The background image is an aerial photograph of a coastal city, likely Havana, Cuba. It shows a dense urban skyline with various high-rise buildings and residential structures. In the foreground, there is a large body of blue water, possibly a bay or harbor, with a concrete pier extending into it. The sky is clear and blue.

PROJECT: CUB/99/G31  
DEMONSTRATION OF INNOVATIVE  
APPROACHES  
TO THE REHABILITATION OF HEAVILY  
CONTAMINATED BAYS  
IN THE WIDER CARIBBEAN

*Regional Workshop to promote Environmental  
Sound Water and Wastewater Provision at the  
Community Level in the Caribbean.*

*Kingston, Jamaica 28-29 November 2007*



# REPUBLIC OF CUBA



# INTRODUCTION

The island of Cuba embraces a total area of 110 860 Km<sup>2</sup>. It is divided into 14 provinces and a special municipality. It has a longitude of 1200 Km and its maximum width is of 191 Km in the Eastern region and the minimum one is of 31 Km in the Western region.

The total population counts on little more than 11 million inhabitants.

The national territory covers a surface areas of 110 994 km and it has an insular platform of 67 823 km (approximately) and a marine platform (inner waters and territorial sea) 1.3 times larger than the surface emerged. Coastal areas are characterized by several bays and inlets an run for more than 6000 km (3209 km to the north coast and 2537 in the southern coast).

Havana City, capital of Cuba, is located in the island North West coast. It has a population of 2 181324

inhabitants and a territorial extension of 727, 4 Km<sup>2</sup>, with a demographic density of 3163,7 inhabitants / Km<sup>2</sup>, which is characteristic of big cities.

# Havana Bay – Cuba

Havana Bay is located in the North coast of Cuba, in the Eastern Region of the Country. It is a typical small pouch-shaped bay with a surface of 5.2 Km<sup>2</sup>, an average depth of 9 m. and contains 47 millions of m<sup>3</sup> of water.



The bay has three inlets: Marimelena, at the Northeast, Guasabacoa at the Southeast and Atarés at the Southwest, where three small streams (Luyanó, Martín Pérez and Arroyo Tadeo Rivers) discharge their water. The bay receives inflows from highly polluted water from the streams, storm drainage systems and industries.

The most important pollutant source to Havana Bay is the Luyanó River, which carries about 90 % of the organic pollutant load to the bay. Also, important sources of pollution are the oil refinery (the main source of oil pollution), and the large volume of untreated wastewater discharged by the Arroyo Matadero.

# PROJECT: CUB/99/G31 " DEMONSTRATION OF INNOVATIVE APPROACHES TO THE REHABILITATION OF HEAVILY CONTAMINATED BAYS IN THE WIDER CARIBBEAN"

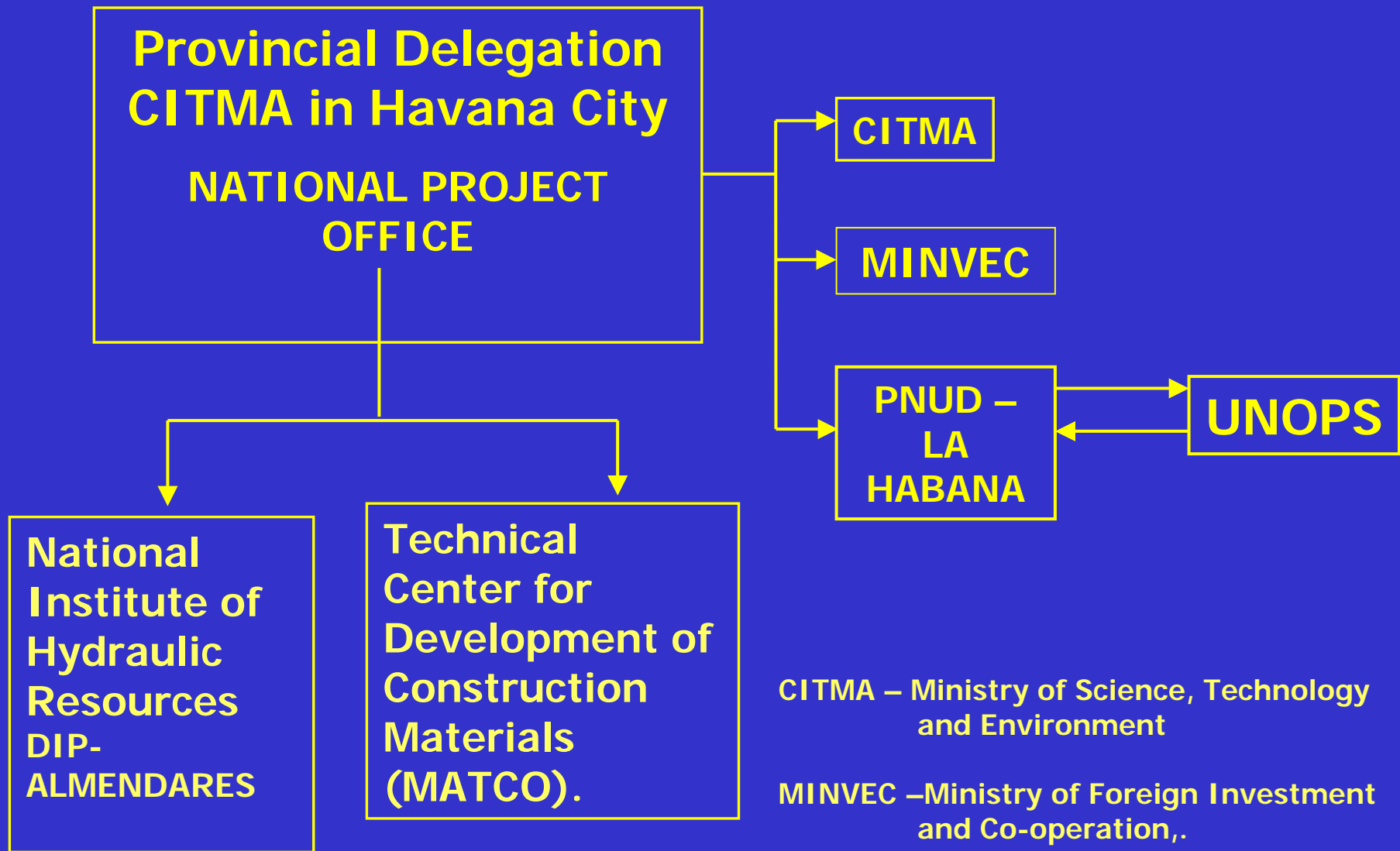
## The *global environmental objective:*

To demonstrate and promote regional replication of innovative technical, management, legislative and educational approaches to reducing nutrient loads to Havana Bay and to the Wider Caribbean.

- The *long-term objective:*

To promote and facilitate environmentally sustainable development and management of the Havana bays and to disseminate and replicate successful approaches to other sites in the wider Caribbean facing similar environmental challenges.

# ORGANIZATIONAL STRUCTURE



CITMA – Ministry of Science, Technology and Environment

MINVEC – Ministry of Foreign Investment and Co-operation,

PNUD – United Nations Development Program

UNOPS – United Nations Office for Project Services

**OUTPUT No1: Construction of a sewage treatment plant, including nutrient removal and sludge utilisation . (Treatment plant and Collectors wastewater)**

**Activity No.1:  
Nutrient Removal  
(Nitrogen and  
Phosphorous)**

**Activity No.2 :  
Sludge utilisation**

**Executant :National Institute of Hydraulic Resources  
DIP-ALMENDARES**

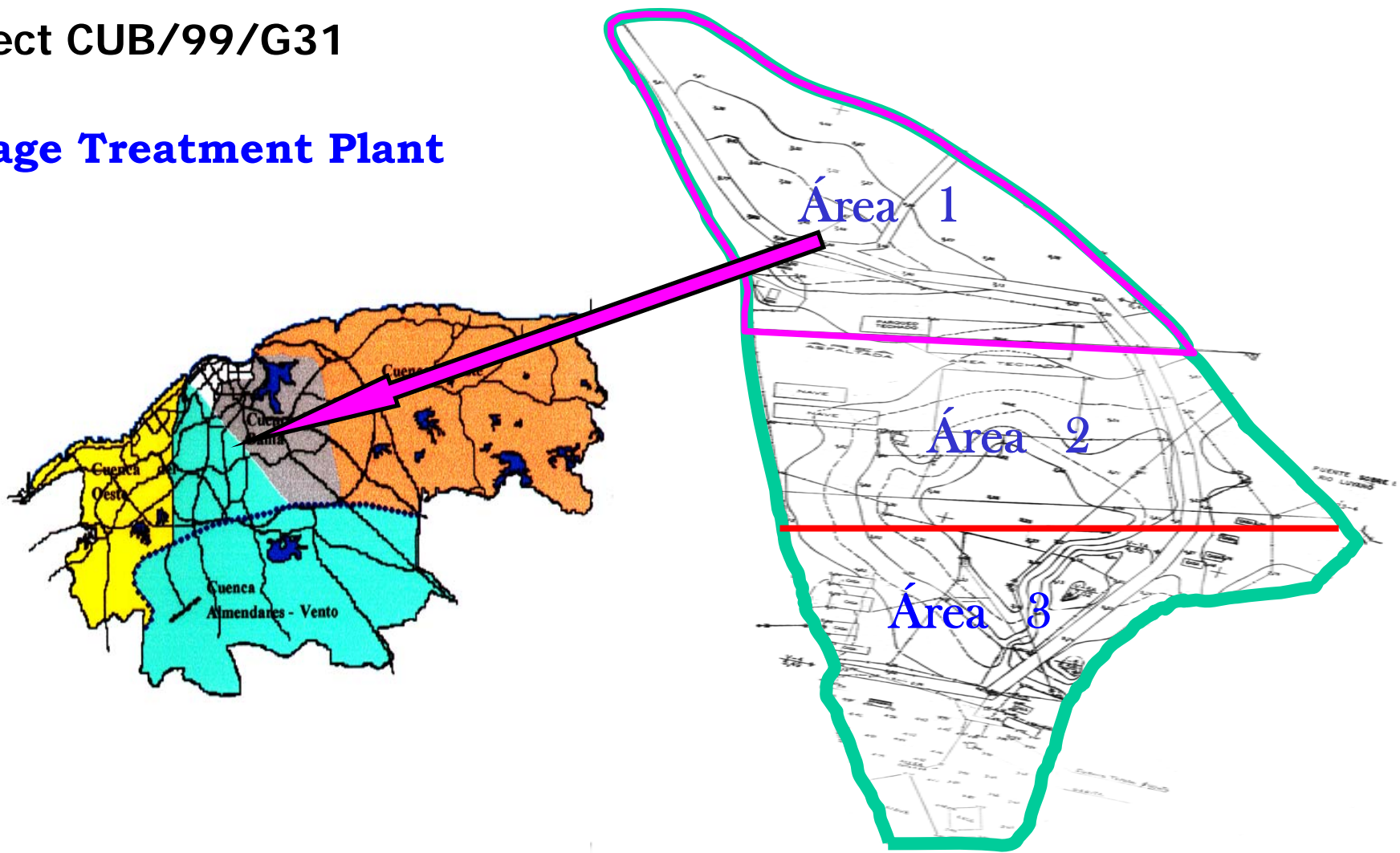
# SEWAGE TREATMENT PLANT LUYANO IV

This Plant is located to the north of Havana City on the Luyanó River, 10 de Octubre municipality and has an area of 4.6 ha.

The plant will treat the inflow from the residential areas, its flow being 200 l/s (17, 280 m<sup>3</sup> / hr) for a coverage of 62 000 people living in municipalities on the Havana Bay's tributary watershed.

# Project CUB/99/G31

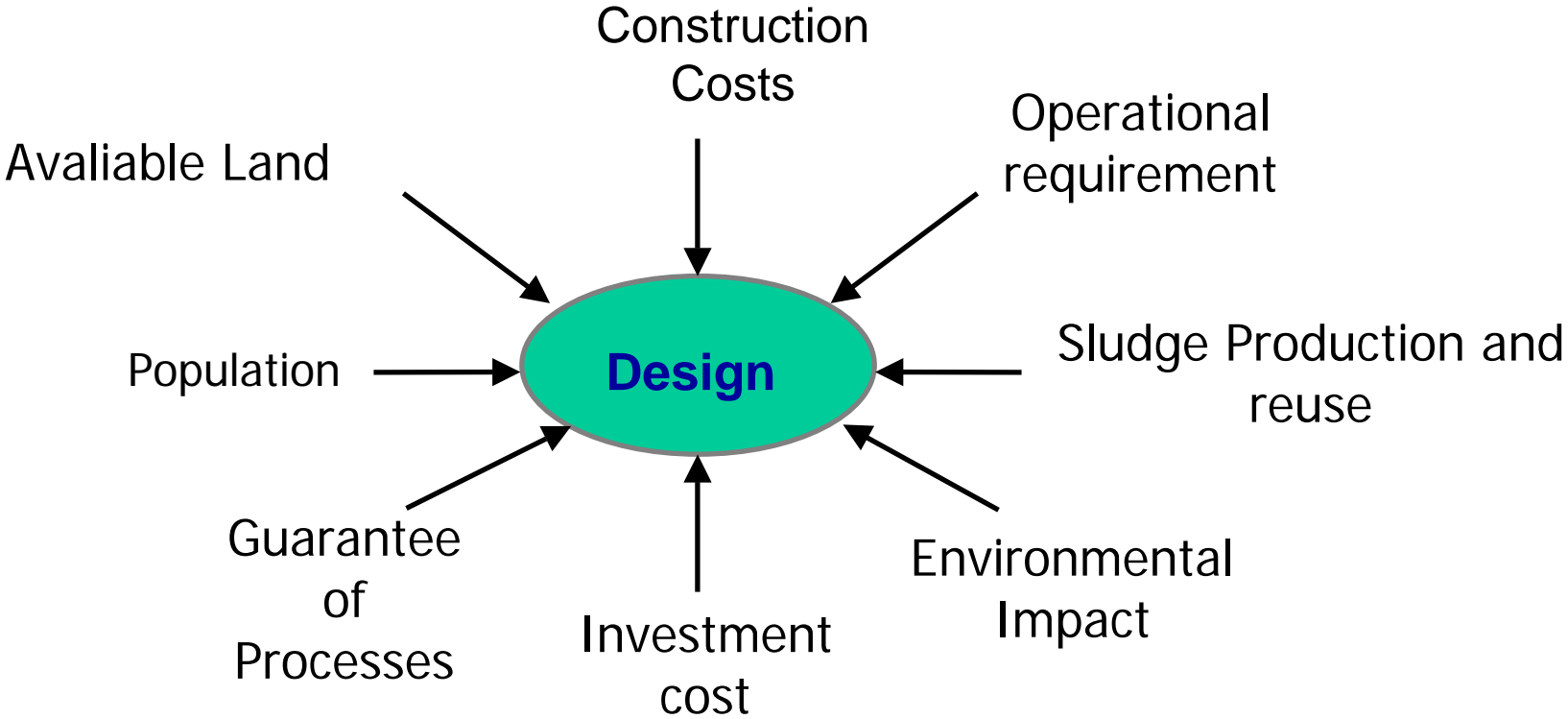
## Sewage Treatment Plant



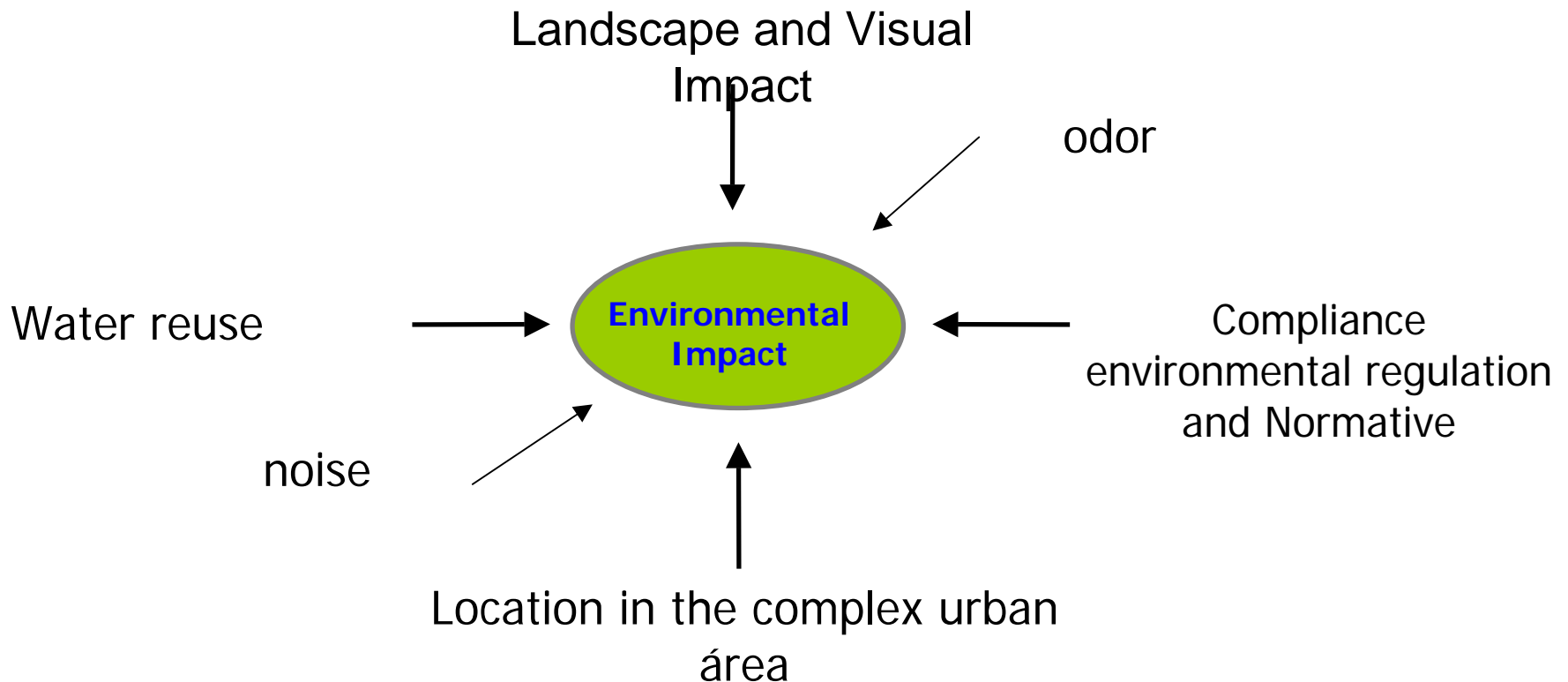
# Location of Wastewater Treatment Plant



# MAIN INDICATORS FOR DESIGN



# ENVIRONMENT IMPACT ASSESSMENT



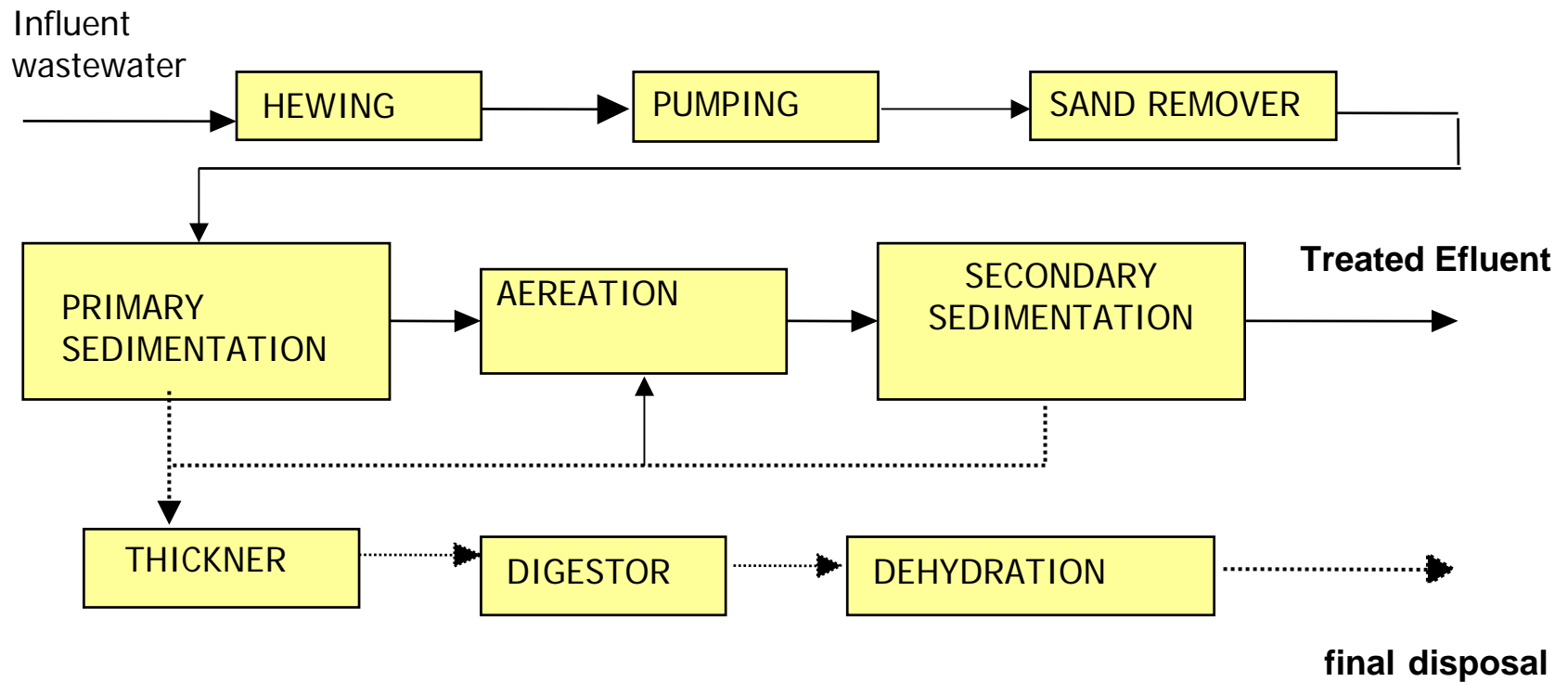
# DESIGN CRITERIA

Organic matter	BOD <sub>5</sub>	200 mg/l
Suspended Solids		220 mg/l
D.Q.O.		500 mg/l
Nitrogen-K		32 mg/l
Phosphorous	Total	9 mg/l

# Efluent Quality

<b>Organic matter BOD<sub>5</sub></b>	<b>40 mg/l</b>
<b>Suspended Solids</b>	<b>2 mg/l</b>
<b>D.Q.O.</b>	<b>90 mg/l</b>
<b>Nitrogen-K</b>	<b>10 mg/l</b>
<b>Phosphorous Total</b>	<b>4 mg/l</b>

# DIAGRAM OF SEWAGE TREATMENT PLANT LUYANO IV



———— Line of sewage

..... Line of sludge

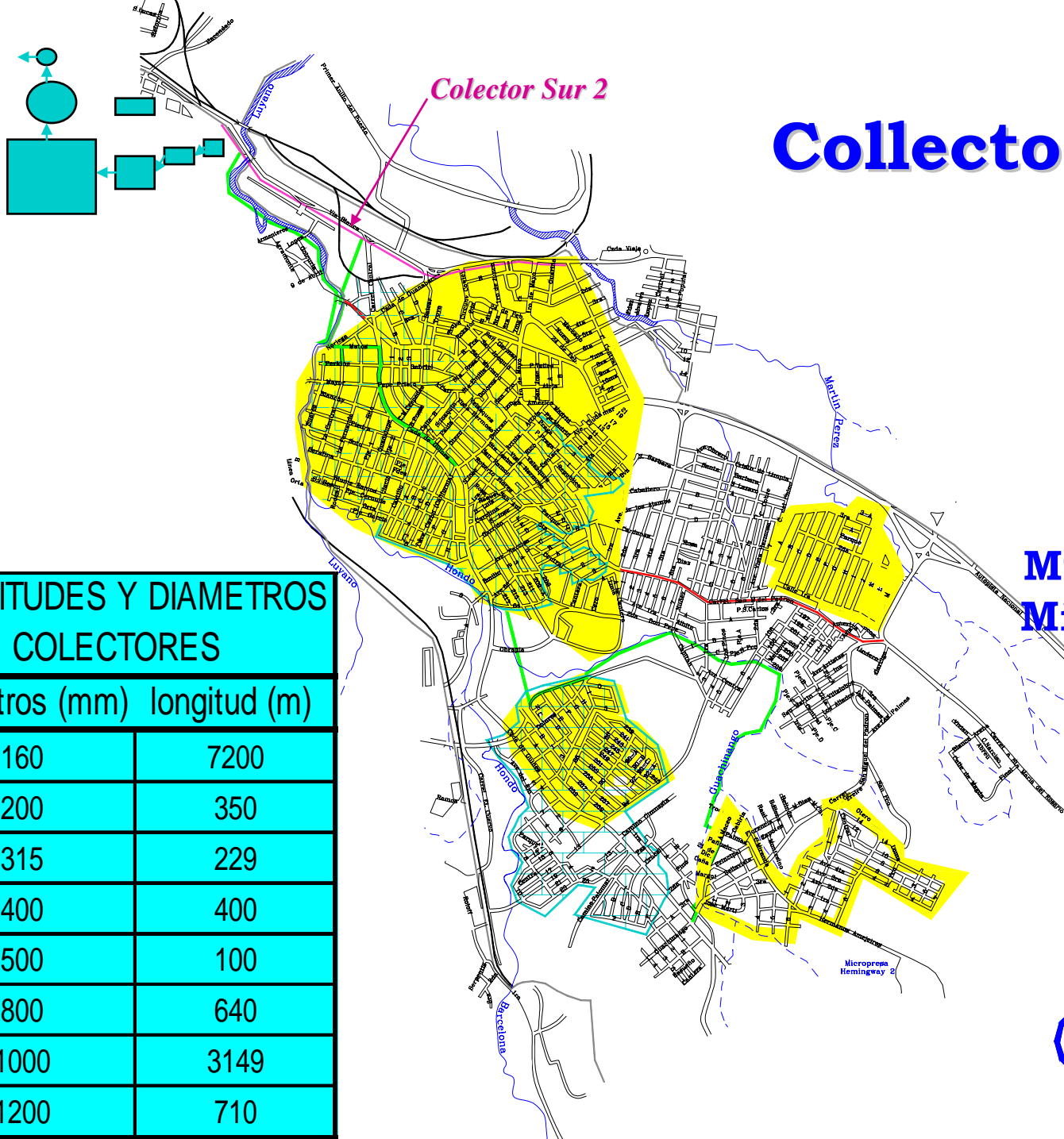
# Collectors System

Municipality San Miguel del Padrón

## LONGITUDES Y DIAMETROS DE COLECTORES

diametros (mm) longitud (m)

160	7200
200	350
315	229
400	400
500	100
800	640
1000	3149
1200	710



*Investigaciones  
y Proyectos  
Hidráulicos Habana*

**OUTPUT No. 2: Demonstration projects focusing on recycling of nutrients and energy from wastewater.**

```
graph TD; A["OUTPUT No. 2: Demonstration projects focusing on recycling of nutrients and energy from wastewater."] --- B["Activity No.1:  
Zero emission housing"]; A --- C["Activity No.2 : Sewage treatment in are as with low infrastructure and housing standards"];
```

**Activity No.1:  
Zero emission housing**

**Activity No.2 : Sewage treatment in are as with low infrastructure and housing standards**

**Executant: Technical Center for Development of Construction Materials (MATCO).**

PROJECT

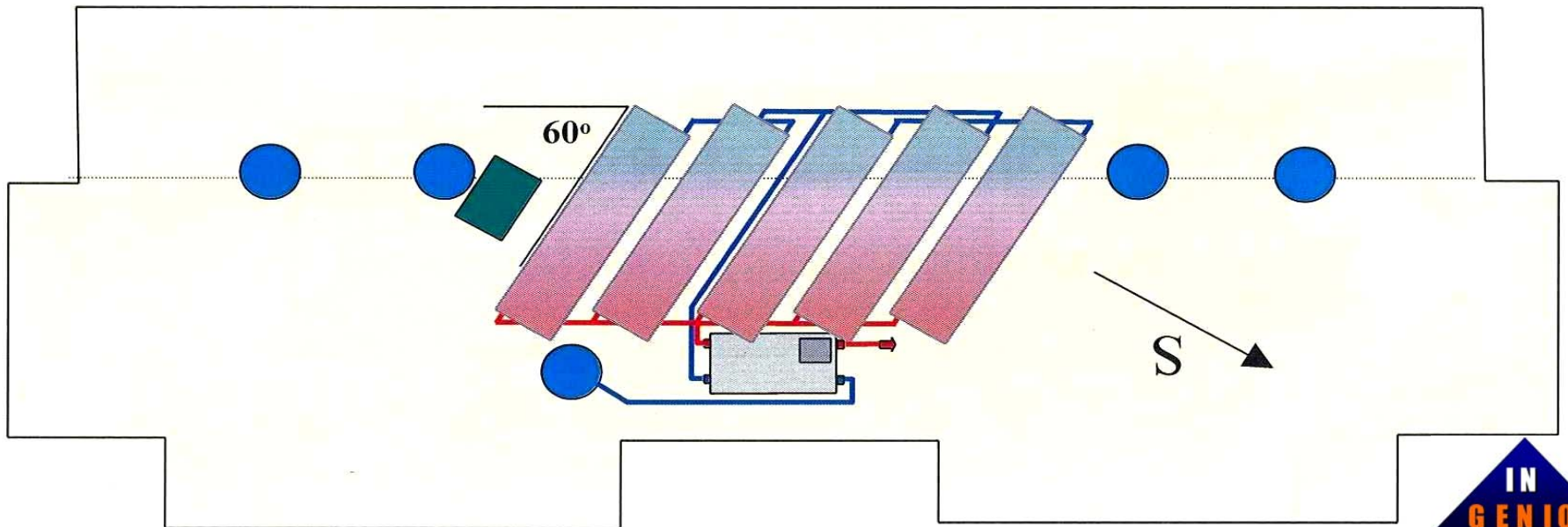
"ZERO EMISION"

## OUTPUT No. 2: Demonstration projects focusing on recycling of nutrients and energy from wastewater.

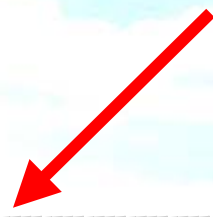
- The main purpose is the demonstration of the relevant technologies as well as building local capacities to manage pollution problems based on the hydro-sanitary facilities making up the wastewater treatment system at Havana Bay's watershed.
- A Zero emission 16-apartment residential building is completed with an original Norwegian wastewater treatment system.
- Sewage: To be collected by means of special water closets, the organic waste being treated anaerobically in order to produce biogas and fertilizers for use in urban agriculture.
- Grey water: To be treated for crop irrigation.
- This activity involves monitoring, analysis and control of all the results in addition to the technical-economic and social evaluation of the impacts.

# SOLAR PANELS OF THE BUILDING

This project includes the use of the solar energy. The photovoltaic cells give the energy for the hot water of the 16 apartments and the operation from the vacuum pumping.

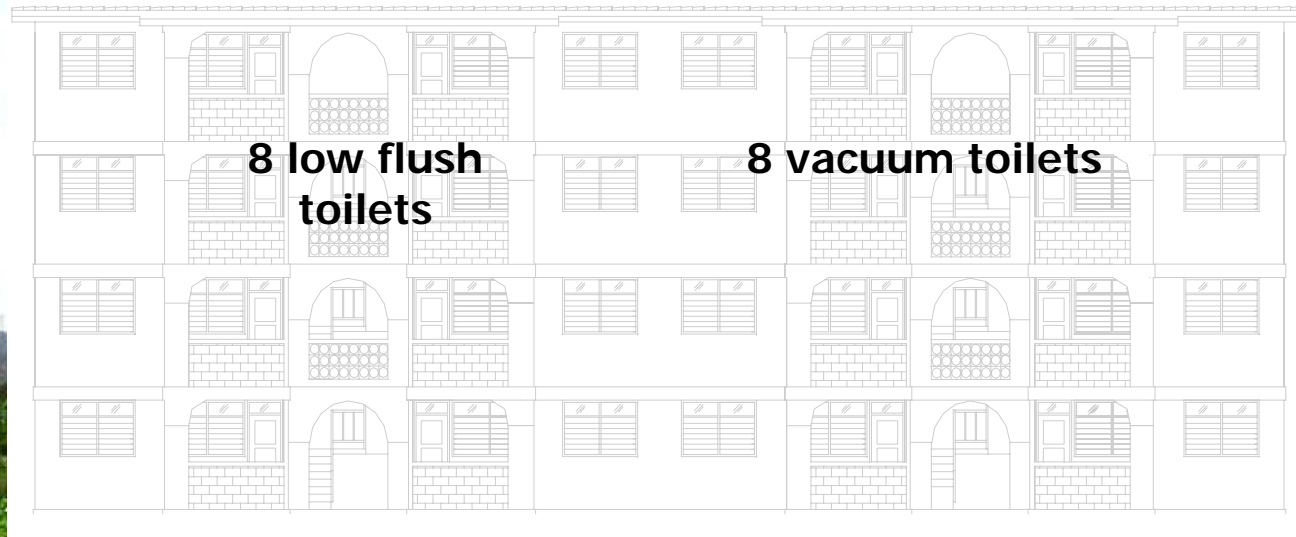


# Solar Panel on The Building for operación of vacuum pumping



**Biogas**

# TREATMENT OF GRAY WATER





**CONSTRUCTION OF  
BUILDING  
"ZERO EMISSION "**



# *EXPERIMENT "ZERO EMISSION"*

## *ADVANTAGES*

- Nitrogen recycling between 80 – 90 % of waste waters.
- Decreasing organic matter (DBO > 90%).
- Decreasing of pipelines necessity (more expensive phase in the sewerage construction)
- Substitute expensive and harmful chemical fertilizers.
- Nutrient recycling at local level, decreasing necessity transportation
- Energy generation from wastewater
- Treatment Facilities can be adjusted easily to the available lands.
- Reduce of water consumption from toilet use. (25-30%)

# LEARNED LESSONS

- The integration of Project objectives with the national environmental policies has contributed valuably for its successful development.
- The implementation of the project has promoted the invigoration from the technical specialized capacities to national level.
- The efficiency of the Project has been increased through team work that includes to the technical and scientific entities (at local and national level), Cuban companies, and entities of the United Nations and foreign companies.
- It would have been beneficial for the implementation of FSP (Full Size Project) a first phase of PDF that includes time and financing for the design stages, projects of basic engineering, the preparation of the bid documents, the estimate of costs and the implementation arrangements.