No.

Republic of Mauritius
Mauritius Wastewater Management Authority

Republic of Mauritius
Technical Assistance
for
Grand Baie Sewerage Project Phase 1-B

Final Report

Volume2: Report of Topographic Survey

March 2011

Japan International Cooperation Agency (JICA)

NIPPON KOEI CO.,LTD. (NK)

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1. REPORT OF SURVEY

Republic of Mauritius
Technical Assistance
for
Grand Baie Sewerage Project Phase 1-B

STREET SURVEY

HOUSEHOLD SURVEY

NIPPON KOEI CO. LTD

(21.03.11)

KDA GEOSYSTEMS LTD

ENGINEERING DESIGN, DATA PROCESSING &
GEOMATICS CONSULTING FIRM
Stratton Court, Office No 24, Poudrière Street
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INTRODUCTION

1. Introduction

1.1 Background of survey

It is the Government's intention to provide a sewer reticulation network in the Grand Baie area under the Grand Baie Sewerage Project Phase 1-B. The area of interest (AOI) forming part of the survey area is indicated in *Figure 1.1.1* by the red hatchings.

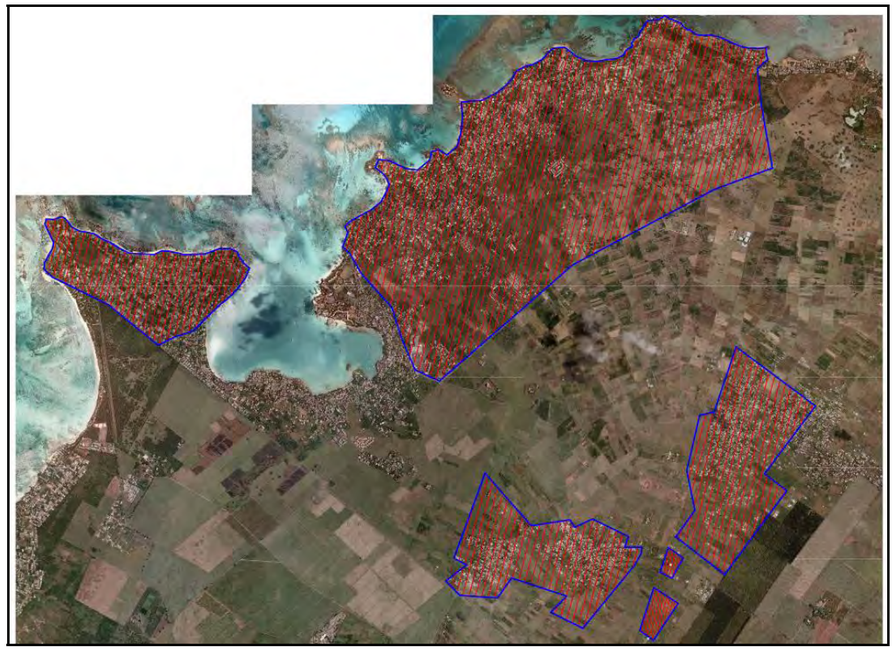


***Figure 1.1.1*: Project area**

The total area covered by the project is approximately 12,064,400 m^2 and include areas of Pointe aux Cannoniers, Petit Raffray, The Vale, Pereybere, Cap Malheureux and Sottise. The survey areas are generally connected by tarred roads.

1.2 Objectives of the survey

The objectives of the survey were as follows:

(a) undertake a street survey
(b) undertake household survey

1.2.1 Street survey

The street survey involved:

- Topographic survey of 35 km including (spot levels)
- Survey of visible services (Electric pole, telephone pole, valves etc)
- Survey of entrances

The 35km earmarked for survey are indicated in *Figure 1.2.1*

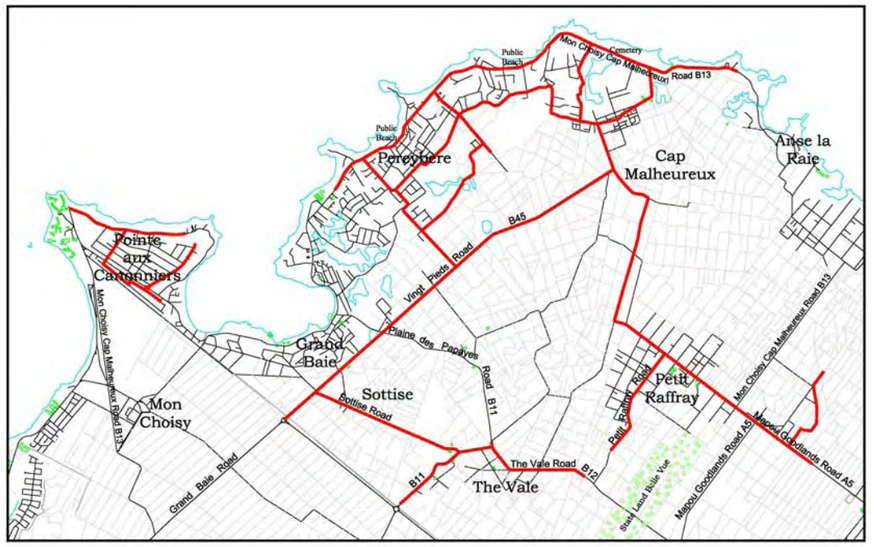


***Figure 1.2.1*: 35km street survey**

1.2.2 House survey

The house survey involved:

- Survey of spot height inside the house yard
- Survey of an additional 5km along identified streets
- Survey of spot height at house entrance where accessible

All surveys were connected to the National grid coordinates with heights above mean sea level (amsl).

2. Equipment

Geodetic quality – dual frequency Leica SR530 with Real Time Kinematic (RTK) link. RTK GPS was used to ensure repeatability of measurements. A base station was set up as indicated below:

***Figure 2.1.1*: GPS Base station**

- Leica Total stations: TC 407 and reflectorless TS06
- Two carbon fibre pole rovers
- Prisms, poles, nails, hammers, tripods, chalk, radios

2.1 Materials used

- Existing plans from KDA Geosystems archives
- Orthorectified aerial photography
- Leica SKI Pro V 2.6

2.2 Constraints

- Vehicles driving along the roads to be surveyed meant obstructions of lines of sight
- Fast moving vehicles were sometimes a safety hazard to the staff working on the street survey.
- Identification of the 35km occurred as survey progressed on site making planning of survey tasks challenging.

3. Street survey

- Reconnaissance was carried out on site to identify site conditions.
- An arbitrary coordinate system was used to begin the street survey given the absence of official coordinates on the national grid
- A plane coordinate system was created on site using the GPS firmware to ensure compatibility between total station equipment and RTK GPS.
- Two GPS rovers were used in RTK mode to collect survey data. The RTK GPS rovers could only be used where “clear sky” was available.
- Where no “clear sky” was available, the total stations were used. The total stations generally also involved the use of prisms.
- Upon completion of the street survey (35km), the survey was connected to the national grid following issue of coordinates on the national grid by the client.

3.1 Connecting the Street survey to the National Grid

The street survey was connected to the national grid using the point and coordinates provided by the client. A static GPS technique was used to that effect. Adequate planning was required in order to assess satellite availability prior to undertaking the static survey. Planning was carried out using the GPS almanac. *Figure 3.1.1* shows the GPS predicted satellite positions:

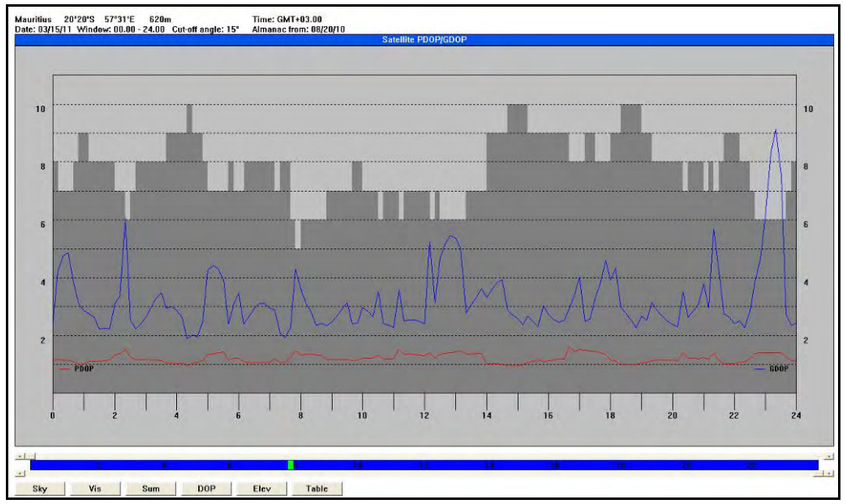


Figure 3.1.1 GPS predicted satellite positions

The transformation was carried out, using a plane transformation and a height adjustment technique. The transformation caters for conversion from WGS84 ellipsoid to a local grid system and change from ellipsoidal height to orthometric height. Conversion from WGS84 to the local

grid was performed using a 1-step transformation. The 1-step transformation ensures greater accuracy and direct conversion to a planar surface. It is also brought to the user's attention that inherent errors are present in the Mauritian national grid (Dare, 1994). Hence the relative precision between coordinates submitted will be correct but traversing or connection of such coordinates to existing points on the national grid may not fit

For the purpose of this exercise, the ellipsoidal height has been neglected.

The GPS North arrow has been used for the purpose of this survey

Corrections:

- Ionospheric using L1/L2
- Tropospheric using Hopfield model
- Ambiguities to all points resolved from a GPS static Base station
- Exogenic factors such as ocean loading and earth body tide displacement have been neglected as survey was performed over a relatively small area

3.2 Downloading & Plotting

- The data collected on site was stored on PCMCIA cards for RTK GPS and internal memories for total stations
- The data was downloaded using appropriate software/firmware and processed for upload into CAD package
- Plotting of features was effected using codes collected/stored on site
- Based on collected spot levels, a DTM was generated and L profiles plotted
- A typical L profile is shown *Figure 3.2.1*

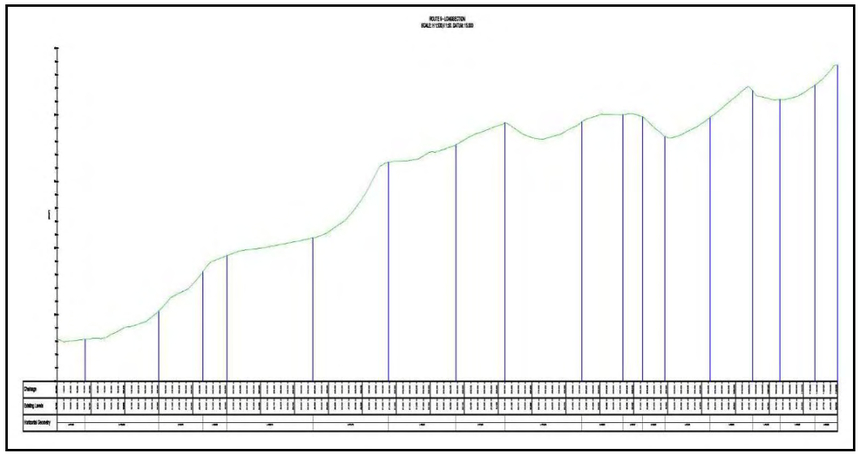


***Figure 3.2.1*: Typical L profile**

4. House survey

Prior to undertaking the above, "low lying" houses were identified by the client. Above 1100 houses were identified compared to an initial estimate of 900. All houses identified as low lying were digitized from the rectified aerial photograph and numbered. The numbering allowed adequate referencing during the survey process. The house survey involved taking spot levels within the house yard close to the bathroom areas. The process was undertaken using a combination of total stations and RTK GPS operating in the same coordinate system as the street survey. As part of the house survey, an additional 5km had also been identified for survey.

4.1 Constraints

- Access passes had been provided by the Waste Water Management Authority (WMA). However several inhabitants were unaware of the study being undertaken and would not allow access. Other inhabitants were against the project arguing disruption would be caused.
- Some households were locked during the survey
- Explanations regarding the project to the local inhabitants resulted in loss of time

4.2 Downloading & Plotting

- The data collected on site was stored on PCMCIA cards for RTK GPS and internal memories for total stations
- The data was downloaded using appropriate software/firmware and processed for upload into CAD package
- Plotting of spot levels inside the house yard was undertaken using individual pin codes assigned to each house.
- A typical area showing digitized households with the individual pin codes is shown in *Figure 4.2.1*. The individual households have been digitized from an aerial photograph rectified to fit onto the street survey.

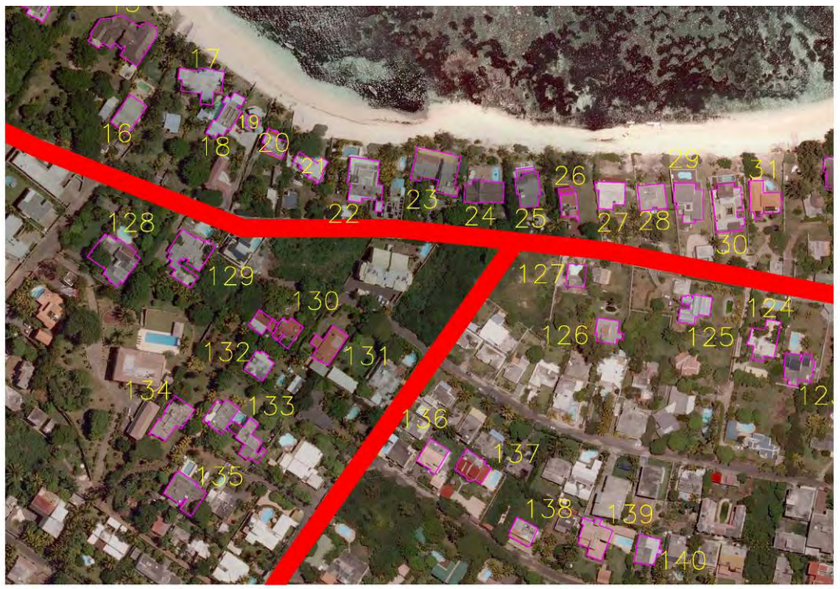


***Figure 4.2.1*: Digitised households**

- *Figure 4.2.2* also shows the pressure lines, gravity lines and individual household connection lines which have been digitized from the aerial photograph shown in *Figure 4.2.1* and superimposed on the street survey.

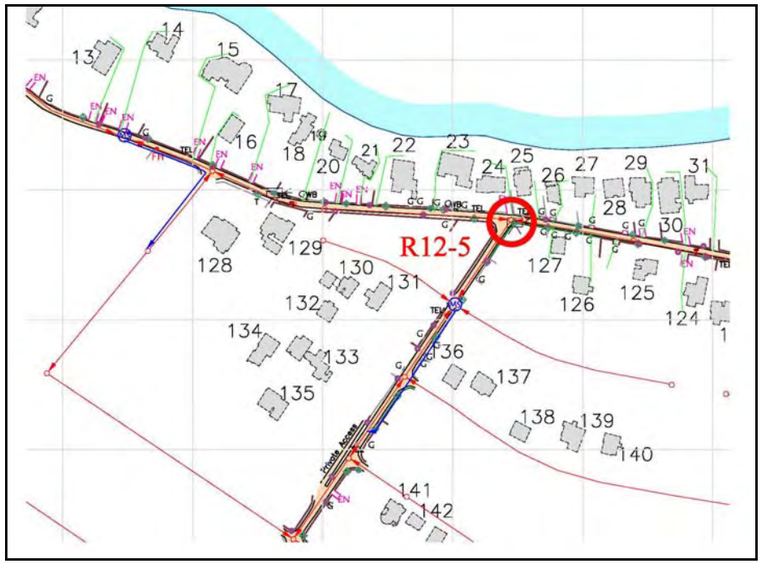


***Figure 4.2.2*: Street survey onto which digitized households have been superimposed**

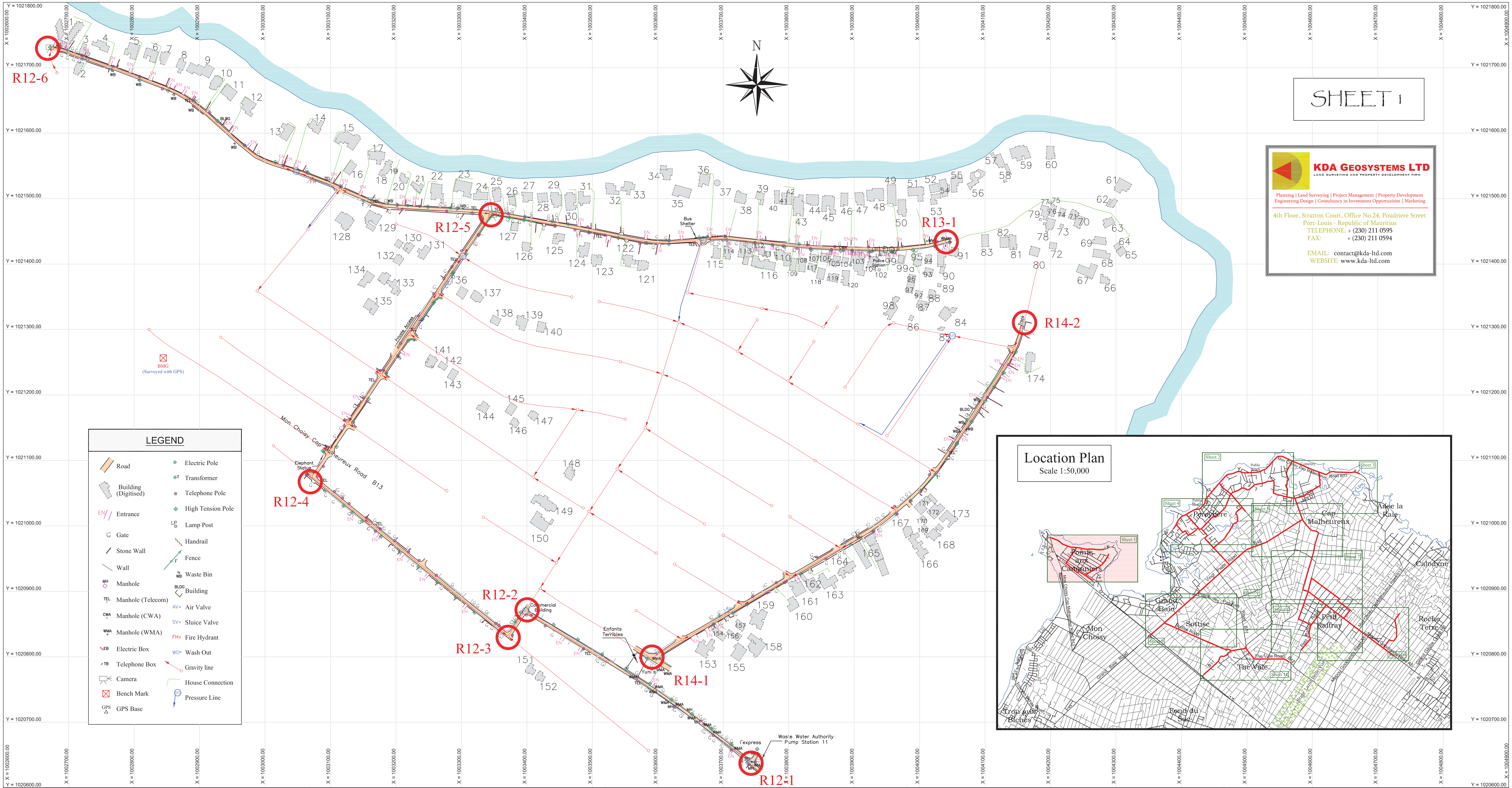
5. Results

The results of the street survey and household survey have taken the form of a topographic map plotted at the scale of 1/3000 on A1 size paper. The spot levels taken during the course of the street survey have been used to plot longitudinal profiles as shown in *Figure 3.2.1* These L profiles have enabled preliminary location of sewer lines. The household survey has enabled location of the bathrooms and difference in level between the street and individual yards. In addition an estimate of the lengths of pipes may be derived from the final maps produced.

Robin Dwarka
DipGeo, BSc (Surveying & Mapping Sciences)
MSc (Civil Engineering)

2. STREET SURVEY

2D DIAGRAM AND SEWER LAYOUT PLAN



TECHNICAL ASSISTANCE FOR GRAND BAIE SEWERAGE PROJECT PHASE 1- B

JAPAN INTERNATIONAL COOPERATION AGENCY

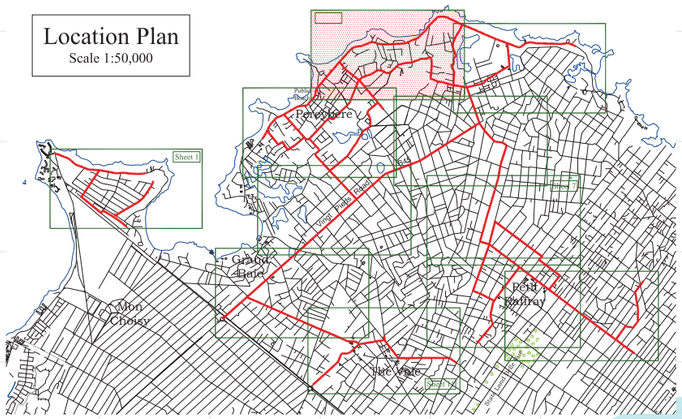
WMA
Wastewater Management Authority

NIPPON KOEI CO.,LTD.

DRAWING TITLE		
STREET SURVEY		
SCALE	DATE	DRAWING NO.
NTS	*MARCH 2010*	1

SHEET 2

Location Plan
Scale 1:50,000



N

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Bain Boeuf Public Beach

Road: Mon Choisy Cap Malheureux Road B13

Bain Boeuf Fish Landing Station

Coin De Mire Hotel

Residence Le Nord

Restaurant Kanaka

Quincaillerie et Supermarché de Paris

Pharmacy

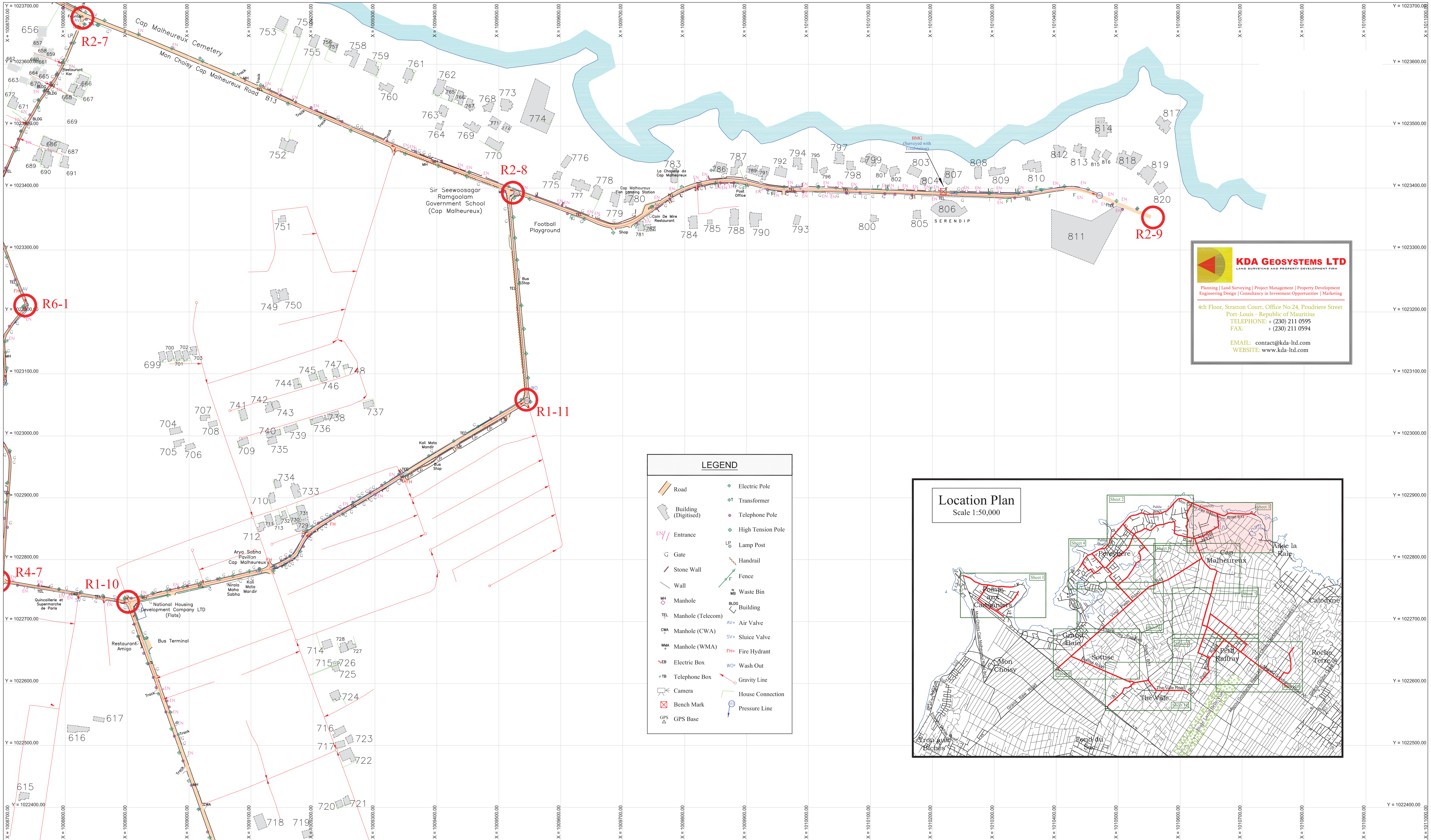
Bus Stop

R2-4 R2-5 R2-6 R2-7 R3-1 R4-3 R4-4 R4-5 R4-6 R4-7 R6-1

LEGEND

- Road
- Building (Digitised)
- Entrance
- Gate
- Stone Wall
- Wall
- Manhole
- Manhole (Telecom)
- Manhole (CWA)
- Manhole (WMA)
- Electric Box
- Telephone Box
- Camera
- Bench Mark
- GPS Base
- Electric Pole
- Transformer
- Telephone Pole
- High Tension Pole
- Lamp Post
- Handrail
- Fence
- Waste Bin
- Building
- Air Valve
- Sluice Valve
- Fire Hydrant
- Wash Out
- Gravity line
- House Connection
- Pressure Line

TECHNICAL ASSISTANCE FOR GRAND BAIE SEWERAGE PROJECT PHASE 1- B	JAPAN INTERNATIONAL COOPERATION AGENCY	Wastewater Management Authority	NIPPON KOEI CO.,LTD.	DRAWING TITLE: *STREET SURVEY* SCALE: *NTS* DATE: *MARCH 2010* DRAWING NO.: *2*


R2-7
R2-8
R2-9
R1-11
R1-10
R4-7
R6-1
Cap Malheureux Cemetery
Mon Choisy Cap Malheureux Road B13
Sir Seewoosagar Ramgoolam Government School (Cap Malheureux)
Football Playground
La Chapelle de Cap Malheureux
Cap Malheureux Fish Landing Station
Post Office
Coin De Mire Restaurant
Shop
SERENDIP
Bus Stop
Kali Mata Mandir
Arya Sabha Pavillon Cap Malheureux
Nirala Maha Sabha
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Pointe aux Canonniers
Pereybere
Cap Malheureux
Anse la Raie
Grand Baie
Sottise
Mon Choisy
Petit Raffray
Roches Terre
Calodyne
The Vale
Fond du Sac
Trou aux Biches

TECHNICAL ASSISTANCE FOR GRAND BAIE SEWERAGE PROJECT PHASE 1- B

JAPAN INTERNATIONAL COOPERATION AGENCY

Wastewater Management Authority

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DRAWING TITLE		
STREET SURVEY		
SCALE	DATE	DRAWING NO.
NTS	MARCH 2010	3

SHEET 4

R2-1 R2-2 R2-3 R2-4 R3-1 R3-2 R3-3 R3-4 R3-5 R3-6 R4-1 R4-2 R5-1 R5-2 R5-3 R5-4

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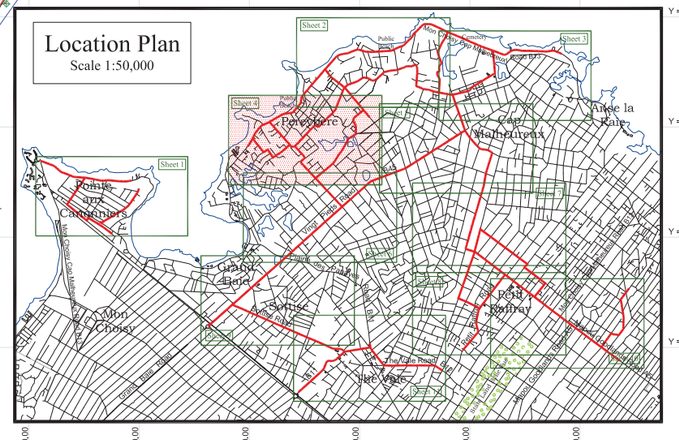

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STREET SURVEY

SCALE	DATE	DRAWING NO.
NTS	*MARCH 2010*	*4*