaches maximum during May, June and July and observed the minimum during September and October. These issues are for traditional Yala cultivation issues. Then there is a steady increase during November, December, January and February. This pattern has to follow for power generation.

Maduru Oya LB Drop 24+140 Issue (M3 /sec)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	13.46	13.46	13.7	9.762	16.88	17.88	18.49	15.4	7.86	10.29	14.22	15.38
1996	13.62	10.79	4.88	11.5	16.45	15.3	16.74	10	3.25	15.7	17.93	13.91
1997	15.97	13.75	2.61	12.25	17.72	15.45	15.54	8.65	2.16	0.606	12.93	10.06
1998	11.71	11.19	8.93	18.45	18.19	17.33	18.26	11.2	5.68	16	18.61	14.92
1999	8.741	10.72	4.36	13.08	21.67	20.3	20.22	17.5	5	4.222	14.54	13.12
2000	13.83	14.47	5.95	6.016	19.74	19	20.12	17.9	7.54	3.391	2.53	8.132
2001	6.984	9.859	12.2	1.616	15.08	18.1	7.104	1.56	0.64	1.141	8.743	11.56
2002	10.68	11.35	8.61	2.87	17.31	18.58	19.21	19.9	5.08	1.231	11.09	8.38
2003	8.991	9.787	6.39	7.069	20.04	17.97	18.03	16.4	5.21	4.363	12.76	14.73
2004	15.27	14.8	4.85	5.866	20.47	18.96	19.36	17	1.45	1.1	2.148	8.296
Mean	11.93	12.02	7.25	8.848	18.35	17.89	17.31	13.5	4.39	5.805	11.55	11.55
Max	15.97	14.8	12.2	18.46	21.67	20.3	20.22	19.9	7.87	16	18.66	15.38
Min	6.984	9.786	2.61	1.614	15.08	15.31	7.104	1.56	0.64	0.606	2.148	8.13
StDv	2.844	1.806	4.13	4.872	1.95	1.47	3.666	5.33	2.32	5.622	5.364	2.784

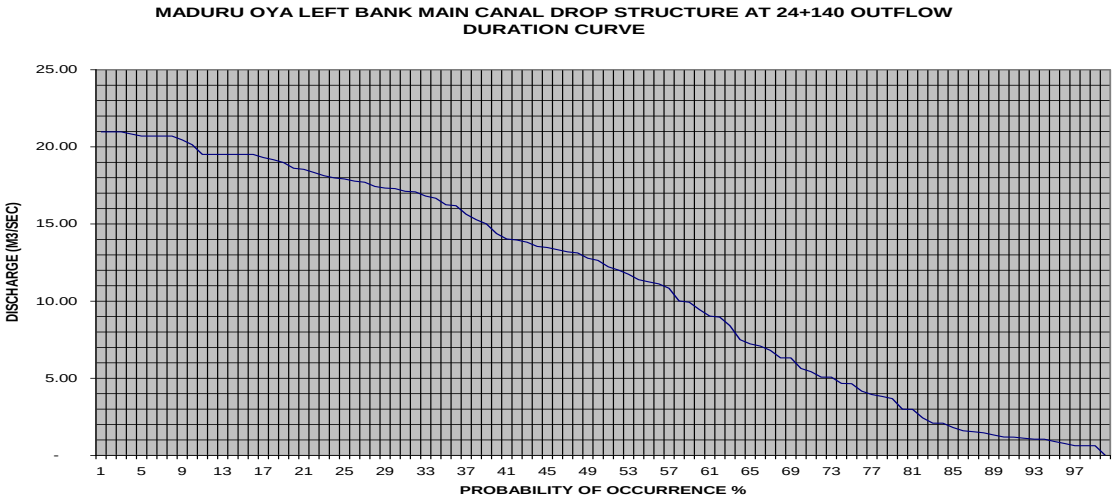
	Maximum flow	Mean flow	Minimum flow m^3/sec
Present situation	21.66 m^3/sec	11.55 m^3/sec	1.01 m^3/sec
At the full development	33.69 m^3/sec	24.81 m^3/sec	2.11 m^3/sec
Designed discharge	48.00 m^3/sec		

Flow duration curve

Flow duration curve has been prepared studying last 10 years flow records at Maduru Oya LB Main Canal at 24+140. As per the present development of the irrigation system flow duration curve explains that maximum of 36 m3/sec has been issued for a short period and minimum of 1 m3/sec during the closed seasons. Following data explains the probability of occurrence of water issues at the sluice.

Probability	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Discharge	31.0	29.0	26.0	23.5	19.0	14.0	9.0	5.0	2.5	1.0

m^3/sec										
Number of days	36	72	108	144	180	216	252	288	324	360



Design head

According to field surveys it is found that there is a maximum head of 11.5 meters. As there is a fixed head, no head variation is possible except limiting to the canal water depth. Only variable factor is discharge. However, the canal water level may vary during the operations. Kaplan turbine, bulb turbine generator or K-tec turbine-generator system is suited for the location. Design head of the power plant is 11.0 meters.

Maduru Oya LB main conveyance is a lined canal designed and constructed to meet the water discharges at various flow conditions having maximum of 56 m^3/sec discharge capacity. Lined canal has following features at the chainage 24 + 140.

Maximum discharge	48	m^3/sec
Canal bed width	3.66	m
Canal slope	0.000167	
Velocity	1.38	m/sec

From sluice upto the proposed location, there are 4 Branch Canal off-takes drawing water for irrigation purposes. Mean discharges of the flows are as follows;

Branch Canal	Mean Discharge m^3/sec
1. LBR 1	1.70
2. LBL1	2.25
3. LBL2	0.98
4. LBR2	1.34

There is an advantage of having a lengthy intake canal to the proposed Power House, which will take the surges at sudden closes for regulation. Sudden regulations on closures of discharges at the turbine produce a water wave or surcharge which moves upstream. Free-board of the canal is

0.75 m and beyond is a compacted earth embankment with turfing. Canal sections are sufficient to take a surge and also arrangements will be made at the existing regulation gate at drop to function on automation during power house closure. The arrangement proposed will not have any unusual surge in the canal.

In the approach canal;

1. Positive surge results from turbine gate closure
2. Negative surge releases from increase in turbine opening

In tail race canal;

1. Positive surge results due to the turbine gate opening
2. Negative surge results due to turbine gate closure

Water releases as per Mahaweli System B Project Managers directives is mandatory. Power House turbine arrangements will be adjusted to meet these requirements, without interrupting the flows in Brach Canals. Consultants have proposed to conduct detailed designs on automation of the entire canal gates to meet the smooth water releases for irrigation waters. Automation will be at;

1. Existing Maduru Oya Sluice gate
2. All Brach canal off takes; LBR 1, LBL1, LBL 2, LBL 3
3. Regulator cum drop gate at 24 + 140

1.2. Sectoral Scope and Project Type

Sectoral scope 1, Type I, AMS-I.D, Grid connected renewable electricity generation, Version 18.0

1.3. Project Proponent

Organization Name	*Eagle Power (Pvt) Ltd*
Contact Person	*Kapila Wijesekara*
Address	*No: 09, Industrial Zone, Panadura, Sri Lanka*
Title	*Director / General Manager*
Telephone	*0773822454*
Fax	*0384282780*
E-mail	kapila@ethimale.lk

1.4. Other Entities Involved in the Project

Organization Name	*Anunine Holdings (Pvt) Ltd*
Role in the project	*Mother company of Eagle power (Pvt) Ltd*
Contact Person	*G.A. Sithara Sewwandi*
Address	*77, Sri Saranankara Rd, Dehiwala-Mount Lavinia.*
Title	*Sustainability Analyst*
Telephone	*0703672748*
Fax	-
E-mail	*sithara@anunine.com*

1.5. Location of Project Activity

Project falls within System B of Mahaweli Project and;

- Authorised Officer - Resident Project Manager (System B)
- Mahaweli Unit Manager office – Medagama
- Mahaweli Block Manager office – Sevanapitiya & the general information is as;

The project site is located at 324 km from Colombo.

Location of Project Activity	*Maduru Oya Left Bank Main Canal Sluice*
Province	*North Central Province*
District	*Polonnaruwa*
DS Division	*Maduru Oya*
City/Town	*Aralaganwilla*
Community	*Medagama*
Coordinates	*Latitudes 7^0 86' 11 52" N* *Longitudes 81^0 16' 37" E*

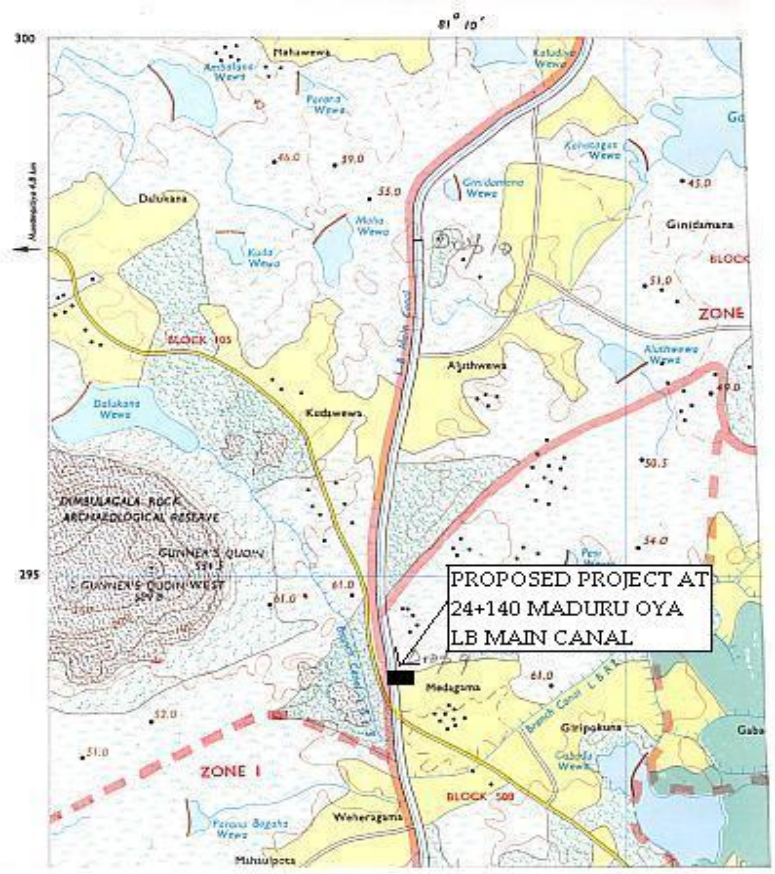


Figure 1 : Location Map
Source: Survey Department

1.6. Project Ownership

The project is fully owned by Eagle Power (Pvt) Ltd.

1.7. Project Fundings

No any funds capitalized on the development of this project.

1.8. Project Start Date

Starting date of the Maduru Oya Left Bank Main Canal Drop at 24+140 small-scale Hydropower project activity is **12th August 2008 (**This was the date when first real action

was taken by PP and Letter of Award for construction of access road to the power house was made along with the advance payment to the contractor**)**

1.9. Project Commissioning Date

The project was successfully commissioned on 19th December 2013

1.10. Project Track

The Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydropower project intends to be registered under track II and issued carbon credits from project will only be used for internal offsetting of emissions.

1.11. Project Crediting Period

The project crediting period is 1st of March 2021 to 28th of February 2028 and totally 7 years renewable. It is notable that at the time of project registration, seven (07) years from the total lifespan of the project has already elapsed. Hence the project's renewable crediting period would be limited two seven (07) year crediting period starting from 1st of March 2021. This may be validated at the renewal of the crediting period of the project activity.

1.12. Scale of Project and Estimated Emission

Project Scale	
Small	√
Large	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2021.03.01-28.02.2022	4512
2022.03.01-28.02.2023	4512
2023.03.01-29.02.2024	4512
2024.03.01-28.02.2025	4512
2025.03.01-28.02.2026	4512

2026.03.01-28.02.2027	4512
2027.03.01-29.02.2028	4512
Total estimated ERs	31584
Total number of crediting years	07
Average annual ERs	4512

1.13. Description of the Project Activity

This project has introduced new proven environmentally safe technology imported from England. Therefore, this project will help transfer the technology from eastern countries to the country.

This project has been using an environmentally safe and sound technology while contributing the improvement of the environment through reducing the emissions from thermal power plants such as SO_x and NO_x pollution in addition to the reduction of CO_2 emission.

Most of the equipment such as turbine, alternator, electrical switchgear etc. has been imported from China and India. All civil works were carried out using locally available materials.

1.14. Conditions Prior to Project Initiation

In the pre-project scenario, there were no any hydropower plant belonging to project participant in that region and this plant is “Greenfield" plant. Therefore, electricity producing by new power plant should have to be produced using fossil fuel consumed power plants since further exploitation of large-scale hydro resources are difficult due to social, economic and environmental impacts associated with the development.
The baseline in the absence of the construction of the new hydropower plants is electricity from grid.

The main purpose of investing for this project activity by Eagle Power (Pvt) Ltd to offset the GHG emission within the Anunine Group of Companies. Korean SPA Packaging (Pvt) Ltd, Atire (Pvt) Ltd Korean SPA Accessories (Pvt) Ltd and Ethimale Plantation (Pvt) Ltd is subsidiary under the group of Anunine Holdings willing to offset their carbon emissions from Sri Lankan Certified Emission Reduction units (SCERs) received from Eagle Power (Pvt) Ltd hydropower project.

1.15. Compliance with Laws, Statutes and Other Regulatory Frameworks

In terms of regulations in Sri Lanka, small scale hydropower projects require approval from the Central Environment Authority (CEA) which looks at both environment and social aspects. In order to get the approval developer should prepare an Environmental Impact Assessment (EIA) report and submit to the CEA. This EIA report corresponds to a TOR provided by the CEA and CEA visits the site with a team of experts and grants approval for the project if they are satisfied, after obtaining all necessary clarifications.

The project developer has already obtained Environmental Clearance from the CEA. The preliminary findings of the EIA reflect that the adverse environment impacts of this project are negligible. No significant mitigatory measures are required for this project.

1.16. Participation under Other GHG Programs

The project has not been registered, or is seeking registration under any other GHG programs.

1.17. Other forms of Credit

The project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

1.18. Sustainable Development

This renewable electricity generation facility is able to reduce the contribution from thermal electricity generation to meet the electricity demand. Unlike in thermal power plants, this project will positively contribute to the electricity demand without compromising the ability of future generations to meet their own needs. Therefore, this renewable energy project is a positive step toward sustainable development. The national sustainable development criteria are,

1) Environmental well-being

2) Economic well-being

3) Social well-being

4) Technological well-being

Environmental well-being

The project contributes to an improvement of the local environment through reducing emissions such as SO_x and NO_x from thermal power plants which have to be operated to generate an equal amount of power using thermal sources if this project is not implemented.

Economic well-being

Discontinuing the use of fossil fuel saves foreign exchange since the entire quantity of fossil fuel requirement is imported to the country.

Social well-being

Good amount of employment opportunities had been created for the local workforce during the project construction phase. The project after implementation provides employment opportunities for the local populace in a sustained manner over the project life time. The enhanced employment opportunities created by this project activity will lead to alleviation of poverty, and eradicate unemployment.

Technological well-being

This power plant has been erected as a fully automated power plant. The project activity has used of the reliable and proven technology available locally to ensure that an environmentally safe technology is only being implemented in this project activity.

1.19. Leakage Management

There is no any fossil fuel consumed operation at the plant during project activity and no any equipment or material transferring from outside for this project.

1.20. Commercially Sensitive Information

No commercially sensitive information has been included in this project scope.

2. Environment Impacts

2.1. Analysis of environmental impacts

In terms of regulations in Sri Lanka, small hydropower projects require approval from the Central Environmental Authority (CEA) which looks at both environmental and social aspects. Developers should prepare an Environmental Assessment Report and submit to the CEA for approval. CEA grants approval for the project if they are satisfied, after obtaining all necessary clarifications.

Then this project has received the Environmental Clearance from the CEA.

These clearances by CEA reflect the finding that the environment impacts of this projects

Hydropower plant	Capacity rating (MW)	Date of environment approval received from CEA
Maduru Oya drop at 24+140	2	31st December 2007

is negligible.

The general and specific conditions of approvals of the EAs are in most instances generic, i.e., guidance on minimizing impacts of site preparation. Also, all projects require an environmental monitoring plan that covers surface water (not relevant in practice for run-of-river projects), flora and fauna within the river and below the diversion point, river bank erosion, and sediments upstream of the weir.

The noteworthy specific condition to the project site is summarized below.

- No damage to the rock boulder deposits in the upstream area from the weir
- Maintain the downstream in proper condition, a continuous uninterrupted flow of 30 litres/sec shall be maintained
- Adhere to the approved trace of the transmission line route identified by the CEB
- Solid waste associated with the work force shall be disposed of in consultation with the local authority
- Shall adapt appropriate conservation methods to stabilize any disturbed slopes
- Sediments collected at the weir site and accumulated in the setting basin should be disposed in controlled manner
- Soil conservation techniques should be adapted in controlled manner
- Should be incorporated in the design at the mouth of intake to prevent entry of fish into conveyances system and build overpass of the open head race canal to facilitate movement of small terrestrial animals

2.2. Environmental impact assessment

The environmental impacts of this project are not considered significant.

3. Local Stakeholder Consultation

3.1. Stakeholder Consultation Process

There should be some public involvement to ensure that critical issues are identified and that local information about the project area is gathered and that alternative ways of achieving the project objectives are considered. Public involvement could be used to avoid biases inaccuracies in analysis to identify local values and preferences to assist in the consideration of mitigation measures and to select the best practicable alternative.

Eagle Power (Pvt) Ltd had expressed their plan to develop the proposed 2 MW grid connected project and called for the suggestions/comments of the local stakeholders. In line with the public notice, a meeting was held on 7th November 2008. Stakeholder consultation for the project activity has been conducted to account for the views of the people impacted either directly or indirectly due to the project activity as well as impact to the environment. This has been carried out at all levels of stakeholders

The stakeholder consultation process of Maduru Oya LB Main Canal Drop at 24+140 Hydropower project started with the identification of most relevant stakeholders to the project. It was found that the several types of stakeholders with different social status were interested in the project.

3.2. Summary of Comments Received

Director and consultant of Eagle Power (Pvt.) Ltd. made a detailed description of the project activity. A series of questions were raised by the participants and majority of them were focused on the possible environmental impacts. In response to them, consultant of project activity described the actions planned to be taken to prevent possible negative environmental impacts. Further the participants were presented with the credentials of stipulated environmental clearance obtained from the relevant authorities. Then villagers were more curious in knowing the advantages and benefits of the project. The participant were convinced that job creation and infrastructure development would be a key outcome of this project. With that insight, participants did not raise any objection against the development and implementation of the project.

3.3. Consideration of Comments Received

Not Applicable

4. Eligibility Criteria

4.1. General Criteria

Sub Section	Eligibility Criteria	Project Activity	Yes/No

4.1.1	The project activity shall be a new project, which will reduce/absorb GHG emissions or the project activity shall be a project, which was implemented on or after 2010 in order to offset GHG emission within the organization.	The project was implemented after 2010 and SCERs are used to offset in-house GHG emission.	Yes
4.1.2	The project activity shall be located in Sri Lanka.	The project is located in Sri Lanka	Yes
4.1.3	The project activity shall not happen in the absence of benefits received from trading Sri Lanka Certified Emission Reduction units (SCERs). (This is not applicable Track II)	SCERs are used for in-house offset	Not applicable
4.1.4	The project shall be implemented voluntarily by the project owner but not implemented based on legislation or regulations in the country	This was a voluntarily implemented project activities and no any legislation from the country to implement this project activities	Yes
4.1.5	The project activity satisfies environmental standard and regulations of the country	This project was implemented as per the environment regulations in Sri Lanka.	Yes
4.1.6	The project shall not have been registered under any other national or international scheme. However, if a registered project under other scheme is willing to register with SLCCS, then, such project shall be deregistered from the other scheme in order to be eligible	This projects has not been registered under any other national or International Schemes.	Yes

4.2. Bundling Criteria

This project is not identified as a bundle project. Hence, this section is not applicable.

5. Application of Methodology

5.1. Title and Reference of Methodology

AMS-1.D "Grid connected renewable electricity generation" Version 18.0

Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, version 03.3

5.2. Applicability of Methodology

The project that is introduced in this report is a new hydro power project that is applicable under “clause 4 (a) Install a Greenfield plant” of the AMS I.D./Version 18/EB 81.

5.3. Project Boundary

The project boundary of Maduru Oya Left Bank Main Canal Drop At 24+140 hydropower plant encompasses the physical, geographical site of the power plant and associated physical structure. The project boundary which includes, penstock, turbine and generator, control panel, transformer and national electricity grid of power plant pictorially presented below.

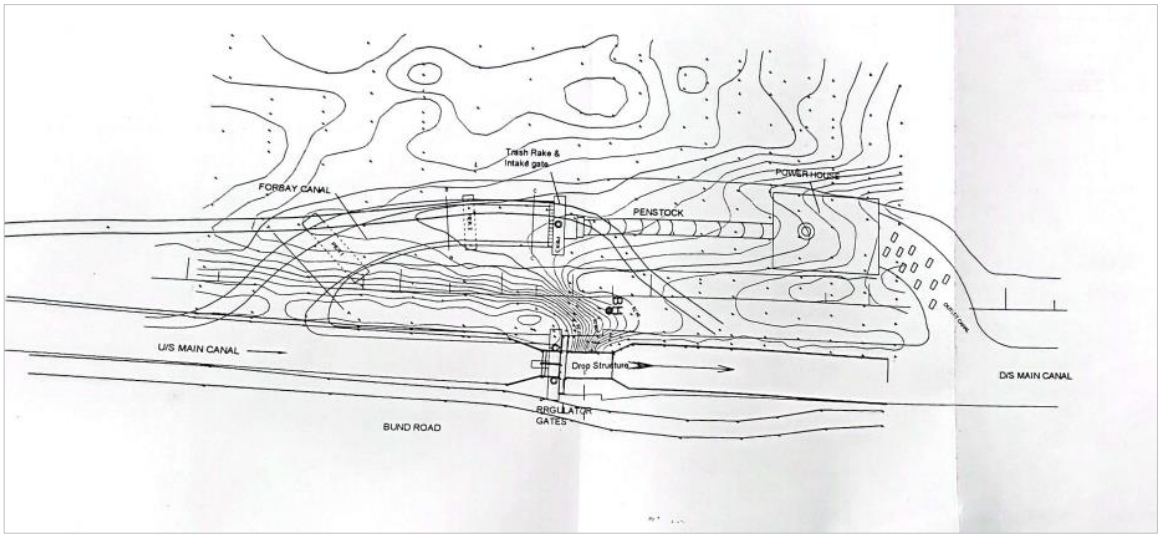


Figure 2: Contour Plan & the general arrangement

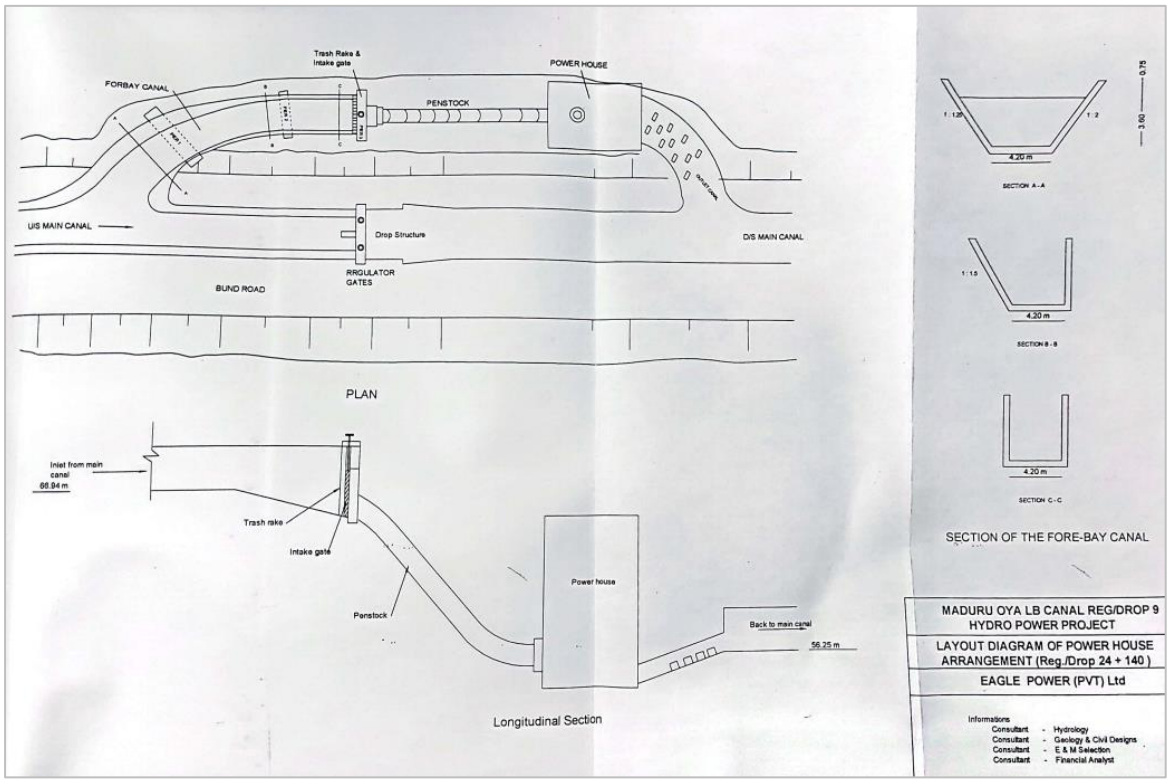


Figure 3 : layout diagram of power house arrangement

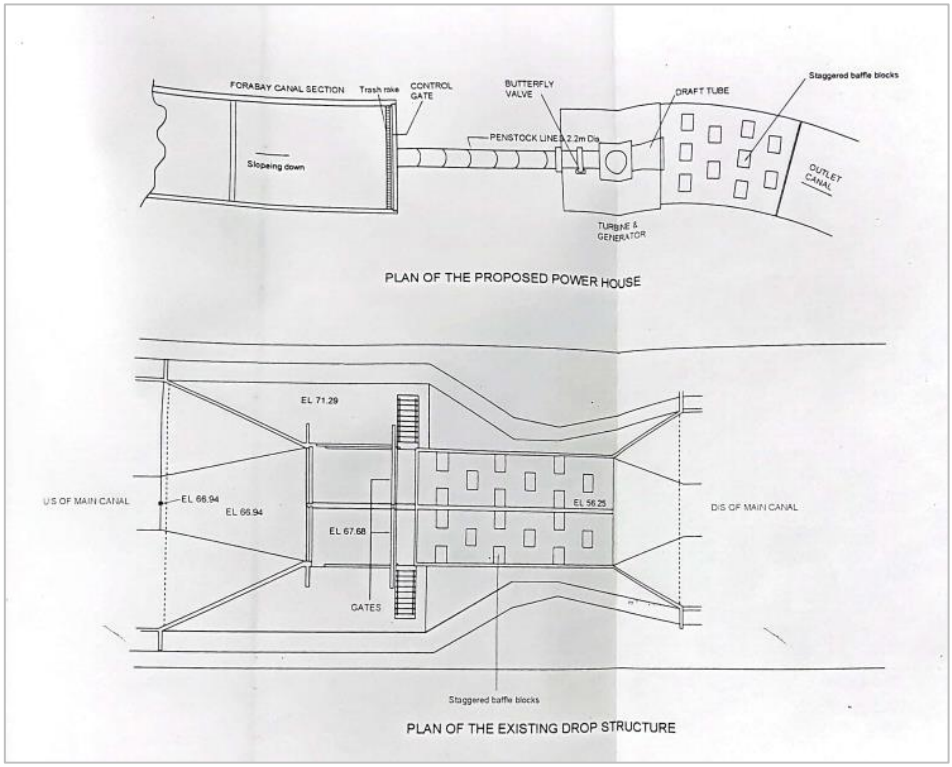


Figure 4 : Plan of the existing drop structure

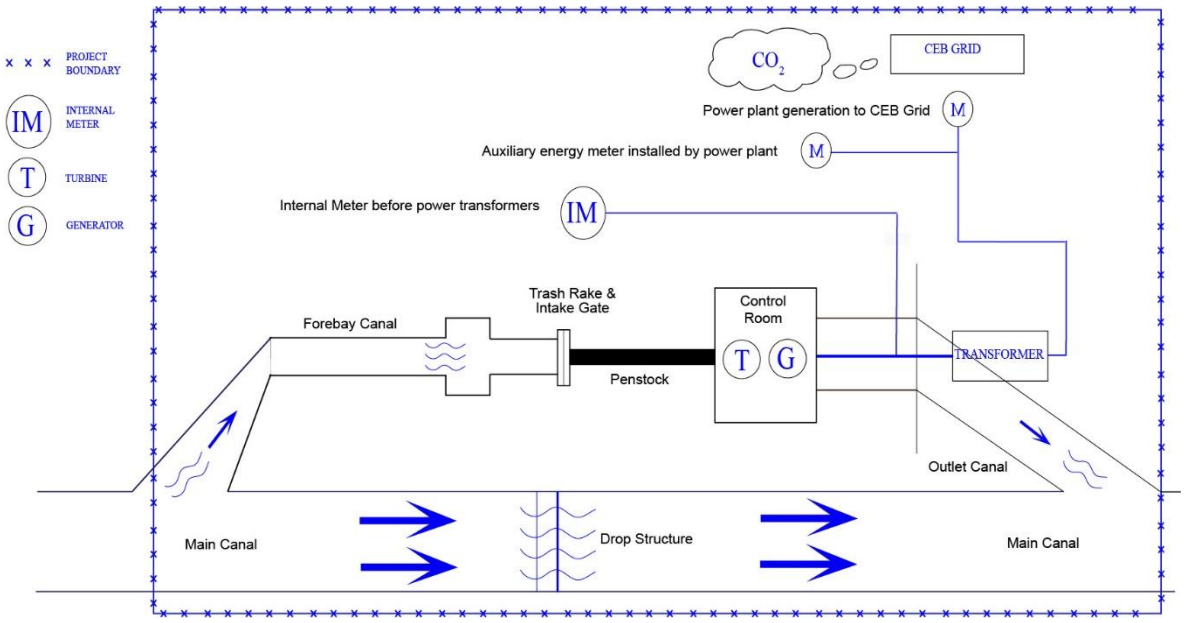


Figure 6 : Project Boundary considered for the project activity

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from fossil fuel fired power plants connected to National Grid of Sri Lanka	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
		Other	No	Minor emission source
Project	CO_2 emissions from burning of fossil fuel in on-site diesel generator	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
		Other	No	Minor emission source
	Emissions from water reservoirs of hydro power plants	CO_2	No	Minor emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
		Other	No	Minor emission source

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5.4. Baseline Scenario

Prior to this project activity there was no hydropower plant at that location hence this is a greenfield plant. Absence of this project, the amount of electricity generated by the project

should be produced using fossil fuel fired power plants connected to national grid. So the baseline is electricity produced by power plant connected to national grid.

5.5. Additionality

The project is intended to be registered under track II. Therefore, additionality is not necessary to be demonstrated.

5.6. Methodology Deviations

Not Applicable

6. Quantification of GHG Emission Reductions and Removals

6.1. Baseline Emissions

The baseline emissions are the product of electrical energy baseline $EG_{Bl.,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{PJ,y} \times EF_{grid,y}$$ Equation (1)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{grid,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Calculation of baseline emission factor

As per paragraph 22 of AMS I.D. Ver18.0, for project activities that do not displace captive electricity generated by an existing plant but displace grid electricity import and/or supply electricity to a grid, the emission factor of the grid shall be calculated as per the procedures detailed in AMS-I.D.

As per AMS I.D, the grid emission factor was calculated using the latest approved version of "Tool to calculate the emission factor for an electricity system" CDM methodology. The

grid emission factor[1] calculated and published by the Sustainable Energy Authority in Sri Lanka for the year 2020 is used in the baseline emission calculation.

6.2. Project Emissions

Project emissions to be considered as per paragraph 39 & 40 of AMS I.D. Ver18.0 and discussion of their relevance for the project are presented in below.

Power plant is to be equipped with a diesel generator as a back-up power source. The emission due to operation of this back-up generator is estimated using the *Methodological tool: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, version 03.0*

As per the tool, the CO_2 emissions from fossil fuel combustion should be calculated based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$ Equation (1)

Where:

$PE_{FC,j,y}$	=	Are the CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (tCO_2/yr)
$FC_{i,j,y}$	=	Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/yr)
$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
i	=	Are the fuel types combusted in process *j* during the year *y*

Tool has also provided guidance on the calculation of CO2 emission coefficient $COEF$

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$ Equation (4)

Where:

$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
i	=	Are the fuel types combusted in process *j* during the year *y*

[1] http://www.info.energy.gov.lk/

Considering the frequency of power cuts and other system emergencies, annual diesel consumption was estimated for the on-site diesel generator as 600 litres. The resulting emission from the combustion of estimated diesel consumption is as follows.

Parameter	Value	Units	Source
Quantity of fuel combustion	600	L	Calculated
	0.6	m^3	
Mass unit/volume unit (Fuel Density)	840	Kg/ m^3	Ceylon Petroleum Corporation (CEYPETCO)
Net Calorific Value (NCV)	0.043	GJ/kg	IPCC Guideline, 2006
CO_2 emission factor	0.0741	tCO2e/GJ	IPCC Guideline, 2006
Project emission from combustion of diesel	1.6	tCO2e/year	Calculated
Rounded emission for conservativeness	2	tCO2e/year	Calculated

As per the ex-ante estimate, the total annual emission from diesel generator is,

PEy = 2 tCO2e/year

Overview of project emissions as per paragraph 39 & 40 of AMS I.D. Ver18.0 and their relevance for the project

Para 39 & 40 of AMS I.D. Ver18.0: Project emissions include:	**Relevance for project activity**
For most renewable energy project activities, *PEy*=0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002. ○ Emissions related to the operation of geothermal power plants (e.g. non condensable gases, electricity/fossil fuel consumption); ○ Emissions from water reservoirs of hydropower plants.	No. As per the latest version of ACM0002, version 10, *Consolidated baseline methodology for grid-connected electricity generation from renewable sources*, the hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents requires to account for CH_4 and CO_2 emissions from the reservoir. The Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project located in the Maduru Oya Left Bank Main Canal Regulator 09, at 24 + 140 has not changed or altered the capacity of the reservoir. In this backdrop, emission from water reservoir is not required to be accounted under the project emissions.

CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.	Yes. A back-up generator has been installed at the power plant to cater to essential power demands in the event of grid failure or sudden power outages. The emission arising from this source has been duly estimated and is reported as a project emission.

6.3. Leakage

As per the paragraph 42 of selected methodology, leakage emission is typically attributable to the operation and processes relating to the biomass project activities. The current project activity does not involve biomass plantation, processing and any treatment after harvesting, hence, no leakage emissions applicable to this project activity.

$$LE_y = 0$$

6.4. Net GHG Emission Reductions and Removals

Emissions reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Since $LE_y = 0$;

$$ERy = BEy - PEy$$

Summary of annual emission reduction calculation

Parameter	Value	Units	Source
Plant Factor	34.3	%	Feasibility Study
Plant Capacity	2	MW	Proposed capacity
Average Energy Output	6009.36	MWh/year	Calculated
Emission Factor	0.7512	tCO2e/MWh	Energy Balance-2020, SLSEA
Emission Reduction	4514	tCO2e/year	Calculated

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2021.03.01-28.02.2022	4514	2	0	4512
2022.03.01-28.02.2023	4514	2	0	4512
2023.03.01-28.02.2024	4514	2	0	4512
2024.03.01-28.02.2025	4514	2	0	4512
2025.03.01-28.02.2026	4514	2	0	4512
2026.03.01-28.02.2027	4514	2	0	4512
2027.03.01-28.02.2028	4514	2	0	4512
Total	**31598**	**14**	**0**	**31584**
Total number of crediting years	7 years			
Annual average over the crediting period	**4514**	**2**	**0**	**4512**

7. Monitoring

7.1. Data and Parameters Available at Validation

The responsibilities of various personnel in the organization in keeping records as follow,

Small hydropower operators monitor plant operation including energy generated and exported to the CEB grid by taking at least daily readings of generation levels and recording them on site. The monthly invoice sent to CEB by the small hydropower developers are cross checked by the CEB with the meter reading taken by the CEB staff and payment made accordingly. These data are also archived at Eagle Power (Pvt) Ltd. office in Panadura as well as the power station sites. The verifier will also be welcome to visit the power station sites and the office in Panadura to confirm the status of operations.

No leakage effects are applicable to the plant's operation as the equipment at the plant has not been moved from any other operational location

Data / Parameter	$EF_{CM,Grid,y}$
Data unit	tCO_2e/MWh

Description	Combined margin CO_2 emission factor for grid connected power generation in year y
Source of data	Energy balance 2020 - Sri Lanka Sustainable Energy Authority
Value applied	0.7512 tCO2e/MWh
Justification of choice of data or description of measurement methods and procedures applied	Methodological tool published by UNFCCC to calculate the emission factor for an electricity system
Purpose of Data	Calculate the emission reduction
Comments	This factor will be applied to calculate actual emission reduction throughout the first crediting period.

Data / Parameter	$\rho_{i,y}$
Data unit	Mass unit/ Volume unit
Description	Weighted average density of generator fuel (Diesel)
Source of data	Values provided by national fuel supplier, Ceylon Petroleum Corporation (CEYPETCO)
Value applied	840 kg/m^3
Justification of choice of data or description of measurement methods and procedures applied	CEYPETCO conducts periodic testing of the specifications of Auto Diesel (A0013L99), which it supplies itself, and publishes the results on its official website for public access and reference. The laboratories owned and operated by CEYPETCO adhere to international best practice guidelines, standards, and protocols.
Purpose of Data	Calculate the mass of fuel consumed by the on-site diesel generator
Comments	This factor will be applied to calculate project emissions attributable to the project boundary

Data / Parameter	$NCV_{i,y}$
Data unit	GJ/kg

Description	Weighted average net calorific value of diesel
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied	0.043 GJ/kg
Justification of choice of data or description of measurement methods and procedures applied	IPCC is an organization attached to UNFCCC publishing periodic reports on climate change and guidelines on national inventory development. As a technical body, IPPC reviews the latest global research findings of scientific communities and consolidate them into useable format through simplified reporting framework. The NCV values for fuel type are periodically published by IPPC for the use of reporting emissions from fossil fuels. Though these values are presented with an uncertainty range, they are recommended to be used in the emission offset calculation in the absence of local data. The locally published fuel calorific value is given by CEYPETCO on a gross basis. As this value needs to be converted into NCV using a conversion factor, the default value given in IPCC was used to minimize the uncertainty.
Purpose of Data	To estimate the energy content of fuel
Comments	This factor will be applied to calculate project emissions attributable to the project boundary

Data / Parameter	$EF_{CO2,i,y}$
Data unit	tCO_2e/GJ
Description	Weighted average CO_2 emission factor of fuel type (diesel)
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied	0.0741
Justification of choice of data or description of measurement methods and procedures applied	As per the CDM methodological tool; *Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*, *version 03.3*, this value can be applied in the emission accounting of fossil fuel combustion.
Purpose of Data	To estimate the energy content of fuel

Comments	This factor will be applied to calculate project emissions attributable to the project boundary

7.2. Data and Parameters Monitored

Data / Parameter	$EG_{p,j,y}$
Data unit	MWh/year
Description	Quantity of net electricity exported to the CEB grid
Source of data	Monthly electricity export and import vouchers (bills) issued by CEB
Description of measurement methods and procedures to be applied	This parameter will be continuously monitored by project participants using an electronic energy meter supplied by CEB. The meter is a bidirectional meter and capable of measuring import and export data at the same time.
Frequency of monitoring/recording	Daily and monthly
Value applied	6009.36 MWh
Monitoring equipment	Energy meters Accuracy class of the meters- class 01 From the developer side there will be two meters installed (of same accuracy class). One would be installed before the transformer and one after, so that the losses can be recorded. These meters will track the electricity generation. While CEB meters will track both import and export of electricity.
QA/QC procedures to be applied	The meter will be properly calibrated and maintained in order to ensure accuracy. Testing/Calibration interval : Annually by CEB Cross checking of the data with the cheque received from CEB for import electricity to the grid
Purpose of data	Calculate baseline emission
Calculation method	The parameter is calculated by deducting the import energy from the export energy
Comments	Monitoring data will be archived for two years after the crediting period.

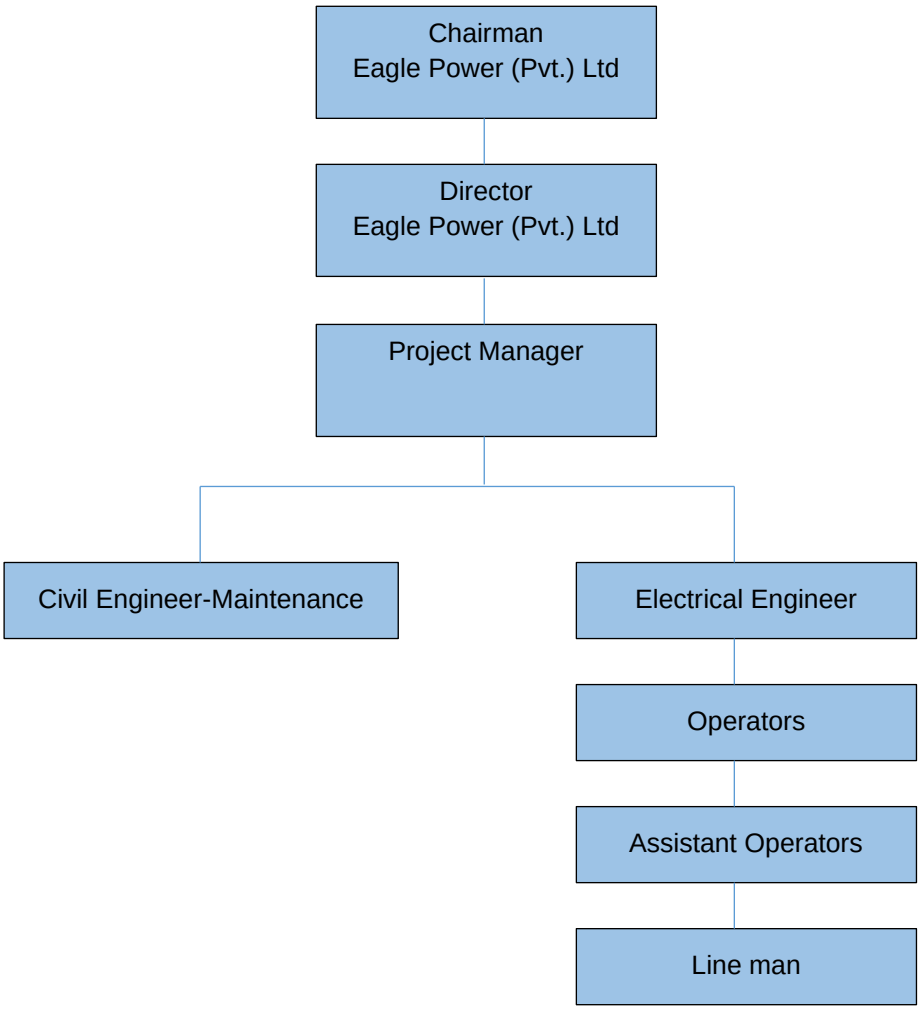
Data / Parameter	$FC_{i,j,y}$
Data unit	L/year
Description	Diesel burnt in the back-up generator
Source of data	Onsite measurements
Description of measurement methods and procedures to be applied	Fuel consumed by generator is measured by a ruler gauge fixed to the fuel tank. Power plant operators/ technicians are responsible for taking monthly measurements of the fuel consumption. A log book is maintained for recording monthly fuel consumption.
Frequency of monitoring/recording	Measurements are taken on monthly basis
Value applied	600 L
Monitoring equipment	Ruler gauge is used to measure fuel consumption
QA/QC procedures to be applied	The fuel gauge will be properly calibrated and maintained in order to ensure accuracy. The fuel quantities consumed by generator is cross-checked with the purchased quantities in the monitoring period.
Purpose of data	Calculate project emission for the operation of on-site diesel generator
Calculation method	N/A
Comments	The recorded data will be reviewed and authorized by the project manager.

7.3. Monitoring Plan

The authority and responsibility for registration and overall monitoring would rest with the Director of the Eagle Waverly Power (Pvt) Ltd. Power plant operational staff team is headed by a Director from VS hydropower, works as consultant for the project, would continue their services, in the capacity of operational and maintenance supervisors after commissioning of the plant. VS hydropower consists an experienced team in various disciplines and would undertake periodic inspections to ensure the quality of the data collected by the team and initiate steps in case of any abnormal conditions.

The project Manager (PM) is responsible for overall operations and maintenance of the power plant. PM is assisted by a well- trained staff including a Civil Engineer-Maintenance, Electrical Engineer as well as operators and assistant operators. Power house operating staff shall operate the plant safely and shall keep records of plant operations. The responsibility of review, storage and archiving of information in good condition would lie with the Plant Manager. Also it is the responsibility of the Plant Manager to make sure that routine maintenance of plant equipment are carried out in line with the instructions given in operations and maintenance manuals provided by the suppliers of respective equipment and recorded in given formats. Plant assistant operating staff is assisted by senior operators whose primary responsibility is to attend to day-to-day works.

Organization Structure



Parameters Requiring Monitoring

The monitoring of all parameters indicated in section 6.2 of the CMA would be monitored under this plan. Necessary documents required for verification of the data would be maintained for later archiving. Using the power exported to the grid, emission reductions would be calculated as illustrated in Section 5.4. Export & Import readings of main meter shall be taken on monthly basis at appointed day & hour (time) by authorized officer and would be reported to the Director. The plant operators would be responsible for taking measurements of fuel consumption of the back-up generator which is operated at the emergence events of the power plant.

Training of monitoring person

The project would employ qualified and experienced persons for plant operations. The project would maintain standard log sheets and formats to record the monitoring parameters. The plant staff would be given proper training to maintain the plant records. The Plant operator would be the designated person to verify, compile and archive all the monitored data. The parameters to be monitored during the crediting period would be provided in a tabular format to the designated person. The Plant operators would be provided with necessary training with respect to maintenance of the relevant monitoring records to enable him/her to deal the monitoring independently. The training would be provided to the monitoring personnel for monitoring of the following parameters:

- Electricity Export
- Electricity Import
- Gross electricity generated
- Parameter of the plant, such as bearing temperature, electrical properties, etc
- Fault/Breakdown recording

Procedures for documentation and storage

Recorded data in monitoring sheets carried out by operators need to be checked by the Project Manager to identify any abnormalities. If any abnormality is noticed, Plant In Charge as well as operators need to take appropriate actions to rectify it. All the abnormalities need to be recorded in the log book maintained at the power house. In addition, regular maintenance work needs to be recorded in the given log books for each section. The day-to-day records are verified by Plant manager and internal monthly report would be prepared for review by the Director. Internal reports are the basic documents for the monitoring and storage of plant operational data. CEB will prepare monthly bills at the end of each month, based on export and import meter reading. CEB has the facility to monitor the readings through online metering system.

Procedures for Corrective actions

The parameters to be monitored during a crediting period would be compiled as internal report for every month of each crediting year and submitted to the Designated Director for review. The parameters include the Gross generation, Auxiliary consumption, Energy

export and Import. The Designated Director would discuss and recommend necessary mechanism to improve the operational efficiency of the plant and directs the respective person to rectify the problem with the consultation from operator team.

QA & QC Procedures

The projects would employ such equipment or instruments that would measure, record, report, monitor and control of various key parameters of the plant. These monitoring and controls would be the part of the Control Systems of hydroelectric plant. For measuring the energy exported / imported main meter and a check meter as required would be in service. The check meter reading will be used to measure electricity export/import in case of failure of the main meter. The CEB officials will replace the main meter immediately on PP request. The meter would be calibrated and sealed at least once a year as per the CEB standard. Records of these test certificates would be maintained for verification. Hence, high quality is ensured with the above parameters. Delivery records would be used and kept for checking the consistency of the recorded data.

The fuel consumption of generator is data to be monitored during the project. These records are periodically collected and verified the Project Manager. Additionally, the fuel consumed by the generator will be cross-checked with the fuel purchased records maintained for the corresponding monitoring period.

Data Storage & Archiving

Export & Import readings from main meter will be collected under the supervision of the Plant Manager. Export and Import data would be recorded and stored in logs as well as in electronic form. The records are checked periodically by the Plant Manager .The period of storage of the monitored data will be 2 years after the end of crediting period or till the last issuance of CERs for the project activity whichever occurs later. The baseline emission factor would be adopted from the CEB published generation data for the latest available year for the CEB grid and the same would be used for the future projection and would be reviewed each year based on data published by the CEB. The monitored data would be presented to an independent verification agency or DOE to whom verification of emission reductions is assigned.

Maintenance of Equipment

All the equipment used in the project activity will undergo scheduled maintenance as specified in the operational manual of the equipment supplier. If meters are found to be defective, it would be tested and calibrated immediately. The defective meters will be replaced immediately by a new meter. The plant Manager is responsible to oversee the maintenance activity on periodic basis.

8. Appendix

Appendix 01: Adoption of a reliable plant factor for ex-ante emission reduction calculation

The ex-ante emission reduction presented in CMA version 02, dated 15 May 2023, was computed using the plant load factor (59%) as provided in the Feasibility Study Report of the Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project. Under the agreed scope of validation assessment, the SLCCS Assessment Team examined the parameters and methodology applied baseline emission calculation and observed that the plant factor utilized in CMA version 02 does not accurately represent the operational efficiency of the power plant. As a result, a corrective action was requested, urging the utilization of a reliable plant factor for the calculation of ex-ante emission reduction. In response, the project team adopted the methodological approach outlined below to establish a reliable plant load factor.

a. Obtained historical energy export data from the management of the power plant
b. Confirmed the accuracy and completeness of the data by cross-checking it with the CEB physical bills.
c. Calculated annual actual plant load factor for the respective years
d. Calculated average of plant load factor for the period considered
e. Applied the average plant factor in the ex-ante emission reduction calculation.

Calculation of Plant load factor

Historical energy generation data were considered for a period of five (05) years starting from 2018 to 2022

	Total Annual Energy Export (MWh)				
	2018	**2019**	**2020**	**2021**	**2022**
Jan	770.796	813.212	727.892	75.138	599.406
Feb	617.02	505.382	746.162	267.541	319.704
Mar	59.484	56.677	412.103	166.229	91.086
Apr	116.329	536.208	1204.022	1118.634	0.342
May	744.257	1071.236	502.009	812.01	831.778
Jun	923.057	908.602	895.838	908.735	1013.286
Jul	1054.132	997.316	560.872	712.962	893.13
Aug	907.628	392.655	0	20.304	741.702
Sep	0	0	0	25.452	443.226
Oct	0	0	441.53	101.97	167.178
Nov	396.273	309.333	651.502	627.924	908.028
Dec	406.003	94.167	275.465	676.146	467.046
Total	**5994.979**	**5684.788**	**6417.395**	**5513.045**	**6475.912**

Note: During the months in which zero is reported, the power plant remained non-operational due to a restricted water flow within the irrigation canal.

Based on the energy export data, actual plant load factor was calculated for each year. Results of this calculation is as follows.

Year	Total Energy export (MWh)	Calculated Plant factor (%)
2018	5994.979	34.2
2019	5684.788	32.4
2020	6417.395	36.6
2021	5513.045	31.5
2022	6475.912	37.0
Average plant factor computed based on the actual annual plant factors		34.3

The calculated average annual plant factor is 34.3%. This factor was applied in the ex-ante emission reduction of Maduru Oya Left Bank Main Canal at 24+140 Drop 9 Mini Hydro Power Project

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