

## **APPENDIX S : SUB-CONTRACT WORKS (PHASE II)**



# **APPENDIX S.1 HYGIENE EDUCATION CAMPAIGN**



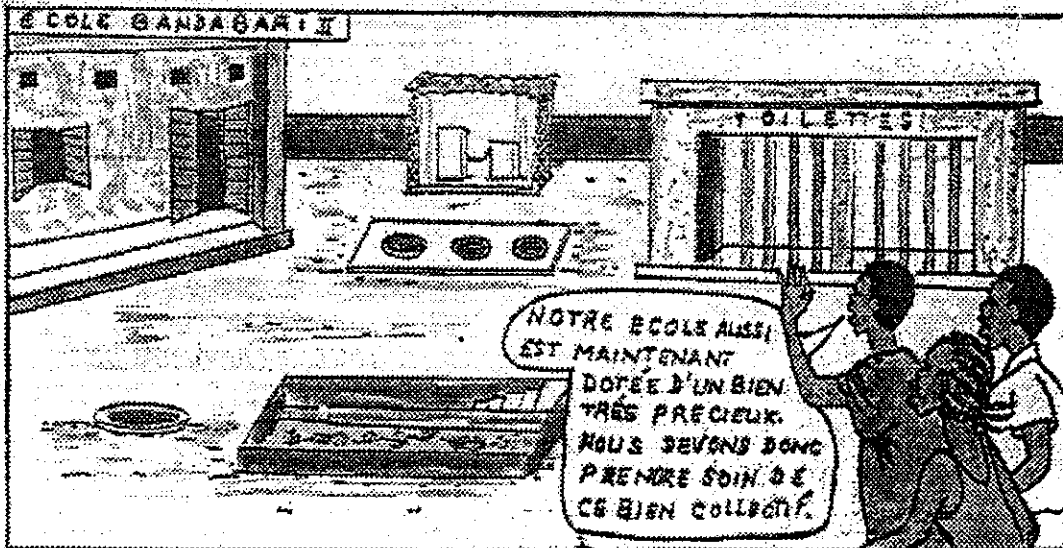
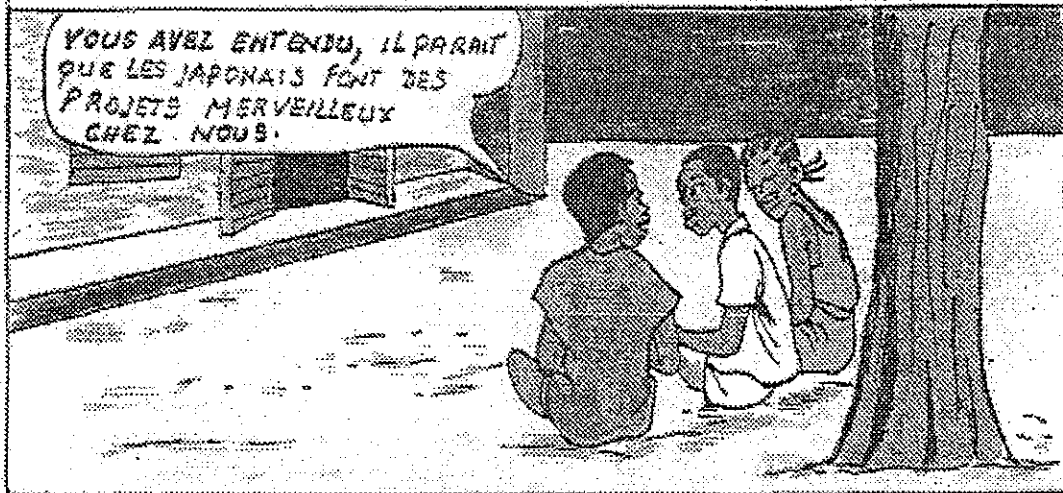
**CAMPAGNE D'HYGIÈNE  
SUR LES SITES  
DE  
L'ÉCOLE DE BANDABARI<sup>II</sup>  
ET  
DE DEÏZEÏBON**

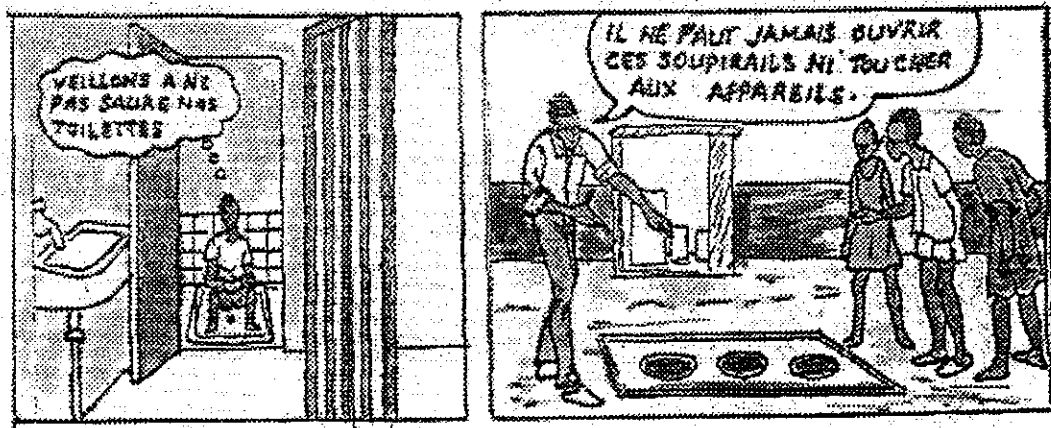
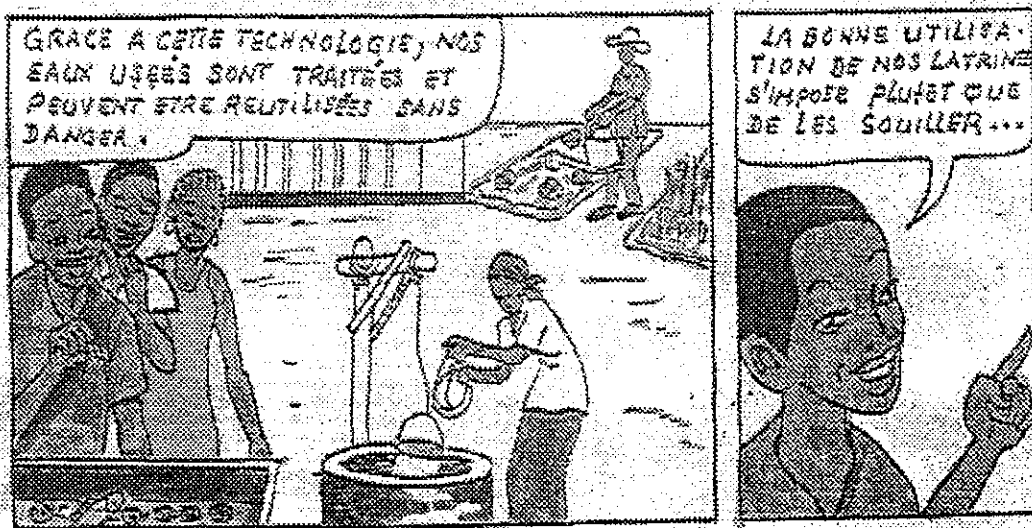
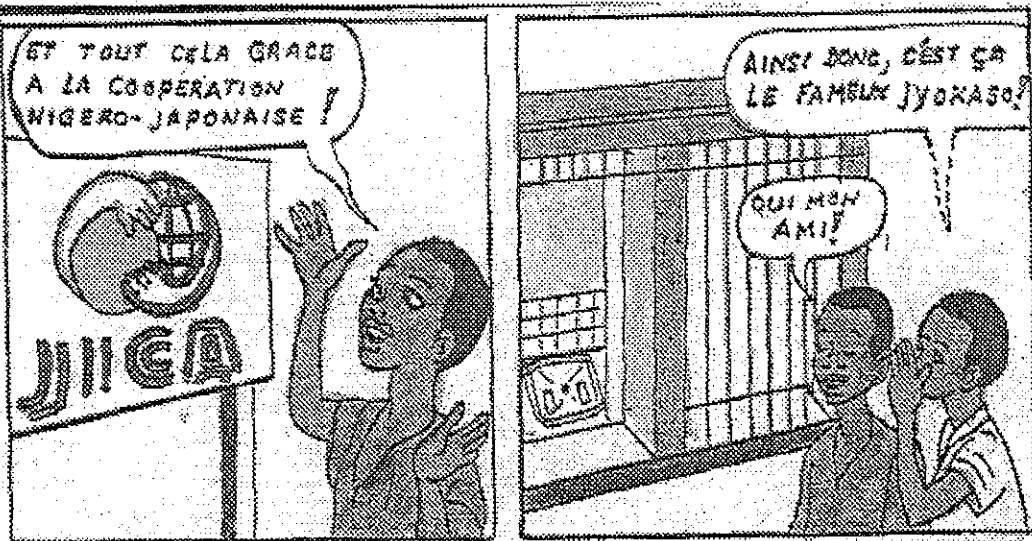


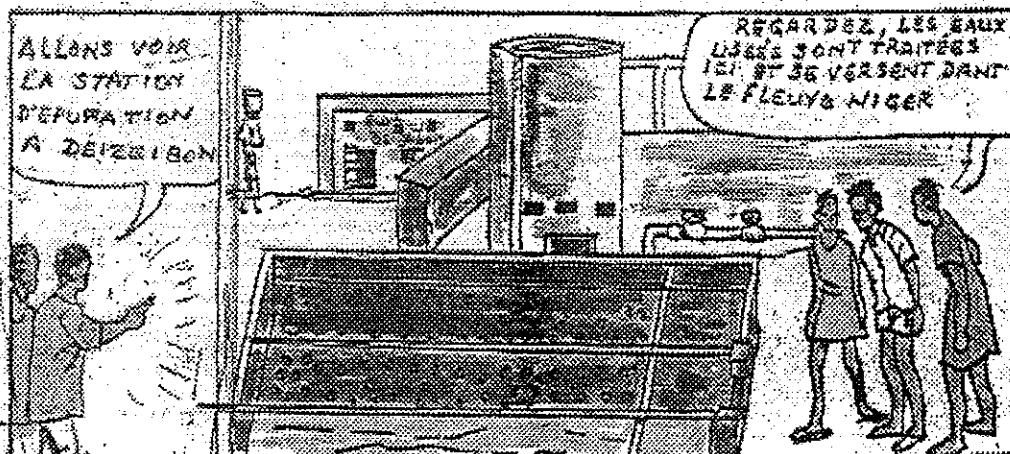
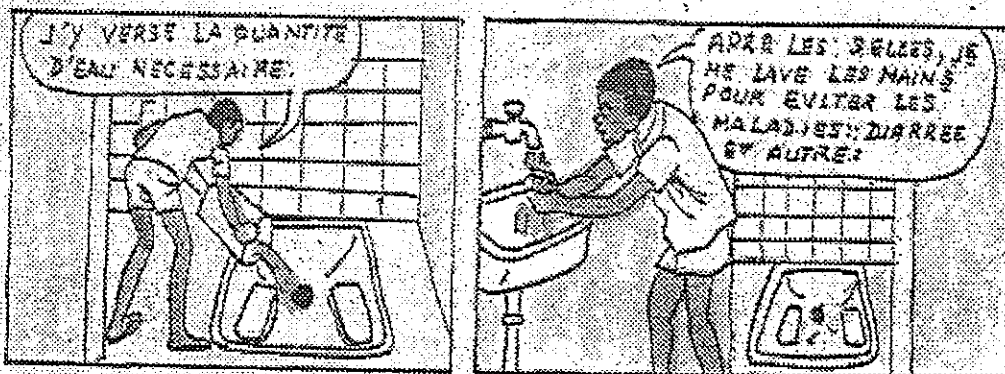
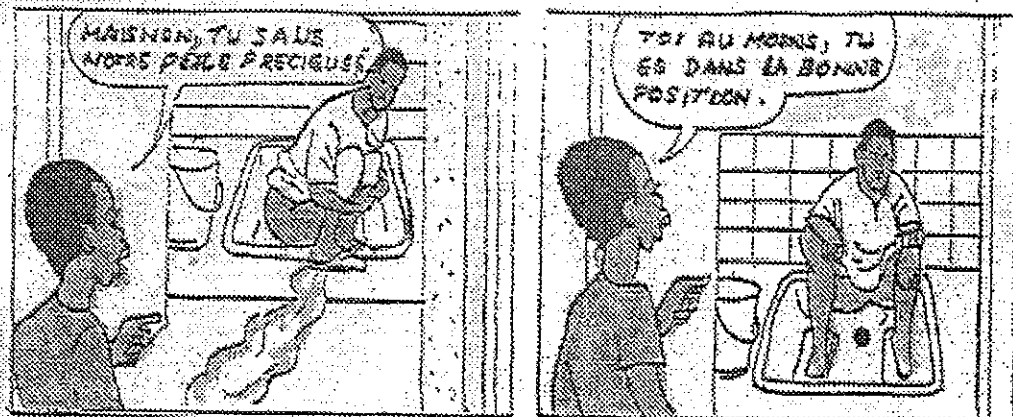
JICA

# CAMPAGNE D'HYGIÈNE SUR LES SITES DE L'ÉCOLE DE BANDABARI ET DE DEÏZÉBON

« Pour rester en bonne santé, il faut être propre sur soi et autour de soi »



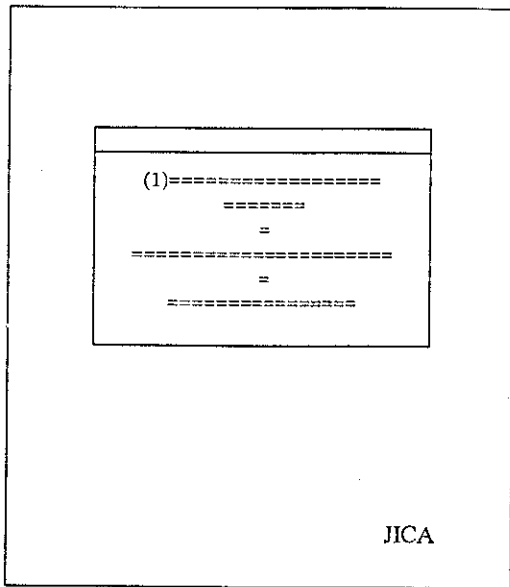




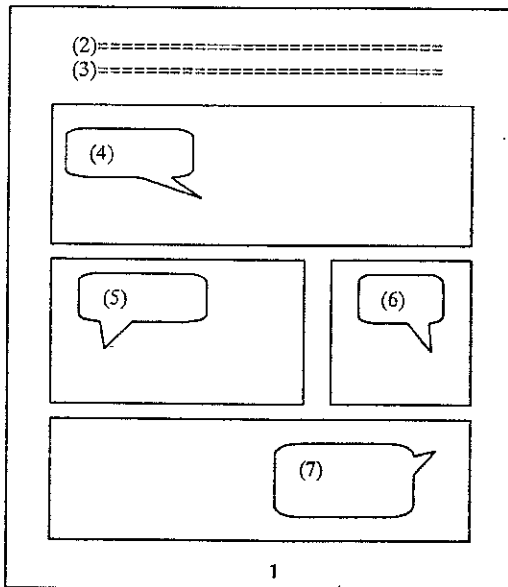








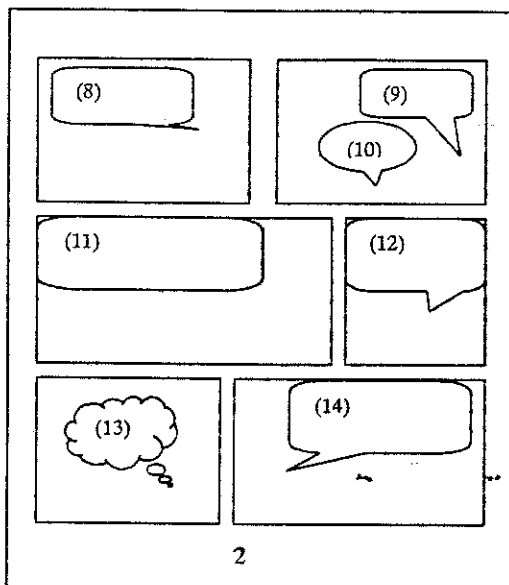
- (1) Hygiene Campaign at *Bandabari* Primary School II and *Deizeibon* Primary School.



- (2) Hygiene Campaign at *Bandabari* Primary School II and *Deizeibon* Primary School.  
 (3) "For good health, Keep Clean Yourself and Your Surroundings"  
 (4) Do you know Japanese has constructed important projects in my country?

- (5) Shall we go there?  
 (6) Let's go first to *Bandabari* School II

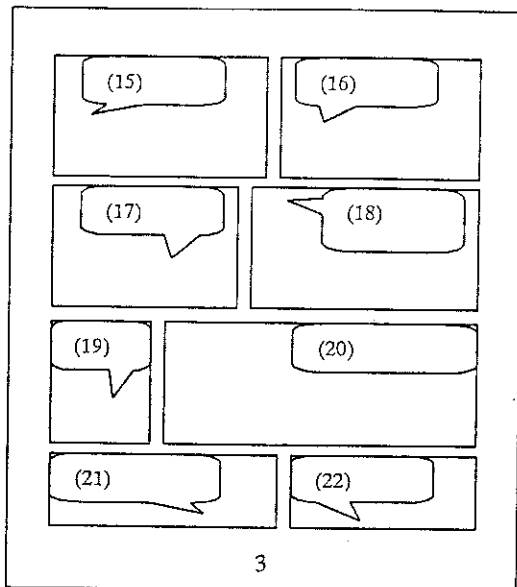
- (7) Look! Excellent facilities have been constructed in our school. We shall take care of the facilities.



- (8) This is constructed under the cooperation between Japan and Niger.  
 (9) I see, this is the *Jyokaso* system, is'nt it?  
 (10) Yes it is, my friend.

- (11) This system can treat the wastewater so that we can re-use the treated water safely.  
 (12) You shall use the toilet appropriately.

- (13) Let's use the toilet clean!  
 (14) You never open the manholes neither touch the equipment.

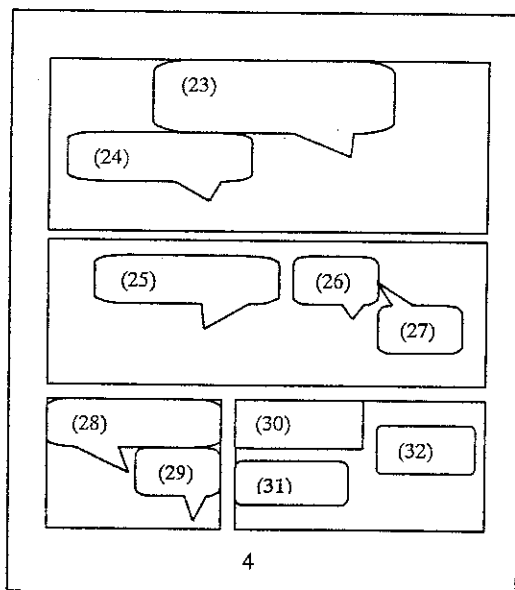


- (15) You are not using the toilet appropriately.
- (16) You are using the toilet appropriately.

- (17) You will use appropriate quantity of water for flushing the toilet.
- (18) We shall wash our hands after toilet for preventing diarrhoea and other diseases!

- (19) Let's go to the *Deizebon* site, next!
- (20) With this system, the wastewater is treated and discharged to *Niger River*.

- (21) Don't throw solid waste into the facility.
- (22) Don't throw solid waste into not only the facility but also anywhere in Niger.



- (23) We are satisfied with the *Jyokaso* and the UASB systems. By the JICA project, We can re-use the treated water!

- (24) We can sprinkle the water to our gardens

- (25) We shall keep environment clean!

- (26) Everybody, I agree with your good idea.

- (27) I inform all of you that a Hygiene Education Campaign is planing to hold.

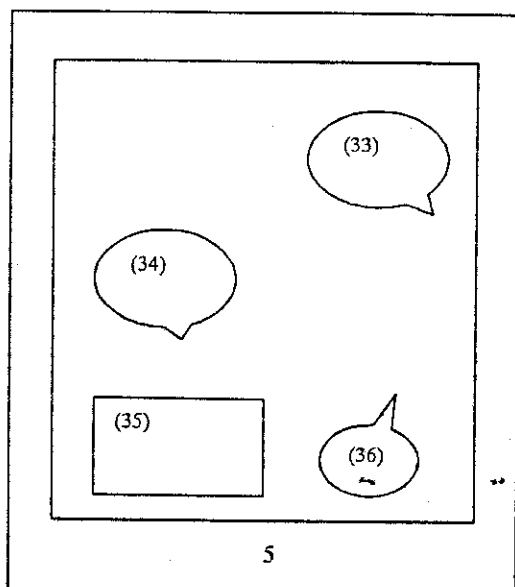
- (28) Shall we participate in the Campaign by the JICA?

- (29) Why not!

- (30) At the Campaign Venue.

- (31) The Hygiene Education Campaign.

- (32) Viva NGO, Viva "Clean City"!

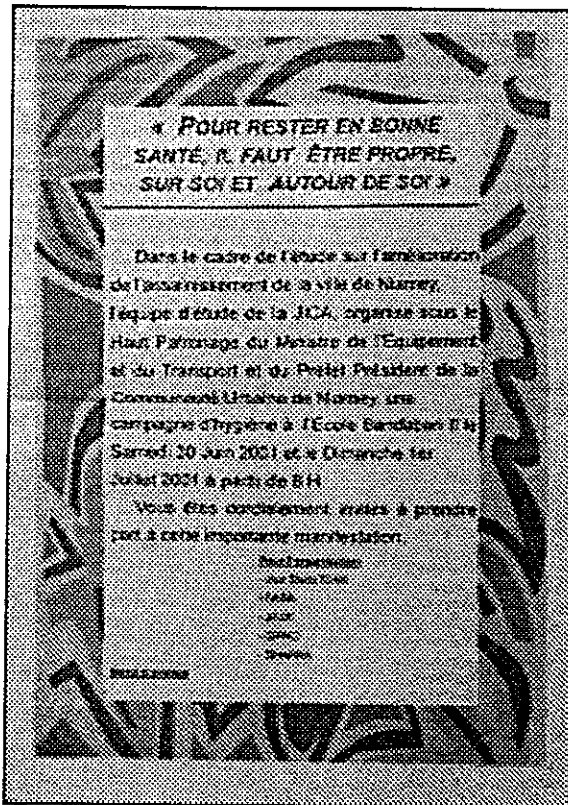


- (33) Viva JICA and UASB!

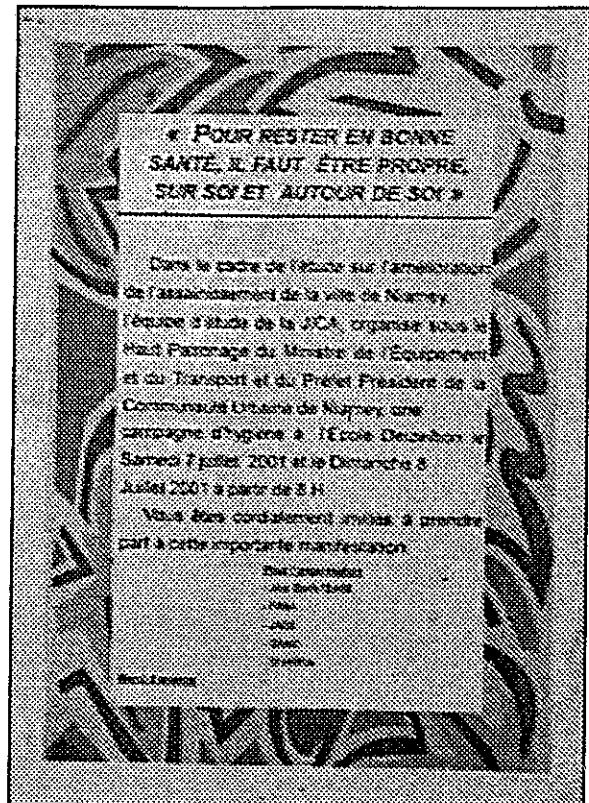
- (34) Viva *Jyokaso*!

- (35) Cleanliness of the city is our duty.

- (36) Viva Niger- Japan Cooperation!



① Poster for the Campaign at Jyokaso Site



② Poster for the Campaign at UASB Site

«For good health, keep clean yourself and your surroundings»

As a part of the Study on Sanitation Improvement for Niamey, the JICA Study Team, under the auspices of the Ministry of Equipment and Transportation (MET) and Niamey Urban Community (CUN), holds a Hygiene Education Campaign at *Bandabari* Primary School II from 8 a.m. on 30<sup>th</sup> June (Sat.), and 1<sup>st</sup> July (Sun.), 2001.

You are all cordially invited to attend this important event!

Implemented by

- The JICA Study Team
- FABA
- JADE
- GANO
- SHARA

Thank you in advance

«For good health, keep clean yourself and your surroundings»

As a part of the Study on Sanitation Improvement for Niamey, the JICA Study Team, under the auspices of the Ministry of Equipment and Transportation (MET) and Niamey Urban Community (CUN), holds a Hygiene Education Campaign at *Deizebon* Primary School from 8 a.m. on 7<sup>th</sup> (Sat.) and 8<sup>th</sup> (Sun.) July 2001.

You are all cordially invited to attend this important event!

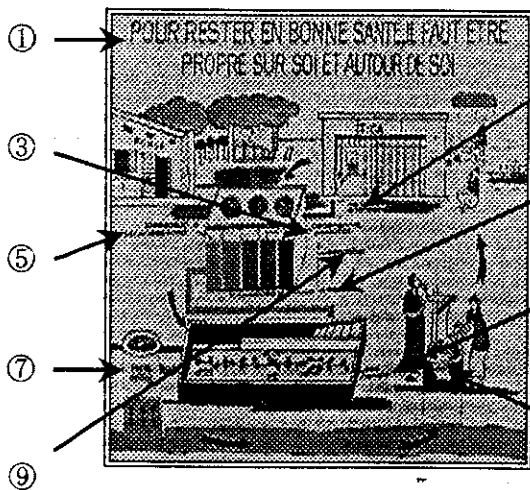
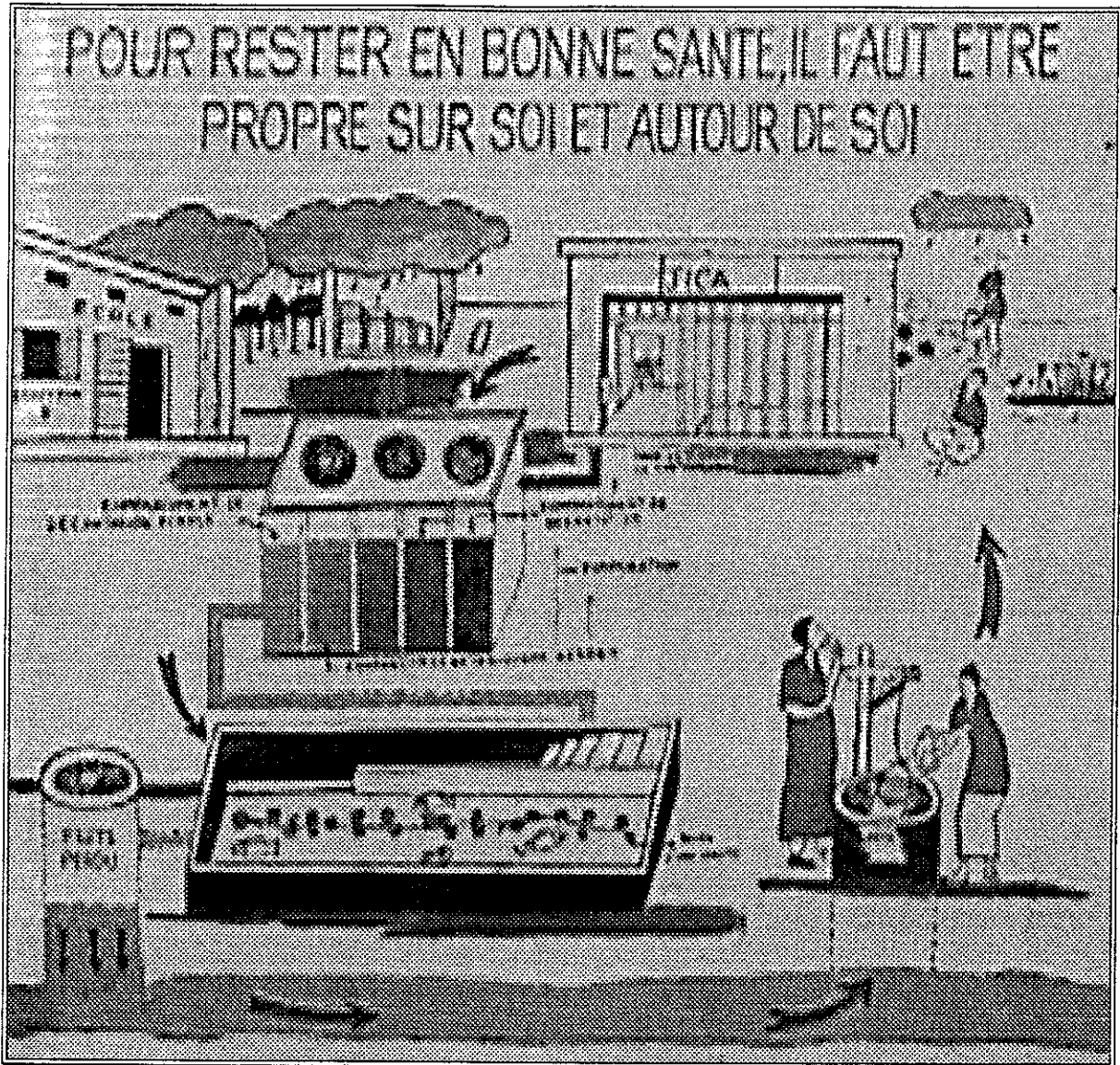
Implemented by

- The JICA Study Team
- FABA
- JADE
- GANO
- SHARA

Thank you in advance

Note: The poster is A3 sized with three colors (Red, Green and Black).

Note: The translation of each poster in French into English is not authorized.



① For good health, keep clean yourself and your surroundings (The main theme)

② Utilization of the Toilet

③ Sedimentation Chamber

④ Anaerobic Treatment Chamber

⑤ Final Sedimentation Chamber

⑥ Eco-Pond

⑦ Soak-Pit

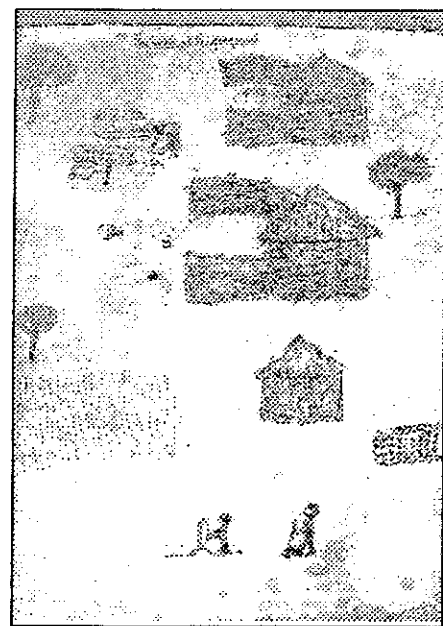
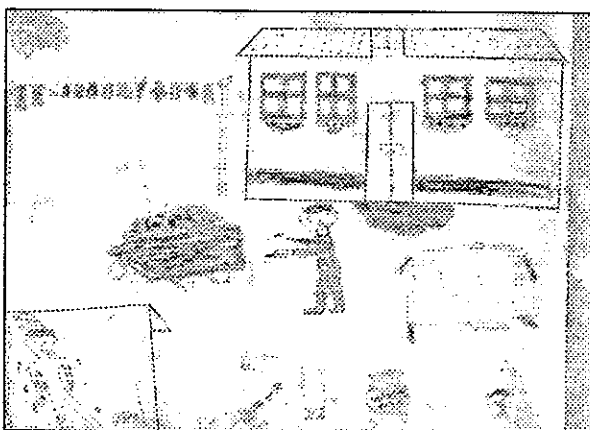
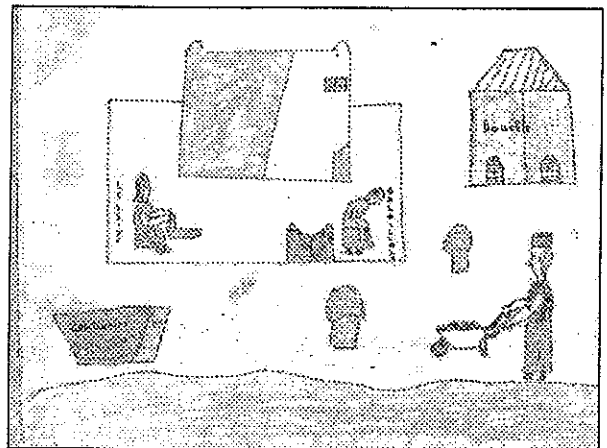
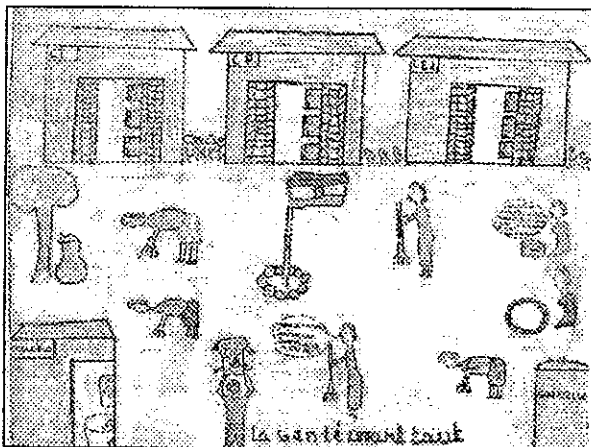
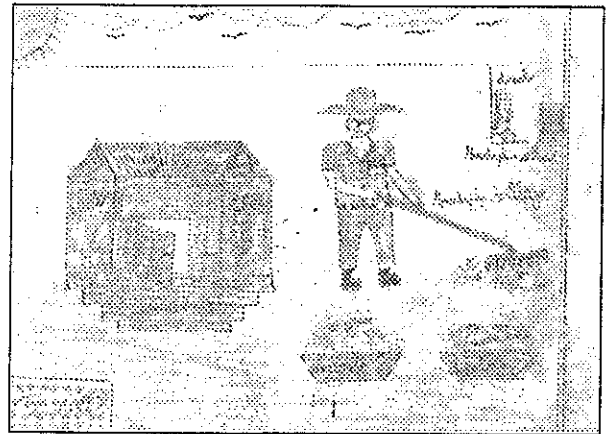
⑧ A Well

⑨ -Evaporation



- ① For good health, keep clean yourself and your surroundings (The main theme)
- ② Keep your shoes clean before enter the toilet
- ③ Don't throw waste into the toilet
- ④ Don't pore wastewater into the toilet
- ⑤ Don't open the manholes
- ⑥ Let's clean out the toilet
- ⑦ The good utilization
- ⑧ Flush the toilet with an appropriate water volume
- ⑨ Don't throw solid waste into the Eco-pond

①			
②	③	④	⑤
⑥	⑦	⑧	⑨



Six Drawings Awarded the First Prize (In random order)

# FABA «Ville Propre»

BP : 2977 Niamey – Niger. TEL : (00227) 73.55.80 FAX : (00227) 73.33.72. E.mail :Faba.comm a Internet

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Hygien Education Campain within the Franework  
of the stydy on sanitation improvement for the  
Niamey Urban Communtty supervised by the  
technical team of JICA.

FINAL RAPPORT

Presented by :

FABA

July 2001

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Table of presence on the pilote site II.



## **I. Introduction :**

Within the framework of the study on sanitation improvement for the town of Niamey, the Jica (Japan international Cooperation Agency) has built two pilot sites for the wastewater treatment whose one is located at Bandabari II school and the other one in the Gountou yena exutoir (UASB-Deizeibon).

These stations are in fact the first in the whole Africa and deserve utmost care particularly concerning the maintenance and survey.

It is for this reason, that Jica team has signed a contract with FABIA NGO for the hygiene education campaign planned for the 30<sup>th</sup> June and 1<sup>st</sup> July 2001 at Bandabari II school and 7<sup>th</sup> July and 8<sup>th</sup> July 2001 at school in order to sensitize the populations on hygiene and sanitation matters.

This campaign has been organized and implemented with the assistance of government agents, NGO, like JADE, GANO service, SHARRA in compliance with the terms of reference and similarly an investigation has been made by the administration of questionnaires in order to get the participant opinions which will help in the improvement of further sensitization campaigns.

## **II. General Objective :**

The general objective of the actual campaign is to contribute in the sanitation improvement of Niamey Urban Community by an effective hygiene and health awareness from the population.

### III. Specific Objectives :

Through the terms of reference of the actual campaign, the following specific objectives can be pointed out :

- ◆ Teaching to Bandabari II school pupils the best ways to use the toilets of pilote site I.
- ◆ Seminar exposure on hygien education in the front of the targeted population.
- ◆ Seminar exposure concerning the community participative approach.
- ◆ Creation of a good relations ship between the public and private sectors.

### IV. Preparatory Works on the Hygien education Campain :

Four days have been planned for the campain organisation in which two days will be used for the pilote I (Bandabari II school) and two days for the pilote site II (UASB-FB Deizeibon).

A planning for the implementation of the campain has been made by taking into consideration the human and material means.

An Organising Comity has also been made during the first meeting which took place on the 22<sup>th</sup> june 2001 (see annexe for the 1<sup>st</sup> meeting report III).

This organising comity has encompassed all the representatives of concerned actors of the sensibilisation campain like chefs de quartier, teachers, government agents, NGOS pupils parents that are willing to bring their modeste contribution for success of this campain.

Thus, this comity has decided the material organisation of the campaign in compliance with the terms of reference.

- ❖ For the Bandabari stage, an explanatory meeting about this campaign has been made with Niamey Urban Community on 19/6/2001.

Participants informations have been realized through invitation letters, media, sonorisation, posters and banners.

It should be noted that the following materials have been put into place.

- ❖ Comic strips (5copies/game of 4 colours)
- ❖ 10 small panels in which selected slogans are established.
- ❖ 2 big panels whose one get the schema of Jyakaso system and the other the utilization of the toilets.
- ❖ 10 posters
- ❖ 30 tee-shirts
- ❖ 10 pennants
- ❖ Audio-visual equipments and a video cassette of 120 minutes concerning hygien and sanitation
- ❖ 300 games of colouring pencils
- ❖ 300 drawing papers
- ❖ 300 pencils and erasers
- ❖ drinks

The night before the ceremony de Bandabari, the floor of the school and its environs have been swept up by FABBA, JADE labores, the women of other NGOS, helped by some participants before installing the tables, chairs and sheds.

It should be noted that the panels, posters, and banners have been put into place on Friday 29<sup>th</sup> June 2001.

❖ For Deizeibon stage, a meeting of the organising comity took place on the July 6<sup>th</sup> 2001 in the Urban Community hall in order to discuss about the remaining preparatory works of the hygien education campaign on the pilote site II (see annexe III for the meeting report).

The organising comity has been maintained in his tasks and has later implemented all the necessary materiels for the campaign.

This :

- ❖ 10 posters
- ❖ Comic strips (5 copies/game of 4 colours)
- ❖ Banners
- ❖ Audio-visual materials and a video-cassette on hygien and sanitation hare been already implemented.

It should be noted that, like in the case of Bandabari, the labores of FABA, JADE and other participants have cleaned up the site and its environs before installing the chairs, tables and sheds.

A sonorous campain has been made in the night before the manifestation in order to inform the population. This campain has enforced by the posters and the media.

The transportation of the participants to preparatory activity has been ensured by the bus of FABA.

## **V Manifestations of the hygien education campain :**

The hygien education campain took place during four days whose two days in the Bandabari II school (pilote site I) and two days in Deizeibon school (UASB-FB-Deizeibon) as planned by the terms of reference.

### **5-1 Manifestation of the hygien education campain on the pilote site I (Bandabari II).**

The hygien education campain has started on 30<sup>th</sup> june and has finished on july 1<sup>st</sup> 2001 at Bandabari II school, where the Jyakaso system has been constructed. For the first day of this manifestation, it was arround 9h 30mn (a.n) that the welcome address from the Directrice of Bandabari II school took place preceded by a song of the school pupils.

Then it was the tour of Mr, "l'Administrateur Delege" of the Niamey Commune II to presented his allocution followed by Mr SUZUKI the head of the study team of JICA.

The representative of ministry of equipment and transport has also presented his address and has urged the participants to put much more efforts in the daily clean-up and maintenance of the toilets.

After differents allocutions, Mr TANIDA TAKAYAKI, a Japan voluntary has presented a lyric song with the Bandabari II school pupils.

It was the tour of miss SETO, Japan voluntary to presente a cartouns by 10 hours (a.n), the participants and the authorities have visited the new toilets and the Jyokaso.

A bref explanation on Jyokaso mecanism and utilization has been made by Mr Coustaline, a consultant of the JICA study team.

After some minutes of pause and refreshments about hygien and sanitation have been given by the exposure of panch marked with varied slogans and drawings.

In the evening time from 16h 30mn there was video-film presentation on sanitary and environnemental education for about 120 minutes followed by a comment.

From 18h 30mn a drawing test was announced for the july 1<sup>st</sup> 2001.

At the second day of the manifestation was happened from 9h to 10 hours (a.n) a drawing test organised for the 5<sup>th</sup> to 6<sup>th</sup> year school pupils.

The requirements for marking drawing test are related to hygien, sanitation ant art.

From 10h 30mn to 11h 30mn the organising comity has proceded to the test marking.

From 11h 30mn to 12h a session of sweeping was done by the laborers of FABBA and JADE.

The drawing test results have come out in the evening from 16hour this, six prices have been attributed to the winners and 165 prices of encouragement have been distributed over 206 participants to the test.

From 16h 30mn, comic strips have been distributed to the participantss, followed by a brief discussion on hygien and sanitation.

By 17h 20mn the speech of the closure of the ceremony at Bandabari II school has been pronourced by Mr SUZUKI.

It should be noted that along these manifestations questionnaires have been direct in order to make an investigation on participants opinions about the campain.

During the two days of manifestations, the transport has been ensured by the bus of FABBA.

At the first day of manifestation of Bandabari we have registered 964 participants in the morning and 592 participants in the evening.

At the second day, 839 participants have been registered in the morning and 940 participants in the evening.

### **5-2 Hygien education campain on the pilote site II (UASB-FB Deizeibon)**

Hygien education campain on the site of Deizeibon school has started on 7<sup>th</sup> of july and has finished the 8<sup>th</sup> of july 2001.

At first day of manifestation, the opening speech has been pronouced by the headmaster of Bandabari II school.

It was then the tour of Mr SUZUKI to make his speech.

At 10h, the participants have visited purifying station and explanation on the fonctionning principles on the station has been given by M. HAMZA, the JICA homologue.

From 10h 30mn to 11h the participants have proceded to the sensibilisation of business men and other people living closer to purifying station in order to bring their assistance in the UASB-FB Deizeibon maintenance.

From 11h to 11h 10mn one of the gardener representative had pronouced his allocution in order to thank the JICA for its willing to help Niger in the sanitaire improvement and has urged the participants to bring their help.

From 10h 10minutes, there was a session of film video projection on hygien and sanitation of the environment for about 120 minutes.

After the projection, Mr Maman Ali the chief of hygien and sanitation service of the commune Niamey I has issued a comment on film video in husa the has asked children on their comprehension of the video-film and has urged then to contribute to the sanitation of their space by avoidin to four waster where it should not be.

At the second day of the manifestation, the headmaster of Bandabari school has passed au seminar in zarma on the differents efforts done by its school initially polluted by solid waster.

The has shown the need to maintain ours environment clean.

After her seminar, a drummer on the paper has been presented by miss SETO YIKIKO, drummer which was very much appreciated by the participants.

From 12h, a démonstration of sweeping has been done by the participants in order to sensibilize the business men.

By 13h, these was a closing speech and the deling of banners to the directrice of Deizeibon school.

It should be noted that like the Bandabari II manifestation, questionnaires have been directed to the participants in order to get their opinions and to serve like pedagogic tools for the futur campains.



Liste of presence have been established and in the first day of the campaign we have registered 691 participants againsts 522 for the second day.

It should be noted that contrary to Bandabari II stage, the Deizeibon manifestation happened for shours to 13hours due to Bandabari experience where it was remarked that people are reluctant to participate in the evening time.

During the two days of manifestation the transport has been ensured by *FABA*.

## **APPENDIX S.2 TOPOGRAPHIC SURVEY**



**BATIMENTS ET TRAVAUX PUBLICS**

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FAX. 74 - 25 – 68 NIF 185  
E-mail : [eam@intnet.ne](mailto:eam@intnet.ne)  
NIAMEY – NIGER**

**TOPOGRAPHIC SURVEY REPORT**

**FOR**

**THE STUDY ON SANITATION IMPROVEMENT**

**FOR**

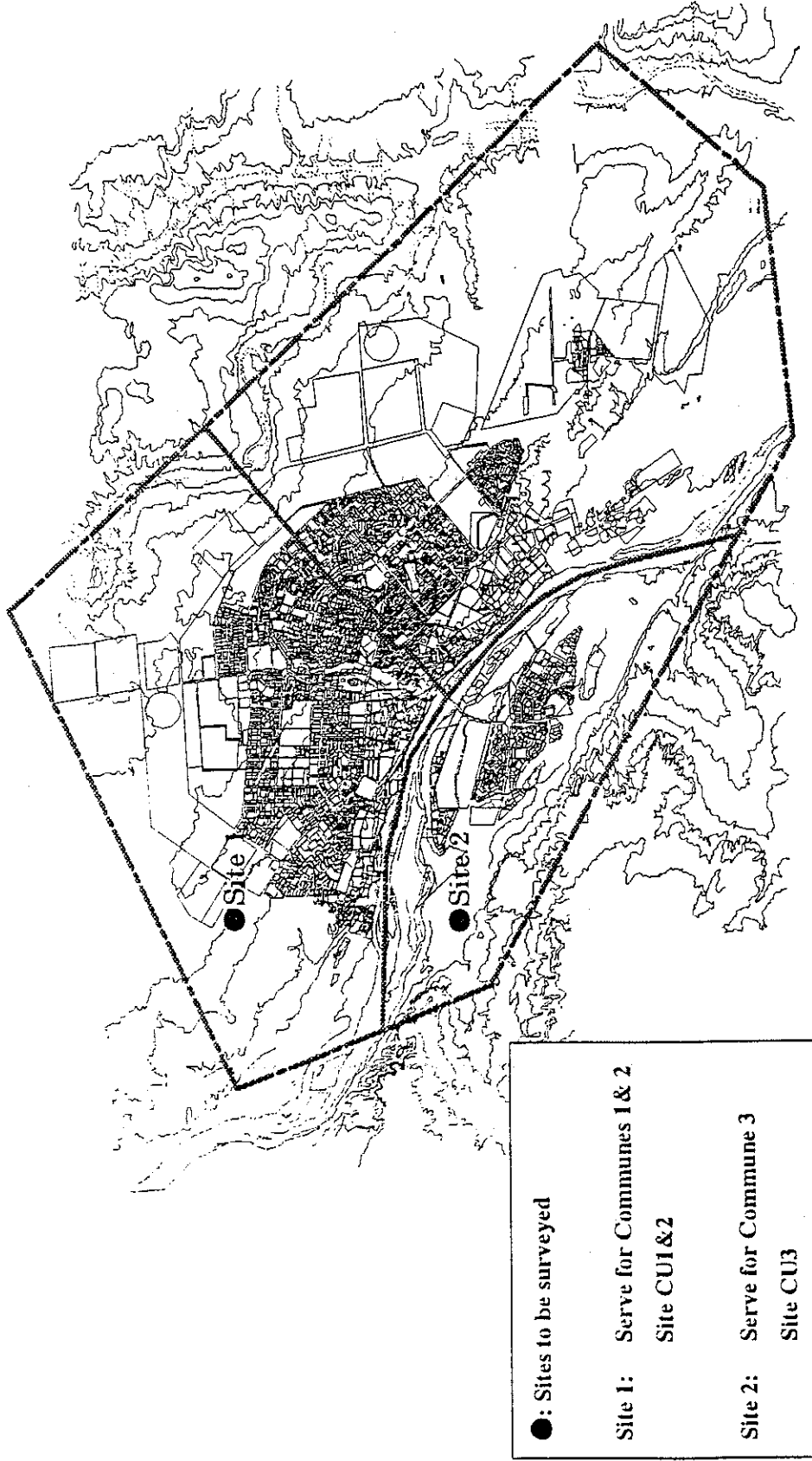
**THE NIAMEY CITY**

**IN**

**THE REPUBLIC OF NIGER**

**JULY 2001**

Annex-1 Site to Survey



## APPENDIX S.2 TOPOGRAPHIC SURVEY

### 1. SITE CU1&2 (Koubia)

The benchmarks were set as follows from the points, P935 and P936 of the Niamey local grid lines and the triangulation point ST103.

No.	X (m)	Y (m)	Z (m)
EAM 1	11,650.86	26,191.97	218.21
EAM 2	11,453.99	26,249.12	217.81
EAM 3	11,227.60	26,328.80	219.11
EAM 4	11,130.18	26,455.98	219.60

The result is shown in Figure S2.1-1 to 12.

### 2. SITE CU3 (Bengale Torombi)

The benchmarks were set as follows from EL NASSERI1, EL NASSER2, Lazaret antenna and Leclerk water tower and P222 of the Niamey local grid lines.

No.	X (m)	Y (m)	Z (m)
EAM 1	7,740.32	21,896.07	204.36
EAM 2	7,605.78	21,922.94	210.41

The result is shown in Figure S2.2-1 to 21.

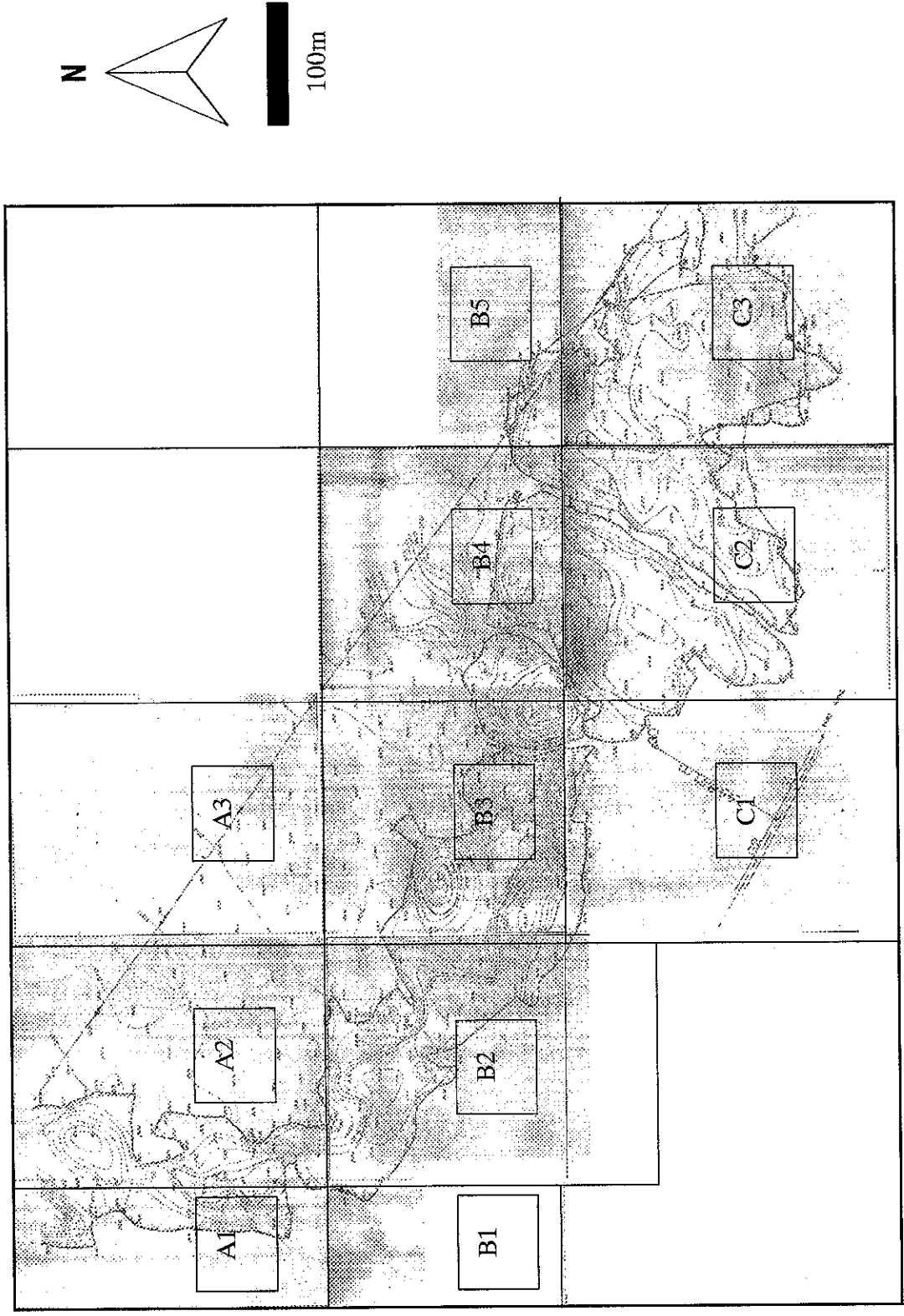


Figure S2.1-1-1 Index Map of Result CU1&2

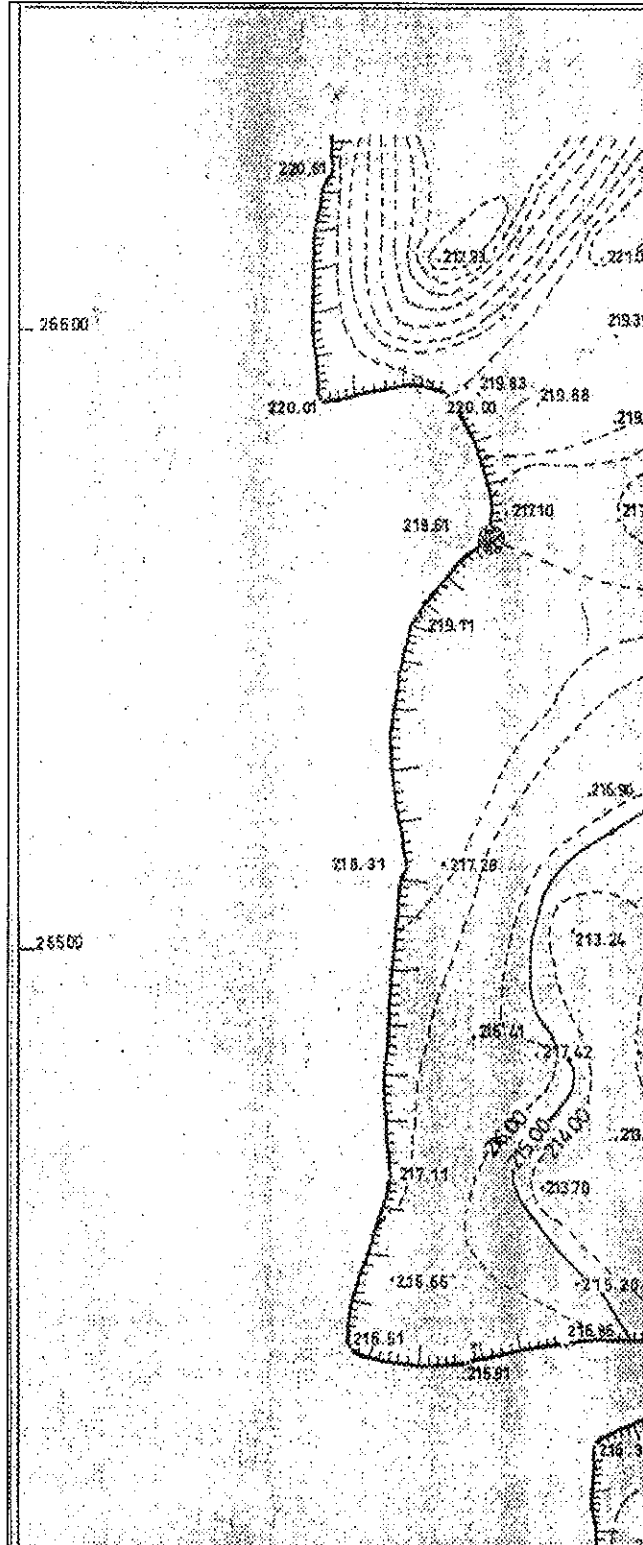


Figure S2.1-2 Map A1 (1:1250)

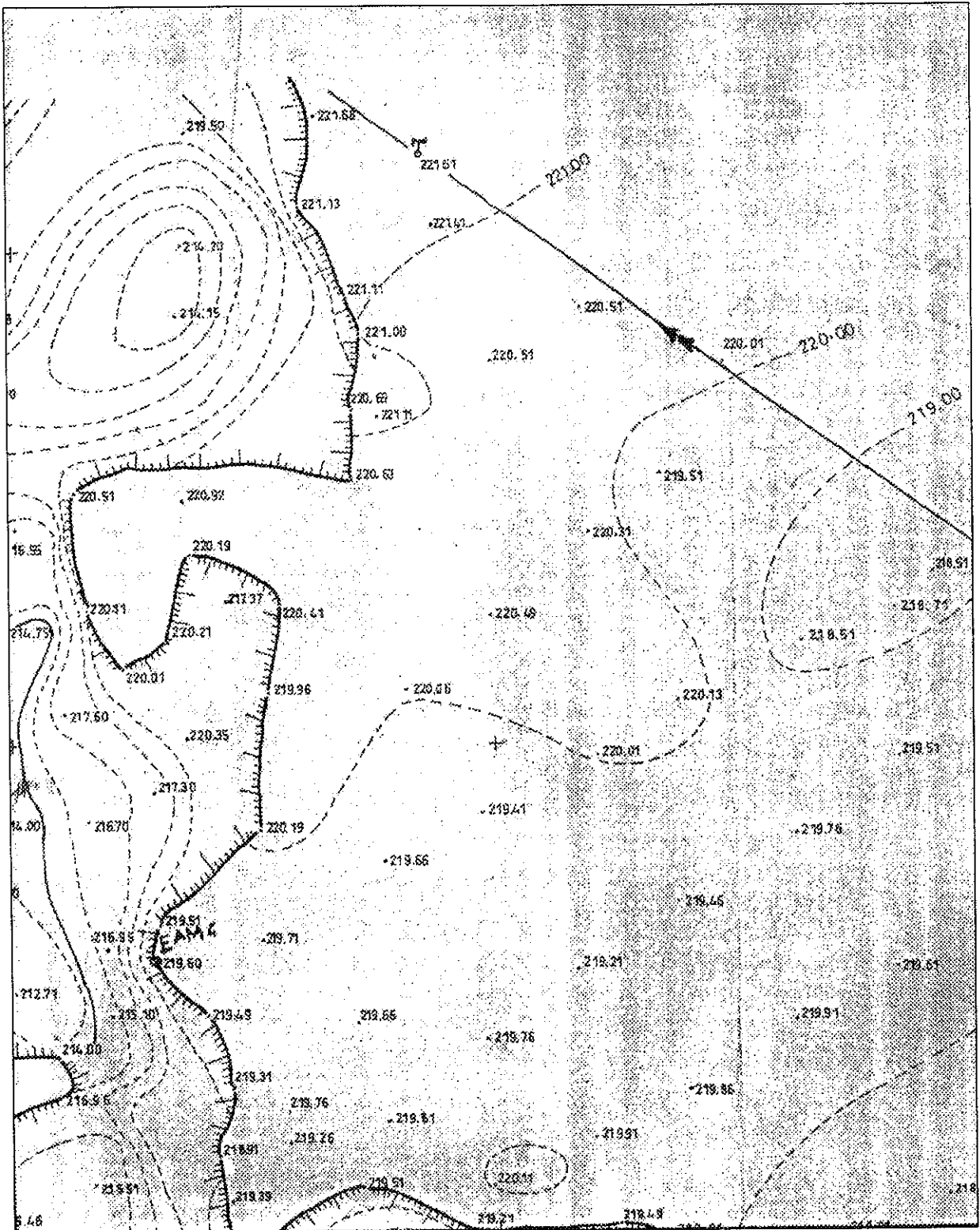


Figure S2.1-3 Map A2 (1:1250)



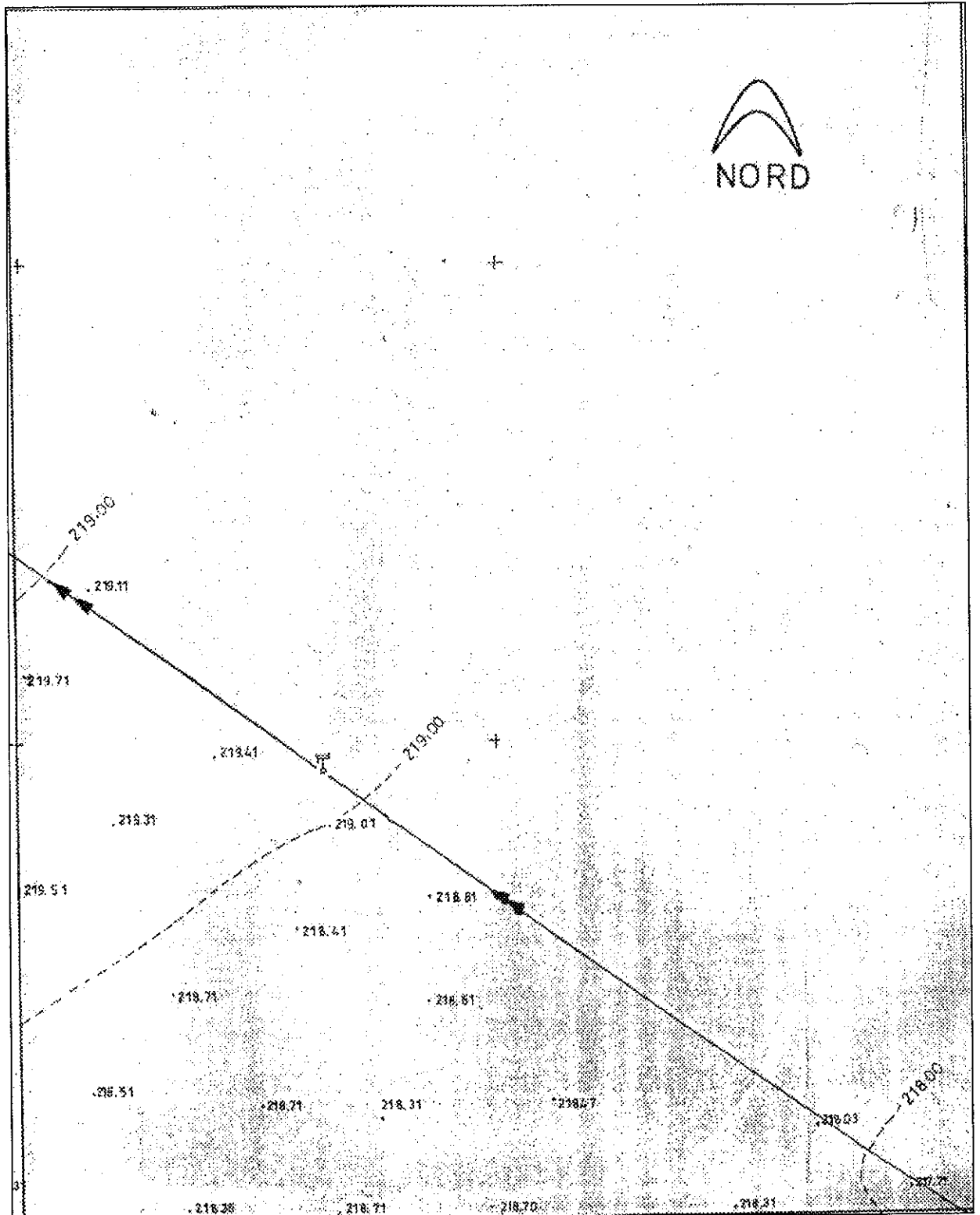


Figure S2.1-4 Map A3 (1:1250)

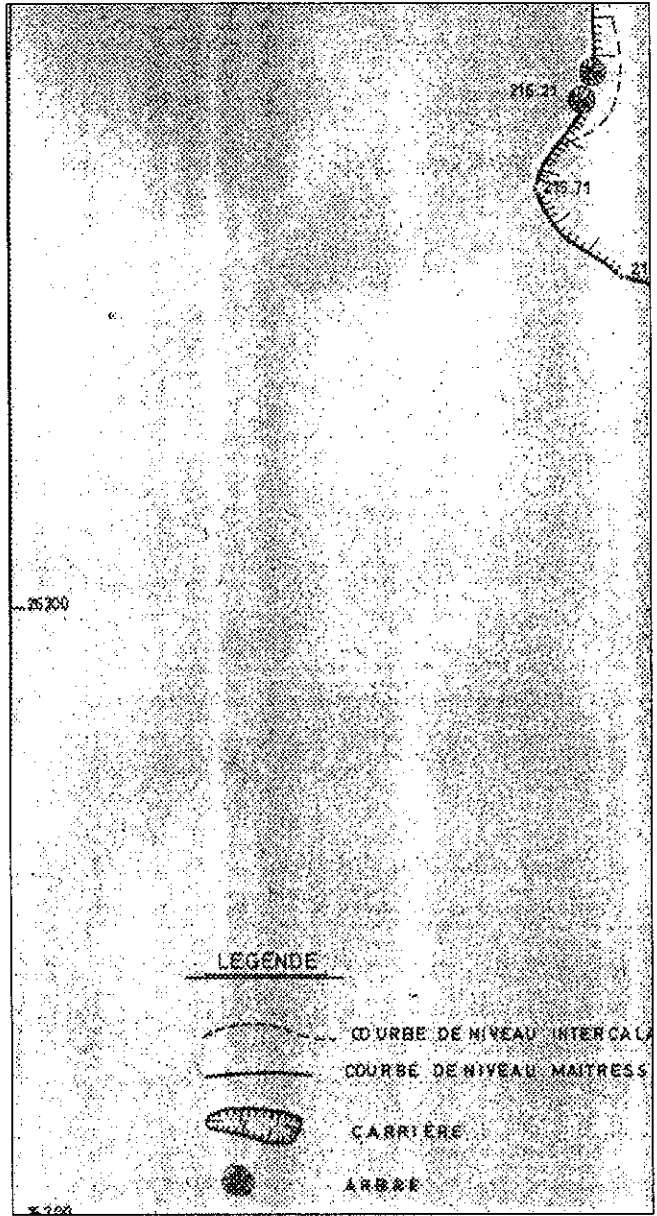


Figure S2.1-5 Map B1 (1:1250)

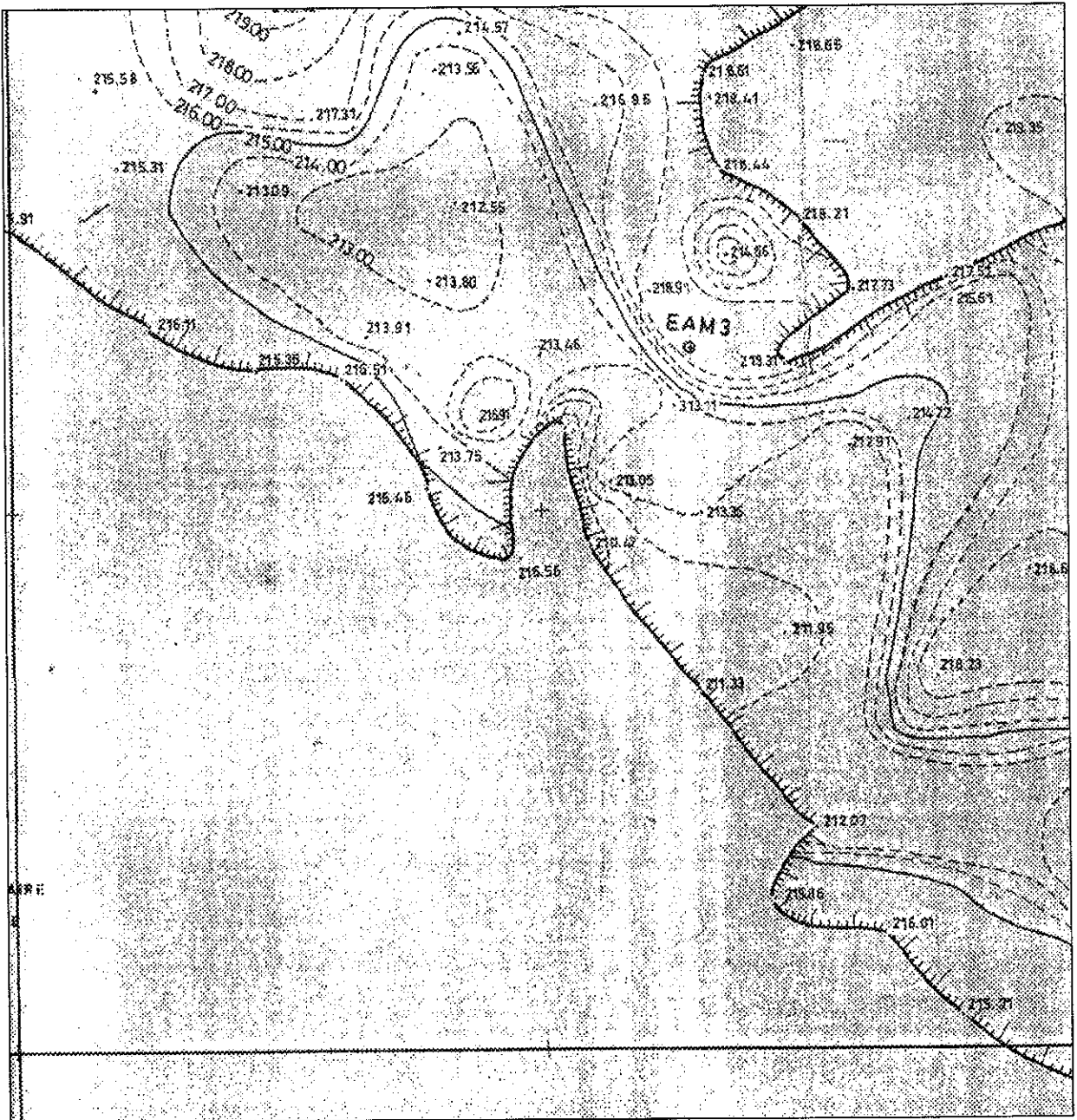


Figure S2.1-6 Map B2 (1:1250)

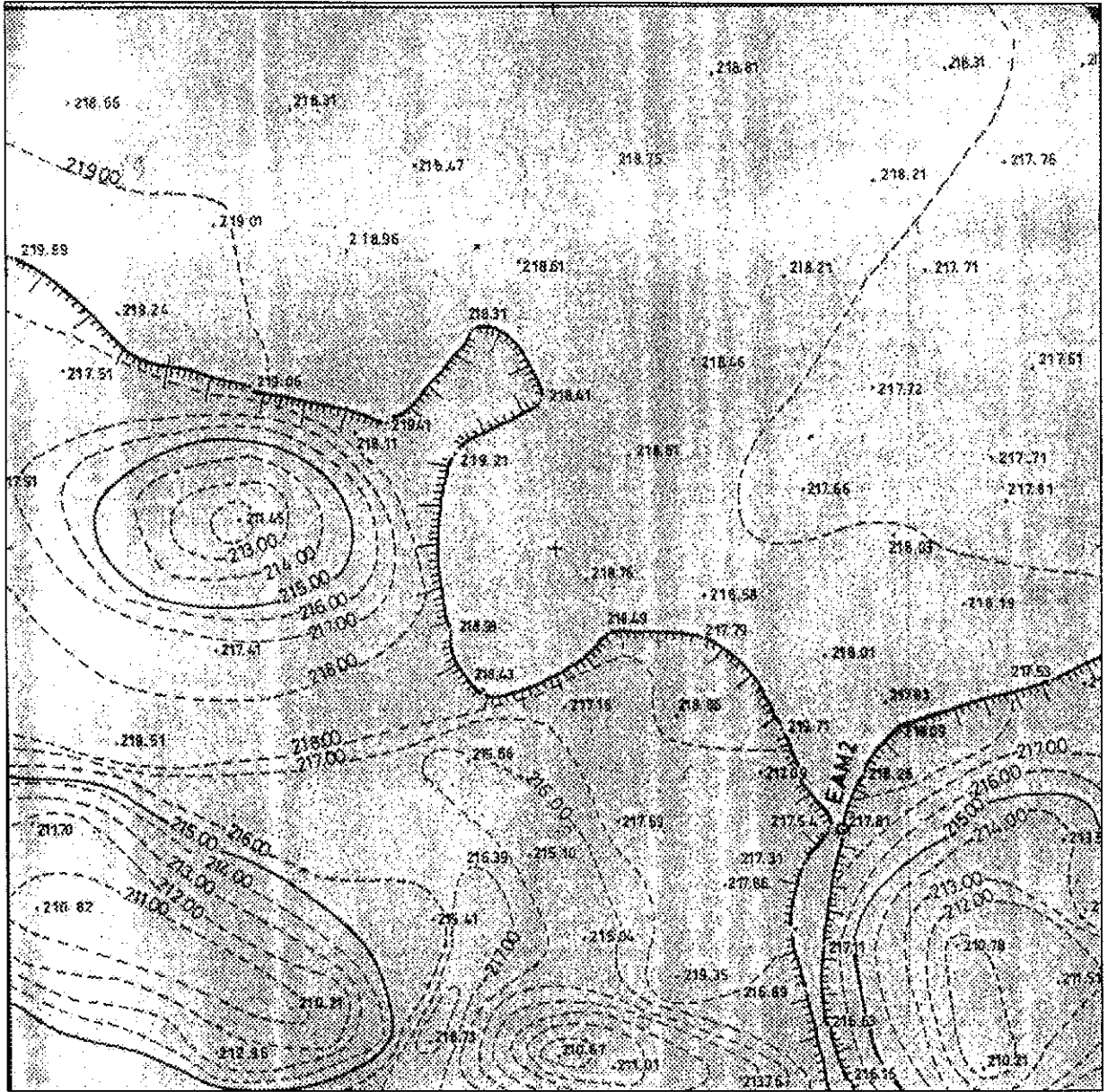


Figure S2.1-7 Map B3 (1:1250)

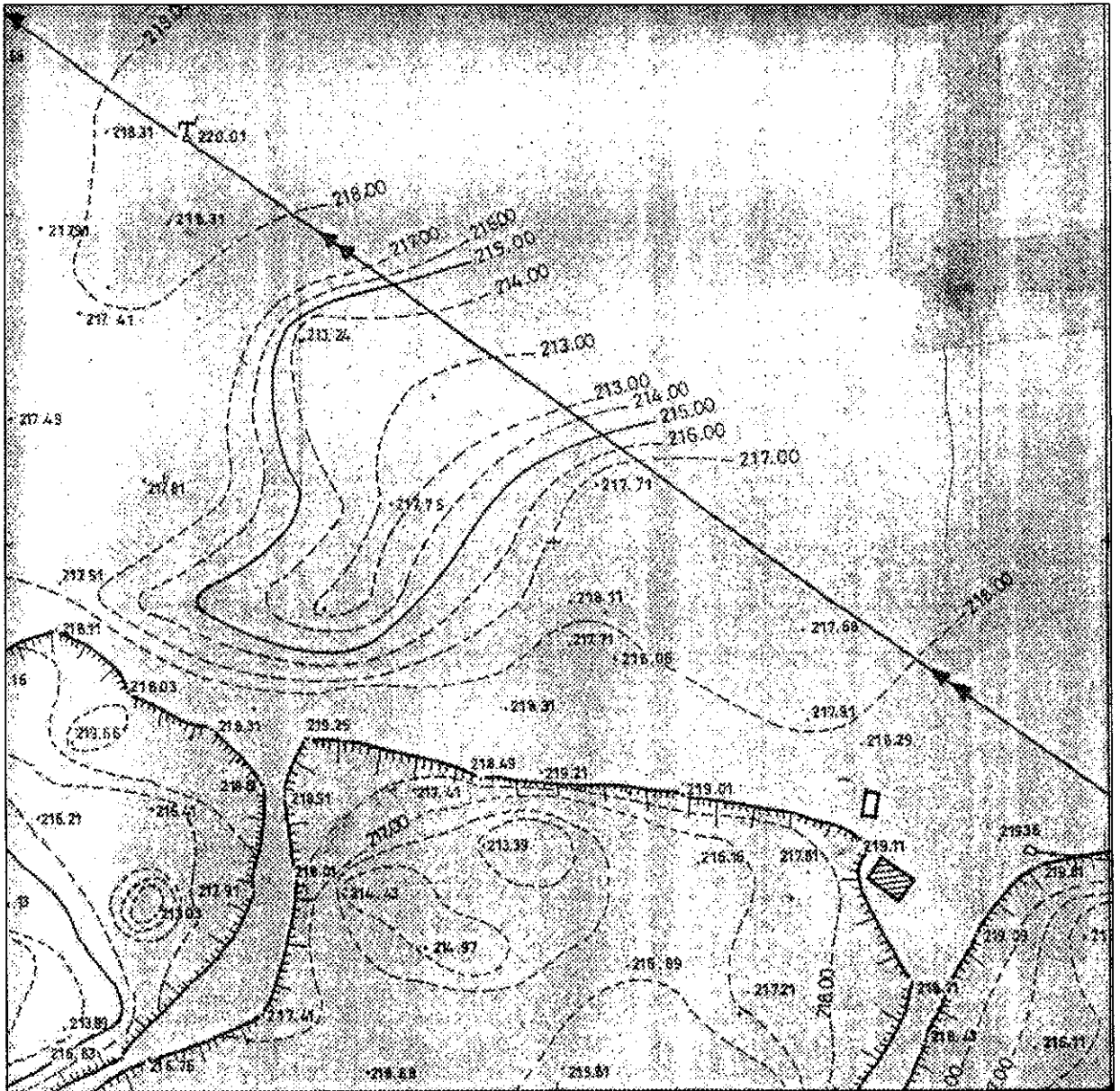


Figure S2.1-8 Map B4 (1:1250)

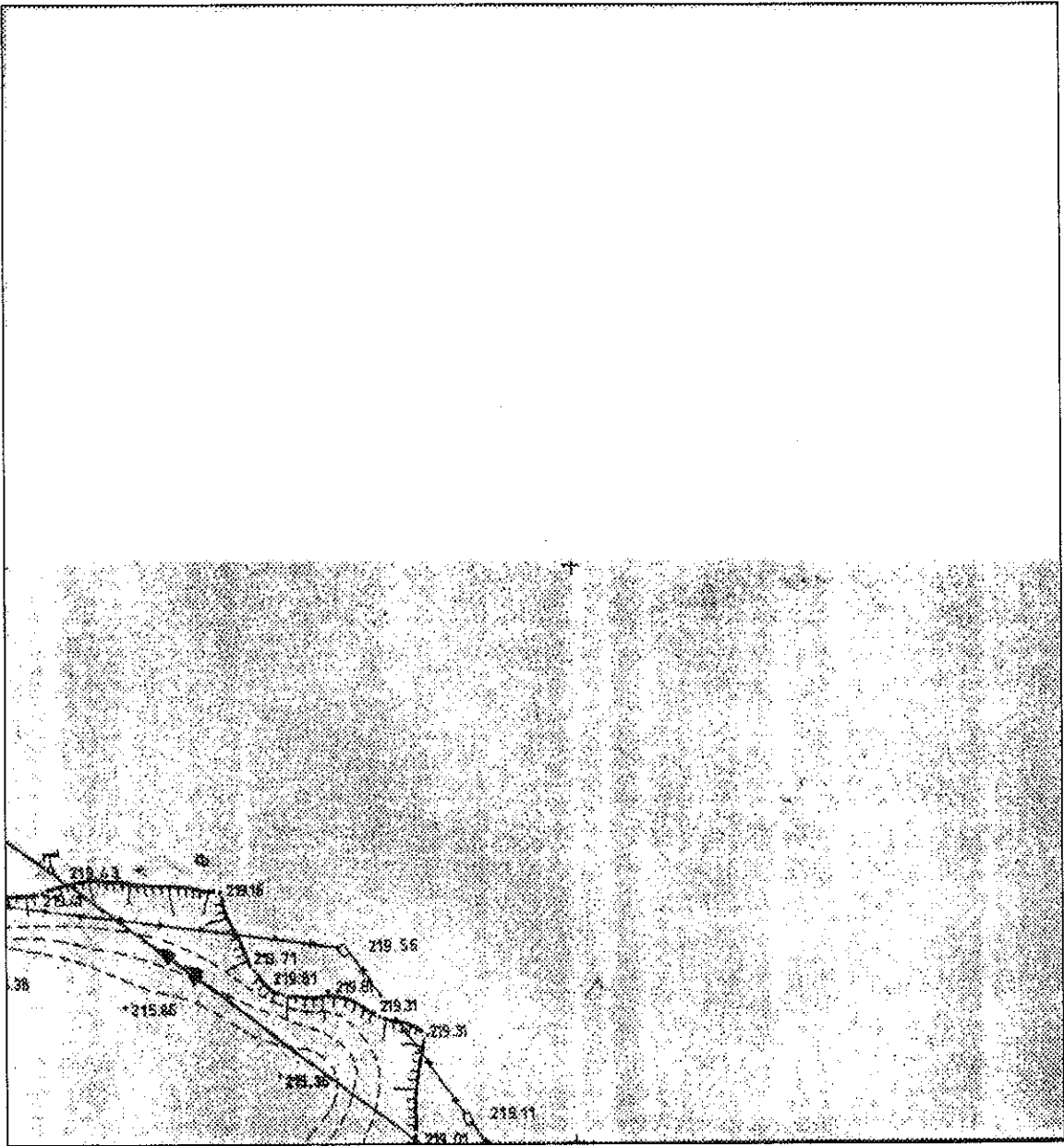


Figure S2.1-9 Map B5 (1:1250)

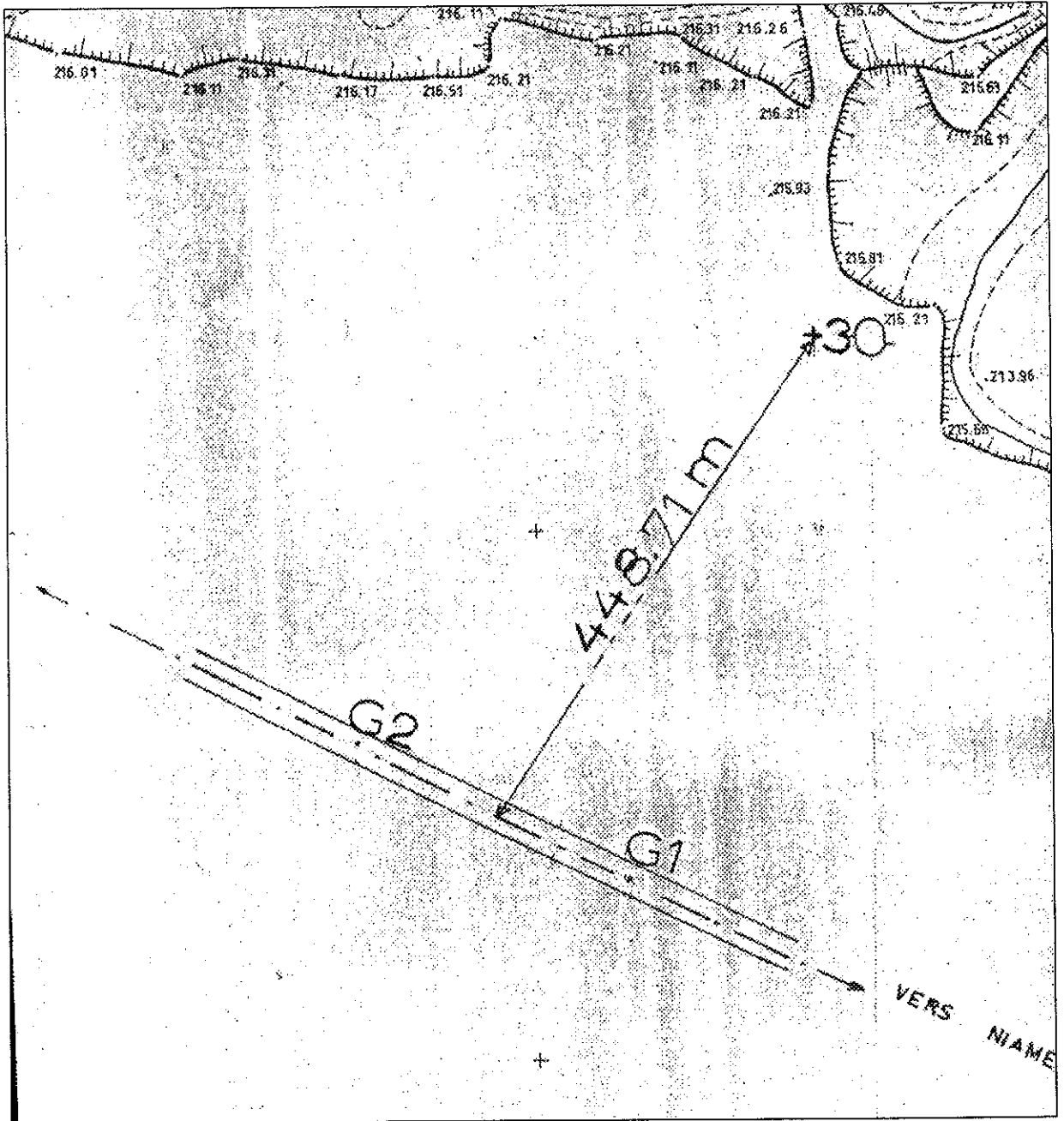


Figure S2.1-10 Map C1 (1:1250)

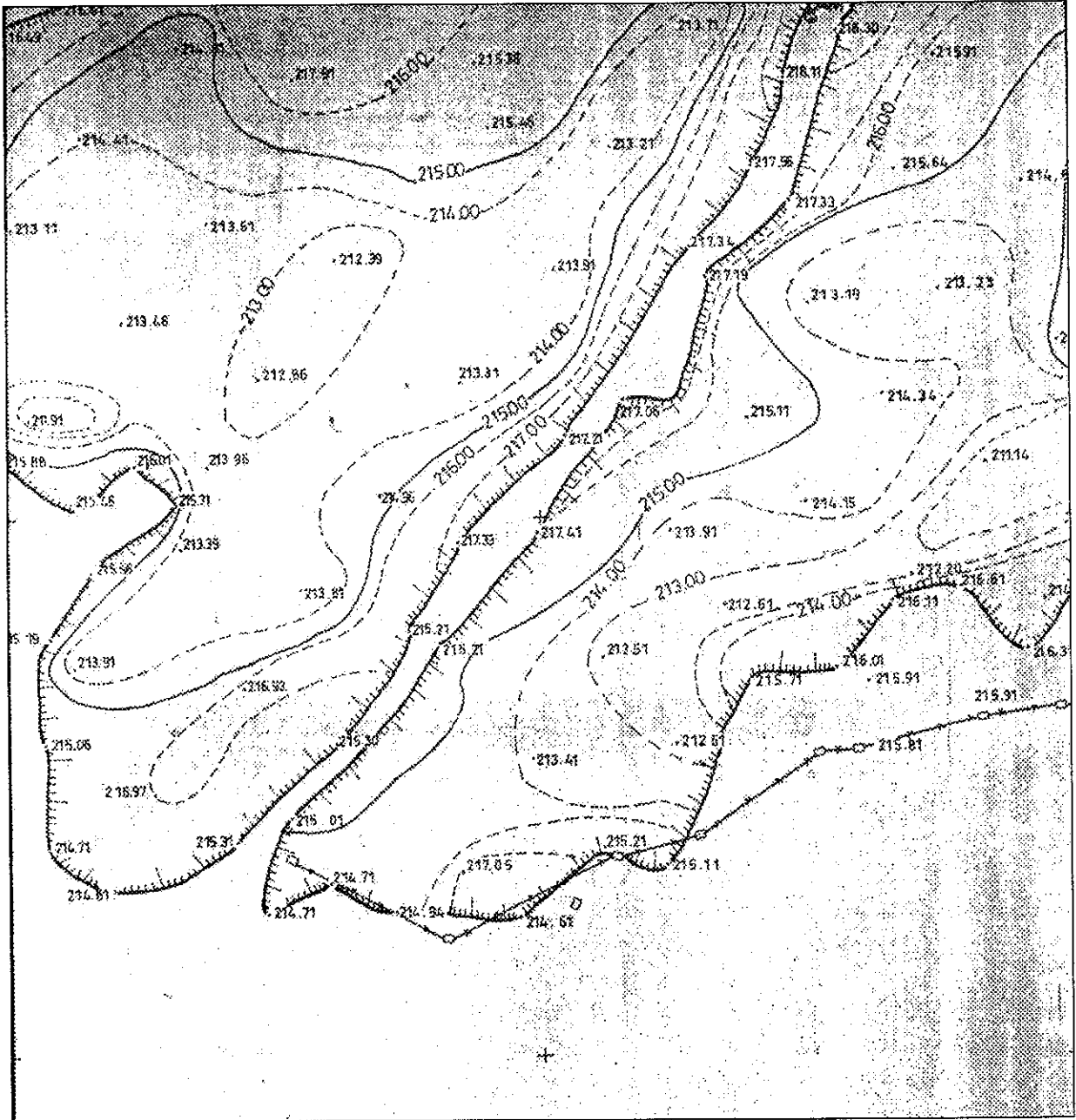


Figure S2.1-11 Map C2 (1:1250)



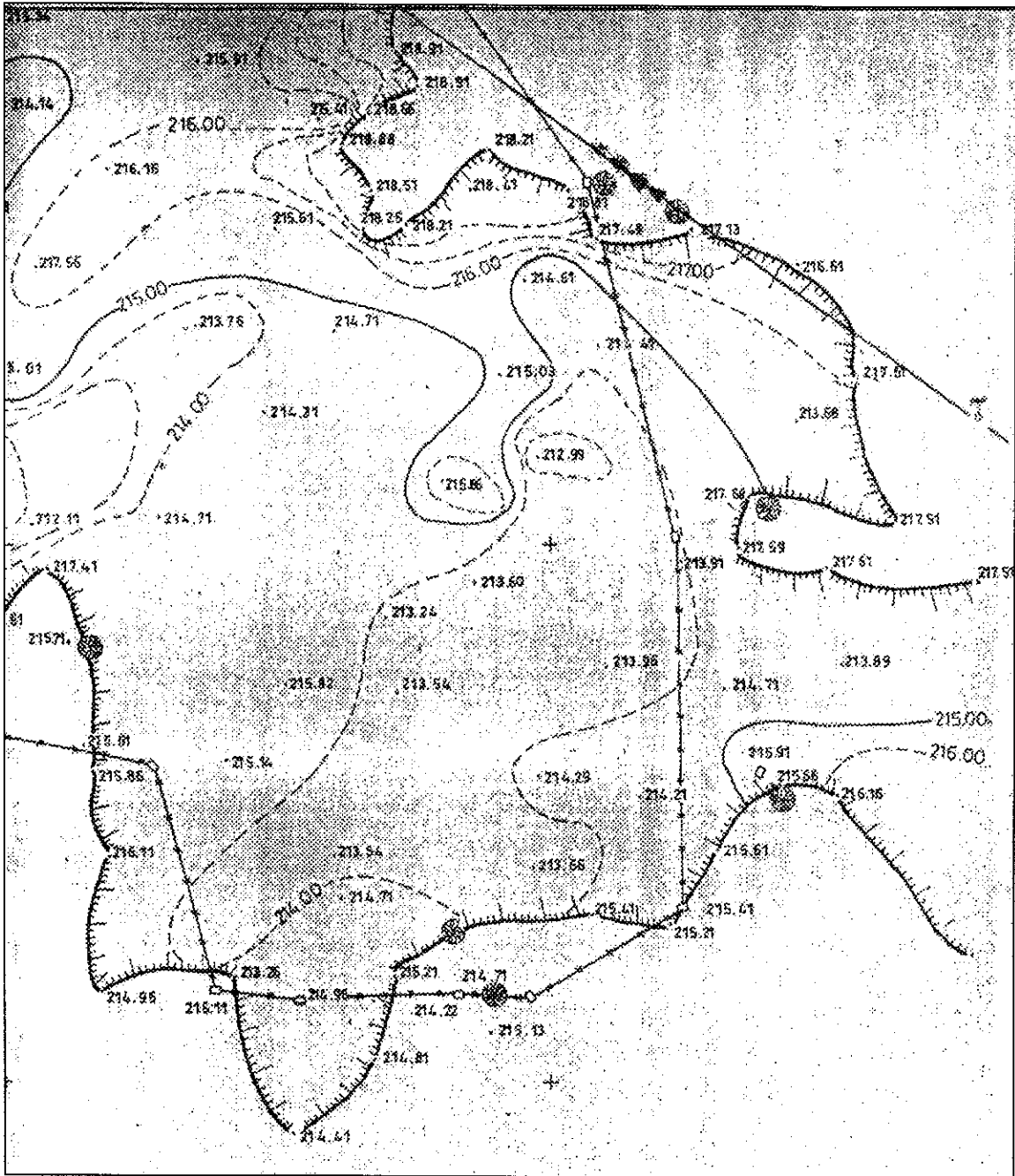


Figure S2.1-12 Map C3 (1:1250)

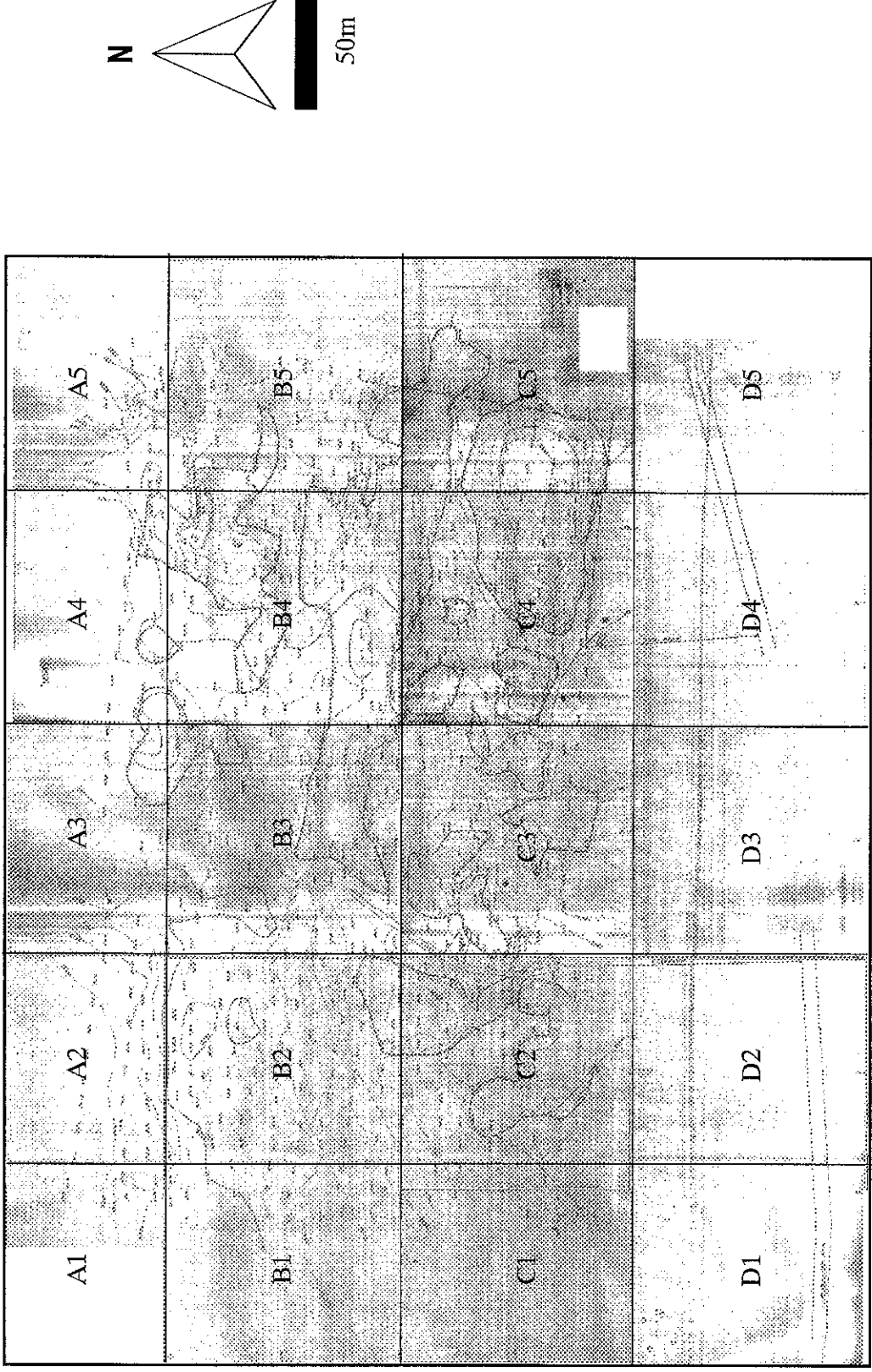
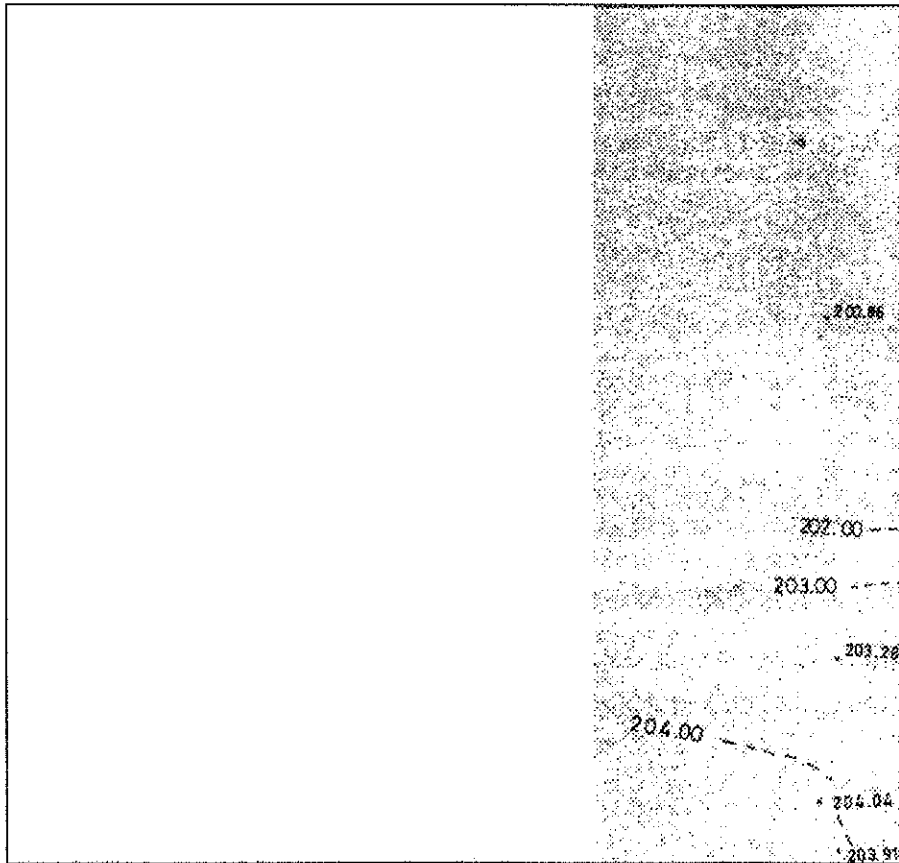


Figure S2.2-1 Index Map of Result CU3



**Figure S2.2-2 Map A1 (1:625)**

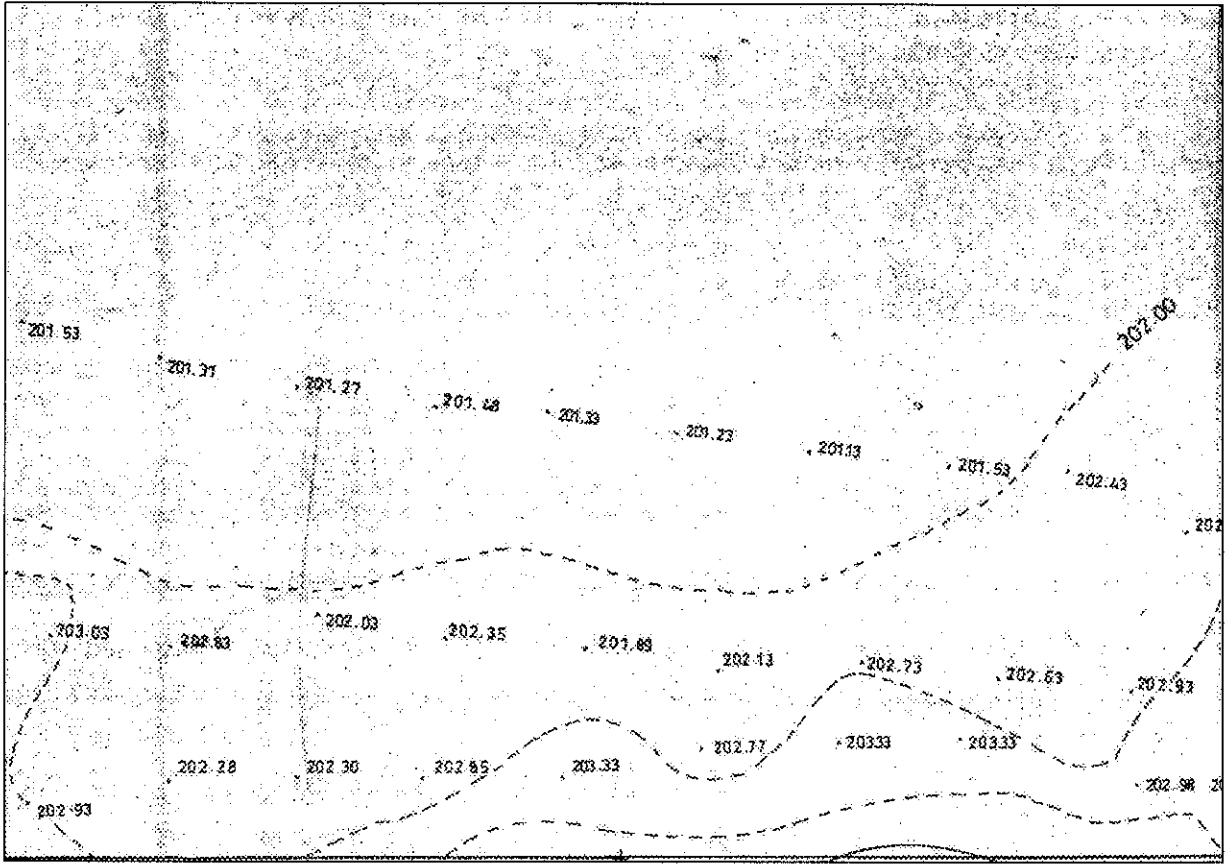


Figure S2.2-3 Map A2 (1:625)

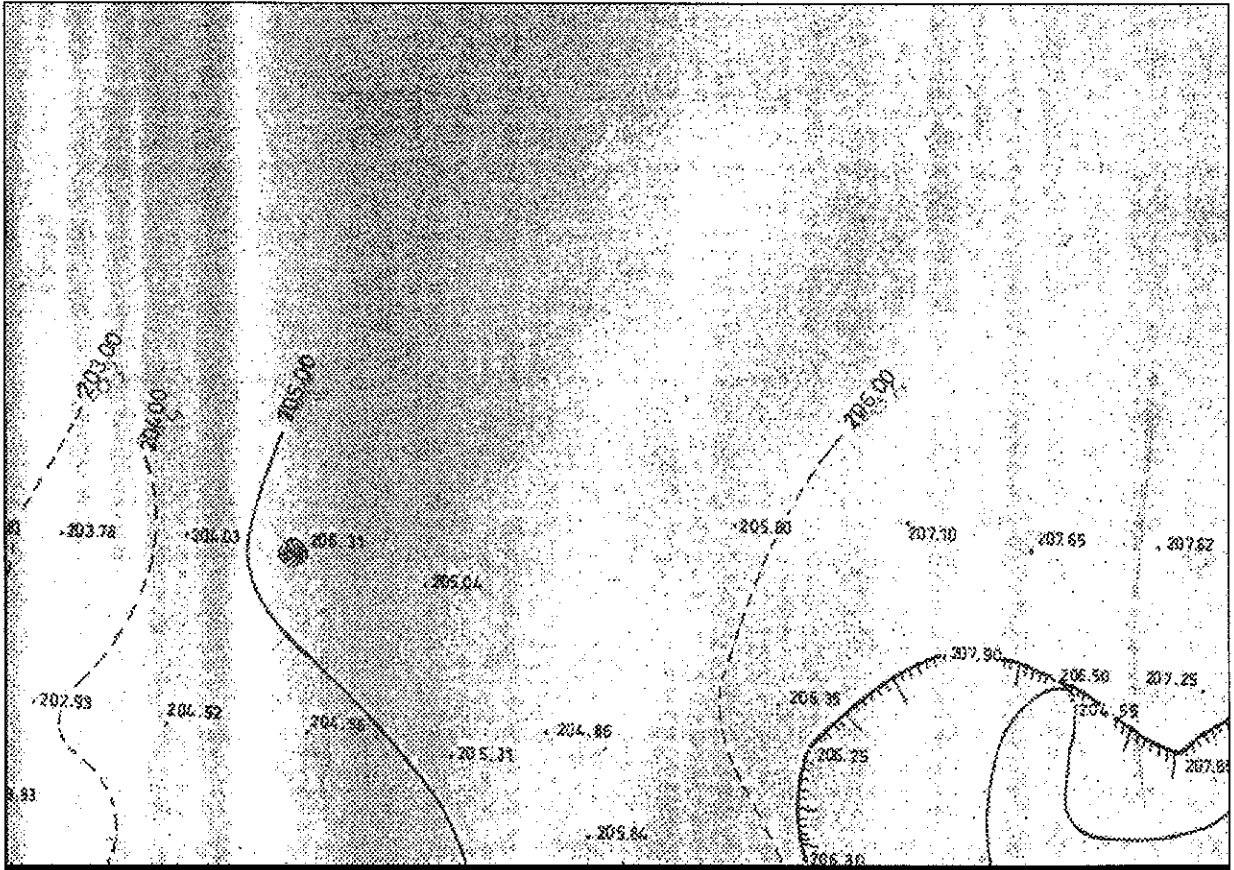


Figure S2.2-4 Map A3 (1:625)

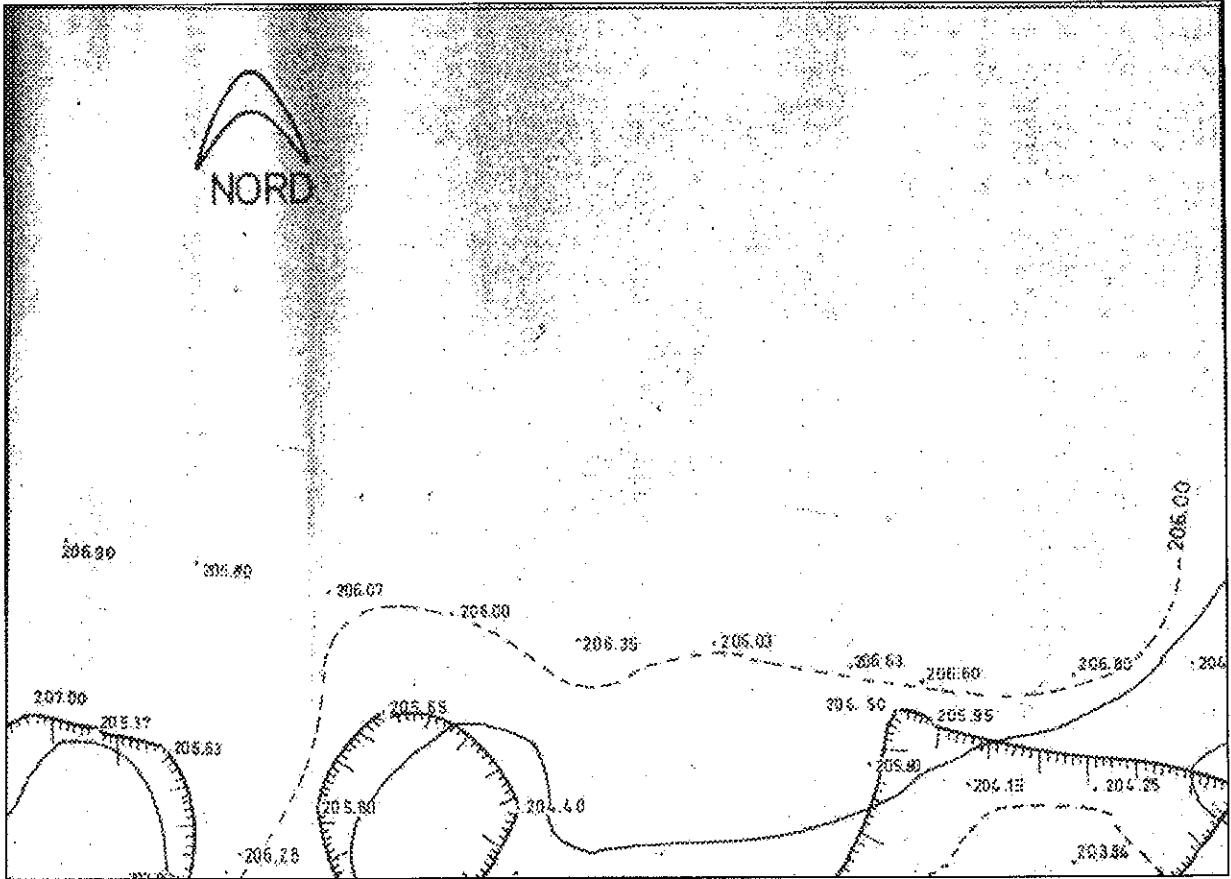


Figure S2.2-5 Map A4 (1:625)

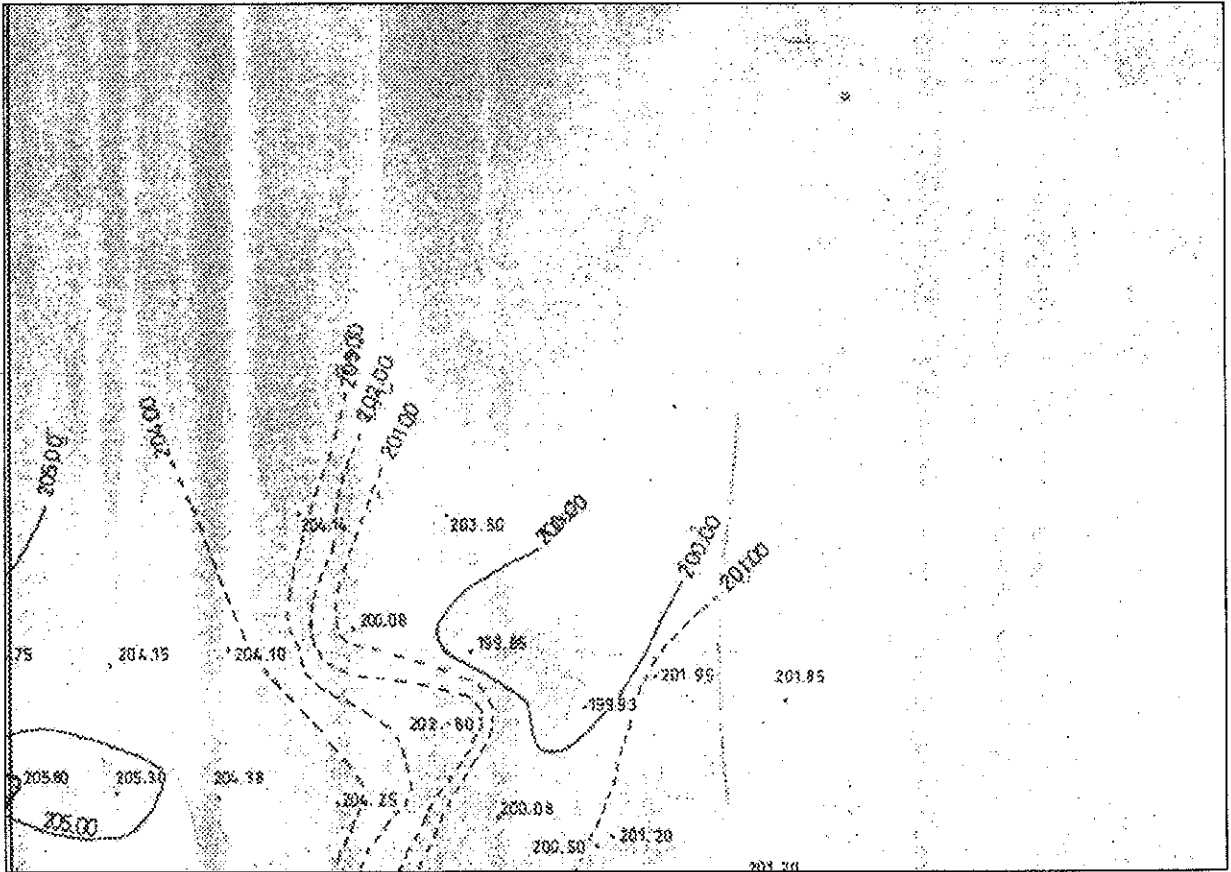


Figure S2.2-6 Map A5 (1:625)

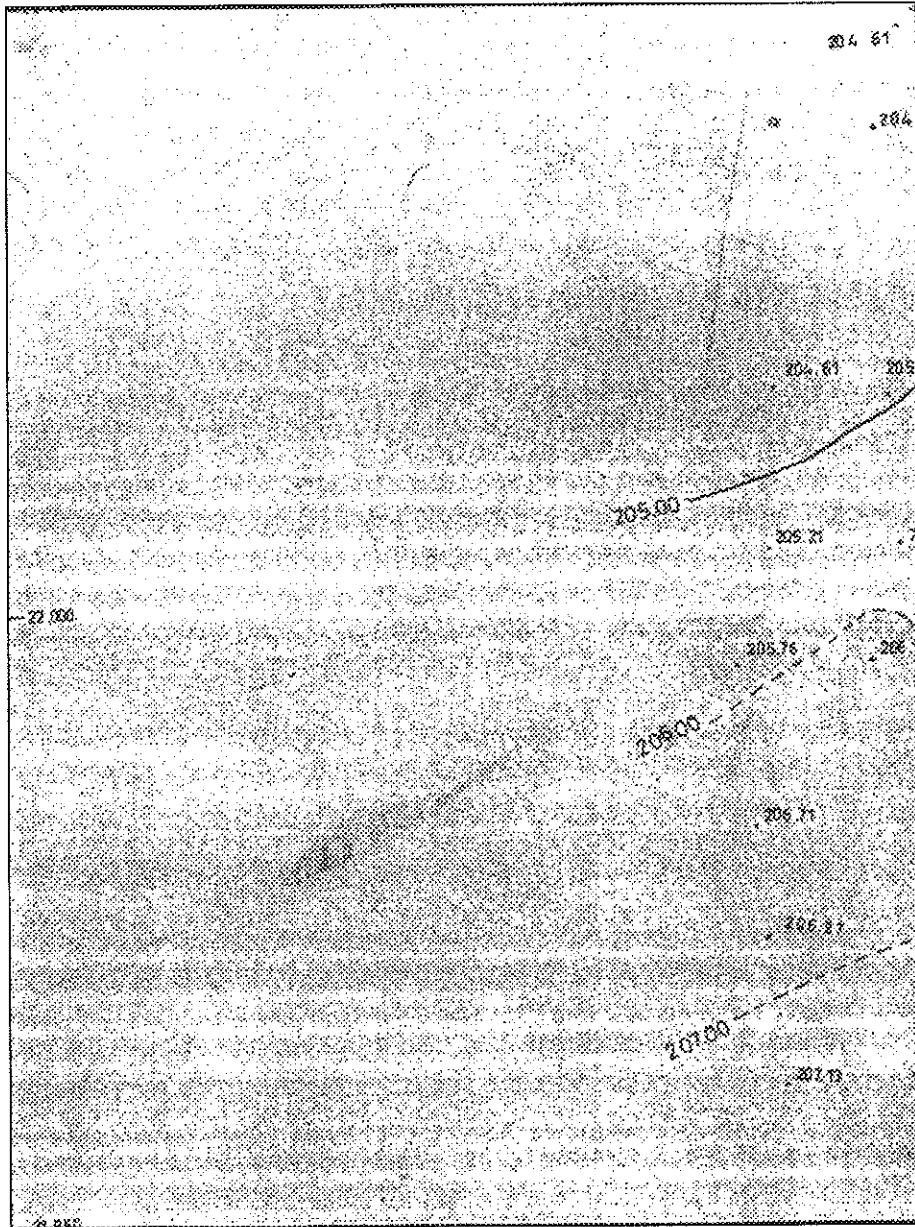


Figure S2.2-7 Map B1 (1:625)



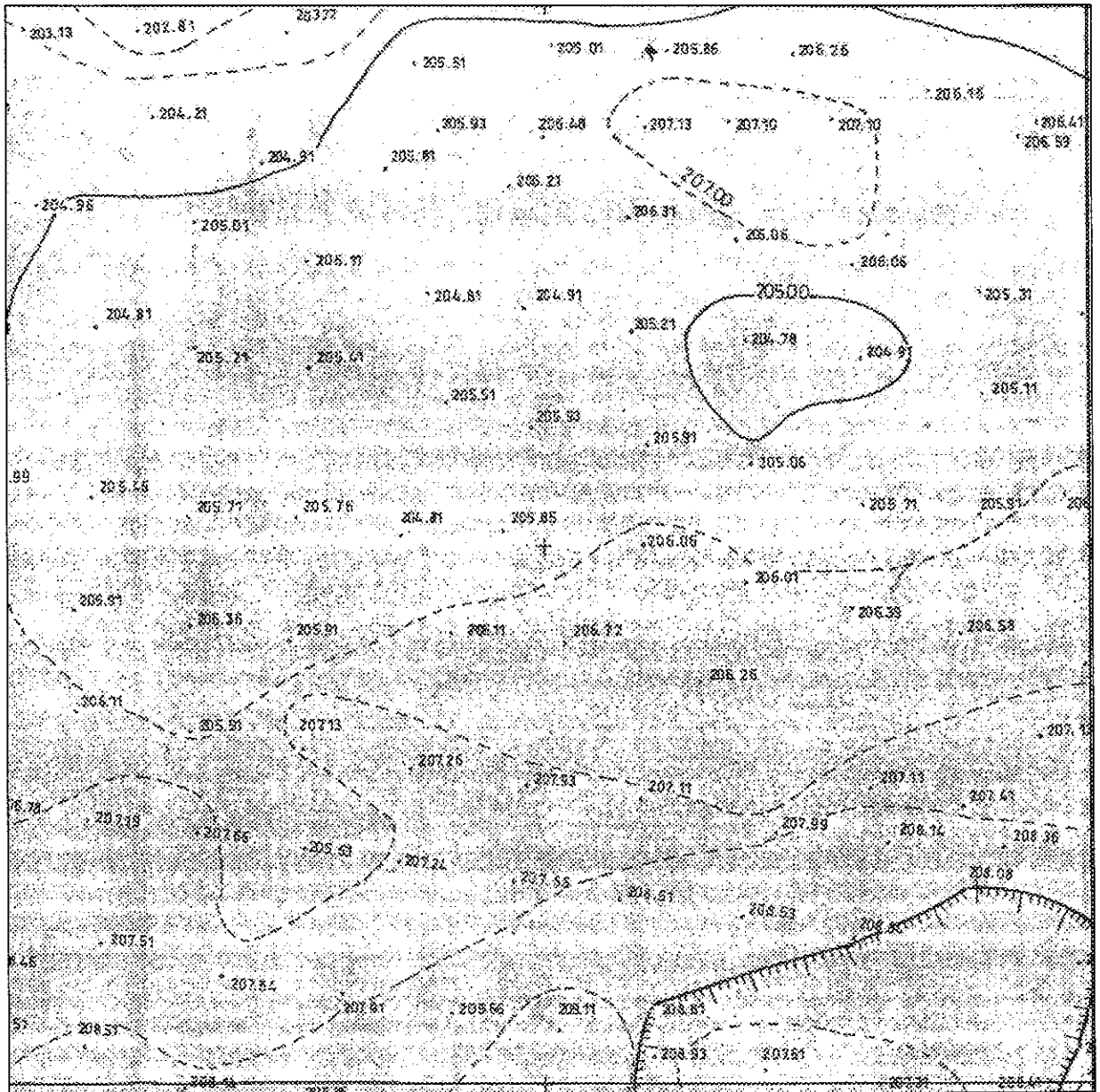


Figure S2.2-8 Map B2 (1:625)

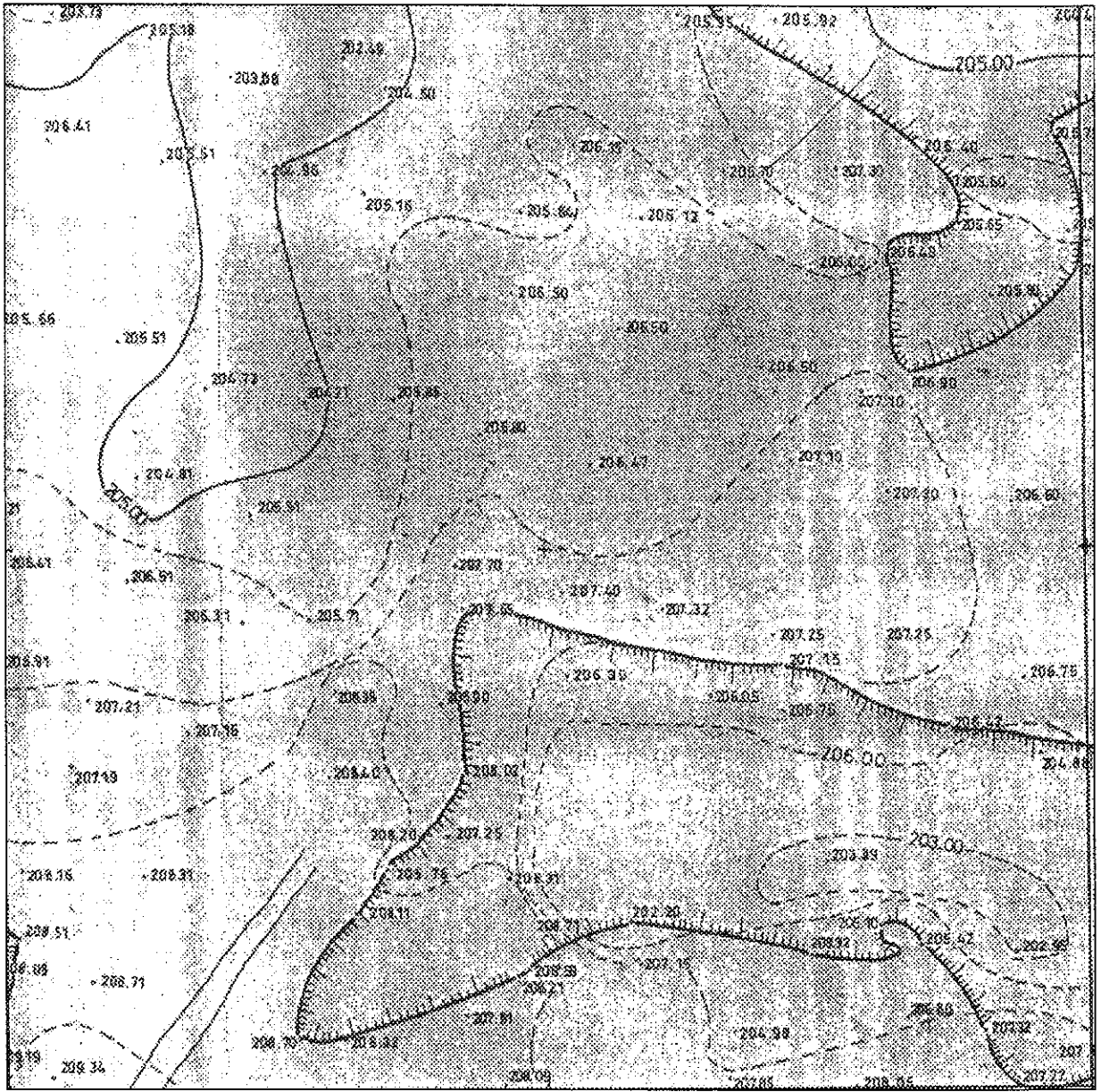


Figure S2.2-9 Map B3 (1:625)

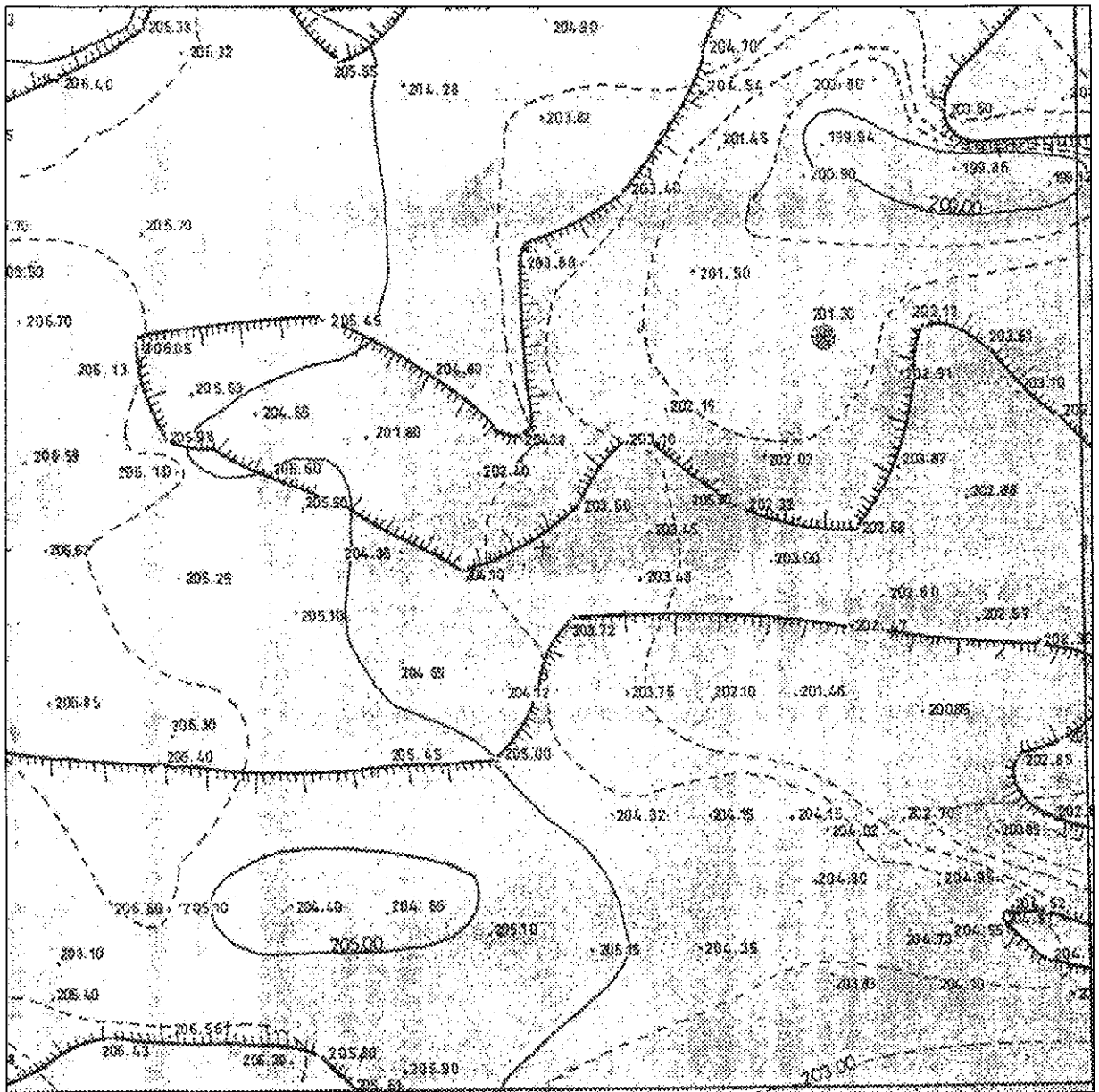


Figure S2.2-10 Map B4 (1:625)

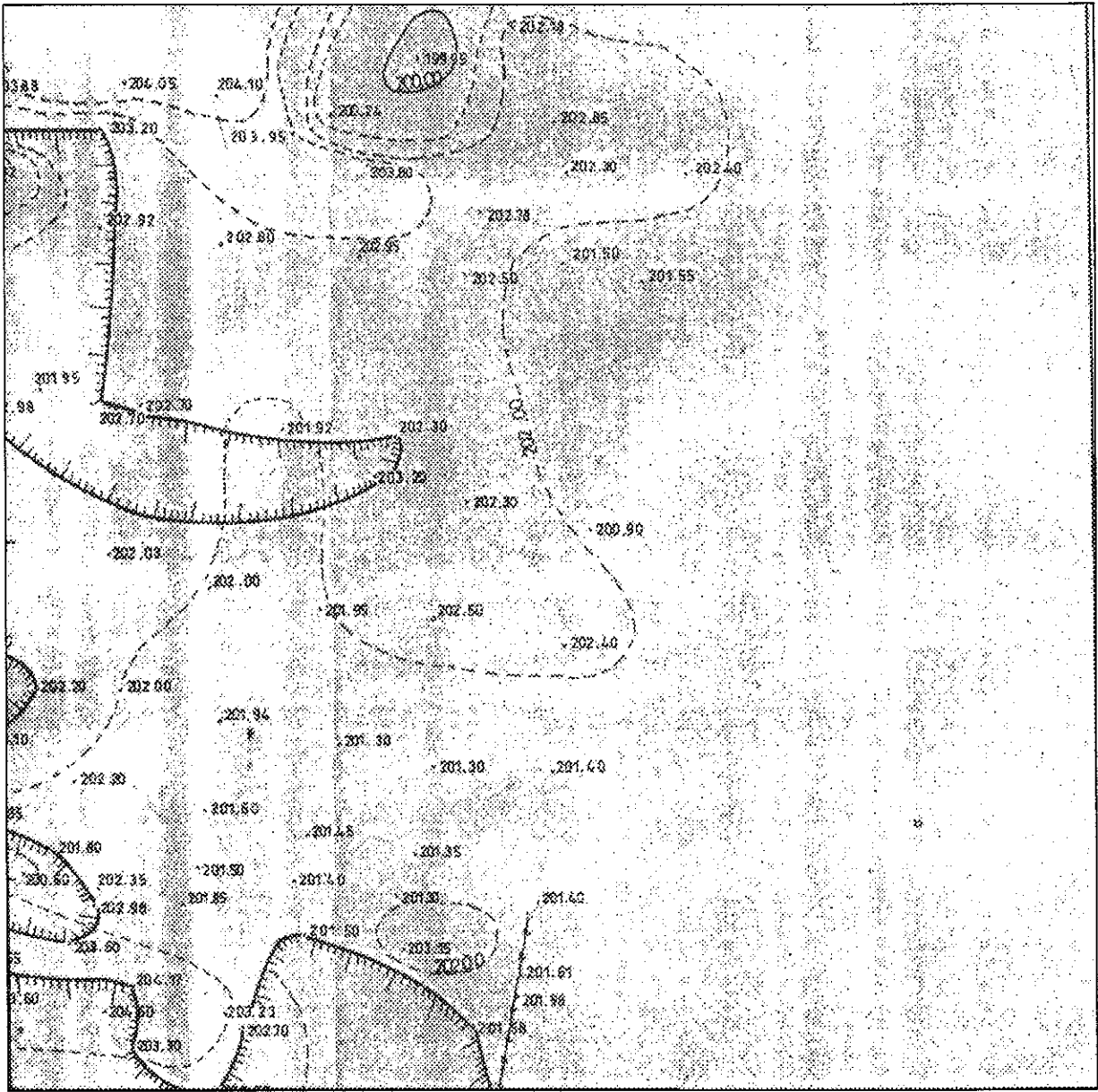


Figure S2.2-11 Map B5 (1:625)

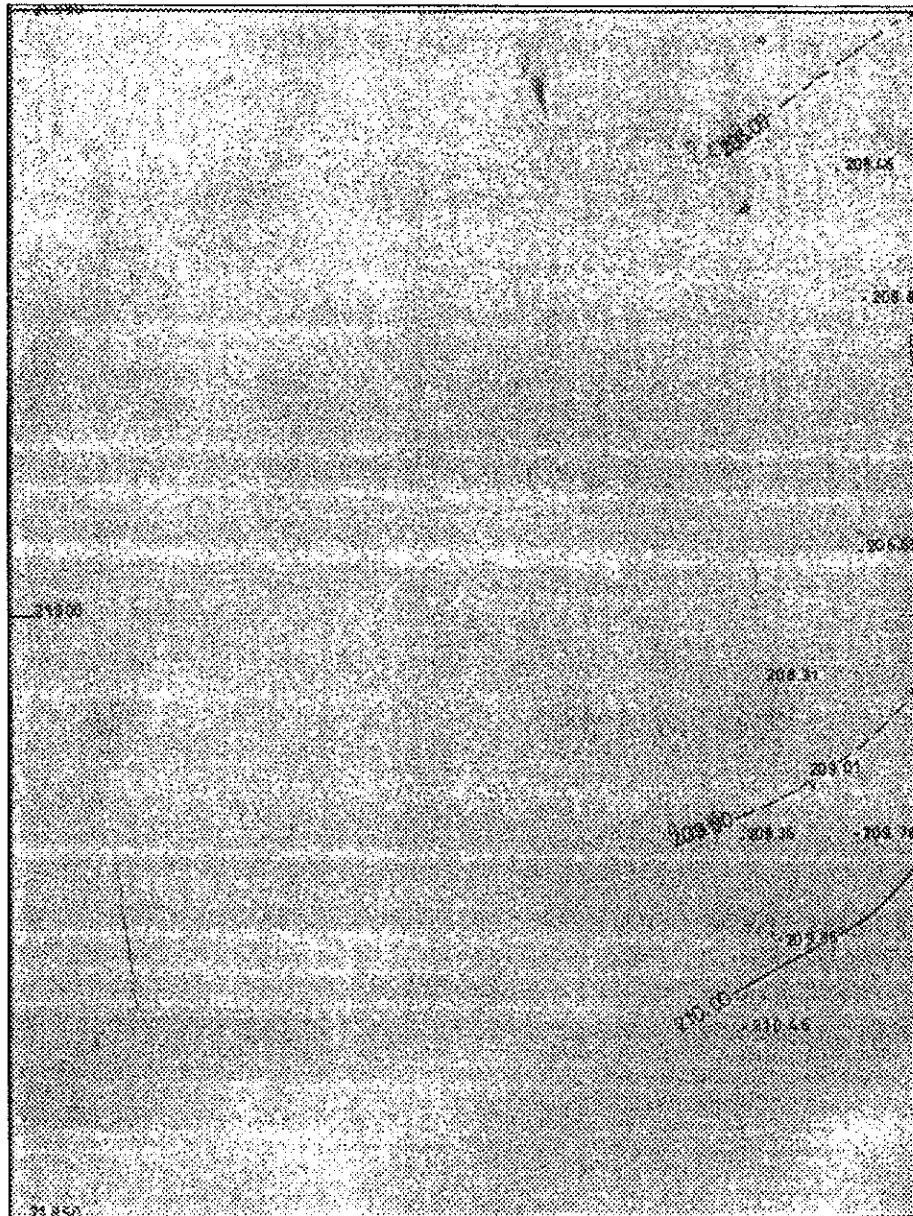


Figure S2.2-12 Map C1 (1:625)

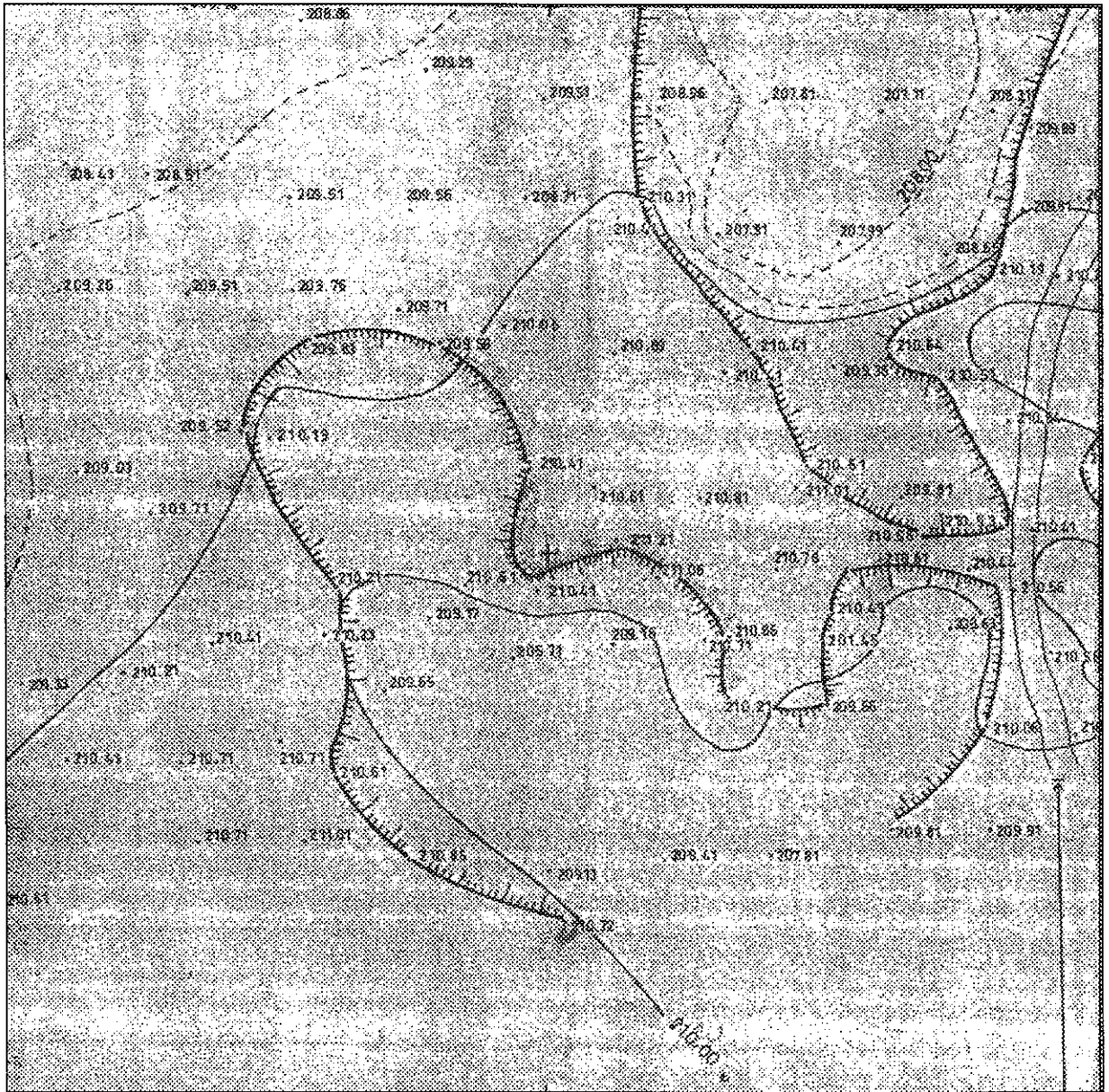


Figure S2.2-13 Map C2 (1:625)

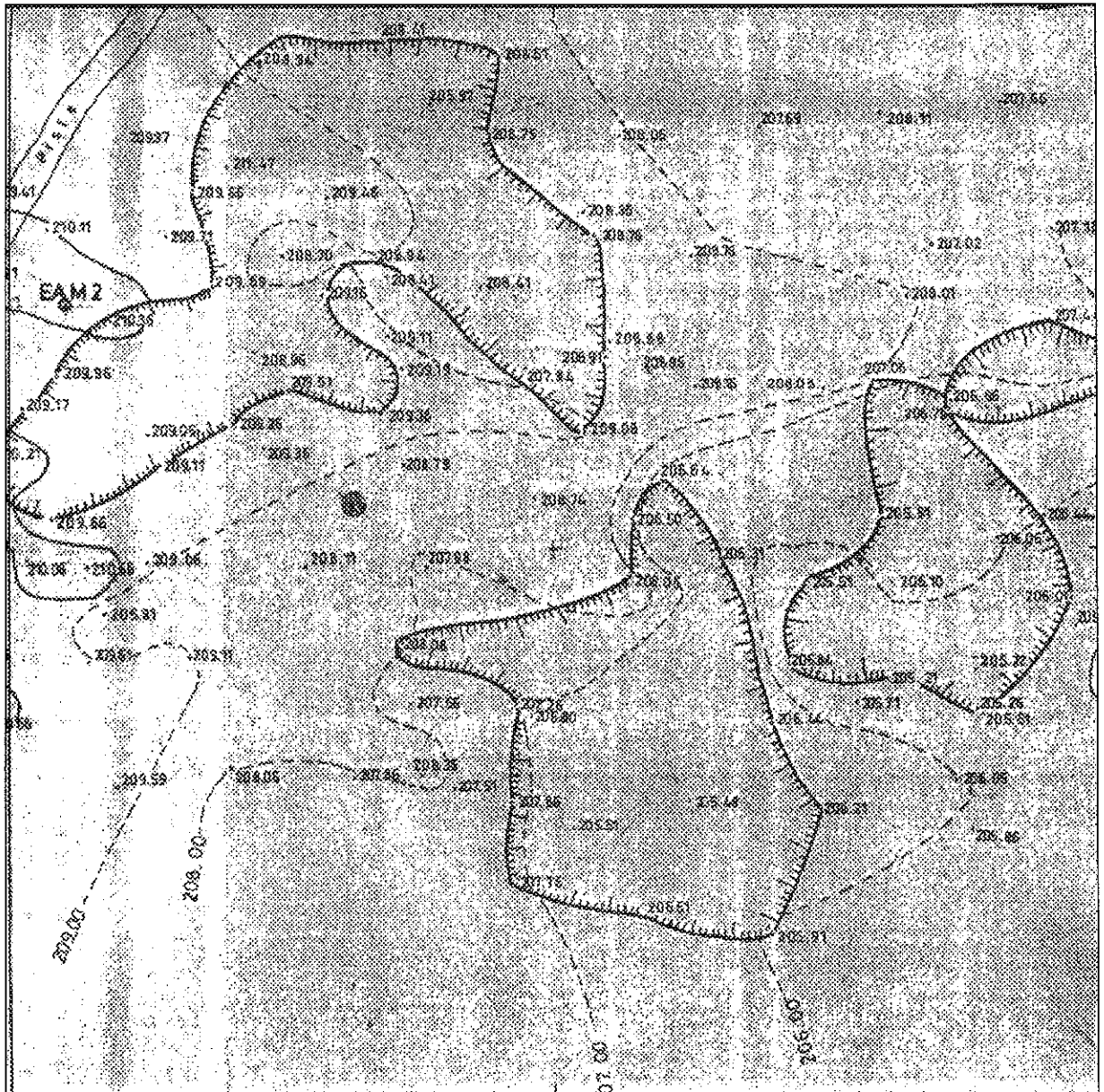


Figure S2.2-14 Map C3 (1:625)

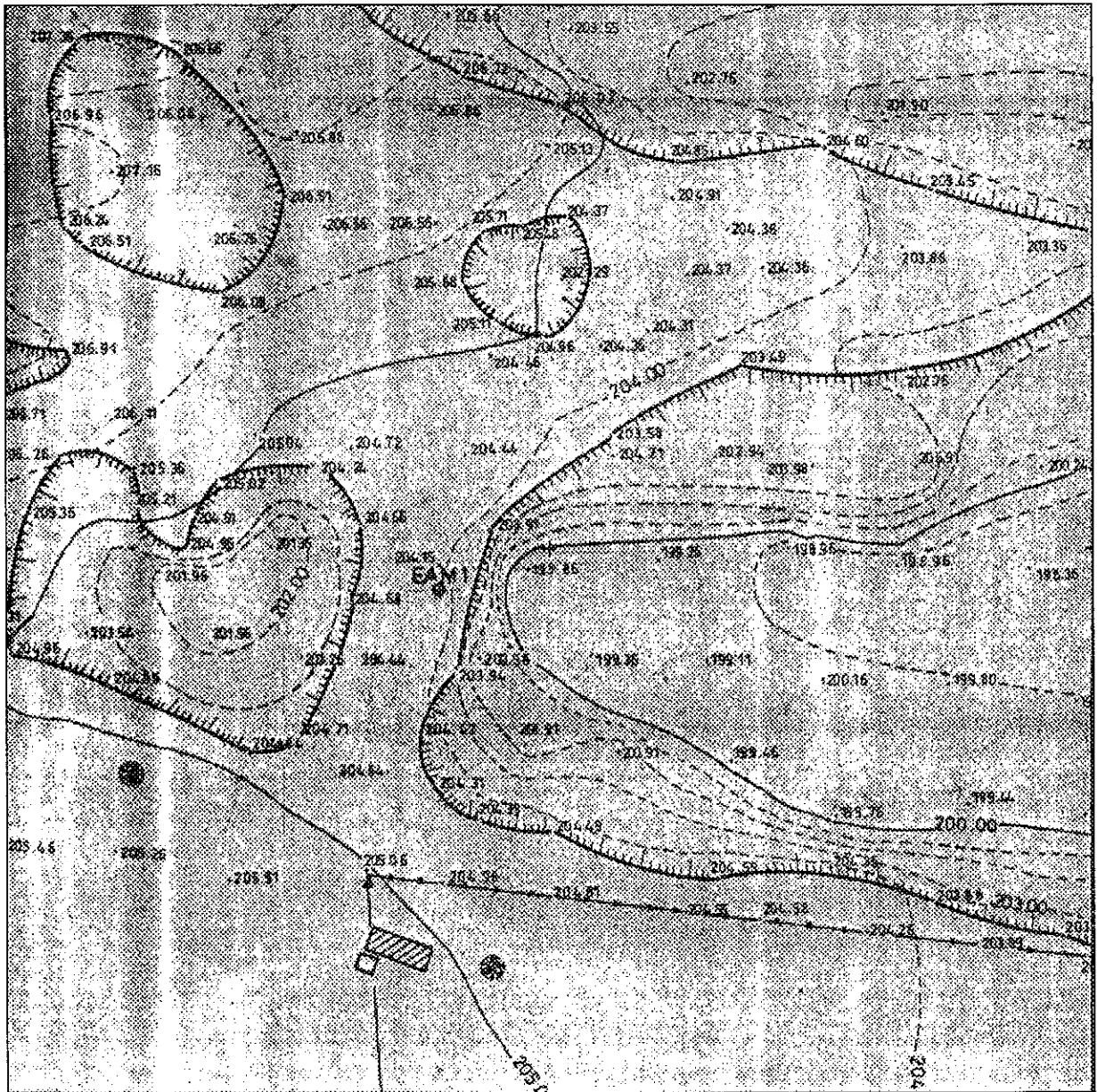


Figure S2.2-15 Map C4 (1:625)



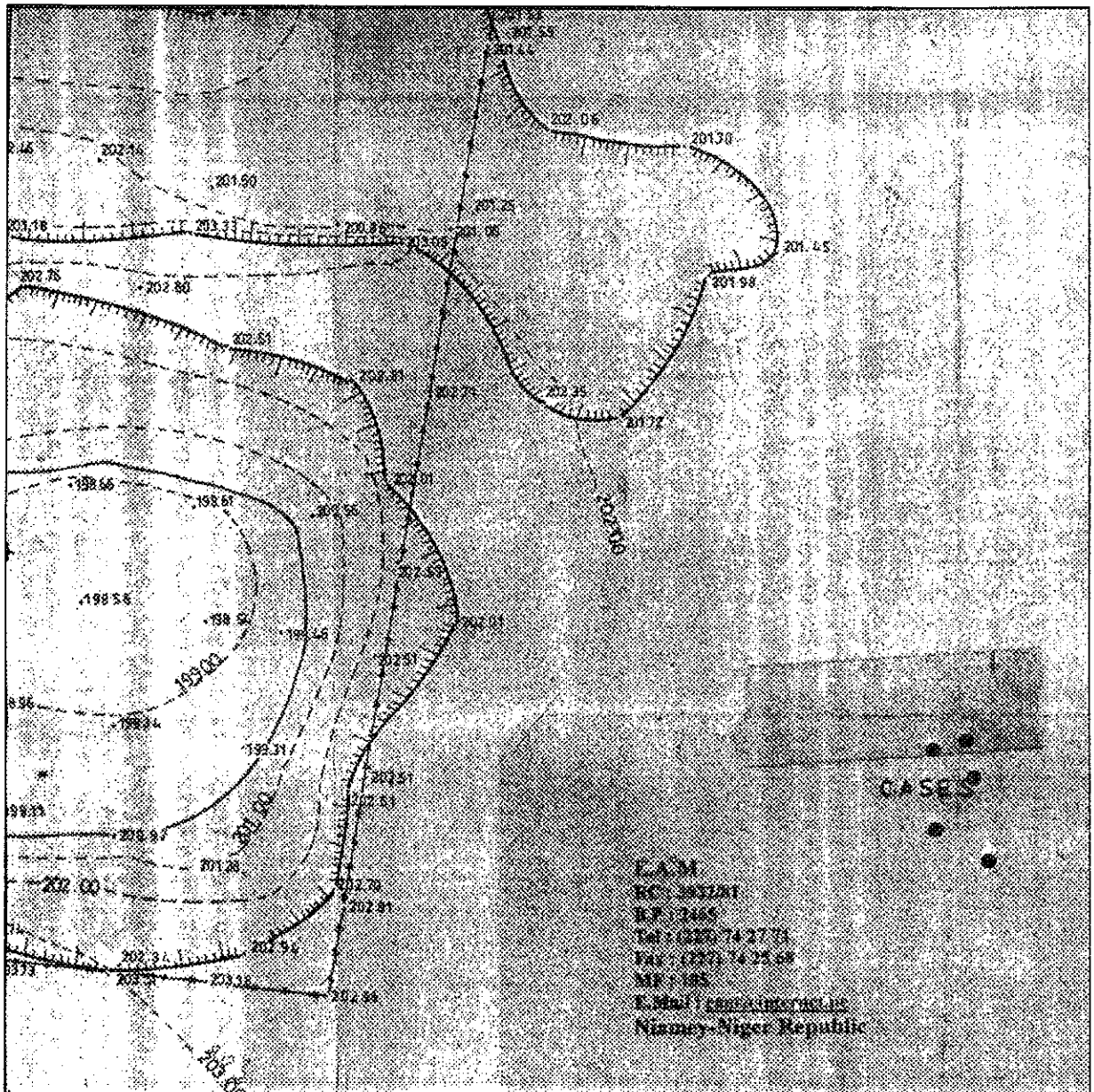


Figure S2.2-16 Map C5 (1:625)

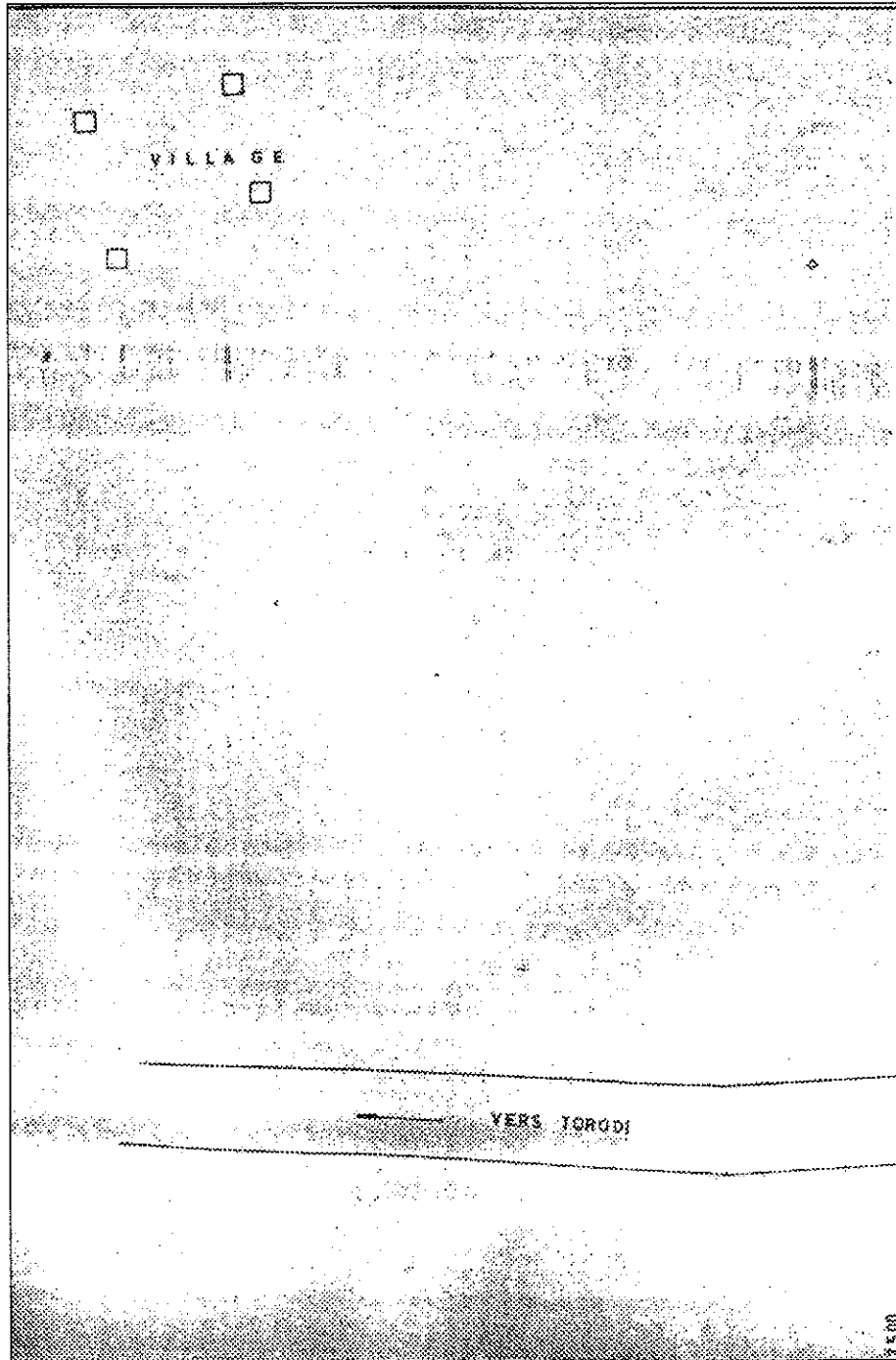


Figure S2.2-17 Map D1 (1:625)

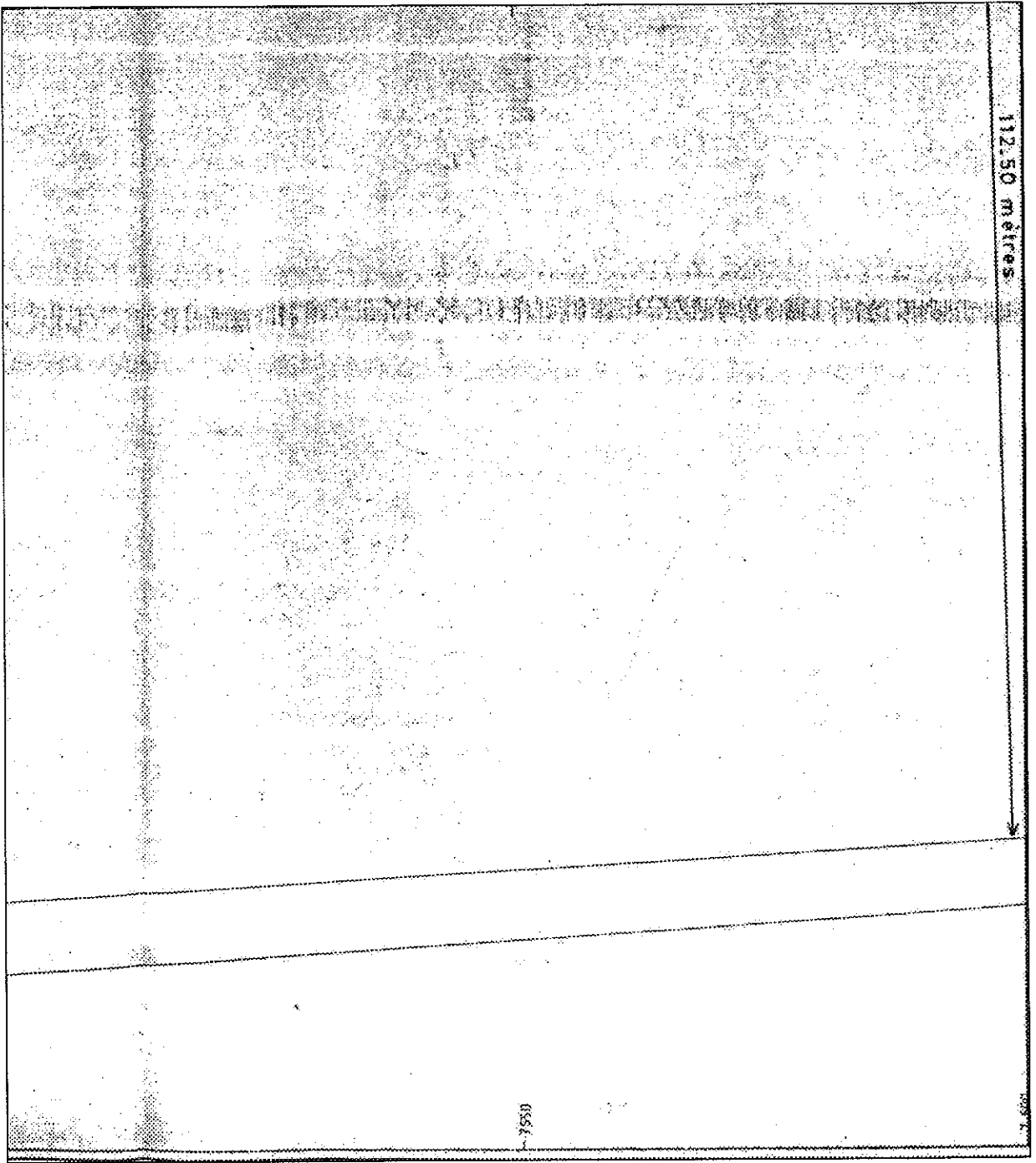
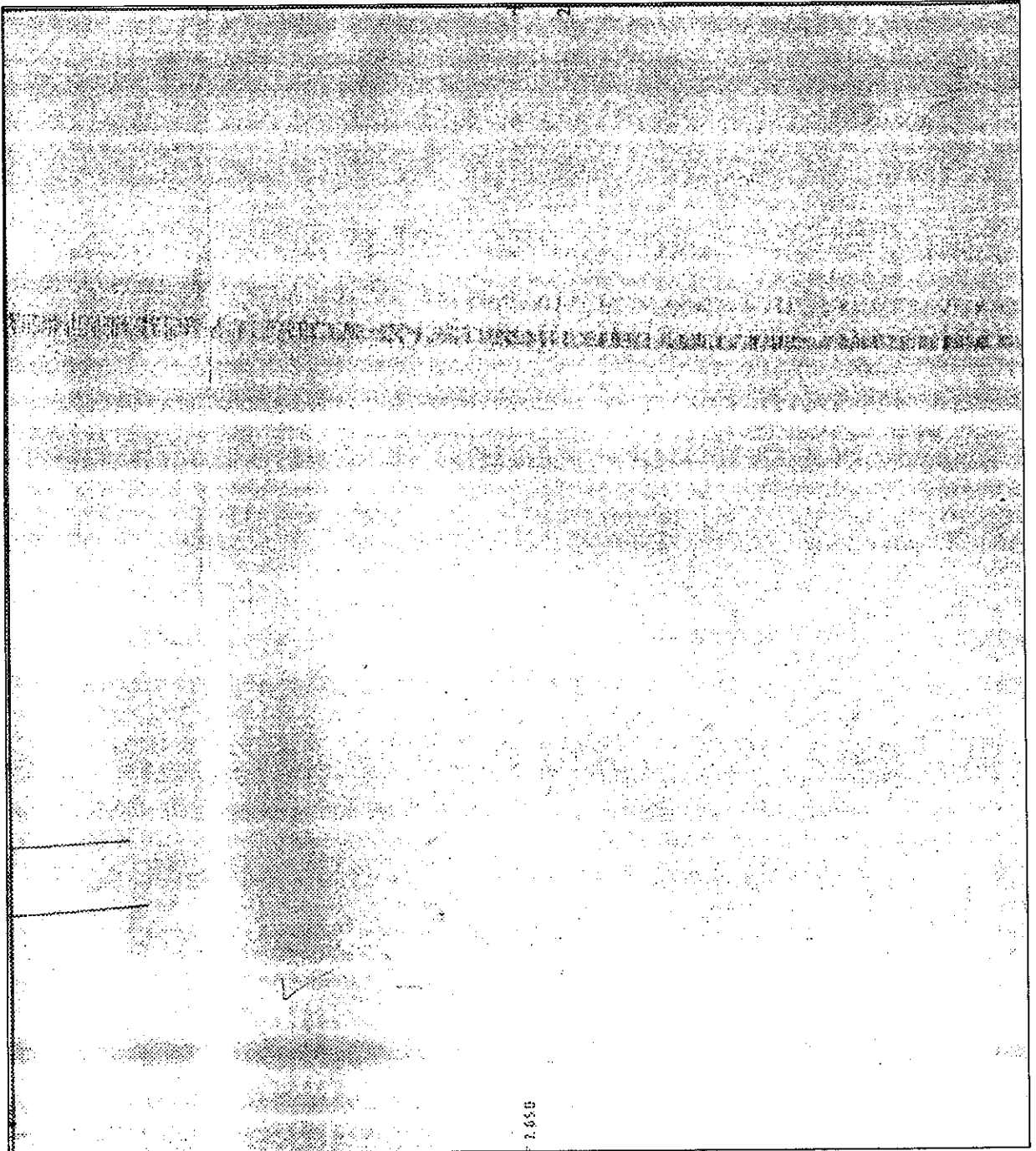


Figure S2.2-18 Map C2 (1:625)



**Figure S2.2-19 Map C3 (1:625)**

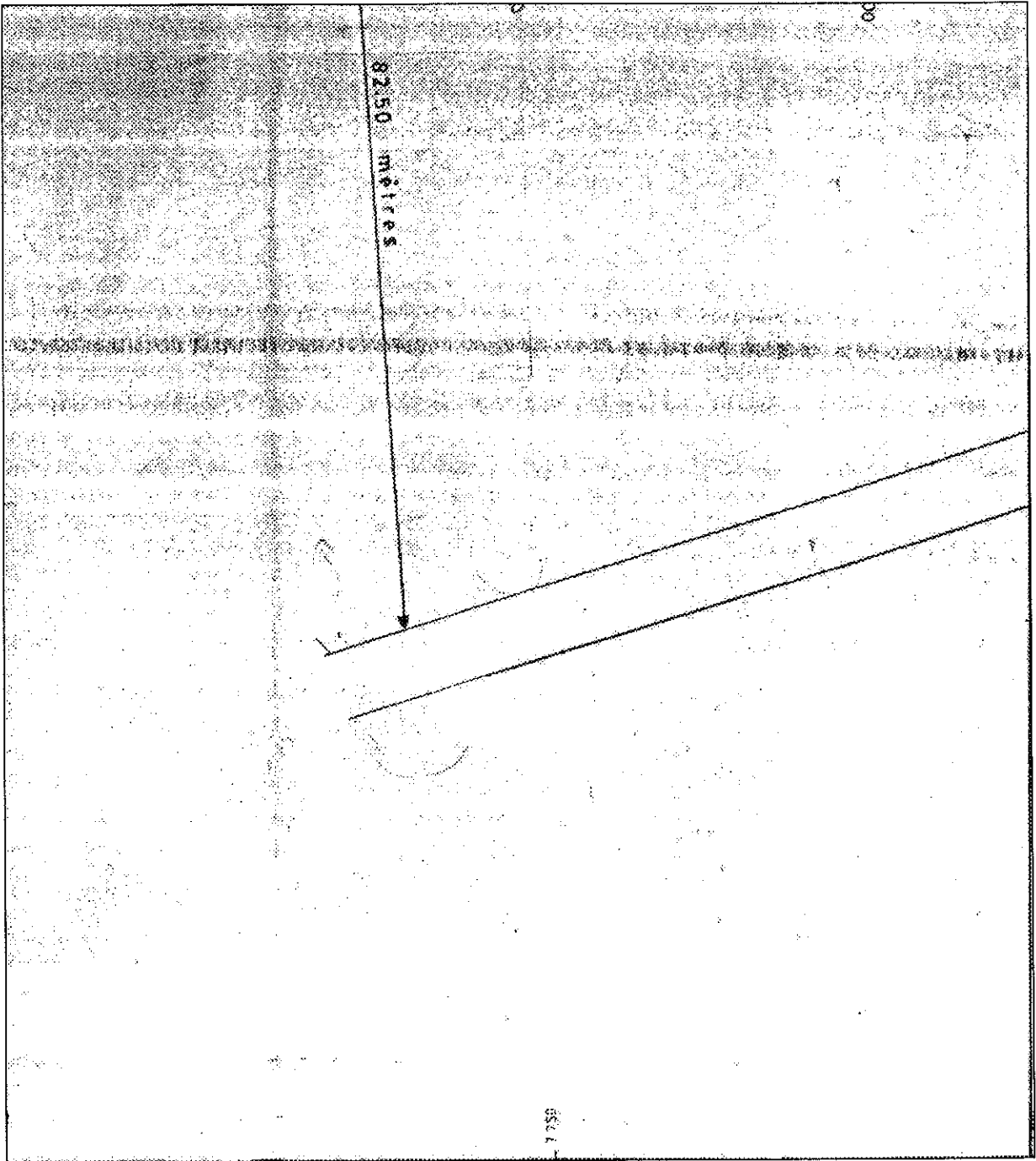
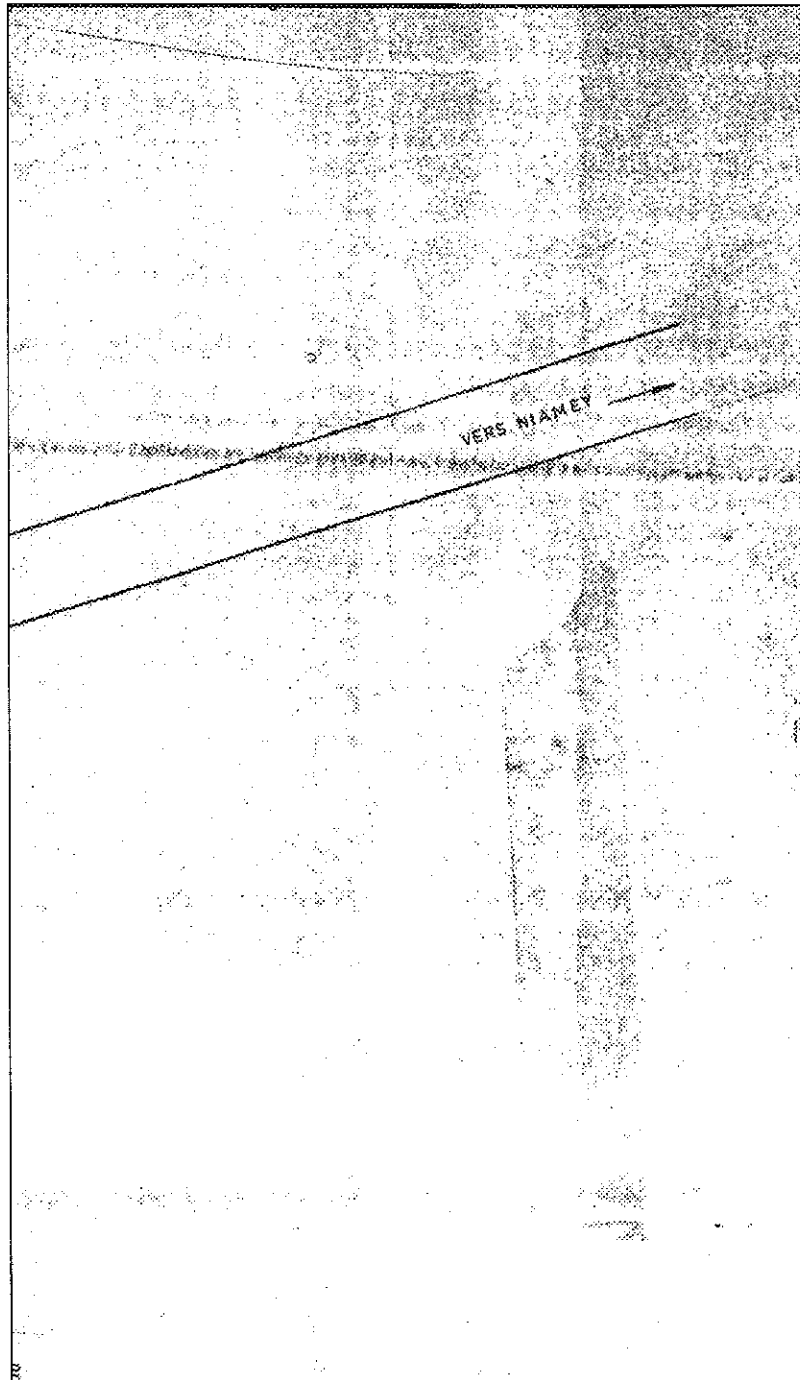


Figure S2.2-20 Map C4 (1:625)



**Figure S2.2-21 Map D5 (1:625)**

**APPENDIX S.3 SOIL INVESTIGATION  
SURVEY**

## **APPENDIX S.3 SOIL INVESTIGATION**

### **1. Investigation Points**

The soil investigation was carried out at 2 points of each planned final disposal sites , Koubia and Bengale Torombi (Torodi). The points are shown in Figure S3.1-1 and2.

### **2. Test and Result**

At each point, a bore hole survey was carried out including the standard penetration test. And soil samples were obtained from cohesive layer. The samples were tested in permeability. The result is attached herewith.



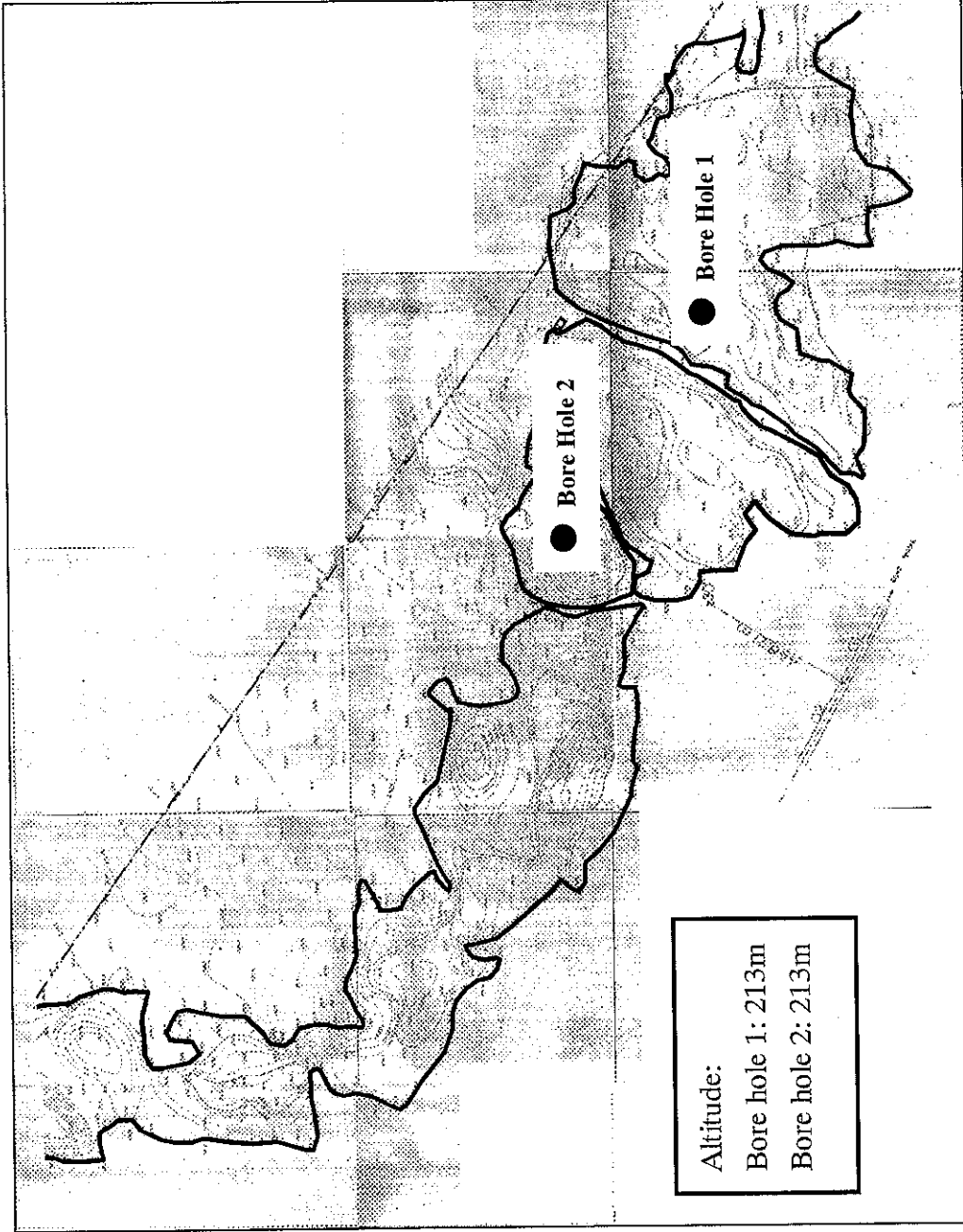


Figure S3.1-1 Survey Points in Site Koubia

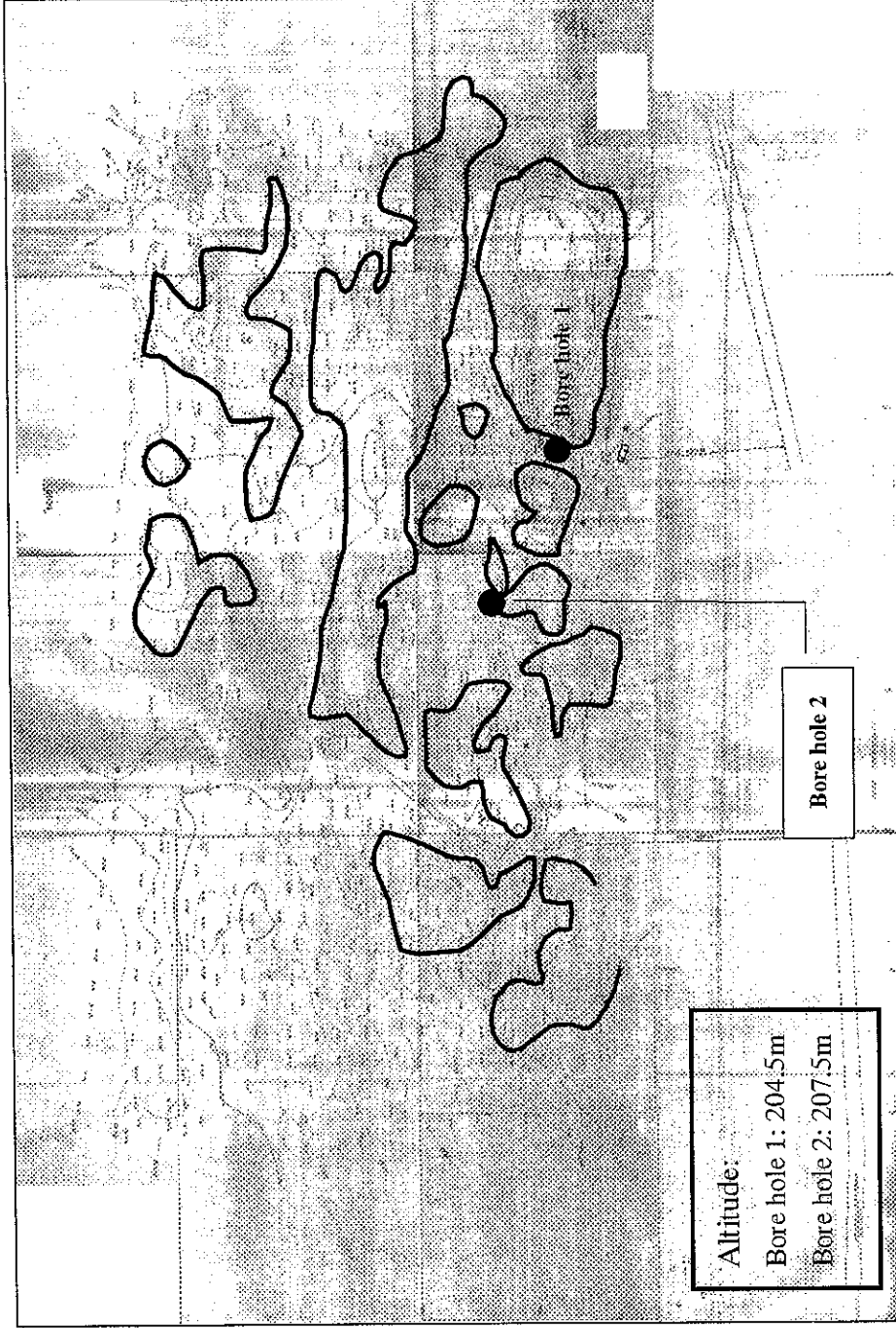


Figure S3.1-2 Survey Points in Site Bengale Torombi (Torodi)

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**AND TRANSPORT**  
**NATIONAL GEOTECHNIC**  
**LABORATORY (LNTP/B)**  
**POB : 464 Niamey**  
**TEL : 73 25 62**

**SOIL INVESTIGATION SURVEY**  
**FOR**  
**THE STUDY ON SANITATION IMPROVEMENT**  
**FOR**  
**NIAMEY CITY**  
**IN**  
**THE REPUBLIC OF NIGER**

**Niamey, July 2001**

**NIGER REPUBLIC  
MINISTRY OF EQUIPMENT  
AND TRANSPORT  
NATIONAL GEOTECHNIC  
LABORATORY(LNTP/B)  
POB : 464 Niamey  
TEL : 73 25 62**

## **SOIL INVESTIGATION REPORT**

### **I- INTRODUCTION**

For the study on Sanitation Improvement for the Niamey City in the Niger Republic, the National Geotechnic Laboratory, on EAM behalf has carried out soil investigation on the following sites:

\*Site 1 : CUN 1 and 2, located at Koubia on Tillabery road and,

\*Site 2 : CUN3, located on Torodi road.

The work done consists of bore-holes, surveys of the sites, Standard Penetration Test and sampling (disturbed and undisturbed ).

### **II – Soil Characteristics**

Four bore- holes with NORDMEYER'S drill have been made on the sites for the determination of soil layers and sampling for laboratory tests.

#### **A - Site 2: CUN 3 - Torodi Road**

##### **\*Bore-hole n° P1**

Bore-hole n° P1, has been driven up to 20,25m depth, showing coloured clay.

Water table is at 9,50m depth.

Four samples were taken, two for permeability test and two for identification test.

Summarized results are shown in table.

##### **\*Bore-hole n° P2**

Bore-hole n° P2, was bored up to 20,25m depth, showing coloured clay throughout.

Water table is at 14,20m depth.

Four samples were taken, two disturbed for identification test, and remaining two for permeability test.

Summurized results are shown in table.

#### **B) Site 1 : CUN 1 and 2 – Koubia quarry site.**

##### **\*Bore – hole N°P1**

It has been driven to 11,70m depth, showing coloured clay alternate with laterite and sand layers throughout.

Water table was not reached.

Five samples were taken, two disturbed for identification test, and three undisturbed for permeability test.

Summarized results are shown in table.

Bore- hole N° P2

The boring was done up to 10,25m depth, showing alternate sandstone more or less clayed, and coloured compacted clay intersperce with sand and clay mix.

Two samples were taken at this site. One disturbed for identification test and the second for permeability test.

Summarized results are shown in table.

**III – Standard Penetration Test.**

One Standard Penetration Test was made at each soil layer reached for the determination of soil bearing Capacity.

Standard Penetration Test was caried out by hammering the standard rod which has the following characteristics:

- \*Hammer weight                    63,5 kg
- \*Hammering height                76 cm
- \*Rod total length                 100 cm
- \*Rod aera                            20 cm<sup>2</sup>

After the execution of the bore-holes up to predetermined depth, the standard rod is lowered at the bottom then driven for about 15 cm in the layer to be tested. The number of knocks **N** for lowering it to 30 cm are counted.

The approximative dynamic resistance of the soil **RP** can be calculated from the correlation formula **RP = C x N**,

Where:

**C** = coefficient proportion varying from 2 for clay to 10 for clean sand.

**N** = number of knocks.

However it is indicated to calculate the soil admisible bearing capacity **q<sub>a</sub>**, from the relation existing between **N** and the footing width.

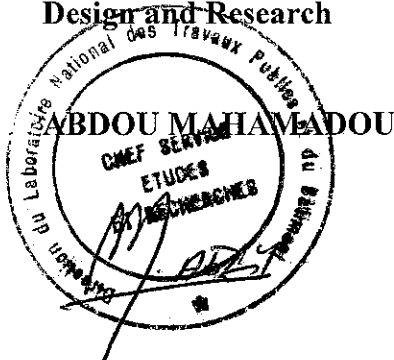
**IV Conclusion**

Standard Penetration Test and laboratory tests show that soils are more resistant at lower depth/ levels.

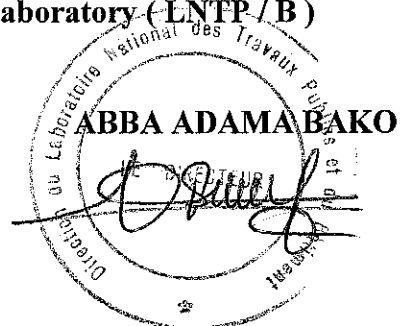
They are compacted clay and sandstone more or less mix with clay of bearing capacity resistance average of **N**. with aproximative resistanc of 140 bars.

**Niamey, 18 th July 2001**

**Departmental Manager  
Design and Research**



**Director of National Geotechnic  
Laboratory (LNTFP / B)**

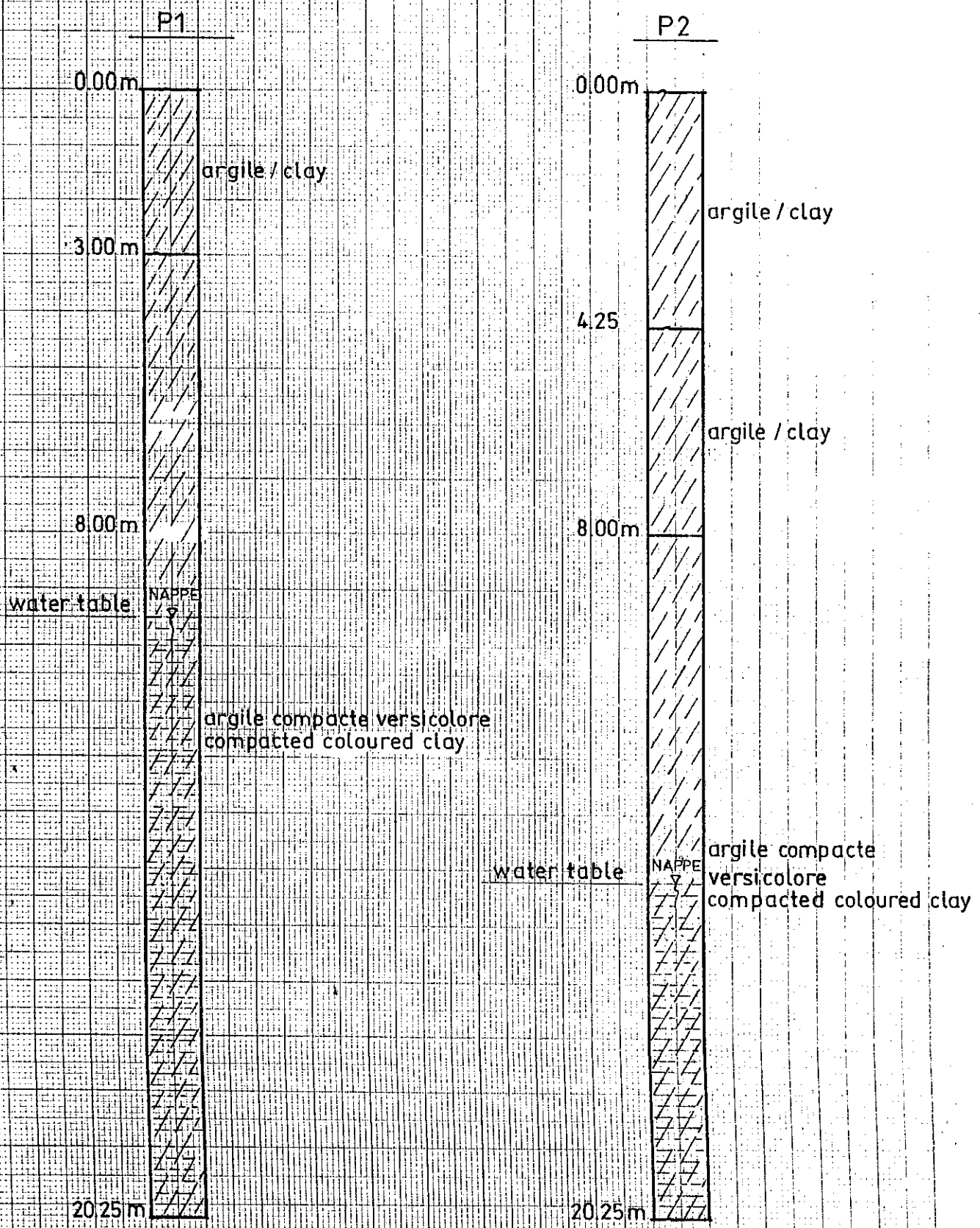


# SANITATION OF NIAMEY ASSAINISSEMENT DE NIAMEY

## SITE ROUTE TORODI

### COUPES DES PUIS DE SONDAGE

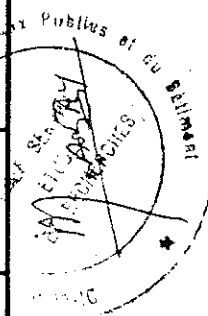
#### BORE HOLES SECTION



# THE STUDY ON SANITATION OF THE NIAMEY CITY

## SUMMARIZE RESULTS TABLE

BORE - HOLES	AVERAGE DEPTH	SAMPLE NATURE	SIVE ANALYSIS			Permeability K20 (cm/s)	Dry Density γ <sub>d</sub> g/cm <sup>3</sup>	RESISTANCE TO PENETRAT <sup>o</sup>			
			< 5mm	< 2 mm	< 0,4 < 0,08 mm			N(30 cm)	bars	γ/m <sup>2</sup>	
TORODI ROAD BORE - HOLE N° 1	2,25 m	Colored clay	99	97	91	81	1,5	20	40	0,40	
	5,75 m						1,49	26	52	0,52	
	10,30 m							54	108	1,08	
	12,30 m							29	58	0,58	
	14,30 m							50	100	1,00	
20,25 m			100	98	90	74	10,9 * 10 <sup>-3</sup>				
BORE - HOLE N° 2	2,45 m	Colored clay						60	120	1,20	
	4,30 m							70	140	1,40	
	6,55 m							46	92	0,92	
	8,55 m			100	99	97	85	1,55	23	46	0,46
	11,25 m			100	100	98	89	impermeable	32	64	0,64
KOUBIA SITE BORE - HOLE N° 1	2,15 m	Latérite						32	96	0,96	
	4,00 m	Clay	97	95	87	78		45	90	0,90	
	8,00 - 11,70 m	Compacted whitish clay	100	100	91	78					
	8,25 m						5,3 * 10 <sup>-3</sup>				
	9,25 m						8,2 * 10 <sup>-5</sup>				
9,5 m						1,4 * 10 <sup>-6</sup>					
BORE - HOLE N° 2	2,30 m	Latérite						72	216	2,16	
	4,15 m	Latérite						68	204	2,04	
	6,45 m	Sand stone						51	204	2,04	
	8,65 m	Compacted clay	99	98	93	84		78	156	1,56	
	10,25 m	Compacted clay						104	208	2,08	



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## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 06/07/2001

BORE - HOLE: TORODI ROAD

APPLICANT : S E R

DEPTH : 2.00 - 2.25 m

OPERATOR: LABARAN

SOIL NATURE: Tubular casing n° 7 S CLAY

TEST TEMPERATURE:  $\varnothing$  30.3 °C  
 CYLINDER SECTION a = 78.54 mm<sup>2</sup>  
 SAMPLE SECTION A = 78,54 cm<sup>2</sup>  
 SAMPLE HEIGHT/LENGTH L = 18,8 mm

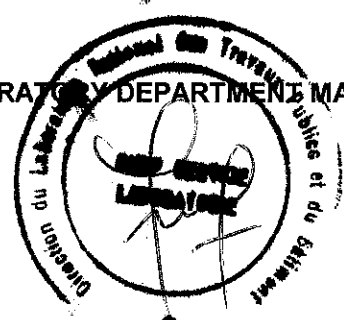
TEST N°	1	2	3
H o	90	80	70
H 1	12	12	15
TIME: t (s)	24	13	10
K $\varnothing$ (cm/s)	$1.2 \cdot 10^{-3}$	$2.2 \cdot 10^{-3}$	$2.4 \cdot 10^{-3}$
K $\varnothing$ AVERAGE (cm/s)		$1.9 \cdot 10^{-3}$	
K 20 (cm/s)		$2.9 \cdot 10^{-3}$	

**OBSERVATIONS:**

W% = 15.32

$\gamma_d = 1.50$

TEST LABORATORY DEPARTMENT MANAGER





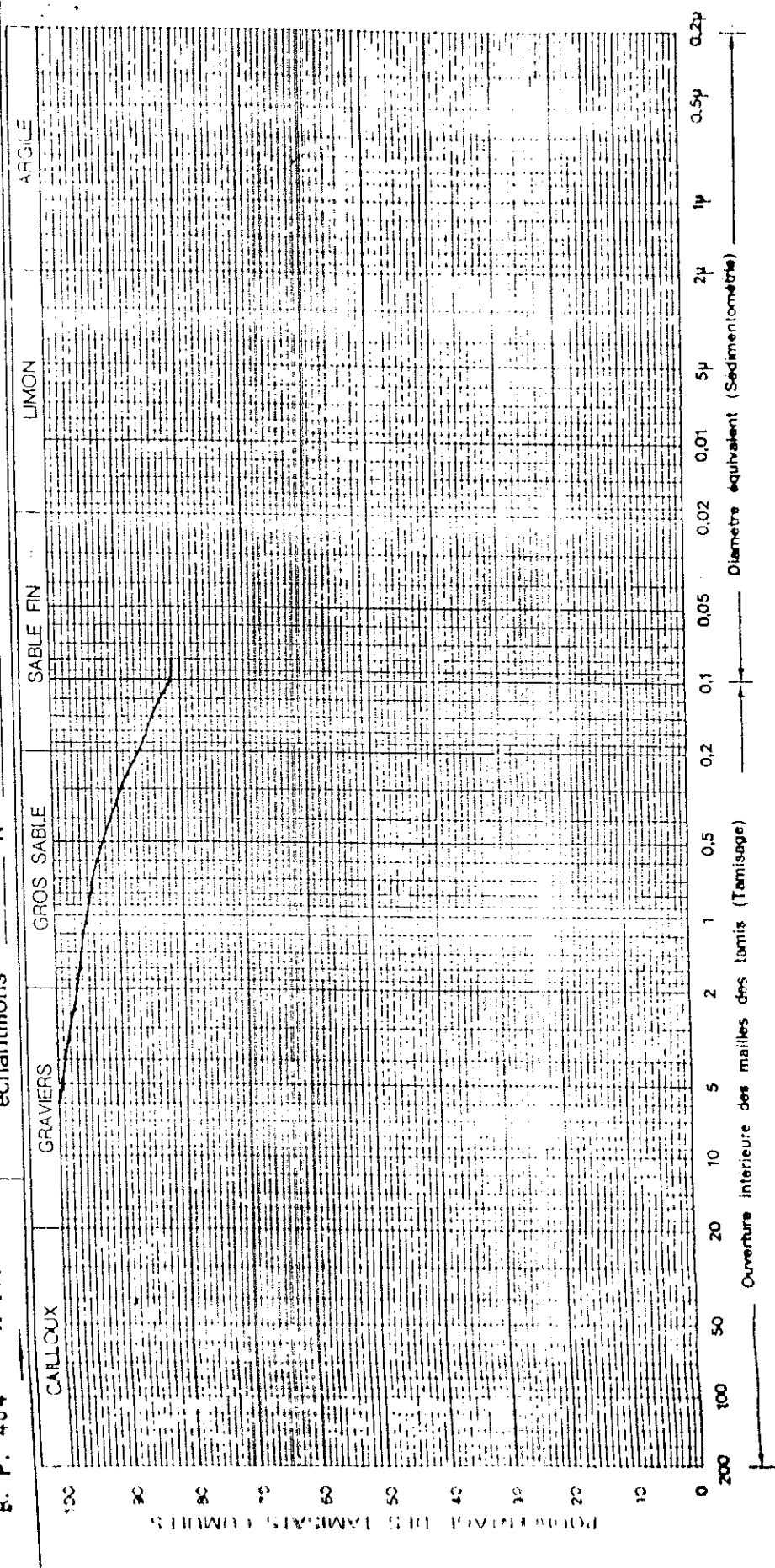
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## ANALYSES GRANULOMETRIQUES

Provenance: Assainiss. ville ny. / Site route Torodi  
 Echantillon : Argile compacte versicolore  
 P1 / Prél. 3.00 à 5.75m

Opérateur: \_\_\_\_\_ N° \_\_\_\_\_  
 Désignation des échantillons N° \_\_\_\_\_

B. P. 464 - NIAMEY



N°	LL.	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp. rel.
	58	28	81%									

# PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE: 05/07/2001

BORE - HALE : TORODI ROAD P1

APPLICANT : S E R

DEPTH: 4.00 - 4.25

OPERATOR: LABARAN

SOIL NATURE: Tubular casing n° 6 F Compact clay

TEST TEMPERATURE:  $\theta = 28.1$  °C  
 CYLINDER SECTION  $a = 28.26$  mm<sup>2</sup>  
 SAMPLE SECTION  $A = 78,54$  cm<sup>2</sup>  
 SAMPLE HEIGHT/LENGTH  $L = 18,8$  mm

TEST N°	1	2	3
H o	90	80	70
H 1	30	10	15
TIME: t(s)	64	80	40
K $\theta$ (cm/s)	$3.2 \cdot 10^{-4}$	$3.7 \cdot 10^{-4}$	$6.1 \cdot 10^{-4}$
K $\theta$ AVERAGE (cm/s)		$4.3 \cdot 10^{-4}$	
K 20 (cm/s)		$6.0 \cdot 10^{-6}$	

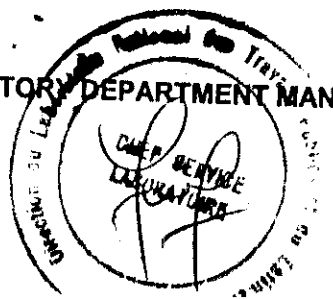
**OBSERVATIONS:**

W% = 23.71

$\gamma_d = 1.49$

TEST LABORATORY DEPARTMENT MANAGER

S.3-8



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# ANALYSES GRANULOMETRIQUES

Provenance: Assainiss. ville ny. / Site route Torodi

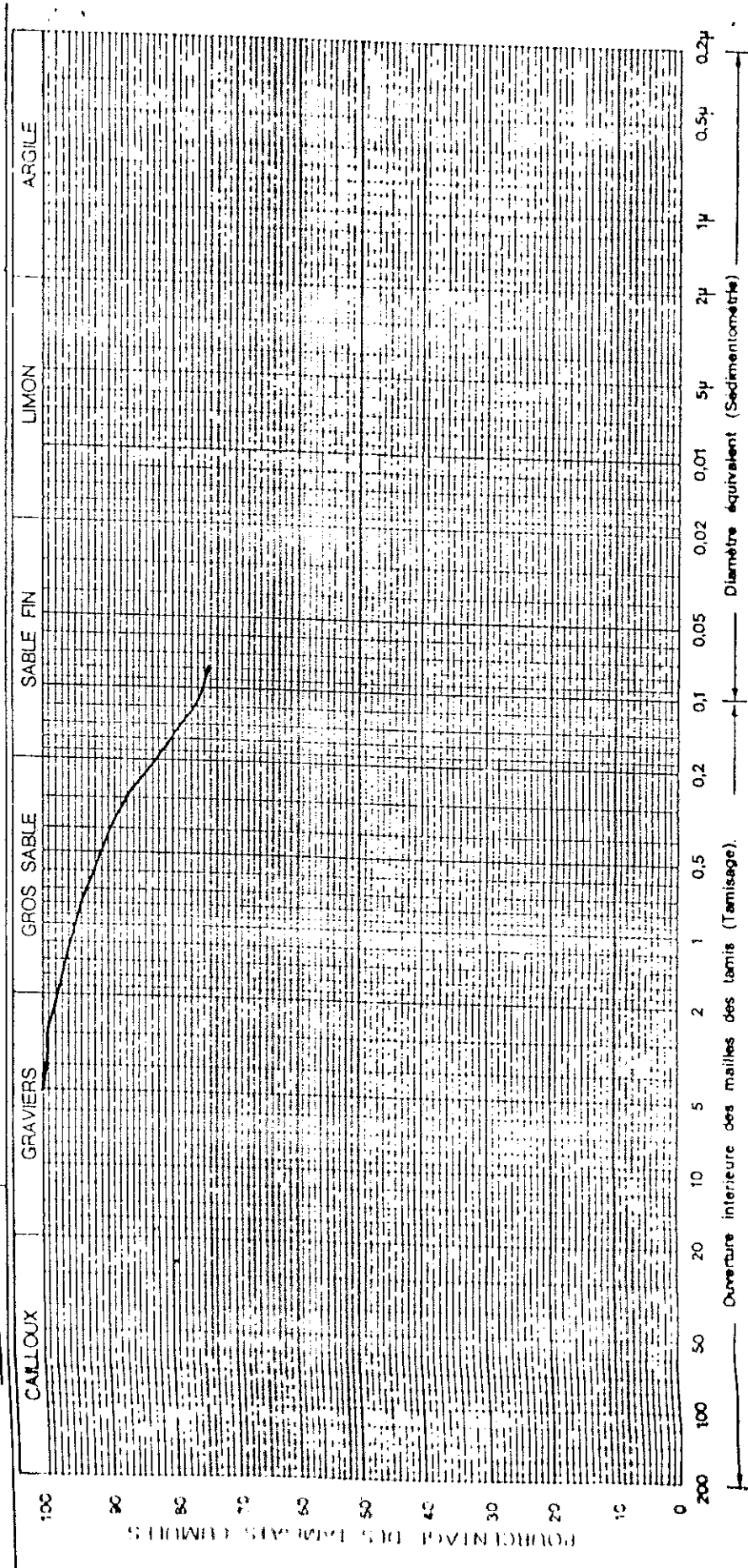
Echantillon: Argile compacte versicolore

P1 / Prél. 8.00 à 20.25

Opérateur: \_\_\_\_\_

Désignation des échantillons N° \_\_\_\_\_

N° \_\_\_\_\_



N°	LL	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp rel.
	50	23	76%									

## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE: 05/07/2001

PORE - HALE : TORODI ROAD P1

APPLICANT : S E R

DEPTH : 20.00 - 20.25 m

OPERATOR: LABARAN

SIL NATURE : Tubular casing n° 2 T Compact clay

TEST TEMPERATURE:	$\theta = 29.2$	°C
CYLINDER SECTION	$a = 28.26$	mm <sup>2</sup>
SAMPLE SECTION	$A = 78,54$	cm <sup>2</sup>
SAMPLE HEIGHT/LENGTH	$L = 18,8$	mm

TEST N°	1	2	3
H o	80	85	90
H 1	10	5	6
TIME: t (s)	4	5	6
$K_{\theta}$ (cm/s)	$7.4 * 10^{-3}$	$8.6 * 10^{-3}$	$6.5 * 10^{-3}$
$K_{\theta}$ AVERAGE (cm/s)		$7.5 * 10^{-3}$	
K 20 (cm/s)		$10.9 * 10^{-3}$	

**OBSERVATIONS:**

$V_w\% = 33.95$

$\gamma_d = 1.36$

TEST LABORATORY DEPARTMENT MANAGER

S.3-10



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# PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 05/07/2001

BORE - HALE : TORODI ROAD P2

APPLICANT : S E R

DEPTH : 6.00 - 6.25 m

OPERATOR: LABARAN

SOIL NATURE : Tubular casing N° 7 S Clay

TEST TEMPERATURE:	$\theta = 28.7$	°C
CYLINDER SECTION	a = 28.26	mm <sup>2</sup>
SAMPLE SECTION	A = 78,54	cm <sup>2</sup>
SAMPLE HEIGHT/LENGTH	L = 18,8	mm

TEST N°	1	2	3
H o	90	64	46
H 1	70	50	36
TIME: t(s)	74	72	71
K $\theta$ (cm/s)	$2.2 \cdot 10^{-4}$	$2.3 \cdot 10^{-4}$	$2.3 \cdot 10^{-4}$
K $\theta$ AVERAGE (cm/s)		$2.3 \cdot 10^{-4}$	
K 20 (cm/s)		$3.3 \cdot 10^{-4}$	

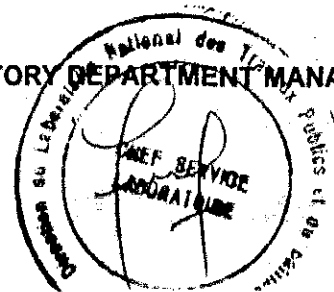
**OBSERVATIONS:**

W% = 20.6

$\gamma_d = 1.55$

TEST LABORATORY DEPARTMENT MANAGER

S.3-11

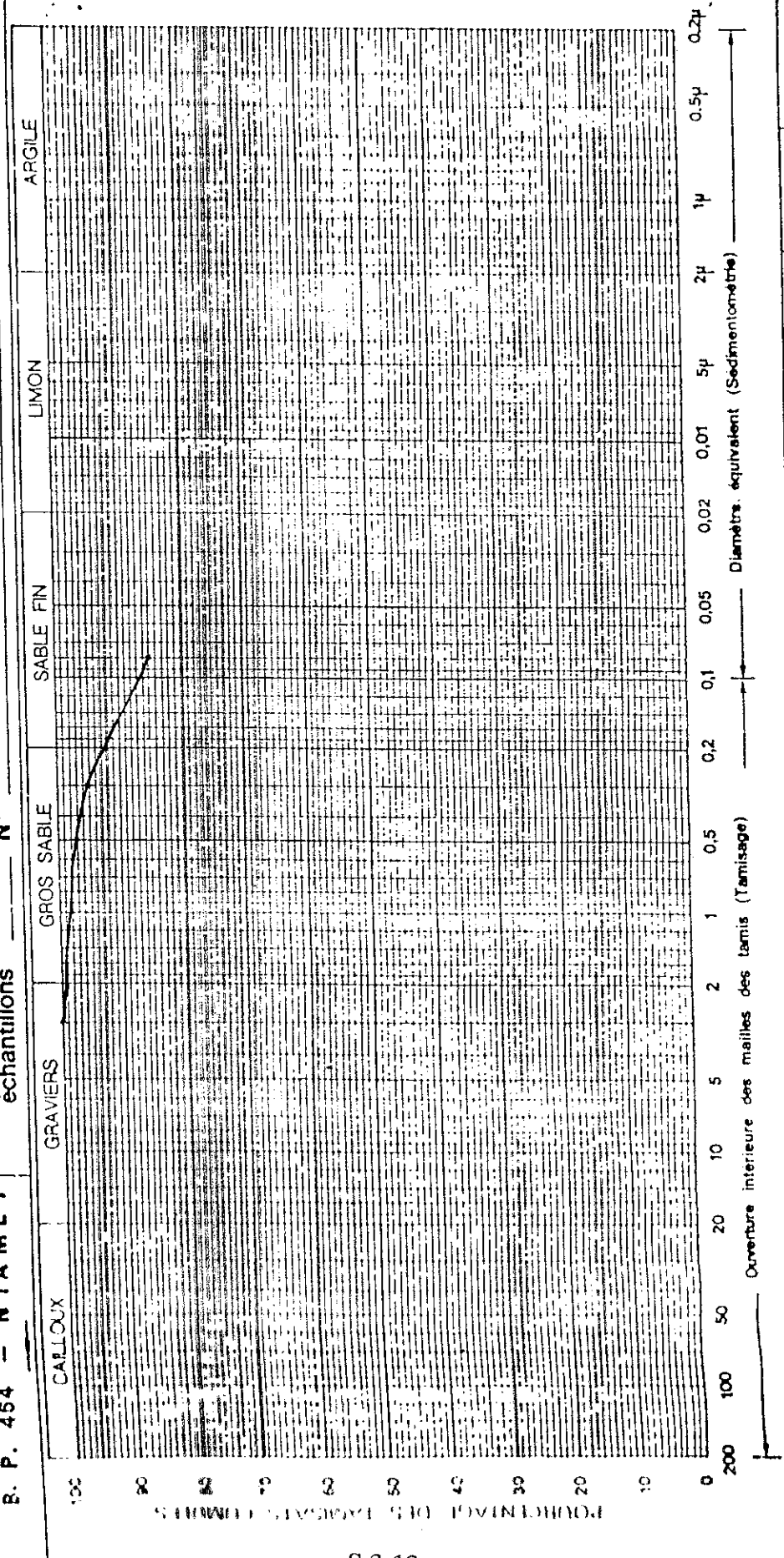


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# ANALYSES GRANULOMETRIQUES

Provenance: Assainiss. ville ny. / Site route Torodi  
Echantillon: Argile compacte versicolore  
P2 / Prél. 800 à 900m

Opérateur: \_\_\_\_\_ N° \_\_\_\_\_  
Désignation des échantillons: \_\_\_\_\_ N° \_\_\_\_\_



N°	LL.	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp. rel.
	65	32	85%									

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## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 05/07/2001

BORE - HALE : TORODI ROAD P2

APPLICANT : S E R

DEPTH : 8.00 - 8.25 m

OPERATOR: LABARAN

SOIL NATURE : Tubular casing N° 6 F Compact clay

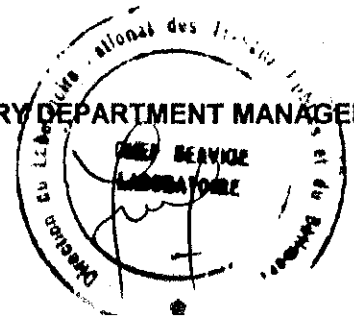
TEST TEMPERATURE:  $\theta = 28.7$  °C  
 CYLINDER SECTION a = 28.26 mm<sup>2</sup>  
 SAMPLE SECTION A = 78,54 cm<sup>2</sup>  
 SAMPLE HEIGHT/LENGTH L = 18,8 mm

TEST N°	1	2	3
H <sub>o</sub>			
H <sub>1</sub>			
TIME: t (s)			
K $\theta$ (cm/s)			
K $\theta$ AVERAGE (cm/s)			
K <sub>20</sub> (cm/s)			

**OBSERVATIONS:**

W% = 28.53 , impermeable sample

TEST LABORATORY DEPARTMENT MANAGER

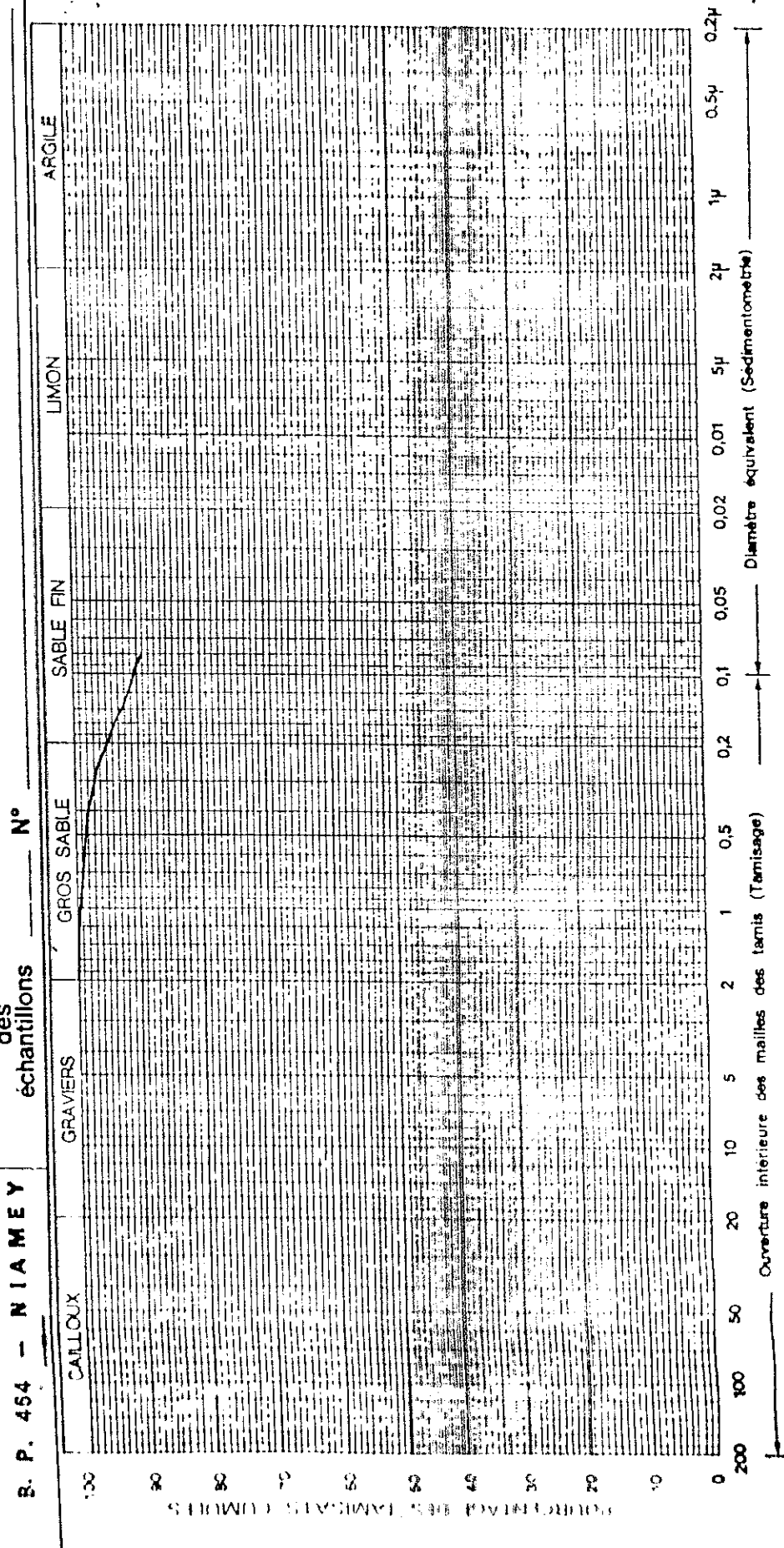


# ANALYSES GRANULOMETRIQUES

Provenance: Assainiss. ville ny. / Site route Torodi  
 Echantillon : Argile compacte versicolore  
 P2 / Prél. 9.00 à 11.25m

DIRECTION  
 DU LABORATOIRE NATIONAL  
 DES TRAVAUX PUBLICS  
 ET DU BATIMENT  
 B. P. 454 - N I A M E Y

Opérateur: \_\_\_\_\_ N° \_\_\_\_\_  
 Désignation des échantillons \_\_\_\_\_ N° \_\_\_\_\_



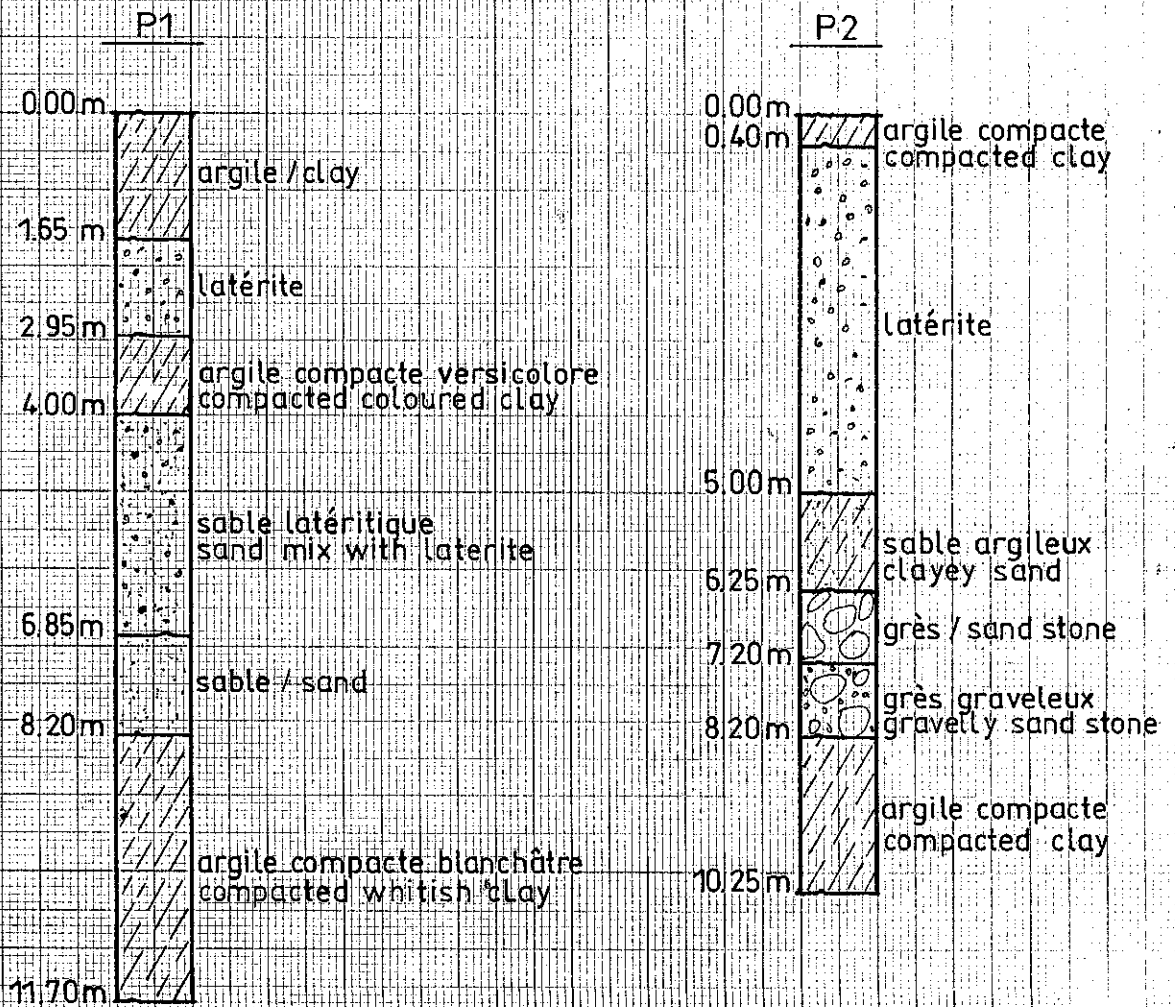
N°	LL	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp.rel.
	49	23	89%									



# SANITATION OF NIAMEY ASSAINISSEMENT DE NIAMEY

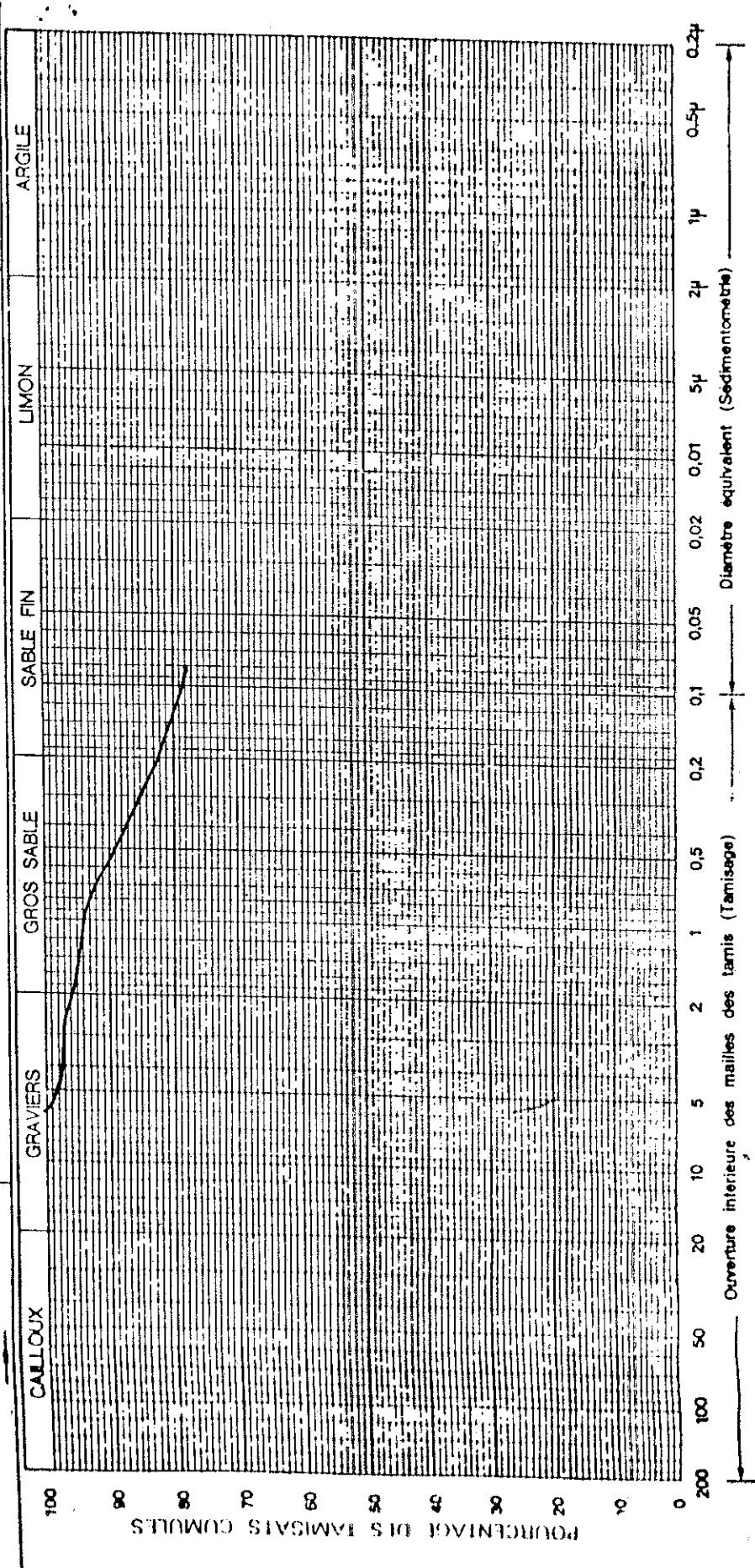
## SITE KOUBIA

### COUPES DES PUIITS DE SONDAGE BORE HOLES SECTION



Opérateur: \_\_\_\_\_  
N° \_\_\_\_\_  
Désignation des échantillons: \_\_\_\_\_  
N° \_\_\_\_\_

iver e: \_\_\_\_\_  
Echantillon: Argile compacte versicolore  
P1 / Prél. 370 à 4.00 m



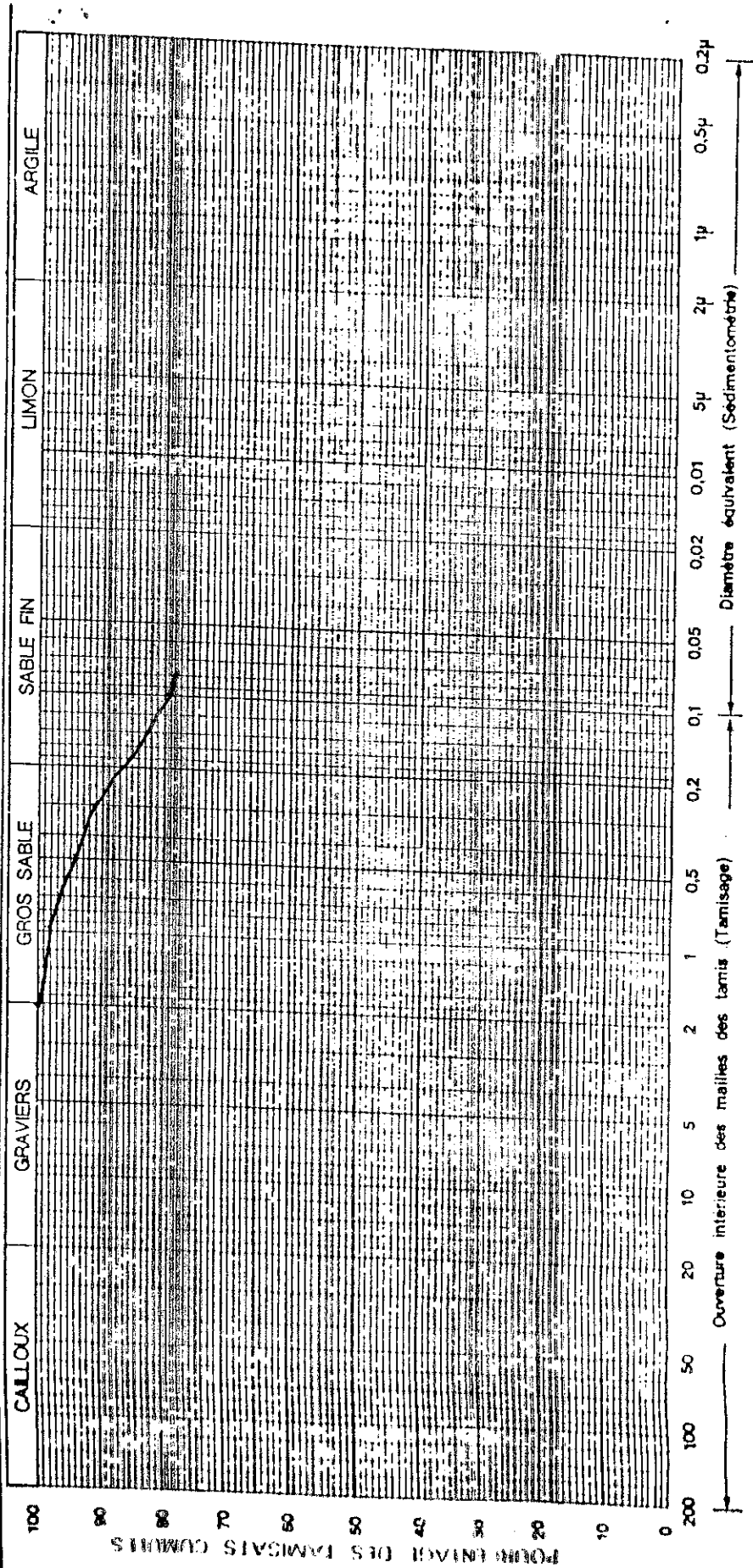
N°	LL	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp. rel.
	57	29	78%									

DIRECTION  
DU LABORATOIRE NATIONAL  
DES TRAVAUX PUBLICS  
ET DU BATIMENT  
B. P. 464 - NIAMEY

# ANALYSES GRANULOMETRIQUES

Provenance: Assainiss. ville ny. / Site Koubia  
Echantillon: Argile compacte blanchâtre  
P1 / Prél. 8.20 à 11.70m

Opérateur: \_\_\_\_\_  
N° \_\_\_\_\_  
Designation des échantillons: \_\_\_\_\_  
N° \_\_\_\_\_



N°	L.L.	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp.rel.
	38	18	78%									

**REPUBLIQUE DU NIGER**  
**MINISTRE DE L'EQUIPEMENT ET DES**  
**TRANSPORTS**  
**DIRECTION DU LABORATOIRE NATIONAL**  
**DES TRAVAUX PUBLICS ET DU BATIMENT**  
**B.P 464 Tel:73 - 25 - 62 Niamey**

## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 02/07/2001

BORE - HALE : KOUBIA P1

APPLICANT : S E R

DEPTH : 8.00 - 8.25 m

OPERATOR: LABARAN

SOIL NATURE: Tubular casing N° 2 F White sand

TEST TEMPERATURE:	$\theta = 32 \text{ } ^\circ\text{C}$
CYLINDER SECTION	$a = 28.26 \text{ mm}^2$
SAMPLE SECTION	$A = 78,54 \text{ cm}^2$
SAMPLE HEIGHT/LENGTH	$L = 18,8 \text{ mm}$

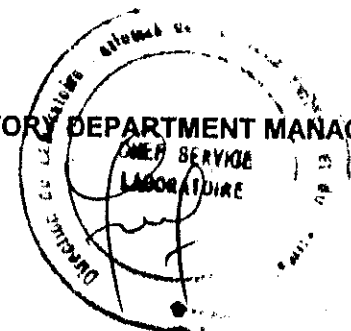
TEST N°	1	2	3
H o	70	80	85
H 1	10	20	5
TIME: t (s)	8	9	11
$K \theta \text{ (cm/s)}$	$3.6 \cdot 10^{-3}$	$2.5 \cdot 10^{-3}$	$3.9 \cdot 10^{-3}$
$K \theta \text{ AVERAGE (cm/s)}$		$3.3 \cdot 10^{-3}$	
K 20 (cm/s)		$5.3 \cdot 10^{-3}$	

**OBSERVATIONS:**

W% = 8.3

$\gamma_d = 1.69$

TEST LABORATORY DEPARTMENT MANAGER



**REPUBLIQUE DU NIGER**  
**MINISTRE DE L'EQUIPEMENT ET DES**  
**TRANSPORTS**  
**DIRECTION DU LABORATOIRE NATIONAL**  
**DES TRAVAUX PUBLICS ET DU BATIMENT**  
**B.P 464 Tel:73 - 25 - 62 Niamey**

## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 06/07/2001

BORE - HALE : KOUBIA P1

APPLICANT : S E R

DEPTH : 9.00 - 9.25 m

OPERATOR: LABARAN

SOIL NATURE : Tubular casing N° 5 T

Compact clay

TEST TEMPERATURE:	$\theta = 29.5$	°C	
CYLINDER SECTION	a = 28.26	mm <sup>2</sup>	
SAMPLE SECTION	A = 78,54	cm <sup>2</sup>	
SAMPLE HEIGHT/LENGTH	L = 18,8	mm	

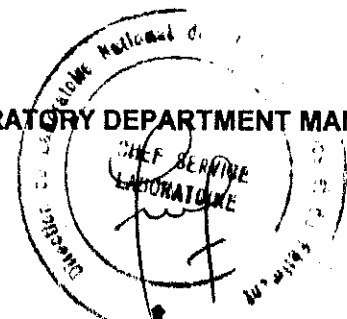
TEST N°	1	2	3
H <sub>o</sub>	100	90	80
H <sub>1</sub>	92	81	73
TIME: t(s)	279	326	255
K <sub>θ</sub> (cm/s)	$5.7 \cdot 10^{-5}$	$4.9 \cdot 10^{-5}$	$6.2 \cdot 10^{-5}$
K <sub>θ</sub> AVERAGE (cm/s)		$5.6 \cdot 10^{-5}$	
K <sub>20</sub> (cm/s)		$8.2 \cdot 10^{-5}$	

**OBSERVATIONS:**

W% = 21.41

TEST LABORATORY DEPARTMENT MANAGER

S.3-19



**REPUBLIQUE DU NIGER**  
**MINISTRE DE L'EQUIPEMENT ET DES**  
**TRANSPORTS**  
**DIRECTION DU LABORATOIRE NATIONAL**  
**DES TRAVAUX PUBLICS ET DU BATIMENT**  
**B.P 464 Tel:73 - 25 - 62 Niamey**

## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 06/07/2001

BORE - HALE : KOUBIA P1

APPLICANT : S E R

DEPTH - HALE : 9.25 - 9.50 m

OPERATOR: LABARAN

SOIL NATURE : Tubular casing N° 1 S

Compact clay

TEST TEMPERATURE:  $\theta = 28.9$  °C  
 CYLINDER SECTION  $a = 28.26$  mm<sup>2</sup>  
 SAMPLE SECTION  $A = 78,54$  cm<sup>2</sup>  
 SAMPLE HEIGHT/LENGTH  $L = 18,8$  mm

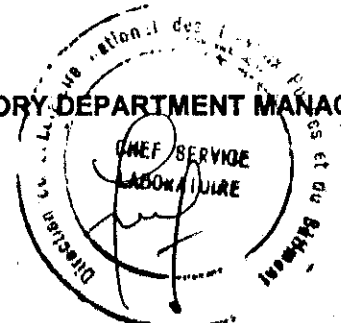
TEST N°	1	2	3
H <sub>o</sub>	94	82	68
H <sub>1</sub>	84	70	54
TIME: t (s)	116	176	238
K <sub>θ</sub> (cm/s)	$13.7 \cdot 10^{-5}$	$9.2 \cdot 10^{-5}$	$6.9 \cdot 10^{-5}$
K <sub>θ</sub> AVERAGE (cm/s)		$9.9 \cdot 10^{-5}$	
K <sub>20</sub> (cm/s)		$1.4 \cdot 10^{-6}$	

**OBSERVATIONS:**

W% = 20.00

$\gamma_d = 1.43$

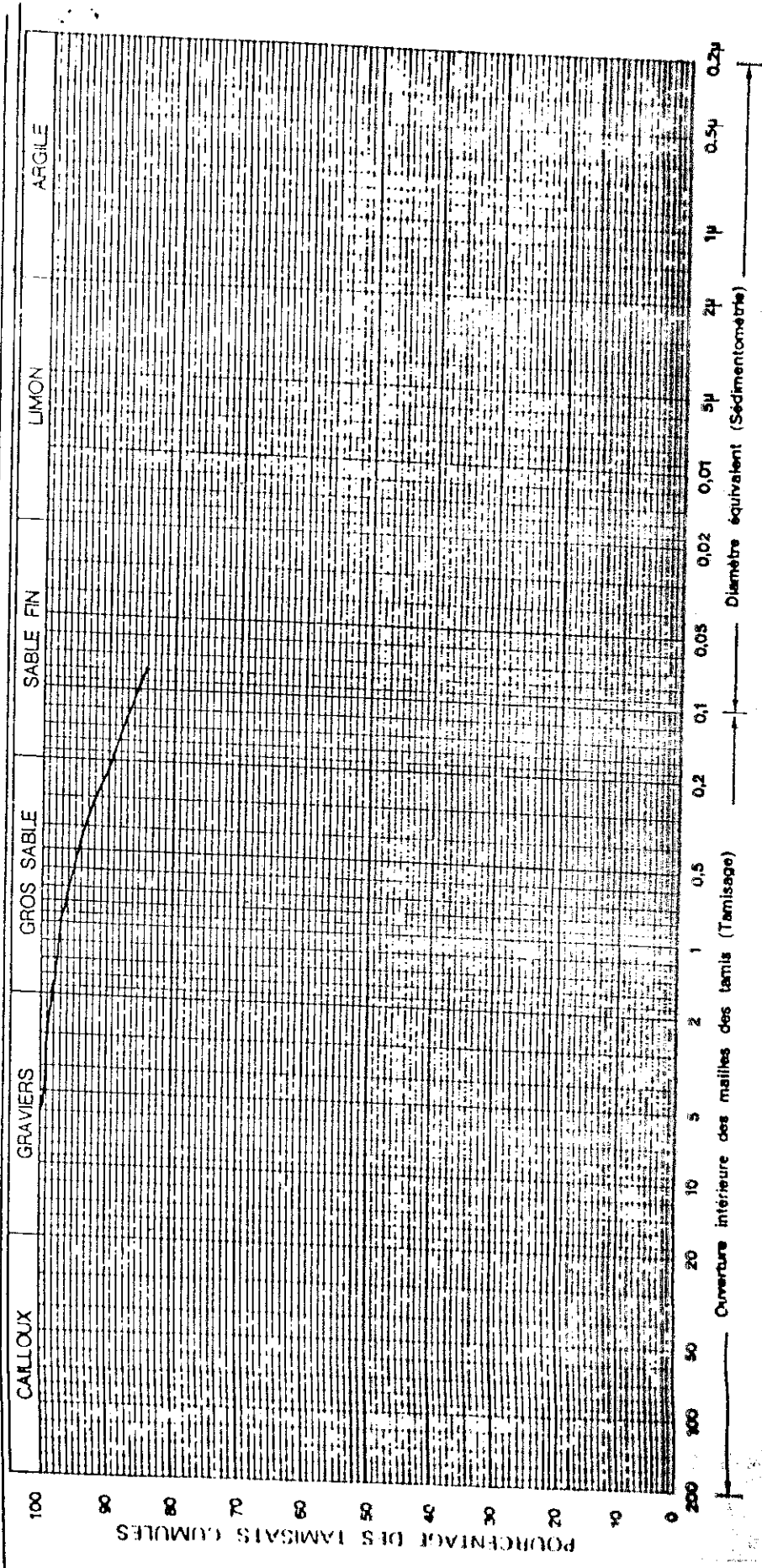
TEST LABORATORY DEPARTMENT MANAGER



Provenance: Assainiss. ville ny / Site Koubia  
Echantillon : Argile compacte

Opérateur: \_\_\_\_\_  
Désignation des échantillons: \_\_\_\_\_ N° \_\_\_\_\_  
N° \_\_\_\_\_

P2 / Prél. 8.20 à 10.25m



N°	LL.	I.P.	< 0,08	HRB	F.P.	I.G.	ds max.	α opt.	CBR	Gonfl.	ds situ.	comp rel.
	30	14	84%									

**REPUBLIQUE DU NIGER**  
**MINISTERE DE L'EQUIPEMENT ET DES**  
**TRANSPORTS**  
**DIRECTION DU LABORATOIRE NATIONAL**  
**DES TRAVAUX PUBLICS ET DU BATIMENT**  
**B.P 464 Tel:73 - 25 - 62 Niamey**

## PERMEABILITY TEST WITH OEDOMETER

FROM: Sanitation of NAMEY CITY

DATE : 07/07/2001

BORE - HALE : KOUBIA P2

APPLICANT : S E R

DEPTH : 8.25 - 8.50 m

OPERATOR: LABARAN

SOIL NATURE : Tubular casing N° 5 F

Compact clay

TEST TEMPERATURE:

$\vartheta = 29 \text{ }^{\circ}\text{C}$

CYLINDER SECTION

a = 28.26 mm<sup>2</sup>

SAMPLE SECTION

A = 78,54 cm<sup>2</sup>

SAMPLE HEIGHT/LENGTH

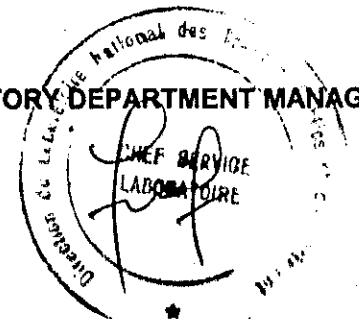
L = 18,8 mm

TEST N°	1	2	3
H <sub>o</sub>	80	90	100
H <sub>1</sub>	30	20	15
TIME: t (s)	10	22	28
K $\vartheta$ (cm/s)	$20 \cdot 10^{-4}$	$10.6 \cdot 10^{-4}$	$9.4 \cdot 10^{-6}$
K $\vartheta$ AVERAGE (cm/s)		$13.3 \cdot 10^{-4}$	
K <sub>20</sub> (cm/s)		$1.9 \cdot 10^{-5}$	

**OBSERVATIONS:**

W % = 15.20

TEST LABORATORY DEPARTMENT MANAGER





**APPENDIX S.4 DEMAND SURVEY ON  
PRE-COLLECTION AND  
SAND SORTED OUT**

## APPENDIX S-4 DEMAND SURVEY ON PRE-COLLECTION AND RECYCLING SAND

During the feasibility phase demand Survey on Pre-Collection and Recycling sand was carried out. Population in the chosen areas have been interviewed as well as 20 construction enterprises. The population were asked among others about their willingness to pay for waste pre-collection service and the enterprises about the demand of recycled sand. The main results are summarized regarding below

### 1. Demand and willingness to pay for pre-collection services

Table S4-1 is summarizing the results of the demand survey. It is remarkable that the trend of interest and willingness to pay is similar beyond income classes. Although the willingness to pay of Area 1 (high income area) seems to be the lowest than other income classes (86 CFAF/month/head). Regarding the high revenue of this class, it could be possible to set the fee at 100 - 110 CFAF/month/head since the current pre-collection activity in the area collects 1000 – 1500 CFAF/month/house. Furthermore the rate of interested household (85% in high standing, 58% in middle standing, 77% in low standing) is already exceeding the assumptions made in the master plan study. It was expected that the collection rate would be 80%, 45% and 40% respectively in introducing.

**TABLE S4-1 SUMMARY OF RESULT: DEMAND AND WILLINGNESS TO PAY OF PRE-COLLECTION**

Area	No. of Household	Average No. of family	Income				Interest in pre-collection			Expected price of pre-collection		
			over 100,000 CFAF/M	50,000 - 100,000 CFAF/M	30,000 - 50,000 CFAF/M	less than 30,000 CFAF/M	Yes	No	Not judge	No. of house	CFAF/ Month/ house	CFAF/ Month/ head
<b>Area 1</b>	47	8.4	34	6	3	3	40	6	1	40	723	86
High standing			72%	13%	6%	6%	85%	13%	2%	85%		
<b>Area 2</b>	50	5.6	17	18	8	0	29	5	12	28	677	121
Middle standing			34%	36%	16%	0%	58%	10%	24%	56%		
<b>Area 3</b>	53	6.4	26	17	5	3	41	8	2	41	912	143
Low standing			49%	32%	9%	6%	77%	15%	4%	77%		
<b>Total</b>	<b>150</b>	<b>6.8</b>	<b>77</b>	<b>41</b>	<b>16</b>	<b>6</b>	<b>110</b>	<b>19</b>	<b>15</b>	<b>109</b>	<b>782</b>	<b>116</b>
			51%	27%	11%	4%	73%	13%	10%	73%		

### 2. Demand and Price of Recycled Sand

Among the interviewed construction enterprises, the total sand demand is approximately 108,000 m<sup>3</sup>/year by the 13 companies that answered the question. The average price for sand, the enterprises would be able to pay for sand is about 1,600 CFAF/m<sup>3</sup>. The use of sand is very various and includes concrete purposes. As the recycled sand contains small organic substances, using it for concrete shall be avoided. From the feed back of the survey, one third of sand demand can be recycling sand. Assuming the fluctuation of construction and sand demand of 30%, the demand of recycling sand can be estimated at 25,000 m<sup>3</sup>/year (about 40,000 t/year). The estimated amount of recycling sand generated in the priority project area amounts to about 15,000 ton/year in 2015, the demand of the 13 companies is two times more than production. The price of recycled sand would be appropriate to set at 1,000 CFAF/ton from the answers to questions.



BATIMENTS ET TRAVAUX PUBLICS

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NIAMEY - NIGER

REPORT  
ON  
DEMAND SURVEY  
ON PRE - COLLECTION AND SAND SORTED OUT  
FOR  
THE STUDY ON SANITATION IMPROVMENT  
FOR  
THE NIAMEY CITY  
IN  
THE REPUBLIC OF NIGER

AUGUST 2001

## CONTENS

### Introduction

#### **I – Sequence of operations**

##### I 1 – Awareness

I 1.1 – EAM and survey team representatives meeting

I.1.2 – District leaders

I.1.3 – CUN I & II leaders

#### **II – Survey of targeted household**

II.1 – Recruiting and training of interviewers

II.2 – Operations during survey

II.2.1 – Households identification

II.2.2 – Questionnaires filling

#### **III – Pre - collecte and waste sorting out**

III.1 – Waste collection from household

III.2 – Collection sequence

III.3 – Storage

III.4 – waste sorting out

#### **IV – Exploitation of resultats from household according to head of family duties**

Tableau n° 1 : Break down of household according to matrimonial situation

Tableau n° 2 : Break down of household according to head of family duties

Tableau n° 3 : Break down of household according of type habitat

Tableau n° 4 : Household needs for waste collection

Tableau n° 5 : Break down of household according to kids number

Tableau n° 6 : Household waste weighing

Tableau n° 7 : Household interview

Observations

#### **V – Exploitation of result from construction companies**

Tableau 8 : Construction companies interview

Observations

### Conclusion

## **INTRODUCTION**

The terms of reference (TOR) of the demand survey on pre – collection and sand sorted out initiated by JICA aim to determine from targeted 150 households, the various constituents, collection system and waste removal difficulties.

This 150 households are spread in three areas (fourteen district of Niamey city).

The objective of this study is the improvement of the sanitation in Niamey city and its population well – being.

The demand survey was extended also to twenty construction companies to collect information on the sand used for their construction activities and to propose to them the recycled sand.

## **I – SEQUENCE OF OPERATION**

### **I-1 AWARENESS**

A series of meetings have been organised at three levels :

#### **I-1.1 EAM AND SURVEY TEAM REPRESENTATIVES MEETING**

EAM and Study team representation have held a contact meeting. During this meeting the terms of references (TOR) has been studied, the duties and responsibility of each side has been highlighted.

The interview forms and questionnaires have been read and explained to the study team to insure that the content of the study is understood. A programme of activities was prepared by EAM and sent to JICA Study team for acceptance, some observations have been made to improve this programme.

#### **I-1.2 ANNEXES WARD OF TOWN LEADERS**

On June 22<sup>th</sup> and 23<sup>rd</sup> the survey team staff Mr AGBO FRANCK MARIE and Mr DEMBA KADER have entered into contact with the ward leaders. This first contact is to inform them on the survey that will be carried out in their respective areas.

#### **I-1.3 MEETING WITH THE COUNCIL I AND II AUTHORITIES**

The administrative procedures have been engaged towards the leaders of commune I & II to acquire the necessary authorisation to carry out the survey in their respective areas.

These administrative authorisations were granted to the survey team, and it is covering the concerned fourteen districts.

## **II INTERVIEW OF HOUSEHOLDS**

For this operation interviewers have been recruited

### **II-1 RECRUITING AND TRAINING OF INTERVIEWERS**

On June 29, 2001, interviewers have been trained for social marketing. The programme of the training is to teach them the methods and attitude when dealing with households such that not to frustrate them.

The objective and the expected results of the demand survey form contents and their filling procedures have been also taught to them.

### **II-2 DEMAND SURVEY OPERATION**

After learning the demand survey methodology, the interviewers have been deployed into the retained areas to carry out their duties.

## **II – 2.1 IDENTIFICATION OF HOUSEHOLDS.**

With the aid of the 150 family sensus cards, and the cadastral plan they have covered the fourteen districts. From June 30th to July 14th, 2001, this operation has led to the selection of the targeted households. Some of these households were septic to interviewers queries.

### **II.2.2 QUESTIONNAIRE FILLING.**

Once the 150 households known, the interview phases for households and construction companies have started simultaneously. With a duration of four days, these phases have been extended to 10 days due to various factors such that :

- need of enough time for the amount of question to be asked and the lengthy team for the collection of answers.
- Household leaders are often absent and the other family members are not able to answer in the household leader's place, and this led to many go and come back.

### **AT THE CONSTRUCTION COMPANIES LEVEL**

- we noted that some companies were susceptible and thought that it's a trap for those that not in order with tax rights payment and personnel recruitment regulations.
- Information retention from some companies bring their leaders to redemand to interviewers to come back later and to finally refuse to answer.

Due to these difficulties, only thirteen companies out of twenty could be recorded.

Started on July 3<sup>rd</sup> the process has ended on July 12<sup>th</sup>, date of the pre-collection – commencement.

## **III – PRE – COLLECTION AND WASTE TREATMENT**

This activity aim :

- to collect waste from households;
- to stock waste at the treatment site
- to sort - out sand
- sampling for construction companies.

### **III – 1 HOUSE HOLD'S WASTE COLLECTION**

This activity has started July 12<sup>th</sup> simultaneously in the districts of Poudriere and Cite façal.

zone n°1. It has been progressively extended to other Districts of Zone II and III according to the table shows below:

**TABLE HOUSEHOLD REPARTITION ACCORDING THE ZONING AND THE COLLECTION DURATION.**

N°	District	Date July 2001	Days	Household
1	Bani Fandou	15 au 19	5	16
2	Maourey – Deyzeibon	16 au 20	5	13
3	Terminus et Niamey bas	14 au 20	7	15
4	Gandatché	15 au 20	6	15
5	Poudrière	12 au 17	6	7
6	Zongo	15 au 20	6	11
7	Yantala	20 au 23	4	18
8	Dar Es Salam	14 au 20	7	16
9	Cité Fayçal	13 au 26	14	25
10	Boukoki 1 – 2 – 3 - 4	24 au 26	13	15
	<b>TOTAL</b>			<b>150</b>

**III – 2 COLLECTION SEQUENCE.**

Each morning plastic bags of 50 kg are distributed to the selected household.

The plastic bags filled with waste are collected every evening by the pre collection team and dropped at the treatment site.

It is to be noted that the waste collected the first day are not used for this study because they contained waste collected on several days.

At the treatment site each plastic bag is accurately weighed and weight form is filled every day.

**III – 3 STORAGE.**

Waste collection between 4 and 5 o'clock in the evening of the day before are directly emptied the following morning from 8<sup>th</sup> o'clock AM. This precaution is to avoid long waste conservation in bags which will deteriorate it. As these activities are taken during raining season, waste are stored packed under sheds.

**III – 4 SORTING – OUT**

The work is done with the appropriate tools such as:

Two types of sieves 5mm and 3mm, mesh were used to sort - out sand .

Dry Waste are sifted 5 times in the sieve of 5mm then wet waste are sifted also 10 times.

After sifting the raw waste in the sieve of 5mm mesh the sand obtained still contain various debris; it is then sifted again in the 3mm mesh 5 times for dry sand. and 10 times for wet sand. The passing sand obtained is a fine sand. It is dried undersand for four hours before been put into plastic bags and stored under shed.

**TABLE OF WASTE PRODUCTION FOUR HOUSEHOLDS / DICTRICT**

District	Waste production (kg)	Nbre of Persons	Specific Weight P
Maourey – Deizeibon	468	71	6,59
Poudrière	237	42	5,64
Gandatché	705	79	8,92
Bani Fandou	573	92	6,22
Yantala	579	114	5,07
Dar El Salam	1205	153	7,87
Terminus	915	113	8,09
Cité Fayçal	1872	212	8,83
Zongo	488	55	8,87
Boukoki 1-2-3-4	769	114	8,83
<b>14 quartiers</b>	<b>8810</b>	<b>1045</b>	

Eight thousand eight hundred and ten kilograms (8810 kg) of waste have been pre – collected and treated. The treatment of 150 household waste has produced six thousand one hundred and six kilograms (6156 kg) of fine sand.

The percentage of sand extracted from raw waste is :

$$\frac{6156 \times 100}{8810} = 69,87\%$$

This value has confirmed the values obtained during the first phase of the previous study. Table shows more the population a district is high more the quantity of waste produced is important. For example in Cite fayçal 212 persons have generated 1872 kg of waste where as 42 persons from Poudriere have only generated 235 kg.

**WASTE COMPOSITION**

Designation	Weight / kg	%
Organic matters	1674	19 %
Recyclable matter	969	11 %
sand	6167	70 %
<b>Total</b>	<b>8 810</b>	<b>100 %</b>

The results show in the above table are issued from weighing of the components listed below:  
 Organic matters ( plastics, cardboard, herbs, dry leaves etc...)  
 Recyclable matters : ( Can, bottles, various used objects)



#### IV RESULTS EXPLOITATION/ INTERPRETATION

**TABLE N°1 HOUSEHOLDS REPARTION ACCORDING TO THEIR MATRIMONIAL SITUATION.**

Matrimonial Status	Number	%
Monogamous	107	71,33
Polygamous	20	13,33
Celibate	12	8,00
Widow	9	6,00
Divorced	2	1,33
<b>Total</b>	<b>150</b>	<b>100</b>

Out of the targeted .150 households 85% are married, that is to say 127 households. It is to be noted that the tendency from the above table 71% are monogamous and 13% are polygamous families with at least two wives.

**TABLE 2 : REPARTITION OF HOUSE HOLDS ACCORDING THE LEADER ACTIVITY**

Activity	Number	Activity	Number	%
Civil servant	56			37,33
House wife	20			13,33
Private : Liberal	70			46,67
Farmer	1			0,67
Watch – man	1			0,67
Jobless	1			0,67
Student	1			0,67
<b>TOTAL</b>				<b>100</b>

The above table shows that the group of households where the leaders are exercising liberal activities represent ( 47% ). They are followed by civil servants, with 37%.

We noticed also that there is more and more households with women as leaders. We noticed again the case of housewife without any activity and still the household leaders they represent 13% of sample. being the household leaders, they represent 13% of the sample. It can be pointed out that in the residential neighbourhoods, civil servants couples are in majority

**TABLE 3 : REPARTITION OF HOUSE ACCORDING TO THE TYPE OF HABITAT**

Zone	Concrete	Semi concrete	Clay	Statch	Total
Poudrière	7	0	0	0	7
Cité Faycal	25	0	0	0	25
Terminus	11	2	2	0	15
Bani Fandou	14	0	0	2	16
Dar El Salam	12	0	3	1	16
Zongo	1	0	10	0	11
Gandatché	3	0	12	0	15
Yantala	18	0	0	0	18
Maourey-Deizeybon	1	8	4	0	13
Boukoki 1-2-3-4	4	5	5	0	14
Total		15	36	3	150
%	64,00	10,00	24,00	2,00	100

In the hold heighbourings as Boukoki; Maourey, Dezeibon, Gandathé and Zongo, the demand survey has concerned more house constructed with traditional materials.

The new heighbourings as Banifandou, Dar El salam, Terminus are mainly sound construction about 81% households. Where as in poudriere and cite Fayçal, whith are residentail heighbourings all then households are living in standing flats (100%)

**TABLE 4 :NEEDS IN WASTE COLLECTION OF HOUSEHOLDS**

Answers			Number		
Yes			150		
No			0		
Other			0		
Total			150		
%			100		

100% of the target 150 households wish to benefit of the waste precollection system, this shows that it is important to put in place and organise a system of waste collection and transoportation through – out the Niamey City.

TABLE 5 : REPARTITION OF HOUSEHOLDS ACCORDING TO THE NUMBER OF KIDS

Nbre of	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	>20	Total
Nbre of Household	18	14	18	19	21	16	11	5	5	5	6	1	1	2	3	3	0	1	1	0	0	0	150
%	12	9,3	12	13	14	11	7,3	3,3	3,3	3,3	4	0,7	0,7	1,3	2	2	0	0,7	0,7	0	0	0	100

We noticed the high tendency of households with four kids.

We noticed that there is more waste produced in family with many persons.

For examples in a household comprising 16 persons there is 77 kg of waste where for a family of one person there is only 18 kg of waste production.

Household Waste Weighing  
District: Maourey & Deizeybon

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda	Average/per
01	Mariatou So	2					5	7	4	3	3								22	2,20	1,10
02	Abdou Hamidou	1					3	7	5	2	1								18	3,60	3,60
03	Babacar Hauma	8					15	13	10	8	5								51	10,20	1,28
04	Salisou Majé	16					25	20	15	10	7								77	15,40	0,96
05	Absatou Souley	5					10	8	7	5	4								34	6,80	1,36
06	Yacouba Halidou	4					9	7	3	4	5								28	5,60	1,40
07	Hadjia Ma	3					7	6	4	3	2								22	4,40	1,47
08	Mintou Boubacar	7					14	10	9	7	5								45	9,00	1,29
09	Issaka Mamacou	6					10	8	5	4	2								29	5,80	0,97
10	Rabi Manamane	5					9	5	4	3	2								23	4,60	0,92
11	Mohamed Afazzi	2					5	4	2	2	2								15	3,00	1,50
12	Boubacar Tiemogo	6					15	10	8	5	4								42	8,40	1,40
13	Halimatou Amadou	6					18	15	12	10	7								62	12,40	2,07
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		71					145	120	88	66	49										
Household total		13																			
Nbre of person		71																			
Total weight of debris		468																			
Average weight/waste/pers/day/district		1,31831																			

D: day A: average  
W: weight  
W: waste  
D: district  
Pers: person

This observation obtained from Maourey and Deizeybon district is valuable to the district of poufri etc.  
We noticed that the average waste weight produced / per / day is 0,94 kgs.

Household Waste Weighing  
Districts: Poudrière

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda	Average/per
01	Saley Isstak A.	2	12	6	4	4	3	14											43	1,02	21,50
02	Barké Fatimata	4	5	4	4	3	5	4											25	0,89	6,25
03	Adamou Harouna	9	7	7	5	6	2	13											40	1,43	4,44
04	Mariama Boukari	6	4	5	4	3	5	17											38	1,36	6,33
05	Hadj Kadi	7	3	5	3	3	6	4											24	0,86	3,43
06	Hassane Amadou	11	9	6	4	5	13	15											52	1,86	4,73
07	Issoufou Marou	3	3	4	3	2	2	1											15	0,54	5,00
08																					
09																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		42	43	37	27	26	36	68													
Household tota:		7																			
Nbre of person		42																			
Total weight of debris		237																			
Average weight/waste/pers/day/district		0,94048																			

D: day A: average

W: weigh:

W: waste

D: district

Pers: person

This observation obtained from Maourey and Deizeibon district is valuable to the district of poudrière.  
We noticed that the average waste weight produced / per / day is 0,94 kgs.

Household Waste Weighing  
District: Gandatché

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda.	Average/per
01	Tinari Baba Koudou	7				15	12	10	8	7	5								57	1,36	8,14
02	Amsatou Boubacar	3				10	8	9	7	5	2								41	0,98	13,67
03	Modi Djibo	7				20	15	12	10	7	5								69	1,64	9,86
04	Hadjia A.	4				9	12	10	7	8	5								51	1,21	12,75
05	Alzouma Mounkalla	2				5	9	7	5	4	2								32	0,76	16,00
06	Boncani Gabery	11				25	20	15	12	10	5								87	2,07	7,91
07	Abdou	3				8	10	8	7	5	6								44	1,05	14,67
08	Ramatou Oatba	6				13	15	10	9	7	5								59	1,40	9,83
09	Hamidou Zak	9				15	13	10	8	7	5								58	1,38	6,44
10	Rabou Abdou	6				10	8	6	5	4	2								35	0,83	5,83
11	Maimouna Hamidou	10				25	15	10	5	3	5								63	1,50	6,30
12	Hadjo A.	2				8	5	7	4	3	2								29	0,69	14,50
13	Ousmane Moussa	3				10	8	7	5	3	2								35	0,83	11,67
14	Issa Sofio	2				7	5	3	4	2	2								23	0,55	11,50
15	Sambane Ba	4				6	4	5	3	2	2								22	0,52	5,50
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		79				186	159	129	99	77	55										
Household total		15																			
Nbre of person		79																			
Total weight of debris		705																			
Average weight/waste/pers/day/district		1,48734																			

D: day A: average

W: weight

W: waste

D: district

Pers : person

The same observation made for Maourey, Deizeïbon and Poudrière is also valuable for Gandatché; it can be noted that the average waste production / person / day is 1,49 kg

Household Waste Weighing

District: BANI Fadou

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawda	Average/per
01	Harouna Idrissa	7				13	6	16	5	12									52	0,46	7,43
02	Yacouba Biro	3				5	3	2	4	8									22	0,20	7,33
03	El Maman Sani	6				5	7	5	5	13									35	0,31	5,83
04	Salé Adamou	6				6	3	14	7	12									42	0,38	7,00
05	Boubacar Ali	8				15	10	7	5	10									47	0,42	5,88
06	Mahamadou Acamou	2				4	2		4	11									21	0,19	10,50
07	Marouana Sourmana	5				3	5	3	3	11									25	0,22	5,00
08	Hamadou Sarrbo	4				6	8	3	3	15									35	0,31	8,75
09	Issaka Maingidou	3				7	5	4	5	13									34	0,30	11,33
10	Hama Barkiré	5				5	4	6	5	10									30	0,27	6,00
11	Abdoulaye Issaka	12				15	12	16	4	10									57	0,51	4,75
12	Sourmana Seyni	6				7	4	10	4	3									28	0,25	4,67
13	Laouali Sansan	11				10	5	14	4	18									47	0,42	4,27
14	Haridou Issaka	4				8	3	9	4	9									33	0,29	8,25
15	Moussa Harouna	7				7	5	12	3	5									32	0,29	4,57
16	Abdoulaye Issaka	3				5	7	11	6	4									33	0,29	11,00
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		92				121	89	132	67	164											
Household total		16																			
Nbre of person		92																			
Total weight of debris		573																			
Average weight/waste/pers/day/district		1,24565																			

D: day

A: average

W: weight

W: waste

D: district

Pers : person

Household with many persons generate big amount of waste,

We noticed that the average waste weight produced / per / day is 0,94 kgs. moyen d'ordures produites 1,25 kgs

Household Waste Weighing  
District: Yamtala

N° C	Chef de famille	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	PMOPJM	Moy/per
01	Labo Boubacar	4									6	7	5	4					22	0,31	5,50
02	Yagi Yacouba	7									12	10	9	7					38	0,53	5,43
03	Issa Amadou	3									7	9	8	6					30	0,42	10,00
04	Amadou Moussa	6									10	12	7	5					34	0,47	5,67
05	Boureima Moussa	2									4	3	1	2					10	0,14	5,00
06	Diallo Razak	2									3	4	5	3					15	0,21	7,50
07	Abdoulaye Issaka	12									15	16	9	7					47	0,65	3,92
08	Araoye Didier	7									11	9	7	6					33	0,46	4,71
09	Mamadou Ibrahim	3									7	8	4	2					23	0,29	7,00
10	Modi Gaye	1									2	3	1	1					7	0,10	7,00
11	Ndiaye Boureima	7									15	12	8	7					42	0,58	6,00
12	Mamadou Souma	9									14	15	12	10					51	0,71	5,67
13	Bitah Ka	4									3	2	1	2					8	0,11	2,00
14	Dobi Mannan	7									25	20	17	15					77	1,07	4,53
15	Gozo Marian	1									3	4	1	2					10	0,14	10,00
16	Moussa Nabiga	17									20	18	15	12					65	0,90	3,82
17	Moussa Nomaou	8									12	10	9	7					38	0,53	4,75
18	Hadiza Mamadou	4									8	11	7	5					31	0,43	7,75
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		114	177	173	126	103															
Household total		18																			
Nbre of person		114																			
Total weight of debris		579																			
Average weight/waste/pers/day/district		1,26974																			

D: day A: average

W: weight

W: waste

D: district

Pers: person

Household with many persons generates big amount of waste,  
We noticed that the average waste weight produced / per / day is 0,94 kgs.



Household Waste Weighing  
District: Dar El Salam

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda	Average/per
01	Daouda Hamani	2			6	7	5	4	3	3	2								30	0,27	15,00
02	Moukaila Hassane	5			12	15	9	7	5	4	3								55	0,49	11,00
03	Roukaya Ibrahim	4			7	5	6	4	3	3	3								31	0,28	7,75
04	Hamidou Harouna	7			15	10	12	8	5	2	2								54	0,48	7,71
05	Seyni	3			7	5	4	3	4	3	2								28	0,25	9,33
06	Abcoulaye Hassane	5			11	10	15	12	10	8	7								73	0,65	14,60
07	Hama Hamidou	6			15	12	10	11	12	10	8								78	0,70	13,00
08	Madougou Djibo	13			25	20	15	10	5	7	5								87	0,78	6,69
09	Moussa Lazan	7			15	10	5	3	3	3	3								42	0,38	6,00
10	Bourkari Saley	10			20	15	10	8	5	2	2								62	0,55	6,20
11	Halidou Chékarao	9			15	10	8	5	4	3	3								48	0,43	5,33
12	Madougou Djibo	24			50	40	25	30	20	15	10								190	1,70	7,92
13	Mamadou Hairik	19			35	20	25	20	15	15	10								140	1,25	7,37
14	Mamane Hassane	13			30	20	15	10	10	9	7								101	0,90	7,77
15	Djibo Hamadou	18			35	30	25	15	10	10	5								130	1,16	7,22
16	Chaibou Sabari	8			15	10	8	9	7	5	2								56	0,50	7,00
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		153			313	239	197	159	121	102	74								48		
Household total		16																			
Nbre of person		153																			
Total weight of debris		1205																			
Average weight/waste/pers/day/district		1,12512																			

Same observation as the above table with an average waste weight / person / day of 1,13 kgs

A: average  
W: weight  
W: waste  
D: district  
Pers: person

Household Waste Weighing  
District: Terminus

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda	Average/per
01	Safi Maiga	7			15	3	10	8	5	3	3								47	0,96	6,71
02	Tino Idrissa	6			12	10	8	7	5	4	3								49	1,00	8,17
03	Ibrahim M. Djibo	9			20	18	15	10	12	9	7								91	1,86	10,11
04	Katiaou Maiga	4			7	5	3	3	2	2	1								23	0,47	5,75
05	Zeinaba Assam	3			5	4	4	3	2	2	1								21	0,43	7,00
06	Hadjia Hadiza	7			12	10	8	5	4	2	1								42	0,86	6,00
07	Mariama Tatirou	10			25	20	15	12	11	9	7								99	2,02	9,90
08	Boubacar Ibrahim	10			20	15	10	9	7	5	3								69	1,41	6,90
09	Hadjia Hamissatou S.	5			10	8	6	5	4	3	2								38	0,78	7,60
10	Salaou Beilo	7			15	10	8	7	5	3	2								50	1,02	7,14
11	Rahiratou Idrissa	11			25	20	15	13	10	9	7								99	2,02	9,00
12	Geny Helele	6			10	8	6	5	4	3	2								38	0,78	6,33
13	Hessia Gado	10			25	20	15	10	13	12	9								104	2,12	10,40
14	Mame Ahouseiri	8			15	13	10	7	5	4	3								57	1,16	7,13
15	Monamed Kallou	10			25	20	15	10	8	6	4								88	1,80	8,80
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		113			241	184	148	114	97	76	55										
Household total		15																			
Nbre of person		113																			
Total weight of debris		915																			
Average weight/waste/pers/day/district		1,15676																			

D: day A: average  
W: weight  
W: waste  
D: district  
Pers: person

Household Waste Weighing  
District: Cité Rayçal

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwda	Average/per
01	Col. Miamane Mamadou	7		25	22	20	18	15	12	10	11	10	9	7	5	2	3		169	0,48	24,14
02	Madou Mamadou	6		15	12	11	7	5	4	5	6	5	4	3	3	2	2		84	0,24	14,00
03	Chabou Laouly	5		20	15	12	10	10	11	8	9	7	4	4	3	3	2		118	0,34	23,60
04	Cdt. Aidou	6		15	13	10	8	7	6	7	6	5	4	4	3	2	3		93	0,27	15,50
05	Lt. Col. Yayé Garba	7		10	8	7	5	5	4	7	8	6	4	5	4	3	2		78	0,22	11,14
06	Sanda Marnane	3		7	5	4	3	4	3	3	4	3	4	2	2	2	2		86	0,25	28,67
07	Sani Boukari	16		30	25	23	20	22	20	18	15	12	10	9	9	5	4		222	0,63	13,88
08	Lestao Ibrahim	15		18	18	17	15	16	15	12	12	10	7	6	7	5	2		160	0,46	10,67
09	Amadou Garba	7		12	13	9	10	9	10	9	8	9	10	7	5	3	4		115	0,33	16,43
10	Mele Adji	6		10	12	12	10	8	9	**	5	4	4	2	3	2	2		83	0,24	13,83
11	Mady Abdou	8		15	13	12	10	10	9	4	5	7	6	5	4				100	0,29	12,50
12	Iro Yabouza	15		26	15	13	12	11	10	9	7	6	7	5	3	4	3		125	0,36	8,33
13	Moussa Harouna	15		25	15	14	11	10	8	7	5	4	4	2	3	2	3		113	0,32	7,53
14	Marnane Boukari	10		10	8	7	5	4	5	5	4	5	4	3	3	2	2		67	0,19	6,70
15	Issaka Djibo	12		30	27	15	12	10	9	7	8	7	4	4	3	2	2		140	0,40	11,67
16	Sako Amadou	5		25	20	18	15	13	10	9	7	8	7	5	4	3	3		147	0,42	29,40
17	Maidadj A-ambaye	15		20	15	12	10	10	8	5	4	4	3	3	2	3	2		101	0,29	6,73
18	Sidi Moulaye	12		15	15	13	11	10	8	6	3	5	4	5	4	3	2		104	0,30	8,67
19	Ibrahim Labo	4		12	12	11	8	8	5	5	4	4	3	2	2	2	2		80	0,23	20,00
20	Amadou Hama	8		15	13	10	5	8	5	4	5	6	5	4	4	3	2		89	0,25	11,13
21	Gastor Kaba	5		15	12	11	10	9	10	8	5	7	6	4	3	2	3		105	0,30	21,00
22	Abdallan Bouréma	5		12	10	9	7	8	10	9	7	8	9	7	4	3	4		107	0,31	21,40
23	Bakeka Monique	7		20	15	14	12	10	12	10	11	10	8	6	5	1	3		137	0,39	19,57
24	Yerina Ledan	5		15	12	13	11	10	8	9	7	6	5	4	3	2	3		108	0,31	21,60
25	Djibril Hanoucou	8		20	15	17	15	12	11	10	8	9	7	5	4	4	3		140	0,40	17,50
26																					
Total		212		431	357	314	260	244	222	186	174	167	180	113	95	65	63				
Household total		25																			
Nbre of person		212																			
Total weight of debris		2871																			
Average weight/waste/pers/day/district		0,96732																			

D: day A: average

W: weight

W: waste

D: district

Pers: person

The household having the more number of persons (N° 7) has generated the highest quantity of waste

The average waste weight is 222 in 14 days

Household Waste Weighing

District: Zongo

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Wawwida	Average/per
01	Lamy Mamane	2				10	7	8	6	4	3								38	0,58	19,00
02	Mariama Garba	2				8	9	7	5	3	2								34	0,52	17,00
03	Safi Djibo	4				15	10	8	5	2	1								41	0,62	10,25
04	Hassane Kagéré	7				15	20	15	12	10	8								80	1,21	11,43
05	Amadou Adramane	11				25	20	12	13	10	7								87	1,32	7,91
06	Madougou Moussa	7				10	12	7	8	5	3								45	0,68	6,43
07	Adamou A. Djibo	10				15	10	8	5	3	2								43	0,65	4,30
08	Méhaou Djibo	5				10	8	6	4	4	2								34	0,52	6,80
09	Aissa Faragou	4				9	7	5	5	4	4								34	0,52	8,50
10	Amadou Comial	1				5	4	5	3	2	1								20	0,30	20,00
11	Boureima Moukaila	2				8	6	7	5	4	2								32	0,48	16,00
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		55				130	113	88	71	51	35										
Household total		11																			
Nbre of person		55																			
Total weight of debris		488																			
Average weight/waste/pers/day/district		1,47879																			

D: day A: average  
W: weight  
W: waste  
D: district  
Pers : person

The tendency observed at Cité Fayçal is repeated at Zongo where household (N°5) has generated the highest quantity of waste 87 kg

Household Waste Weighing

District: Boukoki

N°	Household leader	Nber/Per	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Waverage	Average/per
01	Boubacar Soumana	6													25	20	20		65	1,55	10,83
02	Mamadou Issa	8													30	25	20		75	1,79	9,38
03	Boubacar Saley	4													20	15	12		47	1,12	11,75
04	Ferdinand Eknedzé	4													15	15	12		42	1,00	10,50
05	Cissé Amadou	15													35	20	15		70	1,67	4,67
06	Mamadou Soumaila	7													15	10	10		35	0,83	5,00
07	Issaka Maïtrakouri	6													20	17	10		47	1,12	7,83
08	Baradjé Noma	8													20	20	12		52	1,24	6,50
09	Issaïfou Nahaïk	4													10	12	15		41	0,98	10,25
10	Ali Arzika	10													25	20	15		60	1,43	6,00
11	Haoua Bagné	5													15	20	10		45	1,07	9,00
12	Mamadou Mamadou	12													30	25	20		75	1,79	6,25
13	Nouhou Harouna	5													15	10	20		45	1,07	9,00
14	Abdoulaye Ali	12													30	25	20		75	1,79	6,25
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
Total		106													305	254	215				
Household total		15																			
Nbre of person		106																			
Total weight of debris		774																			
Average weight/waste/pers/day/district		2,43396																			

D: day A: average  
W: weight  
W: waste  
D: district  
Pers: person

Boukoki makes an exception to the above consist of the above table; the household N° 2 with 8 persons has produced 75 kilos ; and the household N°12 has produced the same quantity with 12 person. However the average waste weight produced / per / day is higher than that of other district with 2,44 kilos.

Month of July 2001

Household interview		Maurey & Deizeibon district (1-13)											
N°	01	02	03	04	05	06	07	08	09	10	11	12	
A1	2	2	4	4	2	3	3	6	7	6	6	5	
A2	1	1	1	1	1	0	1	0	1	1	1	1	
A3	5	5	3	5	3	1	3	1	3	4	3	3	
A4	3	3	4	4	3	1	2	1	3	4	3	4	
A5	1	2	2	3	1	1	1	1	2	3	2	3	
B1	1	1	1	3	2	1	2	2	1	7	2	2	
B2	2	2	2	2	2	2	2	2	2	2	2	2	
B3													
B4													
B5	2	2	2	2	2	2	2	2	3	2	2	2	
B6	3	3	2	2	4	4	3	2	3	2	3	3	
B7	3	2	3	2	2	3	3	4	3	3	3	3	
B8	1	1	1	1	1	1	1	1	1	1	1	1	
B9	2	1	2	1	1	1	1	1	2	2	2	1	
B10													
B11													
B12													
C1	1	1	1	1	1	1	1	1	1	1	1	1	
C2													
C3	1	1	1	1	1	1	1	1	1	1	1	1	
C4													
C5	2	2	2	1	1	2	2	2	1	1	1	2	
C6	1	1	1	-	400	1	1	1	500	750	400	1	
C7	-	-	-	500	2				1	7	2	-	
C8	-	-	-	3								-	

Month of July 2001

Household interview N°	Poudrière District (14-20)							Gandatché district (21-35)						
	13	14	15	16	17	18	19	20	21	22	23	24		
A1	11	5	3	11	2	1	8	16	5	4	3	7		
A2	1	1	1	1	2	1	1	1	1	1	2	1		
A3	3	3	4	4	7	7	5	5	1	7	1	4		
A4	4	4	3	4	1	2		4		3	1	4		
A5	3	2	2	4	2	3	3	3	1	2	2	3		
B1	1	2	3	3	4	5	3	3	3	3	6	3		
B2	2	2	2	2	1	1	1	1	1	1	1	1		
B3														
B4														
B5	2	2	2	2				2						
B6	2	3	3	3				3						
B7	2	3	2	2				2						
B8		1	1	1				1						
B9	2	1	2	1				1						
B10					4	3	2	2	2	3	2	2		
B11					3	3	4	2	3	4	4	3		
B12					1	1	1	1	1	2	2	1		
C1	1	1	1	1	1	1	1	1	1	1	1	1		
C2														
C3	1	1	1	1	1	1	1	1	1	1	1	1		
C4														
C5	2	1	2	2	1	1	3	1	3	1	1	1		
C6	1		1	1										
C7	-	400	-	-	1000	1000	-	1000	-	1000	1000	1000		
C8	-	2	-	-	7	7	-	6	-	7	6	7		

Month of July 2001

Household interview

N°	25	26	27	28	29	30	31	32	33	34	35	36
A1	6	5	2	6	6	10	8	10	6	5	7	5
A2	3		1	2	1	0		3	0	1	1	0
A3	1	3	4	1	1	7	7	7	7	6	7	7
A4	3	3	2	2	-	2	3	4	3	3	2	3
A5	2	2	1	1	2	3	4	3	3	3	3	3
B1		5	6	4	3	1	3	3	2	1	7	3
B2	1	1	1	1	1	3	1	1	3	1	1	1
B3						1500			500			
B4						3			3			
B5						2						
B6												
B7												
B8												
B9												
B10	2	2	3	2	3		1	1		2	4	4
B11	5	4	2	4	4		4	5		4	3	2
B12	2	1	3	3	3		1	1		3	1	1
C1	1	1	1	1	1	1	3	1	1	1	3	1
C2												
C3	1	1	1	1	1	1		1	1	1		1
C4												
C5	3	1	1	1	1	1		1	1	1		1
C6												
C7		1000	1000	500	1000	1500		750	500	500		500
C8		7	6	5	7	3		3	7	3		7



Month of July 2001

Household interview		Bani Fandon district (36-51)															
N°	37	38	39	40	41	42	43	44	45	46	47	48					
A1	10	10	7	3	4	9	7	6	7	3	7	4					
A2	2	1	1	1	1	4	1	2	3	1	2	1					
A3	4	4	7	7	7	5	3	3	1	3	6	1					
A4	3	3	3	2	4	4	4	3	-	2	2						
A5	4	1	2	2	3	4	4	2	1	1	2	2					
B1	2	2	3	3	7	3	7	7	3	3	2	2					
B2	1	1	1	2	1	1	1	3	2	1	2	1					
B3								750									
B4								3									
B5				2					2								
B6				4					4								
B7				2					2								
B8				1					1								
B9				1					2								
B10	4	5	1		2	4	4	4		3	3	3					
B11	2	2	4		3	2	4	4		3	3	3					
B12	1	1	1		1	1	2	2		2	1	1					
C1	1	1	3		1	3	1	1	1	1	1	1					
C2						2											
C3	1	1			1	2	1	1	1	1	1	1					
C4						3											
C5	1	1			1	3	2	1	1	3	1	1					
C6							2										
C7	700	500			500			750	250		500	250					
C8	7				4			7	5	4	6	4					

Month of July 2001

Household interview		Yantala district (52-69)											
N°	49	50	51	52	53	54	55	56	57	58	59	60	
A1	2	11	3	6	9	6	10	2	3	2	4	8	
A2	1	2	2	1	3	1	0	1	1	1	1	1	
A3	5	6	3	1	1	3	1	4	3	5	1	5	
A4	4	3	3		2	3	3	3	4	3	-	4	
A5	2	2	2	2	1	2	3	2	3	2	1	3	
B1	2	3	4	2	3	4	3	2	3	3	2	2a3	
B2	1	2	2	2	2	1	1	5	1	1	2	1	
B3								1000					
B4								3					
B5		1		2	1						1		
B6		4		4	5			5			5		
B7		1		2	1			1			1		
B8		1		1	1			1			1		
B9		1		3	1			1			2		
B10	3		1			2	1		1	2		1	
B11	4		5			4	5		5	4		3	
B12			2			2	2		2	2		1	
C1	1	1	1	1	1	1	1	1	1	1	2	1	
C2											3		
C3	1	1	1	3	1	1		1	1	1	1	1	
C4													
C5	1	3	3		1	1	2	1	1	1	3	1	
C6													
C7	1000					1000		1000	750	1000		750	
C8	7					6		4	5	5		3	

Month of July 2001

Household interview N°	Dar salam district (70-85)											
	61	62	63	64	65	66	67	68	69	70	71	72
A1	4	9	6	6	11	3	2	2	4	7	11	7
A2	1	0	1	1	2	1	1	0	1	1	2	1
A3	4	7	5	7	4	5	3	3	1	3	1	4
A4	4	2	4	2	4	4	3	2	-	3	-	3
A5	3	3	5	3	7	3	2	1	1	2	3	2
B1	4	1 à 2	3	2	1	2	3	3	2	3	3	2
B2	1	3	1	1		3	1	1	1	1	1	1
B3		750				600						
B4		1 à 2				2						
B5												
B6												
B7												
B8												
B9												
B10	2		2	2	2		5	5	5	5	5	3
B11	3		3	3	2		2	2	4	4	4	3
B12	1		1	1	1		1	1	1	1	2	1
C1	1	1	1	1	1	1	1	1	1	1	1	1
C2												
C3	1	1	1	1	1	1	1	1	1	1	1	1
C4												
C5	1	1	1	1	1	1	3	3	2	1	3	1
C6							1					
C7	1000	750	500	1000	500	31000		500		750		
C8	7	3 à 4	4	7	4	3 à 4		3		7		

Month of July 2001

Household interview		73	74	75	76	77	78	79	80	81	82	83	84
N°													
A1		10	5	4	1	2	3	6	2	6	11	3	2
A2		2	1	2	0	1	1	1	1	1	1	1	1
A3		3	3	1	6	6	5	3	3	4	3	3	4
A4		3	3	-	3	2	4	4	3	4	4	4	4
A5		2	2	2	2	1	3	3	2	3	3	4	3
B1		3	3		2 3	2	3	1	2	3	3	2	2
B2		1	1	1	1	1	2	2	2	2	2	2	2
B3													
B4													
B5							2	2	2	2	2	2	2
B6							1	1	1	1	1	1	1
B7							4	4	4	4	5	5	4
B8							1	1	1	1	1	1	1
B9							1	1	1	1	1	1	1
B10		2	2	5	2	3							
B11		4	5	5	3	4							
B12		2	2	1	1	1							
C1		1	1	1	1	2	1	1	1	1	1	1	1
C2						2							
C3		1	1	1	3	1	1	1	1	1	1	1	1
C4													
C5		3	3	3		3	1	2	1	2	1	1	1
C6								1					
C7							500		400		500	1000	600
C8							3		2		3	2	2

Month of July 2001

Household interview		Terminus district (86-100)													
No	85	86	87	88	89	90	91	92	93	94	95	96			
A1	5	2	6	3	1	14	8	2	7	16	1	8			
A2	1	2	1	1	1	1	1	1	1	1	1	1			
A3	4	4	4	5	5	4	4	3	4	3	3	5			
A4	4	4	4	3	4	4	4	2	4	3	3	4			
A5	3	3	2	2	3	4	4	1	3	3	1	3			
B1	2	1	3	2	2	2	1	2	2	2	2	7			
B2	2	2	2	2	2	1	1	2	2	2	2	2			
B3															
B4															
B5	2	2	2	2	1			2	1	1	2	2			
B6	1	1	2	2	5			5	5	5	1	2			
B7	4	5	4	4	1			1	1	1	4	4			
B8	1	1	1	1	1			1	1	1	1	1			
B9	1	1	1	2	2			2	1	2	1	2			
B10						1	1								
B11						5	5								
B12						1	1								
C1	1	1	1	1	1	1	1	1	1	1	1	1			
C2															
C3	1	1	1	1	1	1	1	1	1	1	1	1			
C4															
C5	1	1	1	1	1	1	2	1	1	1	1	1			
C6	-	-	-	-	-	-	1	-	-	-	-	-			
C7	500	400	500	300	1000	800	-	400	500	500	500	500			
C8	2	1	3	2	2	2	-	2	2	2	2	7			

Month of July 2001

Household interview No	Cite Faycal district ( 101-125)												
	97	98	99	100	101	102	103	104	105	106	107	108	
A1	18	13	19	24	24	10	7	2	5	4	6	13	
A2	1	1	0	1	1	1	1	1	1	1	1	1	
A3	3	4	1	3	3	4	3	5	3	3	3	3	
A4	4	4	1	4	4	4	4	3	3	4	4	4	
A5	4	3	2	4	4	4	2	2	2	2	3	3	
B1	7	7	7	7	7	7	3	1	1	1	1	2	
B2	2	2	2	2	2	2	2	2	2	2	2	2	
B3													
B4													
B5	2	2	2	2	2	2	2	2	2	2	2	2	
B6	3	3	4	4	4	4	3	4	4	4	4	4	
B7	3	3	2	3	3	1	2	2	2	2	2	2	
B8	1	1	1	1	1	1	1	1	1	1	1	1	
B9	2	1	2	3	3	1	2	2	2	3	3	2	
B10													
B11													
B12													
C1	1	1	1	1	1	1	1	1	1	1	1	1	
C2													
C3	1	1	1	1	1	1	1	1	1	1	1	1	
C4													
C5	1	1	2	1	1	1	1	1	1	1	1	1	
C6													
C7	800	1000	-	500	200	1000	300	200	200	200	200	500	
C8	7	7	-	7	2	7	3	1	1	1	1	2	

Month of July 2001

Household interview		109	110	111	112	113	114	115	116	117	118	119	120
Nº													
A1		5	3	7	7	6	5	6	7	3	16	15	7
A2		1	1	0	2	2	2	2	2	1	2	3	2
A3		6	4	1	5	5	5	5	5	5	5	5	5
A4		2	4	1	4	4	4	4	4	4	4	4	4
A5		1	3	1	4	4	4	4	4	4	4	4	4
B1		1	2	7	4	7	7	7	7	7	7	7	7
B2		2	2	2	1	1	1	1	1	1	1	1	1
B3													
B4													
B5		2	2	2									
B6		4	1	1	3	2	1	3	3	1	3	1	3
B7		3	5	4	1	1	1	1	1	1	1	1	1
B8		1	1	1	1	1	1	1	1	1	1	1	1
B9			1	2	1	1	1	1	1	1	1	1	1
B10					1	1	2	1	1	1	1	1	1
B11					1	1	1	1	1	1	1	1	1
B12					1	1	1	1	1	1	1	1	1
C1		1	1	1									
C2		1	1	1									
C3		1	1	1	1	1	1	1	1	1	1	1	1
C4													
C5		2	1	2	1	1	1	1	1	1	1	1	1
C6		1		1									
C7			1000		1000	1000	1000	1000	1000	1000	1000	1000	1000
C8			2		7	7	7	7	7	7	7	7	7

Month of July 2001

Household interview		Zongo district (126-136)											
No		121	122	123	124	125	126	127	128	129	130	131	132
A1		6	8	11	15	10	12	5	15	12	4	8	5
A2		1	2	2	2	2	2	2	2	1	2	2	2
A3		5	5	5	5	5	5	5	5	3	5	5	5
A4		4	4	4	4	4	4	4	4	4	4	4	4
A5		4	4	4	4	4	4	4	4	4	4	4	4
B1		7	7	7	7	7	7	7	7	7	7	7	7
B2		1	1	1	1	1	1	1	1	1	1	1	1
B3													
B4													
B5													
B6		4	4	3	3	3	3	3	3	3			3
B7		1	1	1	1	1	1	1	1	1	1	1	1
B8		1	1	1	1	1	1	1	1	1	1	1	1
B9		1	1	1	1	1	1	1	1	1	1	1	1
B10		1	1	1	1	1	1	1	1	1	1	1	1
B11		1	1	1	1	1	1	1	1	1	1	4	4
B12		1	1	1	1	1	1	1	1	1	1	1	1
C1									1	1			1
C2													
C3		1	1	1	1	1	1	1	1	1	1	1	1
C4													
C5		1	1	1	1	1	1	1	1	1	1	1	1
C6													
C7		1000	1000	1000	1000	1000	1000	1000	1000	2000	1000	1000	2000
C8		7	7	7	7	7	7	7	7	7	7	7	7



Month of July 2001

Household interview		Boukoki district (137-150)												
N <sup>o</sup>		133	134	135	136	137	138	139	140	141	142	143	144	
A1		5	7	5	2	6	8	4	4	15	7	6	8	
A2		2	2	2	2	1	1	1	1	1	1	1	1	
A3		5	5	5	5	5	3	5	5	5	3	5	5	
A4		4	4	4	4	3	4	3	3	4	4	3	4	
A5		4	4	4	4	3	4	4	4	3	4	3	4	
B1		14	7	7	7	3	7	2	2	2	3	1	7	
B2		1	1	1	1	2	2	2	2	2	2	2	2	
B3														
B4														
B5						2	1	2	2	2	2	2	2	
B6						3	4	2	3	3	2	3	3	
B7		1				1	1	1	1	1	1	1	1	
B8		1				1	1	1	1	1	1	1	1	
B9		1				1	1	1	1	1	1	1	1	
B10		1	1	1	1	2	1	1	1	1	1	1	1	
B11		1	4	3	3	1	1	3	3					
B12		1	1	1	1	1	1	1	1					
C1		1	1	1	1	1	1	1	1	1	1	1	1	
C2														
C3		1	1	1	1	1	1	1	1	1	1	1	1	
C4														
C5		1	1	1	1	1	1	1	1	1	1	1	1	
C6														
C7		1500	2000	1000	1000	750	1000	1000	750	1000	1000	1000	1000	
C8		2 à 3	7	7	3	3	3	2	2	7	7	7	7	

Month of July 2001

Household interview No	145	146	147	148	149	150														
A1	4	10	6	12	5	12														
A2	1	1	1	1	1	1														
A3	4	5	3	3	5	3														
A4	4	3	4	4	3	4														
A5	4	5	4	4	4	4														
B1	2	3	7	7	3	3														
B2	2	3	2	2	2	2														
B3																				
B4																				
B5	2	1	2	2																
B6	3	4	3	3	1	1														
B7	1	1	1	1	2	1														
B8	1	1	1	1	1	1														
B9	1	1	1	1	1	1														
B10	1				1	1														
B11					1															
B12	1				1															
C1	1	1	1	1	1	1														
C2																				
C3	1	1	1	1	1	1														
C4																				
C5	1	1	1	1	1	1														
C6																				
C7	750	500	1000	1000	500	1000														
C8	7	7	7	7	7	7														

## Observations

From the exploitation of the result issued from household interviews we can notice the following :

- 97 households are headed by one person who has a revenue
- In 34 households two persons have a revenue.
- In 5 households three persons have a revenue
- Finally 14 households are without revenue

The monthly average revenue :

- 6 households earn less than 30 000 F/CFA
- 39 households earn between 50 000 and 100 000 F/CFA
- 73 households earn above 100 000 F/CFA
- 32 households have not replied

The frequency of household waste removal is four to five times per week. Most of waste are evacuated towards the municipality dumping area. About sixty households are dumping their waste anyhow. Only one household used to burn their waste. From the above it arises the need of large campaign to discipline households for handling their waste.

This also the opinion of three district mayors of Niamey, the mass media and development agencies.

Regarding the taxes paid for the garbage removal, most of the households have not answered. Those that have answered think that the amount to be paid waste removal\* can vary from 500 to 1500 F/CFA / month.

- It can be noted that 1/3 of households think that the dumping site is too far from them.
- Some have not answered showing indifference about the distance to the dumping point.
- Estimated distance wished by households is 500m

The majority of households think that the pre collection should be done directly at their houses

Unanimously they have agreed for a system of general pre collection which could contribute to improve the population well being. However the cost of this system should be acceptable for the various households.

143 persons over 150 are wishing affordable cost.

Regarding the number of the weekly waste pre collection rotation 27% of households did not answer: from this constat a wide awareness should be done to the population on the impact of waste proximity in the population surrounding. As the adage have said : who wants to improve his health should be hygienic and clean his environment.

For the impact of the pre collection project and its benefit effect on the Niamey city population, 16% of households have not answered, 4% are favorable, 2% have not opinion.

We can conclude that the portion of the population that is not interviewed can be neglected (4%). 18% of households interviewed and that have not given their opinion could be brought back and adhere to the system of pre collection after awareness campaign.

In fact the waste pre collection project creation with household financial contributions should be organized. Nevertheless the monthly contribution / amount proposed by households varies from one district to another.

From commentary on the demand survey households have deeply wish the suppression of the waste tax of 1500 F/CFA paid to mayor's office and its transfer to organized private waste collection system ..

Month of July 2001

**Construction company interviews ( Turn - over in 1000 F/CFA )**

N° de société Réponse	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A1																				
A2	200000	80000	240000	481634	16000	150000	120000	200000	240000	90000	120000	11000	30000							
A3	9	25	40	9	30	>9	>10	24	>22	9	11	8	6							
A4	13000	30000	275	10000	10000	11000	1900	26000	45000	4900	10000	22000	225							
A5	1,2,5,6,7	3,6	2	1,2,4,5,7	7	1,2,5,6	1,2,5	7	1,2,6	5	3,6	1,2	1,2,3,5							
A6	1,3	2		2	4	1,3	1,2		1,2,3	1,3	1,2,3	1,3	1,2,3							
A7	4	5	3	5	4	4	4	1,2,3,4	5	54	5,4	5	4							
A8	2	2000	2000	300	750	2000	2000	2200	2000	1000	1500	2500	1000							
B1	1,3,5	3	2	3	3	1,3,5	1,3,5	3	3	135	3	3	5							
B2	2	2,4	1	3		6	1,3	2	2,3	1,3	2	2,4	1							
B3	1,5,6	1,6	2	234567	7	1,5,6	1,5,6	1,5,6	136	13	1,6,3	6,3	1,5							
B4			100	10000					1	1	1	1								
B5		1000	1600	300					1000	1000	1000	1500	1000							
B6		2000	1600	300					1000		1000									
C1	2	1,2	2	2	2				2	1,2	2	2	1,2							

Companies from 14 to 20 have not replied

## Observations

It can be noted that during the construction company interviews some difficulties have arisen then due to these reasons only thirteen companies have been concerned out of the forecasted twenty. These thirteen construction companies turn-over varies from 73 000 000 millions to 461 634 200 F/CFA.

We noticed that sand is quite used in their construction activities such as back filling, concreting, screeding, plastering, decking etc... The source of the sand varies but it is mainly from trading company quarry or from river and koris bed.

Sand cubic meter is sold between 300F to 1000F and its buying rate is not related to the company turn-over but is essentially based only on the quality of the structure, for example a construction company with 481 600 000 F/CFA of turn-over wish to buy one cubic meter of sand at 300 F/ CFA where as another company with 80 000 000 F/CFA of turn-over which is six times less than the previous can buy the same cubic meter of sand at 2000 F/CFA.

From their the price fixing is based upon the quality of work to be done. Although few companies have answered to the question. The average price of sand varies from 966,66 F/CFA to 1000 F/CFA .

Annual needs of sand for construction companies varies according to their construction activities.

## Conclusion

The recycled sand is not suitable for concrete works. Regarding the sand proposed to construction companies all have suggested to sift it again.

Still, before giving their definite opinion they wish to analyse this sand through the National Geodesic Laboratory ( LNTP/B) which can determine its suitability for construction activities.

The recycle sand can be used for the following works :

- External plasterings (tyrolienne)
- Paved road
- Screeding
- Manure / fertilizers

It can be noted that some household leaders may group themselves to contribute some money and buy the recycled sand for backfilling water locked areas during raining season which block roads and make it difficult to circulate.

Moreover the communal containers that are not emptied generate crowd of mosquitos and flies, harmful environment, microbes, diseases, bad odours, dirtiness. In fact the use of the recycled sand can solve the above mentioned issues and will keep safe environment.

From the study carried out on the peripheral neighbouring of Niamey called << villages agricoles >> It can be draw that farmers are favorables for the use of the recycled sand due to its high manure / nutrient contents. From the same study it has been also showed that chemical fertilizers are expensive.

It is sure that the recycled sand in its status can be used for farming purpose and if improve can also be used by construction companies. After all it will contribute to the improvement of the city environment

## LIST OF HOUSEHOLD LEADERS

### District:Maourey & Deizeybon

N°	Household leaders
01	Mariatou So
02	Abdou Hamidou
03	Babacard Hauma
04	Salisous Majé
05	Absatou Souley
06	Yacouba Halidou
07	Hadja Ma
08	Mintou Boubacar
09	Issaka Mamadou
10	Rabi Mahamane
11	Mohamed Afazazi
12	Bouboucar Tiemogo
13	Halimatou Amadou
<b>District:Poudrière</b>	
14	Saley Issiak A.
15	Barké Fatimata
16	Adamou Harouna
17	Mariama Boukari
18	Hadj Kadi
19	Hassane Amadou
20	Issoufou Marou
<b>District:Gandatché</b>	
21	Tinni Baba Koudou
22	Amsatou Boubacar
23	Modi Djibo
24	Hadja Ai
25	Alzouma Mounkaila
26	Boncani Gabery
27	Abdou
28	Ramatou Garba
29	Hamidou Zaki
30	Rabiou Abdou
31	Maïmouna Hamidou
32	Hadjo Ali
33	Ousmane Moussa
34	Issa Soffo
35	Sambana Ba

N°	Household leaders
<b>District: BANI Fadou</b>	
36	Harouna Idrissa
37	Yacouba Biro
38	El Maman Sani
39	Salé Adamou
40	Boubacar Ali
41	Mahamadou Adamou
42	Marouana Soumana
43	Hamadou Sambo
44	Issaka Maitoubou
45	Hama Barkiré
46	Abdoulaye Issaka
47	Soumana Seyni
48	Laouali Sansan
49	Hamidou Issaka
50	Moussa Harouna
51	Abdoulaye Issaka
<b>District: Yantala</b>	
52	Labo Boubacar
53	Yagi Yacouba
54	Issa Amadou
55	Amadou Moussa
56	Boureima Moussa
57	Diallo Razak
58	Abdoulaye Issaka
59	Araoye Didier
60	Mamadou Ibrahim
61	Modi Gaye
62	Ndiaye Boureima
63	Mamadou Souma
64	Bilali Kâ
65	Dobi Maman
66	Gozo Mariam
67	Moussa Nabiga
68	Moussa Nomaou
69	Hadiza Mamadou
<b>District: Dar El Salam</b>	
70	Daouda Hamani
71	Moukaila Hassane
72	Roukaya Ibrahim
73	Hamidou Harouna
74	Seyni
75	Abdoulaye Hassane

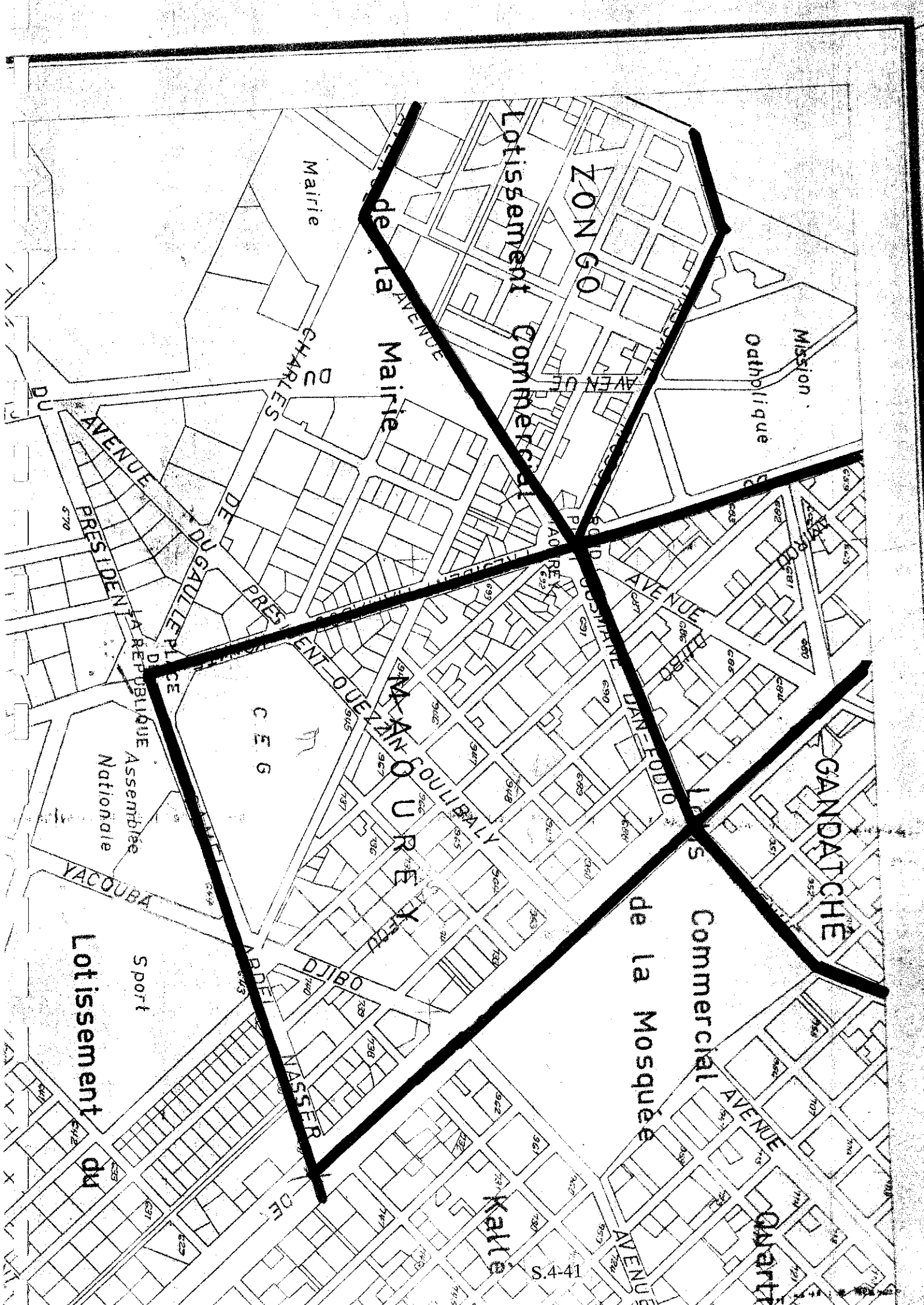
N°	Household leaders
76	Hama Hamidou
77	Madougou Djibo
78	Moussa Ladan
79	Bourkari Saley
80	Halidou Chékarao
81	Madougou Djibo
82	Mamoudou Hainik
83	Mamane Hassane
84	Djibo Hamadou
85	Chaibou Shabari
<b>District: Terminus</b>	
86	Safi Maïga
87	Tino Idrissa
88	Ibrahim M. Djibo
89	Kaliatou Maïga
90	Zeinaba Assam
91	Hadjia Hadiza
92	Mariama Tahirou
93	Boubacar Ibrahim
94	Hadjia Hamisatou S.
95	Salaou Bello
96	Rahinatou Idrissa
97	Gomey Helene
98	Issia Gado
99	Mme Alhouseini
100	Mohamed Kaïlou
<b>District: Cité Fayçal</b>	
101	Col. Mamane Mamadou
102	Madou Mamadou
103	Chaïbou Laouly
104	Cdt. Alidou
105	Lt. Col. Yayé Garba
106	Sanda Mamane
107	Sani Boukari
108	Lesteno Ibrahim
109	Amadou Garba
110	Mele Adji
111	Mady Abdou
112	Iro Yahouza
113	Moussa Harouna
114	Mamane Boukari
115	Issaka Djibo
116	Sako Amadou



N°	Household leaders
117	Maïdadji Alambaye
118	Sidi Moulaye
119	Ibrahim Labo
120	Amadou Hama
121	Gaston Kaba
122	Abdallah Boureima
123	Bakeka Monique
124	Yerima Ladan
125	Djibril Hanounou
<b>District: Zongo</b>	
126	Lamy Mamane
127	Mariama Garba
128	Safi Djibo
129	Hassane Kagéré
130	Amadou Abdramane
131	Madougou Moussa
132	Adamou A. Djibo
133	Méhaou Djibo
134	Aïssa Hamadou
135	Amadou Comlal
136	Boureima Moukaila
<b>District: Boukoki</b>	
137	Boubacar Soumana
138	Mamoudou Issa
139	Boubacar Saley
140	Ferdinand Eknedzé
141	Cissé Amadou
142	Mamadi Soumaïla
143	Issaka Maïrakoum
144	Baradjé Noma
145	Issoufou Nahanki
146	Ali Arzika
147	Haoua Bagué
148	Mohadidou Mamidou
149	Nouhou Harouna
150	Abdoulaye Ali

**LIST OF CONSTRUCTION COMPANIES**

<b>Nber</b>	<b>Construction Companies</b>	<b>P.O. Box</b>	<b>Tél</b>
1	<b>EUCB</b>	10 083	75 38 16 75 28 08
2	<b>EGEC</b>	2 678	74 04 96
3	<b>MAMAN M. SANOUSI</b>	Poudrière	Niamey
4	<b>MAGOR</b>	12 000	75 18 44 90 01 66
5	<b>ABDOU KIMBA (Technicien des Travaux Publics)</b>		7325 07
6	<b>BACHIR LAWALI</b>	Bani Fandou	
7	<b>AESTB</b>	2 358	
8	<b>SANI ABDOU &amp; Fils</b>	12 281	74 29 32
9	<b>AHMADOU MAÏGA</b>	11 657	73 39 41
10	<b>BEIDARI MAMADOU</b>	12 871	
11	<b>EAM</b>	2 465	74 27 71
12	<b>BOUBACAR SOUMANA Ingénieur TP</b>		
13	<b>TOP BTP / SARL</b>	12 616	74 22 96



Mairie

Mission Catholique

Assemblée Nationale

Lotissement du Sport

Kalla

S.4-41

Lotissement de la Mairie

Lotissement Commercial

Lotissement Commercial de la Mosquée

GANDATCHE

ZONGO

MAKAYAN COULIBALY  
URÉX

CEG

Commercial

Quartier

DE CHARLES

DE GAULLE PLACE

DE LA REPUBLIQUE

AVENUE PRESIDENT

AVENUE DE LA LIBERTE

AVENUE DE LA JUSTICE

AVENUE DE LA PAIX

AVENUE DE LA SOLIDARITE

AVENUE DE LA COOPERATION

AVENUE DE LA CULTURE

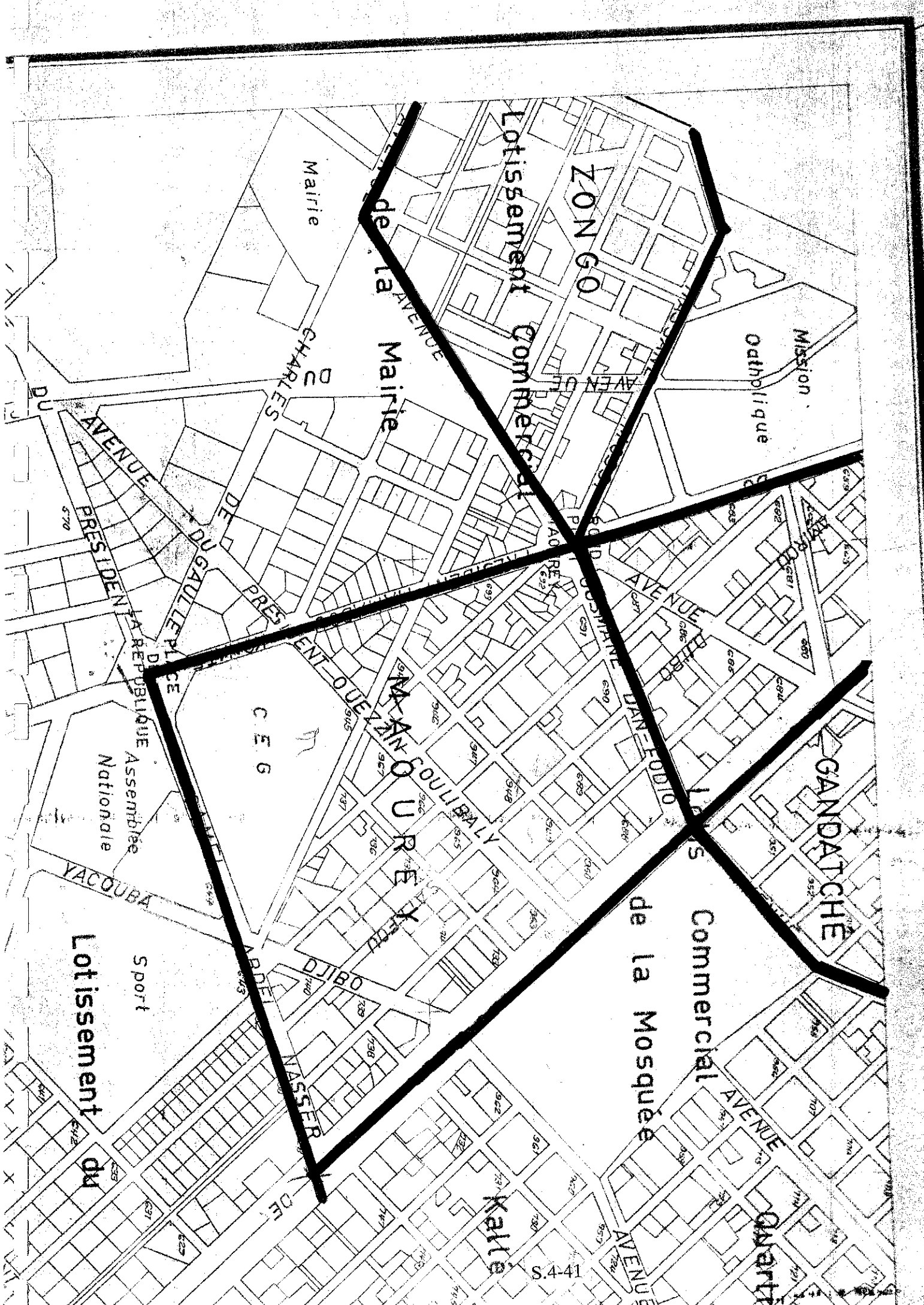
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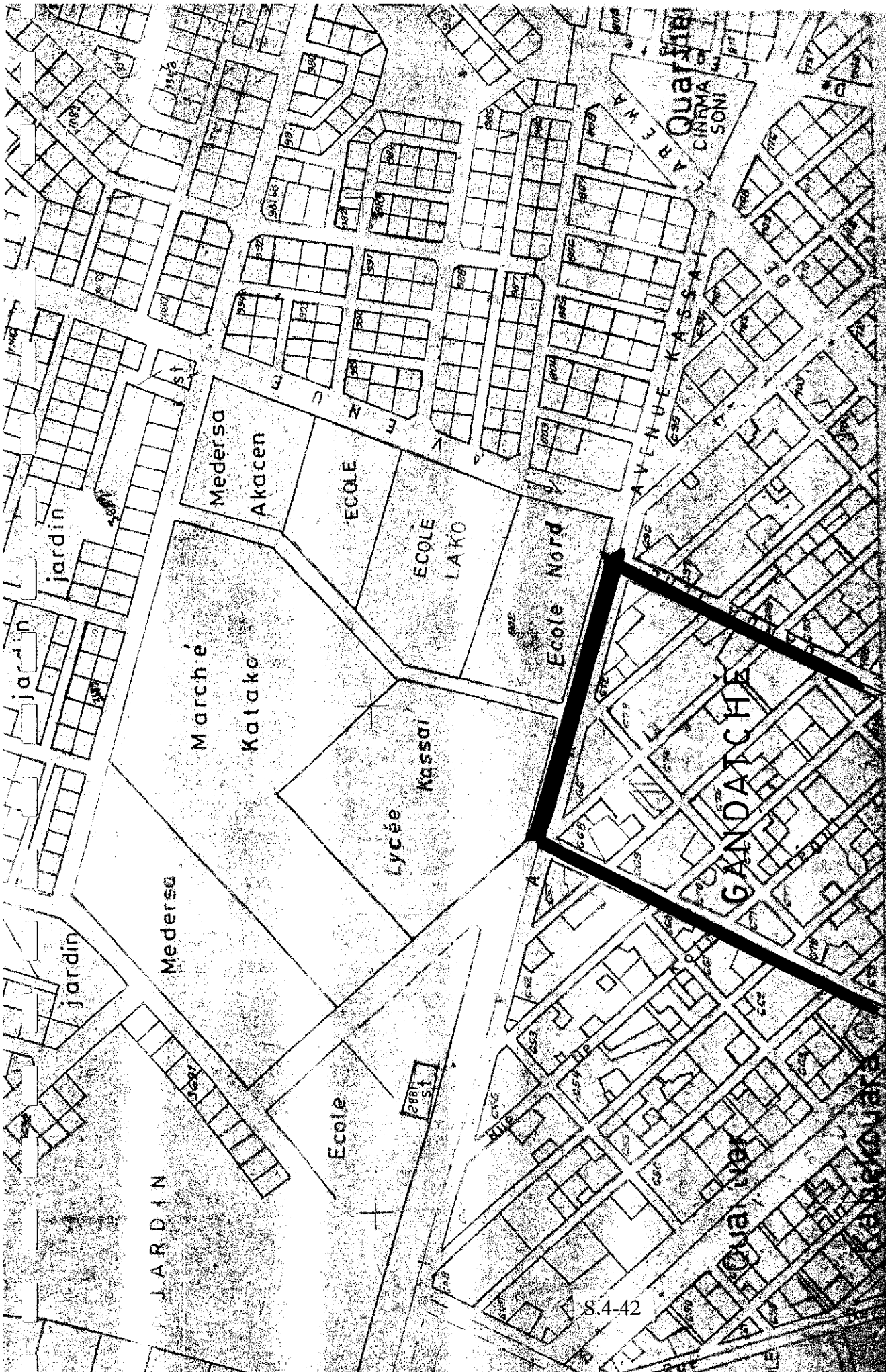
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Marché Katakò

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Lycée Kassai

Ecole Nord

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Quartier

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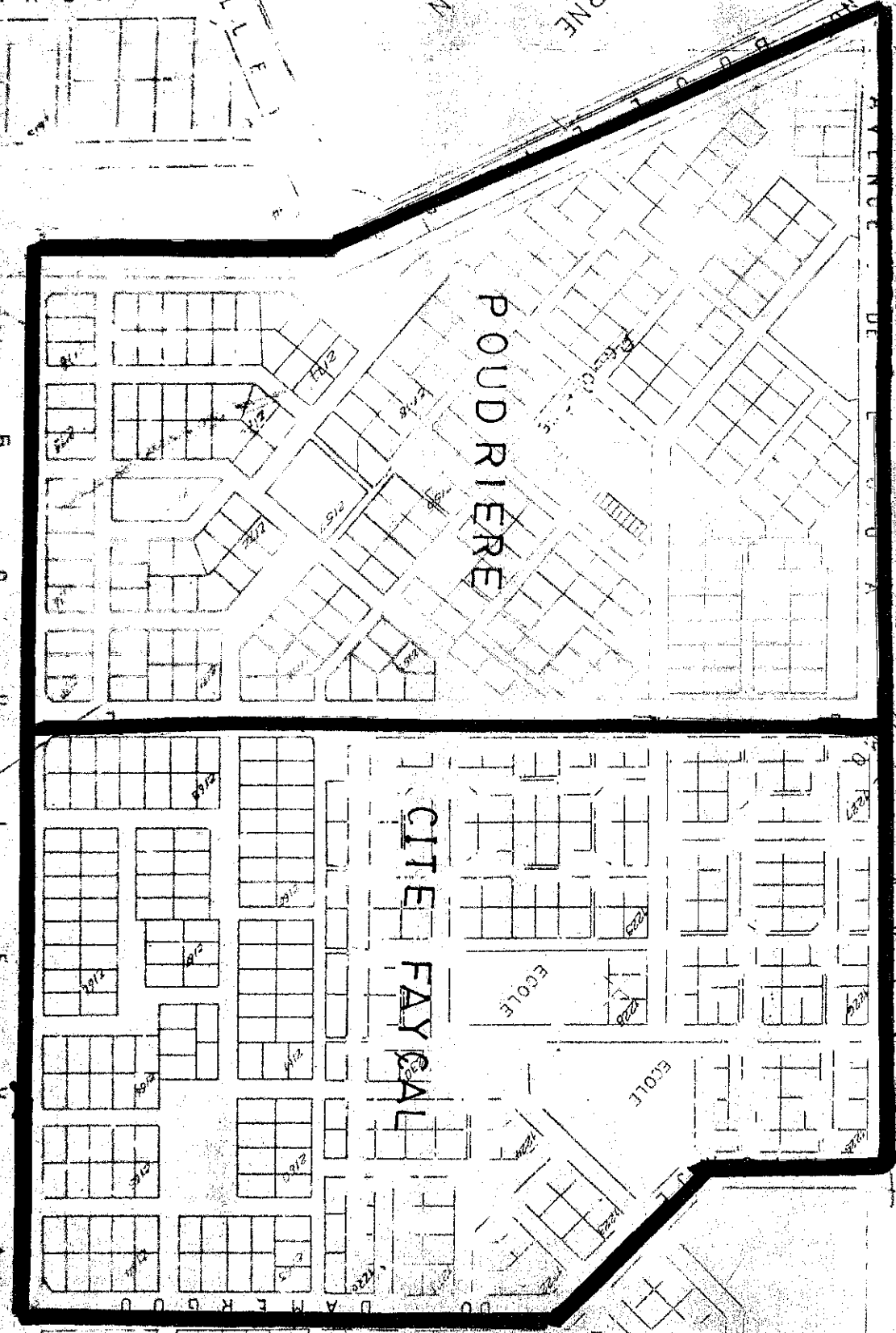
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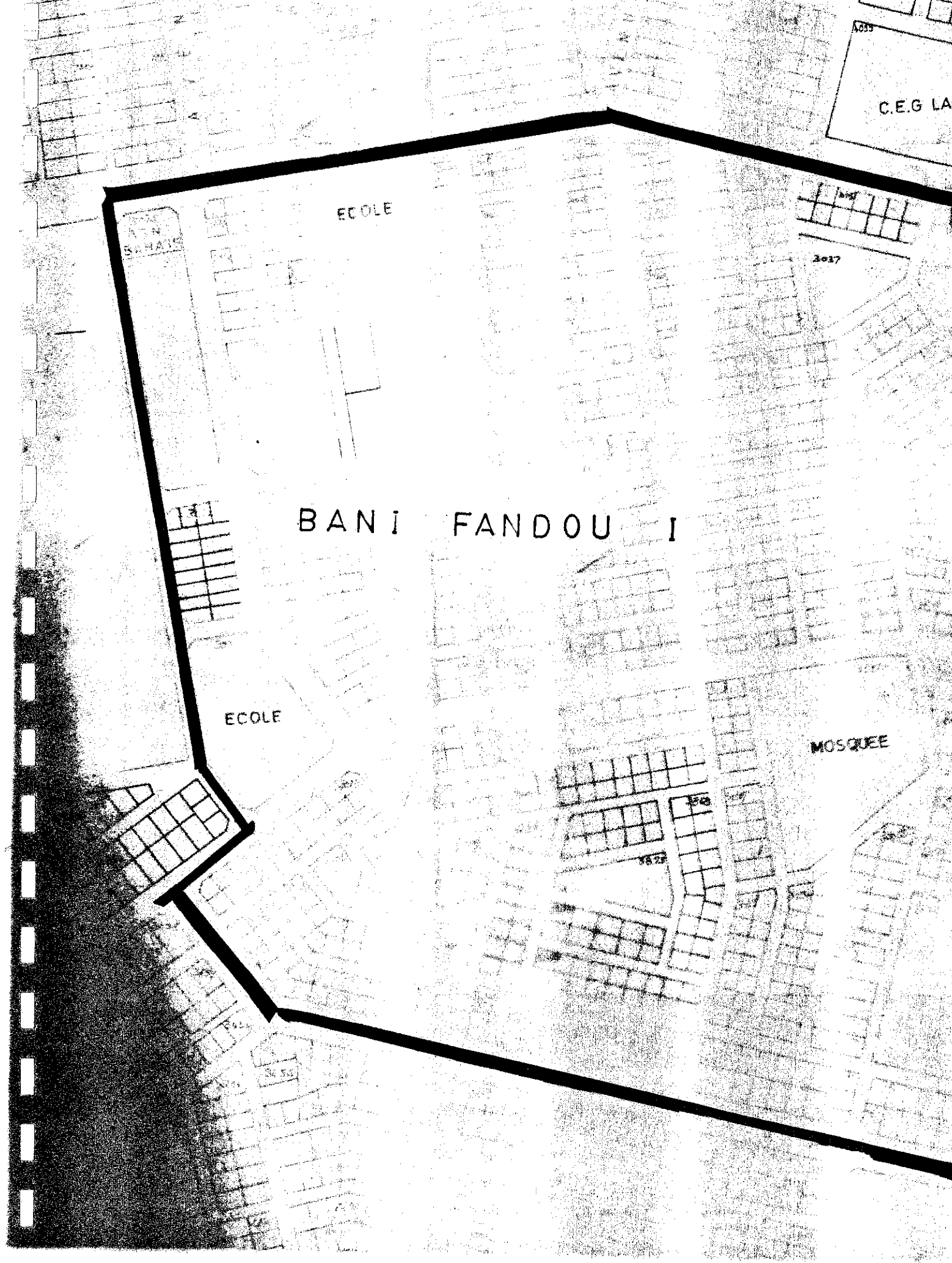
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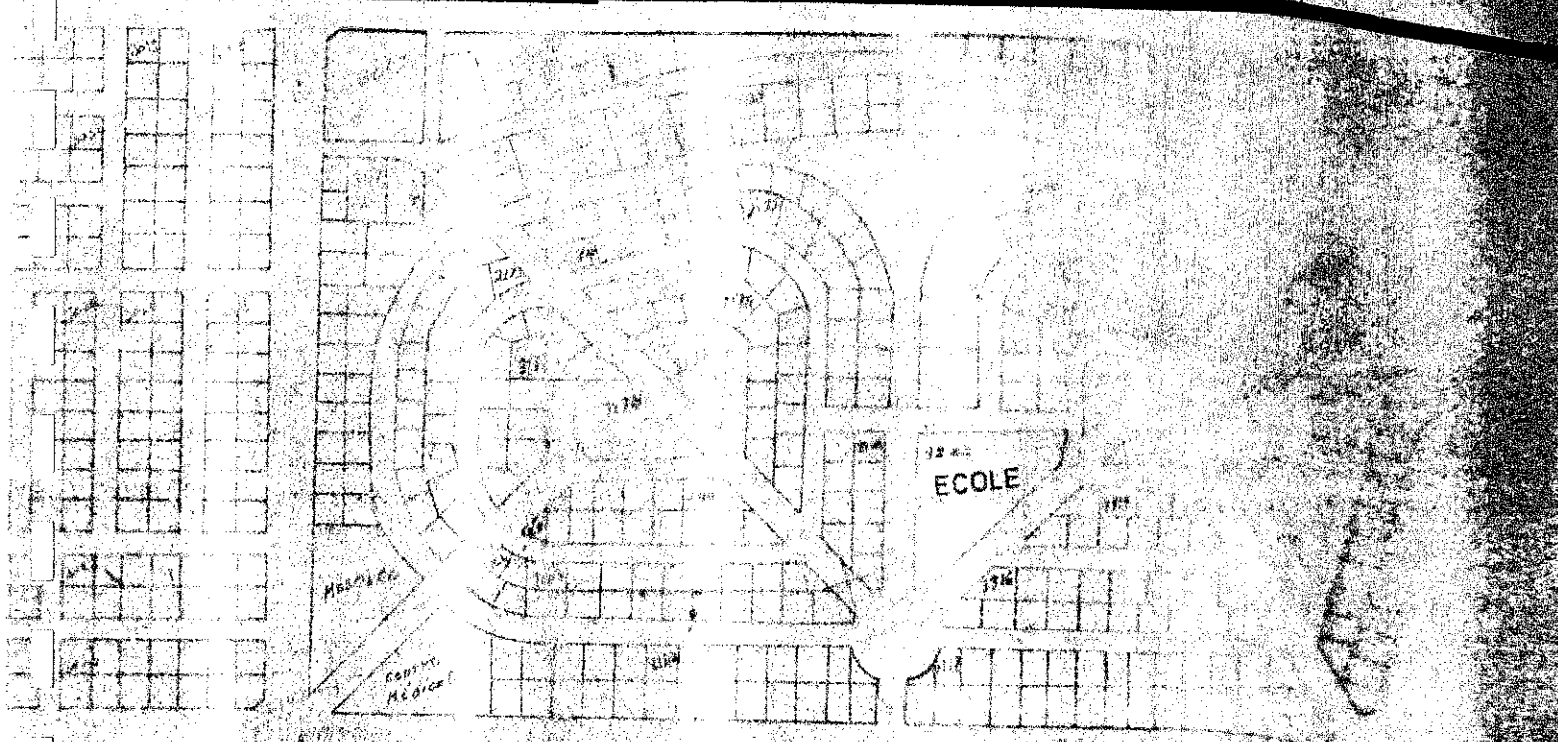
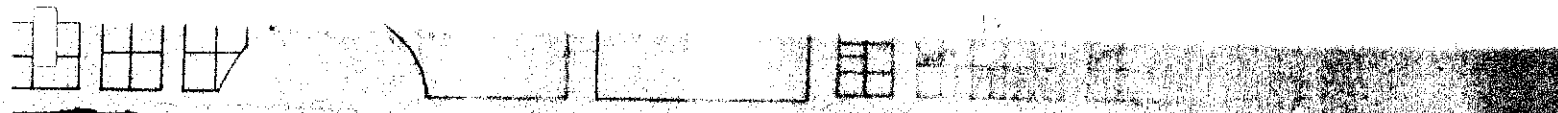
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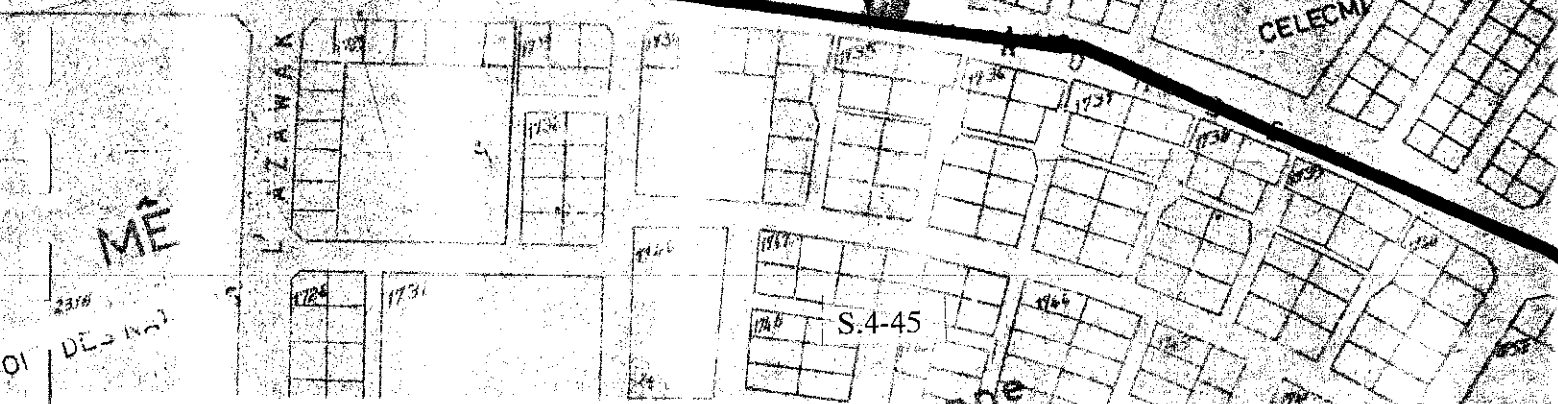
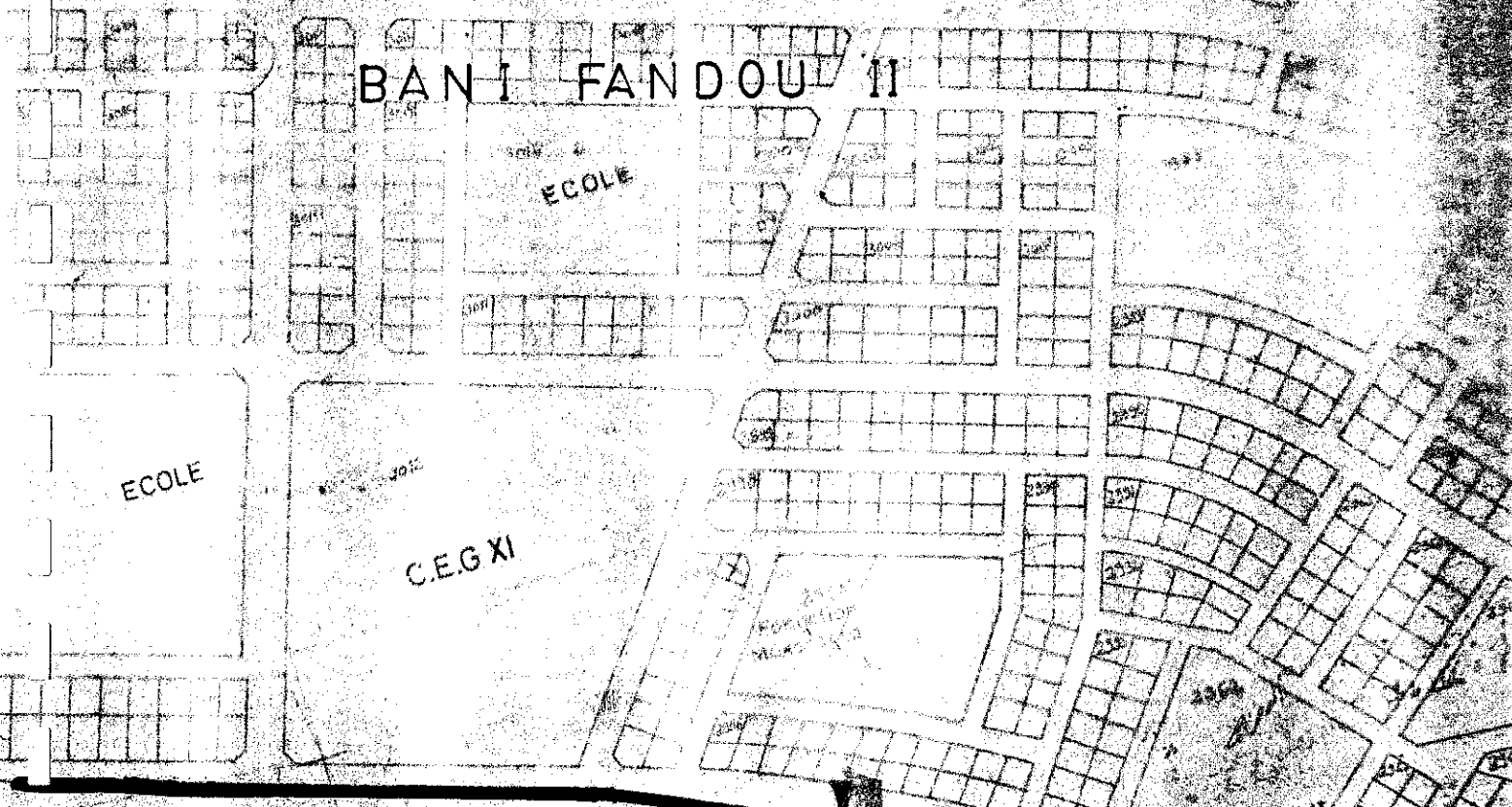
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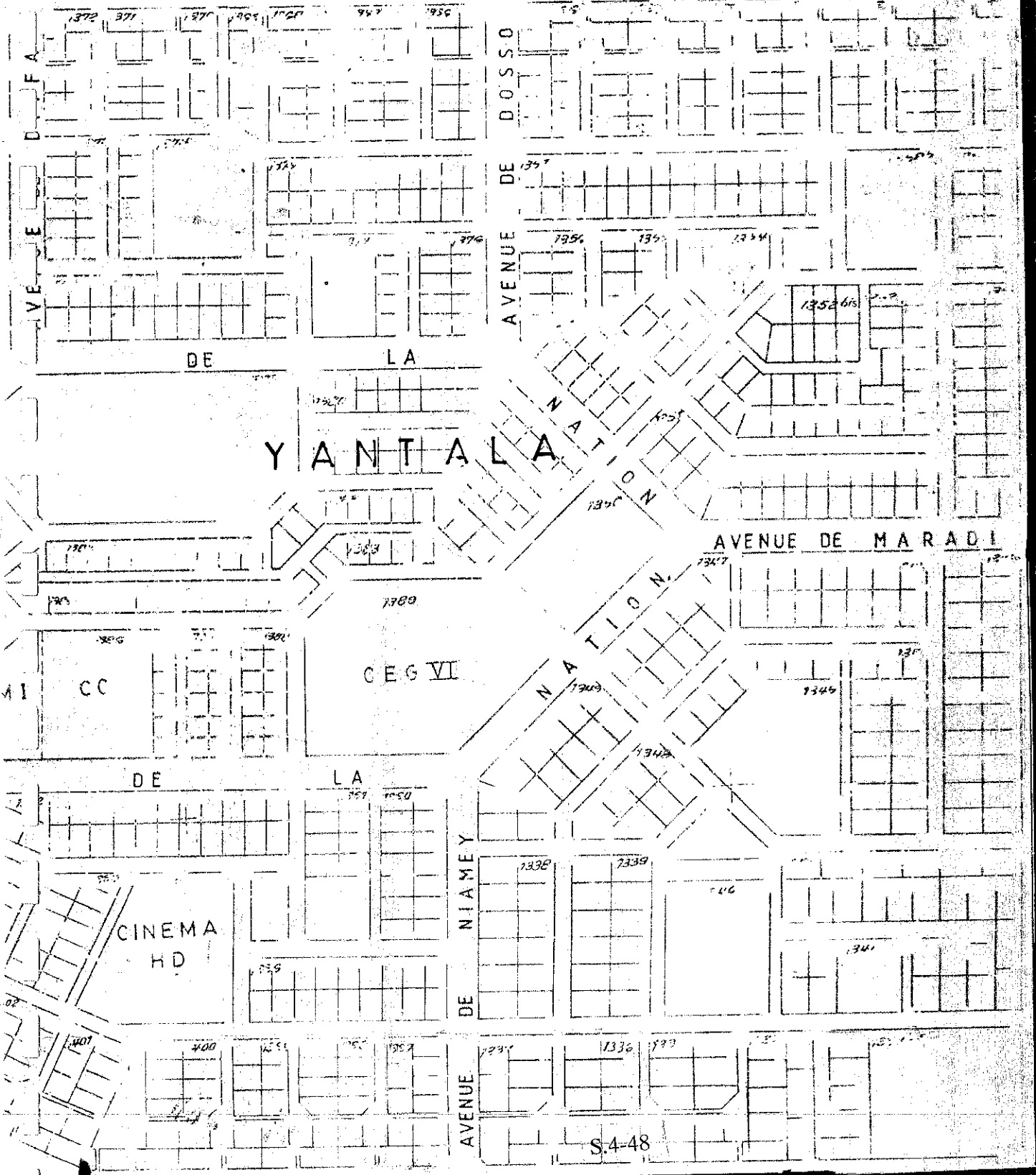
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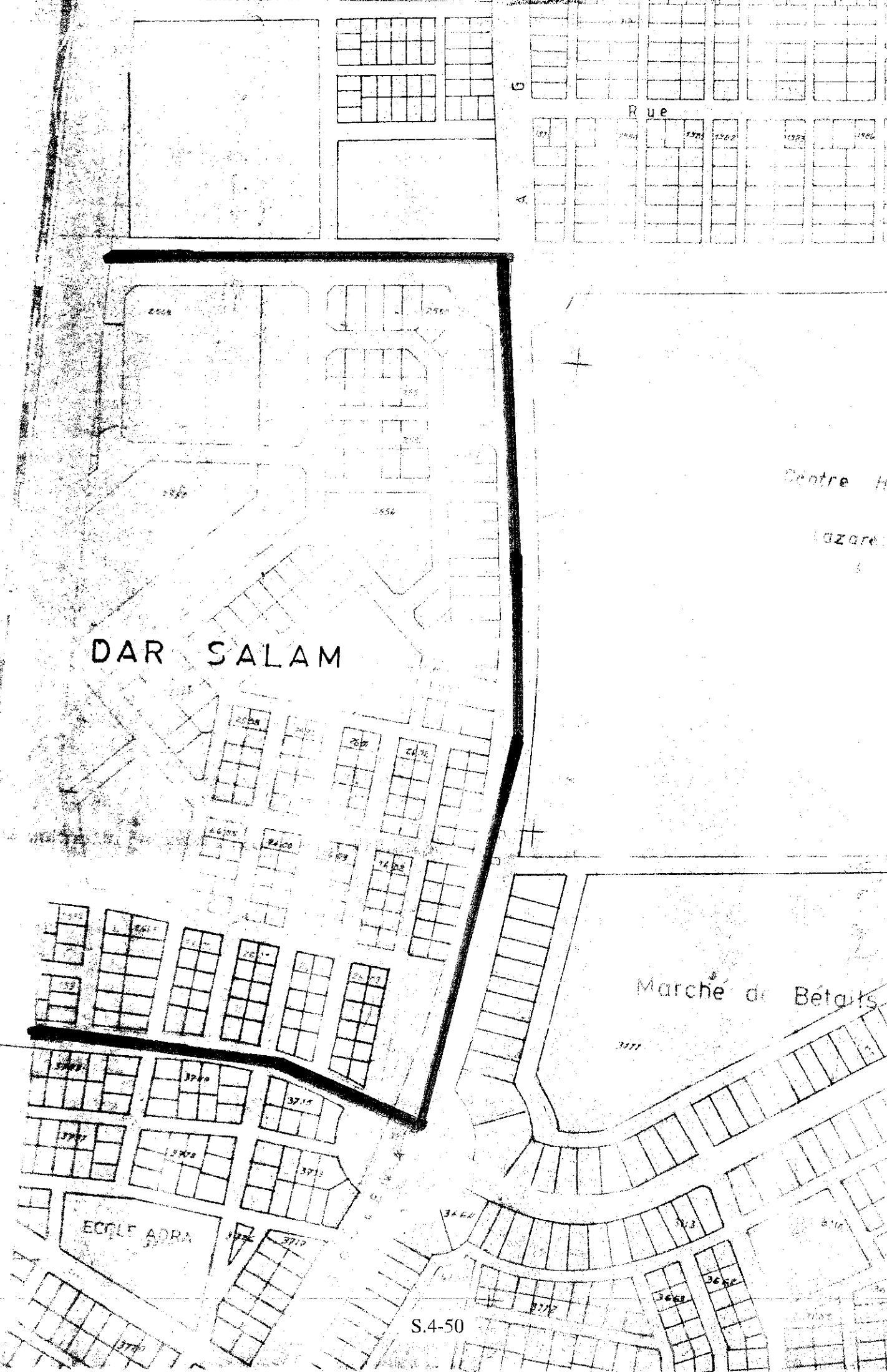
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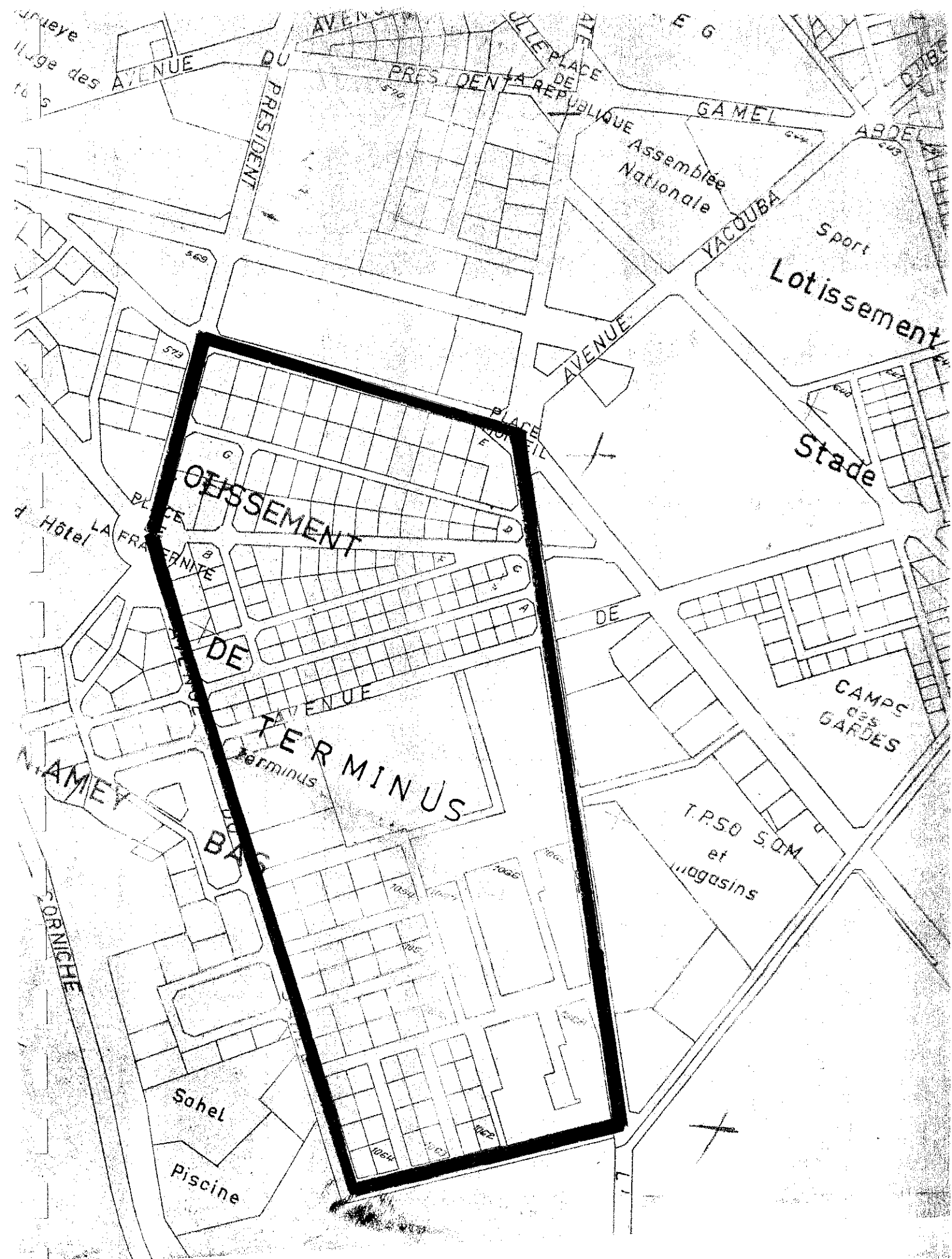
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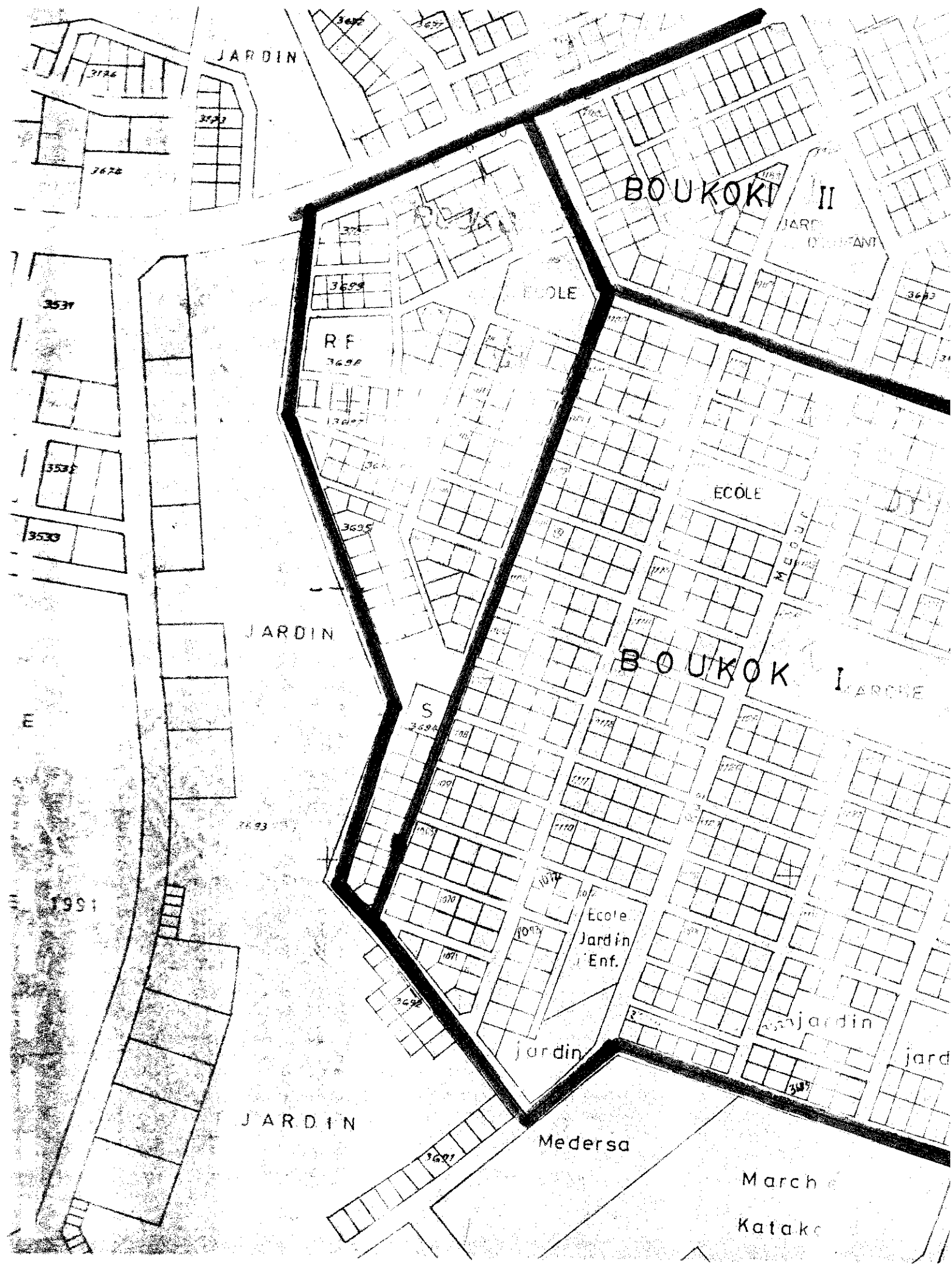
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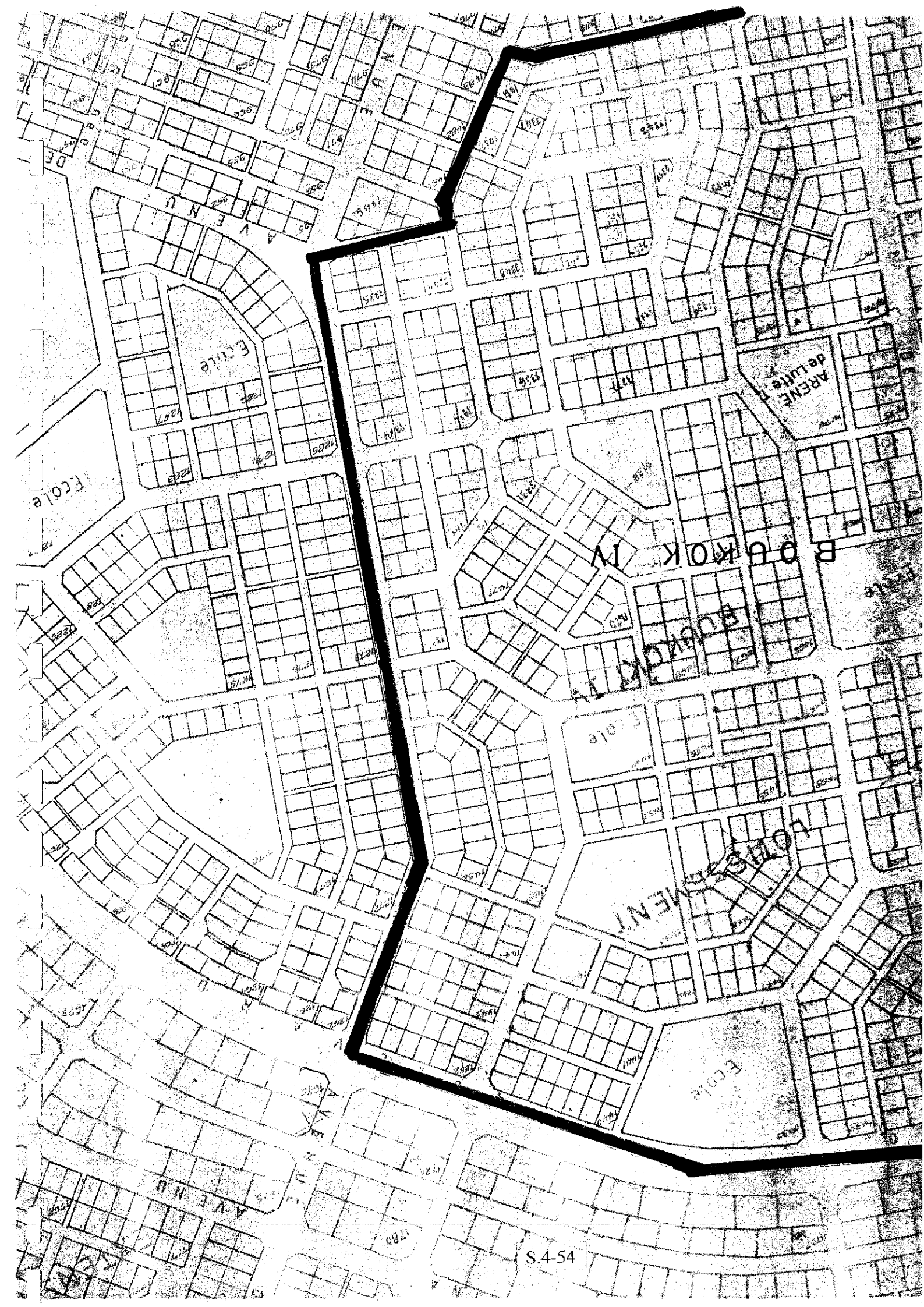
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**APPENDIX S.5 ENVIRONMENTAL  
IMPACT ASSESSMENT**

JAPAN INTERNATIONAL  
COOPERATION AGENCY  
**JICA**

**FEASIBILITY STUDY**

**IMPROVEMENT OF URBAN SANITATION OF NIAMEY :  
CONTRIBUTION TO THE ENVIRONMENTAL IMPACT ASSESSMENT**

**- Final report -**

  
**CADRES-CONSEILS**  


*SARL R.C: N° 138/RCCM/98; NIF: 2364, N° CNSS : 32227  
BP: 10421 Niamey, Rue du Parc du W, Niger  
Tel:(227) 734320, Fax:(227) 734320  
E-mail: cadres@intnet.ne  
Internet : <http://www.acmad.ne/cadres-conseils/>*

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September 2001

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## **I- INTRODUCTION**

The implementation of the guidelines is based on the installation infrastructure for the collection and processing of solid and liquid waste in order to improve the quality of the environment in Niamey.

The study made on environment conditions in the city of Niamey shows the existence of critical stakes for the environment as well as the people's living conditions.

Accordingly, Framework Act No. 98-56 relating to environment management and executive order 97-001 of January 10, 1997 require that projects and development programs conduct impact surveys on the environment.

As a result, priority programs prioritaires planned within the guidelines are subject to this impact survey in order to identify the potential positive and negative effects of these projects. After analyzing them, negative impacts reduction measures and positive impacts strengthening measures will be developed.

This survey is conducted by a team of environment specialists and sociologists for a better understanding of the stakes.

The objectives of this study, as provided by the TDRs ( see attached) are to conduct investigations on the environmental and socio-economic, in order to identify the potentials impacts of the various environmental projects and to ensure that the improvement of sanitation will not lead to a transfer of pollution.

In order to reach these objectives the selected methodology is presented below.

## **II- METHODOLOGICAL APPROACH**

The methodological approach adopted in line with this survey comprises three major components.

### **2.1 DATA COLLECTION**

This step allowed the gathering of maximum information on the various aspects of the survey, with the intent to meet the requirements of the project's implementation. Accordingly, the survey was conducted through the following phases :

#### **2.1.1 DOCUMENTARY ANALYSIS**

To make a critical assessment of the existing documentation and to seek information with the institutions involved in this issue, namely Communes Niamey I, II and III.

#### **2.1.2 FIELD OBSERVATION**

Through visits to the selected sites, the exercise consisted of gaining first-hand knowledge of the sites, checking documentary information and encouraging in-depth discussions with the concerned population.

### **2.1.3 FIELD SURVEY**

This is a series of individual and collective semi-structured interviews based on the following :

#### **2.1.3.1 Sampling**

The sample is made up of the following :

- For Banguel Torombi : 50% families living near the garbage dumping site, i.e. 4 families over 8 :
- For Koubia : 50% farmers near the site including 2 residents farmers in the vicinity of the site and two (2) others who resident elsewhere, i.e. 4 out of 8 farmers ;
- For Boukoki : 20% compounds near waste water discharges, at the rate of one household head per compound. This makes 35 household leaders for the all neighborhoods in Boukoki.
- For Dezeibon : there, 80% gardeners have been interviewed, i.e. 4 out of 5 gardeners directly affected by the installation of the waste processing plant.

#### **2.1.3.2 Data collection tools**

Following are the various aids used :

- Field observation guide;
- Semi-structured interview guide for individual interviews ;
- Semi-structured interview guide for individual interviews for collective interviews ;
- Interview guide concerning local authorities.

#### **2.1.3.3 Constraints**

This data collection phase encountered some difficulties:

- Interviewees not available (busy during farming season, daily chores for urban neighborhoods) ;
- Lack of information on the different implications of the project on their living environment.

In order to overcome these difficulties, the survey's schedule had to be reviewed to fit the particular demands of interviewees and to give them basic information on the project, as necessary.

## **2.2 DATA ANALYSIS**

This is the environmental data analysis of information that includes :

- Establishing the initial condition of the various sites at the biophysical and human levels ;
- identifying potential impacts (positive, negative) on the environment according to the different steps of the project by focusing on interactions between the activities planned for the project, environmental components (water, soil, air, vegetation, wildlife) and the living environment ;
- evaluate impacts in order to measure their importance and their possible effects on the environment ;
- identifying negative impacts alleviation measures that allow adequate integration of the project in the area, and strengthening positive impacts.

## **2.3 PROPOSAL FOR AN ENVIRONMENT MANAGEMENT PLAN**

Suggestions have been made in order to allow better integration of priority projects (4 sites under current survey) in their respective environment through a surveillance and environmental monitoring program.

### **III- ÉTAT INITIAL DE LA ZONE D'ÉTUDE**

The objective of this chapter is to determine the vulnerability or sensitiveness of target areas to the impact of the project. This description will allow the evaluation of impacts likely to be generated by the project. It establishes a selection of the major elements describing the environment to be taken into account within the selected sites. There are two sites for controlled garbage dump and sites for collection and treatment of waste water.

This description of the initial condition will focus on the biophysical and et human environment regarding the dumping sites (located outside the city of Niamey) while the environment will be discussed at length in the description of waste water collection and treatment (located in the city of Niamey).

#### **3.1 CONDITION OF CONTROLLED CITY GARBAGE DUMPS**

##### **3.1.1 Koubia Dumping Site (Communes 1 and 2)**

###### **3.1.1.1 Location of the site**

The Koubia site is administratively located in the Niamey Commune1, north-western side of the city, on Tillabéri Road (State Road RN 1).

It is located on 13°33,410' N and 2°03,560'E in the village of Koubia, 500 meters East of the police checkpoint on Tillabéri Road. The site is on a residual plateau used as a laterite extraction quarry.

###### **3.1.1.2 Historical background and land status of the site**

Before the urban growth, there were two distinct hamlets called Koubia Beri and Koubia Kaina. The indigenous population near the site stated that they belonged to Koubia Beri and had their homes located between 150 and 200 meters from the garbage dump. This current site is located on land owned by the landlords of Goudel, an urban village at three (3) km west of the site. It is surrounded by a parcelled out estate and another one that is not apportioned.

The population of the non parcelled area is made up of Goudel people and two Fulani families that had settled there for more than fifty (50) years, farming contiguous plots of land as loans. These originally nomadic people have permanent settlers and have only farms as means of production. The people who settled in the apportioned part come from various backgrounds that are difficult to identify because the parcels are bare or under construction. However, one notes the presence of a few households more than 150 meters away from the site and that will be several blocks away from the site when construction is completed. Therefore they are not direct neighbors of the site since land parcelling extends to a little less than five (5) meters from the dumping site. The site being already delimited, the neighborhood parceled out, land owners identified and given compensation, the survey focused especially on the

extension aspect of the site and the owners or users of the farmland near the site. Thus, table 1 shows the status of farms as a sample for the survey.

As a result, 50% of land users acquired their plots by purchase, and therefore they own their land. 25% by rent and loan. Behind these two cases are the Goudel landlords. Socio-economic and land tenure impacts are two-fold in this respect, that is, they involve landowners as well as agricultural workers. Interviewed landowners believe that they should be involved in any use of the site within the limits of their fields. Map No. 1 shows the site, the location of the apportioned area, the position of the two older families and the farming plots.

**Table 1 : Distribution of farmers according to land acquisition method**

<b>Status</b>	<b>Number of farmer</b>	<b>%</b>
Purchase	2	50.0
Loan	1	25.0
Rent	1	25.0
<b>Total</b>	<b>4</b>	<b>100.0</b>

### **3.1.1.3 Biophysical environment**

#### 3.1.1.3.1 Landscape and hydrography

The lanscape of the area where the site is located is caracterized by a fairly level plateau.

There is almost no water, except a few flows observed during the rainy season. This explains the lack of a visible natural outlet. Nevertheless, far from the site to the east, appears the Gountou Yéna valley that divides the plateau into two parts.

#### 3.1.1.3.2 Geology and hydrology

The entire area of Koubia is included in the Continental Terminal water table that becomes thicker as one moves away from the river. At the Continental level, one can see valleys with alluvial deposits and an alluvial ground water. Under the alluvial water lies the continental water table, which is deeper as one moves far to the est. Continental layers are in general muddy, but in valleys one essentially finds sand and alluvia.

As one moves toward the river, the closer the platform becomes, the more discontinuous the water level is. This ground water table is at about twenty meters above river level, its table is between 10 and 70 m deep and is replenished by direct infiltration of surface water.

Its filtering power goes from poor to average because the terrain is made up of sandstone and sand. The water sheet has an east-westward flow; it is in continuous line with the sheet under the flatland.

#### 3.1.1.3.3 Soil

JICA's geotechnical survey has helped to identify a series of clay, laterite, sand and sandstone layers over 10 meters deep, without reaching the water table. Highly compact clays toward the 204 meter level are fairly porous/permeable.

Soils are tropical ferruginous, more elaborate, and they mostly belong to the group of more or less lixiviated soils. Lightly humid upper horizons are made up of fine to coarse sand while lower horizons consist of sandstone in the form of a ferruginous shield. The site is actually a sandstone quarry and all around the soils that developed on old dune reliefs covering the plateau.

While they are poor in appearance, they are very easy to work due to their sandy texture and they fit less demanding crops such as millet and peanuts. However, they are very fragile and their upper horizons are sometimes eroded by the rain or wind.

The floor of the projected excavation site will be 214 meters high, that is, 9 meters above that natural protection layer. The underground water lies below, at an Not determined depth. Sandy levels intercalated between the dumping site and the protection layer, located between the 205 and 209 meter levels, that is, a 4-cm width, are therefore exposed to lixiviat infiltration. The forefield of the excavation project will be about 2 to 3 meters high.

#### 3.1.1.3.4 Climate

This element of the biophysical environment includes all the sites in this survey, because all of them are located in the same climate zone of the City of Niamey. This area has a Sahel-Sudanian climate.

Rainfall is irregular. The rainfall for Niamey is on average 600 millimeters per year (graph 1). The rainy season lasts 160 days maximum. Rainfall intensity is relatively moderate despite their stormy nature. Here the average intensity per rainy day is 11.6 mm.

However, rainfall can be exceptional some years. That was the case in 1998, when the city had over 1,161 mm.

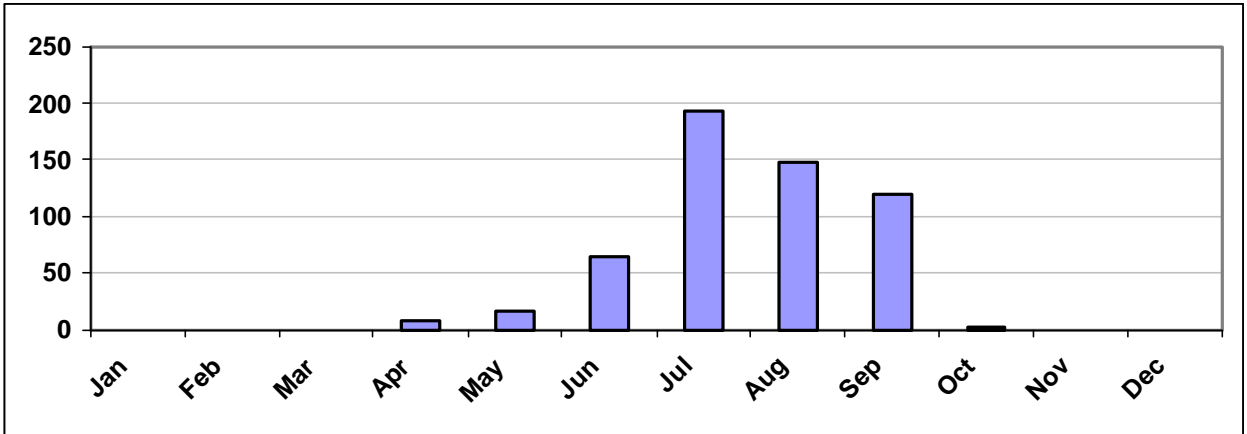
Relative average humidity ranges from 60 to 78% from June to September, usually with a peak of 83% in August and 48 to 59% from October to May, and a minimum of 22% in March (graph 3). Average annual temperature ranges from 25.5 C to 34.7 C (graph 2). Thermal amplitude (temperature variation) is about 9 C.

Evaporation depends on high temperatures and it decreases in August-September due to increasing relative humidity. Airflow is marked by the alternating flow of two air masses that oppose each other by their humidity. That is the harmattan or

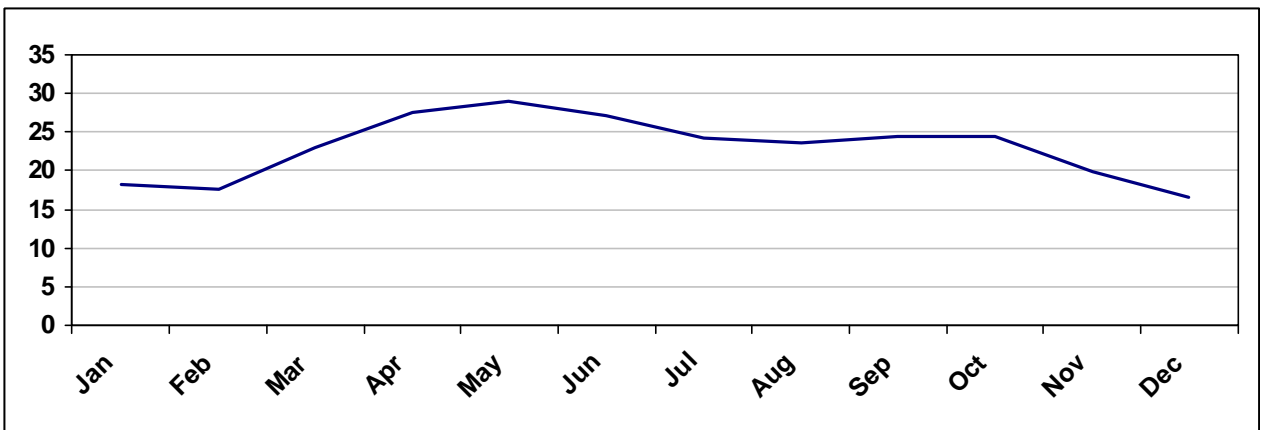


continental wind, a very dry wind that blows from north to south; and the monsoon coming from the south-west. The speed of the observed winds is 10 m per second.

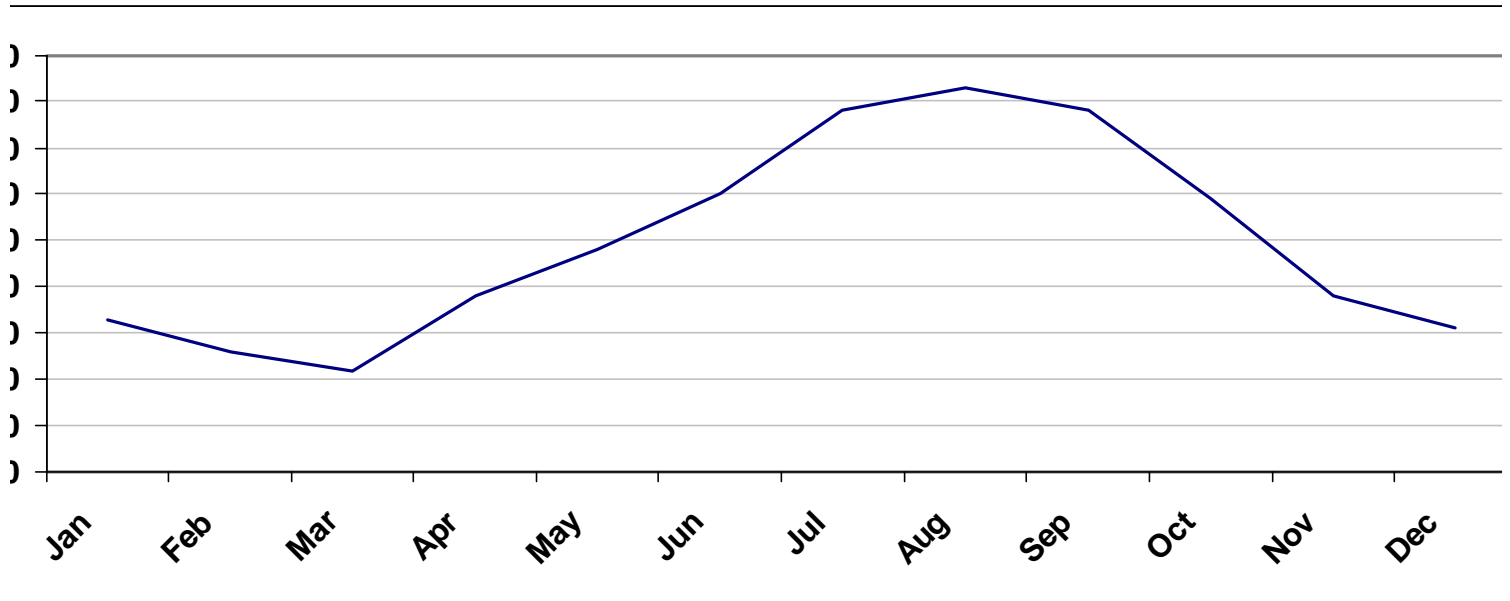
Like everywhere else in the country, the feature that marks the climate in Niamey is the drought and the rainfall that is unevenly spread over time and space.



**Graph 1 : Average monthly rainfall (in millimeters) for the 1999-2000 period - Niamey airport**



**Graph 2 : Average monthly temperatures (C) from 1999 to 2000 - Niamey Airport**



**Graph 3 : Average relative humidity (%) over the period 1999 to 2000 - Niamey Airport**

#### 3.1.1.3.5 Vegetation and Wildlife

In the north-eastern part of Niamey where the site is located, the vegetation is steppic, made up of trees and shrubs. However, this vegetation deteriorates gradually under the influence of rainy season crops, but especially under the increasing areas under construction. The current landscape may further deteriorate under the influence of the urban pressure.

The tree and shrub vegetation is made of only a few trees and shrubs in farms neighboring the site, with species such as *Balanites aegyptiaca*, *Acacia albida*, *Bauhinia rufescens* and *Calotropis procera*, as well as a small number of planted *Prosopis juliflora*. The grass stratum on the site is hardly observable on the field.

Wildlife is almost unavailable due to human destructive actions on wildlife dwellings. However, the presence of some bird species has been noted.

#### **3.1.1.4 Human environment**

##### 3.1.1.4.1 Space organization and functioning

The former village of Koubia Kaina and its site are integrated in the modern neighborhood under construction called Koubia. It is under the administration of the Commune Niamey I, but falls directly under the authority of the traditional chief, the Amirou of Goudel.

Concerning the settlement, one can notice that the allotted area and the farming areas form a belt all along the site. Only two big non-owner farmers' families have been living there for over 50 years in the vicinity of the site. The first family actually lives by one of the two access roads to the site. This track is the way out to more or less remote villages from Koubia. The other families (broken apart) that are owners or farmers are scattered in Koubia far from the site, in Goudel or in Kouara Kano. At present, some parts of the site are used as city garbage dumps while others are used for the extraction of laterite. Cesspit emptying tankers load off all day long near the site.

#### 3.1.1.4.2 Condition of the road traffic

The current condition of traffic on Tillabery road is essentially passenger transport. In addition, the same road is used by funeral convoys during the day between 9 and 10 a.m. and between 4 and 5 p.m. These two types of use of the road, in addition to city traffic plus the transport of waste to the Koubia dumping site will further increase the intensity of traffic.

#### 3.1.1.4.3 Housing

The habitat next to the Koubia site is made up of an allotted area and another area not yet allotted.<sup>(1)</sup>

The allotted area comprises:

- un set of cement houses under construction;
- non built parcels used provisionally as farming land during the rainy season.

The area that is not allotted:

- 7 mud houses;
- 2 thatch huts;
- 1 mosque in banco clay;
- 1 cement mosque in advanced construction.

The ongoing construction dynamic does not allow to establish a sound typology of the area of the site. One notes however the existence of walls for all houses except the mosques and one hut.

Residents near the site are the owners of their houses.

#### 3.1.1.4.2 Socio-demographic situation

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<sup>1</sup> The area located to the west side of the paved road (RN!) is not taken into account in this survey.

The area of the Koubia site is an urban outskirts which, under the influence of the city's extension, becomes an urban center. The population of the allotted area that still lives in the big city is very difficult to contact due to its constant movement. In fact, these are households that come to work during the day and return at night their places of residence. These facts make it difficult to control socio-demographic indicators.

Nevertheless, a comparison of survey data has allowed to determine the size of surveyed households based on table 2. One can notice a predominance of women who represent 53% of this population against 47% for men.

Thus the 4 households surveyed make up a total population of 91 inhabitants with an average of 23 people per household.

**Table 2 : Surveyed population pattern per gender**

<b>Gender</b>	<b>Number of people</b>	<b>%</b>
Men	43	47.0
Women	48	53.0
<b>Total</b>	<b>91</b>	<b>100.0</b>

Currently, it is difficult to determine the exact size of the neighboring population of the site that will be directly affected by the project. In addition, concerning the allotted area, settlement is ongoing and the area not allocated may be so any time, with an important flow of people.

For time being, there is no health center, no playgrounds in the vicinity of the Koubia site within a 150 m radius. Families that reside there have to attend schools and health centers located either in Niamey or in Goudel, with respective distances of 1 and 3 km. For children with illness and pregnant women, walking these long distances may prove difficult.

#### 3.1.1.4.3 Economic Activities

If the activities have to be related to the quarry exploitation policies, three major activities can be identified, including: vegetable production, livestock raising and indirect and indirect exploitation of the quarry. An indication of the function of each of these activities is presented in table 3.

**Table 3: Appreciation of the relative importance of economic activities in the families' daily lives**

<b>Economic activities</b>	<b>Types de produits</b>	<b>Fonction</b>
Cereal Production	millet, sorghum, black-eyed peas, corn, peanuts	- production mainly used for self consumption during the most of the year in case of good harvests
Livestock raising	sheep, goats and cattle (cows)	<ul style="list-style-type: none"> <li>- animals are bred and sold in order to generate revenues needed to address urgent money needs</li> <li>- Women's livestock (small ruminants) represents up to 80% of family herds</li> <li>- about 20% of the milk are home-consumed by children and women and 80% are processed into sour milk and butter sold on the markets in Niamey</li> <li>- women use the proceeds in order to solve their personal or their children's financial needs</li> </ul>
Indirect and direct exploitation of the quarry	500-750 Francs per day per truckload, that is 22,500 CFA Francs per month	<ul style="list-style-type: none"> <li>- revenues earned allows to meet daily needs:</li> <li>= access to groceries used in cooking (daily meals)</li> <li>= access to medical care</li> <li>= help poor relatives and friends</li> </ul>

### **A- Vegetable Production**

Millet is the main crop in the 7 neighboring fields of the site. According to farmers, the production varies from twenty (20) to one hundred (100) bundles of millet depending on the crop year, with a regular frequency of fifty bundles per field, for an estimate of five 100 kg-sacks of 10 bundles per sack. Millet is grown in association with black-eyed peas that are the second crop, sorghum, corn and peanuts.

Throughout the year, the field study noticed that labor was provided by daily agricultural workers in 6 fields out of 7. This is explained by the fact that agriculture is not the farmers' main activity. All the farmers (100%) interviewed stated that the agricultural production is used for the households consumption. Finally, it should be noted that visits on the fields has helped to find out that 100% of the farmers use city waste as organic fertilizer in order to improve soil quality and increase their production.

### **B- Livestock raising**

This is home-breeding made up of a few cattle used for fattening and which use local pastures within and around the site. The are animals coming daily from nearby neighborhoods (Koiria Kano, Yantala, Koubia).

Commonly-encountered animals are cattle, sheep, goats and donkeys. This activity is actually exotic for the urban population, which makes it really difficult to measure the resources generated by this activity.

### **C- Resources related to the exploitation of the quarry**

The whole site is considered as apart of the land owned by landlord families. There is A tacit regulation that obliges each transporter of quarry materials to pay on average CFA 500 per truckload to the owner of the place. Owners of these parts of the site that do not have fences and are not exploited enough earn on average CFA 750 per day and per owner. This average was established during busiest and less busy days and provide about CFA 22, 500 francs per month and per owner.

There are also cases of barter or direct exchanges of waste dumped on the fields against quarry materials according to negotiated proportions. Thus, unlike its appearance, Kobia proves a profitable Kobia implicit or explicit business setting.

### **3.1.2 COMMUNE III TORODI ROAD GARBAGE DUMP (BANGUEL - TOROMBI)**

#### **3.1.2.1 Location**

This site belongs to the City of Niamey Commune 3 (3<sup>rd</sup> Precinct) on the right hand side of the River Niger. Its coordinates are: 13° 29, 820'N et 2° 02, 543' E on the right la route de Torodi, west the city of Niamey , at about 3 km form the police check point, on a residual plateau used as a quarry.

#### **3.1.2.2 Historical background and status**

According to the data of the field survey, the first settler next to this site is called Torombi, that gave the name Banguel – Torombi, which means Torombi's hill or residence or résidence. Torombi's descendents organized in three families currently live east of the site that constitutes their living and production/work environment. According to representatives of these families, they have lived there for more than 150 years, that is since Torombi's time, who comes from Djanyawai, then his son Djibo who gave birth to Quéranga. Finally Boukari, a descendent of the latter is the father of the current families. Therefore it is the basis for claiming legal ownership of the land by these families claim, while other families that settled there recently consider in their majority the site as a community resource, a vision that coincides with that of Commune III officials.

In this category, there is a family from the neighboring village of Banguel that asserts that the land of this site belong to their ancestors before Torombi's settlement. Otherwise, other families have acquired their plots of land next to the site via purchase. One also notes the presence of families from Kourtéré. Therefore there are several versions of the story regarding the status of the land and the conflicting claims are potential sources for conflicts. In terms of land ownership, the level of intensity of the people's bonds with their land determines the degree of satisfaction therefore the psychological and material impact in case of overexploitation, resettlement and compensation. In other words, the more affective ties (ancestral) one has with the land, the less inclination one has to accept expropriation and resettlement and one is less likely to be satisfied by material compensation.

As a result, owners or farmers per purchase, bequest or loan are less likely to be satisfied by the compensation than the owners through legacy who consider the land as a irreplaceable family property. A first identification of the owners of fields contiguous to the site has been carried out by the technicians of Commune III and determined three owners.

However the field study, based on the possible impacts of operations on the site has identified eight (8) families spread out around the site that exploit farmlands near the site. All these families have direct access to the site and consider the extension of their farm on the site as part and parcel of their land. That is why each family claims the payment of some kind of rent for the exploitation of its portion of the quarry by private farmers.

### **3.1.2.3 Biophysical environment**

#### 3.1.2.3.1 Landscape and hydrography

The site that lies on flatland is part of the quarry transformed into a dump.

The hydrographical component that is relatively close to the area is the River Niger, about 2 km east of the site. In Niamey, the river valley is inserted in sandstone of the Continental Terminal that overlook the new alluvia.

The river is a permanent water course that floods and low waters are respectively during the period of January - February and June - July. The site is on the bank of the River Niger.

#### 3.1.2.3.2 Geology and hydrogeology

The water table of river alluvia commonly called the flatland underground water. After the river, it is the second water resource for domestic and agricultural use by neighboring quarters (Gawèye, Lamordé, etc.).

From the geological point of view this water table is linked to the quaternary alluvial overflow of the river ; it has replenishment cycles that depends on rainfall.

The underground water is particularly exposed to pollution threats due to its shallowness and its situation under alluvia that are usually very porous (Gross et al, 1999). The underground water level overflows and varies between 0 and 15 m. The water table presents a filtering power that is virtually null.

### 3.1.2.3.3 Soils

The same study carried out by JICA allowed to identify a series of clay layers over about twenty meters deep, with a water table of 195 m, protected by the impermeable clay layer at the 199 m level.

The floor of the excavation site will be developed just over this natural protection. Lithological layers crossed by the excavation are also clay.

Around the site, soils are ferruginous and somehow less lixiviated than the site dealt with earlier. These soils with sandy texture are used for the cultivation of millet. But the mid horizon of the site serves as a quarry because it is made up of gravel.

### 3.1.2.3.4 Vegetation and wildlife

The vegetation is made up of trees and shrubs, but more dense and more diversified than the previous site. In fact, there is less pressure on existing resources and species within each stratum. The tree stratum is made up of species such as *Hyphaena thébaïca*, *Acacia nilotica*, *Balanites aegyptiaca*, *Bauhinia rufescens*.

The shrub stratum is made up of species such as *Calotropis procera* and *Combretaceas sp.*

Et the grass stratum contains the following species : *Leptadenia chastata*, *Brachiaria sp.*, Bagodalo (D), *Pergularia tomentosa*, Kikir (D).

The small wildlife is made up of squirrels, snakes, rats, scorpions and birds.

## **3.1.2.4 Human environment**

### 3.1.2.4.1 Space organization

The eight (8) families neighboring the site are administratively linked to the village of Kourtéré for some and Ganguel for others. These two villages belong to the County of Bitinkodji in the Kollo District (Tillabéri Region). Until the promulgation of new laws on decentralization to transfer this area to the Commune III of Niamey, this area is still not part of the City of Niamey. Therefore, some harmonizing and collaboration work remains to be done between the Commune III and the District of Kollo.

As regards settlement, each family is made up of a family head, one or several wives and children, thus forming the household. Each household has its own house and one or several plots of land that allow the family to support itself. All fields and houses form a belt around the dumping site. Houses are located within ten (10) and thirty (30) meters from the site, all of them surrounded by gardening plots. Each family has a small enclosure for animals during the rainy season.

In addition, the site serves as a pasturing area, rest and passage corridor for the animals of neighboring population. It also serves as a restroom for the population that



also use water from the three main ponds for their laundry and bath during the rainy season.

In terms of traffic, movements between families or households and outside are made using paths through farms and the site that is crossed by several passages only known by the local people. These tracks serve as shortcuts to facilitate access from one point to another.

The of Banguel-Torombi is part of the daily lives of the neighboring population that developed a real strategy over time in order to adapt themselves to the local environment.

#### 3.1.2.4.2 Condition of the road traffic

The Torodi road is not only used by long truck convoys from the ports of Abidjan, Lomé, Accra and Tema, but also by a lot of used car imported from Europe. In addition to this regular traffic and the city traffic, there is the daily transport of waste toward the site, making traffic heavier on this road.

#### 3.1.2.4.3 Housing

The Banguel-Torombi site is located outside the city of Niamey and the Commune III, especially in the rural area. Houses are essentially traditional style. Table 4 provides the housing typology.

**Table 4 : Distribution of farmers according to type of housing**

Type	Number of farmers	%
Hut/thatch	20	80.0
Mud/Banco clay	3	12.0
Cement	2	08.0
<b>Total</b>	<b>25</b>	<b>100.0</b>

From this table, one notices the presence of 20 thatch hut that represent 80% of all houses. Huts are arranged in circles making up families. There are also 2 cement houses owned by a businessman who recently settled near the site. The there are 3 mud houses, that is 12% of all houses around the site. All heads of households are owners of their houses. By observing the place, one notices that there are no walls around the houses except the house of the businessman. In addition, the doors are open about 17 hours a day, and this allows flies, mosquitoes, insects and odors to invade the houses during the use of the site. Food reserves (granaries) that are made up of thatch and located in the vicinity of the site will also be invaded by these insects.

#### 3.1.2.4.4 Socio-demographic Situation

Two ethnic groups make up the population of the site :

- A majority of Fulani settlers (7 families) made up of about 88 people ;
- One Zarma family counting 12 people.

This population is 100% Muslim ; as an evidence, 60% of the people interviewed have a coranic education. Each family has a space that serves as a mosque. However, the inhabitants of the site go to big villages, especially Kourtéré and Guanguel to participate in socio-cultural activities, health care and schools.

Concerning the structure of the population, table 5 shows the data from the field survey.

**Table 5 : Population Structure**

Age groups	Men		Women		Total	
	Number	%	Number	%	Number	%
0-10 years	7	14,00	8	16,00	15	30,0
11-20 years	3	6,00	6	12,00	9	18,0
21-30 years	4	8,00	6	12,00	10	20,0
31-40 years	3	6,00	4	8,00	7	14,0
41-50 years	2	4,00	2	4,00	4	8,0
51 years &over	3	6,00	2	4,00	5	10,0
<b>Total</b>	<b>22</b>	<b>44,00</b>	<b>28</b>	<b>56,00</b>	<b>50</b>	<b>100,0</b>

This table shows that the population of the site is predominantly young, with a 30% majority of 0 to 10 years and a lower group below 41 to 50 ans representing only 08% of the population. Considering the 0 to 30 years old, there are about 68% of the population qui sont jeunes. This is an important and very sensitive group to any form of pollution, as the site and its vicinity are recreational areas. Young people also constitute a source of new needs in farmalnd. There are also more women (56%) than men (44%). By making the average of people per family or compound from a sample of 4 families, there are about 13 people per family (12.5), that is 100 inhabitants for the 8 families directly concerned by the site.

#### 3.1.2.4.5 Economic activities

Economic activities in this rural area are agriculture, livestock-raising and the indirect exploitation of the quarry (exploitation tax collection).

#### **A- Agriculture**

Millet is the main crop, cultivated in association with black-eyed peas, sorghum, melon, okra and watermelon. Te Agricultural production is used for home consumption, but associated crop surpluses are sold on the Commune III market.

Note that farming plots are very small due to their position between the River Niger and the a mountain by the site. Interviewed people are very reluctant about providing figures on their production, and this does not allow an assessment of its importance.

In addition, over 90% of the families by the site have gardens near their houses, located outside or in the fields exploited during the rainy season. Irrigated crops are also practiced in the river valley. In the gardens one finds tomatoes, onions, corn, sesame, pumpkins, melon, watermelon, moringa, cabbage, lettuce, okra, cassava, etc. These products are used for home consumption as food supplement strategy, and for sale in order to secure some financial resources to meet basic needs and to purchase small ruminants (sheep and goats) for women. The products are essentially sold in the city of Niamey.

Therefore, the Banguel-Torombi neighboring populations have developed a strategy to adapt to their physical environment with associated crops, gardens during the rainy season, and gardens throughout the year the production of which is sent to the urban markets.

## **B- Livestock-raising**

Livestock-raising is the second economic activity of the area. The people there are agro-pastoralists made up of 90% Fulani herders. Even if animals are sent up north during the rainy season, each family has an enclosure for a few animals used for fattening or to address daily needs in dairy products and earn related revenues.

The direct count of animals with the Fulani people being a taboo, one may only note the presence of cattle, sheep and goats. These animals use the areas around the site for pasture and passage corridors or access to other grazing areas. During the rainy season the animals get water in the site's natural ponds. There is also poultry in the various houses of the site.

## **C- Resources related to the use of the quarry**

Before the limitation of a portion of the quarry in order to create the garbage dump, people said that the use of the quarry for laterite was dense. Each family could earn on average CFA 1000 francs per day, that is CFA 30,000 per month due to the use of the quarry. It should be noted that each family collects its own " tax" on the portion contiguous to their field and considered as an extension. To this date, for each truckload of laterite, the users of the quarry pay to the owner family CFA 500 on average.

The intervention of Commune III authorities has limited the power of the population on laterite transporters, which resulted in a reduction of their income because the payment depended on the truckers' mood or holding official permits issued by the Commune.

At the present time, the three families earn on average CFA 250 each per day, that is CFA 7,500 francs per month. In this rural environment, gaining an income represents a blessing and is relatively sufficient to meet the basic needs. The laterite on the site is finally used for households needs and for construction.

## **D- Management of a blacksmith's workshop**

This activity is practiced by the members of a family near the site, that has its workshop at about ten meters from the place. Mainly agricultural and household tools are made there (hoes, knives, rakes, axes, etc..). Their income may be estimated at CFA 300 per day, that is, about CFA 9,000 per month. This workshop is the meeting place of the men and a commercial place for women - selling onions, green leaves, etc. to local people and to passers-by on the Niamey-Torodi paved road.

## **3.2 CONDITION OF WASTE WATER COLLECTION AND TREATMENT SITES**

### **3.2.1 BOUKOKI WASTE WATER COLLECTION SITE: GENERAL**

#### **3.2.1.1 Location**

The site, a network for the collection of waste water, circumscribes the neighborhoods of Boukoki in several separate sections.

This site is located on the east bank of the river and shares about the same biophysical elements described initially for the Koubia dumping site, especially the landscape, hydrography, geology, hydrogeology and climate. However, due to the fact that it was a built structure, it does not have urban farmland, much less a natural vegetation.

As regards wildlife, one observes some domestic birds (pigeons) and groups of bats (*Rousettus aegytiacus*) nesting on trees.

#### **3.2.1.2 Housing**

There are three types of houses in the survey area:

- So-called traditional housing made up of compounds in mud, a material that does not resist rains, as mud houses easily erode;
- Modern housing in cement or a mixture of cement and clay and some infrastructures (health centers, schools, shops, gas stations, etc.) ;
- Thatch or thatch-roofed house in some places.

However it was determined that for the whole of Boukoki, the proportion of construction materials used is 32.1% cement; 16.4% mixed, 47.4% banco clay and 3.8% thatch. In addition, the floor in the rooms is in cement for 92.2% of the cases and in sand for 6.5%.<sup>2</sup>

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<sup>2</sup> Ibid, p.22.

### **3.2.1.3 Infrastructure**

#### 3.2.1.3.1 Roads

The road network is less developed and under continuous degradation (garbage, sand, potholes) due to lack of maintenance. There are some paved roads.

All along these roads are shops, grain mills (391 kiosks have been counted in Boukoki), wild dumpsters, water fountains, that may be affected by the construction of a new sewage system.

The paved road built in order to facilitate the drainage of surface waters receives household waste waters and garbage. The road gradually deteriorates due to lack of maintenance and poor use by the community.

Only the big Avenue de l'Ader carries heavy traffic, sometimes with troubling noises and heavy smokes and dust.

#### 3.2.1.3.2 Electricity

There are electric poles beside the roadway at 1 or 2 m from houses. A good portion of the population is connected to the network, but it is only the Avenue de l'Ader that has public lighting.

#### 3.2.1.3.3 Running water

The distribution of consumption water by the Niger Water Company (SEEN) is made through canalization made up of buried pipes of various dimensions. About 60% households are served directly (private) and 40% indirectly through public fountains placed at the border of the streets.

#### 3.2.1.3.4 Socio-demographic Aspects

##### **A- Total Population**

Boukoki population is about 39,805 inhabitants spread out in 4,422 households, according to a census conducted in 1999. The distribution of this population by gender is about 50% male and 50% female according to the same source.<sup>3</sup>

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<sup>3</sup> Ibid, p. 12.

According to the results of this survey (table 6), male household heads represent 54.3% of the sample and females 45.7%. Further, the average size of a household is 8 (7.76 to be exact) people.

**Table 6: Distribution of household heads by gender**

<b>Gender</b>	<b>Number of household heads</b>	<b>%</b>
Male	19	54.3
Female	16	45.7
<b>Total</b>	<b>35</b>	<b>100.0</b>

### **B- Socio-professional Categories**

As shown in table 7, the population met is diverse in terms of socio-professional categories, but there is a significant proportion of housewives (34.3%) and small traders (14.3%). In the latter case, commercial activities relate to the sale of food , wood and groceries on the streets, just near residential areas.

**Table 7: Socio-professional categories of household heads**

<b>Socio-professionalCategories</b>	<b>Hommes</b>	<b>Women</b>	<b>Number total</b>	<b>%</b>
Unemployed (no profession)	1	-	1	2,9
Small street trader	2	3	5	14,3
Miller	1	-	1	2,9
Plumber	1	-	1	2,9
Marabout	1	-	1	2,9
Farmer	1	-	1	2,9
Électrician	1	-	1	2,9
Mechanic	1	-	1	2,9
Gas station manager	1	-	1	2,9
Housewife	-	12	12	34,3
Guard	2	-	2	5,7
Small Contractor	1	-	1	2,9
Civil servant	2	-	2	5,7
Retired	2	1	3	8,6
Tailor	1	-	1	2,9
Not determined	1	-	1	2,9
<b>Total</b>	<b>19</b>	<b>16</b>	<b>35</b>	<b>100,0</b>

### **C- Socio-economic Infrastructures**

The neighborhood has a certain number of socio-economic equipments made up of schools and health care facilities and a variety of private sales places for basic

products (stores and shacks), repair shops of every kind and other stalls installed informally.

Regarding health care facilities in the neighborhood there are:

- Two public health centers
- One private dispensary
- One maternal and Child care center (CSMI)
- One maternity hospital
- One dermatological center.<sup>4</sup>
- Two private pharmacies

Concerning health care facilities, the neighborhood has:

- ten (10) public toilets
- eleven (11) garbage containers
- twelve(12) official dumpsters
- gutters (6,860 m).

#### **D- Land aspects and settlement**

Boukoki is a neighborhood that is entirely allotted, governed by private as well as public ownership. In the first case, there are private houses in which surveyed households reside, as well as non governmental institutions; in the second case, there are government structures (dispensaries, maternity hospitals, schools, public toilets, etc.).

Among the household heads met around the space intended for the waste water collection network of Boukoki, 57.1% own their houses, 22.9% are tenants and 11.4% have free lodging. The high owner rate means that the stakes for the implementation of the projects will have more impact on this part of the population because it is related to this portion of the population, as it would affect tenants and the "free lodged" who could eventually seek another place as needed.

In addition, the average residing period of households is 11 years and maximum stay is 42 years.<sup>5</sup>

**Table 8: Distribution of household heads according to the status of housing**

<b>Status of habitat</b>	<b>Number</b>	<b>%</b>
Owners	20	57,1
Tenants	8	22,9
Free lodging	4	11,4
Not determined	3	8,6
<b>Total</b>	<b>35</b>	<b>100,0</b>

<sup>4</sup> Ibid, p.10.

<sup>5</sup> Ibid, p.17.

### 3.2.2 FEATURES OF NEIGHBORHOOD BLOCKKS

Given Boukoki's configuration, one may distinguish 3 entities.

The first entity (block 1) has a poorly structured population. In this part of Boukoki there are 5 schools, which shows that the population is young. In terms of space occupation, it is the most recent, the least structured due to the small nature of houses (crowded) built in light and therefore more vulnerable materials. This situation clearly shows the poverty of the population and explains the poor economic activities that it does for a living.

The second entity (block 2) presents a relatively structured population in terms of space occupation and household income. Households here are medium size, with relatively sustainable incomes (civil servants). This part of Boukoki is the oldest and has been inhabited since 1975. It has more basic infrastructures, and this explains that residents are more familiar with city management.

The third entity (block 3) is a non residential area and has three markets, among which the Katako market the boundaries of which are not determined.

#### 3.2.2.1 Block 1

##### 3.2.2.1.1 Location of Block 1

Block 1 is located in the northern part of Boukoki and covers areas called Boukoki 1, 2 and 4.

##### 3.2.2.1.2 Housing status

Table 9 shows a substantial proportion household heads who are owners of their houses, with a rate of 57.7%, against 30% for tenants and 3.8% for those with free lodging.

**Table 9: Distribution of household heads according to housing status**

Status	Number of household heads	%
Owner	15	57,7
Tenant	7	26,9
Free lodging	1	3,8
Not determined	3	11,5
<b>Total</b>	<b>26</b>	<b>100,0</b>

In general, the population especially tenants live in the compounds where several households live together, using most often the same facilities (bathrooms and latrines), the same social spaces such as the trees within the compound.



### 3.2.2.1.3 Human environment : socio-demographic pattern

#### A- Population and human density

Boukoki, as shown by a survey conducted in 2000, is part of those areas considered as poor.<sup>6</sup> Block 1 of this neighborhood is therefore poor. In addition, its socio-demographic, economic and environmental situation as well as housing conditions add to its situation as impoverished area.

In fact, the apparent density of the population during the daytime and early evening shows the compounds' overcrowding, thereby showing the poor socio-economic level of the area. In general, overcrowding in Niamey involves 43.9% of households, particularly for those residing in traditional compounds as well as "single housing". The major reasons are among other things the demographic configuration made up of a substantial number of children per woman, as well as the inadequacy between the type of housing and the traditional family lifestyle.<sup>7</sup>

Under these circumstances, the lack of free space and normal family life is clear for all households in this block. For this Boukoki neighborhood, 45.5% of the households live in this overcrowded environment.<sup>8</sup>

The survey as also allowed to note that the size of households is between 2 and 23 people, with an average of 8, which corresponds to an estimated surveyed population of 208 people. The number of children ranges from 2 to 20, with an average of 6 children per household, which corresponds to the national average<sup>9</sup>.

#### B- Age and gender of household heads

26 household heads have been interviewed. Their ages range from 25 to 80 years old, for an average of 49 years. As shown in table 10, men represent a little less than 58% and women a little more than 42%.

**Table 10: Distribution of household heads according to gender**

<b>Gender</b>	<b>Number of household heads</b>	<b>%</b>
Men	15	57,7
Women	11	42,3
<b>Total</b>	<b>26</b>	<b>100,0</b>

<sup>6</sup> Sanitation conditions in poor neighborhoods of the city of Niamey (Niger), Études de milieu, Cabinet Sékou et Associés, Niamey, juin 2000.

<sup>7</sup> Plan régionale de développement économique et social de la communauté urbaine de Niamey 2000-2004, CUN, octobre 2000, p. 127.

<sup>8</sup> Cabinet Sékou et Associés, p.19.

<sup>9</sup> EDSN 98.

### C- Marital Status of household heads

Married people are the most numerous, with 64% representation, followed by widowers with 7.7% and divorcees with 3.8% (table 11).

**Table 11: Distribution of household heads according to marital status**

<b>Status</b>	<b>Number of household heads</b>	<b>%</b>
Married	22	64,6
Single	0	0
Widow	2	7,7
Divorced	1	3,8
Not determined	1	3,8
<b>Total</b>	<b>26</b>	<b>100,0</b>

### D- Educational level of household heads

Table 12 shows that only 3.8% have primary education, 11.5% have secondary education college and more than 23% have coranic instruction. However, more than 61% have no instruction at all, and this is characteristic of poorer classes.

**Table 12: Distribution of household heads according to educational level**

<b>Educational level</b>	<b>Number de household heads</b>	<b>%</b>
Primary	1	3,8
Secondary/technical	3	11,5
Coranic	6	23,1
None	16	61,6
<b>Total</b>	<b>26</b>	<b>100,0</b>

### E- Professional training of household heads

The training that reflects the instruction or education is key to determining the individual's working life. In this case, one may logically notice that about 77% of household heads have no training while 23% have technical training.

**Table 13: Distribution of household heads according to their formal training**

<b>Training</b>	<b>Number de household heads</b>	<b>%</b>
None	20	76,9
Technical	6	23,1
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### **F- Socio-professional Category of household heads**

Table 14 shows that a large set of socio-professional categories dominated by housewives, followed by neighborhood traders and civil servants, as well a many crafts-related professions.

**Table 14: Socio-professional Categories of household heads**

<b>Socio-professional Categories</b>	<b>Men</b>	<b>Women</b>	<b>Total Number</b>	<b>%</b>
Street traders	2	3	5	19,2
Miller	1	-	1	3,8
Plumber	1	-	1	3,8
Marabout	1	-	1	3,8
Farmer	1	-	1	3,8
Électrician	1	-	1	3,8
Gas station manager	1	-	1	3,8
Housewife	-	7	7	26,9
Guard	1	-	1	3,8
Civil servant	1	1	2	7,7
Retired	3	-	3	11,5
Tailor	1	-	1	3,8
Not determined	1	-	1	3,8
<b>Total</b>	<b>15</b>	<b>11</b>	<b>26</b>	<b>100,0</b>

#### 3.2.2.1.4 Women's Economic Activities

Most economic activities in block 1 are carried by women and young people. They are basically household-related and small trade. In the later case women sell foodstuffs, wood, kerosene in retail, etc. This activity usually takes place in front of the compound or in a corner near the house.

This activity is in fact an obligation for poor women who do not hold any salaried employment and who must earn their living honorably. This small business helps women to generate more or less substantial revenues in order to address their needs and those of their children. The money earned helps purchase feed the family and buy clothes for the children. It also helps them to have access to health care and allows them to consolidate social and family ties. Mutual help is particularly at play during weddings or naming ceremonies that require individual financial contribution for the organizing family. The amount of such contribution equals systematically the double of that received previously with other women in previous events organized by

those women. Therefore for women, failing to fulfill such requirements is a weakness the psychological consequences of which may impact family pride and renown. Small trade therefore becomes inevitable for poor women.

### 3.2.2.1.5 Hygiene behavior of Block 1 population

#### A- Waste water disposal system

Based on table 15, one may notice that waste water is spilled out on the street in 57.7% of cases, in the sewers for 23.1%, in cesspits for 7.7% or in a hole dug outside the compound for 3.8% of the cases.

**Table 15: Distribution of household heads according to waste water disposal system**

Place of waste water disposal	Number de household heads	%
On the street	15	57,7
In sewers	6	23,1
Modern cesspit	2	7,7
Traditional cesspit	1	3,8
Not determined	2	7,7
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### B- Pollution relating to waste water

Poor waste water disposal causes pollution to the populations. As a result 73% of interviewed household heads relate the proliferation of mosquitoes to stagnating waste water. Only 3.8% believe that bad odors are caused by waste water and 7.7% find that there is no pollution.

**Table 16: Distribution of household heads according to their perception of pollution related to waste water**

Types of pollution	Number de household heads	%
Mosquitoes	19	73,1
Bad smells	1	3,8
None	2	7,7
Not determined	4	15,4
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### C- Household refuse and solid waste disposal system

For 69.2% of households, waste and other refuse are disposed of in public dumpsters. For 23%, disposal is made in an anarchic manner on the street. For 3.8% garbage is piled up in the courtyard, then taken to the neighborhood dumpster.

**Table 17: Distribution of household heads according to household refuse and solid waste disposal system**

<b>Solid waste disposal</b>	<b>Number de household heads</b>	<b>%</b>
In public dumpster	18	69,2
In the street	6	23,0
In courtyard	1	3,8
Not determined	1	3,8
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### **D- Pollution related to household waste**

Pollution is due to the accumulation of household waste. In addition to mosquitoes for 65.4% of households there are 19,2% bad smells.

**Table 18: Distribution of household heads according to their perception of pollution related to garbage**

<b>Perception of pollution due to household waste</b>	<b>Number of household heads</b>	<b>%</b>
Mosquitoes	17	65,4
Bad smells	5	19,2
Not determined	4	15,4
<b>Total</b>	<b>23</b>	<b>100,0</b>

#### **E- Perception of diseases due to poor hygiene**

Various diseases have been indicated as being due to lack of hygiene cause by the accumulation of waste water and solid waste near houses. These include malaria for 80.7% of household heads, cholera for 11.5%, tetanus and amoebas for 3.8% .

**Table 19: Distribution of household heads according to their perception diseases due to lack of hygiene**

Type of disease	Number of household heads	%
Malaria	21	80,7
Cholera	3	11,5
Tetanus	1	3,8
Amoebas	1	3,8
<b>Total</b>	<b>26</b>	<b>100,0</b>

### 3.2.2.1.6 Population's response to the project

#### A- Awareness of the project

Table 20 shows that the majority of household heads interviewed, that is about 77%, were not aware of the project while 23% know about it. From this group, only 2/3 know that canalizations would be built for the drainage of waste and surface water.

**Table 20: Distribution of household heads according to their awareness of the project**

Awareness of the project	Number of household heads	%
Yes	6	23,1
No	20	76,9
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### B- Perception of project benefits

After a brief information session on the project by consultants, interviewed household heads indicated the following advantages, as shown on table 21. It was essentially about the sanitation of the neighborhoods for about 54% of respondents and about the drainage of waste and surface water for 34.6%. In 3.8% of the cases, the discussion was mainly about the improvement of sidewalks/pedestrian crossings.

**Table 21: Distribution of household heads according to their perception of project benefits**

<b>Perceived advantages</b>	<b>Number of household heads</b>	<b>%</b>
Sanitation	14	53,8
Drainage of water	9	34,6
Improvement of crossing	1	3,8
Not determined	2	7,7
<b>Total</b>	<b>26</b>	<b>100,0</b>

### **C- Perception of project disadvantages and risks**

Disadvantages found are various (table 22). For 61.5% of respondents, this regards the risks related to accidental falling of children, old people and animals in open sewers. In fact, Block 1 is relatively overcrowded with a high of poorly cared-for children and the lack of public lighting, so such concerns are justified.

In addition, 11.5% respondents pointed out the putrefaction that come out of the sewers and 7.7% indicated the reduction of recreational and commercial space. In fact, in poor, overcrowded neighborhoods, streets are used for social gatherings in case of weddings or naming ceremonies, encounters among neighbors or friends (fada), cultural events, sports by young people and the display of various goods for sale.

While a few respondents state the proliferation of mosquitoes as a major disadvantage, it should be pointed out that this concern is real due to the bad behavior of some citizens who may use sewers to dispose of their waste. Accordingly, the accumulation of waste may contribute to creating proliferation conditions for mosquitoes, with all the consequences on people's health, especially women with pregnancies and children that represent the most vulnerable groups.

**Table 22: Distribution of household heads according to their perception of the disadvantages of the project**

<b>Types of disadvantages</b>	<b>Number de household heads</b>	<b>%</b>
Children, old people, and animals falling accidentally	16	61,5
Putrefaction	3	11,5
Reduction of living space	2	7,7
Proliferation of mosquitoes	1	3,8
None	2	7,7
Not determined	2	7,7
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### **D- Possible contribution to the project's implementation**

Household heads have attempted in anticipation to provide their views on their possible participation to the construction of a waste and surface water disposal system. Based on table 23, 50% were committed to contribute, but the form of their contribution will be defined only when they are consulted by the managers of the upcoming project. However, it should be noted that 7.7% would like to be hired as unskilled laborers, and 3.8% intend to even contribute financially. The level of the contribution will be determined at the appropriate time with the managers of the project. Also note that 11.5% made it clear that they would not contribute in any way.

**Table 23: Distribution of household heads according to the form of contribution to the project**

<b>Form of contribution</b>	<b>Number of household heads</b>	<b>%</b>
None	3	11,5
If consulted	13	50,0
Infrastructure maintenance	2	7,7
Financial contribution	1	3,8
Undecided	2	7,7
Not determined	3	11,5
<b>Total</b>	<b>26</b>	<b>100,0</b>

#### **E- Suggestions for the success of the project**

In order to make the project a success, the actions to be undertaken in line with the implementation of the project, the following suggestions have been made by the respondents (table 24). These include:

- construction of closed sewers;
- entrust work to specialists in the field;
- construct access bridges to houses;
- complete the project as speedily as possible in order to cause less inconvenience to the population.



**Table 24: Distribution of household heads according to their suggestions**

Type of suggestion	Number of household heads	%
Covering sewers	11	42,3
Give the work to specialized contractors	7	27,0
Construct access bridges to houses	1	3,8
Speedy completion of project	1	3,8
<b>Total</b>	<b>26</b>	<b>100,0</b>

### **3.2.2.2 Block 2**

#### 3.2.2.2.1 Location of the Block

The Block 2 is located in the eastern part of the Boukoki neighborhood, covering in part the area called Boukoki 4.

#### 3.1.2.2.2 Human environment

### **A- Housing Status**

Table 25 shows that 55.6% of household heads interviewed are owners of their houses, while 11.1% are tenants and 33.3% people with free lodging.

**Table 25: Distribution of household heads according to housing status**

Status de l'habitat	Number of household heads	%
Owner	5	55,6
Tenant	1	11,1
Free lodging	3	33,3
<b>Total</b>	<b>9</b>	<b>100,0</b>

It is worth mentioning that the houses in this Block are relatively less crowded than those in Block 1. In fact, a high proportion of civil servants and other salaried employees live in this Block. In addition, the number of villas and single housing generally used by smaller families seems dominant as compared to the traditional type compounds.

## **B- Socio-demographic pattern**

### **B-1 Population and human density**

The size of households in this Block is on 6 people on average with a minimum of one person (single) and a maximum of nine (9) members. The total population surveyed in this Block may be estimated at 54 people. The average number of children per household is 5, with a minimum of zero (0) and a maximum of 8.

### **B-2 Age et gender of household heads**

The average age of household heads met is 50 years old with a minimum of 38 years and a maximum of 65 years. As shown in table 26, women represent 55.6% and men 44.4%.

**Table 26: Distribution of household heads according to gender**

<b>Gender</b>	<b>Number of household heads</b>	<b>%</b>
Men	4	44,4
Women	5	55,6
<b>Total</b>	<b>9</b>	<b>100,0</b>

### **B-3 Marital Status of household heads**

According to table 27, the majority of respondents are married with a high proportion of 89% while widows make up 11%.

**Table 27: Distribution of household heads according to marital status**

<b>Marital status</b>	<b>Number de household heads</b>	<b>%</b>
Married	8	88,9
Widow	1	11,1
<b>Total</b>	<b>9</b>	<b>100,0</b>

### **B-4 Household heads' education and training**

Among respondents, only one (1) has a primary school education.

The majority of household heads have no training in 89% of the cases, while only 11.1% have trained as automobile mechanics (table 28).

**Table 28: Distribution of household heads according to their professional training**

Type de formation	Number de household heads	%
None	8	88,9
Technical	1	11,1
<b>Total</b>	<b>9</b>	<b>100,0</b>

### **B-5 Socio-professional category of household heads**

Table 29 shows that housewives make up a dominant category with 55.6% against 11.1% for each of the other categories (mechanic, guard, small contractor)

**Table 29: Distribution of household heads according to their profession**

Socio-professional Categories	Number of household heads	%
Unemployed	1	11,1
Mechanic	1	11,1
Housewife	5	55,6
Guard	1	11,1
Former contractor	1	11,1
<b>Total</b>	<b>9</b>	<b>100,0</b>

#### 3.2.2.2.3 Women's Economic activities

Among the women household heads surveyed, none has economic activities. One should note, however, that in the Block 2 area, while there are less women conducting activities, they do some small trade near the house. They basically sell pancakes and cereal porridge used for breakfast by certain layers of the neighborhood population. Revenues are used to meet some small family needs, especially for the children.

#### 3.2.2.2.4 Block 2 population sanitation behavior

### **A- Waste water disposal system**

In Block 2, surveyed households dispose of waste water in the sewer in 66.7% of the cases, in cesspits in 22.2% of the cases and on the streets in 11.1% of the cases (table 30).

**Table 30: Distribution of household heads according to waste water disposal system**

Place of waste water disposal	Number of household heads	%
On the street	1	11,1
In sewers	6	66,7
In cesspits	2	22,2
<b>Total</b>	<b>9</b>	<b>100,0</b>

#### **B- Pollution due to waste water**

The perception of pollution as due to waste water seems low, because only one of the respondents stressed the proliferation des mosquitoes. This situation is probably due to the fact that the population has a better sense of hygiene than Block 1.

#### **C- Household refuse and solid waste disposal system**

The notion and observance of hygiene rules seem to be well integrated in people's behavior, as waste is disposed of in a more acceptable manner. Table 31 indicates that in 55.6% of the cases solid waste is burnt and in 22.2% of the cases, it is taken and disposed of by garbage collectors (paid) in dumpsters set up for that purpose. However, on should note that for 22.2% of cases, waste is used in order to fill flooded spaces within or outside the compounds.

**Table 31: Distribution of household heads according to the waste disposal system**

Solid waste disposal System	Number of household heads	%
Incineration	5	55,6
Filling the courtyard	2	22,2
Garbage collector	2	22,2
<b>Total</b>	<b>9</b>	<b>100,0</b>

#### **D- Perception of diseases due to poor hygiene**

The only disease noted was malaria, and this has been noted by about 78% of the respondents (table 32).

**Table 32: Distribution of household heads according to their perception of diseases due to poor hygiene**

Type of diseases	Number of household heads	%
malaria	7	77,8
Not determined	2	22,2
<b>Total</b>	<b>9</b>	<b>100,0</b>

### 3.2.2.2.5 Population's response to the project

#### **A- Awareness of the project**

The survey shows that 88,8% of household heads interviewed were not aware of the project while only 11.1% know about it, but do have no clue as to its objectives.

#### **B- Perception of project benefits**

Despite their not having full information on the project, most people appreciated the benefits after its implementation. In addition, 66.7% noted that it would improve sanitation/hygiene in the target neighborhoods and for 33.3%, it will contribute to the reduction of diseases such as malaria (table 33).

**Table 33: Distribution of household heads according to their perception of project benefits**

Perceived advantages	Number of household heads	%
Sanitation/hygiene	6	66,7
reduction of diseases (malaria)	3	33,3
<b>Total</b>	<b>9</b>	<b>100,0</b>

#### **C- Perception of disadvantages and risks related to the project**

While the project present advantages, it also has disadvantages as perceived by surveyed household heads. In addition, for about 79% of the respondents, disadvantages are related essentially children falling accidentally in open sewers.

For other respondents (21%), the construction of these sewers will reduce the recreational space of the children. They may also serve as dumpsters for all sorts of waste and even places to get rid of unwanted babies.

### D- Possible contribution to the implementation of the project

Contribution to the success of the project is perceived under three perspectives (table 34). In 22.2% of cases, the commitment consists in the maintenance of sewers along the compound. In 55.6% cases, contribution will be in kind (drinking water and food) for construction workers. The 22.2% contribution could be determined in consultation with project managers.

**Table 34: Distribution of household heads according to contribution to the implementation of the project**

<b>Intended contribution</b>	<b>Number of household heads</b>	<b>%</b>
Maintenance of the structure	2	22,2
If consulted	2	22,2
Incentives to workers	5	55,6
<b>Total</b>	<b>9</b>	<b>100,0</b>

### E- Suggestions for the success of the project

As shown in table 35, following are the suggestions:

- regular maintenance of the infrastructure;
- covering sewers ;
- build canalizations to link houses to the collection network.

**Table 35: Distribution of household heads according to the type of suggestion**

<b>Type of suggestion</b>	<b>Number of household heads</b>	<b>%</b>
Regular maintenance	2	22,2
Recruiting neighborhood labor	2	22,2
Build water disposal canalizations linking houses to the network	1	11,1
Covering sewers	1	11,1
Don't know	3	33,3
<b>Total</b>	<b>9</b>	<b>100,0</b>

### 3.2.2.3 Block 3

#### 3.2.2.3.1 Location of Block 3

Block 3 is located in the southwestern part of the Boukoki. It covers the entire area of the Katoko market.

### 3.2.2.3.2 Status of the market

The Katako market is by essence informal although some of the economic payers who have activities there are licensed. One must admit that due to this situation, it is quite difficult to obtain reliable measurable data.

### 3.2.2.3.3 Socio-economics patterns

#### **A- Human environment**

Due to its informal status, the market is made up of "escaped" players of the formal sector on the one hand and on the other hand, small businessmen coming essentially from rural areas, pushed by the constraints of their home regions. Generally, most actors are residents of the other Blocks of Boukoki and other neighborhoods around the city of Niamey, such as Lazaret and Koira Tégui. An informal and very old public transportation system (Lazaret-Lazaret) allows the daily movements of the deprived people from their place of residence to the market. The daily traffic is estimated at 4,000 people and the one way trip per person costs CFA 125<sup>10</sup>

In addition, some market actors have organized themselves in various socio-professional in order to protect the material and moral interests of their members. As a reference, there is an association of Katako carpenters made up of about fifty members<sup>11</sup>.

#### **B- Commercial Infrastructure**

The market presents a random occupation of space by shacks, hangars and other stalls set up in complete disorder, although some specialized blocks can be identified within the market. For example, the following specialized sales places can be identified for :

- construction materials (sheet metal, boards, cement, iron bars, IPN, etc.) ;
- Earth-moving equipment (shovels, daba, picks, etc.)
- Wooden furniture (tables, chairs, coat hangers, etc.)
- Vehicle tires and spare parts ;
- Cereals (millet, sorghum, rice, corn, etc.) ;
- Fruit and vegetables, etc.

Often times the shacks of some big merchants are well equipped (air conditioning, telephone and computers) making trade more modern.

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<sup>10</sup> Plan régional de développement économique et social de la communauté urbaine de Niamey 2000-2004, CUN, octobre 2000, p. 98.

<sup>11</sup> Ibid, p. 94.

### **C- Sectors of activity**

As one of the main commercial centers serving not only the city of Niamey but also the whole country, the Katako market has big economic operators in fiscal terms , but these often operate in the informal.

Due to its informal status, the market hosts artisan economic sectors, which somehow show the poor level of the county's economy. Accordingly, apart from wholesalers, there is a diversity of economic operators, such as :

- Wood and metal workers ;
- recyclers of all kinds (wood, metal, plastic, glass, etc.) ;
- hardware sellers ;
- restaurant owners
- transporters ;
- household appliances repairmen
- glass workers;
- blacksmiths ;
- shoemakers ;
- foodstuff sellers;
- butchers;
- spices/groceries sellers ;
- various stall managers, etc.

### **D- Sales**

The informal nature of activities does not allow to obtain an indication of the sales made by the various actors working in the jungle of the Katako market. Government official statistics also have no figures, and this gives way to speculation.

### **3.2.3 MAJOR CHARACTERISTICS OF THE BOUKOKI NEIGHBORHOOD**

#### **3.2.3.1 General**

- Poverty of the population ;
- Overcrowding ;
- Lack of sanitation ;
- Pollutions and nuisance.



### **3.2.3.2 Specific Situation of the Blocks**

#### **3.2.3.2.1 Block I**

##### **A- Environmental point of view**

- Housing is of the traditional type (80% in banco clay); people's income is very low; heavy human concentration. In terms of sanitation, infrastructures are inadequate or almost inexistent.
- Waste water is disposed of in cesspits or holes dug within or outside the compounds and drained in the streets through pipes placed to this effect. Latrines are traditional and most often, the same latrine is used by several families in the same compound.
- Defecation in open air or on dumpsters is a common practice especially for children and youngsters from families that do not have cesspits.
- Damage due to flooding is important in this area (collapsing houses, kiosks and hangars blown away, puddles in the middle of the streets or in compounds).
- Major activities are small trade and small ruminants raising carried out particularly by women.
- The proliferation of mosquitoes giving malaria is a reality.
- Pedestrian traffic is more important, especially students and unemployed young people. Five primary schools are recorded in this part of Boukoki that seems to be the most populated.
- There are some small shops but women's small trade is predominant.

##### **B- Sensitiveness of the environment**

###### **B-1 Problems of surface or running water erosion due to :**

- Environnement topography;
- Sand taken by people in the streets in order to fill ditches or for other use;
- Increasing surface water and flooding phenomena (soil is very fragile).

## **B-2 Sanitation Problems :**

- Lack of sanitation infrastructures: sewers, modern latrines, modern cesspits, etc.) ;
- Disorderly dumpsters full of plastic bags.

## **B-3 Pollution Problems :**

- Putrid odors from waste water and latrines disposals ;
- Proliferation of mosquitoes.

## **B-4 Population's behavior toward their environment :**

- Illiteracy, poverty, lack of sensitization.

### 3.2.3.2.2 Block II

#### **A- Environmental point of view**

- Residential area is built with cement (about 65%) ; waste water disposal infrastructures exist but they are poorly maintained (sewers, paved streets, modern latrines).
- The main economic activities are trade and services. The majority of the residents are civil servants and some businessmen and this explains the presence of many kiosks and other businesses (gas station, télé-center, beauty salon, grocery stores, etc.).
- Roads are less deteriorated (no signs of erosion), though at some points the paved streets present signs of degradation due to lack of maintenance.
- Traffic is important on the Avenue de l'Ader that crosses the area, one of the busiest in the city.
- Disposal of waste water is made through existing sewers and solid waste in containers/dumpsters. Only one wild discharge was identified.
- The nuisance in this part Boukoki are rather vehicle noises and gases due to the heavy traffic and pedestrians going back and forth downtown, particularly toward the Katako market.
- Animals do not wander much in this area, as the livestock is kept in the compounds for those families that have some.

## **B- Regarding the sensitiveness of the environment**

- Pollution and nuisance problems ;
- Traffic density (Avenue Ader) ;
- Noise ;
- Exhaust gases and dust.

### 3.2.3.2.3 Block III : Katako market

#### **A- Environmental point of view**

- A high concentration of shops and other stalls by small traders in a disorderly manner.
- This market is different from the others. One can buy and sell anything and where the flow of traders and customers is very high.
- Space management is inadequate and there is no sanitation system. Garbage is thrown behind the shops or in improvised dumpsters and waste water is spilled on the ground. This creates bad hygiene conditions and an unpleasant living environment.
- During the rainy season, circulation becomes difficult in the market due to puddles and mud that impede commercial activities.
- The main problem on traffic are the jams created by big trucks near the market on the big avenue and sometimes within the market.

#### **B- Regarding the sensitiveness of the environment**

- Sanitation problems (existence of a big market called Katako, source of big amounts of waste) ;
- Living environment deterioration problem (mud and bad odors, all kinds of waste, etc.);
- Nuisance problem (noise, inaccessibility, wild dumpsters within and outside the market).

**Table 36: Summarized Presentation of the urban environment data for the Boukoki site**

BLOCKS	TYPES OF NEIGHBORHOOD	ACTIVITIES AND PASSAGE	INFRASTRUCTURES	USE OF PUBLIC SPACE	LIVING ENVIRONMENT OBSERVATIONS
I	<ul style="list-style-type: none"> <li>- High density</li> <li>- Dominant housing: traditional compounds</li> <li>- Poor standard of living</li> </ul>	<ul style="list-style-type: none"> <li>- Residential area</li> <li>- important flow of students (5 schools) nq children</li> <li>- high vehicle traffic Ader : big road to Cité Caisse</li> <li>- Heavy pedestrian traffic on the avenue Ader linking surrounding neighborhoods</li> </ul>	<ul style="list-style-type: none"> <li>- waste water disposed of in the street or inside compounds</li> <li>- cesspits, and traditional latrines pipes drain waste water toward sewers</li> <li>- sewers drain surface water toward Gountou Yéna</li> <li>- Electrical poles at 1 or 2 m from houses</li> <li>- Public lighting on Avenue de l'Ader</li> <li>- Road network less developed and full of potholes</li> <li>- Paved segments: Cinéma Soni-Station Tamesna, station Tamolli-Program lutte contre la lèpre</li> <li>- Pavéd streets in decay</li> <li>- Fountains along roads</li> </ul>	<ul style="list-style-type: none"> <li>- Multitude of stalls owned by women for the sale of food and other foodstuffs to take away</li> <li>- Disorderly installation of kiosks to sell basic goods (soap, sugar, milk, batteries, etc.)</li> <li>- Existence of schools, health centers and public health facilities</li> <li>- women practice livestock raising at home</li> <li>- Proliferation of mosquitoes</li> </ul>	<ul style="list-style-type: none"> <li>- insufficient or lack of Sanitation Infrastructure in some places</li> <li>- disposal in regular cesspits or street</li> <li>- traditional and collective latrines</li> <li>- children's excreta in open air or on rubbish heaps</li> <li>- frequent floods</li> <li>- population aware of the effects of filth on their health and their living environment</li> <li>- populations not fully informed of the project</li> <li>- they appreciate very much the advantages that the project will bring</li> </ul>

Table 36 (suite)

BLOCKS	TYPES OF NEIGHBORHOOD	ACTIVITIES AND PASSAGE	INFRASTRUCTURES	USE OF PUBLIC SPQCE	LIVING ENVIRONMENT OBSERVATIONS
II	<ul style="list-style-type: none"> <li>- Relatively low human Density</li> <li>- Compounds more modern (65% cement)</li> <li>- Standard of living: poor and less poor</li> </ul>	<ul style="list-style-type: none"> <li>- Residential area</li> <li>- existence of businesses and service centers</li> <li>- majority of population are business ;en and civil servants</li> <li>- gas stations</li> <li>- beauty salons</li> <li>- traffic important Avenue Ader</li> </ul>	<ul style="list-style-type: none"> <li>- existence of sewers, paved streets, ;modern latrines</li> </ul>	<ul style="list-style-type: none"> <li>- Educational Infrastructures non existent</li> </ul>	<ul style="list-style-type: none"> <li>- nuisance : noise, vehicle exhaust gases and dust</li> <li>-population poorly informed on the project</li> <li>- they appreciate advantages generated by the project</li> </ul>
III	<ul style="list-style-type: none"> <li>- Important commercial center in Niamey</li> <li>- players from all backgrounds (city dwellers, rural) and from all socio-economic levels</li> </ul>	<ul style="list-style-type: none"> <li>- Important and diversified</li> <li>- Informal is key</li> </ul>	<ul style="list-style-type: none"> <li>- mud in rainy season</li> <li>- accumulation of various solid waste</li> <li>- access streets very narrow (passage difficult)</li> <li>- wild parking of big trucks blocking passage</li> </ul>	<ul style="list-style-type: none"> <li>- kiosks and stalls installed in disorderly manner</li> </ul>	<ul style="list-style-type: none"> <li>- putrid smells due to mud and waste</li> <li>- wild dumpsters (within and outside the market)</li> <li>- noise due to traffic</li> </ul>

### **3.2.3 DEZEIBON WASTE WATER CLEANING PLANT**

#### **3.2.3.1 Location**

The site is located at 13° 31,441'N et 2° 06,764' E on the left bank of the Gountou Yéna valley near the *Dezeibon* school and the *Tillabéri* bus station.

It is bordered :

- To the east by the Tillabéri station and the Dezeibon primary school;
- To the west by the gardens not involved by the extension ;
- To the north by the neighborhood of Dézeibon located at about thirty meters of the site ;
- To the south by the valley and other gardens of Gountou Yéna.

#### **3.2.3.2 Biophysical environment**

Located on the left bank of the Gountou Yéna, the site now has on it the pilot station over a land area of 1,070 m<sup>2</sup> and on the other part, seasonal crops.

The total land area of the UASB station of the project is 6,420 m<sup>2</sup>.

The current pollution level is moderate despite the bad smells and the lack of hygiene, because all around wild dumps are being developed by the population that throw their garbage there.

##### **3.2.3.2.1 Soils**

Within the framework of the surface water survey undertaken by l'IRD, HERBEAUD J. described the overall features of the soil in the various catchments of the Gountou Yéna, in urban areas as well as within the city of Niamey.

The soil in the Gountou Yéna slopes are generally sandy and porous, except in certain places where one finds ferruginous shield layers and eroded clayey sand. On the greatest part of the of the catchments representing the UASB plant installation site, some agricultural activities are practiced. The main slope of the terrain is weak on most of the catchments, except along the main thalweg land escarpments.

##### **3.2.3.2.2 Vegetation**

A large part of the site is used for gardening. There are also tree species like : neem, fruit trees, *Acacia albida*, *Calotropis procera*, *Adansonia digitata*, *Piliostigma reticulatum*, *Leuceuna leucocephala*, *Ziziphus mauritiana*, *Abzelia leubeck*, *Balanites aegyptiaca*, *Cassia occidentalis*.

This vegetation is used for traditional medicines and consumption.

Birds also find a refuge here.

#### 3.2.3.2.3 Niger river water

Niger river is about 15 km long in the CUN territory. It is the main source of water supply for the city.

Activities like fishing and agriculture have been developed riverside.

Niger river also owns habitats for aquatic fauna and vegetal species.

Water of Niger river is used by people for irrigation, bathing, washing and consumption. Niger river is however the place of discharge of waste water from industries and households of Boukoki through the Gountou Yéna.

Niger river has following problems:

- solid and liquid pollution load;
- sanding ;
- organic pollution and proliferation of water jacinth

#### 3.2.3.2.4 Watershed of Gountou Yéna

The site is in watershed of Gountou Yéna with characteristics like :

- area : 50 km<sup>2</sup> ;
- perimeter : 30 km ;
- length : 10 km ;
- width : 5 km.

Gountou Yéna valley drains mainly waste water of Boukoki and rain water.

The groundwater, which is in communication with surface water of Niger river in which are discharged pollutants, is receiving infiltration.

Five wells of less than 3 m depth have been found on the site of Dezeibon.

The watershed of Gountou Yéna collects about 10 waste water outlets of peripheral quarters located on left bank of Niger river. Analyses have indicated organic pollution, and presence of faecal germs in Gountou Yéna water.

River banks of Gountou Yéna are used not only for gardening but also for defecation for riverside inhabitants, which pollutes water during rainy season.

These waste water are then particularly polluted and are discharged in Niger river, which critically affects aquatic life and human health.

### **3.2.3.3 Human environment**

The same area as for Boukoki sewerage area is concerned, with in addition few human settlements Katakou market, school of Dezeibon and others.

The site of concern is an extension of the pilot plant. The project is then a development of present activities. Then only concerned population has been object of study here.

### **3.2.3.4 Land tenure**

Dezeibon is in centre of Niamey, in commune Niamey I.

About land tenure, the site belongs to 3 families of Dézeibon and Maourey. Further identification will be done by the municipality.

Moreover, we have found information from 4 gardeners interviewed among 5 concerned as in Table 37. Only one is landowner.

**Table 37: Distribution of gardeners according to land tenure**

<b>Land tenure</b>	<b>Number of farmers</b>	<b>%</b>
Land owners	1	25
Lease	3	75
<b>Total</b>	<b>4</b>	<b>100</b>

We see that one farmer is also land owner, while 75% are under land lease. One farmer has said to be working here since 16 years.

Farmers are at minimum 23 years old and maximum 67 years old with predominance of age between 31- 40 years, being 50% of total (Table 38). Age average of farmers is 34 years. Farmers sex distribution is men for 75%, which is 3 men, against one woman. (Table 39).



**Table 38: Age structure of surveyed farmers**

<b>Age rank</b>	<b>Number of persons</b>	<b>%</b>
20 – 30	1	25
31 - 40	2	50
41 - 50	0	0
51 - 60	0	0
61 - 70	1	25
<b>Total</b>	<b>4</b>	<b>100,0</b>

**Table 39 : Distribution of farmers by sex**

<b>Sex</b>	<b>Number of farmers</b>	<b>%</b>
men	3	75,0
women	1	25,0
<b>Total</b>	<b>4</b>	<b>100,0</b>

As shown in Table 40, the matrimonial situation of surveyed farmers of the site is as follows :

- 2 single ;
- one household chief ;
- one widow who has in charge children

**Table 40: Distribution of farmers by matrimonial situation**

<b>Status</b>	<b>Number of farmers</b>	<b>%</b>
single	2	50,0
married	1	25,0
widow	1	25,0
<b>Total</b>	<b>4</b>	<b>100,0</b>

### **3.2.3.5 Activities done on the site and resources**

#### 3.2.3.5.1 activities

We note the following activities close to the site:

- primary school ;
- Katako market ;

- Bus terminal ;
- Shops and workshops ;
- habitations ;
- health centre (Dézeibon) ;
- gasoline stations;
- several small traders

What should be retained :

The main activity is gardening. Fruit trees are ownership of the land owner while gardening produces are to the farmer. There are 3 harvest per year and production is sold on markets, apart from self consumption. Clients are women who sale produces on markets and to restaurants.

There are crops like :

- plants used for traditional cooking ;
- cabbage ;
- carrots ;
- maize ;
- moringa ;
- tomato ;
- French beans.

We also note that given the density of vegetal cover, this site is used for rest, and plays, but also consumption of drugs and refuge of criminals.

#### 3.2.3.5.2 Resources got from activities

For all the farmers, gardening constitutes the main source of family income. Each land owner receives on average 3.000 francs cfa per month for lease. Farmers, in addition to self consumption and gifts to family, get on average 250.000 francs cfa per season as net income.

Farmers wives use and cook produces like moringa, maize, cabbage, etc. for sale, which constitutes an important earning for them. The money earned is used for satisfying needs of the woman herself and for children: access to health services, purchase of school furniture, etc.

#### **IV- ANALYSIS OF POTENTIAL IMPACTS OF PRIORITY PROJECTS ON ENVIRONMENT**

The impact of project results from comparison between initial state without project and final state including project. We must evaluate both situations and obtain the impact by determining the difference.

The implementation of priority projects within the scope of sanitation master plan of Niamey will permit achievement of objectives of master plan, namely improvement of living conditions and health of population. The evaluation of potential impacts on environment of project will give a ranking of the importance of expected impacts in order to define measures.

However, as usual for evaluation of the impacts on environment of project, we must consider the evolution of sites in absence of priority projects. The non-implementation of construction of waste disposal sites projects would only contribute to worsening of urban environment of Niamey.

As well, the non-implementation of construction of projects of sewers and waste water treatment plant would contribute to increase risks of diseases and worsening of sanitation conditions of Boukoki and Gountou Yéna valley.

##### **4.1 IDENTIFICATION OF IMPACTS**

The identification of impacts of priority projects is conducted in 2 phases :

1. First phase has consisted in identification of main components of environment which will be affected with implementation of activities ;
2. Second phase has been identification of potential impacts of priority projects on environment during all steps.

##### **4.1.1 IDENTIFICATION OF POTENTIAL IMPACTS OF PROJECT ON SITE OF KOUBIA**

Waste disposal site is a place to dispose of waste by compacting them. This process generates leachate and gases like methane.

The waste disposal site should have a water proof layer in order to avoid contamination of ground and leachate must be evacuated as well as gases. The waste disposal sites must be in a valley which, once filled with waste, should be covered with earth.

However, the waste disposal sites are too often in unsuitable places and / or badly conceived. Then they contaminate soil and water.

Table 41 below details main components of environment affected by activities of implementation of the waste disposal site of Koubia.

**Table 41: Main components of environment affected with implementation of the waste disposal site of Koubia**

Activities	Components of environment
<p><b>Construction Phase</b></p> <ul style="list-style-type: none"> <li>- Transportation and traffic of machines and equipment</li> <li>- Excavation, levelling, development.</li> </ul>	<p>Traffic and security on road, vegetation, fauna habitats, population, noise.</p> <p>Soil, surface water, groundwater, air, fauna, flora, fauna habitats, use of soil, landscape, human activities, population, noise, employment.</p>
<p><b>Operation Phase</b></p> <ul style="list-style-type: none"> <li>- Transportation of waste</li> <li>- Waste disposal</li> </ul>	<p>Soil, air, noise, traffic and security on road, human activities, employment.</p> <p>Soil, groundwater, surface water, air, human activities, population, fauna, flora.</p>

Among the components noted in the Table n° 1, air, groundwater, human activities, population, and landscape will be more affected because of proximity of habitations and also of urbanisation in the area. Other components will be more or less affected according to intensity of activities.

**4.1.1.1 Construction Phase**

Transportation and traffic of machines and equipment on the site will have effects on road traffic, vegetation, noise and population. The effects although being low are however damaging.

Evacuation works, levelling and development of quarry and road accesses will affect components identified in Table 49. As well as destruction of vegetal cover.

**4.1.1.2 Operation Phase**

Activities of transportation of waste and waste disposal will have effects on air, soil, groundwater, human activities, and other components more or less sensitive. The effects are direct or indirect, damaging or not.

Works during the 2 phases create employment and also other activities are generated (small trade).

Table 42 below gives potential impacts on environment identified on the site of Koubia.

**Table 42: Potential impacts of project of waste disposal site of Koubia**

<b>Physical environment</b>	<b>Impacts</b>	<b>Importance</b>
Water	1. contamination of groundwater, wells and surface water.	+
Soil	2. erosion and modification of nature of soil or sediments ;	+ +
	3. Modification of topography.	+ +
	4. increase of noise level	+
Air	5. alteration of air quality	+ +
	6. smells.	+
<b>biological environment</b>	<b>Impacts</b>	<b>Importance</b>
Fauna and Flora	1. destruction of vegetal cover	+
	2. destruction of fauna habitats et moving of fauna ;	+
	3. development of pests	+ +
<b>human environment</b>	<b>Impacts</b>	<b>Importance</b>
socio-economic framework and Infrastructures	1. increase of risk of communicable diseases ;	+
	2. additional source of atmospheric and water pollution;	+ +
	3. diminution of income of population;	+
	4. increase of traffic ;	+
	5. creation of employment.	+ +
Use of soil and Landscape	6. decrease extraction of laterites ;	+ +
	7. impairment to agricultural activities and cattle feeding ;	+ +
	8. loss of agricultural areas.	+

Legend : + low importance ; ++ important ; +++ very important.

Table 42 below explains that expected impacts according to different phases of project which are development phase of site (quarry) and operation.

Then, during development phase of site, impacts are :

1. Increase of noise nuisances due to transportation and use of vehicles ;
2. Alteration of air quality;
3. Modification of topography ;

4. Destruction of vegetal cover ;

5. Creation of employment.

During operation phase of site, impacts are :

6. Contamination of groundwater ;

7. Organisation of waste management;

8. smells ;

9. Increase of risks of disease ;

10. Development of pests ;

11. Decrease of extraction of laterite ;

12. Impairment to agricultural activities.

#### 4.1.2 IDENTIFICATION OF POTENTIAL IMPACTS OF PROJECT ON SITE OF (BANGUEL TOROMBI)

Table 43 below details main components of environment affected by activities of implementation of the waste disposal site of Banguel Torombi.

**Table 43: Main components of environment affected with implementation of the waste disposal site of Banguel Torombi**

Activities	Components of environment
<b>Construction Phase</b>	
Transportation and traffic of machines and equipment	Traffic and security on road, vegetation, fauna habitats, population, noise.
Deforestation	Soil, surface water, groundwater, air, fauna, flora, fauna habitats, use of soil, landscape, human activities, population, noise, employment.
- Excavation, levelling, development.	Soil, surface water, groundwater, air, fauna, flora, fauna habitats, use of soil, landscape, cultural patrimony, human activities, population, noise, employment.
<b>Operation Phase</b>	
Transportation of waste	Soil, air, noise, traffic and security on road, human activities, employment.
Waste disposal	Soil, groundwater, surface water, air, human activities, population, public health, fauna, flora.

Both phases of project as well as activities are same as for Koubia.

However, environmental components are identical but importance is different.

Vegetation is more important here, as well as availability of resources in surface water and groundwater.

Inhabitants near the site are few families.

Potential impacts of project of waste disposal site here are given in Table 44.

**Tableau 44: Potential impacts of project of waste disposal site of Banguel Torombi**

<b>Physical environment</b>	<b>Impacts</b>	<b>Importance</b>
Water	<ul style="list-style-type: none"> <li>▪ contamination of groundwater, wells and surface water.</li> </ul>	+
Soil	<ul style="list-style-type: none"> <li>▪ erosion and modification of nature of soil or sediments</li> </ul>	+ +
Air	<ul style="list-style-type: none"> <li>Modification of topography.</li> <li>▪ increase of noise level;</li> <li>▪ alteration of air quality</li> <li>▪ smells.</li> </ul>	+ + + + + +
<b>biological environment</b>	<b>Impacts</b>	<b>Importance</b>
Fauna and Flora	<ul style="list-style-type: none"> <li>▪ destruction of vegetal cover</li> <li>▪ destruction of fauna habitats et moving of fauna ;</li> <li>▪ development of pests</li> </ul>	+ + + + + +
<b>human environment</b>	<b>Impacts</b>	<b>Importance</b>
socio-économique framework and Infrastructures	<ul style="list-style-type: none"> <li>▪ increase of risk of communicable diseases;</li> <li>▪ delocation of populations ;</li> <li>▪ additional source of atmospheric and water pollution;</li> <li>▪ diminution of income of population;</li> <li>▪ increase of trafic ;</li> <li>▪ creation of employment..</li> </ul>	+ + + + + + + + + +
Use of soil et Landscape	<ul style="list-style-type: none"> <li>▪ decrease extraction of laterites ;</li> <li>▪ impairment to agricultural activities and cattle feeding ;</li> <li>▪ loss of agricultural areas.</li> </ul>	+ + + + + +

Legende : + low importance ; ++ important ; +++ very important.

Table above explains that expected impacts are same as Koubia. But only their importance is different.



#### 4.1.4 IDENTIFICATION OF POTENTIAL IMPACTS OF PROJECT ON SITE OF WASTE WATER SEWERS

Main components of environment that can be affected by implementing this project are given in Table 45.

**Tableau 45: Main components of environment that can be affected**

<b>Activities</b>	<b>Components of environment</b>
<b>Construction Phase</b>	
Transportation and traffic of machines and equipment	Soil, water surface, air, trees, habitats, population, infrastructures, noise, traffic and security on road.
Works of drainage and construction	Soil, surface water, water runoff et infiltration, use of soil, habitats, infrastructures, patrimony, human activities, public health, population, noise, trees, employment, traffic and security on road.
<b>Operation Phase</b>	
Drainage of rain water and waste water	Soil / water runoff et infiltration of surface water, air, human activities, populations, public health, traffic and security on road, habitats.
Maintenance and repair	Water, soil, air, noise, public health, population, traffic and security on road, habitats, human activities.

Table above shows 2 phases in activities: one for construction including transportation of equipment and construction works of drains and one for operation including drainage or collection of waste water and rain water of the quarter, and facilities maintenance.

Second column suggests all components of identified environment which are liable to be affected during both phases of the project.

Potential impacts of project are detailed in Table 46.

**Tableau 46: Potential impacts of project of construction of sewers**

<b>Physical environment</b>	<b>Impacts</b>	<b>Importance</b>
Water	<ul style="list-style-type: none"> <li>▪ modification of characteristics surface water et groundwater (contamination of groundwater).</li> </ul>	+
Soil	<ul style="list-style-type: none"> <li>▪ erosion and destabilisation of soil;</li> <li>▪ nuisances caused by location of equipment (oil release).</li> </ul>	+ + +
Air	<ul style="list-style-type: none"> <li>▪ increase of smells near sewers ;</li> <li>▪ increase of noise;</li> <li>▪ alteration of air quality by dust and emissions from vehicles.</li> </ul>	+ +
<b>biological environment</b>	<b>Impacts</b>	<b>Importance</b>
Fauna and Flora	<ul style="list-style-type: none"> <li>▪ destruction du vegetal cover (trees felling)</li> </ul>	+ +
<b>human environment</b>	<b>Impacts</b>	<b>Importance</b>
socio-economic framework and Infrastructures	<ul style="list-style-type: none"> <li>▪ creation of employment, purchase of goods with construction ;</li> <li>▪ improvement of hygiene and sanitation</li> <li>▪ improvement of living environment ;</li> <li>▪ improvement of accesses</li> <li>▪ alteration of health conditions;</li> <li>▪ moving of shops near sewers</li> <li>▪ impairment of urban activities;</li> <li>▪ risk of falling of walls;</li> <li>▪ increase of risks of accidents from traffic increase of traffic</li> <li>▪ damages caused to road concerned by sewers</li> </ul>	+++ + + + + ++ + + + + + + + + + + + + + + + + ++
Use of soil and Landscape	improvement of amenities.	+ +

Legend : + low importance ; ++ important ; +++ very important.

Table 46 above explains that expected impacts according to different phases of project which are construction phase and operation phase.

#### **4.1.4.1 Construction Phase**

Potential impacts sources identified at this level are:

- erosion and destabilisation of soil ;
- nuisances caused by location of equipment ;
- increase of noise ;
- alteration of air quality;
- destruction of trees ;
- moving of kiosks;
- risk of falling of walls;
- damages caused to roads with sewers ;
- creation of employment.

#### **4.1.4.2 Operation Phase**

Potential impacts sources identified at this level are:

1. modification of characteristics of water ;
2. increase of smells ;
3. alteration of sanitary conditions in case of bad operation ;
4. improvement of accesses to area;
5. improvement of amenities.

#### **4.1.5 IDENTIFICATION OF POTENTIAL IMPACTS OF THE WASTE WATER TREATMENT PLANT OF DEZÉIBON**

The main environmental components liable to be affected by implementation of construction activities of the waste water treatment plant of Dezéibon are detailed in table 47.

**Table 47: Main environmental components liable to be affected (site of Dezeibon)**

<b>Activities</b>	<b>environmental components</b>
<p><b>Construction Phase</b></p> <ul style="list-style-type: none"> <li>- Transport and circulation of machines and equipments</li> <li>- Construction works</li> </ul>	<p>Soil, surface water, air, fauna, flora, habitats, population, infrastructures, noise, circulation and security on road.</p> <p>Soil, surface water (Niger river), air, fauna, flora, fauna habitats, infrastructures, noise, human activities, public health, employment, patrimony, circulation and security on road</p>
<p><b>Operation Phase</b></p> <ul style="list-style-type: none"> <li>- Waste water treatment</li> <li>- Maintenance and repair</li> <li>- Reuse of treated water</li> </ul>	<p>Water, air, noise, public health, population, human activities, surface water (Niger river), aquatic fauna, flora.</p> <p>Water, soil, air, noise, public health, population, fauna habitats, human activities.</p> <p>Water, soil, air, public health, population, surface water, human activities, flora, fauna.</p>

Table 48 below shows activities that will be realised during the 2 phases of construction works of the waste water treatment plant and environmental components that will be affected.

For each activity there is a number of components that could be affected.

The potential impacts of the plant are detailed in Table 48 below.

**Table 48: Potential impacts of the waste water treatment plant ( UASB) at Dezéibon**

<b>Physical environment</b>	<b>Impacts</b>	<b>Importance</b>
Water	<ul style="list-style-type: none"> <li>▪ modification of characteristics of surface water and groundwater ;</li> </ul>	+ +
Soil	<ul style="list-style-type: none"> <li>▪ modification of soil quality;</li> <li>▪ modification of topography;</li> <li>▪ alteration of air quality by dust vehicles exhaust;</li> </ul>	+ + + + +
Air	<ul style="list-style-type: none"> <li>▪ increase of noise levels near the site ;</li> <li>▪ diminution of smell nuisances.</li> </ul>	+ + + +
<b>Biological environment</b>	<b>Impacts</b>	<b>Importance</b>
Fauna and Flora	<ul style="list-style-type: none"> <li>▪ destruction of vegetation ;</li> <li>▪ destruction of fauna habitats;</li> <li>▪ diminution of productivity of ecosystems;</li> <li>▪ reduction of biodiversity.</li> </ul>	+ + + + + + +
<b>Human environment</b>	<b>Impacts</b>	<b>Importance</b>
socio - economic frame and Infrastructure	<ul style="list-style-type: none"> <li>▪ development of economic activities by creation of employment;</li> <li>▪ improvement of conditions de security in project area ;</li> <li>▪ improvement of public health through improvement of hygiene and destruction of pathogen vectors habitats.</li> </ul>	+ + + + + + +
Use of soil and landscape	<ul style="list-style-type: none"> <li>▪ loss of agricultural land.</li> </ul>	+ +

Legend: + low importance ; ++ important ; +++ very important.

From Table 48 we conclude about the foreseeable impacts on environment according to 2 project phases of construction of the plant of Dézeibon.

#### **4.1.5.1 Construction Phase**

Potential impacts sources identified for this phase are :

- modification of characteristics of surface water and groundwater ;
- modification of soil quality and topography ;

- alteration of air quality by dust vehicles exhaust;
- increase of noise levels near the site
- destruction of vegetation and fauna habitats;
- creation of employment;
- loss of agricultural land.

#### **4.1.5.2 Operation Phase**

Potential impacts sources identified for this phase are :

- development of economic activities;
- improvement of health and life conditions;
- improvement of conditions de security;
- diminution of smell nuisances.

## **4.2 EVALUATION OF POTENTIAL IMPACTS**

The impact of project is identified from comparison between the initial state before project and the final state with project. The issue is then to evaluate both situations and see the impact by determining the difference between them. Potential impacts are the positive and negative impacts that can be induced by a project.

### **4.2.1 LEVEL OF MUNICIPAL WASTE DISPOSAL SITES OF KOUBIA OF COMMUNES 1 AND 2**

#### **4.2.1.1 Positive Impacts**

The foreseen positives impacts are :

- Creation of employment for drivers and labour ;
- Implementation of this project will considerably reduce unauthorised waste deposits through creation of recycling centres, valorising reusable materials;

All these nuisances will be eliminated from centre city.

#### **4.2.1.2 Negative Impacts**

Risk of contamination and communicable diseases :

- Liquids and other products in leachate may contaminate groundwater and water resources of the area ;
- Sanitary risks related to proximity of housing are also to be taken into consideration with proliferation of diseases vectors when garbage is not well recovered with earth;

Moreover, smells emanating from the site will certainly threaten the neighbourhood inhabitants.

#### **4.2.2 LEVEL OF MUNICIPAL WASTE DISPOSAL SITES OF Koubia of Commune 3, Banguel Torombi**

##### **4.2.2.1 Positives Impacts**

The foreseen positives impacts are :

- Creation of employment for drivers and labour ;
- Implementation of this project will considerably reduce unauthorised waste deposits through creation of recycling centres, valorising reusable materials;
- Municipalities will make money savings because transport a part of waste will be valorised.

All these nuisances will be eliminated from centre city.

##### **4.2.2.2 Negative Impacts**

From the point of view of socio-economy, land owners will loss financial advantages provided by the exploitation of the quarry by truck drivers.

Moreover, in spite of low permeability at the site, the possibility shallow groundwater contamination should not be excluded. Infiltration waters may transport pollutants to groundwater and affect the nature of soil or sediments;

Finally, the sanitary consequences related to the proximity of habitations are also to be considered in the near future.

Regarding the analysis of socio-economical impacts, it has been made for both waste disposal sites as follows:

#### 4.2.2.2.1 Social aspects

- This is the possible relocation of families living around the site. For most of them, this land has both a symbolic meaning related to their ancestral origin and an economic one because it constitutes their livelihood. They are land owners of the farmed land since several decades. Expropriate these people would mean a double loss, both at the psycho-cultural level and the social and economical level. In the first case, no compensation, even material or financial, could really compensate for the loss
- It must be foreseen that in case of relocation, new constraints related to the accesses to health centres, schools, capital city markets, etc. will be important. As shown by history, the urban development does not always follow the extension of municipalities.
- Moreover, it must be foreseen that in such situation, the disorganisation of families could occur if conditions necessary for collective relocation are not gathered.

#### 4.2.2.2.2 Economical aspects

- The impact at this level is of course the loss of the productive base, which means fields exploited each year not only for production of cereals for self-consumption but also cattle feeding which provides supplementary income. It should be noted that temporary water ponds exist on the site and grazing area all around are used for production of animal produces.
- It is however clear that without such resources, women and children who take benefit of milk and its by-products will see their living conditions decreasing. This situation will be as much worrying as even the income got from indirect exploitation of the quarry will be no more available to these families.
- Then, the creation of project site might mean a reduction or even a loss of income.

#### 4.2.2.2.3 Health aspects

- It is worthwhile to note that for this neighbourhood population, the diseases risks related to vectors like flies and other insects will increase.
- The time going, groundwater might be contaminated possibly inducing the pollution of groundwater.



#### 4.2.2.2.4 Living environment aspects

- Noise nuisances caused by waste transporting trucks, by unpleasant smells and toxic gases, crying birds attracted by waste and proliferation of insects will be more than inconvenient to population which has been living in a healthy environment for so many years.
- For the particular case of people who progressively inhabit in the area around the site of Koubia, the situation is critical since distance between modern housing under construction and the site is small or almost non-existent.

#### **4.2.2.3 Positives Impacts**

##### 4.2.2.3.1 At the level of communes quarters

The positive effects of the creation of these sites can be mainly found at the level of improvement of living conditions through :

- Improving health of population;
- Creating employment;
- Improving working place (workshops, shops, street restaurants, etc.) ;
- Improving the living environment (apartments, yard and outside space, leisure places, amenities, etc.).

##### 4.2.2.3.2 At the level of sewer project of Boukoki

The construction of a sewer network will permit reducing various types of pollution (physical, chemical, biological) related to the waste water discharged on the ground. This will undoubtedly improve sanitation of Boukoki where waters are stagnant several days which is favourable to a lot of diseases vectors. On a whole, the living environment of people in this quarter will improve.

Other positives impacts are also foreseen especially as regards to the creation of employment, improvement of health conditions and accesses to the area, economical benefits through purchase of goods and services at the time of construction, and exchanges.

#### **A- Health aspects**

In this field, there are 2 aspects to retain, which are:

- The expected improvement of health of population mainly due to the possible reduction of diseases vectors like mosquitoes and flies, as a result of eradication of stagnant waters and decrease of flooding events.
- Improvement of the living environment due to the evacuation of waste water and rain water through the new sewers.

- **B- Economical aspects**

- For certain people, the evacuation of rain water through sewers will permit to open space and make their kiosks accessible to the people, which was not the case before due to flooding. Then, with the project their small trade will be accessible, which will improve supply of products and income.

- **4.2.2.4 Negative Impacts**

- From the environmental point of view, the execution of the project will have negative impacts on soil, air, groundwater through related activities.
- These impacts would come (mainly during phase of construction) from air pollution by dust and gas exhaust from vehicles, from destabilisation of soil and from nuisances caused by the location of equipment, and increasing unpleasant smells around sewers.
- The construction of sewers will cause the moving of shops and small trade shops established streets sides along the works to be undertaken, and the risk to damage houses and road infrastructure because of vibrations of machines and others.
- Increase of traffic (already very important on the Ader avenue) will induce risks of accidents and worsening of traffic conditions.
- These construction works will then induce falling of trees which are on both sides of the route of sewers.
- During the operation of facilities, negative impacts will be more related to the users behaviour. It can be expected that when facilities are badly maintained or badly used, the increase of unpleasant smells and the proliferation of mosquitoes can result.

- **A- Social aspects**

- The construction of sewers means the occupation of a part of the streets. However, in a quarter which is overpopulated like Boukoki where streets constitute a social vital space for population, any reduction of this space will worsen the density conditions in compounds.
- Moreover, streets are used with several social and physical objectives. They are organisation of socio-cultural events like baptism and marriage, feasts, meetings of associative groups, praying (in street mosques), sports of children (foot-ball, running, struggles, etc.), as well as discussion (fada) of the young and adults. Furthermore, during heat periods, few inhabitants use streets for rest and sleeping in night.
- Accordingly, the realisation of the project will probably induce a social disorganisation with readjustments of individual scale as well as collective,

within the communities of the quarter. Such readjustments will probably appear as more concentration of inhabitants in their reduced space inside houses, which is still psychologically more stressing, or outside by extension to new places.

- It should be noted that any people concentration in a reduced space is favourable to propagation of diseases or raising of conflicts between occupants. It should be recognised that in an urbanising area, there are traditional life virtues (social solidarity) that progressively disappear for urban individualism, generally characterised by egoism, which lead individuals to adopt a defensive behaviour of their rights in a basically illiterate environment. In such context, misunderstanding may easily lead to more or less important conflicts between neighbours.

## **B- Health aspects**

- The concern here is the risk related to accidental falls of children, elderly people, and other handicapped people as well as animals. Regarding the children, we should underline that households of Boukoki quarter have a high ratio of children. These children are very active and spend most of the time in streets, that they use as a playing field. Then, they are seriously exposed to risks of falling down in sewers, especially during the night since lighting is insufficient if not absent in the quarter.
- As for the children, elderly people, handicapped people as well as animals are also subject to the same type of accidents.

## **C- Economical aspects**

- The negative impact is related to the cut of income especially for the women who work in small proximity trade along the streets and close to the residence. The products on sale are those of bare necessities and include a large proportion of food products (pancakes, doughnuts, porridge, peanuts and others). As a matter of fact, one of the inconvenient aspects of the project is the eventual proliferation of flies and other insects taking refuge in sewers. However, as the sale points are localised street side, near the sewers, the risks of contamination of food products by flies and insects are important. In such context, clients will obviously be aware of risks and will not come to buy, reducing then the income of small shopkeepers.
- For these women any reduction of income is a prejudice to their standard of living. This situation will limit their possibilities of access to health care, children care as well as care for the solidarity relationships (participation to social events only).
- Moreover, the realisation of the project will eventually induce the relocation of few kiosks and other workshops with all related inconvenience. Moving and more specifically relocating small shops will cause at short or long term

additional expenses and loss of earnings, without speaking about the associated discomfort.

### **4.2.3 LEVEL OF WASTE WATER TREATMENT PLANT OF DEZEIBON**

#### **4.2.3.1 Positives Impacts**

Treatment of waste water will induce an improvement of public health and creation of employment. Several sanitary risks are associated to bacterial, viral and parasite pollution which will be avoided. This pollution is in fact responsible of several infectious diseases such as typhoid fever, dysentery, cholera, and bad smells will be considerably reduced.

In other words, the improvement of water quality, since treated waste water will not present danger, will reduce the pollutants load of river water and be used for irrigation of market gardening fields. Excepted in the case of operation failure or excessive flows of collected waste water.

The rational operation of the plant and a good maintenance will have big positives impacts.

Improvement of security conditions is also to be noted compared with present conditions of the site, which constitutes a refuge for criminals then establishing a permanent insecurity.

The starting operation of the waste water treatment plant will significantly improve human and animal health since the Gountou Yéna valley and the Niger river are the outlets of waste water and the receiving environment is used in several ways (bathing, drinking for animals, drinking, etc.).

Hydrographic networks were previously receiving waste water of the urban community of Niamey. But the quantity has increased because of demography, leading to heavy pollutants load, with as one consequence the eutrophication of water courses.

However, thanks to the waste water treatment, the Gountou Yéna water course and Niger river will have lower load of nitrogen and phosphate substances.

Accordingly, this will limit the increase of aquatic vegetation especially phytoplankton and proliferation of algae which cause eutrophication.

This is important since it is quite harmful for aquatic flora and fauna.

#### **A- Social aspects**

The project implantation site constitutes the access zone to dense vegetation which serves as refuge to criminals. Then, the construction of the plant will close such direct access, which provides a better security for neighbour population.

## **B- Economical aspects**

- The creation of employment during construction works of the plant and for maintenance works ;
- The gardeners of the Gountou Yéna will be able to use the treated waste water for irrigation of market gardens. This will guarantee the quality of market gardening produces and then increase quantities and sale prices.

## **C- Health aspects**

- The implantation of the plant is development of a site where mosquitoes and flies proliferate. By decreasing the chance of such proliferation, the frequency of diseases (malaria, diarrhoea) related to it is reduced.
- The supply of treated waste water to gardeners will improve the quality of market gardening produces, then reduce the diseases related to the use of waste water. This problem should anyway be considered as a public health issue.

### **4.2.3.2 Negative Impacts**

The siting of the waste water treatment plant will have negative impacts. The activities of development of the site and construction works could induce the release of pollutants, which are not admissible for the Niger river, through Gountou Yéna water.

Pollutants can be: garbage, cement, gasoline, oils, waste water after washing of equipment.

This would be harmful to aquatic life (fauna, flora) already threatened by the present level of pollution.

Activities that could also generate noise nuisances and also threaten air quality through dust and vehicles exhaust gases with all consequences on health of neighbour population.

Trees and bushes as all the vegetation will be destroyed by development works of the site. This will induce the destruction of fauna habitats and a lack of earnings for users of plants.

Agricultural land already exploited will lose this function and then affect the income of inhabitants.

There will probably be few indirect impacts and secondary impacts on daily life activities of the population caused by the implantation of the plant in urban centre (Dezeibon school, Katako market, bus terminal of Tillabéry, etc.).

## **A- Social aspects**

- The expropriation of land owners from land under exploitation for market gardening;
- Unemployment of farmers and then their impoverishment;
- Loss of social prestige related to land ownership or cultivation.

## **B- Economical aspects**

- The loss of livelihood constituted by land gardening;
- Impoverishment of land owners and farmers due to the loss of income earned from land lease for the first and from sale of market produces for the second;

## **C- Health aspects**

- The lack of income makes difficult the access to medicines and health services.

## **V- ANALYSIS OF MEASURES FOR MITIGATION OF NEGATIVE IMPACTS AND IMPROVEMENT OF CONDITIONS FOR IMPLEMENTATION OF POSITIVE IMPACTS**

Mitigation measures and strengthening measures are proposed in order to limit or reduce impacts that threaten the environment and strengthen the positive impacts.

Measures are presented in terms recommendations to apply for most of them to construction works, which should be as soon as possible integrated in the bid of companies which have been selected for works.

### **5.1 GENERAL MEASURES**

#### **5.1.1 MEASURES OF INFORMATION AND FOR AWARENESS HEIGHTENING**

- Actions for public information and awareness heightening of people about the projects (objectives, implementation, expected results, impacts, etc.) and for making population more responsible (maintenance and appropriate use) will be done before and during execution of projects.
- These actions can involve responsible people of administration, chiefs of quarters, NGOs and technical services of municipalities.
- A competent structure in this field must be identified for executing this important aspect of information, education and communication.

### **5.1.2 MEASURES RELATED TO LABOUR**

- It is necessary to elaborate the companies bids giving priority to works with intense use of labour in order to provide an optimal level of employment to neighbour population
- This measure will give not only income but also associate population to integrate infrastructures which will be realised and to make them aware of problems for maintenance of works.

### **5.1.3 COMPENSATING MEASURES**

- In the sensitive areas and especially in the urban area, it will be necessary to reduce as much as possible the duration of works and to control accesses to the sites.
- We recommend the use of local labour to associate populations in project.
- At the end of construction, need to take measures for cleaning and restore the site.

## **5.2 SPECIFIC MEASURES**

### **5.2.1. MEASURES FOR MITIGATION OF NEGATIVE IMPACTS AND STRENGTHENING OF POSITIVE IMPACTS IN THE WASTE DISPOSAL SITES**

#### **5.2.1.1 Measures to reduce the negative impacts**

It is recommended to avoid the disposal of the following waste:

- Radioactive waste;
- Animal waste;
- Hospital waste;
- Toxic waste;
- Waste generated by veterinary unit.

Restoring the places of extraction of earth used for covering waste at the landfill site in order to avoid the formation of erosion sources.

In order to avoid any contamination of groundwater, it is necessary to strengthen water proof layers.

It would be appropriate to plan a thick cover of earth on compacted waste in order to minimise risks of proliferation of disease vectors, of pests and unpleasant smells.

Finally, given the density of road traffic on Tillabéry and Torodi roads, transport of waste must be done in such conditions that nuisances are reduced as much as possible. Then, it will be necessary to use trucks equipped with sheets. It will be pertinent to avoid overlapping of trucks trips time with the time of passage of funeral processions already mentioned.

#### **5.2.1.2 Measures for strengthening the positive impacts**

Setting up a legal and institutional framework is necessary in order to maximise the advantages of valorising and transporting waste. This framework will concern municipal services, NGOs and drivers.

Municipal services will coordinate all operations from door to door collection to disposal.

NGOs will be in charge of door to door collection and valorising

Drivers will transport waste and value added materials.

#### **5.2.2 MEASURES FOR MITIGATION OF NEGATIVE IMPACTS AND STRENGTHENING OF POSITIVE IMPACTS IN THE SITES FOR COLLECTION AND TREATMENT OF WASTE WATER**

##### **5.2.2.1 Measures to reduce the negative impacts**

Construction of sewers will generate nuisances, which mitigation needs:

- To avoid execution of noisy works outside normal working at proximity of habitats;
- Maintain transport vehicles and equipment in good working conditions in order to avoid leak of oil and gasoline;
- Make people of target area aware before starting works, focusing on small kiosks and shops for moving;
- Additional measures must be taken for construction works of the UASB plant in order to reduce surface water pollution risks;
- Site development activities and construction of the waste water treatment plant will be conducted in strict accordance with regulations of Niger and recorded in the bid of construction companies.



### **5.2.2.2 Measures for strengthening the positive impacts**

In addition to the public awareness campaign that will be led before and during construction works, it will be necessary to employ guardian staff for the plant to control and follow-up activities on the site, like market gardening and fish feeding.

#### 5.2.2.2.1 Economical aspects

- Giving priority to employment of local labour (land owners and farmers directly affected by extension) ;
- Leading a campaign for information and communication toward farmers and consumers of market garden produces about the quality of treated waste water and as a result about the quality of these produces. This campaign must tend to promotion of produces of Gountou Yéna cultivated with treated waste water.

#### 5.2.2.2.2 Health aspects

- Making a treatment of polishing ponds against proliferation of mosquitoes and flies;
- Getting a large use of irrigation practice from treated waste water;
- Regularly checking the water quality after treatment in order to prevent any form of contamination.

## **VI- PROPOSAL FOR ENVIRONMENT MANAGEMENT PLAN**

### **6.1 PREVENTION OF SOIL POLLUTION**

Risks of soil pollution, as low as they can be, must be taken care by the construction works contractor, who will take all precautions in order to avoid accidental release of materials or contaminants.

In case of serious release, the contractor must remediate to the situation.

Costs for such operation will be the responsibility of the contractor.

### **6.2 PREVENTION OF WATER POLLUTION**

At the time of signature of contract, the contractor must conform to Niger regulations as far as water pollution is concerned.

Activities of construction must be led in view to avoid as possible the release of contaminants or pollutants in water bodies and groundwater.

In case of serious release of contaminants, services of concern (environment, health, etc.) must be informed.

All these measures of repair or getting rid of pollution required by competent services must be executed by the contractor or any other organism having agreement, and costs will be borne by the contractor

### **6.3 REDUCTION OF NOISE AND AIR POLLUTION**

Noise nuisances during the construction works will be mainly generated by the equipment and machines.

Noise levels can be attenuated as follows :

- The contractor must make sure that machines used on project field are equipped to get suitable noise levels which have to be conform with regulations.
- The contractor must make sure that, as many times as possible, machines and les equipment are located far from a place sensitive to noise;
- Equipment and vehicles producing too much exhaust gas because of bad tuning or any other lack for good work must not be used unless remediation measures are taken;
- Incineration of materials generated by trees felling, wood and others is not authorised, excepted after approval by the competent authorities;
- The contractor must take all necessary actions in order to fight with, prevent and minimise emissions or release of air pollutants.

Measures aiming at eradication of dust can be:

- Installation of water points at entrance and exit in order to avoid propagation of dust in neighbourhood (compounds, shops, schools, etc.) ;
- The setting and strict respect of speed limitation for all vehicles which circulate on the route to sites ;
- Closure of all materials transporting vehicles with sheets to avoid excessive dust.

Costs for water spraying and other means to fight with dust will be part of the bid.

## **VII- CONCLUSION**

Priority projects present a largely beneficial expected impact with several advantages.

The identified negative impacts, mostly related to the risk of contamination of groundwater, degradation of vegetal cover, can be attenuated by measures which have been proposed and which cost is reasonable.

This impact study should not be limited to the definition of environmental constraints and identification of mitigating measures, but this work must be continued during the project planning phase.

A technical assistance in the field of environment is desirable in order to achieve the final formulation of environmental impacts mitigating plan and the monitoring programme and environmental follow-up.

The main lines of this programme are defined in the proposed environment management plan.

The environmental impact assessment study will permit the effective integration of projects in the environment and the identification of directions for the participation of population. In this perspective, a real programme of information, education and communication must be prepared and executed.

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## **APPENDIX S.6 MONITORING OF PILOT STUDY**

## **S.6 MONITORING OF PILOT STUDY**

There are two pilot plants, one is Jyokaso plant in Bandabari primary school and the other is UASB plant at Deizeibon. Jyokaso plant was commissioned from the middle of March and monitoring was done from April to September in 2001. UASB plant was commissioned from the beginning of July and monitoring was done from July to September, 2001.

Following is the operation and monitoring reports of Jyokaso and UASB plants which mention major activities for operation and maintenance. In addition water quality monitoring reports are enclosed for both pilot plants.

**OPERATION AND MONITORING REPORT JYOKASO PLANT  
APRIL 2001**

After the precommissioning of Jyokaso (09 04 01) plant located at Bandabari Primary School, the process of maintenance and monitoring have started, these include the inspection and cleaning of its major component.

DAYS	WORK DONE	ACTION
2 <sup>nd</sup> and 16 <sup>th</sup> " " " " "	<ul style="list-style-type: none"> <li>- Check pit n° 1 to n° 5</li> <li>- Cleaning pit n° 1 to n° 5 with CUN technicians</li> <li>- Blowers inspection</li> <li>- Settling tank</li> </ul>	<ul style="list-style-type: none"> <li>- Flushing pits n° 1 to n° 5 to remove sludge.</li> <li>- Cleaning air filters</li> <li>- Check sludge surface into the plant</li> </ul>
Daily	<ul style="list-style-type: none"> <li>- Washing toilets tiles and sanitary appliance</li> <li>- Cleaning pounds</li> </ul>	<ul style="list-style-type: none"> <li>- Sweeping sand and tiles and washing sanitary appliances</li> <li>- Removal of falling plastics, stones and wood</li> </ul>
2 <sup>nd</sup> and 17 <sup>th</sup>	<ul style="list-style-type: none"> <li>- Sampling</li> </ul>	<ul style="list-style-type: none"> <li>- Analysis : BOD, COD, NTK, SS, NH<sub>4</sub>, t°, O<sub>2</sub>, turbidity, color, coliforms, streptococcus.</li> </ul>

**OPERATION AND MONITORING REPORT JYOKASO PLANT  
MAY 2001**

DAYS	WORK DONE	ACTION
7 <sup>th</sup> and 21 <sup>st</sup> " " Daily "	<ul style="list-style-type: none"> <li>- Cleaning pit n° 1 to n° 5</li> <li>- Blowers inspection</li> <li>- Clean surrounding of blowers</li> <li>- Washing toilets tiles and sanitary appliance</li> <li>- Cleaning ponds</li> </ul>	<ul style="list-style-type: none"> <li>- Flushing pits n° 1 to n° 5 to remove sludge.</li> <li>- Cleaning air filters</li> <li>- Sweeping with broom around the blowers cage</li> <li>- Sweeping sand and tiles and washing sanitary appliances</li> <li>- Removal of falling plastics, stones and wood</li> </ul>
15 <sup>th</sup> "	<ul style="list-style-type: none"> <li>- Roof for blowers shed and lattice grid and door for toilet entrance and blowers.</li> <li>- Fish in pond n°2</li> </ul>	<ul style="list-style-type: none"> <li>- Erection of blowers roof covering with galvanized iron sheet.</li> <li>- Erection of metallic grid and doors.</li> <li>- Twenty (20) fishes brought from Niger river put in pond n°2</li> </ul>
8 <sup>th</sup> , 14 <sup>th</sup> , 21 <sup>st</sup> and 28 <sup>th</sup>	<ul style="list-style-type: none"> <li>- Sampling</li> </ul>	<ul style="list-style-type: none"> <li>- Analysis : BOD, COD, NTK, SS, NH<sub>4</sub>, t°, O<sub>2</sub>, turbidity, color, coliforms, streptococcus.</li> </ul>



**OPERATION AND MONITORING REPORT JYOKASO PLANT  
JUNE 2001**

DAYS	WORK DONE	ACTION
4 <sup>th</sup> and 18 <sup>th</sup> " Daily "	<ul style="list-style-type: none"> <li>- Cleaning pit n° 1 to n° 5</li> <li>- Blowers inspection</li> <li>- Washing toilets tiles and sanitary appliance</li> <li>- Cleaning pounds</li> </ul>	<ul style="list-style-type: none"> <li>- Flushing pits n° 1 to n° 5 to remove sludge.</li> <li>- Cleaning air filters</li> <li>- Sweeping sand and tiles and washing sanitary appliances</li> <li>- Removal of falling plastics, stones and wood</li> </ul>
15 <sup>th</sup>	<ul style="list-style-type: none"> <li>- V notch enlarged</li> </ul>	<ul style="list-style-type: none"> <li>- V notch enlarged to increase it depth to allow quick flow of water from pound to the pit.</li> </ul>
18 <sup>th</sup>	<ul style="list-style-type: none"> <li>- Fish in pound n°2</li> </ul>	<ul style="list-style-type: none"> <li>- Second time : twenty (20) fishes brought from Niger river put in pond n°2.</li> </ul>
6 <sup>th</sup> , 8 <sup>th</sup> , 15 <sup>th</sup> and 29 <sup>th</sup>	<ul style="list-style-type: none"> <li>- Sampling</li> </ul>	<ul style="list-style-type: none"> <li>- Analysis : BOD, COD, NTK, SS, NH<sub>4</sub>, t°, O<sub>2</sub>, turbidity, color, coliforms, streptococcus.</li> </ul>

**OPERATION AND MONITORING REPORT JYOKASO PLANT  
JULY 2001**

DAYS	WORK DONE	ACTION
2 <sup>nd</sup> and 16 <sup>th</sup> " " Daily "	- Cleaning pit n° 1 to n° 5  - Blowers inspection  - Washing toilets tiles and sanitary appliance  - Cleaning pounds	- Flushing pits n° 1 to n° 5 to remove sludge. - Cleaning air filters  - Sweeping sand and tiles and washing sanitary appliances  - Removal of falling plastics, stones and wood
15 <sup>th</sup>	- V notch enlarged	- V notch enlarged to increase its depth to allow quick flow of water from pond to the pit.
18 <sup>th</sup>	- Fish in pond n°2	- Second time : twenty (20) fishes brought from Niger river put in pond n°2.
6 <sup>th</sup> and 21 <sup>st</sup>	- Sampling	- Analysis : BOD, COD, NTK, SS, NH <sub>4</sub> , t°, O <sub>2</sub> , turbidity, color, coliforms, streptococcus.
Remark	School close	Summer holidays

**OPERATION AND MONITORING REPORT JYOKASO PLANT  
AUGUST 2001**

DAYS	WORK DONE	ACTION
6 <sup>th</sup> and 20 <sup>th</sup> " " Daily "	<ul style="list-style-type: none"> <li>- Cleaning pit n° 1 to n° 5</li> <li>- Blowers inspection</li> <li>- Washing toilets tiles and sanitary appliance</li> <li>- Cleaning pounds</li> </ul>	<ul style="list-style-type: none"> <li>- Flushing pits n° 1 to n° 5 to remove sludge.</li> <li>- Cleaning air filters</li> <li>- Sweeping sand and tiles and washing sanitary appliances</li> <li>- Removal of falling plastics, stones and wood</li> <li>- Remove too many water jacints</li> </ul>
1 <sup>st</sup>	<ul style="list-style-type: none"> <li>- Sampling</li> </ul>	<ul style="list-style-type: none"> <li>- Analysis : BOD, COD, NTK, SS, NH<sub>4</sub>, t°, O<sub>2</sub>, turbidity, color, coliforms, streptococcus.</li> </ul>
Remark	School close	Summer holidays

**OPERATION AND MONITORING REPORT JYOKASO PLANT  
SEPTEMBER 2001**

DAYS	WORK DONE	ACTION
3 <sup>rd</sup> and 17 <sup>th</sup> "        "  Daily  "	<ul style="list-style-type: none"> <li>- Cleaning pit n° 1 to n° 5</li> <li>- Blowers inspection</li> <li>- Washing toilets tiles and sanitary appliance</li> <li>- Cleaning pounds</li> </ul>	<ul style="list-style-type: none"> <li>- Flushing pits n° 1 to n° 5 to remove sludge.</li> <li>- Cleaning air filters</li> <li>- Sweeping sand and tiles and washing sanitary appliances</li> <li>- Removal of falling plastics, stones and wood</li> <li>- Remove too many water jacints</li> </ul>
1 <sup>st</sup>	Analysis canceled	
Remark	School close	Summer holidays

**OPERATION AND MONITORING REPORT UASB PLANT  
JULY 2001**

DAYS	WORK DONE	ACTION
1 <sup>st</sup> to 31 <sup>st</sup>	- Daily removal of sludge and scum - Cleaning of inlet channel and pump pit.	- Bare screen cleaning twice a day - Top of UASB and grit channel one a day - Once a week and after rain.
1 <sup>st</sup> to 31 <sup>st</sup>	- Civil works :	- Tiles and finishing MCC room. - Fencing wall plastering and finishing.
1 <sup>st</sup> to 31 <sup>st</sup>	- Daily check of general station working	- Checking submersible pump pressure and flow. - Checking of gas flow. - Visual checking of treated water.
18 <sup>th</sup> to 31 <sup>st</sup>	- Plumbing and sanitary	- General water supply connection to gas holder, chlorine tank and MCC toilets and garden. - Toilets outlet connection from MCC to pumping pit.
2 <sup>nd</sup> 11 <sup>th</sup> and 20 <sup>th</sup>	- Sampling for water quality testing	- Analysis : BOD, COD, NTK, SS, NH <sub>4</sub> , t°, O <sub>2</sub> , turbidity, color, coliforms, streptococcus. - 4 series : Inlet, outlet UASB, outlet biotower, outlet station
16 <sup>th</sup>	- Putting fish in pond n°3	- "Silure" and "tilapia"
23 <sup>rd</sup>	- Putting plants	- Water jacinth in pond n°1

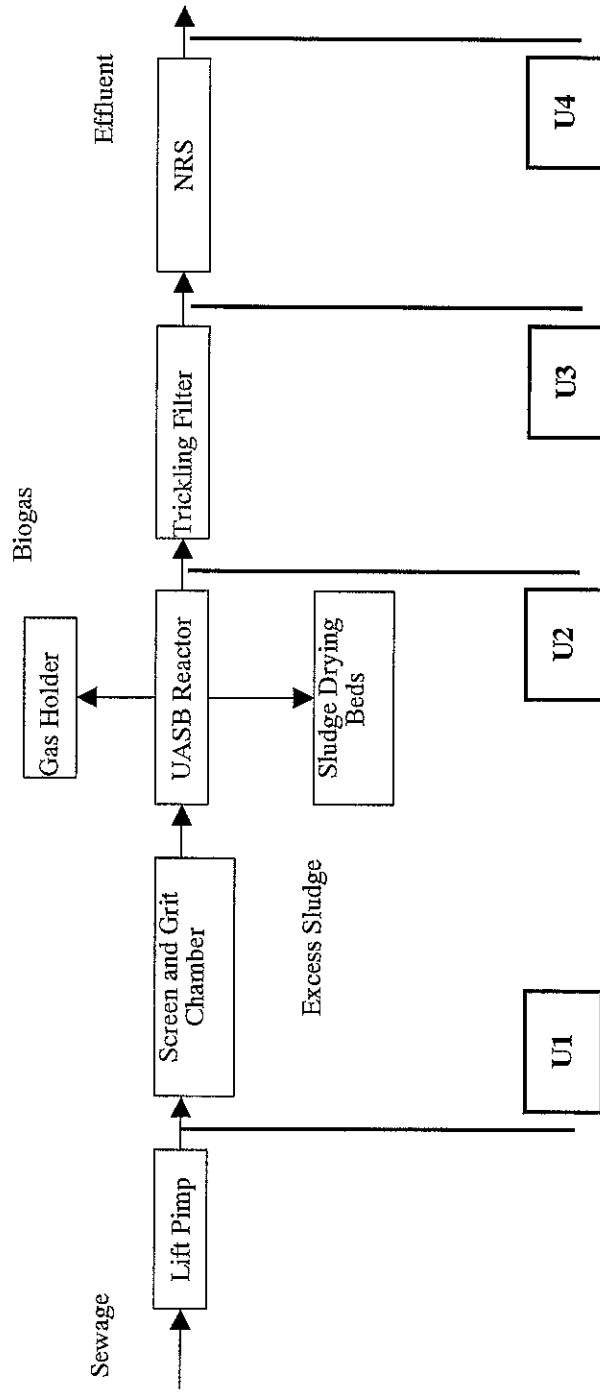
**OPERATION AND MONITORING REPORT UASB PLANT  
AUGUST 2001**

DAYS	WORK DONE	ACTION
1 <sup>st</sup> to 31 <sup>st</sup>	- Daily removal of sludge and scum - Cleaning of inlet channel and pump pit.	- Bar screen cleaning twice a day - Top of UASB and grit channel one a day - Once a week and after rain.
15 <sup>th</sup> to 31 <sup>st</sup>	- Electricity work	- Outside lighting - MCC room lighting - MCC panel
1 <sup>st</sup> to 31 <sup>st</sup>	- Civil works :	- Fencing wall plastering and finishing. - Kerbs installation
18 <sup>th</sup> to 31 <sup>st</sup>	- Plumbing and sanitary	- Sanitary appliances installation.
20 <sup>th</sup>	- UASB launder channels	- Adjustment
1 <sup>st</sup> 11 <sup>th</sup> and 21 <sup>st</sup>	- Sampling for water quality testing	- Analysis : BOD, COD, NTK, SS, NH <sub>4</sub> , t°, O <sub>2</sub> , turbidity, color, coliforms, streptococcus. - 4 series : Inlet, outlet UASB, outlet biotower, outlet station
1 <sup>st</sup> to 31 <sup>st</sup>	- Daily check of general station working	- Checking submersible pump pressure and flow. - Checking of gas flow. - Visual checking of treated water.
16 <sup>th</sup>	- Putting fish in pound n°3	- "Silure" and "tilapia"
23 <sup>rd</sup>	- Putting plants	- Water jacinthe in pound n°1 and water lettuce in pound n°2
25 <sup>th</sup> to 31 <sup>st</sup>	- Putting more sponge support for media filter	- Addition of extra sponges to biotower media filter.
27 <sup>th</sup> to 31 <sup>st</sup>	- Connection of effluent chamber to main sewage channel.	- Installation of PVC pipes.
29 <sup>th</sup> to 31 <sup>st</sup>	- Inlet channel protection	- Concrete reinforcement for basement.
20 <sup>th</sup> to 25 <sup>st</sup>	- Painting	- MCC room, gates and windows.

**OPERATION AND MONITORING REPORT UASB PLANT  
SEPTEMBER 2001**

<b>Date</b>	<b>Work Done</b>	<b>Action</b>
4 September	Introduced plant in Eco-Pond no. 2 and 3.  Flare arrangement, KO Drum Additional packing in Bio-Tower	The appearance was not right. Hence decided to replace it.  Streamlined the pipelines. Spark arrestor is to be installed on the KO drum. Additional packing was installed in the Bio-Tower.
5 September	Spark arrestor installed. Manometer put into operation Lettuce plant introduced in the first and second pit. Technology Transfer and customer training	Flare lit for the first time. Rotameter and bypass valve operation explained to counterpart. Frogs were introduced in Eco-Pond No. 1 and 2 but they escaped. Fish in Biotower sump could not be alive for long time. Mr. Bashir was explained the plant in detail and specifically for the pump operation and UASB reactor operation.
6 September	Secretary General visit.  Sand Filter Sludge blowdown sample taken from Bottom and middle level.	Secretary General visited to the plant and was explained the plant operation. Sand was put in middle compartment. No settlement of sludge. Floccs were observed. Sludge blowdown is required at regular frequency.
7 September	USAB sludge withdrawal from the middle zone. Additional packing	Approximately 2000 lit. was blowdown to sand pit. Preparation for the additional packing to be installed in the Bio-Tower.

# SAMPLING POINTS FOR UASB PLANT





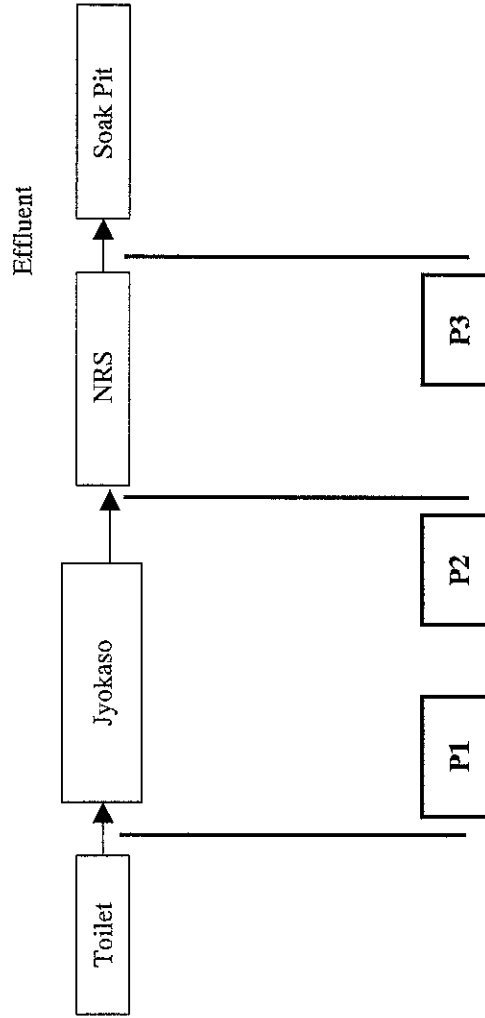
STATION D'EPURATION UASB

			02/07/01	11/07/01	21/07/01	01/08/01	11/08/01	22/08/01	01/09/01	11/09/01
DCO mg/l	U1	brut	1210	1440	1869	1421	1984	1370	1670	
		filtr	718	808	765	677	789	525	798	
	U2	brut	832	758	695	412	655	661	535	
		filtr	605	635	510	211	254	417	162	
	U3	brut	812	560	610	274	357	155	256	
		filtr	600	433	501	118	246	95	151	
	U4	brut	831	704	671	302	286	140	214	
		filtr	718	600	500	105	238	83	146	
DBO <sub>5</sub> mg/l	U1	brut	740	980	1250	820	1300	1100	1250	
		filtr	480	680	520	460	640	580	605	
	U2	brut	490	600	520	220	420	420	450	
		filtr	360	540	320	140	200	360	335	
	U3	brut	390	340	500	80	107	69	75	
		filtr	330	320	320	39	50	35	32	
	U4	brut	500	540	500	45	56	36	42	
		filtr	380	500	300	22	47	25	29	
NTK mg/l de N	U1	brut	213	236	254	230	250	245	238	
		filtr	128	120	162	130	145	142	138	
	U2	brut	140	136	164	142	151	146	149	
		filtr	102	98	110	108	105	103	99	
	U3	brut	110	104	123	109	100	102	106	
		filtr	102	95	106	68	90	93	91	
	U4	brut	115	112	95	90	87	89	93	
		filtr	92	80	63	54	52	55	60	
MES mg/l	U1		492	360	700	687	885	579	543	
	U2		102	110	210	214	310	358	242	
	U3		100	93	204	105	150	46	88	
	U4		111	88	106	50	35	21	28	
NH <sub>4</sub> mg/l	U1		61	62	63	61	69	63	72	
	U2		60	54	64	53	58	64	68	
	U3		58	58	62	47	48	68	65	
	U4		57	57	59	35	47	62	56	
NO <sub>3</sub> mg/l	U1		3.1	2.9	3.4	2.7	2.8	3.0	2.9	
	U2		3.7	2.6	2.8	2.5	2.4	2.5	2.7	
	U3		3.2	2.3	2.5	2.1	2.4	2.4	2.5	
	U4		3.6	2.7	2.9	3.2	2.9	2.8	2.7	
NO <sub>2</sub> mg/l	U1		0.7	<0.01	1.0	0.2	0.03	0.04	0.60	
	U2		0.9	<0.01	1.3	0.1	0.03	0.05	0.20	
	U3		0.45	0.08	1.0	0.4	0.04	15.20	19.60	
	U4		0.5	0.09	0.9	<0.01	0.07	0.09	20.50	
PO <sub>4</sub> mg/l	U1		8.1	7.8	9.5	8.4	9.7	8.0	7.6	
	U2		9.9	9.4	10.2	9.2	10.1	9.3	10.1	
	U3		9.7	7.9	10.1	9.5	9.9	9.7	9.1	
	U4		9.8	8.5	10.2	9.8	10.5	10.0	9.9	
pH	U1		7.60	7.22	7.41	7.18	7.33	7.76	7.37	
	U2		7.08	6.93	6.94	6.69	7.00	6.99	7.10	
	U3		7.08	7.89	6.94	7.63	7.86	7.90	7.93	
	U4		7.35	7.33	7.22	7.51	7.81	7.42	7.96	

STATION D'EPURATION UASB

T° (°)	U1		31.3	30.8	30.6	28.9	29.9	31.3	29.5
	U2		31.2	30.6	30.4	28.2	30.3	29.4	29.1
	U3		31.2	27.8	30.4	26.7	30.4	28.0	28.4
	U4		31.2	30.1	30.7	27.6	29.7	31.7	28.9
O <sub>2</sub> mg/l	U1		0.10	0.09	0.14	0.15	0.15	0.12	0.15
	U2		0.60	0.17	0.25	0.40	0.40	0.25	0.27
	U3		0.60	0.09	0.24	0.40	0.73	4.92	4.04
	U4		0.23	0.26	0.34	2.00	0.39	0.52	1.25
Turb. NTU	U1		43	45	25	62	30	7	145
	U2		52	71	21	39	54	8	12
	U3		52	62	19	13	19	5	7
	U4		37	48	28	14	26	8	7
Coul. mg/l	U1		600	550	650	850	600	890	1120
	U2		650	600	700	500	800	370	450
	U3		650	600	700	360	500	240	250
	U4		800	550	600	300	750	420	300
Colif. u/100ml	U1		1.5E+08	7.0E+07	6.3E+07	5.3E+07	1.5E+08	6.6E+07	5.6E+08
	U2		2.7E+07	2.3E+07	2.5E+07	1.3E+07	2.6E+07	1.2E+07	2.2E+07
	U3		1.2E+07	3.0E+07	1.2E+07	1.1E+07	4.6E+06	7.8E+06	8.6E+06
	U4		8.0E+06	5.0E+07	8.2E+06	1.7E+06	1.7E+06	1.5E+06	1.6E+06
Strept. u/100ml	U1		1.0E+07	6.5E+06	6.0E+06	5.3E+06	8.5E+06	6.4E+06	8.9E+06
	U2		1.8E+06	1.4E+06	2.2E+06	1.4E+06	1.4E+06	9.9E+05	1.2E+06
	U3		1.2E+06	5.6E+05	8.7E+05	1.1E+06	5.7E+05	4.1E+05	6.7E+05
	U4		2.4E+05	2.9E+05	6.4E+05	4.8E+05	6.2E+05	2.3E+05	3.0E+05

# SAMPLING POINTS FOR JYOKASO



STATION D'EPURATION JYOKASO ECOLE BANDABARI 2

			02/04/01	17/04/01	08/05/01	14/05/01	21/05/01	28/05/01	06/06/01	08/06/01	15/06/01
DCO mg/l	P1	Brte	1140	860	1275	650	575	1455	970	630	1947
		Ftre	621	376	620	355	250	924	609	410	968
	P2	Brte	56	58	126	60	30	132	77	51	55
		Ftre	30	34	88	32	25	56	56	43	38
	P3	Brte	69	106	102	80	50	146	69	56	59
		Ftre	34	34	80	43	25	54	56	43	46
DBO <sub>5</sub> mg/l	P1	Brte	600	684	775	425	250	830	620	390	1400
		Ftre	310	280	385	315	190	526	380	300	680
	P2	Brte	50	50	80	56	50	85	70	40	40
		Ftre	30	28	50	28	30	75	50	30	30
	P3	Brte	40	56	67	70	40	106	70	50	40
		Ftre	30	26	52	40	20	65	50	40	30
NTK mg/l de N	P1	Brte	121	86	103	45	65	74	96	48	233
		Ftre	103	73	70	40	62	58	78	42	101
	P2	Brte	5.0	4.0	5.0	7.0	8.0	11.0	11.0	8.9	12.0
		Ftre	4.0	2.0	5.0	7.0	8.0	10.0	9.8	8.3	11.0
	P3	Brte	5.0	3.0	3.0	5.0	6.2	10.0	10.1	8.9	8.8
		Ftre	4.0	1.0	3.0	5.0	6.0	7.0	9.6	6.4	8.3
MES mg/l	P1		360	313	715	300	320	468	340	280	694
	P2		15	16	12	10	8	23	34	7	22
	P3		38	48	46	18	20	25	24	12	18
NH <sub>4</sub> mg/l	P1		74	38	64	44	27	98	58	47	58
	P2		6	4	12	20	24	22	29	25	21
	P3		4	<0.1	7	14	13	18	27	24	15
NO <sub>3</sub> mg/l	P1		0.9	0.9	1.6	2.4	1.7	5.7	2.0	1.3	1.8
	P2		1.1	1.1	2.0	109	126	124	116	125	121
	P3		6.4	1.5	7.3	108	116	126	120	126	124
NO <sub>2</sub> mg/l	P1		<0.01	0.06	0.02	<0.01	<0.01	0.4	<0.01	0.03	<0.01
	P2		51	46	3	0.5	0.3	1.8	1.6	1.6	1.7
	P3		47	49	9	2.0	1.5	2.6	1.9	2.0	3.9
PO <sub>4</sub> mg/l	P1		8.4	8.6	6.4	4.4	3.4	10.3	7.6	5.2	8.9
	P2		1.2	5.1	5.8	7.1	7.9	11.5	7.7	6.9	7.4
	P3		0.24	1.2	4.8	5.9	4.6	6.6	7.5	7.1	6.8
pH	P1		6.83	7.06	7.12	7.19	6.89	7.22	7.05	7.77	7.50
	P2		8.36	8.06	7.06	6.89	6.85	7.20	6.98	6.52	6.88
	P3		10.50	10.40	7.50	8.11	8.59	8.35	7.91	6.98	7.20
T° (°)	P1		33.6	33.9	32.7	33.4	33.2	34.3	34.2	33.8	32.4
	P2		28.6	30.5	32.6	32.4	34.6	33.6	33.8	34.7	33.4
	P3		26.8	29.3	31.2	31.4	31.8	30.3	32.7	31.8	30.0
O <sub>2</sub> mg/l	P1		5.87	0.40	3.50	4.20	4.50	1.80	0.90	2.50	2.20
	P2		10.40	7.00	2.90	4.10	2.30	3.50	2.42	1.70	1.50
	P3		14.30	9.40	5.04	8.40	8.30	8.50	11.24	4.30	5.35
Turbidité NTU	P1		7	9	10	10	10	12	9	10	40
	P2		2	2	1	1	2	2	2	2	3
	P3		2	2	1	2	3	3	3	2	3
Couleur mg/l	P1		320	240	250	200	200	450	200	240	900
	P2		38	65	60	90	100	110	130	120	140
	P3		30	45	55	80	100	110	120	110	140
Coliformes u/100ml	P1			6.0E+06	3.7E+07	2.3E+07	1.7E+06	2.9E+08	1.5E+08	2.3E+07	4.0E+06
	P2		5.5E+04	2.5E+04	6.0E+04	9.5E+03	2.3E+04	1.3E+04	8.6E+03	4.5E+03	5.0E+03
	P3		2.5E+03	2.0E+05	1.6E+05	1.5E+04	8.0E+03	6.0E+03	1.5E+04	1.2E+03	2.5E+04
Streptocoq u/100ml	P1			7.9E+05	3.0E+06	2.9E+06	4.4E+06	1.2E+07	6.7E+06	8.9E+06	1.3E+06
	P2		3.0E+02	3.3E+03	3.5E+02	1.5E+02	3.0E+02	8.5E+02	5.0E+02	3.4E+02	1.0E+02
	P3		5.0E+01	3.0E+02	1.1E+02	2.5E+02	5.5E+02	2.5E+02	8.3E+02	3.3E+02	1.4E+03

STATION D'EPURATION JYOKASO ECOLE BANDABARI 2

			29/06/01	06/07/01	21/07/01	01/08/01	11/08/01	22/08/01	01/09/01	11/09/01	moyen.
DCO mg/l	P1	Brte	2833	621	1614	589	645	879	940		1108
		Ftre	1484	264	680	223	232	387	597		561
	P2	Brte	67	74	60	45	55	84	100		70
		Ftre	59	45	43	40	39	65	72		48
	P3	Brte	91	71	51	41	50	70	70		73
		Ftre	71	60	43	37	36	61	60		49
DBO <sub>5</sub> mg/l	P1	Brte	1200	460	860	240	319	433	398		611
		Ftre	390	250	460	180	166	159	178		314
	P2	Brte	60	60	45	70	36	55	78		58
		Ftre	50	40	45	20	29	43	48		39
	P3	Brte	70	50	50	45	32	25	28		51
		Ftre	60	40	45	20	23	18	21		36
NTK mg/l de N	P1	Brte	230	95	110	54	75	103	120		104.6
		Ftre	112	68	80	37	62	68	76		70.8
	P2	Brte	11.5	10.2	7.0	6.0	8.0	9.6	8.5		8.3
		Ftre	11.0	9.1	5.0	5.0	7.7	9.3	8.0		7.6
	P3	Brte	9.2	8.7	7.0	5.0	6.4	7.7	6.4		6.9
		Ftre	8.9	8.2	4.0	4.0	5.0	5.6	5.6		5.7
MES mg/l	P1		630	280	950	307	578	655	651		500
	P2		14	6	4	4	5	7	8		12
	P3		21	8	7	6	6	6	10		18
NH <sub>4</sub> mg/l	P1		55	44	59	20	32	28	29		47.3
	P2		25	35	43	26	29	24	23		23.7
	P3		22	30	33	21	22	22	19		19.7
NO <sub>3</sub> mg/l	P1		1.7	1.8	2.0	2.1	1.9	2.0	2.2		2.0
	P2		97	131	99	118	103	109	117		95.6
	P3		100	132	102	127	120	114	119		99.0
NO <sub>2</sub> mg/l	P1		0.08	1.5	2.1	0.9	0.9	0.1	0.2		0.48
	P2		0.5	4.3	1.9	1.5	6.7	3.5	4.2		7.59
	P3		4.3	6.0	4.7	0.06	0.3	0.2	1.3		7.81
PO <sub>4</sub> mg/l	P1		7.4	4.9	9.7	4.7	5.3	6.8	6.1		6.7
	P2		9.3	10.4	19.5	8.6	10.1	8.3	7.2		8.6
	P3		8.6	9.8	22.3	7.8	13.6	12.6	9.9		8.5
pH	P1		7.92	7.01	8.28	7.11	7.13	7.56	7.96		7.37
	P2		6.56	6.41	4.76	4.45	5.69	5.88	6.22		6.46
	P3		6.80	6.70	6.41	5.57	6.35	6.56	6.88		7.43
T° (°)	P1		30.4	31.7	31.1	27.6	29.8	29.6	30.6		31.8
	P2		30.9	30.2	32.3	30.7	30.2	30.6	30.5		31.7
	P3		28.8	30.0	29.7	27.2	28.6	29.3	28.9		29.8
O <sub>2</sub> mg/l	P1		2.15	0.78	0.38	5.25	4.32	3.52	1.65		2.73
	P2		2.27	1.60	2.60	2.60	3.00	2.98	3.12		3.29
	P3		4.50	3.10	2.50	1.15	4.98	5.02	4.62		6.01
Turbidité NTU	P1		11	9	13	12	15	14	16		13
	P2		4	5	3	2	3	3	2		3
	P3		4	4	3	2	2	2	2		3
Couleur mg/l	P1		250	200	250	300	250	225	300		293
	P2		150	160	150	160	160	175	225		132
	P3		130	140	130	140	140	130	135		111
Coliformes u/100ml	P1		1.4E+08	8.0E+07	7.0E+07	2.6E+07	3.2E+07	9.9E+07	5.6E+07		6.9E+07
	P2		2.5E+03	2.0E+03	3.8E+03	1.5E+03	5.6E+03	3.2E+03	3.0E+03		1.3E+04
	P3		4.5E+03	3.5E+03	2.4E+03	2.5E+03	4.3E+03	2.1E+03	4.2E+03		2.6E+04
Streptocoq u/100ml	P1		1.9E+07	1.0E+07	1.0E+07	1.5E+06	9.9E+06	7.8E+06	6.5E+06		7.1E+06
	P2		5.0E+01	8.5E+01	8.0E+02	1.2E+02	1.3E+02	4.5E+02	4.6E+02		4.9E+02
	P3		4.5E+02	3.2E+02	9.3E+02	2.0E+02	2.1E+02	6.0E+02	5.6E+02		4.6E+02

## ANALYSES EAUX DU FLEUVE

			02/07/01	11/07/01	21/07/01	01/08/01	11/08/01	22/08/01	01/09/01	11/09/01
DCO mg/l	Y	brut	15	22	13	20	19	21	17	
		filtr	8	17	13	20	18	20	17	
	S	brut	15	22	21	30	19	22	18	
		filtr	8	15	19	27	19	20	18	
DBO <sub>5</sub> mg/l	Y	brut	10	20	10	15	10	15	15	
		filtr	10	15	10	15	10	10	15	
	S	brut	10	30	20	18	15	20	20	
		filtr	10	20	15	16	10	15	18	
NTK mg/l de N	Y	brut	2.2	1.1	1.8	2.4	1.6	2.2	2.0	
		filtr	1.6	0.8	1.3	2.0	1.3	1.9	1.6	
	S	brut	2.7	1.9	2.0	2.6	2.1	2.5	2.2	
		filtr	1.5	1.2	1.4	1.8	1.8	1.7	1.9	
MES mg/l	Y		154	312	650	570	590	540	450	
	S		156	392	940	695	625	560	580	
NH <sub>4</sub> mg/l	Y		1.14	0.20	0.90	1.60	1.25	0.65	0.85	
	S		1.18	0.40	0.40	1.20	1.00	0.40	0.55	
NO <sub>3</sub> mg/l	Y		2.1	2.0	1.7	2.3	1.9	2.1	2.3	
	S		2.4	<0.01	2.2	2.7	2.2	2.5	2.4	
NO <sub>2</sub> mg/l	Y		0.20	<0.01	0.90	0.80	0.75	0.80	0.95	
	S		0.16	<0.01	0.96	0.90	0.80	0.75	1.05	
PO <sub>4</sub> mg/l	Y		0.20	0.05	0.20	0.40	0.35	0.45	0.25	
	S		0.30	0.10	0.10	0.45	0.30	0.45	0.20	
pH	Y		7.52	7.50	7.55	6.80	7.52	7.43	7.62	
	S		7.36	7.89	7.28	7.23	7.44	7.35	7.55	
T° (°)	Y		29.9	29.0	29.0	27.5	28.6	29.0	29.6	
	S		30.3	30.2	29.4	29.8	29.3	29.9	30.3	
O <sub>2</sub> mg/l	Y		6.00	5.76	5.56	6.50	6.23	6.44	6.05	
	S		6.00	5.60	6.01	6.04	6.20	6.36	6.21	
Turb. NTU	Y		203	337	330	322	346	365	420	
	S		212	279	256	307	339	375	400	
Coul. mg/l	Y		1650	2500	2150	2600	2400	2350	2700	
	S		1750	2200	2090	2380	2350	2250	2650	
Colif. u/100ml	Y		1.4E+04	3.0E+04	6.5E+05	6.8E+04	7.8E+04	1.2E+05	6.4E+04	
	S		1.7E+04	2.6E+04	1.8E+05	7.3E+04	8.3E+04	9.0E+04	4.2E+04	
Strept. u/100ml	Y		2.0E+02		7.5E+02	5.6E+02	3.2E+02	4.3E+02	8.9E+02	
	S		5.0E+02		1.3E+03	3.2E+03	1.5E+03	6.5E+02	1.4E+03	

Y: Yantala Upstream

S: Sagha Downstream

**APPENDIX S.7 OPERATING MANUAL  
FOR PILOT PLANT  
SEWAGE TREATMENT  
PLANT**

**OPERATING MANUAL**  
**FOR**  
**PILOT PLANT SEWAGE TREATMENT PLANT**  
**NIGER**

**JAPAN INTERNATIONAL COOPERATION AGENCY**



TITLE : OPERATING MANUAL  
 CLIENT : EAM NIAMEY – NIGER  
 PROJECT : PILOT PLANT – WEAGE TREATMENT PLANT  
 REF : PL/528

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12.	<b>GAS HOLDER</b>	12 – 1 to 12 – 2
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#### **ANNEXES**

I.	Laboratory Analysis Procedures	I – 1 to I – 14
II.	Lubrication Schedule	II – 1

#### **DRAWING LIST**

P&I Diagram with Hydraulic Levels	- Dwg No. PL/528/P-01
Plant Layout	- Dwg No. PL/528/L-01
Single Line Diagram	- Dwg No. PL/528 /EE-01

## 1.1 **Introduction**

The pilot plant for Treating Sewage at Niamey, is based on the technology developed by the Tokyo Engineering Corporation, who are the overall consultant for the sewerage Project in that country. The technology is developed by the TEC and engineered by M/s. Paramount Limited, Vadodara (India), which is executed by M/s. EAM who are the contractors for execution of this project.

This pilot plant of 100 m<sup>3</sup>/day capacity where sewage is drawn from the nearby drain - which carries the sewage all the year around. The objective of this plant is to establish the performance of such system particularly, the UASB followed by a biotower with sponge media. After evaluating the performance of this system, a full scale plant then incorporating this system will be built to treat the city sewage.

## 1.2 **Characteristics of Raw Sewage**

<b><u>Parameter</u></b>	<b><u>Design Value</u></b>
pH	6.0 - 7.5
Suspended solids (mg/l)	250 - 300
COD (mg/l)	850
BOD (mg/l)	500

## 1.3 **Treated Sewage Quality**

<b><u>Parameter</u></b>	<b><u>Treated Value</u></b>
pH	5.5 - 9.0
Suspended solids (mg/l)	<30
COD (mg/l)	<100
BOD (mg/l)	<30

## 2.1 **Process Description**

The pilot plant sewage treatment plant is mainly provided to give insight of the technology and its suitability to treat sewage. The proposed pilot plant is to be executed incorporating two stage biological process viz. Anaerobic process using UASB(upflow anaerobic sludge blanket) reactor as first stage and second incorporating a biotower with sponge media, which allows the microbes to grow on a fixed surface. Based on performance of pilot plant, full scale treatment system will be developed.

The raw sewage for proposed pilot plant shall be diverted from existing channel. The raw sewage will be first passed through coarse & fine bar screens for removal of coarse and fine screening material. The screened sewage will be then transferred to pump pit from where raw sewage will be pumped to one of the two grit channels. The grit present in the sewage will be separated in grit channel and overflow from unit will be further treated in a 1<sup>st</sup> stage biological process(UASB) for the stabilisation of organic matter under anaerobic conditions. As the sewage passes upward through a biomass blanket the organic matter gets degraded anaerobically, while the gas is collected separately from reactor top.

The anaerobically treated sewage from UASB reactor is transferred by gravity to second stage biological process viz. Biotower provided with top distribution trough and spongy media. The sewage travels downward through this media in presence of active biomass developed on spongy media and thus further degradation takes place.

The unit is provided with proper ventilation so that required air/oxygen is transferred for effective degradation of organic matter. The stabilised sewage shall be collected at bottom of unit and then transferred for separation of biomass and clear effluent. The clear effluent overflow from clarifier is transferred to ecoponds for polishing the effluent quality. The outlet of ecoponds shall be further chlorinated using chlorine solution and then shall be discharged for irrigation purpose. In biotower system a provision is made to recirculate the clarifier overflow to maintain the desired irrigation rate over biotower.

The sludge generated in the UASB reactor as well as clarifier bottom shall be frequently transferred over drying beds. The filtrate from bottom of sludge drying beds shall be taken to raw sewage pump pit for treatment by gravity.

The gas generated in the UASB reactor is transferred from top dome to flare burner through gas dome.

Refer P & I diagram Dwg. No. PL/528/P-01 & Layout Dwg. PL/528/L-01, giving the brief details of the scheme.

### 3.1 **Precommissioning**

The precommissioning activities are essential before starting the water runs and commissioning the plant by taking sewage. The various precommissioning activities involve checking the plant, equipment completion according to the engineering drawings, checking the equipment for proper cleaning, leakage, flushing of pipelines, arresting leakage, no load/load testing of pumps and operability test of each and every equipment etc. This is followed by water run to check-up for any leakage in the pipelines & flushing of pipeline.

In order to have a smooth commissioning and subsequent plant run it is essential to see that all the precommissioning activities are carried out thoroughly as well as in a systematic manner. No activity or check should get overlooked during precommissioning stage. It is, therefore, necessary to plan the precommissioning activities for each and every equipment of the plant. These activities span from 'no load' test of motors to the 'water run' through the complete process units.

#### 3.1.1 **Precommissioning of civil units**

The civil units in the sewage treatment plant are mainly either constructed in RCC with appropriate lining wherever required.

A thorough check of all the civil units from various aspects is required to be done during precommissioning activities. General detail guidelines and checks are given here for different type of units to be precommissioned. The precommissioning activities for various civil units are explained below.

- Check for complete removal of blockage in the incoming and outgoing pipe of each and every unit and chamber which has been lugged during construction of unit or during hydro-testing of unit.
- Check for proper level and smoothness of inlet and outlet overflow weir, wherever they are provided.
- Check inlet pipes of distribution box are properly erected in UASB reactor.
- Check proper sealing at outlet launder of reactor so that overflow of reactor pass only through launder and not from side/bottom of launder, on either side of gas dome.
- Check that tank/units are properly cleaned from any debris and construction materials.
- Check whether proper lining is provided in the units as per requirement/drawings.

- Check whether manholes/valve chambers are covered as per requirement.
- Check whether supporting arrangement for instruments/cables/piping/valves, media etc. are provided as per requirements/drawings.
- Ensure that approaches and provision of railings etc. are provided as shown in the drawings.

After thorough checks, ensure that all the RCC water retaining structures have been tested for any leakage as per standard specifications.

### 3.1.2 **Precommissioning of mechanical units**

The mechanical equipment in the sewage treatment plant consists of following categories.

1. Rotating equipment(Pumps)
2. Piping

A thorough check of all the above equipment is required to be made during precommissioning activities. Detail guidelines and checks are given here for each type of equipment for precommissioning. However the procedure for each and every equipment will be modified according to the location and installation of the particular equipment.

The major categories of equipment consisting of following sets of equipment are as under:

#### 1. **Rotating equipment**

- a. Pumps
- b. Biotower mechanism

#### 2. **Piping**

This includes piping, special, valves and fittings for all classes.

The checks and procedure for precommissioning activities of each set of equipment are given here below:

### 3.1.2.1 **Rotating Equipment**

Precommissioning checks for various rotating equipment shall be as explained under:

#### a) Horizontal Centrifugal and Submersible Pumps:

Horizontal centrifugal pump will be checked according to the following procedure:

- Check the level of base plate.
- Check that pump is properly tightened to the base plate.
- Check that inlet and outlet of the pumps are connected and tightened.
- Check that pressure gauges are installed on the delivery of all pumps.
- The pumps alignment has been done after no load test of motors.
- Ensure the proper direction of rotation of rotating equipment.
- Check the lubricant level before starting the pump. If required fill up to the mark.
- Keep the suction valve in full open position before starting the pump.
- See that tank is filled with water before starting the pump.
- Start the pump by pressing 'ON' button.
- Slowly open the discharge valve and bring the pump delivery pressure at normal operating pressure.
- Check the motor load, pump vibration, overheating etc.
- Run the pump for 6 – 8 hours and record the bearing temperature, motor load, delivery pressure etc. at regular intervals viz. 1 hr.
- During the test, see that there is sufficient water in the connected tank. Ensure that continuous supply of water to sump/tank is maintained.
- Rectify any abnormality and continue the test.
- For submersible pump check that pump is operating for low and high level liquid condition for its auto stop w.r.t float level – operated switch. For this



purpose pump may be lowered in a pit having water, and operate by appropriate power supply.

b) Biotower mechanism

Biotwer mechanism shall be checked as per the following procedure:

- Remove debris, construction material etc. from the unit.
- Check that motor, gear box and drive mechanism is tightened properly on the mounting frame.
- Check that gear box and motor are aligned properly after 'no load' test of motor.
- Check the lubricant level in the gear box and drive mechanism and fill up to marked level if required.
- Check that chain & sprocket wheels are greased properly.
- Rotate the drive for one revolution with tank empty, to ensure that the distribution arm rotates in the tank without any obstruction.
- Rotate entire mechanism to check for free movement.
- Start the motor and allow it to rotate dry. Check for overheating, vibrations or unusual noise of motor or gears/bearings etc.
- Check direction of rotation in the unit. The rotation of mechanism shall be clockwise when viewed from top.
- Run the mechanism for at least 8 hours and check bearing temp., vibration, motor load at regular interval and record.
- Rectify any abnormality observed.

**3.1.2.2 Piping**

The precommissioning activity for piping includes all type of pipes, fittings and valves. This activity includes following:

- Checking all the pipes and valves as per P&I diagrams.
- Checking for all instrument connection, sampling points, or any other fitting that is required to be provided as per P&I diagrams.

- Check that all the pipes are correctly supported and cleaned keeping in view the location and service.
- Check and ensure that all valves and gates are well lubricated and operating smoothly.
- All the pipes are water flushed to clean any construction debris etc. before pressure test.
- The water flushing will be done by clean water.
- If the pipe line is very long, it will be suitably divided into different length by opening few flanged bends if possible.
- Sludge lines will be flushed by water in the clarifier and drained by opening the drain valve/flange completely.

### 3.2 **Water Run**

The water run will be conducted after successful precommissioning of all the equipment viz. Motors, pumps, piping, etc. During water run, water will be taken in the first unit and run through all the process units. This test will be conducted to check the normal flow conditions and hydraulic system of the plant.

Following checks and procedure will be conducted before the water run of the plant.

- Make sure that all the equipment are cleaned thoroughly and all construction debris are removed.
- All temporary blinds, that were put during hydrotest of pipe lines and equipment etc. are removed.
- Make sure that all utilities are available.
- Check all valves and gates for smooth operation.
- Ensure availability of adequate water quantity so as to fill up all the sumps, processing units, storage tanks etc. to its full supply level.

The complete plant can be subdivided into various sections for ease of conducting the water run.

### 3.3 **Commissioning of the Plant**

After completion of all trial runs of equipment, water run and checking all systems, the plant shall be commissioned. Commissioning for plant will be done

based on the quality of effluent available and its chemical analysis(conc. of pollutants). The details of commissioning of major process equipment like UASB reactor, Biotower etc. is given in individual chapters of this manual.

#### 3.4 **Sampling and Analysis**

Start taking samples of influent and effluent and analyse it for pH, COD, BOD, Total Suspended Solids(TSS) and Total Dissolved Solids(TDS). The sample analysis procedures for various parameters are enclosed under Annexure – I.

#### 4.1 Equipment List

SR. NO.	DESCRIPTION	QTY.	MOC	SIZE M x M	REMARKS
1.	Inlet Channel	1	RCC	5.0 x 0.5 wide	
2.	Inlet pump pit	1	RCC	1.5 x 1.5 x 1.0 ld	
3.	Inlet pumps	1+1	CI	5.0 cu. M/hr x 10 m	Submersible motor type (one pump in store)
4.	Coarse screen	1	SS 316	20 mm clearance 500 mm wide	
5.	Fine screen	1	SS 316	5 mm clearance 500 mm wide	
6.	Grit channel	2	RCC	4.0 x 0.5 x 0.25 LD	
7.	Weir Plate(V-notch)	1	SS 316		With flow measurement
8.	UASB Reactor & gas/solid/liquid separator	1	RCC & PVC/ FRP	4.0 x 3.0 x 4.0 LD	Inside epoxy painted
9 a.	Biotower	1	RCC	3.2 m dia.	Mechanically MSEP operated mechanism
b.	Media	Lot	Polyura- thene	3.2 dia. x 2.5 Media depth	PU cubes tied to SS Grid.
10.	Circulation pump	1	C.I.	5.0 cu.m/hr x 8 m head	CP semi open
11.	Eco ponds	3	RCC	6.0 x 3.0 x 0.75 LD	
12.	Chlorine contact tank	1	RCC	3.0 x 1.25 x 0.8 LD	
13.	Chlorine solution tank	1	HDPE	100 lit	
14.	Sludge drying beds	3	Brickwork	4.0 x 2.2	Under drain pipes
15.	Gas Holder	1	MSEP	1.2dia. (1.0 m <sup>3</sup> )	Inside & outside epoxy painted
16.	Flare & Gas flow meter	1	M.S	3.0 m ht.	

### 5.1 **Objective**

The inlet channel with gate is provided to divert required quantity of sewage into pilot plant.

The bar screens and pump pit are provided for removal of large size floating matter from the raw sewage and pumped from pump pit to inlet of grit channel for treatment.

### 5.2 **Unit Description**

The inlet channel is constructed in RCC and rectangular in shape with its top open. The unit is also provided with inlet gate installed in channel. The top of units are taken above high flood level (H.F.L).

The bar screen channel and pump pit are constructed in RCC. The channel is provided with coarse & fine screens in series along with removable baskets to collect the screenings. A dry rectangular RCC chamber with cat ladder and a fixed pulley are provided for operation & maintenance of bar screens. The pump pit is provided with M.S. cover and a submersible pump.

### 5.3 **Operation**

#### Procedure - start-up

- Clean the incoming main inlet channel, bar screen channel and pump pit.
- Check the inlet gate, bar screens, baskets and submersible pumps are in proper position.
- Check the basket lifting pulley for smooth movement.
- Check all valves are operating smoothly and are installed in correct position.
- Check and ensure pressure gauge is are functioning properly.

#### 5.3.2 Procedure - Normal operation

- Allow the sewage from main inlet channel by opening the inlet gate.
- Allow the pump pit to be filled upto full supply level. Generally level in pump pit and main sewage drain will remain same.
- Start raw sewage pump to transfer the sewage from pump pit to inlet of grit channel.

- Remove screenings from the bar screen manually with a scrapper into the basket, frequently based on screen matter collected at screens.

### 5.3.3 Procedure - shut down

- In case of non-availability of sewage, stop raw sewage pump. Since the pump is float operated switches, it will stop at low level and start at high level automatically. Therefore to take the plant under shut down local push button off should be pressed.
- Close the delivery valves of the pump
- Close the inlet gate, if the shut down is for long times.

## 5.4 Data Sheet

### a) Inlet channel

Flow	:	100 m <sup>3</sup> /day
Purpose	:	To divert raw sewage from main drain
Width - m	:	0.5
Total depth - m	:	2,65 (above FGL)
Material of construction	:	RCC
Top	:	Open

### b) Bar screen channel

No. of channels	:	One
Total length (non)	:	4800
Width (mm)	:	500
Liquid depth (mm)	:	50
Total height (mm) (upto top)	:	2650
Inlet gate	:	1 No.
Gate size	:	200 x 200

No. of bar screens	:	Two (1 No. coarse screen and 1 No. fine screen)
Angle of screen with horizontal	:	60°
Spacing		
Coarse screen	:	20 mm
Fine screen	:	5 mm
Hand rail	:	Provided

**MOC**

Channel	:	RCC
Inlet gate	:	C.I.
Coarse screen	:	SS-316
Fine screen	:	SS-316
Basket	:	S.S
Pulley	:	S.S.

c) **Pump pit**  
**(Model No. DX, 50-11)**

No. of pits	:	One
Size (m x m)	:	1.0 x 1.0
Liquid depth (mm)	:	1000
Total depth of the pit (mm)	:	3700
Top cover	:	Yes
Hand rail	:	Provided

**MOC**

Pit	:	RCC
Top cover	:	M.S.

d) **Raw Sewage Pump (P-01 A/B)**

No.	:	Two (One in store)
Capacity	:	5.0 M <sup>3</sup> /hr
Head	:	14.0 M water column
Type	:	Vertical single casing submersible pump with motor
Material of construction	:	Body : Stainless steel Impeller : Stainless steel
Type of impeller	:	Semi open
Seal	:	Lip Seal (Motor side) Mech. Seal (Pump side)
Motor type	:	Single phase 230 V, 50 Hz, with built in thermal overload protection
HP	:	1.5 (single phase)



## 6.1 **Objective**

The grit channels are provided to remove the inert material from the sewage prior to biological treatment.

## 6.2 **Unit Description**

Two number grit channels are provided with a common wall and are constructed in RCC. Overflow weirs and baffle walls are provided at inlet and outlet of the unit and are constructed in RCC. A V-notch is provided in common outlet chamber of the unit to measure the flow entering to biological treatment.

## 6.3 **Operation**

### 6.3.1 **Procedure - start-up**

- Clean both the channels
- Check the V-notch level for proper installation
- Check all valves are operating smoothly and are installed in correct position.
- Check the trolley for collecting grit is empty

### 6.3.2 **Procedure - Normal operation**

- Place the grit collection trolley below the respective grit outlet valve.
- Open one of the valves of the grit channel to take the sewage form its common inlet chamber. Open the grit outlet valve at frequent intervals to remove the grit.
- To change the first grit channel in use, open the other inlet valve of the other grit channel to take in use and close the same in first channel and vice versa.

### 6.3.3 Procedure - shut down

- In case of non-availability of sewage, stop the submersible pump. As such raw sewage pump, provided with low level switch(float) will automatically trip.
- Close the respective inlet valve of the grit channel.

### 6.4 Data Sheet(Dwg. No. PL/528/Ga-02)

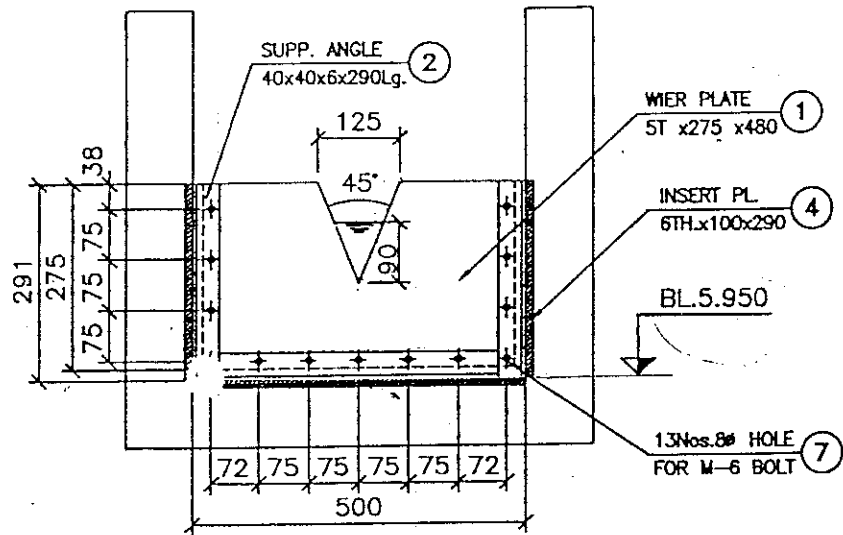
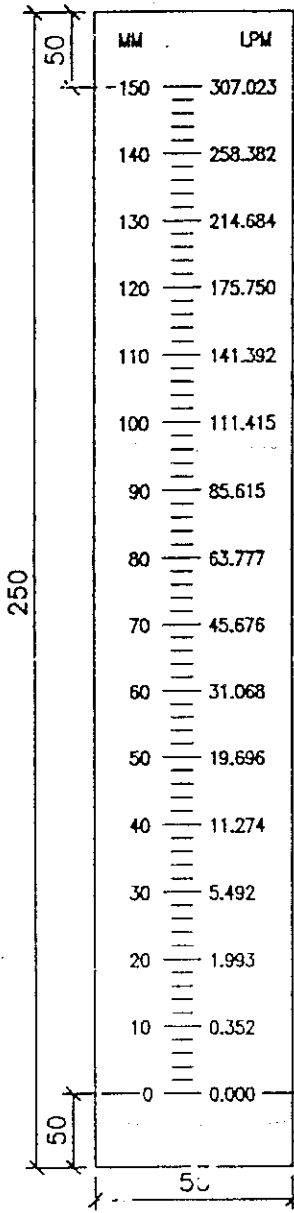
#### Grit channel

Number	:	1 Working + 1 stand by
Size	:	0.5m wide x 4m long
Bottom slope	:	1 in 10
Sludge removal	:	Manual cleaning
Material of construction	:	
Channel	:	RCC
V-notch	:	S.S with calibration for flow measurement. (Note-1)

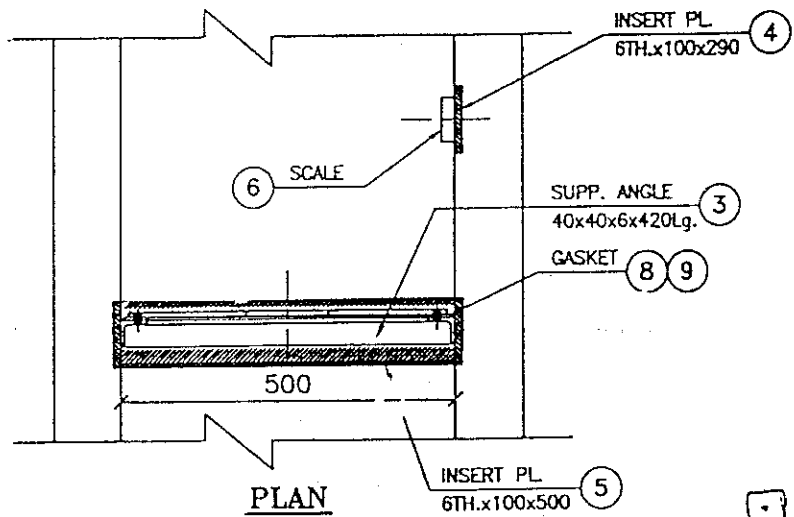
Note-1 : A drawing No. PL/528/ME-02 for V-notch (weir plate) with calibration is enclosed for reference.

### BILL OF MATERIAL

SR. No.	DESCRIPTION	SIZE	QTY.	MATL.	RMRK.
1	WIER PLATE	5Thk x275 x480	1	SS 316	
2	SUPP. ANGLE	40 x40 x6T x290Lg.	2	IS 2062	
3	SUPP. ANGLE	40 x40 x6T x420Lg.	1	IS 2062	
4	INSERT PL.	6TH x100 x290	3	IS 2062	
5	BOTTOM INSERT PL.	6TH x100 x500	1	IS 2062	
6	SCALE	5TH x50 x275	1	SS 316	
7	NUT WITH BOLT	M-6 x25Lg.	13	IS 1367	
8	GASKET	3TH x35 x300	2	RUBBER	
9	GASKET	3TH x35 x500	1	RUBBER	



ELEVATION CONTROLLED



PLAN

SCALE (1)

CAD CODE:- 528-ME02

**PARAMOUNT LIMITED.**  
(Formerly Paramount Pollution Control Limited)  
PARAMOUNT COMPLEX, GOTRI ROAD, RACE COURSE, BARODA-390007.

Client proj. **PILOT PLANT SEWAGE TREATMENT**

**M/s. TOKYO ENGINEERING**

TITLE

**DETAIL OF WIER PLATE**

SCALE	NTS	DATE	29/11/07
DRN.	N.D. RAVAL	DESIGN	K.J.D
CHKD		APPD.	
DRG.No.		REV.	(1)
PL/528/ME-02			

## 71 **Objective**

The UASB system is provided as a first stage anaerobic biological treatment to reduce COD & BOD of the sewage prior to take into a fixed film anoxic reactor (i.e. Biotower). The units are meant for anaerobic treatment and the valuable product of anaerobic treatment such as biogas is collected separately from the top of the reactor.

## 7.2 **Unit Description**

UASB reactor is a specially designed high rate anaerobic reactor, where anaerobic flocculant biomass forms sludge bed at the bottom and then a transitional sludge blanket above the sludge bed by means of upward travel of liquid and gas flow. This helps in optimum contact of biomass with effluents and in achieving high loading rates for anaerobic system.

UASB reactor is rectangular in shape made of RCC with inside epoxy coating with a higher depth of tank to maintain an anaerobic condition inside the reactor. The reactor top has a specially designed separators made of PP-FRP, by which solid, liquid and biogas separation takes place very effectively. The biogas is collected separately in the top gas chamber and further in gas holder for flaring. Flow indicator is provided for biogas flow measurement generated from the reactor.

The biomass free from biogas settles to bottom of reactor for taking part in further degradation activity. The clarified sewage from UASB reactor is taken to Biotower for further treatment. The inflow distribution in UASB reactor is regulated in the system by providing a distribution box and overflow weir type arrangement in the inlet chamber. This sort of flow distribution will keep the biomass uniformity distributed in sludge bed at the bottom and hence avoid the settlement of sludge bed and short circuiting of sewage. The units are also provided with sampling at different elevation to monitor the sludge profile. The unit also has sludge withdrawal facility by operating valves at different levels to withdraw excess sludge from the reactor.

## 7.3 **Operation**

### 7.3.1 **Procedure - start-up**

- Clean the UASB reactor and distribution box and ensure that incoming pipes to the reactor and outgoing pipes from the reactor are through and free from any clogging as per precommissioning procedure.
- Take the sewage from grit channel to UASB reactor through distribution box.

- Check that flow passes through all overflow weir without any hindrance in the distribution box.
- Fill the UASB reactor with sewage so that overflow shall go to outlet launder of the reactor.
- Once the reactor starts overflow, stop taking sewage flow into the reactor for next 12 – 24 hrs. Thus allow the anaerobic conditions to be generated in the reactor.
- Monitor pH, VFA, Alkalinity, temperature of overflow sewage & gas production. Observe these parameters once daily.
- The tank is ready for operation.

### 7.3.2 Procedure - Normal operation

After successful start-up, the reactors are regularly loaded continuously till the reactor treats its designed capacity and the steady state of operation is achieved.

Monitor pH, VFA, Alkalinity, COD and gas production daily.

- Extreme care should be taken to operate the reactor in the optimum pH range (6.8 – 7.2) and never allow the pH should go below 6.8. This happens when VFA(Volatile Fatty Acid) is shooting up with corresponding decreases of alkalinity. Therefore in situation where VFA is increasing within corresponding decrease of alkalinity, the loading (flow) to the reactor should be controlled/reduced/stopped depending on the situation.
- Ensure that ratio of COD/Volatile suspended solids is mentioned at 0.5.
- The sign of reactor upsets are sudden increase of VFA, sudden increase of gas production with rapid falling of CH<sub>4</sub> content in biogas etc. in such situation reactors should not be fed.
- To check this ratio of COD, MLSS & VSS in the tank, by taking samples through sampling point provided on the tank.
- Withdraw sludge regularly to maintain required MLSS through two level sludge outlet provided on the tank bottom. Take sludge to the drying bed under gravity.

### 7.3.3 Shutdown & Restarting

When it is likely that the sewage flow will be interrupted for more than 2 days, the reactors should be shut down. The procedure is as follows:

- Shut down the influent flow to reactor.

Shut down period is as follows:

a. Shut down for 1 – 2 days

Keep the plant in an idle mode and start at full flow as soon as influent is available.

b. Shut down for 3 days – 1 week

Start the plant at 75% of previous load, but pay close attention to keep the sludge in fluidised position by regular feeding.

c. Shut down beyond 1 week

Start the plant as outlined in procedure start up for UASB reactor.

### 7.4 Data Sheet(Dwg. No. PL/528/GA-02)

The details of UASB reactor are as under:

#### UASB Reactor

Number	:	One
Size	:	4 m W x 3 m L x 4 m liquid depth
Free board	:	0.4 m
Gas/solid/liquid separator	:	PVC/FRP
Depth of separator(Gas collection system)	:	1.5 m
Effluent feed pipe	:	75 OD HDPE
Material of reactor	:	Concrete
Internal protection	:	Epoxy coating of 350 micron thick

### **UASB Internals**

- a) Distribution box with nozzles for 1 : 900 x 500 x 600 deep  
No. – 90 OD inlet & 4 Nos. – 75 MOC in (PP + FRP) of (5 + 3)  
OD bottom outlet thickness
- b) No./ Details of inlet pipes up to : 4/75 OD HDPE @ 6.0 kg/cm<sup>2</sup>  
100 mm above reactor bottom
- c) Gas Collection Dome : 2 Nos. – each 500 x 600 x 1375 long  
in PP + FRP of (5 + 3) thickness
- d) Gas separator/collection system : 410 at top x 2930 at bottom x 1500 ht  
with necessary supports & fixing in PP + FRP of (5 + 1) thickness  
details
- e) Outlet launder : 2 Nos. – 3300 long  
300 high on one side & 200 high on  
other side (weir side), 200 wide with  
V-notch – MOC 5 + 3 (PP + FRP)  
thick
- f) Baffle : 2 Nos. – 250 wide, 3300 long  
attached to outlet launder in PP +  
FRP of (5 + 3) thickness
- g) Gas outlet pipe up to end of : 63 mm OD PP + FRP – with 2 Nos.  
reactor with flange connection of gas collection points at top
- h) Fasteners & gaskets : For inlet box with distribution outlet  
launders, gas separator/collection  
system/outlet etc.

Note: 1. All flanges shall be as per ANSI B-16.5, 150# FF

## 8.1 **Objective**

The biotower unit is provided to remove the remaining BOD from the partially treated sewage through UASB unit provided upstream.

## 8.2 **Unit Description (Drg. No. (PL/528/GA-03)**

The biotower unit is provided with bottom clarifier constructed in RCC and is circular in shape. The top portion of unit comprises of DHS media having sponge cubes arranged in vertical position and supported by frame. The bottom portion of unit is clarifier with sloped bottom so as to function it as settler to separate biomass from it. The biotower (DHS) media functions as fixed film aerobic reactor where facultative micro-organisms get attached to supporting media. Sewage will be spreaded on the media by mechanically rotated distribution arms. The arms are provided with staggered V-notches to maintain equal flow distribution on the entire area. Natural ventilation is provided through sides. The biomass in the sewage from the biotower is settled in the bottom clarifier. The clarified sewage will be taken to polishing ponds with part recirculation into the inlet of biotower.

## 8.3 **Operation**

### 83.1 **Procedure start-up**

- Ensure precommissioning procedure given are attended.
- Check that media is properly tied up with frame and frame is installed properly in position.
- Check the filter media top for uniformity distribution and check for any media projecting outside or making obstructions to distribution arm movement.
- Check all the V-notches of distribution arm for any clogging etc.
- Check levels of all distribution arms for its uniform level of V-notch to ensure that uniform flow distribution over top of media.
- Assure free movement of distribution arm by moving it manually.
- Check inlet chamber and bottom of clarifier for any debris or foreign material.
- Check all suction & discharge valves of recirculation pumps are operating smoothly and are installed in correct position.
- Check lubrication of bearings etc.

If all above is in order the unit can be commissioned by taking sewage.



### 8.3.2 **Procedure Normal Operation**

- Start the motor 'ON' to rotate the distribution arm and take sewage into the unit by opening the inlet valve under gravity
- Check rotation of distribution arm and uniform flow distribution of sewage over filter media. The COD/BOD removal depends on the uniform distribution of sewage over the media. Stoppage of rotating arms or clogging of notches will reduce the performance of the system.
- Collect & transfer water from biotower unit to clarifier.
- Collect the over flow from the clarifier in the outlet chamber.
- Operate the sewage circulation pumps to recirculate the clarified sewage back to the inlet chamber of biotower to maintain the required hydraulic loading.
- Higher recirculation with less organic load will result in washing of bacterial film from the surface of media. Therefore the recirculation is to be controlled appropriately.
- Atleast once or twice in each shift remove the sludge from bottom of clarifier by opening the sludge outlet valve and take the sludge to sludge drying bed to be taken in operation.

### **Procedure shut down**

- In case of non-availability of sewage, close inlet valve of biotower .
- In case, biotower and clarifier is to be taken for maintenance close the inlet and open the bypass line valve.
- Take out sludge from clarifier bottom by crack opening the sludge line valve of clarifier and transfer to sludge drying bed to be taken in line.
- The sludge from bottom of clarifier should be taken during 15 - 20 minutes period every two hrs. This duration is to be decided such that solids from overflow of clarifier are not carried over

Note: Daily checking of the system is essential to make sure that distributing arms are rotating and V-notches are not clogged up. Also ensure daily that media and not much displaced from its position.

### 8.4 **Data sheet**

#### a) **Reactor**

No. : One

Shape	:	Circular
Size	:	3.2 M dia. x 2.5 M media depth
Media	:	Polyurethane cubes
Material of construction		
- Vessel	:	Concrete
- Distribution Arm	:	M.S. with epoxy painting with staggered V-notch
Media support for random packing	:	Cubes tied with nylon thread and fixed with S.S. grid/frame
Rotation of the arm	:	Distribution arms are mechanically driven
Settling/clarifier zone	:	Bottom portion of Biotower is provided with a slope for separation of biosludge. Clean overflow will be led into ECO-PONDS and then through chlorination chamber for final discharge.
b) <u>Recirculation pump</u> (P-02)		
Purpose	:	To recirculate treated sewage
No.	:	One
Service	:	Recirculation of clean overflow back to trickling filter to achieve desired irrigation rate
Capacity	:	5 M <sup>3</sup> /hr
Head	:	6 M water column
Type	:	Horizontal centrifugal gland packed
Material of construction	:	Body : Cast Iron Impeller : CS/Bronze
Type of impeller	:	Semi open
Motor HP x RPM	:	0.75 HP x 1450 (three phase)

### 9.1 **Objective**

Eco-ponds are provided to store and polish the treated effluent received from final clarifier.

### 9.2 **Unit Description (Drg. No. PL/528/GS-04)**

This is standard unit provided in rectangular shape. the unit is provided with three compartment with each compartment provided with overflow weir. The unit is constructed in RCC with inlet and outlet arrangement..

### 9.3 **Operation**

- Ensure that tanks are clear of the debris and also ensure that precommissioning checks are completed.
- Take the treated effluent into the first compartment of the unit.
- Allow the effluent to overflow from first compartment to second compartment and then to enter third compartment by gravity. The outlet from third compartment will finally enter into next unit i.e. chlorine contact chamber.

### 9.4 **Data sheet**

No.	:	One with three compartment
Holding period - hrs.	:	10.0 (approx.)
Volume - m <sup>3</sup>	:	40.0
Size m x m	:	9.0 x 6.0
Liquid depth - m	:	0.75
Free board - m	:	0.30
Overflow	:	Provided
Material of construction	:	RCC

## 10.1 **Objective**

Chlorination system is provided to disinfect the treated sewage flow and minimise the pollution load before final disposal.

## 10.2 **Unit Description (Drg. No. PL/528/GA-04)**

The chlorination system comprises of chlorine contact chamber, chlorine solution tank with dosing piping.

The chlorine contact chamber is provided at outlet of ecoponds and receives overflow from ecopond outlet under gravity. Chlorine solution under gravity is also mixed at inlet of chlorine contact chamber. The chlorine solution of about 2% concentration strength is to be prepared. (The concentration shall depend on type of disinfectant used). The chlorine solution tank capacity is equivalent to 12.0 hours holding period.

The chlorinated effluent from chlorine contact chamber shall be taken out from bottom at outlet end and then disposed under gravity at desired disposal point.

## 10.3 **Operation**

### 10.3.1 **Procedure start up & Normal**

- Check that unit/tanks are clear of any debris or any obstructing material.
- Ensure that chlorine solution tank contains adequate amount of chlorine solution. Also ensure that chemicals for chlorine solution preparation is available in adequate quantity.

While preparing chlorine solution, ensure that chemical is properly dissolved in water. For this purpose adequate mixing should be done manually with rod.

- Approximate dose of chlorine is 10 ppm and vary between 5 to 15 ppm depending upon the COD/BOD concentration of sewage. The max. dose is advisable upto 15.0 ppm.
- Take the effluent through overflow into tank.

- Dose chlorine solution by appropriate operation of outlet valve of chlorine solution tank. The measurement for chlorine solution through tank is to be decided based on falling in level in chlorine solution tank for prepared solution strength. Hence level in chlorine solution tank should be observed every half an hour.
- Allow to travel effluent through tank so as to provide adequate contact time. The chlorinated effluent shall be taken out at outlet and shall be discharged by gravity to disposal point.

### 10.3.2 **Procedure shut down**

- In case effluent is not available, the chlorine dose should be discontinued at outlet of Eco-ponds.

### 10.4 **Data Sheet**

#### a) Chlorine Contact Chamber

No. of tank	:	One
Holding depth - m	:	0.75
Volume - m <sup>3</sup>	:	2.5
Size m x m	:	3.0 x 1.25
Liquid depth - m	:	0.75
Free Board - m	:	0.3 (min.)
Material of construction	:	RCC

#### b) Chlorine solution tank

No. of tank	:	One
Chlorine dose - ppm	:	5 - 15
Chlorine quantity require - kg/day	:	1.5 (Pure)
Holding period	:	12.0 hrs

Solution strength	:	2%
Tank volume - litres	:	100
Dosing	:	Under gravity
Material of construction	:	HDPE

### 11.1 **Objective**

The sludge drying beds are provided for dewatering the excess sludge from the UASB reactor & Biotower unit. After drying the sludge will be taken for disposal and the filtrate will be transferred under gravity pump pit.

### 11.2 **Unit Description (Drg. No. PL/528/GA-05)**

The sludge drying beds are rectangular in shape and constructed in brick masonry and with PCC at bottom. The bottom of the drying bed is sloping towards the channel laid open jointed pipe for collecting the filtrate. The filtering media is metal and sand layer. The filtrate from sludge drying beds is taken to sewage main drain under gravity.

### 11.3 **Operation**

#### 11.3.1 **Procedure Start up**

- Check the thickness of sand and gravel layers and top up to its designed thickness and clear out earth debris etc. if any.
- Open the inlet valve of the sludge drying bed to be commissioned & allow the clean water to spread all over sludge drying bed thereby soaking the entire sand & gravel area.
- The sludge liquor will filter through the filter media to the under drains.
- See that there is unhindered flow of filtrate coming from the sludge drying bed.
- If all the above points are satisfied, the start up is complete. Then start taking the sludge on the sludge drying bed.

#### 11.3.2 **Procedure Normal**

- Take one of the sludge drying bed in operation.
- Open the feed valve to allow the sludge on that particular drying bed.

- The sludge will fall on the RCC splash pad and spread over the media of the sludge drying bed.
- Continue to take the sludge in the bed till it gets filled to the required level of 300 mm. Simultaneously filtrate will be coming out through the under drains.
- Close the valve of the filled drying bed and change over to the next drying bed.
- Allow the sludge to dry under sun till it becomes sufficiently dried for disposal. The cracking of bed indicates the removal of moisture from the sludge.
- After drying, remove the dried sludge cake manually ensuring that there is minimum sand sticking underneath the dried cake.
- Store the dried cake on hard surface & then transfer it to the disposal area.
- After removal of dried cake from entire bed, the same is again ready for the second use.
- Top layer of sand sticks to sludge and is removed, therefore topping up of sand is required after few cycles.

### **11.3.3 Procedure Shutdown**

- Close the inlet gate of that particular sludge drying bed which is to be isolated.
- Allow the remaining sludge on the filtering media to completely dry.
- Remove the dried sludge from the top of sludge drying beds manually.
- Clear the top surface and sand with fresh water to remove any sludge particles etc. from the top.
- After completion of necessary shutdown job, the bed can be put to operation again as per start up procedure.



#### 11.4 **Data Sheet**

No. of beds	:	3
Sludge depth (m)	:	0.3
Size of each bed (m x m)	:	4.0 x 2.2
Free board (mm)	:	300
Filling media	:	Sand supported on gravel
Drying cycle	:	7 days
Filtrate collection system	:	Open jointed 100 dia. C.I. pipe

#### Filter Media :

Material	Thickness of layer (mm)	Effective size (mm)
Gravel layer	300	25 to 50
Sand layer	300	0.5 to 0.75

Material of construction : Brick Masonary & PCC bottom

## 12.1 **Objective**

The objective of gas holder is to store the gas generated at UASB reactor and control the same to transfer it for flaring.

## 12.2 **Unit description (Drg. No. PL/528/GA-06)**

The unit is circular in shape having covered dome at one end and other end open and constructed in M.S. with epoxy painting for protection against corrosion. The unit is fixed with wheels and installed in invert vertical position in a RCC circular pit. RCC circular pit is provided with guide rails on which inverted dome slides up and down as per gas availability and its pressure. The M.S. dome and tank are designed to hold pressure of 200 mm water column. A limit lock arrangement is also provided so that required water seal arrangement always remains and gas does not escape out into the atmosphere.

A safety with flame arrestor at top of tank is provided to arrest flame, if any. The breather valve provided with flame arrestor gives safety against higher pressure at tank top as well as against vacuum, in case gas generation does not take place inside tank.

## 12.3 **Operation**

### 12.3.1 **Procedure start-up**

- Ensure manually that tank moves in vertical position up and down from bottom to limit lock provided on vertical guide rail and tank. Ensure that tank does not move beyond limit lock.
- Close outlet drain valve of RCC sump
- Ensure that all instruments are functioning properly.
- Fill the water upto full water supply level with clear water
- Ensure flow water operation provided on inlet line
- Allow the gas to enter into dome into tank at top of dome.

### 12.3.2 **Procedure - Normal**

- Once the gas is taken in the dome, observe its lifting properly.
- Take the gas through gas outlet pipe to flare.
- The dome will move up and down as per pressure in the tank.

- Moisture trap provided out gas inlet pipe should be frequently drain with trapped water, if any.
- Top up the water in RCC sump, if required, regularly.

### 12.3.3 Procedure shut down

- In case of gas is not generated at UASB reactor, close the outlet valve provided on gas line after moisture trap.

### 12.4 **Data sheet**

Service	:	Storage of biogas
No. of unit	:	One
Volume m <sup>3</sup>	:	1.0
Dia. of gas dome - m	:	1.2
Height - m	:	0.75
Pressure	:	200 - 300 mm WC
Sump	:	Provided for water seal

#### **Material of Construction**

Dome	:	M.S. inside and outside epoxy painted
Sump	:	RCC
Flame Arrestor	:	Provided
Breather valve	:	Provided

### 13.1 **Objective**

The purpose of this unit is for flaring of Biogas from the Gas Holder, as this gas contains methane cannot be discharged in the atmosphere without burning.

### 13.2 **Unit Description**

This is a standard flare to flare Biogas at the flow rate of 1.0 M<sup>3</sup>/hr. The detailed description of the unit would be available from the vendor's equipment manual.

### 13.3 **Operation**

- Ensure that enough biogas is stored in gas holder for flaring.
- Open the valves at outlet line of gas holder which allows the biogas to flow to the flare.
- Light the flare stack manually with ignition torch.
- Make sure that biogas is flaring at the mouth of flare.
- Continue the flaring till the holder comes to low limit level.
- Close the gas line valve of outlet pipe to stop the flaring, in case of non-availability of gas.

### 13.4 **Data Sheet**

#### **Flare**

Purpose	:	To burn biogas
No.	:	One
Flow m <sup>3</sup> /hr	:	1.0
Type	:	Manually ignition
Height - m	:	3.0
Material of construction	:	M.S.

## 1. **ESTIMATION OF pH**

(Ref. section 423 PP 402 - of standard methods 15th Edition). Published by APHA, AWWA & WCP

### a. Principle

i. The basic principle of electrometric determination of pH consists in the determination of the Hydrogen ion activity by potentiometric method in which a glass electrode and a reference electrode is used.

### ii. Interference :

The glass electrode is generally free from interference by colour, turbidity, colloidal matter, oxidants, reductants and salinity.

### b. Apparatus

A standard pH analog or digital type consisting of a reference electrode like calomel - Silver/Silver chloride and glass Electrode.

### c. Reagents

Standard buffer solutions (or buffer tablets) for pH ranges 4, 7 and 9.2 can be purchased readily from suppliers of reagents in order to avoid the laborious task to preparing standard buffer solutions in the laboratory. Prepare a set of standard solutions of 0.1 N NaOH/0.1 HCl etc.

### d. Procedure

The manufacturers instructions should be strictly followed for calibration of the apparatus and its operation.

### i. Standardisation of the instrument

1. Rinse the electrodes units with distilled water or DM water.
2. Dry electrodes with soft tissue paper.
3. Bring sample and buffer to the room temperature.
4. Record temperature measurement and adjust the temperature adjustment on the instrument to the temperature of the buffer and sample.

5. Standardise the instrument, with the electrode immersed in the standard buffer solution within a 2 pH units of sample.
  6. Remove electrodes from buffer solution, rinse thoroughly and wipe out. Immerse in a second buffer below pH 10 and approximately 3 pH units different from the first. The reading should be within 0.1 unit of the second buffer.
- ii. Sample Analysis
1. Introduce the electrodes in the breaker containing the test samples, stirring the sample to ensure homogeneity and read pH.
  2. Repeat with a fresh sample to measure pH.
  3. Remove the electrodes from the sample, rinse thoroughly and wipe dry and keep them immersed in glass distilled water or DM water.

By careful use of the laboratory pH meter, a precision of + 0.02 pH unit and an accuracy of + 0.05 pH unit can be achieved.

## 2. ESTIMATION OF TOTAL SUSPENDED SOLIDS

### i. Estimation of total suspended solids

#### 1. Principle

A measured volume of the sample is filtered through a weighed glass fiber filter and the residue retained on the filter is dried to a constant weight at 103 - 105 deg. C. The increase in weight of the filter is the weight of the total suspended solids.

#### 2. Procedure

##### A. Apparatus

- a. Glass fibre filter (Whatman GF/C or whatman Grade 934 AH) or membrane filter.
- b. Gooch crucible or with glassfibre mat prepared.
- c. Filter assembly.
- d. Vacuum/Suction pump

**B. Preparation of Glass filter or membrane filter**

Place filter on either membrane filter apparatus or the bottom of a gooch crucible. Apply vacuum and wash filter with three successive 20 ml portions of distilled water. Remove the filter from the apparatus to a metal filter holder of aluminium or S.S to support or the Gooch Crucible and dry in a hot oven at 103 deg.C - 105 Deg. C. Cool in a dessicator and weigh.

**C. Sample treatment**

Take a suitable sample volume 50 ml or more (depending on the S.S. conc.) of the well mixed sample and filter through the filter, adding small portions at a time. After the sample is filtered, under suction or vacuum, wash filter with three successive 10 ml portions of distilled water. Carefully transfer the filter to the container or alternatively transfer the Gooch Crucible, to the oven and dry at 103 to 105 Deg.C for 1 to 2 hours allow to cool in a desiccator and weigh. Repeat drying, cooling and weighing until constant weight. The residue after drying in the filter or Gooch Crucible, should be preserved for determining volatile and fixed matter at 550 Deg.C.

**3. Calculation**

$$\text{Total Suspended Solid (mg/l)} = \frac{(A - B) \times 1000}{\text{Sample volume}}$$

Where A = Wt. of filter + residue, mg and

B = Wt. of filter alone, mg.

**3. ESTIMATION OF OXYGEN DEMAND - BIOCHEMICAL (BOD TEST)**

**Reagents**

**a. Phosphate Buffer**

Dissolved 8.5 g  $\text{KH}_2\text{PO}_4$ , 21.75 g  $\text{K}_2\text{HPO}_4$ , 33.4 g  $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$ , and 1.7 g  $\text{NH}_4\text{Cl}$  in distilled water and dilute to 1 litre pH=7.2

**b. Magnesium Sulphate Solution**

Dissolve 22.5 g  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  in distilled water and dilute to 1 litre.

**c. Calcium Chloride Solution**

Dissolve 27.5 g anhydrous  $\text{CaCl}_2$  in distilled water and dilute to 1 litre.

d. Ferric Chloride Solution

Dissolve 0.25 g  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$  in distilled water and dilute to 1 litre.

e. Seeding Material

A proper seeding material must be used in BOD determination, usually raw settled sewage is used, but at times acclimate seed or soil, or receiving water can be used as seed.

f. Acid and Alkali Solution

To neutralize the samples, hence any strength can be used.

**Procedure**

Certain pretreatment is required for the samples which are highly toxic.

- a. The sample either highly acidic or highlyalkaline must be neutralised to about 7.0. The pH of dilution water should not change with lowest dilution of sample.
- b. Samples which has residual chlorine, either they should be kept for about 2 hrs. to dissipate the residual chlorine or should be treated with equivalent quantity of sodium sulfite solution.
- c. Samples containing toxic metals etc. should be carefully treated. The metals must be precipitated out.
- d. If supersaturation of D.O. is there in water, then D.O.should be brought down to saturation valve at 20 Deg. C by vigorously shaking it.

**Dilution suggested**

<u>Waste Quality</u>	<u>% Dilution</u>
Strong industrial effluents	0.1 - 1.0
Raw and settled sewage	1.0 - 5.0
Oxidized effluents	5.0 - 25.0
river water samples	25.0 - 100.0

The dilution water is prepared by adding 1 ml/l of each phosphate buffer,  $\text{MgSO}_4$  solution,  $\text{CaCl}_2$  solution and  $\text{FeCl}_3$  solution. Seed, if necessary is also added in



the same amount i.e. 1 ml/L. Then the required dilution of sample is prepared in graduated cylinders. The diluted samples is then siphoned into BOD bottles. One is tested for initial D.O. by azide modification method and the other is incubated for 5 days at 20 Deg.C. A blank is also tested for initial D.O. and after incubation. After incubation for 5 days, the D.O. is found out using azide modification method.

## **CALCULATION**

### **Biological Oxygen Demand**

D = Initial D.O. of diluted sample taken after 15 minutes of preparation of diluted sample.

D<sup>1</sup> = Final D.O. of diluted sample after 5 days incubation at 20 deg.C.

P<sup>2</sup> = % dilution taken.

$$\text{BOD mg/l} = \frac{D1 - D2}{P} \times 100$$

## 4. **ESTIMATION OF CHEMICAL OXYGEN DEMAND**

### **Reagents**

1. Standard Potasium dichromate solution (0.25 N). Dissolve 12.259 gm K<sub>2</sub>CR<sub>2</sub>O<sub>7</sub> previously dried at 103 Deg.C for 2 hrs. Dilute distilled water and dilute to 1000 ml.
2. Conc. Sulphuric Acid :  
1000 ml Conc. H<sub>2</sub>SO<sub>4</sub> containing 10 gm Ag<sub>2</sub>SO<sub>4</sub>
3. Standard Ferrous Ammonium Sulfate Solution :  
Dissolve 39.2 gm Fe<sub>4</sub>(NH<sub>2</sub>)<sub>4</sub> 6H<sub>2</sub>O in distilled water. Add 20 ml conc. H<sub>2</sub>SO<sub>4</sub> and cool and dilute to 1000 ml. This should be standardised daily against the standard K<sub>2</sub>CR<sub>2</sub>O<sub>7</sub> solution
4. Ferroin Indicator solution :  
Dissolve 1.485 g 1/10 phananthroline monohydrate together with 0.595 g FeSO<sub>4</sub> 7H<sub>2</sub>O<sub>4</sub> in water and dilute to 100 ml.
5. Silver sulfate analytical grade

6. Mercuric Sulfate analytical grade crystals
7. Sulfamic acid analytical grade

### Interference

1. All halides gets precipitated with silver sulfate and interfere in the reaction, hence mercuric sulfate is added to form the soluble halides of mercury.
2. Nitrite nitrogen exerts a comparatively high COD. The sulfamic acid - 10 mg per 1 mg of Nitrate N is added. The reagent blank should also contain the sulfamic acid reagent.

### **PROCEDURE**

#### Standardization of $\text{Fe}_4(\text{NH}_2)_4(\text{SO}_4)_2$ solution

Take 10 ml of standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution in flask and add 30 ml. conc.  $\text{H}_2\text{SO}_4$  dilute and cool. Titrate against  $\text{Fe}_4(\text{NH}_2)_4(\text{SO}_4)_2$  solution using ferroin as indicator. The end point is bluish green to reddish brown.

#### Determination of COD of samples

Take 10 ml  $\text{K}_2\text{Cr}_2\text{O}_7$  in round bottom flask. Add 0.4 g  $\text{HgSO}_4$ . Add 30 ml conc.  $\text{H}_2\text{SO}_4$  and cool it. Add sample upto light green solution. Note the sample taken, then reflux the mixture for more than 2 hrs. Cool and then weigh down the condensor. A blank containing the same amount of  $\text{K}_2\text{Cr}_2\text{O}_7$  and conc.  $\text{H}_2\text{SO}_4$  also taken. Titrate the blank and refluxed sample against standard  $\text{Fe}_4(\text{NH}_2)_4(\text{SO}_4)_2$  using ferroin as indicator.

### **Note :**

Soluble COD is done by after centrifugation or filtration through whatman No. 42 filter paper of the parent sample and taking the clear sample.

### **CALCULATION**

Normality of  $\text{Fe}_4(\text{NH}_2)_4(\text{SO}_4)_2$

$$= \frac{\text{ml } \text{K}_2\text{Cr}_2\text{O}_7 \times 0.25 \text{ N}}{\text{ml } \text{Fe}_4(\text{NH}_2)_4(\text{SO}_4)_2}$$

$$\text{mg/lit COD} = \frac{(\text{A}-\text{B}) \times \text{N} \times 8000}{\text{ml of sample}}$$

- A = ml  $\text{Fe}_4(\text{NH}_2)(\text{SO}_4)_2$  used for blank
- B = ml  $\text{Fe}_4(\text{NH}_2)(\text{SO}_4)_2$  used for sample
- N = Normality of  $\text{Fe}_4(\text{NH}_2)(\text{SO}_4)_2$

## 5. ESTIMATION OF VOLATILE SOLIDS

### a. Principle

The residue from Method TOTAL SOLIDS DRIED AT 103 - 105°C, Total Dissolved Solids dried at 180°C Total Suspended solids dried at 103 - 105°C is ignited to constant weight at 500 + or - 50°C. The remaining solids represent the fixed total, dissolved or suspended solids while the weight lost on ignition is the volatile solids.

### b. Procedure

Ignite residue produced by Method 08, 09 or 10 to constant weight in a muffle furnace at a temperature of 500 + or - °C. Have furnace up to temperature before inserting sample. Usually, 15 to 20 min. ignition are required. Let dish cool partially in air until most of the heat has been dissipated. Transfer to a desiccator for final cooling in a dry atmosphere. Do not overload desiccator. Weigh dish as soon as it has cooled to balance temperature.

### c. Calculation

$$\text{mg volatile solids/L} = \frac{(A - B) \times 1000}{\text{Sample volume ml}}$$

$$\text{mg fixed solids/L} = \frac{(B - C) \times 1000}{\text{Sample volume ml}}$$

Where,

- A = Weight of residue + dish before ignition, mg
- B = Weight of residue + dish of filter after ignition mg and,
- C = Weight of dish or filter, mg

Ref : Standard methods of analysis by APHA : 18th edition

## 6. ESTIMATION OF FREE RESIDUAL CHLORINE (ISOMETRIC METHOD)

### a. Principle

i. Chlorine will liberate free iodine from potassium iodide (KI) solution at pH 8 or less. The liberated iodine is titrated with a standard solution of sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) with starch as the indicator. Titrate at pH 3 to 4 because the reaction is not stoichiometric at neutral pH due to partial oxidation of thiosulfate to sulfate.

### ii. Interference

Oxidized forms of manganese and other oxidizing agents interfere. Reducing agents such as organic sulfides also interfere. Although the neutral titration minimizes the interfering effect of ferric and nitrite ions, the acid titration is preferred because some forms of combined chlorine do not react at pH 7. Use only acetic acid for the acid titration, sulfuric acid ( $\text{H}_2\text{SO}_4$ ) will increase interferences; never use hydrochloric acid (HCl).

### b. Reagents

- i. Acetic acid conc. (glacial)
- ii. Potassium iodide, KI crystals
- iii. Standard Sodium thiosulfate, 0.1 N

Dissolve 25 g  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  in 1 L freshly boiled distilled water and standardise against potassium bi-iodate or potassium dichromate. Use boiled distilled water and add a few milliliters chloroform ( $\text{CHCl}_3$ ) to minimize bacterial decomposition.

\*

Standardise 0.1  $\text{Na}_2\text{S}_2\text{O}_3$  by one of the following :

- Iodate method - Dissolve 3.249 g anhydrous potassium bi-iodate  $\text{KPH}(\text{IO}_3)_2$ , primary standard quality; or 3.567 g KID dried at  $103 \pm 0.5^\circ\text{C}$  for 1h. in distilled water and dilute to 1000 ml to yield a 0.1000 N solution. Store in a glass stoppered bottle. To 80 ml. distilled water, add, with constant stirring, 1 ml conc.  $\text{H}_2\text{SO}_4$ , 10.00 ml 0.1000 N  $\text{KH}(\text{IO}_3)_2$ , and 1 g KI. Titrate immediately with 0.1 N  $\text{Na}_2\text{S}_2\text{O}_3$  titrant until the yellow color of the liberated iodine almost is discharged. Add 1 ml starch indicator solution and continue titrating until the blue color disappears.

- Dichromate method - Dissolve 4.904 g anhydrous potassium dichromate,  $K_2Cr_2O_7$ , of primary standard quality, in distilled water and dilute to 1000 ml to yield a 0.1000 N solution. Store in a glass stoppered bottle.

Proceed as in the iodate method, with the following exceptions; substitute 10.00 ml 0.1000 N  $K_2Cr_2O_7$  for iodate and let reaction mixture stand 6 minutes in the dark before titrating with 0.1 N  $Na_2S_2O_3$  titrant.

$$\text{Normality } Na_2S_2O_3 = \frac{1}{\text{mL } Na_2S_2O_3 \text{ consumed}}$$

- iv. Standard sodium thiosulfate titrant, 0.01 N or 0.025 N:

Improve the stability of 0.01 N or 0.025 N  $Na_2S_2O_3$  by diluting managed 0.1 N solution, made as directed above, with freshly boiled distilled water. Add 4g sodium borate and 10 mg mercuric iodide/L solution. For accurate work, standardise this solution daily in accordance with the directions given above, using 0.01 N or 0.025 N iodate or  $K_2Cr_2O_7$ .

- v. Starch indicator solution

To 5g starch (potassium arrow root, or soluble), add a little cold water and grind in a mortar to a thin paste. Pour into 1 l of boiling distilled water, stir, and let settle overnight. Use clear supernate. Preserve with 1.25 g salicylic acid or 4 g zinc chloride, or a combination of 4 g sodium propionate and 2 g sodium azide/l starch solution. Some commercial starch substitutes are satisfactory.

c. **Procedure**

i. **Preparation for titration :**

Place 5 ml acetic acid, or enough to reduce the pH to between 3.0 and 4.0, in a flask or white porcelain casserole. Add about 1 g KI estimated on a spatula. Pour sample in and mix with a stirring rod.

ii. **Titration**

Titrate away from direct sunlight. Add 0.025 N or 0.01 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> from a burette until the yellow color of the liberated iodine almost is discharged. Add 1 ml starch solution and titrate until blue color is discharged.

If the titration is made with 0.025 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> instead of 0.01 N then, with a 1 L sample, 1 drop is equivalent to about 50 ug/l. It is not possible to discern the end point with greater accuracy.

iii. **Blank titration :**

Correct result of sample titration by determining blank contributed by oxidising or reducing reagent impurities. The blank also compensates for the concentration of iodine bound to starch at the end point.

Take a volume of distilled water corresponding to the sample used for titration, add 5 ml acetic acid, 1 g KI and 1 ml starch solution.

d. **Calculation**

For standardising chlorine solution for temporary standards :

$$\text{mg Cl as Cl}_2/\text{ml} = \frac{(A - B) \times N \times 35.45}{\text{ml sample}}$$

For determining total available residual chlorine in water sample :

$$\text{mg Cl as Cl}_2/\text{l} = \frac{(A - B) \times N \times 35.450}{\text{ml sample}}$$

Where,

A = ml titration for sample

B = ml titration for blank (positive or negative), and

C = normality of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

Ref : Standard methods of analysis APHA; 18th edition.

## **ESTIMATION OF VOLATILE FATTY ACIDS & ALKALINITY**

### 1. **General**

The filtered or centrifugated sample is first acidified with standard 0.1000 N hydrochloric acid to pH = 3. Bicarbonate is converted into CO<sub>2</sub> and volatile fatty acids are practically completely converted into non-dissociated form. After eliminating CO<sub>2</sub> by boiling under reflux, the solution is titrated back with standard 0.1000 N sodium hydroxyde solution to pH = 6.5. The volatile fatty acids and other weak acids present are now again converted into the dissociated forms. From the quantities of acid and alkali used, the bicarbonate alkalinity and the volatile fatty acids can be calculated.

### 2. **Reagents**

- \* Hydrochloric acid 0.1000 N (standard vial into 1 liter).
- \* Sodium hydroxide solution 0.1000 N (standard vial into 1 liter).

### 3. **Apparatus**

- \* 250 ml flask with a ground stopper
- \* 200 ml beaker
- \* Reflux column with ground glass connection
- \* Buret
- \* Filtration unit or centrifuge
- \* pH meter
- \* Magnetic stirrer and stirrer bars
- \* Stop watch
- \* Gasburner or electric heater

### 4. **Procedure**

- \* Filter or centrifugate a waste water sample.
- \* Transfer a quantity (= V ml) of the sample (maximally 100 ml) containing not more than 3 meq Fatty Acids into a 200 ml beaker.
- \* Titrate with hydrochloric acid (0.1000 N) to pH = 3.0 (= a ml).



- \* Transfer the contents of the beaker into the flask, add some boiling stones and connect the flask to the reflux column. Boil the liquid for exactly 3 minutes.
- \* Remove the heat and cool for 2 minutes.
- \* Pour the liquid back into the beaker and titrate immediately with sodium hydroxide (0.1000 N) to pH = 6.5 (= b ml).

## 5. Calculations

The fatty acids concentration, expressed in meq/l is :

$$\text{VFA (meq/L)} = \frac{(b \times 101) - (a + 100)}{99.23} \times \frac{100}{V}$$

The bicarbonate alkalinity, expressed in meq/L is :

$$\text{ALK (meq/L)} = (a - b) \times \frac{100}{V}$$

In which

b = mL used of NaOH (0.1000 N)

a = mL used of HCL (0.1000 N)

V = Sample volume (mL)

## 6. Reference

J.B.R. Van der Laan and S.W. Hobma, H<sub>2</sub>O, 11, (1978), 20, 465 - 467.

## Biogas Analysis

The routine analysis of biogas can be done by using Orsat apparatus. A brief description of Orsat Apparatus is as follows.

## ORSAT APPARATUS

A simple portable apparatus consists of a water jacketed burette of 100 ml. capacity, connected at the top to a stopcock manifold constructed of capillary tubing. An absorption pipette is connected at each stopcock position, each pipette contains a liquid absorbent which is used to remove one or more

constituents from biogas mixture. The bottom of the burette is connected to a movable reservoir (levelling bottle) containing a confining liquid such as 20 - 25 percent sodium chloride solution acidified with methyl orange. By adjusting the height of the levelling bottle gases in the burette may be brought to any desired volume or pressure. Since shaking of the apparatus is not very practicable, pipetter have been designed so as to ensure intimate contact of the gas with the absorption liquid. The absorption pipette is in two parts, an absorber and a reservoir for the displaced liquid, from which its returns when the gas is withdrawn.

## **ABSORBENTS FOR THE VARIOUS GASES**

### **1. Carbon Dioxide**

The most common reagent is 40 - 50 percent aqueous solution (by weight) of A.R. grade potassium hydroxide. Sodium hydroxide solution is not recommended due to the tendency of the bicarbonate to crystallise out; the potassium salt is much more stable.

### **2. Determination of Hydrogen Sulfide in Biogas**

Starch solution is used in the levelling bottle and dilute iodine solution in the graduated cylindrical funnel. The gas sample is introduced and its volume adjusted to 100 ml. The levelling bottle is lowered and small amounts of iodine solution are allowed to enter the burette through the graduate funnel; the burette is shaken after each addition. Addition of iodine is continued until the starch containing confining liquid turns blue. The hydrogen sulfid content of the gas is calculated from the volume of iodine solution used.

**ANNEXURE-II  
LUBRICATION SCHEDULE**

Sr. No.	Tag No.	Description	Qty	Lubricant		Operating Hours			Remark	Model	
				Type	Make	Qty (ltrs)	First Charge	Second Charge			Subsequent Charge
<b>A. PUMPS</b>											
1	P-02	Recirculation pump	1	SAE20 OR Equivalent	IOC	2	200 hrs.	1000 hrs.	1000 hrs.	HCF	CHP-ST 1 1/2x1.6
<b>B. AGITATORS/MECHANISM</b>											
1	---	Biotower mechanism	1	Servo mesh SP-320 OR Enklo - 320	IOC OR H.P.	0.3	2500 hrs	5000 hrs	5000 hrs	Gear Box	A-200





## GENERAL SPECIFICATIONS AND NOTES.


REV. NO.	DRN. BY.	DATE	REVISION
0	R.Jadav	01-11-2000	SUBMITTED WITH OFFER
1	R.Jadav	27-11-2000	REVISED AS MARKED.
2	R.Jadav	02-01-2001	REVISED AS MARKED.

**NOTES :-**

- 1 DISTRIBUTION BOARD SHALL BE SINGLE FRONT, WALL MOUNTED, DUST & VARMIN PROOF, COMPARTMENTALISED IN FIXED EXECUTION.
- 2 BOARD SHALL BE PAINTED WITH RAL - 7032 SHADE EXTERNALLY AND GLOSSEY WHITE SHADE INTERNALLY, AS PER SPECIFICATION.
- 3 ALL MOTOR FEEDERS SHALL BE PROVIDED WITH 'ON', 'OFF', AND 'TRIP'. LED INDICATION AND 'STOP' & 'RESET', PUSH BUTTONS ON PANEL.
- 4 SWITCHGEAR COMPONENTS SELECTED FOR FEEDERS SHALL BE TYPE-2 CO-ORDINATED FOR SEQUENTIAL OPERATION.
- 5 DETACHABLE 3MM. CABLE GLAND PLATES SHALL BE PROVIDED AT BOTTOM WHERE AS CU. BUS BARS SHALL BE PROVIDED AT TOP OF BOARD HORIZONTALLY.
- 6 CABLE ALLEY SHALL BE PROVIDED ILLUMINATION ON OPERATING DOOR THROUGH LIMIT SWITCH.
- 7 BOARD SHALL BE SUITABLE FOR MOUNTED IN 45° CELCIUS AMBIENT.
- 8 FOR DETAILED DISTRIBUTION OF LIGHTING CIRCUITS IN LIGHTING PANEL. PLEASE REFER DRAWING NO. PL/528/EE-03 & 04.

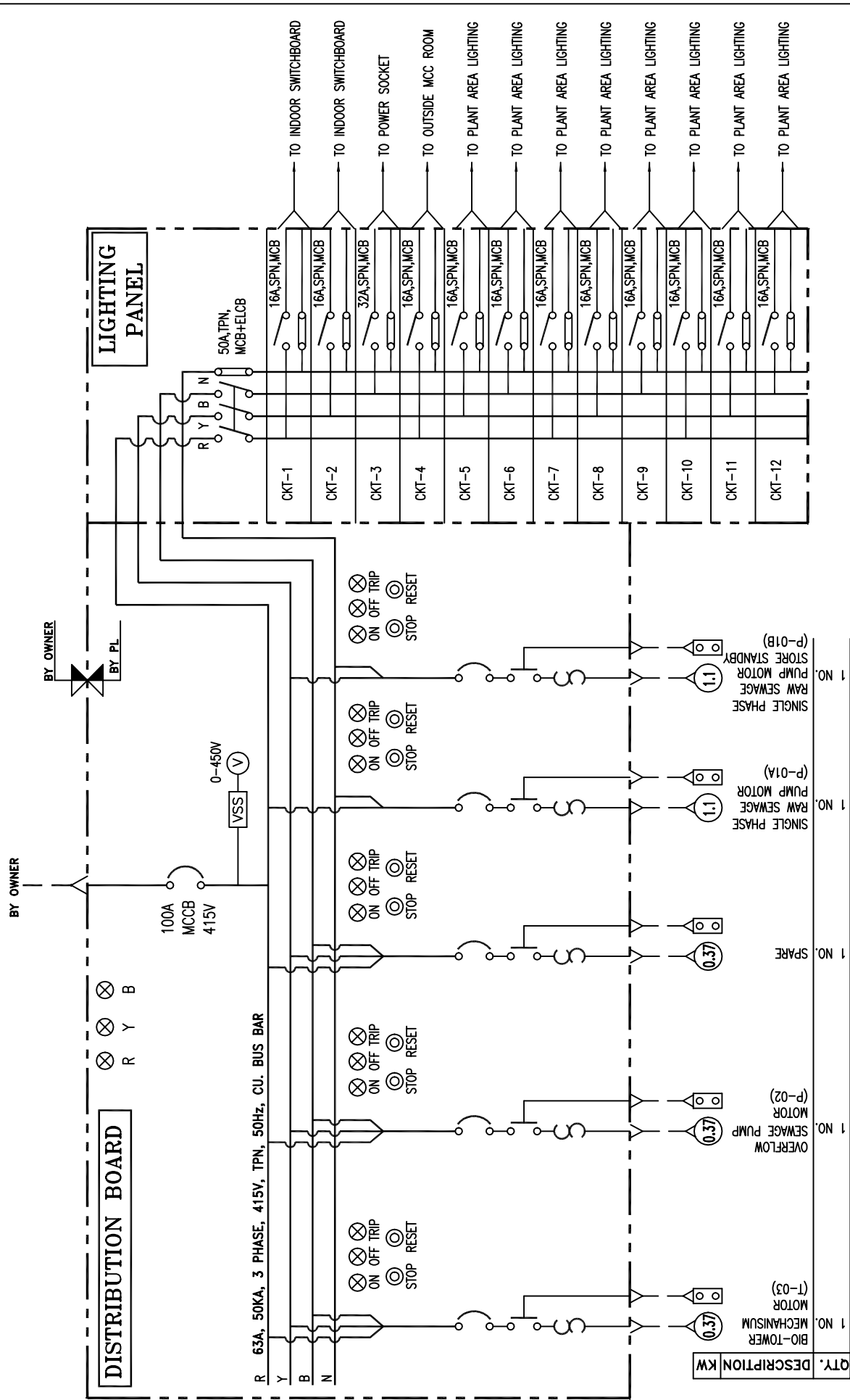
**LEGEND**

 CABLE GLAND TERMINATION	 CONTACTOR	 INDICATION LAMP	 MCCB
 VOLTMETER	 ON, OFF, RESET PUSH BUTTON	 SWITCH	

	PROJECT : PILOT PLANT FOR SEWAGE TREATMENT (100M /DAY) - NIGER	DRAWING NO:	PL/528/EE-01	REV.	
	CONSULTANT : ---	TITLE:	SINGLE LINE DIAGRAM		
CLIENT :	KAM NIAMEY - NIGER (J.I.C.A. STUDY) 	DRN. BY: R.Jadav	DESIGN BY: KASHYAP PANDYA	CHD:	APPD:
					2

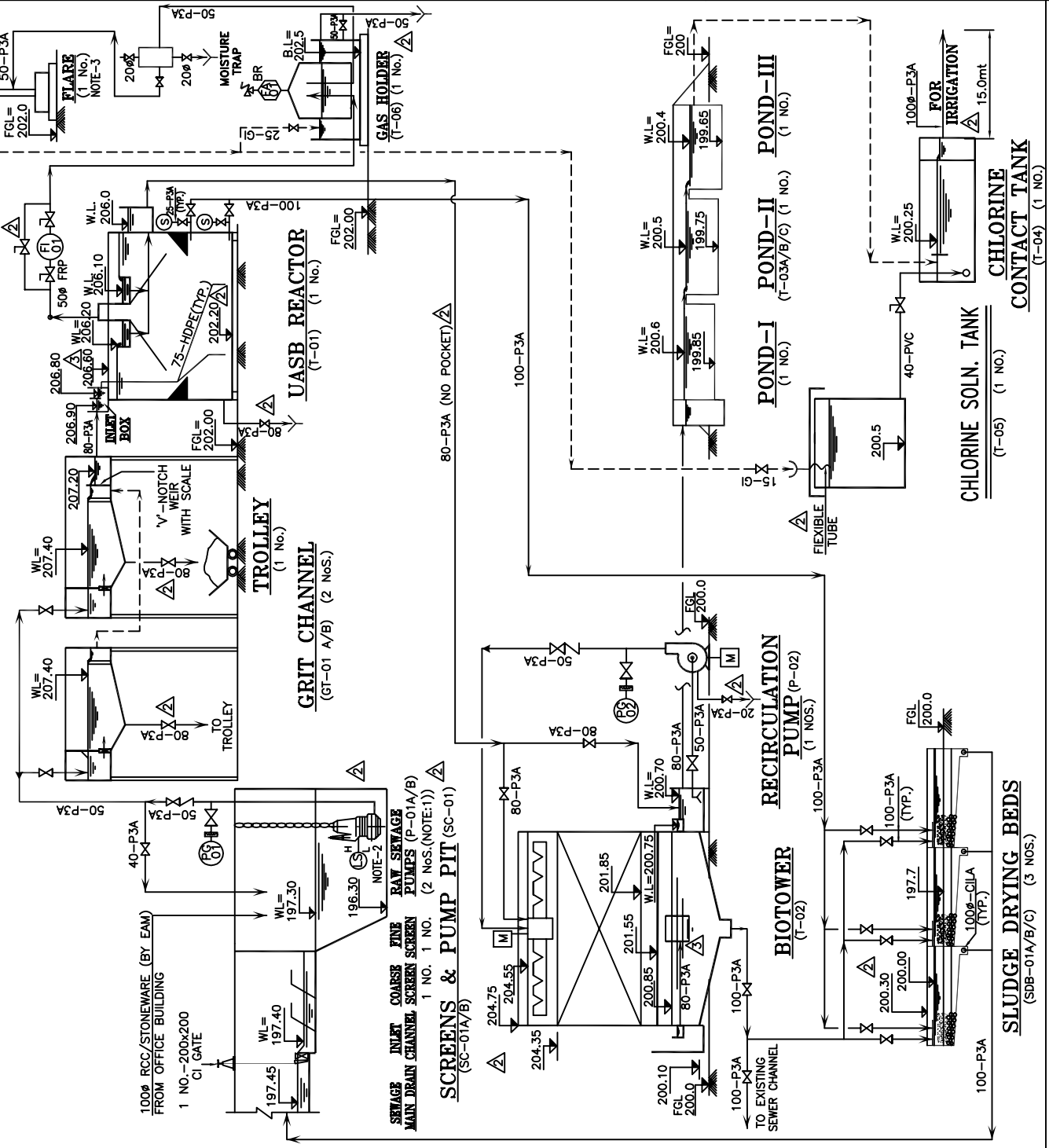
# SLD FOR DISTRIBUTION BOARD

REV. NO.	DRN. BY.	DATE	REVISION
0	R.Jadav	01-11-2000	SUBMITTED WITH OFFER
1	R.Jadav	27-11-2000	REVISED AS MARKED.
2	R.Jadav	02-01-2001	REVISED AS MARKED.



SHEET NO. : 2 OF 2	
PROJECT : PILOT PLANT FOR SEWAGE TREATMENT (100M /DAY) - NIGER	DRAWING NO: PL/528/EE-01
CONSULTANT : ---	TITLE: SINGLE LINE DIAGRAM
CLIENT : KAM NIAMEY - NIGER (J.I.C.A. STUDY)	DRN. BY: R.Jadav
	DESIGN BY: KASHYAP PANDYA
	CHD: ---
	APPD: 2
REV.	REV.

WATER SUPPLY (BY EAM)  
REFER NOTE:-4



NO.	DATE	REVISION	CHD.	APPD.
1	21.11.00	REVISED AS PER DISCUSSIONS	P.G.A	A.G.S
2	4.12.00	REVISED AS PER PIPING FOR ENGINEERING	P.G.A	A.G.S
3	29.12.00	REVISED AS MARKED.		

S.NO.	REFERENCE DRAWING	DRAWING NO.
1	LAYOUT	PL/528/L-01

**NOTE:-**

- ONE RAW SEWAGE IS PUMP SPARE IN STORE.
- LEVEL SWITCH IS IN BUILT WITH PUMP.
- FLARE HEIGHT IS 3.0 M FROM FGL.
- M/S EAM SHALL PROVIDE TUBE WELL WATER SUPPLY UP TO GAS HOLDER & CHLORINE SOLUTION TANK.

**INSTRUMENTS LEGEND:-**

- FI FLOW INDICATOR
- PG PRESSURE GAUGE
- S SAMPLING
- FA FLAME ARRESTER
- BR BREATHER VALVE
- FGL: FINISHED GRADE LEVEL
- NGL: NATURAL GRADE LEVEL
- WL WATER LEVEL
- FLOW DIRECTION ONLY
- FIELD MOUNTED INSTRUMENT
- (LS) LEVEL SWITCH(HIGH/LOW)
- XX-XX : DIA - PIPE MATERIAL
- P3A CARBON STEEL
- GI GALVANISED IRON
- FRP FIBRE REINFORCED PLASTIC
- PVC POLY VINYL CHLORIDE
- CILA CAST IRON-CLASS LA
- RCC REINFORCED CONCRETE PIPE
- ⊗ GATE VALVE
- ⊘ BALL VALVE
- ⊘ NON RETURN VALVE
- ⊘ REDUCER
- ⊘ CENTRIFUGAL PUMP
- ⊘ SUBMERSIBLE PUMP
- ⊘ ELECTRIC MOTOR
- ⊘ GATE

**PIPE LEGEND & MATERIAL:-**

- XX-XX : DIA - PIPE MATERIAL
- P3A CARBON STEEL
- GI GALVANISED IRON
- FRP FIBRE REINFORCED PLASTIC
- PVC POLY VINYL CHLORIDE
- CILA CAST IRON-CLASS LA
- RCC REINFORCED CONCRETE PIPE

**PILOT PLANT SEWAGE TREATMENT  
(100m<sup>3</sup>/day) - NIGER.**

**M/S. TOKYO ENGINEERING.**

SCALE	N.T.S	SUPERSEDES DRG. NO.
DESIGNED	J.N.P.	PL/528/P-01 REV-0.
DRAWN	SATISH PATEL	SUPERSEDED BY DRG. NO.
CHECKED	P.G.A	A.G.S
DATE	2.11.00	
DRAWING NO.		
REV.		<b>3</b>

## APPENDIX T: SEWERAGE / DRAINAGE





# **APPENDIX T. 1    CALCULATION OF DRAINAGE NETWORK**







## **APPENDIX T. 2 DESIGN CALCULATION FOR UASB SYSTEM**

## T.2 DESIGN CALCULATION FOR UASB SYSTEM

### INLET CONDITION

DAILY AVERAGE FLOW	1923	M3/D(80.1 M3/H AV.)
DAILY MAX FLOW FACTOR	1.3	
DAILY MAX FLOW	2,500	M3/D(104.2 M3/H AV.MAX)*
(Note * : As pilot plant(100m3/d) is incorporated, new plant is designed at 2,400 m3/d.)		
HOURLY MAX FACTOR	1.8	
PEAK HOURLY FLOW	144.2	M3/H PEAK
INLET BOD	160	PPM
INLET COD	370	PPM
INLET TSS	640	PPM
TEMP	24	C

### OUTLET CONDITION

OUTLET BOD	40	PPM
OUTLET TSS	30	PPM

### INLET CHAMBER

INLET CHAMBER OF PILOT PLANT IS USED FOR NEW PLANT.

### SCREEN CHAMBER

1	SET WITH DOUBLE BAR SCREEN
---	-------------------------------

### PUMP PIT

RETENTION TIME	10	MIN
VOLUME REQUIRED	24.0	M3
DEPTH	2.0	M
LENGTH	3.0	M
WIDTH	4.0	M

### PUMP

NO. OF PUMP	2	OPERATE, 1	STANDBY
CAPACITY	72	M3/H	
HEAD	20	MH	
PUMP EFFICIENCY	75	%	
BHP	5.2	KW	

### GRIT CHAMBER

HORIZONTAL VELOCITY	0.21	M/S	
LOADING RATE	30	M3/M2/H	(30 - 40)
GRIT PRODUCTION RATE	30	L/1000M3	(7.5 - 90)
GRIT REMOVAL INTERVAL	2	DAYS	(2 - 3)
GRIT SETTLING VELOCITY	0.017	M/S	
NO. OF CHANNEL	1	OPERATE, 1	STANDBY
REQUIRED SECTION	0.1	M2	
WATER DEPTH	0.7	M	
WIDTH	0.3	M	
LENGTH	8.0	M	

GRIT PRODUCTION	0.004	M <sup>3</sup> /H		
VOLUME OF GRIT/ONCE	0.2	M <sup>3</sup>		
<b>UASB REACTOR</b>				
NO. OF REACTOR	2			
HEIGHT OF REACTOR	4	M		
HIGHT OF GAS COLLECTOR	1.4	M		
AV. LIQ UPFLOW VELOCITY	0.5	M/H		
MAX. LIQ UPFLOW VELOCITY	0.8	M/H		
PEAK LIQ UPFLOW VELOCITY	1.5	M/H		
BIOSLUDGE PROD. RATE	0.1	MG-VSS/MG-BOD INLET		
ASH CONTENT IN INLET TSS	0.65			
DEGRADATION OF TSS	0.4			
ASH CONTENT IN SLUDGE	0.4			
SLUDGE BED CONCENTRATION	80	KG-TSS/M <sup>3</sup>		
% AGE OCCUPIED BY BED	0.85			
SLUDGE RETENTION TIME	31	DAYS @24C		
BIOSLUDGE PRODUCTION	16	MG-VSS/L		
NON BIOSLUDGE PRODUCTION	249.6	MG-VSS/L		
TOTAL SLUDGE PRODUCTION	442.7	MG-TSS/L		
HYDRAULIC RETENTION TIME(HRT min)	7.45	HR		
UPFLOW VELOCITY(HRT BASE)	0.54	M/HR		
CHECK FROM MAX LIQ UPFLOW VELOCITY				
REQ'D LIQ UPFLOW V. AT AVE. FLOW	0.58	M/H		
APPLIED UPFLOW VELOCITY	0.54	M/H	(TAKE MIN.!)	
REACTOR SURFACE/EACH	97.0	M <sup>2</sup>		
REACTOR VOLUME/EACH	388.1	M <sup>3</sup>		
RETENTION TIME AVERAGE	7.5	HRS		
REACTOR WIDTH/LENGTH	12.25	M-WIDTH,	8.0	M-LENGTH
<b>SLUDGE DRYING BED</b>				
SLUDGE PRODUCTION	1106.6	KG/D		
SLUDGE AMOUNT TO BE REMOVED	1031.6	KG/D		
TOTAL SLUDGE VOL. DISCHARGED	12.9	M <sup>3</sup> /D		
SLUDGE BED LOAD	2	KG-TSS/M <sup>2</sup> /D		(0.7 - 2.8)
SURFACE AREA REQUIRED	515.8	M <sup>2</sup>		
NO. OF BED	2	(1 BED<400M <sup>2</sup> )		
BED WIDTH/LENGTH PER BED	20.0	M-WIDTH,	13.0	M-LENGTH
BED DEPTH	1.0	M		
DRYING CYCLE	7	DAYS		
DISCHARGED SLUDGE PER WEEK	90.3	M <sup>3</sup> /W		
WATER CONTENT DRY SOLID	40	%		
SLUDGE TO BE REMOVED	12.0	M <sup>3</sup> /W		
<b>SLUDGE DISCHARGE SYSTEM</b>				
SLUDGE REMOVAL FREQUENCY	6	DAYS/WEEK		
SLUDGE DISCHARGE/ONE TIME	15.0	M <sup>3</sup>		

**FINAL POLISHING POND**

RETENTION TIME	0.5	DAYS
TOTAL VOLUME	1250	M3
WATER DEPTH	1	M WITH FREEBOARD 0.25 M

REQUIRED TOTAL AREA	1250	M2
1 <sup>ST</sup> POND	20.4	M-WIDTH, 20.4 M-LENGTH
2 <sup>ND</sup> POND	20.4	M-WIDTH, 20.4 M-LENGTH
3 <sup>RD</sup> POND	20.4	M-WIDTH, 20.4 M-LENGTH

**CHLORINATION**

INJECTION RATE	5	PPM
CHLORINE CONSUMPTION	12.5	KG/D AS 100%
EFFECTIVE CHLORINE	15	%
REQUIRED HYPOCHLORITE	83.3	L/D

**BIO GAS PRODUCTION**

GENERATION RATE	0.2	M3/KG-COD REMOVED (0.15 - 0.25)
METHANE CONTENT IN GAS	70 - 80	Vol %
COD REDUCTION	0.65	
AV. GAS PRODUCTION	120.2	M3/D