CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Title: Curva de Rodas and La Pradera landfill gas management project.

Version: 04

Date: 08/09/2010

Amendments to this PDD (applicable as from 03 December 2009) reflect the project activity with the replacement of the flare from Curva de Rodas landfill site to the La Pradera landfill site.

A.2. Description of the project activity:

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The purpose of the project activity is to install a controlled methane capture and flaring system simultaneously at the Curva de Rodas and the La Pradera landfills in order to reduce the greenhouse gas (GHG) emission. The project activity will take place in the central northwestern part of Colombia.

The Curva de Rodas landfill has a total area of 73 ha, from where 33 ha have been used as disposal area. Approximately 8.5 million tons of solid waste has been disposed to the landfill during its operation from the year 1984 up to year 2003, when it was closed. The other project site La Pradera sanitary landfill has been operational since the year 2003. The landfill La Pradera comprises three modules La Carrilera (3.2 ha), La Música (7.1 ha) and Altair (not defined yet, approx. 15 – 20 ha). Currently filling is occurring in the module La Música, this module is permitted to accept approximately 3.5 million tons waste according to the environmental license. Once the module La Música is closed, the filling will occur in the module Altaír, which permitted to accept approximately 6.5 million tons waste according to the environmental license. The landfill receives daily approximately 2,100 tones of waste per day. Hence, the expected closure is in year 2027. The waste disposed at the both sites La Pradera and Curva de Rodas comes from the metropolitan area of Medellin, specifically from the municipalities Medellín, Bello, Barbosa, Girardota, Itagüí, Sabaneta, Caldas, Copacabana, Envigado and La Estrella, Guarne, El Retiro and Rionegro.

At both sites there is no active treatment of the landfill gas (LFG). However, a passive collection system of chimneys exists where manual and irregular flaring takes place. The landfill gas flows to this existing vertical gas collection wells due to the pressure differences. Altogether 315 ventilation wells exist, but only a small part of them are in operation. The landfill gas is flared on the top of these gas stacks (please

see picture 1). The objective of these stacks is to keep the concentration of methane from reaching explosive levels. This kind of flaring is highly inefficient in destroying methane. Thus, most of the methane is currently released into the atmosphere. Furthermore both of the landfills are encompassed with rainwater management canals. Currently the leachate water is extracted from the landfill body by pumping systems based on compressed air and interacting pipes. In La Pradera also oxidation ponds for leachate pre-treatment exist, but in Curva de Rodas the leachate is directly collected from the wells and transported to the municipal water treatment plant.

Picture 1. Baseline flares

The project activity

The aim of the project activity is to capture, flare and consequently destroy landfill gas in high efficient flaring stations. A biogas extraction system will be built with new extraction wells, a conveyance piping, and a vacuum suction (blower) in order to transport the biogas extracted from the landfill to a high efficient flaring system. As the existing wells for venting as well as for leachate extraction are in bad conditions (e.g. have been collapsed) almost all of these venting wells will be closed to avoid any uncontrolled biogas emissions or intake of ambient air. The project activity will lead to a significantly

reducing of GHG emissions and it will demonstrate the application of a state-of-the-art methane capture incl. high efficient flaring systems in Colombia.

Sustainable development

The project activity will contribute to sustainable development in different ways. At the local level it will improve sanitary conditions and quality of life in the surrounding communities. Especially aspects related to bad odour, leachate nuisances and the risk of fire are to be significantly improved. Furthermore the risk of landslides will diminish due to a decrease of internal pressure in the landfill body, through landfill gas extraction. The project activity will also have positive effect on local employment as local material suppliers and contractors are used where ever it is technically possible and economically feasible.

A share of the Certified Emissions Reduction proceeds will be contributed to promote research at the University of Antioquia. The students of the University of Antioquia belong to the lowest income level groups (1, 2 and 3 out of 6) of the society. In comparison to other countries Colombia is well behind in research investments in terms of gross national product. Hence, the effort to strengthen research will clearly contribute to sustainable development. Additionally, the University of Antioquia will take advantage of this project as a training facility for engineering students, as the project activity represents an example of good management practices on a solid waste landfill. The project activity will lead to technology transfer and especially transfer of know-how.

An additional revenue share of the CER transactions will be allocated to the Empresas Varias de Medellin (EEVVM), which is a public utility company that owns and operates on both landfill sites in Medellin, La Pradera and Curva de Rodas. These proceeds are used to improve the environmental management including landfill post closure activities. Both, the University and EEVVM, will voluntarily allocate 5% of their net CER benefits to finance training opportunities in entrepreneurship in the communities influenced by the landfills.

The project activity is consistent with the national sustainable development criteria identified by the Colombian DNA and published by the Ministry of Environment, Housing and Land Use Planning[1] and Colombian Constitution of 1991.

A.3. Project participants:

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[1] Ministerio de Ambiente, Vivienda y Desarrollo Territorial 2004. Resolución número 0453 de abril 27 de 2004 and annexo 1

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	Public entity: Universidad de Antioquia	No
United Kingdom of Great Britain and Northern Ireland	Private entity: Green Gas Germany GmbH	No
United Kingdom of Great Britain and Northern Ireland	Private entity: Green Gas Colombia S.A. E.S.P.	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>> Republic of Colombia

A.4.1.2. Region/State/Province etc.:

>> Department of Antioquia

A.4.1.3. City/Town/Community etc:

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The project activity will take place at the two locations Curva de Rodas and La Pradera landfill sites. Curva de Rodas is situated in the metropolitan area of Medellin, on the borders of the municipalities of Bello and Copacabana. The La Pradera landfill is situated in the region of northern Antioquia in the municipality of Don Matias.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity:

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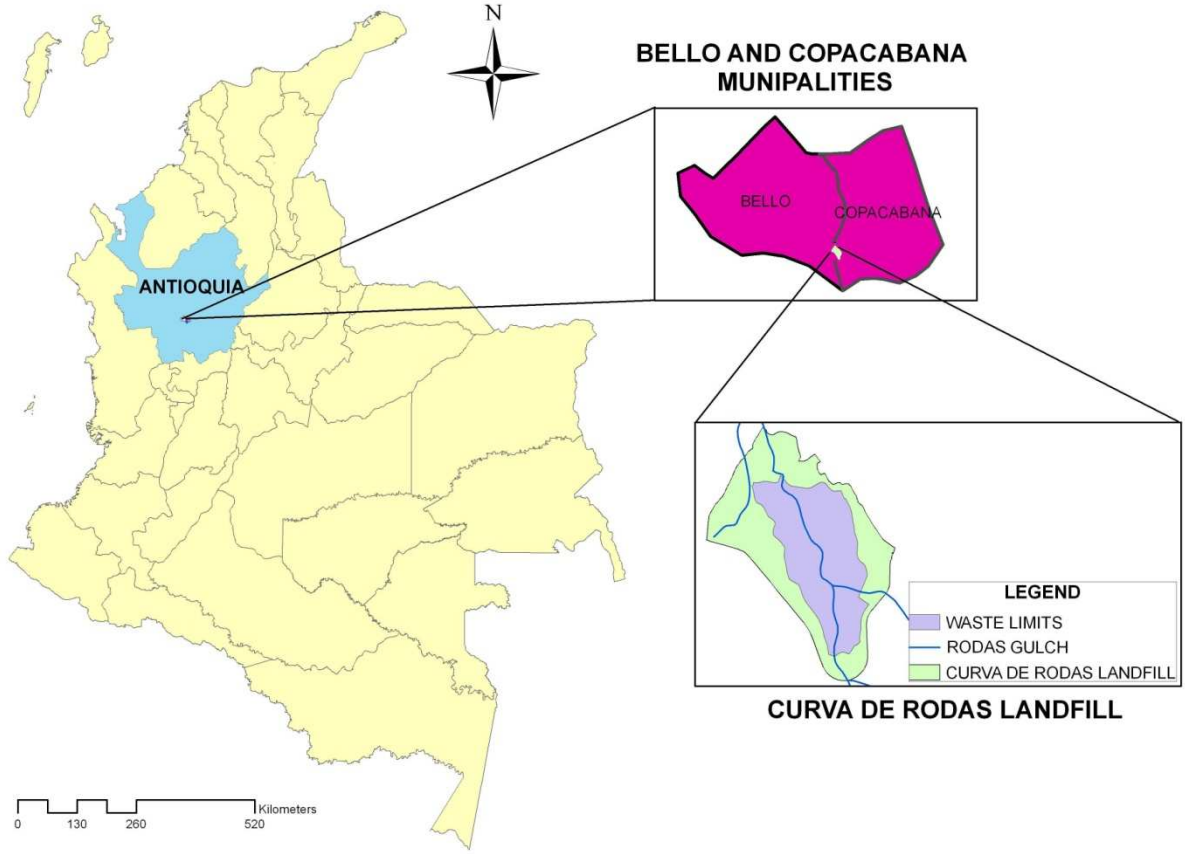
Curva de Rodas

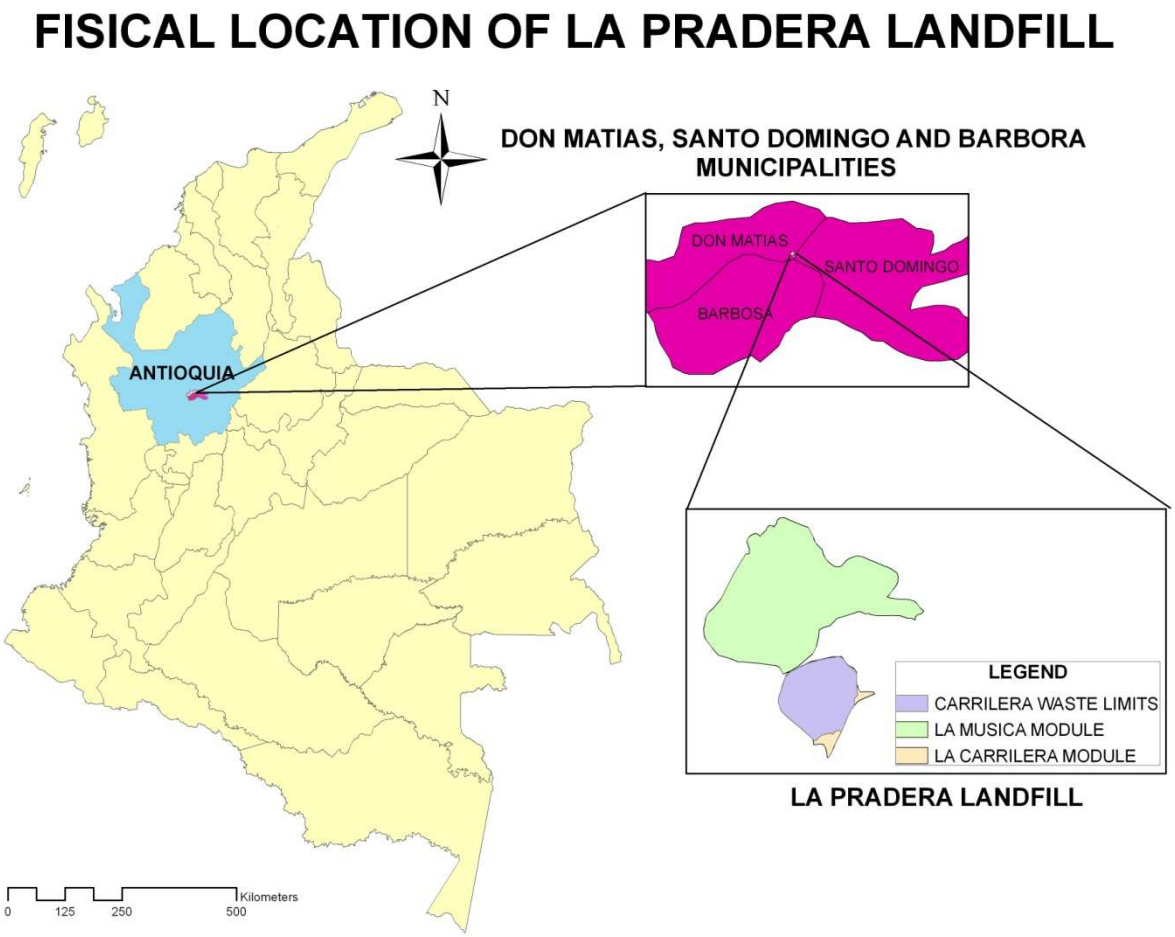
The Curva de Rodas landfill is 10 km far from the centre of Medellin in the northeastern part of the Aburra valley. The specific location is on the basin of Medellin River, about one km upstream from the settlements of Machado and Fontidueño in the municipalities Bello and Copacabana. The site is located in an elevation of 1,600 m. The geographical coordinates of the Curva de Rodas landfill site are 6° 19’21.83“ north, 75° 31’50.76 west (approximation).

FISICAL LOCATION OF CURVA DE RODAS LANDFILL



La Pradera

La Pradera sanitary landfill is located 65 km away from the centre of Medellin on the road to Cisneros, in the municipality of the Don Matias, close to the urban area of the Barbosa municipality. The geographical coordinates of the La Pradera landfill site are 6° 25'59.28" north, 75° 11'59.77 west (approximation).



Both sites are emplaced in steep locations with medium to high precipitation regimes that are typical characteristics of the central region of Antioquia. The Curva de Rodas site is surrounded partly with forest. There are some settlements on the bottom part of the landfill and a water distribution plant on the top. The La Pradera landfill is mainly surrounded with forest and with a few leisure farms. Some grazing and crop farming activities take place on the other side of Medellin River. The nearest settlement is approximately 1 km away from the landfill site.

A.4.2. Category(ies) of project activity:

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The project activity will reduce GHG emission by capturing and flaring methane from two landfill sites. Thus, the project activity comes under the sectoral scope "No. 13 - Waste handling and disposal" and the approved CDM methodology "ACM0001 – Consolidate baseline methodology for landfill gas project activities".

A.4.3. Technology to be employed by the project activity:

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The project activity encompasses the installation of a landfill gas recovery system and an enclosed flare combustion station at both sites. The technology proposed for the extraction and the burning of landfill gas can be regarded as standard technology. It is the most up-to-date technology, fully in compliance with EU-legislation. The Green Gas Germany GmbH as announced equipment supplier has applied the technology with more than 500 installations on landfill sites in Europe and elsewhere.

The planned investment comprises the following hardware: gas collection network with comprising permeable filter pipes, gas domes, gas wells and gas transport piping; blower suction network; high temperature gas flares; landfill gas monitoring and control equipment as well as improvement of existing landfill covers and sealing of the landfill surface as well as civil works.

At both landfill sites new vertical gas extraction wells will be installed and connected to a horizontal piping network. The project activity will try to advantage from the existing wells, but because of the poor material choices in the past the existing venting wells have perished and the project activity make use only from a very few wells. In Curva de Rodas approximately 80 new extraction wells will be installed to the gas collection system, with approximately 7,800 m of HDPE pipes. In La Pradera the already closed deposit area La Carrilera will be equipped with approximately 16 extraction wells, with a total 1,200 m gas collection pipes. The design for the currently operating module La Música is still open, but it will apply the same solutions. In Curva de Rodas Landfill, the wells reach depths of up to 30 m, and in La Pradera Landfill, Module La Carrilera the wells reach depths of up to 20 m. Each well has a diameter of 80 cm were the HDPE filter pipe is centrally located. The gas collection pipes will be connected with a flexible connection to the lateral pipe of the gas wellhead. A gravel bed surrounds the pipes. The maximum trench depth for the gas collection pipes is 0.7 m allowing the pipes to be installed within the cover. Accordingly no trenching is required in the landfill body. In order to prevent the water flowing off after strong precipitation as well as damages to the pipeline routes the pipes will be installed in a trench with an inclination of at least 5 % from the gas wells towards the gas control stations. Furthermore, if condensate is generated, this solution will lead the condensate to gas control stations, and is subsequently

fed into a condensate shaft. The gas collection pipes will be covered with 20 cm sand and the pipe layer will be built in compacted manner.

At both sites the piping network will be connected to the blowers that create a pressure gradient in the piping system necessary for the extraction of the landfill gas. The gas transport pipes will also be installed in a trench, with a surrounding sand layer. In contrast to the gas collection pipes, the transport pipes cannot be installed with a steady angle of inclination towards one point and hence a condensate trap is necessary in this case. The gas transport pipe will be installed horizontal, in order to create low points for condensate discharge. Before flaring the extracted landfill gas, the gas goes through a cleaning system that will extract the humidity and the sulphur dioxides, as a preparation for the enclosed flares. The gas will be flared with enclosed high temperature flares (> 1,000°C, retention time > 0.3 s). The standard destruction efficiency for these flares is 99.99 %. The projected extraction and flaring stations at both sites are operated by an electrical control system, equipped with a monitoring system for methane, oxygen, gas flow, pressure and temperature. The maintenance consists of the control of subsiding and distortion of the gas wells and the pipeline system.

The constructions in Curva de Rodas landfill site started on January 13, 2008. The landfill gas collection has started in June 2008, as commissioning of the flare-booster-station took place on the 1st of July 2008. However, in spite of the earlier gas prognosis for the site Curva de Rodas, the closed landfill had not enough gas to efficiently operate the implemented flare as substantiated by monitored volumes and an independent gas prognosis. Therefore, as from the 3rd of December 2009, the flare was relocated to the La Pradera landfill site. The time schedule for construction of landfill gas collection at La Pradera landfill is affected by waste filling. For this reason only the section La Carrilera was constructed and commissioned in third quarter of 2008, while La Música section was connected to degassing system by the end of 2008. In contrast to the earlier gas prognosis, La Pradera landfill site has got significantly more gas than predicted several years ago. This is due to the continuous large amount of filling to the landfill and the quicker access to the newly deposited waste. Therefore, the flare that was commissioned on the site of Curva de Rodas was decommissioned on the 27th of November 2009 and re-commissioned on the site of La Pradera on the 3rd of December 2009. As such, the two flares installed on La Pradera destroy significant methane volumes that would otherwise be vented into the atmosphere. On the site of Curva de Rodas, continuous passive flaring is taking place with the use of the already implemented gas collection system. This activity is in accordance with the requirements of the Colombian Designated National Authority, the Ministerio de Ambiente, Vivienda, y Desarrollo Territorial which is described in their official document (reference number: 2000.2.18109) The project lifetime is expected to be 21 years,

which corresponds the technical lifetime of the flaring equipment. The gas production is estimated to be sufficient for 25 years, as average gas production of fast and medium long term degradable waste is up to 15 years and the operation of La Pradera site is supposed to last for 20 years until 2027.

The design of the gas collection and destruction system in the follow-up landfill section Altair of the La Pradera landfill will apply the same solutions presented here. However, the design has been excluded from the current plans and accordingly it is left out from the investment cost analysis as well as from the emission reduction prognosis. If applicable the project is extended to the follow-up landfill section Altair at a later date.

In the event that a power generation should be realised a CHP equipment or gas to pipeline connection would be installed at both sites, allowing more useful destruction of the landfill gas and furthermore the reduction of emissions by substituting fossil fuels. This is a theoretical future option, which will be considered if a financial feasible solution is found. If such an event occurs, a second separate project will be submitted to the DOE and CDM Executive Board.

The project activity will transfer state-of-the-art gas collection and flaring technology to Colombia. In addition it will extend the transfer of know-how, as the University of Antioquia will take advantage of this project as a training facility.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Table 1. Estimated emission reductions

Year	Annual estimation of emission reductions in tonnes of CO_2e
2008 (Oct 15 – Dec 31)	35,734
2009	226,409
2010	201,367
2011	219,687
2012	217,216
2013	204,501
2014	151,176
2015 (Jan1 - Oct 14)	95,105
Total estimated reductions (t CO_2e)	**1,351,195**

Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tCO_2e)	**193,028**

Note: Crediting start October 15, 2008 or the date of registration which might be earlier or later (applies also to the table 12).

The total emission reductions due to the project activity are calculated to amount to 1,351,195 tons of CO_2 for a crediting period of 7 years. The annual estimation of the emission reductions due to the proposed project activity is given above.

A.4.5. Public funding of the project activity:

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The project activity is not subsidized by official development assistance or any other public funding from Annex I countries.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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The approved baseline methodology applied for this project activity is:

- ACM0001 – Consolidate baseline and monitoring methodology for landfill gas project activities, version 07 from 2nd of November 2007.

Furthermore the following tools from the CDM Executive Board are applied:

- Tool to determine project emissions from flaring gasses containing methane (EB 28, annex 13),
- Tool to demonstration and assessment of additionality (EB 29, version 03),
- Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site (EB 35, annex 10, version 02).
- Tool to calculate project emissions from electricity consumption (EB 32, annex 10, version 01)

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The proposed project activity conforms to project category "ACM0001 – Consolidate baseline and monitoring methodology for landfill gas project activities" since:

- the baseline is a partial atmospheric release of the landfill gas to the atmosphere, and
- the project activity will flare the captured gas.

B.3. Description of the sources and gases included in the project boundary

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According to the methodology ACM0001 the project boundary "is the site of the project activity where the gas is captured and destroyed". Because the project activity requires electricity the source of the electricity generation is included with in the project boundary. Figure 1 below presents the project boundary.

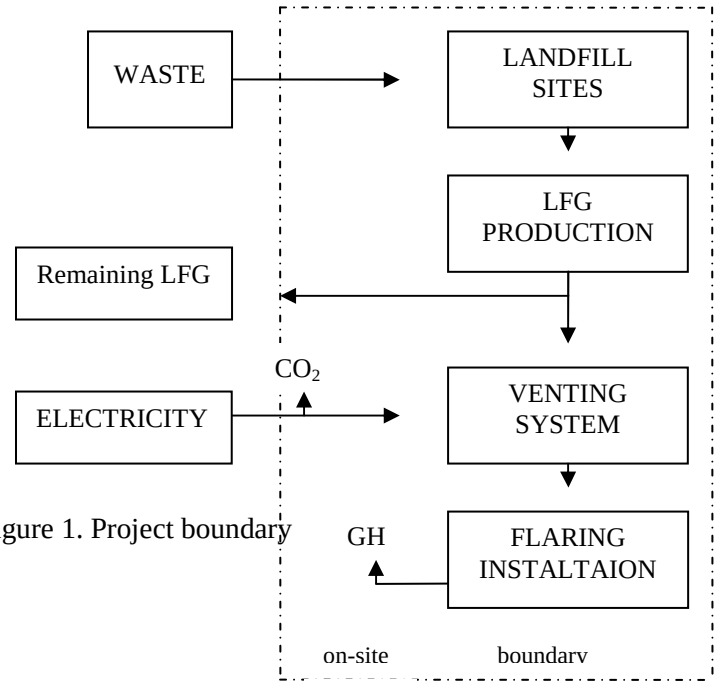

Figure 1. Project boundary

The gases included in baseline and project activity emissions are described in the table 2 below.

Table 2. Baseline and project emissions

	Source	Gas	Included	Justification/Explanation
Baseline	Decomposition of waste at the landfill site	CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N2O emissions are small compared to CH4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	No	CO2 emissions from the decomposition of organic waste are not accounted.
	Electricity consumption	CO_2	No	Not applicable.
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
	Thermal energy generation	CO_2	No	Not applicable.
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
Project Activity	On-site fossil fuel consumption	CO_2	No	Not applicable.
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
	Electricity consumption	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The most plausible baseline scenario is that the methane produced through anaerobic decomposing in the landfill body will be emitted directly to the atmosphere, while only a very small part will be passively collected and destroyed with help of the existing passive and manual flaring system. The most plausible baseline scenario was identified with help of the "Tool for demonstration and assessment of additionality". The detailed identification procedure is presented in section B.5. The baseline emissions were calculated with help of the "First order decay model" from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site". The baseline emission calculations are presented in detail in section B.6. as well as in annex 3.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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The current situation at the Curva de Rodas and La Pradera landfill sites is that by far the most part of the landfill gas is emitted directly into the atmosphere. A small part of the landfill gas is collected and flared on the top of the passive wells. The "Tool for the demonstration and assessment of additionality" has been applied to determine the most plausible baseline scenario and to approve the additionality of the project activity, as required in the methodology ACM0001.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity

Potential baseline scenarios without the generation and sale of emission credits	**Probability**
1. Continuation of the current situation: simple venting system with infrequent manual direct burning at the top of wells.	**Most probable:** no legal obligations or economic incentives could be identified which should have or would lead to committing realisation of an efficient flaring system. This scenario corresponds to business-as-usual in Colombia.
2. Project activity without implementing the generation and sale of emission credits.	**Not probable**: project faces financial and technical barriers, since the sales of CERs are the only income stream of the project activity.
3. Investment in a landfill gas collection equipment combined with power generation and grid connection.	**Not probable***:* the price of the electricity in Colombia is very low and makes such a project unviable, considering the high investments in infrastructure. In addition in case of Colombia, there is no experience due this kind of operations.
4. Realization of alternative technology, like air or O2 injection.	**Not probable**: this option is even less attractive, as it is more expensive than recovery and flaring, and furthermore it does not produce LFG to generate economic revenues.

Sub-step 1b. Enforcement of applicable laws and regulations

The applicable legislation in Colombia does not enforce efficient recovery and flaring or other utilisations of landfill gas. The national regulation on potable water and sanitary conditions[2] requires the installation of a passive landfill gas collection system with flaring on the top of a well. Both of the landfill sites Curva de Rodas and La Pradera are attending all applicable legal requirements and in consequence have all necessary licenses in date. It is unlikely that regulations will change in a way that would render any of the above-identified scenarios come true.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Since the project activity will not generate any financial or economic benefits other than CDM related incomes and no other incentives will be obtained for the capturing and flaring of methane, the simple cost analysis (option I) will be applied.

Sub-step 2b. Option I. Apply simple cost analysis

The most probable baseline scenario does not generate any financial benefits. The project activity involves the implementation of landfill gas collection and flaring systems at two landfill sites. This requires construction of the gas collection wells, the piping system, mechanical instrumentations to induce vacuum and analytical instrumentation necessary for monitoring. Additionally on-going expenses will be incurred to operate and maintain gas collection and flaring systems. The costs associated with the project are presented in the table 3. The simple cost analysis clearly concludes that the project activity is financially unattractive, without CDM incomes.

Sub-step 2b and 2c. – Option III. Benchmark analysis

The project participants want's to take into account the theoretical option of LFGTE equipment to be installed within a potential second construction stage and hence also an investment analysis is applied. The summary of the results of the investment analysis are presented in table 3. (For more detailed information please see appendix I and II.) The financial analysis was undertaken using assumptions which are conservative from the point of view of analysing the additionality. The life time of the LFGTE equipment was considered to be ten years due to the fact that the equipment can be used up to two times the optimal operational lifetime which is 5 years. After the first period of operation an exhaustive overhaul with spare parts and reparation is needed. After the second period the need for replacements

[2] Reglamento de Agua potable y Saneamiento básico (RAS).

would be very extensive, causing excessive increase of the costs. The use of LFGTE equipment for a longer period than ten years would be economically unattractive. Under these conditions the IRR of the project activity neutralising all CDM positions accounts negative. Furthermore the NPV is strongly negative (La Pradera – 9,706,221 € and Curva de Rodas – 7,222,818 €), which means that the project participants are not apple to conduct the LFGTE option since it is economically not feasible.

Table 3. Investment analysis

Item	Specification	La Pradera		Curva de Rodas		Total	
		Value	Unit	Value	Unit	Value	Unit
Flaring Investment	Gas system	728.000	Euro	1.170.000	Euro	1.898.000	Euro
	Blowers/Flares	369.400	Euro	213.700	Euro	583.100	Euro
Total Flaring without fees		1.097.400	Euro	1.383.700	Euro	2.481.100	Euro
Energy Production Investment	CHP	4.726.000	Euro	2.701.000	Euro	7.427.000	Euro
	Grid Connection	2.542.000	Euro	1.901.000	Euro	4.443.000	Euro
Total Energy Production without fees		7.268.000	Euro	4.602.000	Euro	11.870.000	Euro
Total INVESTEMENT without fees		8.365.400	Euro	5.985.700	Euro	14.351.100	Euro
Fees		836.540	Euro	598.570	Euro	1.435.110	Euro
Total INVESTMENT with fees		9.201.940	Euro	6.584.270	Euro	15.786.210	Euro
NPV @ 10%		- 9.706.221	Euro	- 7.222.818	Euro		
IRR		<0	%	<0	%		
Payback period		not paid back	Years	not paid back	years		
Project Lifetime		10	Years	10	years		
Electrical Feed-in-Tariff		0,03	Eur/kWh	0,03	Eur/kWh		

According the UNFCCC rules local commercial lending rates are considered to be appropriate benchmarks. The lending rates in Columbia amount to 10 – 15 %[3]. A benchmark of 10 % is considered to be conservative and thus applied for this project. The conservatively chosen benchmark is much higher than the calculated project IRR, which is negative. Hence, both parameters IRR and NPV clearly show that the project activity cannot be considered as financially attractive.

[3] http://banrep.gov.co/index_eng.html# and http://www.thedti.gov.za/econdb/IMFLenCOLOMBIALENDIN.html

Sub-step 2d. Sensitivity analysis

To prove the robustness of the financial analysis a sensitivity analysis with variations in the critical assumptions was conducted. The two parameters increase on electricity tariff and decrease of investment were chosen for this analysis. The results are shown in table 4 below.

Table 4. Variation in the parameter values

La Pradera					
Deviance of parameter	Investment costs (CAPEX)	IRR corresponding	Deviance of parameter	Electricity fed in tariff	IRR corresponding
75 %	8,140,308	-	50 %	0.0150	-
80 %	8,682,995	-	60 %	0.0180	-
85 %	9,225,682	-	70 %	0.0210	-
90 %	9,768,370	-	80 %	0.0240	-
95 %	10,311,057	-	90 %	0.0270	-
100 %	10,853,744	-	100 %	0.0300	-
105 %	11,396,431	-	110 %	0.0330	-
110 %	11,939,118	-	120 %	0.0360	-
115 %	12,481,806	-	130 %	0.0390	-
120 %	13,024,493	-	140 %	0.0420	-16.5%
125 %	13,567,180	-	150 %	0.0450	-13.8%
Curva de Rodas					
75 %	5,736,894	-	50 %	0.0150	-
80 %	6,119,354	-	60 %	0.0180	-
85 %	6,501,813	-	70 %	0.0210	-
90 %	6,884,273	-	80 %	0.0240	-
95 %	6,573,312	-	90 %	0.0270	-
100 %	7,649,192	-	100 %	0.0300	-
105 %	8,031,652	-	110 %	0.0330	-
110 %	8,414,111	-	120 %	0.0360	-
115 %	8,796,571	-	130 %	0.0390	-
120 %	9,179,030	-	140 %	0.0420	-
125 %	9,561,490	-	150 %	0.0450	-14.8%

The analysis was performed with a deviance range from – 50 % to + 50 % for the electricity fed in tariff and with a range from – 25 % to + 25 % for the investment costs, compared to their reference values in the financial model. The decreasing or increasing of both parameters at the presented range did not lead to positive IRR. The sensitivity analysis shows clearly that the derived conclusions on the financial unattractiveness is very robust to variations of important costs and income parameters especially when

assuming that the applied cost approaches are reasonably low in a conservative sense. Hence, the additionality analysis is continued with the step 4 as determined in the additionality tool.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

There are no comprehensive statistics about the total number of landfill sites and the landfill site management in Colombia. According to the Super-intendancy of Home and Public Services Colombians generate ca. 21,000 tons of solid waste per day [4], from which 3,913.4 tons are disposed properly.[5] However, the Ministry of Environment Housing and Territorial Development has shown in separate documents that between 2006 and 2007, Colombia generated 30,800 tons solid waste per day. The National Planning Department claims that only 357 municipalities report that their solid waste is disposed in sanitary landfills. Furthermore it estimated that around half of them do not comply with the specifications of a landfill or that they do not operate in a proper way. The rest of the municipalities (1,119) dispose their waste in open-air dumps, water bodies or with unauthorized fires.[6] Furthermore the Viceministry of Water and Sanitation states that today 40% of the municipalities in the country dispose their solid waste in unsanitary ways.[7] The national development plan from 2006-2010 contends that 633 municipalities have inadequate solid waste disposal.

Hence, like in other South American countries the common practice in Colombia is the collection and flaring of methane with a simple passive venting system, as identified in the baseline scenario. A simple passive venting system complies with the national regulation of potable water and sanitary conditions. For dumps, which technically do not exist, this law does not pertain. As no appropriate information about the common practice was available, the project partners interviewed local waste experts (evidence has been provided to the validation team). In the discussions with local waste management experts, no other landfill sites with a functioning effective gas collection and flaring system comparable to the project activity could be identified in Colombia. The only landfill to be considered as having an efficient degassing system is Doña Juana in Bogota. However, this system is not operating currently.

Furthermore an inquiry concerning the current practice in the landfill sites in big Colombian cities where conducted on behalf of the University of Antioquia. For the inquiry ten solid waste deposal sites where visited between June 2007 and March 2008. The results of the inquiry can be seen in the annex three. The inquiry clearly showed that landfill gas management and destruction is not prevailing practice in

[4] Superintendencia de Servicio Públicos Domiciliarios, Estudio Sectorial Aseo 2002 – 2005, Bogotá, Colombia, 2006, pág 207.
[5] Superintendencia de Servicio Públicos Domiciliarios, Estudio Sectorial Aseo 2002 – 2005, Bogotá, Colombia, 2006, pág 208.
[6] Departamento Nacional de Planeación, www.dnp.gov.co, Agua Potable y Saneamiento Básico, Indicadores del Sector, http://www.dnp.gov.co/paginas_detalle.aspx?idp=33, Consultado julio de 2007.
[7] MAVDT, Viceministerio de Agua y Saneamiento, Líneas estratégicas 2007 – 2010, Bogotá, Colombia, 2007, pág 15.

Colombia. Nine of the ten inquired landfills only have a simple venting system. The Doña Juana solid waste disposal sites (SWDS), which was also mentioned in the interviews, has an effective gas management system. This SWDS has applied CDM status and is currently under validation (Doña Juana landfill gas-to-energy project). Furthermore, the project partners are aware of two other SWDS in Colombia in which active landfill gas collection and flaring systems have been designed. Also these two activities have applied CDM status and they are currently under the validation. These landfill sites are Interaseo Landfill Gas Mitigation Project and El Henequén landfill gas project.

Sub-step 4: Discuss any similar options that are occurring

There are no similar options occurring without CDM status (see sub-step 4a).

The additionality analysis performed clearly shows that there are no similar activities with similar conditions that would be financially attractive without the CDM revenues. The project is very unlikely to move forward without the additional financial support of the CDM. As the project is anticipated to generate 1,351,195 tons of CO_2 credits in its first seven-year crediting period, the carbon sales would be sufficient to alleviate the economic hurdles and push the project forward.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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According to the methodology ACM0001 version 07 the emission reduction (ERy) due to the project activity are calculated through the following steps:

Baseline emissions:

$$BE_y = \left(MD_{project,y} - MD_{reg,y}\right) * GWP_{CH4} + EL_{LFG,y} \cdot CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y} \quad (1)$$

Where:

BEy = baseline emission (t CO_2 e),

$MD_{project,y}$ = amount of methane actually destroyed/combusted during the year (t CH_4),

$MD_{reg,y}$ = amount of methane that would have been destroyed/combusted during time period t in the absence of the project activity (t CH_4),

GWP_{CH4} = global warming potential value for methane (21 t CO_2 e/t CH_4),

$EL_{LFG,y}$ = net quantity of electricity produced using LFG (MWh),

$CEF_{elecy,BLy}$ = CO_2 emissions intensity of the electricity displaced (t CO_2e/MWh),

$ET_{LGF,y}$ = net quantity of thermal energy produced utilizing the landfill gas (TJ),

$CEF_{ther,BLy}$ = CO_2 emissions intensity of the thermal energy displaced (t CO_2 e/TJ).

Seeing that the project activity is a simple flaring project without generation of thermal or electric energy, the emission reductions are calculated with the simplified formula:

$$BEy = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} \quad (2)$$

An adjustment factor (AF) is used to determine the $MD_{reg,y}$. According to the methodology ACM0001 this factor describes the destruction efficiency of methane in the baseline situation that should be equal to the regulatory and contractual requirements. The amount of methane that would have been destroyed in the absence of the project activity is calculated as follows:

$$MD_{reg,y} = MD_{project,y} * AF \quad (3)$$

According to the methodology the factor $MD_{project,y}$ is the total amount of methane that is destroyed/combusted during a year and is determined by monitoring the actual amount of methane flared, sent to natural gas distribution pipeline, used to generate electricity and/or thermal energy. The amount of methane destroyed is calculated with the following equation:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \quad (4)$$

As already mentioned, no electric or thermal use or piping of the landfill gas is planned in Curva de Rodas and La Pradera landfills. Hence, the second, third and fourth factors are not considered and the formula can be simplified as follows:

$$MD_{project,y} = MD_{flared,y} \quad (5)$$

The $MD_{flared,y}$ is expressed by the formula:

$$MD_{flared,y} = LFG_{flared,y} * w_{CH4,y} * D_{CH4} - (PE_{flare,y}/GWP_{CH4}) \quad (6)$$

Where:

$MD_{flared,y}$ = quantity of methane destroyed by flaring during the year (t),

$LFG_{flared,y}$ = quantity of landfill gas flared during the year (m^3),

w_{CH4y} = average methane fraction of the landfill gas as measured during the year and expressed as a fraction (m^3CH_4/m^3LFG),

$PE_{flare,y}$ = project emissions from flaring of the residual gas stream during the year (t CO_2),

GWP_{CH4} = global warming potential of methane.

According to the methodology ACM0001 the factor $PE_{flare,y}$ shall be determined in accordance with the "Tool to determine project emissions from flaring gases containing methane". This tool is applicable for project activities that flare residual gases obtained from decomposing of organic material, which containing only methane, carbon monoxide and hydrogen. The project activity is applicable under these conditions and hence the tool will be applied. In the ex-post calculations all the seven steps of the tool will be applied. However, only the step 7 is applicable for the ex-ante calculation presented in this PDD.

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000} \quad (7)$$

Where:

$TM_{RG,h}$ = mass flow rate of the methane in residual gas in the hour,

$\eta_{flare,h}$ = flare efficiency in hour,

GWP_{CH4} = global warming potential of methane.

The ex-ante emission reduction calculation requires the estimation of the landfill gas production potential generated from the disposed waste. The gas production potential is needed in order to determine the factors $TM_{RG,h}$ and $MD_{project,y}$. This estimation is made using the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" and considering the following additional equation:

$$MD_{project,y} = BE_{CH4,SWDS,y} / GWP_{CH4} \quad (8)$$

According this tool the total methane released from solid waste at a landfill is given by the following formula:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j (y-x)} \cdot (1-e^{-k_j}) \quad (9)$$

Where:

$BE_{CH4,SWDS,y}$ = baseline methane emissions avoided during the period from the start of the project activity to the end of the year y (t CO2e),

φ = model correction factor to account for model uncertainties,

f = fraction of methane captured at the SWDS and flared, combusted or used in another manner,

GWP_{CH4} = global warming potential of methane,

OX = oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste),

F = fraction of methane in the SWDS gas (volume fraction),

DOC_f = fraction of degradable organic carbon that can decompose,

MCF = methane correction factor,

Wj,x = amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (t),

DOC_j = fraction of degradable organic carbon (by weight) in the waste type *j*,

kj = decay rate for the waste type *j*,

j = waste type category (index),

x = year during the crediting period (x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y),

y = year for which methane emissions are calculated.

Project emissions

$$PE_y = PE_{EC,y} + PE_{FC,y} \quad (10)$$

Where:

$PE_{EC,y}$ = emission from consumption of electricity in the project case,

$PE_{FC,y}$ = emission from consumption of heat in the project case.

No thermal energy is required for this project activity and accordingly the project emissions are equal to the emission from electricity consumption. These emissions are calculated using the "Tool to calculate project emissions from electricity consumption". As the electricity consumed is purchased from the grid following equation is applied:

$$PE_{EC,y} = EC_{PJ,y} * EF_{grid,y} * (1 + TDL_y) \quad (11)$$

Where:

$PE_{EC,y}$ = project emissions from electricity consumption by the project activity during the year, (t CO_2/),

$EC_{PJ,y}$ = quantity of electricity consumed by the project activity during the yeas y (MWH)

$EF_{grid,y}$ = emission factor for the grid in year (t CO_2/MWh),

TDL_y = average technical transmission and distribution losses in the grid in year y for the voltage, level at which electricity is obtained from the grid at the project site.

Emission reduction:

$$ER_y = BE_y - PE_y \quad (12)$$

Where:

ER_y = emission reductions in year (tCO_2e/y),

BE_y = baseline emissions in year (tCO_2e/y),

PE_y = project emissions in year (tCO_2/y).

Leakage

No leakage has been identified and due to the methodology ACM0001 no leakage effects need to be accounted.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The default value 0.9 recommended in the Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site is applied.
Any comment:	Oonk et el. (1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor, reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The tool determines: "Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost." The waste is currently covered with soil and hence the value 0.1 is applied.
Any comment:	

Data / Parameter:	**F**

Data unit:	-
Description:	Volume fraction of methane in the SWDS gas.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The default value 0.5 is recommended by the Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site is applied.
Any comment:	

Data / Parameter:	**DOCf**
Data unit:	-
Description:	Fraction of degradable organic carbon that can decompose.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The default value 0.5 is recommended by the Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site is applied.
Any comment:	

Data / Parameter:	**MCF**
Data unit:	1.0
Description:	Methane correction factor.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The tool to determine methane emissions avoided from dumping waste at a solid waste disposal site determines: "Use…1,0 for anaerobic managed solid waste disposal sites." The project activity takes place in solid waste disposal sites that fulfils the criteria of "managed". Hence the value 1,0 is applied.
Any comment:	The methane correction factor accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter:	**DOCj**
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The following values for the different waste types *j* are applied:
Any comment:	The values applied are for wet waste.

Waste type *j*	**DOCj (%)**
Paper	40
Food	15
Textiles	24
Plastics	0
Inert	0

Data / Parameter:	**K**

Data unit:	-
Description:	Decay rate for the waste type *j*.
Source of data:	First order decay model from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Measurement procedure (if any):	The following values are applied for the different waste types:
Any comment:	The values applied are for wet (MAP > 1000m) tropical (MAT> 20°C) conditions.

Waste type *j*	**k**
Paper	0.07
Food	0.40
Textiles	0.07
Plastics	0
Inert	0

Data / Parameter:	**f**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared.
Source of data:	Adjusted baseline setup
Measurement procedure (if any):	The factor f is set to zero as the amount of methane captured and flared is taken in to account with the factor AF (please see hereinafter).
Any comment:	

Data / Parameter:	**Wtotal**
Data unit:	Tons
Description:	The amount of waste disposed in the landfill sites in year *x*
Source of data:	Waste projections (Waste management scheme for the metropolitan area of Medellin 2005)
Measurement procedure (if any):	

La Pradera			
Module 1		*Module 2*	
Year	**W_{total}**	**Year**	**W_{total}**
2003	310,886	2004	403,977
2004	278,301	2005	704,887
		2006	703,147
		2007	686,007
		2008	664,033
		2009	591,174
		2010	566,887
		2011	522,600
		2012	522,600

	Curva de Rodas

Module 1		*Module 2*	
Year	**W_{total}**	**Year**	**W_{total}**
1984	14,400	1996	598,500
1985	189,600	1997	629,700
1986	218,100	1998	713,400
1987	234,000	1999	732,000
1988	264,600	2000	716,700
1989	284,400	2001	699,000
1990	287,400	2002	657,900
1991	317,100	2003	255,000
1992	372,600		
1993	431,100		
1994	532,800		
1995	580,200		

Any comment:	The amount of waste is divided to different waste fractions according the baseline situation. Please see annex 3.

Data / Parameter:	**GWP_{CH4}**
Data unit:	t CO_2 e/t CH_4
Description:	Global warming potential of methane.
Source of data used:	IPCC 2007, The Physical Science Basis. Changes in Atmospheric Constituents and in Radiative Forcing, p.212
Value applied:	
Measurement procedure (if any):	The default value 21 is applied.
Any comment:	Factor needed to quantify the amount of landfill gas flared (MDflared).

Data / Parameter:	**CE**
Data unit:	%
Description:	LFG collection efficiency.
Source of data:	Project setup
Measurement procedure (if any):	The value 60 % is applied based on engineers judgment. During the years 2008 and 2009 waste is still disposed in La Pradera and accordingly the gas collection efficiency is estimated to be lower for the first 24 months. In this time the coverage and sealing is optimized and the gas collection efficiency increases progressively. Hence, following values are applied: 25 % for the last quarter of 2008, 40 % for the year 2009 and 55% for the year 2010 for La Praderea landfill.
Any comment:	Factor needed to quantify the amount of landfill gas flared (MDflared).

Data / Parameter:	**$\eta_{,h}$**
Data unit:	%
Description:	Flare efficiency in hour.
Source of data used:	Project setup
Value applied:	
Measurement procedure (if any):	The project activity applies a high- temperature flare. A study (Green Gas 2006. Report on the carrying out of emission measurements at the high-temperature

	flare system at Zámbiza waste disposal site, Quito, page 15) about the same flare instrument applied by the same supplier as in this project activity shows that the flare operates with an efficiency of 99.99 %. Hence the 99.99 % flare efficiency is applied for the ex-ante calculations.
Any comment:	

Data / Parameter:	**$EF_{grid,y}$**
Data unit:	kg CO_2/kWh
Description:	Emission factor for electricity consumed during the project activity
Source of data:	Default value given in the Tool to calculate project emissions from electricity consumption is applied.
Measurement procedure (if any):	The validity of the value applied will checked annually from the applied tool.
QA/QC procedures:	--
Any comment:	Value applied: 1.3 tCO_2/MWh

Data / Parameter:	**Regulatory requirements related to landfill gas projects**
Data unit:	--
Description:	Regulatory requirements relating to landfill gas projects
Source of data:	Regulatory requirements and baseline setup.
Measurement procedure (if any):	The operator of the project activity will annually check the regulatory requirements from the DNA. This information is used change the adjustment factor AF or directly $MD_{reg,\,y}$. An adjustment factor of 2 is applied for the ex-ante calculation. Please see annex 3 for the detailed assumptions and calculations.
Any comment:	Required for changes in adjustment factor AF or directly in $MD_{reg,y.}$

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{CO}	kg/kmol	Molecular mass of carbon monoxide	28.01
MM_{CO2}	kg/kmol	Molecular mass of carbon dioxide	44.01
MM_{O2}	kg/kmol	Molecular mass of oxygen	32.00
MM_{H2}	kg/kmol	Molecular mass of hydrogen	2.02
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02
AM_C	kg/kmol (g/mol)	Atomic mass of carbon	12.00
AM_H	kg/kmol (g/mol)	Atomic mass of hydrogen	1.01
AM_O	kg/kmol (g/mol)	Atomic mass of oxygen	16.00
AM_N	kg/kmol (g/mol)	Atomic mass of nitrogen	14.01
P_n	Pa	Atmospheric pressure at normal conditions	101,325
R_u	Pa m^3/ kmol K	Universal ideal gas constant	8,314.472
T_n	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O2 volumetric fraction of air	0.21
MV_n	m^3/Kmol	Volume of one mole of any ideal gas at the normal temperature and pressure	22.414
$\rho_{CH4,\,n}$	kg/m^3	Density of methane gas at normal conditions	0.7168
$N_{Ai,j}$	Dimensionless	Number of atoms of element j in component i, depending on molecular structure	
Source of data:	Tool to determine project emissions from flaring gases containing methane.		

B.6.3 Ex-ante calculation of emission reductions:

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Based on the formula and justifications given in section B.6.1 and the parameters presented in section B.6.2, the resulting emission reduction due to the project activity is calculated through the following steps.

Baseline emissions:

The estimated landfill gas production potential is calculated by the equation 8 from section B.6.1 and it is presented in table 5. The calculation bases on the amount, category and age of the waste disposed. Please see annex 3 for more detailed information. Assuming 60% landfill gas collection efficiency for the project activity based on engineers' judgements, the amount of landfill gas recovered and sent to the flare station is obtained (note adjustments for La Pradera as explained in page 27).

Table 5. Gas production potential and gas collection

	La Pradera		Curva de Rodas	
Year	**LFG production (t CO_2)**	**LFG collected (t CO_2)**	**LFG production (t CO_2)**	**LFG collected (t CO_2)**
2008	78,217	19,554	30,862	18,517
2009	376,688	150,675	144,859	86,915
2010	381,347	209,741	0	0
2011	380,061	228,037	0	0
2012	375,802	225,481	0	0
2013	353,876	212,326	0	0
2014	261,929	157,157	0	0
2015	164,981	98,989	0	0
Total	**2,372,901**	**1,301,960**	**175,721**	**105,432**

The methane destroyed ($MD_{project,y}$) due to the project activity are given by formulas 5, 6 and 7. The flare efficiency is expected to be 99.99 % based on study about the high-temperature flare's operation[8]. The amount of landfill gas flared as well as the project emissions from flaring are presented in table 6. The amount of landfill gas flared correspond the amount of landfill gas collected presented in table 5.

Table 6. Landfill gas flared and the emissions from flaring

	La Pradera	Curva de Rodas

[8] Green Gas 2006. Report on the carrying out of emission measurements at the high-temperature flare system at Zámbiza waste disposal site, Quito, page 15

Year	LFG gas flared (t CO_2)	Emissions from flaring (t CO_2)	LFG gas flared (t CO_2)	Emissions from flaring (t CO_2)
2008	19,554	2	18.517	2
2009	150,675	15	86.915	9
2010	209,741	21	0	0
2011	228,037	23	0	0
2012	225,481	23	0	0
2013	212,326	21	0	0
2014	157,157	16	0	0
2015	98,989	10	0	0
Total	**1,301,960**	**131**	**105,432**	**11**

Since the data given is already in form of CO_2 equivalents (based on the first order decay model calculation), the factors $w_{CH4,y}$, D_{CH4}, GWP_{CH4} are not needed and the amount of methane destroyed due to the project activity can be calculated as presented in the table 7.

Table 7. Amount of landfill gas destroyed during the project activity

	La Pradera	Curva de Rodas
Year	**$MD_{project,y}$ = $MD_{flared,y}$ (t CO_2)**	**$MD_{project,y}$ = $MD_{flared,y}$ (t CO_2)**
2008	19,552	18,515
2009	150,660	86,906
2010	209,720	0
2011	228,014	0
2012	225,458	0
2013	212,305	0
2014	157,141	0
2015	98,979	0
Total	**1,301,829**	**105,421**

The landfill gas emission reduction in the baseline is calculated by the equation 3. A simple passive gas collection and flaring system that meets all the current regulatory requirements exist in the baseline. The methane destruction efficiency of this system is estimated to be very low (0.9975 %) and the derived adjustment factor is set to 2.0 %. Please see annex 3 for detailed information concerning the assessment of the baseline flare efficiency and the adjustment factor. The amount of landfill gas destroyed in the baseline is presented in table 8.

Table 8. Landfill gas destroyed in baseline

		La Pradera	Curva de Rodas

Year	*AF (%)*	$MD_{reg,y}$	$MD_{reg,y}$
2008	2	1,564	617
2009	2	7,534	2,897
2010	2	7,627	0
2011	2	7,601	0
2012	2	7,516	0
2013	2	7,078	0
2014	2	5,239	0
2015	2	3,300	0
Total		**47,459**	**3,514**

Project emissions

To calculate the emission reduction achieved due to the project activity, the emissions caused by electricity consumption during the project activity has to be taken into account. The project activity requires electricity for the blowers that suck the gas from the landfill body and blows it further to the flare. The emissions are calculated using the equation 11 and they are presented in table 9. The electricity consumption bases on the engine capacity of the gas collection systems and to the estimation of the pre-calculated load of 60 %. The 20 % default value is applied for the technical transmission and distribution losses.

Table 9. Project emissions from electricity consumption

		La Pradera		Curva de Rodas	
Year	**GF (tCO_2/ MWh)**	**Electricity consumption (kWh/a)**	**Emissions caused (tCO2)**	**Electricity consumption (kWh/a)**	**Emissions caused (tCO_2)**
2008	1,3	37,000	58	60,000	94
2009	1,3	177,600	277	288,000	449
2010	1,3	465,600	726	0	0
2011	1,3	465,600	726	0	0
2012	1,3	465,600	726	0	0
2013	1,3	465,600	726	0	0
2014	1,3	465,600	726	0	0
2015	1,3	368,600	574	0	0
Total			**4,539**		**543**

Emission reductions

Finally the ex-ante emission reduction is calculated by the equation 2. Since the data given is already in form of CO_2 equivalents the global warming potential factor of methane is not needed. The project activity is anticipated to reduce 1,351,195 tons of CO_2 equivalents in the first seven years crediting period. The emission reductions are presented in the tables 10 and 11.

Table 10. Emissions reductions achieved by the project in the La Pradera landfill

La Pradera			
Year	**Baseline emissions (t CO_2)**	**Project emissions (t CO_2)**	**Emission reduction (t CO_2)**
2008	17,988	58	17,930
2009	143,126	277	142,849
2010	202,093	726	201,367
2011	220,413	726	219,687
2012	217,942	726	217,216
2013	205,227	726	204,501
2014	151,902	726	151,176
2015	95,679	574	95,105
Total	**1,254,370**	**4,539**	**1,249,831**

Table 11. Emissions reductions achieved by the project in the Curva de Rodas landfill

Curva de Rodas			
Year	**Baseline emissions (t CO_2)**	**Project emissions (t CO_2)**	**Emission reduction (t CO_2)**
2008	17,898	94	17,804
2009	84,009	449	83,560
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
Total	**101,907**	**543**	**101,364**

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Table 12. Summary of emissions

Years	Estimation of project activity emissions (t CO2 e)	Estimation of baseline emissions (t CO2 e)	Estimation of leakage (t CO2 e)	Estimation of overall emission reductions (t CO_2 e)
2008 (Oct 15-Dec 31)	152	35,886	0	35,734
2009	726	227,135	0	226,409
2010	726	202,093	0	201,367
2011	726	220,413	0	219,687
2012	726	217,942	0	217,216
2013	726	205,227	0	204,501
2014	726	151,902	0	151,176
2015 (Jan 1- Oct 14)	574	95,679	0	95,105
Total (t CO_2 e)	**5,082**	**1,356,277**	**0**	**1,351,195**

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**LFG_{total}**
Data unit:	m^3
Description:	Total amount of gas captured.
Source of data to be used:	Measured by the gas flow meter of the blowers.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	Average value of captured LFG during the crediting period is 2,001,184 Nm^3 for Curva de Rodas and 24,712,251 Nm^3 for La Pradera.
Description of measurement methods and procedure applied:	Measured by the flow meter placed directly on the installation. The proportion of the data to be monitored is 100%. The data aggregated monthly and yearly. There will be continuous measurement frequency.

QA/QC procedures:	The flow meter will be subject to a regular maintenance and testing regime to ensure accuracy. The flow meter will be calibrated according manufacturers specifications. Uncertainty level is low (+/- 1,0 %).
Any comment:	

Data / Parameter:	**$LFG_{flare} = FV_{RG,h}$**
Data unit:	m^3/h
Description:	Amount of landfill gas flared.
Source of data to be used:	Measured by the gas flow meter of the flares.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	Average value of captured LFG during the crediting period is 2,001,184 Nm³ for Curva de Rodas and 24,712,251 Nm³ for La Pradera.
Description of measurement methods and procedure applied:	Measured by the turbine flow meter, placed directly on the installation. The proportion of the data to be monitored is 100%. The data is aggregated monthly and yearly. The fraction is measured on wet basis. There will be continuous measurement frequency.
QA/QC procedures:	The flow meter will be subject to a regular maintenance and testing regime to ensure accuracy. The flow meter will be calibrated according manufacturers specifications. Uncertainty level is low (+/- 1,0 %).
Any comment:	The factor $FV_{RG,h}$ refers to the "Tool to determine project emissions from flaring gases containing methane".

Data / Parameter:	**$W_{CH4} = fv_{ch4,h}$**
Data unit:	$m^3 CH_4/m^3$ LFG
Description:	Methane fraction in the landfill gas in hour.
Source of data to be applied:	Gas quality analyser.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	The fraction of methane in the landfill gas is assumed as 0.5 according to IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Description of measurement methods and procedure applied:	Measured by quality analyzer. Measurement principle of the gas analyser is infrared. The proportion of the data to be monitored is 100%. The fraction is measured on wet basis. There will be continuous measurement frequency.
QA/QC procedures:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according manufacturers specifications. Uncertainty level is low (+/- 1.0 %).
Any comment:	As simplification only the methane content of the residual gas is measured and the remaining part (CO, CO_2, H_2, N_2, O_2) is considered as N_2. The factor $fv_{ch4,h}$ refers to the "Tool to determine project emissions from flaring gases containing methane".

Data / Parameter:	**$t_{O2,h}$**

Data unit:	$m^3 CH_4/m^3$ LFG
Description:	Fraction of O_2 in the exhausted gas of the flare in hour.
Source of data to be applied:	Gas quality analyser.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.
Description of measurement methods and procedure applied:	Measured by gas quality analyzer. The point of measurement shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes). An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. The measurement principle of the gas analyser is electrochemical. The proportion of the data to be monitored is 100% and it will be aggregated monthly. There will be continuous measurement frequency.
QA/QC procedures :	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according manufacturers specifications (all four weeks with two point calibration). Uncertainty level is low (< 1%).
Any comment:	

Data / Parameter:	**$fv_{CH4,FG,h}$**
Data unit:	--
Description:	Concentration of methane in the exhausted gas of the flare in dry basis at normal conditions in hour.
Source of data to be applied:	Gas quality analyser.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.
Description of measurement methods and procedure applied:	Measured by gas quality analyzer. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes). An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. Measurement principle of the gas analyser is infrared. The proportion of the data to be monitored is 100% and it will be aggregated monthly. There will be continuous measurement frequency.
QA/QC procedures:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according manufacturers specifications (all four weeks with two point calibration). Uncertainty level is low (< 1%).

Any comment:	

Data / Parameter:	**T**
Data unit:	°C
Description:	Temperature of the landfill gas.
Source of data to be applied:	Thermometer by the gas flow meter of the blowers.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.
Description of measurement methods and procedure applied:	Measured to determine the density of methane $DC_{H4.}$ Measured by the thermometer of the blowers. There will be continuous measurement frequency.
QA/QC procedures:	The thermometer will be subject to a regular maintenance and testing regime to ensure accuracy. The thermometer will be calibrated according manufacturers specifications. Uncertainty level is very low.
Any comment:	Measured to determine the density of methane $DC_{H4.}$

Data / Parameter:	**P**
Data unit:	Pa
Description:	Pressure of the landfill gas.
Source of data to be applied:	Manometer by the gas flow meter of the blowers.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.
Description of measurement methods and procedure applied:	Measured to determine the density of methane $DC_{H4.}$ Measured by the manometer of the blowers. There will be continuous measurement frequency.
QA/QC procedures:	The manometer will be subject to a regular maintenance and testing regime to ensure accuracy. The manometer will be calibrated according manufacturers specifications. Uncertainty level is very low.
Any comment:	

Data / Parameter:	**T_{flare}**
Data unit:	°C
Description:	Temperature in the exhausted gas of the flare.
Source of data to be applied:	Thermocouple by the gas flow meter of the flares.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.

Description of measurement methods and procedure applied:	Measured by the thermocouple (PtRh10 –Pt) of the flares. If the temperature is less than 500 °C or no temperature records exist, the flare efficiency shall be assumed to be zero. There will be continuous measurement frequency.
QA/QC procedures:	The thermocouple will be subject to a regular maintenance and testing regime to ensure accuracy. The thermocouple will be calibrated according manufacturers specifications (EN Standard).
Any comment:	Measured to determine the flare efficiency and furthermore project emissions from flaring.

Data / Parameter:	**PE_{EC}**
Data unit:	MWh/a
Description:	Onsite consumption of electricity provided by the grid during the year y.
Source of data to be applied:	Onsite power consumption meter
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	No value was estimated.
Description of measurement methods and procedure applied:	Measured by power meter. The proportion of the data to be monitored is 100%. The data is aggregated annually. There will be continuous measurement frequency.
QA/QC procedures:	The power meter will be subject to a regular maintenance and testing regime to ensure accuracy. The power meter will be calibrated according manufacturers specifications. Cross check with invoices for purchased electricity if relevant.
Any comment:	For the ex-ante calculations the value 177,6 MWh for Curva de Rodas and 288 MWh for La Pradera are applied. For more detailed information please see page 29-31.

Data / Parameter:	**TDL_y**
Data unit:	-
Description:	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.
Source of data to be applied:	The default value 20 % given in the Tool to calculate project emissions from electricity consumption is applied for the ex-ante calculation.
Values of data applied for the purpose of calculation expected emission reductions in section B.5:	The value of 2.0 was estimated for transmission and distribution losses.
Description of measurement methods and procedure applied:	Reference values from utilities, network operators or other official documents are applied.
QA/QC procedures:	--
Any comment:	

B.7.2 Description of the monitoring plan:

>>

The emission reductions achieved by the project activity in each year will be assessed ex-post through direct measurements. The consolidated baseline and monitoring methodology ACM0001 version 07 is applied to this project activity. According to the methodology the amount of landfill gas captured and flared shall be measured directly. The remaining parameters needed to determine the quality and quantity of the captured and flared gas are: fraction of methane in landfill gas, and the flow of the landfill gas to flare as well as the temperature and pressure of landfill gas at flow measurement point for transformation to standard conditions (T_N = 273°K, p_N = 1013.15 Pa). The monitored parameters are described in detail under section B.7.1.

The monitoring of landfill gas collection and destruction efficiency will be a part of the standard operating procedure for the project activity. The Green Gas Germany GmbH operates the project and will be responsible for the supervision of the monitoring activities. The technical staff of the landfill site will continuously perform the project monitoring including the quality control and the quality assurance. The staff of the landfill will be trained in terms of record keeping, equipment calibration, overall maintenance, and procedures for corrective action before starting the operation and monitoring of the project activity. Furthermore the quality control and assurance activities include re-audits and training. In addition an "Operation and Maintenance Schedule" have been developed for the operating personnel. The supplier of the equipment, the Hofstetter Umwelttechnik AG, will supervise the correct installation of the equipment. Furthermore external service are requested to do major service and overhaul steps of main components. As already mentioned, the university will take advantage of this project as a training facility for engineering students, so the monitoring will be highly supervised.

All data recorded will be archived in electronic form in a data logger. Calibration certificates will be stored as paper copies or scanned copies in electronic form. The data will be archived two years after the seven years crediting period.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completing the final draft of the baseline: August 3, 2008

Name of person/entity determining the baseline:

Organization	GreenStream Network GmbH
Address	Grosser Burstah 31
Postal Zip/city	20457 Hamburg
Country	Germany
Represented by:	
Salut. / First Name /Last Name	Ms Laura Lahti
Telephone	+ 49 40 809063 109
Fax	
Email	laura.lahti@greenstream.net

Note: The above party is not a project participant.

Date of updating the baseline by replacing estimated values with justified historical data:

Organization	Green Gas Colombia S.A. E.S.P.
Address	Avenida 82. No. 10-62, Piso 5
Postal Zip/city	Bogota
Country	Colombia
Represented by:	
Salut. / First Name /Last Name	Ms Tamara Vasziljevics Dr
Telephone	+44 20 8614 7324
Fax	+44 20 8614 7329
Email	Tamara.vasziljevics@greengas.net

Note: The above party is project participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>> 01/02/2007

C.1.2. Expected operational lifetime of the project activity:

>> 21 years

C.2 Choice of the crediting period and related information:

>> Renewable crediting period.

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>> 15/10/2008

C.2.1.2. Length of the first crediting period:

>> 7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> Not applicable.

C.2.2.2. Length:

>> Not applicable.

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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The environmental impacts attributable to project activity were assessed in a qualitative manner. As already stated at the local level the project activity effects the environment very positively and hence it improves the quality of life in the surrounding communities. Especially the aspects related to bad odour, leachate nuisances, ground and surface water contamination, as well as the risk of explosion and fire are significantly improved. Furthermore the risk of land slides will diminish since the internal pressure of the landfill body will decrease due to the extraction of landfill gas.

It should be noted that landfill gas combustion will produce small amounts of nitrogen oxides (NOx), particulate matter (PM) and carbon monoxide (CO). However, the emissions from the enclosed high efficiency flares installed for this project activity comply with the EU standards as detailed in “Guidance on Landfill Gas Flaring”. The complete extraction and flaring stations installed at both sites are equipped with necessary safety features for the safe handling of the landfill gas. The stations are in accordance with the guideline EN60079-ff for explosion protection.

All necessary permits are available to operate the landfill as well as the project activity.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>> Not applicable.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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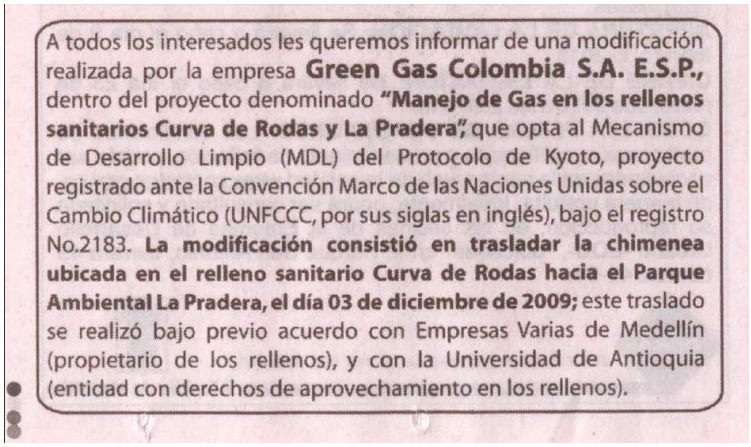
The stakeholders of this project are defined to be: the government Colombia at the municipal, sub-regional, departmental and national levels; the academic sector particularly universities; the civic, community and private sector. The stakeholders were informed about the project activity and the spokesmen of these stakeholders were invited to comment the project between February and November, 2006 (please see table 13).

Different strategies were used to inform and invite the stakeholders to comment the project activity. The spokespersons of the governmental structure of Colombia (municipalities, corporations, enterprises, and ministries) as well as the civic, community and private sectors were invited directly via phone calls, written invitations and e-mail, on behalf of the project and with the support of the EEVVM. The academic sector, especially the universities, was invited by similar strategies. In addition, these stakeholders were addressed by open invitations to seminars, forums, and academic events promoted by the University of Antioquia. The table 14 further down in this chapter presents the main activities that took place with the stakeholders between February and November, 2006. Furthermore an illustrative flyer (see annex 6 - additional document) about the essential aspects of the project - the problem it addresses, the solution it proposes and the benefits it generates - was produced and distributed among the stakeholders.

The stakeholders were also informed about the relocation of the flare from Curva de Rodas to La Pradera.



A todos los interesados les queremos informar de una modificación realizada por la empresa **Green Gas Colombia S.A. E.S.P.,** dentro del proyecto denominado **"Manejo de Gas en los rellenos sanitarios Curva de Rodas y La Pradera"**, que opta al Mecanismo de Desarrollo Limpio (MDL) del Protocolo de Kyoto, proyecto registrado ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático (UNFCCC, por sus siglas en inglés), bajo el registro No.2183. **La modificación consistió en trasladar la chimenea ubicada en el relleno sanitario Curva de Rodas hacia el Parque Ambiental La Pradera, el día 03 de diciembre de 2009;** este traslado se realizó bajo previo acuerdo con Empresas Varias de Medellín (propietario de los rellenos), y con la Universidad de Antioquia (entidad con derechos de aprovechamiento en los rellenos).

To Whom It May Concern, we would like to announce the modification of the project called "Curva de Rodas and La Pradera landfill gas management project", implemented by the company Green Gas Colombia S.A. E.S.P. The project is developed under the Clean Development Mechanism (CDM) of the Kyoto Protocol and is registered by the UNFCCC under No. 2183. The modification refers to moving the flare from Curva de Rodas landfill site to the Environmental Park of La Pradera on the 3rd of December 2009. This transfer was carried out with the consent of Empresas Varias de Medellín (owner of the landfill) and with the University of Antioquia (entity with the rights to exploit the landfills).

Table 13. The spokesmen of the local stakeholders invited to the stakeholder process

Name	Institution	Position
Aicardo Serna O.	Pavimentar S.A.	Various
Alberto Uribe Correa	University of Antioquia	Chairman
Alberto L. Gutiérrez TaMay	Research Group MASO-UdeA	Teacher, researcher
Alejandra García C	University of Antioquia	Student
Alexandra Cortés Aguilar	Industrial University of Santyer	Teacher
Alfonso Correa	Community Action board of La Pradera	Various
Alfonso Monsalve S.	University of Antioquia	Research vice chairman
Álvaro Roldán Pérez	University of Antioquia	Administrative vice chairman
Andrea Herrera Gallo	Sanear S.A.	Topographer
Andrés Amell	University of Antioquia	Teacher, researcher
Andrés De Bedout Jaramillo	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	General manager
Andrés Felipe Martínez	University of Antioquia	Student
Ángelica Gómez	University of Antioquia	Engineer
Angélica María Pineda Botero	UTP – CIEBGRG	Student
Antonio Jiménez Z.	Ingeprop	Various
Armando de J. Correa	Public Health Faculty - University of Antioquia	Teacher
Beatriz Hernández O.	Territorial council of Planning -Bello (A)	Director of Parks y offices
Carlo Vigna	ASJA Ambiente Italia SPA – América Latina	Management Engineer
Carlos Arroyave	Engineer Faculty of the University of Antioquia	Dean
Carlos Baena T.	Sanear S.A.	Inspector
Carlos Díaz	Research Group GASURE- University of Antioquia	Researcher
Carlos Osorio	Community Action board of La Pradera	Various
Carlos Ospina	MGM	Environmental Administrator
Carlos Zárate	Environmental Academic Corporación - University of Antioquia	Director
Carlos Andrés Uribe	University of Antioquia	Engineer
Carlos H. Fonseca Zárate	University of Antioquia	Director SIU
Carlos Mario Méndez Restrepo	University of Antioquia	Postgraduate student

Carlos Roberto Herrán Cadavid	University of Antioquia	Student
Carmen Lucía Mirya Ortiz	CIEBREG	Teacher
Carolina Castrillón Marín	University of Antioquia	Student
Carolina Villafañe	Ministry of environment – climate change office	Employee
Catalina Ramírez Bermúdez	University of Antioquia	Student
Catherine Araujo Navarro	University of Antioquia	Student
Claudia Molina	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	Employee
Danilo Castrillón Alzate	Community Action board of La Pradera	Various
David Tobón	Economy Faculty - University of Antioquia	Researcher
Diego Montejo Camello	Administrative vicerectory - University of Antioquia	Assistant
Dora Inés Vivanco July	San Buenaventura University	Student
Doralba Muñeton Cataño	Community Action board of La Pradera	Various
Edel Laura Sánchez Higuita	University of Antioquia	Student
Elizabeth Corrales M.	UTP – CIEBGRG	Student
Erika Mazo Osorio	Research Group GDCON- University of Antioquia	Sanitary Engineer
Eugenio Montoya	SIU- University of Antioquia	Director Administrative
Ever Álvarez Sánchez	University of Antioquia	Student
Fanor Mondragón	Research Group QUIREMA- University of Antioquia	Director
Félix Echeverría	Research Groups SIU- University of Antioquia	Teacher y Representative
Ferney Henao A.	Fumigax	Technician applicator
Francisco Charry	Ministry of environment – climate change office	Employee
Francisco Idárraga	Propav consortium	Various
Francisco Javier Correa Restrepo	University of Medellín	Docent, researcher
Francisco Jaramillo Piedrahita	University of Antioquia	Student
Frank Montoya Arroyave	Copacabana Municipality (Antioquia)	Mayor Municipal
Franklin Orlyo Rúa O.	Alpha Security	Guard
Fredy Agudelo A.	Propav consortium	Various
Gabriel Ignacio Isaza Ramírez	University of Antioquia	Student
George Hill	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	Engineer- Planning direction

Germán Jaramillo López	Biochemical for Colombia	Engineer
Gloria Cecilia Ceballos	University of Antioquia	Student
Gonzalo Jaramillo	Juridical Office – University of Antioquia	Lawyer, teacher
Guillermo Herrera	Ministry of environment –Territorial development	Employee
Guillermo Restrepo	Community Action board of La Pradera	Various
Guillermo L. Bedoya	Propav consortium	Manager
Gustavo Peñuela	Research Group GDCON- University of Antioquia	Director
Héctor Idárraga	Propav consortium	Various
Hugo Alexyer Sánchez Yepes	University of Antioquia	Student
Isabel Cristina Álvarez Ojeda	Industrial University of Santyer	Teacher
Jaime Andrés Restrepo	Biogás Project UdeA y EEVVM	Environmental Administrator
Jairo Bladimir Medina	Propav consortium	Topographer
Jessica Santis Salas	University of Antioquia	Student
Joaquín E. García	Association of Community Action boards of Barbosa (Antioquia)	Various
Jhon Bayron Tobón	Association of Community Action boards of Barbosa (Antioquia)	Various
Jhon Fredy Mora	Community Action board of La Pradera	Various
Jhon H. Moreno Moreno	Sanear S.A.	Topographer
Jorge Rodas	Sanear S.A.	Employee
Jorge Jaramillo	Technologic management - University of Antioquia	Director
Jorge Hugo Castrillón M.	Propav consortium	Various
José Santiago Arroyo Mina	Pontific Javeriana University	Teacher
Juan B. Restrepo H.	Sanear S.A.	Topographer
Juan Carlos Muñoz	Research Group GEA- University of Antioquia	Researcher
Juan David Rodríguez Meléndez	University of Antioquia	Student
Juan David Gómez García	University of Antioquia	Student
Juan de Dios Uribe	Association of Community Action boards of Barbosa (Antioquia)	Various
Juan José Osorno Osorno	Propav consortium	Various
Juan Pablo Domínguez	Biogás Project UdeA y EEVVM	Economist
Leidy Yomari García Pérez	University of Antioquia	Student
Leonardo Alberto Ríos Osorio	University of Antioquia	Teacher

Leonel Arias Zapata	Fumigax	Applicator technician
Liliana Montoya Londoño	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	Environmental management specialist
Liliana Sánchez Mazo	Research Group MASO-UdeA	Researcher
Liliana Suárez Tamay	Public utilities of Medellín	Manager of the area gas
Liliana Andrea Murcia Ballesteros	University of the Yes	Student
Lina Marcela Benítez Castrillón	University of Antioquia	Student
Lubier Calle	Public utilities of Medellín	Employee
Luís Alejandro Palacio García	Industrial University of Santyer	Teacher
Luis Alfonso Escobar	CORANTIOQUIA	Director General
Luis Alfredo Rojo S.	Association of Community Action boards of Barbosa (Antioquia)	Operator
Luis Anibal Sepulveda	CORANTIOQUIA	Sub-director
Luis Eduardo De Ávila	ETEISA-Colombia	Legal Representative
Luis Fernando Restrepo A.	Juridical Office – University of Antioquia	Law Assessor
Luis Oliverio Cárdenas M.	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	Planning Director
Luis Ovidio Ramírez	Internal Control – University of Antioquia	Director
Manuel Villarraga	Interinsa S.A.	Employee
Marcos Morales	Agriculture Secretariat of Antioquia	Employee
María del Mar García	ASJA Ambiente Italia SPA – América latina	International promoter
Maria Isabel Arango U.	Empresas Varias de Medellín (public utility managing the landfills in Medellin)	Environmental engineer
Mariela Higuita Jaramillo	Territorial Planning council -Bello (A)	Bello municipality Assessor
Mauricio Alviar	Economy Faculty - University of Antioquia	Dean
Mauricio Barrera V.	Propav consortium	Various
Mauricio Echeverri Duque	CIEBREG	Teacher
Mauricio Mora O.	Community Action board of La Pradera	Various
Mauricio Valencia	University of Antioquia	Teacher
Natalia González Parias	University of Antioquia	Student
Nelson Osorio	Antioquia state government	Private Secretary
Nelson Andrés Álvarez Montoya	University of Antioquia	Student
Néstor Raúl Escobar S.	Copacabana´s Mayr house (Antioquia)	Infrastructure secretariat
Nohemí Saldarriaga	Territorial Planning council -Bello (A)	Planning secretariat of Bello

Orfely María Rueda	Biogás Project UdeA y EEVVM	Engineer
Pablo Emilio Montoya	Community Action board of La Pradera	Various
Pastora Murillo	Ministry of environment –Territorial development	Employee
Patricia García	Agricultural secretariat	Employee
Raquel Vergara Gómez	University of Antioquia	Student
Ronald Marín Vahos	University of Antioquia	Student
Rubén Alberto Agudelo G.	Research Group GIGA-UdeA	Director
Sandra Enríquez	Ecomethane-Ecosecurites	Engineer
Sandra Escobar Izquierdo	Biogás Project UdeA y EEVVM	Social Communicator
Sandra Viviana Polanía	University of the Yes	Teacher, researcher
Sandra Turbay Ceballos	Grupo de Investigación MASO-UdeA	Director
Sergio Andrés Velásquez	Consejo Territorial de Planeación-Bello	Bello governmental secretariat
Silene Andrea Gómez Alarcón	University of the Yes	Student
Sonia Stella Sánchez López	Biogás Project UdeA y EEVVM	Social worker
Tomás Tintinago	CORANTIOQUIA	Engineer
Tulio Betancur Tobón	Empresas Públicas de Medellín	Employee
Walter de Jesús Bravo Ramírez	Biogás Project UdeA y EEVVM	Planning, development
Walter Rengifo Carvajal	Universidad de Antioquia	Student
William A. Álvarez P.	Consejo Territorial de Planeación-Bello (A)	Secretariat of Infrastructure
William Cañas	Community Action board of La Pradera	Various
William Valencia	Propav consortium	Various
Wilson Vélez P.	Association of Community Action boards of Barbosa (Antioquia)	Various
Wilson Darío Valencia	Propav consortium	Various
Wilson de J. Gómez Ramírez	Propav consortium	Topographer
Wiston Mosquera Moreno	Inteinsa	Industrial Instrumentation
Ximena Marcela Morales Ramírez	University of the Andes	Student

Table 14. Activities taken place with the stakeholders

Place and date	**Activity**	**Stakeholder**	**Evaluation**
Medellín, 27th of January	Signing of Contract 162/2006 for creation y operation of the landfill Project in Curva de Rodas y La Pradera	EEVVM and UdeA	No objection. Legal support for the institutional framework

			of the landfill project.
Medellín, 15th of February	Creation of Coordinating commission for the landfill Project in the Antioquia university y by sectoral Resolution number 22116	Rectoría, Vice-Adtva and Vice-Investigación, Facultades de Ingeniería and Economía-UdeA	No objection
Medellín, 22nd of February	Ecomethane project proposal	Sector private and UdeA	No objection
Medellín, 28th of February	Biochemical project proposal	Sector private and UdeA	No objection
Medellín, 3rd of March	MGM project proposal	Sector private and UdeA	No objection
Medellín, 24th of March	Antioquia Governors office approval y discussion of the ASJA-Italia	Private sector, governmental departmental and UdeA	No objection
Quito (Ecuador)	Latin American Carbon Forum. Presentation of Project LANDFILL en rellenos Curva de Rodas y La Pradera	Private sector and UdeA	No objection. Inclusion in Colombian LANDFILL- portfolio.
Medellín, 7th of April	Turn in PIN y budget to elaborate PDD with financial options from la UdeA	UdeA	No objection
Medellín, 28th of April	3rd advance report of the landfill project	UdeA and EEVVM	No objection
Medellín, 12th of May	Contract approval for international assessment in LANDFILL y PDD	UdeA	No objection
Medellín, 21st of June	Legal Analysis landfill Project	CAA, SIU e Ingeniería UdeA	No objection
Medellín, 3rd of July	5th landfill project advance report	UdeA y EEVVM	No objection
Medellín, 1st of August	Presentation Project LANDFILL ante CORANTIOQUIA	Authority y environmental and UdeA	No objection. The fulfillment of the environmental laws.
Bogotá, 15th of August	Presentation and legal consult with Ministerio de Ambiente Vivienda y Desarrollo Territorial-Colombia	Sector Gubernamental nacional (MAVDT) yand UdeA	No objection. Legal orientation.
Medellín, 25th of August	Landfill project presentation for SIU-UdeA	Academic sector and UdeA	No objection
Medellín, 13th of September	Inscripción del Project LYFILL Biogás en CODI-UdeA, Vicerectoria Administrativa	UdeA	No objection. Resolve legality.
Bello, 19th of September	Landfill project presentation for the mayor of Bello-Secretaria Privada on behalf of the headmaster of the UdeA, Alberto Uribe Correa y Engineer Carlos Fonseca, Project Director	Governmental sector and municipality (Bello) and UdeA	No objection. Support from the administration of the municipality and for landfill gas project.

Medellín, 22nd of September	Advance report (no number) of landfill	UdeA and EEVVM	No objection
Bello, 22nd of September	Landfill project presentation for the Territorial de Planning council of Bello (A)	Sector governmental de Bello (A), UdeA and EEVVM	No objection
Rionegro, 4th and 6th of October	II Seminario Internacional Economía Agrícola y Recursos Naturales	Academia Sector, UdeA, Governmental and Productive	No objection
Medellín, 10th of October	Comité de Seguimiento UdeA-EEVVM	UdeA and EEVVM	No objection. Approved pre-document for tenders in order to find an international partner.
Medellín, 26th of October	Comité de Seguimiento UdeA-EEVVM	UdeA, EEVVM and EPM	No objection
Medellín,1st of November	Agreement of pre-tenders notice an tenders notice for the search of an strategic international business partner contracting	UdeA	No objection
Don Matías, 8th of November	La Pradera Landfill presentation for interested parties	Social sector, Service and product sector, UdeA and EEVVM	No objection
Copacabana, 9th of November	Landfill Presentation for the Mayor of Copacabana (Antioquia)	Governmental Sector of Copacabana and UdeA	No objection

E.2.	Summary of the comments received:

>>

The project did not receive any objections from the local stakeholders. On the contrary it is well accepted and supported particularly due to the benefits that it generates. However, the combustion of the gas in a flare was not considered to be the best option for the use of the gas. The subjects discussed and comments received from the stakeholders cover a wide range. The comments received have been grouped under three aspects according their relation to: the problem of global warming that the project addresses, the solutions it proposes and the benefits it generates. The summary of these comments is presented below.

1. The problem of global warming that the project addresses:

- Review of the main commitments derived from the subscription of the Kyoto Protocol: the reasons why some of the countries did not ratify Kyoto Protocol and the ones that led other countries especially Colombia to ratify Kyoto Protocol.
- Obligations contracted by the parties of the protocol.
- How much does the project activity contribute to the reduction of global warming, and the decrease of pollution in the direct and indirect influence area of the landfill sites.
- Relation between greenhouse effect, burning of landfill gases and change in the rainfall in the landfill sites.
- Environmental characteristics of the landfill sites that influence gas production.

2. Possible solutions:

- Viability of the project.
- Additional problems that the project could create on the landfill sites.
- Possible pollution occurring from flaring.
- Necessitate of the project to land movements, big constructions or large equipments.
- Possibilities to obtaining a better use of the gas than flaring, like electric or thermal use.
- Type and quantity of the landfill gas in the landfill bodies.
- Differences between the high efficiency flaring and the current flaring activity.
- Issues cornering the operator of the activity, the investment of resources on behalf of the municipalities, the project costs and the ownership of the generated gas.
- Projects need for approval from a municipal or a government entity.
- If there was a governmental entity in charge of the evaluation and control of the project.

- Negative impacts on the nearby areas and inhabitants, as well as project relation to the closure and post-closure plans, environmental management and other legal topics related to the landfills of La Pradera and Curva de Rodas.
- Project impact on tax revenues.

3. The benefits from the project:

- A highly acclaimed benefit was the appreciation of biodiversity in order to prevent species, for example butterflies.
- Benefits and the distribution criteria of the benefits: benefits for the nearby population of the landfill sites as well as for the nearby municipalities, benefits to be invested in education and the possibility for social and civic organizations to participate in the project.
- Significant appreciation was obtained from the stakeholders on the decreasing risk of landslides, bad odours and leachate management that decreases the pollution of water and soil.

E.3. Report on how due account was taken of any comments received:

>>

The comments received were taken in consideration in the final project design. The comments contributed to adjustments made on the institutional, economic, social, legal administrative, environmental and technical aspects of the project. To be more precise, the comments affected to the high percentage of certificate incomes assigned for research inside the University of Antioquia and the investments in social development programs, with emphasis in the population placed in the direct influence zone of the sanitary landfills. The industrial or commercial activities that could be identified so far for the utilization of the landfill gas would generate high negative charges that would reduce the volume of benefits. Hence, the high efficiency flaring of the landfill gas was decided to be the best option.

The verification sources for the stakeholder process conducted are presented in annex 5.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Please see section A.4.5

Annex 3

BASELINE INFORMATION

This annex contains two items: 1) A derivation of the parameters used to estimate landfill gas generation from solid waste. These parameters are only used in the ex-ante estimation of emissions reductions; and 2) A calculation of the adjustment factor, which describes the destruction efficiency of methane in the baseline situation in Colombia.

Landfill gas generation potential

The ex-ante emission reduction calculation requires the estimation of the landfill gas production potential of the waste deposited in the landfill sites. The gas production potential was estimated using the "First order decay model" from the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site". The model assumes a one-year time lag between the placement of waste and gas generation. In addition it assumes that the landfill gas generation decreases exponentially as the organic fraction of waste is consumed. The methodology and the formula applied are presented in section B.6.1 equation 8. The parameters applied are presented and justified in the section B.6.2. This annex gives additional information and justifications for the applied waste amounts and waste categories, as well as presents more in detail the amounting gas generation.

Wtotal

The historical filling rates are taken from the files of Las Empresas Varias de Medellín, and the future filling rates are taken from Resolution 351 from the Ministry of Environment (page 17 Artículo 18). To be conservative the applied values were rounded down. There is enough land available in La Pradera to accept waste up to 2027. Hence, only the waste disposed until the end of the year 2012 is considered for the gas generation potential calculations since the waste deposit in Altair did not commence yet, therefore, is not taken into account in this calculation (according to page 10 of the PDD). The amount of waste disposed in the landfill sites is presented below. In Curva de Rodas Landfill, the waste deposited was divided in two modules, agree with the garbage age, in this way, the garbage deposited between 1984 and 1995 is Module 1, and the garbage deposited between 1996 and 2003 is Module 2.

Waste disposed in the landfill sites

Curva de Rodas				**La Pradera**			
Module 1		*Module 2*		*Module 1*		*Module 2*	
Year	**W_{total}**	**Year**	**W_{total}**	2003	310,886	2004	403,977
1984	14,400	1996	598,500	2004	278,301	2005	704,887
1985	189,600	1997	629,700			2006	703,147
1986	218,100	1998	713,400			2007	686,007
1987	234,000	1999	732,000			2008	664,033
1988	264,600	2000	716,700			2009	591,174
1989	284,400	2001	699,000			2010	556,887
1990	287,400	2002	657,900			2011	522,600
1991	317,100	2003	255,000			2012	522,600
1992	372,600						
1993	431,100						
1994	532,800						
1995	580,200						

Fraction of waste type

The decay rate as well as fraction degradable organic carbon in the waste depends on the different waste fraction. Hence, the amount of waste is divided into different waste fractions according a waste management study performed in the Metropolitan area of Medellin (Universidad de Antioquia (U. de A.) – Asociación de Ingenieros Sanitarios y Ambientales de Antioquia (AINSA) 2006. Entre Área Metropolitana del Valle de Aburrá (AMVA) Convenio Nº 325 de 2004.) The fractions are:

Food	Paper	Textile	Plastics	Inert
59.48 %	12.02 %	3.56 %	11.29 %	13.65 %

The emissions generated from the disposed waste during the first crediting period are presented below. The emissions are presented in tons of CO_2 equivalent.

Curva de Rodas, module 1

	Years of emissions generation						
Years waste Deposed	Oct 15,2008 Oct 14, 2009	Oct 15, 2009 Oct 14, 2010	Oct 15, 2009 Oct 14, 2010	Oct 15, 2011 Oct 14, 2012	Oct 15, 2012 Oct 14, 2013	Oct 15, 2013 Oct 14, 2013	Oct 15 2014 Oct 14 2015
1984	67	63	58	54	51	47	44
1985	953	887	826	769	717	668	622
1986	1,180	1,097	1,020	950	885	824	768
1987	1,363	1,266	1,177	1,095	1,019	949	884
1988	1,662	1,541	1,431	1,330	1,238	1,152	1,073
1989	1,931	1,786	1,656	1,538	1,430	1,331	1,239
1990	2,115	1,951	1,805	1,674	1,554	1,445	1,345
1991	2,540	2,334	2,153	1,992	1,847	1,715	1,594
1982	3,265	2,984	2,742	2,530	2,340	2,170	2,015
1993	4,163	3,778	3,453	3,173	2,927	2,708	2,511
1994	5,724	5,145	4,669	4,267	3,921	3,617	3,347
1995	7,019	6,233	5,603	5,084	4,647	4,270	3,939

Curva de Rodas, module 2

	Years of emissions generation						
Years waste deposed	Oct 15,2008 Oct 14, 2009	Oct 15, 2009 Oct 14, 2010	Oct 15, 2009 Oct 14, 2010	Oct 15, 2011 Oct 14, 2012	Oct 15, 2012 Oct 14, 2013	Oct 15, 2013 Oct 14, 2013	Oct 15 2014 Oct 14 2015
1996	10,124	9,860	9,732	9,709	9,773	9,910	10,114
1997	11,117	10,652	10,374	10,239	10,215	10,282	10,427
1998	13,414	12,595	12,068	11,753	11,600	11,573	11,649
1999	14,840	13,593	12,764	12,234	11,922	11,774	11,755
2000	16,492	14,676	13,445	12,625	12,097	11,783	11,631
2001	18,718	16,119	14,345	13,143	12,341	11,824	11,516
2002	21,200	17,618	15,171	13,502	12,370	11,615	11,129
2003	10,253	8,217	6,829	5,880	5,233	4,795	4,502

La Pradera, module 1: La Música

	Years of emissions generation						
Years waste disposed	Oct 15,2008 Oct 14,2009	Oct 15,2009 Oct 14,2010	Oct 15,2009 Oct 14,2010	Oct 15,2011 Oct 14,2012	Oct 15, 2012 Oct 14, 2013	Oct 15,2013 Oct 14,2013	Oct 15 2014 Oct 14 2015
2004	11,772	9,137	7,287	5,968	5,011	4,301	3,761
2005	13,936	10,538	8,180	6,523	5,342	4,485	3,850

La Pradera, module 2: La Carrliera								
		Years of emissions generation						
		Oct 15,2008 Oct 14,2009	Oct 15,2009 Oct 14,2010	Oct 15,2009 Oct 14,2010	Oct 15,2011 Oct 14,2012	Oct 15,2012 Oct 14,2013	Oct 15,2013 Oct 14,2013	Oct 15 2014 Oct 14 2015
Years waste disposed	2004	20,230	15,297	11,873	9,469	7,755	6,511	5,588
	2005	47,810	35,298	26,692	20,718	16,522	13,531	11,361
	2006	65,961	47,692	35,211	26,626	20,666	16,481	13,498
	2007	90,575	64,353	46,530	34,353	25,977	20,163	16,079
	2008	125,159	87,674	62,292	45,039	33,252	25,145	19,517
	2009		111,426	78,054	55,457	40,097	29,604	22,386
	2010			104,964	73,527	52,240	37,772	27,887
	2011				98,501	69,000	49,024	35,446
	2012					98,501	69,000	49,024

Adjustment factor

The baseline and monitoring methodology ACM001 necessitate the identification of an adjustment factor (AF) that describes the baseline gas collection and flaring efficiency. The methodology states: "In case where regulatory or contractual requirements do not specify $MD_{reg,y}$ an "Adjustment Factor" shall be used and justified, taking into account the project context. The formula applied is presented in section B.6.1 equation 3. An adjustment factor of 2.0 % is estimated for this project using the following procedure:

1. Percentage of LFG vented through the passive system

The simple passive venting system that is in accordance with all regulatory requirements has been installed in both landfill sites. This system consists of vertical gas extraction wells. Altogether 314 gas wells (flares) exist; in Curva de Rodas 200 gas wells have been installed, La Música has 70 gas wells and La Carrilera 44 gas wells. These gas wells are lit manually and they function like a chimney above the gas well. The value applied bases on technical literature. According the literature a simple gas collection and venting system has an efficiency of approximately 10 %[9].

2. Percentage of chimneys available for flaring

Although a quite large number of gas wells exist, only a part of them are available for flaring. The EEVVM has monitored the wells in La Carrilera since May 2006. These monitoring records are used to determine the amount of flares available for flaring. In year 2006 (May-December) 75 % of the gas wells ignited once approached with a flame and in year 2007 (January-October 24th) the value has been 39 %. Accordingly an average of 57 % can be determined for the flares that are available for flaring. This

[9] IDEAcarbon Ratings Feature 2007, Performance of Landfill Gas Projects, page 2.

value is considered to be very conservative, because the degression upon time is not taken into account. Hence the value 57 % is applied.

3. Percentage of time the chimneys were actually lit

The flaring of the landfill gas is not continuously mainly due to strong wind and rainfall that easily blow out the flares. To achieve a continuous combustion the gas wells that are lit manually should be reignited continuously. Currently the ignition should occur every second day except Sundays. However, the danger of igniting reduces the ignition done in reality. The monitoring records from EEVVM show that during the year 2006 the gas wells flared 40.2 % of the time and in year 2007 the gas wells have been flaring 17.4 % of the time. These values give an average of 28.8 % . After the closure of a landfill (that is the case in Curva de Rodas) and during the filling (that is the case in La Música) the gas wells are not likely to be lit. For purposes of being very conservative, 35 % value is applied for the time that the gas wells were actually flaring.

4. Combustion efficiency of an open flame

A default value of 50 % is applied for the open flares. This value is considered to be conservative, as no oxidation supply to the flares exists in the baseline. Hence the real flare efficiency is considered to be much lower.

5. Methane destruction efficiency in baseline:

10 % · 57 % · 35 % · 50 % = 0.9975 %

6. Methane destruction efficiency in the project:

60 % · 99.99 % = 59.99 %

7. Adjustment factor

According the justifications and calculations made above an adjustment factor (AF) of 1.663 % is attained: 0.9975 % : 59.99 % = 1.663 %

In order to be very conservative an adjustment factor of 2.0 % is applied for the project activity.

Common practice analysis

The table below presets the current practices in SWDS in big Colombian cities.

CURRENT PRACTICE								
Site visit date	**City**	**Landfill**	**Operator**	**Waste amount (ton/day)**	**Total area (ha)**	**Gas management system**	**Daily cover**	**Leachate collection**
Jun 07	Bogotá	Doña Juana	PROACTIVA DOÑA JUANA ESP S.A	5700	450	P	Y	Y
Jan 08	Bucaramanga	El Carrasco	EMPRESA DE ASEO DE BUCARAMANGA S.A E.S	650	98	N	Y	P
Mrz 08	Cali	Navarro	EMSIRVA E.S.P	1700	31	N	N	P
Feb 08	Cartagena	Loma de Los Cocos	CARIVE VERDE S.A E.S.P	750	39	N	Y	Y
Dez 07	Cúcuta	Guayabal	URBASER S.A E.S.P	650	40	N	Y	Y
Feb 08	Girardot	Praderas del Magdalena	SERVICIOS AMBIENTALES S.A E.S.P	300	69	N	Y	Y
Dez 07	Manizales	La Esmeralda	EMAS S.A E.S.P	400	54	N	Y	Y
Feb 08	Montería	Loma Grande	SERVIGENERALES S.A E.S.P	140	6,5	N	Y	Y
Feb 08	Montería	Botadero Municipal	Municipio de Montería	70	10	N	N	N
Feb 08	Tunja	Pirgua	SERVITUNJA S.A E.S.P	230	5,2	N	Y	Y

Abrevations: N = no, Y = yeas, P = partly

Annex 4

MONITORING INFORMATION

Please see section B.7.

Annex 5

REFERENCES

Verification sources for the stakeholder process

No.	Type of support and verification documents
1	Acta No. 8 del Comité Coordinador Proyecto MDL, abril 07 de 2006, donde se registra informe sobre la presentación del Proyecto MDL en Curva de Rodas y La Pradera como parte del Portafolio MDL-Colombia, en el Foro Latinoamericano del Carbono, Quito (Ecuador), marzo de 2006.
2	Acta entrega 3er. Informe de Avance Proyecto MDL, Medellín, Salón Consejos UdeA, abril 28 de 006
3	Acta reunión sobre aspectos legales y jurídicos Proyecto MDL, SIU-CAA-Ingenierías, junio 21 de 2006
4	Acta entrega 5º. Informe de Avance Proyecto MDL, Medellín, Salón Consejos-UdeA, julio 31 de 2006
5	Acta y registro de asistencia a la presentación del Proyecto MDL y consulta jurídica sobre POT-Bello al Ministerio de Ambiente, Vivienda y Desarrollo Territorial, Bogotá, sede del Ministerio, Agosto 15 de 2006
6	Acta sin número, de septiembre 20 de 2006, informando sobre presentación del Proyecto MDL en la Alcaldía de Bello (A), Secretaría Privada, por parte del Rector de la UdeA, Alberto Uribe Correa y del Ingeniero Carlos Fonseca, Director Proyecto y su alto grado de aceptación.
7	Acta Informe de Avance del Proyecto MDL, Medellín-Sala Juntas EEVVM, septiembre 22 de 2006
8	Acta y registro de asistencia a la presentación del Proyecto MDL ante Consejo Territorial de Planeación del Municipio de Bello, Alcaldía Municipal, septiembre 22 de 2006
9	Certificado de asistente y ponente Dr. Carlos Fonseca al II SIEAyRN, Rionegro, octubre 4 al 6 de 2006. Registro fílmico del evento y listado de asistentes.
10	Acta Comité de Seguimiento convenio UdeA-EEVVM, Medellín, octubre 10 de 2006
11	Acta Comité de Seguimiento convenio UdeA-EEVVM, Medellín-Rectoria UdeA, octubre 26 de 2006
12	Actas de Comité Técnico Asesor del Proyecto MDL UdeA-EEVVM realizadas en la SIU-UdeA, de los días agosto 10, 23 y 30; septiembre 06, 13, 20 y 27 de 2006.
13	Acta, registro fílmico, fotográfico y de asistencia de la presentación del Proyecto MDL ante partes interesadas, relleno sanitario La Pradera, municipio de Don Matías, noviembre 8 de 2006.
14	Acta, registro fotográfico y de asistencia de la presentación del Proyecto MDL ante la Alcaldía del municipio de Copacabana (Antioquia), sede municipal Copacabana, noviembre 9 de 2006.
15	Actas del Comité Técnico Asesor Proyecto MDL UdeA-EEVVM, sin número, de agosto 10, 23 y 30; septiembre 6, 13, 20 y 27 de 2006.
16	Actas número 1 a 10, 16 y 18 del Comité Coordinador Proyecto MDL UdeA-EEVVM, fechadas en febrero 15, 22 y 28, marzo 3,10, 23 y 24; abril 7 y 28; mayo 12; agosto 23; septiembre 13, respectivamente. Además, sin número, las de septiembre 6, 20 y 27; octubre 11, 18 y 25 y, noviembre 01 de 2006.