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Environmental/Location Study for new Waste Processing Options for Curaçao

Transforming waste to value

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Environmental consultancy and management

Project:

Environmental/Location Study for new Waste Processing Options Curaçao

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CONTENTS

1 Introduction

1.1 Background

Curaçao's sole legal landfill at Malpais is projected to reach its maximum capacity within the next 10 to 15 years, making it crucial to adopt more sustainable methods for solid waste management. To address this, Selikor N.V. and the Curaçao government have prioritized implementing a new management structure and transforming waste into value in an environmentally responsible way.

The initial step in this effort was conducting a comprehensive Waste Characterization Study (WCS) to gather detailed data on the volume, composition, and nature of solid waste generated in Curaçao. This study provided a thorough inventory of waste flows, including their quantities and specific characteristics. Completed in April 2024, the WCS results now serve as the foundation for the next phase: a feasibility study to identify the most suitable waste processing options (WPOs) for Curaçao, and an environmental and location study to determine optimal sites for new WPOs with minimal environmental impact.

The ultimate objective is to establish one or more Waste Management Processing Plants (WMPPs) to ensure long-term, sustainable waste management for Curaçao.

1.2 Objectives

The specific objectives (outcomes) of this contract (Resembid-005) are as follows:

a. determine the best/most suitable location(s) for realizing the waste processing option(s) as recommended in the "Feasibility Study to Determine the Most Appropriate Waste Processing Options for Curaçao".
b. assess the environmental impact of the waste processing option(s) as recommended in the "Feasibility Study to Determine the Most Appropriate Waste Processing Options for Curaçao".

Additional to what was agreed in the contract, an additional waste processing option has been considered for this Environmental/Location Study, totaling 4 WPOs.

2 Approach and methods

2.1 Introduction

As described in section 1.2, the Environmental/Location Study aims to assess potential sites for the WPOs that emerge from the feasibility study. Due to time constraints, the location study has been launched in September 2024, based on three assumed WPO setups, pending the inception report of the feasibility study. This allowed part of the work to be done at an early stage, to be fine-tuned upon the outcome of the feasibility study. The 4 initial WPOs were: A Waste to Energy Plant (WtE), a mechanical recycling plant, a Construction & Demolition (C&D) waste recycling plant and a composting facility.
The assumed WPO setups were discussed with the contracting party and the feasibility study contractor prior to the start of the work. EcoVision received the final WPOs from RHDHV on October 15, 2024.

2.2 Environmental Impact Assessment

No Environmental Impact Assessments (EIA) in the traditional sense (with stakeholder consultations, assessment of alternatives and such) have been performed, as agreed with the contracting authority. Instead EcoVision only assessed the environmental impacts relevant for location evaluation and selection, and did this for multiple locations. The impacts are described in chapters 5-9.

2.3 Sessions with Government and stakeholders

No sessions with Government and stakeholders were conducted[1]. The main reasons for this were the large number of possible combinations of WPOs and locations and the lack of time available to prepare these sessions. In EcoVisions view, communication about techniques and locations for WPOs is a delicate process and should be given ample preparation time. The output of the project on the other hand will provide a good basis for consultation of Government and stakeholders after the project.

Baseline information per site and impacts by the WPOs have been described insofar as they have significance for the location evaluation (except for Chapter 10: Green House Gas Emissions).
As much as possible criteria were quantified and objectified. This is not always possible: for some criteria subjective judgement is required (e.g. impact on local community). To minimize the randomness of this judgement we worked with a Focus Group who discussed the criteria and the scoring of the criteria and produced joint outcomes. The Focus Group numbered seven: three consultants from EcoVision, an energy transition expert, a specialist on utilities infrastructure, a road infrastructure and traffic expert and a chemical engineer.

[1] Only the Steering Committee was consulted on November 26, 2024

2.4 Literature review

The main documents and reports used in this study, along with the type of information taken from these documents and reports, are listed below:

Eilandelijk Ontwikkelingsplan Curaçao (EOP, 1994)

- Areas on Curaçao with designation “Industry” and “Agriculture”
- Several industrial areas have specific, more detailed designations for the type of industry present or to be realized: e.g. industry depending on deep water harbor, industry depending on airport, high tech industry, waste processing, medium/small enterprises etc.

Waste Characterization Study Curaçao, RESEMBID 003 (EcoVision, 2024)

- Number of transport movements (per type of vehicle) per month to current landfill
- Waste composition Curaçao

Waste Management and Processing Plant Curaçao, Design Feasibility Study, Phase 1 (RHDHV, 2011)

- Draft criteria for location selection

Environmental and Health Impact Assessment of the Waste Processing Plant (WPP) Sint Maarten (EcoVision, 2014)

- The waste composition on Curaçao is very similar to the composition on Sint Maarten
- Number of transport movements (per type of vehicle) per month to landfill

CBS (2001) Census Atlas

- Geo-zones from CBS

Selikor description of service areas

- Number of households/garbage containers (kliko’s) per service area

For the remainder we refer to Chapter 11 Literature.

2.5 Information requests to RHDHV and Selikor

On September 4th, 2024 and September 12th, 2024, requests for information were sent to Royal HaskoningDHV and Selikor, respectively. From RHDHV we received Information on September 13th, 16th and 25th. From Selikor we received information on September 17th, 2024.

The main information received from RHDHV was:

- Footprints required in m^2 (for WPO WtE and WPO recycling)
- For the WPO WtE: flue gas volumes and temperatures, stack height, stack diameter
- Electrical power needed for recycling plant and WtE plant
- Electrical power generated by WtE

- Noise sources and noise power of these sources

The main information received from Selikor was:

- Fuel use of operational vehicles and support vehicles
- An update of Selikor's service areas

A summary of the most relevant information from RHDHV and Selikor is presented in Chapter 3.

2.6 Preliminary WPOs and creation of long list

On September 10, 2024, EcoVision prepared a memo for Selikor with proposals for:

- the setup (basic elements) of 4 preliminary WPOs used for information collection;
- the draft criteria to be used to establish the longlist of locations;
- a draft of the longlist of locations for the 4 WPOs.

The memo was approved by Selikor on September 13, 2024.

2.7 Collection of site information

For the entire longlist of locations, information was collected by means of requests to Kadaster, Domeinbeheer and UOW (Uitvoeringsorganisatie Openbare Werken) and by meetings with the landowners (followed by information requests). Part of the information was collected by means of assessments by EcoVision, such as number of houses within noise and air quality contours, and by conducting site visits, among others to assess nature quality at and near the proposed locations.

The following meetings have taken place:

- Meeting with Refineria di Korsou (September 18, 2024)
- Meeting with CPA (September 20, 2024)
- Meeting with CDM Holding (September 20, 2024)
- Meeting with Buskabaai N.V. (September 27, 2024)
- Meeting with JAJO/CWM (Tafelberg, Brievengat, September 26, 2024)
- Meeting with Selikor (September 27, 2024)
- Meeting with Curaçao Airport Holding (October 3, 2024)
- Meeting with Curinde (December 6, 2024)
- Meeting (brief) with UO-Domeinbeheer (December 10, 2024)
- Meeting with DiMondi (December 13, 2024)
- Meeting with Smart Lifestyle Connection (December 19, 2024)
- Meeting with Aloe Farm (December 19, 2024)
- Meeting with Soltuna (January 6, 2025)
- Meeting with AVB-GMN (January 6, 2025)

Minutes of the meetings are included in Annex 2. Relevant outcomes for phase 1 of this project are included in Chapter 3.

2.8 Workshop with Client and RHDHV

On October 1, 2024, a workshop on the process of location selection and the first results obtained was held by EcoVision, with participation of Selikor and RHDHV.

2.9 Preparation of draft detailed criteria

During the workshop of October 1, 2024, a draft list of detailed criteria for location assessment was presented. The participants proposed to include a few additional criteria (a.o. safety for the plant, see Annex 2).

After the workshop, EcoVision sent the draft criteria to the participants, including weighing factors. On October 16, Selikor commented on the draft criteria and on October 21 RHDHV did. This led to a second version of the draft criteria (included in Chapter 4).

3 Waste Processing Options and locations

In their feasibility study, RHDHV presented four Waste Processing Options (WPOs). These options were selected to address key waste management challenges and to promote sustainable waste processing methods, for Curacao:

1. Waste to Energy,
2. Construction and Demolition Waste Recycling,
3. Industrial Recycling Hub and
4. Composting of garden waste (or green waste).

For these WPOs suitable locations need to be found and evaluated. The following paragraphs describe the main characteristics of the plants and facilities (section 3.1-3.4), specifications relevant for location selection (section 3.5) and the possible locations brought forward during phase 1 of the project (section 3.6). Most of the information in sections 3.1-3.5 is received from RHDHV.

3.1 Waste to Energy

Main characteristics of plant and footprint

One of the Waste Processing Options proposed by RHDHV is a state-of-the-art waste-to-energy (WtE) plant with a capacity to process 103,000 tons of municipal solid waste (MSW) annually. The facility will convert waste into heat, electricity and bottom ash while complying with stringent European environmental regulations. It will feature advanced grate furnace technology for efficient waste combustion, along with combustion control, flue gas treatment, and energy recovery systems.

Key processes include:

- **Waste Reception**: MSW is received and stored in a controlled area, with automatic systems ensuring consistent furnace feeding.
- **Grate Furnace System**: This system ensures complete combustion of various waste types, minimizing residual waste and controlling odors.
- **Flue Gas Treatment**: Advanced filters and scrubbers will reduce emissions of pollutants like NOx, SOx, and particulates to meet EU standards.
- **Energy Recovery**: The plant will generate electricity and low-temperature heat for local use.
- **Compliance and Monitoring**: Continuous emissions monitoring will ensure regulatory compliance and provide real-time data.
- **Bottom ash removal**: bottom ash is the residual byproduct of the WtE combustion process, making up around 25% of the input MSW. It consists of noncombustible materials like fines, minerals, and metals. Given that it contains small amounts of hazardous substances, such as heavy metals (lead, cadmium, mercury, chromium, nickel, and zinc), it cannot be disposed of in

regular landfills, it should be disposed of in specialized landfills. If improperly disposed of, the toxic materials in bottom ash could leach into the ground, posing environmental risks.

The total footprint of the plant will be 2.5 hectares, with a built-up surface of 10,000 m^2 (see also section 3.5 for more specifications). Figure 3.1 shows a schematical drawing of a WtE plant.

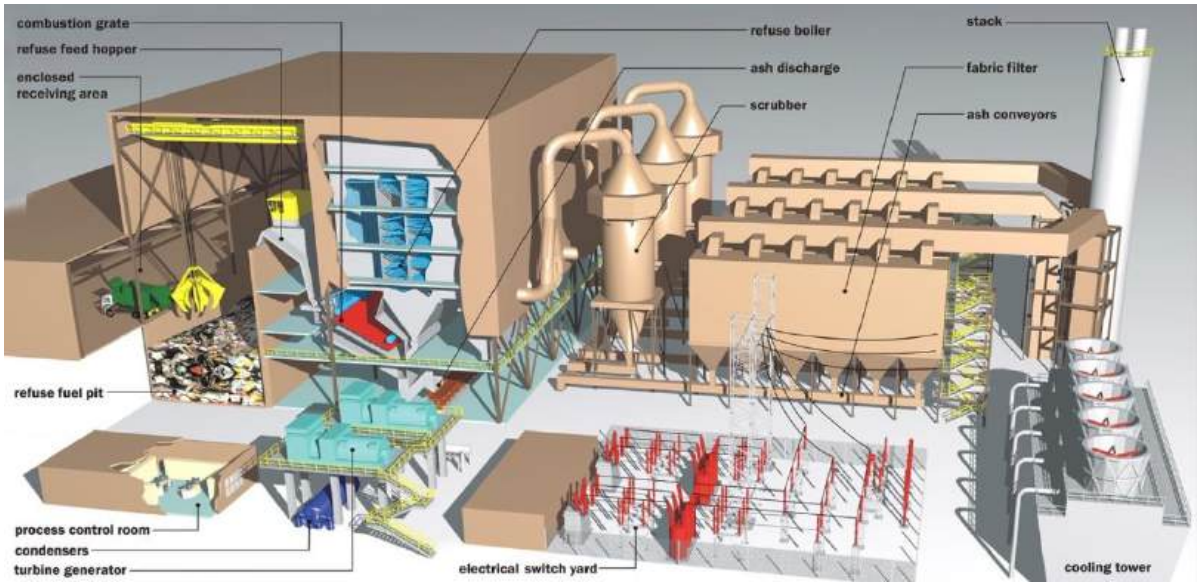


Figure 3.1: Schematic diagram of WtE plant (source: Pinellas County, Florida USA)

Heat exchange and cooling

Heat exchange can take place by air-cooled condensers (ACC's), cooling towers (as in figure 3.1) or once-through water-cooled condensers (seawater-cooled).

Mass balance

For WtE the following mass balance was produced by RHDHV (RHDHV, 2025):

Table 3.1: Mass balance Waste to Energy

Type of waste/residu	ton/y
Amount combusted	103,179
Ferrous scrap	1,282
Non-ferrous scrap	865
Bottom ash	25,795
FGT residues	1,548

Most of the volume/mass is converted to gases and energy. The largest residue remaining is bottom ash.

Air-emissions

Key emissions from Waste to Energy (WtE) plants include CO_2, N_2O, NO_x, NH_3, and organic carbon (Directive 2010/75/EU). Trace pollutants like heavy metals, dioxins and furanes and dioxin-like PCB's can also be present in flue gases.

Dioxins and furanes (PCDD and PCDF)

Dioxins and furanes are recognized globally for their harmful effects to humans and ecosystems, even in small concentrations. While modern WtE plants use best practices and advanced technology to reduce dioxin emissions to low levels (often below regulatory thresholds), complete elimination is extremely challenging. Recent research findings indicate that start-up and shut-down procedures are the critical phases in which dioxins and furanes are being produced (Arkenbout et al, 2017; Arkenbout et al, 2021; Rijkswaterstaat, 2018). A single start-up event can equal several months of dioxins emissions under normal conditions (Zero Waste Europe, 2023). This is the reason why the European Union amended the Industrial Emissions Directive (2010/75/EU) in 2023 to include full-time/continuous monitoring of dioxines and furanes and not only during normal operations, so that measures can be taken in case of higher than normal emissions[1].

Field research points out that significantly elevated concentrations of persistent organic pollutants (POPs such as dioxines, furanes, PCBs) are present in the immediate surroundings of waste incinerators, that have been constructed 5-25 years ago. These levels are elevated in backyard chicken eggs in a radius of 5 kilometers from existing WtE plants (Arkenbout et al, 2017, Arkenbout et al, 2021). Elevated levels in pine needles and grass are found up to 1.5 kilometers from the WtE plants.

These findings raise the discussion in Europe whether industrial facilities like WtE plants can be constructed in the heart of cities, like this is the case in Copenhagen, Brussels, and Paris, where hundreds of thousands of inhabitants live downstream of incinerators. Other experts claim that the use of the best technical means make WtE in urban areas safe operations.

NO_2 and $PM_{2.5}$

In the last few years much focus by the World Health Organization (WHO) was on NO2 and particulate matter, especially $PM_{2.5}$. For these two parameters, WHO updated air quality guidelines significantly in 2021, highlighting health risks. Particularly childhood asthma is linked to NO_2 levels in air, in concentrations as low as 4 µg/m³ - 10% of the current guideline level (annual mean, 40 µg/m³) and 20% of the current background level at Kas Chikitu: annual mean 21 µg/m³, source GMN-MNB).

Noise

Major noise sources at waste facilities include shredders, equipment handling metal (scrap), bottom ash, stony materials, and waste incinerators. The noise impact largely depends on how well these sources are insulated and their proximity to noise-sensitive areas such as residences.

For noise emissions, so-called plot emissions were used, which have been derived from data on comparable companies in the Netherlands, using a 1996 DGMR inventory of the Rijnmond area (commissioned by the Port Authority). For the modelling in Chapter 6, a plot emission for WtE of 65 dB(A)/m² (day-night), covering an area of 2.5 hectares (24/7 operation) was chosen. In addition to the

[1] Modern Waste-to-Energy (WtE) plants use auxiliary burners to prevent the release of harmful substances during startup, shutdown, and unexpected stoppages. These burners, running on gas or oil, preheat the boiler to over 850°C before waste is introduced and help maintain the temperature when waste feeding is stopped or when low-calorific waste is burned. This ensures continuous combustion and minimizes emissions.

factory's noise emissions, transport-related noise (by trucks, vans and other vehicles) was included in the model. Transport primarily occurs during the daytime (assumed 90% of transport).

Traffic to the facility

Table 3.2 shows current transportation to Landfill Malpais per month for various types of trucks. The numbers are based on the Waste Generation Analysis, carried out in 2023-2024 (EcoVision, RHDHV, 2024). In case of a location other than Malpais, more than 85% of the logistic flows to and from Malpais landfill will shift to the new (WtE) location (source RHDHV, 2025)[1]. A waste reception station will have to be established on the WtE site where private individuals can deliver their waste (instead of dumping it at the landfill). After inspection and acceptance, the waste is taken to the waste bunker of the WtE plant. Per day over 100 heavy trucks and approximately 90 smaller trucks (including vans and pickups) will arrive at the facility.

Table 3.2: Anticipated transportation per month (number of vehicles)
Source: Waste Characterization Study (EcoVision/RHDHV, 2024)

Type of vehicle	Total/ mnth	total/ day	Percentage of total
Selikor “HV”, “ROL”, or “Bulky”	692	23	10%
Selikor commercial (“afzet”)	329	11	5%
Private person	216	7	3%
Commercial/company (*)	5,470	179	82%
Total	6,707	220	100%

Assuming that 50% of all commercial trucks are small vans and pickups, the total number of heavy trucks per month will be approximately 3,800 (125 per day) and the total number of small trucks, vans and pickups per month will be approximately 3,000 (100 per day).

3.2 Facility for recycling of construction and demolition waste

A Construction and Demolition (C&D) recycling plant processes 30.227 metric tons of construction and demolition waste using various sorting techniques to separate materials and prepare them for further use or disposal. The primary activities in the plant include pre-sorting (creating monostreams), breaking down larger materials, sieving, and separating different fractions of the waste:

- **Waste reception**: Only construction and demolition waste will be accepted. Hazardous materials such as contaminated soils and asbestos will be refused at the recycling company's gate.
- **Pre-sorting**: Organizing materials like debris and wood.
- **Crushing**: Reducing large mineral items into smaller pieces.
- **Sieving and de-ironing**: Using a drum screen to separate materials larger than 300 mm, followed by a magnet to remove steel scrap.

[1] For this study we assume current transportation numbers for the landfill are valid for the WtE plant at all locations (100%)

- **Further sieving and separation**: A double-deck screen separates materials into smaller sizes, with various technologies (wind shifters, magnets, separators) used to further separate materials like wood, plastics, metals, and gypsum.
- **Manual Sorting**: To identify and separate non-ferrous metals and gypsum.

The total footprint of the C&D waste recycling plant will be 2.0 hectares, with a built-up surface of 8,000 m^2 (see also section 3.5 for more specifications). In figure 3.2 a schematic drawing is presented.

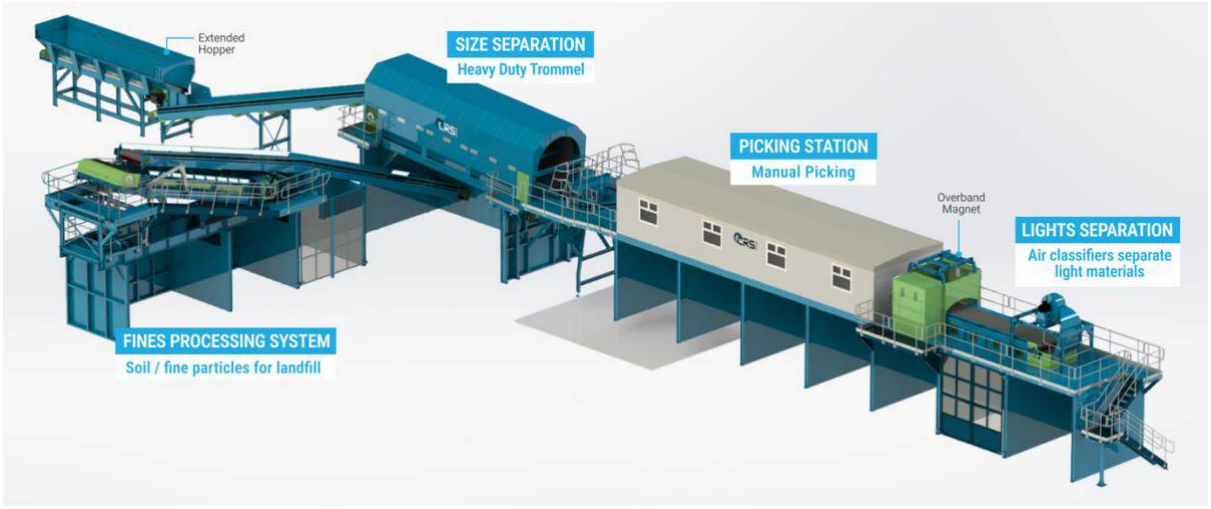


Figure 3.2: Schematic drawing of Construction and Demolition Waste recycling plant. Most activities take place inside a building (not shown). Source: Waste Initiatives, Australia.

The facility includes a presorting area, a separation line with various machines, and storage areas for incoming waste and processed materials. Most operations occur in a building where conditions can be controlled and dust emissions can be minimized. The sorted waste can be sent to a Waste-to-Energy plant or a landfill for further treatment, depending on the chosen scenario. The first phase of the C&D recycling plant involves preprocessing, where mixed C&D waste is sorted into clean mineral fractions and other materials like wood. The process uses conveyor belts and hydraulic excavators for separation. Companies such as Heavy Mix and Mijnmaatschappij have expressed their interest to collect the mineral fraction for free and further process it into products like gravel and sand. In phase 2, the plant will add crushing and sieving of the mineral fraction. EcoVision conducted an environmental impact evaluation for the full recycling plant (including crushing and screening of fractions).

Mass balance

C&D waste recycling produces two recyclables: mineral (stony) materials in higher and lower qualities and metals (ferro and non-ferro). These recyclables together are 68% of the original C&D waste flow. Wood, light materials, gypsum and sorting residues are approximately 32% of the C&D waste (RHDHV, 2025), see table 3.3.

Table 3.3: Mass balance C&D waste recycling

Fraction/recyclable	ton/y	%
Minerals lower quality	13,126	43.4%
Minerals higher quality	6,159	20.4%
Wood to landfill or WtE	1,995	6.6%
Ferrous	1,088	3.6%
Non-ferrous	151	0.5%
Light materials to landfill or WtE	453	1.5%
Gypsum to landfill	242	0.8%
Sorting residu to landfill or WtE	7,013	23.2%
Total C&D waste	30,227	100.0%

Noise

In the first phase of the operation (without stone crushing) the most important noise sources in the C&D waste recycling plant are trucks bringing the waste and mobile excavators sorting the waste. In the second phase the major noise sources are the crushers and screens pulverizing and screening the mineral materials. The noise impact largely depends on how well these sources are insulated and isolated and their proximity to noise-sensitive areas such as residences.

For noise emissions, so-called plot emissions were used, which have been derived from data on comparable companies in the Netherlands, using a 1996 DGMR inventory of the Rijnmond area (commissioned by the Port Authority). For C&D recycling, a plot emission of 63 dB(A)/m² (day-period only) was selected, covering an area of 2.0 hectares.

Traffic to and from the facility

During a 28-day Waste Generation Analysis carried out in 2023 (EcoVision/RHDHV, 2024), 599 vehicles were counted bringing C&D waste to the landfill. This is an average of 23 vehicles per day (average tonnage per vehicle: 3.9 metric tons).

Contrary to a landfill, for a recycling plant transport for recycled products and transport of residues must be taken into account. It can be assumed that all waste coming in in the plant will either leave the plant as a recycled product (2/3 of the materials, RHDHV, 2025) or as a residue (1/3 of the materials, RHDHV, 2025).

Waste brought to the C&D waste recycling plant will be transported in a mix of small and large trucks: 7,808 trucks per year carrying 3.9 metric tons on average per truck (EcoVision/RHDHV, 2024). If transport of both products and residues will take place in a more efficient way in tandem-axle or tri-axle dumptrucks carrying approximately 15 metric tons per truck load, the additional number of trucks is 8 per day (total of 38 trucks or 76 truck movements per day, see table 3.4). Operation hours will be six days per week (no Sundays), 12 hours per day.

Table 3.4: Number of trucks to the C&D waste recycling plant

	Waste to plant	Products and residue from plant
trucks/year	7,808	2,015
trucks per day	30	8 (*)
trucks/hour	2.5	0.6
ton/truck	3.9	15

(*) Estimated 5 trucks/h for product and 2-3 trucks/h for residues

3.3 Industrial Recycling Center

A centralized industrial recycling hub in Curaçao aims to consolidate and enhance recycling efforts by existing companies such as Paradise Paper Recycling, Green Phenix, Green Force, and Fuse/Kooyman, while also accommodating new ventures for glass recycling, secondhand tools or textiles (RHDHV, 2025). The recycling companies continue to collect waste themselves and bring the collected material to the hub. The facility, spanning a 4,000 m² warehouse, is primarily designed to handle commercial recycling needs and is not intended for direct public access. However, it may incorporate a dedicated waste drop-off center for individuals to contribute recyclable materials.

Key operations will include the collection and processing of recyclables, manual sorting of plastics and aluminum cans, baling, and educational initiatives. Centralized services will encompass warehousing, office space, and security. The Industrial Recycling Hub will occupy a total footprint of 1.5 hectares, with Figure 3.3 providing an illustrative overview of part of the facility. Operation hours will be six days per week (no Sundays), 12 hours per day.

Figure 3.3: Impression of a part of the Industrial Recycling Hub (handpicking station)

Mass balance

In the scenario of maximum recycling, the following mass balance will be realized for the Industrial Recycling Center (RHDHV, 2025):

Table 3.5: Mass balance Industrial Recycling Center

Fraction	ton/y	%
Paper	2,200	9%
Cardboard	5,000	21%
Higher quality plastics	2,200	9%
Low quality plastics	6,000	25%
Metals & E-waste	3,000	13%
Glass	4,200	18%
Textiles	1,000	4%
Total	**23,600**	**100%**

Noise and traffic

An Industrial Recycling Hub is a light industrial activity, and environmental issues such as noise, dust and traffic are of minor impact. It is anticipated that approximately two medium/heavy trucks per day will visit the Industrial Recycling Hub and 8 small trucks (RHDHV parameters, section 3.5).

Transport to container harbor

A significant portion of sorted and pretreated waste will be shipped abroad for further recycling. Unlike all other waste processing options, the Industrial Recycling Hub will depend on the container harbor for their operations.

3.4 Composting facility for green waste

The composting plant proposed by RHDHV converts organic waste from gardens and bush clearing into high-quality compost. To enhance compost quality and reduce organic waste volume by up to 80%, the plant will utilize composting tunnels with forced aeration and controlled moisture levels.

The process begins with accepting source-separated organic waste, followed by a thorough visual inspection to prevent contamination. Remaining impurities will be removed manually, and the waste will then be sorted into three distinct flows: 1) direct composting, 2) structuring material, and 3) wood for chipping. After removing impurities and sorting, the organic material will be shredded by means of a tub grinder or chipped into wood chips for use as mulch or landscaping material. In the future chicken manure may be added to the organic material (ratios need to be determined after research).

The plant will monitor three critical parameters during composting: temperature, moisture, and aeration. Maintaining optimal conditions will promote efficient water use and effective microbial breakdown of organic matter.

The facility will feature dedicated areas for acceptance, shredding and chipping, composting, maturation, packaging, and utilities. The total footprint of the composting facility will be 1.0 hectares, with a built-up surface of 2,000 m^2. The composting tunnels and concrete basins where the composting process takes place are inside this building.

Figure 3.4 shows an impression of a part of the process: shredding by means of a tub grinder.

Figure 3.4: Shredding by means of a tub grinder

Mass balance

In a scenario of maximum recycling, the mass balance of the composting facility will be as follows (RHDHV, 2025):

Table 3.6: Mass balance Composting facility

Fraction	ton/y	%
Organic waste incoming	17,789	100%
Compost outgoing	8,894	50%
Water loss and biological conversion	8,894	50%

Noise

The most important sources of noise in a Composting facility are the tub grinder and the wood-chipper, that shred the green waste to smaller particles. In addition, vehicles arriving and leaving the facility contribute to the noise emissions.

For noise emissions, so-called plot emissions were used, which have been derived from data on comparable companies in the Netherlands, using a 1996 DGMR inventory of the Rijnmond area (commissioned by the Port Authority). For Composting, a plot emission of 60 dB(A)/m² (day-period only) was selected, covering an area of 1.0 hectares.

Traffic to the facility

During a 28-day Waste Generation Analysis carried out in 2023 (EcoVision/RHDHV, 2024), 2092 vehicles were counted bringing green waste to the landfill. This is an average of 75 vehicles per day. It should be noted however that the landfill is opened 7 days a week, and a composting facility may not (assumed 6 days a week, with working days of 12 hours). The number of incoming trucks will therefore be substantially higher (105 per day). Average weight of the incoming truck loads is 700 kg, demonstrating the use of (often) small and medium sized trucks.

Additionally, the transport of product will add approximately 24 trucks per day, assuming the weight per truck load is double the weight of incoming truck loads. The total of trucks per day will be 129

(corresponding to 258 truck movements), which is approximately half of the numbers compared to the WtE option[1].

Table 3.7: Number of trucks to and from the Composting facility

	Waste to facility	Products from facility
trucks/year	27,271	6,353
trucks per day	105	24
trucks/hour	8.7	2.0
ton/truck	0.7	1.4

3.5 Summary of relevant specifications for WPOs

In dialogue with RHDHV the following list of specifications for the four WPOs was elaborated.

Table 3.8: Relevant specifications for WPOs (source: RHDHV "final parameters" and Geluid op Niveau (for noise parameters)

Waste processing option	Waste to Energy	C & D separation plant	Industrial recycling hub	Chipping & Composting facility
CapEx (-000) *	216,667	6,667	1,194	472
OpEx (-000) excl. staff	8,889	333	111	56
Total FTE	56	15	10	5
Avg cost per FTE	25,000	25,000	22,222	22,222
Total OpEx (-000)	10,289	708	333	167
Night / weekend shifts	yes	no	no	no
Start development	2,027	2,027	2,027	2,026
Start operation	2,031	2,028	2,027	2,027
Area (m2)	25,000	20,000	15,000	10,000
Buildings (m2)	10,000	8,000	4,000	2,000
Noise emissions in dB(A)/m²	65	63	-	60
Logistical movements per day (trucks)	125	20	2	10
Logistical movements per day (vans / cars)	98	5	8	65
Max Floor load (kN / m2)	200	150	120	120
Processing indoors?	yes	yes	yes	partly
Running hours / y	8,000	2,150	2,150	2,150
Processing capacity per year (kton)	103	30	24	18
Power connection (MVA)	9	2	1	1
Avg electricity usage (MVA)	1	1	0	0
Water usage M3 / day (max.)	5	6	1	8
Connection to sewage	yes	yes	yes	yes
Separate industrial waste water flow?	no	no	no	no

* Excluding construction of electrical, water and road infrastructure to the location and excluding groundworks in case of insufficient carrying capacity and accidented terrains

[1] The WtE option is a 24/7 operation, traffic movements are spread over 365 days per year, while at the Composting facility they are spread over 260 days per year

4 Locations and criteria for evaluation

4.1 Overview of longlisted locations

In phase 1 we made a first selection of potentially suitable locations for WtE, Recycling (including C&D waste recycling) and composting. The option of an Industrial Recycling Hub was not included yet[1]. The locations for C&D waste recycling are potentially suitable also for the WPO Industrial Recycling Hub. However, for the Industrial Recycling Hub, the precondition is formulated that it should be centrally located and it should be a low-cost location (RHDHV, 2025), resulting in three potentially suitable locations (see Chapter 8 for more information).
The following locations were subject to further analysis. A number of these were subsequently not subject to the multicriteria analysis (MCA), since they did not meet the initial "go/no-go criteria (section 4.2).

- WPO Waste to Energy (WtE, 8 locations)
  - Bullenbaai East and West
  - Meiberg
  - Malpais
  - Bleinheim
  - Van Leer
  - ISLA East (small area, North of Aqualectra diesel plant)
  - Asphalt Lake

- WPO C&D waste recycling (9 locations)
  - Meiberg
  - ISLA West
  - Malpais
  - Brievengat
  - Asphalt Lake
  - Batipaña
  - Manzaliña Bay
  - Shut
  - "Amstel"-area

- WPO Industrial Recycling Hub (3 locations)
  - ISLA West
  - Asphalt Lake
  - Buskabaai North

[1] This option was presented by RHDHV after completion of phase 1

- WPO composting (5 locations)
    - Aloë Farm
    - LVV Klein Kwartier
    - Soltuna/De Savaan
    - Soltuna/Bakufal
    - Ronde Klip

Figures 4.1-4.7 present overviews of areas of interest (see also Annex 1 for more detail).

Waste to Energy

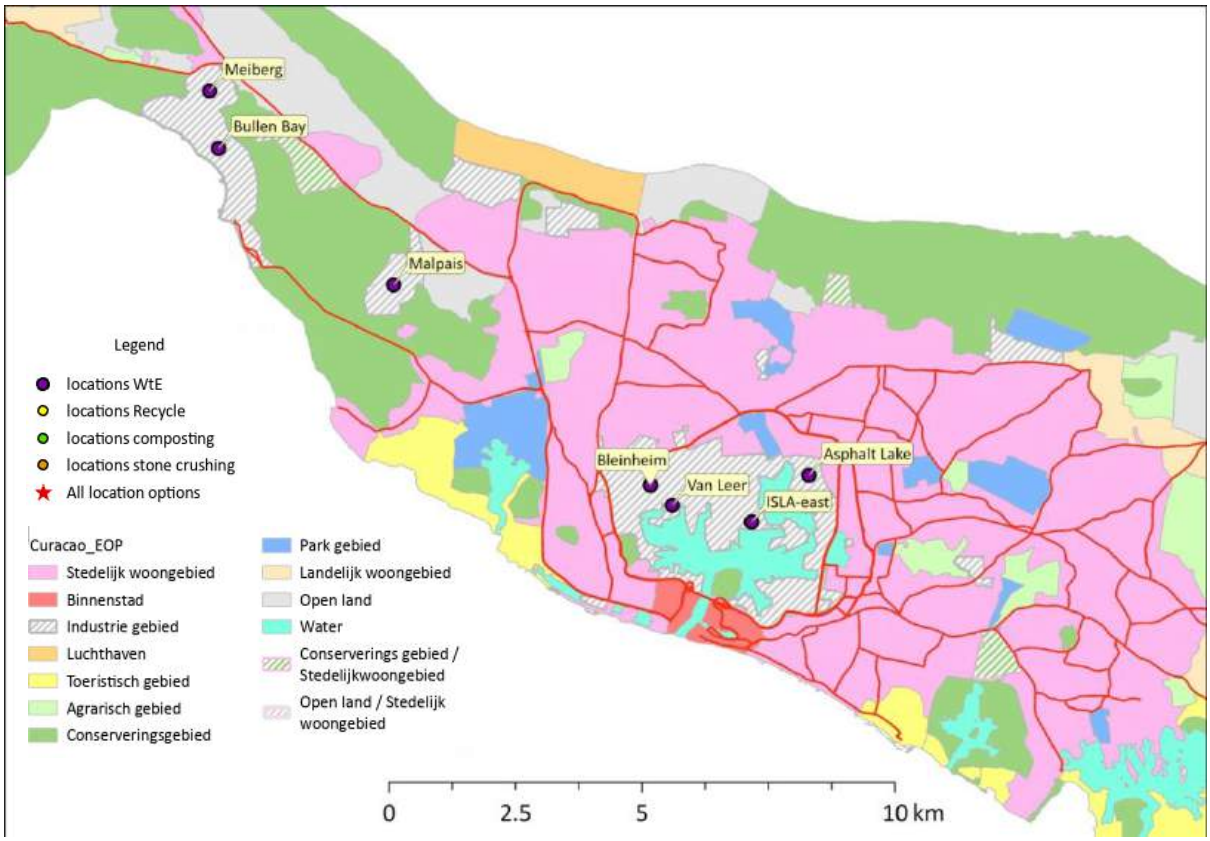


Figure 4.1: Overview suitable locations for Waste to Energy.

Meiberg

Bullenbaai East

Malpais

Bleinheim

Van Leer

Isla East

Asphalt Lake

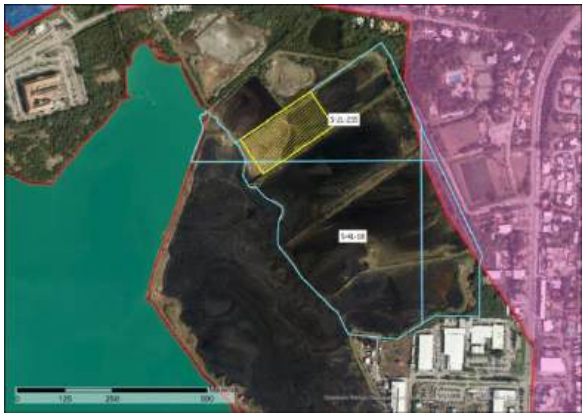


Figure 4.2: Areas of interest Waste to Energy

C&D Waste Recycling

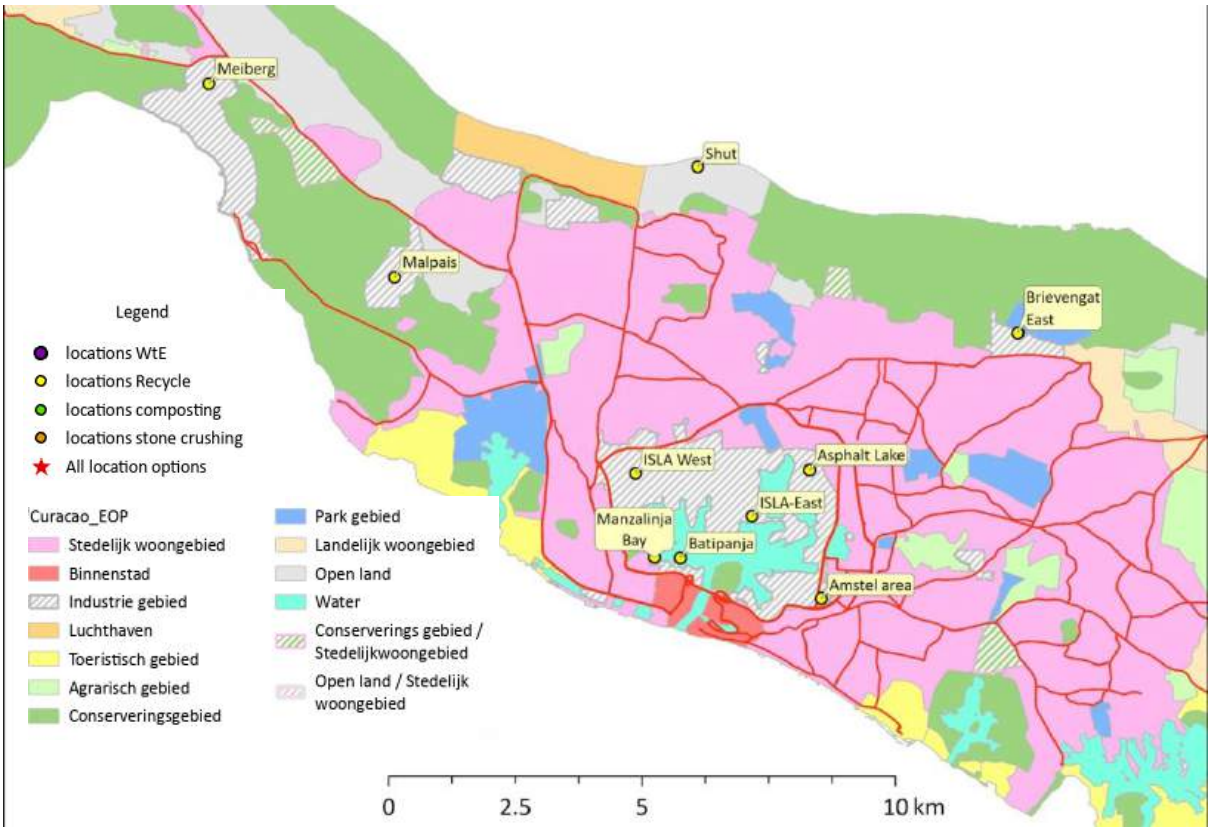


Figure 4.3: Overview suitable locations for C&D Waste Recycling. All locations are designated as Industry (EOP, grey-striped areas) except for Shut (Open Land).

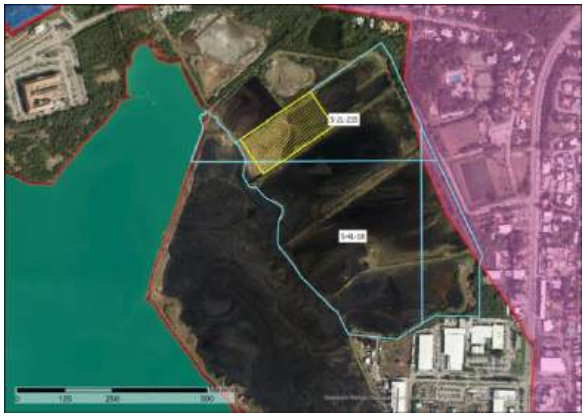
Meiberg

Malpais

Shut

Isla West

Asphalt Lake



Manzaliña Bay

Bati Paña

Brievengat

Figure 4.4: Areas of interest C&D Waste Recycling

Industrial Recycling Hub

Isla West

Asphalt Lake

Buskabaai North

Figure 4.5: Areas of interest Industrial Recycling Hub

Composting facility

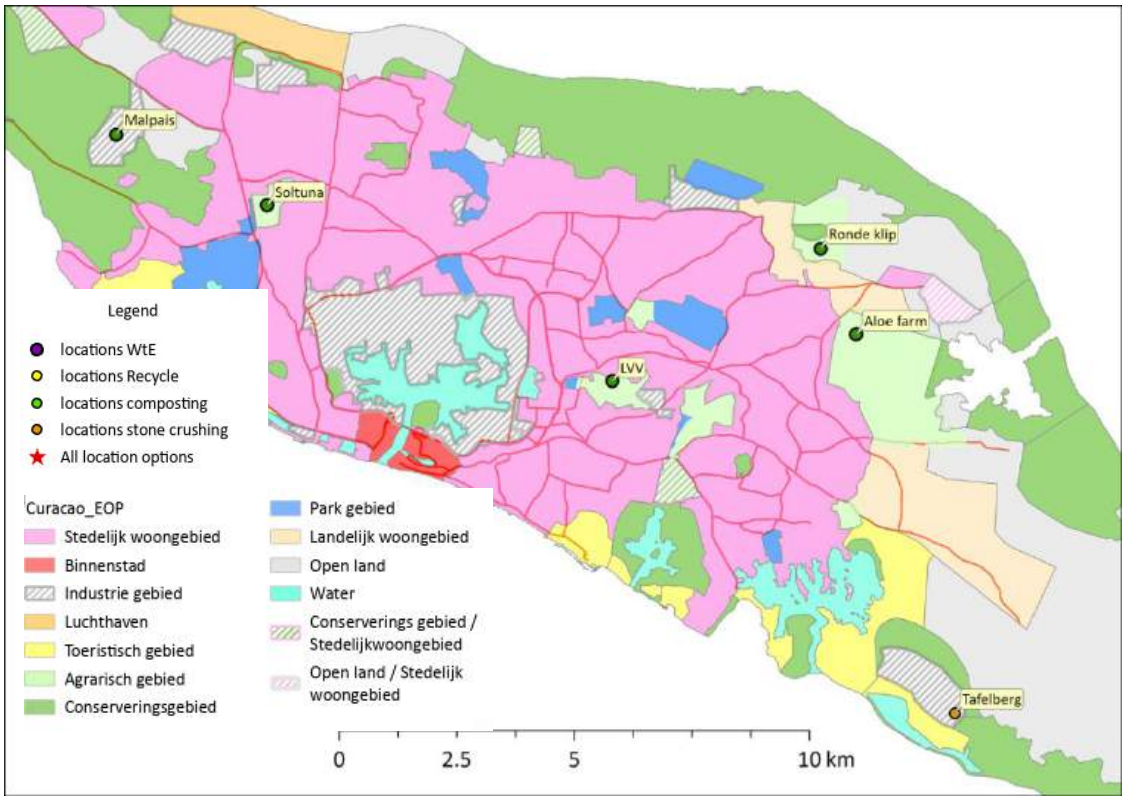
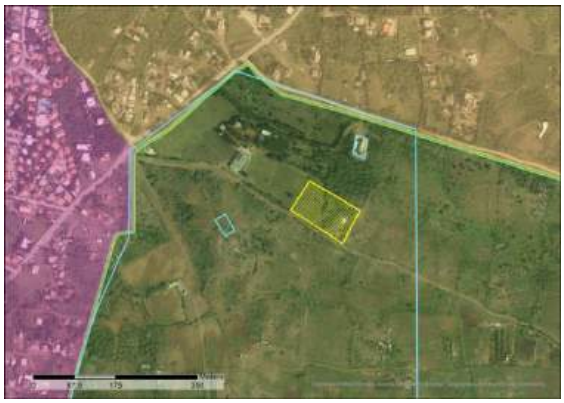


Figure 4.6: Long list suitable locations for C&D waste recycling and Composting

Aloe Farm



Klein Kwartier

Soltuna

Malpais

Figure 4.7: Areas of interest Composting (Klein Kwartier and Soltuna: no areas of interest shared by landowner)

4.2 Criteria for location evaluation

Tables 4.1-4.4 present the detailed criteria used for the Multi Criteria Analysis. For a number of criteria, chapter 5 presents location specific information. Where this is not the case, the criteria are further discussed (and scored) in Chapters 6-9. Some of the criteria discussed in these chapters were deemed irrelevant because they lacked discriminative power. The choice for applying (or not applying) a certain criterion is also further motivated in Chapters 6-9.

4.2.1 Go/no-go criteria

Table 4.1: Go/no-go criteria used for the four WPOs (if applicable indicated by "x")

Waste Processing Option (WPO) / Criterion	WtE Ch. 6	C&D Ch. 7	Hub Ch. 8	Compost Ch. 9
Location in "Industrial Area"	x	x	x	
Location in "Agricultural Area"				x
Available for WPO and fits specific location policy	x	x	x	x
Minimum area for footprint met	x	x	x	x
No major obstacles for availability (e.g. heavy contamination)	x	x	x	x
Largely uninhabited 2 km downwind of W2E	x			
No obvious conflict with other industry	x	x		
No further than 20 (road) km's from the center of Curacao	x	x	x	
No further than 2 (road) km's from primary road				x
No obvious safety risks for facility	x	x	x	x
No sensitive objects in safety zone	x			
Acceptance by Government	x			

The application of the go/no-go criteria resulted in the voidance of the following locations:

Bleinheim:	Not available: in use by Curoil
Former Amstel Area:	Not available: option taken by Government of Curaçao
De Savaan	Not available: not enough space available
Bakufal:	Not available: not enough space available
Klein Kwartier:	Not available: not enough space available

See Chapters 6-9 for further clarification.

4.2.2 Site-related financial criteria

Table 4.2: Financial criteria used for the four WPOs (if applicable indicated by "x")

Waste Processing Option (WPO) / Criterion	WtE Ch. 6	C&D Ch. 7	Hub Ch. 8	Compost Ch. 9
Site-specific investments				
Electrical infrastructure	x	x	x	x
Water infrastructure	x	x	x	x
Road infrastructure	x	x	x	x
Ground works	x	x	x	x
Waste acceptance infrastructure	x	x		x
Land lease cost (per year)	x	x	x	x

Three site specific financial criteria contributing to OpEx were left out of the evaluation, for the following reasons (see also Chapter 6):

Site specific maintenance: For instance, comparing areas with salt spray with areas without salt spray. Negligible impact on overall CapEx and OpEx.

Synergy with other companies: Uncertainties with respect to possibilities and valuation of this phenomenon

Air cooling or water cooling: Water cooling not necessarily more advantageous

Maintenance: Site-specific maintenance, such as the need for specific coating and frequency of coating treatments in corrosive environments is deemed insignificant considering the low cost and the high-level nature of all other investments and operational costs.

Synergy with other companies: At this stage accurate and firm information on operations of nearby companies is lacking in most cases. Therefore, these synergies could not be included in the financial analyses and criteria.

4.2.3 Environmental criteria

Table 4.3: Environmental criteria used for the four WPOs (if applicable indicated by "x")

Waste Processing Option (WPO) / Criterion	WtE Ch. 6	C&D Ch. 7	Hub Ch. 8	Compost Ch. 9
Impact on local communities (including traffic)	x	x	x	x
Future residential developments near site	x	x		
Dwellings impacted by noise	x	x		x
Dwellings impacted by air quality - year average	x			
Dwellings incidentally impacted by nuisance (odor, dust, 24h average)	x	x		
Existing nature values at specific lot	x	x		x
Risk for nature in adjacent areas	x	x	x	
Visual impact from public areas	x	x		
Establishment of WPO does not "cost" any landfilling space	x	x		x
Possible conflict with other industry	x	x		

One environmental criterion was left out of the evaluation: Acceptance by environmental NGOs and community groups. The reason is that stakeholder consultations were not possible within the timeframe of the study. For the WPO Waste to Energy this criterion was discussed and scored, based on the Focus Group's own judgements, but not included and weighed in the multicriteria analysis (MCA).

4.2.4 Logistical criteria

Table 4.4: Logistical criteria used for the four WPOs (if applicable indicated by "x")

Waste Processing Option (WPO) / Criterion	WtE Ch. 6	C&D Ch. 7	Hub Ch. 8	Compost Ch. 9
Proximity to primary road	x	x	x	x
Proximity to known congestion points	x	x		x
Average transportation distance for waste (source)	x	x		x
Transportation distance for recycled products				
Transportation distance to container harbor			x	
Transportation distance for residues: landfill	x	x		
Uncertainty with respect to aviation regulations	x			
Accessibility for emergency units	x			

4.3 Weights of criteria

Like the criteria, the weights of the criteria, used in the Multi Criteria Analysis are differentiated for the WPOs. The weights are discussed and determined in Chapter 6-9.

5 Baseline research and site information

5.1 Cadastral information

Cadastral information of all locations is summarized in Annex 1. The annex contains: cadastral lots and numbers, size of lots, ownership, long lease (if applicable), designations in Island Development plan (Eilandelijk Ontwikkelingsplan, EOP) and more.

5.2 Long lease costs

Industrial land

For the establishment of the WPOs/facilities land must either be purchased or acquired for long lease. Some of the landlords offering industrial land were reluctant to share long lease prices or prices of land per m^2. Therefore, EcoVision had to apply their own method to produce estimations for costs of land use. This was done by searching for sites comparable to the sites on our long list and by collecting price information of those locations. Subsequently we prepared a matrix in which locations and costs could be compared.

We converted all prices to land lease costs. In case only prices of land purchase were available, we used this to estimate the long lease costs of the land. As a rule of thumb, 5-10 percent of the land value per year can be chosen as an approximation for land lease. We used 10%. Because EcoVision depended on this method and could not rely on direct information of the respective land lots, the estimations of land acquisition costs are high-level estimates.

Information on long lease costs and land value (industrial)

- For HCCC, Nicasia Kade, Manzalina Bay and Batipaña a long lease fee of 36 USD/m^2.y is offered by Curaçao Ports Authority. If a quay and other infrastructure are not present, investments by the project owner can be settled with the future long lease fees.
- For an industrial area in the refinery area (Eastern part) 15 USD/m^2.y was agreed by 2Bays and an undisclosed company;
- Asphalt Lake Recycling (ALR) pays 14 USD/m^2.y; Curaçao Bitumen 21 USD/m^2.y (source: Buskabaai N.V.);
- CDM Holding offers land without buildings in the Dok area for 20 USD/m^2.y;
- The Wharf purchased land from CPA for ANG 300/m2, 10% of which corresponds to 17 USD/m^2.y;
- An industrial area adjacent to the airport was recently purchased by an undisclosed company for ANG 100/m^2, corresponding to 6 USD/m^2.y.
- Government land can be leased (long lease) for USD 2.00 – USD 3.00/m^2.y. The latter price is for centrally located land (e.g. Schottegat area, Government-owned parts of Asphalt Lake, Amstel area) and the lower price for non-centrally located land (e.g. Malpais, Meiberg). The prices can be lower if important island functions (e.g. waste management) are concerned.

- In the Buskabaai area, the Government of Curaçao offered 3,000 m^2 of industrial land to a recycling company with a land lease fee of USD 2.80/m^2.y.
- Bullenbaai East: land lease price is significantly higher than Bleinheim/Van Leer (source: 2Bays)

Classification of locations

With this information we produced a matrix with determining factors for land prices (centrally located or not, located at navigable water or not, infrastructure available or not). Subsequently we tagged the cells with a range of cost levels (bold in table 5.1). Locations from the longlist to be assessed were allocated to one of the cells of the matrix.

Most information about long lease prices is available for areas with road and utility infrastructure, without navigable water (both centrally and not centrally located). These are also the categories of locations where EcoVision seeks most prices for.

Information from 2Bays shows that at Van Leer a multiuse quay is present, which can be used by enterprises nearby. The areas adjacent to this quay are among the most expensive in the former refinery area. Since activities in the Bullenbaai area, reserved for heavy industry, can make use of deepwater harbor facilities, these locations are offered for a higher long lease price than at Bleinheim/Van Leer (also reserved for heavy industry).

Long lease prices are considered market-based and valid for fully useable land, i.e. without any limitations such as soil and groundwater contamination.

Table 5.1: Estimated long lease costs in USD per m^2 per year. Source: CPA, CDM, Buskabaai N.V., Curinde N.V., Domeinbeheer. Printed in blue: long lease costs made available by landowner or retrieved otherwise. Printed in black: long listed locations allocated to a price category, with estimation of land lease cost

	Harbor area, quay	**No access to navigable water no quay**
Centrally located Infrastructure for roads and utilities present	**25-35 USD/m^2.y** **(1)** HCCC, Nicasia Kade, Manzaliña Bay, Batipaña 36 Bleinheim/Van Leer: 25-35*	**10-20 USD/m^2.y** **(2)** ISLA East Industrial project 15; ALR 14; CDM Holding 20, Curaçao Bitumen 21; The Wharf 17 ISLA East: 15-20 (heavy industry)*; ISLA West: 10-15 (light industry)*
Centrally located. NO infra-structure for roads and utilities present (greenfield, brownfield)	**(3)**	**5-10 USD/m^2.y** **(4)** Asphalt Lake (Buskabaai N.V.): 5-10*
Not centrally located Infrastructure for roads and utilities present	**25-35 USD/m^2.y** **(5)** Bullenbaai East: 35	**0-5 USD/m^2.y** **(6)** Brievengat Curinde USD 3.33
Not centrally located NO infrastructure for roads and utilities present (greenfield)	**(7)** Bullenbaai West	**0-5 USD/m^2.y** **(8)** Industrial project airport: 5.60; Government land non-centrally located: Meiberg, Malpais, Brievengat: 2; Schottegat area 3 Shut: 5; Buskabaai North: 3

* Where a range is presented, the average is selected for the multicriteria analysis

(1) HCCC, Nicasia Kade, Manzaliñabaai, Batipaña: all locations cost 36 USD/m^2.y. If a quay and other infrastructure are not present, investments by the project owner can be settled with the long lease fee.
(2) Industrial area ISLA East 15 USD/m^2.y; ALR 14 USD/m^2.y; Curaçao Bitumen 21 USD/m^2.y; CDM Holding 20 USD/m^2.y; The Wharf 17 USD/m^2.y
(3) No information, no long-listed locations in these categories. Bullenbaai East: land lease price is significantly higher than Bleinheim/Van Leer (source: 2Bays)
(4) Buskabaai is taking preparations with real estate experts to put land prices in the market. Prices estimated using (2) and (8)
(5) 2Bays: Price Bullenbaai East is higher than price Bleinheim/Van Leer
(6) Curinde: location without buildings in Industrial Park Brievengat: USD 3.33/m^2.y
(8) Industrial area adjacent to airport, purchased at ANG 100/m^2. Government land (long lease): USD 2.00 – USD 3.00/m^2.y.

With respect to Malpais it is important to mention that Selikor does not pay for current land use. As it is not certain that this arrangement can be continued for the next 20 years, we choose a land lease price of USD 2.00/m^2.y for Malpais, which is the usual price for Government land in locations outside the center of Curaçao (source: Domeinbeheer Curaçao). For Meiberg which is also Government land, the same price is selected. From Curinde we received a long lease price of ANG 6,00/m^2.y, corresponding to USD 3.33/m^2.y. For ISLA West we select USD 12.50/m2.

Agricultural land

Agricultural land is mostly available for lease (Klein Kwartier, Bakufal, Ronde Klip) or long lease (Aloe Farm). Prices for lease of agricultural land can be very low, e.g. ANG 20.00 per year for 10 hectares (Ronde Klip, contract from the 80s[1]). Prices for long lease of agricultural land are higher, e.g. ANG 16.000 for 100,000 m^2 (0,16 ANG or 0,09 USD per m^2 per year). In Chapter 9 on the composting facility long lease prices are further evaluated.

5.3 System integration analysis - Power

The existing power infrastructure was analyzed, including proximity to substations and the capacity of existing power lines and the nearby power distribution stations. Distances to the nearest substations were measured using local maps. The power requirements (see section 3.5) were used as a starting point. Additionally, the team evaluated the possibility of feeding surplus power back into the grid (for WtE), assessing both technical feasibility and investment costs. Based on this analysis, a Class 5 estimate was calculated, covering the investments for connection and potential infrastructure upgrades. In some cases, two alternatives were calculated for a specific location. The lowest investment is used in the evaluations unless stated otherwise. Connected load for the WPOs is as follows: Waste to Energy 9 MW, Construction and Demolition waste recycling 2 MW, Industrial Recycling Hub 1 MW and Composting 1 MW (see also Section 3.5).

[1] Source: Dimondi,Ms. Tiarah de Doelder

In the calculations, the most important variables are length of cable to be installed and costs per meter for civil works and installation works. The latter vary from ANG 300 to ANG 650 or USD 166-360 per meter for power infrastructure, depending on the situation (type of road, other infrastructure present, hard underground etc.). For water infrastructure the price per meter varies from 300 to 500 ANG. See table 5.2 for further explanation.

Table 5.2: Price per meter (civil costs and cable, pipes) for power and water infrastructure

Situation	Sites	Power ANG/ m	Water ANG/ m
Several road crossings, public road finishings must be of high standards, several areas to be finished according to public road standards. Some areas have difficult ground conditions. Some areas have challenging existing infrastructure.	Bullenbaai East, Malpais, Shut, Isla West, ISLA East, Van Leer (from Nijlweg)	650	400-500
Industrial area, all areas considered same, no need for road crossing special finishings, road finishings do not need to be according to public road standards which are higher costs	Van Leer (from CRU/2Bays Substation)	550	350
Most of construction will be in areas with less finishings according to public road standards. No road crossings. Limestone underground.	Manzaliñabaai, Batipaña	500	350
Minimum road crossings, construction on private property, or construction in greenfield or brownfield areas, less public road standards	Meiberg, Asphalt Lake	450	350
Some roads in the area in poor condition. Less need for executing fine finishing works for public roads and road crossing	Brievengat	400	350
No (or only one) road crossings needed. Power connection will be from a HV above ground infrastructure. Some excavations in dirt roads do not require high quality finishings	Aloe Farm	300	300

In table 5.3 the class 5 estimates are presented for all locations.

Table 5.3: Investments for construction of electrical power to proposed locations

Location, connection	Meters to power connection	Price/m (ANG)	Civil works and cable (ANG)	Trafo/ switchgears (ANG)	Total ANG	Total USD
Bullenbaai East	300	650	195,000	100,000	295,000	**165,730**
Meiberg	2,850	450	1,282,500	100,000	1,382,500	**776,685**
Malpais, option from Zegu substation	3,000	650	1,950,000	180,000	2,130,000	**1,196,629**
Shut from CHB Station	1,850	650	1,202,500	100,000	1,302,500	**731,742**
Isla West From CRU/2Bays Substation	2,050	650	1,332,500	100,000	1,432,500	**804,775**
Isla West from AQ Nijlweg substation	1,100	650	715,000	100,000	815,000	**457,865**
Van Leer Power from CRU/2Bays Substation	1,760	550	968,000	100,000	1,068,000	**600,000**
Van Leer Aqualectra Nijlweg Substation	1,000	650	650,000	100,000	750,000	**421,348**
Isla East, from new Wärtsilä Power Plant	140	650	91,000	100,000	191,000	**107,303**
Asphalt Lake from Dokweg (*) (**)	1,250	450	562,500	100,000	662,500	**372,191**
CPA Manzaliñabaai from Nijlweg	800	500	400,000	100,000	500,000	**280,899**
CPA Batipaña from Nijlweg	600	500	300,000	100,000	400,000	**224,719**
Brievengat Industrial Park	200.00	400	80,000	100,000	180,000	**101,123**
Aloe Farm	120.00	300	36,000	100,000	136,000	**76,404**

(*) For Buskabaai North, the same amounts in USD can be applied

(**) Buskabaai N.V. is preparing to realize their own energy production facility. In that case, investments can be significantly lower (approximately 115,000 USD). However, it is not yet clear when this will be realized. Therefore, the option has been disregarded and a power connection will be constructed from the Dokweg Power station.

5.4 System integration analysis - Water

A similar technical review was conducted for the water infrastructure. The team investigated the capacity and proximity of existing potable water systems near each location. Where necessary, expansions or new connections to the current water supply were proposed.

Forecasted water usage for the four WPOs is as follows: Waste to Energy 5 m^3/day, Construction and Demolition waste recycling 6 m^3/day, Industrial Recycling Hub 1 m^3/day and Composting 8 m^3/day (see also Section 3.5).

The following table presents a Class 5 Estimate for the water integration possibilities for the proposed WPOs. For the costs of installation of infrastructure per meter we refer to table 5.2 (previous section).

Table 5.4: Class 5 estimate for the integration of water infrastructure to proposed locations

Property Options/Possibilities	Distance connec-tion (m)	Price/m (ANG) (*)	Civil & pipe DN63 ** installation (ANG)	Pipes > DN63 installation (ANG)	Total ANG	Total USD
Bullenbaai East	300	500	150,000	5,000	155,000	**87,079**
Meiberg	1,250	350	437,500	25,000	462,500	**259,831**
Malpais, from water distribution WN Westpunt	500	500	250,000	25,000	275,000	**154,494**
Shut/CAH	1,400	500	700,000	40,000	740,000	**415,730**
Isla West from CRU/2Bays	500	500	250,000	20,000	270,000	**151,685**
Isla West from Aqualectra Nijlweg	375	500	187,500	22,000	209,500	**117,697**
Bleinheim/Van Leer from CRU/2Bays	550	350	192,500	0	192,500	**108,146**
Bleinheim/Van Leer from Aqualectra Nijlweg	300	500	150,000	0	150,000	**84,270**
Isla East, from new Wartsila Power Plant	150	450	67,500	0	67,500	**37,921**
Asphalt Lake from Dokweg	600	350	210,000	15,000	225,000	**126,404**
CPA Manzaliñabaai from existing water infra	800	350	280,000	32,000	312,000	**175,281**
CPA Batipaña Option existing water infrastructure	100	350	35,000	10,000	45,000	**25,281**
Brievengat from Industry Park	200	350	70,000	12,000	82,000	**46,067**
Aloe Farm	150	300	45,000	0	45,000	**25,281**

(*) Table 5.2 includes explanations for the price per meter for installation for water infrastructure.

(**) Pipe with diameter of 63 mm

5.5 Construction of road infrastructure

To assess investments for road infrastructure, we checked with landowners whether road infrastructure is present or will be present and whether it is included in the long lease contract. If not, an estimation was made of the investments required. For the following locations no additional road infrastructure is needed: Bullenbaai East, Malpais, Shut, ISLA West, Bleinheim/Van Leer, ISLA East, Brievengat.

Table 5.5 presents the investments required for the construction of road infrastructure at four locations (Class 5 estimate). Investments in a new road are roughly calculated as ANG 1,000,000 (USD 556,000) per kilometer. Investments in road widening are estimated at 75% of that amount. On-site roads are not included in these costs.

Table 5.5: Class 5 estimate for investments in road infrastructure

Location, connection	Road new km	Road widening km	New road construction ANG	Road widening ANG (75% of new road)	Total ANG	Total USD
Meiberg	0.5		500,000		500,000	**278,000**
Asphalt Lake	1.08	0,08	1,080,000	60,000	1,140,000	**633,333**
Buskabaai North	0.4	0.00	400,000	0	400,000	**222,000**
Manzaliñabaai	*1.82	0.00	1,820,000	0	1,820,000	**1,011,111**
Batipaña	*1.82	0.00	1,820,000	0	1,820,000	**1,011,111**
Aloe Farm	0.5	0.00	500,000	0	500,000	**277,777**

* A two-way connection in both directions (east and west) is needed

Location specific aspects

Meiberg: The area of interest is at the current dirt road running North-South from the Road to St. Willibrordus. Road construction required over 500 meters.

Asphalt Lake: For a small part of the trajectory near the Aqualectra Battery System, the road must be widened. For a small site just North of Asphalt lake (Buskabaai North), which is only suitable for an Industrial Recycling Hub, a road trajectory of 400 meters needs to be constructed.

Manzaliñabaai and Batipaña: The locations Batipaña and Manzaliñabaai located near Otrobanda are currently connected by an existing unpaved access road along the coast of the inland water Schottegat. Therefore, if a WPO is to be installed, the existing road must be paved. On the west side, this new paved road connects to the Nijlweg, and on the east side to the Kortenaerstraat. Due to the ownership situation, negotiations negotiation with CPA and/or a private landowner is required for a part of the road (see figure 5.1).

Figure 5.1: Likely route for road construction for opening Manzaliñabaai and Bati Paña area.

5.6 Geological situation and groundworks

Figure 5.2 presents the geological formations of Curaçao (from De Buisonjé, 1974). Figure 5.3 shows an overlay of the historic situation of Schottegat (1915, Werbata) and the current situation, from which it becomes clear that small limestone islets were present near the shoreline of the bay. Where the former islets may indicate solid underground (mostly limestone), the space between the former coastline and the former islets indicates where filling of land has taken place and unstable conditions may occur. Table 5.6 summarizes the geological classifications some general soil characteristics. Table 5.8 shows the main groundworks that need to be done at the sites with unit prices.

Figure 5.2: Geological formations of Curaçao

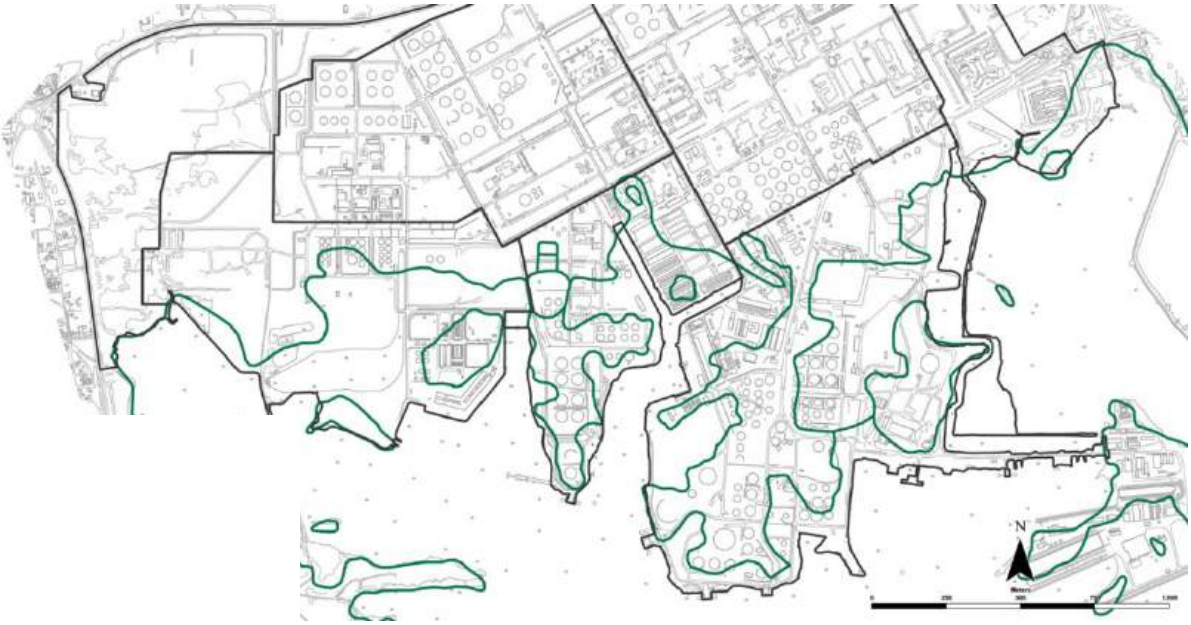


Figure 5.3: Shoreline 1915 (green line, from Werbata) and current situation (black and grey lines), indicating areas that have been filled in the 20th century

Table 5.6: Geological classification and general soil characteristics of sites

Geological formation	Area/location	Characteristics of sites
Limestone formation	Bullenbaai East, Batipaña, Manzaliñabaai, Shut	Somewhat accidented terrain. Topsoils can vary significantly, but stable ground conditions are assumed.
"Midden Curaçao" formation	Meiberg, Malpais West, Brie-vengat	Flat terrain. Assumption: stable ground conditions
Curaçao Lava formation	ISLA West, ISLA East, Asphalt Lake, Aloe Farm	Sites, except for Aloe Farm, are near historic coastlines of Schottegat with sub-optimal soil conditions. Sections of ISLA West are known to have stable soil conditions*
Coral rubble or filled land	Bleinheim/Van Leer	Flat terrain. Assumption: unstable ground conditions. Pile foundation needed

* We assume that at ISLA West a lot can be made available with stable soil conditions

With support from CCM-Engineering and Civil Engineering Curaçao we developed a matrix with estimations of costs for groundworks needed prior construction of the WPOs. For this matrix, the unit prices were selected as summarized in table 5.7. For proper calculation of costs of groundworks, the results of soil investigations and terrain measurements and a design of the WPO are essential. These investigations did not take place for the longlisted sites, and the estimated costs must be seen as high level (Class 5) and rather conservative estimations.
The costs are specified for removal of vegetation, earth moving, levelling, ground works for foundations and pile foundation (if needed). The cost of a plate foundation is considered included in construction costs.

One of the risk factors for construction of a waste processing plant is that the ground bearing capacity of the location is insufficient. This may especially be the case in areas around the Schottegat, where extensive filling of land took place in the 20th century. A well-known example is the recent construction in the North part of the Dock-area by Energis, where high costs were involved for deep foundations.
For the Industrial Recycling Hub and the Composting facility, we assume that no pile foundations will be necessary even in areas with unstable ground conditions. Other options such as mixing of soil with cement additives are assumed to provide sufficient soil stabilization in these cases.
For one of the locations - Asphalt Lake - it will be necessary to elevate the ground level by approximately 60 cm (pers. comm. Buskabaai N.V.). For the other locations this will not be necessary (see next section "Climate resilience").

Table 5.7: Unit costs for groundworks

Works	ANG/ m²	Specification per site
Removal of vegetation	5	Normal terrain: all sites except Batipaña and Manzaliñabaai
	10	Removal of vegetation in difficult terrain: Batipaña and Manzaliñabaai
Earth moving, levelling	40	All locations, not limestone, and not Asphalt Lake
	60	Asphalt Lake: including land elevation of 60 cm
	125	Accidented or slightly accidented terrain, limestone: Bullenbaai East**, Shut, Batipaña and Manzaliñabaai
Ground works for foundations	150	Soil improvement: soil treatment (compaction, grouting, mixing) or replacement of soil. All sites, except in case of pile foundations
Pile foundation*	400	Cost of purchase of poles, pile driving, filling with concrete. Only assumed for Van Leer, ISLA East and Asphalt Lake (WtE scenario en C&D waste)

* The cost of a plate foundation is considered to be part of construction costs

** Bullenbaai East is a location with a relatively steep slope (2.5%)

Table 5.8 Class 5 estimation of costs for civil ground works per site

Location	Removal vegetation ANG/m²	Levelling ANG/m²	Works for foundations ANG/m²	Pile foundation ANG/m2	Total ANG	Total USD
WtE – area m²	**25,000**	**25,000**	**10,000**	**10,000**		
Bullenbaai East	125,000	3,125,000	1,500,000	0	4,750,000	**2,638,889**
Meiberg	125,000	1,000,000	1,500,000	0	2,625,000	**1,458,333**
Malpais	125,000	1,000,000	1,500,000	0	2,625,000	**1,458,333**
Bleinheim/Van Leer	125,000	1,000,000	0	4,000,000	5,125,000	**2,847,222**
ISLA East	125,000	1,000,000	0	4,000,000	5,125,000	**2,847,222**
Asphalt Lake	125,000	1,500,000	0	4,000,000	5,625,000	**3,125,000**
C&D Waste area m²	**20,000**	**20,000**	**8,000**	**8,000**		
Meiberg	100,000	800,000	1,200,000	0	2,100,000	**1,166,667**
Malpais	100,000	800,000	1,200,000	0	2,100,000	**1,166,667**
Shut	100,000	2,500,000	1,200,000	0	3,800,000	**2,111,111**
ISLA West	100,000	800,000	1,200,000	0	2,100,000	**1,166,667**
Asphalt Lake	100,000	1,200,000	0	3,200,000	4,500,000	**2,500,000**
Batipaña	200,000	2,500,000	1,200,000	0	3,900,000	**2,166,667**
Manzaliña Bay	200,000	2,500,000	1,200,000	0	3,900,000	**2,166,667**
Brievengat	0	800,000	1,200,000	0	2,000,000	**1,111,111**
Hub - area m²	**15,000**	**15,000**	**4,000**	**4,000**		
ISLA West	75,000	600,000	600,000	0	1,275,000	**708,333**
Asphalt Lake	75,000	900,000	600,000	0	1,575,000	**875,000**
Composting - m²	**10,000**	**10,000**	**2,000**	**2,000**		
Malpais	50,000	400,000	300,000	0	750,000	**416,667**
Aloe Farm	50,000	400,000	300,000	0	750,000	**416,667**

Climate resilience

The location must also be resilient to climate change to ensure long-term viability and operational continuity, and minimize financial and environmental risks. Vulnerable sites, especially industrial sites around Schottegat (figure 5.4) may require land elevation (e.g., raising by 1 meter with diabase). After the completion of a new digital elevation model (DEM) for Curaçao in 2025, more accurate information will be available for assessing climate risks.

Figure 5.4 shows that none of the locations are under serious threat of flooding from high seawater levels by the end of this century. Buskabaai N.V. however recommends elevating the terrain of the dry Asphalt Lake with 60 cm of diabase, which is also related to expected storm water in the area. 2Bays does not anticipate risk of flooding for their locations (see also section 5.10).

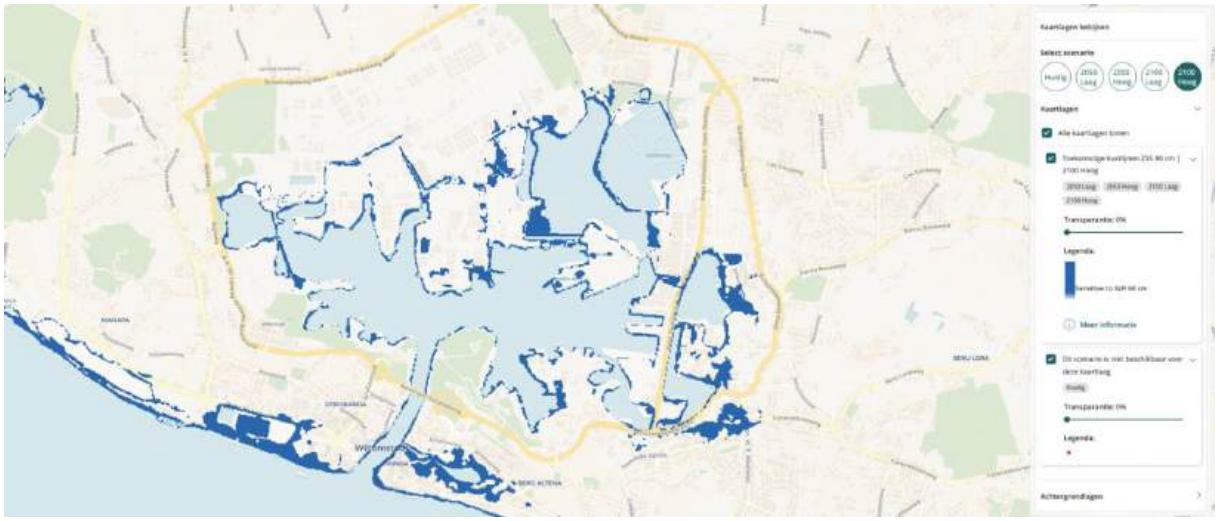


Figure 5.4: Areas forecasted to be inundated by the year 2100 (scenario “high sea level rise, 86 cm in 2100”. Source: www.klimakorsou.com)

5.7 Soil contamination

Most of the proposed locations have no history of (known) soil contamination. Some locations however, such as the locations on the refinery premises (ISLA West, ISLA East, Bleinheim/Van Leer) do. Some of the locations have minor soil contamination such as Asphalt Lake (only immobile contaminants) and Malpais (only groundwater contamination). This section presents some additional information on soil contamination and costs for remediation. It should be noted however that these costs are not considered relevant for the price of the long lease to be paid. Long lease prices as estimated in section 5.2 are valid for fully useable land, i.e. without any soil and groundwater contamination. The costs for soil remediation should either be borne by the landowner delivering useable land, or a formula could be chosen in which the project owner will (wholly or in part) finance soil remediation and is allowed to deduct this from future land lease costs. The (high level) costs for land remediation in this section are added for reference only and should not be weighed in the multicriteria analysis (MCA).

For several locations, table 5.10 presents the main characteristics of the soil contamination and the investments needed for the remediation of this contamination. Calculations of remediation-costs are

based on research done by Ecorys, EcoVision and Havenwerken Rotterdam in 2012 by assignment of Refineria di Korsou. 2Bays consented to the use of this document on November 18, 2024.

Bleinheim/Van Leer

According to the EcoVision and Gemeentewerken Rotterdam study (2012), the Bleinheim/Van Leer area contains both heavily and mildly contaminated zones. In some areas, LNAPL (light non-aqueous phase liquid), such as hydrocarbons floating on top of groundwater, is present. In less contaminated areas, only immobile pollutants, such as heavy metals, have been detected.

It is assumed that 2Bays can make a location with medium soil and groundwater contamination available for use. The estimated cost for remediating a 4-hectare area to industrial standards was approximately €200 per m² in 2012. Adjusted for a 35% price increase due to inflation over the period, this figure rises to €338 per m². The total remediation costs for a 2.5-hectare lot are estimated at approximately 8.9 million USD (+/- 40%).

ISLA East

In ISLA East, contamination consists of immobile contaminants in soil and mobile contaminants in groundwater. Remediation to industrial quality of a 2.5-hectare area costs approximately 135 €/m^2, or 3.54 million USD for a 2.5 ha area (+/- 40%).

Asphalt Lake:

In the “Dry” Asphalt Lake, contamination consists of immobile components (heavy metals). Remediation can take place by adding 1 meter of clean soil on top of the current layer at a cost of 25 USD/m^3 (delivered). Remediation costs (investment) are estimated to be USD 625,000 for a 2.5 ha area (+/- 40%).

ISLA West

ISLA West is an area with both heavily contaminated subareas and non-contaminated subareas. Since ISLA West is a very large area, we assume that non-contaminated subareas are available for the WPOs under research in this project.

Other areas

In other areas than the ones mentioned in the sections above, no known soil contamination is present.

In Malpais groundwater may be polluted by the nearby landfill, but no sources of contamination are known on the site itself.

In Manzaliñabaai and Batipaña the shoreline of Schottegat may be polluted with oil, but no intervention is expected to be necessary.

Final remarks

Since the Ecorys investigation in 2012 took place on a high level for the entire premises, the results per site are not very detailed and need to be interpreted with much caution. Another factor to recognize is that the costs estimated are based on full remediation, while 2Bays is also considering other methods,

such as excavation and removal to a nearby landfill site. More detailed research will be needed in later phases of the project preparations.

Table 5.9: Characterization of soil contamination and estimation of remediation costs (margin of error of ± 40%) for 6 locations.

Location, connection	Type of pollution	Cost/m2 Corrected for inflation (€)	Cost per 2.5 ha (M€)	Cost per 2.5 ha (M USD)
Malpais	Possible groundwater contamination from landfilling activities	-	-	**0.00**
Bleinheim/Van Leer	Both significant contamination and mild contamination, see text	338	8.44	**8.86**
ISLA West	Non-contaminated areas of sufficient size present	-	-	**0.00**
ISLA East	Immobile contaminants in soil; mobile contaminants in groundwater	135	3.38	**3.54**
Asphalt Lake	Possible contamination with im-mobile components	-	-	**0.63**

5.8 Ecological values

To support the identification of a suitable location for a new WPO, “Yu di Tera” (a local company for ecological research) conducted an assessment of natural values at seven potential sites that still have intact vegetation and where significant natural values may be present. This evaluation considered both the vegetation within the sites as well as in their immediate surroundings (see Annex 3 for results). Additional research was carried out by EcoVision during field trips and based on past experience. The tables below present a summary of the findings as well as a system for scoring the locations on the criterion “existing nature values at specific lot”.

Scoring factors (scores for nature values) are considered universal for all Waste Processing Options and are presented in a scoring guide in table 5.10 (lower nature values are awarded higher scores).

Table 5.10: Scoring guide natural values for specific locations

Value	Explanation	Score
Very low natural value	Little to no biodiversity, heavily disturbed area, no significant ecological function	**5**
Low natural value	Limited species, no rare or protected species present, moderate ecological significance	**4**
Average natural value	Moderately diverse ecosystem with some protected or valuable species present, lacking distinctive or exceptional characteristics	**3**
High natural value:	Good biodiversity, the area hosts a rich variety of species, including important ones and plays a significant role in supporting the ecological network	**2**
Exceptional natural value	High level of biodiversity, with rare and protected species present, fulfills a vital ecological function	**1**

Table 5.11. Scoring results of existing natural values for specific locations (by Yu di Tera except ISLA West and Asphalt Lake)

Area/location	Specification	Nature value	Score
Bullenbaai East (***)	Heavily disturbed area, no significant ecological function	Very low	**5**
Meiberg	Somewhat diverse ecosystem, some protected and valuable species	Average (*)	**3**
Malpais West	No protected, rare or valuable species	Low	**4**
Shut	Somewhat diverse ecosystem, some protected and valuable species	Average	**3**
ISLA West	Heavily disturbed and polluted area, no significant ecological function	Very low	**5**
Van Leer (**)	Heavily disturbed and polluted area, no significant ecological function	Very low	**5**
ISLA East	Heavily disturbed area, no significant ecological function	Very low	**5**
Asphalt Lake	Heavily disturbed area, not vegetated	Very low	**5**
ISLA West	Heavily disturbed area, no significant ecological function	Very low	**5**
Manzaliñabaai	No protected, rare or valuable species	Low	**4**
Batipaña	Strongly disrupted area	Very low	**5**
Brievengat	Heavily disturbed area, no significant ecological function	Very low	**5**
Aloe Farm	Heavily disturbed area, no significant ecological function	Very low	**5**

(*) Depending on the specific location chosen within the area. Within Meiberg also locations with high value are present. (**) Based on observations field trip. (***) Based on experience and earlier visits, area not visited in 2024

Figure 5.5 shows relevant Ramsar sites, conservation areas and reef sites near the proposed locations are indicated on a map.

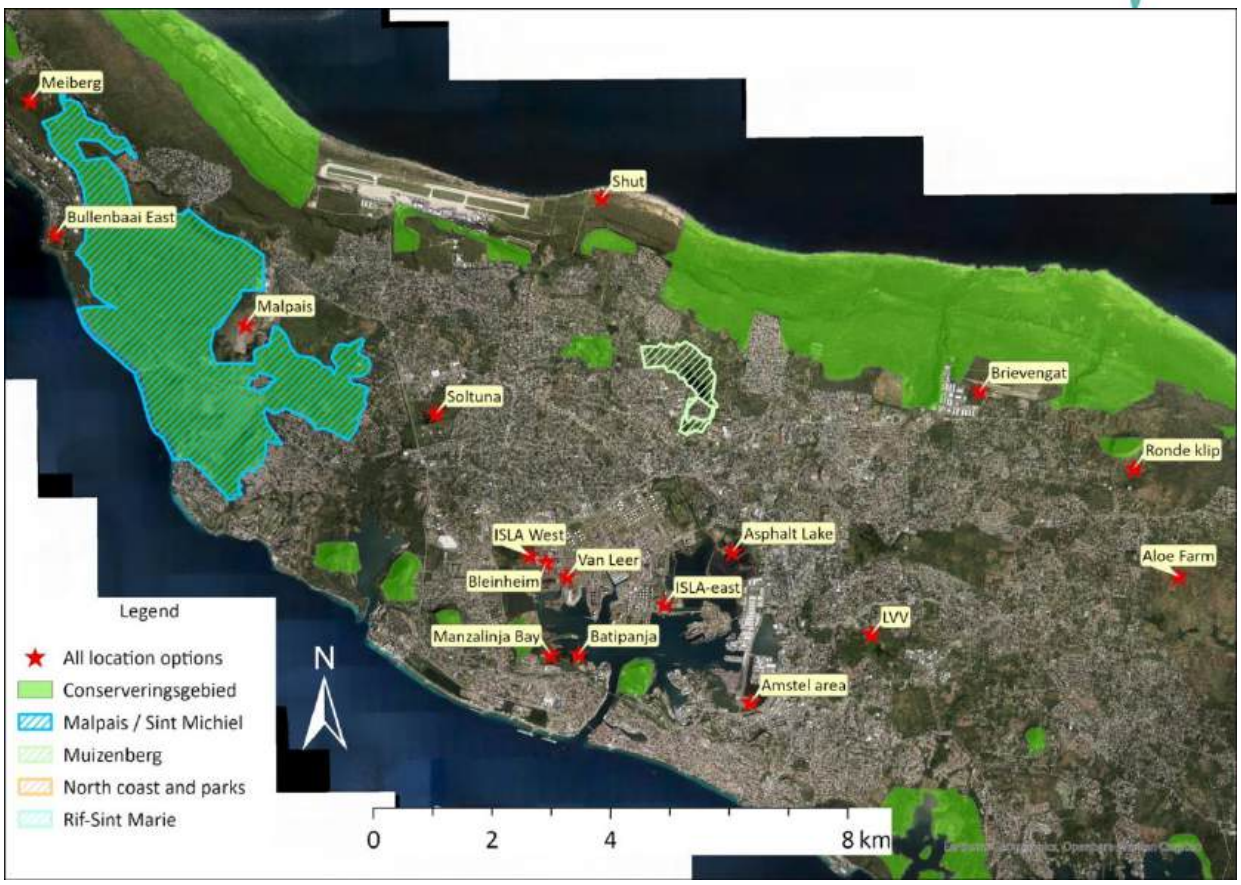


Figure 5.5: Ramsar sites (hatched), conservation areas and reef sites (south coast) near the proposed locations.

5.9 Distance from waste sources

The closer a waste processing facility is to the waste generation source, the more cost-effective it becomes to transport waste. Ideally, the site should be near large waste producers such as urban and commercial areas. Short distances minimize emissions associated with hauling waste.

Table 5.12 shows for the eight categories of waste that are currently brought to the landfill, the amount of waste (in % of the total, i.e. 130,000 metric tons) and information on the origin of the waste. The text below explains that the bulk of all waste (all categories except for industrial waste and for hotel waste), i.e. 93% of total waste, follows the distribution pattern of domestic waste. Industrial waste and hotel waste exhibit a different pattern (see table 5.12).

Domestic waste (non-bulky)

Of all waste categories originating on Curaçao, domestic waste is the largest. Domestic waste is generated in 65 service areas (neighborhoods). For our calculations of average distance of service areas to waste processing locations, we divided the 65 service areas into six clusters. These six clusters were chosen in such a way that each cluster represents approximately 12,000 unit bins (“kliko’s”).

Domestic bulky waste

Since domestic bulky waste is also generated by households, the distribution/origin is the same as for non-bulky domestic waste.

Non-bulky waste "Selikor routes

Non-bulky waste from Selikor routes is generated by small commercial enterprises in urban areas and the inner city and to a lesser degree a number of households. The origin of this waste is assumed to be largely the same as domestic waste (urban areas).

Hotel waste

Hotel waste is generated by hotels, of which most (and the largest) are located in the coastal zone and the city center. The conclusion is that the distribution of this type of waste is different from domestic waste. Hotel waste contributes 6% of total waste.

Commercial waste (bulky and non-bulky)

The second largest category of waste (24% of total) is commercial waste (bulky and non-bulky). According to the Waste Categorization Study (EcoVision, 2024), households (33%), construction and demolition (23%), gardens (11%), shops and supermarkets (8%) and "mixed origin" (7%) are the largest contributors. These origins (together 82 of commercial waste) are assumed to overlap largely with the urban areas of Curaçao and therefore distribution is assumed to also be largely the same as domestic waste.

Garden/yard waste

Garden waste (11% of total) is assumed to mainly originate from densely developed areas. It can also originate from to-be-developed areas, but in most instances these areas are located near developed areas. Distribution is assumed to be largely the same as domestic waste.

Construction and demolition waste

Similar to garden waste, construction and demolition waste (23% of total) is assumed to mainly originate from densely developed areas. It can also originate from to-be-developed areas, but in most instances these areas are located near developed areas. Distribution is assumed to be largely the same as domestic waste.

Industrial waste

Like hotel waste, the distribution of this type of waste is different from domestic waste. Industrial waste, contributing 0.6% of total waste, is generated in a small number of active industrial areas (such as Industriepark Brievengat).

Table 5.12: Distribution of waste categories

Waste category	% of total	Assumptions for distribution
Domestic municipal waste	26	65 service areas divided into 6 clusters
Bulky domestic waste	3	Distribution as domestic waste
Non-bulky Selikor routes	6	Distribution as domestic waste
Commercial bulky and non-bulky waste	24	Distribution as domestic waste
Garden/yard waste	11	Distribution as domestic waste
Construction & demolition waste	23	Distribution as domestic waste
Hotel waste	6	Coastline and city center
Industrial waste	<1	Small number of active industrial areas

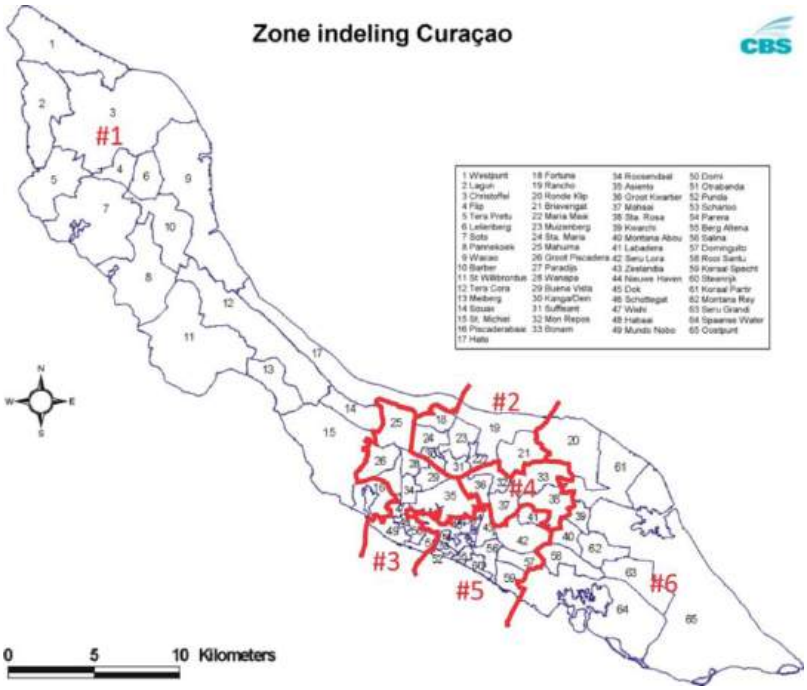


Figure 5.6: Clusters of Selikor's service areas. These service areas largely coincide with the geocode zones (numbers in black). Service areas are grouped into 6 clusters (numbers in red).

Results

Table 5.13 shows the average distances from the proposed WPO locations to the service areas (geographical source of waste). This information is only applicable to Waste to Energy, C&D waste recycling and composting, since the origin of the waste resembles that of domestic waste. The geographical origin of wastes for an Industrial Recycling Company may be quite different and cannot be forecasted yet.

No scoring factors are presented here, since scoring varies along with the Waste Processing Options (see Chapters 6-9).

Table 5.13: Transportation distances (in km) from service areas (source of waste) to WPO locations

Location	WPO	Service area 1	Service area 2	Service area 3	Service area 4	Service area 5	Service area 6	Average Distance
Bullenbaai East	WtE	25.94	15.81	11.29	22.55	16.28	26.15	**19.67**
Meiberg	WtE, C&D	10.03	15.94	12.42	21.73	17.68	25.33	**17.19**
Malpais	WtE, C&D, C	13.80	10.44	7.87	17.18	13.13	20.78	**13.87**
Shut	C&D	22.17	8.94	5.94	15.71	13.03	19.29	**14.18**
ISLA West	C&D	23.42	4.90	2.18	11.64	7.83	15.24	**10.87**
Van Leer	WtE	23.42	4.90	2.18	11.64	7.83	15.24	**10.87**
ISLA East	WtE	28.37	4.52	7.28	11.26	8.06	14.86	**12.39**
Asphalt Lake	WtE, C&D	27.10	3.23	6.99	9.94	6.74	13.54	**11.26**
Batipaña	C&D	25.01	11.01	3.83	10.77	3.56	13.15	**11.22**
Manzaliñabaai	C&D	24.19	10.19	3.01	11.59	4.38	13.97	**11.22**
Brievengat	C&D	31.34	4.06	14.35	9.73	8.32	13.29	**13.52**
Aloe Farm	C	38.04	12.42	21.05	4.08	10.42	3.39	**14.90**

5.10 Meetings with landowners and other relevant parties

In the following sections the main points discussed with the landowners are summarized. Meeting reports are included in Annex 2.

5.10.1 Refineria di Korsou/2Bays

The industrial zones of Bullenbaai are all designated for heavy Industry (by 2Bays). The most western part of Bullenbaai is available for industry depending on a deep-water harbor and is not likely to be made available for industry not depending on a deepwater harbor. Therefore, 2Bays' preference for a waste processing industry would be the Schottegat area (Bleinheim/Van Leer, ISLA West, ISLA East). The designation of the industrial zones of Schottegat (light, medium and heavy industry) are indicated in Annex 1.

Locations that are reserved for heavy industry (such as Bleinheim/Van Leer) may be available for Waste to Energy (WtE) but not for recycling of waste (light/medium industry). On the other hand, locations that are reserved for light/medium industry may be available for recycling but not for WtE.
Location Bleinheim/Van Leer is not entirely discarded by EcoVision despite the presence of extreme pollution. The reason for this is that the recovery of the site is possible within 5 years from now, according to 2Bays).

For WtE three areas are available: Bullenbaai (50 ha, not preferred by 2Bays), Bleinheim/Van Leer (36.5 ha) and a small lot of 2.5 ha at ISLA East, just North of the new location for the Aqualectra diesel plant. For recycling, ISLA West (70 ha) and ISLA East (55 ha) are available.
Areas will be made available for long lease, including infrastructure (roads, power and water infrastructure). Costs for long lease have not yet been communicated.

5.10.2 Curaçao Ports Authority (CPA)

In the Southwest area of Schottegat, two locations with sufficient surface area are available for light/medium industry: Batipaña (2.5 ha, sufficient for smaller WPOs) and Manzaliña Bay (6.2 ha). Both areas are 'greenfield areas', no infrastructure (road and utilities) is present. There are good possibilities for constructing a quay for bulk transport. The costs for long lease are USD 3,00/m^2 per month (USD 36,00/m^2 per year, in the highest category of all prices communicated with landlords).
Other industrial properties of CPA in this area such as Velt Salu and Parera do not meet the criteria for sufficient land area.

5.10.3 CDM Holding

In the Drydock area/Koningsplein, the available industrial lots for long lease are all too small (< 0.2 ha) and lots are not connected to each other. These locations have been disregarded.

5.10.4 Curaçao Airport Holding (CAH)

According to CAH's policies, the Shut area (total surface area available 19 ha East of the road to Shut and 35 ha west of the road) is the only suitable CAH-location for waste processing. The area of interest is the location where in earlier decades waste recycling (car wrecks and glass) took place. The so-called "Obstacles Limitation Cone" used by Aviation Authorities will most likely allow for the establishment of a waste processing facility without a high stack. According to CAH, recycling activities will be a good match for both sites, WtE will not. CAH has a preference for long lease of land as opposed to selling of land. Costs for long lease cannot yet be presented, however. On the other hand, CAH indicates that it is willing to be a serious partner in the development of the area for sustainable purposes such as waste management. Investments in infrastructure (road and utilities which are now absent) can be shared together with the project owner.
The Shut area is not an Industrial Area in the EOP, but Open Land and is currently vegetated. The preparations by CAH have already started to re-designate the area to "Industrial area". Therefore, this location is included in the longlist.

5.10.5 Selikor

According to Selikor, the area northwest of the current landfill is the only industrial area available for a waste processing facility. The area east of the road to the landfill is reserved for other purposes. The area available is 6 ha large and vegetated. Some construction waste has been deposited in the past. Electrical and water infrastructure are not available in this area, and where this infrastructure is present in other Selikor locations, it is inadequate (both water and power).
According to the EOP, Malpais is the only industrial area where waste processing (including incineration) is specifically indicated as a preferred use. Selikor is using the area (owned by the Country) for free.

5.10.6 Buskabaai N.V.

Part of the so-called Dry Asphalt Lake has been recovered by Buskabaai N.V. and ALR The area is roughly 10 hectares large, and it is designated as "Industry" in the EOP. No infrastructure is present. On the other hand, the location is situated relatively close to the Dokweg road and to Aqualectra, where a substation is present (2 x 50 MVA). According to the policies of Buskabaai N.V., future activities must contribute to Island sustainability. Waste processing activities match this condition.

The primary access to the Dry Asphalt lake is through Dokweg, passing the new Battery Storage Facility of Aqualectra. If another access is needed, Buskabaai N.V. considers access at the Regentesselaan (opposite of Rustenburgh).

5.10.7 Janssen de Jong

Janssen de Jong currently recycles 10,000 Mt of C&D waste per year at Tafelberg. This production can be upscaled significantly at their three locations: Tafelberg, Brievengat and Malpais.

Currently, Janssen de Jong accepts clean stony materials only (no waste mixed with wood, plastics and other fractions). Accepting of mixed C&D waste in the future will be an option. Furthermore, it is Janssen de Jong's intention to also recycle glass and car tires in the future.

At this point, no detailed information on their properties is requested, this may not be needed in detail, depending on the business model chosen in the final WPOs by RHDHV.

5.10.8 Curinde

Curinde has sites at Freezone Nieuwe Haven, Freezone Hato, and Industriepark Brievengat. Brievengat offers the best potential for a (C&D) recycling plant, with three available joint plots (C5, K4, K3) totaling approximately 2 hectares. The industrial park is secured 24/7, accessible for heavy transport, and has adequate electricity and water supply, though occasional power outages occur. The plots can be leased under a long-term lease agreement (6 ANG/m²/year, negotiable) for 10-30 years. Measures must be taken to minimize dust and noise to prevent disturbances to other businesses. The plots are flat and free from soil contamination.

5.10.9 GMN-AVB

Klein Kwartier is designated as Agricultural Land in the EOP[1]. GMN-AVB wishes to start a composting process on its premises at Klein Kwartier. During a follow-up conversation with GMN-AVB, they indicated that composting at Klein Kwartier would not be feasible.

Instead, GMN-AVB expressed interest in exploring the possibility of establishing the composting project in the vicinity of St. Joris where the area is also designated as Agricultural Land in the EOP. This consideration arises from ongoing discussions about redirecting chicken manure to this area, given the existing challenges with its disposal. They have indicated openness to collaborating on a joint effort to

[1] The land is owned by Land Curaçao while 2Bays owns the right of superficies, "recht van opstal"

integrate the composting of green waste with the disposal of chicken manure as part of the composting process. Further discussions with GMN-AVB will be necessary to explore these possibilities.

5.10.10 Soltuna

Foundation Soltuna manages agricultural land, as designated in the EOP, at De Savaan and Bakufal that could potentially be suitable for composting. However, Soltuna has indicated that there is no available space at Savaan, and the land at Bakufal is insufficient to meet the requirements for composting activities at the scale of this project.

5.10.11 Smart Lifestyle Connection

A collaboration between Smart Lifestyle Connection (SLC) and Soltuna provided access to locations such as Bakufal for a composting project aimed at raising awareness, training youth, and phased implementation. SLC primarily focuses on startups and aims to eventually transfer the acquired knowledge. While European subsidies and local partners are being explored as funding options, slow decision-making, and a lack of cohesion among stakeholders pose major obstacles, leaving the project to proceed without subsidies for now.

5.10.12 Aloe Farm

Aloe Farm identified 5 hectares of available, unused lease land within a 10-hectare plot designated as an agricultural area by the EOP. Infrastructure requirements include a sufficient weekly water supply sourced from Seru Loraweg, alongside improvements to roads and terrain leveling. Key challenges include illegal waste dumping near Dam Pretu, lease cost negotiations with shareholders, and government approvals for additional construction or composting activities on the leased land. Additionally, the presence of an on-site Bed & Breakfast raises concerns about potential impacts such as odors, pests, and noise for visitors. This would be mitigated by conducting composting activities primarily indoors. Discussions with shareholders and the government will be necessary to secure approvals and finalize lease terms, as well as clarify land use permissions.

5.10.13 DiMondi

The site where DiMondi conducts its composting activities at Ronde Klip is designated as a Conservation Area in the EOP. It covers 2 hectares, has been leveled, and has two wells but lacks electricity infrastructure. The land is leased under an outdated agricultural lease contract at 20 ANG per year for 10 hectares. Challenges for this location include the absence of fencing, theft, illegal waste dumping, and restrictions due to its location in a conservation area, which complicates the issuance of permits for buildings.

6 Evaluation locations Waste to Energy

The longlist of locations for Waste to Energy (WtE) is: Bullenbaai West, Bullenbaai East, Meiberg, Malpais, Bleijnheim, Van Leer, ISLA East and Asphalt Lake (see Chapter 4). The list of criteria used to score the locations for WtE is presented in Chapter 4.

6.1 Go/no-go criteria

In this section the scoring of “go/no-go” criteria are discussed. Go/no-go criteria are criteria that - if not met - lead to disregarding the location for further research.

Location in “Industrial Area”

All longlisted locations for WtE classify as “Industrial area” in the Island Development Plan (EOP). All sites are “go”.

Location fits specific spatial policies

The EOP also describes a number of more specific designations. In case of “Industrial area” these designations are: "dependent on (deep water) harbour", "dependent on airport", "high-tech", "waste management", “small-medium companies”. In some cases, landowners have specific spatial policies or Masterplans where WtE should fit in. As an example, 2 Bays’ Development plan for Curaçao Port Industrial Sites can be mentioned, which is approved by the Council of Ministers of Curaçao.
Table 6.1 points out per area on the WtE longlist what specific policies apply and whether the policies imply a “go” or a “no-go”.

Table 6.1 Specific location policies

Location	Remarks	Go/no-go
Bullenbaai West	WtE does not fit in 2Bays' policy for this location (the location near the entrance - ISLA East - is available only (for WtE)	No go
Bullenbaai East	Location is earmarked as "dependent on (deep water) harbour in EOP However, according to 2Bays, Bullenbaai East is reserved for heavy industry (in general)	Go
Meiberg	EOP: area specifically reserved for industry depending on deep seawater AND industry not depending on deep seawater	Go
Malpais	Waste incineration is explicitly mentioned in EOP	Go
Bleinheim	Location awarded to Curoil	No go
Van Leer	EOP: Schottegat areas are primarily reserved for industry dependent on harbor. Other industry is allowed as long as this does not harm harbor development as a whole. 2Bays: locations reserved for heavy industry[1].	Go
ISLA East	EOP: see previous location. 2Bays: location reserved for heavy industry[2]	Go
Asphalt Lake	EOP: see previous location. Buskabaai N.V.: future activities must contribute to Island sustainability. Waste processing activities match this condition	Go

With respect to the locations of Van Leer and ISLA East it is important to mention that these are currently not under 2Bays' management, but under the Oryx lease agreement. 2Bays however encouraged us to also look for favorable locations in the periphery of the "Oryx-premises".

Minimum area for footprint of WtE met

The required surface area of a WtE plant is 2.5 hectares. Location surface areas are included in Annex 1. All sites are "go".

No major obstacles for timely availability

Locations with significant challenges, such as heavily polluted land, may require extensive remediation or preparation, resulting in project delays, increased costs, and potential regulatory issues. The locations of Bleinheim/Van Leer and ISLA East can be regarded as significantly contaminated. According to 2Bays, the areas under their management can be remediated within a time span of 5 years.

The Asphalt Lake location has been remediated by Buskabaai N.V. by taking out asphalt and putting back clean sand and construction waste (mineral fraction). Land elevation of 60 cm is needed according to Buskabaai N.V. A soil and groundwater investigation has yet to be carried out. For other locations, no significant land contamination is known (see also section 5.7). It does not seem likely that any soil contamination will lead to a "no-go"; all locations are "go"[3].

[1] Van Leer is outside the management domain of 2Bays (Oryx domain). However, according to 2Bays, areas near Oryx' periphery may become available/accessible for their use.

[2] ISLA East is outside the management domain of 2Bays (Oryx domain). However, according to 2Bays areas near Oryx' periphery may become available for 2Bays.

[3] For a planned start in 2030, and for all investment decisions to be made in time, the decision to execute soil remediation should be made in 2026 ultimately.

External risk: site-specific risk

Most commonly, Waste to Energy facilities are constructed in such a way that a safety zone or bufferzone between the facility and sensitive objects (e.g. residences) is applied. At the same time examples are known where WtE plants have been constructed quite near residential areas, such as in Austria and in Copenhagen, Denmark, with residences as near as 200 meters from the plant (Edo, 2021).

The site-specific risk is the chance (per year) that an (unprotected) person will die from an accident involving an external risk such as hazardous substances, fire or explosion. The limit values with respect to acceptable risk are included in Annex VII of the Dutch Decree for Quality of the Environment (Besluit Kwaliteit Leefomgeving)[1]. These values are spatially translated into distances that must be taken into account from buildings and locations.

For storage of regular domestic or commercial waste in a WtE facility no risk zones apply according to the Dutch Decree. In case hazardous wastes are being stored in quantities over 2,500 kg and less than 30,000 kg, the risk zones for site-specific risk vary from 20-340 meters (in case of a storage no larger than 100m^2, which is assumed here)[2]. This wide range is related to the possibility of taking specific mitigating measures such as automatic fire extinction and monitoring. In case the storage for hazardous waste is only used for a short period of time pending subsequent transport to a recipient known in advance, the risk zone is only 20 meters. NB: there may be other environmental aspects that require zoning, such as air quality, odor, noise, etc. For all locations a “go” is selected.

Safety for WtE plant

The facility should be located at a safe distance from obvious safety risks such as flaring operations and other potential hazards. Industry standards, such as those from the National Fire Protection Association (NFPA 58 & 30), recommend maintaining a safe buffer zone between flares and industrial facilities. For moderate flares, this distance typically falls between 100 to 200 meters. The API Standard 521 suggests a minimum distance of 90 meters for smaller flares and 150 to 250 meters for larger industrial flares[3]. For LPG tanks larger than 13m^3, a distance of 160 meters should be kept to sensitive objects and locations (Besluit kwaliteit leefomgeving), which the WtE facility is not. These tanks, managed by Curoil are situated more than 300 meters from the Van Leer location.

A final assessment for Van Leer cannot be made as yet, since 2Bays has not indicated a specific potential location. The Van Leer site is located approximately 250 meters from the LPG and HL flares. Table 6.2 summarizes the situation for the sites and concludes with “go” or “no go”.

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[1] The Dutch decree includes a limit value for the location-related risk of no more than one in a million per year (10^{-6}/year) for (very) vulnerable buildings and vulnerable locations (Article 5.7). This limit value must be taken into account in the environmental plan or decision. This means that people in (very) sensitive buildings, such as homes, schools and hospitals and in sensitive locations, such as large recreational areas, may not be exposed to a site-specific risk of more than one in a million per year. (Very) vulnerable buildings and vulnerable locations may therefore not be realized within the PR (location-related risk) 10^{-6} contour of an activity.

[2] According to the Seveso Guideline of the EU, hazardous wastes can be regarded as hazardous materials for safety regulations (Note 5 with Annex 1 of Seveso Guideline).

[3] In the design phase, a case-specific risk assessment should be conducted to evaluate the specific hazards at the site and determine an appropriate safety buffer tailored to those risks.

Table 6.2: Safety for WtE plant (safety zones NFPA 58 & 30, API 521, Besluit kwaliteit leefomgeving)

Location	Remarks	Go/no-go
Bullenbaai East	No obvious safety risks for facility within 300m	Go
Meiberg	No obvious safety risks for facility within 300m	Go
Malpais	No obvious safety risks for facility within 300m	Go
Bleinheim/Van Leer	LPG and HL flair >250m; LPG tanks of Curoil > 160m	Go
ISLA East	No obvious safety risks for facility within 300m	Go
Asphalt Lake	No obvious safety risks for facility within 300m	Go

Area 2 km downwind of WtE facility largely uninhabited

WtE operations generate air emissions that could impact the health and well-being of nearby densely populated areas. Communities in densely populated areas within 2 km downwind may raise concerns about perceived health risks, air quality, or environmental impacts, potentially resulting in delays, legal challenges, or project cancellations. To promote public acceptance, the location must have minimal habitation in the downwind area.

Table 6.3 shows the distances of residential areas downwind, with prevailing wind from East to west[1]. The criterion for including a location is a free distance of more than 2 km. For Bleinheim/Van Leer an exception is made. The distance to downwind residential areas is 1,200 meters. The reason to include Bleinheim/ Van Leer is that the location is centrally located, fit for heavy industry, and approved for Waste to Value by 2 Bays and the Council of Ministers.

Table 6.3 Distance to downwind residential areas

Location	Distance to residences downwind	Go/no-go
Bullenbaai East	4.9 km	Go
Meiberg	4.5 km	Go
Malpais	8.3 km	Go
Bleinheim/Van Leer	1.3 – 1.5 km	Go
ISLA East	1.9 - 2.9 km	Go
Asphalt Lake	2.3 - 3.5 km	Go

No obvious conflict with other industry

According to RHDHV (pers. comm. K. van Beekveld), no safety zones apply to WtE in industrial parks with other heavy industry. This may be different in case of fuel storage activities. In addition to this, caution is required in case of nearby light industry.

Within a 200-meter zone, we assessed the presence of petrol and gas storage facilities, food processing companies, pharmaceutical and healthcare industries, data centers, and high-tech industries (see table 6.4).

[1] Downwind is defined as westward plus or minus 20 degrees (wind directions >90% of time, Meteo Curaçao, AERMOD 2015-2019)

Table 6.4: Presence of other industry within 200-meter zone, possible conflicts

Location	Remarks	Go/no-go
Bullenbaai East	Steamboat Fuels left the premises. No obvious conflict with storage of oil products (at 200 meters)	Go
Meiberg	No other industry planned. No obvious conflict	Go
Malpais	No other industry present in 200-meter zone. No conflict	Go
Bleinheim/Van Leer	In case of Van Leer: Curoil located in 200-meter zone. No obvious conflict but Quantitative Risk Assessments required in EIA phase	Go
ISLA East	Adjacent to planned location for new diesel plant of Aqualectra and adjacent to CRU. Operations of Global Oil. No obvious conflict but Quantitative Risk Assessments required in EIA phase	Go
Asphalt Lake	No other industry present in 200-meter zone. No conflict	Go

No further than 20 (road) km from the center of Curaçao

The facility must be located within 20 road kilometers of the center of Curaçao to minimize the distance waste needs to be transported. All longlisted locations for the WtE facility meet this requirement.

Acceptance by Government

The location option must not be excluded in advance by the government. If a location is excluded by the government due to zoning restrictions, alternative designations, or conflicting uses, resources will not be spent to further analysis. In a meeting with the Steering Committee of the RESEMBID projects, it became clear that the Government does not exclude any of the proposed (longlisted) locations for Waste to Energy. For all locations on the WtE longlist, “go” is selected.

6.2 Site specific investments

For most site-specific investments we refer to Chapter 5. In the text below additional investments will be discussed as well as some considerations with respect to water cooling, air cooling and wastewater treatment.

Waste acceptance infrastructure

On all locations, except for Malpais, a new waste acceptance infrastructure (weighbridge and related infrastructure) must be installed. Investments for this are approximately 800k USD (see table 6.5).

Table 6.5: CAPEX for weighbridge and related infrastructure

Item	Estimated Cost (USD)
Weighbridge	300,000
Weighbridge office	50,000
Automation and software	100,000
Site preparation/Civil works	200,000
Security Infrastructure	50,000
Environmental control	100,000
Total	800,000

Cooling water or air cooling

For a 5 MWe energy plant, approximately 15 MWth of heat must be rejected. In areas where the availability of fresh (ground)water is restricted, and no adequate alternative is available, evaporative cooling by means of cooling towers is not feasible, and air cooling is considered Best Available Technique (BAT). An "energy penalty" i.e. a lower energy efficiency, however, must be accepted. This lower efficiency amounts to 2-3% in warm climates (Hamanaka et al., 2009). In coastal areas, once-through seawater cooling systems are considered BAT, especially for larger capacities (> 10 MWth; European Commission, 2001)[1]. One of the main advantages of air cooling is that no impact is generated on the marine environment.

A complete feasibility study for cooling options is out of scope for this study. However, according to Moser et al (2013), investments (CAPEX) for once-through water cooling are considered "low", for recirculating (evaporative) systems "medium" and for air cooling "high". These differences may be relatively small when using sea water instead of fresh water. The use of seawater for cooling incurs investments in expensive corrosion resistant condensers (titanium or copper alloys). Besides, cooling water may not be available at certain locations or only at high cost, e.g. when use of a large refinery pumphouse may be too expensive for a relatively small energy plant. For "own" cooling water infrastructure, high investments may be required.

Since the investments in cooling equipment are a fraction of the total investments[2], the difference in CAPEX between air cooling and water cooling is not considered relevant and will not be used as a location criterion. Likewise, the possible energy efficiency benefit of 2-3% is not considered relevant within the high-level context of this study[3].

Wastewater treatment

A WtE plant may produce several types of industrial wastewater:

- Boiler blowdown water
- Ash handling wastewater
- Sanitary wastewater

In the WtE proposed by RHDHV, this is not the case. Flue gas treatment will take place by method of dry scrubbing, not resulting in any wastewater. Likewise, ash handling will not result in a wastewater flow in this concept.
The only type of wastewater produced by the facility is sanitary wastewater by personnel. This water can be collected in septic tanks. The amount is too insignificant to result in any location-specific choices.
Wastewater treatment as a location criterion is disregarded.

[1] Other down sides of air cooling are that air cooling is more unstable than water cooling, varying significantly with ambient air temperature). Air cooling involves a larger footprint.
[2] Total investments WtE: 220 mio USD, of which a maximum of which 50% is for equipment. For air cooling system: 1-2 million USD or approximately 1-2% of total equipment, pers. comm. K. van Beekveld RHDHV.
[3] 5,000*24*365*0.03*0.083*0.9 = USD 98.155 per year (5MW, 3% more efficiency, 0.15 USD/kWh, 10% downtime).

Scoring of site-related investments

Investments for a WtE plant as proposed in Chapter 3 amount to USD 220 million (RHDHV, 2025). These investments account for a facility on a location ready for use and do not include site-specific investments such as ground works and construction of electrical, water and road infrastructure to the specific lot. Site-specific investments roughly add 3 million to 5 million USD to this amount (1.3%-2.3%, averaged 1.7% of total investments, see table 6.6 and Annex 7). Since the relative contribution of site-specific investments to total estimated investments is low, while at the same time accuracy of the estimations is low (+/- 40%), the criterion "site-specific investments" will be given a relatively low weight (see also section 6.7).
Tables 6.6 and 6.7 present the results of the scoring of the criterion "site specific investments".

Table 6.6: Scoring of site-specific investments

Amount (USD)	Score
< 1 million	5
1 million-2 million	4
2 million-3 million	3
3 million-4 million	2
> 4 million	1

Table 6.7: Site-specific investments for composting of green waste (in kUSD)

Site-specific investments x 1000	Bullen baai	Meiberg	Malpais	Van Leer	ISLA East	Asphalt Lake
Electrical infrastructure	166	777	1,197	421	107	372
Water infrastructure	87	260	154	84	38	126
Road infrastructure	0	278	0	0	0	633
Ground works	2,639	1,458	1,458	2,847	2,847	3,125
Waste acceptance infrastructure	800	800	0	800	800	800
Total site-specific investments	3,692	3,573	2,809	4,152	3,792	5,056
Percentage of total investments	1.7%	1.6%	1.3%	1.9%	1.7%	2.3%
Score	**2**	**2**	**3**	**1**	**2**	**1**

6.3 Long lease costs for land use

Table 5.1 of section 5.2 summarizes the estimated costs for long lease of land for all locations, including the locations suitable for WtE. With respect to Malpais it is important to mention that Selikor does not pay for current land use. However, it is not certain that this arrangement can be continued for the next 20 years. Therefore, we allocate an estimated investment for land acquisition to Malpais (USD 2.00/m^2.y). Land lease costs comprise on average 3.9% (varying from 0.5% to 8.8%, Annex 7) of total operational costs which amount to USD 10 million (RHDHV, 2025). This is slightly higher than the average in the USA industrial sector, which is 2-3% (nation-wide, source: United States Census Bureau)[1]. The weight of the

[1] In the sectors of construction and manufacturing

criterion will be in line with this, see further in this chapter. Table 6.8 and 6.9 present a scoring guide and scoring results for long lease costs.

Table 6.8: Scoring guide long lease costs

Long lease costs per year (range) USD/y	Score
0-200,000	5
200,000-400,000	4
400,000-600,000	3
600,000-800,000	2
> 800,000	1

Table 6.9: High level estimation of land lease costs

Location, connection	USD/m².y	Land lease per year Total USD (2.5 ha)	Scoring
Bullenbaai East	35	875,000	1
Meiberg	2	50,000	5
Malpais	2	50,000	5
Bleinheim/Van Leer	30	750,000	2
ISLA East	17.50	437,500	4
Asphalt Lake	7.50	187,500	5

6.4 Environmental criteria

6.4.1 Impact and perceived impact on local communities

Impact on local communities is assessed using three sub-criteria, all related to anticipated opposition by the community:

1. Distance of new facility to a community or neighborhood including sensitive objects such as schools, senior citizen's homes, healthcare facilities, etc. This sub-criterion is related to nuisances in the direct vicinity (up to several 100s of meters), such as noise, vibrations, dust and such;
2. Distance of new facility to a downwind community or neighborhood. This sub-criterion is related to air-emissions from the stack, which can have impacts up to 5 or more kilometers (dioxins and furanes, see section 3.1);
3. Traffic through neighborhood.

Noise impact and air quality are also scored in a quantitative manner by separate environmental criteria (see sections below).
Scoring of the criterion “impact on local communities” in 5 classes is done in a qualitative way, with the following options:

Table 6.10: Scoring guide impact on local communities and opposition from communities

Opposition anticipated	Score	Scoring applies to the following situations		
		Shortest distance neighborhood *	Distance neighborhood downwind **	Traffic through neighborhood
Severe opposition	1	< 400m	< 2 km	intense traffic
Significant opposition	2	400-600m	2-4 km	medium-intense traffic
Medium opposition	3	600-800m	4-6 km	medium traffic
Light opposition	4	800-1000m	6-10 km	medium-light traffic
Very light or no opposition	5	> 1000m	> 10 km	light traffic

* Sub-criterion is related to nuisances in the direct vicinity (up to several 100s of meters)

** Sub-criterion is related to air-emissions (e.g. dioxins and furanes attached to plants up to 1.5 kilometers from WtE, and elevated in eggs from backyard chickens up to 5 kilometers from WtE, see section 3.1). Distance downwind is defined as distance westward from WtE plant (90 degrees westward +/- 20 degrees from west)

Section 3.1 describes traffic to (and from) the WtE plant. Per day over 100 large trucks and approximately 90 smaller trucks will arrive at the facility. In the text below, location specific aspects are discussed. Table 6.11 evaluates the impact on local communities.

Location specific aspects

Bullenbaai: Neighborhoods are at more than 1000 meters distance (Harmonie), while downwind distance is 4,900 meters (Rif St. Marie). All traffic for Bullenbaai needs to pass through the neighborhoods of Julianadorp, JanDoret and St. Michiel. Dwellings are located relatively close to the road, as is a school in Jan Doret. Opposition may be expected.

Meiberg: Neighborhoods (Kashutuin) are at approximately 500 meters distance. Downwind from the WtE plant the distance to the first neighborhood is 4,500 meters (Rif St. Marie). Traffic will pass by Kunuku Aqua Resort, and the neighborhood of Kashutuin. Opposition (qualified as medium) may be expected.

Malpais: The residential area Wechi is at approximately 500 meters distance. Downwind from the WtE plant the distance to the first neighborhood is more than 8,300 meters (Rif St. Marie). The situation with respect to traffic will not change significantly; noise and nuisance by traffic remain a factor.

Van Leer: With respect to nuisances, the proposed plant is at relatively large distance from neighborhoods and will result in little impact by traffic. The downwind distance to a neighborhood is 1,300 – 1,500 meters (Wishi-Marchena).

ISLA East: With respect to nuisances, the proposed plant is at relatively large distance from neighborhoods. Traffic from primary road can only be directed to the location through the neighborhood of Emmastad. Severe opposition is to be expected with respect to this aspect. The downwind distance to a neighborhood is 1,900 -2,900 meters (Buena Vista).

Asphalt Lake: For Asphalt Lake the entrance is assumed to be through Dokweg. If Buskabaai N.V. will also create a new entrance to the Asphalt Lake at Regentesselaan (opposite of Rustenburgh), significantly more traffic is to be expected through the neighborhood of Emmastad. See figure 6.1. The downwind distance to a neighborhood is 2,300 - 3,500 meters (Buena Vista).

Figure 6.1: Possible entrances to Asphalt Lake via Dokweg (green) and/or via Regentesselaan (yellow).

Table 6.11: Impact on local communities

Location	Nearest neighborhood (m)	Score	Nearest neighborhood downwind (m)	Score	Traffic through neighborhood	Score	Average Score
Bullenbaai East	> 1,000	5	4,900	3	intense	1	**3.0**
Meiberg	500	2	4,500	3	medium	3	**2.7**
Malpais	500	2	8,300	4	no significant change	5	**3.7**
Van Leer	800	4	1,300 - 1,500	1	low	5	**3.3**
ISLA East	800	4	1,900 - 2,900	2	intense	1	**2.3**
Asphalt Lake	> 400	2	2,300 - 3,500	2	Low [(1)]	5	**3.0**

[(1)] Assumption: entrance via Dokweg only

6.4.2 Acceptance by environmental NGOs

No consultations were held with the environmental stakeholders during the project execution (out of scope). This criterion is evaluated and scored (but not weighed in the MCA, see section 4.2), using the Focus Group's views on what environmental NGOs deem important, mostly air emissions, traffic and nature values. Results of qualitative scoring are included in table 6.13.

The scoring takes into account that the basic attitude of NGOs is expected to be in favor of initiatives promoting prevention and recycling and against Waste to Energy.

Table 6.12 Scoring guide acceptance by environmental NGOs

Situation	Score
No opposition expected	5
Light opposition expected	4
Medium opposition expected	3
Strong opposition expected	2
Very strong opposition expected	1

Table 6.13: Acceptance by environmental NGO's

Location	Evaluation	Score
Bullenbaai East	Significant impact for populations by traffic. Low impact for populations by emissions. No nature values at site	3
Meiberg	Significant impact for populations by traffic. Low impact populations by emissions. Important nature values at site and nearby	2
Malpais	Low impact for populations by traffic. Low impact for populations by emissions. Low nature values at site and nearby. EOP reserves Malpais as the only site suitable for WtE	3
Bleinheim/Van Leer	Low impact for populations by traffic. Low-medium impact for populations by emissions. No nature values at site and nearby	3
ISLA East	Significant impact for populations by traffic. Low impact for populations by emissions. No nature values at site	2
Asphalt Lake	Low impact for populations by traffic (access Dokweg). Low-medium impact for populations by emissions. No nature values at site	3

6.4.3 Future residential developments near site

Future residential developments may be possible in any of the designated areas for residential occupation as described in EOP, such as: "stedelijk woongebied" (urban area), "landelijk woongebied" (rural residential area), "binnenstad" (inner city). The criterion is assessed in the same way as "impact on local communities", by assessing the distance of the future residential area to the planned WPO and thereby the risk of environmental impact (nuisance) and opposition expected.

The scoring is done by checking EOP and by consulting VVRP during the Steering Committee meeting(s).

Table 6.14: Proximity of planned residential areas

Location	Nearest distance to future residential area	Score	Nearest downwind distance to future residential area	Score	Average Score
Bullenbaai East	1.4 km	5	5 km	3	**4**
Meiberg	850 m	4	4.5 km	3	**3.5**
Malpais	450 m	2	> 8 km	4	**3**
Van Leer	not relevant*	5	not relevant*	5	**5**
ISLA East	not relevant*	5	not relevant*	5	**5**
Asphalt Lake	not relevant*	5	not relevant*	5	**5**

* Existing residential areas are nearer to the WPO than future residential areas

Location specific aspects

Bullenbaai East and Meiberg: A significant part of Harmonie West will be developed in the near future (first activities seem to have started). A future residential development of importance may be the Rif-Sint Marie area, which is 4-5 kilometers downwind of the potential WtE site. This development was halted (by Jansen de Jong) but was recently announced to be started again.

Malpais: The southern parts of Wechi will be developed over the next years (windward from potential WtE location).

Van Leer, ISLA East and Asphalt Lake: Nearest unbuilt residential area is directly South of Sambil (North of Veerisweg). However, current reidential areas (Wishi, Marchena are nearer to the WPO)

6.4.4 Dwellings impacted by noise

Noise contours of 40 dB(A) were modeled for potential locations (see explanation of plot emissions in section 3.1). The number of houses within this contour was selected as a proxy for noise impact. Noise contours for Waste to Energy were calculated for both daytime (07:00–19:00) and evening/nighttime (19:00–07:00) periods at a height of 2 meters. In the noise model 90% of transports take place during the day period and 10% during the night period.

The 40 d(B)A contour is used as criterion to assess site suitability, with priority given to locations that have fewer dwellings within the impacted zone. The scoring is based on the following options:

Table 6.15: Scoring guide dwellings impacted by noise

Situation	Score
0-10 dwellings in 40 dB(A) noise contour	5
11-25 dwellings in 40 dB(A) noise contour	4
26-50 dwellings in 40 dB(A) noise contour	3
51-100 dwellings in 40 dB(A) noise contour	2
More than 100 dwellings in 40 dB(A) noise contour	1

Modelling results

For the WtE facility, the 40 dB(A) noise contour is located approximately 500 meters from the facility (see Annex 4). For all locations except Asphalt Lake, no dwellings are located within the modeled noise contours. As a result, Asphalt Lake scores lower (26-50 dwellings within contour: **score 3**) on this criterion compared to the other WtE locations (**score 5**). Figure 6.2 displays the modeled 40 dBA noise contour, and the dwellings located within it for the Asphalt Lake area.

Figure 6.2: Noise contour showing several dwellings within contour. Example location at Asphalt Lake.

6.4.5 Dwellings impacted by air quality

Year averaged air quality (annual mean)

Key emissions from Waste-to-Energy (WtE) plants include CO_2, N_2O, NO_x, NH_3, and persistent organic pollutants (see section 3.1). For a preliminary air quality assessment of WtE sites, a conceptual model was developed for NO_2, which is the high-focus parameter of WHO in recent years. The model was developed using local meteorological data and a stack of 30 meters height (worst-case scenario). Half hour emission limits defined by the European Union were used as worst-case levels for emissions to the atmosphere.
As a significant impact contour for air quality, we used the NO_2 contour of 2 µg/m³ which is 10% of the current baseline air quality in the Schottegat Area[1]. The value of 2 µg/m³ represents a low but measurable impact.
The criterion is scored in a quantitative way, with the following options:

Table 6.16: Scoring guide air quality (year averaged)

Situation	Score
0-10 dwellings in air quality contour	**5**
11-25 dwellings in air quality contour	**4**
26-50 dwellings in air quality contour	**3**
51-100 dwellings in air quality contour	**2**
More than 100 dwellings in air quality contour	**1**

[1] Ministry of GMN: the annual mean at Kas Chikitu is 21 µg NO_2/m^3

Modelling results

Results show the 2 µg/m³ NO_2 immission contour extends to approximately 1,750 meters from the stack[1]. These contours serve as criteria to evaluate site suitability, prioritizing fewer dwellings within the affected zones. NB: background values in the Schottegat area are 21 µg/m³ NO_2.

For all locations except Van Leer, no dwellings are located within the modeled contours. For Van Leer, approximately 100 dwellings are located within the 2 µg/m³ contour for NO_2 (figure 6.3). As a result, Bleinheim scores lower on this criterion (**score 2**) compared to the other WtE locations (**score 5**). Figure 6.3 shows the 2 µg/m³ contour for the location van Leer as an example. The annual mean emission contours for the other locations can be found in Annex 5a.

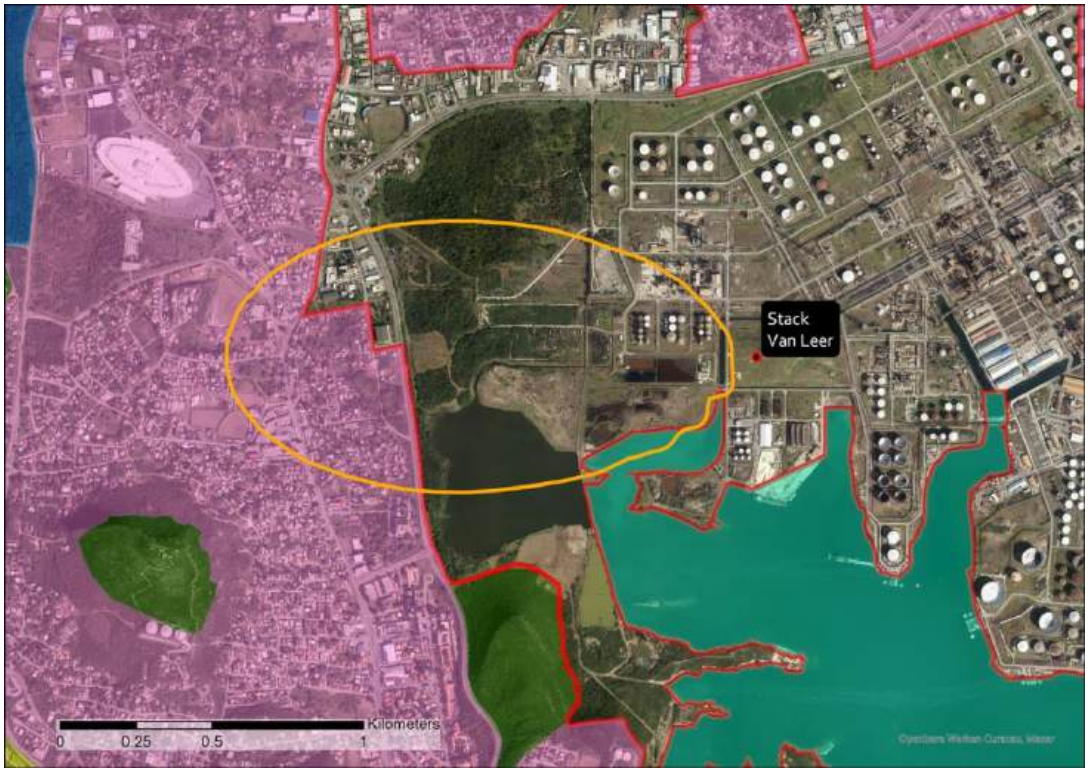

Figure 6.3: The 2 µg/m³ for NO2 (orange contour), showing dwellings within contour (in pink-red area).

Table 6.17: Scores dwellings impacted by air quality

Location	Dwellings in air quality contour	Score
Bullenbaai East	0	**5**
Meiberg	0	**5**
Malpais	0	**5**
Van Leer	>100	**1**
ISLA East	0	**5**
Asphalt Lake	0	**5**

[1] This distance is roughly the distance where dioxins and furanes from older types of WtE's can be measured in grass, see section 3.1. Dioxins and furanes in backyard eggs can be measured further from the source, up to 5 kilometers

6.4.6 Dwellings incidentally impacted by nuisance (odor, dust)

Hourly mean

A similar assessment as in the previous section is conducted using 10% of the value of the WHO hourly averaged guideline levels for NO_2 (20 µg/m³)[1]. This is considered to be a low but measurable impact. The hourly averaged concentrations represent situations in which neighborhoods other than the predominantly impacted (downwind) neighborhoods may be impacted incidentally. The criterion is scored in a quantitative way, with the following options:

Table 6.18: Scoring guide air quality (incidental impact by NO2)

Situation	Score
0-10 dwellings in air quality contour	**5**
11-25 dwellings in air quality contour	**4**
26-50 dwellings in air quality contour	**3**
51-100 dwellings in air quality contour	**2**
More than 100 dwellings in air quality contour	**1**

Modelling results

Modelling results show that the 20 µg/m³ contour for NO_2 extends to approximately 400-900 meters from the stack. Several dwellings fall within this contour, in case of a WtE plant at Asphalt Lake, Malpais, and Meiberg. Consequently, these sites perform less favorably on this criterion compared to other WtE locations. Figure 6.4 presents an example of the 1 hour averaged NO_2 contours for the Asphalt Lake, while emission contours for the remaining locations are provided in Annex 5b.

[1] The value of the WHO hourly averaged guideline level for NO_2 is 200 µg/m³

Figure 6.4: The 20 µg/m³ contour for NO_2, in case of a WtE plant at Asphalt Lake, showing several dwellings within contour.

Table 6.19: Scores air quality (incidental impact by NO2)

Location	Dwellings in air quality contour	Score
Bullenbaai East	0	**5**
Meiberg	~80	**2**
Malpais	25-50	**3**
Bleinheim/Van Leer	0	**5**
ISLA East	0	**5**
Asphalt Lake	>100	**1**

6.4.7 Impact by odor/dust

This criterion is not considered relevant for a Waste to Energy plant, since all areas where risk of odor (and dust formation) exists, such as the tipping area, bunker, etc., will be in a building section where under-pressure is kept by mechanical ventilation. The ventilated air will be used for the incineration process. Potential for odor/dust do exist in other WPOs (see following chapters).

6.4.8 Existing nature values at specific lot

Nature values are linked to the locations investigated and have been evaluated in section 5.8. Risks for adjacent nature are not only linked to the locations but also to the WPO chosen and are discussed in this chapter (next section).

6.4.9 Risk for nature in adjacent areas

The establishment of a WPO at a specific location may present potential risks to nearby natural areas. This could include pollution and disturbances such as noise and light (in evening) to highly valuable and internationally protected conservation areas like Ramsar sites or coral reefs. Therefore, the risks to nature in adjacent areas will be assessed based on their proximity to the facility location.

Not only terrestrial nature, but also marine nature is included in the evaluation of locations. According to a study conducted by Waitt, the Bullenbaai area supports the highest herbivore biomass (fish and other hebivores) on the island. While the average coral cover is relatively low in the eastern half of the bay, it is significantly higher in the robust reefs near the western point of the bay.

Similarly, the area between the eastern side of Bullenbaai and the western side of Malpais is designated as a conservation area in the EOP and is internationally recognized as a Ramsar site.

The proximity of the optional WtE locations to such valuable natural areas is a critical factor for risk to these areas. In section 5.8 relevant Ramsar sites, conservation areas and reef sites near the proposed locations are indicated on a map. Table 6.20 provides the distances from the site boundaries to these protected and ecologically significant areas.

Table 6.20 Distances to ecologically significant areas

Locations	Situation	Distance to Conservation area (m)	Distance to Ramsar site (m)	Distance to coral reef (m)	Score
Bullenbaai East	Important reef Ramsar site 1 Ramsar site 2	 <100m 2 km	 <100m 2 km	350m	**1**
Meiberg	Ramsar site 1 Ramsar site 2	250m 500m	250m 500m	~600	**2**
Malpais	Ramsar site	100m	100m	NA	**2**
Bleinheim/Van Leer	NA	~1000	NA	NA	**5**
ISLA East	NA	~1600	NA	NA	**5**
Asphalt Lake (*)	NA	~2100	NA	NA	**4**

(*) Small wetland North of Asphalt Lake may be impacted

6.4.10 Visual impact

The visual impact needs to be assessed on a case-by-case basis, as general rules are not applicable . This criterion was discussed in the Focus Group, taking into account the specific local conditions. The evaluation outcome is as follows:

Table 6.21: Scoring of visual impact

Locations	Evaluation	Score
Bullenbaai East, Meiberg, Malpais	Near natural areas with free sight. Large WtE building and stack will produce significant visual impact	2
Bleinheim/Van Leer, ISLA East	Location situated in area where heavy industry is established (large buildings, stacks, etc.)	5
Asphalt Lake (*)	Industrial area with only few residences visually impacted	4

6.4.11 WPO takes or does not take landfill capacity

If the Waste Processing Option (in this case C&D recycling) would be realized at Malpais, this would take away space that could be used as landfilling space in the future. Landfilling is a permitted use of the Malpais area, while it is highly doubtful whether the Government of Curaçao will open a new landfill area in other parts of the island. Landfilling space must therefore be highly valued.
Scoring will take place as follows: Malpais will receive 1 point, other locations 5 points.

6.4.12 Possible conflict with other industry

In this section other aspects are assessed than safety risks (described in section 6.1). Noise and odors generated by a WtE facility could hinder operations of neighboring industries, particularly those in sectors such as food processing, hospitality, communication and data centers, or other sensitive operations. Furthermore, neighboring industries might oppose the placement of a WtE due to potential reputational impacts, especially if their operations rely on a clean or eco-friendly image.
Potential conflicts with other industries are assessed in a qualitative way as follows:

Table 6.21: Scoring guide possible conflict with other industry

Situation	Score
Positive attitude expected	**5**
No opposition or conflict expected	**4**
Little opposition or conflict expected	**3**
Medium opposition or conflict expected	**2**
Strong opposition or conflict expected	**1**

Table 6.22: Possible conflict with other industry

Locations	Evaluation	Score
Bullenbaai East	Oil storage, heavy industry, high standards (exporting industry), medium compatibility	**3**
Meiberg	No industry present	**5**
Malpais	Asphalt production (2 companies), waste recycling, gas station, overall considered compatible industry	**4**
Bleinheim/Van Leer	Solar plant (2Bays), fuel storage Curoil, pyrolysis (OnePlant), overall, not considered compatible	**2**
ISLA East	Power plant (Aqualectra and CRU), asphalt production, Global oil, considered compatible	**5**
Asphalt Lake	Solar plant (Buskabaai N.V., future). Power plants (Aqualectra Dokweg) considered compatible	**4**

6.5 Logistical criteria

6.5.1 Proximity to primary road

Primary roads on Curaçao are the ring road “Schottegatweg” and the “Nieuwe Havenweg”. Proximity to one of these primary roads improves accessibility from different parts of the island significantly. Proximity to a primary road for incoming vehicles and outgoing vehicles is assessed in a quantitative way (table 6.24). The scoring guide of table 6.23 was used.

Table 6.23: Scoring guide proximity to primary road

Proximity	Score
0-3 km	5
3-6 km	4
6-9 km	3
9-12 km	2
12+ km	1

Table 6.24: Proximity to primary road and proposed scores

Location	Road kilometers to primary road	Score
Bullenbaai East	9.55	**2**
Meiberg	13.70	**1**
Malpais	8.20	**3**
Bleinheim/ Van Leer	1.22	**5**
ISLA East	2.79	**5**
Asphalt Lake	1.61	**5**

6.5.2 Proximity to known congestion points

In general, it should be avoided that already congested roads will get even more congested. A WtE plant will have significant impact on local traffic. Except for the location of Malpais, over 190 additional vehicles per day can be expected compared to any current situation.

Known congestion points are: Caracasbaaiweg, the roundabout of Santa Rosa and Weg naar Westpunt. Since the congestion of the roads is not an absolute phenomenon, but takes mainly place at rush hours, the Focus Group decided to only score in the center of the spectrum of 1-5 (value 3 or 4). The scoring results are indicated in table 6.25.

Table 6.25: Proximity to known congestion points

Location	Evaluation	Score
Bullenbaai East, Bleinheim/ Van Leer, Asphalt Lake	no nearby congestion points, or congestion points avoidable	**4**
Meiberg, Malpais, ISLA East	Weg naar Westpunt often congested at rush hours. ISLA East: substantial additional traffic over Wilhelminalaan	**3**

6.5.3 Average distance to source of waste

Transportation distance for waste from service areas to the potential WPO locations is assessed in a quantitative way, in Chapter 5. Table 6.27 summarizes the average transportation distances and the scoring for this criterion. The scoring guide of table 6.26 was used.

Table 6.26: Scoring guide proximity to primary road

Distance	score
5-8 km	5
8-12 km	4
12-16 km	3
16-20 km	2
20+ km	1

Table 6.27: Transportation distances (in km) from service areas to WPO locations

Distance	score	Score
Bullenbaai East	19,67	**2**
Meiberg	16.46	**2**
Malpais	13.87	**3**
Bleinheim/ Van Leer	10.87	**4**
ISLA East	12.39	**4**
Asphalt Lake (*)	11.26	**4**

(*) For Asphalt Lake, access will be realized from the Dokweg. In case a second access road is constructed at Regentesselaan (opposite of Rustenburg) a traffic light needs to be installed at the crossing of Regentesselaan-Nieuwehavenweg (for traffic to Schottegatweg Noord).

6.5.4 Transportation distance to recycling companies

WtE produces only two recyclables: ferro and non-ferro metals. These flows together are 2% of the original waste flow. This means approximately 1 truck load per month. This criterion is not considered significant for location choice of a WtE plant (as it is for a recycling plant).

6.5.5 Transportation distance for residues (landfill)

Transportation distance for waste from the potential WtE locations to the landfill at Malpais is assessed in a quantitative way. The scoring guide of table 6.28 was used, resulting in the scores in table 6.29 (distances to landfill).

Table 6.28: Scoring guide distance to landfill

Distance	score
<5 km	5
5-7 km	4
7-9 km	3
9-11 km	2
11+ km	1

Table 6.29: Transportation distance to landfill

Location	Road kilometers to landfill (km)	Suggested score
Bullen Bay East	12.1	**1**
Meiberg	5.4	**4**
Malpais	<1	**5**
Bleinheim/ Van Leer	9.5	**2**
ISLA East	14.4	**1**
Asphalt Lake	13.0	**1**

6.5.6 Presence of a nearby quay and proximity to container harbor

The presence of a nearby quay may have a significant advantage in cases where bulk transport is essential. WtE however is a process almost independent of exports of recyclables (see also section on “distance to recycling facilities”). The same is true for a container harbor. (Note: import of “raw” waste from other countries is excluded from the scope of our research). This criterion is disregarded for WtE.

6.5.7 Uncertainty with respect to aviation regulations

On Curaçao, all developments in which high constructions such as tall buildings and stacks are involved, require consent of the Curaçao Civil Aviation Authority (CCAA) and Dutch Caribbean Air Navigation Service Provider (DC-ANSP).

According to CCAA, obstacles in the air space, especially near the airport, should be avoided as much as possible. This is because of collision risk, and risk of disturbance of radar and radio signals. In general, if a building is located further than 20 km’s from the airport, no restrictions apply. It is not possible to exclude

certain developments within this 20 km zone beforehand. In all occasions approval can only be given after extensive study by an expert[1].

Figure 6.5 presents the aviation guidelines: concentric circles are height zoning guidelines, the areas in the extension of the runway are the approach and take-off zones, where radar contact is very important.

On a high level CCAA indicated that an evaluation related to permitting for locations at Bullenbaai, Meiberg and Malpais will be significantly more lengthy and more complex than an evaluation for locations in the Schottegat area. This may imply (EcoVision's view) that due to uncertainties that may exist or arise, the risk of an ultimate objection by CCAA in the former areas will be higher than in the Schottegat area.

Figure 6.5: Aviation regulations. Source: Eilandelijk Ontwikkelingsplan Curaçao (AB 1995, no 36.)

Table 6.30: Uncertainty with respect to aviation regulations

	Height restriction (m)	In take-off approach surface	Interference with radar aviation	Remark	Suggested score
Bullenbaai East	<45-145	No	possible	Risk of objection	**2**
Meiberg	<45-145	Yes	likely	Risk of objection	**1**
Malpais	<45	No	possible	Risk of objection	**2**
Bleinheim/V.Leer	>145	No	not likely	Less risk of objection	**5**
ISLA East	>145	No	not likely	Less risk of objection	**5**
Asphalt Lake	>145	No	not likely	Less risk of objection	**5**

[1] Experts mentioned by CCAA are: Moving Dot, TNO, NACO

6.5.8 Construction works (5y) impede local operations

The construction period for a WtE plant can be up to 5 years. These activities could seriously hinder other operations in the same area. E.g. in Malpais the operations of Selikor where already long waiting times are experienced. This aspect was discussed elaborately in the Focus Group and it was concluded that even in the case of Malpais, good workarounds exist. For instance, the road west of Alliansa Asphalt Plant can be extended southward to reach the construction area for the WtE. In this case no serious hindrance would exist for the daily operations of Selikor.

2Bays indicated no hindrance for other companies is to be expected in case of construction of a WtE plant at Bleinheim/Van Leer and at Bullenbaai). For the other two locations (Meiberg and Asphalt Lake) this is not likely either.
The conclusion of the Focus Group is that for none of the locations hindrance by construction traffic is a serious issue. The criterion will be disregarded.

6.5.9 Accessibility for emergency units

We assume that all industrial sites are accessible to emergency units; however, their relative accessibility is evaluated based on their proximity to emergency services, such as fire departments, hospitals and ambulance posts. The Fire Department is located in Barber and Suffisant, and the hospital is located in Otrobanda, while ambulance availability at the time of an emergency may determine its response location, which could be from Barber, Montaña, or Zakitó.

Table 6.31: Evaluation accessibility for emergency services

Location	Evaluation	Score
Bullenbaai East, Meiberg	Large distance from centrally located emergency services, and from Barber	2
Malpais	Medium distance from centrally located emergency services	3
Bleinheim/ Van Leer, ISLA East, Asphalt Lake	Favorably located near all central emergency services	5

6.6 Weighing factors

Relative importance of criteria and criterion-groups is allocated through weighing factors. The weighing factors of a criterion or criterion group vary between 5% (minimum weight) and 50% (maximum weight). The total of the weights within a criteria-group is 100% and the total weights of the criteria-groups is 100%.

Site-specific investments

Site-specific investments as a percentage of total investments (Capital Expenditures, CapEX) vary over the WtE locations from 1.3% to 1.9% (average 1.6%). Since these site-specific investments are marginal in the high-level context of all estimations, this criterion receives the lowest weight: 5%. Another reason is that logistical and environmental criteria are deemed quite important by the Focus Group.

Long lease costs

Long lease costs as a percentage of total operational expenses (OpEx) vary over the WtE locations from 0.5% to 8.8% (average 3.9%). These figures are in line with international averages (2-3% in the industrial sectors of construction and manufacturing, source: United States Census Bureau). Long lease costs are marginal in the high-level context of the long lease costs estimations (+/- 30%), therefore this criterion receives a relatively low weight: 5%. Both logistical and environmental criteria are considered very important by the Focus Group for selecting a location for a WtE plant and should be awarded most weight.

Environmental criteria

The environmental criteria are given the highest weight due to the nature of the industry (heavy industry), the intensity of traffic, the nature of the air emissions and the public opinion with respect to this type of industry. In the past, in other countries, public concerns about the operation of waste incinerators have had significant impact on procedures and lead time for these procedures. The criteria-group is given 50% weight.

Most of the individual criteria receive 10% weight, impact on local communities 20% and two criteria receive a lower weight (5%): incidental emissions, and occupation of landfilling space. The weight of the latter criterion is relatively low but since the scoring is either 1 (Malpais) or 5 (other locations, 5 times more), this criterion is still allocated significant weight.

Logistical aspects

Logistical criteria are given high weight (40%) due to the fact that intensive traffic needs to be redirected radically when choosing for another site than Malpais. Most of the individual criteria are awarded 20% weight, including transportation distance for waste (from source to WtE location). Since residue (ashes) constitute 25% of the incoming mass, the weight of the criterion “distance to landfill” is awarded 5%. Accessibility for emergency units is awarded 15%.

Table 6.32: Weights of criteria-groups

Criterion-group	Weight
Site-specific investments	5%
Long lease cost	5%
Environmental impact	50%
Logistical criteria	40%

Absolute weight of criteria

Annex 6 presents the absolute weights of the criteria (product of individual weight and group weight).

6.7 Results of scoring

The scoring results for all criteria for all WtE locations are included in Annex 7. In figure 6.6 the results are shown for the criteria groups. The table and figure show that Van Leer, ISLA East and Asphalt Lake are preferred sites for WtE. Bearing in mind the high-level nature of this study a meaningful distinction

between these 3 locations cannot be made. Malpais scores slightly better than the locations of Bullenbaai and Meiberg.

The end-result is mainly the result of the scoring on both environmental and logistical criteria, weighing significantly heavier than the financial criteria. Bullenbaai, Meiberg and Malpais score significantly lower on the environmental and logistical criteria:

Environmental: significantly lower scores on “future developments”, “nature values” and “risks for nature”; “incidental nuisance” and “visual impact”

Logistical: significantly lower scores on “average distance of waste sources to WtE location”, “uncertainty with respect to aviation regulations” and “accessibility for emergency services” (see scoring results Annex 7).

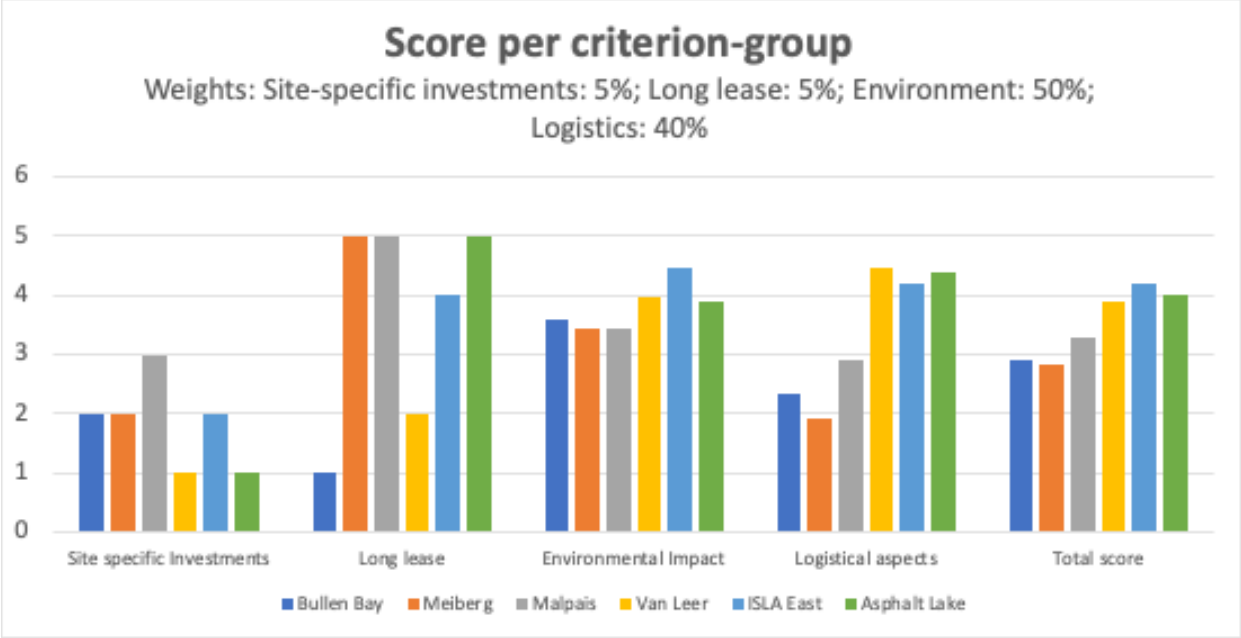

Figure 6.6 Results of scoring of locations for Waste to Energy

7 Evaluation locations C&D waste recycling

The longlist of locations for C&D waste recycling is: Meiberg, ISLA West, Malpais, Brievengat, Asphalt Lake Batipaña, Manzaliña Bay, Shut and the “Amstel”-area (see Chapter 4). The list of criteria used to score the locations for WtE is presented in Chapter 4.

7.1 Go/no-go criteria

The list of criteria used to score the locations for C&D recycling is presented in Chapter 4. In this section the scoring of “go/no-go” criteria are discussed. Go/no-go criteria are criteria that -if not met- lead to disregarding the location for further research.

Location in “Industrial Area”

The location under scrutiny must be “Industrial area” according to the Island Development Plan (EOP), which is true for all locations except for Shut (designation “Open land”). This exception is agreed upon by the Focus Group because Curaçao Airport Holding (CAH) already started a procedure to come to a designation change. All longlisted C&D locations are “go”.

Location fits specific spatial policies

The designation “Industrial area” of EOP may includes more detailed designations such as: "dependent on (deep water) harbor", "dependent on airport", "high-tech", "waste management", “small-medium companies”. In some cases, landowners have specific spatial policies or Masterplans where a recycling plant should fit in. Table 7.1 points out per area on the C&D recycling longlist what specific policies apply and whether the policies imply a “go” or a “no-go”.

Table 7.1 Specific location policies

Location	Remarks	Go/no-go
Bullenbaai East	In EOP the location is earmarked as "dependent on (deep water) harbour". 2Bays: Bullenbaai East is reserved for heavy industry	No go
Meiberg	EOP: area specifically reserved for industry depending on deep seawater AND industry not depending on deep seawater	Go
Malpais	Waste management is explicitly mentioned in EOP	Go
Shut	CAH: location suitable for light industry. Procedure started for change of designation to industry	Go
ISLA West	2Bays: location reserved for light-medium industry	Go
Bleinheim/Van Leer	2Bays: location reserved for heavy industry	No go
ISLA East	2Bays: location reserved for heavy industry	No go
Asphalt Lake	Buskabaai N.V.: future activities must contribute to Island sustainability. Waste processing activities match this condition	Go
Manzaliña Bay	CPA: suitable for light industry. EOP: Schottegat areas primarily reserved for harbor related activities. Other industry is allowed as long as this does not harm harbor development as a whole	Go
Batipaña	See previous location	Go
Amstel"-area	Domeinbeheer: Government has other plans with this area	No-go
Brievengat Industrial Park	EOP: medium to light industry. Curinde: Recycling of Construction and Demolition waste fits their own policies	Go

Minimum area for footprint of C&D recycling plant met

The required surface area of a C&D recycling plant is 2.0 hectares. Location surface areas are included in Annex 1 and Chapter 6. All longlisted C&D waste recycling locations are "go".

No major obstacles for timely availability

Locations with significant challenges, such as heavily polluted land, may require extensive remediation or preparation, resulting in project delays, increased costs, and potential regulatory issues. This is not the case for any of the locations marked as "go" in the previous section. The location of the (dry) Asphalt Lake has been remediated by Buskabaai N.V. (previous Chapter). For other locations, no significant land contamination or other major obstacles are known. All longlisted locations are "go".

Safety risks

This criterion is not applicable to C&D recycling; there are no activities with hazardous substances, nor are large quantities of incinerable waste stored.

Safety for C&D recycling plant

Since the recycling plant will be located on an industrial site with other light industry, no obvious risks for the C&D recycling plant exist. The criterion is not applicable. The (minor) risks will be evaluated in a future EIA.

No obvious conflict with other industry

Within a 200-meter zone, we assessed sensitive industries and facilities, such as food processing companies, pharmaceutical and healthcare industries, datacenters, and high-tech industries (see table 7.2). Grom the table it can be concluded that all locations are “go”.

Table 7.2: Presence of other industry within 200-meter zone, possible conflicts

Location	Remarks	Go/no-go
Meiberg	No other industry planned. No obvious conflict	Go
Malpais	No other industry present in 200-meter zone. No obvious conflict	Go
Shut	No other industry present in 200-meter zone. No obvious conflict	Go
ISLA West	Solar plant nearby but location can be adjusted to avoid conflict	Go
Asphalt Lake	No other industry present in 200-meter zone. No obvious conflict	Go
Manzaliña Bay	As previous	Go
Batipaña	Directly adjacent to Seaharbor Group (windward)	Go
Brievengat Industrial Park	Global Paint, Building Depot and Distribier and some smaller companies leeward of prevailing winds. Dispersion of particulates may become an issue and need to be dealt with in the EIA. Mitigation measures will be required	Go

No further than 20 (road) km’s from the center of Curacao

The facility must be located within 20 road kilometers of the center of Curaçao to minimize the distance waste needs to be transported. All longlisted locations for the C&D facility meet this requirement.

Acceptance by Government

If a location is excluded by the government due to zoning restrictions, alternative designations, or conflicting uses, resources will not be spent to further analysis. In a meeting with the Steering Committee of the RESEMBID projects, it became clear that the Government does not exclude any of the proposed (longlisted) locations for C&D recycling.

7.2 Site specific investments

For most site-specific investments we refer to Chapter 5. In the text below one additional investment will be discussed as well as some considerations wastewater treatment.

Waste acceptance infrastructure

On all locations, except for Malpais, a new waste acceptance infrastructure (weighbridge and related infrastructure) must be installed. Investments for this are approximately 150,000 USD (source: RHDHV).

Wastewater treatment

The only type of wastewater produced by the facility is sanitary wastewater by personnel. This water can be collected in septic tanks. The amount is too insignificant to result in any location-specific choices.

Scoring of site-specific investments

Investments for a C&D waste recycling plant as proposed in Chapter 3 amount to USD 6.7 million (RHDHV, 2025). These investments account for a facility on a location ready for use and do not include site-specific investments such as ground works and construction of electrical, water and road infrastructure to the specific lot. Site-specific investments roughly add 1.5-4 million USD to the plant investment (approximately 17-36%, averaged 30%. Since the contribution of site-specific investments to total estimated investments is relatively high, the criterion "site-specific investments" will be given significant weight (see further in this chapter).

Tables 7.3 and 7.4 present the results of the scoring of the criterion "site specific investments".

Table 7.3: Scoring of site-specific investments

Amount (USD)	score
< 2 million	5
2 million-2.5 million-	4
2.5 million-3 million	3
3 million–3.5 million	2
> 3.5 million	1

Table 7.4: Site-specific investments for C&D waste recycling (in USD x 1000)

Site-specific investments	Meiberg	Malpais	Shut	ISLA West	Asphalt Lake	Manzaliñabaai	Bati Paña	Brieven-gat
Electrical infrastructure	777	1,197	732	458	372	281	225	101
Water infrastructure	260	154	416	118	126	175	25	46
Road infrastructure	278	0	0	0	633	1,011	1,011	0
Groundworks	1,167	1,167	2,111	1,167	2,500	2,167	2,167	1,111
Weighbridge	150	0	150	150	150	150	150	150
Total	2,632	2,518	3,409	1,893	3,781	3,784	3,578	1,408
% of CapEx	28%	27%	34%	22%	36%	36%	35%	17%
Score	**3**	3	2	5	1	**1**	1	5

7.3 Long lease costs for land use

For estimates for long lease costs, we refer to Chapter 5. Table 7.6 summarizes estimated costs for locations for C&D waste recycling (20,000 m^2). From this table it can be concluded that long lease costs vary remarkably over locations. Especially the locations Manzaliñabaai and Batipaña (CPA) are exceptionally high-priced. On the contrary, the locations of Meiberg and Malpais are exceptionally low priced.

Total operational costs of a C&D waste recycling plant (employees, materials, consumables, energy etc.) are estimated at USD 708,000 (RHDHV, 2025). Besides land lease costs per location, table 7.6 also

presents these land lease costs as a percentage of total estimated operational expenditures (OpEx)[1]. The percentages vary from approximately 6% to 102% with an average of 37%, which is significantly above the USA average in the industrial sector (2-3%, source: United States Census Bureau). The weight of the criterion will be in line with this, see further in this chapter. Table 7.5 presents a scoring guide for long lease costs. In table 7.6 the results of the scoring of the locations are presented.

Table 7.5: Scoring guide long lease costs

Long lease costs per year (range)	Score
0-50,000	5
50,000-100,000	4
100,000-150,000	3
150,000-200,000	2
> 200,000	1

Table 7.6: Results of scoring of locations

Location, connection	USD/m².y	Land lease 20,000 m²	% of estimated OpEx	Score
Meiberg	2	40,000	5.6%	5
Malpais	2	40,000	5.6%	5
Shut	5 *	100,000	14.1%	3
ISLA West	12.5 *	250,000	35.3%	1
Asphalt Lake	7.5 *	150,000	21.2%	2
Manzaliña Bay	36	720,000	101.7%	1
Batipaña	36	720,000	101.7%	1
Brievengat Industrial Park	3.33	66,600	9.4%	4

7.4 Environmental criteria

7.4.1 Impact and perceived impact on local communities

Impact on local communities can be assessed in a semi-qualitative way by means of applying the following sub-criteria, both related to anticipated opposition by the community:

- Distance of new facility to a community or neighborhood including sensitive objects such as schools, senior citizen's homes, healthcare facilities, etc. This sub-criterion is related to nuisances, such as noise, vibrations, dust and such;
- Traffic through neighborhood

[1] OpEx estimated by RHDHV includes costs for land use. These costs for land use were not subtracted to determine the percentage of long lease costs to total estimated OpEx

Noise impact and air quality are scored in a quantitative manner by separate environmental criteria as well (see sections below).

Distance from the WPO-location to the neighborhood is chosen as the main criterion. Typically, nuisance from dust is experience up to a few hundred meters from the source (Rijkswaterstaat, 2023). With this information the scoring guide of table 7.7 was drawn up.
Traffic to and from a C&D waste recycling plant amounts to 38 vehicles per day or 3 vehicles per hour (taking a 6 day work week and 12-hour working day into account). Compared to the waste processing option of Waste to Energy this number is rather modest. Still, impact of truck movements may be experienced by inhabitants of a neighborhood e.g. as noise, vibrations, or a feeling of unsafety. These possible impacts by traffic are considered to be stronger in the direct vicinity of a WPO location compared to greater distances. Therefore, the sub-criterion (nuisance by) "traffic through neighborhood is weighed in the first sub-criterion "distance of new facility to a community or neighborhood".

Table 7.7: Scoring guide impact on local communities

Distance to neighborhood	Risk of environmental impact (nuisance including traffic)	Opposition expected	Score (points)
Distance more than 800m meters	No risk of any nuisances	No opposition expected	5
Distance 600-800 meters	Low risk of light nuisances (downwind)	Light or no opposition expected	4
Distance 400-600 meters	Moderate risk of light nuisances (downwind)	Moderate opposition expected	3
Distance 200-400 meters	Risk of moderate nuisance (upwind and downwind)	Significant opposition expected	2
Distance less than 200 meters	High risk of significant nuisance (upwind and downwind)	Strong opposition expected	1

Table 7.8: Impact on local communities

Location, connection	Proximity neighborhoods	Name of the neighborhood	Score
Meiberg	500m	Kashutuin	**3**
Malpais	500m	Wechi	**3**
Shut	700m	Seru Fortuna Ariba	**4**
Isla West	500m	Buena Vista	**3**
Asphalt Lake	350m	Emmastad	**2**
Manzaliña Bay	150m	Domi	**1**
Bati Paña	150m	Domi	**1**
Brievengat	500m	Schelpwijk	**3**

7.4.2 Future residential developments near site

Future residential developments may be possible in any of the designated areas for residential occupation as described in EOP, where no residences have been built yet. Future construction of such areas can take place in the following designation types: “stedelijk woongebied” (urban area), “landelijk woongebied” (rural residential area), “binnenstad” (inner city), or other. The criterion is assessed in the same way as “impact on local communities”, by assessing the distance of the area to the planned WPO and thereby the risk of environmental impact (nuisance) and the opposition expected.

Table 9.8: Proximity of planned residential areas and scoring of criterion

Location	Name residential area not yet developed	Distance	Score
Meiberg	Harmonie	750 m	**4**
Malpais	Wechi	450 m	**3**
Shut	Fortuna Ariba	700 m	**4**
ISLA West	-	> 2 km	**5**
Asphalt Lake	-	> 3 km	**5**
Manzaliña Bay	Domi	> 2 km	**5**
Batipaña	Domi	> 2 km	**5**
Brievengat	Schelpwijk	950	**5**

Location specific aspects

Meiberg: A significant part of Harmonie West will be developed in the near future (first activities seem to have started).

Malpais: The southern and central parts of Wechi will be developed over the next years.

Shut: In some parts of Fortuna Ariba (urban area) no residential construction has taken place yet.

ISLA West and Asphalt Lake: no new residential areas are foreseen in a radius of 2 km or less.

Manzaliñabaai and Bati Paña: In some parts of Domi (urban area, nearby) no residential construction has taken place yet, but these areas are unfit for housing (steep hillsides).

7.4.3 Dwellings impacted by noise

The noise contour of 40 dB(A) was modeled for potential locations. The number of houses within this contour was selected as a proxy for noise impact (40 d(B)A represents a low noise impact). The noise contour for the C&D recycling plant was calculated for the daytime period (07:00–19:00) at a height of 2 meters. Locations are scored quantitatively based on the situations stated in table 7.9.

Table 7.9: Scoring guide dwellings impacted by noise

Situation	Score
0-10 dwellings in 40 dB(A) noise contour	5
11-25 dwellings in 40 dB(A) noise contour	4
26-50 dwellings in 40 dB(A) noise contour	3
51-100 dwellings in 40 dB(A) noise contour	2
More than 100 dwellings in 40 dB(A) noise contour	1

For the C&D recycling plant facility, the outer 40 dB(A) noise contour is located approximately 350-450 meters from the perimeter of the plot. The modeling results indicate that several dwellings fall within the modeled noise contours at locations ISLA West, Manzaliñabaai and Bati Paña (see table 7.10). To illustrate the modeling results for the C&D recycling plant, figure 7.1 shows the 40 dB(A) contour at the location of Bati Paña.

Figure 7.1: The noise contour of 40 dB(A) projected at the location of Batipaña, showing several dwellings within contour (urban area, pink and inner city, red).

Table 7.10. Scores dwellings impacted by noise

Location	Dwellings in noise contour	Suggested score
Meiberg	0	**5**
Malpais	0	**5**
Shut	0	**5**
ISLA West	20	**4**
Asphalt Lake	0	**5**
Manzaliña Bay	51-100	**2**
Batipaña	26-50	**3**
Brievengat	0	**5**

7.4.4 Dwellings impacted by air quality

Since dispersion of particulate matter (dust) is the main factor when evaluating air emissions, this criterion should be read as “dwellings impacted by dust”. Measurements show that elevated (particulate) dust concentrations can be expected in the direct vicinity of a stone crusher. A few hundred meters from the source, the source no longer contributes significantly to air pollution (Rijkswaterstaat, 2023).

Research shows that dust from C&D waste recycling (separating, sorting, crushing, sieving) is reduced effectively by keeping the site moist and applying atomization at the emission points, for example using fog cannons. This results in a particulate matter reduction of 88%. The costs of a fogging cannon vary between EUR 10,000 to 25,000 per fog cannon (Enviro Challenge, 2008). Atomization of water can also be applied at all points where waste material is processed mechanically, a measure that has virtually the same effect.

We assume that only “normal” dust will be produced, and there will be no risk of dispersion of asbestos particles. In other words: asbestos will always have to be refused at the recycling company's gate.

Since noticeable dust dispersion and noticeable noise production can both be experienced a few hundred meters from the C&D recycling plant we use the same contour for dust and noise for counting of dwellings. **The scoring is the same as in the assessment of noise** (preceding section).

7.4.5 Existing nature values at specific lot

The scoring for this criterion done in a qualitative way, see section 5.8 for results and clarification.

7.4.6 Risk for nature in adjacent areas

The establishment of a WPO at a specific location may present potential risks to nearby natural areas. This could include pollution and disturbances such as noise and light (in evening) to highly valuable and internationally protected conservation areas like Ramsar sites or coral reefs. The proximity of the C&D waste recycling plant to such valuable natural areas is a critical factor to take into account. Table 7.11 provides the distances from the site boundaries to these protected and ecologically significant areas. Scores are awarded by the Focus Group, based on these distances.

Table 7.11 Distances to ecologically significant areas

Locations	Situation	Distance to Conservation area (m)	Distance to Ramsar site (m)	Distance to coral reef (m)	Suggested score
Meiberg	Ramsar site 1 Ramsar site 2	250m 500m	250m 500m	~600	**2**
Malpais	Ramsar site	100m	100m	NA	**2**
Shut	Conservation area	300m	N.A.	250	**3**
ISLA West	N.A.	N.A.	N.A.	N.A.	**5**
Asphalt Lake	Wetland	~2100m	N.A.	N.A.	**4**
Manzaliña Bay	Conservation area	<50m	N.A.	N.A.	**2**
Batipaña	Conservation area	700m	N.A.	N.A.	**4**
Brievengat	Conservation area	<50m	N.A.	N.A.	**3**

Location specific aspects

Asphalt Lake: North of the location Asphalt Lake a small wetland is present. It is not designated as conservation area in EOP, but it can be regarded as valuable (and rich in birdlife).

Meiberg and Malpais: for Ramsar sites: see section 5.8.

Brievengat: Part of the location of Brievengat is near a small extension of a larger conservation area (see section 5.8).

7.4.7 Visual impact

Visual impact needs to be assessed from case to case, general rules do not apply. This criterion is discussed in the Focus Group, the local situation is taken into account. The outcome of the evaluation is as follows:

Table 7.12: Scoring of visual impact

Locations	Evaluation	Score
Meiberg, Shut	Near natural areas with free sight. Large building will produce significant visual impact	2
ISLA West, Brievengat	Location situated in area where industry is established (large buildings, heavy equipment, etc.)	5
Asphalt Lake, Manzaliña Bay and Bati Paña, Malpais	Industrial areas with only few residences visually impacted	4

Location specific aspects

Malpais: Building visually obscured by other industry and by bufferzone West of Wechi

7.4.8 WPO takes or does not take landfill capacity

If the Waste Processing Option (in this case C&D recycling) would be realized at Malpais, this would take away space that could be used as landfilling space in the future. Landfilling space must be highly valued. Scoring will take place as follows: Malpais will receive 1 point, other locations 5 points.

7.4.9 Possible conflict with other industry

Noise, dust and odors generated by a WPO (in this case a C&D waste recycling plant) could hinder operations of neighboring industries, particularly those in sectors such as food processing, hospitality, communication and data centers, or other sensitive operations. Neighboring industries may also weigh potential reputational impacts, especially if their operations rely on a clean or eco-friendly image.
Potential conflicts with other industries are assessed in a qualitative way as follows (table 7.13 and 7.14):

Table 7.13 Scoring guide possible conflict with other industry

Situation	Score
Positive attitude expected	5
No opposition/conflict expected	4
Little opposition/conflict expected	3
Medium opposition/conflict expected	2
Strong opposition/conflict expected	1

Table 7.14: Possible conflict with other industry

Locations	Situation	Score
Meiberg	No other industry	**5**
Malpais	Asphalt production (2 companies), recycling, gas station, generally considered compatible industry	**4**
Shut	No other industry, airport at >700 m	**5**
ISLA West	Solar plant, but area large enough to allow for zoning	**4**
Asphalt Lake	Solar plant (Buskabaai N.V., future). Power plants Aqualectra at more than 500m	**5**
Manzaliña Bay	Crown Automotives (South)	**3**
Batipaña	Sea Harbor Group, windward (East)	**2**
Brievengat	Building Depot, Global Paint, Distribier (Distribier is downwind)	**2**

Location specific aspects

ISLA West: Solar plant nearby, but the area is large enough to allow for zoning (pers. comm. 2Bays).
Batipaña: Sea Harbor Group: less than 50 m distance. Compatibility with this industry is an unknown factor
Manzaliñabaai: Sea Harbor Group: less than 200 m eastward
Brievengat: Nearby industry considered sensitive

7.5 Logistical criteria

7.5.1 Proximity to primary road

Primary roads on Curaçao are the ring road “Schottegatweg” and the “Nieuwe Havenweg”. Proximity to one of these primary roads improves accessibility from all different of the island. Proximity to a primary

road for incoming vehicles and outgoing vehicles is assessed in a quantitative way. Tables 7.15 and 7.16 present the scoring guide and the results of scoring of the criterion.

Table 7.15: Scoring guide proximity to primary road

Proximity	Score
0-3 km	5
3-6 km	4
6-9 km	3
9-12 km	2
12+ km	1

Table 7.16: Proximity to primary road and proposed scores

Location	Road kilometers to primary road	Suggested score
Meiberg	13.70	**1**
Malpais	8.20	**3**
Shut	6.2 km	**3**
ISLA West	1.22	**5**
Asphalt Lake	1.61	**5**
Batipaña	1.82	**5**
Manzaliñabaai	1.29	**5**
Brievengat	5.8	**4**

7.5.2 Proximity to known congestion points

It should be avoided that roads already congested will get even more congested. A C&D waste recycling plant, however, with an expected number of 38 vehicles per day (3 per hour in a 6-day work week and 12 hour working day), will not have significant impact on local traffic.

Examples of known congestion points are: Caracas Bay Road, the roundabout of Santa Rosa, Gosieweg and Weg naar Westpunt.

Since the congestion of the roads is not an absolute phenomenon, but takes mainly place at rush hours, the Focus Group decided to only score in the center of the spectrum of 1-5 (value 3 or 4). The scoring guide and scoring results are given in table 7.17.

Table 7.17: Proximity to known congestion points

Location	Evaluation	Score
Shut, ISLA West, Asphalt Lake	No nearby congestion points, or congestion points avoidable	**4**
Meiberg, Malpais, Brievengat	Weg naar Westpunt often congested at rush hours. Same applies to Gosieweg	**3**
Mazaliñabaai, Batipaña	Some of the traffic must pass through narrow roads of Otrobanda	**3**

7.5.3 Average distance to source of waste

The method for assessing the criterion “average distance to source of waste“ is described in section 5.9. We refer to that section for further clarification. Distances vary from approximately 10 to 17 km for the C&D waste recycling locations (see also table 7.19). The scoring guide of table 7.18 can be used.

Table 7.18: Scoring guide proximity to source of waste

Distance	Score
8-10 km	5
10-12 km	4
12-14 km	3
14-16 km	2
16+ km	1

Table 7.19: Distances (in km) from service areas to WPO locations

Location	Average Distance	Score
Meiberg	16.46	**2**
Malpais	13.87	**3**
Shut	14.18	**3**
ISLA West	10.87	**4**
Asphalt Lake (*)	11.26	**4**
Batipaña	11.22	**4**
Manzaliña Bay	11.22	**4**
Brievengat	13.52	**3**

Location specific aspects:

Asphalt Lake: For Asphalt Lake, access will be realized from the Dokweg. In case a second access road is constructed at Regentesselaan (opposite of Rustenburg) a traffic light needs to be installed at the crossing of Regentesselaan-Nieuwehavenweg (for traffic to Schottegatweg Noord). Since the number of vehicles visiting a C&D recycling plant is significantly lower than for a Waste to Energy plant (Chapter 6), there seems to be no drawback to open an additional entrance at Regentesselaan. This would not significantly increase the traffic intensity through Emmastad.

7.5.4 Transportation distance to recycling companies

It may be assumed that the higher qualities of mineral recyclables (20% of CD waste) will be fully absorbed by either Heavy Mix or Betonindustrie Brievengat. For the lower qualities this is impossible to predict: much of it may be transported to areas where large scale developments occur for ground works. Since the offtake locations cannot be defined, this criterion cannot be assessed and is left out of the MCA.

7.5.5 Transportation distance for residues (landfill)

Transportation distance for waste from the potential C&D waste recycling locations to the landfill at Malpais is assessed in a quantitative way. The scoring guide of table 7.20 has been used for scoring the criterion. Results are presented in table 7.21.

Since the amount of waste to be landfilled is 32% of the total waste brought to the landfill, the weight of the criterion will be 32% of the weight of the weight of "average distance to source of waste".

Table 7.20: Scoring guide distance to landfill

Distance	Score
<6 km	5
6-8 km	4
8-10 km	3
10-12 km	2
12+ km	1

Table 7.21: Transportation distance to landfill

Location	Road kilometers to landfill (km)	Score
Meiberg	5.4	**5**
Malpais	<1	**5**
Shut	8.5	**3**
ISLA West	9.4	**3**
Asphalt Lake	13.0	**1**
Batipaña	11.9	**2**
Manzaliña Bay	11.1	**2**
Brievengat	18.26	**1**

7.5.6 Accessibility for emergency units

This criterion is not deemed important. In a C&D waste recycling plant only storage of mineral fractions occurs. Flammable fractions such as wood and plastics will be transported away from the plant on a daily basis.

7.5.7 Presence of a quay, proximity to container harbor

The presence of a nearby quay or container harbor may have a significant advantage in cases where recyclables need to be transported in bulk or in 20 or 40 ft (or ISO) containers. This is however not the case for C&D recycling, where most of the recyclables find their way to local users. Only a small portion of the recyclables is exported and shipped (1,100 tons of steel per year, 4% of recyclables in C&D waste). This criterion is disregarded for C&D waste recycling.

7.6 Weighing factors

Relative importance of criteria and criterion-groups is allocated through weighing factors, which are determined by the Focus Group. The weighing factors of a criterion group vary between 5% (minimum weight) and 50% (maximum weight). The total of the weights within a criteria-group is 100% and the total weights of the criteria-groups is 100%.

Financial criteria

Financial criteria are relatively more important in C&D waste recycling than in the Waste to Energy scenario. Site-specific investments are a substantial part of total investments, on average 30%. Long lease costs as a percentage of total operational expenses (OpEx) average 37%. The latter are also high compared to international averages (e.g. 2-3% in the USA; United States Census Bureau, 2022).
Both criteria together are awarded 45% weight of total weight of criteria, divided over site-specific investments (20%) and long lease costs (25%, see table 7.22).

Environmental and logistical criteria

Environmental and logistical criteria together are given slightly more weight than the financial criteria. Fifty five percent (55%) are divided over environmental criteria (30%) and logistical criteria (25%).
Four of the individual environmental criteria are awarded the highest weight (15% per individual criterion): (1) impact on local communities (including traffic), (2) future residential developments near site, (3) dwellings impacted by noise and (4) dwellings impacted by dust. The other environmental criteria are awarded less weight (10% or 5%). The weight of the criterion “establishment of WPO does not cost any landfilling space” is chosen as 5%. This is a relative low weight but since the scoring is either 1 (Malpais) or 5 (other locations, 5 times more) this still represents a significant weight.

Individual logistical criteria are all awarded 30% weight except for “transportation distance of residues to landfill”, which receives 1/3 of the weight of “average distance to source of waste” (10% as discussed in section 7.5.5).

Table 7.22: Weights of criteria-groups

Criterion-group	Weight
Site-specific investments	20%
Long lease cost	25%
Environmental impact	30%
Logistical criteria	25%

Annex 6 presents the absolute weights of the criteria (product of individual weight and group weight).

7.7 Results of scoring

Annex 7.B shows the results of the scoring of the locations for C&D waste recycling. The main result from the MCA is that for this activity two locations outside the center of Curaçao score best overall: Malpais

and Brievengat. The main reason for this outcome is that both locations score well on "site specific investments" and "long lease costs". ISLA West and Meiberg are two other locations with high overall scores. Manzaliñabaai and Batipaña have the lowest overall scores, mainly caused by low scores on long lease costs and environmental criteria (among others neighborhoods nearby).

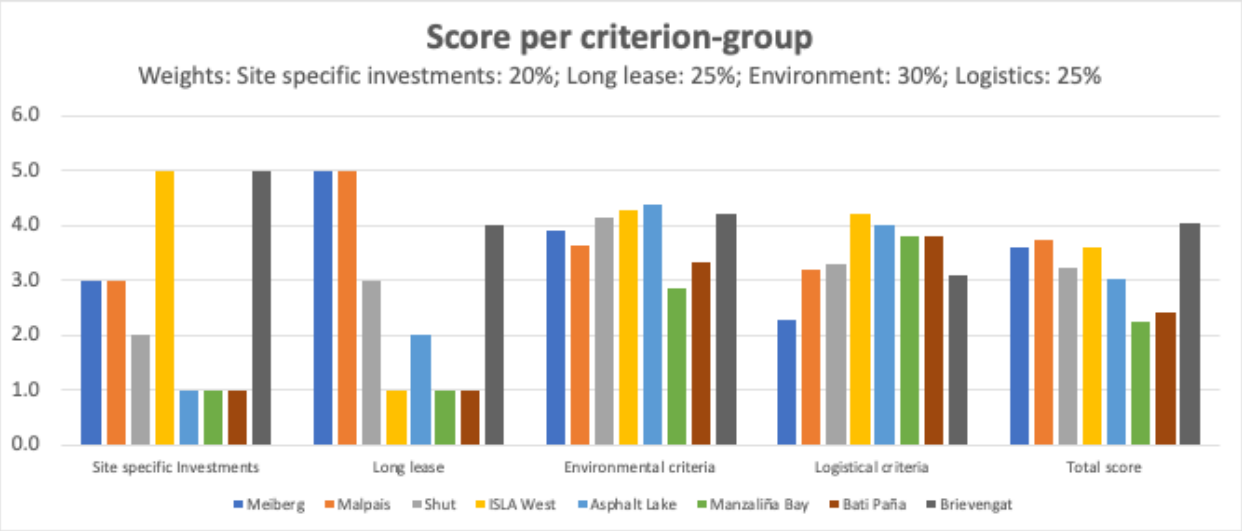

Figure 7.2: Results of scoring of locations for C&D waste recycling

It needs to be emphasized here that the scores relate to a full recycling plant, including stone crushers and screening systems. In the first phase of the C&D waste recycling plant the main operation is only sorting of C&D waste into mineral fractions, ferro and other (waste) fractions. This operation will be carried out using excavators/cranes and shovels. Since these are mobile equipment, it will be possible to move the equipment from one location to another[1] and carry out the sorting activity at these two locations, e.g. Malpais and Brievengat. In a later phase one of these locations can develop into a full recycling plant.

[1] Since investments are low in phase 1, another possibility is to purchase this equipment for two locations

8 Evaluation locations Industrial Recycling Hub

8.1 Go/no-go criteria

The activities of the Industrial Recycling Hub are described in Chapter 3. The essence of an Industrial Recycling Hub is that the current recycling companies work together to optimize logistics and costs to ultimately reduce costs for these companies (RHDHV, 2025):

- By centralizing recycling activities to one area in Curaçao, centralized functions such as warehousing, office, manual sorting, weighing bridge, pressing, gate and security can be combined[1];
- If landlords require compensation, this initiative may face significant challenges in being realized due to the substantial annual costs involved.

Locations for heavy industry were disregarded as were locations with high costs for land lease (such as Batipaña). Figure 8.1 shows that most current recycling companies have their activities in the Schottegat area (near the ring road). The main starting point for the location of the Industrial Recycling Hub is that it should be centrally located, as close as possible to the recycling companies (and thus the ring road)[2]. As a go/no-go criterion we selected "location no more than 2 km from ring road".

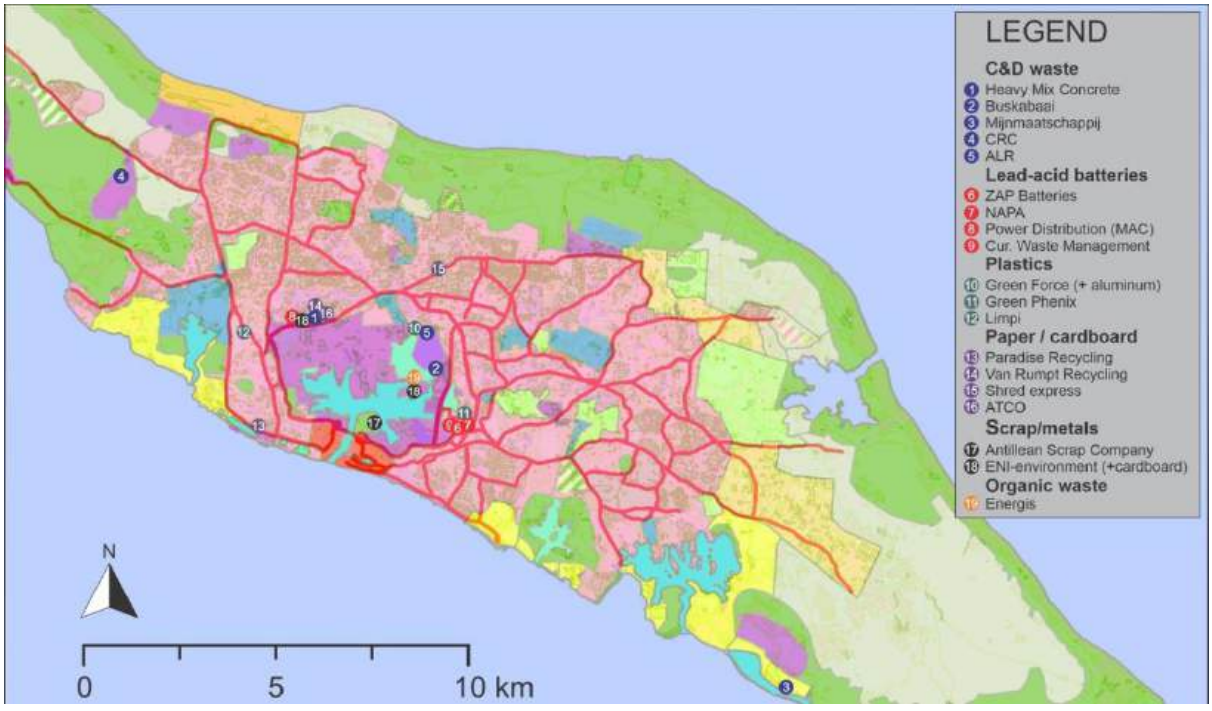

Figure 8.1: Location of current recycling companies

[1] With respect to logistical aspects, it is important to mention that - unlike C&D waste recycling, where mobile equipment can be used at 2 different locations - the activities in the Industrial Recycling Hub will be limited to one location only

[2] In the Industrial Recycling Hub mainly paper, cardboard, plastics, aluminum cans and glass will be recycled, but other and new ventures are also welcomed (e.g. textiles and secondhand tools, RHDHV, 2025)

In order to meet this criterion, we selected three centrally located areas for further evaluation: ISLA West, Asphalt Lake and Buskabaai North[1]. We excluded Batipaña and Manzaliña Bay because these are in a significantly higher price segment, see Chapter 5.

The location in Buskabaai North is a separate compartment surrounded by dams, adjacent to the Asphalt Lake location. Buskabaai North is different from the Asphalt Lake location (discussed in Chalter 4) in two ways: first, the area is partly covered with sediments (dredging spoils) from the Schottegat, which may have resulted in mild contamination with (immobile) contaminants, mainly heavy metals; the other difference is that the area is temporarily under management of Buskabaai N.V., but will be delivered back to the Curaçao Government for future long lease[2]. This means that the rates for long lease issued by Government may apply, which are at an entirely different level (USD 3.00/m^2.y for centrally located areas) than the long lease rates applied by the Governmental Companies (2Bays, CDM Holding, CPA, lease prices are significantly higher, see section 5.2).

The surface area required for the recycling activities is 1.5 hectares (see section 3.3). All three potential locations meet this criterion. The other go/no-go criteria are also met: the areas have a designation "Industry" and the activity of an Industrial Recycling Hub fits the policies of 2Bays and Buskabaai N.V. Parts of ISLA West are heavily contaminated with asbestos, spent clay and other contaminants (field trip 2Bays November 25, 2024; Ecorys, 2012), but large sections are free of contamination. It is assumed that 1.5 hectares of uncontaminated land can be reserved. The reclaimed land of the Dry Asphalt Lake has been remediated and is free of contamination. Buskabaai North may be mildly contaminated with heavy metals.

The criterion "No obvious conflict with other industry" was deleted from the list of go/no-go criteria, because of the nature of the activity: light industry with minor environmental impact (see section 10.4).

8.2 Site specific investments

Investments for an Industrial Recycling Hub as proposed in Chapter 3 amount to USD 1.2 million (RHDHV, 2025). These investments are related to a location ready for use and do not include site-specific investments. Site-specific investments such as ground works, construction of electrical and water infrastructure, and construction of roads roughly add 1.3 to 2.0 million USD to this amount, which amounts to 52-63% of total investment (averaged 57%).

Location specific aspects

- Waste acceptance infrastructure is excluded as a criterion, because none of the sites feature a weighbridge;
- For Buskabaai North additional measures are required for remediation of the soil contamination with immobile components. Since the location of Buskabaai North (and Asphalt Lake) requires

[1] Buskabaai North did not qualify for WtE and C&D Waste recycling, because of the dimensions (1.5 hectares)

[2] It should be noted that only the asphalt lake (location where asphalt was temporarily stored) was intended to be the property of Buskabaai N.V. A number of nearby areas were temporarily transferred to Buskabaai N.V. by the government. By Deed of Transfer dated 21 October 1985, Buskabaai N.V. committed to transfer ownership of those plots that do not belong to the asphalt lake to the Island Territory of Curaçao (EGC). Source IMZP Buskabaai N.V.

land elevation of approximately 1 meter, the contamination will be sufficiently isolated and can be regarded as remediated (source: Circulaire bodemsanering 2013).

As the relative contribution of site-specific investments to total estimated investments is high (much higher than in the case of WtE and C&D waste recycling) the criterion “site-specific investments” will be given considerable weight in the scoring of the locations (see further in this chapter).
Table 8.1 and 8.2 present the scoring guide and the results of scoring of the criterion “site-specific investments”.

Table 8.1: Scoring guide site-specific investments Industrial Recycling Hub

Amount (USD)	score
< 500,000	5
500,000-1,000,000	4
1,000,000-1,500,000	3
1,500,000-2,000,000	2
> 2,000,000	1

Table 8.2: Site-specific investments Industrial Recycling Hub

Site-specific investments	ISLA West	Asphalt Lake	Buskabaai North
Electrical infrastructure	458	372	372
Water infrastructure	118	126	152
Road infrastructure	0	633	222
Ground works	708	875	875
Total	1,284	2,006	1,621
Percentage of total investments	52%	63%	57%
Score	**3**	**1**	**2**

8.3 Long lease costs for land use

Long lease costs for ISLA West are estimated at USD 188,000 (USD 12.50 x 15.000 m^2). Long lease costs for Asphalt Lake are estimated at USD 113,000 (USD 7.50 x 15.000 m^2) and for Buskabaai North: 45,000 USD (USD 3.00 x 15.000 m^2), see also Section 5.2. Long lease costs are relatively high at 12% to 36% (averaged 24%) of total OpEx (USD 333,000/y). The criterion “long lease costs” will therefore be given significant weight (see section 8.6).

Table 8.3: Scoring of long lease costs Industrial Recycling Hub

Amount (USD)	score
< 50,000	5
50,000-100,000	4
100,000-150,000	3
150,000-200,000	2
> 200,000	1

Table 8.4: Long lease costs and scoring per location Industrial Recycling Hub

Land lease costs per year	ISLA West	Asphalt Lake	Buskabaai North
Total	188,000	113,000	45,000
Score	1	3	5

8.4 Environmental criteria

An Industrial Recycling Hub is a light industrial activity, and environmental issues such as noise, dust and traffic[1] are of minor impact. The total weight awarded to the environmental criteria is low compared to the weight of the financial criteria. Environmental criteria used for location selection have been grouped into two criteria: (1) “impact on local communities”, and (2) in the absence of nature values at the sites themselves: “risk for nature in adjacent areas”.

All three locations received the maximum score on “impact on local communities”. For “risk for nature in adjacent areas”, Buskabaai North scores lower (3) than the other locations (5), because of the presence of a bird-rich valuable wetland, just North of the location (see Annex 1).

8.5 Logistical criteria

The starting point of a central location for the hub near the existing recycling companies results in the situation that some of the logistical criteria are rendered irrelevant, such as “transportation distance for recycled products” and “accessibility for emergency units”. All three locations are very close to the primary (ring) road and therefore these criteria are not discriminative. The criterion “distance to source of waste” is deleted because it is impossible to identify the exact future sources of waste (supermarkets, other companies, other sources).

Transportation distance for residues to the landfill is also irrelevant because no significant amounts of residues are produced (RHDHV 2025, see also mass balance section 3.3). On the other hand, the criterion “distance to container harbor” is included as a criterion for this WPO, where it is irrelevant for other WPOs (WtE, C&D waste recycling and Composting).

Two criteria remain: (1) proximity to primary road and (2) distance to container harbor. Because of the starting point of a central location for the Industrial Recycling Hub, logistical criteria are less important compared to the financial criteria and therefore receive less weight (section 8.6).

[1] On average 2 large trucks and 8 small truck/pickups are expected per day (RHDHV final parameters, section 3.5)

Table 8.5: Scoring guide proximity to primary road

Distance	score
< 500m	5
500m -1 km	4
1 km -1500m	3
1500m – 2 km	2
2 km – 2500m	1

Table 8.6: Scoring guide distance to container harbor

Distance	score
< 2 km	5
2-4 km	4
4-6 km	3
6-8 km	2
> 8 km	1

Table 8.7 Proximity to primary road and to container harbor and scoring per location

	Proximity to primary road	Score	Distance to container harbor	Score
ISLA West	400m	5	7.3 km	2
Asphalt Lake	1.1 km	3	4.1 km	3
Buskabaai North	1.1 km	3	4.1 km	3

8.6 Weight of criteria

Site specific investments are a substantial part of total capital expenditures (CapEx, 57%). Likewise, long lease costs are a substantial part of total operational expenditures (OpEx, 24%). Therefore, the criteria "site-specific investments" and "long lease costs" will be given significant weight. At the same time environmental criteria and logistical criteria are less significant, since the Industrial Recycling Hub is a low impact facility which will be centrally located, near the origins of waste, the recycling companies and the container harbor. We chose the weights as follows: site-specific investments 50%, land lease costs 30%, environmental criteria 10%, logistical criteria 10% (see table 8.8).

Table 8.8: Weights of criteria-groups

Criterion-group	Weight
Site-specific investments	50%
Long lease cost	30%
Environmental impact	10%
Logistical criteria	10%

8.7 Scoring and analysis

Annex 7.C and figure 8.2 show the results of the scoring, using the information from this chapter and using the weights as proposed in the previous section.

From the diagram it can be concluded that the locations of Buskabaai North and ISLA West have the highest scores, with Buskabaai North scoring slightly higher. The main factors in this outcome are the low long lease cost for Buskabaai North and the low site-specific investments for ISLA West. Buskabaai North and ISLA West are the recommended locations, however, a relevant precondition for the success of Buskabaai North is that the negotiations with Buskabaai N.V. and the Government lead to the anticipated long lease fee (USD 3.00/m^2 or less. At the same time lower long lease fees than USD 12.50/m^2.y may be negotiated with 2Bays.

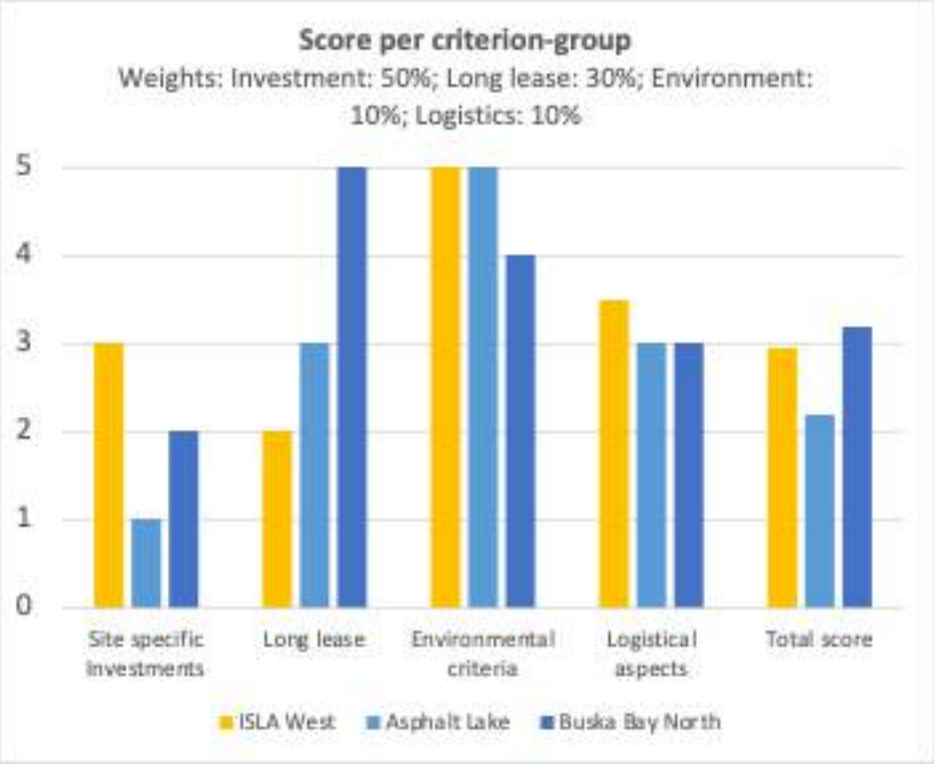

Figure 8.2: Scoring of locations for Industrial Recycling Hub per criteria-group

9 Evaluation locations Composting

Longlisted locations for composting are: Aloe Farm, Klein Kwartier (AVB-GMN), De Savaan or Bakufal (Soltuna), Ronde Klip and Malpais (see Chapter 4). Although Malpais is designated Industry, the location is added as a potential location for composting because of the relatively low long lease fees and the general designation of the location for "waste management".

9.1 Go/no-go criteria

During a consultation with Foundation Soltuna, we were informed that both De Savaan and Bakufal are not available: the land requirement of the WPO Composting exceeds the availability of land (pers. comm. Mr. Ben Kleine, Chairman of Soltuna). Small scale operations may be accommodated but composting of the volumes at the scale of the whole of Curaçao cannot.
During our consultations with AVB-GMN we were informed that AVB-GMN is preparing a composting activity in Klein Kwartier. This activity is not at the scale of island wide composting of green waste. AVB-GMN was unable to propose a location for large scale composting. The location of Klein Kwartier was therefore excluded from our evaluation.
The location of Ronde Klip is designated as "Conservation Area". This means that for this location restrictions are to be expected, a.o. for construction of a building. As described in Section 3.4, construction of a building with concrete basins for composting will be required. Therefore, Ronde Klip is also excluded from further evaluation.

The locations included in the evaluation are: Aloe Farm (designated "Agriculture") and Malpais (designated "Industry"). Both locations are available for composting of green waste by the owners and fit their policies: The Aloe Farm has 5 hectares available for activities carried out by others, including composting of green waste; Selikor also has 5 hectares available at Malpais (see Chapter 4 and Annex 1). Both locations are located less than 20 (road) km from the center of Curaçao (Biesheuvel). No specific obstacles are known to the use of these two locations for composting of green waste.

The following go/no-go criteria have not been applied, for reasons summarized in the table:

Table 9.1: Go/no-go criteria not applied for Composting

Criterion not applied	Reason
No obvious conflict with other industry	There may be some impact to other industry from the composting activity but no obvious conflicts. This criterion is not considered relevant
Acceptance by Government	Government did not object to any of the proposed locations
No obvious safety risks for facility	Composting of green waste brings about risk of fire. However, no hazardous substances are involved. This criterion is not considered relevant for location choice, it should be included in a final EIA however

9.2 Site specific investments

Investments for a composting facility as proposed in section 3.4 amount to USD 472,000 (RHDHV, 2025). These investments account for a location ready for use and do not include site-specific investments such as ground works and construction of electrical, water and road infrastructure to the specific lot. These investments roughly add 900,000 to 1,800,000 USD to this amount (approximately70-80% of total investments, see section 3.5 and table 9.3). Since the relative contribution of site-specific investments to total estimated investments is high (much higher than in the case of WtE and C&D waste recycling) the criterion "site-specific investments" will be given significant weight (see further in this chapter).

Table 9.2: Scoring of site-specific investments

Amount (USD)	score
< 500,000	5
500,000-1,000,000	4
1,000,000-1,500,000	3
1,500,000-2,000,000	2
> 2,000,000	1

Table 9.3: Site-specific investments for composting of green waste

Site-specific investments	Aloe Farm	Malpais
Electrical infrastructure	76	1,197
Water infrastructure	25	154
Road infrastructure	277	0
Ground works	417	417
Waste acceptance infrastructure	150	0
Total site-specific investments	945	1,768
Percentage of total investments	67%	79%
Score	**4**	**2**

Location specific aspects

Total site-specific investments are practically the same for Aloe Farm and Malpais. At Malpais, electrical and water infrastructure are more costly while at Aloe Farm 500 meters of road and a weighbridge need to be constructed.

Natural water (groundwater) infrastructure

Both locations have availability of groundwater. At Aloe Farm, deepwells are present and the water is of sufficient quality (EC) though slightly calcareous. Recycled water from the Klein Kwartier sewage treatment plant is available at Aloe Farm (trucked to location). Just North of the Malpais landfill, old water wells are present, used by the refinery in the 60's (RHDHV, EcoVision, 2002), indicating the presence of

sufficient groundwater. This information is also used for further analysis in the final section of this chapter.

9.3 Long lease costs for land use

Long lease costs at Malpais are currently zero for Selikor. At Aloe Farm these costs are very low: 0.10 USD/m2.y. It is quite uncertain whether these conditions can continue to apply for both locations. Therefore we calculated a regular Government long lease fee of USD 2,00/m2.y for locations outside the center of Curaçao for both Aloe Farm and Malpais. It is important to mention that according to Domeinbeheer lower prices are negotiable in case of land use with importance for Government. We therefore carried out a sensitivity analysis in the final section of this chapter.

Table 9.5 presents the long lease to be paid per year for 1 ha of land (see also section 5.2). Table 9.4 presents a scoring guide to score for both locations.

Table 9.4: Scoring guide for long lease costs Composting

Amount (USD per year)	score
< 5,000	5
5,000-10,000	4
10,000-15,000	3
15,000-20,000	2
> 20,000	1

Since the amount of USD 20,000 per year is considered a worst case, and possibly better prices can be negotiated, the scoring range is set from USD 5,000 to USD 20,000 per year. Estimated land lease costs amount to 11% of total operational expenses.

Table 9.5: Long lease costs and scoring per location Composting

Land lease costs per year	Aloe Farm	Malpais
Total	20,000	20,000
Score	3	3

9.4 Environmental criteria

The most important environmental impacts of a composting facility for green waste are: (1) noise impact from the tub grinder, (2) dust production from the tub grinder (3) odor production from the aerobic conversion of green waste to compost and (4) impact to nature. Although the process takes place in a building, odor production may be an important aspect, especially in case of co-processing chicken manure.

To cover these environmental impacts, three environmental criteria were used: “impact on local communities” (dust and odor), “dwellings impacted by noise” and “existing nature values at specific lot”.

In addition, the criterion “establishment of WPO does not ‘cost’ any landfilling space” was used to weigh the use of scarce and valuable landfilling space on Curaçao.

9.4.1 Impact on local communities

Distance of neighborhoods

Impact on local communities is assessed using three sub-criteria, all related to anticipated opposition by the community:

- Distance of new facility to a community or neighborhood including sensitive objects such as schools, senior citizen's homes, healthcare facilities, etc. (related to nuisances, such as noise, vibrations, dust and such);
- Distance of new facility to a downwind community or neighborhood (related to odor emissions)
- Traffic through neighborhood

Noise impact and air quality are scored by separate environmental criteria (see sections below).

Scoring of the criterion “impact on local communities” in 5 classes is done in a semi-qualitative way, with the options shown in table 9.6. Locations are scored taking into account the composting facility will use chicken manure in the process. The building in which the process takes place features a mechanical air ventilation system and air treatment. It is yet uncertain how much of the odor emissions can be mitigated.

Distances

Table 9.6 presents a scoring guide for the criterion “impact to local communities”. Distances are chosen according to intensity of nuisance by noise and dust (second column of table) and according to intensity of nuisance by odor (third column of table). Odor nuisances are experienced at much greater distances especially in downwind situations, than noise and dust. On Curaçao, experience and data exist from the situation at Egg Farm Moderno near the neighborhood of Sunset Heights (intense odor nuisance at 750 meters distance to the heart of the neighborhood).

Traffic

Section 3.4 describes traffic to (and from) the composting facility. Per day approximately 130 vehicles will arrive at the facility, all during the day period. This is a substantial number of vehicles (in comparison: in the WtE scenario 220 trucks per day arrive at the WtE plant[1]).

[1] This is for two reasons: 1) a composting facility needs trucks to take away product, while in a WtE scenario, this is only a small portion: bottom asheses. 2) A WtE plant is a 24/7 operation, see also section 3.1

Table 9.6: Scoring guide impact on local communities

	Distance neighborhood (nuisances, not odor)	Distance neighbor-hood downwind (odor)*	Traffic intensity through neighborhood	Score
Very light/no opposition expected	> 400m	> 2 km	Low	5
Light opposition expected	300-400m	1.5-2 km	Medium-low	4
Medium opposition expected	200-300m	1-1.5 km	Medium	3
Significant opposition expected	100-200m	0.5-1 km	Medium-intense	2
Severe opposition expected	< 100m	< 500 m	Intense traffic	1

In the text below, location specific aspects are discussed. Table 9.7 evaluates the impact on local communities.

Location specific aspects

Aloe Farm: A bed and breakfast is located near the proposed location (< 100 meters). The facility should not cause any inconvenience to the guests of the B&B. Use of chicken manure in the composting process may result in a significant odor impact, also for other dwellings in the vicinity (200-300m downwind of the facility). Mitigating measures for odor and noise are important. Traffic through the neighborhood of Koral Partier can be qualified as “intense” (130 vehicles per day; 260 movements, 22 movements per hour).

Malpais: Residences in Wechi are located at 500 meters east of the facility. The use of chicken manure could pose an impact on the residential areas, but with prevailing wind from the East this will not be significant. Traffic will not change compared to the current situation.

Table 9.7: Impact on local communities

Location	Nearest neighborhood (m)	Score	Nearest neighborhood downwind (m)	Score	Traffic through neighborhood	Score	Average Score
Aloe Farm	250-350m	3	350	1	intense	1	**1.7**
Malpais	500m	5	> 8,000	5	No change	5	**5.0**

9.4.2 Dwellings impacted by noise

The most important sources of noise are the tub grinder and the wood-chipper, that shred the green waste to smaller particles (see section 3.4). In addition, vehicles arriving and leaving the facility contribute to the noise emissions. Table 9.8 shows the number of dwellings impacted by noise (dwellings within 40 d(B)A contour). Table 9.7 presents a scoring guide. The noise contours are included in Annex 4. Figure 9.1 shows the noise contour for the location of the Aloe Farm as an example.

For noise emissions, so-called plot emissions were used, which have been derived from data on comparable companies in the Netherlands, using a 1996 DGMR inventory of the Rijnmond area (commissioned by the Port Authority). For Composting, a plot emission of 60 dB(A)/m² (day-period only) was selected, covering an area of 1.0 hectares.

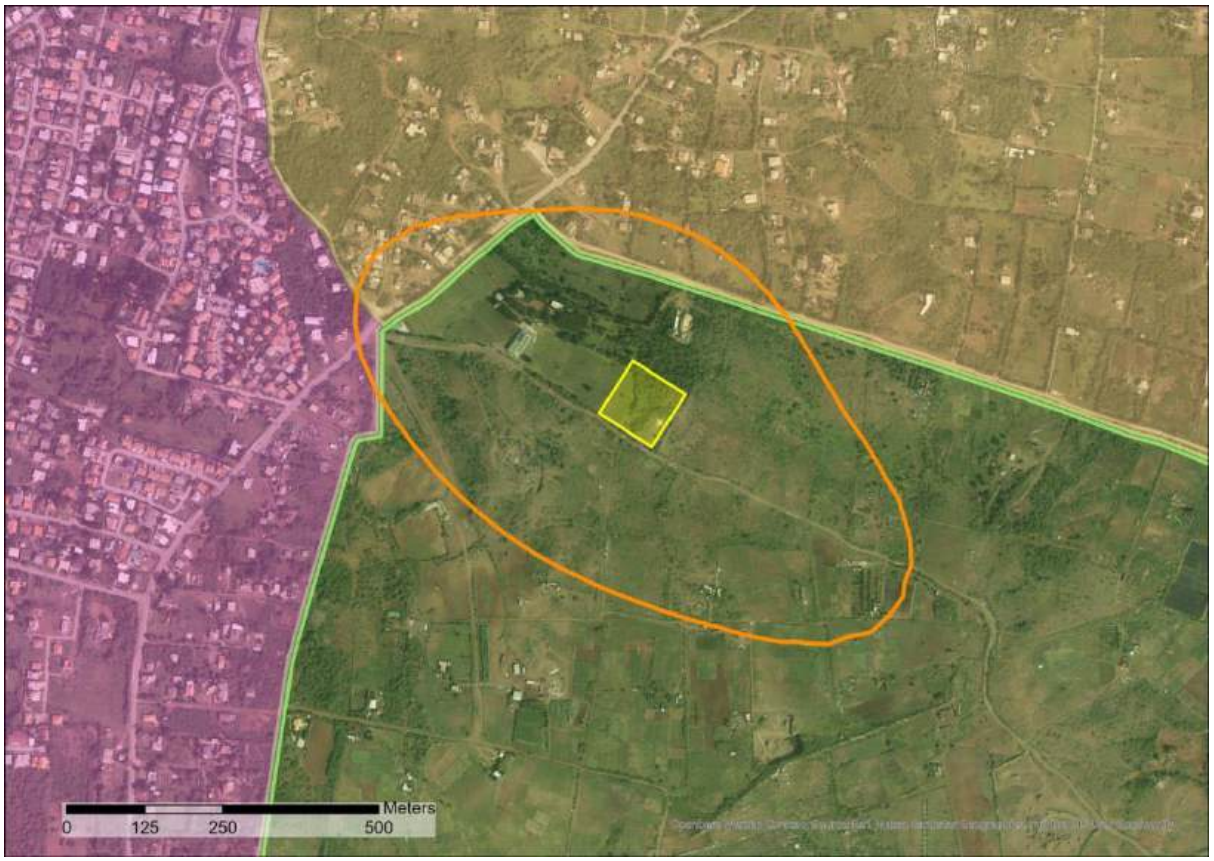

Figure 9.1: Noise contour Aloe Farm Composting

Table 9.7: Scoring guide noise impact Composting

Situation	Score
0-10 dwellings in 40 dB(A) noise contour	5
11-20 dwellings in 40 dB(A) noise contour	4
21-30 dwellings in 40 dB(A) noise contour	3
31-40 dwellings in 40 dB(A) noise contour	2
More than 40 dwellings in 40 dB(A) noise contour	1

Table 9.8. Scores dwellings impacted by noise by Composting facility

Location	Dwellings in 40 d(B)A noise contour	Score
Aloe Farm	11-20	**4**
Malpais	0	**5**

9.4.3 Existing nature values at specific lot

Nature values are described in section 5.8 and Annex 3. Tables 9.9 and 9.10 present the scoring guide and the score for the criterion “existing nature values at specific lot”.

Table 9.9: Scoring results of existing natural values for specific locations Composting

Area/location	Value	Suggested score
Aloe Farm	Very low	**5**
Malpais	Low	**4**

9.4.4 Landfilling space

The criterion "establishment of WPO does not cost any landfilling space" is scored as follows:
Malpais: score 1; Aloe Farm: score 5.

9.5 Logistical criteria

Three out of six logistical criteria were deemed fit for the evaluation of the locations for composting of green waste: (1) proximity to primary road, (2) proximity to known congestion points, (3) average transportation distance for waste (source) and (4) accessibility for emergency units.
The following logistical criteria have not been applied, for reasons summarized below:

Table 9.10: Logistical criteria not applied

Criterion not applied	Reason
Transportation distance for recycled products	Not (yet) known where the final product will be transported to
Transportation distance for residues to the landfill	Minimal amounts of residue
Accessibility for emergency units	Safety risks are considered low. The criterion is largely covered by "proximity to primary (ring) road" which is accessible for emergency services

9.5.1 Proximity to primary road

Proximity to primary roads and the score for this criterion is described for both locations in table 9.12. Table 9.11 presents the scoring guide.

Table 9.11: Scoring guide proximity to primary road

Distance	score
0-3 km	5
3-6 km	4
6-9 km	3
9-12 km	2
12+ km	1

Table 9.12: Proximity to primary road and proposed scores Composting

Location	Road kilometers to primary road	Suggested score
Aloe Farm	10.0	**2**
Malpais	8.20	**3**

9.5.2 Proximity to known congestion points

Proximity to known congestion points was (subjectively) scored by consensus in the Focus Group. Results are presented in table 9.13.

Table 9.13: Proximity to known congestion points Composting

Location	Congestion points	Suggested score
Aloe Farm	Roundabout Sta. Rosa	**3**
Malpais	Road to Westpunt	**3**

9.5.3 Proximity to source of waste

Information on distances to the source of green waste (garden waste) is presented in section 5.9. Tables 9.14 and 9.15 present the scoring guide and the scores for the criterion “proximity to source of waste”.

Table 9.14: Scoring guide proximity to source of waste Composting

Distance	score
5-8 km	5
8-12 km	4
12-16 km	3
16-20 km	2
20+ km	1

Table 9.15: Score for criterion “proximity to source of waste” Composting

Location	Average distance (km)	Score
Aloe Farm	14.9	**3**
Malpais	13.9	**3**

9.6 Weight of criteria

Weights of criteria are distributed according to their significance. The minimum-weight of a criterion group is 5% and the maximum weight is 50%. Individual criteria are weighed uniformly unless there are specific reasons not to do so.

Site-specific investments for Composting are approximately 70-80% of total investments and therefore the maximum weight (50%) is allocated to this criterion. Long lease costs are a maximum 11% of total OPEX, but possibly significantly lower. The weight for this criterion is selected relatively low (10%).
The use of chicken manure in the composting process poses a serious risk of odor nuisance, even though much of the work takes place inside the building. Noise by the shredder/tub grinder is another serious environmental impact. The criterion environment impact receives moderate weight: 20%.
Garden waste is the waste category with most trucks involved (see section 3.4), albeit these are often small trucks. Logistical criteria - like environmental criteria - receive moderate weight: 20%.

Table 9.16: Weights of criteria-groups

Criterion-group	Weight
Site-specific investments	50%
Long lease cost	10%
Environmental impact	20%
Logistical criteria	20%

9.7 Results of analysis

Annex 7.D shows the full results of the scoring of the locations for a composting facility, using the information from this chapter. Figure 9.1 shows that the Aloe Farm is the preferred location.
From Annex 7.D is can be observed that location Aloe Farm has a significantly better score of “site-specific investments” and “establishment of WPO costs landfilling space” (at Aloe Farm no landfilling space will be occupied). At the same time, Malpais scores significantly better on the criterion: “impact to local communities”, since no neighborhoods are located downwind.

If no chicken manure would be used in the process, the location of Aloe Farm would even be more favorable. If however electrical and water infrastructure would not be constructed and the composting facility would be run with a biodiesel generator set and deepwells for fresh groundwater, Malpais would be the preferred location for composting (see figure 9.2).

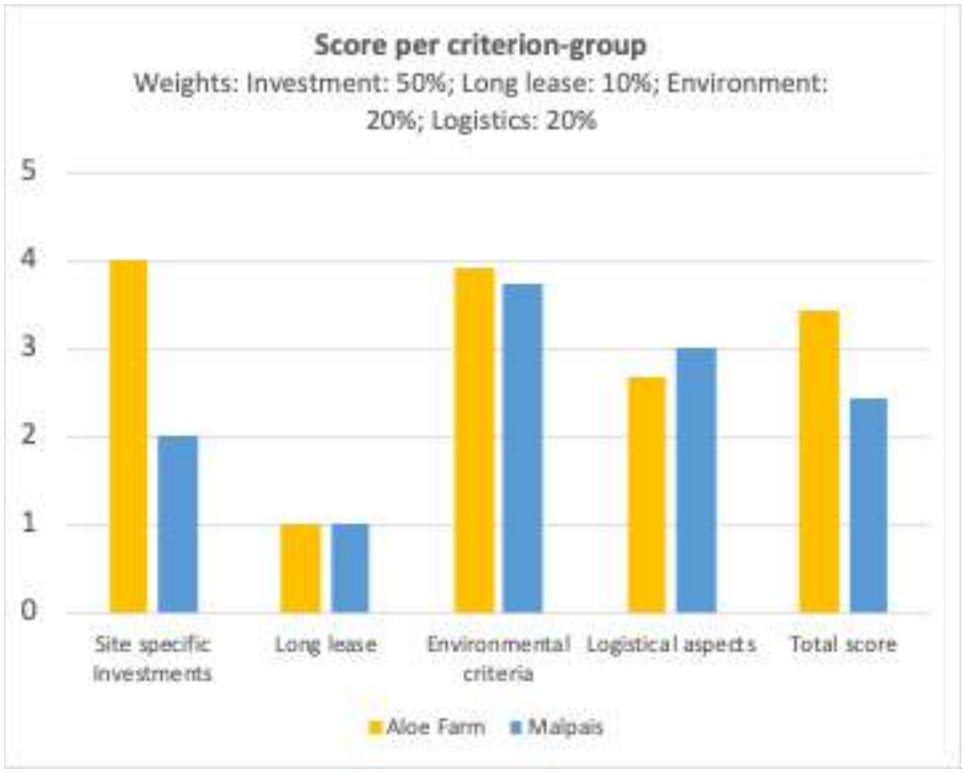

Figure 9.1: Scoring results for locations Aloe Farm and Malpais for the Waste Processing Option Composting of garden waste.

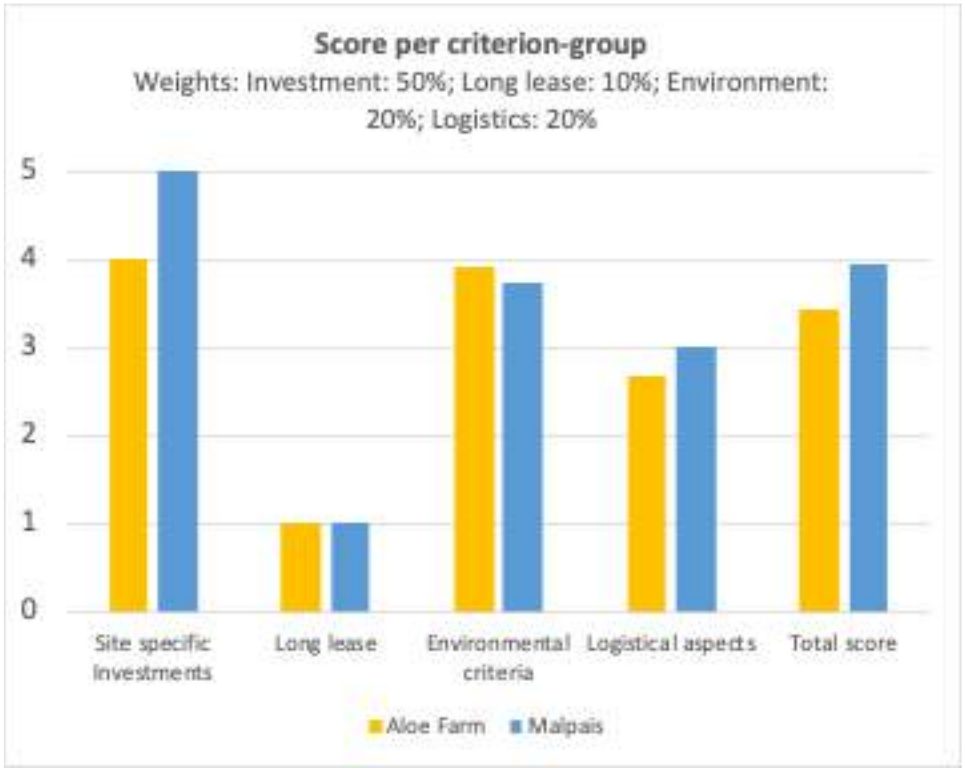

Figure 9.2: Scoring results for locations Aloe Farm and Malpais for the Waste Processing Option Composting of garden waste in case of no construction of electrical and water infrastructure (and use of biodiesel generator and deepwells)

10 Greenhouse gas (GHG) emissions

10.1 Climate Change

Waste disposal and waste treatment produce GHG emissions through aerobic and anaerobic decomposition. The GHGs emitted at a landfill are methane (CH_4), biogenic carbon dioxide (CO_2) and small amounts of nitrogen oxides (NOx) (IPCC, 2006). Methane and carbon dioxide are emitted roughly in equal volume amounts (see EPA website).

Methane and carbon dioxide have different impacts on climate change. This difference is expressed as the Global Warming Potential (GWP)[1]. The larger the GWP, the more a given gas warms the earth compared to carbon dioxide over a given period. The GWP for methane[2] is 28, the GWP for carbon dioxide is 1.

10.2 Approach determining greenhouse gas emissions

For estimating the GHG emissions, we used the Solid Waste Emissions Estimation Tool (SWEET). SWEET was developed by the U.S. Environmental Protection Agency (EPA). SWEET is an Excel-based tool that quantifies the total GHG emissions, being emissions of methane, carbon dioxide and other GHGs. The GHG emissions are expressed in metric ktons CO_{2eq}[3]. The calculations are in line with the First Order Decay (FOD) method defined in Volume 5 of the 2006 IPCC guidelines for National Greenhouse Gas Inventories. This method assumes that the degradable organic component (degradable organic carbon, DOC) in waste decays slowly throughout a few decades, during which CH_4 and CO_2 are formed.

Starting points

The calculation of GHG emissions is based on the emissions at the landfill and for the selected waste processing options at the waste processing plants. This includes emissions from all equipment used at the landfill and at the waste processing plants of the selected waste processing options. Emissions from trucks for waste collection are not considered.

General information for SWEET

The first tab to be completed in SWEET is the *General Information* tab. Annex 9A shows an overview of the filled-out tables on the *General Information* tab.

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[1] To compare GHG emissions of various gasses a comparison value (Global Warming Potential, GWP) for each greenhouse gas relative to CO_2 was introduced. The GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period, relative to the emissions of 1 ton of carbon dioxide (CO_2).

[2] The figure based on the IPCC's 4th Assessment Report (Forster et al., 2007) is 25. This is the GWP used in the United States of America and other developed countries. The IPCC's 5th Assessment report (2014) included methane GWP values ranging from 28 to 34.

[3] CO_{2eq} is a unit to express total GHG emissions and is calculated by multiplying the emissions of each of the six greenhouse gases by its 100-year GWP.

The *Per capita waste generation rate inside formal collection zones* has been adapted to the local situation, based on the *Total waste received at Malpais* (EcoVision, 2024)[1] and the population size according to Central Bureau of Statistics Curaçao (January, 2023).

The *Average annual % growth rate in quantity of waste collected – historical and projected future* are taken from the Waste Characterization Study. For the historical % growth rate this is -1% and for the projected future growth rate this is 2%.

The *Average composition of collected waste* has been taken from Table 9-1 and Table 9-2 of the Waste Characterization Study. Since the items in this table do not completely match the items in the SWEET table, adjustments were made to complete the SWEET table. Table 10.1 shows the conversion from Table 9-1 and 9-2 in the Waste Characterization Study to the items in the SWEET table.

Table 10.1: Conversion of items in Waste Characterization Study to items in SWEET.

Item name SWEET	Items from Table 9-1 (and 9-2) in Waste Characterization Study
Food Waste	Organic kitchen/food waste (Table 9-2) plus Sanitary waste
Green	Organic waste minus Organic kitchen/food waste (Table 9-2)
Wood	Wood
Paper/Cardboard	Paper/Cardboard
Textiles	Textiles
Plastics	Plastics
Metal	Metals + E-waste
Glass	Glass
Tires	Rubber
Other	Other materials + Minerals from construction and demolition waste + Hazardous + Durable non-metal goods

Landfill information

The second tab in SWEET to be completed is the tab *Collection – Transportation*. On this tab only the equipment used at the landfill is added. These are 1 excavator, 1 forklift, 1 bulldozer and 1 backhoe. Default values were used for hours of usage per year, horsepower rating and fuel usage.

The third tab in SWEET to be completed is the tab *Landfills and Dumpsites*. Opening of the landfill at Malpais is set on 1985 and closing in 2050. All waste collected (128.720 tons/yr) as indicated on the *General Information* tab is indicated to be disposed of on the Malpais landfill.

A crucial item is the classification in SWEET of the site as "landfill" (managed) or "dumpsite" (unmanaged). According to the IPCC *Solid Waste Disposal Guidelines* (IPCC, 2019)[2], the methane emissions strongly depend on the type of management of the solid waste disposal site (SWDS). Annex 9B shows table 3.1 of the IPCC *Solid Waste Disposal Guidelines.* Based on this table, the Malpais landfill must be classified as a

[1] Table 9-1 Waste Characterization Study Curaçao
[2] 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Managed – anaerobic site, because the site uses mechanical compacting and covers the waste with diabase. This type of SWDS has the highest default factor for the methane correction factor (MCF)[1], meaning that this type of SWDS has the highest emission of methane per ton of waste.

10.3 Results baseline greenhouse gas emissions

Using the SWEET tool, the calculated projected baseline GHG emissions for 2024 are **144 kton CO_{2eq}**. The graph in figure 10.1 shows the annual GHG emissions at the Malpais landfill from 1985 to 2050 for the baseline situation (continued landfilling expected until 2050).

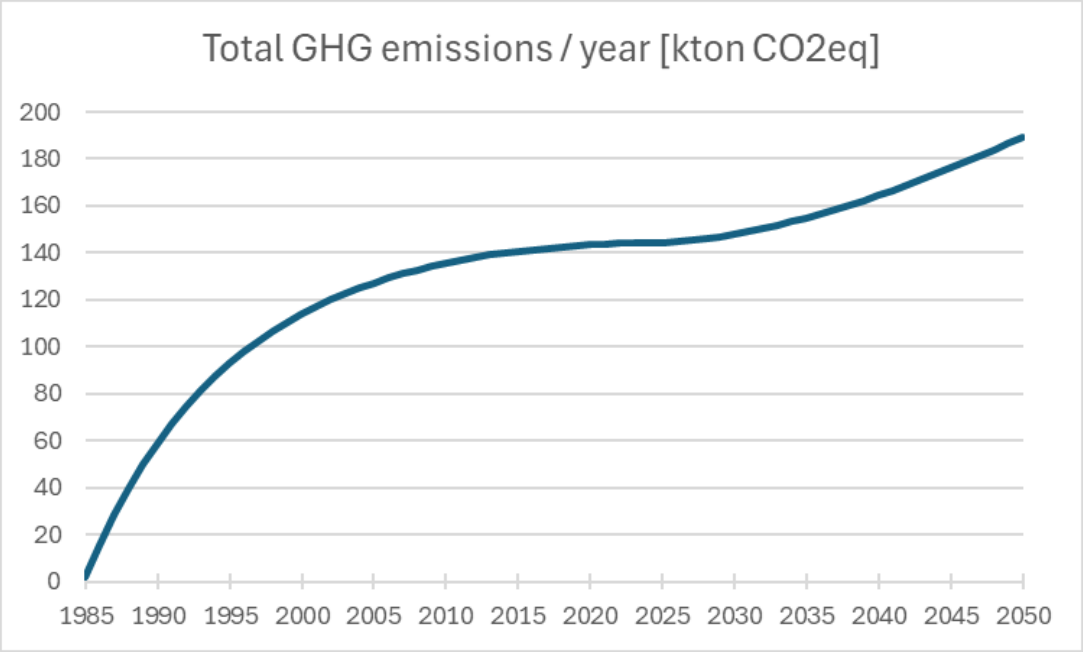

Figure 10.1: Graph of annual GHG emissions at the Malpais landfill for the baseline situation.

10.4 Verification of results

As a verification of the baseline results of the GHG emissions, we also calculated the GHG emissions using the Excel tool LandGEM. The inputs for LandGEM differ from SWEET. The main inputs for LandGEM are: *Methane Generation Rate, k* and *Potential Methane Generation Capacity* L_0. In SWEET these factors are calculated based on waste composition, region and climate input. The values used for these factors are summarized in the tab *Default Values* of the SWEET file.

For the *Methane Generation Rate (k)* the value determined in SWEET is **0.062/yr** and the value determined for the *Potential Methane Generation Potential* (L_0) is **70**. Annex 9D shows the tables from the *Default Values* tab in SWEET related to the calculation of the beforementioned factors.

Using the LandGEM model with the same waste amount and waste composition as in the SWEET model, resulted in a methane emission of **9.5 x 10^6 m^3/yr or 6.65 kton/yr** for 2024.

[1] *MCF* represents the portion of organic carbon that decomposes anaerobically.

Since LandGEM is meant to calculate landfill gas (methane) emissions and not greenhouse gas (GHG) emission, the GHG emissions had to be calculated based on the following assumptions (as also used in SWEET): GHG emissions consist for 50% of methane and 50% of CO_2 (both by volume) and the equivalent CO_2[1] emission for methane is 28. This resulted in a GHG emission of **202 kton CO_{2eq}/yr** for 2024.

Comparing the results of SWEET (144 kton CO_{2eq}/yr) with the results of LandGEM (202 kton CO_{2eq}/yr) both for 2024, shows a higher GHG emission from the LandGEM calculation by roughly 40% of the SWEET GHG emission. After contacting the organization Global Methane Initiative (GMI) that manages the SWEET model, we received the explanation that the LandGEM model is not as accurate as the SWEET model and most of the time it gives an overestimation. This is even more true in countries outside the USA (See Annex 9F for the full email response.)

Based on the response of GMI that the LandGEM results generally show an overestimation of the GHG emissions compared to the SWEET model, it can be concluded that the results of the SWEET model give a good representation of the GHG emissions at the Malpais landfill.

10.5 Evaluation of Waste Processing Options

10.5.1 Approach greenhouse gas emissions

We determined the anticipated production of GHG emissions in CO_{2eq} from the WPO(s) and compared it to the current situation (landfilling) as determined in section 10.3. For the GHG emission calculation of the WPOs we used the same Solid Waste Emissions Estimation Tool (SWEET) as for the current situation.

10.5.2 Greenhouse gas emissions option WtE

The mass balance for the WtE option indicates for each fraction how much of it will be recycled, which part will be incinerated, and which part will be landfilled. In the mass balance several residues from the WtE are also recycled and separated wood will be sent to the WtE. Table 10.2 shows an overview of the total amount of fractions recycled, based on information from the mass balance. The total amount of waste that will be recycled in the WtE option is 27.5 kton/yr. Based on the information from Table 10.2 and using Table 10.1 to convert the fraction names in the Waste Characterization Study to fractions in SWEET, the WtE alternative input table has been filled out. See Annex 9E for the WtE scenario in SWEET.

[1] In order to compare GHG emissions of various gasses a comparison value for each greenhouse gas relative to CO_2 was introduced, called the Global Warming Potential (GWP). This GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period, relative to the emissions of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the Earth compared to CO_2 over that time.

Table 10.2 Overview of total amount of fractions that will be recycled.

fraction	initial processing [ton/yr]	to WtE [ton/yr]	from WtE [ton/yr]	from C&D separation [ton/yr]	Total [ton/yr]
Paper	726				**726**
Cardboard	1,650				**1,650**
Plastics higher quality	550				**550**
Metals + e waste	1,500		2,147	1,239	**4,886**
Glass	0				**0**
Textiles	330				**330**
Minerals	0			19,285	**19,285**
Wood	1,995	-1,995			**0**
Total	6,751	-1,995	2,147	20,524	**27,427**

The results of the modelling of the GHG emissions for the WtE scenario show a significant increase in GHG emissions in 2030 (first year of operation of WtE scenario). GHG emissions in 2030 from the WtE scenario are 217 kton CO_{2eq} while emissions from the baseline scenario are 147 kton CO_{2eq}. This is due to the direct CO_2 emissions from the burning of the waste. For the year 2050 the GHG emissions from the WtE scenario show lower GHG emissions (167 kton CO_{2eq}) compared to the baseline scenario (189 kton CO_{2eq}). This decrease in GHG emissions from the WtE scenario is because less waste will be landfilled, resulting in lower methane and CO_2 emissions at the landfill. Figure 10.2 shows the GHG emissions for the baseline scenario and for both alternative scenarios.

10.5.3 Greenhouse gas emissions option Recycling Center

The mass balance for the Recycle option indicates for each fraction which part of it will be recycled at a recycling center, which part will be separated at a C&D separation plant, and which part will be composted or landfilled. In the mass balance several residues from the C&D separation are sent to the recycling center after separation. Table 10.3 shows an overview of the total amount of fractions recycled, based on the information from the mass balance. The total amount of waste that will be recycled in the Recycle option is 48.9 kton/yr and the total amount of waste that will be composted is 17.8 kton/yr.

Table 10.3 Overview of total amount of fractions recycled at option Recycling Center

fraction	initial processing Rec Center [ton]	from C&D separation [ton]	total [ton]
Paper	2,200		**2,200**
Cardboard	5,000		**5,000**
Plastics higher quality	2,200		**2,200**
Low quality plastics (post separation)	6,000		**6,000**
Metals + e-waste	3,000	1,239	**4,239**
Glass packaging to cans	4,755		**4,755**
Glass	4,200		**4,200**
Textiles	1,000		**1,000**
Minerals	0	19,285	**19,285**
Total	28,355	20,524	**48,879**

Based on the information from table 10.3 and using table 10.1 to convert the fraction names in the Waste Characterization Study to fractions in SWEET the Recycle alternative input table has been filled out. See Annex 9.E for the filled out Recycle scenario in SWEET.

The results of the modelling of the GHG emissions for the Recycle Center scenario (see also figure 10.2) show a slight decrease in GHG emissions in 2030 (first year of operation of Recycle scenario). GHG emissions in 2030 from the Recycle scenario are 145 kton CO_{2eq} while emissions from the baseline scenario are 147 kton CO_{2eq}. This is due to less landfilling of green waste. By 2050, the GHG emissions from the Recycle Center scenario are significantly lower (111 kton CO_{2eq}) compared to the baseline scenario (189 kton CO_{2eq}). This reduction in GHG emission under the Recycle Center scenario is due to reduced landfilling, resulting in lower methane and CO_2 emissions.

10.5.4 Comparison of the WtE and Recycle options

Figure 10.2 shows a representation of GHG emissions in ton CO_{2eq} for the baseline situation (business as usual; BAU) and for the waste processing options WtE and Recycle for the period 2024 to 2050. The option with the lowest GHG emissions is the Recycle option. The WtE option has higher emissions than the BAU situation in the first 10 years of operation, but after 10 years emissions are lower. In the long run, the emissions for both the WtE and Recycle option will be significantly lower than for the BAU situation.

The 'jump' in GHG emissions in 2030 for the WtE option is caused by the CO_2 emission from burning the waste, while the existing waste on the landfill continues to emit GHG. The strong decrease in GHG emissions in 2031 for both the WtE and Recycle option is caused by composting of green waste, resulting in a significant reduction of GHG emissions in 2031.

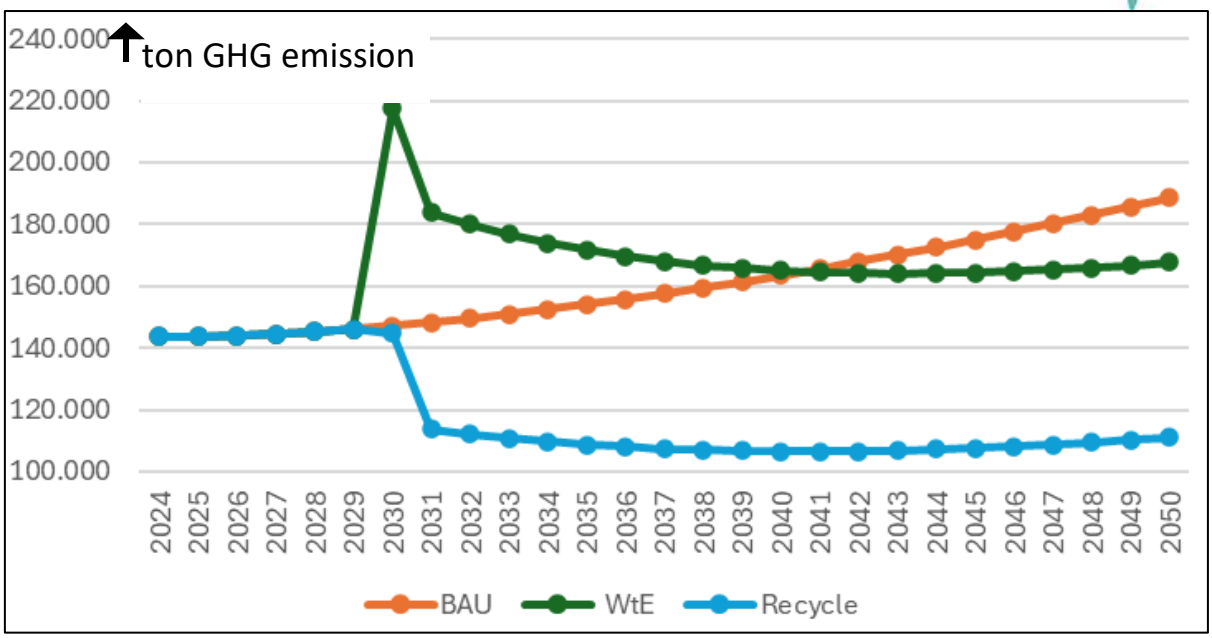

Figure 10.2: Representation of GHG emissions in ton CO_{2eq} for the business as usual (BAU) situation (baseline situation) and for the waste processing options WtE and Recycle Center for the period 2024 to 2050.

11 Conclusions and recommendations

11.1 Conclusions

Waste to Energy

Although the option of Waste to Energy (WtE) is not considered a financially feasible option for Curaçao (RHDHV, 2025), the option cannot be fully excluded for the future and possible locations for WtE have been evaluated in this report.

For Waste to Energy three locations were found to be preferred, all in the center of Curaçao: ISLA East, Asphalt Lake and Van Leer. Compared to other locations, their central position on the island makes these locations highly favorable from a viewpoint of logistical management of waste flows. The three locations West of Willemstad - Bullenbaai East, Meiberg and Malpais - score lower with respect to the logistical aspects, such as distances for hauling of waste, and possible obstruction of aviation, but also because of proximity of future residences, impacts to nature and visual impacts.

Higher land lease costs in the three central locations - compared to the other locations - are still relatively low compared to overall operational expenses and do not weigh significantly in the multicriteria analysis.

It is important that an eventual WtE for Curaçao complies with the latest EU legislation or stricter. This EU legislation stipulates the continuous measurement of POPs (persistent organic pollutants such as dioxins and furanes) and the correct procedures in case of unplanned shutdowns and startups. Planned and unplanned shutdowns and startups lead to much higher dioxin emissions than regular operations.

The downwind distance to residential areas of the three preferred locations is approximately 1.3 to 3.5 kilometers. POPs from previous generations of WtE facilities in Europe are measurable and significantly elevated up to 1.5 kilometers from the source (attached to vegetation) or 5 kilometers from the source (in eggs from backyard chickens).

Construction and Demolition Waste recycling

For Construction and Demolition Waste recycling the preferred locations are Brievengat and Malpais. The main reason for the high scores of these two locations are exceedingly low land lease costs and - in case of Brievengat - low site-specific investments. For this specific waste processing option, financial criteria are given significant weight in the multicriteria analysis, for reasons of low economic margins of the operation.

ISLA West and Meiberg, having the same score, are slightly less preferred than Brievengat and Malpais, but may both be considered as good alternatives.

Industrial Recycling Hub

The preferred locations for an Industrial Recycling Hub are Buskabaai North, a small site just north of the Dry Asphalt Lake and ISLA West. Buskabaai North combines good logistical and environmental conditions with exceptionally favorable land lease costs, a factor given much weight because of low economic margins of the operation. At ISLA West low site-specific investments contribute to the positive valuation.

Composting facility

The preferred location for a Composting facility (with future processing of chicken manure) is the Aloe Farm. Although the location of Malpais scores significantly better on the criterion “impact to local communities” (less risk of odor, no neighborhoods downwind), the high costs of infrastructure for power and water weigh substantially. The reason for weighing financial factors heavily are low economic margins of the operation.

If no electrical and water infrastructure would be constructed at Aloe Farm and Malpais and the composting facility would be run with a generator set (fueled with biofuel) and deepwells, Malpais would be the preferred location for composting.

11.2 Recommendations

All WPOs

Most recommendations are related to location selection. For recommendations related to processes and economy of the WPOs we refer to the feasibility study of RHDHV (RHDHV, 2025).

It is recommended to carry out a full environmental and social impact assessment (ESIA) for the selected combinations of technology and location. Part of this ESIA process would be a stakeholder consultation in which the preferred locations are presented and discussed. The results of this study may provide a basis for such dialogue.

Waste to Energy

Two of the preferred locations for WtE are under the management contract with Oryx, but will probably not be used by them. If WtE would become a serious option for further study, it is recommended to start negotiations with 2Bays and Oryx about the use of the land and the long lease fees.

If WtE would become a serious option for further study, it is important to use the strictest standards for air emissions. Most efficient mitigation of emissions of POPs (persistent organic pollutants such as dioxins and furanes), especially in other than normal operation conditions should be stipulated.

Construction and Demolition Waste recycling

It is recommended to start the first phase of C&D waste recycling (only sorting, no stone crushing) at two locations: Malpais and Brievengat. This minimizes transport distances for waste (from Bandariba and Bandabao) and products (to Heavy Mix and Betonindustrie Brievengat) and offers the opportunity to

build up experience with this type of industry in the vicinity of other industry, sensitive to dust emissions (Brievengat).

The long lease costs for the use of the Malpais area may be lower than 2 USD/m^2.y. It is recommended to start negotiations with Government about the use of the land and the land lease fee as soon as possible.

Industrial Recycling Hub

Carry out negotiations with Buskabaai N.V. and the Government to realize a long lease fee for Buskabaai North of USD 3.00/m^2.y or less. Carry out negotiations with 2Bays to realize a long lease fee for ISLA West of less than USD 12.50/m^2.y.

Composting facility

It is recommended to start negotiations with the Aloe Farm together with Government about land lease options and costs for the Aloe Farm site as soon as possible.

If these negotiations do not lead to the expected result, Malpais should be considered as a good option. In this case the option of being independent from the water- and electrical grid, using deepwells and a (biodiesel) generator, is a promising option.

In this case, a survey for groundwater availability and groundwater quality is recommended, near the area of interest. If sufficient water of sufficient quality (no contamination from the landfill) is present, this water may be used for the composting process and costs for new water infrastructure could be avoided. Costs of electrical infrastructure could be avoided using a (biodiesel) power generator.

12 Literature

Arkenbout, A., Esbensen, K. 2017. Sampling, monitoring and source tracking of dioxins in the environment of an incinerator in the Netherlands.

Arkenbout, A., Bouman, K. 2021. Biomonitoring research results: Kauna (Lithuania), Madrid (Spain), Pilsen (Czech Republic).

United States Census Bureau, 2022. Measuring America's People, Places, and Economy.

EcoVision and Gemeentewerken Rotterdam, 2012. Cost estimations for soil and groundwater remediation Isla Refinery Curaçao, including costs for dismantling refinery units.

EcoVision and Royal Haskoning/DHV, 2024. Waste Characterization Study Curaçao, Waste to Value.

EcoVision N.V., 2006. Intern Milieuzorg Plan behorend bij het project Asfaltwinning Buskabaai.

Edo, 2021. Waste-to-Energy and Social Acceptance: Copenhill Waste-to-Energy plant in Copenhagen.

European Union, 2010. Directive 2010/75/EU.

EPRI, 2004. Comparison of Alternate Cooling Technologies for U. S. Power Plants Economic, Environmental, and Other Tradeoffs.

European Commission, 2001. Reference Document on the application of Best Available Techniques to Industrial Cooling Systems.

Hamanaka, B. Haihua Zhao, Phil Sharpe, 2009. Comparison of Advanced Cooling Technologies Efficiency Depending on Outside Temperature.

Guan, Z., Hal Gurgenci, 2009. Dry Cooling Technology in Chinese Thermal Power Plants. Australian Geothermal Energy Conference 2009.

Put, J.A.L., Janssen, G.M.T., 2008. Inventarisatie Microstof van Megarecycling, Enviro Challenge.

Rijkswaterstaat, 2023. Onderzoek maatregelen bij mobiele puinbrekers.

RHDHV, EcoVision, 2002, Herinrichtingsplan stortplaats Malpais, Curaçao.

RHDHV, 2025: One Feasibility Study to Determine the Most Appropriate Waste Processing Options for Curaçao.

Rijkswaterstaat, 2018. Notitie dioxine emissies bij AVI's.

Werbata, J., 1910. Topographical Map of Curaçao.

Zero Waste Europe, 2023. Long-awaited revamp of Industrial Emissions Directive improves dioxin monitoring in incinerators.
https://zerowasteeurope.eu/press-release/long-awaited-revamp-of-industrial-emissions-directive-improves-dioxin-monitoring-in-incinerators/

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TRANSFORMING WASTE TO VALUE

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