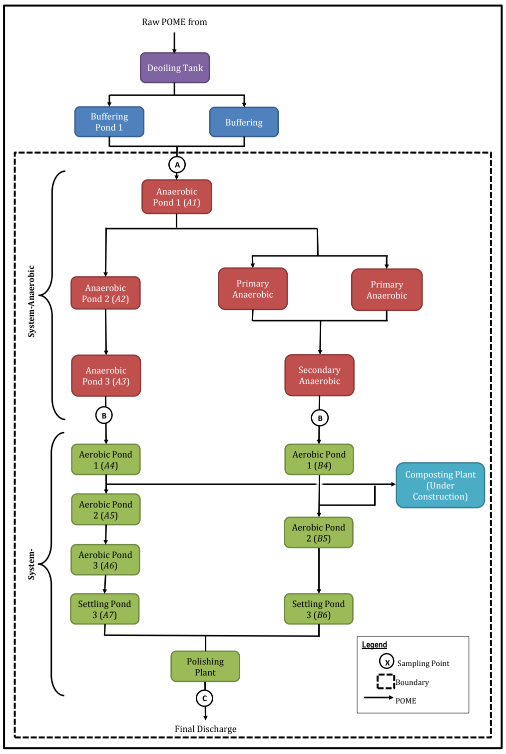
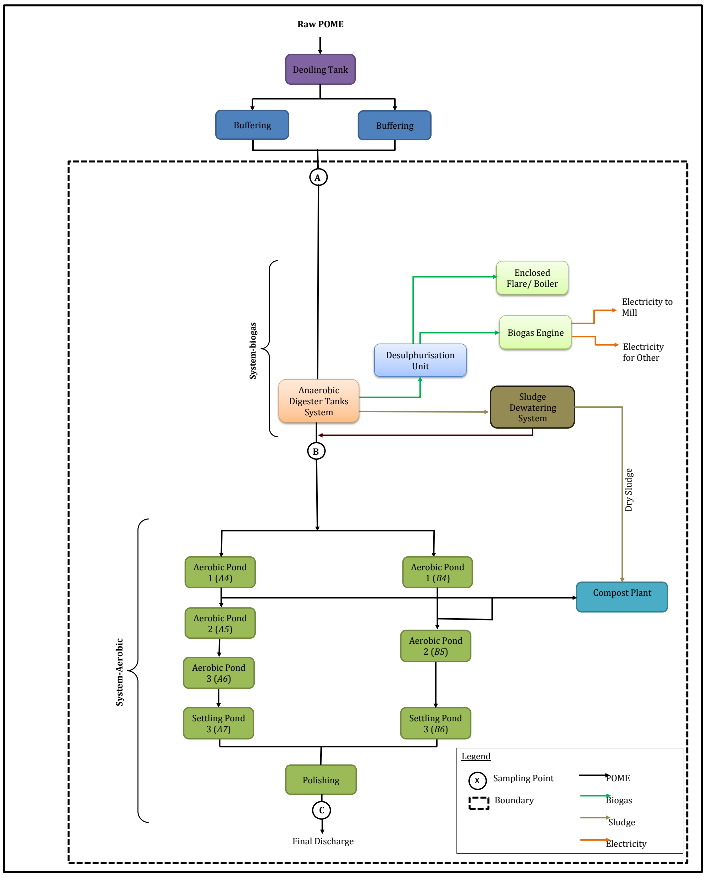
Melewar Palm Oil Mill

Baseline Diagram



Pond Name	Depth (m)
Buffering Pond 1	1.85
Buffering Pond 2	1.85
Anaerobic Pond 1 (A1)	4.25
Anaerobic Pond 2 (A2)	4.25
Anaerobic Pond 3 (A3)	4.25
Aerobic Pond 1 (A4)	1.85
Aerobic Pond 2 (A5)	3.00
Aerobic Pond 3 (A6)	1.50
Settling Pond (A7)	1.50
Primary Anaerobic Pond (B1)	4.50
Primary Anaerobic Pond (B2)	4.50
Secondary Anaerobic Pond (B3)	4.50
Aerobic Pond 1 (B4)	1.85
Aerobic Pond 2 (B5)	3.00
Settling Pond (B6)	1.50

Project Diagram



Baseline Wastewater Treatment System Measurement Campaign

Where historical records of at least one year prior to the proposed project activity implementation are not available, the parameters to calculate the baseline emissions shall be determined by a measurement campaign in the baseline wastewater systems for at least 10 days.

10-days COD Measurement Campaign - Analysis Results

DATE	COD Sampling			Reduction (%) [(Point A-Point B)/Point A]	Reduction (%) [(Point B - Point C)/Point B]
	COD after Acidification Pond (mg/l)	COD after Anaerobic Pond (mg/l)	COD at Final Discharge (mg/l)		
	Point A	Point B	Point C		
12/8/2011	55,332	2,843	710	94.86%	75.03%
15/8/2011	76,541	2,304	708	96.99%	69.27%
16/8/2011	78,445	1,999	758	97.45%	62.08%
17/8/2011	69,414	1,085	532	98.44%	50.97%
19/8/2011	54,206	2,573	613	95.25%	76.18%
20/8/2011	55,385	2,003	628	96.38%	68.65%
22/8/2011	55,778	2,318	546	95.84%	76.45%
23/8/2011	51,992	1,901	497	96.34%	73.86%
24/8/2011	62,856	2,076	411	96.70%	80.20%
25/8/2011	62,080	1,804	411	97.09%	77.22%
Average	**62,203**	**2,091**	**581**	96.64%	72.19%
Uncertainity Factor	0.89	0.89	0.89		
COD Removal Efficiency	55,361	1,861	517	**96.64%**	**72.19%**

Perenia
complete carbon solutions

Inputs for baseline and project wastewater treatment systems				
Inputs for Baseline Wastewater Treatment Systems				
ID	**Value**	**Unit**	**Description**	**Source**
Operating Hours	5,744	hours/year	Operating Hours per year	Average based on Historical Mill Processing (July 2008 - Jun 2011)
FFB Processing per year	384,000	t/yr	Average FFB processing per year	MPOB license
Wastewater generation rate	65%		Amount of wastewater produced per tonne of FFB	NA Ludin et. Al, 'Palm Oil Biomass for Electricity Generation in Malaysia', Page 6
$Q_{ww,y}$	249,600	m^3/year	Volume of wastewater treated in baseline anaerobic wastewater treatment system (System-Anaerobic). This is equivalent to the volume of wastewater treated in baseline aerobic wastewater treatment system (System-Aerobic), and volume of treated wastewater discharged in year y.	Calculation
$B_{o,ww}$	0.25	kg CH_4 / kg COD	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH4 / kg COD. Default value provided in AMS-III.H Ver 16
UF_{BL}	0.89	-	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H Ver 16
GWP_{CH4}	21	-	Global Warming Potential of methane	Default value provided in AMS-III.H Ver 16
$COD_{inflow,y}$	0.05536	tonnes/m^3	Chemical oxygen demand of the wastewater entering the baseline anaerobic treatment system (System-Anaerobic) in year y	Measurement Campaign, Sample Point A. See "Measurement Campaign" tab.
$COD_{outflow,y}$	0.00186	tonnes/m^3	Chemical Oxygen Demand of the wastewater exiting the baseline anaerobic treatment system (System-Anaerobic) in year y. This is equivalent to the COD entering the baseline aerobic treatment in year y	Measurement Campaign, Sample Point B. See "Measurement Campaign" tab.
$\eta_{COD,BL}$	97%	-	COD removal efficiency of the baseline anaerobic treatment system (System-Anaerobic), determined as per the paragraphs 26, 27 or 28 in AMS III.H	Calculation
$COD_{ww,discharge,BL,y}$	0.00052	tonnes/m^3	COD of the treated wastewater sent for plantation irrigation purpose	Measurement Campaign, Sample Point C. See "Measurement Campaign" tab.
$MCF_{ww,treatment,BL}$	0.8	-	Methane correction factor of anaerobic baseline wastewater treatment	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for anaerobic deep lagoon (depth more than 2 m).
$MCF_{ww,BL,discharge}$	0	-	Methane correction factor of baseline wastewater treatment system sent for plantation irrigation purpose	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for aerobic treatment, well managed

Inputs for Project Activity Wastewater Treatment Systems				
ID	**Value**	**Unit**	**Description**	**Source**
$Q_{ww,y}$	249,600	m^3/year	Volume of wastewater treated in project wastewater treatment system (System-biogas). This is equivalent to the volume of wastewater treated in project aerobic wastewater treatment system (System-Aerobic), and volume of treated wastewater discharged in year y.	Calculation
$COD_{inflow,y}$	0.05536	tonnes/m^3	Chemical Oxygen Demand of the wastewater entering the the inlet of the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester.	COD entering the digester is estimated for the purpose of ex-ante emission reductions to be the same as in the baseline situation, as per the Measurement Campaign Sample Point A. Parameter to be monitored.
$\eta_{,PJ}$	80%		Chemical Oxygen Demand removal efficiency of the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester.	Technologist design guarantee based on 80% COD removal efficiency of the digester. Refer to KB.
$COD_{ww,treated,PJ,y}$	0.01107	tonnes/m^3	Chemical Oxygen Demand of the wastewater exiting the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year *y*.	Ex-ante estimate based on the removal efficiency of the digester. Parameter to be monitored.
$COD_{removed,PJ}$	0.04429	tonnes/m^3	The chemical oxygen demand removed by the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year y.	Ex-ante estimate as per the Measurement Campaign Sample Point A; $COD_{inflow,y}$ less design value of digester removal efficiency (80%). Parameter to be recalculated ex-post in accordance with paragraph 20.
$\eta_{,PJ,Aerobic}$	72%	-	Chemical oxygen demand removal efficiency of the project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester in year y (t/m^3). This is equivalent to COD removal efficiency of the baseline aerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H	Calculation.
$COD_{ww,discharge,PJ,y}$	0.00308	tonnes/m^3	COD of the treated wastewater sent for plantation irrigation purpose	Measurement Campaign, Sample Point C. See "Measurement Campaign" tab.
$MCF_{ww,treatment,PJ}$	0.8	-	Methane correction factor for project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester.	MCF values as per table AMS III.H.1. for equipped with biogas recovery system digester
$MCF_{ww,treatment,PJ,Aerobic}$	0.0	-	Methane correction factor for project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester.	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for aerobic treatment, well managed
$MCF_{ww,PJ,discharge}$	0.0		Methane correction factor of project wastewater treatment system sent for plantation irrigation purpose	Ex-ante estimate for project wastewater treatment system k as per AMS-III.H. Table III.H.1. IPCC default values for aerobic treatment, well managed.
$B_{o,ww}$	0.25	kg CH_4 / kg COD	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH4 / kg COD. Default value provided in AMS-III.H Ver 16.
UF_{PJ}	1.12	-	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H Ver 16.

CFE_{ww}	0.9	-	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	Default value provided in AMS-III.H Ver 16.
$\eta_{flare,h}$	0.9	-	Flare efficiency in hour y	As per the "Tool to determine project emissions from flaring gases containing methane" for enclosed flare default values of flare efficiency may be used. 90% if temp in the exhaust gas is above 500°C for more than 40 mins during the hour and the manufacturers specifications on proper operation of the flare are met continuously during hour h. The exhaust temperature of the flare will be monitored.

Inputs for Project Activity Power Generation System				
Parameter	**Value**		**Description**	**Source**
Methane Net Heating Value	50	(MJ/kg)	Energy content of the methane available	11946 kcal/kg = 50,016 kJ/kg = 50 MJ/kg http://www.engineeringtoolbox.com/gross-net-heating-values-d_420.html
Methane produced	2,229	tCH_4/year	Mass flow rate of methane per year	Calculated from the estimated methane production of the wastewater in the digester. (Using $PE_{fugitive}$ formula)
Methane combusted by gas engine	387.98	$kgCH_4$/hr	Mass flow rate of methane to generator per hour	Calculated from the estimated methane production of the wastewater in the digester per day
Methane to flaring system	0.00	$kgCH_4$/hr	Mass flow rate of methane to flaring system in hour h	The flare will be used to combust excess methane/emergency. Parameter to be monitored.
Methane Density, ρ_{CH4}	0.716	kg/m^3	Density of Methane gas at Normal Condition	Methodological "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13)
Methane composition in Biogas	65%	%	Average Methane concentration in Biogas generated from POME	Baseline study of methane emission from anaerobic pondsof palm oil mill effluent treatment Shahrakbah Yacob et.al
Biogas combusted by gas engine, $BG_{fuelled,y}$	4,788,499	Nm^3/yr	Estimated total biogas generated in the anaerobic digester and combusted in the gas engine and or boiler.	Measured at normal condition
Biogas flared at flaring system, $BG_{flared,y}$	0	Nm^3/yr	Estimated total biogas combusted in flare system.	Measured at normal condition
Total biogas fuelled or flared	4,788,499	Nm^3/yr	Estimated total biogas generated in the anaerobic digester	Calculated ($BG_{fuelled,y}$ + $BG_{flared,y}$)

Baseline Emissions from Wastewater Treatment			
$BE_y = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}\}$			
Parameter	**Value**	**Description**	**Source**
BE_y	**49,915**	Baseline emissions in year y (tCO_2e)	From equation 1
$BE_{power,y}$	0	Baseline emissions from electricity or fuel consumption in year y (tCO_2e)	Paragraph 19
$BE_{ww,treatment,y}$	49,916	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)	From equation 2, Paragraph 20
$BE_{s,treatment,y}$	0	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e)	From equation 3, Paragraph 22
$BE_{ww,discharge,y}$	0	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e).	From equation 6, Paragraph 24
$BE_{s,final,y}$	0	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.	From equation 7, Paragraph 25

$BE_{power,y} = EG_{BL,y} * EF_{CO2}$			
Parameter	**Value**	**Description**	**Source**
$BE_{power,y}$	**0**	Baseline emissions from electricity consumption in year y (tCO_2e)	Power supply to the wastewater treatment system is from the mill.
Power supply to the wastewater treatment system is mainly from the biomass boiler using mesorcarp fibre and/or palm kernel shell; which is considered as carbon neutral. Thus, the baseline electricity consumption is considered as zero.			

$BE_{ww,treatment,y} = \sum_i (Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$BE_{ww,treatment,y}$	**49,916**	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)	From equation 2, Paragraph 20
$Q_{ww,y}$	249,600	Volume of wastewater treated in baseline anaerobic wastewater treatment system in the year y	Calculation. To be monitored.
$COD_{inflow,y}$	0.05536	Chemical oxygen demand of the wastewater entering the baseline anaerobic treatment system (System-Anaerobic) in year y	Measurement Campaign, Sample Point A. See "Measurement Campaign" tab.
$\eta_{COD,BL}$	97%	COD removal efficiency of the baseline anaerobic treatment system (System-Anaerobic), determined as per the paragraphs 26, 27 or 28 in AMS III.H	Calculation. To be monitored.
$MCF_{ww,treatment,BL}$	0.8	Methane correction factor of anaerobic baseline wastewater treatment system	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for anaerobic deep lagoon (depth more than 2 m).
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH_4/kg COD. Default value provided in AMS-III.H. Ver 16.
UF_{BL}	0.89	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H Ver 16
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H Ver 16

$BE_{treatment,s,y} = \sum_j S_{j,BL,y} * MCF_{s,treatment,BL,j} * DOC_s * UF_{BL} * DOC_F * F * 16/12 * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$BE_{treatment,s,y}$	**0**	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e)	From equation 3, Paragraph 22
The baseline scenario does not involve sludge treatment. Therefore, on this basis $BE_{treatment,s,y}$ is considered to be zero.			

$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge}$			
Parameter	**Value**	**Description**	**Source**
$BE_{ww,discharge,y}$	**0**	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e).	From equation 6, Paragraph 24
$Q_{ww,y}$	249,600	Volume of treated wastewater discharged in year y (m^3)	Calculation. To be monitored.
$COD_{ww,discharge,BL,y}$	0.00052	COD of the treated wastewater sent for plantation irrigation purpose	Measurement Campaign, Sample Point C. See "Measurement Campaign" tab.
$MCF_{ww,BL,discharge}$	0	Methane correction factor of baseline wastewater treatment system sent for plantation irrigation purpose	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for aerobic, well-managed
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH_4/kg COD. Default value provided in AMS-III.H. Ver 16.

UF_{BL}	0.89	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H. Ver 16.
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H. Ver 16.

$BE_{s,final,y} = S_{final,BL,y} * DOC_s * UF_{BL} * MCF_{s,BL,final} * DOC_F * F * 16/12 * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$BE_{s,final,y}$	**0**	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.	From equation 7, Paragraph 25
In the baseline scenario sludge is periodically removed from the anaerobic open lagoons and sent to the plantation for soil application as a fertiliser. All of the sludge produced in the baseline scenario is used for soil application under aerobic conditions. Therefore, on this basis $BE_{s,final,y}$ is considered to be zero.			

Perenia
complete carbon solutions

Project Emissions from Wastewater Treatment

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$

Parameter	Value	Description	Source
PE_y	**5,200**	Project activity emissions in the year y (tCO_2e)	Calculated
$PE_{power,y}$	0	Emissions from electricity or fuel consumption in the year y (tCO_2e)	As per paragraph 19, for the situation of the project scenario, using energy consumption data of all equipments/devices used in the project activity wastewater and sludge treatment systems for biogas recovery and flaring/gainful use.
$PE_{ww,treatment,y}$	0	Methane Emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO_2e)	From equation 2 in Paragraph 20 using uncertainity factor 1.12 and data applicable to the project situation.
$PE_{s,treatment,y}$	0	Methane emissions from sludge treatment systems affected by the project activity and not equipped with biogas recovery in year y (tCO_2e)	From equation 3 and 4 in Paragraph 22, using an uncertainity factor of 1.12 and data applicable to the project situation.
$PE_{ww,discharge,y}$	0	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2e)	From equation 6 in Paragraph 24, using an uncertainity factor of 1.12 and data applicable to the project conditions.
$PE_{s,final,y}$	0	Methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e)	From equation 7 in Paragraph 25, using an uncertainity factor of 1.12 and data applicable to the project conditions.
$PE_{fugitive,y}$	5,200	Methane emissions from biogas release in capture systems in year y (tCO_2e)	Calculated as per paragraph 30
$PE_{flaring,y}$	0	Methane emission due to incomplete flaring in year y (tCO_2e)	As per the "Tool to determine project emissions from flaring gases containing methane"(Version 1, 15th December 2006). See calculation sheet 'PE $_{flaring}$'
$PE_{biomass,y}$	0	Methane emission from biomass stored under anaerobic conditions	As per the "Tool to determine methane emission avoided from disposal of waste at a solid waste disposal site"

$PE_{power,y} = EG_{PJ,consumption,\ y} * EF_{CO2}$

Parameter	Value	Description	Source
$PE_{power,y}$	**0**	Emissions from electricity or fuel consumption in the year y (tCO2e)	Electricity for all equipment used in the proposed project activity will be sourced from the biogas engines; thus carbon neutral.

Project activity emissions from electricity consumption are determined as per the procedures described AMS.III.H paragraph 19. In the project scenario, electricity use for all equipment used in the proposed project activity will be sourced from the biogas engine or mill . The emission factor for electricity sourced from renewable energy is zero and therefore, on this basis PE $_{power,y}$ is considered to be zero. In any event of any external electricity or fuel consumption, the project emission will be calculated based on "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 2, 2nd August 2008).

$PE_{ww,treatment,y} = \sum_k (Q_{ww,k,y} * COD_{inflow,k,y} * \eta_{,PJ,k} * MCF_{ww,treatment,PJ,k}) * B_{o,ww} * UF_{PJ} * GWP_{CH4}$

Parameter	Value	Description	Source
$PE_{ww,treatment,y,}$	**0**	Methane Emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO_2e)	From equation 2 in Paragraph 20 using uncertainity factor 1.12 and data applicable to the project situation.
$Q_{ww,y}$	249,600	Volume of wastewater treated in project wastewater treatment system (System-Aerobic).	Calculation. To be monitored.
$COD_{ww,treated,PJ,y}$	0.01107	Chemical Oxygen Demand of the wastewater exiting the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year y.	Ex-ante estimate based on the removal efficiency of the digester. Parameter to be monitored.
$\eta_{,PJ,Aerobic}$	72%	Chemical oxygen demand removal efficiency of the project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester in year y (t/m^3). This is equivalent to COD removal efficiency of the baseline aerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H	Calculation. To be monitored.
$MCF_{ww,treatment,PJ,Aerobic}$	0	Methane correction factor for project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester.	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for aerobic treatment, well managed
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH_4/kg COD. Default value provided in AMS-III.H. Ver 16.
UF_{PJ}	1.12	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H. Ver 16.
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H. Ver 16 .

Perenia
complete carbon solutions

$PE_{s,treatment,y}$			
Parameter	**Value**	**Description**	**Source**
$PE_{s,treatment,y}$	**0**	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e)	From equation 3 and 4 in Paragraph 22, using an uncertainity factor of 1.12 and data applicable to the project situation.
In the proposed project activity there is no sludge treatment system. Therefore on this basis PEs,treatment,y is considered to be zero.			

$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge} * UF_{PJ}$			
Parameter	**Value**	**Description**	**Source**
$PE_{ww,discharge,y}$	**0**	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2e).	From equation 6 in Paragraph 24, using an uncertainity factor of 1.12 and data applicable to the project conditions.
$Q_{ww,y}$	249,600	Volume of treated wastewater discharged in year y (m^3)	Calculation. To be monitored.
$COD_{ww,discharge,PJ,y}$	0.00308	COD of the treated wastewater sent for plantation irrigation purpose	Measurement Campaign, Sample Point C. See "Measurement Campaign" tab.
$MCF_{ww,PJ,discharge}$	0	Methane correction factor of baseline wastewater treatment system sent to irrigation to plantation	AMS-III.H Version 16. Table III.H.1. IPCC default values for methane correction factor for aerobic, well-managed
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH_4/kg COD. Default value provided in AMS-III.H. Ver 16.
UF_{PJ}	1.12	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H. Ver 16.
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H. Ver 16.

$PE_{s,final,y} = S_{final,PJ,y} * DOC_s * UF_{PJ} * MCF_{s,PJ,final} * DOC_F * F * 16/12 * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$PE_{s,final,y}$	0	Methane emissions from the anaerobic decay of the final sludge generated in wastewater system in year y (tCO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.	From equation 7 in Paragraph 25, using an uncertainity factor of 1.12 and data applicable to the project conditions.
In the proposed project activity, all of the sludge produced is used for soil application under aerobic conditions. Therefore on this basis $PE_{s,final,y}$ is considered to be zero.			

$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$			
Parameter	**Value**	**Description**	**Source**
$PE_{fugitive,y}$	**5,200**	Methane emissions from biogas release in capture system in year y (tCO_2e)	Calculated as per paragraph 30
$PE_{fugitive,ww,y}$	5,200	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y (tCO_2e)	Calculated as per paragraph 30
$PE_{fugitive,s,y}$	0	Fugitive emissions through capture inefficiencies in the sludge treatment in year y (tCO_2e)	Calculated as per paragraph 30

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$PE_{fugitive,ww,y}$	5,200	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y (tCO_2e)	Calculated as per paragraph 30
CFE_{ww}	0.9	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	Default value of 0.9 provided in AMS-III.H. Ver 16.
$MEP_{ww,treatment,y}$	2,476	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y (tCH_4)	From equation 11, paragraph 30
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H. Ver 16

$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k} * MCF_{ww,treatment,PJ,k}$			
Parameter	**Value**	**Description**	**Source**
$MEP_{ww,treatment,y}$	2,476	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y (tCH_4)	From equation 11, paragraph 30
$Q_{ww,y}$	249,600	Volume of treated wastewater discharged in year y (m^3)	Calculation. To be monitored.
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	IPCC value of 0.25 kg CH_4 / kg COD. Default value provided in AMS-III.H. Ver 16.
UF_{PJ}	1.12	Model correction factor to account for model uncertainties	Default value provided in AMS-III.H. Ver 16.
$COD_{removed,PJ}$	0.04429	The chemical oxygen demand removed by the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year y.	Ex-ante estimate as per the Measurement Campaign Sample Point A; COD inflow,y less design value of digester removal efficiency (90%). Parameter to be recalculated ex-post in accordance with paragraph 20.

$MCF_{ww,treatment,PJ}$	0.8	Methane correction factor for project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester.	Ex-ante estimate for project wastewater treatment system as per AMS-III.H. Table III.H.1. IPCC default values for anaerobic reactor without methane recovery.

$PE_{fugitive,s,y} = (1-CFE_s) * MEP_{s,treatment,y} * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Source**
$PE_{fugitive,s,y}$	0	Fugitive emissions through capture inefficiencies in the sludge treatment in year y (tCO_2e)	From equation 12, paragraph 30
In the proposed project activity there is no sludge treatment system. Therefore on this basis $PE_{fugitive,s,y}$ is considered to be zero.			

"Tool to determine methane emission avoided from disposal of waste at a solid waste disposal site"

$PE_{biomass,y}$			
Parameter	**Value**	**Description**	**Source**
$PE_{biomass,y}$	**0**	Methane emission from biomass stored under anaerobic conditions	No biomass is stored under anaerobic condition
Storage of biomass under anaerobic conditions will not take place due to the proposed project activity. Therefore, on this basis $PE_{biomass,y}$ is considered to be zero.			

"Tool to determine project emissions from flaring gases containing methane"

$PE_{flaring,y}$			
Parameter	**Value**	**Description**	**Source**
$PE_{flaring,y}$	**0**	Methane emission due to incomplete flaring in year y (tCO_2e) - Equal to PE_{flare}	Calculated as per the "Tool to determine project emissions from flaring gases containing methane".
The mass flow rate of the residual gas will be directly monitored using a mass flow meter that includes temperature and pressure compensation to accurately account for the density of the biogas. An online continuous gas analyser will also be used to monitor the composition of the residual gas including the mass fraction of methane. Default value for flare efficiency will be used. On this basis, required Steps and equations are outlined below.			

$PE_{flare} = \sum_{h=1}^{h} FM_{RG,h} * (1-\eta_{flare,h}) * (GWP_{CH4}/1000)$			
Parameter	**Value**	**Description**	**Source**
PE_{flare}	0	Project emission from flaring of methane in year y	Calculated
h	5,744.00	Hours of operation per year (h/y)	Future Mill Capacity
$TM_{RG,h}$	0.00	Mass flow rate of methane in hour h (kg/h)	The flare will be used to combust excess methane.
$\eta_{flare,h}$	0.9	Flare efficiency in hour y	As per the "Tool to determine project emissions from flaring gases containing methane" for enclosed flare default values of flare efficiency may be used. 90% if temp in the exhaust gas is above 500°C for more than 40 mins during the hour and the manufacturers specifications on proper operation of the flare are met continuously during hour h. The exhaust temperature of the flare will be monitored.
GWP_{CH4}	21	Global Warming Potential of methane	Default value provided in AMS-III.H. Ver 16.

Perenia
complete carbon solutions

Emission Reduction				
Year	**AMS III.H**			
	$BE_{y,ex\ ante}$	**$PE_{y,ex\ ante}$**	**$LE_{y,ex\ ante}$**	**$ER_{y,ex\ ante}$**
01/01/2013 – 31/12/2013	49,915	5,200	0	44,715
01/01/2014 – 31/12/2014	49,915	5,200	0	44,715
01/01/2015 – 31/12/2015	49,915	5,200	0	44,715
01/01/2016 – 31/12/2016	49,915	5,200	0	44,715
01/01/2017 – 31/12/2017	49,915	5,200	0	44,715
01/01/2018 – 31/12/2018	49,915	5,200	0	44,715
01/01/2019 – 31/12/2019	49,915	5,200	0	44,715
01/01/2020 – 31/12/2020	49,915	5,200	0	44,715
01/01/2021 – 31/12/2021	49,915	5,200	0	44,715
01/01/2022– 31/12/2022	49,915	5,200	0	44,715
Total	**499,150**	**52,000**	**0**	**447,150**
Average per annum	49,915	5,200	0	44,715

Perenia
complete carbon solutions

Number of COD Sample Calculator

COD Sampling (Point A)		
Sample No.	**Sample Date**	**Sample Value**
1	12/8/2011	55,332
2	15/8/2011	76,541
3	16/8/2011	78,445
4	17/8/2011	69,414
5	19/8/2011	54,206
6	20/8/2011	55,385
7	22/8/2011	55,778
8	23/8/2011	51,992
9	24/8/2011	62,856
10	25/8/2011	62,080

Mean	62,203
Standard Deviation, SD	9,574

Requirement	
Confidence Level	90%
Precision Level	10%

T-Distribution Analysis	
Guess of estimated samples	9
t_{n-1}, Distribution value	1.895
Final number of sample required, n	**9**

Calculation method

The calculation method has been done in accordance to "BEST PRACTICES EXAMPLES FOCUSING ON SAMPLE SIZE AND RELIABILITY CALCULATIONS" (Paragraph 96 - 109) Annex 6 of EB 67. The details as follows:

Paragraph 101

If the sampling times are sufficiently far apart the data can be regarded as a set of independent observations and treated as a simple random sample. The number of COD measurements that are required to meet the 90/10 reliability is:

$n = ((t_{n-1} \times SD)/(0.1 \times mean))^2$

Paragraph 102

Where t_{n-1} is the value of the t-distribution for 90% confidence when the sample size is n. However, the sample size is not yet known, and so a first step is to use the value for 90% confidence when the sample is large, i.e. 1.645, and then refine the calculation.

$n = ((1.645 \times SD)/(0.1 \times mean))^2$

Paragraph 103

This gives $n = ((1.645 \times 6200)/(0.1 \times 31750))^2 = 10.3$ which rounds up to 11.

Paragraph 104

The calculation now needs to be repeated using the t-value for 90% confidence and n=11.

Paragraph 105

The exact figure for this t-value can be acquired from any set of general statistical tables or using standard statistical software. For a sample size of 11 the value is 1.812.

Paragraph 106

The calculation now gives $n = ((1.812 \times 6200)/(0.1 \times 31750))^2 = 12.5$ which rounds up to 13.

Paragraph 107

The process should be iterated until there is no change to the value of n. Here the repeat calculation would have a t-value of 1.782 and the calculation would yield n = 12.11, which would be rounded up to 13. The sample size calculation suggests that sampling every four weeks should be sufficient for 90/10 reliability.

Perenia
complete carbon solutions

Number of COD Sample Calculator

COD Sampling (Point B)		
Sample No.	**Sample Date**	**Sample Value**
1	12/8/2011	2,843
2	15/8/2011	2,304
3	16/8/2011	1,999
4	17/8/2011	1,085
5	19/8/2011	2,573
6	20/8/2011	2,003
7	22/8/2011	2,318
8	23/8/2011	1,901
9	24/8/2011	2,076
10	25/8/2011	1,804

Mean	2,091
Standard Deviation, SD	476

Requirement	
Confidence Level	90%
Precision Level	10%

T-Distribution Analysis	
Guess of estimated samples	16
t_{n-1}, Distribution value	1.753
Final number of sample required, n	**16**

Calculation method

The calculation method has been done in accordance to ""BEST PRACTICES EXAMPLES FOCUSING ON SAMPLE SIZE AND RELIABILITY CALCULATIONS" (Paragraph 96 - 109) Annex 6 of EB 67. The details as follows:

Paragraph 101

If the sampling times are sufficiently far apart the data can be regarded as a set of independent observations and treated as a simple random sample. The number of COD measurements that are required to meet the 90/10 reliability is:

$n = ((t_{n-1} \times SD)/(0.1 \times mean))^2$

Paragraph 102

Where t_{n-1} is the value of the t-distribution for 90% confidence when the sample size is n. However, the sample size is not yet known, and so a first step is to use the value for 90% confidence when the sample is large, i.e. 1.645, and then refine the calculation.

$n = ((1.645 \times SD)/(0.1 \times mean))^2$

Paragraph 103

This gives $n = ((1.645 \times 6200)/(0.1 \times 31750))^2 = 10.3$ which rounds up to 11.

Paragraph 104

The calculation now needs to be repeated using the t-value for 90% confidence and n=11.

Paragraph 105

The exact figure for this t-value can be acquired from any set of general statistical tables or using standard statistical software. For a sample size of 11 the value is 1.812.

Paragraph 106

The calculation now gives $n = ((1.812 \times 6200)/(0.1 \times 31750))^2 = 12.5$ which rounds up to 13.

Paragraph 107

The process should be iterated until there is no change to the value of n. Here the repeat calculation would have a t-value of 1.782 and the calculation would yield n = 12.11, which would be rounded up to 13. The sample size calculation suggests that sampling every four weeks should be sufficient for 90/10 reliability.

Number of COD Sample Calculator

COD Sampling (Point C)		
Sample No.	**Sample Date**	**Sample Value**
1	12/8/2011	710
2	15/8/2011	708
3	16/8/2011	758
4	17/8/2011	532
5	19/8/2011	613
6	20/8/2011	628
7	22/8/2011	546
8	23/8/2011	497
9	24/8/2011	411
10	25/8/2011	411

Mean	581
Standard Deviation, SD	123

Requirement	
Confidence Level	90%
Precision Level	10%

T-Distribution Analysis	
Guess of estimated samples	15
t_{n-1}, Distribution value	1.771
Final number of sample required, n	**15**

Calculation method

The calculation method has been done in accordance to "BEST PRACTICES EXAMPLES FOCUSING ON SAMPLE SIZE AND RELIABILITY CALCULATIONS" (Paragraph 96 - 109) Annex 6 of EB 67. The details as follows:

Paragraph 101

If the sampling times are sufficiently far apart the data can be regarded as a set of independent observations and treated as a simple random sample. The number of COD measurements that are required to meet the 90/10 reliability is:

$n = ((t_{n-1} \times SD)/(0.1 \times mean))^2$

Paragraph 102

Where t_{n-1} is the value of the t-distribution for 90% confidence when the sample size is n. However, the sample size is not yet known, and so a first step is to use the value for 90% confidence when the sample is large, i.e. 1.645, and then refine the calculation.

$n = ((1.645 \times SD)/(0.1 \times mean))^2$

Paragraph 103

This gives $n = ((1.645 \times 6200)/(0.1 \times 31750))^2 = 10.3$ which rounds up to 11.

Paragraph 104

The calculation now needs to be repeated using the t-value for 90% confidence and n=11.

Paragraph 105

The exact figure for this t-value can be acquired from any set of general statistical tables or using standard statistical software. For a sample size of 11 the value is 1.812.

Paragraph 106

The calculation now gives $n = ((1.812 \times 6200)/(0.1 \times 31750))^2 = 12.5$ which rounds up to 13.

Paragraph 107

The process should be iterated until there is no change to the value of n. Here the repeat calculation would have a t-value of 1.782 and the calculation would yield n = 12.11, which would be rounded up to 13. The sample size calculation suggests that sampling every four weeks should be sufficient for 90/10 reliability.

Melewar Palm Oil Mill