GROUNDWATER

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordenadas: 657699 1000871
Date: Lunes 29 de julio de 2002
Hora de Inicio: 10:30 a.m.
Site: Al lado de las oficinas administrativas
Hora de Salida: 1:00 p.m.
Sample # del pozo existente #1

Field Parameters:

Volume of purge: _____ Depth: 2.03 mts Color: Semi claro - amarillo

Time Hr.	Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	4.125	3210	0.10	30.1	3.7	7.3	líquido amarillento
0	10	4.125	3210	0.10	30.1	2.1	7.2	líquido amarillento
0	20	4.125	3230	0.10	30.1	1.8	7.1	líquido amarillento
0	30	4.125	3230	0.20	30.1	1.7	7.1	líquido amarillento
0	40	4.125	3240	0.20	30.1	1.6	7.0	líquido amarillento
0	50	4.125	3256	0.20	30.1	1.5	7.0	líquido amarillento
1	0	4.125	3258	0.20	30.1	1.5	6.9	líquido amarillento
*1	10	4.125	3260	0.20	30.0	1.3	6.9	líquido amarillento
1	20	4.125	3265	0.20	30.0	1.2	6.9	líquido amarillento
1	30	4.125	3268	0.20	30.0	1.2	6.9	líquido amarillento
1	40	4.125	3270	0.20	30.0	1.1	6.9	líquido amarillento
1	50	4.125	3271	0.20	30.0	1.1	6.9	líquido amarillento
2	0	4.125	3271	0.20	30.0	1.1	6.9	líquido amarillento

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations (*) En este tiempo se cambió la altura del tanque receptor del agua.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordenadas: 657945 / 1001477
Date: Jueves 01 de agosto de 2002
Hora de Inicio: 11:00 a.m.
Site: Por la calle de las oficinas-aprox 645 m (después de la Casa de reciclaje)
Hora de Salida: 1:30 p.m.
Sample # del pozo #2

Field Parameters:

Volume of purge: _____ Depth: 2.90 mts Color: Chocolate rojizo

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	1.58	417	0.20	30.0	5.9	7.5	Chocolate
0	9	1.58	414	0.20	29.4	5.6	7.5	Chocolate-rojizo
0	30	1.58	316	0.10	28.7	6.0	7.5	Chocolate-rojizo
1	15	1.58	308	0.10	28.7	6.0	7.2	Chocolate-rojizo

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Después de 9 mín se detuvo el bombeo. Luego de esperar 20 mín, se inició el 2o bombeo pero se precipitó una lluvia a las 11:45 a.m. Se hizo un tercer bombeo para tomar la 3 parte de la muestra a las 12:15 p.m. y finalizó la toma de muestras por lluvia.

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GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordenadas: 657753 / 1001041
Date: Martes 13 de agosto de 2002
Hora de Inicio: 10:00 a.m.
Site: Por la calle de las oficinas-aprox a 170 m
Hora de Salida: 12:15 p.m.
Sample # del pozo #5

Field Parameters:

Volume of purge: _____ Depth: 3.74 mts Color: Chocolate

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	2	2.2	536	0.30	30.6	3.3	6.5	Chocolate
0	6	2.2	545	0.30	30.6	3.0	6.4	Chocolate
1	7	2.2	785	0.30	30.4	5.6	6.3	De color chocolate
1	15	2.2	816	0.40	30.3	4.3	6.2	De color chocolate
1	38	2.2	847	0.40	30.8	4.5	6.2	De color chocolate

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations En el primer bombeo se agotó a los 6 mín 50 seg, con una columna de agua h = 7.30 m. Se esperó 1 hr 6 mín 15 seg, para tener una columna de agua recuperada de h = 4.55 m, con lo que se inició el segundo bombeo que duró aproximadamente 9 mín (1 hr 15 mín 20 seg). El tercer bombeo se realizó con una columna recuperada de h = 5.00. El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para para proteger la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordenadas: 657793 / 1001441
Date: Sábado 27 de julio de 2002
Hora de Inicio: 10:45 a.m.
Site: Por la calle de las oficinas-aprox a 570 m (al lado de la Casa de reciclaje)
Hora de Salida: 12:00 p.m.
Sample # del pozo #1

Field Parameters:

Volume of purge: _____ Depth: _____ Color: Chocolate - lodoso

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	6.35	540	0.20	28.7	0.0	7.5	Chocolate con sedimentos
0	10	6.35	456	0.20	28.8	0.0	7.4	Chocolate con sedimentos
0	20	6.35	424	0.20	28.7	0.0	7.3	Chocolate con sedimentos
						(*) 4.5		

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Se realizaron 4 intentos de bombeo.
(*) Se tomó una última medición de O.D., ya que se tuvo problemas con el aparato (en el cable). Este dato es el de preferencia.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City

Coordenadas: 657449 / 1001132

Date: Viernes 26 de julio de 2002

Hora de Inicio: 11:30 a.m.

Site: Entrando por la calle de la garita de control - aprox a 285 m

Hora de Salida: 2:30 p.m.

Sample # del pozo #8

Field Parameters:

Volume of purge: _____ Depth: 1.82 mts Color: Agua de apariencia clara

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	6.35	440	0.20	28.7	4.5	7.3	Claro -líquido fluido
0	10	6.35	435	0.20	28.6	4.3	7.4	Claro -líquido fluido
0	20	6.35	430	0.20	28.6	4.1	7.3	Claro -líquido fluido
0	30	6.35	444	0.20	28.5	3.4	7.4	Claro -líquido fluido
0	40	6.35	476	0.20	28.5	3.2	7.3	Claro -líquido fluido
0	50	6.35	446	0.20	28.5	3.1	7.3	Claro -líquido fluido
1	0	6.35	450	0.20	28.5	3.2	7.3	Claro -líquido fluido
1	20	6.35	480	0.20	28.5	3.2	7.3	Claro -líquido fluido
1	40	6.35	485	0.20	28.5	3.2	7.3	Claro -líquido fluido
2	0	6.35	488	0.20	28.5	3.2	7.3	Claro -líquido fluido

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Se realizó la instalación de la tubería 2 veces antes de iniciar el bombeo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City

Coordenadas: 657470 / 1001454

Date: Martes 30 de julio de 2002

Hora de Inicio: 10:30 a.m.

Site: Entrando por la calle de la garita de control - aprox a 580 m

Hora de Salida: 3:00 p.m.

Sample # del pozo existente #2

Field Parameters:

Volume of purge: _____ Depth: 4.06 mts Color: Gris

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	5.00	1173	0.50	29.7	3.2	7.4	Color grisáceo
1	30	2.50	1204	0.50	29.7	4.2	7.0	Color grisáceo
4	15	2.50	1170	0.50	30.2	5.7	7.2	Color grisáceo

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Se detuvo el bombeo para una h = 7.49 m, se tomó la muesta y los datos de campo. Se esperó 1 hr 15 mín para la recuperación del pozo. El segundo bombeo duró 5 mín con una columna inicial de agua de 5.21 m, para detenerlo al llegar a h = 7.55 m El tercer bombeo se realizó a las 2:45 p.m. (en ese tiempo de espera se tomó la muestra de agua superficial #1-cerca al puesto de control), con una h = 5.62 m y luego de 9 mín se detuvo para h = 7.47 m. El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para proteger la la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City

Coordenadas: 657313 / 1000894

Date: Miércoles 31 de julio de 2002

Hora de Inicio: 11:00 a.m.

Site: Al lado del puesto de control

Hora de Salida: 12:30 p.m.

Sample # del pozo #6

Field Parameters:

Volume of purge: _____ Depth: 2.90 mts Color: Chocolate claro

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	4.30	648	0.30	29.0	0.5	7.7	Chocolate - líquido espeso
0	7	4.30	741	0.30	29.5	0.4	7.4	Chocolate - líquido espeso
0	14	4.30	905	0.40	29.2	0.5	7.0	Chocolate - líquido espeso
0	25	4.30	990	0.40	29.2	0.6	7.0	Chocolate claro
0	28	4.30	1008	0.50	29.3	0.5	7.0	Chocolate claro
0	35	4.30	1015	0.50	29.3	0.6	7.0	Chocolate claro
0	45	4.30	1017	0.50	29.3	0.5	7.0	Líquido semi - claro
0	55	4.30	1029	0.50	29.4	0.5	7.0	Líquido semi - claro
1	5	4.30	1052	0.50	29.5	0.5	6.9	Líquido semi - claro
1	15	4.30	1055	0.50	29.5	0.7	6.9	Líquido semi - claro

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations La primera toma de muestras fue a los 14 mín. El caudal disminuyó notablemente. La segunda muestra se tomó a los 35 mín. Y la última muestra fue al final (1 hr 15 mín). El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para proteger la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordenadas: 658037 / 1001013
Date: Sábado 10 de agosto de 2002
Hora de Inicio: 9:20 a.m.
Site: Camino a Kuna Nega
Hora de Salida: 12:00 p.m.
Sample # del pozo #3

Field Parameters:

Volume of purge: _____ Depth: 0.64 mts Color: Gris

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	3.30	529	0.20	30.2	2.3	8.3	De color gris
0	2	3.30	534	0.20	30.2	2.3	8.1	De color gris
0	0	3.30	545	0.30	30.2	4.2	7.8	De color gris
0	2	3.30	690	0.30	30.2	4.2	7.8	De color gris
0	0	3.30	695	0.30	30.1	5.5	7.6	De color gris

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations En el primer intento se secó a los 3 mín 25 seg con una h = 7.75 m. Se esperó hasta 1 hr 15 mín a partir de la hora de inicio con una h = 2.47 m se realizó el segundo intento durando 2 mín. Se esperó 40 mín para realizar el tercer bombeo con una h = 4.51 m, el cual duró 1 mín 30 seg. El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para proteger la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City

Coordenadas: 658208 / 1001016

Date: Viernes 09 de agosto de 2002

Hora de Inicio: 10:15 a.m.

Site: Camino a Kuna Nega (antes del puente peatonal)

Hora de Salida: 1:45 p.m.

Sample # del pozo #4

Field Parameters:

Volume of purge: _____ Depth: 3.81 mts Color: Chocolate espeso

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	1.70	755	0.30	29.3	5.5	7.9	Chocolate espeso
0	4	1.70	759	0.30	30.5	5.5	7.9	Chocolate espeso
2	6	1.70	760	0.30	29.5	4.7	7.4	Chocolate con sedimentos
2	9	1.70	779	0.30	30.9	4.7	7.6	Chocolate con sedimentos

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Se detuvo a los 4 mín 20 seg, con una columna de agua de 7.87 m. Se esperó 2 hrs, para que el pozo se recuperará con una h = 4.60 m. Se arrancó para la toma de la segunda muestra (Se tomó muestra compuesta en dos partes). El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para proteger la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

GROUNDWATER MEASUREMENT REPORT

Project: Solid Waste Management Plan for Panama City
Coordinates: 657548 / 1000938
Date: Lunes 05 de agosto de 2002
Start Time: 10:00 a.m.
Site: A aprox 215 m del pozo existente #1 (cerca de lagos)
Finish Time: 11:30 a.m.
Sample # del pozo #7

Field Parameters:

Volume of purge: _____ Depth: 0.67 mts Color: brown clear

Time Hr.	Time Min	Flow (gal / min)	Conductivity (ms)	Salinity (ppt)	Temp. °C	D.O. (mg / L)	pH	Appearance
0	0	3.16	1026	0.50	29.8	3.2	7.3	Chocolate claro con sedimentos
1	20	3.16	1087	0.50	29.6	5.9	7.4	Chocolate claro con sedimentos

Parameters to be analyzed at the lab:

x	Turbidity
x	Alkalinity
x	Oil and Grease
x	Fecal Coliforms
x	BOD5
x	COD
x	Suspended Solids
x	Ammonia Nitrogen
x	Total Nitrogen

x	PCB
x	Total Phosphorus
x	Important Ions (Na+,Ca2+,HCO3-,SiO2,Cl-)
x	Heavy Metals (Cadmium, Cyanide, Lead, Total Chromium, Hexavalent Chromium, Arsenic, Total Mercury, Copper, Zinc, Iron, Manganese)
	Dissolved Oxygen

Observations Se detuvo a los 4 mín 20 seg, con una columna de agua de 7.87 m. Se esperó 1 hr, para que el pozo se recuperará con una h = 3.50 m. Se arrancó para la toma de la segunda muestra (Se tomó muestra compuesta en dos partes). El personal encargado del bombeo tiene por norma suspender el proceso una vez que la columna de agua llegue del 70 al 75% de su profundidad (para este caso es de 7.00 a 7.50 m), para proteger la bomba de posibles daños y evitar el efecto de cono alrededor de pozo.

PHOTOS: GROUNDWATER

Photo 1. Well #1 Pump Test preparation.

Photo 2. Well #6 work area.

Photo 3. Sampling and Análisis Equipment.

Photo 4. Sampling containers.

Photo 5. Turbid water from well #1.

Photo 6. Water from Existing Well #1

Photos 7 & 8. Water from Existing Well #2

Photo 9. Water from well #6

Photo 10. Water from well #2

AIR QUALITY

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 23, 2002
Sitio: Chivo Chivo Road, near Exist. Well #1

Coordinates: 17 P 0657453 East
UTM 1001532 North
Point #: 1

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	1.8
Corrected first test reading (ppm):	**0.45**
Second test reading (ppm):	1.6
Corrected second test reading (ppm):	**0.4**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	10:03:02 a.m.	10:33:25 a.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.009	0.013
Minimum (mg/m³) :	0.005	0.006
Maximum (mg/m³) :	0.122	0.24

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 26, 2002
Sitio: Kuna-Nega Community, near Mocambo River

Coordinates: 17 P 0658534 East
UTM 1001477 North
Point #: 2

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	2.2
Corrected first test reading (ppm):	**0.55**
Second test reading (ppm):	2.8
Corrected second test reading (ppm):	**0.7**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	09:33:32 a.m.	10:03:50 a.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.014	0.013
Minimum (mg/m³) :	0.002	0.003
Maximum (mg/m³) :	0.058	0.228

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 25, 2002
Sitio: "Y" Intersection of Mocambo River Afluents

Coordinates: 17 P 0658289 East
UTM 1001013 North
Point #: 3

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	3.3
Corrected first test reading (ppm):	**0.825**
Second test reading (ppm):	1.8
Corrected second test reading (ppm):	**0.45**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	
Corrected first test reading (ppm):	**0**
Second test reading (ppm):	
Corrected second test reading (ppm):	**0**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 µm	Particles between 4 µm and 10 µm
Start Time:	08:12:02 a.m.	08:43:29 a.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.023	0.029
Minimum (mg/m³) :	0.018	0.021
Maximum (mg/m³) :	0.049	0.105

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 22, 2002
Sitio: DIMAUD Offices, near Existing Well #2

Coordinates: 17 P 0657768 East
UTM 1000894 North
Point #: 4

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	0.3
Corrected first test reading (ppm):	**0.075**
Second test reading (ppm):	0.5
Corrected second test reading (ppm):	**0.125**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	10:36:47 a.m.	10:05:44 a.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.025	0.035
Minimum (mg/m³) :	0.014	0.012
Maximum (mg/m³) :	0.155	0.68

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 22, 2002
Sitio: Quarry - CUSA

Coordinates: 17 P 0657298 East
UTM 1000841 North
Point #: 5

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	0.8
Corrected first test reading (ppm):	**0.2**
Second test reading (ppm):	0.6
Corrected second test reading (ppm):	**0.15**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	01:11:47 p.m.	01:44:48 p.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.029	0.031
Minimum (mg/m³) :	0.017	0.017
Maximum (mg/m³) :	0.285	1.057

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 21, 2002
Sitio: Camino de Cruces, under Transmission Lines

Coordinates: 17 P 0656995 East
UTM 1000015 North
Point #: 6

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	0.7
Corrected first test reading (ppm):	**0.175**
Second test reading (ppm):	0.6
Corrected second test reading (ppm):	**0.15**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	01:24:24 p.m.	12:23:06 p.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.025	0.02
Minimum (mg/m³) :	0.013	0.012
Maximum (mg/m³) :	0.493	0.542

CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

AIR MONITORING REPORT

Project: Solid Waste Management Plan for Panama City
Fecha: August 26, 2002
Sitio: Entrance to Cerro Patacon - Weight Station

Coordinates: 17 P 0657825 East
UTM 1000117 North
Point #: 7

Gas Concentrations

Equipment: GASTEC GV-100 Pump

Sulfur Dioxide (SO_2)

Change in Tube Coloration	Yellowish Green -----> Yellow
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/4
First test reading (ppm):	2
Corrected first test reading (ppm):	**0.5**
Second test reading (ppm):	2.3
Corrected second test reading (ppm):	**0.575**

Total Nitrogen Oxides ($NO+NO_2$)

Change in Tube Coloration	White -----> Yellowish orange
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	2 minutes
Number of pump strokes used:	8
Correction factor according to strokes:	1/5
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.01**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.01**

Hydrogen Sulfide (H_2S)

Change in Tube Coloration	Pale Yellow -----> Reddish Brown
Detection Range (ppm):	0.05 ppm -----> 5 ppm
Time per pump stroke (minutos):	1 minute
Number of pump strokes used:	8
Correction factor according to strokes:	1/2
First test reading (ppm):	0.05
Corrected first test reading (ppm):	**0.025**
Second test reading (ppm):	0.05
Corrected second test reading (ppm):	**0.025**

Measurement of Air Borne Particles

Equipment: DustTrack Aerosol Monitor 8520

Description	Test with Filter	Test without Filter
	Particles < 4 μm	Particles between 4 μm and 10 μm
Start Time:	10:59:42 a.m.	11:33:35 a.m.
Duration (minutes):	30	30
Average (mg/m³) :	0.014	0.022
Minimum (mg/m³) :	0.006	0.007
Maximum (mg/m³) :	0.154	0.379

NOISE AND VIBRATION

Summary of Daytime Noise Levels in the Study Area

POINT	DESCRIPTION	dBA max. (Linear)	dBA max. (SPL)	dBA min.	dBA avg.
1	Chivo Chivo Road, near Exist. Well #1	80.4	91.3	32.3	52.0
2	Kuna-Nega Community, near Mocambo River	84.5	83.7	34.6	50.7
3	"Y" intersection of Mocambo River Affluents	74.6	83.0	28.0	45.8
4	DIMAUD Offices, near Existing Well #2	78.2	80.9	43.9	60.3
5	Quarry - CUSA	88.4	83.3	38.1	55.9
6	Camino de Cruces, under Transmission Lines	62.8	66.3	34.3	43.7
7	Entrance to Cerro Patacon - Weight Station	86.9	89.1	43.9	59.9

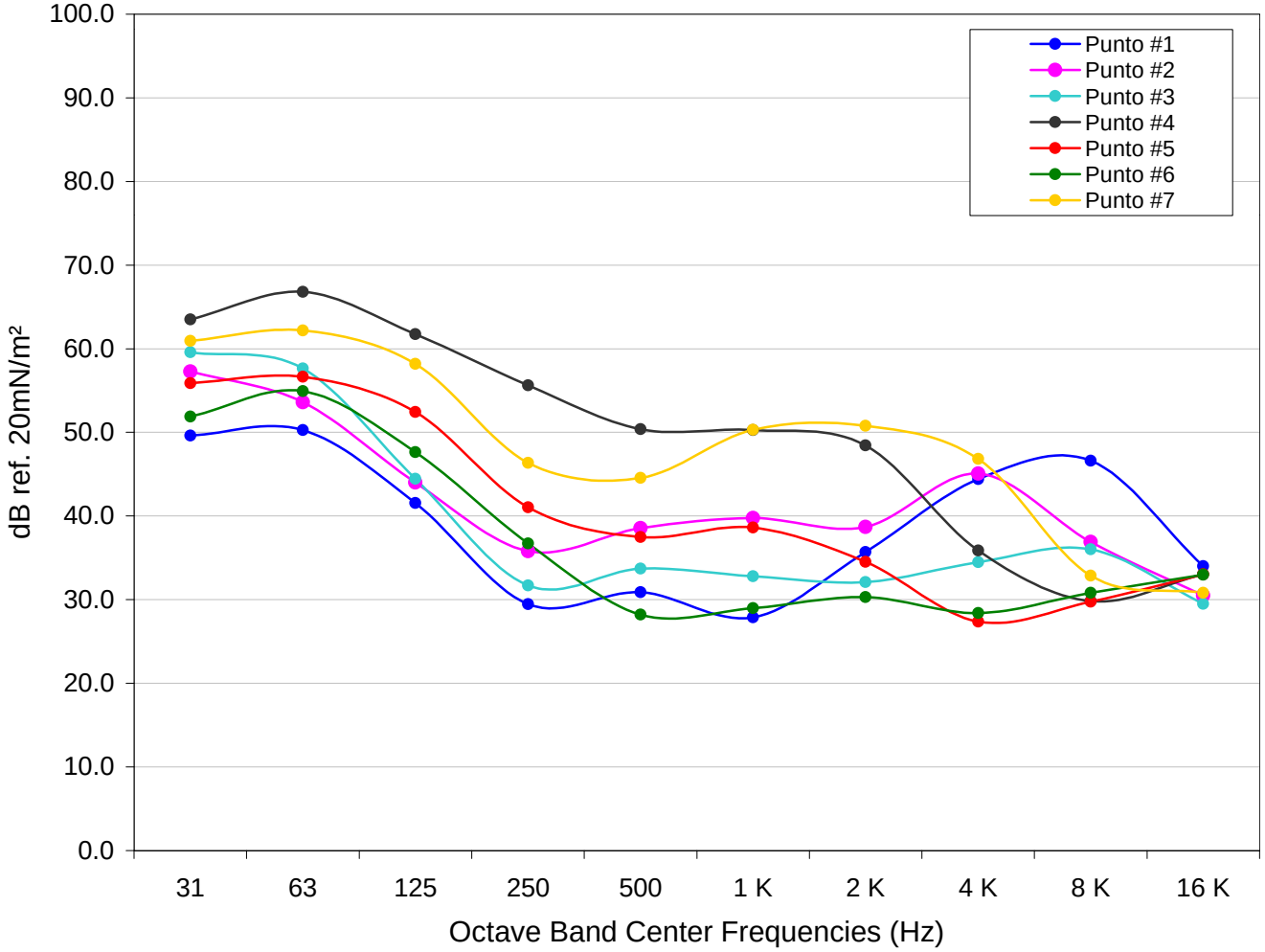
Summary of Night Time Noise Levels in the Study Area

POINT	DESCRIPTION	dBA máx. (SPL)	dBA mín.	dBA prom.
1	Chivo Chivo Road, near Exist. Well #1	73.6	44.5	53.8
2	Kuna-Nega Community, near Mocambo River	54.6	45.0	46.9
3	"Y" intersection of Mocambo River Affluents	75.2	52.3	53.6
4	DIMAUD Offices, near Existing Well #2	74.4	48.3	53.5
5	Quarry - CUSA	65.8	35.8	41.3
6	Camino de Cruces, under Transmission Lines	63.7	40.2	45.7
7	Entrance to Cerro Patacon - Weight Station	73.2	47.4	49.3

VIBRATION GRAPH
(SUMMARY)

Frecuency (Hz)	AVERAGES OF EACH POINT OF SAMPLING						
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
31	49.6	57.3	59.6	63.5	55.9	51.9	60.9
63	50.3	53.6	57.7	66.8	56.6	54.9	62.2
125	41.5	44.0	44.5	61.7	52.4	47.7	58.2
250	29.5	35.8	31.7	55.6	41.0	36.7	46.4
500	30.9	38.5	33.7	50.4	37.5	28.2	44.6
1 K	27.9	39.8	32.8	50.3	38.6	29.0	50.3
2 K	35.7	38.7	32.1	48.4	34.5	30.3	50.8
4 K	44.4	45.1	34.5	35.9	27.4	28.4	46.8
8 K	46.6	36.9	36.0	29.8	29.7	30.8	32.9
16 K	34.0	30.5	29.5	33.1	33.0	33.0	30.8

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 14, 2002
Site: Chivo Chivo Road, near Exist. Well #1

Coordinates: 17 P 0657453 East
UTM 1001532 North

Point #: 1

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Max.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 06:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 07:45 a.m.
00:00:00	56.2 dB	53.2 dB	42.5 dB	47.6 dB	**80.4 dB**	48.6 dB
00:00:30	52.4	52.1	48.9	49.3		44.5
00:01:00	53.8	55.3	54.3	48.6		50.2
00:01:30	54.0	66.0	83.8	49.3		48.4
00:02:00	55.2	76.7	43.1	50.9		48.0
00:02:30	66.6	54.8	40.1	47.0		48.3
00:03:00	58.5	55.1	46.8	49.1		48.9
00:03:30	54.6	56.0	45.9	61.9		48.8
00:04:00	54.1	71.0	47.7	86.8		47.8
00:04:30	52.6	55.2	72.7	57.5		49.8
00:05:00	52.2	50.0	47.8	40.8		63.6 birds
00:05:30	52.7	51.0	42.4	38.0		57.6 "
00:06:00	52.3	49.9	46.1	42.3		62.8 "
00:06:30	51.5	51.6	49.7	43.4		55.7 "
00:07:00	52.2	52.3	50.0	47.1		61.2 "
00:07:30	52.3	52.6	49.2	44.6		60.9 "
00:08:00	56.1	52.5	46.9	48.1		62.8 "
00:08:30	53.7	52.2	47.0	49.8		63.4 "
00:09:00	52.8	52.2	50.2	50.7		50.1 "
00:09:30	53.8	52.1	50.5	49.8		48.0
00:10:00	51.7	52.3	50.4	40.8		48.4
00:10:30	50.2	55.7	49.3	46.3		51.6
00:11:00	50.5	63.2	47.6	52.3		49.0
00:11:30	50.3	66.7	48.6	54.4		47.5
00:12:00	51.1	58.7	49.7	54.0		45.4
00:12:30	52.7	51.5	48.4	56.1		49.7
00:13:00	53.0	52.3	48.5	53.4		50.1
00:13:30	51.6	49.6	47.5	54.7		49.0
00:14:00	52.4	49.3	48.3	64.3		48.1
00:14:30	52.3	47.7	49.1	65.3		49.3
00:15:00	50.4	47.6	49.0	58.8		52.3
00:15:30	51.1	46.4	48.3	67.9		54.6
00:16:00	49.7	50.0	47.6	57.6		49.9
00:16:30	51.9	47.1	50.4	64.9		48.8
00:17:00	52.0	47.7	48.9	61.8		53.4
00:17:30	53.7	49.3	47.5	53.1		49.1
00:18:00	50.7	50.0	48.8	59.6		52.3
00:18:30	51.7	50.1	53.8	70.7		54.7
00:19:00	41.4	51.4	49.8	54.8		54.6
00:19:30	51.1	49.4	47.3	60.1		51.3
00:20:00	52.9	48.3	52.1	60.8		51.1
00:20:30	56.9	51.4	76.3	58.4		54.6

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Max.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 06:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 07:45 a.m.
00:21:00	61.1 dB	52.5 dB	48.9 dB	65.7 dB		55.1
00:21:30	61.8	51.9	53.4	91.3		54.9
00:22:00	50.6	51.4	87.6	53.6		56.8
00:22:30	48.5	51.7	50.7	54.4		58.7
00:23:00	51.0	47.8	48.1	56.1		52.6
00:23:30	49.7	49.3	46.3	59.0		53.1
00:24:00	49.3	46.5	49.8	60.5		54.5
00:24:30	46.7	48.6	51.9	43.5		54.7
00:25:00	44.3	51.6	46.0	47.1		57.0
00:25:30	45.3	74.8	48.5	48.0		58.5
00:26:00	46.5	60.0	51.6	40.4		60.0
00:26:30	47.2	45.9	47.5	43.8		51.0
00:27:00	49.7	45.8	45.8	45.9		52.7
00:27:30	47.6	49.5	45.9	46.0		54.8
00:28:00	47.2	50.2	49.9	49.3		52.2
00:28:30	48.2	46.7	51.3	50.1		53.6
00:29:00	50.2	47.5	49.5	53.0		52.7
00:29:30	50.0	49.9	48.1	57.7		53.0
00:30:00	50.4	50.7	49.4	69.2		54.4
00:30:30	53.1	48.4	57.7	76.1		54.8
00:31:00	54.4	49.5	72.4	80.1		55.0
00:31:30	52.9	49.6	49.2	56.1		54.7
00:32:00	50.9	50.0	47.1	58.0		51.1
00:32:30	51.4	44.3	32.3	61.4		52.8
00:33:00	51.7	46.6	43.0	65.2		52.9
00:33:30	52.5	49.4	57.7	51.9		52.6
00:34:00	53.9	45.8	48.4	55.1		51.7
00:34:30	54.5	49.1	53.6	62.4		52.3
00:35:00	54.2	58.7	57.2	61.4		50.5
00:35:30	53.4	65.8	64.5	54.3		53.5
00:36:00	56.9	52.4	53.0	48.7		54.2
00:36:30	56.2	47.1	50.2	50.8		51.9
00:37:00	62.3	49.3	58.7	48.9		56.3 airplane
00:37:30	63.9	48.4	56.7	51.0		54.0
00:38:00	54.2	48.2	54.6	50.4		53.0
00:38:30	51.4	48.4	51.3	51.9		52.2
00:39:00	51.9	47.7	61.7	55.6		60.6 bugs
00:39:30	52.2	50.5	44.4	51.2		56.6 "
00:40:00	50.9	50.3	40.3	48.7		59.3 "
00:40:30	52.0	50.6	48.9	48.1		60.4
00:41:00	51.4	50.0	51.2	54.6		59.0
00:41:30	53.2	72.6	67.9	55.6		58.5
00:42:00	56.8	50.2	44.9	54.2		57.3
00:42:30	69.5	42.3	45.4	48.4		57.5
00:43:00	55.5	44.8	44.3	53.6		57.2
00:43:30	53.6	46.7	49.0	60.3		58.1
00:44:00	53.4	48.9	53.0	59.4		57.5
00:44:30	52.6	48.6	50.1	51.0		57.9
00:45:00	53.8	48.3	48.7	52.2		57.4
00:45:30	52.8	49.2	48.0	54.2		57.1
00:46:00	53.0	48.5	45.4	49.9		58.1
00:46:30	51.5	49.8	49.8	49.4		59.3
00:47:00	50.9	41.5	50.4	49.6		60.2
00:47:30	51.3	46.3	50.1	51.4		61.0
00:48:00	52.2	44.1	46.0	52.0		68.0 bugs

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Max.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 06:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 07:45 a.m.
00:48:30	52.8 dB	38.1	47.3 dB	44.7 dB		71.3 bugs
00:49:00	52.7	42.2	45.2	44.5		73.6 "
00:49:30	52.8	40.1	48.3	46.8		58.9 "
00:50:00	58.5	42.4	46.4	48.7		65.4
00:50:30	58.0	43.7	44.6	51.8		51.7
00:51:00	55.3	47.8	44.8	52.9		50.9
00:51:30	54.1	48.2	49.2	55.2		56.3
00:52:00	53.7	53.8	45.6	63.1		48.4
00:52:30	53.2	49.5	49.7	57.1		48.2
00:53:00	52.4	48.9	51.9	44.3		46.3
00:53:30	53.8	49.5	51.7	46.5		48.1
00:54:00	56.0	49.2	47.7	50.8		45.1
00:54:30	70.6	48.9	50.4	52.4		44.6
00:55:00	78.2	50.0	51.0	45.7		45.0
00:55:30	56.5	51.0	49.2	44.1		44.8
00:56:00	50.3	50.4	38.3	49.4		48.3
00:56:30	52.3	47.8	40.1	51.4		51.6
00:57:00	56.1	49.8	42.8	47.5		51.4
00:57:30	54.0	54.9	41.1	47.7		51.9
00:58:00	55.5	85.3	42.1	50.7		50.8
00:58:30	52.6	52.9	43.7	75.6		49.5
00:59:00	51.7	49.6	47.8	44.3		49.8
00:59:30	50.6	49.3	63.9	41.7		52.4
01:00:00	51.6	48.5	40.8	49.9		53.3

Observations: _____

	DAYTIME		NIGHT TIME	
Maximum:	91.3	dB (Mode SPL)	73.6	dB (Mode SPL)
Minimum:	32.3	dB (Mode SPL)	44.5	dB (Mode SPL)
Average:	52.0	dB (Mode SPL)	53.8	dB (Mode SPL)

Maximum of Test 5: 80.4 dB (Mode Linear)

Vibration Test

Point #: 1 Date: August 14, 2002

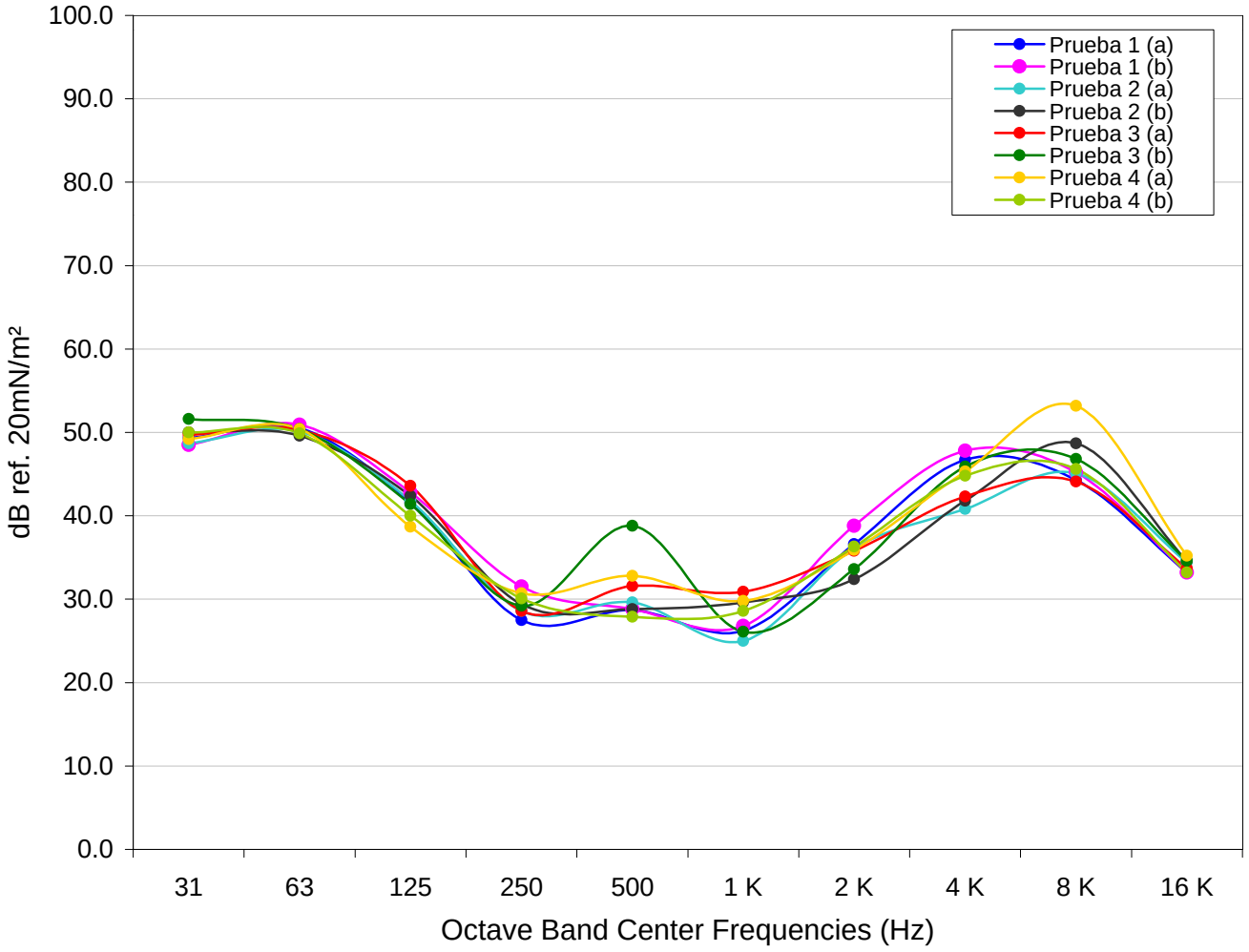
Coordinates 17 P 0657453 East
UTM 1001532 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	09:15 a.m.	Hi=	09:30 a.m.	Hi=	09:45 a.m.	Hi=	07:45 a.m.	
	Hf=	09:30 a.m.	Hf=	09:45 a.m.	Hf=	10:00 a.m.	Hf=	08:00 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	49.3	48.5	48.7	50.0	49.7	51.6	49.2	50.0	49.6
63	50.5	50.9	50.1	49.6	50.3	50.4	50.4	49.9	50.3
125	41.6	42.8	41.8	42.4	43.6	41.4	38.7	40.0	41.5
250	27.5	31.5	28.6	29.4	28.6	29.2	30.7	30.1	29.5
500	28.7	28.8	29.6	28.8	31.6	38.8	32.8	27.9	30.9
1 K	26.2	26.8	25.0	29.6	30.9	26.1	29.8	28.6	27.9
2 K	36.6	38.8	36.1	32.4	35.8	33.6	35.9	36.3	35.7
4 K	46.7	47.8	40.8	41.8	42.3	45.9	45.3	44.8	44.4
8 K	44.3	45.2	45.1	48.7	44.1	46.8	53.2	45.6	46.6
16 K	33.2	33.2	34.4	34.6	33.7	34.6	35.2	33.2	34.0

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 15, 2002
Site: Kuna-Nega Community, near Mocambo River

Coordinates: 17 P 0658534 East
UTM 1001477 North

Point #: 2

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 04:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 05:45 a.m.
00:00:00	43.1 dB	71.8 dB	54.0 dB	50.5 dB	**84.5 dB**	46.0 dB
00:00:30	40.5	74.8	54.6	49.2		51.3
00:01:00	42.4	64.7	51.7	46.1		45.7
00:01:30	43.3	58.3	62.8	44.2		50.5
00:02:00	53.8	60.9	58.1	44.9		45.5
00:02:30	42.9	56.2	83.7	51.6		46.3
00:03:00	46.1	53.2	58.6	55.7		45.2
00:03:30	45.5	54.7	52.8	44.4		45.5
00:04:00	51.9	53.1	49.8	45.8		45.8
00:04:30	52.7	51.4	48.5	46.6		45.7
00:05:00	45.8	45.3	45.5	57.6		45.2
00:05:30	48.2	47.8	49.1	48.0		48.2
00:06:00	47.8	47.7	53.1	48.9		46.0
00:06:30	45.4	43.8	46.7	51.6		45.7
00:07:00	44.3	48.9	62.1	49.7		45.7
00:07:30	45.7	47.4	48.4	46.5		45.2
00:08:00	47.9	47.7	50.1	46.4		45.9
00:08:30	45.4	51.8	51.2	46.3		47.9
00:09:00	53.1	45.6	46.6	43.4		45.6
00:09:30	49.7	48.6	45.9	48.5		45.1
00:10:00	46.7	49.9	47.9	46.8		47.3
00:10:30	50.1	48.6	50.6	46.4		50.5
00:11:00	45.8	54.6	49.2	45.5		46.8
00:11:30	43.8	58.8	49.8	48.8		45.5
00:12:00	44.3	60.9	47.9	52.0		45.6
00:12:30	56.4	56.4	55.3	55.2		45.5
00:13:00	51.1	55.3	66.8	56.1		46.3
00:13:30	48.8	50.3	58.7	56.4		50.3
00:14:00	49.3	48.8	51.0	56.3		45.1
00:14:30	46.2	52.7	52.3	56.5		46.0
00:15:00	47.9	53.1	49.3	58.7		45.6
00:15:30	52.3	45.9	49.1	66.0		45.9
00:16:00	48.9	46.7	49.8	75.7		50.4
00:16:30	45.4	48.0	49.9	82.6		46.1
00:17:00	43.0	50.1	50.4	57.3		45.4
00:17:30	47.3	44.3	49.0	50.3		49.3
00:18:00	48.1	45.9	48.7	52.4		45.5
00:18:30	51.9	49.3	50.8	53.1		46.1
00:19:00	46.4	50.2	52.7	55.3		45.5
00:19:30	50.5	46.8	50.8	46.9		46.8
00:20:00	72.6	46.3	53.5	53.8		46.1
00:20:30	36.1	48.2	50.8	47.2		45.1

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 04:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 05:45 a.m.
00:21:00	47.0 dB	60.9 dB	52.7 dB	48.9 dB		46.8 dB
00:21:30	34.6	61.7	49.4	47.1		45.5
00:22:00	52.7	52.7	64.7	46.6		45.0
00:22:30	47.9	56.7	48.9	51.6		46.2
00:23:00	48.5	49.5	48.3	44.1		46.0
00:23:30	44.1	48.8	49.9	47.4		47.3
00:24:00	48.0	45.4	49.0	44.6		45.6
00:24:30	46.6	46.4	50.4	48.3		49.4 people
00:25:00	44.6	54.9	50.6	46.9		45.3
00:25:30	49.7	49.3	49.7	49.4		45.2
00:26:00	44.8	44.7	52.3	45.9		46.3
00:26:30	47.7	46.6	47.4	48.6		47.7
00:27:00	43.8	60.6	47.8	47.8		48.9
00:27:30	44.7	48.6	48.2	48.0		47.5
00:28:00	65.4	61.7	48.3	41.7		46.4
00:28:30	57.1	67.3	52.4	45.1		46.0
00:29:00	46.5	66.2	48.8	43.1		46.9
00:29:30	55.5	66.9	47.9	50.5		46.7
00:30:00	45.8	50.6	46.8	41.6		46.5
00:30:30	45.9	46.9	49.2	49.3		47.1
00:31:00	47.9	49.5	46.7	44.0		49.2 birds
00:31:30	49.7	47.0	48.2	46.0		46.1
00:32:00	56.4	45.4	46.9	46.9		46.5
00:32:30	50.8	46.2	58.3	50.9		45.9
00:33:00	48.1	46.9	47.6	42.0		48.3
00:33:30	49.5	47.5	49.6	44.5		46.1
00:34:00	47.5	48.1	54.6	52.7		45.8
00:34:30	52.3	46.6	50.3	46.7		51.2 people
00:35:00	48.0	46.5	46.6	50.5		50.0
00:35:30	50.1	45.6	45.0	47.0		50.0
00:36:00	53.5	47.1	49.0	48.8		45.5
00:36:30	49.6	43.9	46.0	50.1		45.9
00:37:00	47.8	44.8	47.1	48.0		47.2
00:37:30	47.4	50.4	46.7	46.9		47.1
00:38:00	48.1	49.8	46.2	45.6		45.8
00:38:30	45.7	55.1	49.2	52.3		45.9
00:39:00	48.1	50.1	53.1	49.5		49.2
00:39:30	50.4	48.6	52.5	48.0		46.5
00:40:00	53.1	47.7	54.3	47.4		46.5
00:40:30	58.3	49.1	51.2	53.4		46.8
00:41:00	51.8	64.1	51.9	58.1		47.2
00:41:30	56.8	75.6	50.6	68.6		46.2
00:42:00	52.5	62.0	47.8	76.2		48.7
00:42:30	48.0	46.2	49.5	61.9		47.0
00:43:00	50.3	52.1	51.7	65.8		46.1
00:43:30	47.4	53.4	48.3	52.8		45.8
00:44:00	51.9	49.6	50.5	53.4		54.6 birds
00:44:30	48.6	49.3	49.6	53.6		48.0
00:45:00	46.4	46.3	48.5	48.6		47.2
00:45:30	47.4	51.2	47.6	50.3		46.9
00:46:00	46.5	51.5	48.8	48.2		47.8
00:46:30	48.7	49.7	47.9	47.1		46.9
00:47:00	52.5	48.5	49.2	46.3		48.0
00:47:30	56.0	50.8	48.9	48.8		45.9
00:48:00	60.7	47.7	47.6	48.9		48.6

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 04:45 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 05:45 a.m.
00:48:30	54.3 dB	46.5 dB	49.1 dB	48.7 dB		46.2 dB
00:49:00	56.8	46.7	51.6	48.5		46.3
00:49:30	64.7	47.4	49.5	45.6		49.1
00:50:00	50.6	68.3	49.6	52.4		46.2
00:50:30	53.1	47.6	48.4	51.0		48.0
00:51:00	51.9	49.3	49.0	52.2		47.2
00:51:30	52.8	58.8	48.5	46.7		46.6
00:52:00	51.4	48.9	47.0	48.2		46.9
00:52:30	53.7	50.3	47.6	49.0		46.5
00:53:00	48.4	48.4	50.6	50.7		47.0
00:53:30	51.4	44.9	51.6	49.0		46.8
00:54:00	49.0	56.1	48.8	48.6		46.1
00:54:30	52.3	51.7	52.7	50.6		48.6
00:55:00	62.4	47.5	49.0	47.1		46.8
00:55:30	50.3	47.9	49.7	49.7		47.9
00:56:00	63.2	48.7	50.4	46.2		46.3
00:56:30	49.5	48.7	48.7	49.8		46.0
00:57:00	48.9	53.6	50.4	49.0		47.7
00:57:30	47.8	62.4	50.2	49.7		46.1
00:58:00	58.7	56.9	52.3	52.3		47.8
00:58:30	51.7	52.7	51.8	51.4		46.6
00:59:00	49.4	51.9	50.8	54.9		46.7
00:59:30	55.6	49.9	49.3	51.0		45.8
01:00:00	57.3	48.8	50.8	62.3		46.8

Observations: _____

	DAYTIME		NIGHT TIME	
Maximum:	83.7	dB (Mode SPL)	54.6	dB (Mode SPL)
Minimum:	34.6	dB (Mode SPL)	45.0	dB (Mode SPL)
Average:	50.7	dB (Mode SPL)	46.9	dB (Mode SPL)

Maximum of Test 5: 84.5 dB (Mode Linear)

Vibration Test

Point #: 2 Date: August 15, 2002

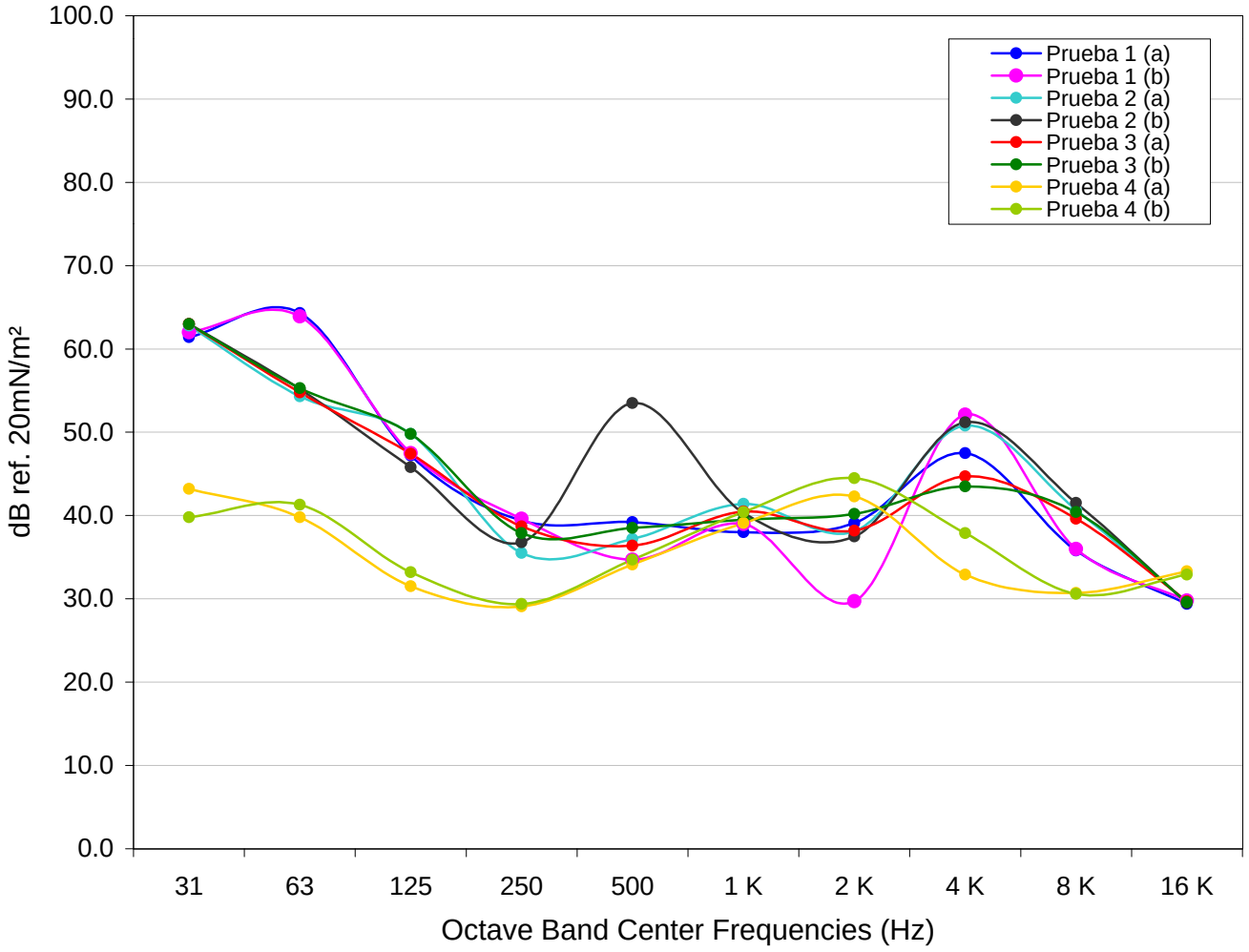
Coordinates 17 P 0658534 East
UTM 1001477 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	09:15 a.m.	Hi=	09:30 a.m.	Hi=	09:45 a.m.	Hi=	05:45 a.m.	
	Hf=	09:30 a.m.	Hf=	09:45 a.m.	Hf=	10:00 a.m.	Hf=	06:00 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	61.4	62.0	62.8	63.0	63.0	63.0	43.2	39.8	57.3
63	64.3	63.9	54.3	55.2	54.8	55.3	39.8	41.3	53.6
125	47.2	47.5	49.8	45.8	47.4	49.8	31.5	33.2	44.0
250	39.4	39.6	35.5	36.8	38.7	37.9	29.1	29.4	35.8
500	39.2	34.7	37.2	53.5	36.4	38.5	34.1	34.7	38.5
1 K	38.0	39.0	41.4	40.3	40.5	39.5	39.1	40.4	39.8
2 K	39.1	29.7	38.1	37.5	38.2	40.2	42.3	44.5	38.7
4 K	47.5	52.1	50.8	51.2	44.7	43.5	32.9	37.9	45.1
8 K	35.8	36.0	40.7	41.5	39.6	40.4	30.7	30.6	36.9
16 K	29.4	29.8	29.6	29.5	29.7	29.6	33.3	32.9	30.5

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 16, 2002
Site: "Y" Intersection of Mocambo River Afluents

Coordinates: 17 P 0658289 East
UTM 1001013 North

Point #: 3

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:30 a.m.	Hi= 11:30 a.m.	Hi= 12:30 p.m.	Hi= 01:30 p.m.	Hi= 02:30 p.m.	Hi= 06:30 a.m.
	Hf= 11:30 a.m.	Hf= 12:30 p.m.	Hf= 01:30 p.m.	Hf= 02:30 p.m.	Hf= 03:30 p.m.	Hf= 07:30 a.m.
00:00:00	76.3 truck	83.0 truck	46.0 dB	41.4 dB	**74.6 dB**	53.0 dB
00:00:30	44.8	62.4	45.9	65.4 Car		52.9
00:01:00	50.6 Car	62.1	44.7	42.4		60.6
00:01:30	41.1	48.8	43.4	37.6		75.2 bus
00:02:00	41.8	41.6	43.8	38.4		55.4
00:02:30	49.7	47.0	35.6	36.8		53.1
00:03:00	44.8	47.8	35.8	38.5		55.7
00:03:30	48.1	49.8	38.8	41.4		52.9
00:04:00	47.6	67.7 Bus	43.8	40.7		52.7
00:04:30	49.7	47.2	66.2 Car	39.0		52.6
00:05:00	51.4	50.5	43.9	35.4		52.7
00:05:30	47.7	48.8	44.6	36.0		53.3
00:06:00	45.1	48.7	44.2	36.6		59.5
00:06:30	46.2	52.6	44.7	35.3		67.4 Car
00:07:00	45.4	46.4	44.3	41.9		54.0
00:07:30	50.6	43.1	45.1	33.7		52.9
00:08:00	45.0	43.3	52.7	34.5		52.8
00:08:30	47.6	41.9	63.6 Car	36.4		52.7
00:09:00	54.6 Car	42.8	39.0	41.1		52.8
00:09:30	51.8	45.8	43.0	40.5		53.1
00:10:00	50.9	44.7	41.7	39.2		52.5
00:10:30	49.8	38.3	41.1	48.3		53.0
00:11:00	50.5	46.1	44.6	64.9 Bus		52.4
00:11:30	42.9	45.5	65.1 Bus	40.0		52.7
00:12:00	45.4	48.4	54.7	39.7		52.6
00:12:30	45.7	47.6	45.3	42.5		52.6
00:13:00	55.5	46.7	50.3	43.3		52.5
00:13:30	49.7	47.6	45.1	56.9 Bus		52.5
00:14:00	47.3	58.1	43.7	45.3		52.7
00:14:30	44.2	41.8	37.9	68.1 Bus		52.4
00:15:00	63.3 Car	49.1	38.3	34.0		52.6
00:15:30	56.0	59.8	36.9	33.8		53.4
00:16:00	51.9	73.3 bugs	39.4	31.5		52.6
00:16:30	51.6	43.0	38.6	35.4		52.7
00:17:00	48.1	42.2	36.1	37.2		53.0
00:17:30	51.2	65.4 bus	38.4	39.8		53.0
00:18:00	49.2	49.9	39.0	35.6		52.8
00:18:30	45.4	65.3 bus	50.1	36.0		53.2
00:19:00	51.4	53.6	66.6 truck	37.9		52.7
00:19:30	63.1 truck	53.9	50.8	50.4		52.5
00:20:00	61.6 Bus	46.8	40.5	41.9		52.7
00:20:30	50.7	49.5	57.0 Car	45.6		52.6

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:30 a.m.	Hi= 11:30 a.m.	Hi= 12:30 p.m.	Hi= 01:30 p.m.	Hi= 02:30 p.m.	Hi= 06:30 a.m.
	Hf= 11:30 a.m.	Hf= 12:30 p.m.	Hf= 01:30 p.m.	Hf= 02:30 p.m.	Hf= 03:30 p.m.	Hf= 07:30 a.m.
00:21:00	50.8 dB	49.4 dB	38.4 dB	74.8 Bus		52.7 dB
00:21:30	49.4	47.3	49.7	45.6		52.8
00:22:00	63.2 truck	47.2	64.7 Car	48.6		52.6
00:22:30	48.2	47.1	45.4	34.0		52.7
00:23:00	50.9	46.6	43.8	36.6		52.5
00:23:30	45.6	45.9	39.4	39.4		52.9
00:24:00	47.3	44.6	34.9	34.8		52.8
00:24:30	58.1 airplane	47.2	41.6	35.5		52.6
00:25:00	52.3	50.6	43.3	34.6		52.8
00:25:30	51.3	42.8	49.8	38.1		56.4
00:26:00	48.5	47.5	44.0	37.7		53.6
00:26:30	47.2	49.2	38.5	33.4		52.8
00:27:00	50.3	45.0	40.0	39.2		52.5
00:27:30	49.6	46.5	41.6	38.5		55.7
00:28:00	46.8	45.8	43.0	41.1		53.8
00:28:30	48.8	46.1	42.2	42.4		55.9 people
00:29:00	51.2	47.1	38.9	75.2 truck		54.0
00:29:30	48.8	64.8	39.9	35.5		54.2
00:30:00	49.8	77.1 Bus	38.9	32.3		52.7
00:30:30	47.5	46.5	54.4	36.1		53.0
00:31:00	44.4	45.7	63.8 Car	39.2		52.8
00:31:30	43.5	45.3	59.0	37.1		52.6
00:32:00	45.5	49.4	56.1	34.5		52.8
00:32:30	42.3	39.7	41.9	43.9		52.7
00:33:00	47.6	41.5	43.2	39.0		56.4
00:33:30	49.1	42.1	40.8	44.8		53.7
00:34:00	50.8	42.4	42.9	42.6		52.7
00:34:30	43.6	41.7	40.7	39.9		52.7
00:35:00	42.6	44.3	39.6	35.2		52.3
00:35:30	43.3	49.4	40.0	38.3		52.7
00:36:00	44.2	58.7	41.1	45.9		52.5
00:36:30	46.6	78.9 truck	43.9	44.4		52.3
00:37:00	48.2	52.7	43.6	65.3 Car		54.3
00:37:30	49.0	53.5	44.7	36.6		52.6
00:38:00	48.3	43.1	42.2	33.6		53.0
00:38:30	47.5	60.2 truck	38.3	35.8		52.7
00:39:00	47.7	48.9	40.0	34.2		52.4
00:39:30	45.8	46.2	40.8	36.0		52.5
00:40:00	49.3	43.2	44.8	32.0		52.4
00:40:30	47.1	43.6	40.8	29.0		52.7
00:41:00	49.8	40.2	55.4	28.6		53.3
00:41:30	51.2	37.4	73.3	32.5		53.2
00:42:00	80.1 Bus	46.4	48.8	39.1		54.2
00:42:30	53.8	46.6	58.1 Bus	38.9		52.6
00:43:00	43.3	46.9	46.2	39.1		52.7
00:43:30	43.4	47.0	40.3	36.5		52.6
00:44:00	43.7	47.9	72.2	43.1		52.9
00:44:30	45.8	47.6	38.9	55.1 Car		52.7
00:45:00	47.3	46.5	44.8	41.0		52.8
00:45:30	46.8	42.9	40.9	39.8		54.6
00:46:00	47.6	56.5	41.4	39.5		52.9
00:46:30	57.1	38.2	38.6	45.4		55.6 people
00:47:00	47.7	41.0	40.1	77.1 Tractor		53.6
00:47:30	46.9	63.3	39.8	59.0 Car		59.9 people
00:48:00	46.7	40.6	39.6	37.6		56.0

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:30 a.m.	Hi= 11:30 a.m.	Hi= 12:30 p.m.	Hi= 01:30 p.m.	Hi= 02:30 p.m.	Hi= 06:30 a.m.
	Hf= 11:30 a.m.	Hf= 12:30 p.m.	Hf= 01:30 p.m.	Hf= 02:30 p.m.	Hf= 03:30 p.m.	Hf= 07:30 a.m.
00:48:30	56.3 dB	39.1 dB	41.6 dB	33.8 dB		52.8 dB
00:49:00	57.0	36.8	42.8	39.1		52.7
00:49:30	50.9	38.3	39.2	39.9		52.3
00:50:00	50.3	40.3	41.0	38.1		52.5
00:50:30	45.9	51.9	38.6	30.1		52.4
00:51:00	46.1	43.6	42.7	28.2		52.3
00:51:30	47.3	40.9	42.2	28.5		52.5
00:52:00	50.9	41.5	42.5	28.8		52.4
00:52:30	71.8	40.5	39.3	29.0		53.0
00:53:00	73.3	40.8	38.9	32.0		52.4
00:53:30	52.7	41.2	39.0	55.7 Bus		52.3
00:54:00	56.3	42.5	46.3	39.9		52.7
00:54:30	72.1	44.8	45.3	37.0		52.3
00:55:00	46.0	44.0	62.4	31.4		52.4
00:55:30	46.6	44.1	80.3	30.3		52.5
00:56:00	47.5	43.3	51.2	28.8		52.5
00:56:30	46.3	42.9	42.9	30.0		59.1
00:57:00	44.6	42.9	43.5	30.6		52.6
00:57:30	42.1	45.8	44.2	28.0		52.8
00:58:00	40.2	75.2	75.6	31.5		52.5
00:58:30	41.3	41.1	45.1	30.3		52.5
00:59:00	45.3	38.7	63.3	30.9		53.0
00:59:30	44.8	39.1	42.9	31.9		52.8
01:00:00	43.9	39.9	41.8	32.3		52.6

Observations: There is Swelling of the Mocambo River

	DAYTIME		NIGHT TIME	
Maximum:	83.0	dB (Mode SPL)	75.2	dB (Mode SPL)
Minimum:	28.0	dB (Mode SPL)	52.3	dB (Mode SPL)
Average:	45.8	dB (Mode SPL)	53.6	dB (Mode SPL)

Maximum of Test 5: 74.6 dB (Mode Linear)

Vibration Test

Point #: 3 Date: August 16, 2002

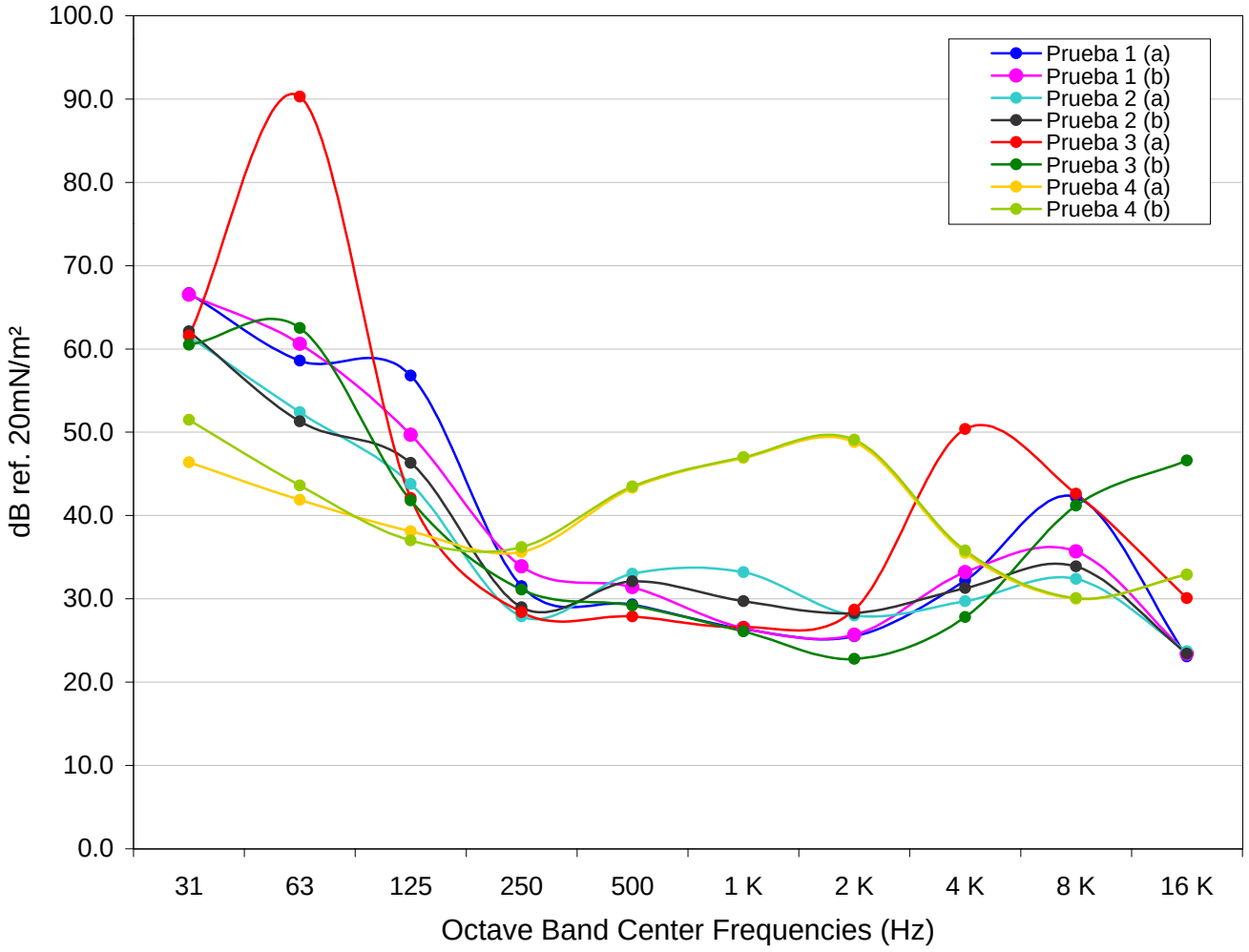
Coordinates 17 P 0658289 East
UTM 1001013 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	10:00 a.m.	Hi=	10:15 a.m.	Hi=	10:30 a.m.	Hi=	07:30 a.m.	
	Hf=	10:15 a.m.	Hf=	10:30 a.m.	Hf=	10:45 a.m.	Hf=	07:45 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	66.7	66.5	61.5	62.1	61.6	60.5	46.4	51.5	59.6
63	58.6	60.6	52.4	51.3	(90.3)	62.5	41.9	43.6	57.7
125	56.8	49.7	43.8	46.3	42.1	41.8	38.1	37.0	44.5
250	31.5	33.9	27.9	29.0	28.4	31.1	35.6	36.2	31.7
500	29.3	31.4	33.0	32.1	27.9	29.2	43.3	43.5	33.7
1 K	26.4	26.5	33.2	29.7	26.6	26.1	46.9	47.0	32.8
2 K	25.5	25.7	28.0	28.3	28.7	22.8	48.8	49.1	32.1
4 K	32.2	33.2	29.7	31.3	(50.4)	27.8	35.5	35.8	34.5
8 K	(42.2)	35.7	32.4	33.9	42.6	41.2	30.0	30.1	36.0
16 K	23.1	23.4	23.7	23.4	(30.1)	(46.6)	32.9	32.9	29.5

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 9, 2002
Site: DIMAUD Offices, near Existing Well #2

Coordinates: 17 P 0657768 East
UTM 1000894 North

Point #: 4

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 08:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 09:00 a.m.
00:00:00	57.6 dB	63.8 dB	63.6 dB	60.5 dB	**78.2 dB**	53.6 dB
00:00:30	58.3	57.0	53.2	63.2		53.2
00:01:00	59.9	56.8	53.6	58.0		49.7
00:01:30	63.9 Truck	56.6	50.7	55.3		51.3
00:02:00	58.0	55.1	48.6	65.4		50.4
00:02:30	58.3	52.9	49.6	57.8		52.4
00:03:00	57.9	58.1	49.7	59.0		57.2 Car
00:03:30	63.9 Truck	71.8	50.4	63.2		49.3
00:04:00	57.9	61.3	48.7	67.7		49.2
00:04:30	70.6	59.2	48.4	61.8		48.3
00:05:00	61.4	61.6	48.3	60.3		50.5
00:05:30	61.0	57.5	50.7	57.4		50.4
00:06:00	61.9	80.9	52.9	57.6		50.9
00:06:30	62.7	55.7	54.8	53.4		48.7
00:07:00	64.3	54.1	52.2	53.8		49.3
00:07:30	65.4	55.0	52.8	56.2		49.5
00:08:00	65.5	54.8	59.8	57.0		50.2
00:08:30	63.9	60.2	53.7	59.3		54.2
00:09:00	61.9	55.6	50.0	59.8		67.4 Truck
00:09:30	62.0	56.1	48.6	61.9		55.3
00:10:00	61.3	56.4	62.7	64.3		60.2
00:10:30	61.5	70.0	61.6	75.0		53.6
00:11:00	62.2	55.6	55.0	72.8		50.4
00:11:30	61.5	55.4	50.1	73.5		51.1
00:12:00	63.2	68.1	49.8	68.1		51.2
00:12:30	63.6	55.1	53.7	71.7		60.2 Truck
00:13:00	63.5	58.1	54.0	64.3		53.4
00:13:30	63.4	62.2	53.2	61.5		48.7
00:14:00	64.7	58.5	53.5	60.3		49.2
00:14:30	65.2	69.7	50.2	66.6		52.1
00:15:00	61.8	59.3	50.6	67.7		50.3
00:15:30	61.6	65.7	50.8	64.4		51.1
00:16:00	62.1	65.3	51.3	68.9		49.2
00:16:30	62.6	61.5	54.0	72.2		48.3
00:17:00	62.0	66.8	69.3	62.0		50.4
00:17:30	61.3	73.6	64.2	62.8		54.6
00:18:00	62.3	71.0	54.9	71.2		58.6 Truck
00:18:30	62.4	59.8	55.7	74.6		55.3
00:19:00	62.3	60.3	52.8	70.2		54.4
00:19:30	62.5	59.1	50.4	65.4		49.8
00:20:00	62.2	56.7	49.6	63.3		51.9
00:20:30	62.6	59.0	60.6	63.5		49.0

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 08:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 09:00 a.m.
00:21:00	61.7 dB	59.9 dB	51.5 dB	64.7 dB		51.3 dB
00:21:30	62.2	63.0	52.0	64.7		50.7
00:22:00	61.9	64.5	51.7	70.9		50.8
00:22:30	61.8	69.7	56.4	62.3		50.7
00:23:00	61.4	66.0	50.9	61.8		54.5
00:23:30	61.3	59.2	52.4	62.1		52.0
00:24:00	61.4	64.7	57.3	62.4		51.1
00:24:30	62.4	76.3	51.7	61.7		50.5
00:25:00	62.9	58.0	53.2	61.5		50.9
00:25:30	61.9	58.3	53.9	62.6		49.7
00:26:00	62.0	58.9	66.9	63.3		50.6
00:26:30	63.4	69.9	65.4	70.9		50.4
00:27:00	61.9	66.4	62.6	71.1		51.0
00:27:30	61.5	57.8	58.7	66.2		53.0
00:28:00	61.2	69.6	53.9	62.1		58.9 Car
00:28:30	61.2	60.3	58.3	60.3		73.6 Truck
00:29:00	63.3 Truck	67.2	58.8	57.0		55.3
00:29:30	61.8	64.4	68.4	57.6		50.8
00:30:00	65.0 Truck	64.9	64.7	66.6		51.3
00:30:30	63.7	61.0	65.4	53.3		52.7
00:31:00	66.5	68.1	67.7	55.8		53.5
00:31:30	68.9 Truck	72.8	53.6	61.1		52.8
00:32:00	69.7	76.4	50.2	66.9		51.9
00:32:30	63.3	63.6	45.6	62.8		51.0
00:33:00	63.5	66.3	43.9	63.6		50.3
00:33:30	64.9 Truck	61.3	44.8	61.3		50.7
00:34:00	60.4	64.7	58.2	56.4		49.8
00:34:30	61.2	63.5	50.6	55.7		49.1
00:35:00	63.4	65.6	52.9	58.1		48.3
00:35:30	62.3	63.6	56.7	61.8		48.6
00:36:00	61.8	64.8	53.4	60.7		48.3
00:36:30	61.9	63.8	48.0	56.0		49.7
00:37:00	64.2	68.1	49.0	60.0		49.6
00:37:30	70.2 Truck	59.2	66.6	68.5		49.9
00:38:00	62.2	58.6	60.0	69.4		50.5
00:38:30	76.2 Truck	60.1	60.3	63.6		50.1
00:39:00	66.4	60.9	60.9	57.3		52.9
00:39:30	61.9	59.1	61.3	54.4		62.4 Car
00:40:00	63.2	59.8	51.2	53.9		63.9
00:40:30	62.4	59.0	50.4	54.6		55.9
00:41:00	62.7	64.8	49.8	53.2		55.1
00:41:30	61.6	56.8	49.1	55.0		52.4
00:42:00	59.9	69.6	49.3	53.6		53.2
00:42:30	60.4	61.4	47.6	54.4		49.7
00:43:00	59.7	70.3	54.8	59.4		52.3
00:43:30	59.4	64.2	54.0	55.0		58.8 Truck
00:44:00	58.3	63.2	59.1	53.1		54.9
00:44:30	58.7	62.7	57.6	53.0		55.1
00:45:00	69.6 Truck	63.4	73.3	54.3		50.1
00:45:30	57.5	63.3	60.9	54.1		51.0
00:46:00	56.6	66.9	53.1	53.7		49.8
00:46:30	60.7	57.8	51.0	53.3		56.3
00:47:00	58.9	54.2	50.9	51.8		66.0
00:47:30	62.4	55.9	55.5	49.7		74.4 Truck
00:48:00	63.0	54.9	60.0	59.2		56.7

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 08:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 09:00 a.m.
00:48:30	62.6 dB	58.9	57.1 dB	57.9 dB		56.0 dB
00:49:00	63.8	57.7	54.3	65.4		54.8
00:49:30	63.4	59.6	57.5	68.4		55.3
00:50:00	64.6	63.8	55.8	58.0		54.6
00:50:30	65.2	73.7	63.9	54.6		55.1
00:51:00	67.6 Truck	76.0	57.9	54.2		52.1
00:51:30	73.6	69.9	63.3	50.3		53.5
00:52:00	68.2 Truck	61.8	62.4	51.6		55.6
00:52:30	63.9	62.9	58.0	54.4		52.1
00:53:00	68.3	67.3	60.9	54.6		50.9
00:53:30	72.2	61.1	61.7	51.7		50.6
00:54:00	62.9	64.3	60.6	53.7		49.8
00:54:30	58.9	65.6	59.7	52.3		50.2
00:55:00	64.9	64.7	58.2	56.6		50.1
00:55:30	57.4	63.8	64.3	53.8		59.3
00:56:00	66.2	60.6	61.7	54.4		69.6 Truck
00:56:30	69.9	62.0	59.7	57.6		72.3 Truck
00:57:00	55.2	61.0	59.4	60.5		56.7
00:57:30	54.3	61.3	59.2	61.0		58.1
00:58:00	59.9	57.0	63.2	57.4		54.2
00:58:30	58.7	59.3	58.5	57.2		57.2
00:59:00	65.1	56.5	57.8	65.1		58.3
00:59:30	64.2	53.8	60.6	64.1		58.4
01:00:00	63.7	57.4	59.0	60.2		63.5 Truck

Observations: Transit of trucks and tractors frequently all the day. Sweepings trucks to 30m, personnel of the DIMAUD cutting grama of the offices.

	DAYTIME		NIGHT TIME	
Maximum:	80.9	dB (Mode SPL)	74.4	dB (Mode SPL)
Minimum:	43.9	dB (Mode SPL)	48.3	dB (Mode SPL)
Average:	60.3	dB (Mode SPL)	53.5	dB (Mode SPL)

Maximum of Test 5: 78.2 dB (Mode Linear)

Vibration Test

Point #: 4 Date: August 9, 2002

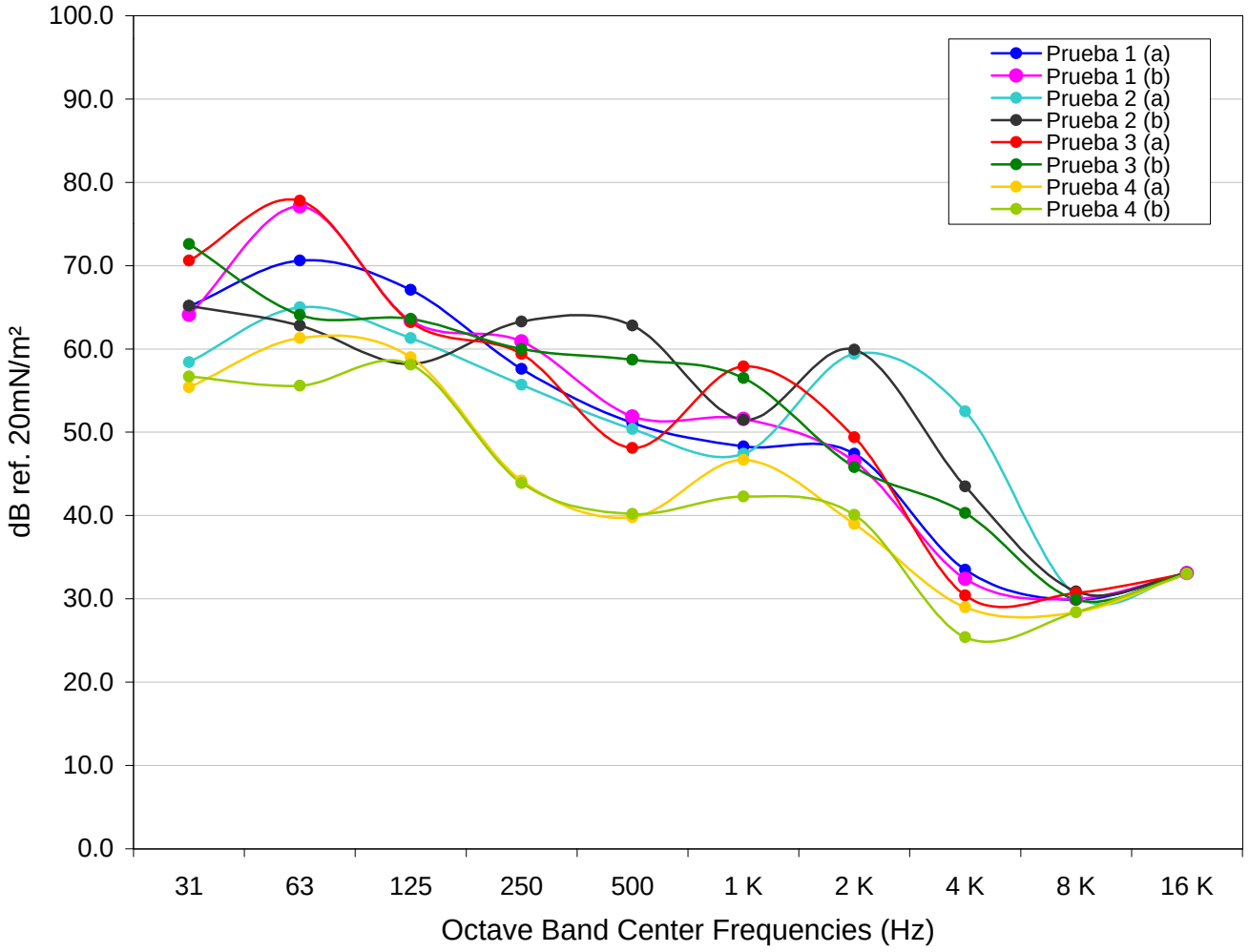
Coordinates 17 P 0657768 East
UTM 1000894 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	03:15 p.m.	Hi=	03:45 p.m.	Hi=	04:15 p.m.	Hi=	09:00 a.m.	
	Hf=	03:30 p.m.	Hf=	04:00 p.m.	Hf=	04:30 p.m.	Hf=	09:15 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	65.1	64.1	58.4	65.2	70.6	72.6	55.4	56.7	63.5
63	70.6	77.1	65.0	62.8	77.8	64.1	61.3	55.6	66.8
125	67.1	63.4	61.3	58.2	63.2	63.6	59.0	58.1	61.7
250	57.6	60.9	55.7	63.3	59.4	60.0	44.2	43.9	55.6
500	51.1	51.9	50.4	62.8	48.1	58.7	39.8	40.2	50.4
1 K	48.3	51.6	47.4	51.5	57.9	56.5	46.7	42.3	50.3
2 K	47.4	46.5	59.4	59.9	49.4	45.8	39.0	40.1	48.4
4 K	33.5	32.4	52.5	43.5	30.4	40.3	(29.0)	25.4	35.9
8 K	29.9	30.0	30.4	30.9	30.7	29.9	28.4	28.4	29.8
16 K	33.1	33.1	33.0	33.1	33.0	33.1	33.0	33.0	33.1

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 13, 2002
Site: Quarry - CUSA

Coordinates: 17 P 0657298 East
UTM 1000841 North

Point #: 5

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 03:00 p.m.	Hi= 01:45 a.m.
	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 04:00 p.m.	Hf= 02:45 a.m.
00:00:00	62.6 dB	44.0 dB	41.4 dB	66.7 dB	**88.4 dB**	43.3 dB
00:00:30	72.3	45.1	43.8	69.3		40.8
00:01:00	62.0	44.7	46.4	69.9		39.5
00:01:30	56.2	43.2	50.0	72.6		39.6
00:02:00	46.1	42.8	50.6	70.3		44.0
00:02:30	42.8	44.0	45.8	60.6		44.5
00:03:00	41.9	48.6	55.7	52.7		46.9 Car
00:03:30	47.5	46.1	46.0	53.8		42.3
00:04:00	47.8	47.3	38.9	56.9		40.4
00:04:30	46.5	58.8	42.9	60.9		39.2
00:05:00	46.0	59.4	40.8	65.4		40.9
00:05:30	46.2	53.7	43.9	70.3		40.1
00:06:00	45.4	58.6	51.2	57.6		41.8
00:06:30	46.8	54.2	44.4	61.9		42.6
00:07:00	49.4	58.5	47.0	58.6		40.8
00:07:30	58.7	50.5	59.1	62.1		39.5
00:08:00	51.9	48.1	56.6	60.8		38.8
00:08:30	50.2	49.9	47.4	62.5		41.8
00:09:00	59.8	48.4	49.3	62.6		42.9
00:09:30	65.3	51.2	48.4	63.1		38.6
00:10:00	48.1	48.7	55.3	63.0		38.0
00:10:30	51.9	42.3	50.1	65.8		39.7
00:11:00	50.7	43.8	50.0	70.3		39.7
00:11:30	50.5	42.9	49.5	73.3		39.3
00:12:00	47.8	49.3	49.0	63.6		38.4
00:12:30	46.0	43.7	41.5	63.4		38.6
00:13:00	55.0	48.6	45.7	67.6		40.7
00:13:30	50.2	42.9	44.4	68.0		39.8
00:14:00	45.8	53.8	52.7	67.5		41.9
00:14:30	45.8	42.9	60.6	68.3		58.1 Truck
00:15:00	45.2	41.5	61.2	72.5		49.9
00:15:30	51.6	51.5	58.7	74.4		41.9
00:16:00	57.2	46.3	49.9	74.3		38.1
00:16:30	59.3	47.0	59.2	73.2		37.7
00:17:00	54.1	51.2	54.6	68.7		37.4
00:17:30	54.2	53.6	45.8	55.2		36.9
00:18:00	53.5	42.8	49.0	55.7		38.1
00:18:30	49.4	45.5	47.4	56.2		36.6
00:19:00	52.4	39.8	55.8	58.3		36.5
00:19:30	58.3	44.8	72.6	59.5		38.7
00:20:00	61.3	42.2	62.6	62.4		37.6
00:20:30	77.3	42.9	59.2	63.5		40.3

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 03:00 p.m.	Hi= 01:45 a.m.
	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 04:00 p.m.	Hf= 02:45 a.m.
00:21:00	48.7 dB	54.9 dB	59.9 dB	60.2 dB		41.2 dB
00:21:30	53.3	42.7	60.0	58.7		41.5
00:22:00	49.0	43.5	63.5	57.5		38.5
00:22:30	48.7	41.7	67.3	55.4		36.8
00:23:00	52.1	44.0	62.7	50.3		37.6
00:23:30	45.9	49.8	63.2	47.8		37.5
00:24:00	49.7	50.4	63.4	44.2		40.3
00:24:30	57.2	51.0	63.7	40.5		38.6
00:25:00	76.7	53.5	63.9	41.3		44.3 airplane
00:25:30	66.6	51.2	64.5	44.0		46.6
00:26:00	56.1	52.0	65.7	50.1		39.7
00:26:30	58.7	54.6	71.9	53.8		39.1
00:27:00	55.8	49.7	75.3	77.5 Thunder		40.7
00:27:30	59.1	42.9	70.0	67.7		41.7
00:28:00	60.8	50.8	68.4	65.5		62.9
00:28:30	57.0	49.1	63.9	63.3		37.6
00:29:00	59.8	50.6	64.8	63.7		38.4
00:29:30	72.9	48.9	67.3	63.2		37.9
00:30:00	64.3	48.0	63.6	65.9		38.4
00:30:30	61.6	43.7	63.0	65.8		36.6
00:31:00	61.9	50.2	64.1	63.9		36.8
00:31:30	59.6	52.6	63.6	64.2		35.8
00:32:00	60.0	53.2	64.0	64.0		36.3
00:32:30	60.6	54.0	63.1	69.9 Thunder		36.4
00:33:00	62.1	47.0	61.2	65.3		37.3
00:33:30	55.2	52.2	62.1	63.4		36.8
00:34:00	55.1	43.8	66.2	66.7		36.5
00:34:30	54.3	47.8	67.7	66.9		37.1
00:35:00	56.3	48.3	63.1	67.5 Thunder		36.5
00:35:30	61.3	46.8	63.0	64.3		37.6
00:36:00	53.4	40.5	63.1	60.1		38.3
00:36:30	63.8	40.2	63.8	59.8		37.7
00:37:00	55.2	38.6	62.5	74.1 Thunder		40.5
00:37:30	54.7	38.1	62.6	70.3		44.3
00:38:00	60.6	39.4	62.7	68.5		65.8 Truck
00:38:30	56.0	48.4	62.9	62.4		50.8
00:39:00	56.4	52.0	63.2	64.3		48.4
00:39:30	56.8	47.0	63.3	66.7		49.7
00:40:00	73.3	39.8	64.8	62.4		50.0
00:40:30	71.6	41.2	63.9	63.5		43.3
00:41:00	56.8	39.2	65.4	62.0		38.8
00:41:30	49.6	45.2	64.8	62.7		38.4
00:42:00	48.8	44.2	65.2	59.1		39.3
00:42:30	44.9	43.7	62.4	55.3		38.2
00:43:00	47.9	44.5	63.8	58.4		36.3
00:43:30	52.7	42.5	70.1	59.3		37.1
00:44:00	48.7	48.1	71.5	59.2		40.0
00:44:30	53.5	60.9	83.3	63.3		38.4
00:45:00	66.4	48.7	75.3	60.7		37.2
00:45:30	71.2	47.7	63.3	64.9		38.6
00:46:00	48.0	49.3	57.7	63.3		40.5
00:46:30	44.9	48.8	57.9	66.8		37.9
00:47:00	43.0	49.3	52.8	61.9		40.4
00:47:30	42.1	54.6	54.7	60.8		39.2
00:48:00	44.1	45.6	53.7	64.2		49.3

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 11:00 a.m.	Hi= 12:00 p.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 03:00 p.m.	Hi= 01:45 a.m.
	Hf= 12:00 p.m.	Hf= 01:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 04:00 p.m.	Hf= 02:45 a.m.
00:48:30	45.8 dB	47.4 dB	52.6 dB	63.5 dB		53.6 dB
00:49:00	66.6	49.5	50.9	62.3		57.3 airplane
00:49:30	69.3	51.6	53.5	61.0		39.8
00:50:00	62.3	50.7	51.8	58.7		41.1
00:50:30	63.0	43.6	78.6	59.3		40.4
00:51:00	62.6	42.3	58.6	59.7		41.7
00:51:30	71.7	45.7	59.7	57.9		42.4
00:52:00	44.7	41.8	55.4	55.6		54.1
00:52:30	44.0	40.5	54.9	54.2		64.9
00:53:00	45.9	41.1	53.2	58.3		54.0
00:53:30	44.9	43.7	58.7	61.3		41.0
00:54:00	47.7	44.9	59.1	62.4		38.3
00:54:30	61.2	52.8	74.0	62.9		39.1
00:55:00	44.6	56.7	66.4	62.6		37.7
00:55:30	44.8	61.2	63.6	61.9		39.8
00:56:00	52.6	58.7	66.5	63.5		40.0
00:56:30	57.0	53.2	65.8	63.0		41.3
00:57:00	46.3	54.4	61.3	64.0		39.9
00:57:30	56.3	47.8	65.8	63.3		38.8
00:58:00	62.5	44.5	61.2	62.7		40.6
00:58:30	59.3	43.2	60.6	62.7		39.7
00:59:00	56.1	44.9	69.4	60.3		42.5
00:59:30	55.5	45.4	62.8	60.1		39.4
01:00:00	55.5	62.0	58.3	58.9		38.7

Observations: The quarry is not toiling normally (only they are dispatching the material)

	DAYTIME		NIGHT TIME	
Maximum:	83.3	dB (Mode SPL)	65.8	dB (Mode SPL)
Minimum:	38.1	dB (Mode SPL)	35.8	dB (Mode SPL)
Average:	55.9	dB (Mode SPL)	41.3	dB (Mode SPL)

Maximum of Test 5: 88.4 dB (Mode Linear)

Vibration Test

Point #: 5 Date: August 13, 2002

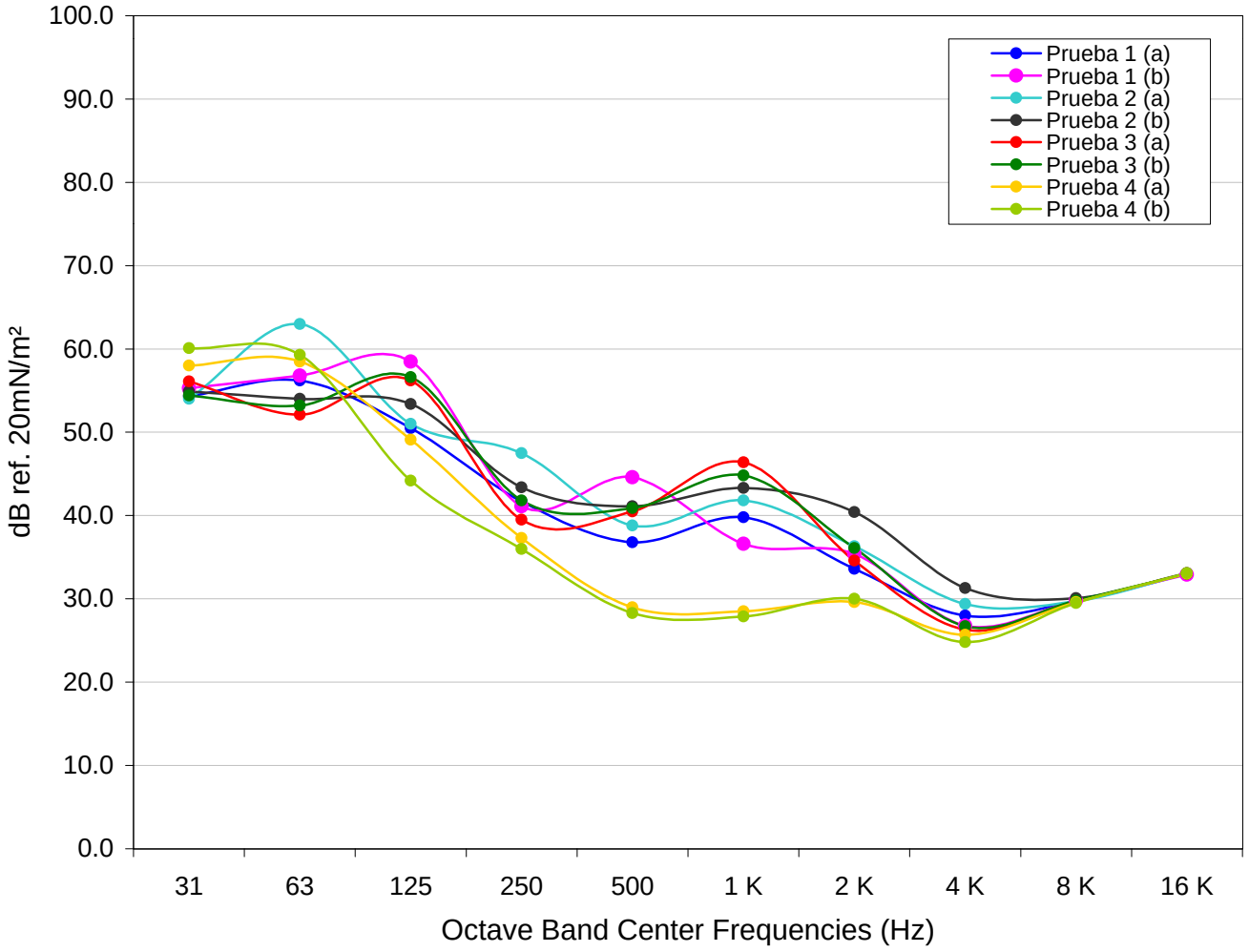
Coordinates 17 P 0657298 East
UTM 1000841 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	10:00 a.m.	Hi=	10:15 a.m.	Hi=	10:30 a.m.	Hi=	02:45 a.m.	
	Hf=	10:15 a.m.	Hf=	10:30 a.m.	Hf=	10:45 a.m.	Hf=	03:00 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	54.3	55.3	54.0	54.9	56.1	54.4	58.0	60.1	55.9
63	56.2	56.8	63.0	54.0	52.1	53.2	58.5	59.3	56.6
125	50.5	58.5	51.0	53.4	56.2	56.6	49.1	44.2	52.4
250	41.7	41.1	47.5	43.4	39.5	41.8	37.3	36.0	41.0
500	36.8	44.6	38.8	41.1	40.5	40.9	29.0	28.3	37.5
1 K	39.8	36.6	41.8	43.3	46.4	44.8	28.5	27.9	38.6
2 K	33.6	35.4	36.3	40.4	34.6	36.1	29.6	30.0	34.5
4 K	28.0	26.8	29.4	31.3	26.3	26.7	25.7	24.8	27.4
8 K	29.7	29.8	29.7	30.1	29.7	29.8	29.6	29.5	29.7
16 K	33.0	32.9	33.0	33.1	33.0	33.0	33.0	33.1	33.0

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 12, 2002
Site: Camino de Cruces, under Transmission Lines

Coordinates: 17 P 0656995 East
UTM 1000015 North

Point #: 6

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 09:00 a.m.	Hi= 10:15 a.m.	Hi= 11:30 a.m.	Hi= 12:45 p.m.	Hi= 01:45 p.m.	Hi= 08:00 a.m.
	Hf= 10:00 a.m.	Hf= 11:15 a.m.	Hf= 12:30 p.m.	Hf= 01:45 p.m.	Hf= 02:45 p.m.	Hf= 09:00 a.m.
00:00:00	43.3 dB	47.1 dB	41.1 dB	44.7 dB	**62.8 dB**	45.9 dB
00:00:30	40.0	50.3	36.9	42.9		47.1
00:01:00	38.1	45.1	35.8	43.4		46.6
00:01:30	41.0	45.3	42.9	41.7		45.7
00:02:00	38.5	43.2	35.3	43.6		46.2
00:02:30	41.4	44.0	41.4	41.1		46.6
00:03:00	39.4	47.7	35.0	40.1		47.2
00:03:30	40.6	53.8 bugs	34.7	45.1		45.2
00:04:00	39.6	49.5	34.8	46.0 Car		44.4
00:04:30	40.0	54.6	34.7	51.8		43.2
00:05:00	38.4	53.7	34.9	55.0		44.1
00:05:30	38.8	45.8	34.3	47.3		42.6
00:06:00	39.0	52.7 bugs	40.1	46.2		45.1
00:06:30	39.7	50.8	34.9	44.8		43.3
00:07:00	39.0	47.0	36.9	41.9		42.6
00:07:30	38.5	50.3	39.2	44.4		42.9
00:08:00	37.6	52.7 bugs	34.6	46.1		43.9
00:08:30	37.0	52.0	35.2	42.7		43.2
00:09:00	35.9	51.1	34.5	43.4		43.6
00:09:30	36.4	48.3	34.8	44.0		44.9
00:10:00	38.2	47.0	36.5	51.5 bugs		42.2
00:10:30	39.1	53.4	37.8	52.0		43.9
00:11:00	38.0	52.0	38.8	50.1		49.0
00:11:30	38.2	46.7	35.3	49.5		43.9
00:12:00	41.1	48.1	36.3	52.1		43.1
00:12:30	38.4	44.3	35.8	51.1		44.0
00:13:00	40.5	47.3 Truck	35.9	53.1		45.1
00:13:30	39.4	54.0	36.4	47.0		44.5
00:14:00	39.3	61.6	36.6	50.7		42.0
00:14:30	39.6	57.0	45.9 bugs	53.6 Helicopter		44.0
00:15:00	40.2	53.2	59.2 Airplane	59.9		43.0
00:15:30	36.7	50.2	46.8	51.8		43.7
00:16:00	39.5	57.7 Truck	49.6 bugs	50.5		44.0
00:16:30	41.6	46.2	36.7	52.0		44.1
00:17:00	41.2	44.1	36.9	46.8		50.4 bugs
00:17:30	38.4	47.0	37.1	43.0		47.6
00:18:00	39.9	49.6	36.6	43.5		43.8
00:18:30	37.3	43.8	39.1	41.4		43.7
00:19:00	37.1	42.4	40.9	43.4		47.4 Avión
00:19:30	50.3	52.4 bugs	39.6	45.8		47.1
00:20:00	45.9	43.7	38.1	55.4 bugs		45.3
00:20:30	37.4	43.5	36.5	54.4		48.5

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 09:00 a.m.	Hi= 10:15 a.m.	Hi= 11:30 a.m.	Hi= 12:45 p.m.	Hi= 01:45 p.m.	Hi= 08:00 a.m.
	Hf= 10:00 a.m.	Hf= 11:15 a.m.	Hf= 12:30 p.m.	Hf= 01:45 p.m.	Hf= 02:45 p.m.	Hf= 09:00 a.m.
00:21:00	37.0 dB	46.8 dB	37.1 dB	45.4 dB		47.4 dB
00:21:30	48.9	50.4	40.2	44.2		44.3
00:22:00	37.6	45.9	38.8	43.3		42.5
00:22:30	37.1	44.0	39.0	42.9		41.8
00:23:00	37.2	43.7	41.5	43.0		43.5
00:23:30	36.3	39.8	42.0	50.8		44.3
00:24:00	38.0	42.9	37.4	47.4		47.3
00:24:30	46.3	40.9	40.4	39.3		46.3
00:25:00	42.9	42.5	40.7	41.8		55.3 bugs
00:25:30	43.3	43.7	43.1	43.3		50.4
00:26:00	37.1	45.9	36.4	41.4		52.4
00:26:30	37.5	46.9	36.8	41.2		50.0
00:27:00	40.0	47.5	36.9	48.3		44.7
00:27:30	38.0	43.0	37.5	46.7		55.2
00:28:00	37.1	42.5	38.5	45.5		49.2
00:28:30	49.0	42.0	39.0	49.0 Car		49.5
00:29:00	38.1	44.7	39.1	55.9		56.3 bugs
00:29:30	47.4	42.3	38.6	45.6		59.9
00:30:00	36.9	47.5	39.5	43.9		58.1
00:30:30	47.4	46.2	38.4	46.3		46.6
00:31:00	38.6	41.4	39.6	46.4		45.9
00:31:30	38.3	46.1	39.1	43.8		47.7
00:32:00	41.1	50.8	43.7	50.6 bugs		54.0
00:32:30	46.8	47.9	44.6	52.3		63.7 Truck
00:33:00	43.1	46.6	41.3	44.2		48.1
00:33:30	45.2	49.9	36.9	63.9 Airplane		45.0
00:34:00	47.1	50.9	39.6	53.8		45.4
00:34:30	41.5	48.0	39.3	51.3		44.9
00:35:00	45.0	47.2	39.2	53.7		43.5
00:35:30	42.3	48.7	38.8	46.1		41.4
00:36:00	42.7	47.6	40.1	50.4		42.9
00:36:30	48.2	45.0	39.6	50.5		42.2
00:37:00	41.9	48.3	39.3	42.0		41.3
00:37:30	43.7	49.7	39.2	38.8		42.8
00:38:00	44.1	49.8	40.6	40.2		47.7
00:38:30	43.7	51.2	44.3	43.6		43.0
00:39:00	42.1	46.0	39.8	51.2		42.4
00:39:30	43.3	49.5	37.3	64.7 Truck		41.8
00:40:00	45.2	48.1	37.8	41.4		44.9
00:40:30	45.1	46.1	38.4	41.9		46.0
00:41:00	49.2	51.2	39.0	42.5		48.1
00:41:30	49.9	47.0	36.6	39.2		46.2
00:42:00	51.5	44.5	36.4	41.7		49.3
00:42:30	39.6	46.4	37.7	40.8		47.3
00:43:00	44.4	43.6	38.6	39.0		53.4 bugs
00:43:30	38.5	42.6	43.9	37.7		44.6
00:44:00	45.1	48.0	42.0	39.5		48.0
00:44:30	49.6	43.3	40.7	37.5		49.0
00:45:00	66.3 Truck	45.5	47.8	38.3		47.2
00:45:30	49.0	46.3	49.1	37.5		46.4
00:46:00	42.3	42.9	50.4	38.3		42.4
00:46:30	41.6	48.3	49.2	38.5		41.8
00:47:00	40.2	45.0	42.5	39.8		43.4
00:47:30	41.3	40.6	44.1	41.9		45.8
00:48:00	41.2	44.2	47.0	42.3		46.0

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 09:00 a.m.	Hi= 10:15 a.m.	Hi= 11:30 a.m.	Hi= 12:45 p.m.	Hi= 01:45 p.m.	Hi= 08:00 a.m.
	Hf= 10:00 a.m.	Hf= 11:15 a.m.	Hf= 12:30 p.m.	Hf= 01:45 p.m.	Hf= 02:45 p.m.	Hf= 09:00 a.m.
00:48:30	40.0 dB	43.7 dB	47.3 dB	42.6 dB		47.8 dB
00:49:00	39.2	42.2	47.9	42.9		44.6
00:49:30	39.7	55.9 Airplane	47.4	42.5		50.6 bugs
00:50:00	41.8	50.4	51.2	43.5		44.2
00:50:30	39.3	42.1	50.5	44.8		48.5
00:51:00	38.5	41.0	45.4	40.6		45.8
00:51:30	43.8	46.7	44.0	39.7		42.3
00:52:00	42.0	45.0	48.2	45.6		51.1 bugs
00:52:30	38.6	44.8	45.6	37.6		40.6
00:53:00	42.2	46.8	44.7	38.3		40.2
00:53:30	39.6	44.5	46.9	39.5		41.2
00:54:00	41.8	44.3	48.2	45.8 Car		40.7
00:54:30	41.9	49.5	41.2	40.6		41.8
00:55:00	43.0	53.1	43.5	46.3 Car		42.5
00:55:30	42.6	46.1	44.6	48.6		41.6
00:56:00	43.4	40.3	42.0	39.8		40.4
00:56:30	43.1	42.5	44.9	40.2		41.2
00:57:00	43.6	42.7	44.7	41.7		41.7
00:57:30	46.7 bugs	43.1	43.1	41.5		42.1
00:58:00	55.1	44.7	42.6	40.8		44.5
00:58:30	55.7	41.0	41.8	40.5		41.7
00:59:00	53.1	40.9	39.6	40.9		42.0
00:59:30	44.8	45.3 Airplane	46.5	47.0		41.8
01:00:00	45.8	53.0	39.3	37.9		41.7

Observations: Distant thunders were heard

	DAYTIME		NIGHT TIME	
Maximum:	66.3	dB (Mode SPL)	63.7	dB (Mode SPL)
Minimum:	34.3	dB (Mode SPL)	40.2	dB (Mode SPL)
Average:	43.7	dB (Mode SPL)	45.7	dB (Mode SPL)

Maximum of Test 5: 62.8 dB (Mode Linear)

Vibration Test

Point #: 6 Date: August 12, 2002

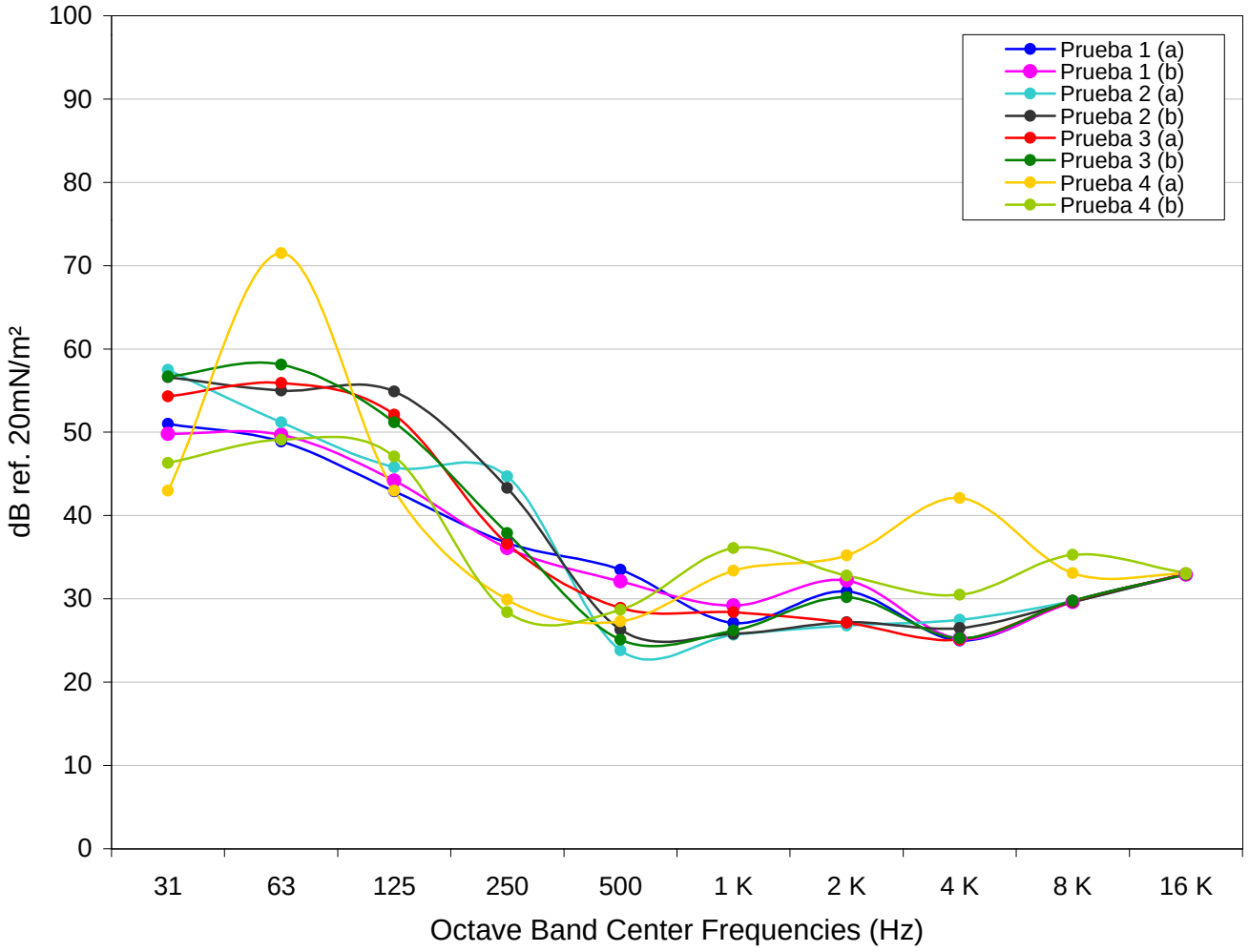
Coordinates 17 P 0656995 East
UTM 1000015 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	02:45 p.m.	Hi=	03:00 p.m.	Hi=	03:15 p.m.	Hi=	07:30 a.m.	
	Hf=	03:00 p.m.	Hf=	03:15 p.m.	Hf=	03:30 p.m.	Hf=	08:00 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	51	49.8	57.5	56.6	54.3	56.7	43.0	46.3	51.9
63	48.9	49.7	51.2	55	55.9	58.1	(71.5)	49.1	54.9
125	42.9	44.2	45.8	54.9	52.1	51.2	43.0	47.1	47.7
250	36.7	36.1	44.7	43.3	36.6	37.9	29.9	28.4	36.7
500	33.5	32.1	23.8	26.3	28.9	25.1	27.3	28.7	28.2
1 K	27.1	29.2	25.7	25.8	28.4	26.2	33.4	36.1	29.0
2 K	30.9	32.2	26.8	27.2	27.1	30.2	35.2	32.8	30.3
4 K	25	25.2	27.5	26.5	25.1	25.3	42.1	30.5	28.4
8 K	29.7	29.6	29.7	29.6	29.7	29.8	33.1	35.3	30.8
16 K	33	32.9	33	33	33	32.9	33.0	33.1	33.0

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



CATEC CONSULTORES EN AMBIENTE Y TECNOLOGÍA, S.A.

NOISE AND VIBRATION MEASUREMENT REPORT

Project: Solid Waste Management Plan for the City of Panama
Date: August 19, 2002
Site: Entrance to Cerro Patacon - Weight Station

Coordinates: 17 P 0657825 East
UTM 1000117 North

Point #: 7

Noise Test

Δt= 30 s

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 12:00 p.m.	Hi= 03:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 01:00 p.m.	Hf= 04:00 a.m.
00:00:00	46.1 dB	53.5 dB	dB	dB	**86.9 dB**	48.5 dB
00:00:30	47.9	49.9				49.2
00:01:00	73.3	70.0				48.5
00:01:30	43.9	68.1				49.1
00:02:00	45.5	78.7				48.8
00:02:30	48.4	52.2				48.7
00:03:00	45.7	49.7				48.9
00:03:30	50.8	49.0				48.6
00:04:00	72.0	52.9				48.1
00:04:30	74.2	66.2				48.6
00:05:00	51.1	51.8				48.1
00:05:30	49.4	49.0				49.0
00:06:00	66.9	51.4				49.4
00:06:30	74.7	50.2				49.2
00:07:00	48.6	49.7				48.8
00:07:30	53.8	52.4				48.5
00:08:00	76.6	71.1				49.3
00:08:30	71.4	61.7				48.7
00:09:00	48.8	74.4				49.0
00:09:30	73.0	53.6				49.6
00:10:00	51.9	74.4				49.0
00:10:30	50.3	78.9				49.1
00:11:00	66.1	87.9				49.3
00:11:30	48.9	83.3				49.7
00:12:00	62.8	89.1				48.8
00:12:30	60.6	73.3				48.4
00:13:00	77.3	70.4				49.3
00:13:30	71.8	57.0				49.5
00:14:00	46.9	55.9				49.6
00:14:30	45.9	56.7				49.1
00:15:00	47.4	68.1				49.0
00:15:30	49.4	54.7				49.7
00:16:00	63.2	64.9				49.0
00:16:30	73.9	68.4				49.1
00:17:00	50.5	56.6				48.7
00:17:30	57.2	55.7				48.2
00:18:00	78.9	56.8				49.9
00:18:30	68.3	73.2				49.0
00:19:00	63.1	64.4				49.2
00:19:30	72.9	75.3				51.2
00:20:00	67.7	61.0				49.0
00:20:30	52.4	65.8				48.9

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 12:00 p.m.	Hi= 03:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 01:00 p.m.	Hf= 04:00 a.m.
00:21:00	49.9 dB	69.5 dB	dB	dB		49.2 dB
00:21:30	52.9	70.4				49.5
00:22:00	54.5	59.8				48.5
00:22:30	68.4	71.3				48.9
00:23:00	74.6	68.9				49.1
00:23:30	72.1	56.7				49.2
00:24:00	49.5	53.8				49.0
00:24:30	69.8	67.5				48.7
00:25:00	50.9	67.9				48.6
00:25:30	48.3	66.1				48.6
00:26:00	58.1	70.3				49.0
00:26:30	52.0	66.0				48.5
00:27:00	75.0	61.7				48.6
00:27:30	47.7	56.0				48.8
00:28:00	48.1	64.9				48.9
00:28:30	73.4	57.4				49.1
00:29:00	53.4	74.2				49.5
00:29:30	65.7	55.2				48.6
00:30:00	53.8	54.9				48.9
00:30:30	52.8	50.8				49.0
00:31:00	74.8	57.6				48.6
00:31:30	54.7	73.6				50.6
00:32:00	44.1	71.2				49.1
00:32:30	72.8	62.4				48.9
00:33:00	45.4	55.6				48.8
00:33:30	55.3	51.9				48.6
00:34:00	54.6	49.3				49.1
00:34:30	52.4	47.6				50.3
00:35:00	62.8	51.1				49.9
00:35:30	72.9	63.9				49.3
00:36:00	65.8	63.2				49.0
00:36:30	48.6	61.2				48.8
00:37:00	71.2	44.1				49.2
00:37:30	63.2	45.2				49.1
00:38:00	50.2	51.9				49.4
00:38:30	75.0	73.3				56.8
00:39:00	50.8	58.3				48.8
00:39:30	70.7	56.5				48.7
00:40:00	71.9	53.6				49.2
00:40:30	55.5	52.7				48.6
00:41:00	53.0	70.2				48.7
00:41:30	54.4	49.7				48.5
00:42:00	59.4	53.3				49.1
00:42:30	64.9	59.6				48.9
00:43:00	76.5	55.0				48.1
00:43:30	57.0	48.8				47.7
00:44:00	60.4	51.9				48.0
00:44:30	54.6	72.7				48.1
00:45:00	62.3	50.1				58.3
00:45:30	74.4	49.3				47.4
00:46:00	50.1	55.7				48.1
00:46:30	51.1	73.5				48.4
00:47:00	67.7	53.2				57.9
00:47:30	57.6	60.9				55.7
00:48:00	55.8	65.4				48.7

Time	Test 1	Test 2	Test 3	Test 4	Test 5 (Máx.)	Test 6
	Hi= 10:00 a.m.	Hi= 11:00 a.m.	Hi= 01:00 p.m.	Hi= 02:00 p.m.	Hi= 12:00 p.m.	Hi= 03:00 a.m.
	Hf= 11:00 a.m.	Hf= 12:00 p.m.	Hf= 02:00 p.m.	Hf= 03:00 p.m.	Hf= 01:00 p.m.	Hf= 04:00 a.m.
00:48:30	54.3 dB	60.2 dB	dB	dB		49.0 dB
00:49:00	65.1	55.7				48.8
00:49:30	51.9	57.2				48.7
00:50:00	58.6	56.8				48.2
00:50:30	67.5	55.1				48.1
00:51:00	78.6	55.0				48.3
00:51:30	70.6	58.3				49.1
00:52:00	55.3	60.9				48.7
00:52:30	51.9	58.5				48.2
00:53:00	52.6	53.6				48.1
00:53:30	55.4	50.9				48.2
00:54:00	74.6	49.7				48.1
00:54:30	56.4	48.6				47.9
00:55:00	70.1	50.5				48.1
00:55:30	81.2	53.4				48.4
00:56:00	58.2	54.5				48.5
00:56:30	52.7	52.8				49.0
00:57:00	51.0	56.2				73.2
00:57:30	64.1	55.8				48.4
00:58:00	50.9	59.8				48.9
00:58:30	70.2	57.6				49.1
00:59:00	72.2	56.2				48.7
00:59:30	65.4	56.3				49.0
01:00:00	51.2	55.1				48.5

Observations: Hard heavy shower to the 12:50 p.m., tests 3 and 4 could not be made

	DAYTIME		NIGHT TIME	
Maximum:	89.1	dB (Mode SPL)	73.2	dB (Mode SPL)
Minimum:	43.9	dB (Mode SPL)	47.4	dB (Mode SPL)
Average:	59.9	dB (Mode SPL)	49.3	dB (Mode SPL)

Maximum of Test 5: 86.9 dB (Mode Linear)

Vibration Test

Point #: 7 Date: August 19, 2002

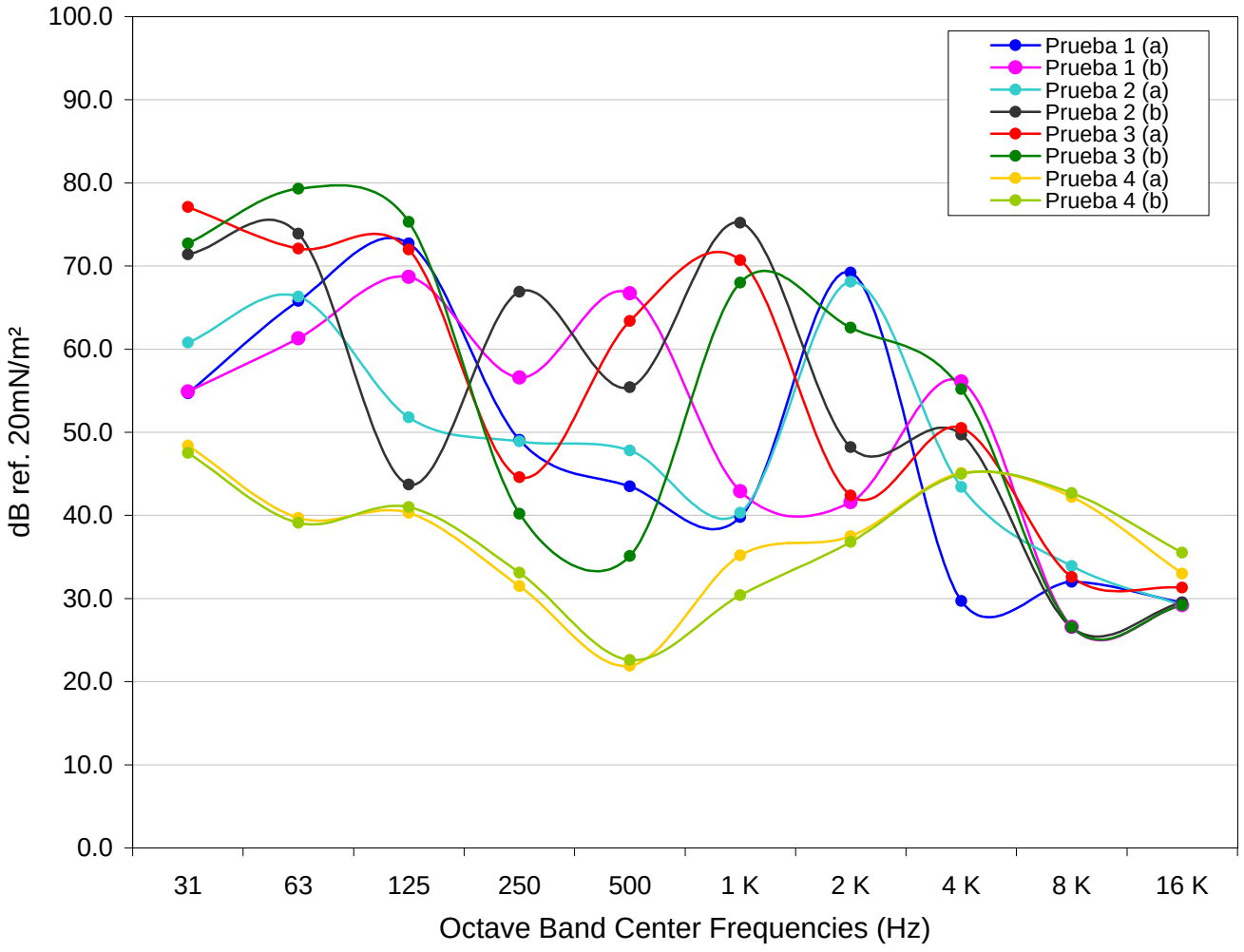
Coordinates 17 P 0657825 East
UTM 1000117 North

Δt= 90 s

Frequency (Hz)	Test 1		Test 2		Test 3		Test 4		Average
	Hi=	08:45 a.m.	Hi=	09:15 a.m.	Hi=	09:45 a.m.	Hi=	04:00 a.m.	
	Hf=	09:00 a.m.	Hf=	09:30 a.m.	Hf=	10:00 a.m.	Hf=	04:15 a.m.	
	dBA:		dBA:		dBA:		dBA:		
	dB LIN:	X	dB LIN:	X	dB LIN:	X	dB LIN:	X	(dBA)
31	54.7	54.9	60.8	(71.4)	(77.1)	(72.7)	48.4	47.5	60.9
63	(65.8)	(61.3)	66.3	(73.9)	(72.1)	(79.3)	39.7	39.1	62.2
125	(72.7)	(68.7)	51.8	43.7	(72.0)	(75.3)	40.3	41.0	58.2
250	49.1	(56.6)	48.9	66.9	44.6	40.2	31.5	33.1	46.4
500	43.5	(66.7)	47.8	55.4	(63.4)	35.1	21.9	22.6	44.6
1 K	39.8	42.9	40.3	(75.2)	(70.7)	(68.0)	35.2	30.4	50.3
2 K	(69.2)	41.6	(68.1)	48.2	42.4	(62.6)	37.5	36.8	50.8
4 K	29.7	(56.1)	(43.4)	(49.7)	(50.5)	(55.2)	45.1	45.0	46.8
8 K	(32.0)	26.6	(33.9)	26.5	32.6	26.6	42.2	42.7	32.9
16 K	(29.5)	29.2	29.2	(29.5)	(31.3)	29.2	33.0	35.5	30.8

NOTE: (##.#) Values registered the passing of a vehicle.

Octave Band Analysis Chart



PHOTOS: Noise and Vibration

Photo 1. Point #1, Noise & Vibration

Photo 2. Point #2, Noise & Vibration

Photo 3. Point #5, Noise & Vibration

Photo 4. Point #6, Noise & Vibration

Photo 5. Point #7, Noise & Vibration

Photo 6. Point #4, Noise & Vibration

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FLORA AND FAUNA

Table A 2.6-1
List of Flora Species Registered
at the Cerro Patacon Sampling Locations

Site 1: Gate

Family	**Scientific Name**	**Common Name**	**Protection Status**
CANOPY ± 15 m			
Rubiaceae	**Antirhea trichantha**	Caobilla	
	Calycophyllum candidissimum	Madroño	
Tiliaceae	*Luehea seemannii*	Guácimo colorado	
Euphorbiaceae	*Croton billbergianus*	Sangrillo	
Malphigiaceae	*Byrsonima crassifolia*	Nance	
Burseraceae	*Bursera simaruba*	Indio desnudo	
Cecropiaceae	*Cecropia peltata*	Guarumo	
Annonaceae	*Annona purpurea*	Toreta	
Fabaceae	*Enterolobium cyclocarpum*	Corotú	
	Ormosia macrocalyx	Frijolito de la suerte	
Anacardiaceae	*Astronium graveolens*	Zorro	V (Pmá)
	Spondias mombin	Jobo	
Palmae	*Scheelea zonensis*	Palma real	V (Pmá)
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
MEDIUM CANOPY ± 7 – 10 M			
Fabaceae	**Pithecellobium rufescens**	Coralillo	
	Andira inermis	Harino	
	Swartzia simplex	Naranjillo	
Lauraceae	*Phoebe cinnamomifolia*	Sigua blanca	
Bombacaceae	*Pseudobombax septenatum*	Barrigón	
Tiliaceae	*Apeiba tibourbou*	Cortezo	
Boraginaceae	*Cordia alliodora*	Laurel blanco	
Myrtaceae	*Eugenia galalonensis*	Guayabillo	
FOREST FLOOR			
Heliconiaceae	**Heliconia latispatha**	Platanillo, chichica	
Gramineae	*Saccharum spontaneum*	Paja canalera	
Marantaceae	*Calathea* sp.	Bijao de monte	
Rubiaceae	**Psycotria horizontalis**	¾	
	Alibertia edulis	Zumbo	
Fabaceae	*Inga hayesii*	Guabo	
Melastomataceae	*Conostegia speciosa*	¾	
Solanaceae	*Solanum* sp.	¾	V? (Pmá)
Anacardiaceae	*Astronium graveolens*	Zorro	V (Pmá)
Tiliaceae	*Triumfetta lappula*	Cadillo mozote	
Adiantaceae	*Adiantum* sp.	Helecho	
Palmae	*Desmocus isthmius*	Matamba	

Site 2: Mocambo River

Family	Scientific Name	Common Name	Protection Status
CANOPY ± 10 - 15 m			
Bombacaceae	**Cavanillesia platanifolia**	Cuipo	
	Pseudobombax septenatum	Barrigón	
Anacardiaceae	*Anacardium excelsum*	Espavé	
	Spondias mombin	Jobo	
Burseraceae	**Bursera simaruba**	Indio desnudo	
Cecropiaceae	*Cecropia peltata*	Guarumo	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
Tiliaceae	*Apeiba tibourbou*	Cortezo	
FOREST FLOOR			
Heliconiaceae	**Heliconia latispatha**	Platanillo, chichica	
Gramineae	*Saccharum spontaneum*	Paja canalera	
	Panicum sp.	Pata de gallina	
Marantaceae	*Calathea* sp.	Bijao de monte	EP? (Pmá)
Adiantaceae	*Adiantum* sp.	Helecho	

Site 3-A: Camino de Cruces Nacional Park

Family	Scientific Name	Common Name	Protection Status
CANOPY ± 20 m			
Annonaceae	*Annona purpurea*	Toreta	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
Anacardiaceae	*Spondias mombin*	Jobo	
Araliaceae	**Sciadodendron excelsum**	Jobo lagarto	
Myrtaceae	*Eugenia galalonensis*	Guayabillo	
	Eugenia coloradensis	Guayabo del monte	
Fabaceae	**Leucaena multicapitula**	Frijolillo	
	Platymiscium pinnatum	Quira	CR (Pmá)
	Andira inermis	Harino	
Tiliaceae	**Luehea speciosa**	Guácimo pacheco	
Cecropiaceae	*Cecropia peltata*	Guarumo	

Site 3-A (Continued)

Malpighiaceae	**Byrsonima crassifolia**	Nance	
Rutaceae	**Zanthoxylum procerum**	Tachuelo	
Elaeocarpaceae	**Sloanea terniflora**	Tercipelo	
Boraginaceae	*Cordia alliodora*	Laurel blanco	
Bombacaceae	**Pachira sessilis**	Yuco de monte	
MEDIUM CANOPY ± 10 – 12 m			
Bombacaceae	**Pachira quinata**	Cedro espino	V (UICN)
	Cavanillesia platanifolia	Cuipo	
Rubiaceae	*Calycophyllum candidissimum*	Madroño	
	Antirhea trichantha	Caobilla	
Anacardiaceae	*Mangifera indica*	Mango	
	Astronium graveolens	Zorro	V (Pmá)
Myrsinaceae	*Ardisia* sp.	Uvito de monte	V? (Pmá)-EP? (UICN)
Tiliaceae	*Apeiba tibourbou*	Cortezo	
Fabaceae	**Ormosia macrocalyx**	Frijolito de la suerte	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	

FOREST FLOOR			
Heliconiaceae	**Heliconia latispatha**	Platanillo, chichica	
Anacardiaceae	*Astronium graveolens*	Zorro	V (Pmá)
Fabaceae	**Acacia collinsii**	Cachito	
	Pitecellobium rufescens	Coralillo	
Tiliaceae	**Triumfetta lappula**	Mozote	
Piperaceae	*Piper* sp.	Hinojo	
Rubiaceae	*Psychotria grandifolia*	¾	
	Alibertia edulis	Zumbo	
	Guettarda foliacea	Azulejo	
Bombacaceae	**Cavanillesia platanifolia**	Cuipo	

Site 3-A (Continued)

Bromeliaceae	**Aechmea magdalenae**	Piñuela	
Connaraceae	*Connarus panamensis*	Liana	
Schiaceae	*Lygodium* sp.	Helecho rastrero	
Chrysobalanaceae	*Hirtella racemosa*	Garrapato	
Annonaceae	*Annona spraguei*	Negrito	V (UICN)
Flacourtiaceae	*Zuelania guidonia*	Arbol caspa	
Sapindaceae	*Cupania sylvatica*	Gorgojo	
Euphorbiaceae	*Margaritaria nobilis*	Clavito	

Site 3-B: Camino de Cruces Nacional Park

Family	**Scientific Name**	**Common Name**	**Protection Status**
CANOPY ± 15 m			
Tiliaceae	*Apeiba tibourbou*	Cortezo	
Annonaceae	**Xylopia frutescens**	Malagueto macho	
	Xylopia aromatica	Malagueto hembra	
Araliaceae	*Scheefflera morototoni*	Guarumo pava	
Lauraceae	*Phoebe cinnamomifolia*	Sigua blanca	
Burseraceae	**Bursera simaruba**	Indio desnudo	
Sapindaceae	*Cupania cinerea*	Gorgojo blanco	
Rubiaceae	**Antirhea trichantha**	Caobilla	
Boraginaceae	*Cordia alliodora*	Laurel blanco	
Tiliaceae	**Luehea speciosa**	Guácimo pacheco	
Anacardiaceae	*Anacardium excelsum*	Espavé	
Cecropiaceae	*Cecropia peltata*	Guarumo	
	Cecropia longipes	Guarumo	EP (Pmá) - EP (UICN)
MEDIUM CANOPY ± 7 – 10 M			
Sapindaceae	*Cupania rufescens*	Gorgojo	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
Fabaceae	**Dalbergia retusa**	Cocobolo	EP (Pmá) – V (UICN)
	Swartzia simplex	Naranjillo	
Araliaceae	*Dendropanax arboreus*	Vaquero	
Cochlospermaceae	*Cochlospermun vitifolium*	Poroporo	
Rubiaceae	*Genipa americana*	Jagua	
Anacardiaceae	*Spondias mombin*	Jobo	
Annonaceae	*Annona spraguei*	Negrito	
Nyctaginaceae	**Neea delicatula**	Mala sombrilla	
Burseraceae	**Bursera simaruba**	Indio desnudo	

FOREST FLOOR			
Heliconiaceae	**Heliconia latispatha**	Platanillo, chichica	
Gramineae	*Chusquea* sp.	Carricillo	
	Saccharum spontaneum	Paja canalera	
Melastomataceae	**Miconia argentea**	Dos caras	
	Miconia impetiolaris	Oreja de burro	
Rubiaceae	**Conostegia speciosa**	¾	
	Palicourea guianensis	¾	
	Psychotria horizontalis	¾	
	Alibertia edulis	Zumbo	
Sterculiaceae	**Sterculia apetala**	Arbol Panamá	
Lauraceae	*Phoebe cinnamomifolia*	Sigua blanca	
	Cordia alliodora	Laurel blanco	
Annonaceae	*Annona acuminata*	Anonilla	
Cecropiaceae	*Cecropia peltata*	Guarumo	
Fabaceae	**Pitecellobium rufescens**	Coralillo	
Araliaceae	*Scheefflera morototoni*	Guarumo pava	
Smilacaceae	*Smilax* sp.	Zarza	
Flacourtiaceae	*Lacistema aggregatum*	Huesito	
Costaceae	*Costus* sp.	Caña agria	

Site 4: Chivo Chivo Road

Family	**Scientific Name**	**Common Name**	**Protection Status**
CANOPY ± 15 m			
Anacardiaceae	*Anacardium excelsum*	Espavé	
Boraginaceae	*Cordia alliodora*	Laurel blanco	
Annonaceae	*Annona purpurea*	Toreta	
	Xylopia frutescens	Malagueto macho	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
Annonaceae	*Annona purpurea*	Toreta	
Fabaceae	*Enterolobium cyclocarpum*	Corotú	
Burseraceae	**Bursera simaruba**	Indio desnudo	

Site 4 (Continued)

MEDIUM CANOPY ± 7 – 10 m			
Sapindaceae	*Cupania rufescens*	Gorgojo	
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	
Myrtaceae	*Eugenia galalonensis*	Guayabillo	
Tiliaceae	*Apeiba tibourbou*	Cortezo	
Anacardiaceae	*Astronium graveolens*	Zorro	V (Pmá)
Araliaceae	*Dendropanax arboreus*	Vaquero	
Rubiaceae	*Genipa americana*	Jagua	
FOREST FLOOR			
Heliconiaceae	**Heliconia latispatha**	Platanillo, chichica	
Gramineae	*Saccharum spontaneum*	Paja canalera	
	Chusquea sp.	Carricillo	
Melastomataceae	**Miconia argentea**	Dos caras	
	Miconia impetiolaris	Oreja de burro	
Sterculiaceae	**Sterculia apetala**	Arbol Panamá	
Lauraceae	*Phoebe cinnamomifolia*	Sigua blanca	
	Cordia alliodora	Laurel blanco	
Annonaceae	*Annona acuminata*	Anonilla	
Cecropiaceae	*Cecropia peltata*	Guarumo	

Protection Status (Nacional and International (UICN)

V= Vulnerable
EP= Endangered
CR= Critical Danger
?= Species was identified to the genre level, it is uncertain if it is threatened.

Table A 2.6-2
List of Fauna Species Registered
at the Cerro Patacon Sampling Sites

MAMMALS

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
DIDELPHIMORPHIA							
Didelphidae							
Didelphis marsupialis	*Zarigüeya común*				C		
XENARTHRA							
Megalonychidae							
Choloepus hoffmanni	Perezoso de dos dedos	O					
Dasypodidae							
Dasypus novemcinctus	Armadillo de 9 bandas	E			O		PE
PRIMATE							
Callitrichidae							
Saguinus geoffroyi	Mono tití	E, O					PE-AI
RODENTIA							
Sciuridae							
Sciurus variegatoides	Ardilla gris	E, O	O				
Echimyidae	Rata espinosa	O			C		
Proechimys semispinosus	Ñeque	E			C		PE
Dasyproctidae							
Dasyprocta punctata							
LAGOMORPHA							
Leporidae							
Sylvilagus brasiliensis	Conejo muleto					O	
CARNIVORA							
Procyonidae							
Procyon sp.	Mapache					H	PE
Nasua narica	Gato solo	E			O		PE
ARTIODACTYLA							
Cervidae							
Odocoileus virginianus	Venado cola blanca			H			PE
CHIROPTERA							
Phyllostomidae							
Carollia perspicillata	Murciélago frugívoro	C					
Carollia castanea	Murciélago frugívoro	C					
Artibeus jamaicensis	Murciélago frugívoro	C		C			
Chiroderma villosum	Murciélago frugívoro			C			
Glossophaga comissarisi	Murciélago nectarívoro			C	C		
Tonatia brasiliensis	Murciélago insectívoro	C					

Sampling Sites

S1 Gate
S2 Mocambo River Bridge
S3A Camino de Cruces Nacional Park
S3B Camino de Cruces Nacional Park
S4 Chivo Chivo Road

Registration Methods

C Capture
O Observation
E Interviews
H Tracks
LL Calls

Protection Status

PE Endangered (Res. Dir. 002-80)
AI y AII Appendices CITES

BIRDS

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
CICONIIFORMES							
Cathartidae		O	O	O			
Coragyps atratus	Gallinazo negro						
ANSERIFORMES							
Anatidae							
Dendrocygna autumnalis	Pato silbador				O		PE
FALCONIFORMES							
Accipitridae							
Buteo nitidus	Gavilán gris	O					AII
Falconidae	Caracara o Cao					O	
Daptrius americanus							
CHARADRIIFORMES							
Jacanidae							
Jacana jacana	Jacana carunculada			O			
COLUMBIFORMES							
Columbidae							
Columba livia	Paloma común				O		
Leptotila verreauxi	Paloma rabiblanca	O			O		
Columbina talpacoti	Tortolita rojiza			O	O		
CAPRIMULGIFORMES							
Caprimulgidae							
Caprimulgus carolinensis	Tapacaminos					C	
APODIFORMES							
Trochilidae							
Phaethornis superciliosus	Ermitaño colilargo			C			AII
Damophila julie	Colibrí ventrivioleta			C	C		AII
Amazilia tzacatl	Amazilia colirufa	C	O	O, C	C		AII
Amazilia edward	Amazilia ventrinivosa	C		C			AII
TROGONIFORMES							
Trogonidae							
Trogon massena	Trogón colipizarra			O			
CORACIIFORMES							
Momotidae							
Electron platyrhynchum	Momoto piquiancho			O			

PICIFORMES							
Ramphastidae							
Ramphastos sulfuratus	Tucán pico iris					O	AII
Pteroglossus torquatus	Tucancillo collarejo	O					
Picidae	Carpintero coronirrojo		O				
Melanerpes rubricapillus	Carpintero lineado	O					
Dryocopus lineatus							
PASSERIFORMES							
Dendrocolaptidae							
Dendrocincla homochroa	Trepatroncos rojizo	C					
Xiphorhynchus guttatus	Trepatroncos gorgianteados			C		C	
Pipridae	Saltarín cuellidorado		O, C	O			
Manacus vitellinus	Saltarín cabecirojo	C					
Pipra mentalis	Saltarín coludo	C					
Chiroxiphia lanceolata							
Troglodytidae							
Thryothorus rufalbus	Soterrey rufiblanco			C			
Thryothorus leucotis	Soterrey pechianteado				C		
Sylviidae	Soterillo piquilargo	O, C					
Ramphocaemus melanurus	Bimbim		O				
Thraupidae							
Euphonia luteicapilla	Azulejo	O	O		O	O	
Thraupis episcopus	Sangretoro	O	O	O			
Ramphocelus dimidiatus	Tangara coroniroja				O	O	
Habia rubica	Tagara oliva			O			
Chlorothraupis carmioli							
Emberizidae	Semillero negriazulado	C					
Volatinia jacarina	Semillero menor				C		
Qryzoborus angolensis	Espiguero ventriamarillo	O					
Sporophila nigricollis	Espiguero variable	O	O, C				
Sporophila americana							
Cardinalidae	Picogrueso negriazulado					C	
Cyanocompsa cyanoides							
Icteridae	Talingo	O	O				
Cassidix mexicanus	Cacique lomiescarlata					O	
Cacicus uropygialis							
Thamnophilidae	Hormiguero negrusco				C		
Cercomacra tyrannina							

Sampling Sites

S1 Gate
S2 Mocambo River Bridge
S3A Camino de Cruces Nacional Park
S3B Camino de Cruces Nacional Park
S4 Chivo Chivo Road

Registration Methods

C Capture
O Observation
E Interviews
H Tracks
LL Calls

Protection Status

PE Endangered (Res. Dir. 002-80)
AI y AII Appendices CITES

Reptiles

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
LACERTILIA							
Gekkonidae	Gecko		O				
Sphaerodactylus homolepis	Lagartija c. naranja	O					
Gonatodes albogularis	Lagartija	O	O		O		
Polychridae							
Anolis sp.	Iguana verde	E					PE-AII
Iguanidae							
Iguana iguana	Borriguero	O	O			C	
Teiidae							
Ameiva festiva	Meracho		O		O	O	
Corytophanidae							
Basiliscus basiliscus							
SERPENTES							
Viperidae	Equis	O					
Bothrops asper	Coral	E				O	
Elapidae							
Micrurus nigrocinctus	Boa arcoiris		O			O	AII
Boidae							
Epicrates cenchria							
CROCODYLIA							
Alligatoridae	Caimán o babilla		E				PE-AII
Caiman crocodylus							

Anphibians

Scientific Name	Common Name	Sampling Sites					Protection Status Protección
		S1	S2	S3A	S3B	S4	
ANURA							
Bufonidae	Sapo común	O	O			O	
Bufo marinus	Sapito de hojarasca	O	O				
Bufo typhonius	Sapo					O	
Bufo granulosus	Rana túngara	O, LL	LL		LL	LL	
Leptodactylidae	Rana gladiadora				C	C	
Physalaemus pustulosus							
Hylidae							
Hyla rosenbergi							

Sampling Sites

S1 Gate
S2 Mocambo River Bridge
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S3B Camino de Cruces Nacional Park
S4 Chivo Chivo Road

Registration Methods

C Capture
O Observation
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H Tracks
LL Calls

Protection Status

PE Endangered (Res. Dir. 002-80)
AI y AII Appendices CITES

Photos: Flora

Photo 1. Area without vegetation on the eastern boundary of the study area.

Photo 2. Canal Grass near the Chivo Chivo Road and PNCC.

Photo 3. The eastern portion of the study area parallel to the main roadway is dominated by herbaceous growth and dispersed trees.

Photo 4. View of disturbed forest dominated by young trees.

Photo 5. View of the River Forest of approximately 10m wide, along Mocambo River near Kuna-Nega .

Photo 6. Herbaceous growth and brushwood near river forest next to Mocambo River.

Photo 7. View of remaining disturbed forest patches located to the left of entrance.

Photo 8. View of an affluent to Mocamo River along the pedestrian crossing leading to Kuna-Nega.

Photos: Fauna

Photo 1. Amazilia Edward, Humminebird captured east of the landfill entrance.

Photo 2. Release of Bats from the nets.

Photo 3. Insect Bat Tonatia Silvícola

Photo 4. Carollia Castanea, captured near the Landfill Entrance.

Photo 5. Black-blue wide beak, common in the forest floor near Mocambo River

Photo 6. Espiguero variable, Sporophila Americana, was abundant in open areas of herbaceous growth toward the norheast limit of the study area.

Photo 7. Chiroderma Uillosum, fruit bat captured in the PNCC Forest.

Photo 8. El borriguero lizard, Ameiva Festiva, was common in brushes of the study area.

Photo 9. Long tail hermit humminebird, Phaetornis Superciliosus, was present in regeneration areas.

Photo 10. Zarigüeya, Didelphys Marsuplalis, in common in all habitats, especially disturbed areas.

Photo 11. Red Tree Climber, Xiphorhynchus Guttatus, was captured in the PNCC forest and the forest area southwest of the study area.

Photo 12. Tangara Coronirroja Habiarubica is common in the secondary forests.

Photo 13. Ñeque, Dasyprocta Punctata, was reported in disturbed areas as well as more preserved areas such as PNCC.

Photo 14. Soterrey Pechianteado o Thryothorus leucotis, common in dense forest floors and forest fringes. This specimen was captured at the limit of the PNCC and the study area.

Photo 15. The Spiny Rat, Proechimys Semispluosus, was common near the crop areas in the eastern part of the study area.

Data I

Collection Improvement Manual

ROUTE IMPROVEMENT PROCEDURE MANUAL

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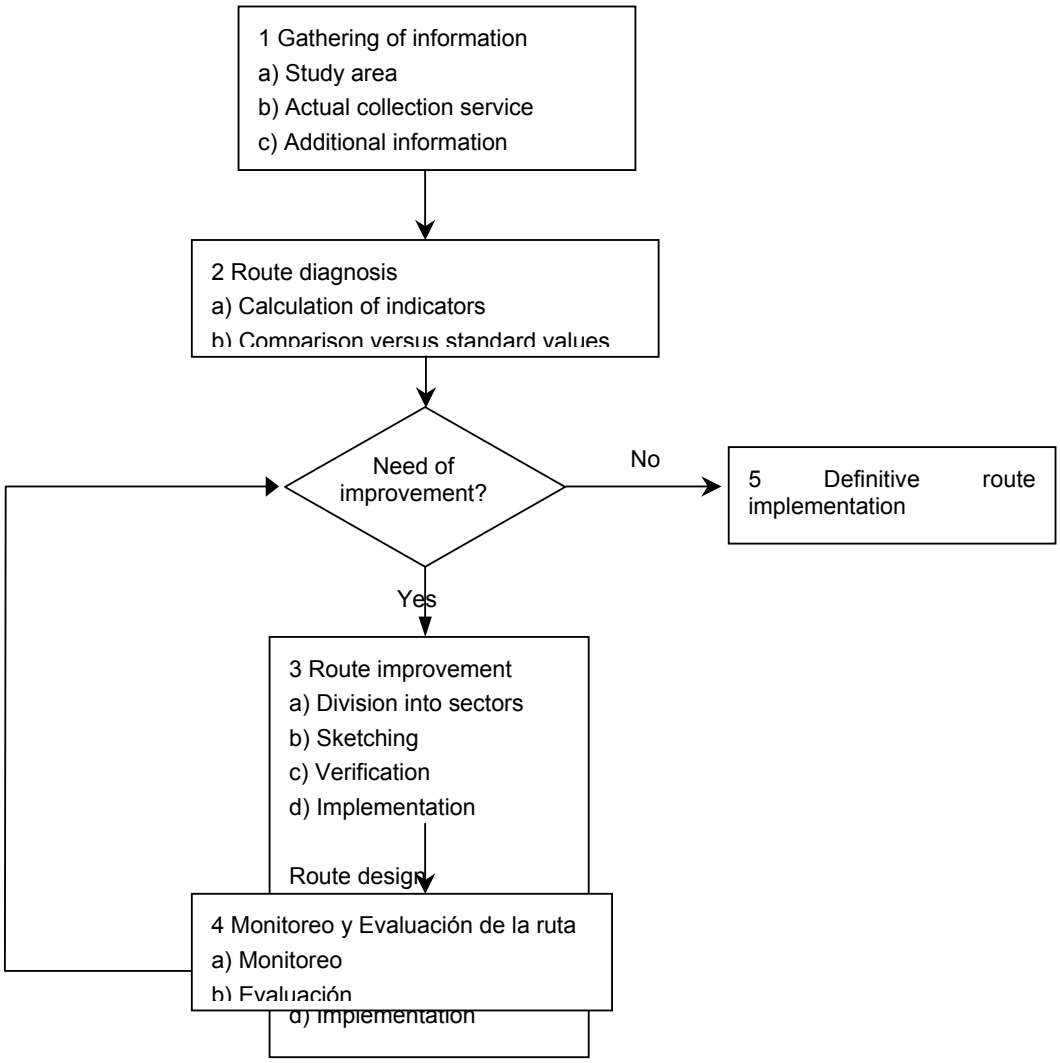
COLLECTION ROUTE IMPROVEMENT

Improvement of collection routes of solid wastes will be carried out from the current routes, trying to preserve the coverage area as much as possible, as well as the vehicles allocated and the 8-hour working day.

Route improvement includes the following steps

1. Gathering of information
2. Route diagnosis
3. Route sketching
4. Route monitoring and assessment
5. Definitive implementation of the route

A flowchart with route improvement is presented next



1. STEP 1 GATHERING OF INFORMATION

The objective of this step is to obtain information related to the area where the routes will be improved, the features of the collection service conducted in such area and surveying of additional information if required. Such data will allow the diagnosis of the current collection trips and will generate the required input for the further improvement of routes.

1.1. STUDY AREA

On a scale drawing which clearly shows the whole study area and the road infrastructure, identify the following:

→ The neighborhoods and their limits, business zones, industrial zones and excessive generators[1] (such as isolated businesses or institutions).

→ Number of inhabitants and houses in each neighborhood. To establish such values, use the data from the last National Census and project such values to the year of study, according to the annual growth rate foreseen by the Office of Statistics from the Comptrollership General's Office of the Republic of Panama.

→ Those streets where the displacement of collection vehicles is not possible.

→ One-way streets or avenues.

→ Streets or avenues with a high traffic flow, displaying the peak hours of this high flow.

→ Streets or avenues that change their way during the day, and displaying the hour when this happens as well.

→ Streets or avenues with outstanding slopes, and their highest and lowest points will be indicated

→ The sector that is closest to the depot

→ The sector that is closest to the sanitary landfill

→ Classify this drawing as the Study Area

Use the signs of the symbology box to represent the information on the drawing (see Annex).

1.2. CURRENT COLLECTION SERVICE

1.2.1 Drawing of actual route

On a similar scale drawing as the above, record the following information:

→ The current collection routes, clearly identifying the direction of the truck, the uptimes and dead times.

→ Location and capacity (yd^3 or m^3) of the containers, if any.

→ Also indicate in a box the productive distances[2], non-productive time distances[3] and total distances for each collection route, as well as the

[1] Excessive generators: those users that generate a larger amount of wastes than that established for the household sector; a value of 200 liters/day can be considered.

[2] Productive distance: the distance traveled by the truck while collecting wastes.

[3] Non-productive distance: the distance when the truck is only shifting and no collection is carried out.

percentage of productive distance versus the route's total distance, which can be determined by the following ratio:

$$\%\ \textbf{Productive distance vs. total distance} = \frac{\text{Productive distance} \times 100}{(\text{Productive distance} + \text{non-productive distance})}$$

Example

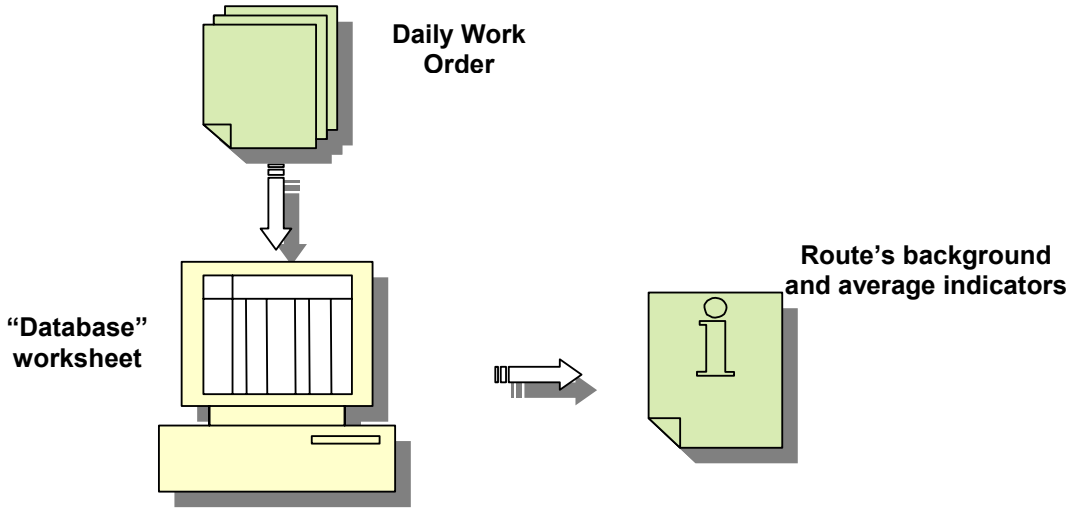
Productive distance	*25 Km*
Non-productive distance	*12 Km*
% =	*25 X 100 =67.56%* *(12+25)*

→ Identify the drawing as Features of Current Routes

Use the signs of the symbology box to represent the information on the drawing (see Annex).

1.2.2 Information regarding Route Times

In the "*Route Improvement*" worksheet[4], record the information contained in the route's Daily Work Orders corresponding to the last three months, so as to obtain the route background and indicators[5], monthly values and averages to be used later on for the diagnosis of the route.



In case the data are contained in the former Work Order format, only take into account the data of the previous two months; the third month will correspond to the

[4] Refer to Annexes for the use of the Route Improvement Worksheet

[5] The Annexes include the definition and calculation procedures for the indicators.

month for surveying additional information. Data to be recorded and the background and indicators to be obtained are shown in the Annex.

1.3. SURVEYING OF ADDITIONAL INFORMATION

As long as the new Work Order is not enforced, the timeframes of the actual routes will not be acknowledged; therefore, the times of the routes to be improved will be directly monitored on the field.

In this case, the times will be recorded in the new Work Order format, and later on will be transferred to the *Route Improvement* worksheet, particularly to the *Month three* sheet.

The monitoring period should be at least one month, and will be conducted by highly trained staff, in order to avoid mistakes while surveying the information and simultaneously to train the driver in gathering data.

On the other hand, if the routes under study include the collection of industrial and/or commercial wastes and it has been decided that they will be collected upon the implemented improved routes by means of the exclusive ICI waste service (institutional, commercial and industrial), proceed to the quantification of wastes belonging to such generators. For such purpose, such wastes will be segregated at least during 15 days and the tons collected will be recorded.

2. STEP 2ROUTE DIAGNOSIS

By using the information obtained in step one clause 1.2.2 regarding the route's background and monthly average indicators, proceed to the diagnosis of the route, in order to define whether the route should be improved or not. The diagnosis is carried out based on the optimal indicators[6] explained below.

2.1. TONS COLLECTED VERSUS HOURS OF COLLECTION

The collection frequency will be monitored to judge if the frequency is the appropriate by comparing the value obtained at the tons collected/collection time ratio (ton/hour) for the routes under study with the optimal value, as shown in the following table:

Acceptable range for the tons/total collection time indicator		
Collection type (urban zone)	Acceptable range	Optimal value
Door-to-door or mixed method, three assistants	2.3 to 2.6 ton/hour	2.45 ton/hour

[6] See optimal indicators in the Annexes

Spot-to-spot method (containers), 3 assistants	2.8 to 3.2 ton/hour	3.0 ton/hour

If the ratio between the indicator value obtained and the optimal value is less than 0.9, it can be said that the frequency of the service is inappropriate and that it is required to expand the period in between the collection days; i.e., to cut down the frequency, which means the route has to be improved.

Example
Amount of wastes collected per month = 300 tons
Total collection time per month = 158 hours
Method: door-to-door, three assistants, urban zone, daily collection frequency

$$\textit{Indicator} = \frac{\textit{Total tons collected per month}}{\textit{Total collection time per month}} = \frac{300}{158} = 1.9 \textit{ ton/hours}$$

Optimal indicator = 2.45 ton/hour

$$\textit{Indicator} = \frac{1.9}{2.45} = 0.78$$

Optimal indicator

The value of 0.78 is below the set figure of 0.9 for the ratio, which means the collection frequency should be reduced.

2.2. TONS VERSUS HOURS PAID

It is verified that the tons collected matches the number of hours paid for executing the service. The diagnosis is conducted through the comparison between the value obtained for the 'tons received' indicator versus the hours paid; the preset value for this indicator ranges between 0.30 to 0.35. For the diagnosis, the route will be deemed as improvable should the value ranges below the optimal figure of 0.33.

Example

Amount of wastes collected per month 300 ton
Hours paid to driver 283
Hours paid to collection workers (3 collectors.) 853
Total hours paid per month 1136

$$\textit{Tons collected per month} = \frac{300}{1136} = 0.26$$

Total hours paid per month

The value of 0.26 is quite below the optimal value, which means the amount of wastes collected on the route is too low as per the hours paid, or the service is not being carried out within the working day, thus generating overtime. For the aforementioned, the route should be improved.

2.3. TONS PER TRIP

It is monitored whether the collection routes have been properly set up or if the vehicles are not working overloaded by comparing the values obtained for the tons/trip indicator to the maximum payload to be hauled by the truck for that route.

It will be found out if the tons/trip and the maximum payload ratio of the truck lies within the optimal range of 0.9 to 1.05; any value outside this range will indicate that the route should be improved.

The maximum payload of the truck will be set by taking into account the truck's gross weight, weight of the framework and the compaction device, according to the following formula:

$$\textbf{\textit{Maximum payload}} = \textit{Vehicle's gross weight} - \textit{framework weight} - \textit{compaction device}$$

Example 1

Tons per average trip per month = 5.9 ton

Maximum truck payload = 7.0 ton

$$\textit{Average tons per trip per month} = \frac{5.9}{7.0} = 0.84$$
Maximum truck payload

The value of 0.84 is below the fixed range; i.e., the vehicle is underused, therefore the route has to be improved.

Example 2

Average tons per trip per month = 7.5 ton

Maximum truck payload = 7.0 ton

$$\textit{Tons per average trip per month} = \frac{7.6}{7.0} = 1.09$$
Maximum truck payload

The value of 1.09 is above the optimal range, which indicates the vehicle is overloaded and therefore the route has to be improved.

2.4. TONS/ASSISTANT/DAY

The daily performance of a collection assistant is evaluated by comparing the amount of wastes collected in the month to the number of actual headcount per month. If the value is substantially lower than the preset optimal value, it can be said that the performance by the assistants (collectors [7]) is inappropriate, supposedly attributable to a lower waste collection and a longer trip; therefore, a different frequency should be studied and the route improved.

[7] Collector: a person who picks up the wastes and places them in the collection truck.

The route will be regarded as poorly designed if the collection assistant performance is below 4.3 ton/assistant/day, which is the preset optimal value.

Example
Tons collected per month *300 ton*
Number of effective collectors per month *3 assistants*
Effective days per month *26*

$$\textit{Performance} = \frac{\textit{Tons collected per month}}{\textit{Number of effective collectors per month x effective days per month}}$$

$$\textit{Performance} = \frac{300}{3 \times 26} = 3.8$$

The performance of 3.8 is lower than the optimal value; therefore, the route has to be improved.

3. STEP 3 ROUTE IMPROVEMENT

The route will be improved when the diagnosis conducted in step 2 shows that some of the indicators have values outside the acceptable or optimal ranges.

3.1. ROUTE DESIGN

3.1.1 Division into sectors

The first activity to conduct is the division into sectors, which consists in splitting the area covered by the current routes, so that each collection crew is assigned an appropriate amount of job for that sector, working at full capacity. Sector can then be divided into sub-sectors, each one of the m corresponding to a collection trip.

a.- <u>Defining the features of the service</u>

Prior to proceeding with the division into sectors, the following characteristics of the collection service must be determined:

Collection frequency:	Could be daily (6 times a week), three times a week or twice a week. The frequency defines the number of days attended in the sub-sector
Collection truck payload:	The truck(s) to be used and their maximum payload will be determined as per step two, clause 2.3.

Number of trips per working day:	The number of trips to be carried out by the truck within the working day will be defined[8].
Number of shifts per day:	It will be established if the study sector will have a day or night working shift; in the latter case, only one shift will be conducted, or even both shifts, which means two working days.
Number of working days per week:	The number of day per week the truck will work in the sector will be defined.

b.- Calculation of the amount of wastes to be collected

Define the amount of wastes to be collected; use the *Route Improvement* worksheet to obtain the amount of wastes collected per month as the average value from the three months of information.

In case the collection of ICI wastes found on the routes is discarded, the tons of the month corresponding to this type of wastes will be subtracted from the total tons collected per month.

$$\text{Tons per month of project} = \text{Total tons of month} - \text{ICI tons per month}$$

With the tons per month of project, determine the **P.P.C.** for the household sector, as per the following formula:

$$\text{P.P.C.} = \frac{\text{Tons month of project} \times 1000}{\text{No. dwellers \& total area} \times \text{No. days of the month}}$$

Tons month of the project correspond to the average tons from the three months of information.
*With the **P.P.C.** and the number of inhabitants per neighborhood calculate the generation of wastes for the week, for the maximum generation day (peak day[9]) and normal generation day (normal day[10]); the latter two values according to the frequency of collection.*

[8] Working day: The number of working hours set forth by Law (eight hours/day).

[9] Peak day: day on which the maximum accumulation of wastes takes place.

[10] Normal day: Days(s) with lower accumulation of wastes.

$$\textbf{Generation of wastes in neighborhood (i)/week} = \frac{\textbf{PPC} \times \text{No. dwellers neighborhood (i)} \times 7\text{days}}{1000}$$

$$\textbf{Generation of wastes in neighborhood (i)/peak day} = \frac{\textbf{PPC} \times \text{No. dwellers neighborhood (i)} \times \text{No. days with maximum generation}}{1000}$$

$$\textbf{Generation of wastes in neighborhood (i)/normal day} = \frac{\textbf{PPC} \times \text{No. dwellers neighborhood (i)} \times \text{No. days normal accumulation}}{1000}$$

The number of accumulation days, based on the collection frequency, corresponds to the following:

Frequency	*No. days of maximum accumulation*	*No. days normal accumulation*
Daily	*2*	*1*
Three times a week	*3*	*2*
Twice a week	*4*	*3*

Once the waste generation per neighborhood has been calculated, compute the total waste output for the study area by adding the total generations per neighborhood.

c.- Calculation of sub-sectors and number of trucks

Calculate the total number of sub-sectors and sub-sectors attended by a truck as follows:

$$\textbf{Total No. of sub-sectors} = \frac{\text{Maximum accumulation tons/day}}{\text{Payload collection truck per trip} \times \text{No. trips per working day}}$$

$$\textbf{No. of sub-sectors attended by a truck} = \frac{\text{(No. days worked /week) x (No. shifts/day)}}{\text{(No. days of service in sub-sector/week)}}$$

Once the total number of sub-sectors and the sub-sectors attended by a truck is acknowledged, calculate the number of required trucks to develop the service, as per the following formula:

$$\text{No. trucks} = \frac{\text{No. total sub-sectors}}{\text{No. sub-sectors attended by a truck}}$$

Identify the sectors and sub-sectors as per the following criterion.

Sector i	Where i is the number of the compaction truck conducting the collection at the sector.
Sub-sector i-j	Where i is the sector number where the sub-sector is located, and j a correlative number that is defined based on the days of provision of the service.

Example
A residential zone has a collection service frequency of three times per week, conducted by two compaction trucks working six times a week and each of them attending two sub-sectors. In this case, the sectors and sub-sectors are identified as follows:

Sector 1		*Compaction truck[11] N°1*
Sub-sector 1-1	*2 trips*	*(Monday – Wednesday – Friday)*
Sub-sector 1-2	*2 trips*	*(Tuesday – Thursday – Saturday)*
Sector 2		*Compaction truck N°2*
Sub-sector 2-1	*2 trips*	*(Monday – Wednesday – Friday)*
Sub-sector 2-2	*2 trips*	*(Tuesday – Thursday – Saturday)*

d.- Verification of the number of trips per working day per truck

Once the number of sub-sectors and required trucks to carry out the collect ion service in the study area has been acknowledged, proceed to check the time required to perform the number of trips per day and the total tons hauled.

Obtain the information related to the average dead times of the routes out of the *Route Improvement* worksheet, specifically of the *Summary* sheet, including the following:

→ Depot-sector time

[11] Compaction truck : packing truck

→ Sector-landfill time

→ Landfill time

→ Landfill-sector time

→ Landfill-depot time

Calculate the tons to be transported by each truck per day on the day of maximum accumulation as per the following:

$$\textbf{Tons peak day to be hauled by truck} = \frac{\text{Tons peak day x No. days of service/day/sub-sector}}{\text{No. days worked/week x No. of trucks}}$$

If more than a trip is considered for the day, always bear in mind that the first trip conveys the truck's maximum payload.

Calculate the dead time and collection time for the first trip as per the following:

$$\text{Dead time } 1^{st} \text{ trip} = \text{Time depot} - \text{route} + \text{time route} - \text{landfill} + \text{Time landfill} + \text{time landfill} - \text{route}$$

$$\text{Uptime } 1^{st} \text{ trip} = \frac{\text{Tons maximum payload}}{\text{Tons/hour of collection}}$$

Adopt the value of the Tons/hour indicator just as the optimal value of step two clause 2.1, taking the type of collection into account.

Add the dead time and uptime of the first trip to obtain the cycle time[12] of the first trip.

$$\text{Cycle time } 1^{st} \text{ trip} = \text{Dead time } 1^{st} \text{ trip} + \text{uptime first trip}$$

If only one trip per day is regarded, compare the cycle time with the working day hours; if such cycle time is less than the working day hours and the ratio between tons per trip versus maximum payload is greater or equal to 0.9, the sub-sectors are properly designed. Otherwise, consider the route design with lower-capacity trucks and calculate again the number of sub-sectors.

[12] Cycle time: the time required by a complete collection trip.

If more than one trip per day is regarded, calculate the available time for the second cycle as follows:

$$\underline{\text{Available time } 2^{nd} \text{ cycle}} = \text{Hours of working day} - \text{Hours first cycle}$$

Calculate the dead time for the second trip and the available time for collection as follows:

$$\underline{\text{Dead time } 2^{nd} \text{ trip}} = \text{Route time} - \text{landfill} + \text{Landfill time} + \text{landfill-depot time}$$

$$\textbf{Available collection time } 2^{nd} \textbf{ trip} = \text{Available time } 2^{nd} \text{ trip} - \text{dead time } 2^{nd} \text{ trip}$$

Calculate the tons to be hauled in the second trip.

$$\underline{\text{Tons } 2^{nd} \text{ trip}} = \text{Tons per truck peak day} - \text{Tons first trip}$$

Calculate the time required to perform the collection of tons of the second trip as follows:

$$\underline{\text{Actual collection time } 2^{nd} \text{ trip}} = \frac{\underline{\text{Tons } 2^{nd} \text{ trip}}}{\text{Tons/hour of collection}}$$

Use the value of the Tons/hour of collection indicator as that one used in the first trip.

If the time available for the collection in the second trip is greater than the actual collection time of the second trip, it is verified that the truck is able to collect the total tons assigned for it within the working day; then calculate the total time worked in the day as follows:

$$\textbf{Total time worked in the day} = \text{Time (dead time + uptime) } 1^{st} \text{ trip} + \text{Time (dead time + uptime) } 2^{nd} \text{ trip}$$

If the time available for collection in the second trip is lower than the actual collection time of the second trip, calculate the tons collected as per the available time as follows:

$$\textbf{\textit{Actual collection tons 2}}^{nd}\textbf{\textit{ trip}} = \textit{Collection time available 2}^{nd}\textit{ trip x (Tons/hour collection)}$$

Use the same value previously employed for Tons/hour of collection.

Calculate the total tons collected in the day as the addition of the first and second trips, and compute the number of trips per day as follows:

$$\textit{N° trips in day} = \frac{\textit{Total tons collected in day}}{\textit{Payload collection truck per trip}}$$

With the new value of the number of trips per day, repeat the process for the calculation of sub-sectors and number of trucks.

e.- Delimitation of sub-sectors

On a copy of the Study Area drawing, mark down the amount of wastes to be collected on the maximum generation day for each neighborhood.

Se the boundaries of the sub-sectors as per the following deliberations:

- → Based on the tons to be collected on the maximum accumulation day, group the neighborhoods in a way that the addition of the tons to be collected is almost the same to the tons assigned per sub-sector (tons to be picked up by a truck on the maximum accumulation day).
- → Use main roads and topographic barriers such as rivers, lakes, and so on, as sub-sector boundaries.

Identify each sub-sector by applying the criterion outlined in clause 3.1.1. letter a)

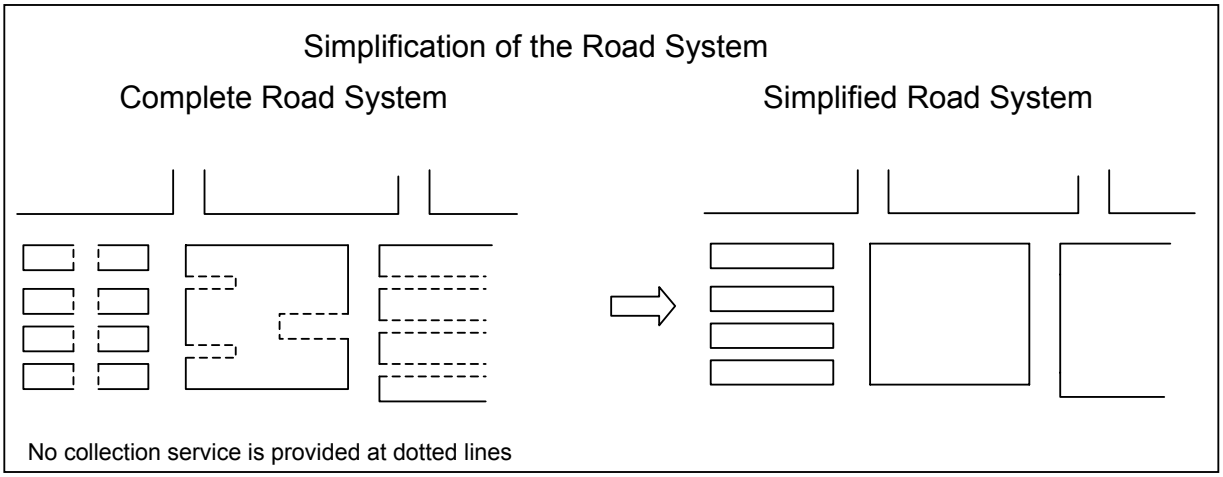
Identify the sectors as per the same criterion outlined above.

Classify the drawing as the sub-sector boundaries.

3.2. SKETCHING

Prepare a working drawing for each sub-sector from a copy of the Sub-sector Boundaries drawing or with tracing paper.

In both cases, simplify the road system according to the information on the Study Area drawing and the following criterion:



Draw the development of the route by taking into account the following criteria and information on the Study Area drawing:

- → Avoid duplications, repeats or unnecessary shifts
- → Respect the traffic regulations
- → Reduce the number of left turns and U-turns, in order to prevent a loss of time while loading, thus minimizing risks for the crew and traffic obstacles
- → Routes with heavy traffic will not be traveled
- → Try to begin the routes at the points closer to the depot and, as the day goes by, try to approach the final disposal with the purpose of cutting down the haulage time.
- → The highest spots of the trip should be traveled at the beginning of the route
- → Steep roads will be traveled downhill whenever possible, conducting collection on both sides of the road, in order to raise safety of the job, speed up collection, minimize the equipment wear-out and reduce oil and fuel consumption.
- → When using the "Comb-style layout"[13], it is preferable to follow the routes of long, straight trips prior to right turns.
- → When using the "double-comb layout"[14], it is preferable to follow the routes with lots of clockwise tours around the blocks.

[13] "Comb-style layout": collection on both sides of the road at the same time; it is traveled only once a day.

Repeat the above procedure to improve the trip, quantifying the number of left and right turns and non-productive distances for each drawing.

Select the route sketching with the lowest number of left turns and lower non-productive runs.

3.3. CALCULATION OF THE NUMBER OF CONTAINERS

In case a frequency variation (increase or decrease) is regarded in the route improvement process and containers are available, the new number of containers will have to be calculated as per the following procedure.

According to the location of the containers (information found on the drawing Features of Current Routes), determine the number of inhabitants that use containers to store their wastes.

With the number of dwellers, the **PPC** calculated in clause 3.1.1. letter b) and the number of days of maximum accumulation of wastes, compute the tons to be stored in the containers.

$$\textbf{Tons to be stored in container} = \text{No. dwellers} \times \textbf{PPC} \times \text{No. days of maximum accumulation}$$

Calculate the total volume of wastes to be stored in the containers as follows:

$$\textbf{Volume of wastes to be stored in container} = \frac{\text{Tons stored in container}}{\text{Waste density in container}}$$

Assume the waste density in the container to range between 0.15 to 0.2 Ton/m^3.

Define the capacity of the containers to be installed and determine the number of containers as follows:

$$\textbf{No. containers} = \frac{\text{Volume of wastes to be stored in containers}}{\text{Container capacity} \times 0.9}$$

A safety factor for the calculation has been considered, therefore it is assumed that containers will fill up to 90% of their top capacity.

Once the number of containers is acknowledged, proceed to spread them around the area based on the number of inhabitants.

---

[14] "Double-comb layout": collection on one side of the road; it is traveled at least twice a day.

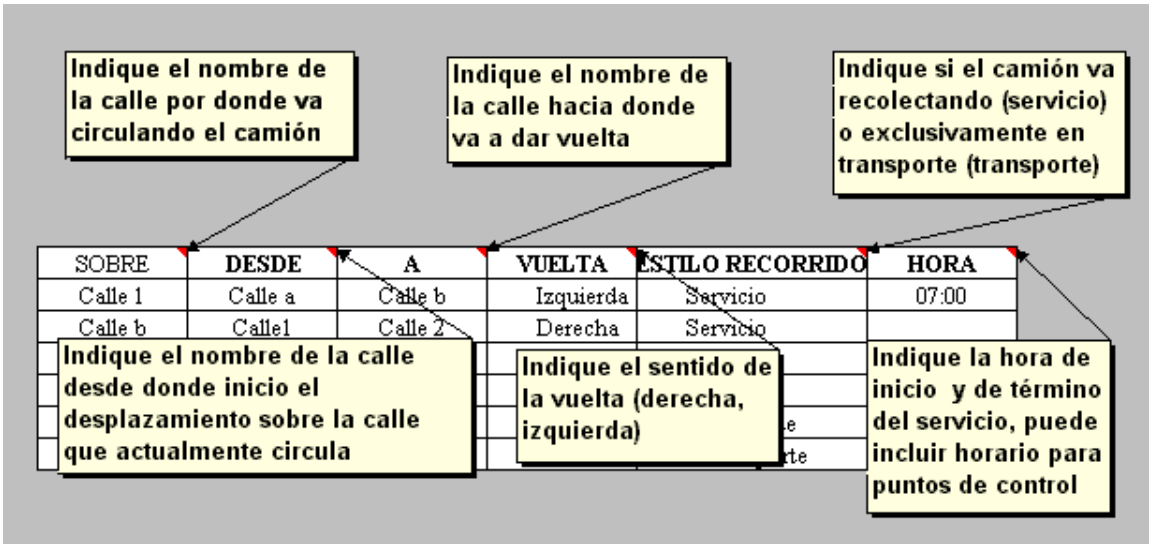
3.4. ROUTE VERIFICATION

Verify each route sketching, conduct an on-field visit and check the following:

- → Distance of the trip in kilometers of each route
- → Verify the road system (traffic ways)
- → Check the traffic fitness; the ideal thing to do is to perform this verification at different times of the year.
- → Inform of the existence of unoccupied blocks and therefore need no cleaning service.
- → Write down the traffic issues such as narrow streets, obstruction due to parked vehicles, severe steep streets, etc.
- → Notify the presence of excessive generators within the route.

If you verify the existence of conditions that alter the sketching, perform the required modifications.

Describe the collection route that has been already checked for the zone, according to the following chart.



3.5. IMPLEMENTATION OF ROUTES

Prior to commissioning the new routes, train the staff, including supervisors, drivers and collectors on the following topics:

- → Responsibilities set per post and function correlations between each other.
- → Interpretation of the symbology applied for the route sketching, such as route beginning and end, direction of the trip, normal service trip and exclusive haulage, auditing points.

→ Way of executing the service, door-to-door collection, lifting of containers, wastes that are not part of the service, how to operate the compacting system, loading and unloading procedures, detection of excessive generators.

→ Use of security devices, subjects related to the inherent labor risks and accidents.

→ Train the driver and supervisor on how to fill out and work with the Daily Work Order format, and train them on field regarding the new trips.

Perform activities aimed at informing the community on the new collection service, and develop the following tasks:

→ Meetings with the dwellers of different neighborhoods, clearly informing on the frequency, days and time of the collection service.

→ Installing of posters in well-attended sites, such as sport fields, supermarkets, schools, etc.

→ Distribution of flyers that indicate the days and hours of attention, frequency of the service and the telephone number to inquiry on the new service and/or pose claims.

Put the new routes into operation and regard a 30-day trial period, during which you will constantly monitor them and perform the required adjustments.

3.6. ROUTE MONITORING AND ASSESSMENT

3.6.1 During the trial period

a.- <u>Monitoring</u>

During the first week, appoint a technician to verify the compliance of the routes every day and detect any anomaly.

Should you detect any anomaly, assess how the latter impacts on the design and/or sketching and perform the corresponding adjustment.

Assign the route supervisor with specific spots where to record the time the truck passes by. Later on, these spots will be used as route control points.

During the trial period, randomly review each of the routes while the collection takes place and immediately after that, and later on check the quality of the service by controlling the following:

→ The appropriate lifting of the wastes

→ The adequate handling of the compaction equipment

→ The appropriate loading and unloading of the containers

→ The presence of scattered wastes

→ Cleaning of the entire area surrounding the containers

→ Excessive noise; identify its source (compacting equipment, horn, personnel's, etc)

→ Seepage of liquids off the truck onto the streets

→ The appropriate use of the uniform and safety devices by the workers

→ The collection staff's behavior towards the users

→ The presence of non-household wastes that cannot be loaded in the compaction truck

Take the corrective actions to get rid or minimize any anomaly detected that downgrades the quality of the service.

If necessary, train the personnel again and enhance their teachings as per the way of executing their job.

Retrieve the data contained in the Daily Work Order every day and record it in the *Route Improvement* worksheet, in the "Routes" sheet.

b.- <u>Assessment</u>

The *Route Improvement* worksheet automatically calculates the indicators and other route background, which will be displayed in the *Summary* sheet.

The control variables and indicators by means of which the routes will be assessed during the trial period are the following:

Control variables

→ Tons

→ Route times

→ Fuel consumption

→ Hours worked per route

Indicators

→ Tons/hours of collection

→ Ton/hours paid

→ Tons/trip

→ Tons/assistant/day

→ Fuel efficiency measured as gallons/hour

The control variables will allow to assess the behavior of the routes throughout the time, therefore a log book with the control variables for each route.

Review the values of the indicators every day and compare them versus the optimal values outlined in step two. If you detect that one of the indicators shows values below the optimal level, analyze the possible causes and adjust the route as necessary.

Likewise, compare the daily indicators between each other, to establish if there are any important changes according to the collection day.

Check the collection times and dead times every day; if you detect any important fluctuations every day, find the cause on the field and correct it.

Compare the results of the indicators for the new improved routes to the indicators under which the routes were initially diagnosed. Calculate the variation percentages of each one and study the need to perform an adjustment on the route.

At the end of the 30-day trial period perform the route diagnosis as peer step two. If the diagnosis indicates that the routes are properly designed, implement the routes for good. If the diagnosis is negative, improve the route again.

At the end of the trial period and after fulfilling the improvement objectives, lay out the definitive route drawing describe each one of them as set forth in step 3.3; include as well the location of the containers, the control points and the hours when the truck will pass in the drawing.

3.6.2 During normal operation period

a.- <u>Monitoring</u>

Survey the timeframe information every day through the daily Work Order.

Retrieve the data contained in the Daily Work Order on a daily basis and save it in the database.

The supervisor is to verify the development of the route by monitoring all the route's control points at least once a week; the supervisor will also check the quality of the service by controlling the same subjects of the trial period, clause 3.5.1. letter a). He/she will report the technical personnel every week in case anomalies are recorded.

b.- <u>Assessment</u>

Obtain the values for the indicators from the database on a monthly basis.

With the indicators obtained, perform a route diagnosis as per step 2 and find out if the goals set have been accomplished (optimal indicators).

For the fuel efficiency indicator, compare the value obtained versus the optimal value assigned per type of vehicle. The ratio between the indicator and the optimal value should not be less than 0.9.

If the goals are not fulfilled, schedule a route monitoring according to clause 3.5.1 letter a) and find out the reasons behind the poor performance. Correct the anomalies; if not possible, consider the need to re-improve the route.

According to the following table, retrieve the values from control variables and the trucks' accumulated working hours from the database, and perform the following evaluations:

Control variables	Assessment
Tons	It will allow you to find out if there was an increase or decrease in the generation of wastes in the area, as well as to schedule the acquisition of new equipment if required. Evaluate the variation in tons collected throughout the month in the sector every six months or on a yearly basis; also calculate the growth rate. Make a projection on the generation of wastes for the sector for the upcoming two or three years, and assess the necessity of incorporating new vehicles. Follow the same operation with the remaining sectors and make a truck acquisition program based on the larger generation of wastes.
Route timeframes	It will allow you to control the times utilized in the different truck motions and to verify the compliance with the route. You will also be able to spot the increase in time of those motions that have to be controlled, such as unloading of the wastes at the sanitary landfill or the truck going through crowded roads. This control variable allows you to audit the work by the collectors and the truck driver, since an increment of the related haulage times are linked with variances in the trip or route beginning. Compare every month if the timeframes undergo important variations; if so, find out the cause(s) and take the required corrective measures. If this is not possible, the working hours of the day will be checked and if overtime exists, the route will have to be improved again.
Fuel consumption	It will allow you to estimate the fuel needs per sector and for the entire truck fleet, as well as to determine the fuel requirements per year. Check if there has been a remarkable peak in fuel

Control variables	Assessment
	consumption on a yearly basis, if so find out the causes (mechanics, mismanagement of the resource) and correct.
Hours worked in the route	It will allow you to compare the use of the truck on a timeframe basis, compliance with the working day and projection of the truck's hours of operation per year. Calculate the variation between the hours worked on route and make a projection of the hours to be devoted in the following two years. The above projected hours will be added to the accumulated operating hours of the truck, and thus you will obtain the projected hours accrued for the two-year period. By distinguishing the truck's service life hours and the projected hours accrued for each of the years you will obtain the remaining time of service life of the truck and will be able to analyze the need to replace the vehicle. Repeat the same procedure with the remaining sectors and lay out a truck acquisition program for replacement.

Update the route's control variables on a yearly basis in the log book.

3.7. EXAMPLE

a) Features of the service

Population of the area to be improved, year 2000	26,808
Projected population, year 2002	27,673
Annual growth rate	1.6%
Defined frequency for improvement	3 times per week
Payload, collection truck	8 tons
Number of trips per day	2
Number of shifts per day	1
Number of days worked per week	6
Number of days of attention to sub-sector	3
Average tons, last three months	686 tons/month
ICI tons	98.4 tons/month

b) Amount of wastes to be collected

Tons of the project month = 686 – 98.4 = 587.6 tons/month

PPC = (587.6 x 1000)/(27,673*30) = 0.71 kg/inhabitant/month

The following table displays the waste generation per neighborhood and the total for the area to be improved; the number of days with maximum accumulation is three.

Neighborhood	*Dwellers year 2000*	*Dwellers year 2002*	*Weekly generation*	*Generation on peak day*	*Generation normal day*
	N°	*N°*	*Ton/week*	*Ton/day*	*Ton/day*
A	*3207*	*3,310*	*16.2*	*7.0*	*4.6*
B	*1989*	*2,053*	*10.1*	*4.3*	*2.9*
C	*2406*	*2,484*	*12.2*	*5.2*	*3.5*
D	*1361*	*1,405*	*6.9*	*3.0*	*2.0*
E	*2321*	*2,396*	*11.7*	*5.0*	*3.4*
F	*1342*	*1,385*	*6.8*	*2.9*	*1.9*
G	*1986*	*2,050*	*10.0*	*4.3*	*2.9*
H	*1636*	*1,689*	*8.3*	*3.5*	*2.4*
I	*1322*	*1,365*	*6.7*	*2.9*	*1.9*
J	*1528*	*1,577*	*7.7*	*3.3*	*2.2*
K	*3898*	*4,024*	*19.7*	*8.4*	*5.6*
L	*1648*	*1,701*	*8.3*	*3.6*	*2.4*
M	*2164*	*2,234*	*10.9*	*4.7*	*3.1*
Total	*26,808*	*27,673*	*135.6*	*58.1*	*38.7*

c) Calculation of sub-sectors and sectors

Number of total sub-sectors = 58.1 / 16 = 3.63 4 sub-sectors

Number of sub-sectors attended per truck = (6 x 1) / 3 = 2 sub-sectors/truck

Number of trucks = 4 / 2 = 2 trucks

Designation of sub-.sectors

Sector 1	*No. of trip*	*Compaction truck No. 1*
Sub-sector 1-1	*2 trips*	*(Monday – Wednesday – Friday)*
Sub-sector 1-2	*2 trips*	*(Tuesday – Thursday – Saturday)*
Sector 2		*Compaction truck No. 2*
Sub-sector 2-1	*2 trips*	*(Monday– Wednesday – Friday)*
Sub-sector 2-2	*2 trips*	*(Tuesday – Thursday – Saturday)*

d) Verification of the number of trips

Tons/peak day per truck = 58.1 x 3 / (6 x 2) = 14.5 Ton/day/truck

The average dead times from the previous months are the following:

Timeframes	*Hours*
Depot-route	*0.2*
Route-landfill	*0.34*
Landfill	*0.25*
Landfill-route	*0.15*
Landfill-depot	*0.35*

Dead time 1st trip =	0.20 + 0.34 + 0.25 + 0.15	= 0.9 hours
Uptime 1st trip	8 / 2.45	= 3.3 hours
Cycle time 1st trip	0.9 + 3.3	= 4.2 hours
Available time 2nd cycle	8 – 4.2	= 3.8 hours
Dead time 2nd trip	0.34 + 0.25 + 0.35	= 0.94 hours
Available collection time 2nd trip	3.8 – 0.94	= 2.9 hours
Tons 2nd trip	14.5 – 8	= 6.5 tons
Real collection time 2nd trip	6.5 / 2.45	= 2.7 hours

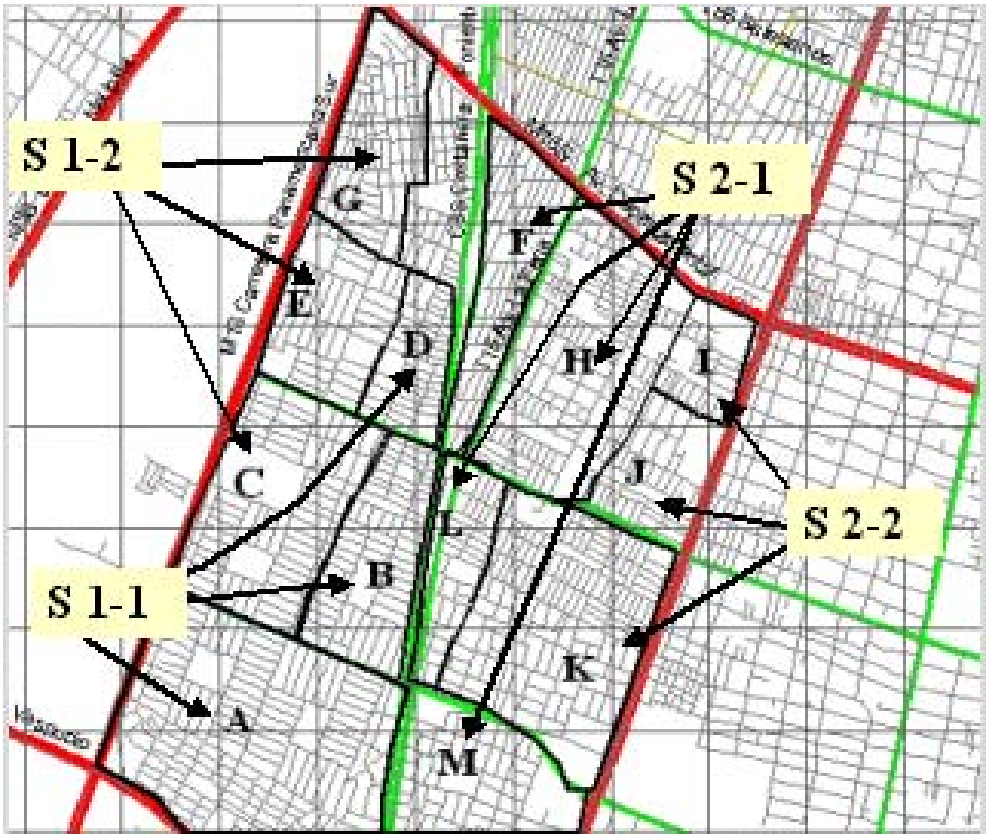
The available collection time in the second trip (2.9 hours) is greater than the actual collection time of the second trip (2.7 hours); therefore, it is verified if the truck can collect the total tons assigned for the working shift on the peak day.

e) Demarcation of sectors

Tons grouping per neighborhoods and their position.

Neighborhood	*Generation peak day*	*S1 -1*	*S1 -2*	*S2 -1*	*S2 -2*
	Ton/day	*Ton/day*	*Ton/day*	*Ton/day*	*Ton/day*
A	*7.0*	*7.0*			
B	*4.3*	*4.3*			
C	*5.2*		*5.2*		
D	*3.0*	*3.0*			
E	*5.0*		*5.0*		
F	*2.9*			*2.9*	
G	*4.3*		*4.3*		
H	*3.5*			*3.5*	
I	*2.9*				*2.9*
J	*3.3*				*3.3*
K	*8.4*				*8.4*
L	*3.6*			*3.6*	
M	*4.7*			*4.7*	
Total	*58.1*	*14.2*	*14.6*	*14.7*	*14.6*

The following figure displays the sector demarcation.



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ANNEX

1. MANAGEMENT OF THE ROUTE IMPROVEMENT WORKSHEET

With the purpose of easing the route improvement process, a spreadsheet was set up that, with time, tonnage, headcount and route fuel consumption input, the control variables and required indicators to measure the latter are estimated.

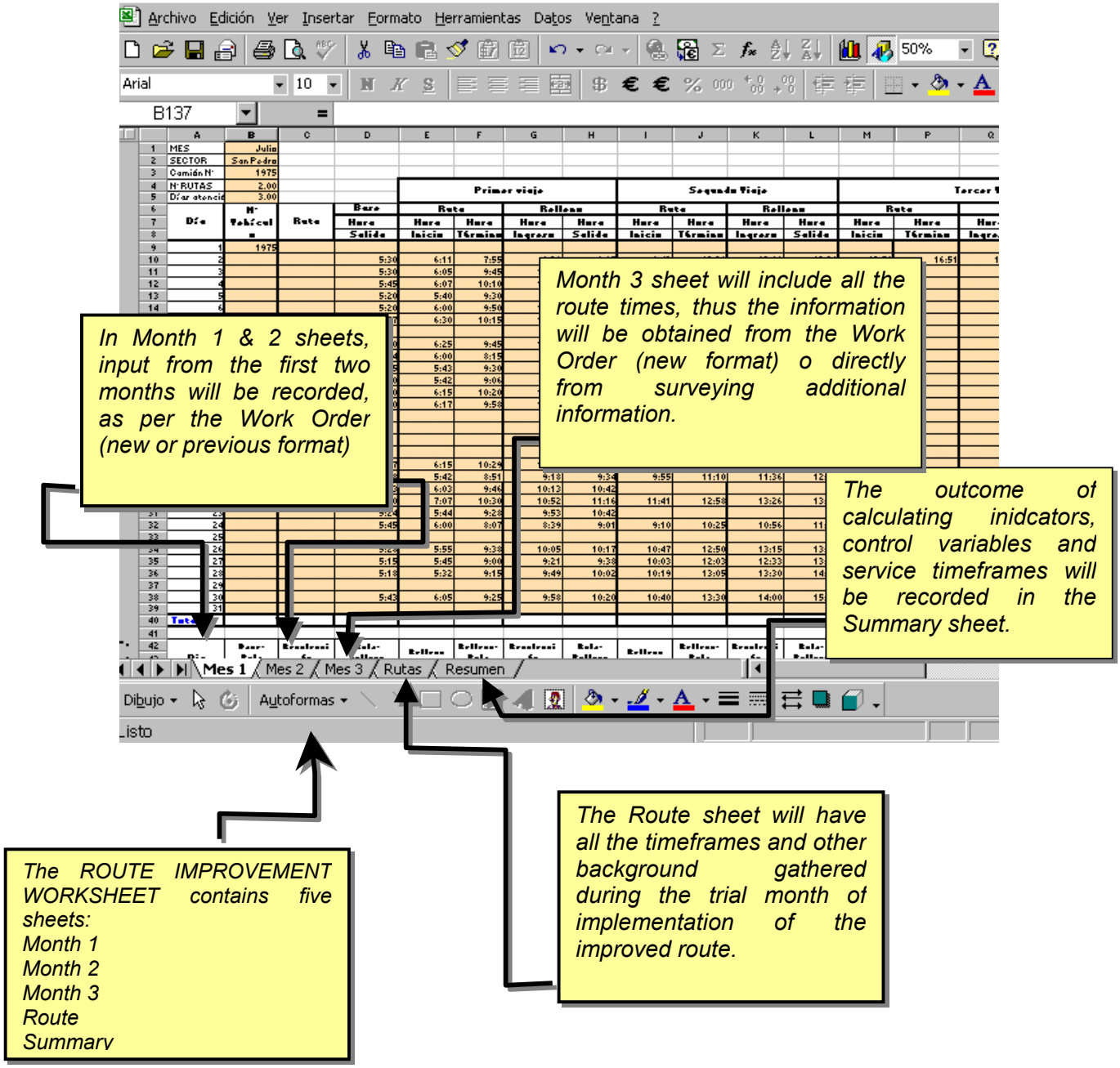
This sheet will be exclusively used for the route improvement process; once the definitive route layout has been implemented, its assessment will be carried out through the database.

The information required by the spreadsheet will be surveyed from the Work Form (new format), which will record the diverse route times. However, currently such document has not been put into effect and the actual form in force only allows for the previous route times in respect of the exit and entrance to the headquarters and the sanitary landfill, being such data insufficient to compute downtimes and uptimes of the service. In virtue of the aforementioned, gathering of information of the current route will have to include at least the last month out of three, as per the input to be included in the new Work Order Format.

Additionally, since not all the collection vehicles are furnished with an odometer to measure the route shifting, assessment of the service will be conducted with the time variable as the exclusive parameter.

The means of operation of the Route Improvement Worksheet is shown next.

The Route Improvement Worksheet is conformed by five sheets known as Month one, Month two, Month three, Routes and Summary, as shown in the next figure.



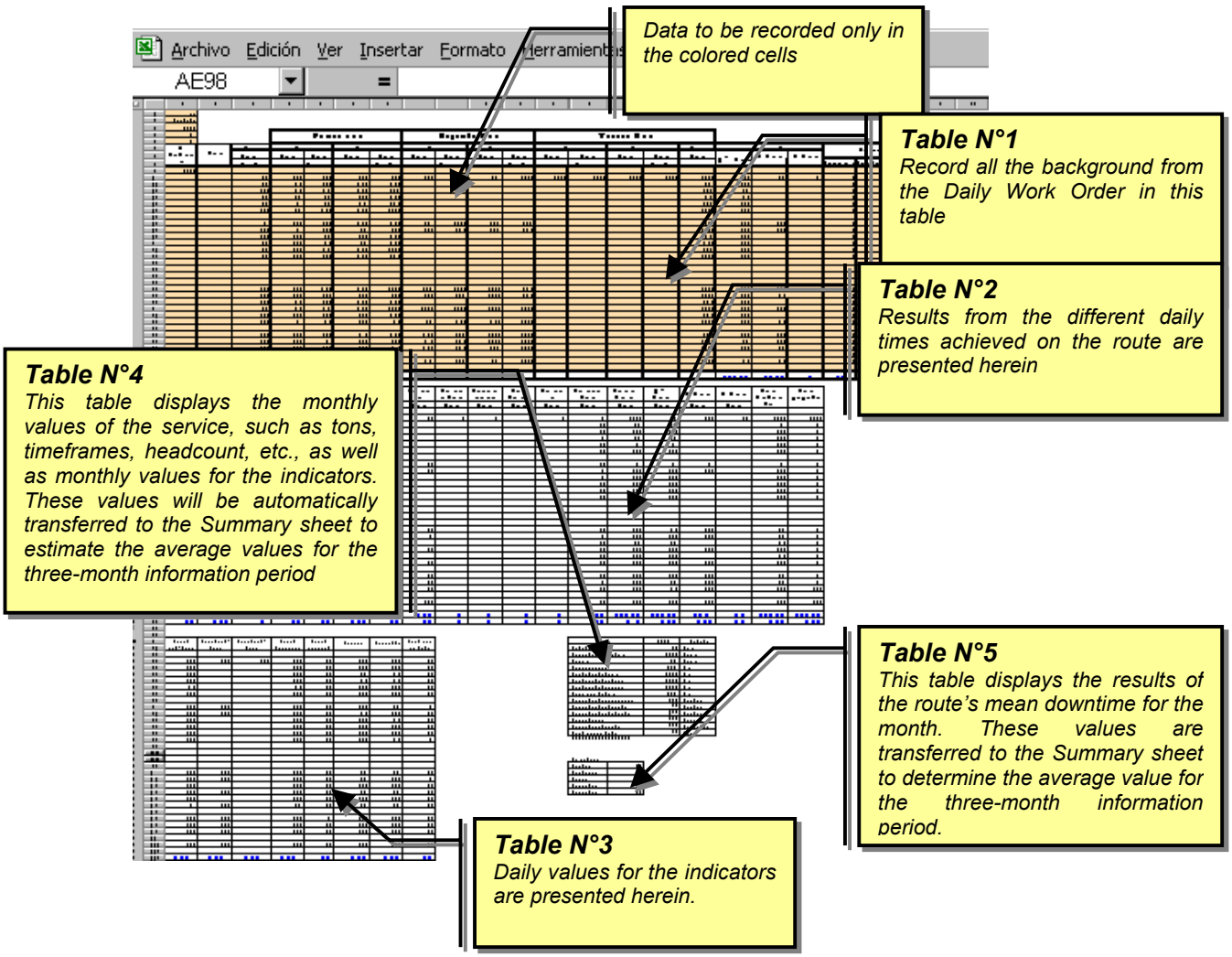
The first three sheets will reflect the antecedents of the service from the Daily Work Orders.

Month one & two sheets will incorporate data from the respective route during the first two months of information available; e.g., if route improvement is conducted during October, Month one will have information from July and Month two from

August. Such information should arise from the existing Work Orders (previous format) or from the newer format, if it has already been implemented.

Month three will include all the timeframe input in the sheet.

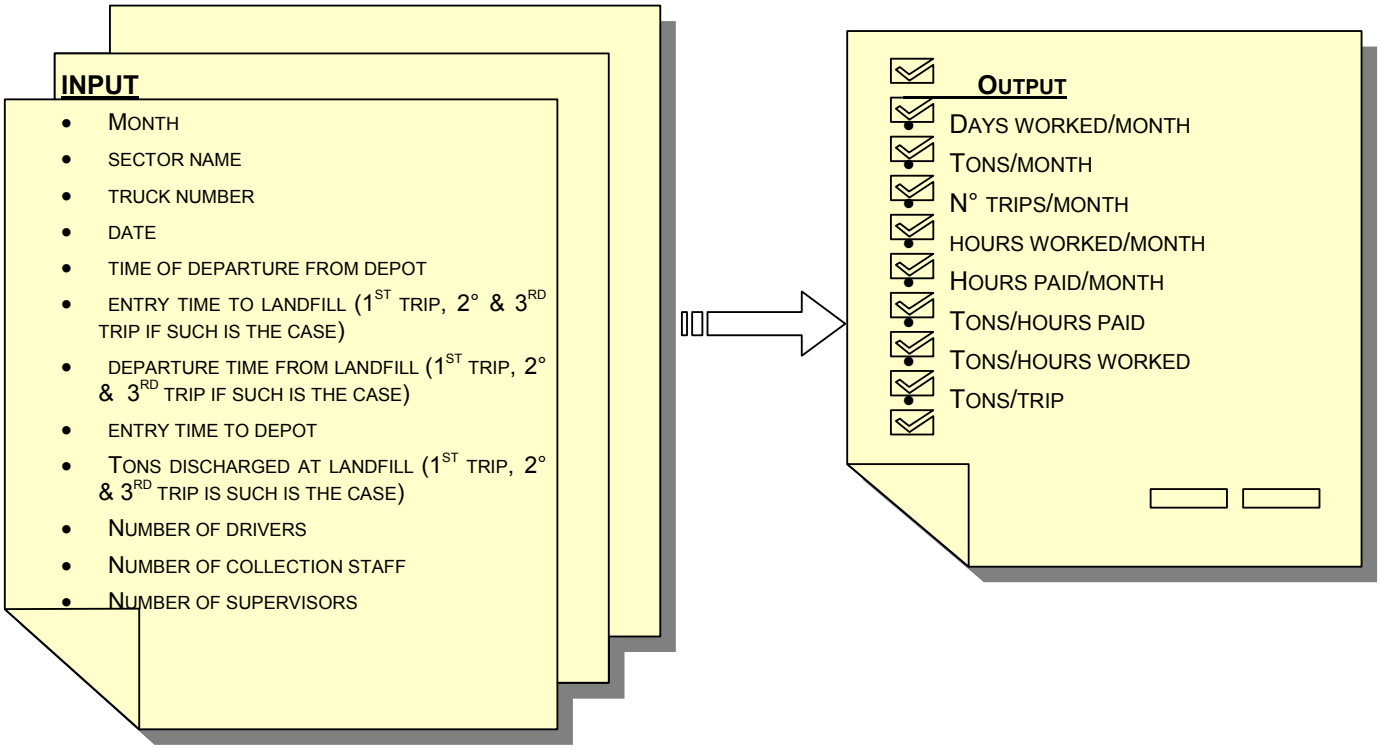
Spreadsheets Month one, Month two and Month three include a total of five Tables, as shown in the following figure.



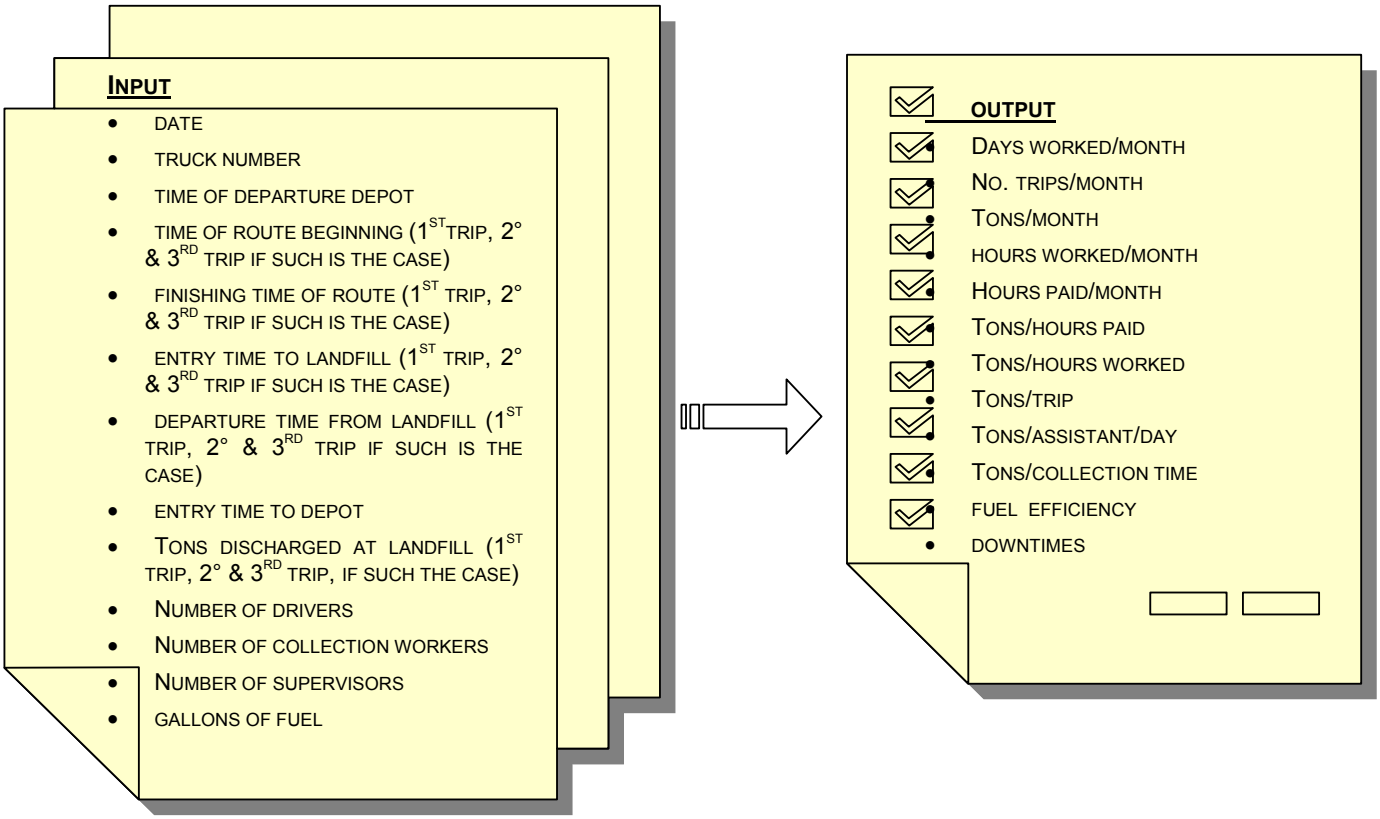
In Table one, which contains the colored cells, the information of Work Orders will be recorded. The remaining cells have been designed to calculate the diverse variables that will allow the assessment of the service, and they will not be modified or record data in them.

Input and output items of the worksheet, as per the Work Order, will correspond to the following:

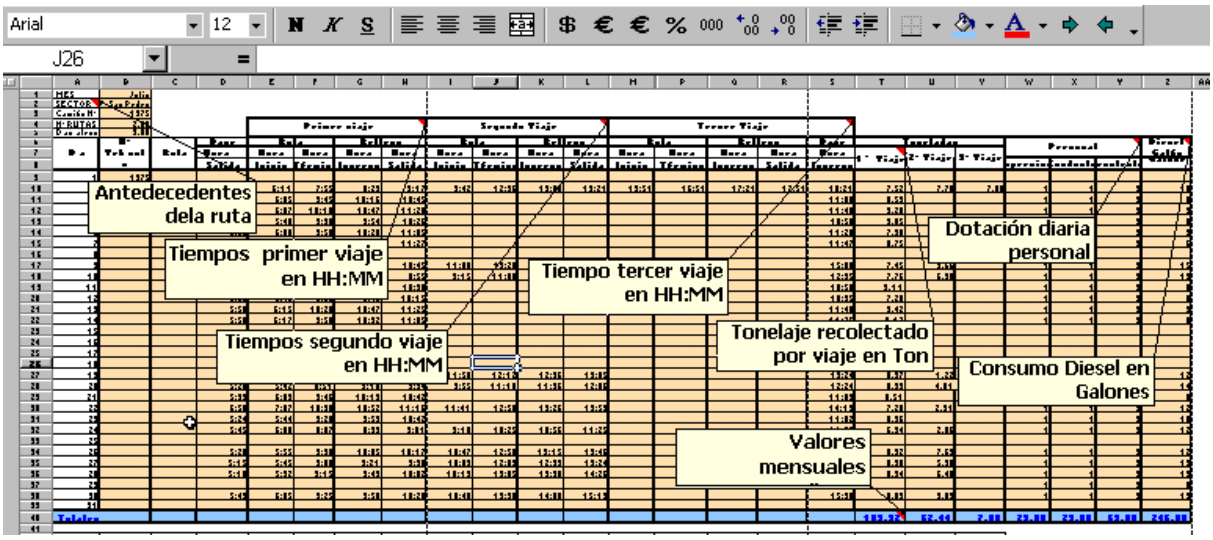
Current Work Order Format



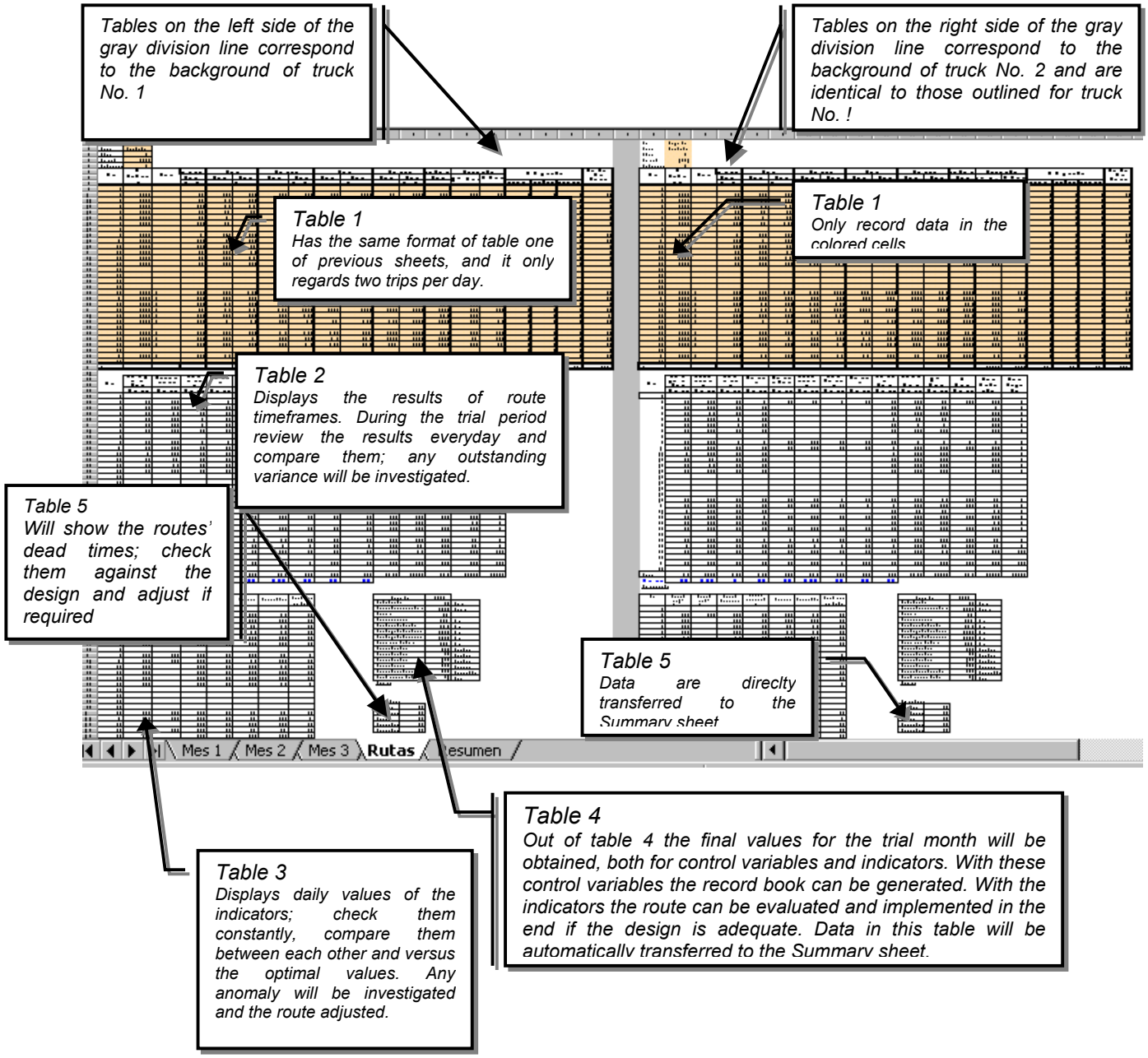
New Work Order Format



Record the above data from the Daily Work Order into the worksheet.



The Route sheet has a similar configuration to the previous ones; however, only two trips per truck per working day and the information from two trucks is taken into consideration. The reason behind the aforementioned is because a modification of the frequency is considered during the improvement process; from seven times a week down to three. The following figures details the sheet.

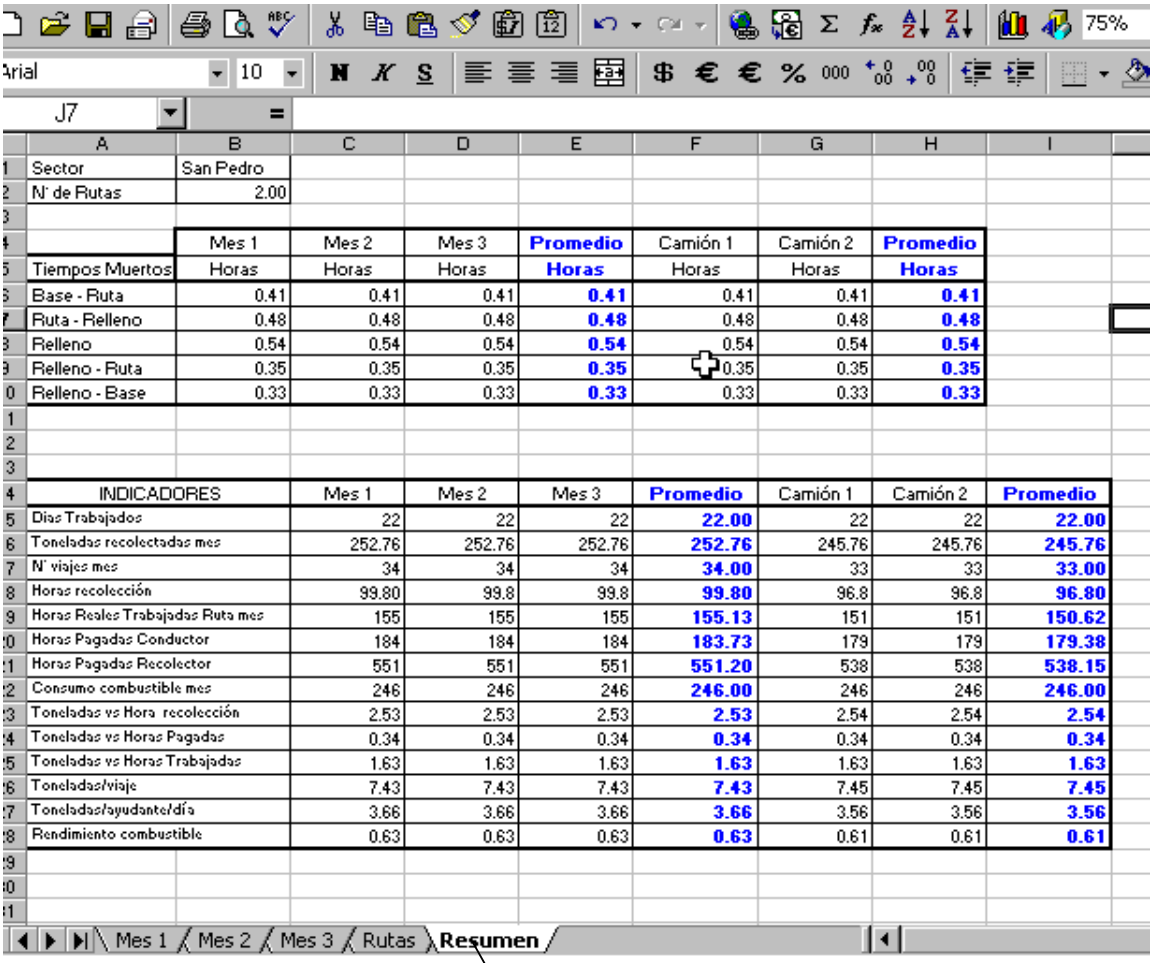


For an easy handling and better understanding of the output generated during the trial period of route implementation, the Summary sheet was created and includes two tables. The first one corresponds to the routes' downtimes, along with the data from the three previous months plus the mean value for that period and the resulting values from the trial period.

The second table encompasses the route's monthly background, such as the number of days worked, the tons collected, number of trips, collection times and totals, hours canceled to the staff, fuel consumption and evaluation indicators. With this table a quick comparison of the service prior and after the improvement can be

achieved, and data to carry on with the economic assessment of the route can also be obtained.

The following figure displays the referred table.



	A	B	C	D	E	F	G	H	I
1	Sector	San Pedro							
2	N° de Rutas	2.00							
3									
4		Mes 1	Mes 2	Mes 3	**Promedio**	Camión 1	Camión 2	**Promedio**	
5	Tiempos Muertos	Horas	Horas	Horas	**Horas**	Horas	Horas	**Horas**	
6	Base - Ruta	0.41	0.41	0.41	**0.41**	0.41	0.41	**0.41**	
7	Ruta - Relleno	0.48	0.48	0.48	**0.48**	0.48	0.48	**0.48**	
8	Relleno	0.54	0.54	0.54	**0.54**	0.54	0.54	**0.54**	
9	Relleno - Ruta	0.35	0.35	0.35	**0.35**	0.35	0.35	**0.35**	
10	Relleno - Base	0.33	0.33	0.33	**0.33**	0.33	0.33	**0.33**	
11									
12									
13									
14	INDICADORES	Mes 1	Mes 2	Mes 3	**Promedio**	Camión 1	Camión 2	**Promedio**	
15	Dias Trabajados	22	22	22	**22.00**	22	22	**22.00**	
16	Toneladas recolectadas mes	252.76	252.76	252.76	**252.76**	245.76	245.76	**245.76**	
17	N° viajes mes	34	34	34	**34.00**	33	33	**33.00**	
18	Horas recolección	99.80	99.8	99.8	**99.80**	96.8	96.8	**96.80**	
19	Horas Reales Trabajadas Ruta mes	155	155	155	**155.13**	151	151	**150.62**	
20	Horas Pagadas Conductor	184	184	184	**183.73**	179	179	**179.38**	
21	Horas Pagadas Recolector	551	551	551	**551.20**	538	538	**538.15**	
22	Consumo combustible mes	246	246	246	**246.00**	246	246	**246.00**	
23	Toneladas vs Hora recolección	2.53	2.53	2.53	**2.53**	2.54	2.54	**2.54**	
24	Toneladas vs Horas Pagadas	0.34	0.34	0.34	**0.34**	0.34	0.34	**0.34**	
25	Toneladas vs Horas Trabajadas	1.63	1.63	1.63	**1.63**	1.63	1.63	**1.63**	
26	Toneladas/viaje	7.43	7.43	7.43	**7.43**	7.45	7.45	**7.45**	
27	Toneladas/ayudante/día	3.66	3.66	3.66	**3.66**	3.56	3.56	**3.56**	
28	Rendimiento combustible	0.63	0.63	0.63	**0.63**	0.61	0.61	**0.61**	

Open a new route improvement spreadsheet for every route to be optimized, and when you are done with the process keep it as backup, should you require to revise or make a new design in the future.

2. INDICATORS

The indicators constitute an excellent assessment tool of the collection service; by using them constantly the service management can be improved; the diverse activities that make it up can be monitored and controlled; and comparison between similar activities can also be achieved.

Indicators are the tool that will allow for the diagnosis of current routes and, if required, to decide if the improvement of that route will follow.

For such purpose, optimal values for the indicators will be set up, which in turn will facilitate the designing of new routes and their assessment once they are improved.

The indicators are the result of connecting preset quantities (base information), which are obtained from the constant monitoring of the activity; the would-be variables to be monitored at the collection service are the following:

Number of effective assistants	*No. asstns/month*
Amount of wastes collected per month	*Ton/month*
Number of trips per month	*No. trips/month*
Number of hours worked per month	*Hours worked/month*
Amount of collection hours per month	*Collect. hours/month*
Number of hours paid to assistants per month	*Hours paid asstns/month*
Number of hours paid to driver per month	*Hours paid driver/month*
Total hours paid per month	*Hours paid/month*
Effective working days per month	*Days/month*
Distance traveled per month	*Km traveled/month*
Total distance traveled per month	*Total Km./month*
Fuel consumption per month	*Gllns/month*

With the above variables, it is possible to estimate the following indicators:

Indicator	Formula	Unit of measurement
Tons/total collection time: This information allows to understand the connection between the amount of tons collected and the time devoted to such activity. Decrease of the value obtained here will obviously be reflected by the increment in the cost of the service. This indicator implicitly considers urban infrastructure, population density, collection method (door-to-door, spot-to-spot), number of collection workers, type of waste storage, features of the vehicle, collection times and average collection speed	Tons collected month collection time per month	Ton/hr collection
Comparison of tons collected versus hours paid: This data is used to acknowledge and forecast the operating costs of the service (direct costs – labor), as well as to check every month if ratio between the tons collected/hours paid to execute the service are congenial.	Tons collected per month Hours paid per month (asstnt+driver)	Ton/hrs paid
Tons/trip:	Tons collected per month	Ton/trip

Indicator	Formula	Unit of measurement
Information to determine whether the collection sectors and routes have been properly set up, as well as to control overloading of vehicles. It works as a base information for measuring and billing the service.	Number of trips per month	
Tons/assistant/day: This information allows to acknowledge the daily performance of a collection assistant as regards to the amount of kilograms collected by the assistant. This indicator implicitly considers the collection method, type of waste storage, the worker's age and physical fitness, type of vehicle and number of trips conducted.	Tons collected per month Number of effective assistants per month	Ton/asstnt/day
Kilograms/Kilometer of sector: This information allows to acknowledge the relationship between the kilograms of wastes collected and the distance traveled in kilometers. The increase or decrease of this value will be obviously reflected upon the cost of the service. Such cost implicitly considers the population density, collection method, type of waste storage, frequency of the service, appropriate collection routes and number of assistants.	Tons collected per month x 1000 Distance traveled in sector per month (Km.)	Ton/km sector
Kilograms/total kilometers traveled: This information allows to acknowledge the connection between the amount of tons collected and total kilometers traveled per month. The increase or decrease of this value will obviously be reflected upon the cost of the service.	Tons collected per month x 1000 Total distance traveled per month (Km.)	Ton/km total
Fuel efficiency: It establishes the relationship between the fuel consumption per month and the hours worked by the vehicle in the month	Gallons of fuel per month hours worked per month (hr.)	Gllns/hr

3. INDICATORS USED FOR ROUTE IMPROVEMENT

The indicators and their corresponding optimal values to be used for the diagnosis and assessment of the route improvement process are shown next.

Indicator: Tons/total collection time

Acceptable range for the Tons/total collection time indicator		
Type of collection (urban zone)	Acceptable range	Optimal value
Door-to-door or mixed method, three assistants.	2.3 a 2.6 ton/hour	2.45 ton/hour
Spot-to-spot (containers), three assistants.	2.8 a 3.2 ton/hour	3.0 ton/hour

Indicator: Tons vs. total paid hours

Acceptable range: 0.30 a 0.35

Optimal value 0.33

Indicator: Tons/trip

Ratio : Tons per trip

Maximum payload of truck

Optimal ratio range: 0.9 to 1.05

Indicator: Tons/assistant/day

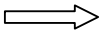
Acceptable range 4.3 to 4.8 ton/assistant/day

Optimal value 4.5 ton/assistant/day

Indicator: Fuel efficiency

The indicator values will be set based on the features of the collection vehicle, to be established by the manufacturer.

4. SYMBOLOGY TABLE FOR MAPS

Symbol	Description
	Productive travel, the direction of the arrow displays the traffic way
	Dead time travel (when the truck does not collect wastes and it is only traveling)
	One-way streets
	Streets with no access to enter
	Highest point on the road
	Lowest point on the road
	Container, its capacity can be identified by coloring it or achurado
	Tinaquera
	Excessive waste generator
	Neighborhood limit
	Industry
	Business
	Streets with traffic jams

Data J

Street Sweeping Improvement Manual

Recommendations for the Design of Street Sweeping Routes.

After the street sweeping diagnostic has been conducted, it is concluded that street sweeping does not follow a rational design and there is not a monitoring system which can assist to control performances, the use of resources, and can help to evaluate it. Moreover, there is not a definition on the aspects that this service covers, where it is executed, its frequency, and quality levels that are expected to be attained.

Due to the previous situation, DIMAUD is unable to quantify the service regarding the efficiency, coverage area, and its future expansion.

This document has the sole purpose to provide fundamentals about the aspects that street sweeping cover and also give some recommendations to improve it.

There are two types of sweeping: manual and mechanical.

1. MANUAL STREET SWEEPING

1.1. STREET SWEEPING AREA:

Two street sweeping areas can be defined:

Between Constructed lines: Street Sweeping is executed mainly on pedestrian avenues, commercial areas, and areas with heavy traffic. Street Sweeping is conducted from the construction line up to the gutter; additionally, tree surroundings are cleaned.

Gutter area: Street Sweeping is also executed in most of the streets which do not have heavy pedestrian traffic or commercial areas. Street sweeping covers approximately 60 cm from the gutter to interior of the road.

1.2. STREET SWEEPING TYPES

a. Daily Street Sweeping without Maintenance

This type of street sweeping covers a sector in an eight hours shift; the street is swept once. If street sweeping is conducted between building lines, the regular performance is 1.25 km/street sweeper/day; on the other hand, if street sweeping also covers the gutter, then the performance can reach 1.5 km/street sweeper/day. Street sweeping should not necessarily be conducted on a daily basis.

b. Street Sweeping with Maintenance

This service is characterized because the streets should be swept at least twice a day. Street sweeping is conducted between the buildings lines and should have a performance of 1.0 km/street sweeper/day. The street sweeper undertakes the his/her first part of the task to fully sweep and dedicates the remaining time to provide maintenance by picking up paper and minor wastes. This type of sweeping is done in pedestrian avenues, commercial areas, and important administrative areas. This sweeping should be done on a daily basis.

c. Sweeping by the Crew

This sweeping is not conducted on a daily basis or with high frequency, but it responds to a permanent program with low frequency or specific program whenever it is detected a deficient cleansing on the sector.

This type of cleansing is generally conducted by a team between 8 to 16 street sweepers; it is advisable to work with a crew of 8 workers who should be directed by a supervisor that should control the performances and satisfaction of goals established for this service. Additionally, it is conducted a removal of wastes which are accumulated on the street and soil; furthermore, light weeding out is conducted.

Performances in this area reach 2.0 km./ street sweeper/ day.

1.3. FREQUENCY

Daily Frequency: Sweeping can be conducted every day from Monday to Sunday or from Monday to Saturday. It is done on main roads, pedestrian avenues, commercial areas, maintenance sweeping.

Three times a week frequency: it is executed every other day from Monday to Saturday; generally, this frequency is adopted on secondary roads or parallel roads to the main ones where there is not heavy commercial activity, street sweeping is conducted without providing additional maintenance during the day.

Frequency of twice per week or less: It is generally conducted in residential sector and it corresponds to sweeping by crews.

The frequency is defined by:

- → Number of pedestrian
- → Importance of the area
- → Economic possibilities
- → Public participation

1.4. CLEANSING LEVELS

The following table provides a proposal to define the cleansing levels.

LEVEL	CHARACTERISTICS
Level A	Dust nor garbage is observed on the streets and sidewalks/gutters.
Level B	A moderate amount of dust is observed
Level C	There are dust and papers in moderate quantities
Level D	There is dust, some papers and a moderate amount of garbage

LEVEL	CHARACTERISTICS
Level E	There is a large amount of dust, papers and other wastes, specially domestic
Level F	There are large amount of wastes on public roads

1.5. DAILY WORK ORDER

In order to monitor and control daily sweeping and, subsequently, evaluate its performance, it is necessary to conduct elaborate a daily work order which at least should include the following information:

- → Date
- → Shift: Daytime – Night-time – Other
- → Sector: One sector will be formed by a group of routes; all of them in charge of a supervisor.
- → Route: The street sweeping service will be designed based on specific routes which could be developed through a street sweeping service without maintenance. Additionally, occasional or special routes are considered; these routes correspond to a specific street sweeping planning in a sector and it is conducted whenever lack of cleansing is detected on a site. For this case, the route designed should be defined and it should be included the meters to be covered.
- → Identification of street sweeper and supervisor; for the case of a whole crew, all personnel should be identified.
- → N° of bags to be used, bags capacity
- → Assigned tools and replacement of them

1.6. ROUTE EVALUATION

The following performances should be evaluated by using operational indicators which will serve as comparative tools. Indicators for the Management of Public Cleansing elaborated by CEPIS can be used. The following table shows these indicators and their acceptable ranges.

Indicator: Street Sweeping Coverage (%)

This indicator reflects the percentage of streets which are being swept in all Panama District or by Corregimiento. It is calculated as follows:

$$\frac{\text{Length of street swept x 100.}}{\text{total length of roads}}$$

Acceptable Range: 85 to 100%

Indicator Lineal Km. swept/ street sweeper / day

This indicator reflects daily average performance of the worker in lineal kilometers. The performance depends of the type of service (between building lines, gutter cleansing area), physical situation of the sidewalks, gutter, worker´s age, and physical condition of the worker, population density, pedestrian flow, shift and service frequency, type of broom which is used, existence of vehicles parked on the sidewalks. This figure is expressed by the following formula:

$$\frac{\text{total length of streets swept in a month (lineal km)}}{\text{(number of effective street sweepers) x (effective days per month)}}$$

Acceptable Range: from 1.3 to 1.5 lineal km / street sweeper / day (sidewalk+gutter, paved roads, street sweeper age of 35 years)

from 1.0 to 1.2 lineal km/ street sweeper / day including maintenance, paved roads

from 1.8 to 2.0 lineal km/street sweeper/day swept by the crew, including paved roads.

Indicator: Bags consumption/street sweeper day

The average number of bags which are used daily by street sweepers can be determined with this indicator. Additionally, it is used to elaborate operative cost estimates of this service (direct material costs). This indicator is calculated by:

$$\frac{\text{Consumption of bags per month (N° of bags)}}{\text{(Number of effective street sweepers) x (effective days a month)}}$$

Acceptable Range: from 7 to 9 bags/ street sweeper/ day (low density PE bags, capacity of 120 liters and 0.002” thickness, paved roads, 2 shifts/day, 60% daily frequency and 40% every other day).

Indicator: Bags consumption / km swept

This indicator reflects the average number of bags which are used per kilometer swept; it helps to make a projection of the number of bags when a new service is introduced. The performance depends on the capacity of the bag, urban infrastructure, service frequency, number of paper bins, population density and floating population.

$$\frac{\text{Consumption of bags in a month (N° of bags)}}{\text{Total length of street swept per month}}$$

Acceptable Range from 5 to 7 bags/ kilometer swept (low density PE bags, capacity of 120 liters and 0.002" thickness, paved roads, 2 shifts/day, 60% daily frequency and 40% every other day).

Indicator Consumption of brooms / kilometer swept

This indicator helps to define the average number of brooms which are used per kilometer swept; it also helps to project the operative costs of the new service. It is calculated as follows:

$$\frac{\text{Total consumption in a month (N° of brooms)}}{\text{Total length of street swept per month (Km.)}}$$

Acceptable Range from 0.02 to 0.04 brooms/ kilometer swept (paved roads, broom with wooden handle 45 cm long, 6 cm wide, and 11 cm of visible fiber).

Indicator: Comparison of kilometers swept versus hours paid

This indicator is used to know and calculate the direct costs of labor and to verify on a monthly basis if there is proportionality of kilometers swept and the hours paid to execute the service. This indicator depends on the performance of the worker, payment of an adequate salary, number of medical licenses and overtime hours per month.

$$\frac{\text{Total length of streets swept in a month (km)}}{\text{Number of hours paid in a month}}$$

Acceptable Range from 0.14 to 0.16 km swept / hours paid

1.7. PROCEDURE TO DESIGN STREET SWEEPING ROUTES

Subsequently, the steps to design street sweeping routes are shown. Ideally, a diagnostic of the current routes should be done before their design; for that purpose, it is necessary to gather information directly from the site, this job should

be done by technical personnel who will design the routes in conjunction with the street sweepers so that the path matches the actual route.

The routes will be drawn on a map to scale (ideally, each map covers a complete sector); it will be measured in lineal meters of street sweeping per route. If there are differences between the actual route and the street layout map, then the map should be modified and the path should be measured again.

Each route will identify the frequency and if street sweeping includes cleansing maintenance or not. Subsequently, the average worker performance will be calculated and it will be compared with acceptable ranges for this indicator in accordance with the characteristics of street sweeping.

If the performance is below the acceptable range, a new route will be design.

It is advisable to separate the street sweeping sector by Corregimiento; this situation will facilitate the calculations for service coverage per Corregimiento. The crew size should be between 10 and 12 street sweepers per supervisor.

For each sector, the lineal kilometers to be swept will be defined. Subsequently, the number of workers per sector will be calculated by using an acceptable range shown by the indicator km/street sweeper/day. The performance indicator will depend on the type of service provided, i.e., if maintenance is provided and which areas should be swept.

For example, if a sector wants to be swept and has a total of 12.4 lineal kilometers, with a service sidewalk+gutter and no maintenance, then the number of street sweepers should correspond to:

Average value of acceptable range: 1.4 Km./ street sweeper/day

N° of workers per sector : $\frac{\text{Lineal kilometers to be swept by sector}}{\text{Range value of average performance}}$

N° Workers per sector: $\frac{10.9}{1.4}$ = 8 Workers

On the other hand, if street sweeping wants to be provided with maintenance then the performance corresponds to approximately: 1.0 km/street sweeper/day. Consequently, the number of workers will be given by:

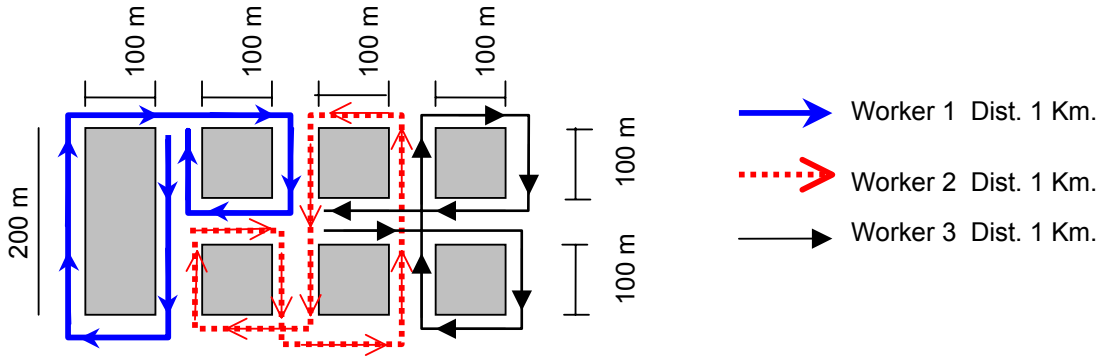
N° Workers per sector: $\frac{10.9}{1.0}$ = 11 Workers

Once the number of workers has been calculated, in a copy of the original map used to survey the routes, then the sector which would provide service will be

drawn. Subsequently, a route diagram will be made taking into account the following:

- The worker should mobilize during his/her work in opposite direction to the traffic.
- To prevent or minimize the street intersections
- Do not cover the same gutter twice, unless it is required as sweeping maintenance
- The route terminal point should be as close as possible to the initiation point.
- Kilometer per street sweeper should be similar to the basic performance values
- To prevent that the route finished in the middle point of the block.

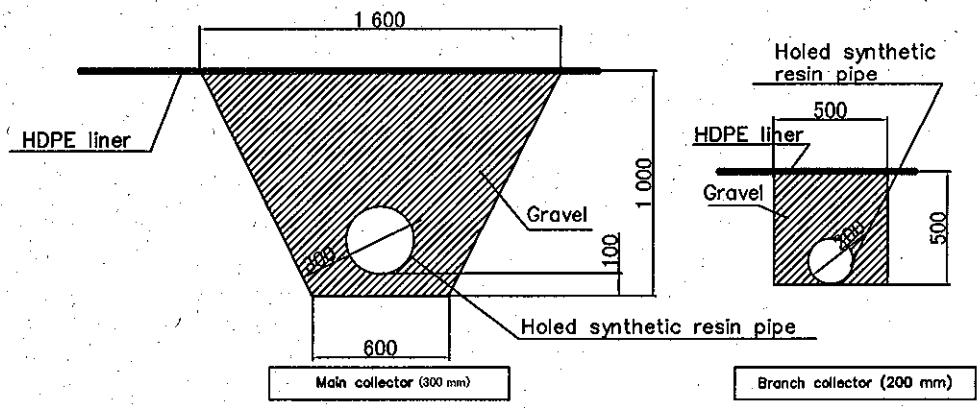
Example: Route´s Diagram Process.

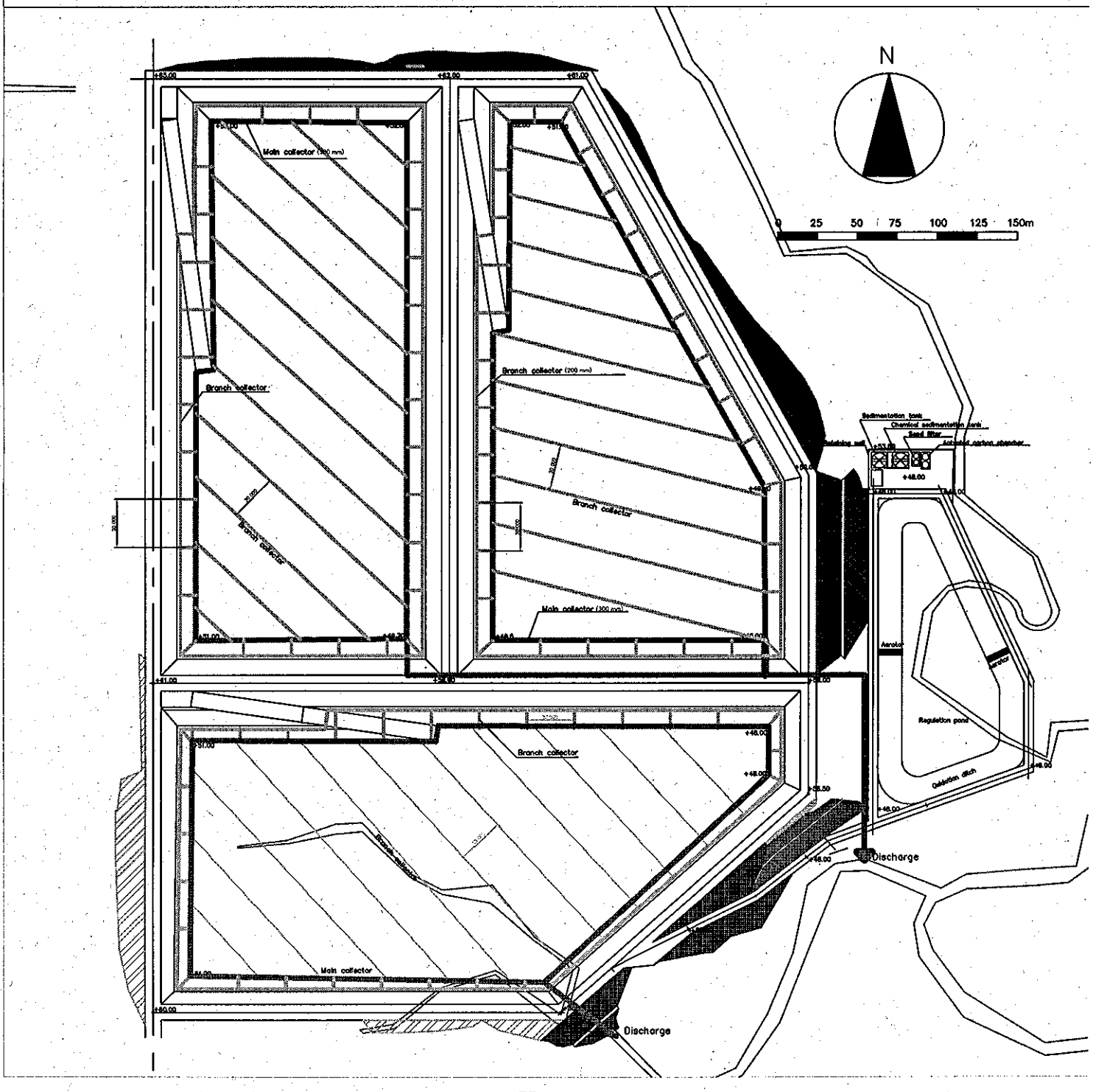


The route´s drawing can be verified on the site and will be described by using the same criteria as the one for collection.

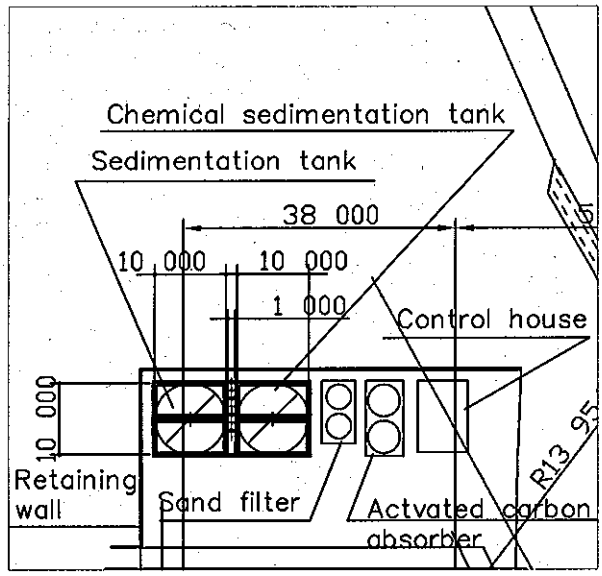
Data K

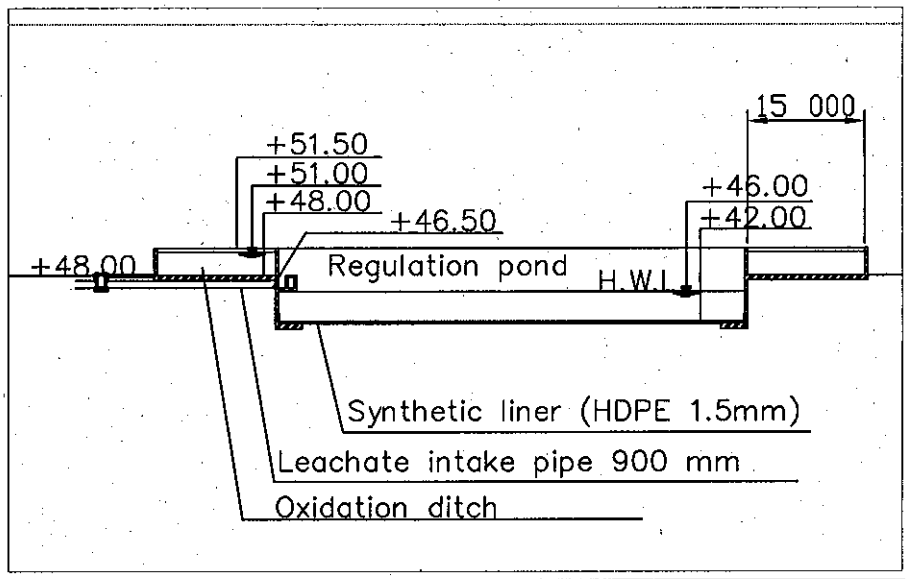
Drawings

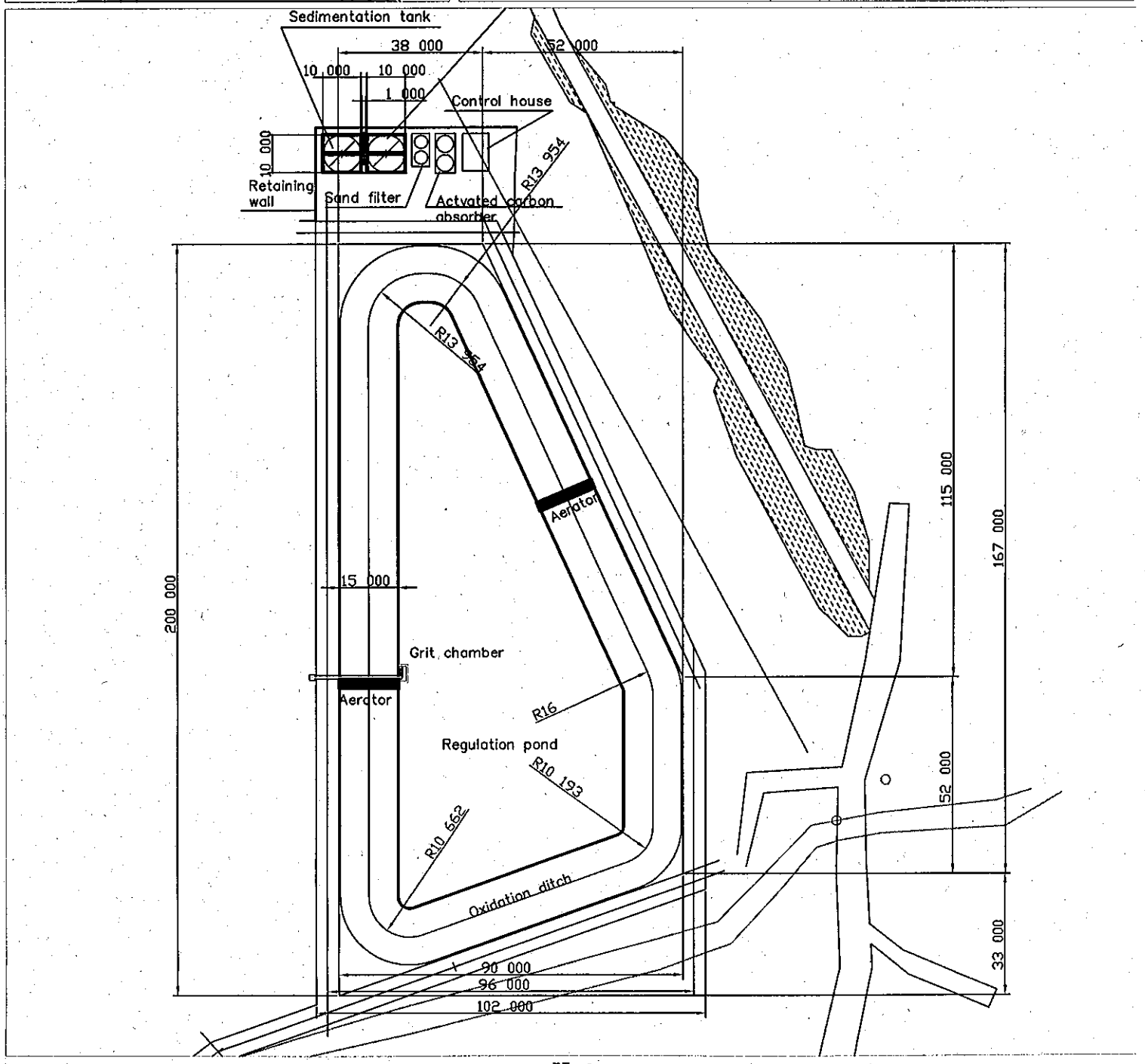

1 600
HDPE liner
Gravel
1 000
100
600
Holed synthetic resin pipe
Main collector (300 mm)
Holed synthetic resin pipe
500
HDPE liner
Gravel
500
Branch collector (200 mm)

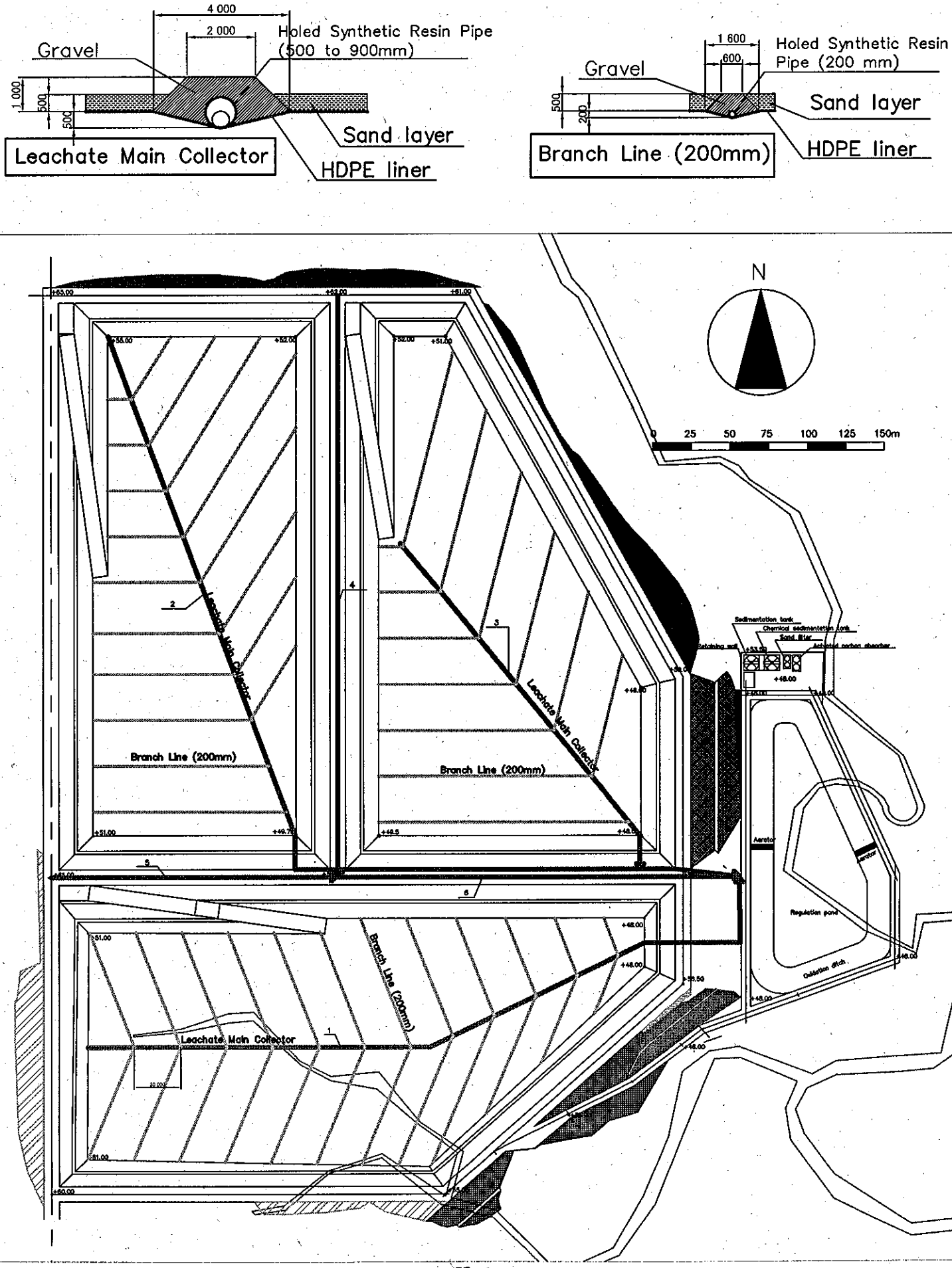

N
0 25 50 75 100 125 150m
Main collector (300 mm)
Branch collector
Branch collector (200 mm)
Branch collector
Branch collector
Main collector (300 mm)
Sedimentation tank
Chemical sedimentation tank
Sand filter
Activated carbon absorber
Aerator
Regulation pond
Oddolom ditch
Discharge
Branch collector
Main collector
Discharge

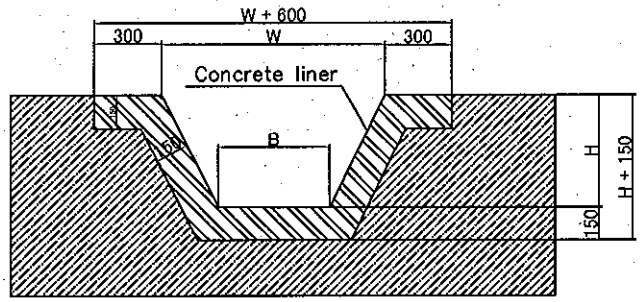
K-1

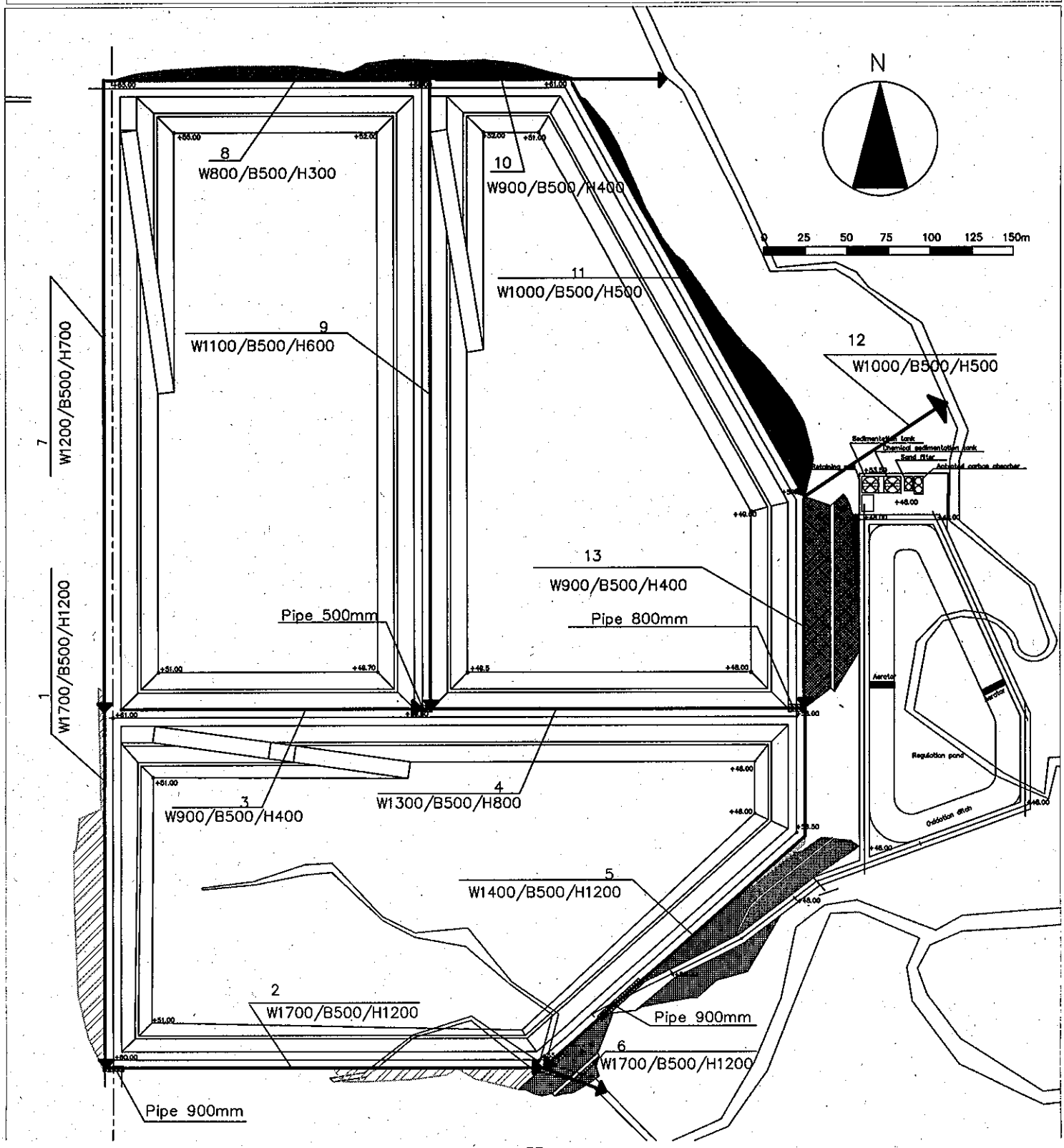

Chemical sedimentation tank
Sedimentation tank
38 000
10 000
10 000
1 000
Control house
10 000
Retaining wall
Sand filter
Actvated carbon absorber
R13 95

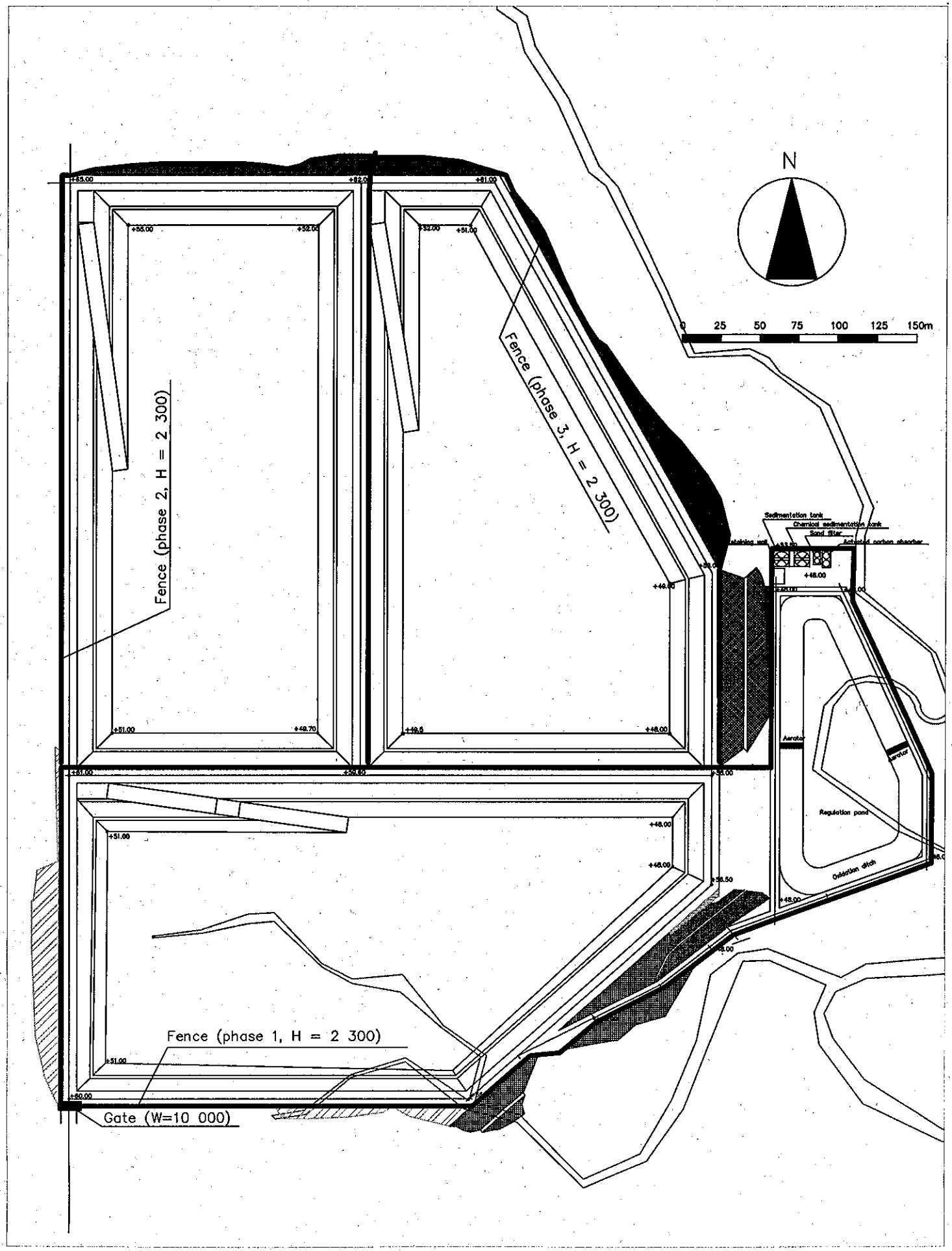

15 000
+51.50
+51.00
+48.00
+46.50
+46.00
+42.00
+48.00
Regulation pond
H.W.L
Synthetic liner (HDPE 1.5mm)
Leachate intake pipe 900 mm
Oxidation ditch


Sedimentation tank
38 000
52 000
10 000
10 000
1 000
Control house
10 000
Retaining wall
Sand filter
Actvated carbon absorber
R13 954
R13 954
Aerator
15 000
200 000
Grit chamber
Aerator
R16
Regulation pond
R10 193
R10 562
Oxidation ditch
115 000
167 000
52 000
33 000
90 000
96 000
102 000


4 000
2 000
Holed Synthetic Resin Pipe
(500 to 900mm)
Gravel
1 000
500
500
Sand layer
HDPE liner
Leachate Main Collector
1 600
600
Holed Synthetic Resin
Pipe (200 mm)
Gravel
500
200
Sand layer
HDPE liner
Branch Line (200mm)
N
0 25 50 75 100 125 150m
Leachate Main Collector
Branch Line (200mm)
Leachate Main Collector
Branch Line (200mm)
Leachate Main Collector
Branch Line (200mm)
Sedimentation tank
Chemical sedimentation tank
Sand filter
Activated carbon absorber
Aerator
Regulation pond
Oxidation ditch


W + 600
300
W
300
Concrete liner
B
H
H + 150
150


N
0 25 50 75 100 125 150m
8
W800/B500/H300
10
W900/B500/H400
11
W1000/B500/H500
9
W1100/B500/H600
12
W1000/B500/H500
7
W1200/B500/H700
13
W900/B500/H400
Pipe 800mm
Pipe 500mm
1
W1700/B500/H1200
3
W900/B500/H400
4
W1300/B500/H800
5
W1400/B500/H1200
2
W1700/B500/H1200
Pipe 900mm
6
W1700/B500/H1200
Pipe 900mm
Sedimentation tank
Chemical sedimentation tank
Sand filter
Activated carbon absorber
Aerator
Regulation pond
Oxidation ditch


N
0 25 50 75 100 125 150m
Fence (phase 2, H = 2 300)
Fence (phase 3, H = 2 300)
Fence (phase 1, H = 2 300)
Gate (W=10 000)
Sedimentation tank
Chemical sedimentation tank
Sand filter
Activated carbon absorber
Aerator
Regulation pond
Oxidation ditch