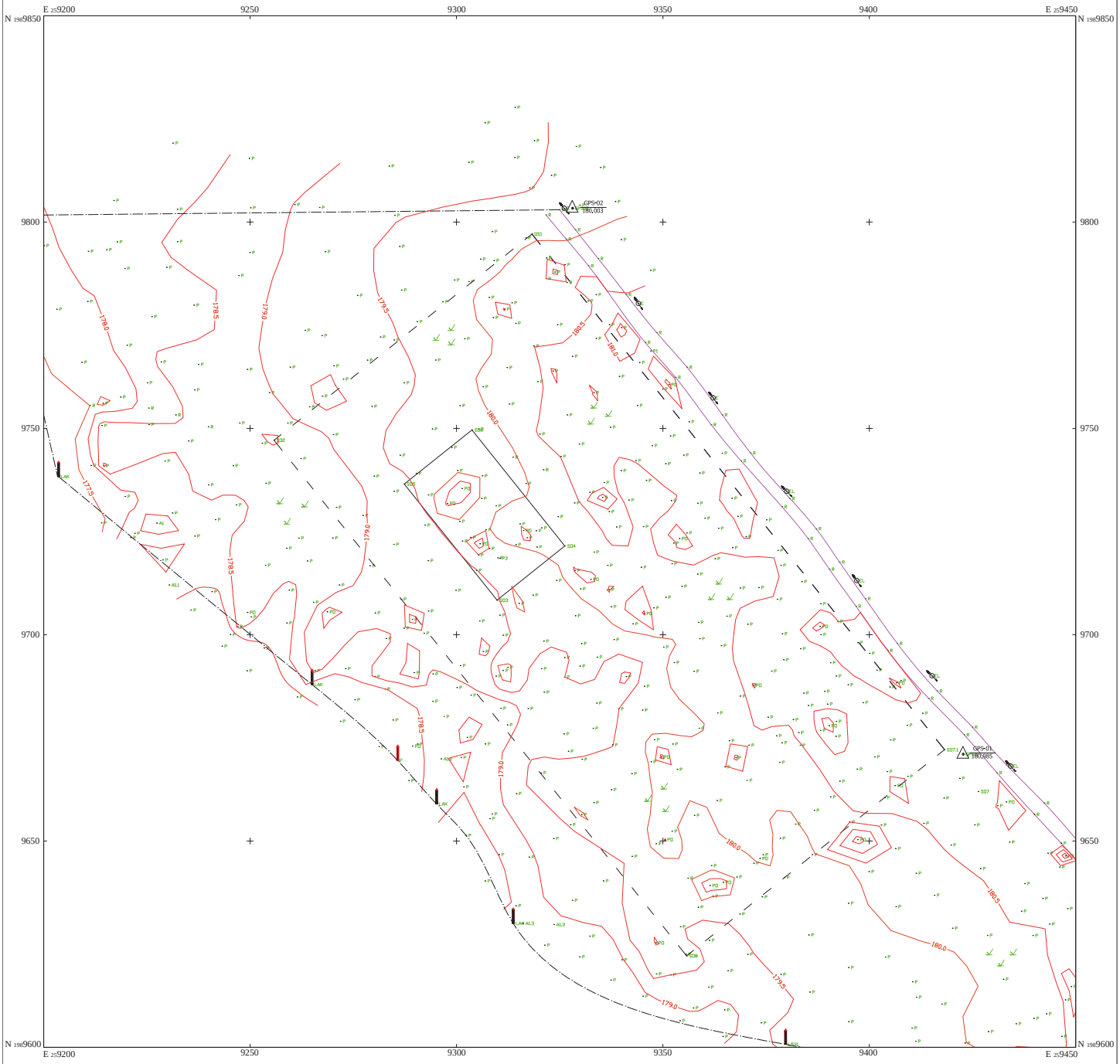
7-1 地形調査

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

Datum - WGS-84



LEGEND

PLAN ORIENTATION	ROAD
180.000 SPOT ELEVATION	BUSH , GRASS
GPS-01 180.895 GROUND CONTROL POINT	TREE
GPS-02 180.003 GROUND CONTROL POINT	BOUNDARY POST
180 CONTOUR LINE	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 500 GRAPHIC SCALE

(IN METERS)

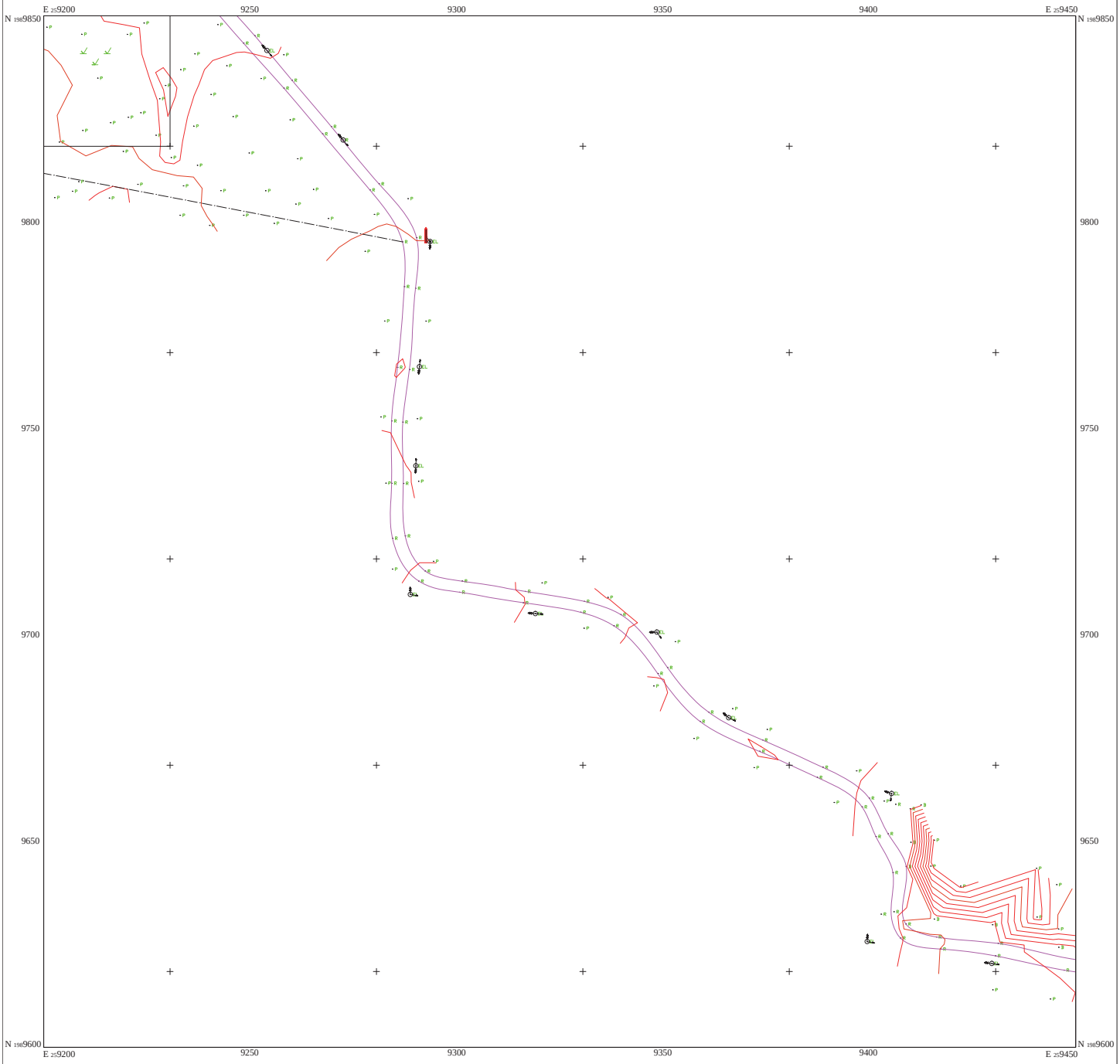
THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGERMENT IN ENVIRONMENTAL SUSTAINABLE CITIES IN LAO P.D.R

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

SURVEY BY : STAFT OF SURVEY AND MAPPING CENTER	CHECKED BY : Mr. Saykham	
DRAWN BY : Mr. SayKham	SHEET INDEX	01
September, 2013	DWG No : 01	

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

Datum - WGS-84



LEGEND

PLAN ORIENTATION	
180.000	SPOT ELEVATION
GPS-01 180.895	GROUND CONTROL POINT
GPS-02 180.003	GROUND CONTROL POINT
180	CONTOUR LINE
ROAD	ROAD
	BUSH , GRASS
	TREE
	BOUNDARY POST
	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 500 GRAPHIC SCALE

(IN METERS)

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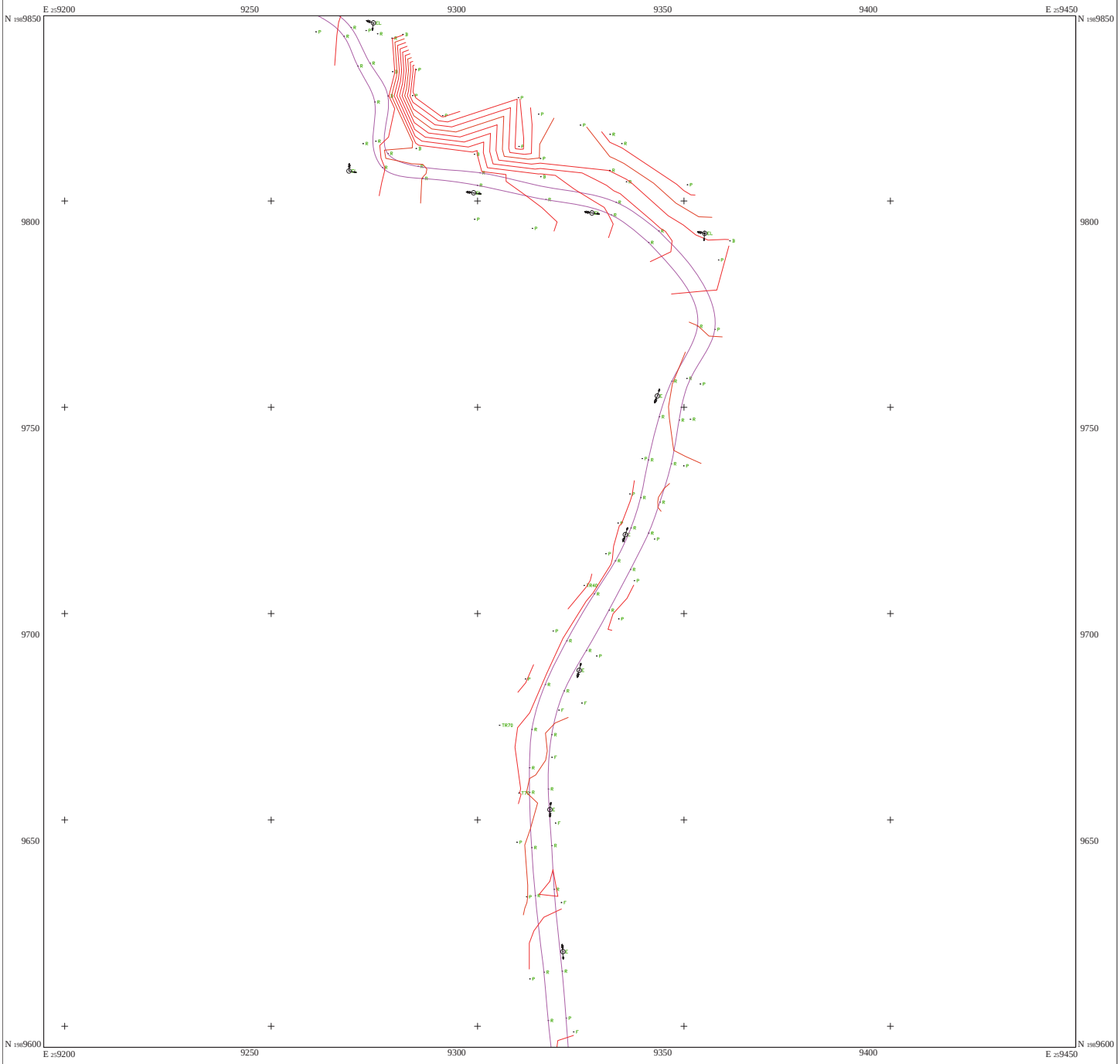
SURVEY FOR TRANSFER STATION

SURVEY BY : STAFT OF SURVEY AND MAPPING CENTER	CHECKED BY : Mr. Saykham
DRAWN BY : Mr. SayKham	SHEET INDEX
September, 2013	DWG No : 01

01

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

Datum - WGS-84



LEGEND

PLAN ORIENTATION	
180.000	SPOT ELEVATION
GPS-01 180.895	GROUND CONTROL POINT
GPS-02 180.003	GROUND CONTROL POINT
180	CONTOUR LINE
ROAD	ROAD
	BUSH , GRASS
	TREE
	BOUNDARY POST
	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 500 GRAPHIC SCALE

(IN METERS)

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TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

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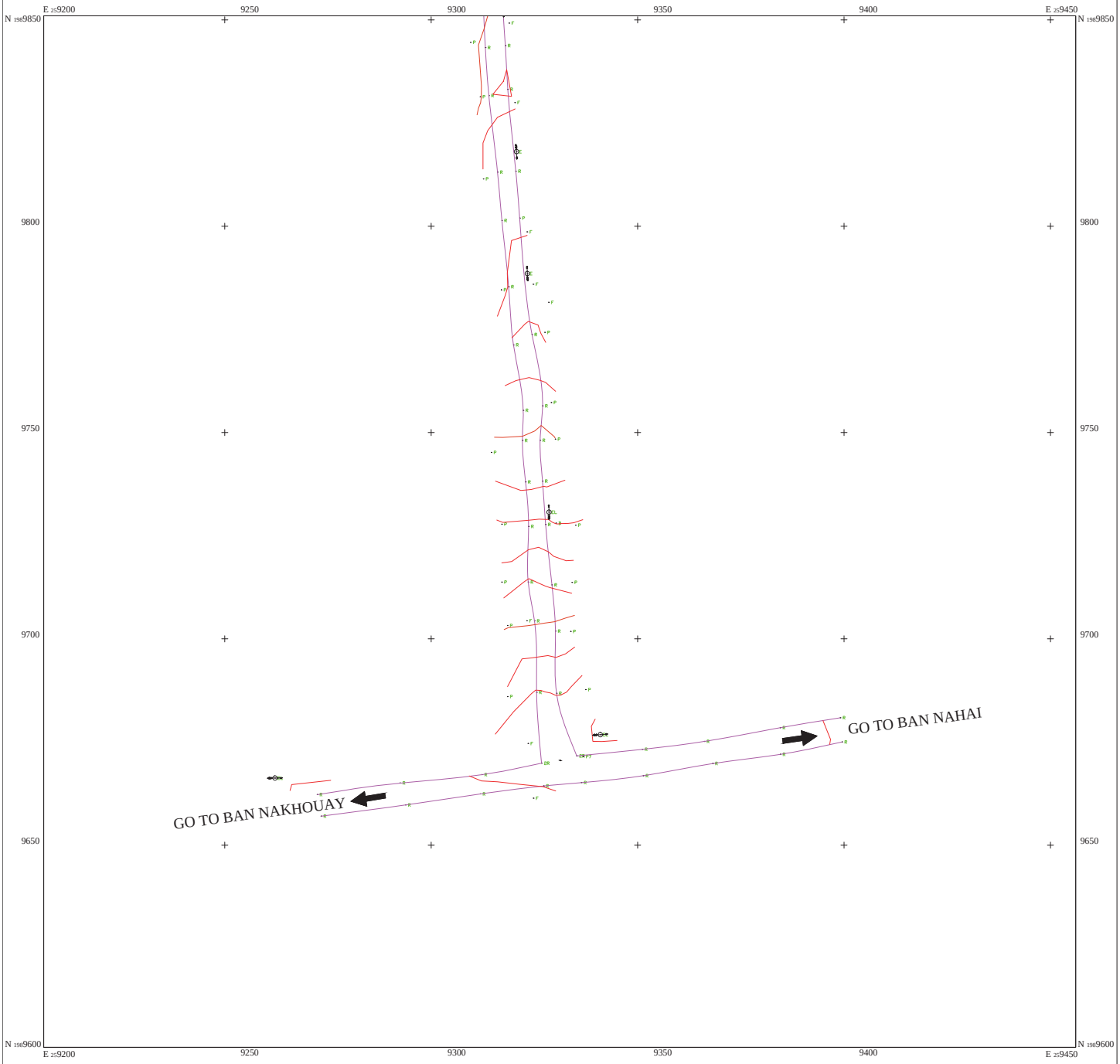
September, 2013	DWG No : 01

01

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

Datum - WGS-84



LEGEND

PLAN ORIENTATION	
180.000 — SPOT ELEVATION	
GPS-01 / 180.895 — GROUND CONTROL POINT	
GPS-02 / 180.003 — GROUND CONTROL POINT	
180 — CONTOUR LINE	
ROAD	ROAD
	BUSH , GRASS
	TREE
	BOUNDARY POST
	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 500 GRAPHIC SCALE

(IN METERS)

THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGERMENT IN ENVIRONMENTAL SUSTAINABLE CITIES IN LAO P.D.R

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

SURVEY BY : STAFT OF SURVEY AND MAPPING CENTER	CHECKED BY : Mr. Saykham
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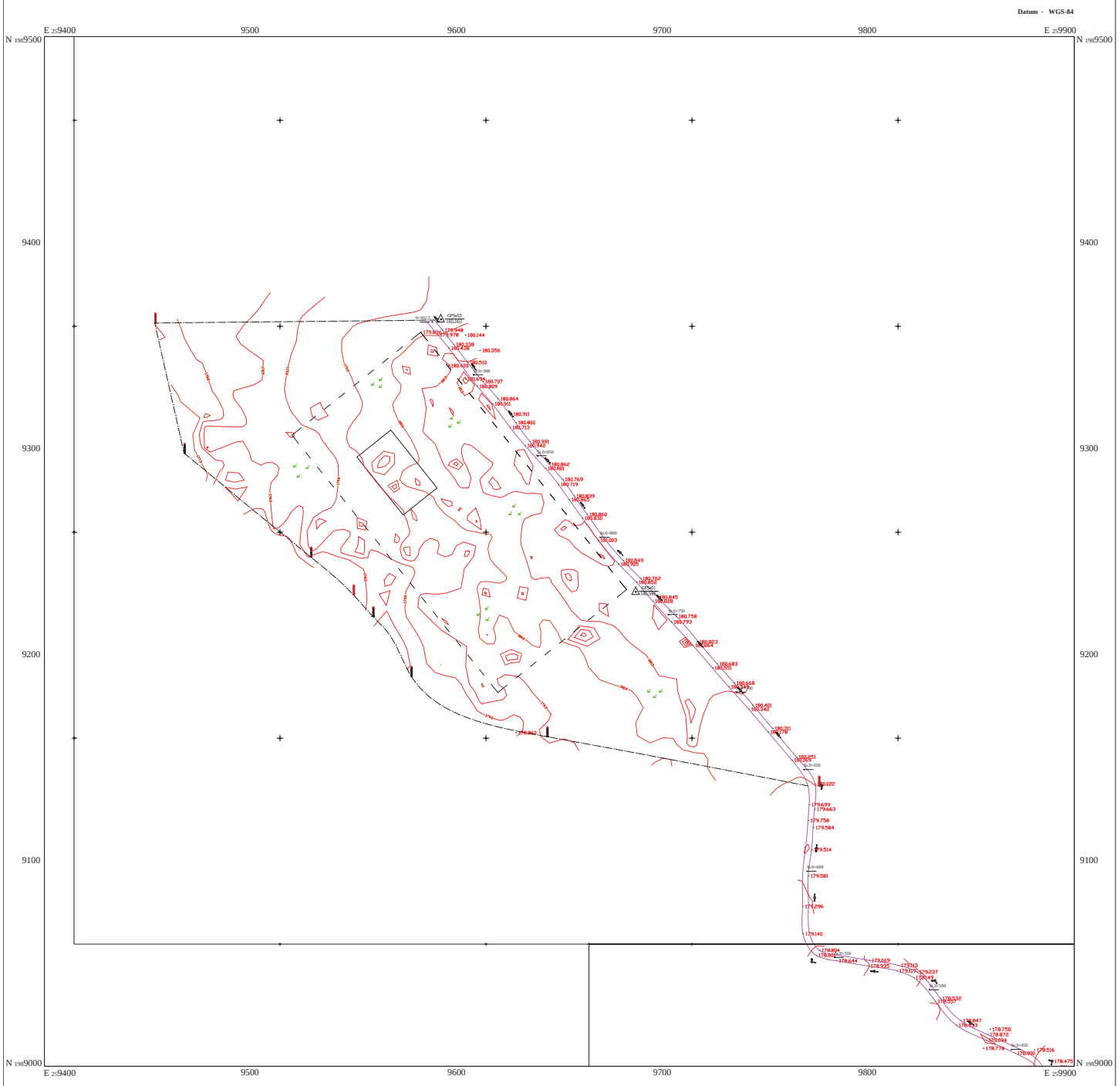
September, 2013	DWG No : 01

01

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION



LEGEND

PLAN ORIENTATION	
180.000	SPOT ELEVATION
GPS-01 180.895	GROUND CONTROL POINT
GPS-02 180.003	GROUND CONTROL POINT
180	CONTOUR LINE
ROAD	ROAD
	BUSH , GRASS
	TREE
	BOUNDARY POST
	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 1000 GRAPHIC SCALE

0 50 100

(IN METERS)

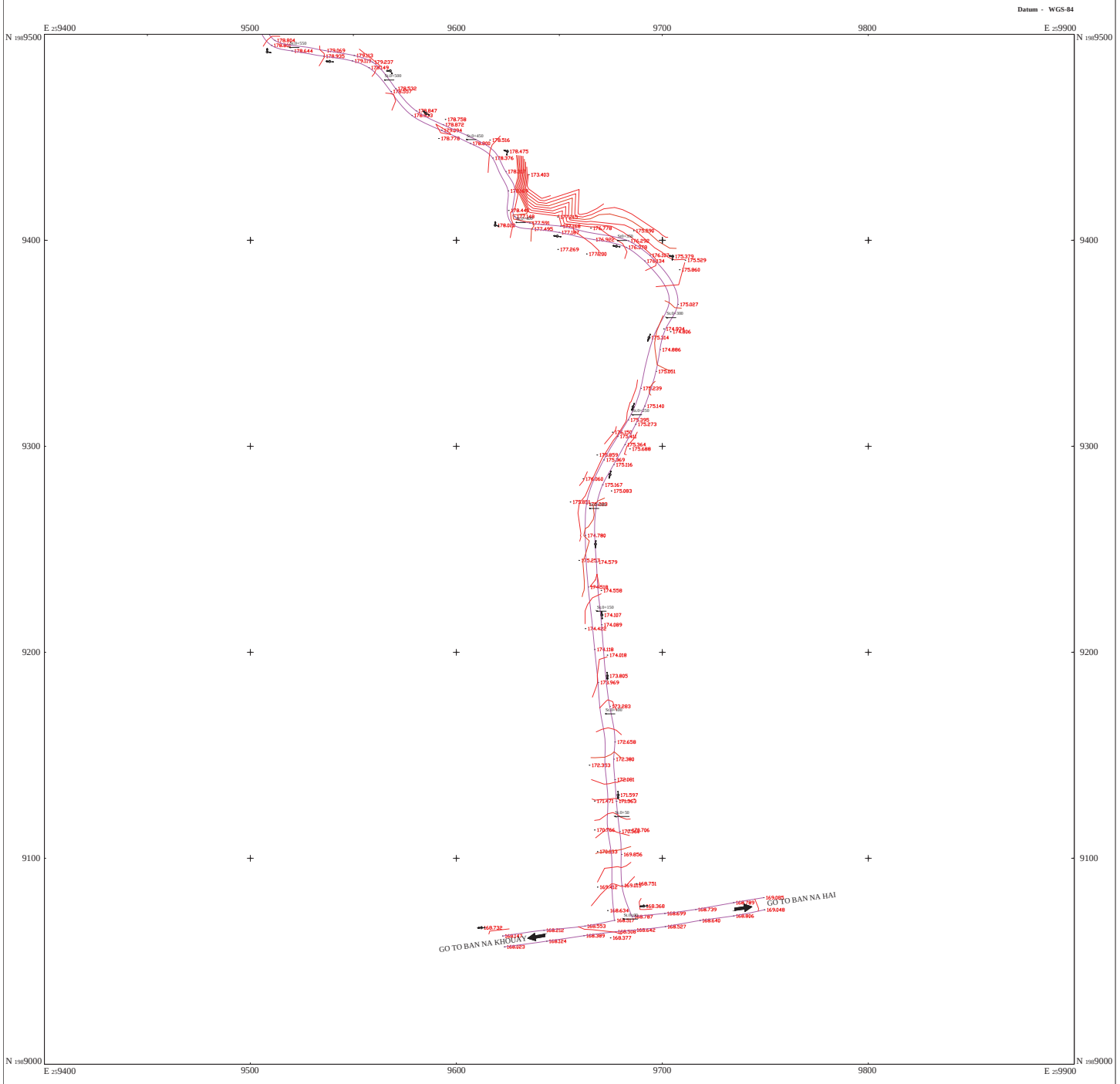
THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGERMENT IN ENVIRONMENTAL SUSTAINABLE CITIES IN LAO P.D.R

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

SURVEY BY : STAFT OF SURVEY AND MAPPING CENTER	CHECKED BY : Mr. Saykham
DRAWN BY : Mr. SayKham	SHEET INDEX
September, 2013	DWG No : 02

01
02

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION



LEGEND

PLAN ORIENTATION	ROAD
180.000 SPOT ELEVATION	BUSH , GRASS
GPS-01 180.895 GROUND CONTROL POINT	TREE
GPS-02 180.003 GROUND CONTROL POINT	BOUNDARY POST
180 CONTOUR LINE	CONSTRUCTION BOUNDARY

HORIZONTAL : 1 : 1000 GRAPHIC SCALE

(IN METERS)

THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGERMENT IN ENVIRONMENTAL SUSTAINABLE CITIES IN LAO P.D.R

TOPOGRAPHIC MAP
SURVEY FOR TRANSFER STATION

SURVEY BY : STAFT OF SURVEY AND MAPPING CENTER	CHECKED BY : Mr. Saykham	
DRAWN BY : Mr. SayKham	SHEET INDEX	01 / 02
September, 2013	DWG No : 02	

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Peace Independence Democracy Unity Prosperity

KOKUSAI KOGYO CO.,LTD

THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT

IN ENVIRONMENT SUSTAINABLE CITIES IN LAO PDR

NAHAI VILLAGE, XAISETTHA DISTRICT, VIENTIANE CAPITAL

SOIL INVESTIGATION

OCTOBER, 2013

Prepared by : SDMT State Enterprise for Survey Design and Material Testing

Tel : 413951, 415258, Fax : (856) - 21 - 41 5259, PO Box : 8438, Vientiane Lao PDR

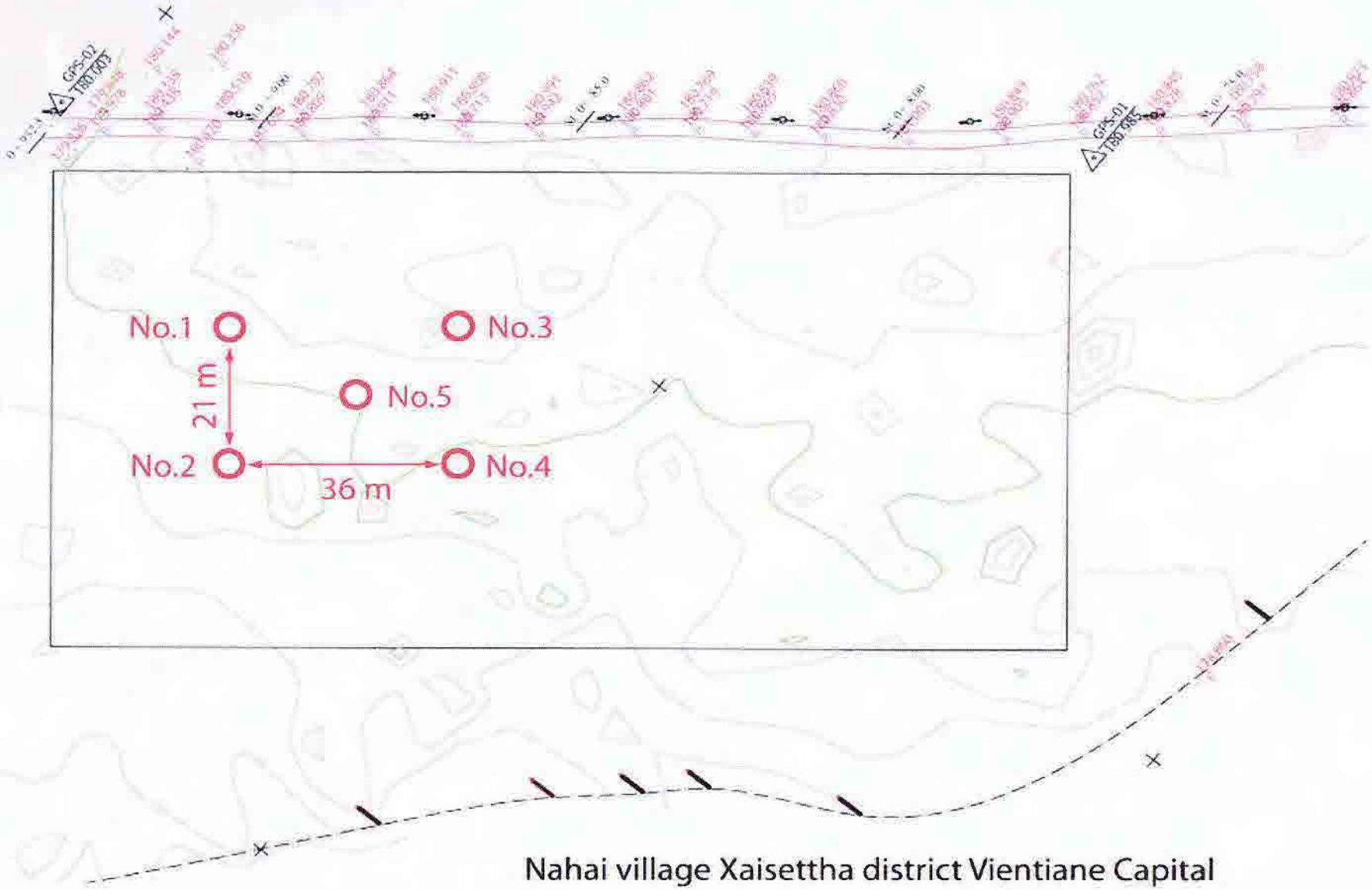
Email: sdmt@ laotel.com www.sdmt.laopdr.com

CONTENT

LOCATION OF BORE HOLES

(BH No. 1 – 5)

The Preparatory Survey on the Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.



Nahai village Xaisettha district Vientiane Capital

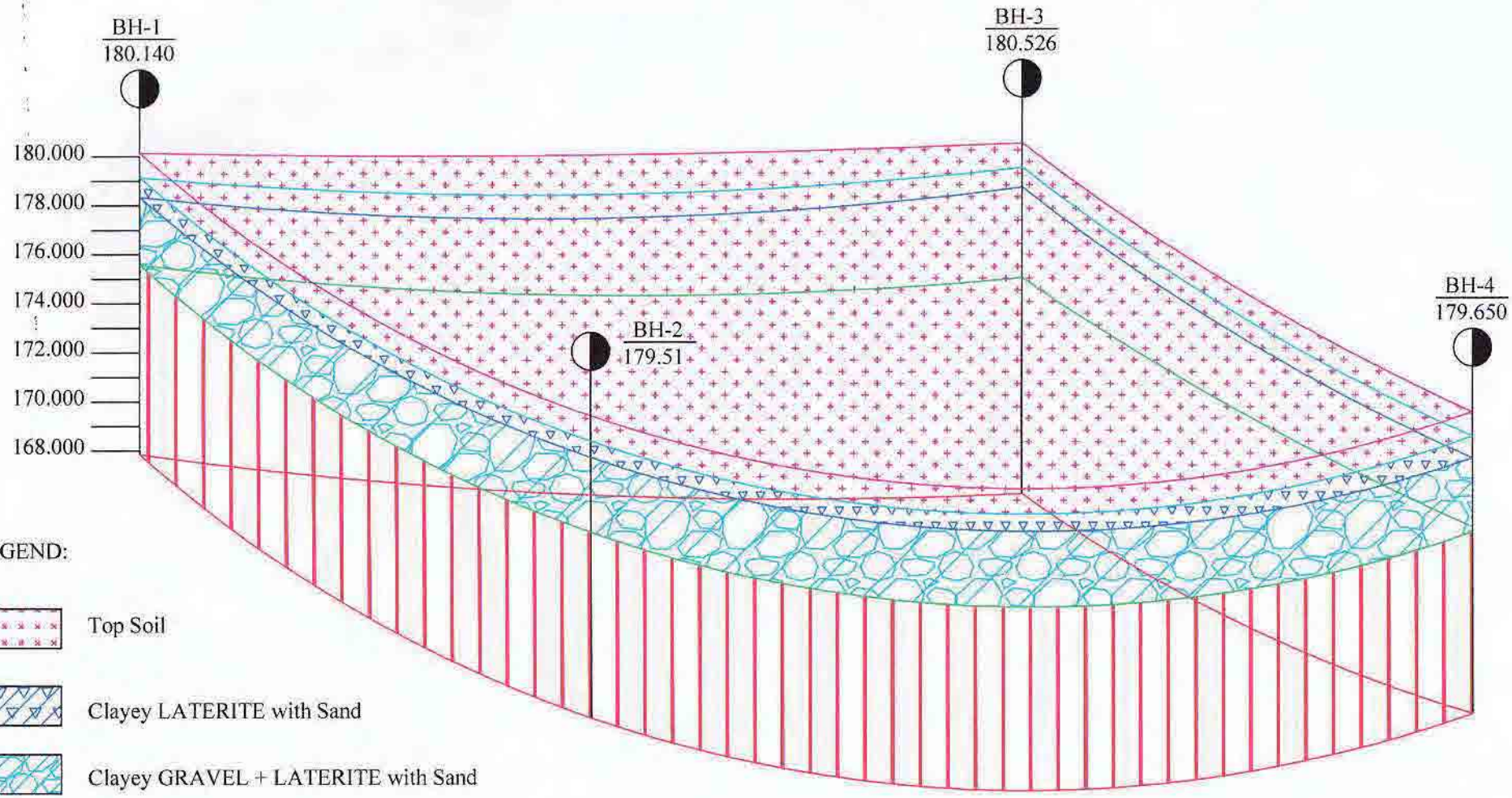
SOIL PROFILE

(BH No. 1 – 5)

SDMT

SOIL PROFILE

The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao PDR



Scale : 1 : 500

DOCUMENTTAION PHOTOGRAPH

(BH No. 1 – 5)

THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT
IN ENVIRONMENT SUSTAINABLE CITIES IN LAO P D R
KOKUSAI KOGYO CO.,LTD
NAHAI VILLAGE, XAISETTHA DISTRICT, VIENTIANE CAPITAL

BH No.01

BH No.02

BH No.03

BH No.04

BH No.05

INTRODUCTION

I. INTRODUCTION:

The Planned Site for Transfer Station in Vientiane Capital is one of The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao PDR as support by JICA need to be construction.

Before the design work start, the foundation design was also need to be close check. The KOKUSAI KOGYO CO., LTD the project's consultant was suggested and agreed that an independent company should be appointed to make the field survey service. The soil geotechnical investigation survey is one of part for the field survey work.

The consultant was giving to State Enterprise for Survey Design and Material Testing company in the contract agreement and approved quotation dated September 13, 2013 and September 16, 2013 respectively as approved by Mr. Naofumi Sato, Manager of Kokusai Kogyo Ltd., to carries out the works.

The consultant purposed of the field survey services is to conduct geotechnical investigation at the project site area.

The scope of the work detailed is including the following:

1. Field investigation including review of previous soil data and soil sampling.
2. In-situ test by Standard Penetration Test (SPT)
3. Analysis of soil sampling and testing including the results of prescribed normal tests.

II. SITE LOCATION:

The project site is located at surround area of Na Hai village , Xaisttha district, Vientiane Capital.

III. SITE SITUATION:

According to the Geotechnical Map of Lao PDR in 1988 by General Department of geology and mind of Vientiane in 1988. This area is the Quaternary, Alluvial deposits of the Mekong River (Mesozoic and younger platform cover). Predominantly terrestrial sediments mainly Claystone and Silt-stone.

IV. WORKS SCHEDULE

The SDMT's staff and project authority representative was make the site visit On September 12, 2013 and the boring holes were starting on September 23, 2013 and field works have been complete on September 27, 2013.

V. TESTING METHOD AND EQUIPMENT USED

5.1 In-situ test:

5.1.1 The investigation work were performed by followed the ASTM D 1586 standard. The Standard Penetration Test (SPT) was conducted at 1.00-m interval with N value (blows/feet) was recorded as the result of two last penetrations.

5.1.2 One of Drilling-boring machine "UKB-50M" was used to works performed.

The arrangement of standard penetration test is as below:

a. Drive weight assembly; consist of a 140-lb weight Donut hammer
b. Guide pipe
c. Anvil
d. Driving rods
e. Auger
f. Split-Barrel sampler 51 mm in OD.
g. Thin Wall Tube
h. Other relative equipment

VI. WORK TO BE DONE

At the site of project as required and instructed by the author, the sub soil investigation is in composed of boring as near as position that instructed and indicated by the author.

Five of boreholes nearly 12.30-m, 10.30-m, 14.30-m, 12.30-m and 12.0-m depths were performed.

The split spoon disturbed samples were collects in connection with the SPT tests.

The ground water table was noted immediately when is encountered and after 24h.

The terminated of the drilling, boring works are confirmed with the N value is more than 70 blows per feet and as designed by project authority.

Project authority representative closely supervises the filed works.

VII. SOIL TESTS

The prescribed soil tests were performed as following the ASTM Standard at the soil engineering laboratory at the SDMT as enumerated below:

- 15 Water content tests
- 15 Atterberg Limit tests
- 15 Sieve analysis
- 15 Soil Classification

All data are given in the appendices.

VIII. SOIL PROFILE

The soil profiles are giving in Bore log and standard penetration tests (SPT) performed at the site. The soil profile consists of three types of soil as described below table:

Layer No.	Soil layer	Depth (m)				
		BH 1	BH-2	BH-3	BH-4	BH-5
1	Top Soil		0.00~ 1.04	0.00~ 1.00	0.00~ 1.00	0.00~ 0.97
2	VST Clayey LATERITE with Sand	0.00 ~ 1.80		1.00 ~ 1.80	1.00 ~ 1.89	0.97~ 1.97
3	ST Clayey GRAVEL + LATERITE with Sand	1.80~3.30	1.04 ~ 2.30	1.80 ~ 4.00	1.89 ~ 3.30	1.97~ 2.65
4	VST Clayey GRAVEL + LATERITE with Sand	3.30~4.57	2.30~4.75	4.00 ~ 5.50	3.30 ~ 4.70	2.65~ 4.55
5	VST Elastic SILT with Sand	4.57~8.30		5.50 ~ 8.30		
6	ST Elastic SILT with Sand	8.30~12.30				
7	Hard Elastic SILT with Sand		4.75~10.30	8.30 ~ 10.30	4.70 ~ 8.30	
8	VST Elastic SILT with Sand			10.30 ~ 11.30	8.30 ~ 9.30	
9	Hard Elastic SILT with Sand			11.30 ~ 14.30	9.30 ~ 12.30	4.55 ~ 12.00
Water level (Encountered) (m)		-6.35	-6.00	-6.85	-7.85	-7.30
Water level after 24 h (m)		-2.58	-2.29	-2.29	-2.60	-2.60

IX. BEARING CAPACITY CALCULATION

BOREHOLE NO.1

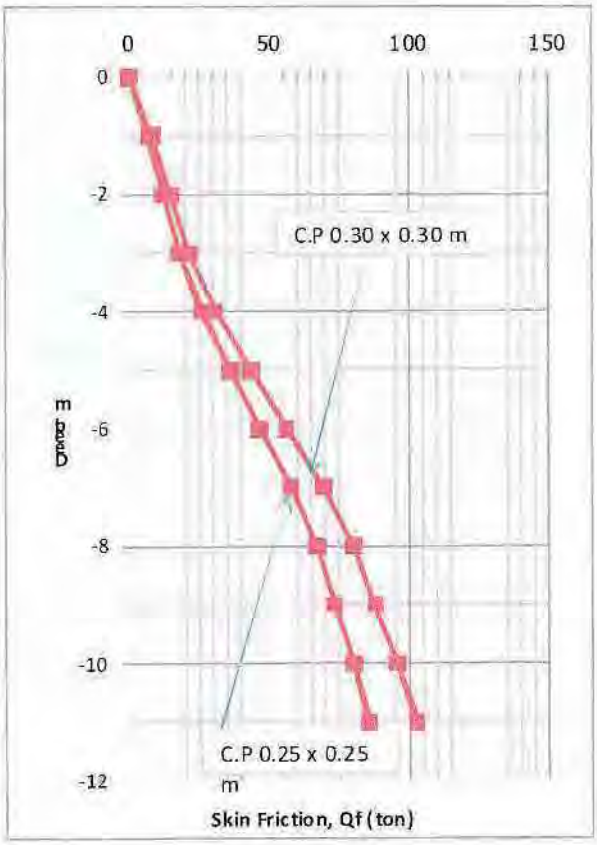
A. SHALLOW FOUNDATION " D ≤ B"

Depth "D", m	Type of footing		Footing dimension		qu*	qu(net)*	qa*	qa (net)*	Factor Safety
			B	L	tsm	tsm	tsm	tsm	
3	Spread footing		2	2	52.60	48.60	20.20	16.20	3
			2.5	2.5	50.80	46.80	19.60	15.60	3
			3	3	49.60	45.60	19.20	15.20	3

qu = Ultimate Bearing Capacity
qa = Allowable Bearing Capacity
qu (net) = Net Ultimate Bearing Capacity
qa (net) = Net Allowable Bearing Capacity
* Bearing Capacity Factor based on SKEMPTON (1951), Fig. 1 & Undrained Shear Strength based on SPT N- value in Fig 2

B. DEEP FOUNDATION (DRIVING PILE)
B-1 SKIN FRICTION "Qf" (FOR DRIVING PILE), t

Depth (m)	Pile section				
	0.25 Lp =	0.25 1.00		0.3 Lp =	0.3 1.20
	x su				
1	7.03	7.03	7.03		8.44
2	5.30	12.33	12.33		14.80
3	5.52	17.85	17.85		21.42
4	7.89	25.74	25.74		30.89
5	10.54	36.28	36.28		43.53
6	10.54	46.82	46.82		56.18
7	11.02	57.84	57.84		69.41
8	9.10	66.93	66.93		80.32
9	6.34	73.27	73.27		87.92
10	6.68	79.95	79.95		95.93
11	5.52	85.47	85.47		102.56



B-2 END BEARING "qe" (FOR DRIVING PILE), t

Depth (m)	Pile section			
	0.25 Lp =	0.25 1.00	0.3 Lp =	0.3 1.20
12	12.60		18.14	

B-3 ULTIMATE BEARING CAPACITY " Qu", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	87.79		105.91	

Note: These value are not including weight of concrete pile
Factor safety = 3

B-4 Allowable BEARING CAPACITY " Qa", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	35.12		42.36	

Note: These value are not including weight of concrete pile
Factor safety = 2.5

BOREHOLE NO.2

A. SHALLOW FOUNDATION " D ≤ B"

Depth "D", m	Type of footing		Footing dimension		qu*	qu(net)*	qa*	qa (net)*	Factor Safety
			B	L	tsm	tsm	tsm	tsm	
3	Spread footing		2	2	68.80	64.80	25.60	21.60	3
			2.5	2.5	66.40	62.40	24.80	20.80	3
			3	3	64.80	60.80	24.27	20.27	3

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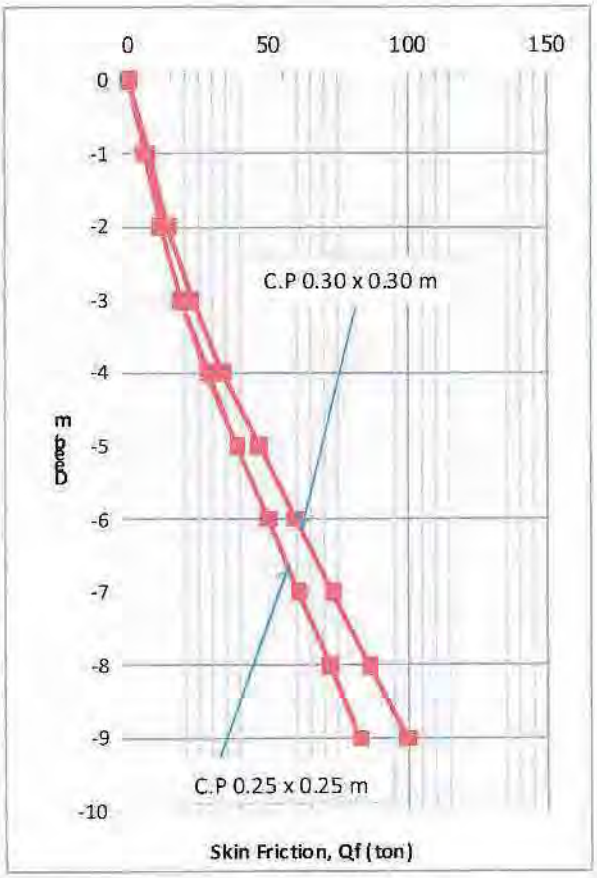
qa = Allowable Bearing Capacity
qu (net) = Net Ultimate Bearing Capacity
qa (net) = Net Allowable Bearing Capacity
* Bearing Capacity Factor based on SKEMPTON (1951), Fig. 1 & Undrained Shear Strength based on SPT N- value in Fig 2

B. DEEP FOUNDATION (DRIVING PILE)
B-1 SKIN FRICTION "Qf" (FOR DRIVING PILE), t

Depth (m)	Pile section				
	0.25 Lp =	0.25 1.00		0.3 Lp =	0.3 1.20
	(x su				
1	5.92	5.92	5.92		7.10
2	5.92	11.83	11.83		14.20
3	7.04	18.87	18.87		22.64
4	9.36	28.23	28.23		33.88
5	10.73	38.96	38.96		46.75
6	11.00	49.96	49.96		59.95
7	11.00	60.96	60.96		73.15
8	11.00	71.96	71.96		86.35
9	11.00	82.96	82.96		99.55



B-2 END BEARING "qe" (FOR DRIVING PILE), t

Depth (m)	Pile section			
	0.25 Lp =	0.25 1.00	0.3 Lp =	0.3 1.20
10	42.00		60.48	

B-3 ULTIMATE BEARING CAPACITY " Qu", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
10	95.40		117.46	

Note: These value are not including weight of concrete pile
Factor safety = 3

B-4 Allowable BEARING CAPACITY " Qa", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
10	38.16		46.98	

Note: These value are not including weight of concrete pile
Factor safety = 2.5

BOREHOLE NO.3

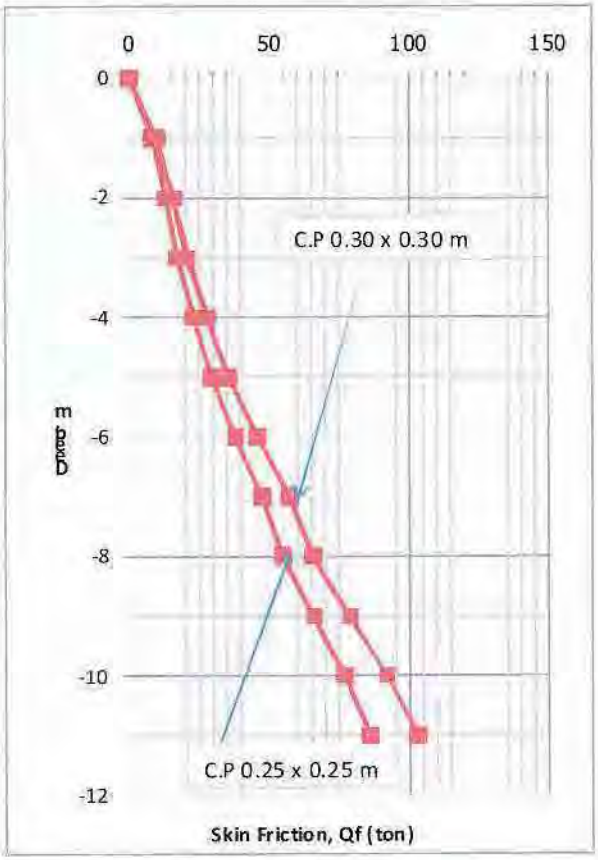
A. SHALLOW FOUNDATION " D ≤ B"

Depth "D", m	Type of footing		Footing dimension		qu*	qu(net)*	qa*	qa (net)*	Factor Safety
			B	L	tsm	tsm	tsm	tsm	
3	Spread footing		2	2	42.88	38.88	16.96	12.96	3
			2.5	2.5	41.44	37.44	16.48	12.48	3
			3	3	40.48	36.48	16.16	12.16	3

qu = Ultimate Bearing Capacity
qa = Allowable Bearing Capacity
qu (net) = Net Ultimate Bearing Capacity
qa (net) = Net Allowable Bearing Capacity
* Bearing Capacity Factor based on SKEMPTON (1951), Fig. 1 & Undrained Shear Strength based on SPT N- value in Fig 2

B. DEEP FOUNDATION (DRIVING PILE)
B-1 SKIN FRICTION "Qf" (FOR DRIVING PILE), t

Depth (m)	Pile section				
	0.25 Lp =	0.25 1.00		0.3 Lp =	0.3 1.20
	τ x su				
1	8.20	8.20	8.20		9.84
2	4.70	12.90	12.90		15.48
3	4.56	17.46	17.46		20.95
4	5.69	23.15	23.15		27.77
5	6.32	29.46	29.46		35.36
6	8.69	38.15	38.15		45.79
7	9.41	47.57	47.57		57.08
8	7.13	54.70	54.70		65.64
9	11.00	65.70	65.70		78.84
10	11.00	76.70	76.70		92.04
11	9.25	85.95	85.95		103.14
12	11.08	97.03	97.03		116.44



B-2 END BEARING "qe" (FOR DRIVING PILE), t

Depth (m)	Pile section	
	0.25 0.25 Lp = 1.00	0.3 0.3 Lp = 1.20
13	52.50	75.60

B-3 ULTIMATE BEARING CAPACITY " Qu", t

Depth (m)	Pile section	
	0.25 0.25 As = 0.06	0.3 0.3 As = 0.09
13	112.50	138.71

Note: These value are not including weight of concrete pile
Factor safety = 3

B-4 Allowable BEARING CAPACITY " Qa", t

Depth (m)	Pile section	
	0.25 0.25 As = 0.06	0.3 0.3 As = 0.09
13	45.00	55.48

Note: These value are not including weight of concrete pile
Factor safety = 2.5

BOREHOLE NO.4

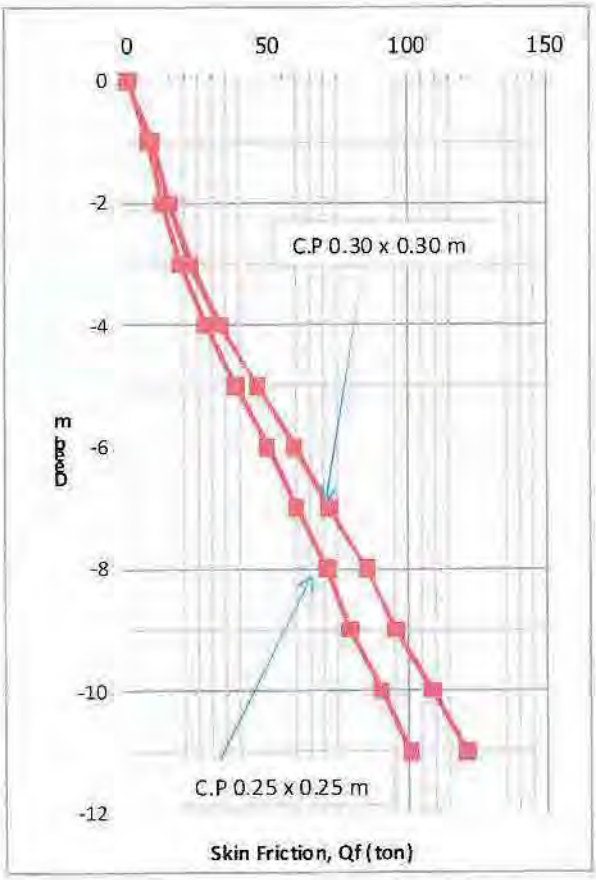
A. SHALLOW FOUNDATION " D ≤ B"

Depth "D", m	Type of footing		Footing dimension		qu*	qu(net)*	qa*	qa (net)*	Factor Safety
			B	L	tsm	tsm	tsm	tsm	
3	Spread footing		2	2	61.50	56.70	23.70	18.90	3
			2.5	2.5	59.40	54.60	23.00	18.20	3
			3	3	58.00	53.20	22.53	17.73	3

qu = Ultimate Bearing Capacity
qa = Allowable Bearing Capacity
qu (net) = Net Ultimate Bearing Capacity
qa (net) = Net Allowable Bearing Capacity
* Bearing Capacity Factor based on SKEMPTON (1951), Fig. 1 & Undrained Shear Strength based on SPT N- value in Fig 2

B. DEEP FOUNDATION (DRIVING PILE)
B-1 SKIN FRICTION "Qf" (FOR DRIVING PILE), t

Depth (m)	Pile section				
	0.25 Lp =	0.25 1.00		0.3 Lp =	0.3 1.20
	ζ x su				
1	7.31	7.31	7.31		8.77
2	5.12	12.43	12.43		14.91
3	6.30	18.73	18.73		22.47
4	8.86	27.58	27.58		33.10
5	11.00	38.58	38.58		46.30
6	11.00	49.58	49.58		59.50
7	10.62	60.20	60.20		72.24
8	11.00	71.20	71.20		85.44
9	8.40	79.60	79.60		95.52
10	10.92	90.52	90.52		108.62
11	10.32	100.84	100.84		121.01



B-2 END BEARING "qe" (FOR DRIVING PILE), t

Depth (m)	Pile section			
	0.25 Lp =	0.25 1.00	0.3 Lp =	0.3 1.20
12	56.70		81.65	

B-3 ULTIMATE BEARING CAPACITY " Qu", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	117.87		145.52	

Note: These value are not including weight of concrete pile
Factor safety = 3

B-4 Allowable BEARING CAPACITY " Qa", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	47.15		58.21	

Note: These value are not including weight of concrete pile
Factor safety = 2.5

BOREHOLE NO.5

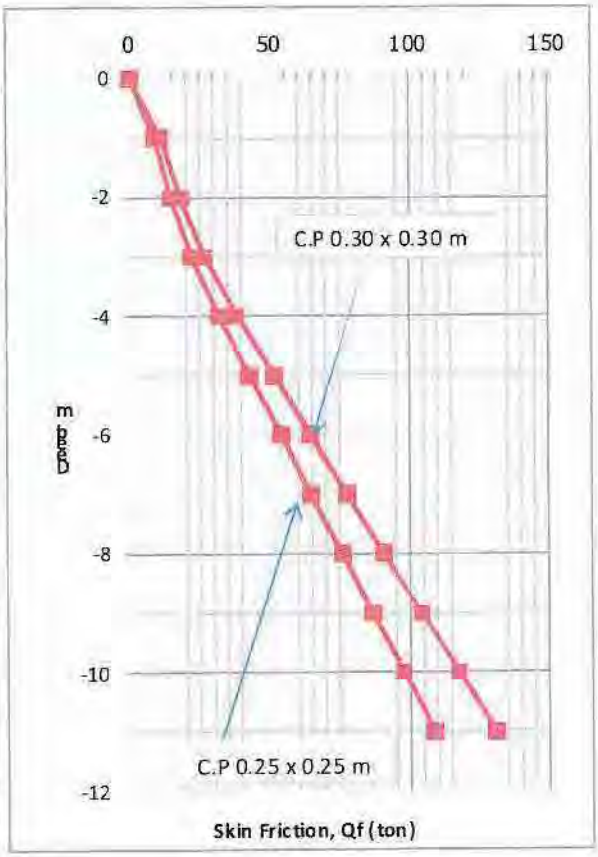
A. SHALLOW FOUNDATION " D ≤ B"

Depth "D", m	Type of footing		Footing dimension		qu*	qu(net)*	qa*	qa (net)*	Factor Safety
			B	L	tsm	tsm	tsm	tsm	
3	Spread footing		2	2	72.85	68.85	26.95	22.95	3
			2.5	2.5	70.30	66.30	26.10	22.10	3
			3	3	68.60	64.60	25.53	21.53	3

qu = Ultimate Bearing Capacity
qa = Allowable Bearing Capacity
qu (net) = Net Ultimate Bearing Capacity
qa (net) = Net Allowable Bearing Capacity
* Bearing Capacity Factor based on SKEMPTON (1951), Fig. 1 & Undrained Shear Strength based on SPT N- value in Fig 2

B. DEEP FOUNDATION (DRIVING PILE)
B-1 SKIN FRICTION "Qf" (FOR DRIVING PILE), t

Depth (m)	Pile section				
	0.25 Lp =	0.25 1.00		0.3 Lp =	0.3 1.20
	ϑ x su				
1	9.36	9.36	9.36		11.23
2	5.70	15.06	15.06		18.08
3	7.31	22.37	22.37		26.85
4	9.49	31.86	31.86		38.24
5	11.00	42.86	42.86		51.44
6	11.00	53.86	53.86		64.64
7	11.00	64.86	64.86		77.84
8	11.00	75.86	75.86		91.04
9	11.00	86.86	86.86		104.24
10	11.00	97.86	97.86		117.44
11	11.00	108.86	108.86		130.64



B-2 END BEARING "qe" (FOR DRIVING PILE), t

Depth (m)	Pile section			
	0.25 Lp =	0.25 1.00	0.3 Lp =	0.3 1.20
12	49.00		70.56	

B-3 ULTIMATE BEARING CAPACITY " Qu", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	123.32		151.46	

Note: These value are not including weight of concrete pile
Factor safety = 3

B-4 Allowable BEARING CAPACITY " Qa", t

Depth (m)	Pile section			
	0.25 As =	0.25 0.06	0.3 As =	0.3 0.09
12	49.33		60.58	

Note: These value are not including weight of concrete pile
Factor safety = 2.5

X. CONCLUSION:

On the top ground extend down to about 1.5 meter were covered by natural dispersive soil. Below 1.5 meter deep extend down ward to 5 m depth is residual soil and below 5 m depth is sedimentary rock.

According to the roughly bearing capacity calculation, the shallow foundation at each borehole could be available at the depth 3 m with net allowable bearing capacity $q_{a(Net)}$ = 15.20, 20.27, 12.16, 17.73, and 21.53 t/m2 respectively, which the footing size 3 x 3 m and factor safety is 3. For deep foundation the allowable bearing capacity Qa = 35.12 (friction pile), 38.16 (End bearing pile), 45.0 (End bearing pile), 47.15 (friction pile) and 49.33 t/m2 (End bearing pile) with 25 x 25 cm pile size and factor safety 3.

This report we was roughly calculated the bearing capacity of shallow and depth foundation. Therein, the undrained shear strength with corrected field procedure and the real ground water level where use in calculated.

However, type of foundation including the pile length and dimension of pile and etc.,.. is could be select by the structure engineer with recheck the bearing capacity of each foundation type.

If the structure engineer select to use the driving pile. He shall be consider the varies of ground water level and the pile head shall be use cast Iron type.

Vientiane Capital, October 3, 2013

DIRECTOR

DEPARTMENT OF TECHNICAL

BORE LOGS

(BH No.1 - 5)

Ministry of Public Works and Transports
State Enterprise for Survey Design and Material Testing
Tel. 856-21-41 3951, 41 4558; Fax. 856-21- 41 5259
Email: sdmt@laotel.com, WWW. sdmt.Laopdr.com

LOG OF BORING No. 1

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

OWNER : KOKUSAI KOGYO CO.,LTD

BORING STARTED : 23 / 09 / 2013

BORING FINISHED : 23 / 09 / 2013

PARTY CHIEF : Souvannarath

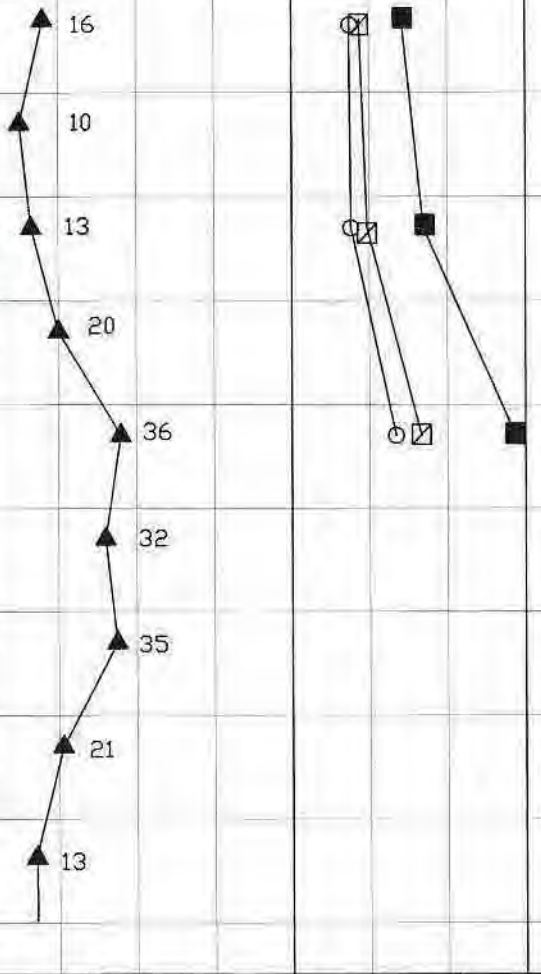
ELEV. = 180.137

W.L = 6.35 M (ENCOUNTERED)

W.L = 2.58 M (24 hrs AFTER BORING)

SHEET : 1 OF 2

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL
1	PA			Top soil 1.00	
	SS	1	45	Clayey LATERITE with Sand, fine, light red, clay of low plasticity, cmf sand. 1.80	
2	PA				
	SS	2	45	Clayey GEAVEL + LATERITE with Sand, cmf, light red, clay of low plasticity, cmf sand.	
3	PA				
	SS	3	45		
4	PA				
	SS	4	45	4.57	
5	PA			Elastic SILT with Sand, high plasticity, red, cmf sand.	
	SS	5	45		
6	PA				
	SS	6	45		
7	PA				
	SS	7	45		
8	PA				
	SS	8	45		
9	PA				
	SS	9	45		
10	PA			10.00	



VS VERY SOFT.
S SOFT.
M MEDIUM
ST STIFF.
VST VERY STIFF.
H HARD.

VL VERY LOOSE.
L LOOSE.
MD MEDIUM DENSE.
D DENSE.
VD VERY DENSE.

cmf – coarse medium to fine
cm – coarse to medium
mf – medium to fine
c – coarse
m – medium
f – fine

TS–THIN WALLED TUBE SAMPLER.
SS–SPLIT SPOON SAMPLER.
PA–POWER AUGERING
SU–UNDRAINED DIRECT SHEAR

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Email: sdmt@laotel.com, WWW. sdmt.Laopdr.com

LOG OF BORING No. 1

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 23 / 09 / 2013

BORING FINISHED : 23 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 180.137 SHEET : 2 OF 2

W.L = 6.35 M (ENCOUNTERED)

W.L = 2.58 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL	▲ SPT–N value (blows/ft) 20 40 60	○ Wn ■ LL ☑ PL (%) 20 40	○ Su (ton/m2) 2.5 5 7.5	UNIT ☒ WEIGHT (ton/m3) 1 2 3
11	SS		30	Elastic SILT with Sand, high plasticity, red, cmf sand.		13			
	PA								
	SS	1	0			10			
	PA								
12	SS	2	20			15			
13				**End of Boring and Drilling**					
14									
15									
16									
17									
18									
19									
20				10.00					

VS VERY SOFT.
S SOFT.
M MEDIUM
ST STIFF.
VST VERY STIFF.
H HARD.

VL VERY LOOSE.
L LOOSE.
MD MEDIUM DENSE.
D DENSE.
VD VERY DENSE.

cmf – coarse medium to fine
cm – coarse to medium
mf – medium to fine
c – coarse
m – medium
f – fine

TS–THIN WALLED TUBE SAMPLER.
SS–SPLIT SPOON SAMPLER.
PA–POWER AUGERING
SU–UNDRAINED DIRECT SHEAR

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Email: sdmt@laotel.com, WWW. sdmt.Laopdr.com

LOG OF BORING No. 2

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 24 / 09 / 2013

BORING FINISHED : 24 / 09 / 2013

PARTY CHIEF : Souvannarath

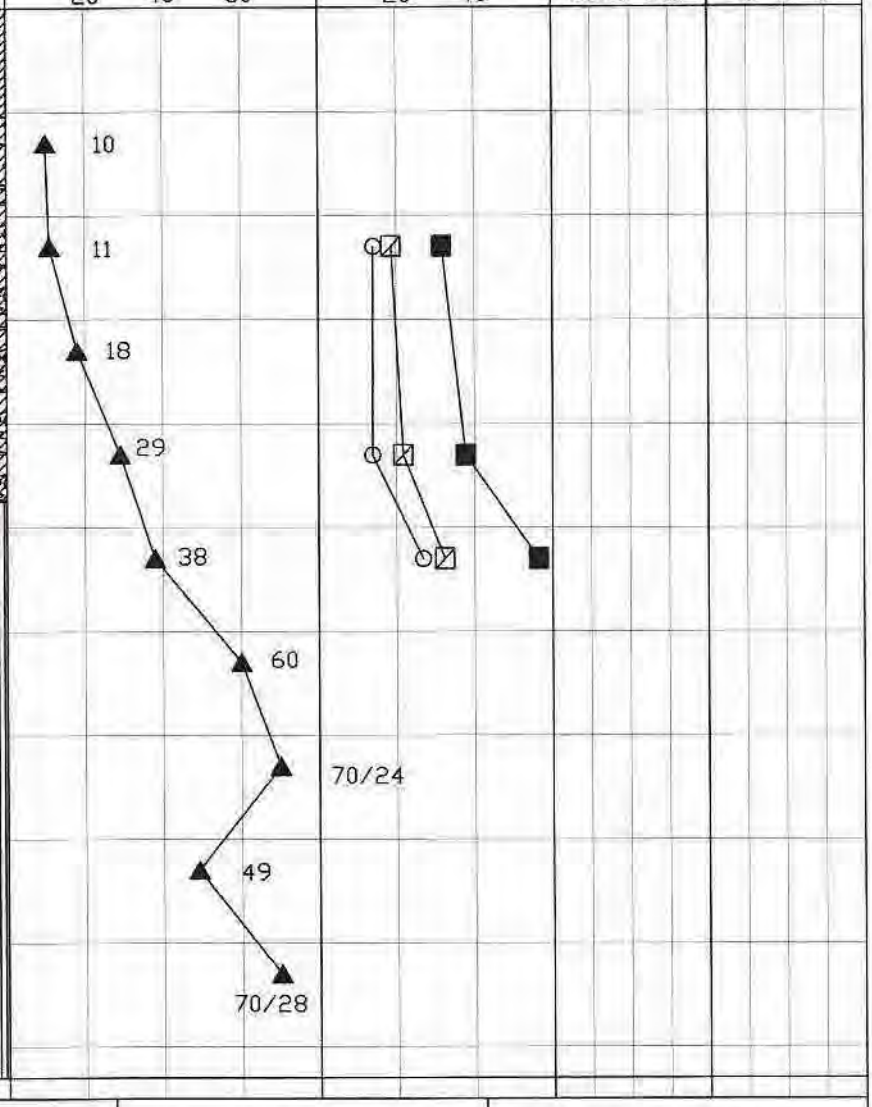
OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 179.551 SHEET : 1 OF 2

W.L = 6.00 M (ENCOUNTERED)

W.L = 2.29 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL
1	PA			Top Soil	
				1.04	
	SS	1	45	Clayey LATERITE with Sand, cmf, light red clay of low plasticity, cmf sand.	
	PA			1.70	
2	SS	2	45		
	PA			Clayey GRAVEL + LATERITE with Sand, cmf, light red caly of low plasticity, cmf Sand.	
3	SS	3	45		
	PA				
4	SS	4	45		
	PA			4.75	
5	SS	5	45	Elastic SILT with Sand, high plasticity, red, medium sand.	
	PA				
6	SS	6	45		
	PA				
7	SS	7	35		
	PA				
8	SS	8	45		
	PA				
9	SS	9	45		
	PA				
10				10.30	
				End of Boring and Drilling	



VS	VERY SOFT.	VL	VERY LOOSE.	cmf – coarse medium to fine	TS–THIN WALLED TUBE SAMPLER.
S	SOFT.	L	LOOSE.	cm – coarse to medium	SS–SPLIT SPOON SAMPLER.
M	MEDIUM	MD	MEDIUM DENSE.	mf – medium to fine	PA–POWER AUGERING
ST	STIFF.	D	DENSE.	c – coarse	SU–UNDRAINED DIRECT SHEAR
VST	VERY STIFF.	VD	VERY DENSE.	m – medium	
H	HARD.			f – fine	

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LOG OF BORING No. 3

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 25 / 09 / 2013

BORING FINISHED : 25 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

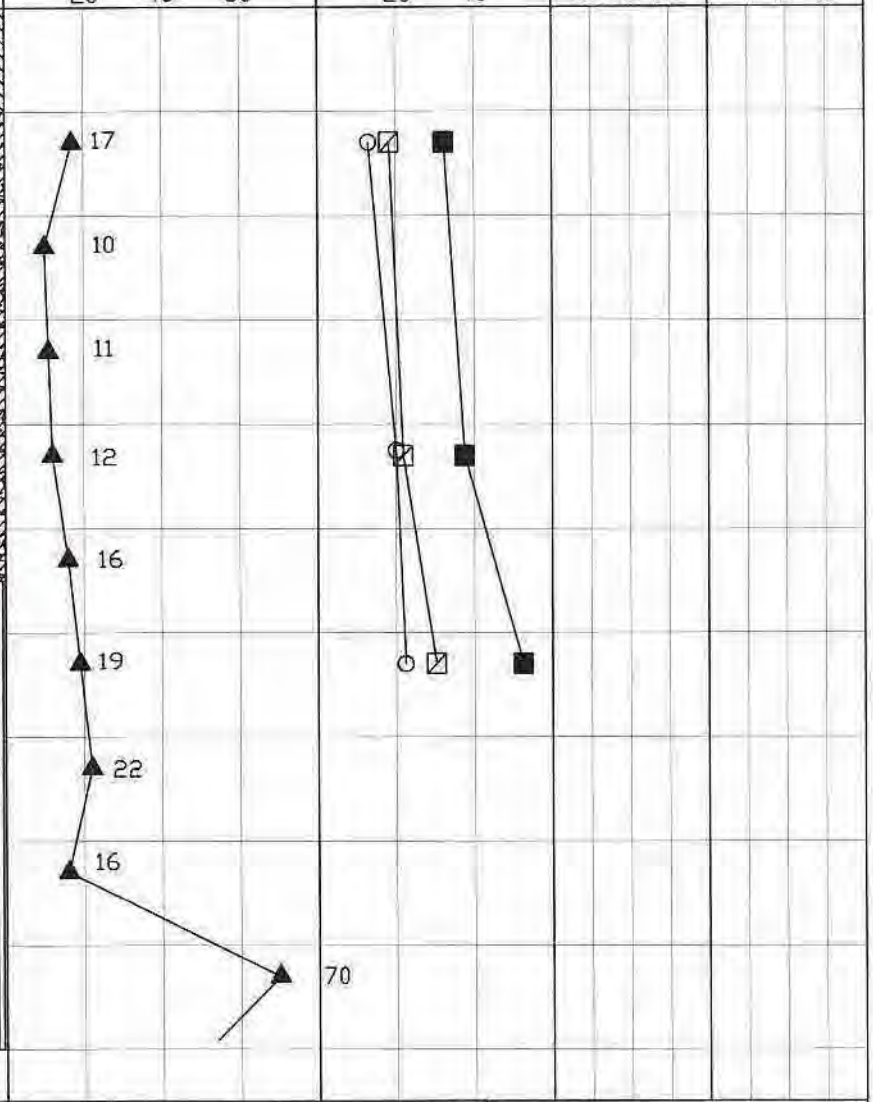
ELEV. = 180.526

W.L = 6.85 M (ENCOUNTERED)

W.L = 2.29 M (24 hrs AFTER BORING)

SHEET : 1 OF 2

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL
1	PA			Top Soil 1.00	
2	SS	1	28	Clayey LATERITE with Sand, cmf, light red, clay of low plasticity, fine sand. 1.80	
	PA				
3	SS	2	45	Clayey GRAVEL+LATERITE with Sand, cmf, light red, clay of medium plasticity, fine sand.	
	PA				
4	SS	3	45		
	PA				
5	SS	4	45		
	PA				
	SS	5	25	5.50	
6	PA				
	SS	6	45	Elastic SILT with Sand, high plasticity, red fine sand.	
7	PA				
	SS	7	45		
8	PA				
	SS	8	0		
9	PA				
	SS	9	28		
10	PA			10.00	



VS	VERY SOFT.	VL	VERY LOOSE.	cmf – coarse medium to fine	TS–THIN WALLED TUBE SAMPLER.
S	SOFT.	L	LOOSE.	cm – coarse to medium	SS–SPLIT SPOON SAMPLER.
M	MEDIUM	MD	MEDIUM DENSE.	mf – medium to fine	PA–POWER AUGERING
ST	STIFF.	D	DENSE.	c – coarse	SU–UNDRAINED DIRECT SHEAR
VST	VERY STIFF.	VD	VERY DENSE.	m – medium	
H	HARD.			f – fine	

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Email: sdmt@laotel.com, WWW. sdmt.Laopdr.com

LOG OF BORING No. 3

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 25 / 09 / 2013

BORING FINISHED : 25 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 180.526 SHEET : 2 OF 2

W.L = 6.85 M (ENCOUNTERED)

W.L = 2.29 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL	▲ SPT–N value (blows/ft) 20 40 60	O Wn ■ LL ☒ PL (%) 20 40	O Su (ton/m2) 2.5 5 7.5	UNIT ☒ WEIGHT (ton/m3) 1 2 3
11	SS		40	Elastic SILT with Sand, high plasticity, red fine sand.		42			
	PA								
	SS	1	20			21			
12	PA								
	SS	2	45	12.30		37			
13	PA			As above, dark red.					
	SS	3	43						
	PA					70			
14	SS	4	40	14.30		62			
15				**End of Boring and Drilling**					
16									
17									
18									
19									
20				10.00					

VS VERY SOFT.	VL VERY LOOSE.	cmf – coarse medium to fine	TS–THIN WALLED TUBE SAMPLER.
S SOFT.	L LOOSE.	cm – coarse to medium	SS–SPLIT SPOON SAMPLER.
M MEDIUM	MD MEDIUM DENSE.	mf – medium to fine	PA–POWER AUGERING
ST STIFF.	D DENSE.	c – coarse	SU–UNDRAINED DIRECT SHEAR
VST VERY STIFF.	VD VERY DENSE.	m – medium	
H HARD.		f – fine	

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Tel. 856-21-41 3951, 41 4558; Fax. 856-21- 41 5259
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LOG OF BORING No. 4

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 26 / 09 / 2013

BORING FINISHED : 26 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 179.650 SHEET : 1 OF 2

W.L = 7.85 M (ENCOUNTERED)

W.L = 2.60 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL
1	PA			Top Soil 1.00	
	SS	1	30	Clayey LATERITE with Sand, cmf, light red, clay of low plasticity, cmf sand. 1.89	
2	PA				
	SS	2	45	Clayey GRAVEL+LATERITE with Sand, cmf, light red, clay of low plasticity, cmf sand 2.30	
3	PA			As above, clay of medium plasticity	
	SS	3	45		
4	PA				
	SS	4	45		
5	PA			4.70	
	SS	5	45	Elastic SILT with Sand, high plasticity, red, medium sand.	
6	PA				
	SS	6	45		
7	PA				
	SS	7	45		
8	PA				
	SS	8	0		
9	PA				
	SS	9	45		
10	PA			10.00	

▲ SPT–N value (blows/ft) 20 40 60

○ Wn ■ LL ⊿ PL (%) 20 40

○ Su (ton/m2) 2.5 5 7.5

UNIT ⊠ WEIGHT (ton/m3) 1 2 3

VS	VERY SOFT.	VL	VERY LOOSE.	cmf – coarse medium to fine	TS–THIN WALLED TUBE SAMPLER.
S	SOFT.	L	LOOSE.	cm – coarse to medium	SS–SPLIT SPOON SAMPLER.
M	MEDIUM	MD	MEDIUM DENSE.	mf – medium to fine	PA–POWER AUGERING
ST	STIFF.	D	DENSE.	c – coarse	SU–UNDRAINED DIRECT SHEAR
VST	VERY STIFF.	VD	VERY DENSE.	m – medium	
H	HARD.			f – fine	

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LOG OF BORING No. 4

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 26 / 09 / 2013

BORING FINISHED : 26 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 179.650 SHEET : 2 OF 2

W.L = 7.85 M (ENCOUNTERED)

W.L = 2.60 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL	▲ SPT–N value (blows/ft) 20 40 60	○ Wn ■ LL ☒ PL (%) 20 40	○ Su (ton/m2) 2.5 5 7.5	UNIT ☒ WEIGHT (ton/m3) 1 2 3
11	SS		45	Elastic SILT with Sand, high plasticity, red, medium sand.		34			
	PA								
	SS	1	28			31			
12	PA								
	SS	2	0	12.30		51			
13				**End of Boring and Drilling**					
14									
15									
16									
17									
18									
19									
20				10.00					

VS	VERY SOFT.	VL	VERY LOOSE.	cmf – coarse medium to fine	TS–THIN WALLED TUBE SAMPLER.
S	SOFT.	L	LOOSE.	cm – coarse to medium	SS–SPLIT SPOON SAMPLER.
M	MEDIUM	MD	MEDIUM DENSE.	mf – medium to fine	PA–POWER AUGERING
ST	STIFF.	D	DENSE.	c – coarse	SU–UNDRAINED DIRECT SHEAR
VST	VERY STIFF.	VD	VERY DENSE.	m – medium	
H	HARD.			f – fine	

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LOG OF BORING No. 5

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

OWNER : KOKUSAI KOGYO CO.,LTD

BORING STARTED : 27 / 09 / 2013

BORING FINISHED : 27 / 09 / 2013

PARTY CHIEF : Souvannarath

ELEV. = 179.977 SHEET : 1 OF 2

W.L = 7.30 M (ENCOUNTERED)

W.L = 2.60 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL	▲ SPT–N value (blows/ft) 20 40 60	○ Wn ■ LL ☒ PL (%) 20 40	○ Su (ton/m2) 2.5 5 7.5	UNIT ☒ WEIGHT (ton/m3) 1 2 3
1	PA			Top Soil 0.97					
	SS	1	28	Clayey LATERITE with Sand, fone light red, clay of low plasticity, cmf sand. 1.97		25			
2	PA								
	SS	2	45	Clayey GRAVEL+LATERITE with Sand, cmf,clay of medium plasticity, cmf sand.		11			
3	PA								
	SS	3	45			21			
4	PA								
	SS	4	45	4.55		28			
5	PA								
	SS	5	25	Elastic SILT with Sand, high plasticity, red medium sand.		62			
6	PA								
	SS	6	45			70			
7	PA								
	SS	7	45			54			
8	PA								
	SS	8	0			50			
9	PA								
	SS	9	28			40			
10	PA			10.00					

VS VERY SOFT. S SOFT. M MEDIUM ST STIFF. VST VERY STIFF. H HARD.

VL VERY LOOSE. L LOOSE. MD MEDIUM DENSE. D DENSE. VD VERY DENSE.

cmf – coarse medium to fine
cm – coarse to medium
mf – medium to fine
c – coarse
m – medium
f – fine

TS–THIN WALLED TUBE SAMPLER.
SS–SPLIT SPOON SAMPLER.
PA–POWER AUGERING
SU–UNDRAINED DIRECT SHEAR

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State Enterprise for Survey Design and Material Testing
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LOG OF BORING No. 5

PROJECT : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P D R

LOCATION : Nahai Village, Xaisettha District, Vientiane Capital

BORING STARTED : 27 / 09 / 2013

BORING FINISHED : 27 / 09 / 2013

PARTY CHIEF : Souvannarath

OWNER : KOKUSAI KOGYO CO.,LTD

ELEV. = 179.977 SHEET : 2 OF 2

W.L = 7.30 M (ENCOUNTERED)

W.L = 2.60 M (24 hrs AFTER BORING)

DEPTH, M.	METHOD	SAMPLE NO.	RECOVERY (CM)	DESCRIPTION OF MATERIAL	SYMBOL	▲ SPT–N value (blows/ft) 20 40 60	O Wn ■ LL ☑ PL (%) 20 40	O Su (ton/m2) 2.5 5 7.5	UNIT ☒ WEIGHT (ton/m3) 1 2 3
	SS		40	Elastic SILT with Sand, high plasticity, red medium sand.		55			
	PA								
11	SS	1	20						
	PA					70			
12	SS	2	45	12.00					
	PA			**End of Boring and Drilling**					
13	SS	3	43						
	PA								
14	SS	4	40						
15									
16									
17									
18									
19									
20				10.00					

VS VERY SOFT.
S SOFT.
M MEDIUM
ST STIFF.
VST VERY STIFF.
H HARD.

VL VERY LOOSE.
L LOOSE.
MD MEDIUM DENSE.
D DENSE.
VD VERY DENSE.

cmf – coarse medium to fine
cm – coarse to medium
mf – medium to fine
c – coarse
m – medium
f – fine

TS–THIN WALLED TUBE SAMPLER.
SS–SPLIT SPOON SAMPLER.
PA–POWER AUGERING
SU–UNDRAINED DIRECT SHEAR

SUMMARIES OF TEST RESULT (BH 1 - 5)

- Moisture Content (MC)
- Atterberg Limit Test (LL, PL, PI)
- Specific Gravity Test (GS)
- Sieve Analysis Test

MINISTRY OF PUBLIC WORKS AND TRANSPORT
SDMT State Enterprise for Survey Design and Material Testing
Tel : 856 - 21 - 413951, 415258, Fax : 856 - 21 - 415259, PO Box : 8438, Vientiane Lao PDR
Email : sdmt@ laotel.com,w.w.w.sdmt. Laopdr.com

SUMMARIES OF TEST RESULT

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R. Location : Nahai Village, Xaisettha District, Vientiane Capital
Submitted by : KOKUSAI KOGYO CO.,LTD.

Boring No. : BH-1 Depth : 12.30 Ground ele. : 180.14 m Observed W.L : -2.58 m
Field Works : 23/09/2013 Lab. Tests :

Sample No.	Depth (m) From	Depth (m) To	USCS group	AASHTO	Description of Material	Gradation (% passing sieve) # 4	# 10	# 40	# 200	Natural Mositure Content, %	Atterberg Limits LL %	PL %	PI %	SPT-N (blows)
	0.00	0.85												
SS-1	0.85	1.30	GC	A-2-6 (0)	Clayey LATERITE with Sand	55.75	42.53	63.22	25.86	14.80	28.30	17.36	10.94	16
SS-2	1.85	2.30												10
SS-3	2.85	3.30	GC	A-2-6 (1)	Clayey GRAVEL+LATERITE with Sand	52.49	47.29	42.31	30.77	15.28	33.80	19.38	14.42	13
SS-4	3.85	4.30												20
SS-5	4.85	5.30	MH	A-7-5 (23)	Elastic SILT with Sand	100.00	98.30	88.56	82.97	26.78	57.50	33.29	24.21	36
SS-6	5.85	6.30												32
SS-7	6.85	7.30												35
SS-8	7.85	8.30												21
SS-9	8.85	9.30												13
SS-10	9.85	10.30												13
SS-11	10.85	11.30												10
SS-12	11.85	12.30												15

Checked by : Mr Viengvisa SIVISAY

Vientiane Capital, ... 03 OCT 2013 .....

DIRECTOR/SDMT

SIVISAY Ngeun

MINISTRY OF PUBLIC WORKS AND TRANSPORT
SDMT State Enterprise for Survey Design and Material Testing
Tel : 856 - 21 - 413951, 415258, Fax : 856 - 21 - 415259, PO Box : 8438, Vientiane Lao PDR
Email : sdmt@ laotel.com,w.w.w.sdmt. Laopdr.com

SUMMARIES OF TEST RESULT

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R. Location : Nahai Village, Xaisettha District, Vientiane Capital

Submitted by : KOKUSAI KOGYO CO.,LTD.
Boring No. BH-2 Depth : 10.30 Ground ele. : 179.51 m Observed W.L : -2.29 m
Field Works : 24/09/2013 Lab. Tests :

Sample No.	Depth (m)		USCS group	AASHTO	Description of Material	Gradation (% passing sieve)				Natural Mositure Content, %	Atterberg Limits			SPT-N (blows)
	From	To				# 4	# 10	# 40	# 200		LL %	PL %	PI %	
	0.00	0.85												
SS-1	0.85	1.30												10
SS-2	1.85	2.30	GC	A-2-6 (0)	Clayey GRAVEL+LATERITE with Sand	52.85	47.78	42.72	29.43	14.12	31.70	18.72	12.98	11
SS-3	2.85	3.30												18
SS-4	3.85	4.30	GC	A-2-6(0)	Clayey GRAVEL + LATERITE with Sand	53.47	45.37	36.81	22.69	13.88	37.80	21.73	16.07	29
SS-5	4.85	5.30	MH	A-7-5 (24)	Elastic SILT with Sand	100.00	98.55	88.36	84.36	26.80	56.40	32.42	23.98	38
SS-6	5.85	6.30												60
SS-7	6.85	7.30												70/24
SS-8	8.85	9.30												49
SS-9	9.85	10.30												70/28

Checked by : Mr Viengvisa SIVISAY

Vientiane Capital, ... 03 OCT 2013 .....
DIRECTOR'S SDMT

SIVISAY Ngeun

MINISTRY OF PUBLIC WORKS AND TRANSPORT
SDMT State Enterprise for Survey Design and Material Testing
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Email : sdmt@ laotel.com,w.w.w.sdmt. Laopdr.com

SUMMARIES OF TEST RESULT

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R. Location : Nahai Village, Xaisettha District, Vientiane Capital

Submitted by : KOKUSAI KOGYO CO.,LTD.

Boring No. BH-3 Depth : 14.30 Ground ele. : 180.526 m Observed W.L : -2.29 m

Field Works : 25/09/2013 Lab. Tests :

Sample No.	Depth (m)		USCS group	AASHTO	Description of Material	Gradation (% passing sieve)				Natural Mositure Content, %	Atterberg Limits			SPT-N (blows)
	From	To				# 4	# 10	# 40	# 200		LL %	PL %	PI %	
	0.00	0.85												
SS-1	0.85	1.30	GC	A-2-6 (1)	Clayey LATERITE with Sand	50.20	43.37	40.56	29.32	13.04	32.30	18.30	14.00	17
SS-2	1.85	2.30												10
SS-3	2.85	3.30												11
SS-4	3.85	4.30	GC	A-6 (2)	Clayey GRAVEL+LATERITE with Sand	60.99	57.09	54.26	37.23	20.13	37.60	21.87	15.73	12
SS-5	4.85	5.30												16
SS-6	5.85	6.30	MH	A-7-5 (19)	Elastic SILT with Sand	100.00	99.40	91.34	78.51	22.39	52.50	30.31	22.19	19
SS-7	6.85	7.30												22
SS-8	7.85	8.30												16
SS-9	8.85	9.30												70
SS-10	9.85	10.30												42
SS-11	10.85	11.30												21
SS-12	11.85	12.30												37
SS-13	12.85	13.30												70
SS-14	13.85	14.30												62

Checked by : Mr Viengvisa SIVISAY

Vientiane Capital, 03 OCT 2013

DIRECTOR S.SDMT

SIVISAY Ntem

MINISTRY OF PUBLIC WORKS AND TRANSPORT
SDMT State Enterprise for Survey Design and Material Testing
Tel : 856 - 21 - 413951, 415258, Fax : 856 - 21 - 415259, PO Box : 8438, Vientiane Lao PDR
Email : sdmt@ laotel.com,w.w.w.sdmt. Laopdr.com

SUMMARIES OF TEST RESULT

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R. Location : Nahai Village, Xaisettha District, Vientiane Capital

Submitted by : KOKUSAI KOGYO CO.,LTD.

Boring No. BH-4 Depth : 12.30 Ground ele. : 179.65 m Observed W.L : -2.60 m

Field Works : 26/09/2013 Lab. Tests :

Sample No.	Depth (m)		USCS group	AASHTO	Description of Material	Gradation (% passing sieve)				Natural Mositure Content, %	Atterberg Limits			SPT-N (blows)
	From	To				# 4	# 10	# 40	# 200		LL %	PL %	PI %	
	0.00	0.85												16
	0.85	1.30												
	1.85	2.30	GC	A-2-6 (0)	Clayey GRAVEL+LATERITE with Sand	55.96	49.86	44.88	32.69	14.94	29.35	17.56	11.79	9
	2.85	3.30												15
	3.85	4.30	GC	A-2-6 (1)	Clayey GRAVEL+LATERITE with Sand	54.95	49.50	45.30	34.41	25.20	39.80	22.36	17.44	24
	4.85	5.30												42
	5.85	6.30	MH	A-7-5 (23)	Elastic SILT	100.00	98.63	94.76	87.02	25.99	53.70	30.96	22.74	41
	6.85	7.30												33
	7.85	8.30												39
	8.85	9.30												20
	9.85	10.30												34
	10.85	11.30												31
	11.85	12.30												51

Checked by : Mr Viengvisa SIVISAY

Vientiane Capital, ... 03 OCT 2013 .....

DIRECTOR'S SDMT

SIVISAY Ngeun

MINISTRY OF PUBLIC WORKS AND TRANSPORT
SDMT State Enterprise for Survey Design and Material Testing
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Email : sdmt@ laotel.com,w.w.w.sdmt. Laopdr.com

SUMMARIES OF TEST RESULT

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R. Location : Nahai Village, Xaisettha District, Vientiane Capital

Submitted by : KOKUSAI KOGYO CO.,LTD.

Boring No. BH-5 Depth : 12.30 Ground ele. : 179.977 m Observed W.L : -2.60 m

Field Works : 27/09/2013 Lab. Tests : xxxxx

Sample No.	Depth (m)		USCS group	AASHTO	Description of Material	Gradation (% passing sieve)				Natural Mositure Content, %	Atterberg Limits			SPT-N (blows)
	From	To				# 4	# 10	# 40	# 200		LL %	PL %	PI %	
	0.00	0.85												
SS-1	0.85	1.30	GC	A-2-6(0)	Clayey LATERITE with Sand	46.48	33.20	28.13	19.92	14.11	28.50	17.50	11.00	25
SS-2	1.85	2.30												11
SS-3	2.85	3.30	GC	A-2-6 (1)	Clayey GRAVEL+LATERITE with Sand	49.00	42.50	38.25	29.00	17.90	38.30	21.77	16.53	21
SS-4	3.85	4.30												28
SS-5	4.85	5.30	MH	A-7-5 (23)	Elastic SILT with Sand	100.00	99.06	89.70	84.78	28.22	53.80	30.67	23.13	62
SS-6	5.85	6.30												70
SS-7	6.85	7.30												54
SS-8	7.85	8.30												50
SS-9	8.85	9.30												40
SS-10	9.85	10.30												55
SS-11	10.85	11.30												70
SS-12	11.85	12.30												70

Checked by : Mr Viengvisa SIVISAY

Vientiane Capital, ... 03 OCT 2013 .....

DIRECTOR'S SDMT

SIVISAY Ngeun

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

SDMT State Enterprise for Survey Design and Material Testing

Tel. 856-21- 41 3951, 41 5258; Fax. 856-21-41 5259; P O Box : 8438 Vientiane Lao PDR

Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

SIEVE ANALYSIS

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Sample No. : xxxxx

Submitted by : KOKUSAI KOGYO CO.,LTD.

Date of Test : 26 / 09 / 2013

Test by : Phindavanh

	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
	Bore Hole No 1 Depth : 0.85~1.30	Bore Hole No 1 Depth : 2.85~3.30	Bore Hole N 1 Depth : 4.85~5.30
	Container No.	Container No.	Container No.
	Weight of Container+Dry Soil 506 g	Weight of Container+Dry Soil 617 g	Weight of Container+Dry Soil 626 g
	Weight of Container 158 g	Weight of Container 175 g	Weight of Container 215 g
	Weight of Dry Soil 348 g	Weight of Dry Soil 442 g	Weight of Dry Soil 411 g
	Description of material : Clayey LATERITE with Sand	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material Elastic SILT with Sand

Sieve size	Sieve Opening mm	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %
3 "	75.000	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00
2 1/2"	63.000	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00
2 "	50.000	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00
1 1/2"	37.500	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00
1 "	25.000	545.00	545.00	0.000	0.00	0.00	100.00	545.00	571.00	26.000	5.88	5.88	94.12	545.00	545.00	0.000	0.00	0.00	100.00
3/4"	19.000	566.00	575.00	9.000	2.59	2.59	97.41	566.00	613.00	47.000	10.63	16.52	83.48	548.00	548.00	0.000	0.00	0.00	100.00
1/2"	12.500	521.00	548.00	27.000	7.76	10.34	89.66	521.00	571.00	50.000	11.31	27.83	72.17	521.00	521.00	0.000	0.00	0.00	100.00
3/8"	9.500	520.00	561.00	41.000	11.78	22.13	77.87	520.00	550.00	30.000	6.79	34.62	65.38	520.00	520.00	0.000	0.00	0.00	100.00
No.4	4.750	499.00	576.00	77.000	22.13	44.25	55.75	499.00	556.00	57.000	12.90	47.51	52.49	500.00	500.00	0.000	0.00	0.00	100.00
No.10	2.000	447.00	493.00	46.000	13.22	57.47	42.53	447.00	470.00	23.000	5.20	52.71	47.29	447.00	454.00	7.000	1.70	1.70	98.30
No. 20	0.840	420.00	433.00	13.000	3.74	61.21	38.79	420.00	432.00	12.000	2.71	55.43	44.57	420.00	440.00	20.000	4.87	6.57	93.43
No.40	0.425	367.00	374.00	7.000	2.01	63.22	36.78	367.00	377.00	10.000	2.26	57.69	42.31	367.00	387.00	20.000	4.87	11.44	88.56
No. 60	0.250	326.00	335.00	9.000	2.59	65.80	34.20	326.00	340.00	14.000	3.17	60.86	39.14	326.00	337.00	11.000	2.68	14.11	85.89
No. 100	0.149	303.00	315.00	12.000	3.45	69.25	30.75	303.00	323.00	20.000	4.52	65.38	34.62	303.00	310.00	7.000	1.70	15.82	84.18
No. 200	0.075	320.00	337.00	17.000	4.89	74.14	25.86	320.00	337.00	17.000	3.85	69.23	30.77	320.00	325.00	5.000	1.22	17.03	82.97
PAN		365.00	365.00	0.000				365.00	365.00	0.000				365.00	365.00	0.000			
			Total:	258.000					Total:	306.000					Total:	70.000			

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
SDMT State Enterprise For Survey Design and Material Testing
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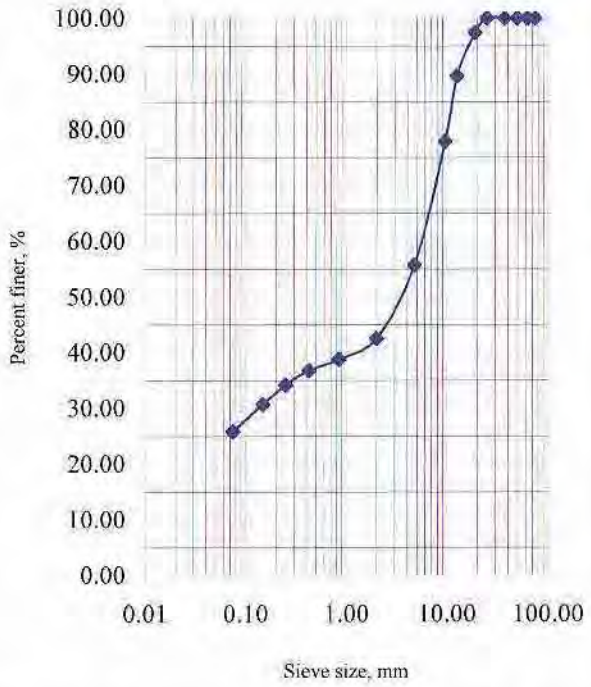
Email: sdmt@laotel.com; W.W.W. sdmt.laopdr

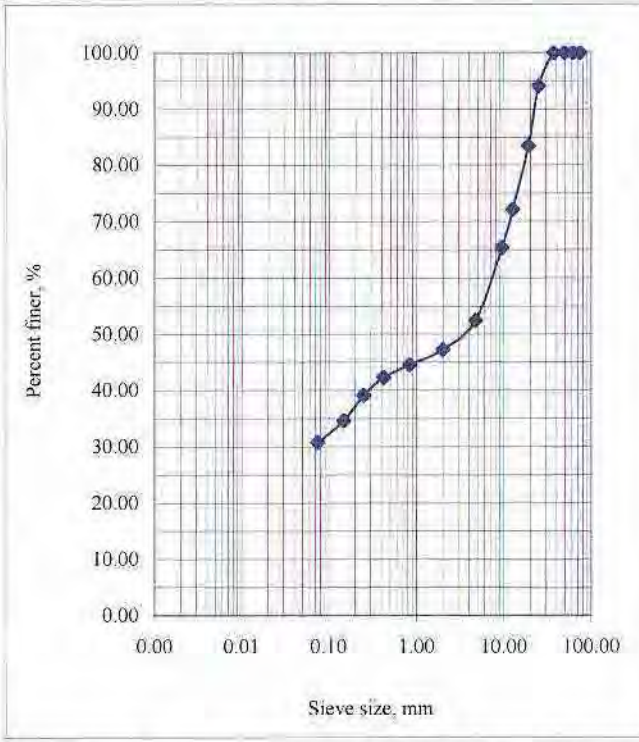
GRAIN SIZE ANALYSIS CURVES

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Sample No. : xxxxx
Submitted by : KOKUSAI KOGYO CO.,LTD.
Date of Test : 26 / 09 / 2013
Test by : Phindavanh

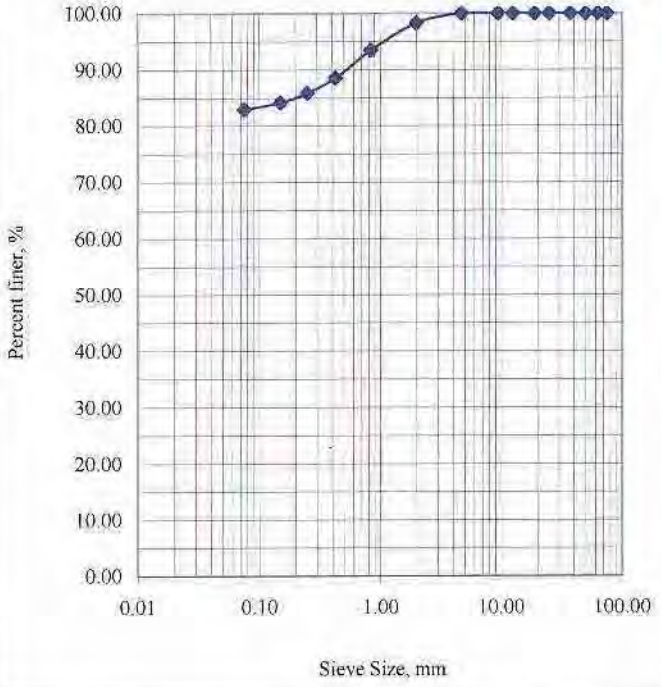
Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
Bore hole : 1 Depth, m 0.85~1.30	Bore hole : 1 Depth, m 2.85~3.30	Bore hole : 1 Depth, m 4.85~5.30



Description of Material : Clayey LATERITE with Sand



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Elastic SILT with Sand

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

SDMT State Enterprise for Survey Design and Material Testing

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Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

SIEVE ANALYSIS

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Sample No. : xxxxx

Submitted by : KOKUSAI KOGYO CO.,LTD.

Date of Test : 27/09/2013

Test by : Phindavanh

	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
	Bore Hole No 2 Depth : 1.85~2.30	Bore Hole No 2 Depth : 3.85~4.30	Bore Hole No 2 Depth : 4.85~5.30
	Container No.	Container No.	Container No.
	Weight of Container+Dry Soil 1029 g	Weight of Container+Dry Soil 603 g	Weight of Container+Dry Soil 446 g
	Weight of Container 713 g	Weight of Container 171 g	Weight of Container 171 g
	Weight of Dry Soil 316 g	Weight of Dry Soil 432 g	Weight of Dry Soil 275 g
	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material : Clayey GRAVEL + LATERITE with Sand	Description of material : Elastic SILT with Sand

Sieve size	Sieve Opening mm	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %
3 "	75.000	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00
2 1/2"	63.000	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00
2 "	50.000	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00
1 1/2"	37.500	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00
1 "	25.000	545.00	570.00	25.000	7.91	7.91	92.09	545.00	585.00	40.000	9.26	9.26	90.74	545.00	545.00	0.000	0.00	0.00	100.00
3/4"	19.000	566.00	605.00	39.000	12.34	20.25	79.75	566.00	596.00	30.000	6.94	16.20	83.80	548.00	548.00	0.000	0.00	0.00	100.00
1/2"	12.500	521.00	547.00	26.000	8.23	28.48	71.52	521.00	589.00	68.000	15.74	31.94	68.06	521.00	521.00	0.000	0.00	0.00	100.00
3/8"	9.500	520.00	541.00	21.000	6.65	35.13	64.87	520.00	539.00	19.000	4.40	36.34	63.66	520.00	520.00	0.000	0.00	0.00	100.00
No.4	4.750	499.00	537.00	38.000	12.03	47.15	52.85	499.00	543.00	44.000	10.19	46.53	53.47	500.00	500.00	0.000	0.00	0.00	100.00
No.10	2.000	447.00	463.00	16.000	5.06	52.22	47.78	447.00	482.00	35.000	8.10	54.63	45.37	447.00	451.00	4.000	1.45	1.45	98.55
No. 20	0.840	420.00	428.00	8.000	2.53	54.75	45.25	420.00	442.00	22.000	5.09	59.72	40.28	420.00	433.00	13.000	4.73	6.18	93.82
No.40	0.425	367.00	375.00	8.000	2.53	57.28	42.72	367.00	382.00	15.000	3.47	63.19	36.81	367.00	382.00	15.000	5.45	11.64	88.36
No. 60	0.250	326.00	337.00	11.000	3.48	60.76	39.24	326.00	353.00	27.000	6.25	69.44	30.56	326.00	331.00	5.000	1.82	13.45	86.55
No. 100	0.149	303.00	319.00	16.000	5.06	65.82	34.18	303.00	323.00	20.000	4.63	74.07	25.93	303.00	307.00	4.000	1.45	14.91	85.09
No. 200	0.075	320.00	335.00	15.000	4.75	70.57	29.43	320.00	334.00	14.000	3.24	77.31	22.69	320.00	322.00	2.000	0.73	15.64	84.36
PAN		365.00	365.00	0.000				365.00	365.00	0.000				365.00	365.00	0.000			
			Total:	223.000					Total:	334.000					Total:	43.000			

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
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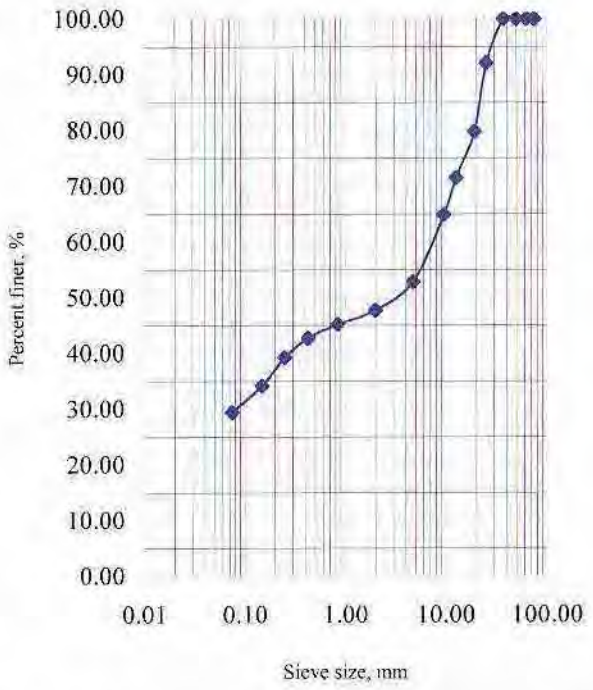
Email: sdmt@laotel.com; W.W.W. sdmt.laopdr

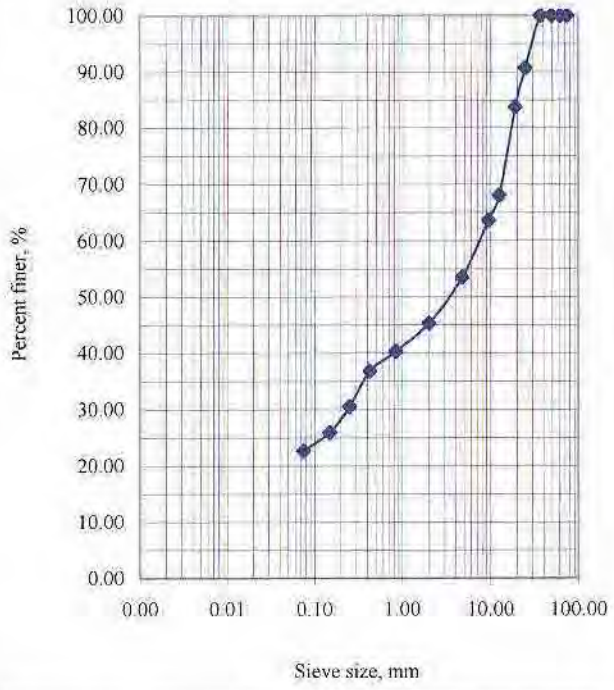
GRAIN SIZE ANALYSIS CURVES

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Sample No. : xxxxx
Submitted by : KOKUSAI KOGYO CO.,LTD.
Date of Test : 27 / 09 / 2013
Test by : Phindavanh

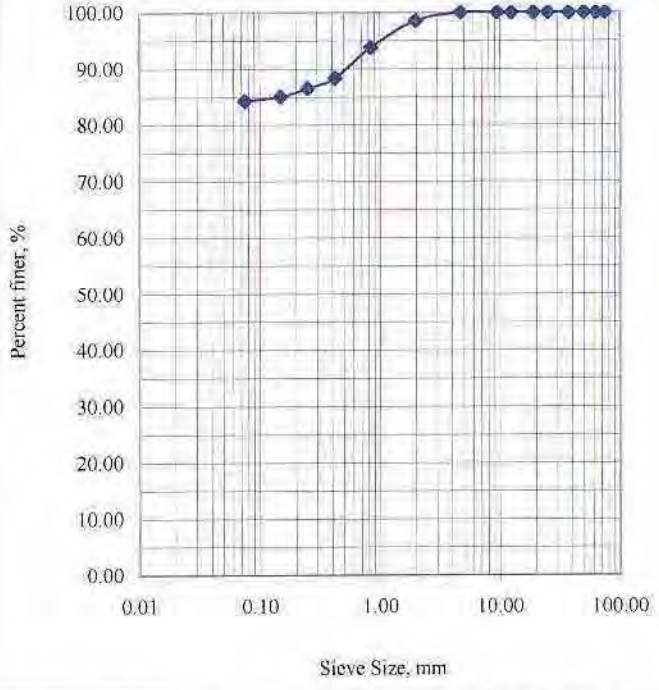
Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
Bore hole : 2 Depth, m 1.85~2.30	Bore hole : 2 Depth, m 3.85~4.30	Bore hole : 2 Depth, m 4.85~5.30



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Clayey GRAVEL + LATERITE with Sand



Description of Material : Elastic SILT with Sand

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

SDMT State Enterprise for Survey Design and Material Testing

Tel. 856-21- 41 3951, 41 5258; Fax. 856-21-41 5259; P O Box : 8438 Vientiane Lao PDR

Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

SIEVE ANALYSIS

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Sample No. : xxxxx

Submitted by : KOKUSAI KOGYO CO.,LTD.

Date of Test : 28/09/2013

Test by : Phindavanh

	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
	Bore Hole Nc 3 Depth 1.00~1.30	Bore Hole Nc 3 Depth : 3.85~4.30	Bore Hole N 3 Depth : 5.85~6.30
	Container No.	Container No.	Container No.
	Weight of Container+Dry Soil 408 g	Weight of Container+Dry Soil 623 g	Weight of Container+Dry Soil 489 g
	Weight of Container 159 g	Weight of Container 341 g	Weight of Container 154 g
	Weight of Dry Soil 249 g	Weight of Dry Soil 282 g	Weight of Dry Soil 335 g
	Description of material : Clayey LATERITE with Sand	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material : Elastic SILT with Sand

Sieve size	Sieve Opening mm	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %
3 "	75.000	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00
2 1/2"	63.000	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00
2 "	50.000	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00
1 1/2"	37.500	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00
1 "	25.000	545.00	545.00	0.000	0.00	0.00	100.00	545.00	545.00	0.000	0.00	0.00	100.00	545.00	545.00	0.000	0.00	0.00	100.00
3/4"	19.000	566.00	588.00	22.000	8.84	8.84	91.16	566.00	589.00	23.000	8.16	8.16	91.84	548.00	548.00	0.000	0.00	0.00	100.00
1/2"	12.500	521.00	549.00	28.000	11.24	20.08	79.92	521.00	568.00	47.000	16.67	24.82	75.18	521.00	521.00	0.000	0.00	0.00	100.00
3/8"	9.500	520.00	546.00	26.000	10.44	30.52	69.48	520.00	529.00	9.000	3.19	28.01	71.99	520.00	520.00	0.000	0.00	0.00	100.00
No.4	4.750	499.00	547.00	48.000	19.28	49.80	50.20	499.00	530.00	31.000	10.99	39.01	60.99	500.00	500.00	0.000	0.00	0.00	100.00
No.10	2.000	447.00	464.00	17.000	6.83	56.63	43.37	447.00	458.00	11.000	3.90	42.91	57.09	447.00	449.00	2.000	0.60	0.60	99.40
No. 20	0.840	420.00	424.00	4.000	1.61	58.23	41.77	420.00	424.00	4.000	1.42	44.33	55.67	420.00	438.00	18.000	5.37	5.97	94.03
No.40	0.425	367.00	370.00	3.000	1.20	59.44	40.56	367.00	371.00	4.000	1.42	45.74	54.26	367.00	376.00	9.000	2.69	8.66	91.34
No. 60	0.250	326.00	331.00	5.000	2.01	61.45	38.55	326.00	339.00	13.000	4.61	50.35	49.65	326.00	332.00	6.000	1.79	10.45	89.55
No. 100	0.149	303.00	312.00	9.000	3.61	65.06	34.94	303.00	323.00	20.000	7.09	57.45	42.55	303.00	311.00	8.000	2.39	12.84	87.16
No. 200	0.075	320.00	334.00	14.000	5.62	70.68	29.32	320.00	335.00	15.000	5.32	62.77	37.23	320.00	349.00	29.000	8.66	21.49	78.51
PAN		365.00	365.00	0.000				365.00	365.00	0.000				365.00	365.00	0.000			
			Total:	176.000					Total:	177.000					Total:	72.000			

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
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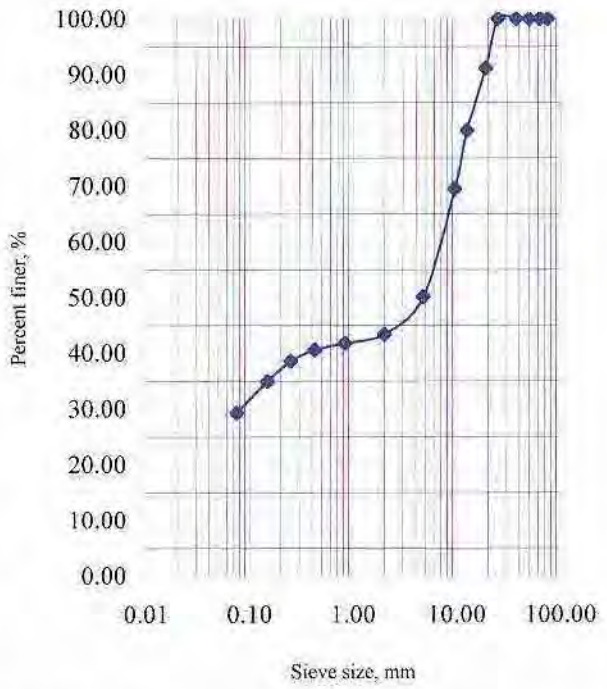
Email: sdmt@laotel.com; W.W.W. sdmt.laopdr

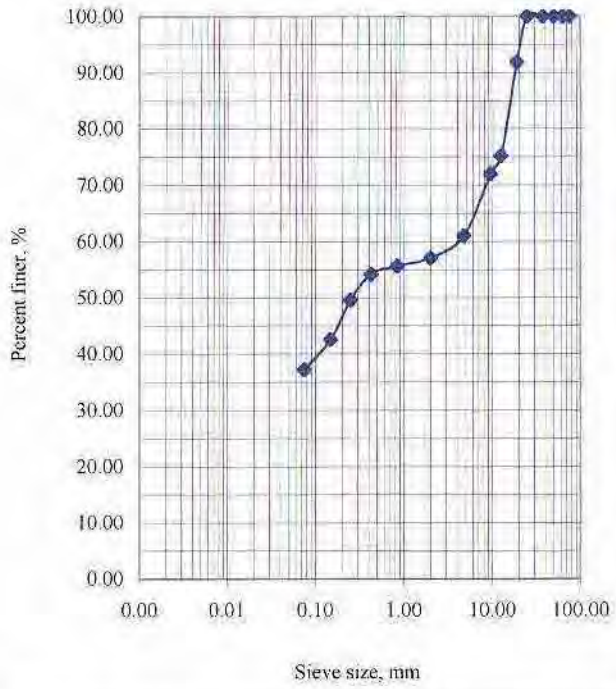
GRAIN SIZE ANALYSIS CURVES

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Sample No. : xxxxx
Submitted by : KOKUSAI KOGYO CO.,LTD.
Date of Test : 27 / 09 / 2013
Test by : Phindavanh

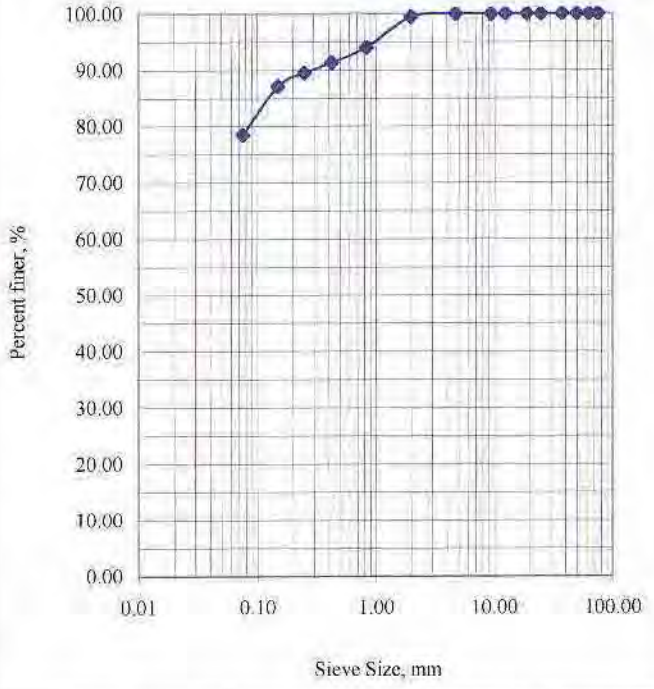
Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
Bore hole : 3 Depth, m 1.00~1.30	Bore hole : 3 Depth, m 3.85~4.30	Bore hole : 3 Depth, m 5.85~6.30



Description of Material : Clayey LATERITE with Sand



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Elastic SILT with Sand

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

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Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

SIEVE ANALYSIS

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Sample No. : xxxxx

Submitted by : KOKUSAI KOGYO CO.,LTD.

Date of Test : 29/09/2013

Test by : Phindavanh

	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
	Bore Hole No 4 Depth : 1.85~2.30	Bore Hole No 4 Depth : 3.85~4.30	Bore Hole No 4 Depth : 5.85~6.30
	Container No.	Container No.	Container No.
	Weight of Container+Dry Soil 678 g	Weight of Container+Dry Soil 621 g	Weight of Container+Dry Soil 692 g
	Weight of Container 317 g	Weight of Container 217 g	Weight of Container 253 g
	Weight of Dry Soil 361 g	Weight of Dry Soil 404 g	Weight of Dry Soil 439 g
	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material : Elastic SILT

Sieve size	Sieve Opening mm	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %
3 "	75.000	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00
2 1/2"	63.000	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00
2 "	50.000	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00
1 1/2"	37.500	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00
1 "	25.000	545.00	545.00	0.000	0.00	0.00	100.00	545.00	576.00	31.000	7.67	7.67	92.33	545.00	545.00	0.000	0.00	0.00	100.00
3/4"	19.000	566.00	604.00	38.000	10.53	10.53	89.47	566.00	611.00	45.000	11.14	18.81	81.19	548.00	548.00	0.000	0.00	0.00	100.00
1/2"	12.500	521.00	562.00	41.000	11.36	21.88	78.12	521.00	567.00	46.000	11.39	30.20	69.80	521.00	521.00	0.000	0.00	0.00	100.00
3/8"	9.500	520.00	544.00	24.000	6.65	28.53	71.47	520.00	539.00	19.000	4.70	34.90	65.10	520.00	520.00	0.000	0.00	0.00	100.00
No.4	4.750	499.00	555.00	56.000	15.51	44.04	55.96	499.00	540.00	41.000	10.15	45.05	54.95	500.00	500.00	0.000	0.00	0.00	100.00
No.10	2.000	447.00	469.00	22.000	6.09	50.14	49.86	447.00	469.00	22.000	5.45	50.50	49.50	447.00	453.00	6.000	1.37	1.37	98.63
No. 20	0.840	420.00	430.00	10.000	2.77	52.91	47.09	420.00	430.00	10.000	2.48	52.97	47.03	420.00	430.00	10.000	2.28	3.64	96.36
No.40	0.425	367.00	375.00	8.000	2.22	55.12	44.88	367.00	374.00	7.000	1.73	54.70	45.30	367.00	374.00	7.000	1.59	5.24	94.76
No. 60	0.250	326.00	336.00	10.000	2.77	57.89	42.11	326.00	340.00	14.000	3.47	58.17	41.83	326.00	330.00	4.000	0.91	6.15	93.85
No. 100	0.149	303.00	318.00	15.000	4.16	62.05	37.95	303.00	319.00	16.000	3.96	62.13	37.87	303.00	308.00	5.000	1.14	7.29	92.71
No. 200	0.075	320.00	339.00	19.000	5.26	67.31	32.69	320.00	334.00	14.000	3.47	65.59	34.41	320.00	345.00	25.000	5.69	12.98	87.02
PAN		365.00	365.00	0.000				365.00	365.00	0.000				365.00	365.00	0.000			
			Total:	243.000					Total:	265.000					Total:	57.000			

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
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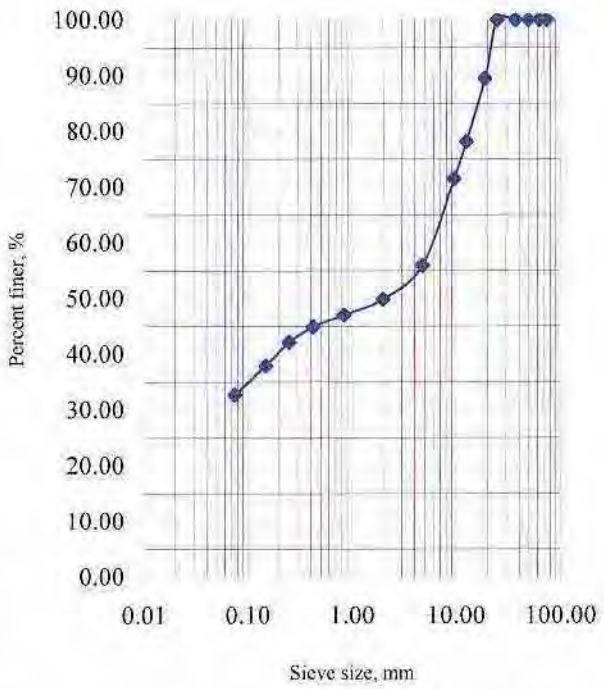
Email: sdmt@laotel.com; W.W.W. sdmt.laopdr

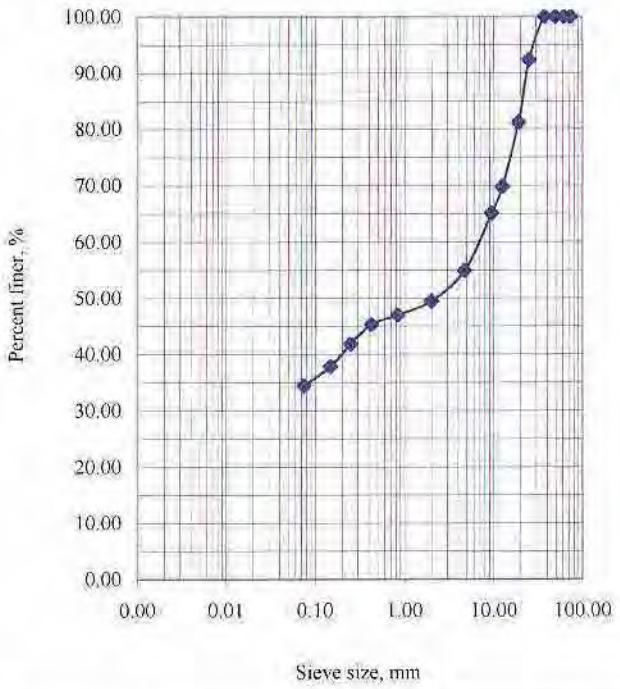
GRAIN SIZE ANALYSIS CURVES

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Sample No. : xxxxx
Submitted by : KOKUSAI KOGYO CO.,LTD.
Date of Test : 27 / 09 / 2013
Test by : Phindavanh

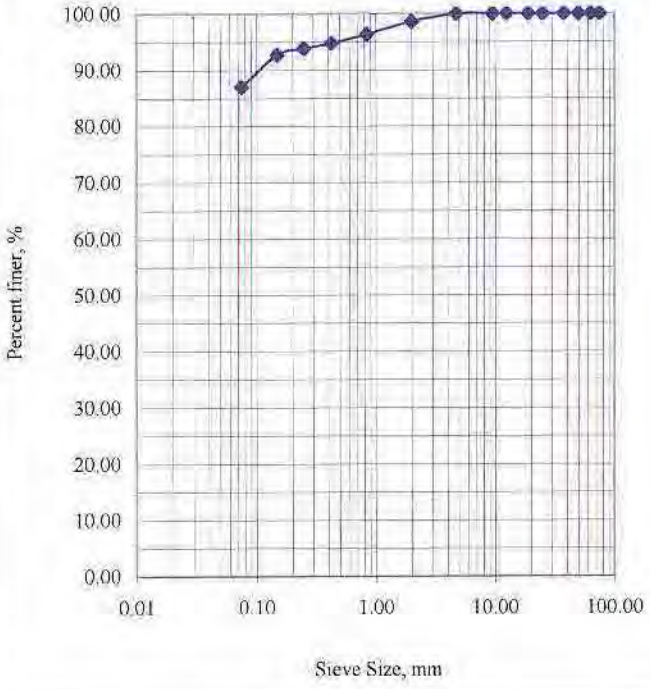
Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
Bore hole : 4 Depth, m 1.85~2.30	Bore hole : 4 Depth, m 3.85~4.30	Bore hole : 4 Depth, m 5.85~6.30



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Elastic SILT

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

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Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

SIEVE ANALYSIS

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Sample No. : xxxxx

Submitted by : KOKUSAI KOGYO CO.,LTD.

Date of Test : 01/10/2013

Test by : Phindavanh

	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
	Bore Hole No 5 Depth : 0.97~1.30	Bore Hole No 5 Depth : 2.85~3.30	Bore Hole N 5 Depth : 4.85~5.30
	Container No.	Container No.	Container No.
	Weight of Container+Dry Soil 497 g	Weight of Container+Dry Soil 644 g	Weight of Container+Dry Soil 658 g
	Weight of Container 241 g	Weight of Container 244 g	Weight of Container 231 g
	Weight of Dry Soil 256 g	Weight of Dry Soil 400 g	Weight of Dry Soil 427 g
	Description of material : Clayey LATERITE with Sand	Description of material : Clayey GRAVEL+LATERITE with Sand	Description of material : Elastic SILT with Sand

Sieve size	Sieve Opening mm	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm.	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm	Percent retained, %	Cumulative percent retained, %	Percent Finer, %	Wt. Of sieve gm.	Wt. Of sieve + Sample gm.	Wt. Of sample retained, gm	Percent retained, %	Cumulative percent retained, %	Percent Finer, %
3 "	75.000	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00	518.00	518.00	0.000	0.00	0.00	100.00
2 1/2"	63.000	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00	563.00	563.00	0.000	0.00	0.00	100.00
2 "	50.000	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00	474.00	474.00	0.000	0.00	0.00	100.00
1 1/2"	37.500	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00	544.00	544.00	0.000	0.00	0.00	100.00
1 "	25.000	545.00	545.00	0.000	0.00	0.00	100.00	545.00	545.00	0.000	0.00	0.00	100.00	545.00	545.00	0.000	0.00	0.00	100.00
3/4"	19.000	566.00	566.00	0.000	0.00	0.00	100.00	566.00	647.00	81.000	20.25	20.25	79.75	548.00	548.00	0.000	0.00	0.00	100.00
1/2"	12.500	521.00	543.00	22.000	8.59	8.59	91.41	521.00	555.00	34.000	8.50	28.75	71.25	521.00	521.00	0.000	0.00	0.00	100.00
3/8"	9.500	520.00	546.00	26.000	10.16	18.75	81.25	520.00	551.00	31.000	7.75	36.50	63.50	520.00	520.00	0.000	0.00	0.00	100.00
No.4	4.750	499.00	588.00	89.000	34.77	53.52	46.48	499.00	557.00	58.000	14.50	51.00	49.00	500.00	500.00	0.000	0.00	0.00	100.00
No.10	2.000	447.00	481.00	34.000	13.28	66.80	33.20	447.00	473.00	26.000	6.50	57.50	42.50	447.00	451.00	4.000	0.94	0.94	99.06
No. 20	0.840	420.00	429.00	9.000	3.52	70.31	29.69	420.00	430.00	10.000	2.50	60.00	40.00	420.00	442.00	22.000	5.15	6.09	93.91
No.40	0.425	367.00	371.00	4.000	1.56	71.88	28.13	367.00	374.00	7.000	1.75	61.75	38.25	367.00	385.00	18.000	4.22	10.30	89.70
No. 60	0.250	326.00	330.00	4.000	1.56	73.44	26.56	326.00	335.00	9.000	2.25	64.00	36.00	326.00	335.00	9.000	2.11	12.41	87.59
No. 100	0.149	303.00	310.00	7.000	2.73	76.17	23.83	303.00	315.00	12.000	3.00	67.00	33.00	303.00	310.00	7.000	1.64	14.05	85.95
No. 200	0.075	320.00	330.00	10.000	3.91	80.08	19.92	320.00	336.00	16.000	4.00	71.00	29.00	320.00	325.00	5.000	1.17	15.22	84.78
PAN		365.00	365.00	0.000				365.00	365.00	0.000				365.00	365.00	0.000			
			Total:	205.000					Total:	284.000					Total:	65.000			

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
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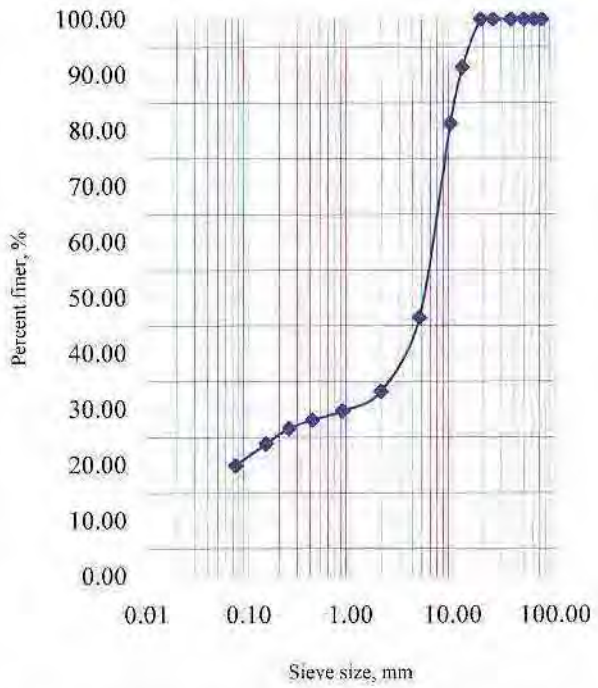
Email: sdmt@laotel.com; W.W.W. sdmt.laopdr

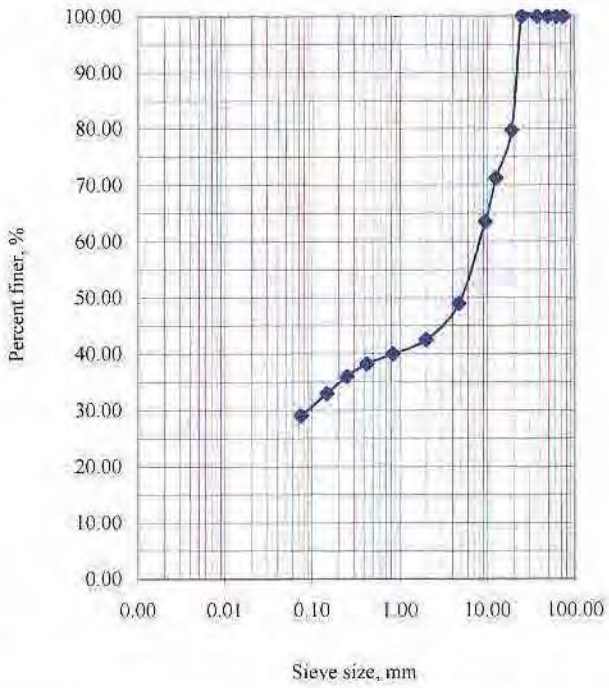
GRAIN SIZE ANALYSIS CURVES

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Sample No. : xxxxx
Submitted by : KOKUSAI KOGYO CO.,LTD.
Date of Test : 27 / 09 / 2013
Test by : Phindavanh

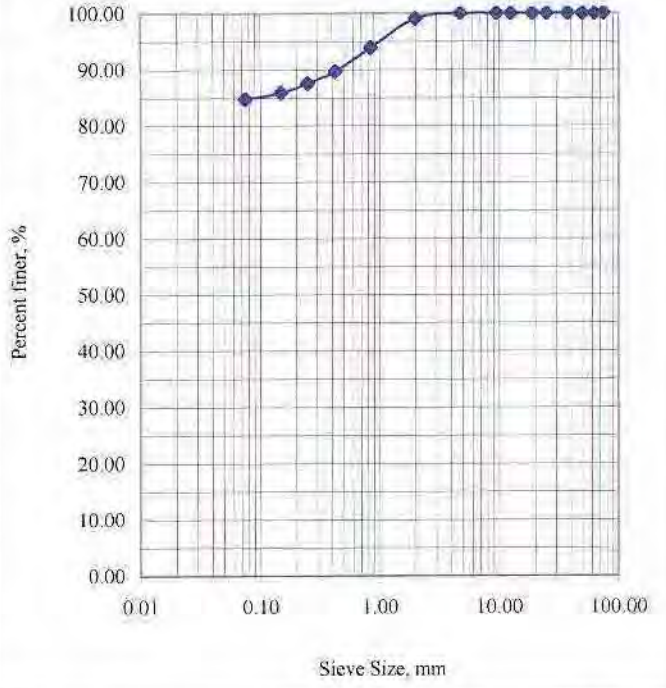
Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital	Location : Nahai Village, Xaisettha District, Vientiane Capital
Bore hole : 5 Depth, m 0.97~1.30	Bore hole : 5 Depth, m 2.85~3.30	Bore hole : 5 Depth, m 4.85~5.30



Description of Material : Clayey LATERITE with Sand



Description of Material : Clayey GRAVEL+LATERITE with Sand



Description of Material : Elastic SILT with Sand

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SDMT State Enterprise for Survey Design and Material Testing

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Email : sdmt@laotel.com, w.w.w . sdmt.laopdr

MOISTURE CONTENT TEST.

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Submitted by : KOKUSAI KOGYO CO.,LTD. Testing Date : 23/09/2013

Location : Nahai Village, Xaisettha District, Vientiane Capital Testing by : Lienthong

Hole No.	Depth m	Description of material	Number of Can	Weight of Sample+Can (g)	Weight of Dry Sample+Can (g)	Weight of can (g)	Weight of Water (g)	Weight of Dry Sample (g)	Moisture Content %	Average
1	0.85~1.30	Clayey LATERITE with Sand	30	138.84	125.07	34.08	13.77	90.99	15.13	14.80
	"		48	149.77	135.38	35.93	14.39	99.45	14.47	
1	2.85~3.30	Clayey GRAVEL/LATERITE with Sand	50	145.46	131.35	36.28	14.11	95.07	14.84	15.28
	"		6	153.08	137.14	35.75	15.94	101.39	15.72	
1	4.85~5.30	Elastic SILT with Sand	45	159.77	133.51	35.88	26.26	97.63	26.90	26.78
	"		47	147.61	123.54	33.29	24.07	90.25	26.67	

Checked by : Mr Viengvisa SIVISAY

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

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Email : sdmt@laotel.com, w.w.w . sdmt.laopdr

MOISTURE CONTENT TEST.

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Submitted by : KOKUSAI KOGYO CO.,LTD. Testing Date : 24/09/2013

Location : Nahai Village, Xaisettha District, Vientiane Capital Testing by : Vanhna

Hole No.	Depth m	Description of material	Number of Can	Weight of Sample+Can (g)	Weight of Dry Sample+Can (g)	Weight of can (g)	Weight of Water (g)	Weight of Dry Sample (g)	Moisture Content %	Average
2	1.85~2.30	Clayey GRAVEL+LATERITE with Sand	5	111.34	101.86	33.89	9.48	67.97	13.95	14.12
	!!		15	120.17	108.89	29.99	11.28	78.90	14.30	
2	3.85~4.30	Clayey GRAVEL + LATERITE with Sand	74	154.35	139.74	34.10	14.61	105.64	13.83	13.88
	!!		13	144.42	131.10	35.53	13.32	95.57	13.94	
2	4.85~5.30	Elastic SILT with Sand	58	131.46	111.35	35.80	20.11	75.55	26.62	26.80
	!!		108	126.14	105.23	27.74	20.91	77.49	26.98	

Checked by : Mr Viengvisa SIVISAY

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

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Email : sdmt@laotel.com, w.w.w . sdmt.laopdr

MOISTURE CONTENT TEST.

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Submitted by : KOKUSAI KOGYO CO.,LTD. Testing Date : 26/09/2013

Location : Nahai Village, Xaisettha District, Vientiane Capital Testing by : Phindavanh

Hole No.	Depth m	Description of material	Number of Can	Weight of Sample+Can (g)	Weight of Dry Sample+Can (g)	Weight of can (g)	Weight of Water (g)	Weight of Dry Sample (g)	Moisture Content %	Average
3	1.00~1.30	Clayey LATERITE with Sand	11	195.61	177.13	35.43	18.48	141.70	13.04	13.04
	!!									
3	3.85~4.30	Clayey GRAVEL+LATERITE with Sand	2	161.25	140.24	35.87	21.01	104.37	20.13	20.13
	!!									
3	5.85~6.30	Elastic SILT with Sand	6	219.84	186.12	35.53	33.72	150.59	22.39	22.39
	!!									

Checked by : Mr Viengvisa SIVISAY

MINISTRY OF PUBLIC WORKS AND TRANSPORTS

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Email : sdmt@laotel.com, w.w.w . sdmt.laopdr

MOISTURE CONTENT TEST.

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Submitted by : KOKUSAI KOGYO CO.,LTD. Testing Date : 27/09/2013

Location : Nahai Village, Xaisettha District, Vientiane Capital Testing by : Phindavanh

Hole No.	Depth m	Description of material	Number of Can	Weight of Sample+Can (g)	Weight of Dry Sample+Can (g)	Weight of can (g)	Weight of Water (g)	Weight of Dry Sample (g)	Moisture Content %	Average
4	1.85~2.30	Clayey GRAVEL+LATERITE with Sand	9	160.16	143.97	35.60	16.19	108.37	14.94	14.94
	!!									
4	3.85~4.30	Clayey GRAVEL+LATERITE with Sand	10	178.05	149.34	35.43	28.71	113.91	25.20	25.20
	!!									
4	5.85~6.30	Elastic SILT	13	151.68	127.75	35.68	23.93	92.07	25.99	25.99
	!!									

Checked by : Mr Viengvisa SIVISAY

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MOISTURE CONTENT TEST.

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

Submitted by : KOKUSAI KOGYO CO.,LTD. Testing Date : 28/09/2013

Location : Nahai Village, Xaisettha District, Vientiane Capital Testing by : Phindavanh

Hole No.	Depth m	Description of material	Number of Can	Weight of Sample+Can (g)	Weight of Dry Sample+Can (g)	Weight of can (g)	Weight of Water (g)	Weight of Dry Sample (g)	Moisture Content %	Average
5	0.97~1.30	Clayey LATERITE with Sand	8	163.53	147.73	35.75	15.80	111.98	14.11	14.11
	!!									
5	2.85~3.30	Clayey GRAVEL LATERITE with Sand	12	163.54	144.12	35.63	19.42	108.49	17.90	17.90
	!!									
5	4.85~5.30	Elastic SILT with Sand	5	185.63	152.63	35.68	33.00	116.95	28.22	28.22
	!!									

Checked by : Mr Viengvisa SIVISAY

MINISTRY OF PUBLIC WORKS AND TRANSPORTS
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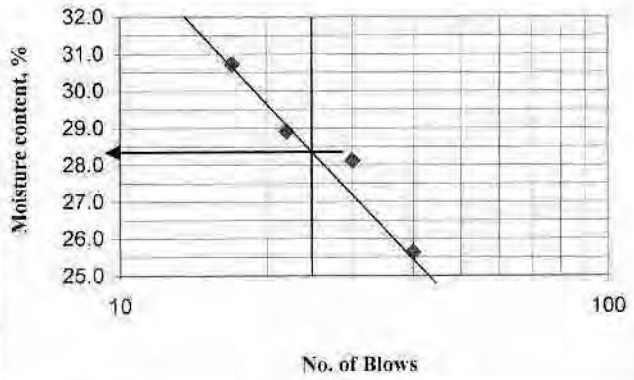
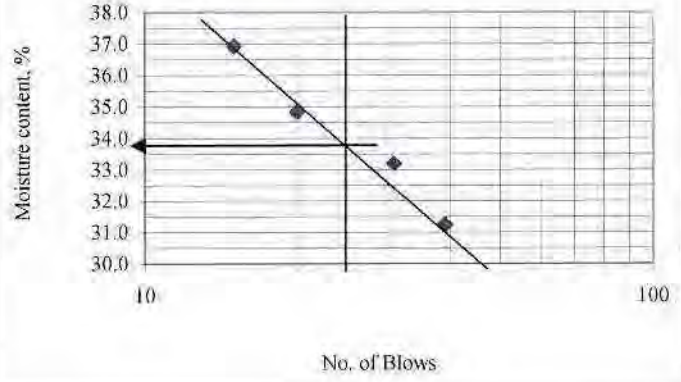
Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

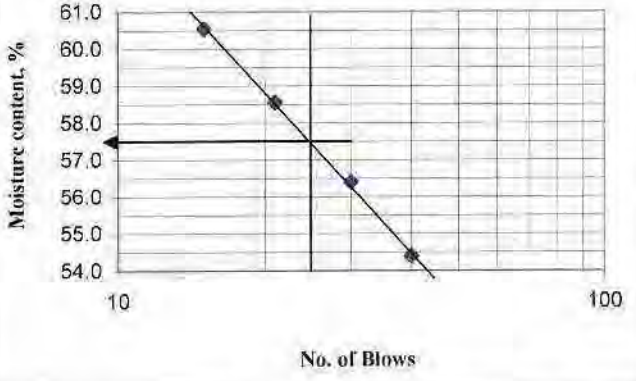
ATTERBERG LIMITS TEST

Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.
Submitted by : KOKUSAI KOGYO CO.,LTD.
Test by : Phayboun
Sample No. : xxxxx
Date of Test : 25 / 09 / 2013

Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital					
Bore Hole No.	1		Depth, m		0.85~1.30		Bore Hole No.	1		Depth, m		2.85~3.30		Bore Hole No.	1		Depth, m		4.85~5.30	
Description of material	Clayey LATERITE with Sand						Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Elastic SILT with Sand					
Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P	
Container Number	19	23	36	47	25	33	Container Number	20	16	15	26	65	66	Container Number	38	27	10	45	22	51
Number of Blows	40	30	22	17			Number of Blows	39	31	20	15			Number of Blows	40	30	21	15		
Wt Wet Soil+Container g	20.13	18.81	18.56	19.19	14.51	14.89	Wt Wet Soil+Container g	19.94	19.89	19.14	19.82	15.25	15.30	Wt Wet Soil+Container g	18.20	17.46	22.91	27.66	22.46	25.08
Wt Dry Soil+ Container g	17.63	16.35	16.12	16.48	13.40	13.80	Wt Dry Soil+ Container g	17.10	16.90	16.14	16.47	13.64	13.73	Wt Dry Soil+ Container g	14.49	13.90	20.55	24.99	21.00	24.23
Wt Container g	7.88	7.60	7.68	7.66	7.01	7.52	Wt Container g	8.01	7.89	7.53	7.40	5.50	5.46	Wt Container g	7.67	7.59	16.52	20.58	16.59	21.69
Wt Water g	2.50	2.46	2.44	2.71	1.11	1.09	Wt Water g	2.84	2.99	3.00	3.35	1.61	1.57	Wt Water g	3.71	3.56	2.36	2.67	1.46	0.85
Wt Dry Soil g	9.75	8.75	8.44	8.82	6.39	6.28	Wt Dry Soil g	9.09	9.01	8.61	9.07	8.14	8.27	Wt Dry Soil g	6.82	6.31	4.03	4.41	4.41	2.54
Water Content %	25.64	28.11	28.91	30.73	17.37	17.36	Water Content %	31.24	33.19	34.84	36.93	19.78	18.98	Water Content %	54.40	56.42	58.56	60.54	33.11	33.46
PI = 10.94	W_L = 28.30				W_P = 17.36		**PI = 14.42**	W_L = 33.80				W_P = 19.38		**PI = 24.21**	W_L = 57.50				W_P = 33.29	







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SDMT State Enterprise for Survey Design and Material Testing

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Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

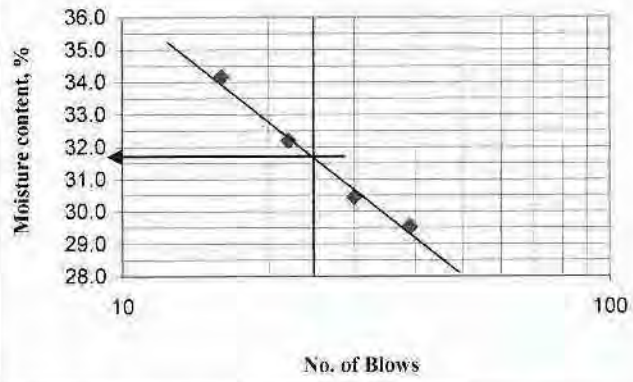
ATTERBERG LIMITS TEST

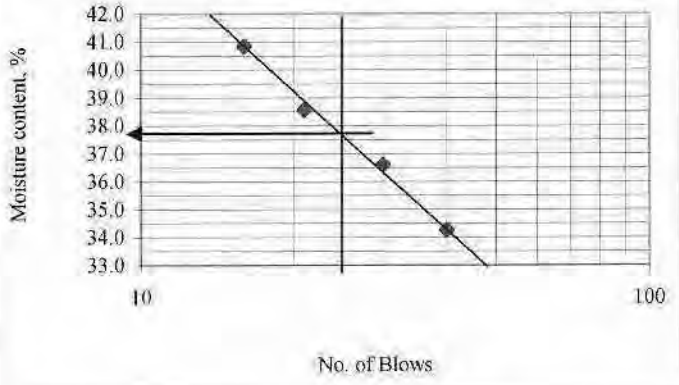
Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

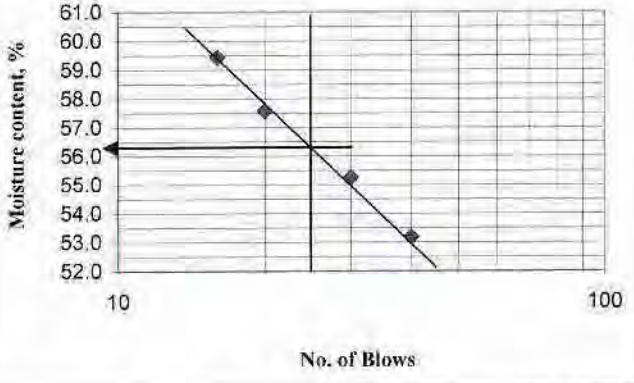
Submitted by : KOKUSAI KOGYO CO.,LTD. Sample No. : xxxxx

Test by : Phayboun Date of Test : 25 / 09 / 2013

Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital					
Bore Hole No.	2		Depth, m		1.85~2.30		Bore Hole No.	2		Depth, m		3.85~4.30		Bore Hole No.	2		Depth, m		4.85~5.30	
Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Clayey GRAVEL + LATERITE with Sand						Description of material	Elastic SILT with Sand					
Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P	
Container Number	45	24	44	18	2	31	Container Number	4	37	9	10	32	11	Container Number	5	43	8	12	28	13
Number of Blows	39	30	22	16			Number of Blows	40	30	21	16			Number of Blows	40	30	20	16		
Wt Wet Soil+Container g	19.37	18.17	19.87	19.86	16.81	15.95	Wt Wet Soil+Container g	20.60	19.94	21.13	19.75	14.24	16.34	Wt Wet Soil+Container g	21.64	20.38	19.76	21.13	15.26	14.82
Wt Dry Soil+ Container g	16.71	15.78	16.87	16.83	15.42	14.70	Wt Dry Soil+ Container g	17.29	16.62	17.37	16.16	13.04	14.78	Wt Dry Soil+ Container g	16.80	15.97	15.35	16.00	13.48	13.16
Wt Container g	7.70	7.93	7.55	7.96	8.00	8.02	Wt Container g	7.63	7.55	7.62	7.37	7.54	7.57	Wt Container g	7.70	7.99	7.69	7.37	7.99	8.04
Wt Water g	2.66	2.39	3.00	3.03	1.39	1.25	Wt Water g	3.31	3.32	3.76	3.59	1.20	1.56	Wt Water g	4.84	4.41	4.41	5.13	1.78	1.66
Wt Dry Soil g	9.01	7.85	9.32	8.87	7.42	6.68	Wt Dry Soil g	9.66	9.07	9.75	8.79	5.50	7.21	Wt Dry Soil g	9.10	7.98	7.66	8.63	5.49	5.12
Water Content %	29.52	30.45	32.19	34.16	18.73	18.71	Water Content %	34.27	36.60	38.56	40.84	21.82	21.64	Water Content %	53.19	55.26	57.57	59.44	32.42	32.42
PI = 12.98	W_L = 31.70				W_P = 18.72		**PI = 16.07**	W_L = 37.80				W_P = 21.73		**PI = 23.98**	W_L = 56.40				W_P = 32.42	







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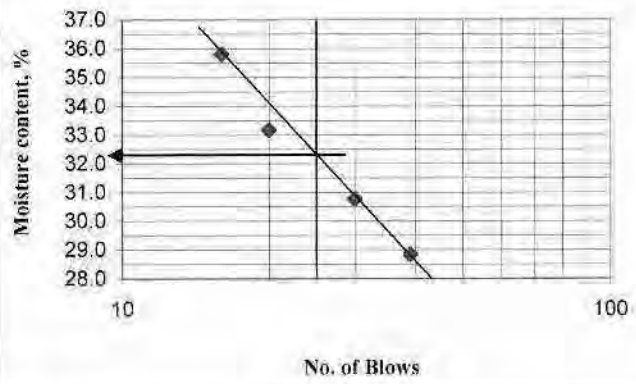
ATTERBERG LIMITS TEST

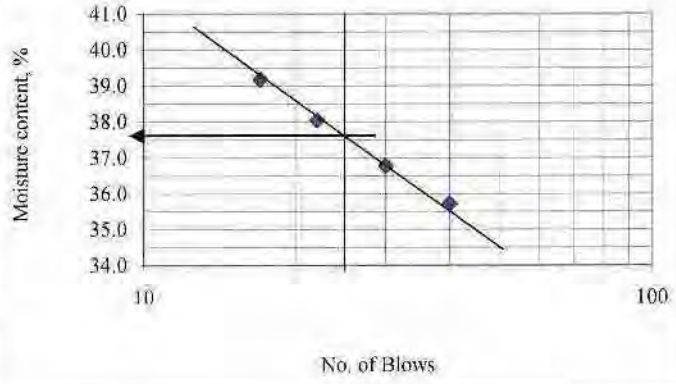
Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

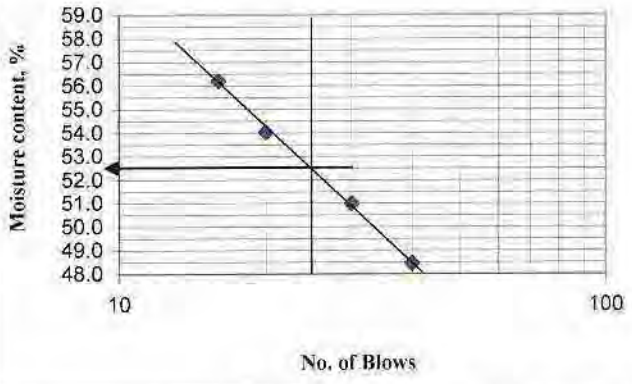
Submitted by : KOKUSAI KOGYO CO.,LTD. Sample No. : xxxxx

Test by : Phayboun Date of Test : 27 / 09 / 2013

Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital					
Bore Hole No.	3		Depth, m		1.00~1.30		Bore Hole No.	3		Depth, m		3.85~4.30		Bore Hole No.	3		Depth, m		5.85~6.30	
Description of material	Clayey LATERITE with Sand						Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Elastic SILT with Sand					
Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P	
Container Number	12	42	25	5	18	44	Container Number	20	11	45	28	2	32	Container Number	43	4	9	31	13	8
Number of Blows	39	30	20	16			Number of Blows	40	30	22	17			Number of Blows	40	30	20	16		
Wt Wet Soil+Container g	18.00	20.51	18.05	17.56	14.81	14.92	Wt Wet Soil+Container g	20.36	21.48	19.89	20.50	15.35	14.29	Wt Wet Soil+Container g	18.76	19.74	18.71	19.58	15.18	14.91
Wt Dry Soil+ Container g	15.62	17.43	15.30	14.96	13.75	13.78	Wt Dry Soil+ Container g	17.11	17.74	16.53	16.97	14.03	13.08	Wt Dry Soil+ Container g	15.18	15.65	14.82	15.42	13.52	13.23
Wt Container g	7.37	7.42	7.01	7.70	7.96	7.55	Wt Container g	8.01	7.57	7.70	7.96	8.00	7.54	Wt Container g	7.79	7.63	7.62	8.02	8.04	7.69
Wt Water g	2.38	3.08	2.75	2.60	1.06	1.14	Wt Water g	3.25	3.74	3.36	3.53	1.32	1.21	Wt Water g	3.58	4.09	3.89	4.16	1.66	1.68
Wt Dry Soil g	8.25	10.01	8.29	7.26	5.79	6.23	Wt Dry Soil g	9.10	10.17	8.83	9.01	6.03	5.54	Wt Dry Soil g	7.39	8.02	7.20	7.40	5.48	5.54
Water Content %	28.85	30.77	33.17	35.81	18.31	18.30	Water Content %	35.71	36.77	38.05	39.18	21.89	21.84	Water Content %	48.44	51.00	54.03	56.22	30.29	30.32
PI = 14.00	W_L = 32.30				W_P = 18.30		**PI = 15.73**	W_L = 37.60				W_P = 21.87		**PI = 22.19**	W_L = 52.50				W_P = 30.31	







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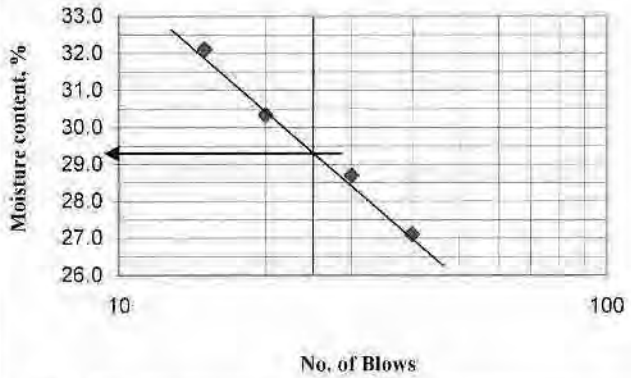
ATTERBERG LIMITS TEST

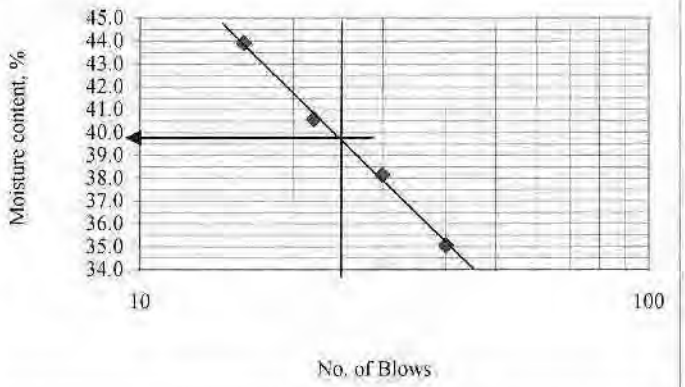
Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

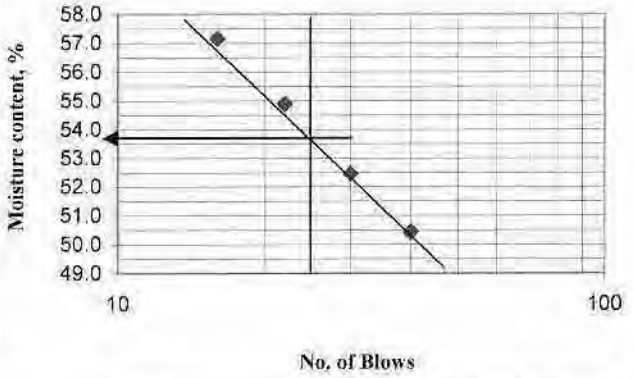
Submitted by : KOKUSAI KOGYO CO.,LTD. Sample No. : xxxxx

Test by : Phayboun Date of Test : 29 / 09 / 2013

Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital					
Bore Hole No.	4		Depth, m		1.85~2.30		Bore Hole No.	4		Depth, m		3.85~4.30		Bore Hole No.	4		Depth, m		5.85~6.30	
Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Elastic SILT					
Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P	
Container Number	20	13	8	11	45	28	Container Number	16	15	9	26	42	18	Container Number	23	321	2	43	12	44
Number of Blows	40	30	20	15			Number of Blows	40	30	22	16			Number of Blows	40	30	22	16		
Wt Wet Soil+Container g	21.14	19.61	21.58	19.05	16.48	15.21	Wt Wet Soil+Container g	19.06	19.30	22.03	20.67	15.25	14.47	Wt Wet Soil+Container g	17.89	19.50	20.02	20.41	14.82	15.37
Wt Dry Soil+ Container g	18.34	17.03	18.58	16.26	15.17	14.13	Wt Dry Soil+ Container g	16.16	16.05	17.87	16.62	13.82	13.28	Wt Dry Soil+ Container g	14.44	15.55	15.76	15.82	13.06	13.52
Wt Container g	8.01	8.04	8.69	7.57	7.70	7.99	Wt Container g	7.89	7.53	7.62	7.40	7.42	7.96	Wt Container g	7.60	8.02	8.00	7.79	7.37	7.55
Wt Water g	2.80	2.58	3.00	2.79	1.31	1.08	Wt Water g	2.90	3.25	4.16	4.05	1.43	1.19	Wt Water g	3.45	3.95	4.26	4.59	1.76	1.85
Wt Dry Soil g	10.33	8.99	9.89	8.69	7.47	6.14	Wt Dry Soil g	8.27	8.52	10.25	9.22	6.40	5.32	Wt Dry Soil g	6.84	7.53	7.76	8.03	5.69	5.97
Water Content %	27.11	28.70	30.33	32.11	17.54	17.59	Water Content %	35.07	38.15	40.59	43.93	22.34	22.37	Water Content %	50.44	52.46	54.90	57.16	30.93	30.99
PI = 11.79	W_L = 29.35				W_P = 17.56		**PI = 17.44**	W_L = 39.80				W_P = 22.36		**PI = 22.74**	W_L = 53.70				W_P = 30.96	







MINISTRY OF PUBLIC WORKS AND TRANSPORTS

SDMT State Enterprise for Survey Design and Material Testing

Tel. 856-21-41 3951, 41 5258; Fax. 856-21-41 5259, PO Box: 8438 Vientiane Lao PDR

Email: sdmt@laotel.com, W.W.W. sdmt.laopdr

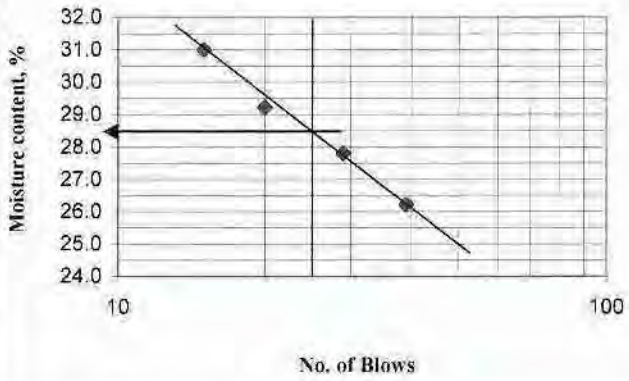
ATTERBERG LIMITS TEST

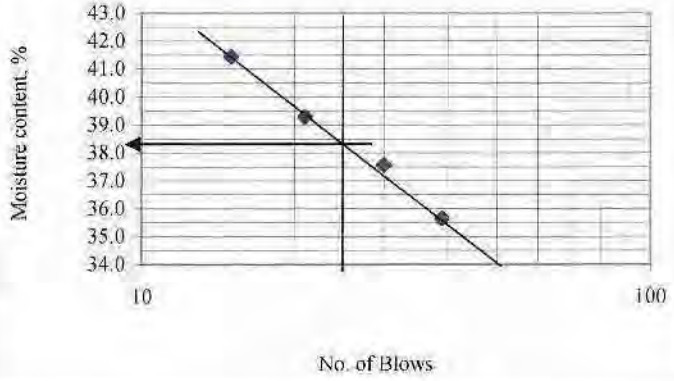
Project : The Project for Improvement of Solid Waste Management in Environmental Sustainable Cities in Lao P.D.R.

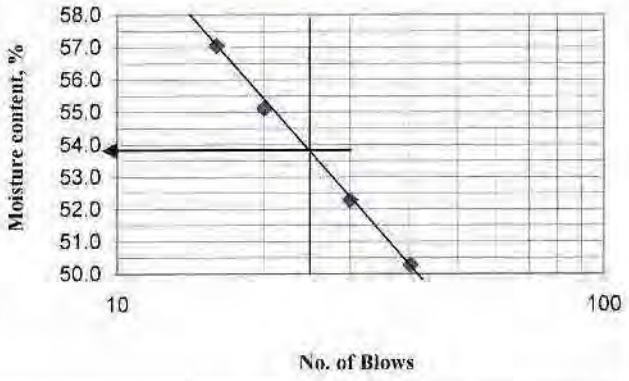
Submitted by : KOKUSAI KOGYO CO.,LTD. Sample No. : xxxxx

Test by : Phayboun Date of Test : 30 / 09 / 2013

Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital						Location	Nahai Village, Xaisettha District, Vientiane Capital					
Bore Hole No.	5		Depth, m		0.97~1.30		Bore Hole No.	5		Depth, m		2.85~3.30		Bore Hole No.	5		Depth, m		4.85~5.30	
Description of material	Clayey LATERITE with Sand						Description of material	Clayey GRAVEL+LATERITE with Sand						Description of material	Elastic SILT with Sand					
Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P		Water Content Determination	Liquid Limit w_L				Plastic Limit w_P	
Container Number	2	16	20	7	37	39	Container Number	42	43	31	10	14	18	Container Number	8	12	26	46	47	44
Number of Blows	39	29	20	15			Number of Blows	39	30	21	15			Number of Blows	40	30	20	16		
Wt Wet Soil+Container g	20.18	19.84	21.10	20.70	14.45	14.78	Wt Wet Soil+Container g	20.66	21.34	21.10	19.76	15.44	14.80	Wt Wet Soil+Container g	21.38	20.77	21.36	19.74	16.11	15.38
Wt Dry Soil+ Container g	17.65	17.24	18.14	17.60	13.42	13.75	Wt Dry Soil+ Container g	17.18	17.64	17.41	16.13	14.06	13.58	Wt Dry Soil+ Container g	16.89	16.17	16.40	15.29	14.14	13.53
Wt Container g	8.00	7.89	8.01	7.60	7.55	7.85	Wt Container g	7.42	7.79	8.02	7.37	7.74	7.96	Wt Container g	7.96	7.37	7.40	7.49	7.66	7.55
Wt Water g	2.53	2.60	2.96	3.10	1.03	1.03	Wt Water g	3.48	3.70	3.69	3.63	1.38	1.22	Wt Water g	4.49	4.60	4.96	4.45	1.97	1.85
Wt Dry Soil g	9.65	9.35	10.13	10.00	5.87	5.90	Wt Dry Soil g	9.76	9.85	9.39	8.76	6.32	5.62	Wt Dry Soil g	8.93	8.80	9.00	7.80	6.48	5.98
Water Content %	26.22	27.81	29.22	31.00	17.55	17.46	Water Content %	35.66	37.56	39.30	41.44	21.84	21.71	Water Content %	50.28	52.27	55.11	57.05	30.40	30.94
PI = 11.00	W_L = 28.50				W_P = 17.50		**PI = 16.53**	W_L = 38.30				W_P = 21.77		**PI = 23.13**	W_L = 53.80				W_P = 30.67	







CONTENT

Table

Diagram

Foreword

Increase of population in urban area increasingly rapid and growth of the industry has increased the life of the people has changed from using raw life daily caused problems recycling more in the problems that have become challenge to society, especially to the health of people arising from the waste water, air pollution, and hazardous waste, those caused by acts of man and nature that caused the pressure of environmental and social benefits now and in the future.

Management or disposal of waste is a problem that society must pay attention and be developed along with the town. Therefore, many countries in ASEAN as well as Laos are seeking the solutions and the transfer station in Nahai village will be a showcase of use the technology from Japan and environmental friendly to reduce negative impacts to the environment and society.

Vientiane is the capital city of the Laos, whose populations live about seven thousand people and places central importance in many areas: political, technical services, technical industry and other make to landfill increased by approximately 220-250 tons / day from a source different as: From communities, households, malls, industries, hotels, schools and agriculture. Lao capital is also increasing attention and 6 in the capital Is a priority Government needs to strike on the situation using modern technology in the waste management problems of the capital

Study of environmental impacts Including environmental management plan established on the basis of analyze problems, The period of construction and operation of project based on the regulations, decrees, and laws for measures to reduce the impact and appropriate for the government With consultation From the Government To incorporate the comment the parties concerned The report comprehensive Present government Consider adoption program To established practic

Section I
Intorduction

1.1 General Information of the Project

Transfer station located in Nahai Village, Saysettha District Vientiane Capital is the investment of Japan (JICA) 100% funding and the time to build factories around 18 months

The Vientiane Urban Development and Administration (VUDDA) in Lao received financial support from Japanese government and engage the Lao Environmental Engineering Consultant., LTD to study Initial Environmental Examination (IEE), to study for the transfer factory, including reporting the study to Department of Natural Resources and Environmental in Vientiane Capital to consider and issue a certificate according to the laws of Laos.

a). Name and address of developer

The Vientiane Urban Development and Administrative (VUDAA)
Mobile: 856 20 22200669

b). Name and address of consultant company

Environmental Engineering Consultant Lao., LTD
Ban Nongsangthor, Saysetha District, Vientiane Capital
Mobile: 856-- 20 55733357
Email:king_la2001@yahoo.com

1.2 Objective of the Study

Reporting the study of Initial Environment Examination is requested the Department of Natural Resources and Environment in Vientiane Capital to consider issuing a certificate approval for the project of Transfer Station and Improving Solid Waste Management, which is important tool for predict the impact on the environment. Which is including the following task:

1. Prepaire primary data about the environment in the factory area.
2. Evaluate to information of impact to factory and characteristics of noise impact noise to people and villagers living nearby.
3. Prepare and evaluate information on measures to reduce environmental impacts have little effect on the reduction measures.
4. Identify sufficient budget management and monitoring.
5. Preparation of information management, reduction measures.

1.3 Methodology and Data Collection.

Report of the study on environmental impacts will filters from the task which the information is obtained from the field data gathering which initialtive data or raw data from team consultant

Methodology and detailed estimated of environment impact from the project , about natural ecosystems and analysis Physical Environmental Impact, economy and society from primary and secondary data

Summary of information on physical and biological must be measured for comparison with the standard of Ministry Natural Resources and Environment set up to estimate the impact togetheo with problems analysis.

Determination, consideration and analysis of regulatory, policy for the study on environmental impact and management system to ensure that significant impacts from construction and operation phase. To measures a good prevention wich is incoresponded the International law and national low of Lao P.D.R.

- physical, biological, economic - social and cultural - environment, conduct research as area current of people and communities, living in the household, and land use planning, property , economic- social, religion, which estimates the impact with project for measures In working through the

- Evaluation biological, physical, social and cultural will be affected and benefits of each stage project. Estimate the effect to lifelihood of people

- Expected for reduce the impact of natural resources and environmental, risk assessment to effected households and property of the household.

- Implementation of Environmental and Social Matigation Plan for People Living along the road to ensure all impact by taking into account the principles of proper management.

1.4 Participation of the government.

Study on environmental impacts of the transfer factory will involve concerned offices and organization below:

- Minstry of Natural Resouces and Environment (MORAE)
- Department of Natural Resource and Environmental of district and province.
- Ministry of Public Works and Transportation.
- Vientiane Urban Development and Administration (VUDAA).
- Local authority of the village, district, province.

In term of implementation the company will setup the budget, time schedule of Government to monitoring Environmental and social work, with relevant sectors and local authorities. At the same time VUDA should establish Environmental Unit the project site to report the progress to government.

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Section II
Laws and regulations Consern

Vientian Urban Development and Administrative (VUDAA) base on laws, decrees and regulations of Lao P D R. To get approval for establish and operate the wast transfer factory. As a reference to determine the measures to prevent and reduce and resolve the environment impact, relevan laws, and regualations requirement wer list in table below:

Table laws relating to the factory

No.	Name of laws and the regulations	year
01	Law on Environmental Protection	2012
02	The Law on Land and propety and Decree on implementation the land law	2008
03	Law water resources and watershed	1996
04	Decree on Environment Impact Assesment (EIA) and Initail Environment Examination (IEE)	2010
05	Decree on the Implementation of the Water Law and Watershed law	2001
06	Regulations on Industry Waste	1994
07	National Environmental Standard	2010
08	Provision on of the President (Lao P.D.R.) on rental rates and concessions of the government's land	2009

Section III
Description of the Project

3.1 importation of factory

3.1.1 History of factory

Based of the party and government to accelerate development of and local all areas the country to exiting poverty in the developed direction and targets It was 2020 and the government across the country.

Garbage problem in Vientiane capital is growing every day. Where central importance in many areas: political, economic, service, and other. So, the Vientiane capital is City clean and beautiful is bility, the government at The Vientiane capital is increased attention on improving waste management system
With funds Aid from the Japanese government to build khian recycling station to reduce economic. So to implement policies 6 of that vientiane capital the development of administrative districts the need and vision to establish facilities recycle at Nahai Village , Saysettha district, vientiane capital at recycle factory from a small and larger garbage trcuk than for send to go waste facility 32.km

Currently, Vientiane Capital has 54 garbage truck is insufficient to meet of transport the garbage in 4 districts. Garbage transport systems operating has not yet replied to the need of people because of the small trucks and it spend too much times for transportation, about 70 km return. Nahai village is one of the village in Saysettha district and its location suitable for establishing the waste transfer station and it is not too far from the road 450 years. So, It is convenience and will be connected to the road 13 south in the near future.

3.1.2 Purpose of factory

The main purpose of establishing the factory as follows:

- Improving waste management in Vientiane, aim making cities clean, green and beautiful.
- Use modern technology and reducing in transportation costs and reduce environmental impact.

3.1.3 Location and size of factory

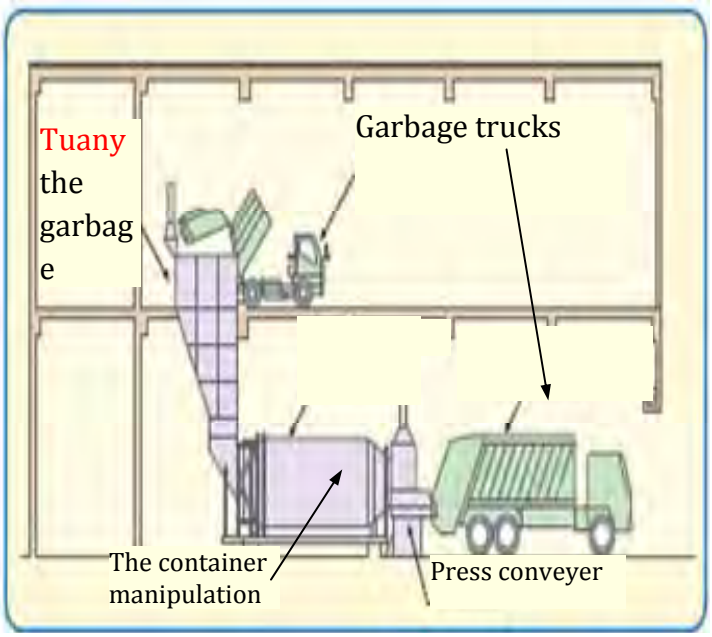
The factory is located in Village Nahai, Saysettha Vientiane Capital, It is belonged to government land (Major Decree number of 1187 / ຈນວ issue date on 5 September 2013) in the area of 2 hectares. Nahai village, has a pupolation of 665 people (Female 330), has 165 househole, the majority religion are Buddhism and professional are farmer and gardenner. Infrastructure in Nahai village is convenience expecialy roads, electricity, water supply and it is located not far from the centre urban.

Construction of the transfer station, will be conducted according to technical design by technicians who are qualified, experienced from Japan and avoid consequences to the

environment and communities in adjacent area. and the plan will be agreed through the approval from the relevant Vientiane capital and adopted in the following.

The transfer station include of building area cover 20m x40 m, the steel structure, 2 floors and the whole area cover of 2 hectares. included offices for staff , office for machines, garbage least 2 sets , the building high 10 m , a parking lot, with a fence around , toilets for workers separately and waste water reservoir to keep water from washing and clearning purpose . Factory is away from the village, about 1 km away from the road 450 years, about 1 km as well from the community. There are border with 4 niegboring's land:

- North border with Mr somphet's land
- South border with Mr somsouk's land
- East border with the Road
- West border with Ms Namfone and Mrs Pumlom's land



The container
manipulation

Inlet of the transfer

No smell because of use of the close system

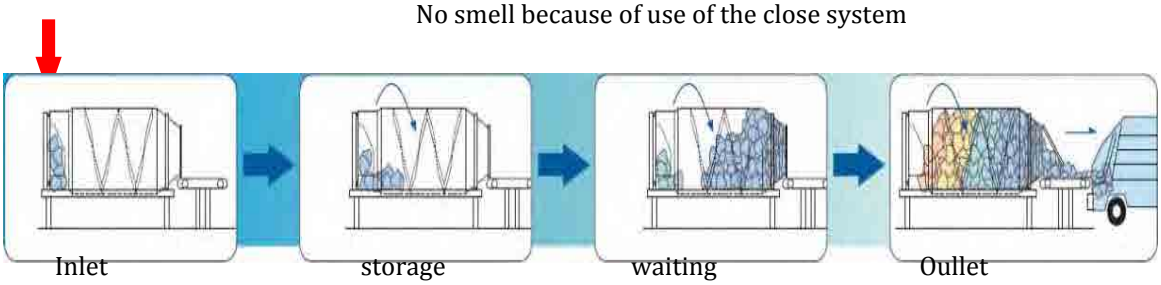


Diagram 1-1: Stage production

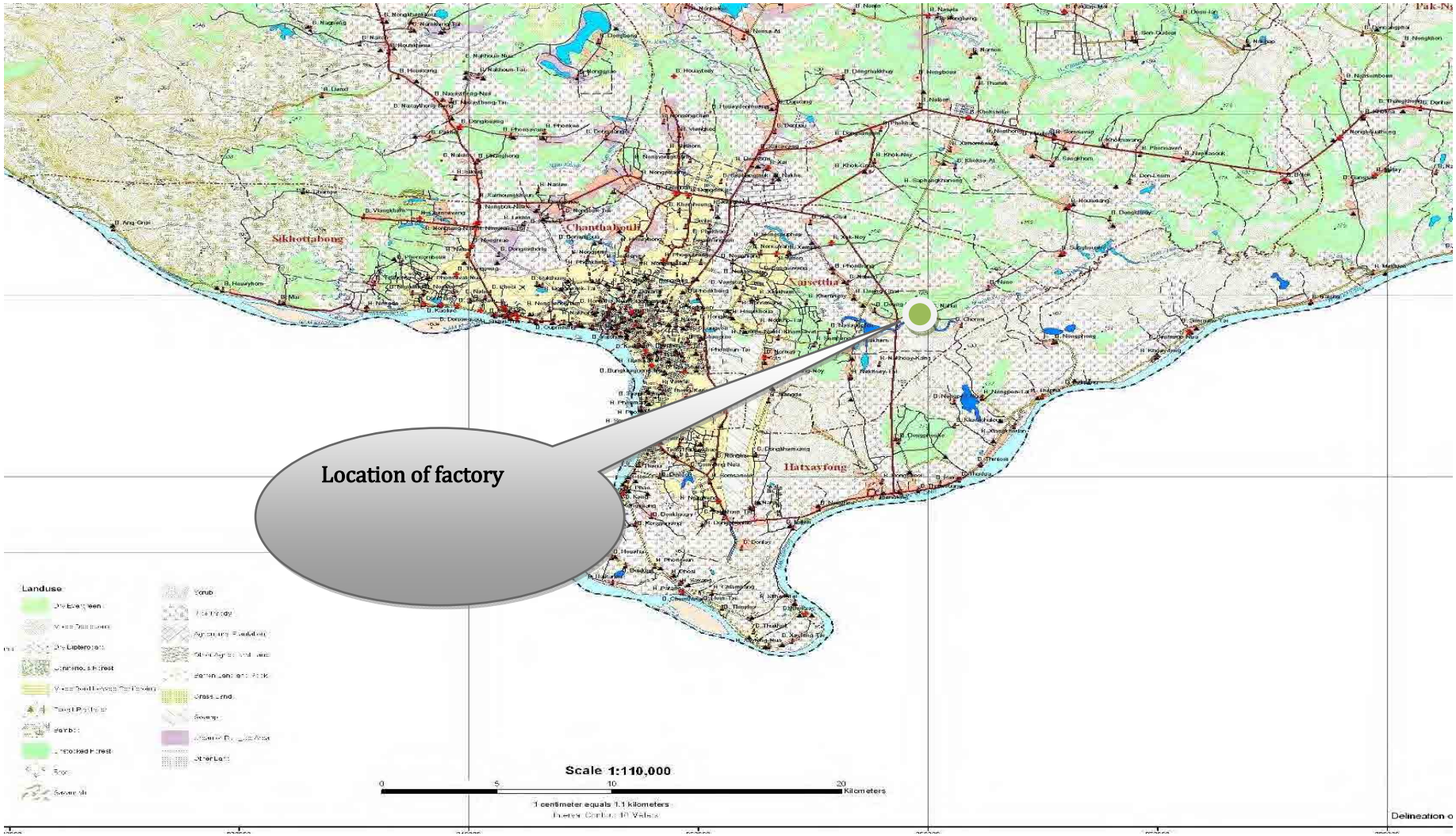


Diagram 1-2: Project location

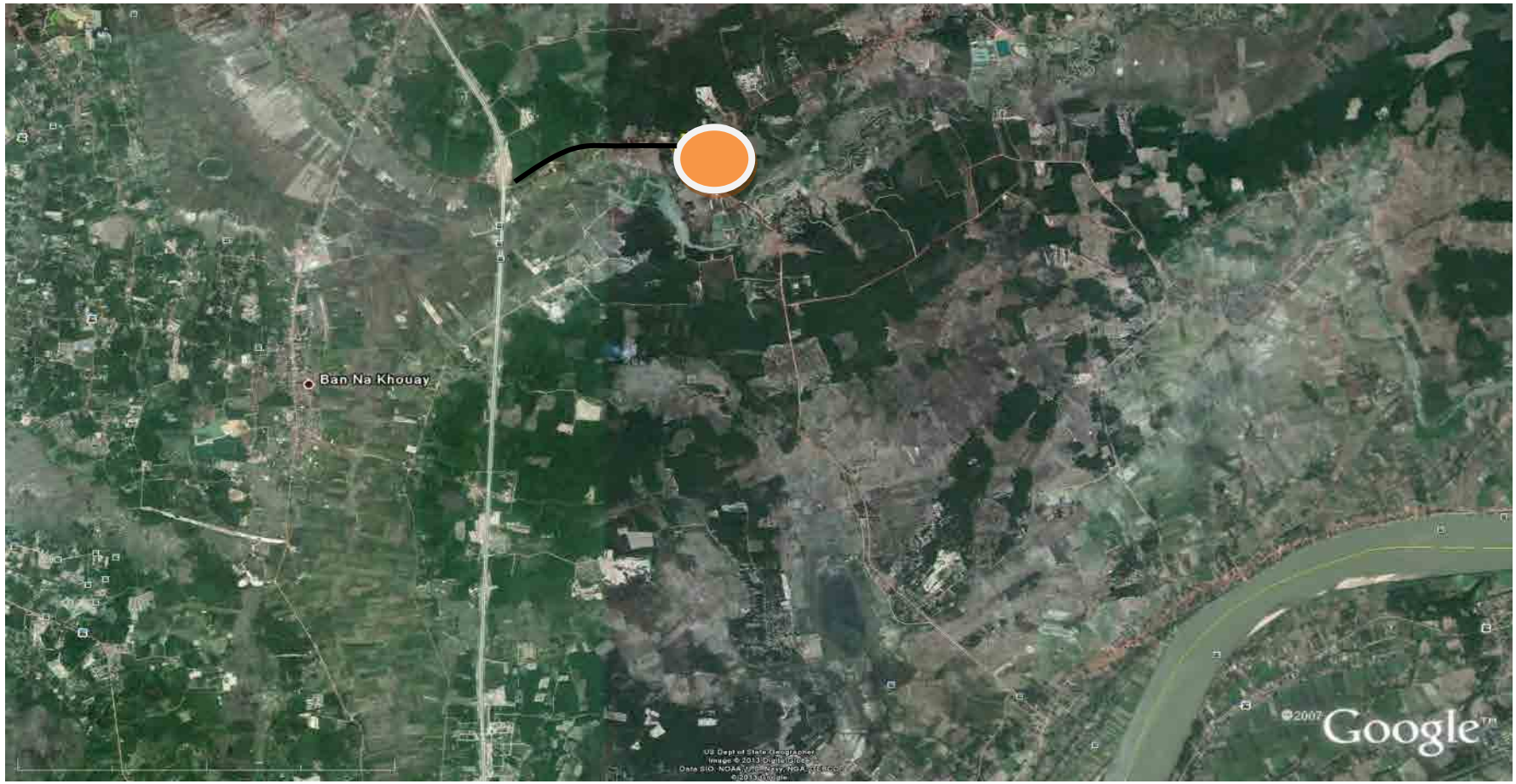


Diagram 1-3: Nahai Village

Diagram1-4 Areas Project

3.1.4 Processes and working procedures of machinery

Garbage of all 220 to -250 tons/day will be delivered through the factory, is has not separate, those garbage to diarrhea on big conical were already connected to barrel manipulation and garbage movement by manipulation, the pressing to the large truck. So, garbage is in the closed system, did not store in the factory, there is no include waste water comes with garbage will sent to garbage truck and has container keeping waste water inside the truck, when garbage are full of the truck about 20- tons and will go out from station to the land field at KM 32.

Water use: water system that the factory will use about 12 m3 / day

Electricity: Factory will pull power Size 22 kW, from high power and installation power into the factory also (50-100 Kwa)

a Need to use of the transfer station in Vientiane capital

- If transfer station use large truck 15 tonnes, tansport will decrease to about 33 times / day.
- Small trucks are suitable for service in urban centre area, as the narrow road the condition of roads is not good. Specific distance from the transfer station to the town does not exceed 15 km.

b. Process of the transportation:

- Transfer station, is one of the facilities. Small garbage trucks are transport garbage to the transfer station and transfer those garbages to the large truck.
- From transfer station, large garbage truck will sent to landfill for disposal.
- The transportion with large truck is lesser expenditures than small truck garbage transport directly to the landfield.
- Transfer station is necessary for the waste disposal has far distance (over 15 km)
- Transfer station has two categories:
    - Put into the container directly and the truck take to place of waste disposal.
    - Put into the machine system and sent to in container or large truck

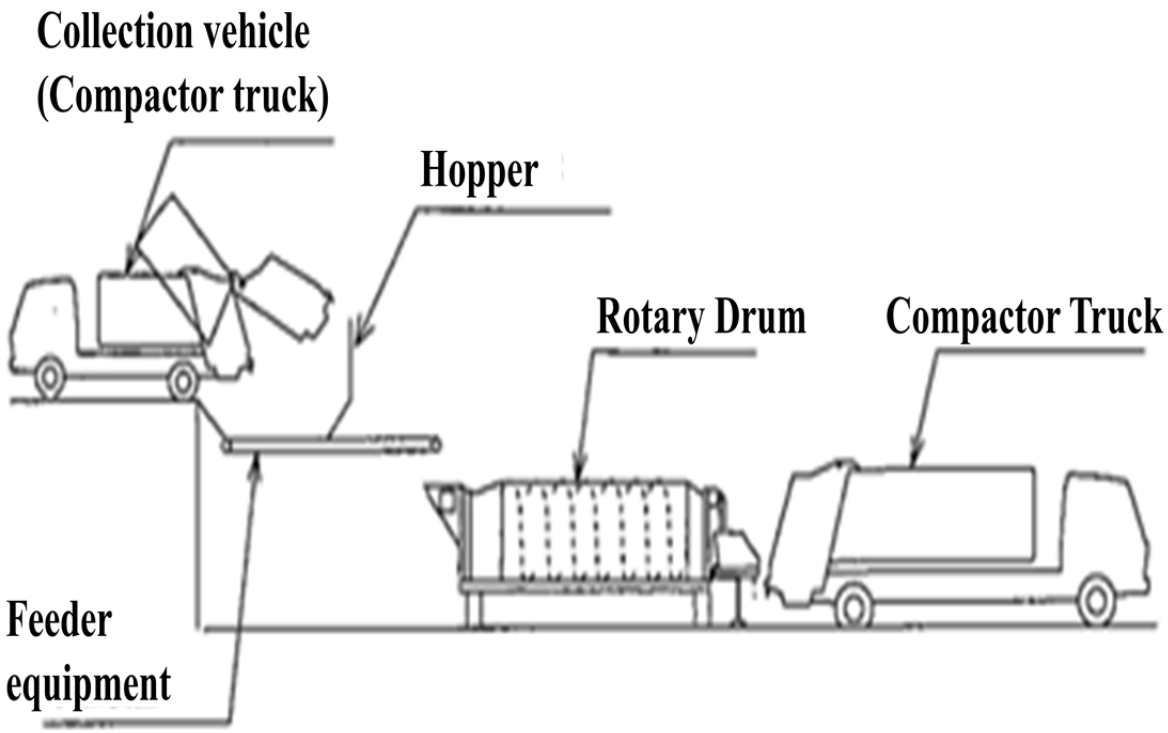


Diagram 1-5: Transfer system

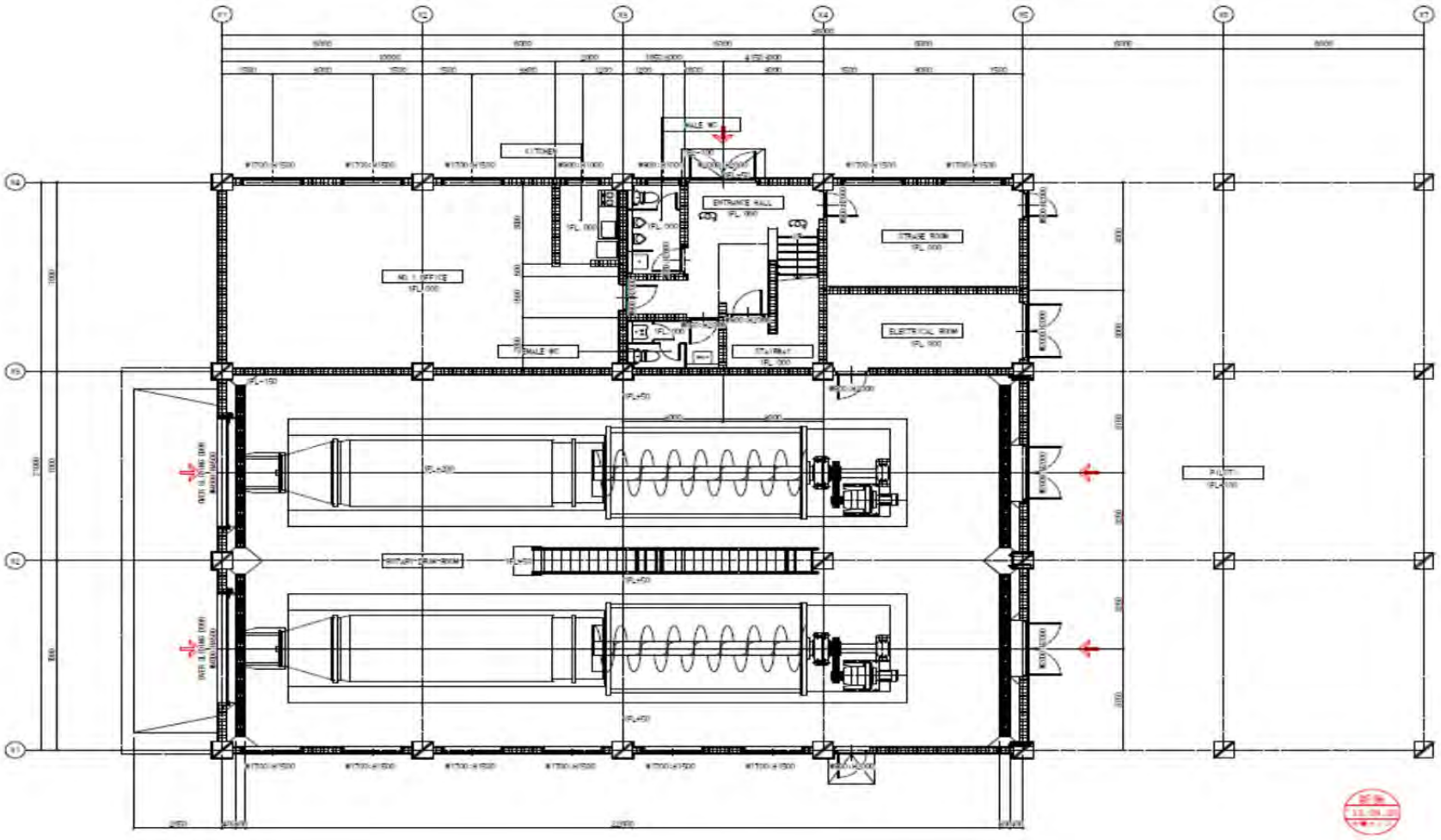


Diagram 1-6 Plan Factories

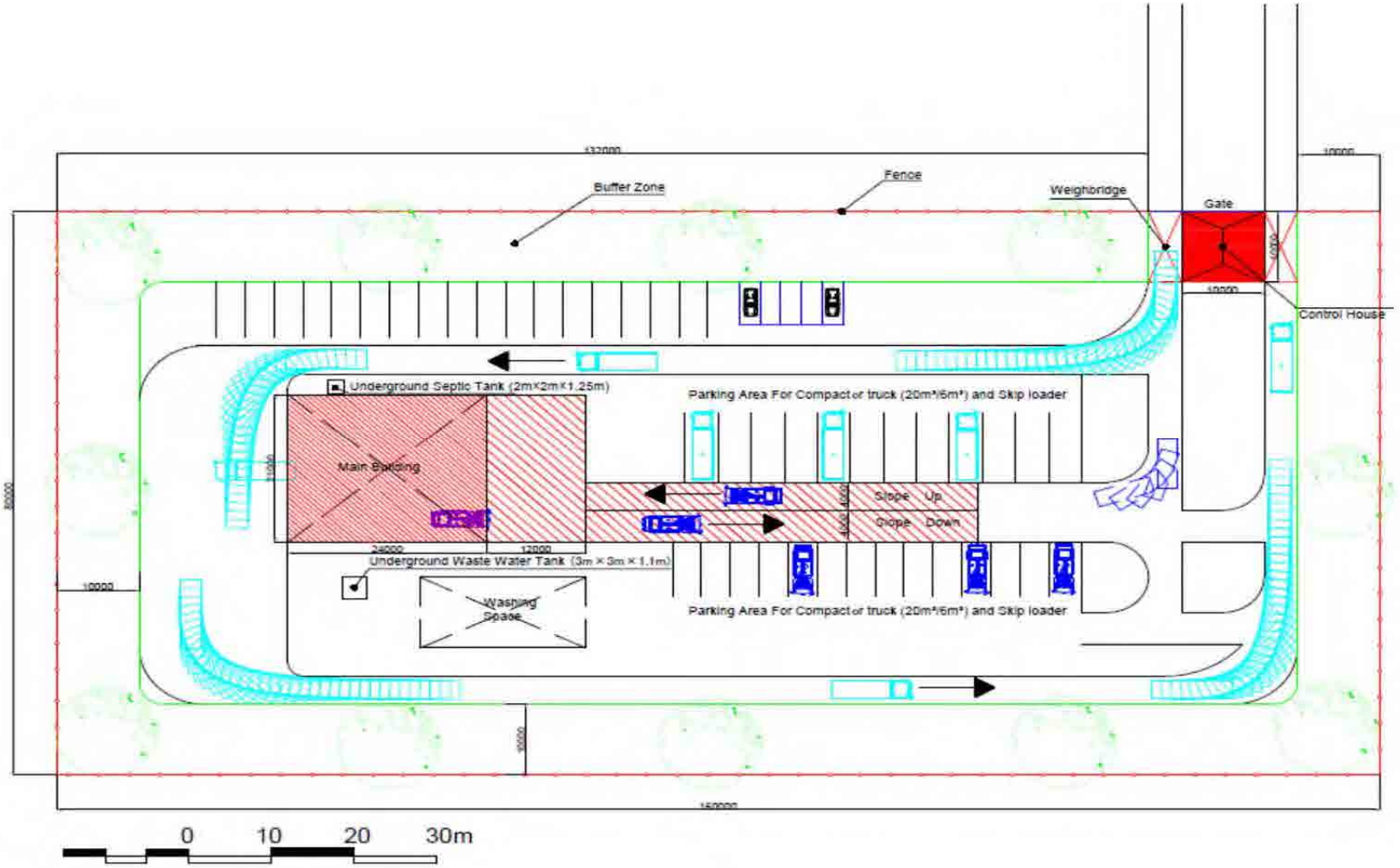


Diagram 1-7 plan

Section IV
Environmental conditions - social

4.1 Environmental condition of the project

Vientiane capital of Lao P.D.R. It is location strategic political-administrative , as centers of economic, cultural social, education, center of the international organization, center partnership of investment, product and service. There are many factories. Along with development, the environmental problems is increased, especially waste from domestic consumption, household waste, offices, hotels, factories, industries and others.

Currently the garbage in Vientiane has increased rapidly with the growth of population in Vientiane capital of 754,384 people (2009). Generate the garbage about 300-350 tons /day, The capacity of transportation to disposal in the land field at KM32 around 220-250 tons/day, The remaining is people manage themselves by burning, dumping, and burring.

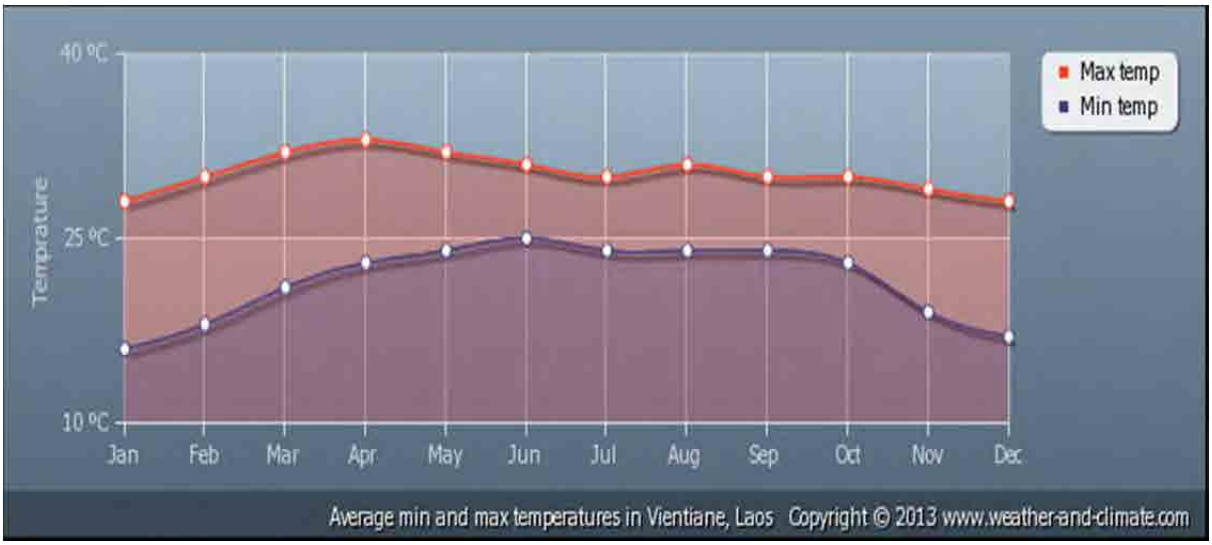
Location of the project is in Nahai Village, Saysettha District, Vientiane capital. Flat land area far from the villagers 1 km, separate from the road 450Year about 1 km and 12 km from the urban centre, it is located in the industrial zone. The future plan of the Lao government.

4.1.1 Physical Environment condition

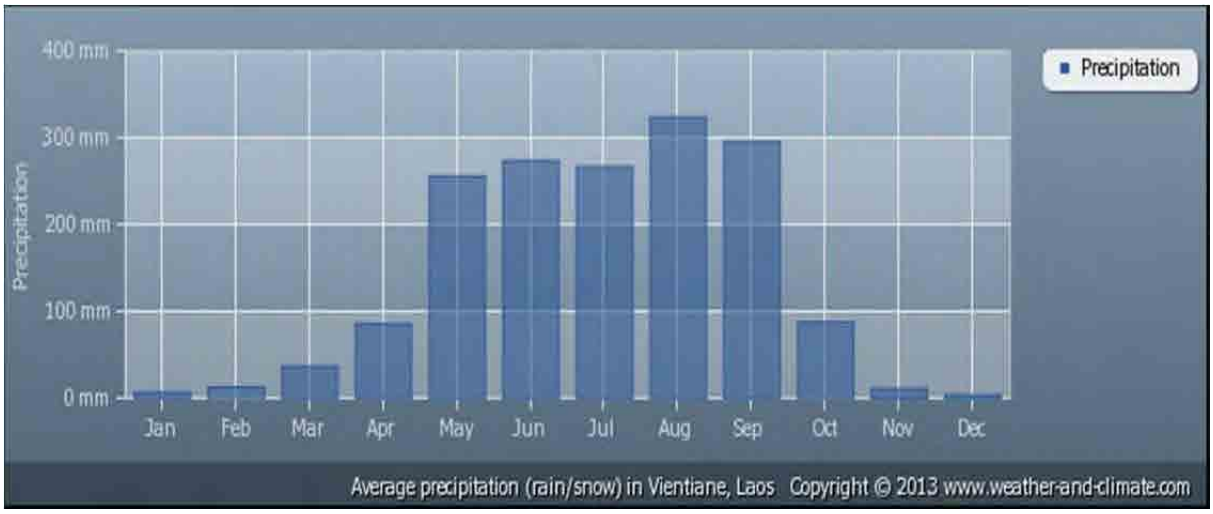
a Climate Condition

Vientiane has a tropical climate. A lot of sunlight and humidity in the medium level, there are 2 seasons. Temperature in Vientiane has change along with seasons with average temperatures of 28 ℃. The lowest temperature around 25℃. The average daylight is 6 hours /day, and month with long daylight on January, February and November which averaged at 7.3 hours / day , the month which less daylight is August and September at which average daylight of 3 hours/day.

Average temperature in capital



Average rainfall



Average sunlight

b Soil Condition

Vientiane Capital is located along the Mekong , total area of 3.920 km2, cover 1.65 % of the country land, agricultural land and other 215,289.37 hectares, pond and wetland 112.000 hectares. Land in Vientiane plains suitable for farming and agriculture. Vary type of occupation such as: officials, agriculture and trade. For the project area of construction is located at Nahai village, Saysettha District ,Vientiane, area total 2 hectares. Soil is dark brown color of thickness layer about 15 - 20 cm, with the pH = 3.5 - 5, which it is the low quality land.

C .Conditions of water sources

Water sources for livelihood and agricultural work is a Mak Hiew stream. The stream is the main water source for villagers. It is far away from the factory, about 1.5 km. The project will not affect water source of the village because the factory will be used tap water or water supply from municipality for cleaning equipment and daily use of the staff and workers working in this factory.

4.1.2 Biological Environmental Condition

Protection of biodiversity and sustainable use of forestry are important tool to ecosystems and livelihoods of the villagers in the project and nearby area. Infrastructure development or constructing the factory will not affect the natural ecosystem, no significant impact on environment and livelihood of the villagers, because there is not large area. The areas is located far away from the community 1 km.

A Condition of forest

Condition of forest in project area. There is no big tree, no valuable tree in the project area, no protected trees and trees with high economic value.

B Condition of vegetation

According to results from the survey and interview of people in the project area. There is no protected trees and valueble plant or vegetation that can count in term of economy value. Project area is not too large. Vegetation found in this area most of them are small tree, with no value for medical resources.

Forest in Project Area

C. Condition of wildlife

According to the interview about wildlife, the project area is located nearby the urban, about 1 km . there is no endange wildlife. General animals are such as : birds, rat, rizards, gekko, scincidae and reptiles (snakes,). In addition, the survey team collected data also found several species insects such as cricket**,** grasshopper and of different insects.

Diagram 1-8 in the areas of environmental projects

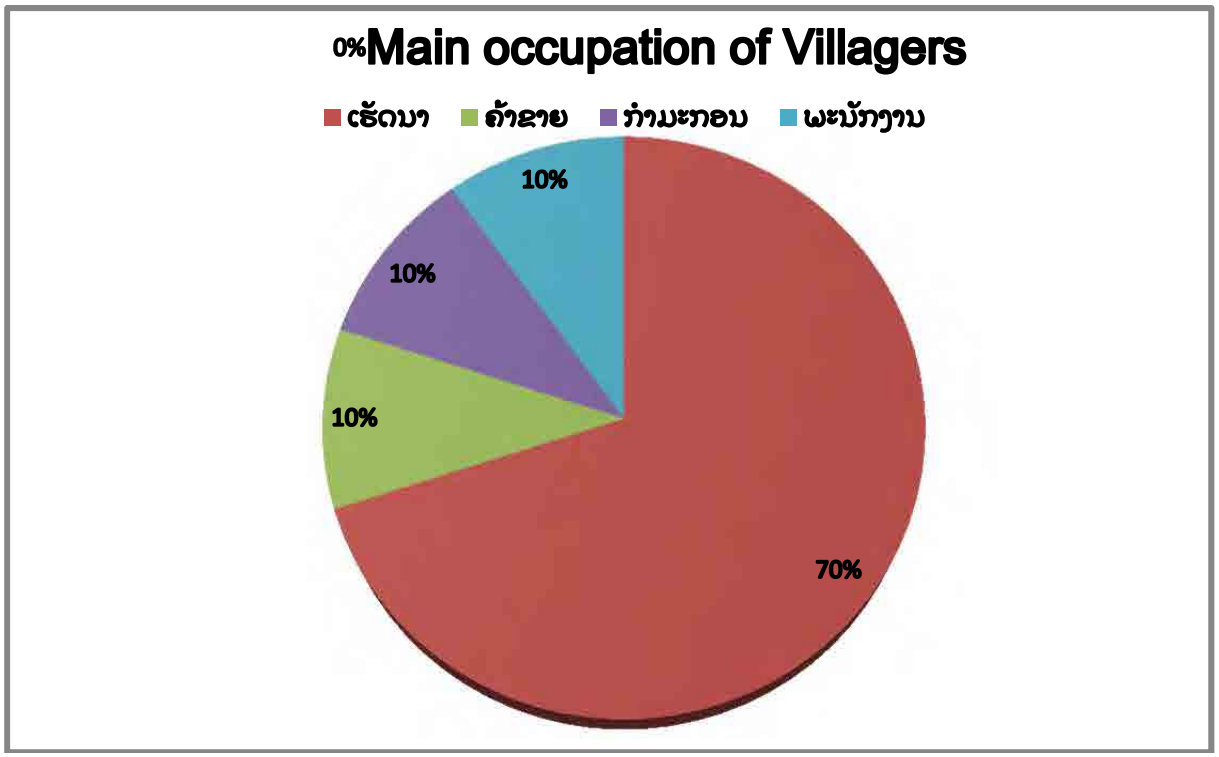
D. Social – Economic

Vientiane Capital combine 9 districts, 4 inner zone and 5 outskirt zone. all population 876.507 people, 483 village, and 201,209 families, combine many national and ethnic living together**.**
Overall, economic of Vientiane capital with the continued growth and others sectors The improvement is specifically infrastructure projects such as: roads, drainage, electricity etc..

Nahai village is an originally village, it total cover area 508 hectares and all population 665 people, women 330 people, 165 household, most of them are Buddhism (99%) and main occupation are farmers and gardening .Those works are income of their families can resolve economic of families. Most household can subsistence.

Organization system of Nahai Village has strong and comprehensive includes head village, youth union, and women union, safety guards. Village activities are planned and regular checking on implementing, cleaning activity, organize sport event and others activities according the guidance of the leader assigned.

The infrastructure in the village is favorable in many aspects such as: electricity, roads, communications, source water, and the other. In addition 2 temple, 1 markets ,1 gas station and repair cars shop, furniture house and create job for people in project area. people in the variety type of the different as following:



E. Public Health Work

Services of public health the attend to ensure the health of the people in factory area. Generally, the public Department of Saysettha has been monitoring the health of people Nahai Village every year, same as other Village. So monitor dengue fever. According to interviews the team studied see problems health of people at Nahai village mostly just flu, diarrhea, malaria and others. During illness mostly they buy drugs at pharmacies, if they get a serious sickness they are going to hospital in the city.

F. Education

According to Laos government policy, education system has expanded from urban to rural, remote area effectively. Public involve in education development, villagers are supported their children to go to school, the number of student go to school have increased, the process involved awareness' campaign for funds rising on education were widespread. In project area 1 primary school. Which 101 students, when students finish their primary school they are going to study secondary school at Dung village, the nearby village.

J. Communication

Apart from main road (450Years), go to community about 1 km and community go to transfer station 1 km and there are some part of the road are not in good condition, it is are inconvenience for the communicator to the village. There is no choice for villagers they have to use that road for daily live for trading , visiting and all activities. During the operating factory will upgrade the road to the road standard to facilitate transportation of waste in and out the factory. The purpose of reducing dust and accident on the road.

Section V
Environmental – Social Impact

5.1 Environmental and social impact

The environmental and social impact is based on the data environmental and social basis collected and compile from the study factory target usually affects the environment and the social in construction phase, it is only short term impact.

- Construction Phase

5.1.1 Air pollution

Construction of the Waste Transfer Station in Nahai village , it is far away from the community about 1 km with minor impact on Climate from the spread of dust from telecommunications of vehicles in the construction or transportation , But the impact of dust poster to the problem slightly controlled and can prevented by the limited speed of the vehicles running in the construction area or construction company should watering the road 2 times / day and preview label, prohibits sign at necessary points. Where people can see risk to ensure safety of life and property of people who are close to those traveling.

5.1.2 Waste water

Water system use is from tap water and it will not affect water sources and other rivers. There may be little impact from the compound of cement, washing cars and the flow of Rainwater and wate water caused by the user in housing of worker. Water contamination or loss will not affect anything because the factory provide water reservoir for collect all wastewater and has Canel around the factory to prevent dirty water to flow outside.

5.1.3 Noise pollution

Pollution control from noise (sound disturb) which may result from activities during construction and transportation by development of administrative districts in project based on Environmental standard of Lao P.D.R. and rules of construction factory industry, with details follows:

Table 2, Target control to pollution sound

No.	Each operating activities	Obligation to implement	Target
1	During clearing	Noise pollution will not exceed	84dB(A)
2	Set over land	Noise pollution will not exceed	89 dB(A)
3	During construction of the building foundation	Noise pollution will not exceed	77 dB(A)
4	Building construction	Noise pollution will not exceed	84 dB(A)

5	During interior decorate	Noise pollution will not exceed	89 dB(A)

Study impact of machinery use during the construction phase. so, some villagers nearby the project areas might be affected by noise disturb which would be impact in the short term (18 months) During the period of the construction, company contractor and Urban Development Administration should have maintained their vehicles regularly to comply with the standards on noise control from the regulation of the Ministry of Labor and Welfare.

5.1.4 Waste Impact

Wastes from activities during the construction phase will include 02 categories such as waste from construction and wastes from daily use of the household. Waste from construction including wood and metal which can be sold to person who collects the metal. For waste from households cannot use will be collected by response organization, and sent to the land field at KM 32.

Waste from daily use of workers may include paper, plastic, food waste. Accord to estimates from waste, used in daily use of workers is not too much. Therefore, we can said affected during the construction phase will not affect the environment and society as a serious issue.

5.1.5 Soil Pollution

Construction of the waste transfer station will not affect the use of soil or public property. It s far away from communities about 1 km, it is empty place. Those land area was clearing and long time use of local people, so there is no big trees. Mix soil such as soil with sand is good for construction, There is no building at the area, before the construction the ares will be dug, tractor for cleaning.

5.1.6 Health affect of workers and community

The results of the study on environment impact shows that during the construction phase will not affect to the health of people living along the road because the factory use modern machinery, international standard level. Therefore it is confidence for health safety:

1) The problem of clearing dust is minimum because the factory area is away from community, may be a bit dust problems by traffic of trucks, construction contractors will watering on roads to reduce dust. Limited speed of vehicles running near a building with a warning label, the label ban to ensure the safety of the community.

2) The problem of waste water, noise and smell from the process of construction is monitoring regularly to ensure the safety of living thing nearby.

The problem secure the health of employee and worker during construction for one of the contractors, and The VUDAA to ensure and avoid the risks if we have an appropriate plan, such as good management and proper preventing air pollution, provide equipment to cover workers at risk by compliance regulations and standard of Lao P.D.R. and prevention measure. In case of accident or illness of employees the construction company assign the team of environmental and social unit will send to treatment in hospital in Vientiane.

Fifty workers and technical staff are needed, such as mechanical workers, designer, site for all monitoring work and other has about. During the construction phase, the period of 6 months is for building temporary house of workers and warehouse for materials. To ensure safety of staffs and workers, the contractor provides safety equipment such as hats, shoes and etc. and provides dustbins and fire distinguishers in the factory area. Meanwhile, the contractor will set the rules and regulation to ensure the social issue such as assets of villagers.

5.2 End of construction phase

After the end of the construction phase, Vientiane municipality major will set up committee for site inspection and this will be monitored by the specialist and relevant sector.

- Operation phase

5.2.1 Air Pollution

During the operation, it might have the impact on some communities from the dust spread and the transport, however dust is a minor issue and can be controlled by limit the speed of trucks and vehicles, and also the condition of road will be upgraded in order to meet the standard. Therefore, this will ensure the safety and security of road using by population and factory's staffs. The traffic sign will be installed in different points which have high risk potential for assure the quality of life and safety.

5.2.2 Water

During the operation phase, it will not have any impact to the water resources because water will not be used in the operation process but only for daily use and cleaning engine. The retention pond will be designed by the expert and this will be proposed to the relavant sector for construction approval. The drainage will be installed surrounding the factory area to prevent the discharge of wastewater to the environment.

5.2.3 Noise Pollution

During the operation phase, minor noise issue would occur due to the transport, however, the VUDAA proposed the great solution to reduce noise pollution by limit the speed of vehicles and provide the traffic signs and monitoring regularly.

5.2.4 Solid waste

Solid waste issue will not impact on communities because all of those wastes will be transferred to the big trucks and transported directly to the landfill at km 32. Thus, this technology is modern and friendly with environment.

5.2.5 Soil

After completing the construction work, the factory area will be lining by reinforce concrete to prevent erosion and land slide to ensure the sanitation and environmental protection for having the good ambiance / atmosphere.

5.2. Health

During the operation, there are 10-15 staffs. All equipments will be controlled by computer system. There is a minor impact on workers and communities' health such as noise from garbage transport and local community transport. However VUDAA proposed the mitigation measure for the driver to decrease the speed and also the budget to road maintenance.

Section **VI**
Environmental Management and Monitoring Plan

6.1 Environmental Management and Monitoring Program

6.1.1 Importance of an Environmental Management and Monitoring Program(EMMP)

The roles and importance of an environmental management and monitoring plan is a bridge between policy and real implementation, the main task to apply on obligation toward the environment protection and social development .

In addition the **(EMMP)** is a one of legal documents which the VUDAA use it as a reference to submit and to request to obtain a certificate for implemention of the project. In principle EMMP would be update periodically or year by year based on existing situation and modify The work plan according to the law and regulation , social need and VUDAA obligation in relation related to ensure the sustainable development.

Table 3: Summary of environmental impact, mitigation measures and monitoring plans

Environmental Impact	Cause	Mitigation measures	Responsibilities
Solid waste	• Waste generated from construction materials and living use by the workers in campus.	• All waste generation would be transported directly to disposal site at KM 32. • Provide waste bins at the factory. • To monitor them regularly.	VUDAA and DONRE office of Saysetha District
Noice	• May produced from construction activities such as driving, tractor, drilling machineries and transportation of equipment and traffic of waste trucks.	• Follow working time: 8:00 am to-16:00pm(8hrs),according to the regulation of the Ministry of Labour. • Determine the speed of truck running in the prevailing standards of MPWT . • Install warning and restricting board for each period. • To monitor at least 1 time / month	VUDAA and DONRE office of Saysetha District
Air impact	• The passing trucks could cause some dust.	• Limit speed of truck and watery every day • inspect at least 1 times / month	VUDAA and DONRE office of Saysetha District
Waste water in the project area	• Washing activities. • Waste water from concrete work. • spilled oil or leakage from machinery. • Waste water from daily use of the temporary house of the staff and workers.	• Facility equiped with water ponds to collect all waste water. • Construction of stormwater drainage system around the project site to prevent direct water pollution to the natural waterstream. • Checking at least 1 time/ month	VUDAA and DONRE office of Saysettha District
Occupational Health and	• Accidents occurred during the	• Employees should have a	VUDAA and DONRE office of

Safety	construction and operation phase. • Getting fire .	protection material such as hats, boots, glasses and others. • Installation of a fire extinguisher in the importance place of building and project site. • Provide enough dustbin at the necessary place of the construction site. • Do not allow to drink alcohol for everyone during working time. • Need to check regularly During construction.	Saysetha District

6.1.2 Implementation of an Environmental Management Plan

The waste transfer station will be assigned 2 persons to take responsibility for the Social and Environmental unit respectively. Two of them should be recruited from Vientian Urban Development and Administration Authority(VUDAA). The monitoring of the environment and social impact is necessary because the accidents and mistaken would be arise at any time such as during construction and operation phase.

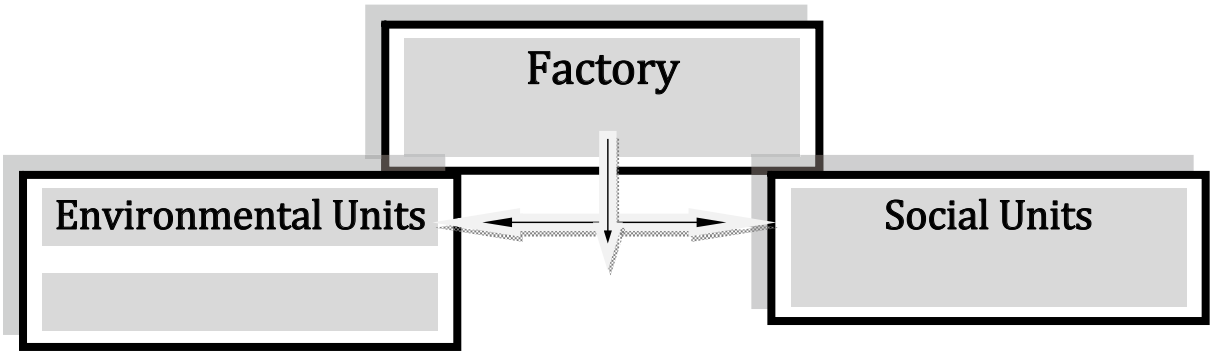


Diagram 1-9 Organization chart

6.1.3. Monitoring Plan

The monitoring for implementation Plan and Environmental Management Community is important in preventing accidents or negative impact to the social and environment . To facilitate the monitoring ,VUDAA must provide information and manual guiline to Environmental Management Unit . VUDAA should establish data base system for monitoring the implementation of environmental and social management.

6.1.4. Reporting system

The report of implementation including progress report and events occurring in factory is an important information. The identification system for reporting and monitoring Management work environment and society as follows:

A. Emergency report

Emergency means all events occurred under the responsibility of Vientiane Urban Development and Administration Authority that could impact to the socio environment. Other emergency report is refered to activities or error of mechanical work by not follow the manual or rules or the contractor company was violated the contract document, technical standards and references to other commitments required. The events listed below will be considered as an emergency report:

- The spill or leakage of fuel /oil leads to danger.
- The fire occurs from construction or in the project area.
- Any changing in the master plan.
- Accidents affecting to the employees who are performing duties In the project area.

B. General report

Environmental and Safety Management Unit must submit a progress report of the work to VUDAA by monthly and quaterly basis . To summary the events and activities performed during the past one month and plan to implement for the next month . Safety issues or activities that will affect the environment and society would have to report regularly .

The quaterly report will include:

- Report of events or activities related to the environment issuies.
- The goal of Implementation measures to prevent and reduce the impact of environmental and social or progress changes.
- Results of the monitoring activities.
- Change or improve environmental management plan for each quarter.

6.1.5. Budget for environmental and social monitoring

The Vientiane Urban Development and Administration set a priority for the environmental protection , workers and communities safety . So, VUDAA should provide some budget to Vientiane capital and district staffs to use for monitoring and implementation of an Environmental Management Plan during the construction and operation phase as detailed below:

Table 4: Monitoring of construction plan by counterpart

No.	Activities	Month				18 Months
		Week 1	Week 2	Week 3	Week 4	Throughout the construction phase
1	Monitoring air quality and odor	← →				
2	Waste Water Management		← →			
3	Noice control			← →		
4	Safety problems	← - - -	- - -	- - -	- - -	- - - →

← → Following the construction of 18 months

Table 5 Estimated budgets for community development

No	type	Amount payments ($)	Amount	Total
1	Renovation access road to factory	25,000	01	25,000
2	Health checking of workers and employees	300	01	300
3	Training and awareness raising	200	03	600
	Total			**25,900**

Table 6 Budget plan for environmental and social monitoring

No	Counterpart responsibility	Amount payments ($)	Amount / year	Total
1	Department of Natural Resources and Environment of Vientiane (DONRE)	300	01	300
2	Office of Natural Resoures and Environment of Saysetha District	150	03	450
3	Contigency	200	01	200
	Total / Month			**950**

LAO PEOPLE'S DEMOCRATIC REPUBLIC
Peace Independence Democracy Unity Prosperity

Ministry of Natural Resource and Environment
Department of Natural Resource and Environment

No 01135/ donre.vte
Date : 10 Jan 2014

CERTIFICATE

- Referred to the amended Environmental Protection Law No 29/ NA, dated on 18 Dec 2012.
- Referred to the orientation on Initial Environmental Examination from invested project and other activities No 8029/monre , dated on 17 Jan 2013.
- Referred to the agreement on organization and implementation of Department of Natural Resource and environment No 1466/ monre, 9 of Mar 2012.
- Referred to the suggestion from Environment Division No 54/ ed , dated on 10 Jan 2014.

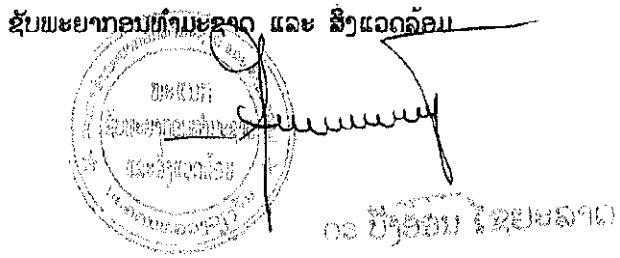
Department of Natural Resource and Environment(DONRE-VTE) agreed on the acceptance to the report of the Initial Environmental Examination(IEE) for :

The project : Waste Transfer station
Company : Vientiane Urban Development and Administration Authority(VUDAA).
Capacity : 220 tons/ day.
Location : in Nahai village, Saysetha district, Vientiane capital.
Area; 2 hectares(ha).

The project developer should take care on Environment Protection with the compliance to the amended Environmental Protection rules No 29/ NA, dated on 18 Dec 2012, others legislation of Lao PDR, and should follow the condition mentioned on the back page of this certificate.

This certificate will be effective from the day of signature.

Vice Director of DONRE



Dr Bang On XAYALATH

(Back page) certificate

The project owner should follow the condition :

1.Directly responsible to the study and data mentioned in the IEE report , in case of Environmental and Social problems occurred and not mentioned in this report, the project owner should take an additional responsibility for environmental plan, measure taken in order to ensure enough budget for implementation.
2. The project owner should be well implemented according to the technical , regulations, orientation , agreement and other related guideline.
3.Take a special care to monitor on Socio- Environmental quality on the construction and implementation phase, make an energy management plan, waste management, water quality, air and so on, including to ensure the implementation of environmental management in the compliance with Lao Standard and oversea standard as well.
4.Assign to district DONRE office in the cooperation with the village authority to take a roles and duties to monitor the implementation of Socio- Environmental Management work of this project.

Copies sending :

1.Vientiane Capital Cabinet Office	1 copy
2.District DONRE office	1 copy
3.DPWT –VTE capital	1 copy
4.Department of Industry and Commerce	1 copy
5. Document keeping	5 copies

7-5 調達機材の数量の算出根拠

1. VTE

(1) 一般廃棄物用収集機材

1) 機材計画の基本的な考え方

① 目標年

プロジェクトの目標年を LPP-E と同じ 2020 年とする。

② 対象ごみ量

現況（2013 年）から、プロジェクトの目標年である 2020 年でのごみ増加量を供与機材の対象ごみ量とする。この対象ごみ量は以下の内容である。

・収集エリア拡張に伴うごみ増加量

・既存収集エリアの中における収集率増加、人口増加、発生原単位の増加に伴うごみ増加量

③ 収集機材の選定

・既存の収集エリアについては現有の収集車両による収集を基本とする。

・2020 年におけるスキップローダによる収集は、現在と同じ台数、収集エリアを基本とする。

2) 人口

既知の 2010 年の人口とマスタープランで用いられている 2020 年の将来予測人口から人口増加率 3.93%を算出し、2013 年、2015 年の人口を設定。

表 7-5-1：VTE の 2010 年から 2020 年の人口予測

Year	2010[1)]	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020[2)]
Population	731,118	759,853	789,717	820,755	853,013	886,539	921,382	957,595	995,231	1,034,347	1,075,000

Source: 1) Vientiane Capital Information and Culture Division, 2010 Population Data from 9 Districts
2) The Project for Urban Development Master Plan Study in Vientiane Capital (JICA 2011)

3) 原単位

ごみの発生原単位は経済成長率に起因する。日本の経済成長時における実績より下式により発生原単位の増加率を算出する。

発生原単位の増加率＝GDP×0.55

＝7.5×0.55

＝4.1％

Source of GDP: The Project for Urban Development Master Plan Study in Vientiane Capital

表 7-5-2：VTE の 2010 年から 2020 年のごみ発生原単位の予測

	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Generation Amount	Generation Rate										
	t/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day
Household Waste	503	0.688	0.716	0.745	0.776	0.808	0.841	0.875	0.911	0.948	0.987	1.027
Waste Other than	134	0.183	0.191	0.199	0.207	0.215	0.224	0.233	0.243	0.253	0.263	0.274
Total		0.871	0.907	0.944	0.983	1.023	1.065	1.108	1.154	1.201	1.250	1.301
	growth rate	4.1										

4)　VTE の収集計画

VTE における VUDAA 及び民間会社の収集エリアについて現状（2013 年）と 2020 年の将来計画を以下に示す。

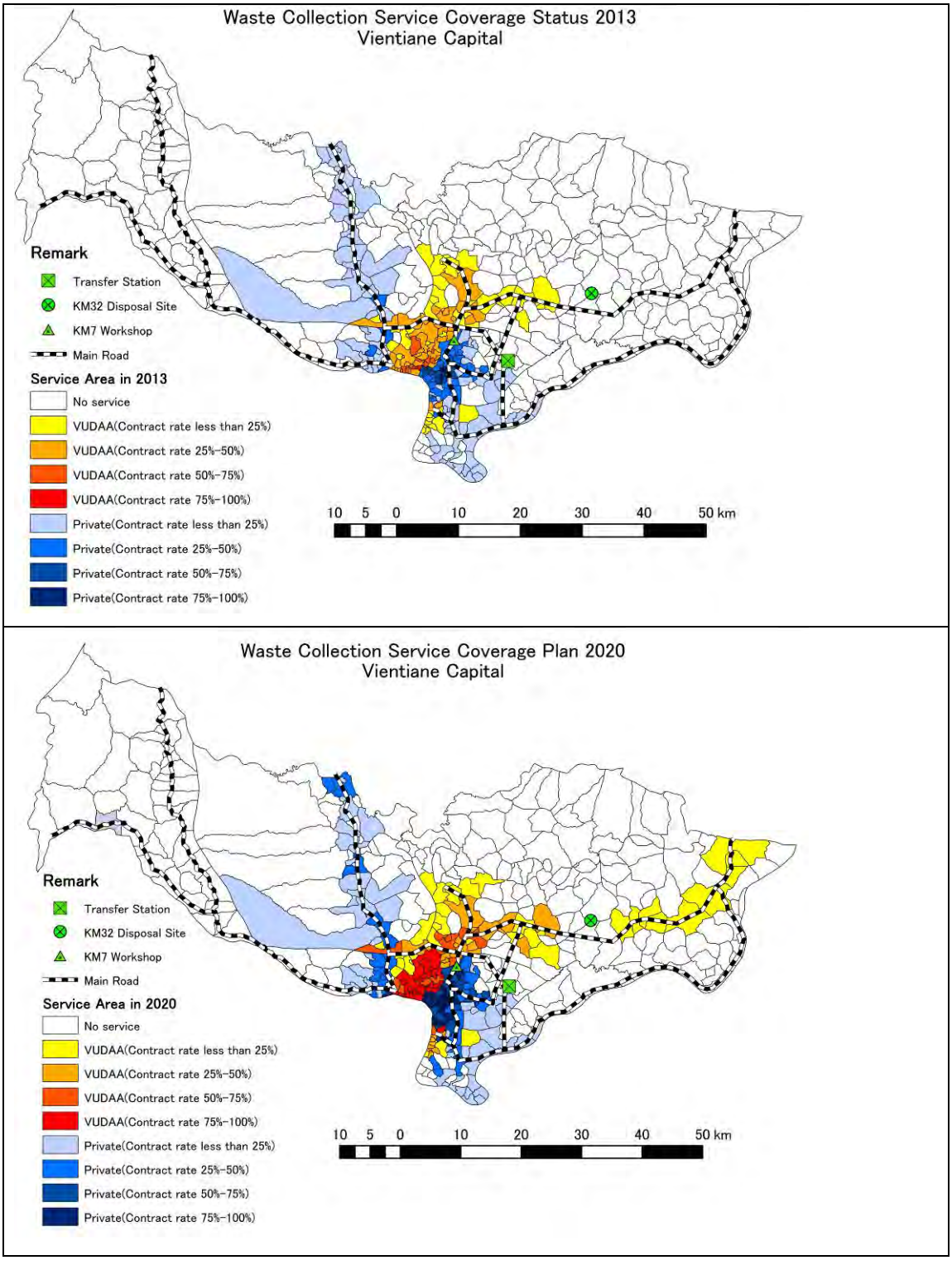


図 VUDAA 及び民間会社による収集範囲（2013 年現況、2020 年計画）

5)　対象ごみ量

上記の条件で算出した各 District の対象ごみ量は以下のとおりである。

表 7-5-3：対象ごみ量（2020 年におけるごみ増加量）　　単位；t

District	Collection Service Organization	Waste generation in 2013	Waste generation in 2020	Growth amount
		データ		
dcne	sks21	合計 / WGA2013	合計 / WGA2020	
Chanthabuly	VUDAA	24.7	98.8	74.1
	Private	11.9	35.0	
Subtotal		36.6	133.8	
Hadxaifong	VUDAA	1.9	5.6	3.7
	Private	5.8	16.9	
Subtotal		7.7	22.5	
Mayparkngum	VUDAA	0.0	2.6	2.6
Subtotal		0.0	2.6	
Naxaithong	VUDAA	0.8	2.3	1.5
	Private	4.3	12.8	
Subtotal		5.1	15.0	
Sikhottabong	VUDAA	20.9	82.4	61.5
	Private	8.3	25.0	
Subtotal		29.2	107.4	
Sisattanak	VUDAA	3.2	14.9	11.7
	Private	28.6	109.6	
Subtotal		31.8	124.6	
Xaysetha	Private	38.5	105.5	
Subtotal		38.5	105.5	
Xaythany	VUDAA	17.8	53.1	35.3
Subtotal		17.8	53.1	
Total		166.7	564.5	

	Waste generation in 2013	Waste generation in 2020	Growth amount
VUDAA	69.3	259.7	190.4
Private company	97.4	304.8	207.4
Total	166.7	564.5	397.7

上表で算出されたごみ増加量（190.4t/日）に対して供与機材の計画を行う。

6)　中継基地計画

中継基地へ搬入する対象エリアを決定するにあたり、中継基地から何 km 圏内を対象にすると効率化が図れるか（トータルコストが安くなるか）を検討した。

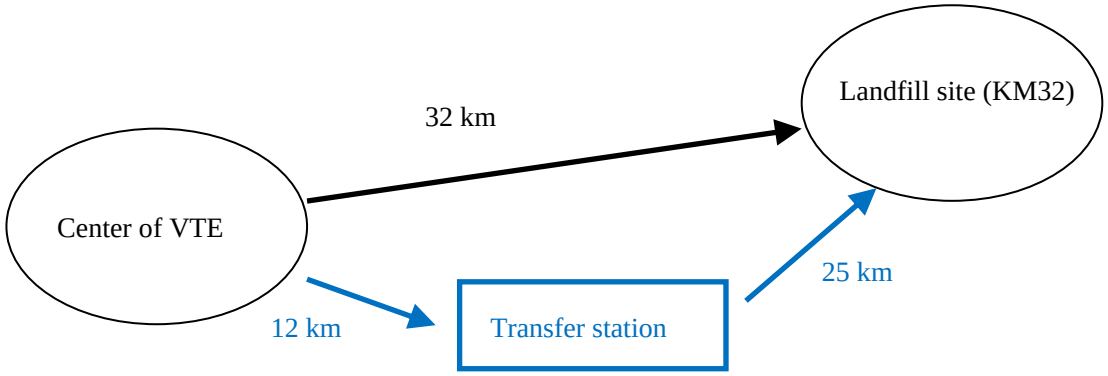


図 1　中継基地の位置関係

表 7-5-4：各収集車両の運営コスト

Depreciation Cost: 0	Maintenance Cost: 6% of CIF price					
Items	Unit	Compactor 6m3		Skip Loader 5m3		Compactor 20m3
Distance	km	32	12	32	12	25
Diesel consumption per km for travelling	km/l	6	6	6	6	2
Collection and discharge time	minutes	53	53	15	15	20
Effeciency for working hours		0.9	0.9	0.9	0.9	0.9
Diesel consumption per minutes for collection	min/l	30	30	30	30	15
Diesel quantity for traveling	liter/trip	10.7	4.0	10.7	4.0	25
Diesel quantity for collection	liter/trip	1.6	1.6	0.5	0.5	1.2
Total consumption quantity of diesel	liter/trip	12.3	5.6	11.1	4.5	26.2
Unit rate of diesel	$/liter	1.1	1.1	1.1	1.1	1.1
Fuel cost per trip	$/trip	13.5	6.2	12.3	4.9	29.0
Trip nos per day	Trip/day	2.00	4.00	3.00	6.00	3.00
Fuel cost per day	$/day	27	25	37	30	87
Maintenance cost	$/day	20	20	20	20	50
Salary	$/day	10.4	10.4	10.4	10.4	10.4
O&M cost per day	$/day	57.5	55.1	67.3	59.9	147.3
O&M cost per trip	$/trip	28.7	13.8	22.4	10.0	49.1
Daily Waste transportation Amount	ton/day	4.86	9.72	4.05	8.10	24.3
Unit cost per ton of waste	**$/ton**	**11.8**	**5.7**	**16.6**	**7.4**	**6.1**

上表は収集機材（コンパクタートラック 6m^3、スキップローダ 5m^3）が VTE 市内から直接 KM32 の最終処分場に搬入した場合（距離；32km）と中継基地を経由し（距離；12km）、KM32 の最終処分場に搬入した場合（距離；25km）の収集ごみ 1t に要するコストを計算したものである。コストには燃料代、人件費、車両のメンテナンス費が含まれている。

その結果、コンパクタートラック 6m^3、スキップローダ 5m^3 共に**中継基地より 12km 圏内を対象とした場合に中継基地を経由した方がコストが安くなるもしくは同等となる**ことが分かった。そこで中継基地へ搬入するエリアを中継基地より 12km 以内と設定した。

表 7-5-5:　運営コスト比較

	直接 KM32 最終処分場へ搬入した場合	中継基地を経由した場合
コンパクタートラック 6m^3	11.8 $/t	5.7 $/t + 6.1 $/t = 11.8 $/t
スキップローダ 5m^3	16.6 $/t	7.4 $/t + 6.1 $/t = 13.5 $/t

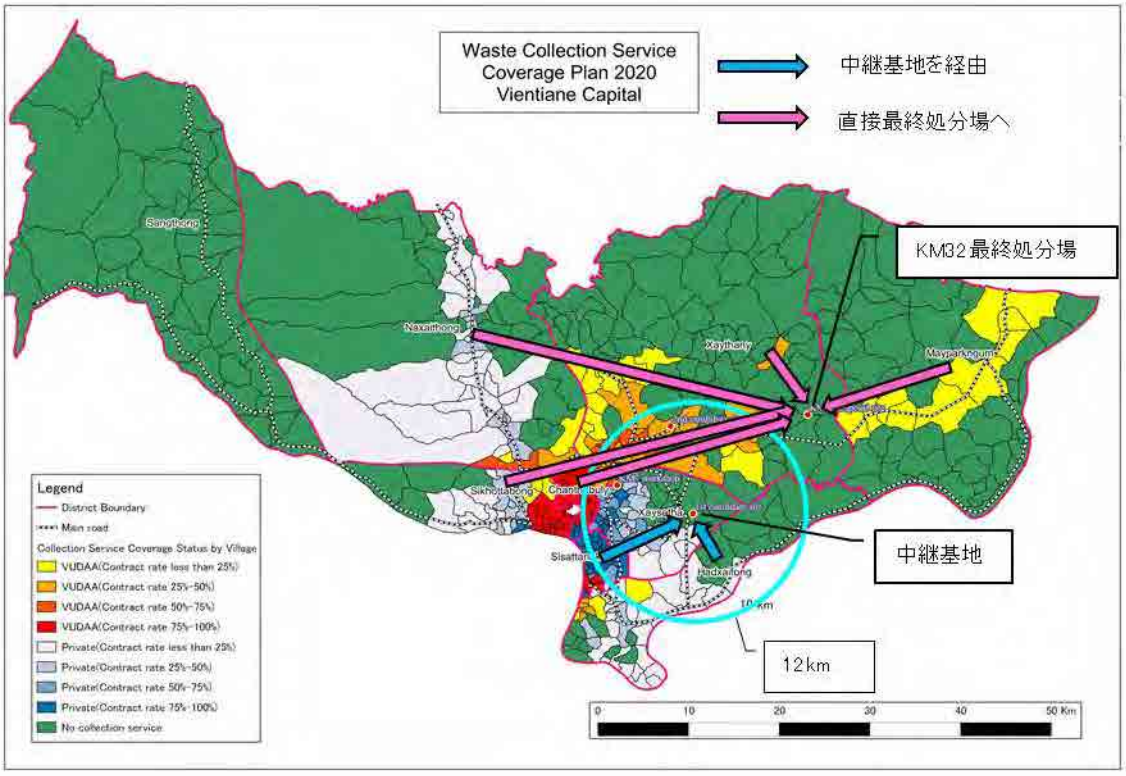


図 2　各 District から収集されたごみの運搬先

7)　機材計画

District 毎に処分場もしくは中継基地までの距離を設定し、トリップ数、積載量から収集に必要な台数を算出した。

1 日当たりの必要収集量は週 6 日収集日を考慮し、対象ごみ量×7/6 で算出した。

表 7-5-6: 各収集車両の必要台数算出根拠

① Collection Site → Landfill Site (10m3 and 6m3 Compactor)

		Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
		km	times	t/trip	t/d	unit	t/d	t/d
Chanthabuly	10m3	33.00	2.00	4.05	8.10	7	56.7	
	6m3	33.00	2.00	2.43	4.86	7	34.02	86.4
	Total						90.72	
Xaythany	10m3	25.00	2.00	4.05	8.10	3	24.3	
	6m3	25.00	2.00	2.43	4.86	4	19.44	41.2
	Total						43.74	
Naxaithong	Dump truck	36.00	1.00	3.15	3.15	1	3.15	
								1.8
	Total						3.15	
Sikhottabong	10m3	37.00	2.00	4.05	8.10	6	48.6	
	6m3	37.00	2.00	2.43	4.86	6	29.16	71.8
	Total						77.76	
Mayparkngum	Dump truck	25.00	1.00	3.15	3.15	1	3.15	
								3.0
	Total						3.15	
Total	10m3					16		
	6m3					17	215.37	201.1
	Dump truck					2		

② Collection Site → Transfer Station (6m3 Compactor)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Hadxaifong	20.00	3.00	2.43	7.29	1	7.29	4.3
Sisattanak	23.00	2.00	2.43	4.86	3	14.58	13.7
Total					**4**	21.87	18.0

③ Collection Site → Transfer Station (5m3 Skip Loader)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
		5.00	1.35	6.75	5	33.75	
Total					**5**		

④ Transfer Station → Landfill Site (20m3 Compactor)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
	26.00	3.00	8.10	24.30	3	72.9	51.7
Total					**3**		51.7

(2) 最終処分場用機材

1) ブルドーザ

KM32 最終処分場には 2020 年において 659t/日、1,648m^3（比重 0.40t/m^3）のごみが搬入される。

ブルドーザ（普通 20t 級）による日当たり作業量は 540m^3（出典；平成 25 年国土交通省土木積算基準）であることから、日搬入量を処理するためには普通 20t 級 3 台が必要である。

2012 年に LPP-E を通じてブルドーザ（普通 21t 級）1 台が供与されており現在稼動していることから、本プロジェクトでは残りの搬入ごみを処理するために、20t 級 1 台を調達する。（現有 1 台と新規調達 1 台の合計 2 台では 1 日の処理量全てを賄うことはできないが、不足するブルドーザは必要に応じて「ラ」国側で調達するものとする。）

2) エクスカベータ

エクスカベータは主に覆土材の掘削、積み込みに使用され、衛生埋め立てにおいて毎日の覆土は必要不可欠である。

1 日当りに必要な覆土量は以下のとおりである。

（日当たりごみ搬入量）÷（ごみ積み上げ高さ）×（覆土厚さ）＝（覆土量）

$1648m^3$ ÷ 2.5m × 0.25m ＝$165m^3$

平成 25 年国土交通省土木積算基準の地山の掘削積み込みに基づき必要台数を算出すると、エクスカベータ（平積 $0.6m^3$）による日当たり作業量は $300m^3$ であるためエクスカベータ（平積 $0.6m^3$）1 台が必要となる。

2011 年にエクスカベータ（平積 $0.6m^3$）1 台が導入されていることから本プロジェクトでは調達は行わない。

3) 散水車

処分場内道路の路面乾燥から発生する砂、粉塵の飛散防止対策としての散水、投棄されたごみの火災時における消火目的として散水車（$6m^3$）を 1 台調達する。

(3) 中継基地用機材

1) バキュームカー

新たに建設される中継基地内の汚水（収集車の洗車汚水）を KM32 最終処分場にあるし尿処理施設に運搬するためバキュームカー（$5m^3$）を 1 台調達する。

(4) 医療廃棄物用収集機材

1) 医療廃棄物用収集車

VTE 内にある 10 箇所の病院から $6.1m^3$/日（約 1.0t/日）の医療廃棄物が発生する。これを収集するための車両（$3.5m^3$）を 1 台調達する。

表 7-5-7：VTE への調達機材一覧

機材内容	要請	検討結果	増減
$10m^3$圧縮収集車	24	16	-8
$6m^3$ 圧縮収集車	6	21	+15
ダンプカー	0	2	+2
コンテナ用複式収集車	4	4	0
長距離輸送車（トレーラー）	10	0	-10
$20m^3$圧縮収集車	0	3	+3
ブルドーザ	1	1	0
エクスカベータ	1	0	-1
散水車	1	1	0
バキュームカー	0	1	+1
医療廃棄物用収集車	1	1	0

2. LPB

(1) 一般廃棄物用収集機材

1) 機材計画の基本的な考え方

① 目標年

プロジェクトの目標年を LPP-E と同じ 2020 年とする。

② 対象ごみ量

プロジェクトの目標年である 2020 年でのごみ量を供与機材の対象とする。

③ 収集機材の選定

・都市部においては、現状のダンプトラックによる収集により発生しているごみの飛散、悪臭、ごみ汁の垂れ流し等の問題を解消するため、コンパクタートラックによる収集を基本とする。また道路幅員が狭い箇所や、行き止まり道路が多いことから小さいコンパクタートラック（6m^3）とする。

・地方部は、現況と同じ大容量を収集できるダンプトラック（10m^3）を基本とする。

・2020 年におけるスキップローダによる収集は、現在と同じ台数、収集エリアを基本とする。

2) 人口

Socio-economic Development Plan (2009-2015) から人口増加率 1.80%を算出し、2020 年の人口を設定。

表 7-5-8:LPB の 2009 年から 2020 年の人口予測

Year	2009[1)]	2010[1)]	2011[1)]	2012[1)]	2013[1)]	2014[1)]	2015[1)]	2016	2017	2018	2019	2020
Population	80,808	82,263	83,743	85,251	86,785	88,347	89,938	91,557	93,205	94,883	96,591	98,330

Source: 1) Socio-economic Development Plan (2009-2015)

3) 原単位

ごみの発生原単位は経済成長率に起因する。日本の経済成長時における実績より下式により発生原単位の増加率を算出する。原単位のベースは技プロで 2011 年に実施した WACS より得られたものを用いる。

発生原単位の増加率＝GDP×0.55

＝7.5×0.55

＝4.1％

Source of GDP: The Project for Urban Development Master Plan Study in Vientiane Capital

表 7-5-9:LPB の 2011 年から 2020 年のごみ発生原単位の予測

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day
Urban	0.569	0.592	0.616	0.641	0.667	0.694	0.722	0.752	0.783	0.815
Rural	0.766	0.797	0.830	0.864	0.899	0.936	0.974	1.014	1.056	1.099
	growth rate	4.1								

4) LPB の収集計画

LPB における UDAA 及び民間会社の収集エリアについて現状（2013 年）と 2020 年の将来計画を以下に示す。

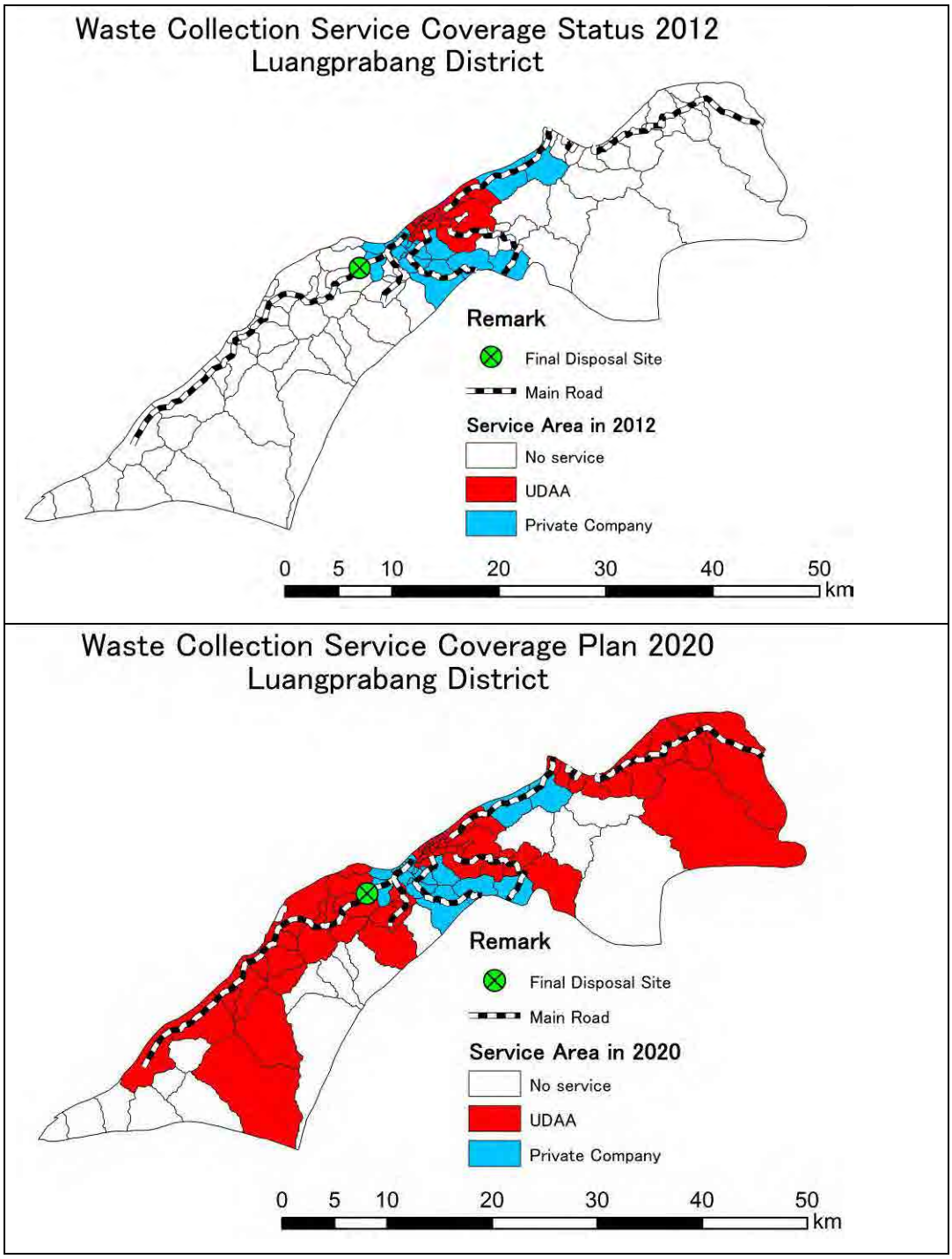


図:UDAA 及び民間会社による収集範囲（2013 年現況、2020 年計画）

5) 対象ごみ量

上記の条件で算出した地区別の対象ごみ量は以下のとおりである。

表 7-5-9:対象ごみ量　　単位；t

合計 / WGA2020 by UDAA(Mod)	
vtype	集計
Central Urban	5.7
Close to main	20.1
Remote	3.4
Sub-urban	19.2
Urban	5.9
総計	54.4

上表で算出されたごみ量（54.4t/日）に対して供与機材の計画を行う。

6)　機材計画

地区毎に既存処分場までの距離を設定し、トリップ数、積載量から収集に必要な台数を算出した。

1 日当たりの必要収集量は週 6 日収集日を考慮し、対象ごみ量×7/6 で算出した。

表 7-5-10:各収集車両の必要台数算出根拠

① Central urban, Urban, Sub-urban → Landfill Site (6m3 Compactor)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Central urban, Urban	8.00	4.00	2.43	9.72	1	9.72	10.2
Sub urban	13.00	3.00	2.43	7.29	3	21.87	19.0
Total					**4**	31.59	29.2

③で算出したスキップローダーによる収集量を「Central urban, Urban」及び「Sub urban」の必要収集量から減じている。

② Close to main, Remote → Landfill Site (Dump truck)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Close to main	20.00	2.00	3.15	6.30	4	25.2	23.5
Remote	25.00	1.00	3.15	3.15	1	3.15	4.0
Total					**5**	28.35	27.5

ダンプトラック5台が必要となるが、2012年に技術協力プロジェクトより既に2台供与されているため、3台を供与する。

③ Central urban, Urban, Sub-urban → Landfill Site (5m3 Skip loader)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Central urban, Urban, Sub-urban	8.00	5.00	1.35	6.75	1	6.75	
Total					**1**	6.75	

トリップ数は現況の数値（5トリップ）採用。

(2)　処分場用機材

1)　ブルドーザ

最終処分場には 2020 年において 87t/日、218m^3（比重 0.40t/m^3）のごみが搬入される。

ブルドーザ（普通 10t 級）による日当たり作業量は 238m^3 であることから、日搬入量を処理するために普通 10t 級 1 台を調達する。

2) 散水車

処分場内道路の路面乾燥から発生する砂、粉塵の飛散防止対策としての散水、投棄されたごみの火災時における消火目的として散水車（6m^3）を 1 台調達する。

表 7-5-11:LPB への調達機材一覧

機材内容	要請	検討結果	増減
6m^{3}圧縮収集車	2	4	+2
ダンプトラック	3	3	0
コンテナ用複式収集車	3	1	-2
ブルドーザ	1	1	0
散水車	1	1	0

3. XYB

(1) 一般廃棄物用収集機材

1) 機材計画の基本的な考え方

① 目標年

プロジェクトの目標年を LPP-E と同じ 2020 年とする。

② 対象ごみ量

プロジェクトの目標年である 2020 年でのごみ量を供与機材の対象とする。

③ 収集機材の選定

・都市部においては、現状のダンプトラックによる収集により発生しているごみの飛散、悪臭、ごみ汁の垂れ流し等の問題を解消するため、コンパクタートラックによる収集を基本とする。幅員の広い道路が多いため大きめのコンパクタートラック（10m^3）とする。

・地方部は、現況と同じ大容量を収集できるダンプトラック（10m^3）を基本とする。

・2020 年におけるスキップローダによる収集は、現在と同じ台数、収集エリアを基本とする。

2) 人口

Census (2005) と Provincial governor office (2012) から人口増加率 1.66%を算出し、2020 年の人口を設定。

表 7-5-12:XYB の 2012 年から 2020 年の人口予測

Year	2012[2)]	2013	2014	2015	2016	2017	2018	2019	2020
Population	70,279	71,449	72,638	73,847	75,076	76,326	77,596	78,887	80,200

Source: 1) Census 83 villages (2005)
2) Provincial governor (2012)

3) 原単位

ごみの発生原単位は経済成長率に起因する。日本の経済成長時における実績より下式により発生原単位の増加率を算出する。原単位のベースは技プロで 2011 年に実施した WACS より得られたものを用いる。

発生原単位の増加率＝GDP×0.55

＝7.5×0.55

＝4.1％

Source of GDP: The Project for Urban Development Master Plan Study in Vientiane Capital

表 7-5-13:XYB の 2011 年から 2020 年のごみ発生原単位の予測

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day	kg/p/day
Urban	0.569	0.592	0.616	0.641	0.667	0.694	0.722	0.752	0.783	0.815
Rural	0.766	0.797	0.830	0.864	0.899	0.936	0.974	1.014	1.056	1.099
	growth rate	4.1								

4) XYB の収集計画

XYB における UDAA 及び民間会社の収集エリアについて現状（2013 年）と 2020 年の将来計画を以下に示す。

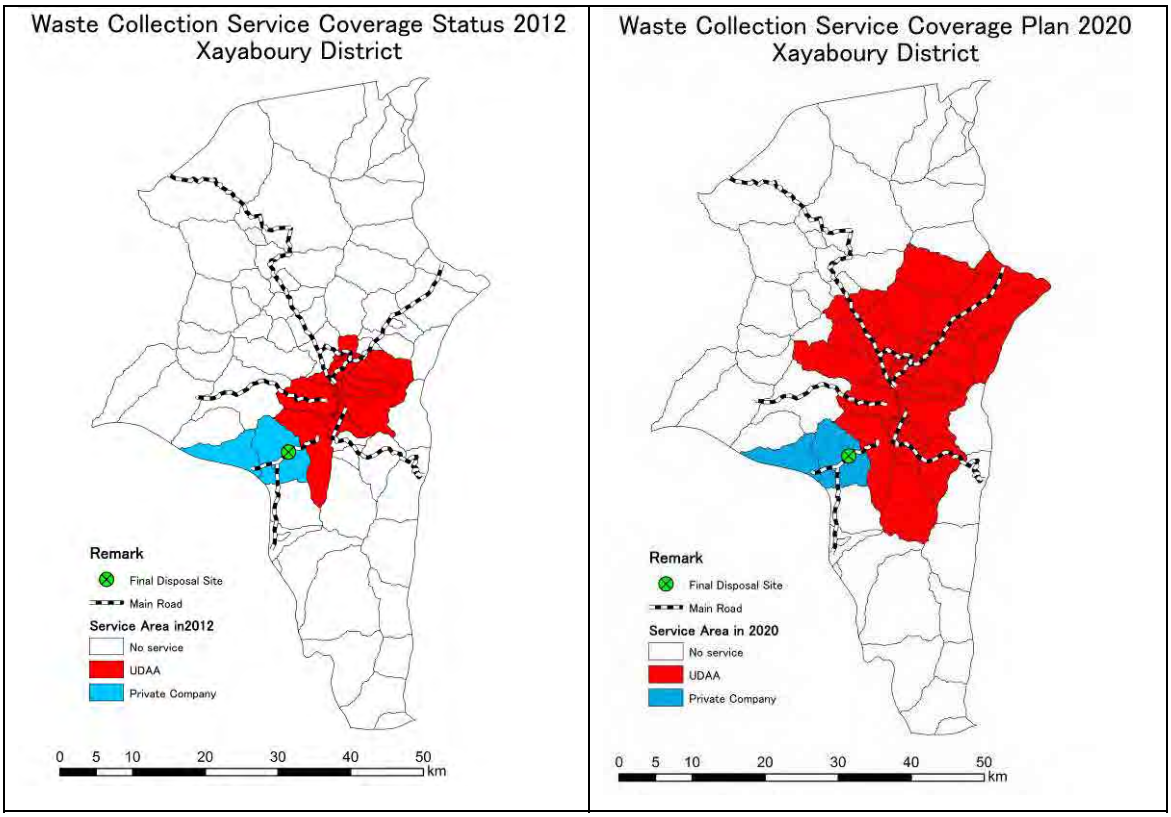


図:UDAA 及び民間会社による収集範囲（2013 年現況、2020 年計画）

5) 対象ごみ量

上記の条件で算出した地区別の対象ごみ量は以下のとおりである。

表 7-5-14:対象ごみ量　　単位；t

合計 / WGA2020 by UDAA	
Category	集計
urban	28.5
sub-urban	9.4
rural	1.3
総計	39.1

上表で算出されたごみ量（39.1t/日）に対して供与機材の計画を行う。

6) 機材計画

地区毎に既存処分場までの距離を設定し、トリップ数、積載量から収集に必要な台数を算出した。

1 日当たりの必要収集量は週 6 日収集日を考慮し、対象ごみ量×7/6 で算出した。

表 7-5-15:各収集車両の必要台数算出根拠

① Urban → Landfill Site (10m3 Compactor)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Urban	10.00	4.00	4.05	16.20	2	32.4	30.5
Total					**2**	32.4	30.5

③で算出したスキップローダーによる収集量をUrbanの必要収集量から減じている。

② Sub-urban, Rural → Landfill Site (Dump truck)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Sub-urban, Rural	20.00	2.00	3.15	6.30	2	12.6	12.5
Total					**2**	12.6	12.5

ダンプトラック2台が必要となるが、2011年に1台供与されているため、1台を供与する。

③ Central urban, Urban → Landfill Site (5m3 Skip loader)

	Half way distance	Trips per day	Waste carried per trip	Waste carried per day	Quantity of truck	Total waste carried per day	Necessary collection amount
	km	times	t/trip	t/d	unit	t/d	t/d
Central urban, Urban	10.00	2.00	1.35	2.70	1	2.7	
Total					**1**	2.7	

トリップ数は現況の数値（2トリップ）採用。

(2) 処分場用機材

1) エクスカベータ

エクスカベータは主に覆土材の掘削、積み込みに使用され、衛生埋め立てにおいて毎日の覆土は必要不可欠である。

XYB の最終処分場では 2020 年において 52t/日、130m^3（0.4t/m^3）のごみが搬入される。これに必要な覆土量は以下のとおりである。

（日当たりごみ搬入量）÷（ごみ積み上げ高さ）×（覆土厚さ）＝（覆土量）

130m^3 ÷ 2.5m × 0.25m ＝13m^3

平成 25 年国土交通省土木積算基準の地山の掘削積み込みに基づき必要台数を算出すると、エクスカベータ（平積 0.6m^3）による日当たり作業量は 300m^3 であるためエクスカベータ（平積 0.6m^3）1 台が必要となる。実際の 1 日当りの作業量と作業能力の数値に開きがあるが、XYB の最終処分場では、搬入されてきたごみを敷き均す作業にもエクスカベータを用いることができるため大きめの重機を調達する。

2)　散水車

処分場内道路の路面乾燥から発生する砂、粉塵の飛散防止対策としての散水、投棄されたごみの火災時における消火目的として散水車（6m^3）を１台調達する。

表 7-5-16:XYB への調達機材一覧

機材内容	要請	検討結果	増減
10m^{3}圧縮収集車	0	2	+2
ダンプトラック	5	1	-4
コンテナ用複式収集車	2	1	-1
エクスカベータ	0	1	+1
散水車	1	1	0

7-6 中継基地の妥当性

１） 中継基地運営費の算定

中継基地の運転コストは、労務費と積み替え機械のモーターを駆動するための電気代とに大きく分かれる。以下に 1 か月当たりの運転コストとごみ 1 トン当たりの積み替えコストの積算結果を示す。

表 7-6-1：中継基地の運営維持管理費

項目	単位	数量	単価（LAK)	金額（LAK)	備考
１．直接運転経費					
労務費	MM	4	800,000	3,200,000	
電気代	KWh	10,400	786	8,174,400	モーター消費電力
雑材量	式	1	1,572,000	1,572,000	
小計				12,946,400	
２．間接経費	%	20	12,946,400	2,589,280	
合計	LAK/月			15,535,680	1月間運転コスト
	LAK/年			186,428,160	1年間運転コスト
	LAK/トン			11,950.5	t当り運転コスト

Note: 1：搬入ごみ量：52t/日、 25 日/月稼働、1,300t/月受け入れ
2：積み替え機械稼働時間、4 時間/日 25 日/月 モーター出力 52kW/基×2 基
3.1LAK=0.013 円

２） 1 日収集車トリップ数とごみ運搬量の計算

次に収集車の 1 日トリップ数の算定するために、以下の条件を設定する。

表 7-6-2：1 日トリップ数算定の条件

中継基地の位置	12km市中心街の収集ポイントからの距離 25km：中継基地から処分場までの距離
最終処分場の位置	32km：市中心街から処分場までの距離
一次収集車	5m^3 Skip Loader：市中心街から中継基地までの運搬
二次収集車	20m^3 Compactor Truck :中継基地から処分場までの運搬
ごみの比重	0.3 t/m^3: Skip Loader 0.45 t/m^3: Compactor Truck

以上の条件のもとに、一次収集によるトリップ数を収集ポイントから中継基地までの距離を 12km、収集ポイントから処分場までの距離を 32km と設定して、処分場へ直接運搬する場合と中継基地へ運搬する場合の 1 日可能トリップ数及びごみ運搬量を下記の通り算出する。

表 7-6-3：一次収集の 1 日可能トリップ数

項目	単位	Skip Loader 5m^3	
		処分場に搬入	中継基地に搬入
Payload	T	6.00	6.00
Capacity in volume	m^3	5.00	5.00
Half way distance	Km	32.00	12.00
One trip distance	Km	64.00	24.00
Velocity of vehicle	km/h	35.00	35.00
Specific gravity of waste	t/m^3	0.20	0.20
Density of waste when hauled	t/m^3	0.30	0.30
t1:Working hour	H	7.50	7.50
t2:Daily service time	Min	30.00	30.00
t3:Loading time per trip	Min	10.00	10.00
t4:Unloading time	Min	5.00	5.00
E: Efficiency of loading capacity	-	0.90	0.90
f: Efficiency of working time	-	0.90	0.90
Waste carried per trip	t/trip	1.35	1.35
Waste carried per day	t/d	4.05	8.10
Nos of trips per day	Times	3.03	6.73
Adjusted Nos of trips per day	Times	3.00	6.00

この結果によると処分場まで直接運搬した場合は 3trip/日、中継基地まで運搬した場合は 6trip/日となった。

次に、二次収集で 20m^3 コンパクタートラックが、中継基地から処分場まで運搬するのに 1 日に可能なトリップ数を下表の通り算出する。

表 7-6-4：中継基地から処分場へ運搬する 1 日可能トリップ数

Description	Unit	Compactor(20 m^3)
Payload	t	10.00
Capacity in volume	m^3	20.00
Half way distance	km	**25.00**
One trip distance	km	50.00
Velocity of vehicle	km/h	35.00
Specific gravity of waste	t/m^3	0.11
Density of waste when hauled	t/m^3	0.45
t1:Working hour	h	7.50
t2:Daily service time	min	30.00
t3:Loading time per trip	Min	15.00
t4:Unloading time	Min	5.00
E: Efficiency of loading capacity	-	0.90
f: Efficiency of working time	-	0.90
Waste carried per trip	t/trip	8.10
Waste carried per day	t/d	24.30
Nos of trips per day	times	3.58
Adjusted Nos of trips per day	times	**3.00**

この結果によると、20m^3 コンパクタートラックは中継基地から処分場まで 1 日 3 トリップ、24.3t のごみを運搬することが可能である。

３） 収集コストの計算

次に以下の条件のもとに、ごみ 1t 当たりの収集コストの算定を行う。

表 7-6-5：収集コストの計算条件

項目	計算条件
燃料（ディーゼル）	8,500LAK/liter
運転手・作業員給与	800,000LAK/月
収集チーム	運転手1名＋作業員3名
為替	1 LAK=0.00013US$
車両の償却費	無償供与につき考慮せず
維持修理費	車両価額（CIF）の6%/年
車両価額（CIF Price）	$20m^3$ Compactor Truck：277,000US$ $5m^3$ Skip Loader：83,000US$

表 7-6-6：ごみ 1t 当たり収集運搬コスト

Items	Unit	Skip Loader $5m^3$		Compactor $20m^3$
Distance	Km	32	12	25
Diesel consumption per km for travelling	km/l	6	6	3
Collection and discharge time	minutes	15	15	20
Efficiency for working hours		0.9	0.9	0.9
Diesel consumption per minutes for collection	min/l	30	30	15
Diesel quantity for traveling	liter/trip	10.7	4.0	25
Diesel quantity for collection	liter/trip	0.5	0.5	1.2
Total consumption quantity of diesel	liter/trip	11.1	4.5	26.2
Unit rate of diesel	LAK/liter	8,685	8,685	8,685
Fuel cost per trip	LAK/trip	96,548	38,650	227,555
Trip nos per day	Trip/day	3	6.0	3
Fuel cost per day	LAK/day	289,656	231,888	682,665
Maintenance cost	LAK/day	157,200	157,200	393,000
Salary	LAK/day	80,000	80,000	80,000
O&M cost per day	LAK/trip	526,856	469,100	1,155,665
O&M cost per trip	t/day	175,615	78,183	385,222
Daily Waste transportation Amount	LAK/t	4.05	8.10	24.3
Unit cost per t of waste	LAK/liter	**130,088**	**57,914**	**47,558**

４） ごみ積み替えによる収集コストの比較

以上の計算結果をもとに、$5m^3$ Skip Loader が直接処分場に運搬する場合と、中継基地で積み替える場合の収集コストの比較結果を以下に示す

表 7-6-8：中継基地ごみ積み替えによる収集コスト比較

項目	積み替えせず (LAK/t)	積み替え（LAK/t）
1次収集（収集ポイント→中継基地 or 処分場）	130,088	57,914
2次収集（中継基地→処分場）		47,558
積み替えコスト（中継基地運営）		11,951
合計	130,088	117,423

7-7 車両１日１台当たり運営維持管理費の算出

維持管理費（CIF6%）減価償却費なし

コンパクタートラック(6m^3) (10m^3)(20m^3)、スキップローダ(5m^3)の１日１台当たり運営維持管理費を下表に掲載する。なお、ダンプトラック、散水車、バキュームカー、医療廃棄物収集車の１日１台当たり運営維持管理費はコンパクタートラック(6m^3)と同じと仮定する。

表 7-7-1：1 日 1 台当たり運営維持管理費

Items	単位	Compactor 6m^3	Compactor 10m^3	Skip Loader 5m^3	Compactor 20m^3
Distance	km	32	32	32	25
Diesel consumption per km for travelling	km/l	6	6	6	3
Collection and discharge time	minutes	53	60	15	20
Effeciency for working hours		0.9	0.9	0.9	0.9
Diesel consumption per minutes for collection	min/l	30	20	30	15
Diesel quantity for traveling	liter/trip	10.7	10.7	10.7	25
Diesel quantity for collection	liter/trip	1.6	2.7	0.5	1.2
Total consumption quantity of diesel	liter/trip	12.3	13.4	11.1	26.2
Unit rate of diesel	LAK/liter	8,685	8,685	8,685	8,685
Fuel cost per trip	LAK/trip	106,449	116,094	96,548	227,555
Trip nos per day	Trip/day	2	2	3	3
Fuel cost per day	LAK/day	212,906	232,188	289,656	682,665
Maintenance cost	LAK/day	157,200	157,200	157,200	393,000
Salary	LAK/day	80,000	80,000	80,000	80,000
O&M cost per day	**LAK/day**	**450,106**	**469,388**	**526,856**	**1,155,665**
O&M cost per trip	LAK/trip	225,053	234,694	175,615	385,222
Daily Waste transportation Amount	t/day	4.86	8.10	4.05	24.3
Unit cost per t of waste	LAK/t	92,614	57,949	130,088	47,558

7-8 最終処分場の運営維持管理費の算出

（1） 最終処分場機材の緒元

処分場へ供与する予定機材の、日当り施工量[1]及び時間当り燃料消費量[2]は次頁の通りである。

表 7-8-1　処分場機材の諸元

機材名	日当り施工能力 (m^3/日)	馬力（kW）	燃料消費量 （liter/時間）	供与場所
ブルドーザ（21 tクラス）	540	152	24	VTE
ブルドーザ（10 tクラス）	238[3]	67	12	LPB
エクスカベータ（0.6m^3クラス）	300	104	18	XYB

（2） 2020 年の処分場の日当たり最終処分量

それぞれの処分場の目標年度（2020 年）の日当たり最終処分量は以下の通り。

表 7-8-2:2020 年の日当たり最終処分量[4]

プロジェクトサイト	最終処分量 (t/日)	体積[5] （m^3/日）	備考
VTE	659	1,648	564.5t/日×7日÷6日
LPB	88	218	75.6t/日×7日÷6日
XYB	52	130	44.3t/日×7日÷6日

（3） 最終処分場の維持管理費

最終処分場の維持管理費として既存の重機や施設を維持管理する運営費および新規機材として供与される重機の労務費（運転手給与）、燃料費を計上する。機械償却費および維持管理費などについては、「ラ」国の地方政府は単年度予算で機械償却費を計上するシステムはなく、かつ機材は無償で供与された新しい機材であり、導入後数年はほとんど修理代も発生しないので計上しない。

1） VTE

KM32 最終処分場の既存の重機や施設を維持管理する運営費は、2012 年の実績から 652,376 千 LAK/年とする。新規機材として供与される重機の労務費（運転手給与）、燃料費は次表のとおりである。

[1] 日当たり施工量は、H25 年度国土交通省土木工事積算基準（建設物価調査会発行）を使用。
[2] 燃料消費量は、作業の負荷によって大幅に異なるが、H25 年度版建設機材等損料表（日本建設機械施工協会発行）の標準的な燃料消費量を使用。
[3] 日当たり施工量は、21 t クラスを標準とし、馬力換算。
[4] 最終処分場は、週 6 日稼働で計算したため、1 日最終処分量は、日発生量×7/6 で計算。
[5] ごみの密度は、0.4 t/m^3 を使用して計算。

表 7-8-3: VTE 最終処分場の運営維持管理費

項目	数量	単位	単価 (LAK)	金額 (LAK)	備考
１．労務費	1	日	40,000	40,000	
２．燃料費	192	L	8,500	1,632,000	8時間/日×24L/時間
合計				1,672,000	LAK/日
ごみ1t当たり処分費		LAK/t		7,741	1,672,000LAK÷(540m^3×0.4t/m^3)

２） LPB

KM8 最終処分場の既存の重機や施設を維持管理する運営費は、2012 年の実績から 85,800 千 LAK/年とする。新規機材として供与される重機の労務費（運転手給与）、燃料費は次表のとおりである。

表 7-8-4: LPB 最終処分場の運営維持管理費

項目	数量	単位	単価 (LAK)	金額 (LAK)	備考
１．労務費	1	日	40,000	40,000	
２．燃料費	87.6	L	8,500	744,600	7.3時間/日×12L/時間
合計				784,600	LAK/日
ごみ1t当たり処分費		LAK/t		8,916	784,600LAK÷88t/日

３） XYB

KM8最終処分場の既存の重機や施設を維持管理する運営費は、2012年の実績から23,181千LAK年とする。新規機材として供与される重機の労務費（運転手給与）、燃料費は次表のとおりである。

表 7-8-5：LPB 最終処分場の運営維持管理費

項目	数量	単位	単価 (LAK)	金額 (LAK)	備考
１．労務費	1	日	40,000	40,000	
２．燃料費	38.5	L	8,500	327,250	3.5時間/日×18L/時間
合計				367,250	LAK/日
ごみ1t当たり処分費		LAK/t		7,063	367,250LAK÷52t/日