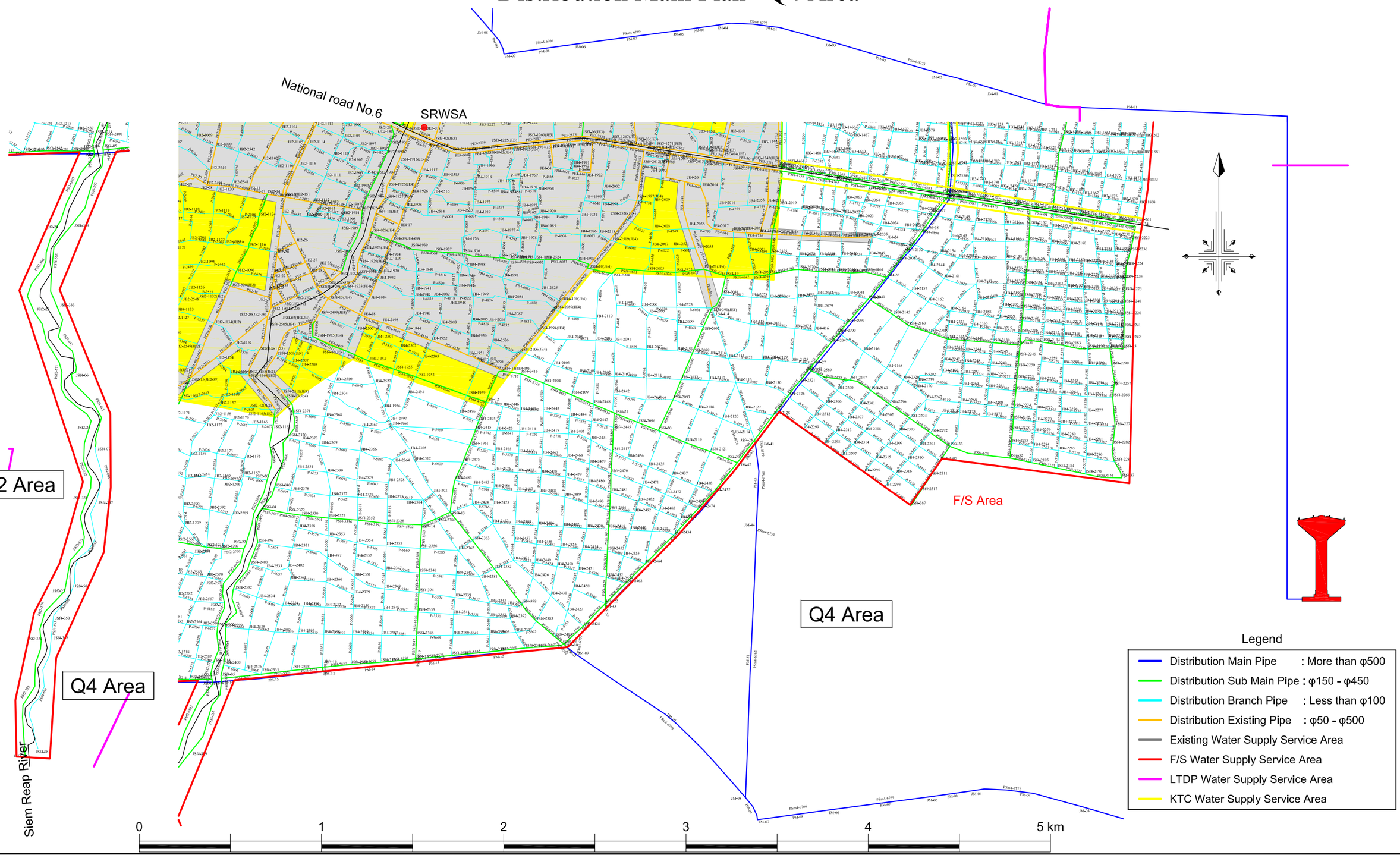
Distribution Main Plan - Q4 Area



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

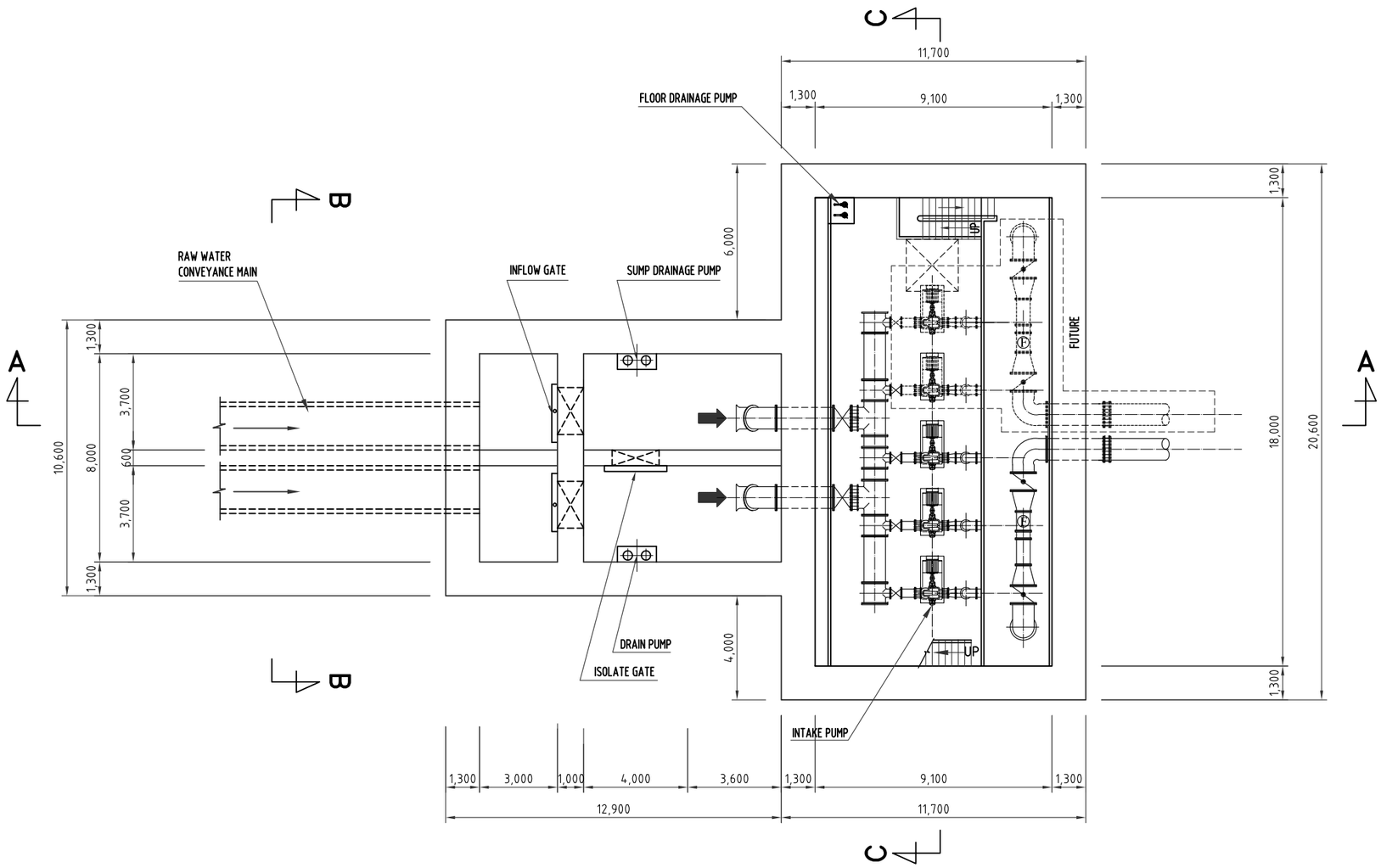
TITLE: Distribution Main Plan - Q4 Area

SCALE: Not To Scale

DATE: 27/02/2010

DRAWING NO.: SR-17-C-16

SR 4.15-25



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

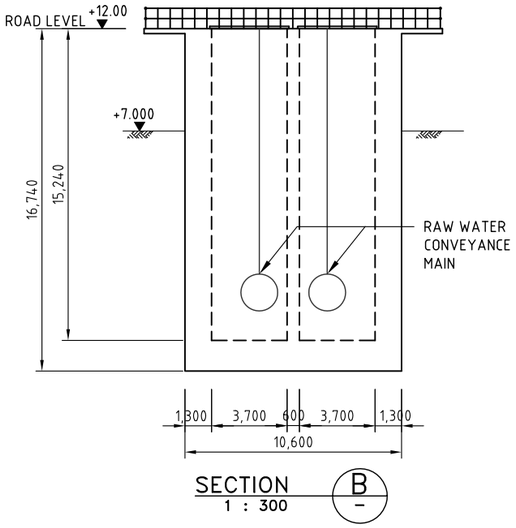
NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

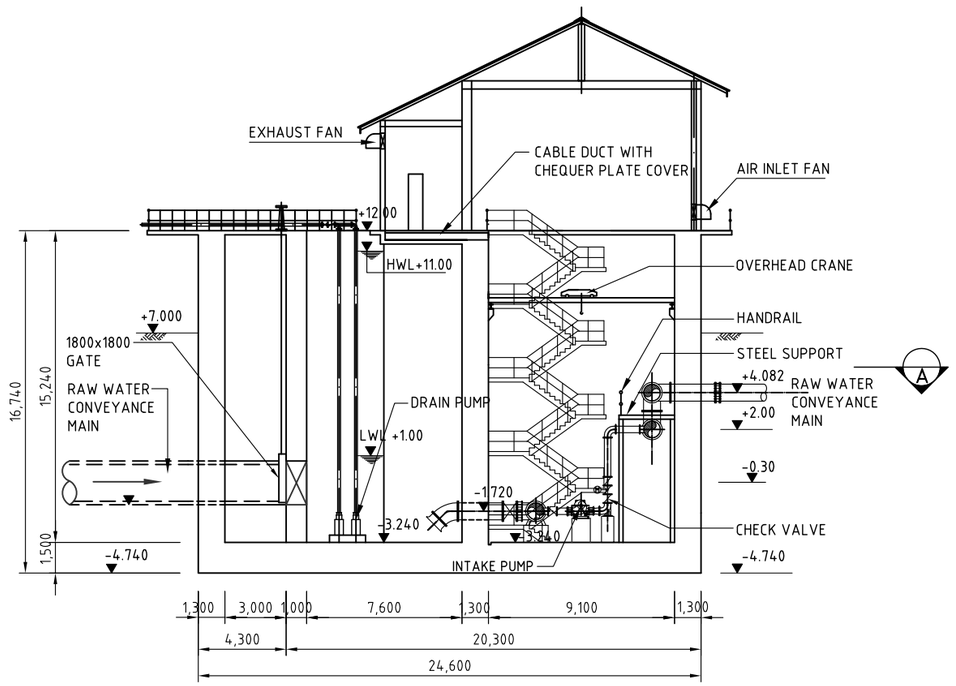
REV.	DESCRIPTION	DATE	SIGN.

TITLE: RAW WATER INTAKE PUMP STATION PLAN

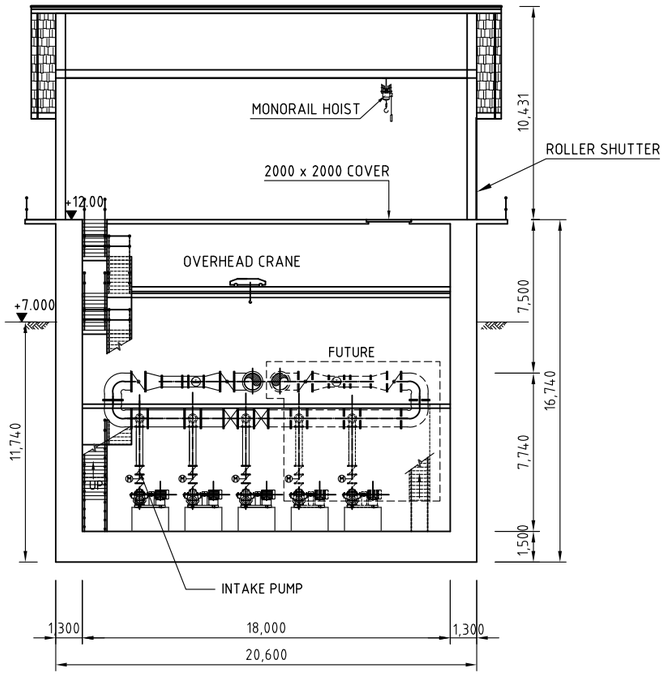
SCALE:	DATE:	DRAWING NO.:
1/200	30/09/2009	SR-02-MA-01



SECTION B
1 : 300



SECTION A
1 : 300



SECTION C
1 : 300

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

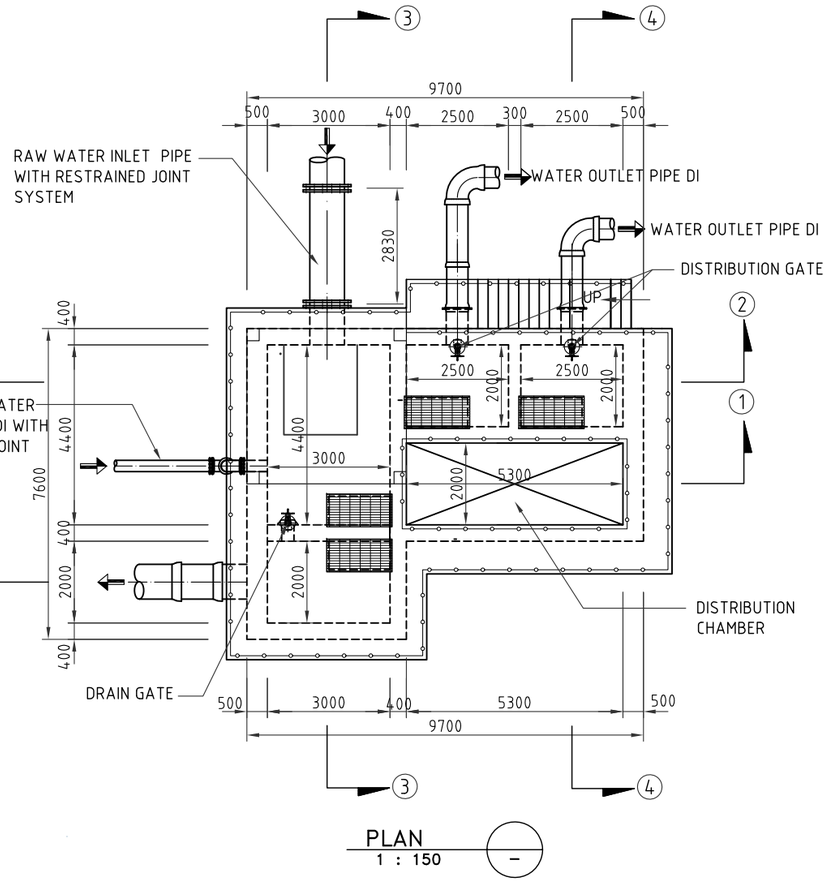
CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

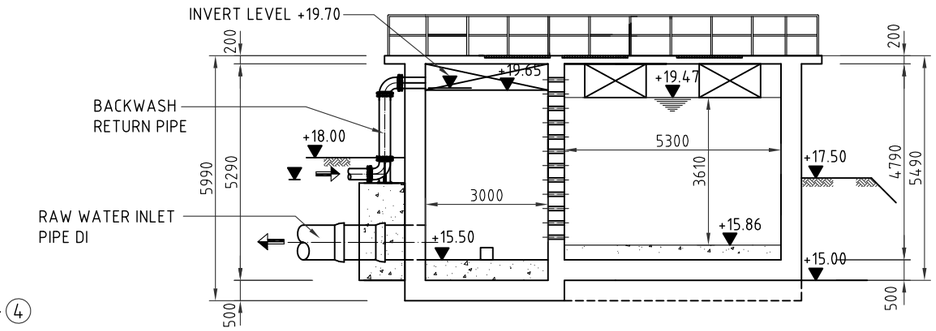
TITLE:
RAW WATER INTAKE PUMP STATION SECTIONS

SCALE:	DATE:	DRAWING NO.:
1/300	30/09/2009	SR-02-MA-02

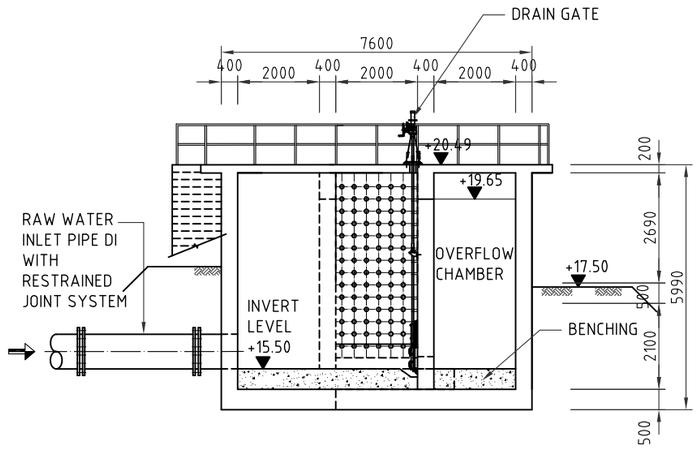
SR 4.15-27



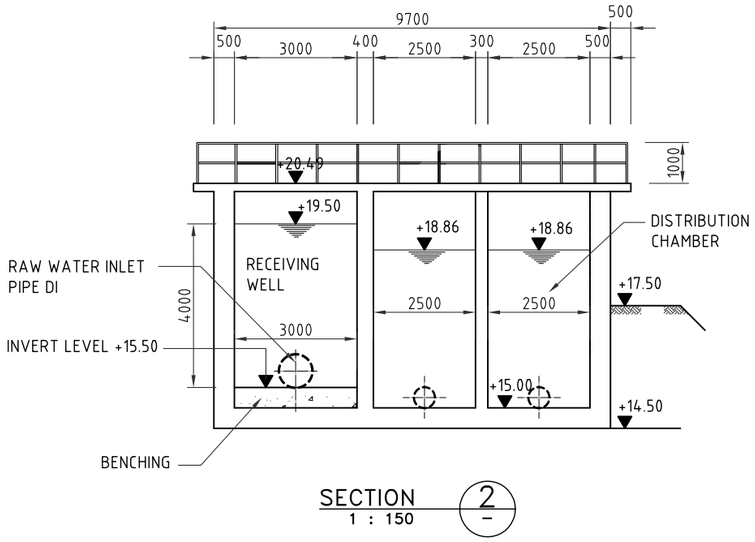
PLAN
1 : 150 –



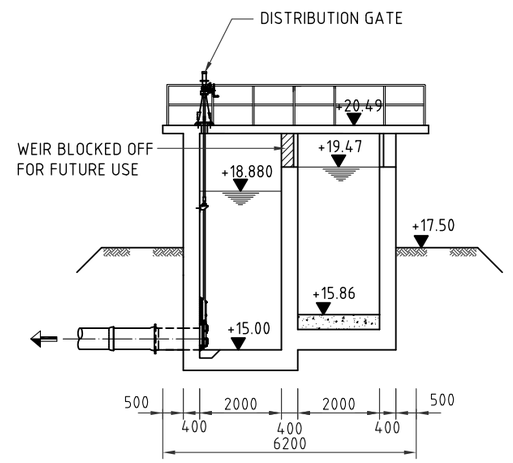
SECTION 1
1 : 150 –



SECTION 3
1 : 150 –



SECTION 2
1 : 150 –



SECTION 4
1 : 150 –

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

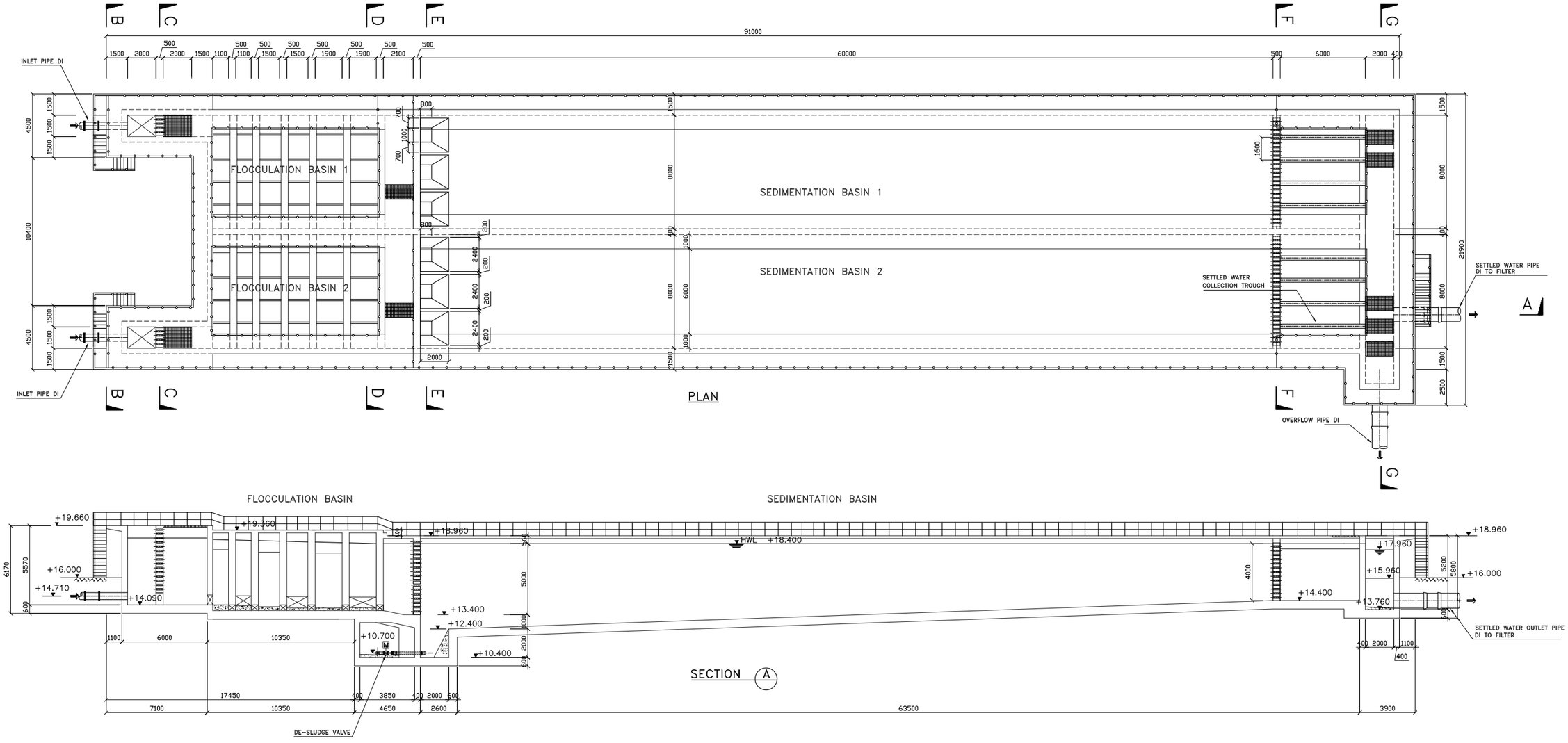
CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE:
DISTRIBUTION CHAMBER PLAN AND SECTIONS

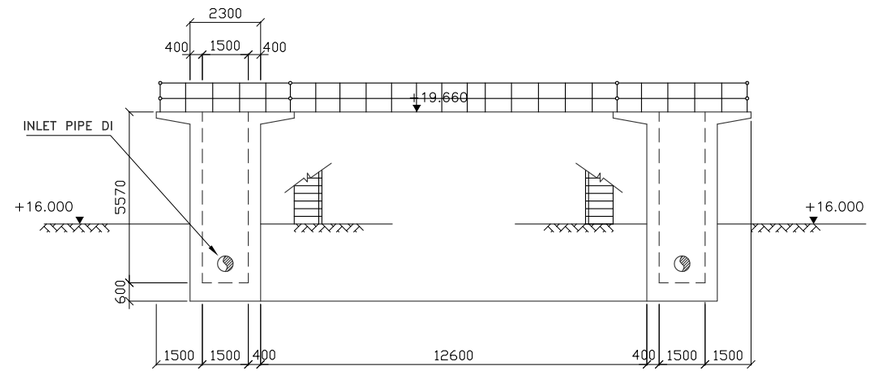
SCALE:	DATE:	DRAWING NO.:
1/150	30/09/2009	SR-04-MA-03

SR 4.15-28

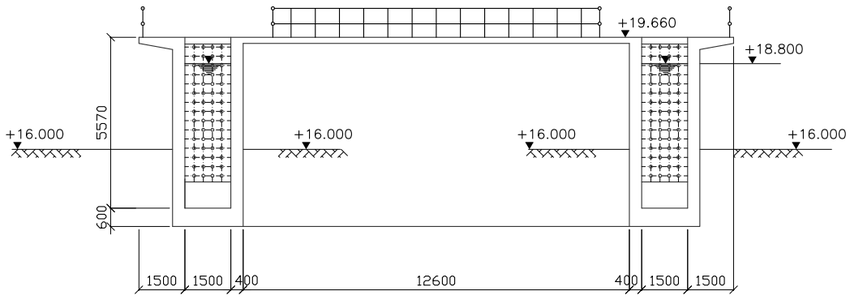


PROJECT:	THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA
CLIENT:	SIEM REAP WATER SUPPLY AUTHORITHY JAPAN INTERNATIONAL COOPERATION AGENCY
CONSULTANTS :	NJS CONSULTANTS CO., LTD. - JAPAN KOKUSAI KOGYO CO., LTD.-JAPAN
TITLE:	FLOCCULATION BASIN AND SEDIMENTATION BASIN PLAN AND SECTION
SCALE:	1/300
DATE:	30/09/2009
DRAWING NO.:	SR-05-MA-04

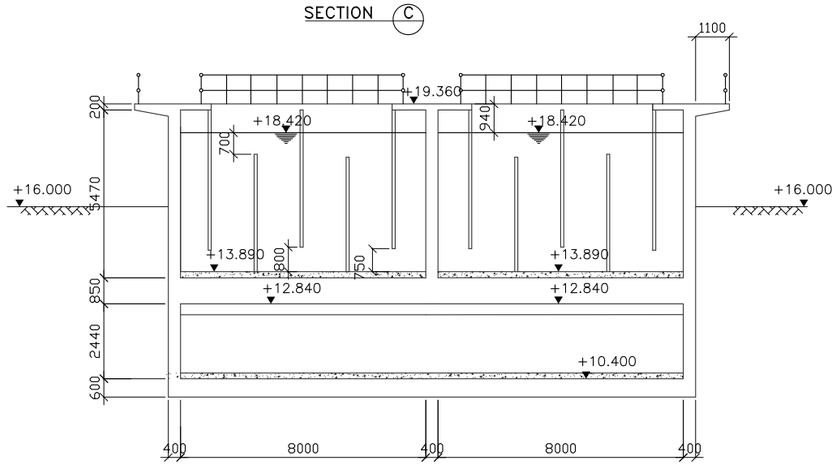
REV.	DESCRIPTION	DATE	SIGN.



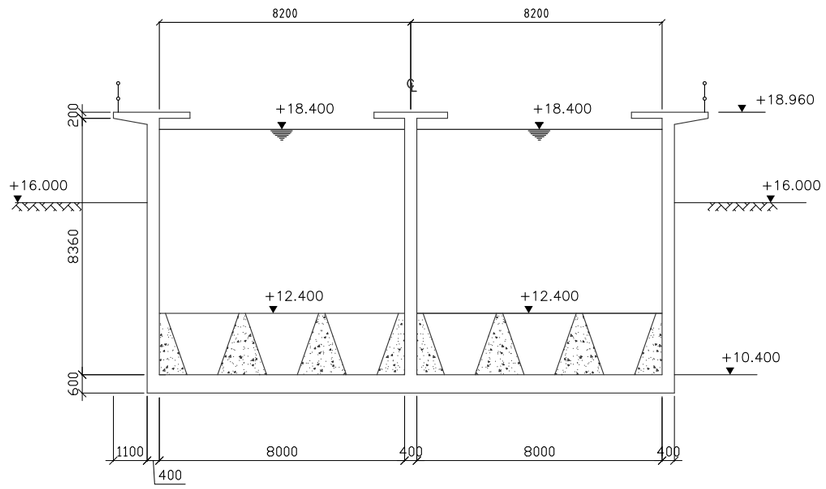
SECTION B



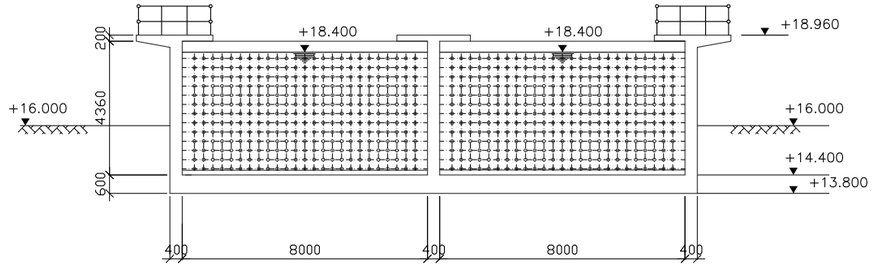
SECTION C



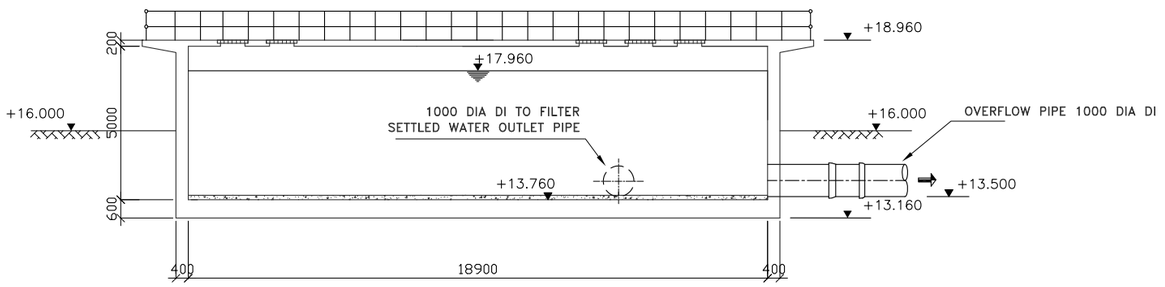
SECTION D



SECTION E



SECTION F



SECTION G

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

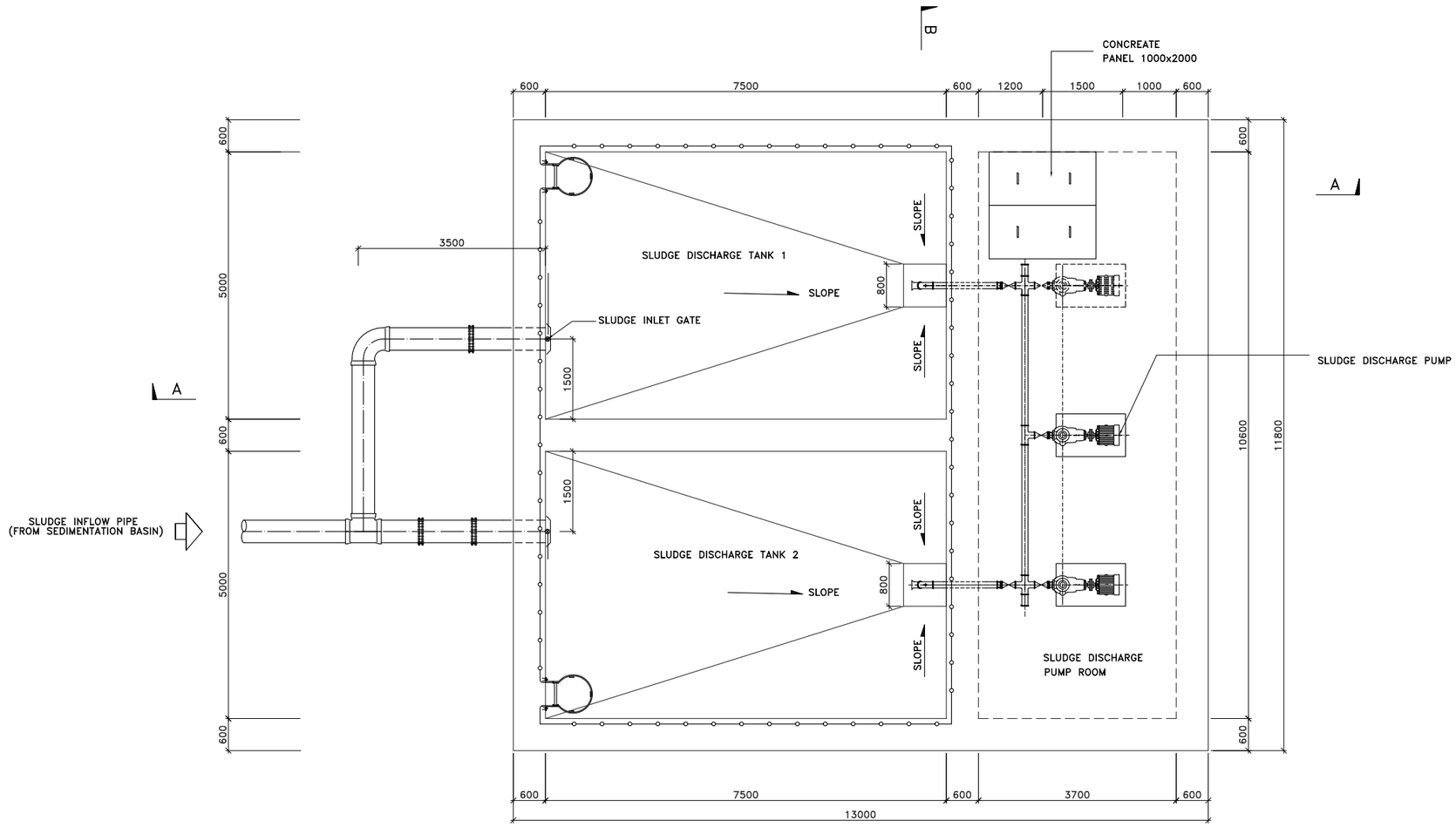
NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE: FLOCCULATION BASIN AND SEDIMENTATION BASIN SECTIONS

SCALE:	DATE:	DRAWING NO.:
1/200	30/09/2009	SR-05-MA-05



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

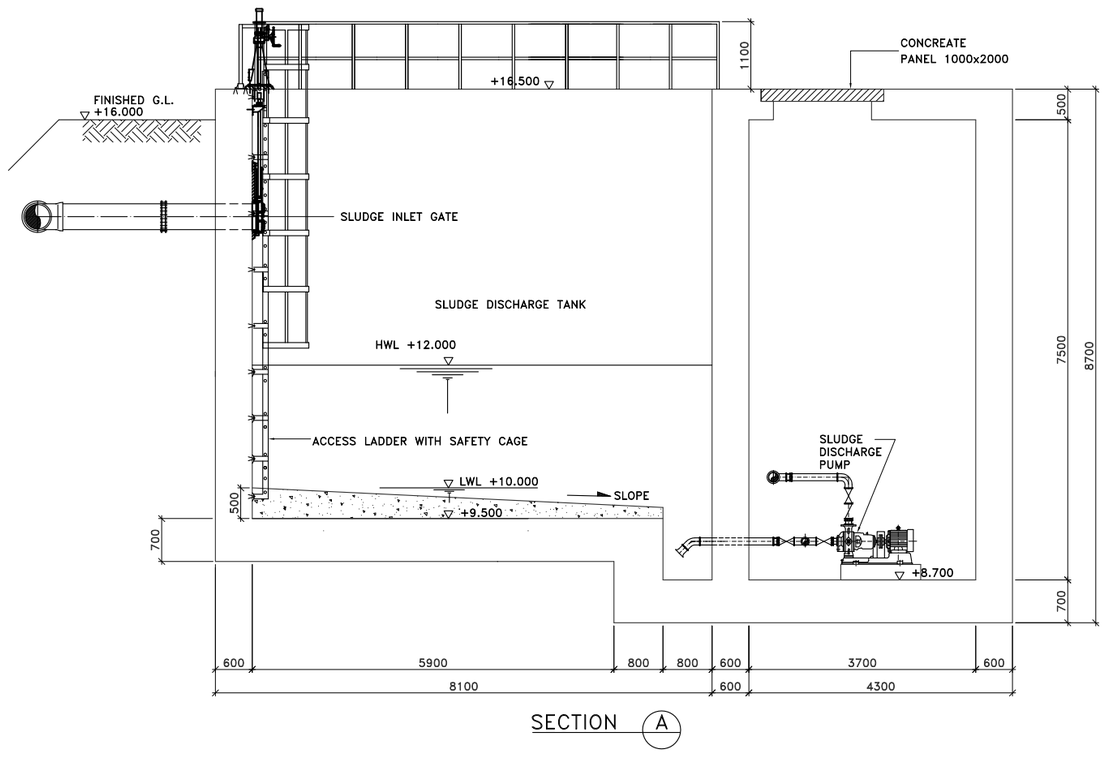
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

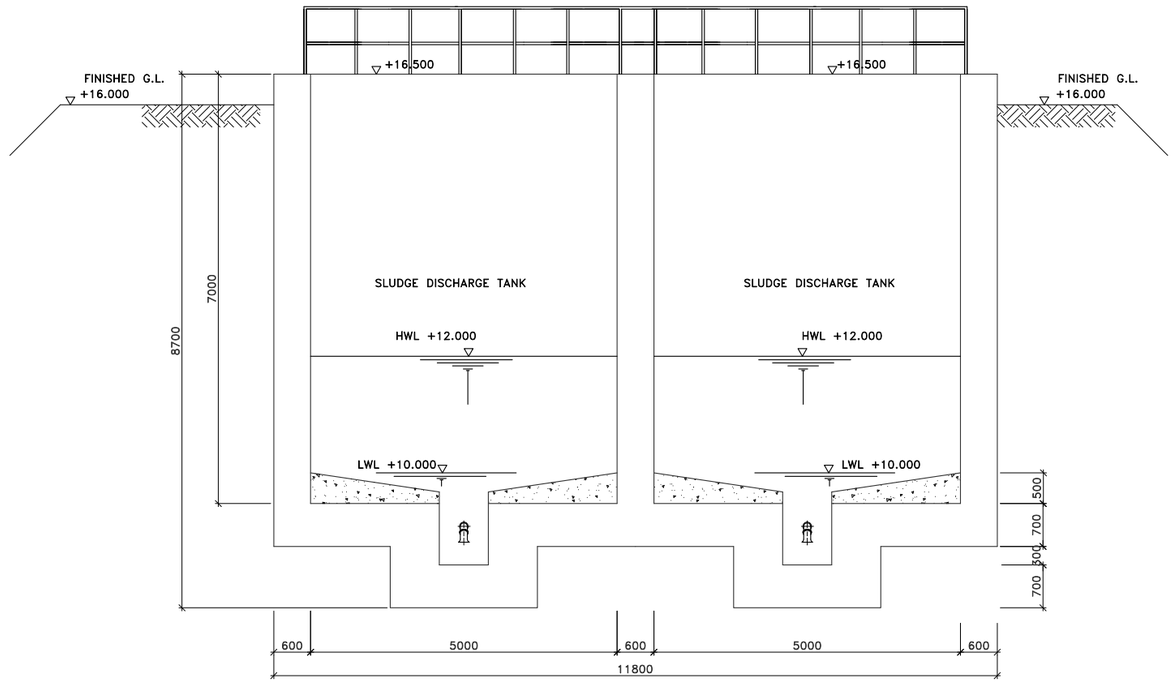
TITLE:

SLUDGE DISCHARGE TANK PLAN

SCALE:	DATE:	DRAWING NO.:
1:100	30/09/2009	SR-06-MA-06



SECTION A



SECTION B

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

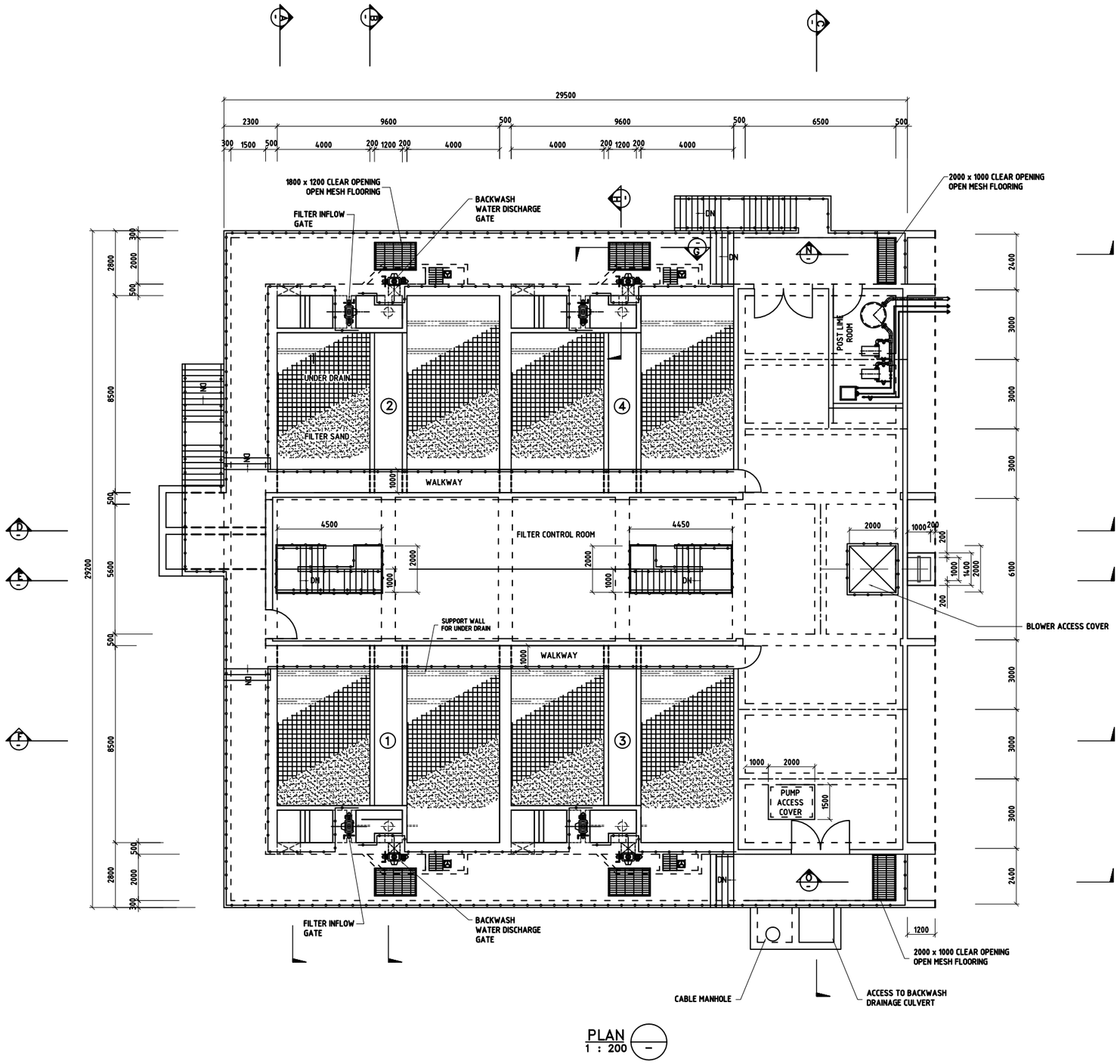
REV.	DESCRIPTION	DATE	SIGN.

TITLE: SLUDGE DISCHARGE TANK SECTIONS

SCALE: 1:100

DATE: 30/09/2009

DRAWING NO.: SR-06-MA-07



PLAN
1 : 200

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

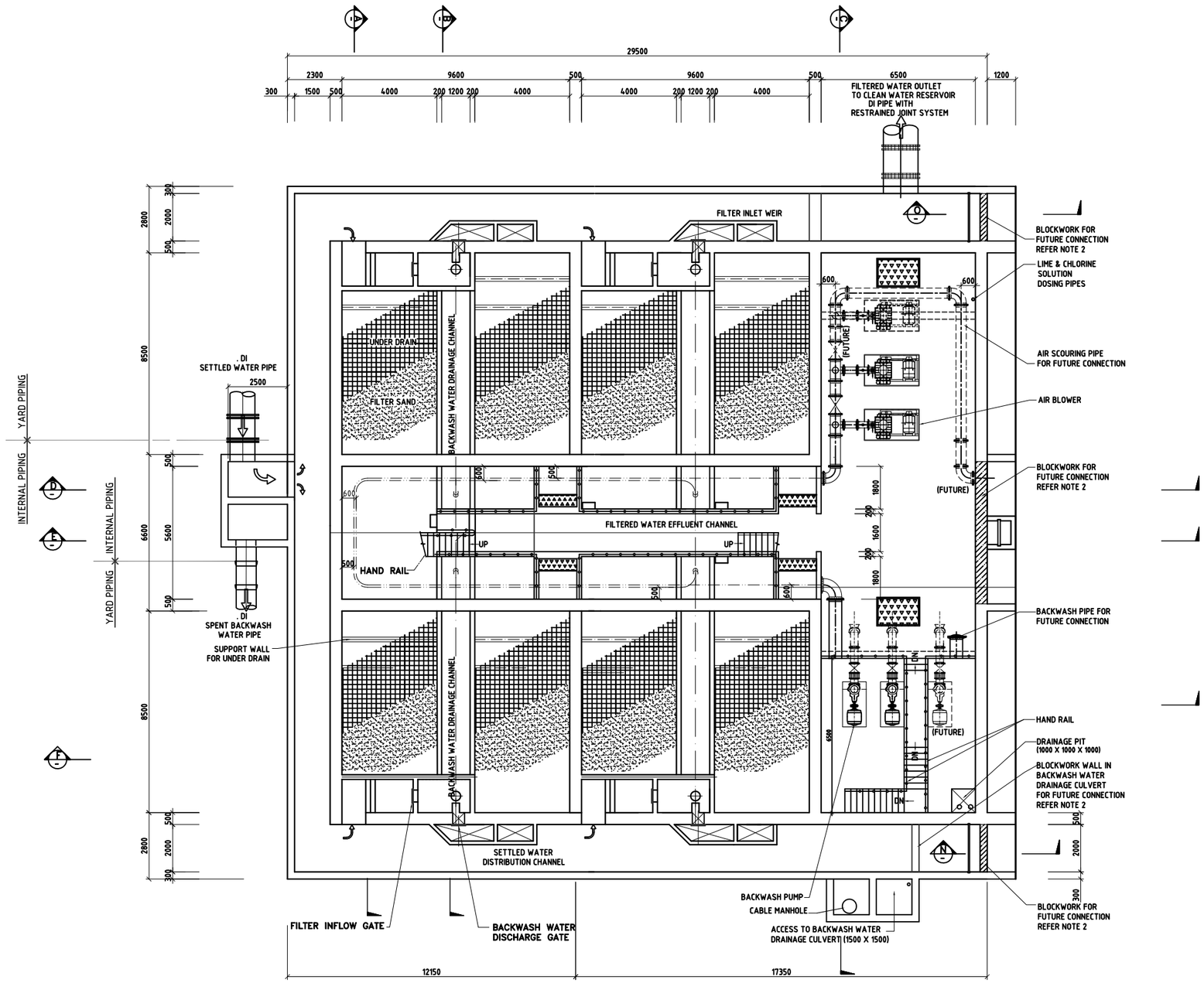
TITLE: FILTRATION UNITS PLAN - 1

SCALE: 1/200

DATE: 30/09/2009

DRAWING NO.: SR-07-MA-08

SR 4.15-33



PLAN
1 : 200

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

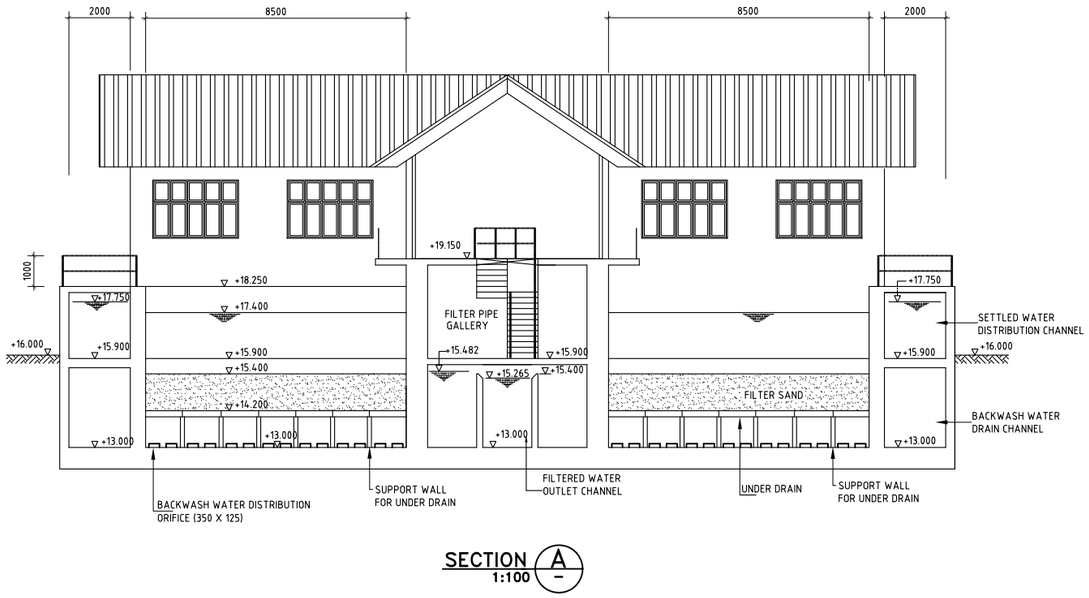
REV.	DESCRIPTION	DATE	SIGN.

TITLE: FILTRATION UNITS PLAN - 2

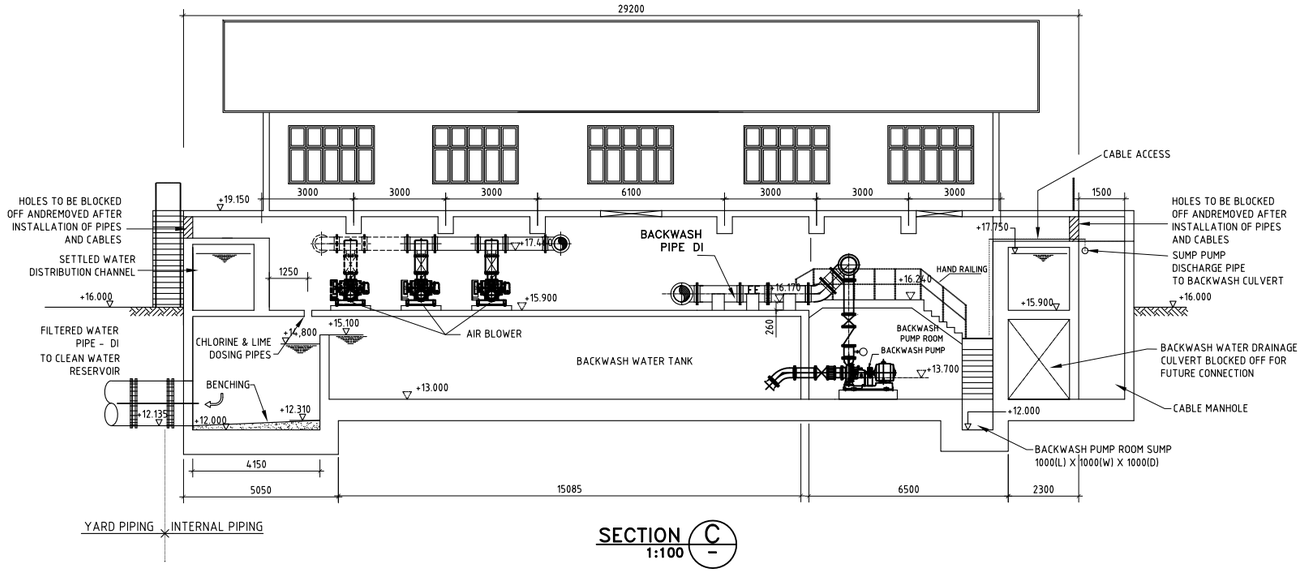
SCALE: 1/200

DATE: 30/09/2009

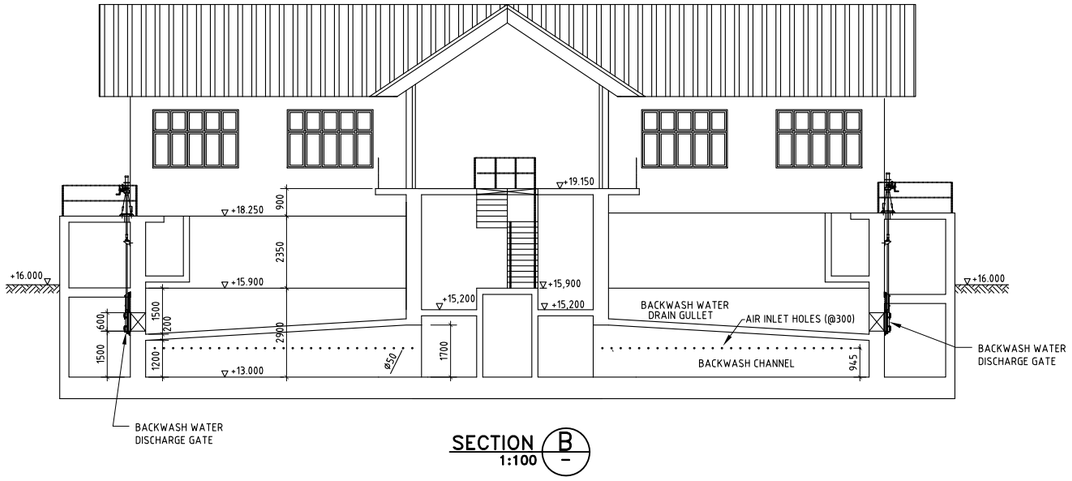
DRAWING NO.: SR-07-MA-09



SECTION A
1:100



SECTION C
1:100



SECTION B
1:100

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

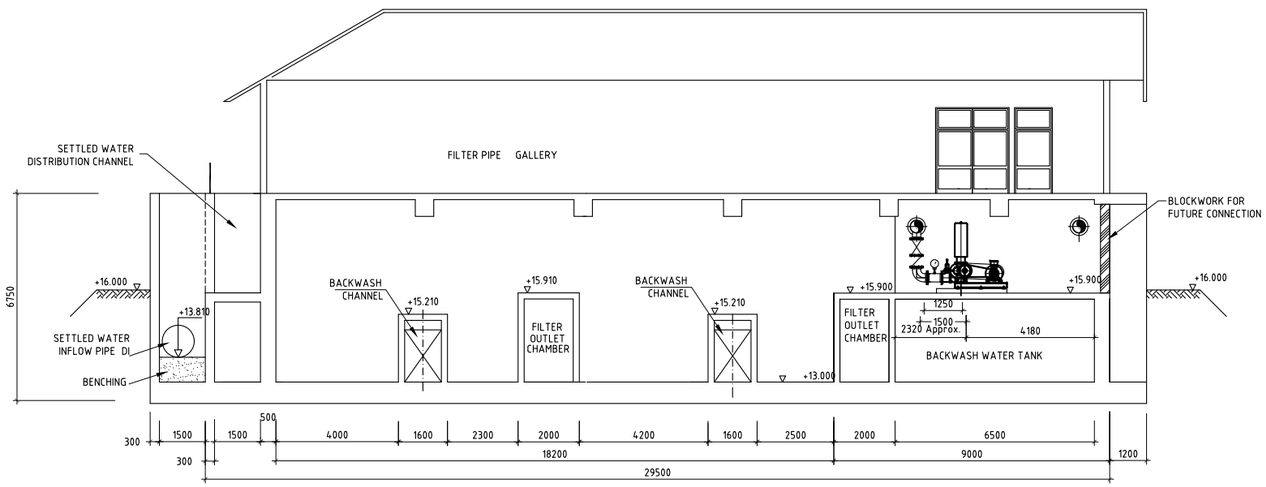
REV.	DESCRIPTION	DATE	SIGN.

TITLE: FILTRATION UNITS SECTION -1

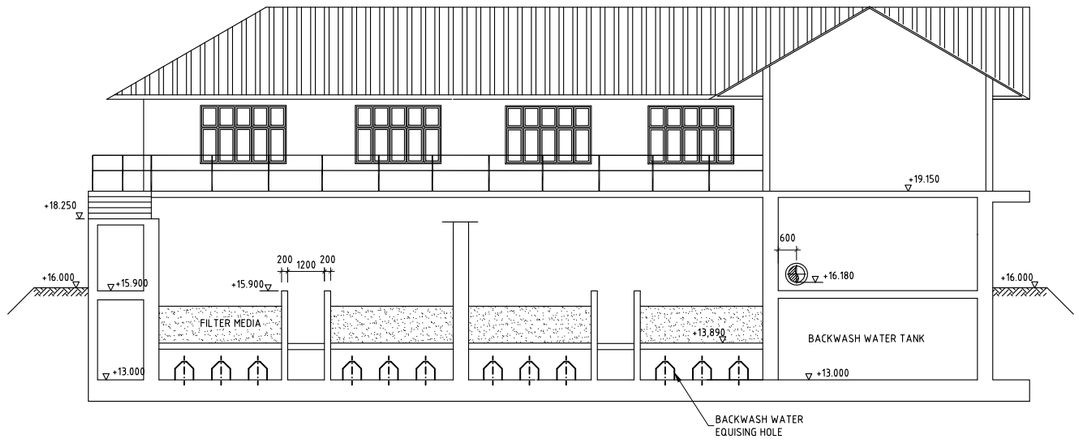
SCALE: 1:200

DATE: 30/09/2009

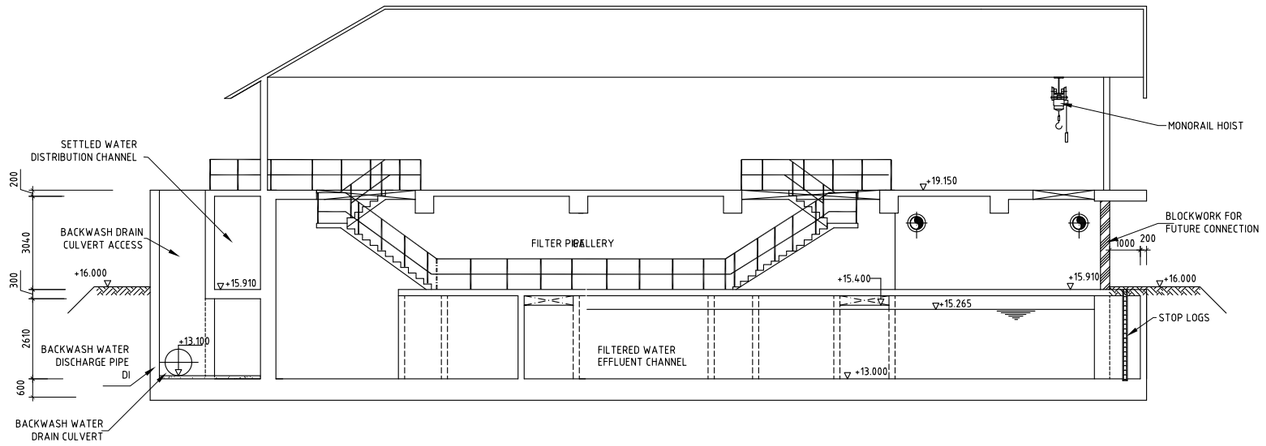
DRAWING NO.: SR-07-MA-10



SECTION D
1:100



SECTION F
1:100



SECTION E
1:100

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

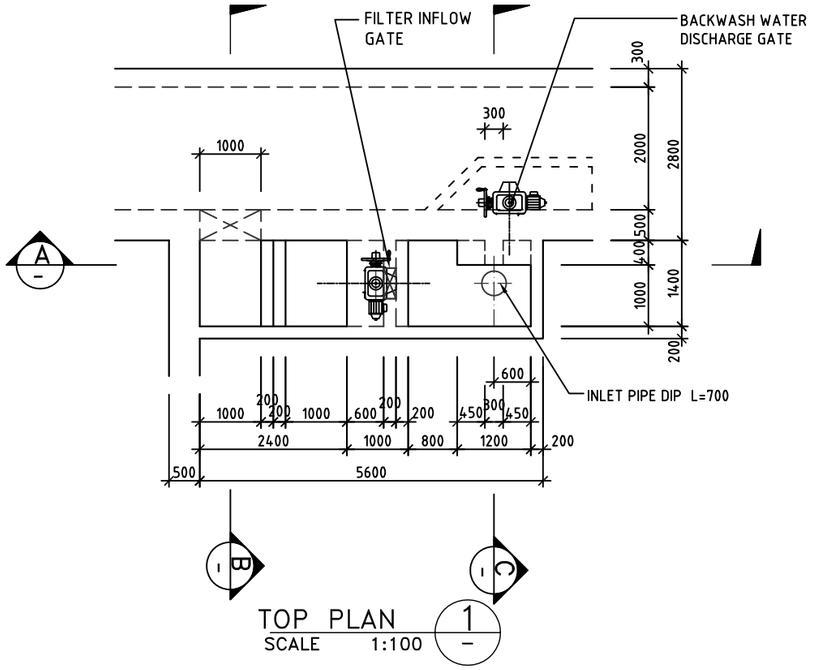
TITLE: FILTRATION UNITS SECTION -2

SCALE: 1:200

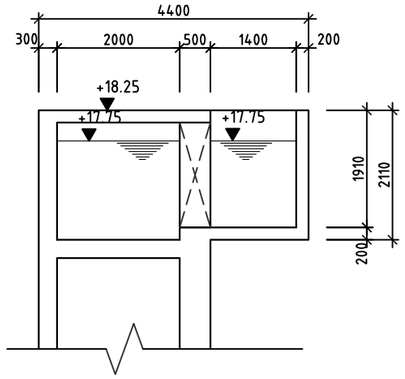
DATE: 30/09/2009

DRAWING NO.: SR-07-MA-11

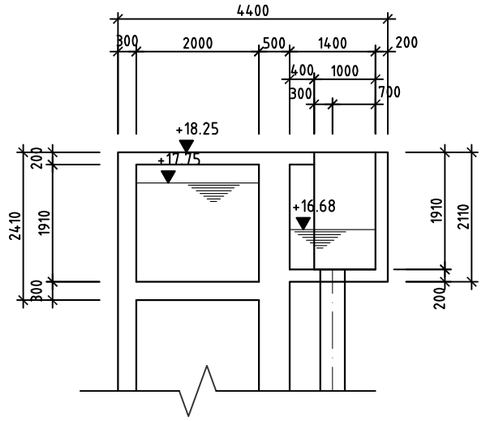
SR 4.15-36



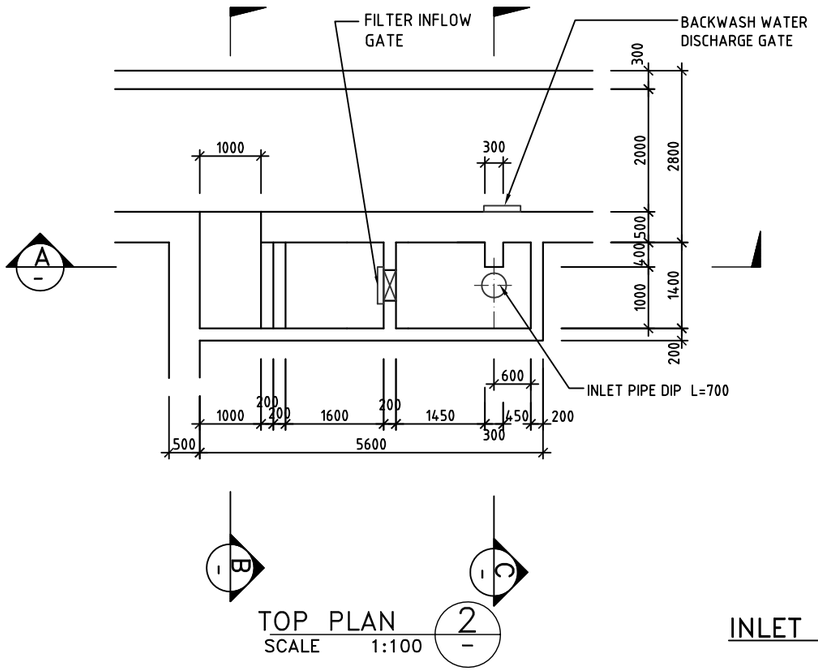
TOP PLAN 1
SCALE 1:100



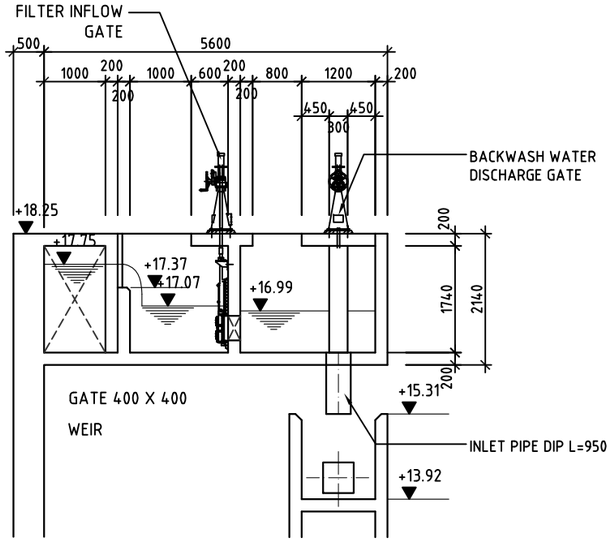
SECTION B
SCALE 1:100



SECTION C
SCALE 1:100



TOP PLAN 2
SCALE 1:100



SECTION A
SCALE 1:100

INLET CHANNEL DETAIL

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

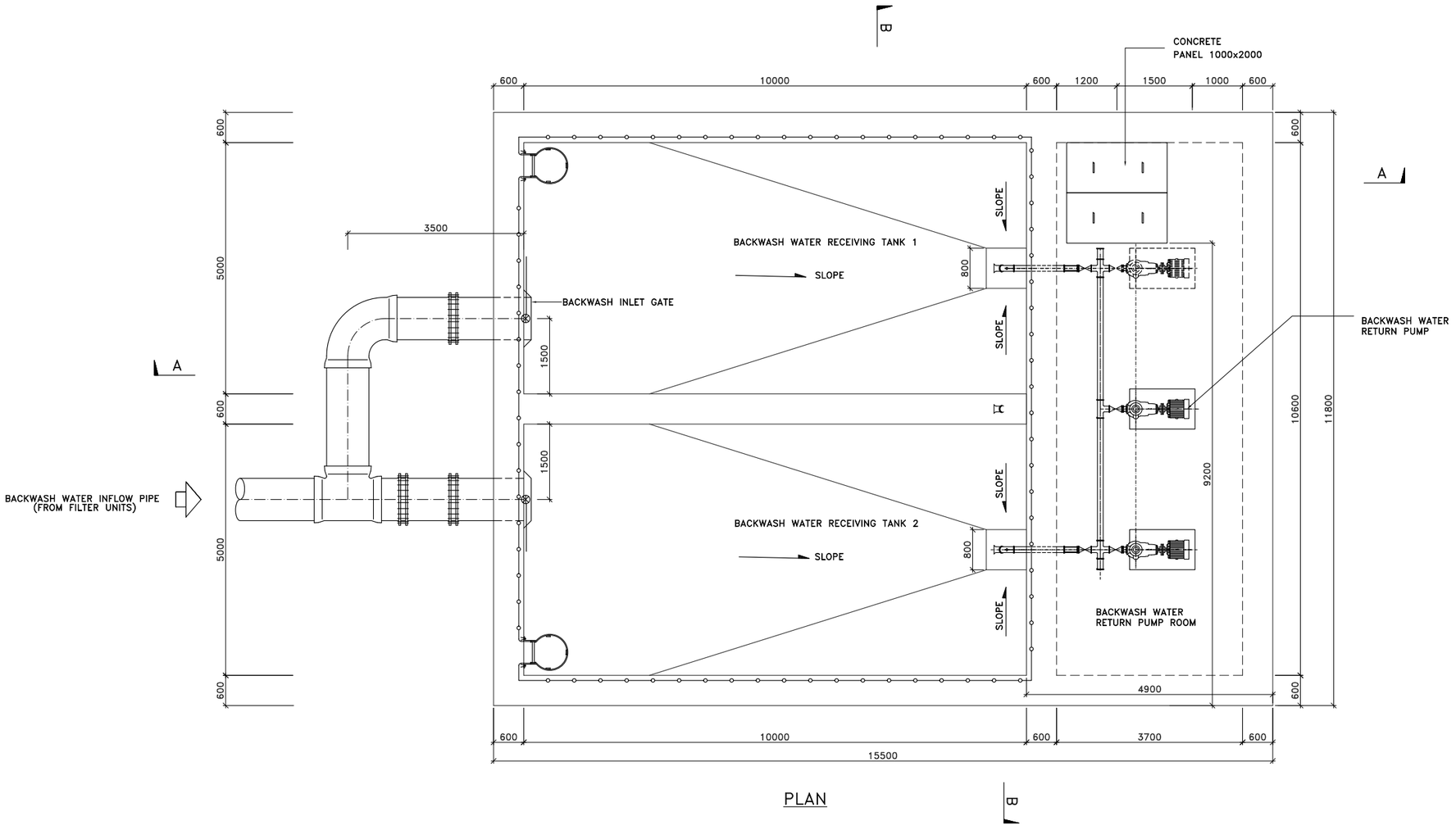
CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE: FILTRATION UNITS SECTION - 3

SCALE: 1/100
DATE: 30/09/2009
DRAWING NO.: SR-07-MA-12



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

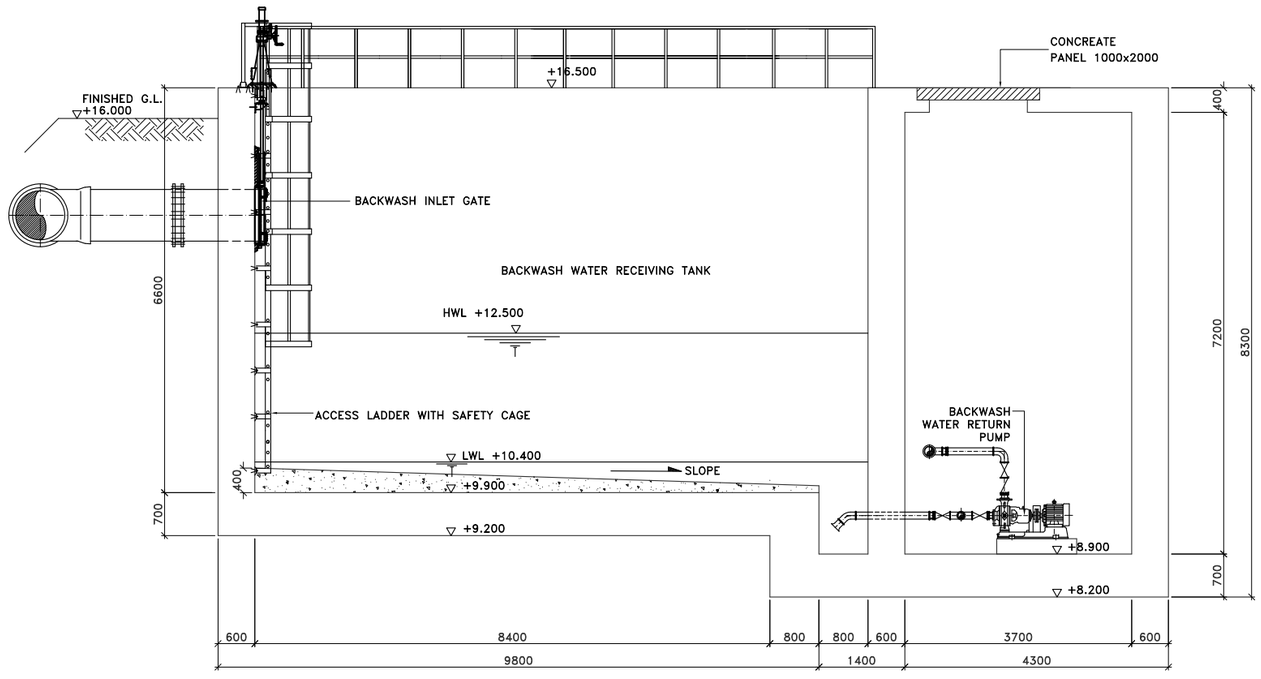
REV.	DESCRIPTION	DATE	SIGN.

TITLE: BACKWASH RECOVERY TANK PLAN

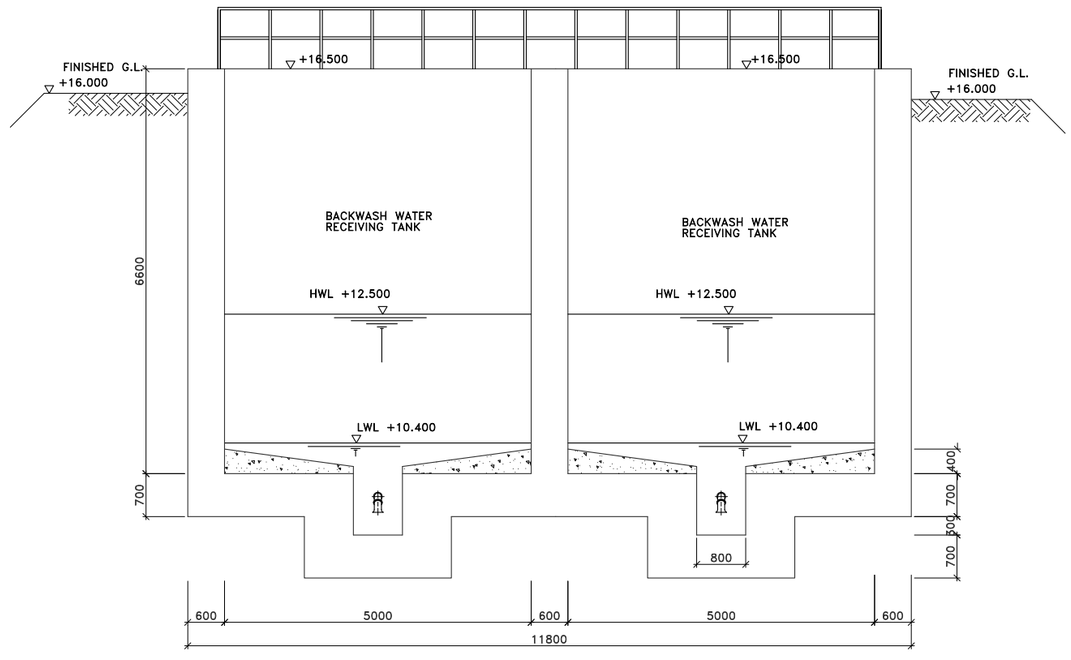
SCALE: 1:100

DATE: 30/09/2009

DRAWING NO.: SR-08-MA-13



SECTION A



SECTION B

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

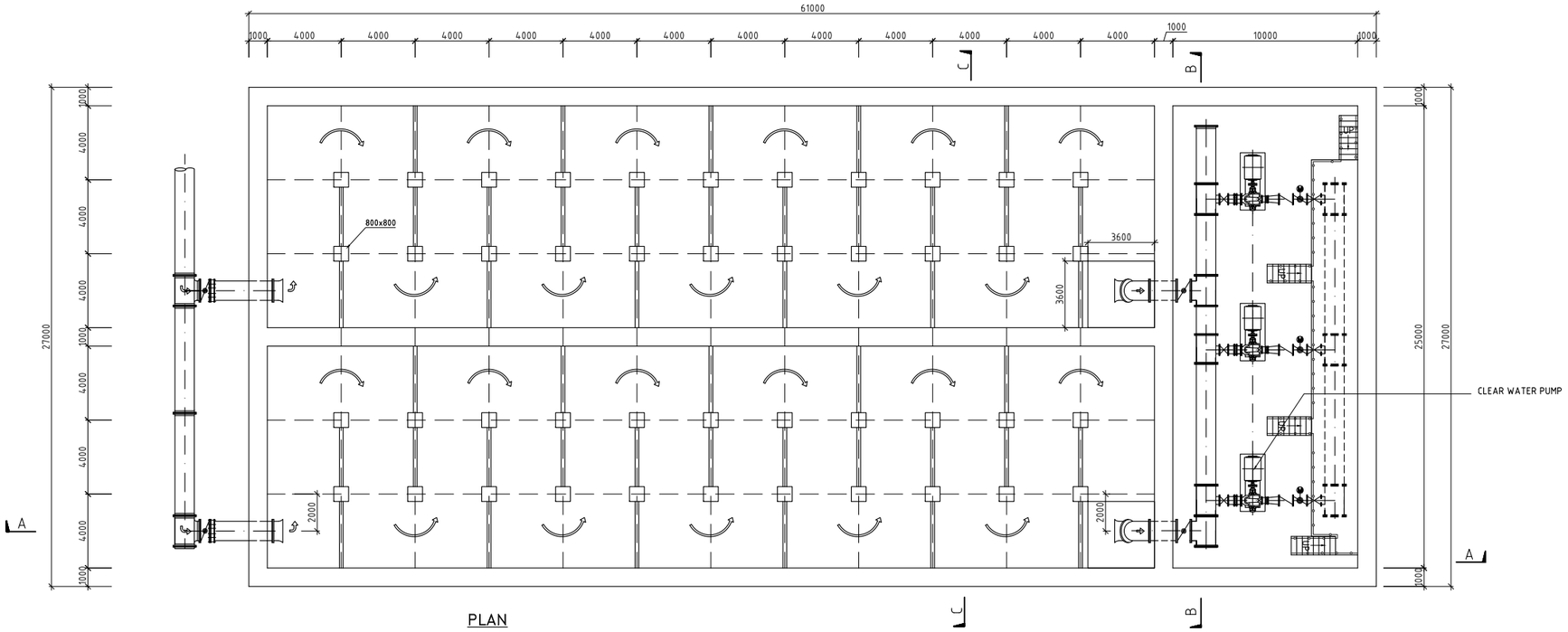
REV.	DESCRIPTION	DATE	SIGN.

TITLE: BACKWASH RECOVERY TANK SECTIONS

SCALE: 1:100

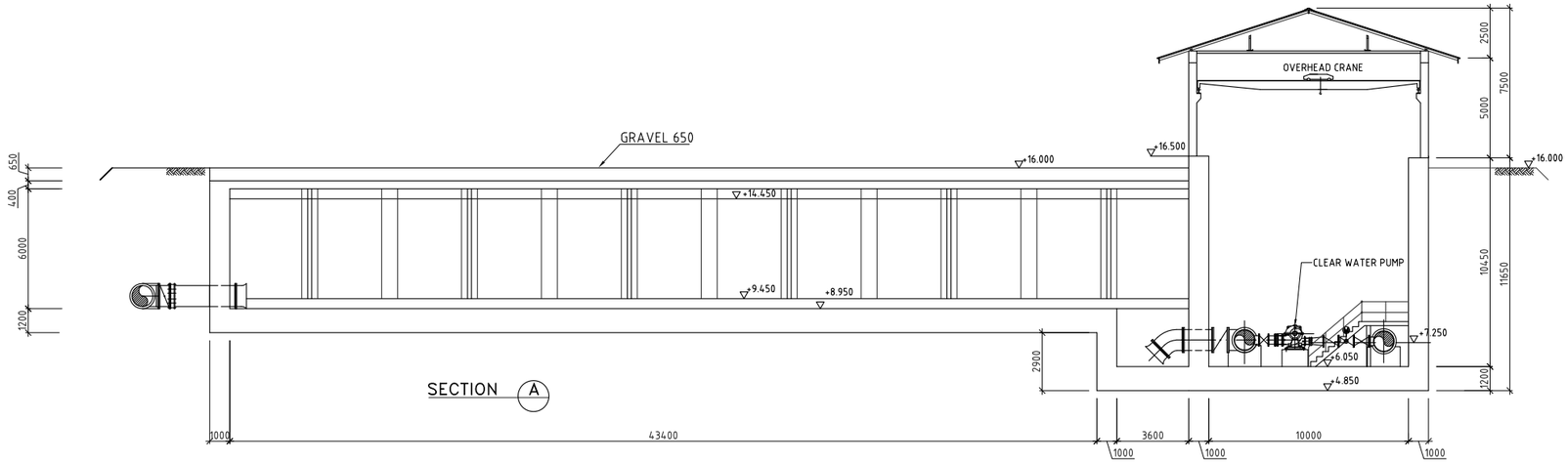
DATE: 30/09/2009

DRAWING NO.: SR-08-MA-14

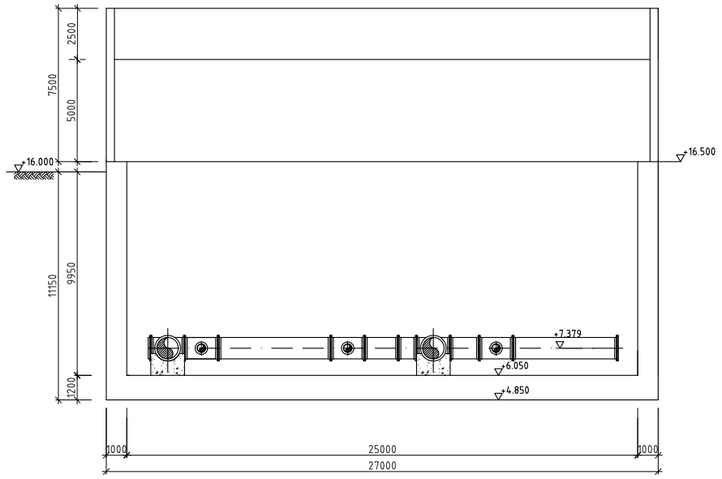


PROJECT:	THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA
CLIENT:	SIEM REAP WATER SUPPLY AUTHORITHY JAPAN INTERNATIONAL COOPERATION AGENCY
CONSULTANTS :	NJS CONSULTANTS CO., LTD. - JAPAN KOKUSAI KOGYO CO., LTD.-JAPAN
TITLE:	CLEAR WATER RESERVOIR AND CLEAR WATER PUMP STATION PLAN
SCALE:	1:300
DATE:	30/09/2009
DRAWING NO.:	SR-09-MA-15

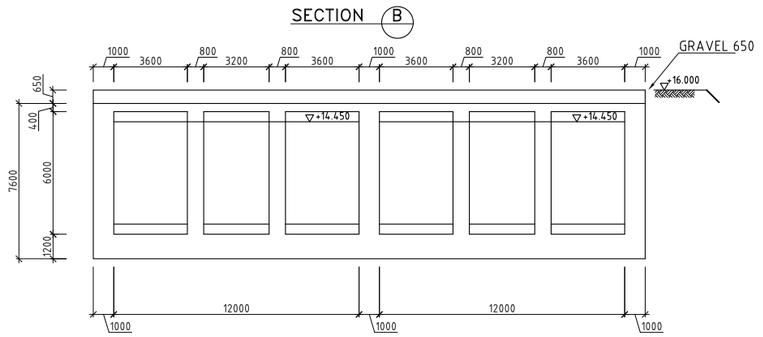
REV.	DESCRIPTION	DATE	SIGN.



SECTION A



SECTION B



SECTION C

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

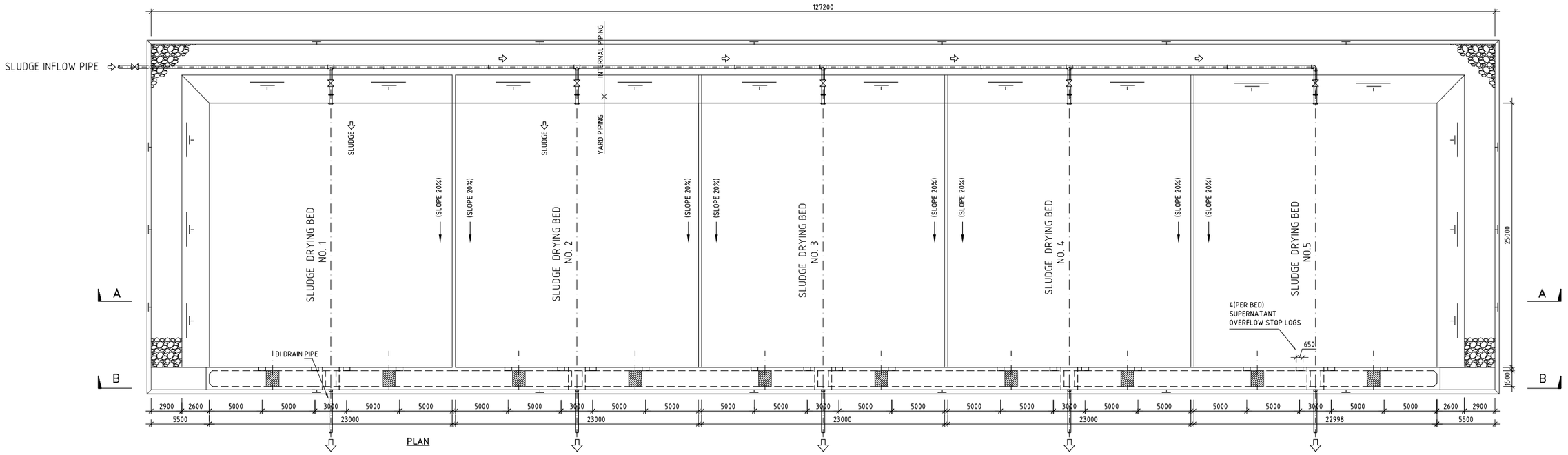
REV.	DESCRIPTION	DATE	SIGN.

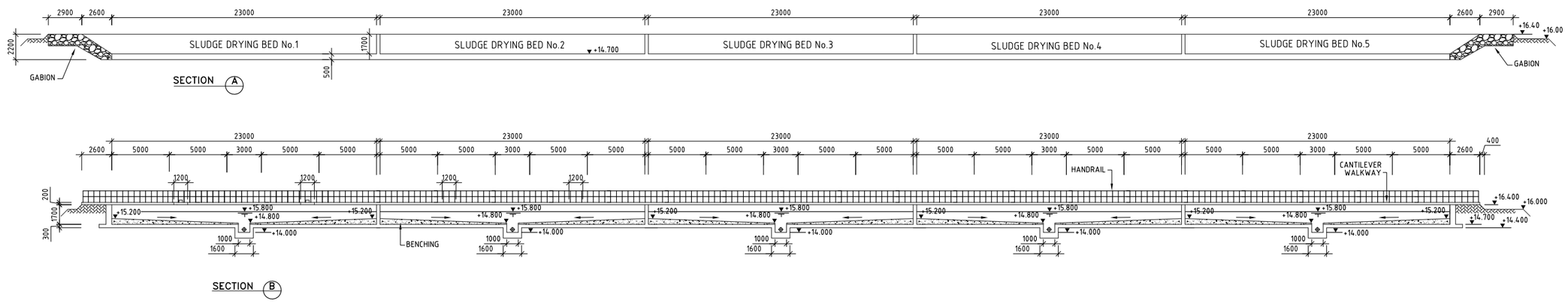
TITLE: CLEAR WATER RESERVOIR AND CLEAR WATER PUMP STATION SECTIONS

SCALE: 1:300

DATE: 30/09/2009

DRAWING NO.: SR-09-MA-16





PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

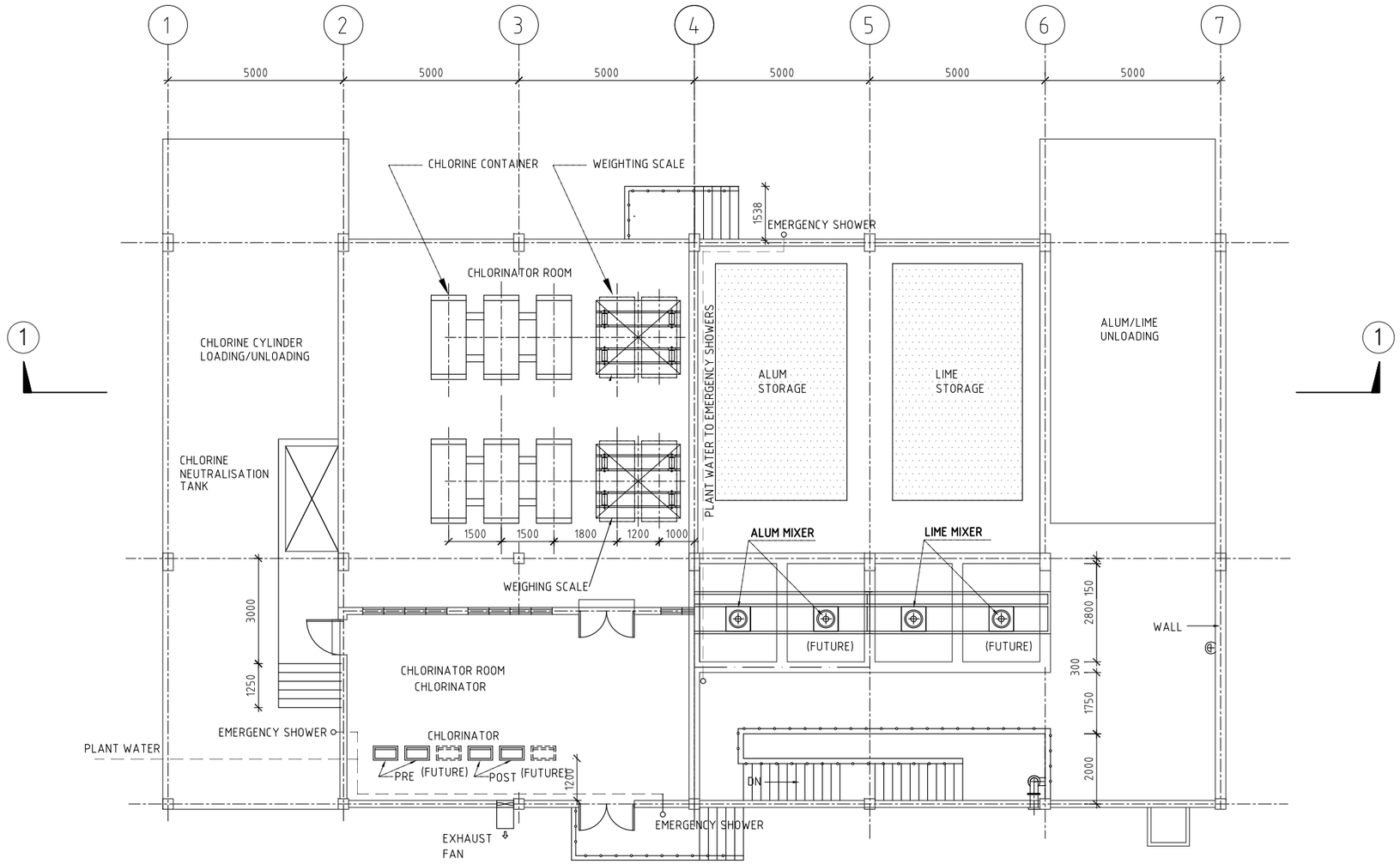
REV.	DESCRIPTION	DATE	SIGN.

TITLE: SLUDGE DRYING BED PLAN AND SECTIONS

SCALE: 1:400

DATE: 30/09/2009

DRAWING NO.: SR-11-MA-17



GROUND FLOOR PLAN

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

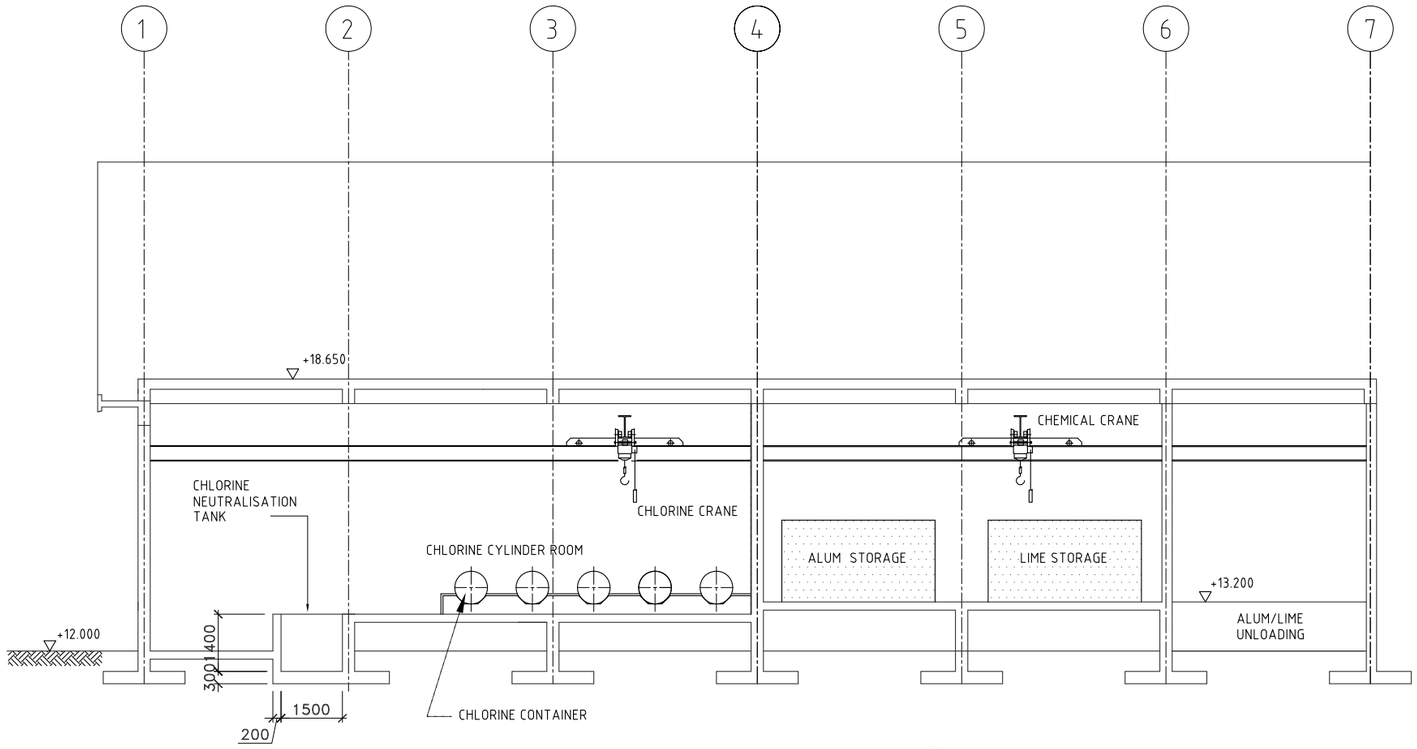
REV.	DESCRIPTION	DATE	SIGN.

TITLE: CHEMICAL BUILDING PLAN

SCALE: 1/150

DATE: 30/09/2009

DRAWING NO.: SR-12-MA-18



SECTION 1

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

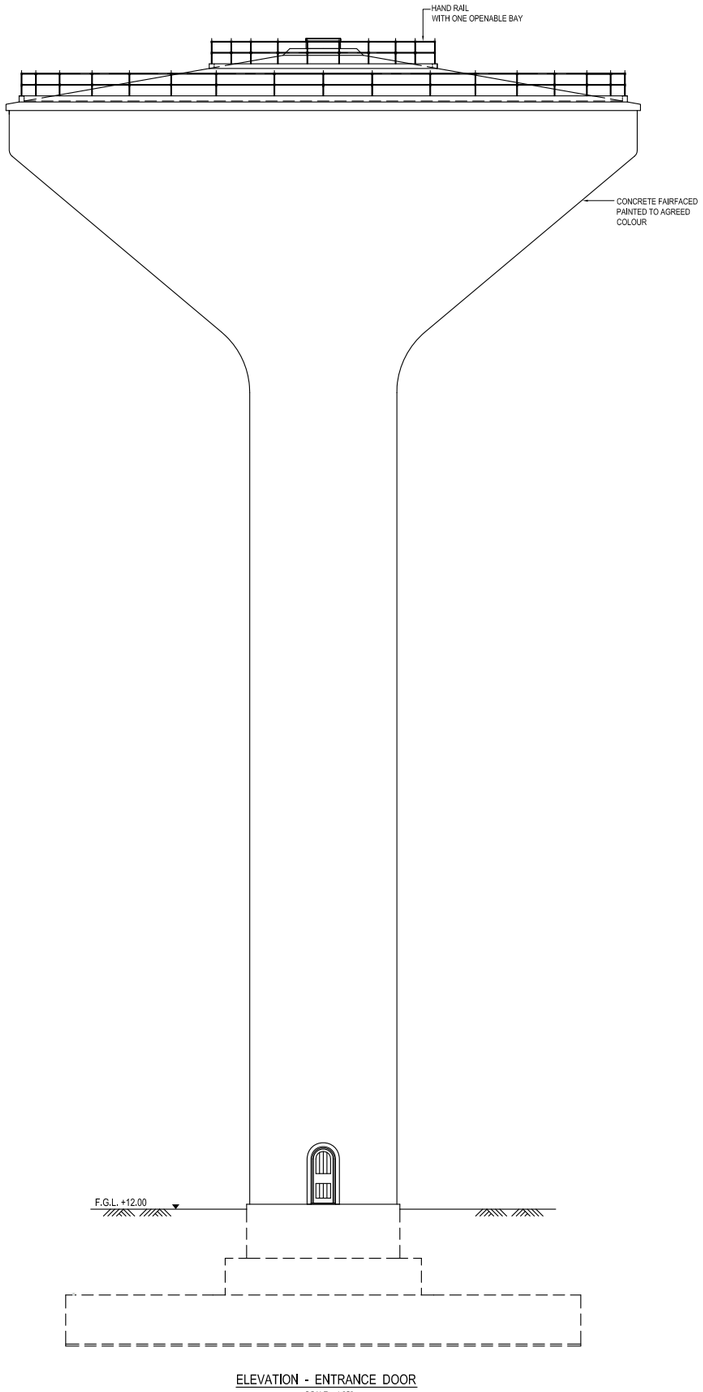
REV.	DESCRIPTION	DATE	SIGN.

TITLE: CHEMICAL BUILDING SECTION

SCALE: 1/150

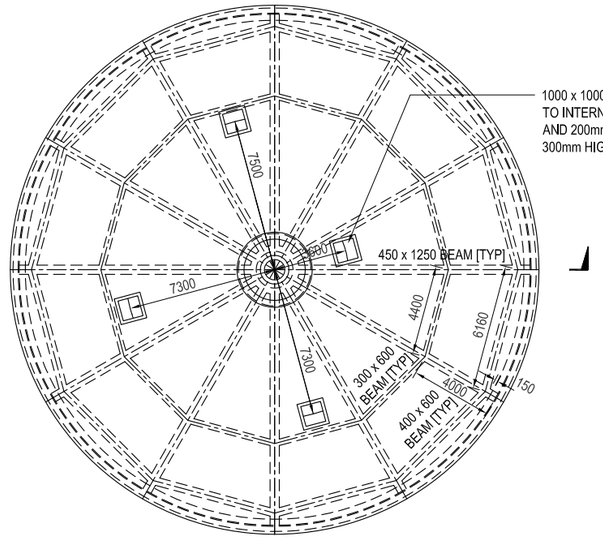
DATE: 30/09/2009

DRAWING NO.: SR-12-MA-19



ELEVATION - ENTRANCE DOOR

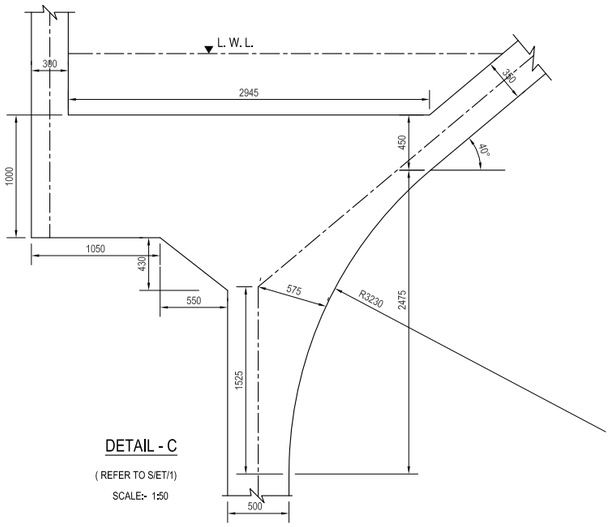
SCALE:- 1:250



ROOF PLAN

(REFER TO S/ET/1)

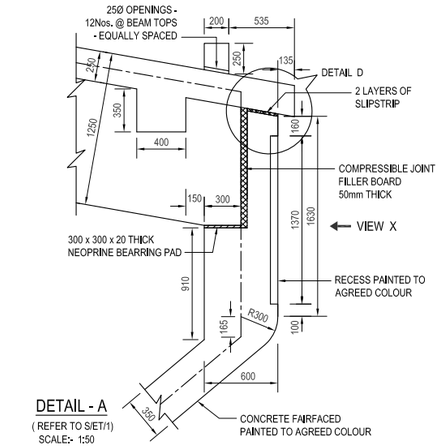
SCALE:- 1:300



DETAIL - C

(REFER TO S/ET/1)

SCALE:- 1:50

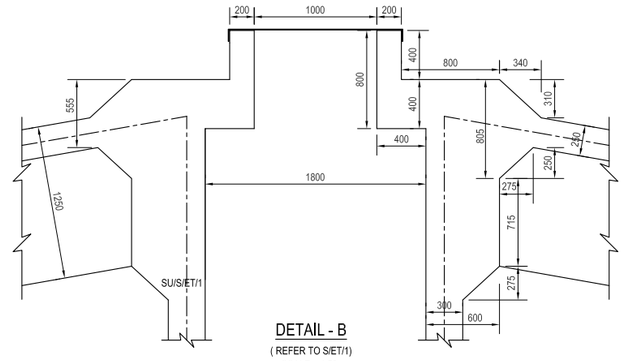


DETAIL - A

(REFER TO S/ET/1)

SCALE:- 1:50

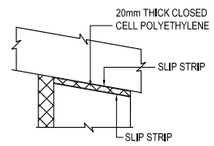
SECTION



DETAIL - B

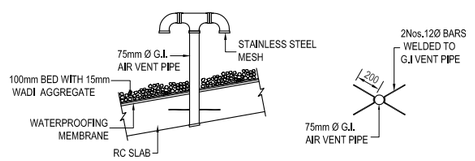
(REFER TO S/ET/1)

SCALE:- 1:50



DETAIL - D

SCALE:- 1:20



SECTION PLAN

DETAILS OF ADAMS VENTILATOR

SCALE:-1:50

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

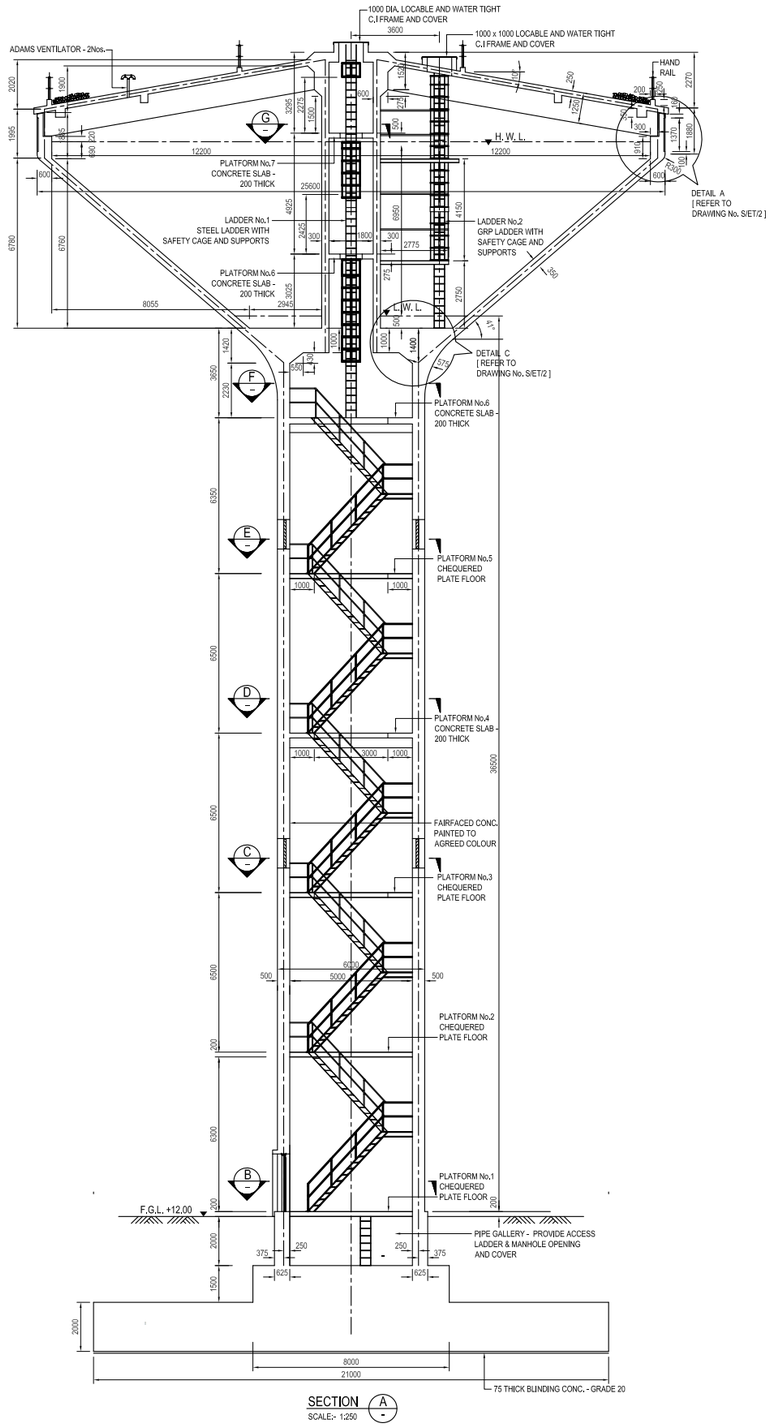
KOKUSAI KOGYO CO., LTD.-JAPAN

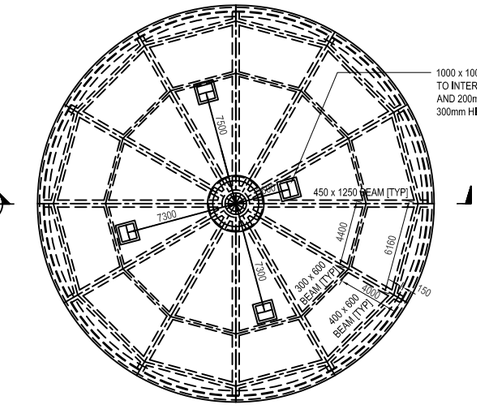
REV.	DESCRIPTION	DATE	SIGN.

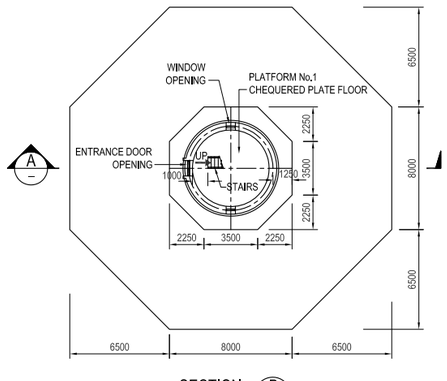
TITLE:

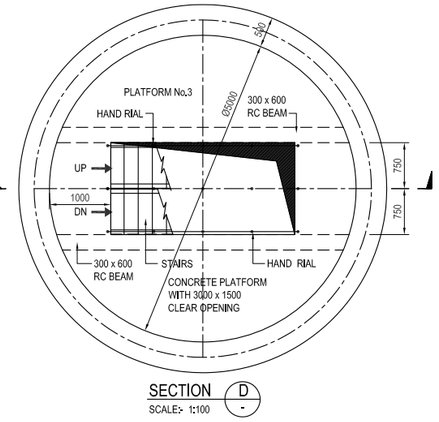
ELEVATED WATER TANK GENERAL ARRANGEMENT

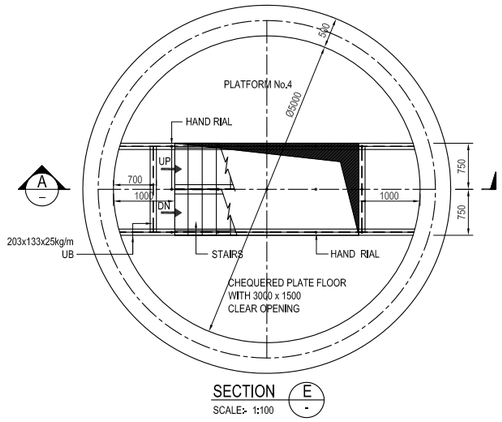
SCALE:	DATE:	DRAWING NO.:
AS SHOWN	30/09/2009	SR-10-A-01

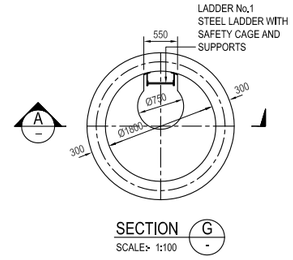


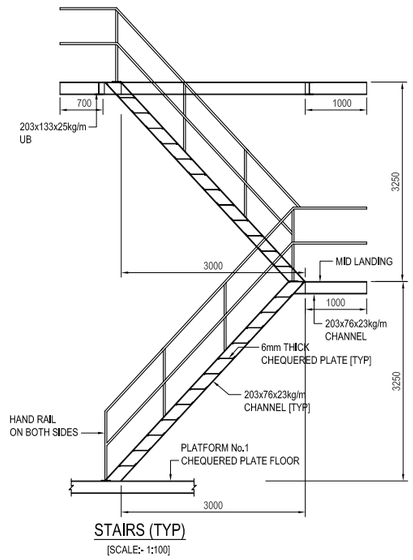












PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

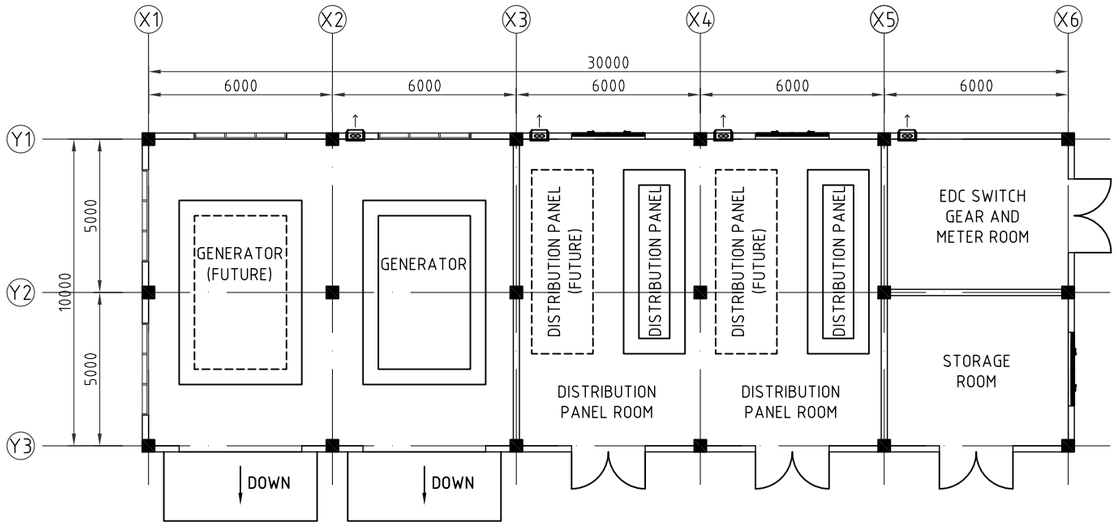
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

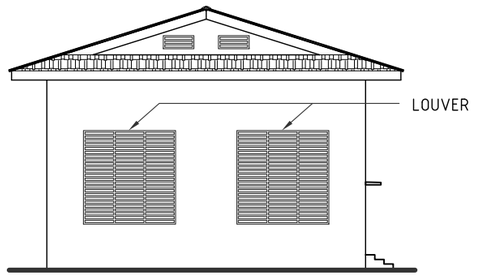
TITLE:

ELEVATED WATER TANK SECTIONS

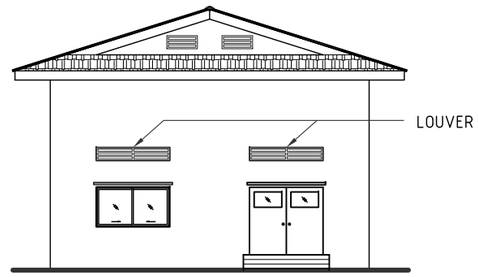
SCALE:	DATE:	DRAWING NO.:
AS SHOWN	30/09/2009	SR-10-A-02



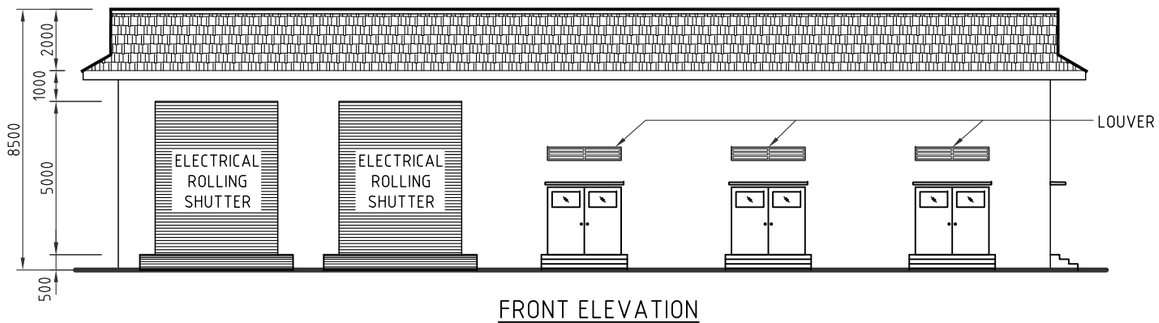
GROUND FLOOR PLAN



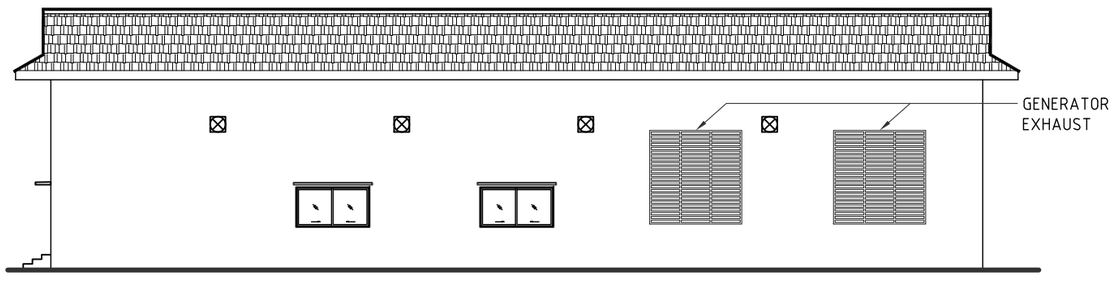
ELEVATION AT X1



ELEVATION AT X5



FRONT ELEVATION



ELEVATION AT Y3

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

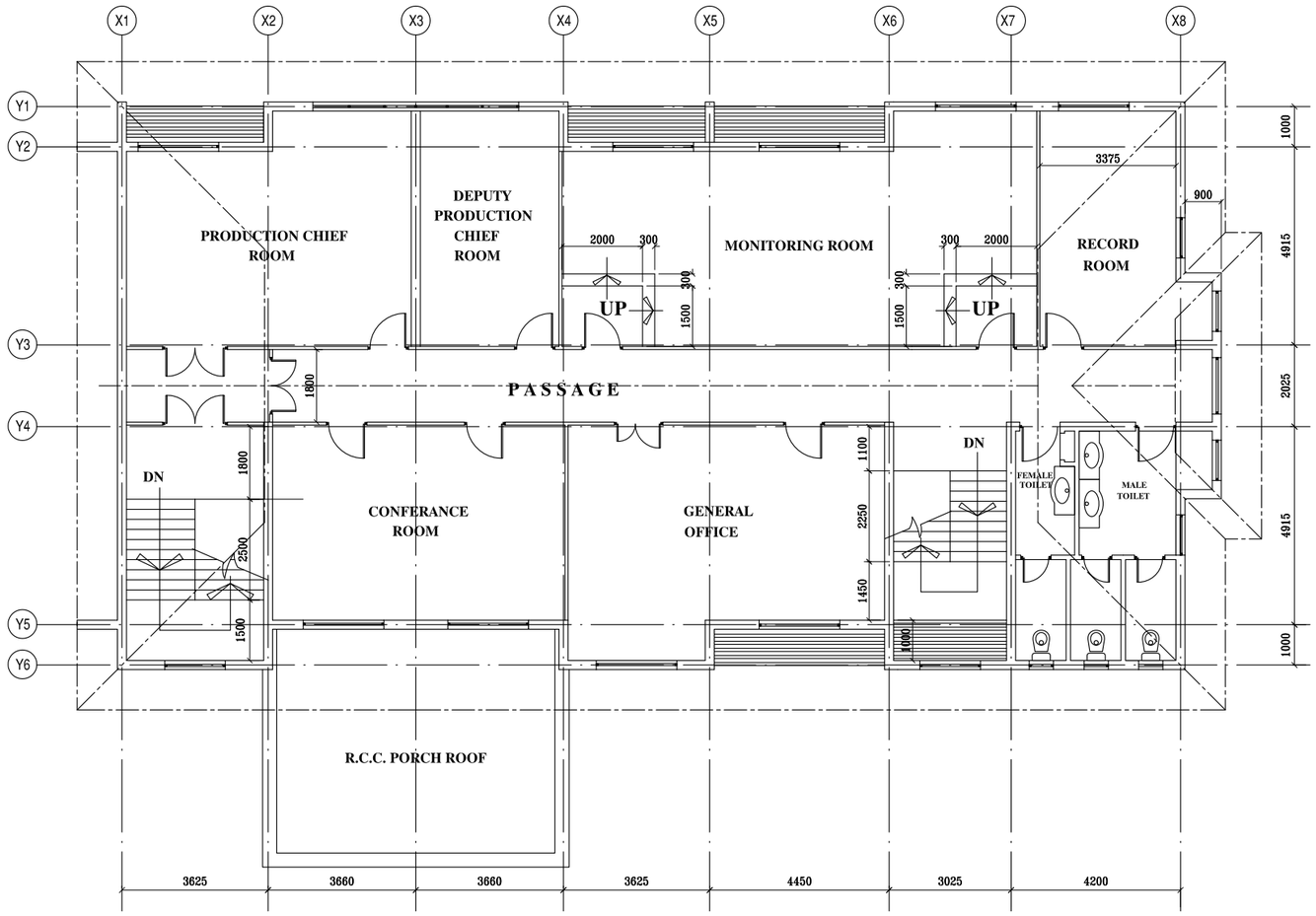
REV.	DESCRIPTION	DATE	SIGN.

TITLE: ELECTRICAL BUILDING FLOOR PLAN AND ELEVATION

SCALE: 1/200

DATE: 30/09/2009

DRAWING NO.: SR-13-A-03



FIRST FLOOR PLAN

SCALE - 1 : 150

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

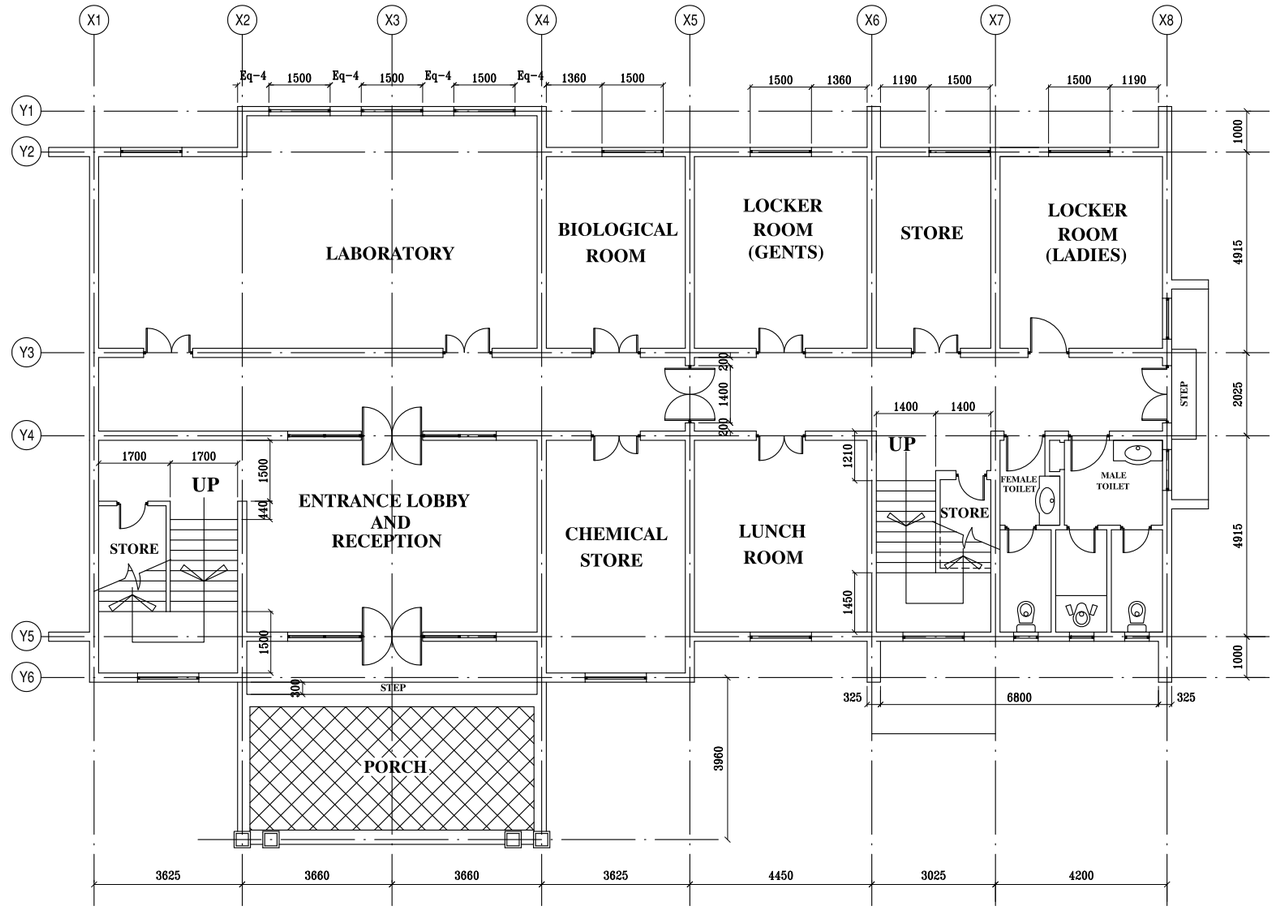
REV.	DESCRIPTION	DATE	SIGN.

TITLE: ADMINISTRATION BUILDING FLOOR PLAN-1

SCALE: 1/150

DATE: 30/09/2009

DRAWING NO.: SR-14-A-04



GROUND FLOOR PLAN

SCALE - 1 : 150

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE: ADMINISTRATION BUILDING FLOOR PLAN-2

SCALE:	DATE:	DRAWING NO.:
1/150	30/09/2009	SR-14-A-05

ELEVATION AT "A"

SCALE - 1 : 150

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

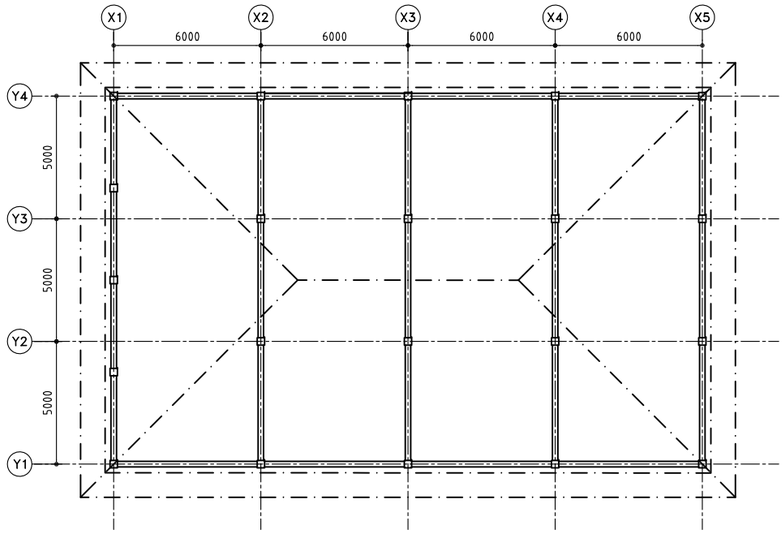
REV.	DESCRIPTION	DATE	SIGN.

TITLE: ADMINISTRATION BUILDING ELEVATION

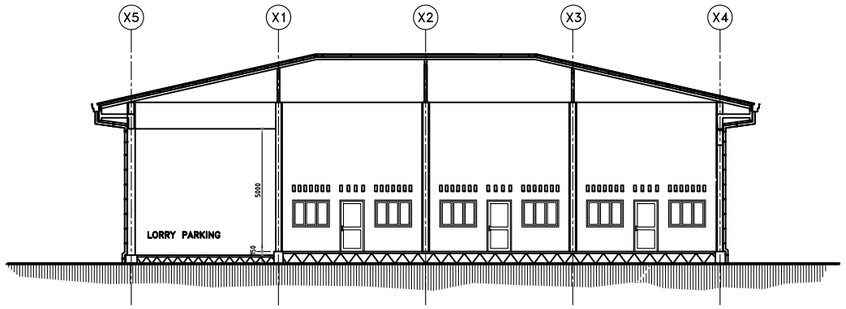
SCALE: 1/150

DATE: 30/09/2009

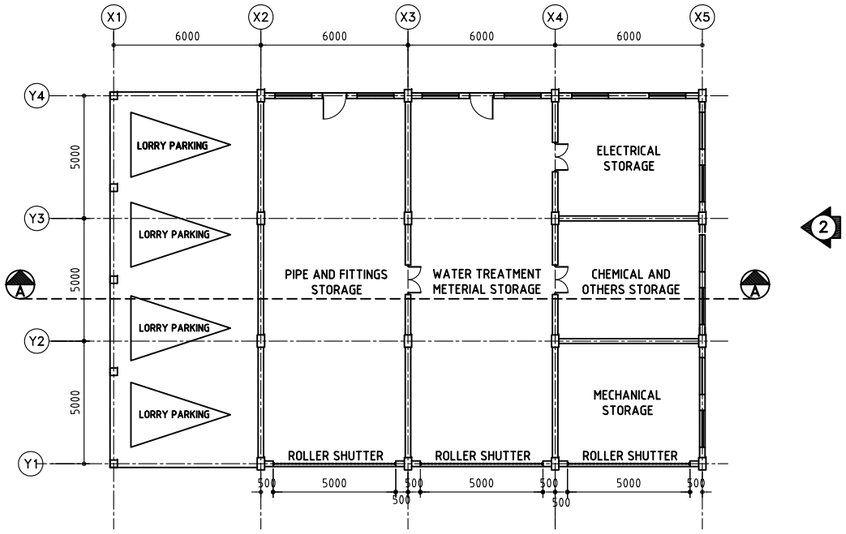
DRAWING NO.: SR-14-A-06



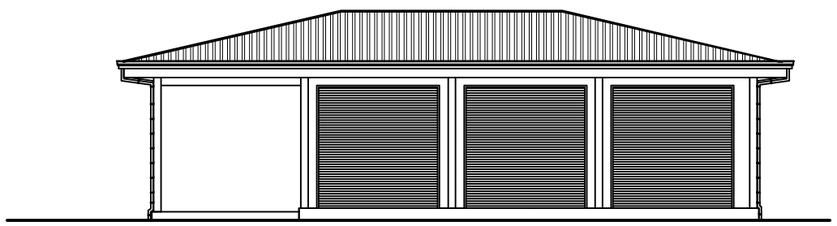
ROOF PLAN
SCALE 1 : 250



SECTION A - A
SCALE - 1 : 250



GROUND FLOOR PLAN
SCALE 1 : 250



ELEVATION AT "Y1"
SCALE - 1 : 250

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

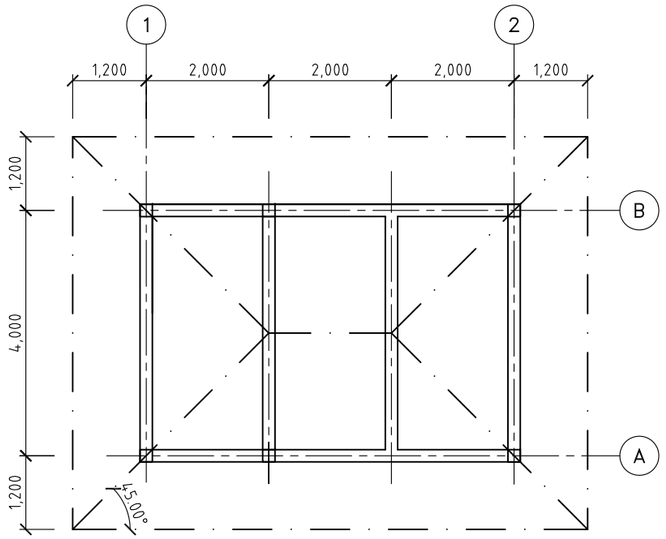
CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

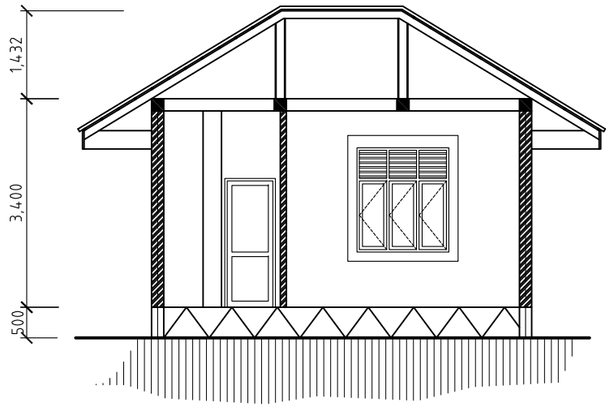
REV.	DESCRIPTION	DATE	SIGN.

TITLE: STORAGE BUILDING FLOOR PLAN, ELEVATION AND SECTION

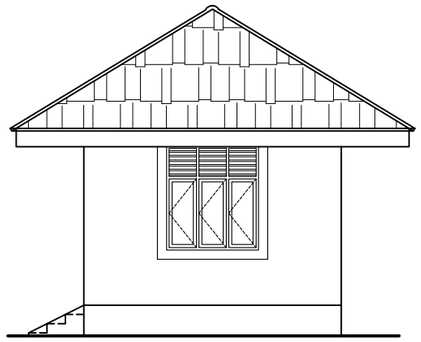
SCALE: 1/250
DATE: 30/09/2009
DRAWING NO.: SR-15-A-07



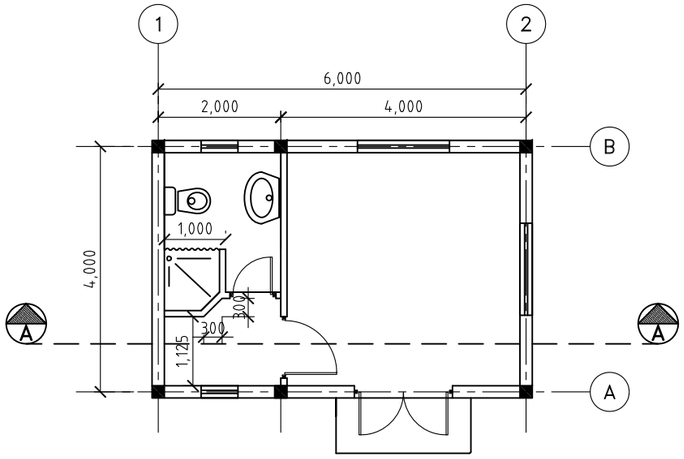
ROOF PLAN
SCALE 1 : 100



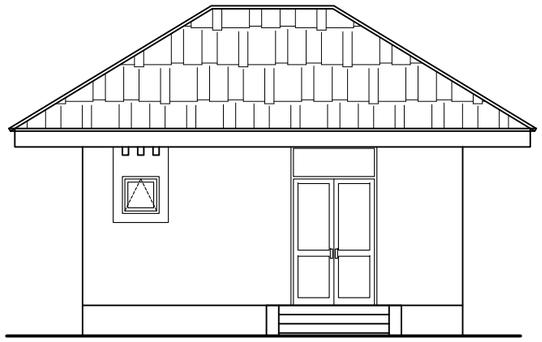
SECTION A - A
SCALE - 1 : 100



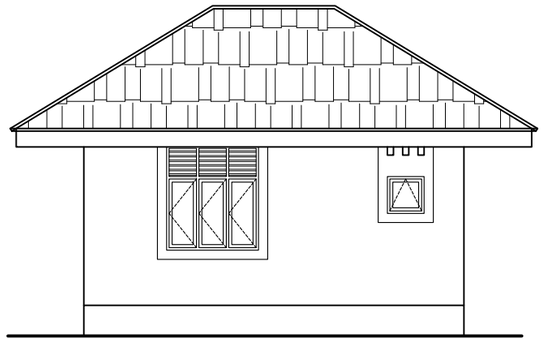
RIGHT ELEVATION
SCALE - 1 : 100



GROUND FLOOR PLAN
SCALE 1 : 100



FRONT ELEVATION
SCALE 1 : 100



REAR ELEVATION
SCALE 1 : 100

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

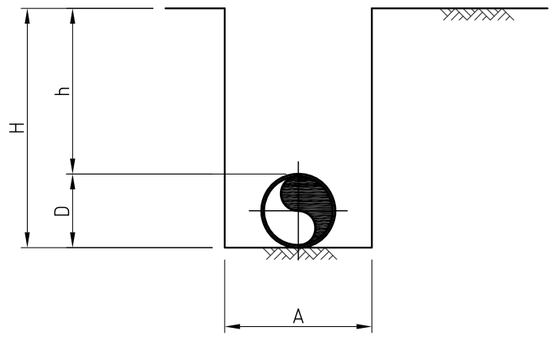
CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE:
GUARD HOUSE FLOOR PLAN, SECTION AND ELEVATION

SCALE:	DATE:	DRAWING NO.:
1/100	30/09/2009	SR-16-A-08

SR 4.15-52

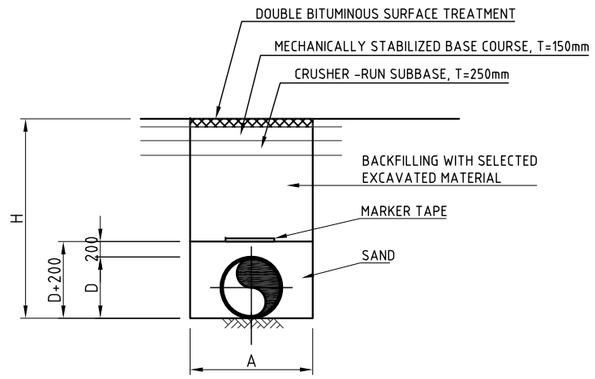


MACHINE EXCAVATION

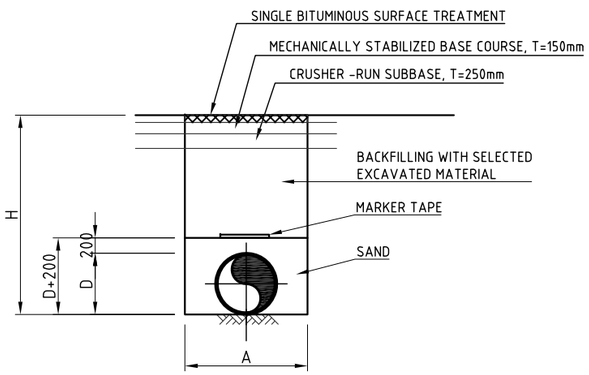
TYPICAL SIZE OF TRENCH EXCAVATION (MACHINE EXCAVATION)

PIPE MATERIAL	PIPE DIAMETER DN(mm	TRENCH WIDTH A(m)	DEPTH OF COVER *1 H(m)	EXCAVATION DEPTH H(m)
HDPE	50	0.50	0.8	0.9
	80	0.60	0.8	0.9
	100	0.65	0.8	0.9
	150	0.70	0.8	1.0
	200	0.75	0.8	1.0
DIP	250	0.80	0.8	1.1
	300	0.95	0.8	1.1
	800	1.45	1.2	2.0
	900	1.55	1.2	2.1
	1000	1.70	1.2	2.2

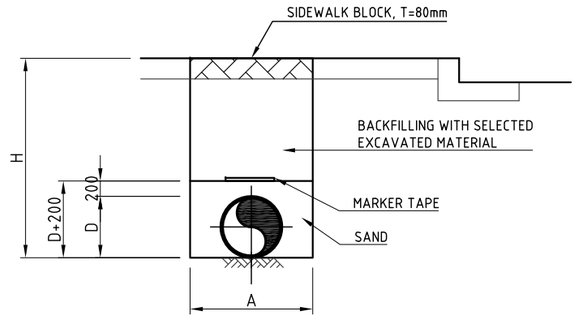
*1 DEPTH OF COVER : DEPEND ON THE SITE CONDITION.



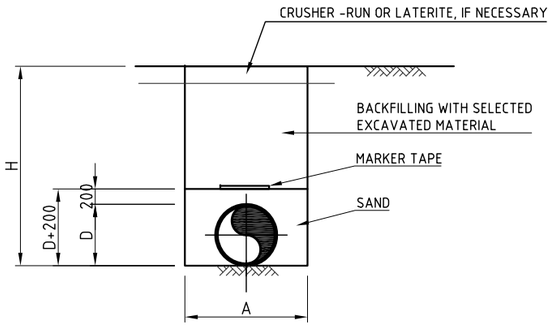
BACKFILL
ROADWAY OF THE NATIONAL ROAD NO.6



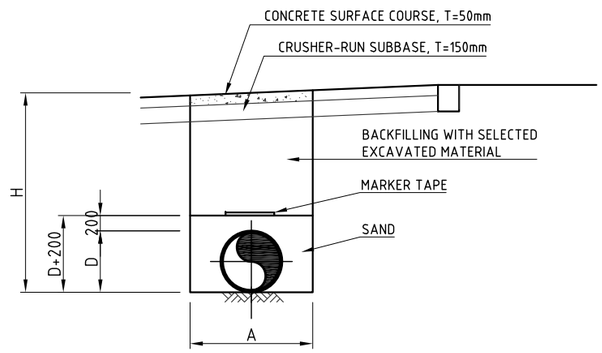
BACKFILL
CITY ROAD (PAVING)
SHOULDER OF THE NATIONAL ROAD NO.6



BACKFILL
SIDEWALK



BACKFILL
UN-PAVING SURFACE



BACKFILL
CONCRETE SURFACE COURSE

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

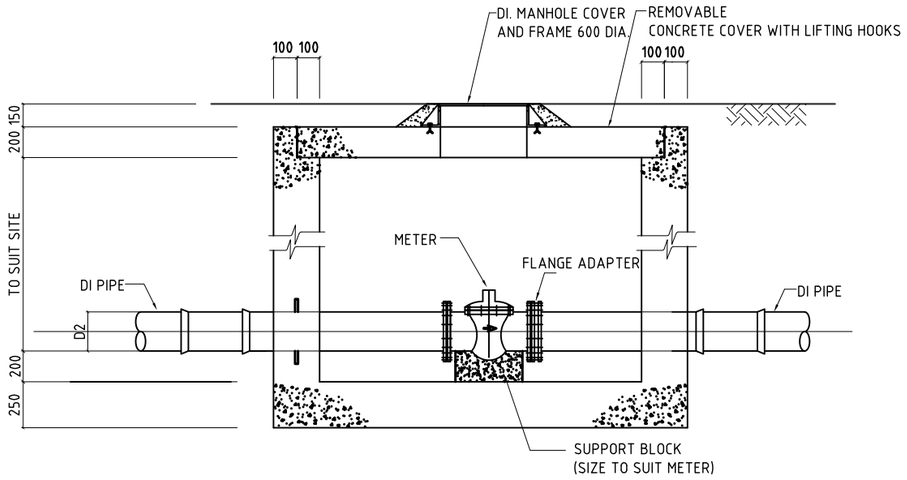
CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

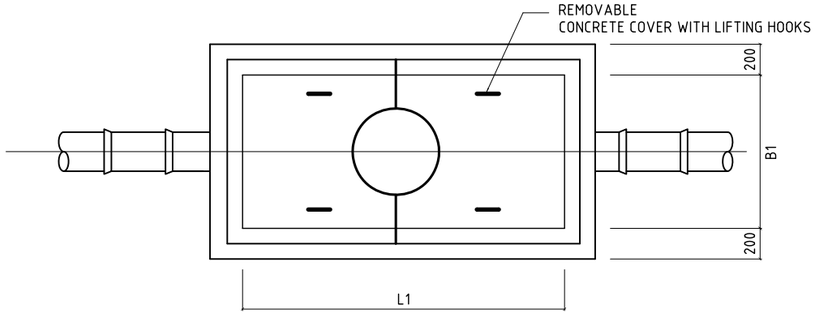
REV.	DESCRIPTION	DATE	SIGN.

TITLE:
GENERAL EARTH WORK FOR PIPE LAYING

SCALE: Not To Scale
DATE: 27/02/2010
DRAWING NO.: SR-00-S-01



ELEVATION



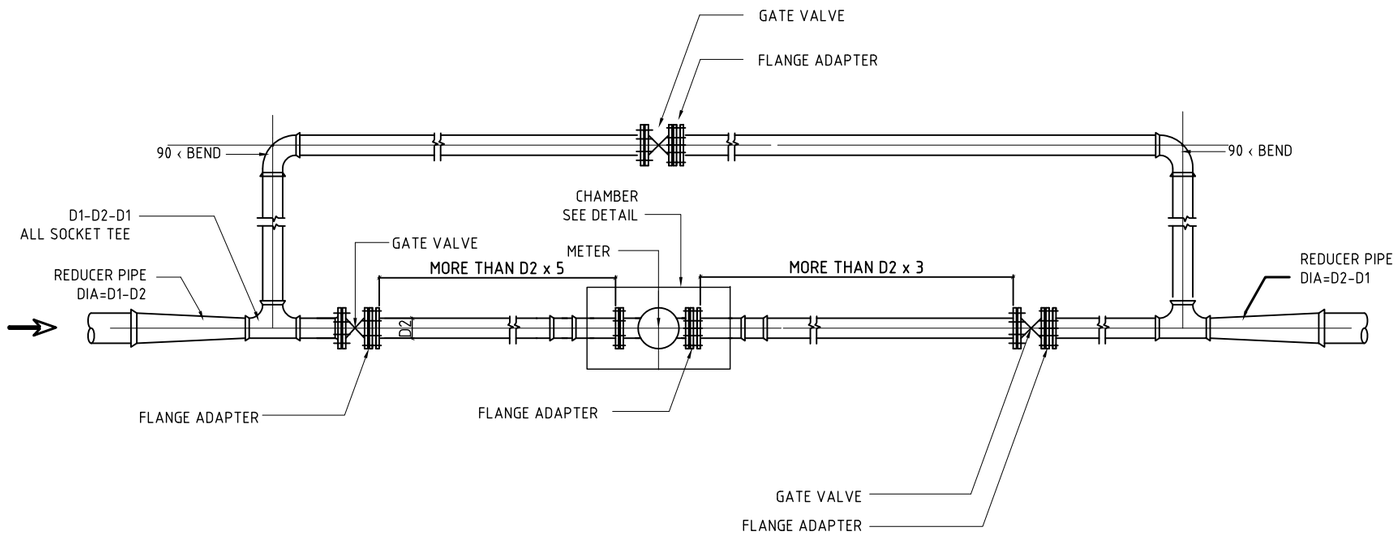
PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. THE HEIGHT OF THE CHAMBER SHALL BE DECIDED TO SUIT THE SITE.
3. IF THE REGISTER OF THE WATER METER IS MORE THAN 500mm FROM THE SURFACE, AN EXTENDED REGISTER ARRANGEMENT SHALL BE PROVIDED TO THE METER, TO THE APPROVAL OF THE ENGINEER.
4. LENGTHS OF PIPE PIECES SHALL BE TO SUIT SITE. LENGTHS SHALL BE VERIFIED BASED ON THE DIMENSIONS OF VALVES ORDERED.
5. FOR DEPTHS MORE THAN 1.0m, LADDER SHALL BE PROVIDED.

SELECTION OF DISTRIBUTION BLOCK METER AND CHAMBER SIZES

D1 (mm)	DIAMETER OF THE WATER METER AND D2(mm)	SIZE OF CHAMBER L1xB1 (mm)
800	600	3000x2000
450	400	2000x1200
250	200	1500x1000
200	150	1200x800
150	100	1000x800



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

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KOKUSAI KOGYO CO., LTD.-JAPAN

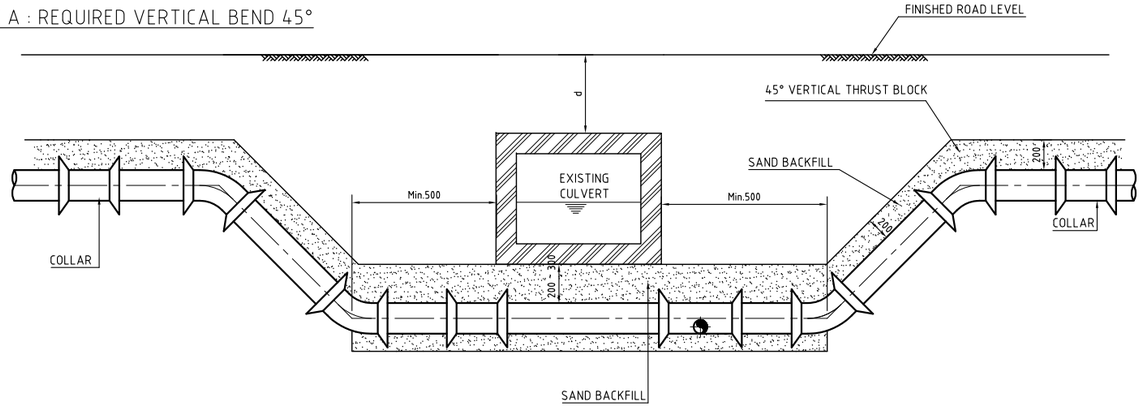
REV.	DESCRIPTION	DATE	SIGN.

TITLE: CHAMBER FOR DISTRIBUTION BLOCK METER

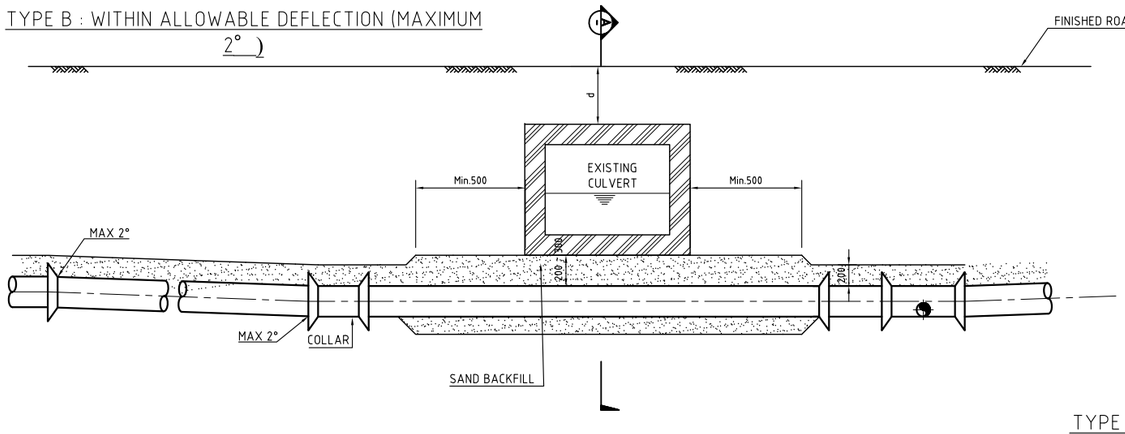
SCALE: Not To Scale | DATE: 27/02/2010 | DRAWING NO.: SR-00-S-02

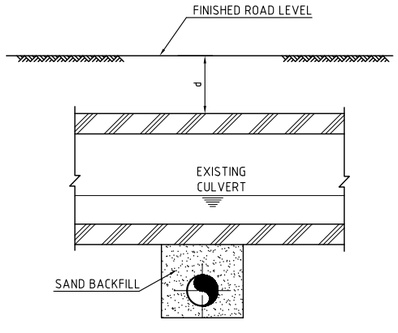
PIPE UNDER CROSSING THE CULVERT

TYPE A : REQUIRED VERTICAL BEND 45°



TYPE B : WITHIN ALLOWABLE DEFLECTION (MAXIMUM 2°)





SECTION (A)

NOTES :

1.THE SPACE BETWEEN INVERT OF THE CULVERT & BOTTOM OF THE TRENCH IN TYPE A,&B SHALL BE FILLED WITH SAND TO THE FULL TRENCH WIDTH.

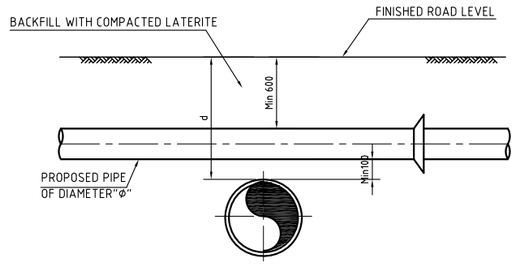
2.FOR OVER CROSSING TYPES D, CONCRETE SURROUND THE PIPE SHALL MINIMUM OF 4 Nos. OF 12 mm DEFORMED BARS AT EACH CORNERS & 10mm DEFORMED BARS 200mm INTERVALS WITH CONCRETE COVER OF 40mm.
CONCRETE STRENGTH SHALL BE 21N/mm2 FOR ALL REINFORCED CONCRETE SECTIONS.

3.IN THE EVENT OF UNDER CROSSING ALL TYPES OF CULVERTS , THE CONTRACTOR SHALL BE RESPONSIBLE FOR USING AN APPROPRIATE SUPPORTING SYSTEM, AS APPROVED BY THE ENGINEER.

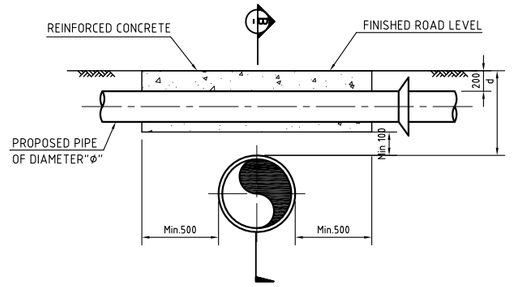
PIPE OVER CROSSING THE CULVERT

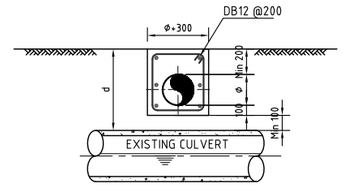
APPLICABLE TO ALL TYPES OF CULVERTS

TYPE C : d ≧ Ø + 700mm



TYPE D : ø +400mm < d < ø +700mm



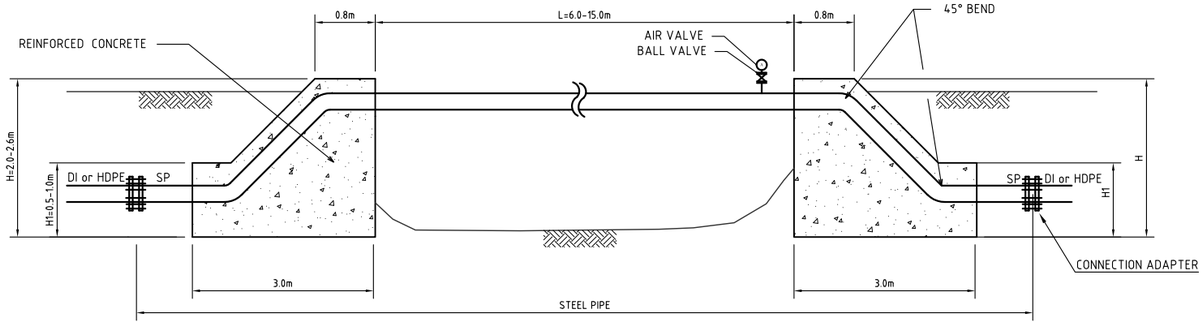


SECTION (B)

PIPE OVER CROSSING THE CULVERT

APPLICABLE TO ALL TYPES OF CULVERTS

TYPE E : PIPE BRIDGE



PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

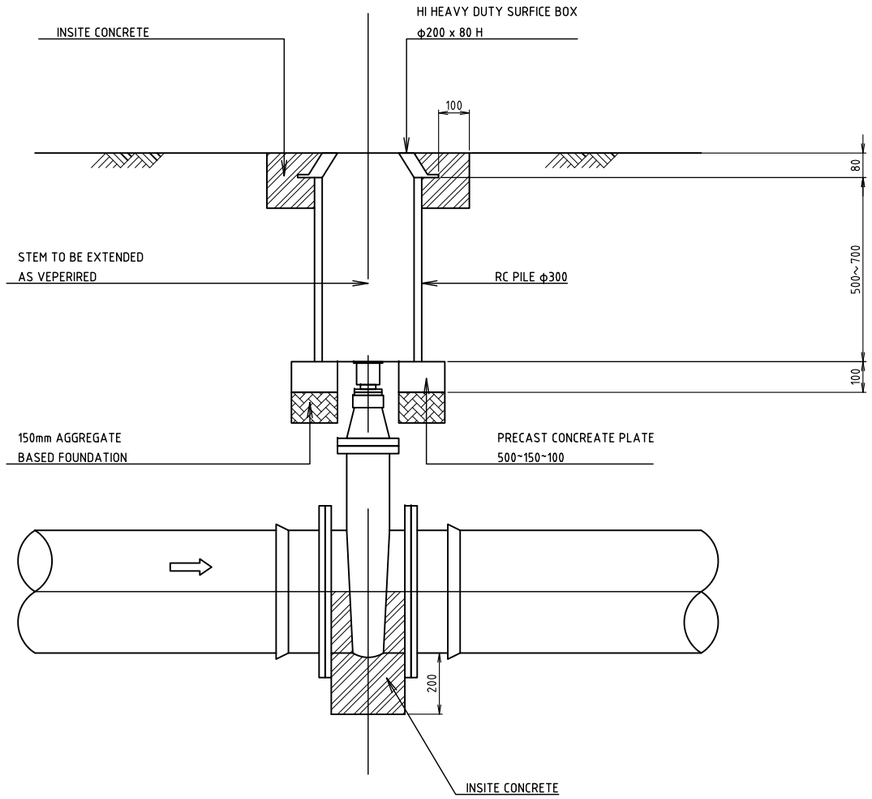
REV.	DESCRIPTION	DATE	SIGN.

TITLE: TYPICAL DRAWING FOR CULVERT CROSSING

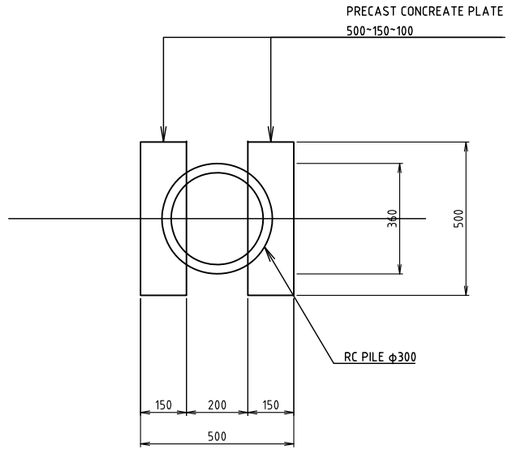
SCALE: Not To Scale

DATE: 27/02/2010

DRAWING NO.: SR-00-S-03



SECTION



PLAN

SLUICE / BUTTERFLY VALVE INSTALLATION
(ϕ80-1000mm)

PROJECT:
THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

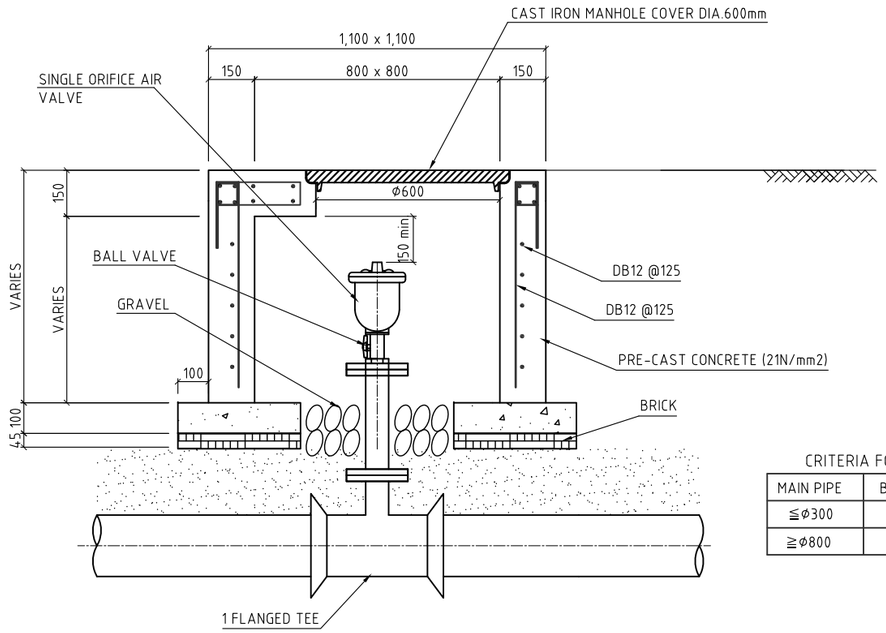
CLIENT:
SIEM REAP WATER SUPPLY AUTHORITHY
JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :
NJS CONSULTANTS CO., LTD. - JAPAN
KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE: TYPICAL DRAWING FOR SLUICE / BUTTERFLY VALVE

SCALE: Not To Scale
DATE: 27/02/2010
DRAWING NO.: SR-00-S-04



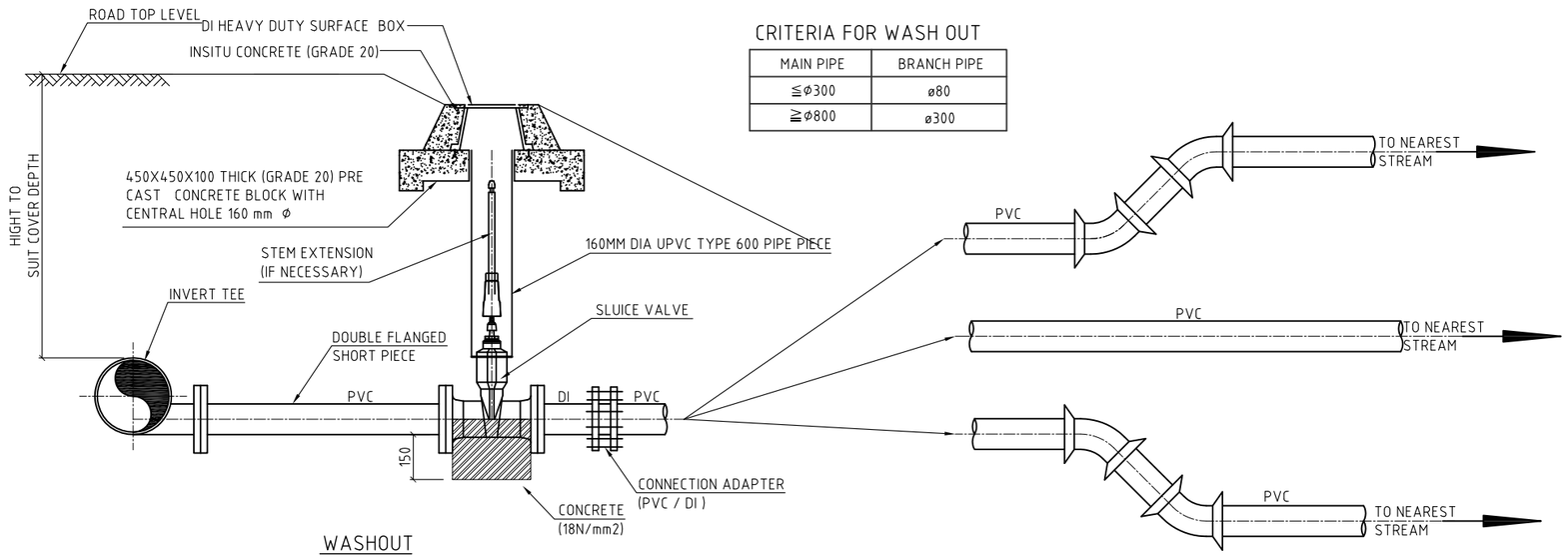
SINGLE ORIFICE AIR VALVE CHAMBER

CRITERIA FOR AIR VALVE

MAIN PIPE	BRANCH PIPE	TYPE OF AIR VALVE
≦ϕ300	ϕ25	SINGLE ORIFICE
≧ϕ800	ϕ75	SINGLE ORIFICE

NOTE

1. THE THICKNESS OF THE BLINDING LAYER SPECIFIED IN THE DRAWING IS FOR NORMAL SOIL TYPES. HOWEVER,IF THE STRUCTURE IS FOUNDED ON VERY WEAK SOIL SUCH AS PEAT, A GROUND STABILIZATION METHOD, AS DIRECTED BY THE ENGINEER, SHALL BE FOLLOWED.
2. THE VALVE BOXES FOR WASHOUT MAY BE ON THE BANK OF THE ROAD.
3. THE TOP OF THE AIR VALVE CHAMBER SHOULD BE AT THE SAME LEVEL AS THE ROAD TOP LEVEL.
4. ALL SLUICE VALVES LESS THAN 150mm DIA WILL HAVE NO CHAMBERS AND WILL BE INSTALLED SEEMLIER TO WASH OUT VALVES HEAVY-DUTY SURFACE BOXES AT THE ROAD LEVEL TO OPERATE THEM.
5. ALL DIMENSIONS ARE IN mm.



CRITERIA FOR WASH OUT

MAIN PIPE	BRANCH PIPE
≦ϕ300	ø80
≧ϕ800	ø300

WASHOUT

PROJECT:

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

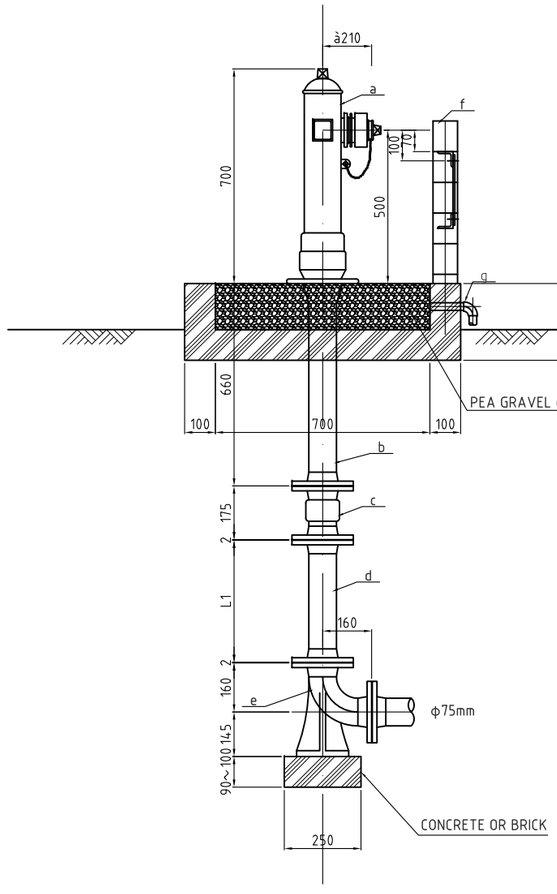
REV.	DESCRIPTION	DATE	SIGN.

TITLE: TYPICAL DRAWING FOR INSTALLATION OF AIR VALVE AND WASHOUT

SCALE: Not To Scale

DATE: 27/02/2010

DRAWING NO.: SR-00-S-05



a ABOVE-GROUND SINGLE MOUTH TYPE FIRE HYDRANT ø75Xø65.ONE-WAY STRIKE-TO-FALL TYPE

b FLANGED EXTENSION PIPE

c AUXILIARY VALVE

d EXTENSION PIPE

e DOUBLE FLANGED 90°BEND WITH DUCK-FOOT

f GUARD POST

g VP DRAIN PIPE

FIRE HYDRANT

PROJECT:

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CLIENT:

SIEM REAP WATER SUPPLY AUTHORITHY

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS :

NJS CONSULTANTS CO., LTD. - JAPAN

KOKUSAI KOGYO CO., LTD.-JAPAN

REV.	DESCRIPTION	DATE	SIGN.

TITLE: TYPICAL DRAWING FOR FIRE HYDRANT

SCALE: Not To Scale

DATE: 27/02/2010

DRAWING NO.: SR-00-S-06

SR 4.16 Water Demand Allocation (LTDP)

Water Demand of Distribution Area

Distribution Area	Item	Long Term Development Plan	
		Population (Nos.)	Water Demand (m^3/d)
Q1	Domestic	56,610	11,790
	Commercial	9,360	4,420
	Sub Total	**65,970**	**16,210**
Q2	Domestic	60,100	12,520
	Commercial	7,220	3,410
	Sub Total	**67,320**	**15,930**
Q3	Domestic	48,460	10,090
	Commercial	18,190	8,590
	Sub Total	**66,650**	**18,680**
Q4	Domestic	78,320	16,320
	Commercial	4,750	2,240
	Sub Total	**83,070**	**18,560**
Central Total	Domestic	243,490	50,720
	Commercial	39,520	18,660
	Total	**283,010**	**69,380**
Q5	Domestic	25,000	5,210
	Commercial	0	0
	Sub Total	**25,000**	**5,210**
Q6	Domestic	3,460	720
	Commercial	0	0
	Sub Total	**3,460**	**720**
East Total	Domestic	28,460	5,930
	Commercial	0	0
	Total	**28,460**	**5,930**
Q7 West Total	Domestic	50,890	10,600
	Commercial	710	340
	Total	**51,600**	**10,940**
Grand Total	**Domestic**	**322,840**	**67,250**
	Commercial	**40,230**	**19,000**
	Total	**363,070**	**86,250**

Area	Coverage Area		LTDP Area											LTDP Area (Supplied Population)												LTDP Area (Max Demand Water)											
Discript	Existing	LTDP	Population	Supplied Populatin		Area allocation rate								Population Allocation (Nos.)												Max Water Demand Allocation (m^3/d)											
	2009	2030	2030	Served	2030	West		Central				East		Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total
Total	22Villages	93Villages	**398,940**	**91%**	**363,070**	Q7	Q8	Q1	Q2	Q3	Q4	Q5	Q6	**16,436**	**35,167**	**51,603**	**65,975**	**67,320**	**66,645**	**83,067**	**283,007**	**24,997**	**3,463**	**28,460**	**363,070**	**3,610**	**7,327**	**10,937**	**16,212**	**15,926**	**18,683**	**18,557**	**69,378**	**5,208**	**721**	**5,929**	**86,244**
Domestic	-	-	**358,710**	**90%**	**322,840**	-	-	-	-	-	-	-	-	**15,726**	**35,167**	**50,893**	**56,614**	**60,096**	**48,456**	**78,321**	**243,487**	**24,997**	**3,463**	**28,460**	**322,840**	**3,275**	**7,327**	**10,602**	**11,792**	**12,516**	**10,094**	**16,315**	**50,717**	**5,208**	**721**	**5,929**	**67,248**
Commercial	-	-	**40,230**	**100%**	**40,230**	-	-	-	-	-	-	-	-	**710**	**0**	**710**	**9,361**	**7,224**	**18,189**	**4,746**	**39,520**	**0**	**0**	**0**	**40,230**	**335**	**0**	**335**	**4,420**	**3,410**	**8,589**	**2,242**	**18,661**	**0**	**0**	**0**	**18,996**

Domestic 208.3 lpcd Commecial 472.2 lpcd

Commune / Village	Existing	LTDP	Population	Served	Supplied Populatin	Q7	Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total
1 Sla Kram														0	0	0	19,279	0	62,785	19,308	101,372	0	0	0	101,372	0	0	0	5,122	0	17,879	4,744	27,745	0	0	0	27,745
Domestic			**84,720**	**90%**	**76,250**									0	0	0	15,084	0	44,596	16,570	76,250	0	0	0	76,250	0	0	0	3,142	0	9,290	3,451	15,883	0	0	0	15,883
Commercial			**25,122**	**100%**	**25,122**									0	0	0	4,195	0	18,189	2,738	25,122	0	0	0	25,122	0	0	0	1,980	0	8,589	1,293	11,862	0	0	0	11,862
1- 1 Slor Kram	○	○												0	0	0	0	0	5,576	0	5,576	0	0	0	5,576	0	0	0	0	0	1,266	0	1,266	0	0	0	1,266
Domestic			5,740	90%	5,180	0%	0%	0%	0%	100%	0%	0%	0%	0	0	0	0	0	5,180	0	5,180	0	0	0	5,180	0	0	0	0	0	1,079	0	1,079	0	0	0	1,079
Commercial			396	100%	396	0%	0%	0%	0%	100%	0%	0%	0%	0	0	0	0	0	396	0	396	0	0	0	396	0	0	0	0	0	187	0	187	0	0	0	187
1- 2 Boeng dunpa	△	○												0	0	0	3,195	0	12,780	0	15,975	0	0	0	15,975	0	0	0	917	0	3,668	0	4,585	0	0	0	4,585
Domestic			12,460	90%	11,210	0%	0%	20%	0%	80%	0%	0%	0%	0	0	0	2,242	0	8,968	0	11,210	0	0	0	11,210	0	0	0	467	0	1,868	0	2,335	0	0	0	2,335
Commercial			4,765	100%	4,765	0%	0%	20%	0%	80%	0%	0%	0%	0	0	0	953	0	3,812	0	4,765	0	0	0	4,765	0	0	0	450	0	1,800	0	2,250	0	0	0	2,250
1- 3 Chong Kavsu	△	○												0	0	0	0	0	26,587	6,647	33,234	0	0	0	33,234	0	0	0	0	0	7,511	1,878	9,389	0	0	0	9,389
Domestic			26,540	90%	23,890	0%	0%	0%	0%	80%	20%	0%	0%	0	0	0	0	0	19,112	4,778	23,890	0	0	0	23,890	0	0	0	0	0	3,981	995	4,976	0	0	0	4,976
Commercial			9,344	100%	9,344	0%	0%	0%	0%	80%	20%	0%	0%	0	0	0	0	0	7,475	1,869	9,344	0	0	0	9,344	0	0	0	0	0	3,530	883	4,413	0	0	0	4,413
1- 4 Dork pou	△	○												0	0	0	0	0	1,986	4,634	6,620	0	0	0	6,620	0	0	0	0	0	414	965	1,379	0	0	0	1,379
Domestic			7,360	90%	6,620	0%	0%	0%	0%	30%	70%	0%	0%	0	0	0	0	0	1,986	4,634	6,620	0	0	0	6,620	0	0	0	0	0	414	965	1,379	0	0	0	1,379
Commercial			0	100%	0	0%	0%	0%	0%	30%	70%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1- 5 Bantay chas	○	○												0	0	0	0	0	5,352	8,027	13,379	0	0	0	13,379	0	0	0	0	0	1,268	1,901	3,169	0	0	0	3,169
Domestic			13,260	90%	11,930	0%	0%	0%	0%	40%	60%	0%	0%	0	0	0	0	0	4,772	7,158	11,930	0	0	0	11,930	0	0	0	0	0	994	1,491	2,485	0	0	0	2,485
Commercial			1,449	100%	1,449	0%	0%	0%	0%	40%	60%	0%	0%	0	0	0	0	0	580	869	1,449	0	0	0	1,449	0	0	0	0	0	274	410	684	0	0	0	684
1- 6 Trang	△	○												0	0	0	4,502	0	10,504	0	15,006	0	0	0	15,006	0	0	0	1,608	0	3,752	0	5,360	0	0	0	5,360
Domestic			7,270	90%	6,540	0%	0%	30%	0%	70%	0%	0%	0%	0	0	0	1,962	0	4,578	0	6,540	0	0	0	6,540	0	0	0	409	0	954	0	1,363	0	0	0	1,363
Commercial			8,466	100%	8,466	0%	0%	30%	0%	70%	0%	0%	0%	0	0	0	2,540	0	5,926	0	8,466	0	0	0	8,466	0	0	0	1,199	0	2,798	0	3,997	0	0	0	3,997
1- 7 Mondol 3	○	○												0	0	0	11,582	0	0	0	11,582	0	0	0	11,582	0	0	0	2,597	0	0	0	2,597	0	0	0	2,597
Domestic			12,090	90%	10,880	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	10,880	0	0	0	10,880	0	0	0	10,880	0	0	0	2,266	0	0	0	2,266	0	0	0	2,266
Commercial			702	100%	702	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	702	0	0	0	702	0	0	0	702	0	0	0	331	0	0	0	331	0	0	0	331
2 Svay Dangkum														11,253	0	11,253	24,408	41,225	0	0	65,633	0	0	0	76,886	2,531	0	2,531	6,140	10,294	0	0	16,434	0	0	0	18,965
Domestic			**73,000**	**90%**	**65,700**									10,543	0	10,543	20,408	34,749	0	0	55,157	0	0	0	65,700	2,196	0	2,196	4,251	7,237	0	0	11,488	0	0	0	13,684
Commercial			**11,186**	**100%**	**11,186**									710	0	710	4,000	6,476	0	0	10,476	0	0	0	11,186	335	0	335	1,889	3,057	0	0	4,946	0	0	0	5,281
2- 1 Pngea Chei	×	○												1,256	0	1,256	0	539	0	0	539	0	0	0	1,795	266	0	266	0	115	0	0	115	0	0	0	381
Domestic			1,970	90%	1,770	70%	0%	0%	30%	0%	0%	0%	0%	1,239	0	1,239	0	531	0	0	531	0	0	0	1,770	258	0	258	0	111	0	0	111	0	0	0	369
Commercial			25	100%	25	70%	0%	0%	30%	0%	0%	0%	0%	17	0	17	0	8	0	0	8	0	0	0	25	8	0	8	0	4	0	0	4	0	0	0	12
2- 2 Kantrork	×	△(○)												3,950	0	3,950	0	0	0	0	0	0	0	0	3,950	823	0	823	0	0	0	0	0	0	0	0	823
Domestic			4,390	90%	3,950	100%	0%	0%	0%	0%	0%	0%	0%	3,950	0	3,950	0	0	0	0	0	0	0	0	3,950	823	0	823	0	0	0	0	0	0	0	0	823
Commercial			0	100%	0	100%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 3 Kouk Krasang	×	△(○)												1,908	0	1,908	0	0	0	0	0	0	0	0	1,908	460	0	460	0	0	0	0	0	0	0	0	460
Domestic			1,860	90%	1,670	100%	0%	0%	0%	0%	0%	0%	0%	1,670	0	1,670	0	0	0	0	0	0	0	0	1,670	348	0	348	0	0	0	0	0	0	0	0	348
Commercial			238	100%	238	100%	0%	0%	0%	0%	0%	0%	0%	238	0	238	0	0	0	0	0	0	0	0	238	112	0	112	0	0	0	0	0	0	0	0	112
2- 4 Svay Chrei	×	△(○)												1,682	0	1,682	0	0	0	0	0	0	0	0	1,682	354	0	354	0	0	0	0	0	0	0	0	354
Domestic			1,850	90%	1,670	100%	0%	0%	0%	0%	0%	0%	0%	1,670	0	1,670	0	0	0	0	0	0	0	0	1,670	348	0	348	0	0	0	0	0	0	0	0	348
Commercial			12	100%	12	100%	0%	0%	0%	0%	0%	0%	0%	12	0	12	0	0	0	0	0	0	0	0	12	6	0	6	0	0	0	0	0	0	0	0	6
2- 5 Pou Bos	×	△(○)												0	0	0	0	1,280	0	0	1,280	0	0	0	1,280	0	0	0	0	267	0	0	267	0	0	0	267
Domestic			1,420	90%	1,280	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	1,280	0	0	1,280	0	0	0	1,280	0	0	0	0	267	0	0	267	0	0	0	267
Commercial			0	100%	0	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 6 Tmei	×	△(○)												0	0	0	0	2,560	0	0	2,560	0	0	0	2,560	0	0	0	0	533	0	0	533	0	0	0	533
Domestic			2,840	90%	2,560	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	2,560	0	0	2,560	0	0	0	2,560	0	0	0	0	533	0	0	533	0	0	0	533
Commercial			0	100%	0	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 7 Svay Dangkum	△	○												0	0	0	0	3,352	0	0	3,352	0	0	0	3,352	0	0	0	0	709	0	0	709	0	0	0	709
Domestic			3,680	90%	3,310	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	3,310	0	0	3,310	0	0	0	3,310	0	0	0	0	689	0	0	689	0	0	0	689
Commercial			42	100%	42	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	42	0	0	42	0	0	0	42	0	0	0	0	20	0	0	20	0	0	0	20
2- 8 Salakanseng	△	○												0	0	0	19,086	4,772	0	0	23,858	0	0	0	23,858	0	0	0	4,648	1,162	0	0	5,810	0	0	0	5,810
Domestic			22,970	90%	20,670	0%	0%	80%	20%	0%	0%	0%	0%	0	0	0	16,536	4,134	0	0	20,670	0	0	0	20,670	0	0	0	3,444	861	0	0	4,305	0	0	0	4,305
Commercial			3,188	100%	3,188	0%	0%	80%	20%	0%	0%	0%	0%	0	0	0	2,550	638	0	0	3,188	0	0	0	3,188	0	0	0	1,204	301	0	0	1,505	0	0	0	1,505
2- 9 Krous	△	○												1,505	0	1,505	2,257	3,762	0	0	6,019	0	0	0	7,524	405	0	405	608	1,012	0	0	1,620	0	0	0	2,025
Domestic			6,430	90%	5,790	20%	0%	30%	50%	0%	0%	0%	0%	1,158	0	1,158	1,737	2,895	0	0	4,632	0	0	0	5,790	241	0	241	362	603	0	0	965	0	0	0	1,206
Commercial			1,734	100%	1,734	20%	0%	30%	50%	0%	0%	0%	0%	347	0	347	520	867	0	0	1,387	0	0	0	1,734	164	0	164	246	409	0	0	655	0	0	0	819
2- 10 Vihear Chin	△	○												0	0	0	0	9,574	0	0	9,574	0	0	0	9,574	0	0	0	0	2,098	0	0	2,098	0	0	0	2,098
Domestic			10,200	90%	9,180	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	9,180	0	0	9,180	0	0	0	9,180	0	0	0	0	1,912	0	0	1,912	0	0	0	1,912
Commercial			394	100%	394	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	394	0	0	394	0	0	0	394	0	0	0	0	186	0	0	186	0	0	0	186
2- 11 Steng Tmei	△	○												952	0	952	0	3,807	0	0	3,807	0	0	0	4,759	223	0	223	0	894	0	0	894	0	0	0	1,117
Domestic			4,760	90%	4,280	20%	0%	0%	80%	0%	0%	0%	0%	856	0	856	0	3,424	0	0	3,424	0	0	0	4,280	178	0	178	0	713	0	0	713	0	0	0	891
Commercial			479	100%	479	20%	0%	0%	80%	0%	0%	0%	0%	96	0	96	0	383	0	0	383	0	0	0	479	45	0	45	0	181	0	0	181	0	0	0	226
2- 12 Mondol 1	○	○												0	0	0	2,412	3,617	0	0	6,029	0	0	0	6,029	0	0	0	702	1,052	0	0	1,754	0	0	0	1,754
Domestic			4,600	90%	4,140	0%	0%	40%	60%	0%	0%	0%	0%	0	0	0	1,656	2,484	0	0	4,140	0	0	0	4,140	0	0	0	345	517	0	0	862	0	0	0	862
Commercial			1,889	100%	1,889	0%	0%	40%	60%	0%	0%	0%	0%	0	0	0	756	1,133	0	0	1,889	0	0	0	1,889	0	0	0	357	535	0	0	892	0	0	0	892
2- 13 Mondol 2	○	○												0	0	0	0	2,081	0	0	2,081	0	0	0	2,081	0	0	0	0	813	0	0	813	0	0	0	813
Domestic			710	90%	640	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	640	0	0	640	0	0	0	640	0	0	0	0	133	0	0	133	0	0	0	133
Commercial			1,441	100%	1,441	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	1,441	0	0	1,441	0	0	0	1,441	0	0	0	0	680	0	0	680	0	0	0	680
2- 14 Ta phoul	○	○												0	0	0	653	5,881	0	0	6,534	0	0	0	6,534	0	0	0	182	1,639	0	0	1,821	0	0	0	1,821
Domestic			5,320	90%	4,790	0%	0%	10%	90%	0%	0%	0%	0%	0	0	0	479	4,311	0	0	4,790	0	0	0	4,790	0	0	0	100	898	0	0	998	0	0	0	998
Commercial			1,744	100%	1,744	0%	0%	10%	90%	0%	0%	0%	0%	0	0	0	174	1,570	0	0	1,744	0	0	0	1,744	0	0	0	82	741	0	0	823	0	0	0	823
3 Sala Kamraeuk														0	0	0	0	4,403	0	38,214	42,617	0	0	0	42,617	0	0	0	0	921	0	8,464	9,385	0	0	0	9,385
Domestic			**45,210**	**90%**	**40,690**									0	0	0	0	4,385	0	36,305	40,690	0	0	0	40,690	0	0	0	0	913	0	7,562	8,475	0	0	0	8,475
Commercial			**1,927**	**100%**	**1,927**									0	0	0	0	18	0	1,909	1,927	0	0	0	1,927	0	0	0	0	8	0	902	910	0	0	0	910
3- 1 Vat Bo	○	○												0	0	0	0	0	0	12,719	12,719	0	0	0	12,719	0	0	0	0	0	0	3,082	3,082	0	0	0	3,082
Domestic			12,320	90%	11,080	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	11,080	11,080	0	0	0	11,080	0	0	0	0	0	0	2,308	2,308	0	0	0	2,308
Commercial			1,639	100%	1,639	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,639	1,639	0	0	0	1,639	0	0	0	0	0	0	774	774	0	0	0	774
3- 2 Vat Svay	×	○												0	0	0	0	4,403	0	4,404	8,807	0	0	0	8,807	0	0	0	0	921	0	922	1,843	0	0	0	1,843
Domestic			9,750	90%	8,770	0%	0%	0%	50%	0%	50%	0%	0%	0	0	0	0	4,385	0	4,385	8,770	0	0	0	8,770	0	0	0	0	913	0	913	1,826	0	0	0	1,826
Commercial			37	100%	37	0%	0%	0%	50%	0%	50%	0%	0%	0	0	0	0	18	0	19	37	0	0	0	37	0	0	0	0	8	0	9	17	0	0	0	17
3- 3 Vat Damnak	△	○												0	0	0	0	0	0	7,671	7,671	0	0	0	7,671	0	0	0	0	0	0	1,665	1,665	0	0	0	1,665
Domestic			8,240	90%	7,420	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	7,420	7,420	0	0	0	7,420	0	0	0	0	0	0	1,546	1,546	0	0	0	1,546
Commercial			251	100%	251	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	251	251	0	0	0	251	0	0	0	0	0	0	119	119	0	0	0	119
3- 4 Sala Kamreak	×	○												0	0	0	0	0	0	3,380	3,380	0	0	0	3,380	0	0	0	0	0	0	704	704	0	0	0	704
Domestic			3,750	90%	3,380	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	3,380	3,380	0	0	0	3,380	0	0	0	0	0	0	704	704	0	0	0	704
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 5 Chun long	×	○												0	0	0	0	0	0	1,940	1,940	0	0	0	1,940	0	0	0	0	0	0	404	404	0	0	0	404
Domestic			2,150	90%	1,940	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,940	1,940	0	0	0	1,940	0	0	0	0	0	0	404	404	0	0	0	404
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 6 Ta Vean	×	○												0	0	0	0	0	0	6,750	6,750	0	0	0	6,750	0	0	0	0	0	0	1,406	1,406	0	0	0	1,406
Domestic			7,500	90%	6,750	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	6,750	6,750	0	0	0	6,750	0	0	0	0	0	0	1,406	1,406	0	0	0	1,406
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 7 Trapang Treng	×	○												0	0	0	0	0	0	1,350	1,350	0	0	0	1,350	0	0	0	0	0	0	281	281	0	0	0	281
Domestic			1,500	90%	1,350	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,350	1,350	0	0	0	1,350	0	0	0	0	0	0	281	281	0	0	0	281
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Kouk Chak														0	0	0	18,303	0	0	0	18,303	0	0	0	18,303	0	0	0	3,932	0	0	0	3,932	0	0	0	3,932
Domestic			**19,840**	**90%**	**17,850**									0	0	0	17,850	0	0	0	17,850	0	0	0	17,850	0	0	0	3,718	0	0	0	3,718	0	0	0	3,718
Commercial			**453**	**100%**	**453**									0	0	0	453	0	0	0	453	0	0	0	453	0	0	0	214	0	0	0	214	0	0	0	214
4- 1 Trapang Ses	△	○												0	0	0	7,143	0	0	0	7,143	0	0	0	7,143	0	0	0	1,608	0	0	0	1,608	0	0	0	1,608
Domestic			7,440	90%	6,690	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	6,690	0	0	0	6,690	0	0	0	6,690	0	0	0	1,394	0	0	0	1,394	0	0	0	1,394
Commercial			453	100%	453	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	453	0	0	0	453	0	0	0	453	0	0	0	214	0	0	0	214	0	0	0	214
4- 2 Veal	△	△												0	0	0	4,430	0	0	0	4,430	0	0	0	4,430	0	0	0	923	0	0	0	923	0	0	0	923
Domestic			4,920	90%	4,430	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	4,430	0	0	0	4,430	0	0	0	4,430	0	0	0	923	0	0	0	923	0	0	0	923
Commercial			0	100%	0	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 3 Kasin tabong	△	○												0	0	0	6,080	0	0	0	6,080	0	0	0	6,080	0	0	0	1,266	0	0	0	1,266	0	0	0	1,266
Domestic			6,760	90%	6,080	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	6,080	0	0	0	6,080	0	0	0	6,080	0	0	0	1,266	0	0	0	1,266	0	0	0	1,266
Commercial			0	100%	0	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 4 Kouk Chan	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 5 Khatean	×	△												0	0	0	650	0	0	0	650	0	0	0	650	0	0	0	135	0	0	0	135	0	0	0	135
Domestic			720	90%	650	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	650	0	0	0	650	0	0	0	650	0	0	0	135	0	0	0	135	0	0	0	135
Commercial			0	100%	0	0%	0%	100%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 6 Kouk Beng	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 7 Kouk Tanot	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 8 Nokor krav	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Commune / Village	Existing	LTDP	Population	Served	Supplied Population	Q7	Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total
5 Siem Reap														0	0	0	0	18,230	0	7,566	25,796	0	0	0	25,796	0	0	0	0	3,802	0	1,577	5,379	0	0	0	5,379
Domestic			28,640	90%	25,780									0	0	0	0	18,214	0	7,566	25,780	0	0	0	25,780	0	0	0	0	3,794	0	1,577	5,371	0	0	0	5,371
Commercial			16	100%	16									0	0	0	0	16	0	0	16	0	0	0	16	0	0	0	0	8	0	0	8	0	0	0	8
5- 1 Pou	×	△(○)												0	0	0	0	3,661	0	1,569	5,230	0	0	0	5,230	0	0	0	0	763	0	327	1,090	0	0	0	1,090
Domestic			5,810	90%	5,230	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	3,661	0	1,569	5,230	0	0	0	5,230	0	0	0	0	763	0	327	1,090	0	0	0	1,090
Commercial			0	100%	0	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 2 Phnom krom	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 3 Pror Lay	×	△(○)												0	0	0	0	0	0	1,590	1,590	0	0	0	1,590	0	0	0	0	0	0	331	331	0	0	0	331
Domestic			1,760	90%	1,590	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,590	1,590	0	0	0	1,590	0	0	0	0	0	0	331	331	0	0	0	331
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 4 Korkragn	×	○												0	0	0	0	3,199	0	1,371	4,570	0	0	0	4,570	0	0	0	0	666	0	286	952	0	0	0	952
Domestic			5,080	90%	4,570	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	3,199	0	1,371	4,570	0	0	0	4,570	0	0	0	0	666	0	286	952	0	0	0	952
Commercial			0	100%	0	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 5 Kra Sangroleung	×	△(○)												0	0	0	0	1,610	0	0	1,610	0	0	0	1,610	0	0	0	0	335	0	0	335	0	0	0	335
Domestic			1,790	90%	1,610	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	1,610	0	0	1,610	0	0	0	1,610	0	0	0	0	335	0	0	335	0	0	0	335
Commercial			0	100%	0	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 6 Spean Chreav	×	○												0	0	0	0	3,493	0	1,497	4,990	0	0	0	4,990	0	0	0	0	728	0	312	1,040	0	0	0	1,040
Domestic			5,540	90%	4,990	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	3,493	0	1,497	4,990	0	0	0	4,990	0	0	0	0	728	0	312	1,040	0	0	0	1,040
Commercial			0	100%	0	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 7 Arragn	×	△												0	0	0	0	3,591	0	1,539	5,130	0	0	0	5,130	0	0	0	0	748	0	321	1,069	0	0	0	1,069
Domestic			5,700	90%	5,130	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	3,591	0	1,539	5,130	0	0	0	5,130	0	0	0	0	748	0	321	1,069	0	0	0	1,069
Commercial			0	100%	0	0%	0%	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 8 Treak	×	△(○)												0	0	0	0	2,676	0	0	2,676	0	0	0	2,676	0	0	0	0	562	0	0	562	0	0	0	562
Domestic			2,960	90%	2,660	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	2,660	0	0	2,660	0	0	0	2,660	0	0	0	0	554	0	0	554	0	0	0	554
Commercial			16	100%	16	0%	0%	0%	100%	0%	0%	0%	0%	0	0	0	0	16	0	0	16	0	0	0	16	0	0	0	0	8	0	0	8	0	0	0	8
6 Teuk Vil														5,183	5,870	11,053	2,177	0	0	0	2,177	0	0	0	13,230	1,079	1,222	2,301	453	0	0	0	453	0	0	0	2,754
Domestic			14,700	90%	13,230									5,183	5,870	11,053	2,177	0	0	0	2,177	0	0	0	13,230	1,079	1,222	2,301	453	0	0	0	453	0	0	0	2,754
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 1 Kouk doung	×	△(○)												933	0	933	2,177	0	0	0	2,177	0	0	0	3,110	194	0	194	453	0	0	0	453	0	0	0	647
Domestic			3,450	90%	3,110	30%	0%	70%	0%	0%	0%	0%	0%	933	0	933	2,177	0	0	0	2,177	0	0	0	3,110	194	0	194	453	0	0	0	453	0	0	0	647
Commercial			0	100%	0	30%	0%	70%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 2 Sandan	×	△(○)												2,608	652	3,260	0	0	0	0	0	0	0	0	3,260	543	136	679	0	0	0	0	0	0	0	0	679
Domestic			3,620	90%	3,260	80%	20%	0%	0%	0%	0%	0%	0%	2,608	652	3,260	0	0	0	0	0	0	0	0	3,260	543	136	679	0	0	0	0	0	0	0	0	679
Commercial			0	100%	0	80%	20%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 3 Chrei	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 4 Prayut	×	○												0	1,060	1,060	0	0	0	0	0	0	0	0	1,060	0	221	221	0	0	0	0	0	0	0	0	221
Domestic			1,180	90%	1,060	0%	100%	0%	0%	0%	0%	0%	0%	0	1,060	1,060	0	0	0	0	0	0	0	0	1,060	0	221	221	0	0	0	0	0	0	0	0	221
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 5 Bantay Cheu	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 6 Teuk Vil	×	○												0	970	970	0	0	0	0	0	0	0	0	970	0	202	202	0	0	0	0	0	0	0	0	202
Domestic			1,080	90%	970	0%	100%	0%	0%	0%	0%	0%	0%	0	970	970	0	0	0	0	0	0	0	0	970	0	202	202	0	0	0	0	0	0	0	0	202
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 7 Pri Chas	×	△												430	0	430	0	0	0	0	0	0	0	0	430	90	0	90	0	0	0	0	0	0	0	0	90
Domestic			480	90%	430	100%	0%	0%	0%	0%	0%	0%	0%	430	0	430	0	0	0	0	0	0	0	0	430	90	0	90	0	0	0	0	0	0	0	0	90
Commercial			0	100%	0	100%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 8 Tuek Tla	×	△(○)												0	980	980	0	0	0	0	0	0	0	0	980	0	204	204	0	0	0	0	0	0	0	0	204
Domestic			1,090	90%	980	0%	100%	0%	0%	0%	0%	0%	0%	0	980	980	0	0	0	0	0	0	0	0	980	0	204	204	0	0	0	0	0	0	0	0	204
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 9 Pri Tmei	×	△(○)												744	1,116	1,860	0	0	0	0	0	0	0	0	1,860	155	232	387	0	0	0	0	0	0	0	0	387
Domestic			2,070	90%	1,860	40%	60%	0%	0%	0%	0%	0%	0%	744	1,116	1,860	0	0	0	0	0	0	0	0	1,860	155	232	387	0	0	0	0	0	0	0	0	387
Commercial			0	100%	0	40%	60%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 10 Chei	×	△												468	1,092	1,560	0	0	0	0	0	0	0	0	1,560	97	227	324	0	0	0	0	0	0	0	0	324
Domestic			1,730	90%	1,560	30%	70%	0%	0%	0%	0%	0%	0%	468	1,092	1,560	0	0	0	0	0	0	0	0	1,560	97	227	324	0	0	0	0	0	0	0	0	324
Commercial			0	100%	0	30%	70%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Chreav														0	0	0	0	0	0	17,979	17,979	0	0	0	17,979	0	0	0	0	0	0	3,772	3,772	0	0	0	3,772
Domestic			19,870	90%	17,880									0	0	0	0	0	0	17,880	17,880	0	0	0	17,880	0	0	0	0	0	0	3,725	3,725	0	0	0	3,725
Commercial			99	100%	99									0	0	0	0	0	0	99	99	0	0	0	99	0	0	0	0	0	0	47	47	0	0	0	47
7- 1 Chreav	×	△(○)												0	0	0	0	0	0	1,450	1,450	0	0	0	1,450	0	0	0	0	0	0	302	302	0	0	0	302
Domestic			1,610	90%	1,450	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,450	1,450	0	0	0	1,450	0	0	0	0	0	0	302	302	0	0	0	302
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 2 Knar	×	○												0	0	0	0	0	0	6,899	6,899	0	0	0	6,899	0	0	0	0	0	0	1,463	1,463	0	0	0	1,463
Domestic			7,570	90%	6,800	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	6,800	6,800	0	0	0	6,800	0	0	0	0	0	0	1,416	1,416	0	0	0	1,416
Commercial			99	100%	99	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	99	99	0	0	0	99	0	0	0	0	0	0	47	47	0	0	0	47
7- 3 Bos Kralang	×	△(○)												0	0	0	0	0	0	2,290	2,290	0	0	0	2,290	0	0	0	0	0	0	477	477	0	0	0	477
Domestic			2,540	90%	2,290	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	2,290	2,290	0	0	0	2,290	0	0	0	0	0	0	477	477	0	0	0	477
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 4 Ta Chek	×	△(○)												0	0	0	0	0	0	1,200	1,200	0	0	0	1,200	0	0	0	0	0	0	250	250	0	0	0	250
Domestic			1,330	90%	1,200	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,200	1,200	0	0	0	1,200	0	0	0	0	0	0	250	250	0	0	0	250
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 5 Veal	×	△(○)												0	0	0	0	0	0	2,380	2,380	0	0	0	2,380	0	0	0	0	0	0	496	496	0	0	0	496
Domestic			2,640	90%	2,380	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	2,380	2,380	0	0	0	2,380	0	0	0	0	0	0	496	496	0	0	0	496
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 6 Kra sang	×	△(○)												0	0	0	0	0	0	2,230	2,230	0	0	0	2,230	0	0	0	0	0	0	465	465	0	0	0	465
Domestic			2,480	90%	2,230	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	2,230	2,230	0	0	0	2,230	0	0	0	0	0	0	465	465	0	0	0	465
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 7 Boeng	×	△(○)												0	0	0	0	0	0	1,530	1,530	0	0	0	1,530	0	0	0	0	0	0	319	319	0	0	0	319
Domestic			1,700	90%	1,530	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,530	1,530	0	0	0	1,530	0	0	0	0	0	0	319	319	0	0	0	319
Commercial			0	100%	0	0%	0%	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Krabei Riel														0	14,330	14,330	0	0	0	0	0	0	0	0	14,330	0	2,987	2,987	0	0	0	0	0	0	0	0	2,987
Domestic			15,920	90%	14,330									0	14,330	14,330	0	0	0	0	0	0	0	0	14,330	0	2,987	2,987	0	0	0	0	0	0	0	0	2,987
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 1 Ta Ros	×	○												0	1,150	1,150	0	0	0	0	0	0	0	0	1,150	0	240	240	0	0	0	0	0	0	0	0	240
Domestic			1,280	90%	1,150	0%	100%	0%	0%	0%	0%	0%	0%	0	1,150	1,150	0	0	0	0	0	0	0	0	1,150	0	240	240	0	0	0	0	0	0	0	0	240
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 2 RoKa	×	○												0	1,690	1,690	0	0	0	0	0	0	0	0	1,690	0	352	352	0	0	0	0	0	0	0	0	352
Domestic			1,880	90%	1,690	0%	100%	0%	0%	0%	0%	0%	0%	0	1,690	1,690	0	0	0	0	0	0	0	0	1,690	0	352	352	0	0	0	0	0	0	0	0	352
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 3 Prei Pou	×	△(○)												0	750	750	0	0	0	0	0	0	0	0	750	0	156	156	0	0	0	0	0	0	0	0	156
Domestic			830	90%	750	0%	100%	0%	0%	0%	0%	0%	0%	0	750	750	0	0	0	0	0	0	0	0	750	0	156	156	0	0	0	0	0	0	0	0	156
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 4 To tear	×	○												0	950	950	0	0	0	0	0	0	0	0	950	0	198	198	0	0	0	0	0	0	0	0	198
Domestic			1,060	90%	950	0%	100%	0%	0%	0%	0%	0%	0%	0	950	950	0	0	0	0	0	0	0	0	950	0	198	198	0	0	0	0	0	0	0	0	198
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 5 Krasang	×	△(○)												0	1,040	1,040	0	0	0	0	0	0	0	0	1,040	0	217	217	0	0	0	0	0	0	0	0	217
Domestic			1,160	90%	1,040	0%	100%	0%	0%	0%	0%	0%	0%	0	1,040	1,040	0	0	0	0	0	0	0	0	1,040	0	217	217	0	0	0	0	0	0	0	0	217
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 6 Popil	×	○												0	800	800	0	0	0	0	0	0	0	0	800	0	167	167	0	0	0	0	0	0	0	0	167
Domestic			890	90%	800	0%	100%	0%	0%	0%	0%	0%	0%	0	800	800	0	0	0	0	0	0	0	0	800	0	167	167	0	0	0	0	0	0	0	0	167
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 7 Trapang veng	×	△(○)												0	940	940	0	0	0	0	0	0	0	0	940	0	196	196	0	0	0	0	0	0	0	0	196
Domestic			1,040	90%	940	0%	100%	0%	0%	0%	0%	0%	0%	0	940	940	0	0	0	0	0	0	0	0	940	0	196	196	0	0	0	0	0	0	0	0	196
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 8 Kouk doung	×	△(○)												0	1,280	1,280	0	0	0	0	0	0	0	0	1,280	0	267	267	0	0	0	0	0	0	0	0	267
Domestic			1,420	90%	1,280	0%	100%	0%	0%	0%	0%	0%	0%	0	1,280	1,280	0	0	0	0	0	0	0	0	1,280	0	267	267	0	0	0	0	0	0	0	0	267
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 9 Boeng	×	△(○)												0	1,810	1,810	0	0	0	0	0	0	0	0	1,810	0	377	377	0	0	0	0	0	0	0	0	377
Domestic			2,010	90%	1,810	0%	100%	0%	0%	0%	0%	0%	0%	0	1,810	1,810	0	0	0	0	0	0	0	0	1,810	0	377	377	0	0	0	0	0	0	0	0	377
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 10 Prorma	×	△(○)												0	1,560	1,560	0	0	0	0	0	0	0	0	1,560	0	325	325	0	0	0	0	0	0	0	0	325
Domestic			1,730	90%	1,560	0%	100%	0%	0%	0%	0%	0%	0%	0	1,560	1,560	0	0	0	0	0	0	0	0	1,560	0	325	325	0	0	0	0	0	0	0	0	325
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 11 Khnar	×	△(○)												0	1,060	1,060	0	0	0	0	0	0	0	0	1,060	0	221	221	0	0	0	0	0	0	0	0	221
Domestic			1,180	90%	1,060	0%	100%	0%	0%	0%	0%	0%	0%	0	1,060	1,060	0	0	0	0	0	0	0	0	1,060	0	221	221	0	0	0	0	0	0	0	0	221
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 12 Prei kroch	×	△(○)												0	1,300	1,300	0	0	0	0	0	0	0	0	1,300	0	271	271	0	0	0	0	0	0	0	0	271
Domestic			1,440	90%	1,300	0%	100%	0%	0%	0%	0%	0%	0%	0	1,300	1,300	0	0	0	0	0	0	0	0	1,300	0	271	271	0	0	0	0	0	0	0	0	271
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Commune / Village	Existing	LTDP	Population	Served	Supplied Population	Q7	Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Total
9 Ampil														0	0	0	0	0	0	0	0	5,220	0	5,220	5,220	0	0	0	0	0	0	0	0	1,088	0	1,088	1,088
Domestic			5,800	90%	5,220									0	0	0	0	0	0	0	0	5,220	0	5,220	5,220	0	0	0	0	0	0	0	0	1,088	0	1,088	1,088
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 1 Kouk Chan	×	○												0	0	0	0	0	0	0	0	1,470	0	1,470	1,470	0	0	0	0	0	0	0	0	306	0	306	306
Domestic			1,630	90%	1,470	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,470	0	1,470	1,470	0	0	0	0	0	0	0	0	306	0	306	306
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 2 Thnal Chak	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 3 Tanot	×	△												0	0	0	0	0	0	0	0	790	0	790	790	0	0	0	0	0	0	0	0	165	0	165	165
Domestic			880	90%	790	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	790	0	790	790	0	0	0	0	0	0	0	0	165	0	165	165
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 4 Trapang Run	×	△												0	0	0	0	0	0	0	0	1,270	0	1,270	1,270	0	0	0	0	0	0	0	0	265	0	265	265
Domestic			1,410	90%	1,270	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,270	0	1,270	1,270	0	0	0	0	0	0	0	0	265	0	265	265
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 5 Ta pang	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 6 Prei kuy	×	○												0	0	0	0	0	0	0	0	1,690	0	1,690	1,690	0	0	0	0	0	0	0	0	352	0	352	352
Domestic			1,880	90%	1,690	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,690	0	1,690	1,690	0	0	0	0	0	0	0	0	352	0	352	352
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 7 Bang Koung	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 8 Kiri manon	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 9 Bos tom	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 10 Trach chrom	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Norkor Thum														0	0	0	0	0	3,860	0	3,860	0	0	0	3,860	0	0	0	0	0	804	0	804	0	0	0	804
Domestic			4,290	90%	3,860									0	0	0	0	0	3,860	0	3,860	0	0	0	3,860	0	0	0	0	0	804	0	804	0	0	0	804
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 1 Rohal	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 2 Sras srang	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 3 Sras srang	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 4 Kravan	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 5 Arak svay	×	×												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial			0	0%	0	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 6 Ang Chang	×	△												0	0	0	0	0	3,860	0	3,860	0	0	0	3,860	0	0	0	0	0	804	0	804	0	0	0	804
Domestic			4,290	90%	3,860	0%	0%	0%	0%	100%	0%	0%	0%	0	0	0	0	0	3,860	0	3,860	0	0	0	3,860	0	0	0	0	0	804	0	804	0	0	0	804
Commercial			0	100%	0	0%	0%	0%	0%	100%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 Srangae														0	8,267	8,267	1,808	3,462	0	0	5,270	0	0	0	13,537	0	1,722	1,722	565	909	0	0	1,474	0	0	0	3,196
Domestic			13,460	90%	12,110									0	8,267	8,267	1,095	2,748	0	0	3,843	0	0	0	12,110	0	1,722	1,722	228	572	0	0	800	0	0	0	2,522
Commercial			1,427	100%	1,427									0	0	0	713	714	0	0	1,427	0	0	0	1,427	0	0	0	337	337	0	0	674	0	0	0	674
11- 1 Kasikam	△	○												0	0	0	1,670	2,947	0	0	4,617	0	0	0	4,617	0	0	0	536	802	0	0	1,338	0	0	0	1,338
Domestic			3,550	90%	3,190	0%	0%	30%	70%	0%	0%	0%	0%	0	0	0	957	2,233	0	0	3,190	0	0	0	3,190	0	0	0	199	465	0	0	664	0	0	0	664
Commercial			1,427	100%	1,427	0%	0%	50%	50%	0%	0%	0%	0%	0	0	0	713	714	0	0	1,427	0	0	0	1,427	0	0	0	337	337	0	0	674	0	0	0	674
11- 2 Tnal	△	○												0	2,208	2,208	138	414	0	0	552	0	0	0	2,760	0	460	460	29	86	0	0	115	0	0	0	575
Domestic			3,070	90%	2,760	0%	80%	5%	15%	0%	0%	0%	0%	0	2,208	2,208	138	414	0	0	552	0	0	0	2,760	0	460	460	29	86	0	0	115	0	0	0	575
Commercial			0	100%	0	0%	80%	5%	15%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 3 Roka Thom	×	○												0	909	909	0	101	0	0	101	0	0	0	1,010	0	189	189	0	21	0	0	21	0	0	0	210
Domestic			1,120	90%	1,010	0%	90%	0%	10%	0%	0%	0%	0%	0	909	909	0	101	0	0	101	0	0	0	1,010	0	189	189	0	21	0	0	21	0	0	0	210
Commercial			0	100%	0	0%	90%	0%	10%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 4 Prei Thom	×	○												0	1,270	1,270	0	0	0	0	0	0	0	0	1,270	0	265	265	0	0	0	0	0	0	0	0	265
Domestic			1,410	90%	1,270	0%	100%	0%	0%	0%	0%	0%	0%	0	1,270	1,270	0	0	0	0	0	0	0	0	1,270	0	265	265	0	0	0	0	0	0	0	0	265
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 5 Srangie	×	△(○)												0	1,560	1,560	0	0	0	0	0	0	0	0	1,560	0	325	325	0	0	0	0	0	0	0	0	325
Domestic			1,730	90%	1,560	0%	100%	0%	0%	0%	0%	0%	0%	0	1,560	1,560	0	0	0	0	0	0	0	0	1,560	0	325	325	0	0	0	0	0	0	0	0	325
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 6 Chanlong	×	△(○)												0	1,440	1,440	0	0	0	0	0	0	0	0	1,440	0	300	300	0	0	0	0	0	0	0	0	300
Domestic			1,600	90%	1,440	0%	100%	0%	0%	0%	0%	0%	0%	0	1,440	1,440	0	0	0	0	0	0	0	0	1,440	0	300	300	0	0	0	0	0	0	0	0	300
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 7 Ta Chouk	×	△(○)												0	880	880	0	0	0	0	0	0	0	0	880	0	183	183	0	0	0	0	0	0	0	0	183
Domestic			980	90%	880	0%	100%	0%	0%	0%	0%	0%	0%	0	880	880	0	0	0	0	0	0	0	0	880	0	183	183	0	0	0	0	0	0	0	0	183
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Sambour														0	6,700	6,700	0	0	0	0	0	0	0	0	6,700	0	1,396	1,396	0	0	0	0	0	0	0	0	1,396
Domestic			7,440	90.1%	6,700									0	6,700	6,700	0	0	0	0	0	0	0	0	6,700	0	1,396	1,396	0	0	0	0	0	0	0	0	1,396
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 1 Pnouv	×	○												0	1,430	1,430	0	0	0	0	0	0	0	0	1,430	0	298	298	0	0	0	0	0	0	0	0	298
Domestic			1,590	90%	1,430	0%	100%	0%	0%	0%	0%	0%	0%	0	1,430	1,430	0	0	0	0	0	0	0	0	1,430	0	298	298	0	0	0	0	0	0	0	0	298
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 2 Sambour	×	○												0	1,670	1,670	0	0	0	0	0	0	0	0	1,670	0	348	348	0	0	0	0	0	0	0	0	348
Domestic			1,850	90%	1,670	0%	100%	0%	0%	0%	0%	0%	0%	0	1,670	1,670	0	0	0	0	0	0	0	0	1,670	0	348	348	0	0	0	0	0	0	0	0	348
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 3 Veal	×	○												0	1,220	1,220	0	0	0	0	0	0	0	0	1,220	0	254	254	0	0	0	0	0	0	0	0	254
Domestic			1,360	90%	1,220	0%	100%	0%	0%	0%	0%	0%	0%	0	1,220	1,220	0	0	0	0	0	0	0	0	1,220	0	254	254	0	0	0	0	0	0	0	0	254
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 4 Chrei	×	△(○)												0	1,080	1,080	0	0	0	0	0	0	0	0	1,080	0	225	225	0	0	0	0	0	0	0	0	225
Domestic			1,200	90%	1,080	0%	100%	0%	0%	0%	0%	0%	0%	0	1,080	1,080	0	0	0	0	0	0	0	0	1,080	0	225	225	0	0	0	0	0	0	0	0	225
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 5 Ta kong	×	○												0	1,300	1,300	0	0	0	0	0	0	0	0	1,300	0	271	271	0	0	0	0	0	0	0	0	271
Domestic			1,440	90%	1,300	0%	100%	0%	0%	0%	0%	0%	0%	0	1,300	1,300	0	0	0	0	0	0	0	0	1,300	0	271	271	0	0	0	0	0	0	0	0	271
Commercial			0	100%	0	0%	100%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Kandaek														0	0	0	0	0	0	0	0	19,777	3,463	23,240	23,240	0	0	0	0	0	0	0	0	4,120	721	4,841	4,841
Domestic			25,820	90%	23,240									0	0	0	0	0	0	0	0	19,777	3,463	23,240	23,240	0	0	0	0	0	0	0	0	4,120	721	4,841	4,841
Commercial			0	100%	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 1 Kouk Tlouk	×	△(○)												0	0	0	0	0	0	0	0	2,760	0	2,760	2,760	0	0	0	0	0	0	0	0	575	0	575	575
Domestic			3,070	90%	2,760	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	2,760	0	2,760	2,760	0	0	0	0	0	0	0	0	575	0	575	575
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 2 Trapang Tem	×	△(○)												0	0	0	0	0	0	0	0	2,280	0	2,280	2,280	0	0	0	0	0	0	0	0	475	0	475	475
Domestic			2,530	90%	2,280	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	2,280	0	2,280	2,280	0	0	0	0	0	0	0	0	475	0	475	475
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 3 Khun Mouk	×	△(○)												0	0	0	0	0	0	0	0	1,850	0	1,850	1,850	0	0	0	0	0	0	0	0	385	0	385	385
Domestic			2,050	90%	1,850	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,850	0	1,850	1,850	0	0	0	0	0	0	0	0	385	0	385	385
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 4 Chras	×	△(○)												0	0	0	0	0	0	0	0	1,890	0	1,890	1,890	0	0	0	0	0	0	0	0	394	0	394	394
Domestic			2,100	90%	1,890	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,890	0	1,890	1,890	0	0	0	0	0	0	0	0	394	0	394	394
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 5 Ou	×	△(○)												0	0	0	0	0	0	0	0	2,550	0	2,550	2,550	0	0	0	0	0	0	0	0	531	0	531	531
Domestic			2,830	90%	2,550	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	2,550	0	2,550	2,550	0	0	0	0	0	0	0	0	531	0	531	531
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 6 Spean Ka ek	×	△(○)												0	0	0	0	0	0	0	0	2,840	0	2,840	2,840	0	0	0	0	0	0	0	0	592	0	592	592
Domestic			3,160	90%	2,840	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	2,840	0	2,840	2,840	0	0	0	0	0	0	0	0	592	0	592	592
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 7 Trang	×	△(○)												0	0	0	0	0	0	0	0	1,232	528	1,760	1,760	0	0	0	0	0	0	0	0	257	110	367	367
Domestic			1,950	90%	1,760	0%	0%	0%	0%	0%	0%	70%	30%	0	0	0	0	0	0	0	0	1,232	528	1,760	1,760	0	0	0	0	0	0	0	0	257	110	367	367
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	70%	30%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 8 Chrei	×	○												0	0	0	0	0	0	0	0	1,745	1,745	3,490	3,490	0	0	0	0	0	0	0	0	363	363	726	726
Domestic			3,890	90%	3,490	0%	0%	0%	0%	0%	0%	50%	50%	0	0	0	0	0	0	0	0	1,745	1,745	3,490	3,490	0	0	0	0	0	0	0	0	363	363	726	726
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	50%	50%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 9 Kouk Tanot	×	○												0	0	0	0	0	0	0	0	1,190	1,190	2,380	2,380	0	0	0	0	0	0	0	0	248	248	496	496
Domestic			2,640	90%	2,380	0%	0%	0%	0%	0%	0%	50%	50%	0	0	0	0	0	0	0	0	1,190	1,190	2,380	2,380	0	0	0	0	0	0	0	0	248	248	496	496
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	50%	50%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 10 Lo ork	×	○												0	0	0	0	0	0	0	0	1,440	0	1,440	1,440	0	0	0	0	0	0	0	0	300	0	300	300
Domestic			1,600	90%	1,440	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	1,440	0	1,440	1,440	0	0	0	0	0	0	0	0	300	0	300	300
Commercial			0	100%	0	0%	0%	0%	0%	0%	0%	100%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

＊Notice＊
○： All Area Covered
△： Partial Area Covered
×： All Area Not Covered
( )： Means Servis coverage of population

SR 4.17 Water Demand Allocation (F/S)

Water Demand of Distribution Area

Distribution Area	Item	F/S	
		Population (Nos.)	Water Demand (m^3/d)
Qfs1	Domestic	56,360	10,490
	Commercial	6,630	2,990
	Sub Total	**62,990**	**13,480**
Qfs2	Domestic	58,090	10,810
	Commercial	4,810	2,170
	Sub Total	**62,900**	**12,980**
Qfs3	Domestic	46,720	8,700
	Commercial	12,580	5,660
	Sub Total	**59,300**	**14,360**
Qfs4	Domestic	71,130	13,240
	Commercial	3,280	1,480
	Sub Total	**74,410**	**14,720**
Total	Domestic	232,300	43,240
	Commercial	27,300	12,300
	Total	**259,600**	**55,540**

Area	Coverage Area			F/S Area	F/S Area			F/S Area (Supplied Population)													F/S Area (Max Demand Water)				
Discript	Existing	F/S	LTDP	Population	Population	Supplied	Population	Area allocation rate						Population Allocation (Nos.)			Population Allocation (Nos.)					Max Water Demand Allocation (m^3/d)				
	2009	2022	2030	Coverage	2022	Served	2022	Central				East		Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
Total	21Villages	32Villages	93Villages	-	**271,820**	95.5%	**259,611**	Q1	Q2	Q3	Q4	Q5	Q6	**0**	**0**	**0**	62,995	62,907	59,300	74,408	259,610	13,475	12,977	14,355	14,715	55,522
Domestic	-	-	-	**100%**	**232,300**	**100%**	**232,300**	-	-	-	-	-	-	**0**	**0**	**0**	56,362	58,090	46,721	71,127	232,300	10,490	10,811	8,695	13,239	43,235
Commercial	-	-	-	**100%**	**39,520**	69.1%	**27,311**	-	-	-	-	-	-	**0**	**0**	**0**	6,633	4,817	12,579	3,281	27,310	2,985	2,166	5,660	1,476	12,287

Domestic 200 lpcd Commercial 450 lpcd

Commune / Village	Existing	F/S	LTDP	Coverage	Population	Served	Supplied Population	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
1 Sla Kram														**0**	**0**	**0**	19,363	0	59,300	19,779	98,442	4,369	0	14,355	4,180	22,904
Domestic					**81,070**	**100%**	**81,070**							**0**	**0**	**0**	16,463	0	46,721	17,886	81,070	3,064	0	8,695	3,329	15,088
Commercial					**25,122**	69.2%	**17,372**							**0**	**0**	**0**	2,900	0	12,579	1,893	17,372	1,305	0	5,660	851	7,816
1- 1 Slor Kram	○	○	○											**0**	**0**	**0**	0	0	6,014	0	6,014	0	0	1,191	0	1,191
Domestic				100%	5,740	100%	5,740	0%	0%	100%	0%	0%	0%	0	0	0	0	0	5,740	0	5,740	0	0	1,068	0	1,068
Commercial				100%	396	69%	274	0%	0%	100%	0%	0%	0%	0	0	0	0	0	274	0	274	0	0	123	0	123
1- 2 Boeng dunpa	△	○	○											**0**	**0**	**0**	3,151	0	12,604	0	15,755	761	0	3,041	0	3,802
Domestic				100%	12,460	100%	12,460	20%	0%	80%	0%	0%	0%	0	0	0	2,492	0	9,968	0	12,460	464	0	1,855	0	2,319
Commercial				100%	4,765	69%	3,295	20%	0%	80%	0%	0%	0%	0	0	0	659	0	2,636	0	3,295	297	0	1,186	0	1,483
1- 3 Chong Kavsu	△	△	○											**0**	**0**	**0**	0	0	24,282	6,070	30,352	0	0	5,884	1,470	7,354
Domestic				90%	23,890	100%	23,890	0%	0%	80%	20%	0%	0%	0	0	0	0	0	19,112	4,778	23,890	0	0	3,557	889	4,446
Commercial				100%	9,344	69%	6,462	0%	0%	80%	20%	0%	0%	0	0	0	0	0	5,170	1,292	6,462	0	0	2,327	581	2,908
1- 4 Dork pou	△	○	○											**0**	**0**	**0**	0	0	2,208	5,152	7,360	0	0	411	959	1,370
Domestic				100%	7,360	100%	7,360	0%	0%	30%	70%	0%	0%	0	0	0	0	0	2,208	5,152	7,360	0	0	411	959	1,370
Commercial				100%	0	69%	0	0%	0%	30%	70%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
1- 5 Bantay chas	○	○	○											**0**	**0**	**0**	0	0	5,705	8,557	14,262	0	0	1,167	1,751	2,918
Domestic				100%	13,260	100%	13,260	0%	0%	40%	60%	0%	0%	0	0	0	0	0	5,304	7,956	13,260	0	0	987	1,481	2,468
Commercial				100%	1,449	69%	1,002	0%	0%	40%	60%	0%	0%	0	0	0	0	0	401	601	1,002	0	0	180	270	450
1- 6 Trang	△	△	○											**0**	**0**	**0**	3,637	0	8,487	0	12,124	1,140	0	2,661	0	3,801
Domestic				86%	6,270	100%	6,270	30%	0%	70%	0%	0%	0%	0	0	0	1,881	0	4,389	0	6,270	350	0	817	0	1,167
Commercial				100%	8,466	69%	5,854	30%	0%	70%	0%	0%	0%	0	0	0	1,756	0	4,098	0	5,854	790	0	1,844	0	2,634
1- 7 Mondol 3	○	○	○											**0**	**0**	**0**	12,575	0	0	0	12,575	2,468	0	0	0	2,468
Domestic				100%	12,090	100%	12,090	100%	0%	0%	0%	0%	0%	0	0	0	12,090	0	0	0	12,090	2,250	0	0	0	2,250
Commercial				100%	702	69%	485	100%	0%	0%	0%	0%	0%	0	0	0	485	0	0	0	485	218	0	0	0	218
2 Svay Dangkum														**0**	**0**	**0**	25,731	40,637	0	0	66,368	5,561	8,700	0	0	14,261
Domestic					**59,130**	**100%**	**59,130**							**0**	**0**	**0**	22,804	36,326	0	0	59,130	4,244	6,761	0	0	11,005
Commercial					**10,476**	69.1%	**7,238**							**0**	**0**	**0**	2,927	4,311	0	0	7,238	1,317	1,939	0	0	3,256
2- 1 Pngea Chei	×	×	○											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	8	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 2 Kantrork	×	×	△(○)											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 3 Kouk Krasang	×	×	△(○)											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 4 Svay Chrei	×	×	△(○)											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 5 Pou Bos	×	×	△(○)											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 6 Tmei	×	△	△(○)											**0**	**0**	**0**	0	2,700	0	0	2,700	0	503	0	0	503
Domestic				95%	2,700	100%	2,700	0%	100%	0%	0%	0%	0%	0	0	0	0	2,700	0	0	2,700	0	503	0	0	503
Commercial				100%	0	69%	0	0%	100%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
2- 7 Svay Dangkum	△	○	○											**0**	**0**	**0**	0	3,709	0	0	3,709	0	698	0	0	698
Domestic				100%	3,680	100%	3,680	0%	100%	0%	0%	0%	0%	0	0	0	0	3,680	0	0	3,680	0	685	0	0	685
Commercial				100%	42	69%	29	0%	100%	0%	0%	0%	0%	0	0	0	0	29	0	0	29	0	13	0	0	13
2- 8 Salakanseng	△	○	○											**0**	**0**	**0**	20,140	5,035	0	0	25,175	4,214	1,053	0	0	5,267
Domestic				100%	22,970	100%	22,970	80%	20%	0%	0%	0%	0%	0	0	0	18,376	4,594	0	0	22,970	3,420	855	0	0	4,275
Commercial				100%	3,188	69%	2,205	80%	20%	0%	0%	0%	0%	0	0	0	1,764	441	0	0	2,205	794	198	0	0	992
2- 9 Krous	△	△	○											**0**	**0**	**0**	2,576	3,523	0	0	6,099	617	772	0	0	1,389
Domestic				100%	5,140	100%	5,140	40%	60%	0%	0%	0%	0%	0	0	0	2,056	3,084	0	0	5,140	383	574	0	0	957
Commercial				100%	1,387	69%	959	40%	60%	0%	0%	0%	0%	0	0	0	520	439	0	0	959	234	198	0	0	432
2- 10 Vihear Chin	△	○	○											**0**	**0**	**0**	0	10,472	0	0	10,472	0	2,020	0	0	2,020
Domestic				100%	10,200	100%	10,200	0%	100%	0%	0%	0%	0%	0	0	0	0	10,200	0	0	10,200	0	1,898	0	0	1,898
Commercial				100%	394	69%	272	0%	100%	0%	0%	0%	0%	0	0	0	0	272	0	0	272	0	122	0	0	122
2- 11 Steng Tmei	△	○	○											**0**	**0**	**0**	0	4,075	0	0	4,075	0	828	0	0	828
Domestic				100%	3,810	100%	3,810	0%	100%	0%	0%	0%	0%	0	0	0	0	3,810	0	0	3,810	0	709	0	0	709
Commercial				100%	383	69%	265	0%	100%	0%	0%	0%	0%	0	0	0	0	265	0	0	265	0	119	0	0	119
2- 12 Mondol 1	○	○	○											**0**	**0**	**0**	2,362	3,544	0	0	5,906	577	867	0	0	1,444
Domestic				100%	4,600	100%	4,600	40%	60%	0%	0%	0%	0%	0	0	0	1,840	2,760	0	0	4,600	342	514	0	0	856
Commercial				100%	1,889	69%	1,306	40%	60%	0%	0%	0%	0%	0	0	0	522	784	0	0	1,306	235	353	0	0	588
2- 13 Mondol 2	○	○	○											**0**	**0**	**0**	0	1,706	0	0	1,706	0	580	0	0	580
Domestic				100%	710	100%	710	0%	100%	0%	0%	0%	0%	0	0	0	0	710	0	0	710	0	132	0	0	132
Commercial				100%	1,441	69%	996	0%	100%	0%	0%	0%	0%	0	0	0	0	996	0	0	996	0	448	0	0	448
2- 14 Ta phoul	○	○	○											**0**	**0**	**0**	653	5,873	0	0	6,526	153	1,379	0	0	1,532
Domestic				100%	5,320	100%	5,320	10%	90%	0%	0%	0%	0%	0	0	0	532	4,788	0	0	5,320	99	891	0	0	990
Commercial				100%	1,744	69%	1,206	10%	90%	0%	0%	0%	0%	0	0	0	121	1,085	0	0	1,206	54	488	0	0	542
3 Sala Kamraeuk														**0**	**0**	**0**	0	4,887	0	41,545	46,432	0	912	0	8,081	8,993
Domestic					**45,100**	**100%**	**45,100**							**0**	**0**	**0**	0	4,875	0	40,225	45,100	0	907	0	7,487	8,394
Commercial					**1,927**	69.2%	**1,333**							**0**	**0**	**0**	0	12	0	1,320	1,332	0	5	0	594	599
3- 1 Vat Bo	○	○	○											**0**	**0**	**0**	0	0	0	13,453	13,453	0	0	0	2,803	2,803
Domestic				100%	12,320	100%	12,320	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	12,320	12,320	0	0	0	2,293	2,293
Commercial				100%	1,639	69%	1,133	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,133	1,133	0	0	0	510	510
3- 2 Vat Svay	×	○	○											**0**	**0**	**0**	0	4,887	0	4,888	9,775	0	912	0	913	1,825
Domestic				100%	9,750	100%	9,750	0%	50%	0%	50%	0%	0%	0	0	0	0	4,875	0	4,875	9,750	0	907	0	907	1,814
Commercial				100%	37	69%	26	0%	50%	0%	50%	0%	0%	0	0	0	0	12	0	13	25	0	5	0	6	11
3- 3 Vat Danmak	△	○	○											**0**	**0**	**0**	0	0	0	8,414	8,414	0	0	0	1,612	1,612
Domestic				100%	8,240	100%	8,240	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	8,240	8,240	0	0	0	1,534	1,534
Commercial				100%	251	69%	174	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	174	174	0	0	0	78	78
3- 4 Sala Kamreak	×	△(○)	○											**0**	**0**	**0**	0	0	0	3,750	3,750	0	0	0	698	698
Domestic				100%	3,750	100%	3,750	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	3,750	3,750	0	0	0	698	698
Commercial				100%	0	69%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 5 Chun long	×	△	○											**0**	**0**	**0**	0	0	0	2,040	2,040	0	0	0	380	380
Domestic				95%	2,040	100%	2,040	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	2,040	2,040	0	0	0	380	380
Commercial				100%	0	69%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 6 Ta Vean	×	○	○											**0**	**0**	**0**	0	0	0	7,500	7,500	0	0	0	1,396	1,396
Domestic				100%	7,500	100%	7,500	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	7,500	7,500	0	0	0	1,396	1,396
Commercial				100%	0	69%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
3- 7 Trapang Treng	×	○	○											**0**	**0**	**0**	0	0	0	1,500	1,500	0	0	0	279	279
Domestic				100%	1,500	100%	1,500	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	1,500	1,500	0	0	0	279	279
Commercial				100%	0	69%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Kouk Chak														**0**	**0**	**0**	15,723	0	0	0	15,723	3,009	0	0	0	3,009
Domestic					**15,410**	**100%**	**15,410**							**0**	**0**	**0**	15,410	0	0	0	15,410	2,868	0	0	0	2,868
Commercial					**453**	69.1%	**313**							**0**	**0**	**0**	313	0	0	0	313	141	0	0	0	141
4- 1 Trapang Ses	△	△	○											**0**	**0**	**0**	5,523	0	0	0	5,523	1,111	0	0	0	1,111
Domestic				70%	5,210	100%	5,210	100%	0%	0%	0%	0%	0%	0	0	0	5,210	0	0	0	5,210	970	0	0	0	970
Commercial				100%	453	69%	313	100%	0%	0%	0%	0%	0%	0	0	0	313	0	0	0	313	141	0	0	0	141
4- 2 Veal	△	△	△											**0**	**0**	**0**	3,440	0	0	0	3,440	640	0	0	0	640
Domestic				70%	3,440	100%	3,440	100%	0%	0%	0%	0%	0%	0	0	0	3,440	0	0	0	3,440	640	0	0	0	640
Commercial				100%	0	69%	0	100%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 3 Kasin tabong	△	○	○											**0**	**0**	**0**	6,760	0	0	0	6,760	1,258	0	0	0	1,258
Domestic				100%	6,760	100%	6,760	100%	0%	0%	0%	0%	0%	0	0	0	6,760	0	0	0	6,760	1,258	0	0	0	1,258
Commercial				100%	0	69%	0	100%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 4 Kouk Chan	×	×	×											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 5 Khatean	×	×	△											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 6 Kouk Beng	×	×	×											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 7 Kouk Tanot	×	×	×											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
4- 8 Nokor krav	×	×	×											**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0

Commune / Village	Existing	F/S	LTDP	Coverage	Population	Served	Supplied Population	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
5 Siem Reap														**0**	**0**	**0**	**0**	**15,204**	**0**	**5,826**	**21,030**	**0**	**2,829**	**0**	**1,085**	**3,914**
Domestic					**21,030**	**100%**	**21,030**							**0**	**0**	**0**	**0**	**15,204**	**0**	**5,826**	**21,030**	**0**	**2,829**	**0**	**1,085**	**3,914**
Commercial					**16**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5- 1 Pou	×	△	△(○)											**0**	**0**	**0**	**0**	**3,864**	**0**	**1,656**	**5,520**	**0**	**719**	**0**	**308**	**1,027**
Domestic				95%	5,520	100%	5,520	0%	70%	0%	30%	0%	0%	0	0	0	0	3,864	0	1,656	5,520	0	719	0	308	1,027
Commercial				100%	0	69%	0	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 2 Phnom krom	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 3 Pror Lay	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 4 Korkragn	×	△	○											**0**	**0**	**0**	**0**	**3,864**	**0**	**966**	**4,830**	**0**	**719**	**0**	**180**	**899**
Domestic				95%	4,830	100%	4,830	0%	80%	0%	20%	0%	0%	0	0	0	0	3,864	0	966	4,830	0	719	0	180	899
Commercial				100%	0	69%	0	0%	80%	0%	20%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 5 Kra Sangroleung	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 6 Spean Chreav	×	△	○											**0**	**0**	**0**	**0**	**3,682**	**0**	**1,578**	**5,260**	**0**	**685**	**0**	**294**	**979**
Domestic				95%	5,260	100%	5,260	0%	70%	0%	30%	0%	0%	0	0	0	0	3,682	0	1,578	5,260	0	685	0	294	979
Commercial				100%	0	69%	0	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 7 Arragn	×	△	△											**0**	**0**	**0**	**0**	**3,794**	**0**	**1,626**	**5,420**	**0**	**706**	**0**	**303**	**1,009**
Domestic				95%	5,420	100%	5,420	0%	70%	0%	30%	0%	0%	0	0	0	0	3,794	0	1,626	5,420	0	706	0	303	1,009
Commercial				100%	0	69%	0	0%	70%	0%	30%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
5- 8 Treak	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	16	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6 Teuk Vil														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6- 1 Kouk doung	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 2 Sandan	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 3 Chrei	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 4 Prayut	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 5 Bantay Cheu	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 6 Teuk Vil	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 7 Pri Chas	×	×	△											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 8 Tuek Tla	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 9 Pri Tmei	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
6- 10 Chei	×	×	△											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Chreav														**0**	**0**	**0**	**0**	**0**	**0**	**7,258**	**7,258**	**0**	**0**	**0**	**1,369**	**1,369**
Domestic					**7,190**	**100%**	**7,190**							**0**	**0**	**0**	**0**	**0**	**0**	**7,190**	**7,190**	**0**	**0**	**0**	**1,338**	**1,338**
Commercial					**99**	**68.7%**	**68**							**0**	**0**	**0**	**0**	**0**	**0**	**68**	**68**	**0**	**0**	**0**	**31**	**31**
7- 1 Chreav	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 2 Knar	×	△	○											**0**	**0**	**0**	**0**	**0**	**0**	**7,258**	**7,258**	**0**	**0**	**0**	**1,369**	**1,369**
Domestic				95%	7,190	100%	7,190	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	7,190	7,190	0	0	0	1,338	1,338
Commercial				100%	99	69%	68	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	68	68	0	0	0	31	31
7- 3 Bos Kralang	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 4 Ta Chek	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 5 Veal	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 6 Kra sang	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
7- 7 Boeng	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	100%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Krabei Riel														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8- 1 Ta Ros	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 2 RoKa	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 3 Prei Pou	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 4 To tear	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 5 Krasang	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 6 Popil	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 7 Trapang veng	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 8 Kouk doung	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 9 Boeng	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 10 Prorma	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 11 Khnar	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
8- 12 Prei kroch	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0

Commune / Village	Existing	F/S	LTDP	Coverage	Population	Served	Supplied Population	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Sub Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
9 Ampil														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
9- 1 Kouk Chan	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 2 Thnal Chak	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 3 Tanot	×	×	△											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 4 Trapang Run	×	×	△											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 5 Ta pang	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 6 Prei kuy	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 7 Bang Koung	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 8 Kiri manon	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 9 Bos tom	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
9- 10 Trach chrom	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Norkor Thum														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
10- 1 Rohal	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 2 Sras srang	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 3 Sras srang	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 4 Kravan	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 5 Arak svay	×	×	×											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
10- 6 Ang Chang	×	×	△											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11 Srangae														**0**	**0**	**0**	**2,178**	**2,179**	**0**	**0**	**4,357**	**536**	**536**	**0**	**0**	**1,072**
Domestic					**3,370**	**100%**	**3,370**							**0**	**0**	**0**	**1,685**	**1,685**	**0**	**0**	**3,370**	**314**	**314**	**0**	**0**	**628**
Commercial					**1,427**	**69.2%**	**987**							**0**	**0**	**0**	**493**	**494**	**0**	**0**	**987**	**222**	**222**	**0**	**0**	**444**
11- 1 Kasikam	△	△	○											**0**	**0**	**0**	**2,178**	**2,179**	**0**	**0**	**4,357**	**536**	**536**	**0**	**0**	**1,072**
Domestic				95%	3,370	100%	3,370	50%	50%	0%	0%	0%	0%	0	0	0	1,685	1,685	0	0	3,370	314	314	0	0	628
Commercial				100%	1,427	69%	987	50%	50%	0%	0%	0%	0%	0	0	0	493	494	0	0	987	222	222	0	0	444
11- 2 Tnal	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 3 Roka Thom	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 4 Prei Thom	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 5 Srangie	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 6 Chanlong	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
11- 7 Ta Chouk	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Sambour														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
12- 1 Pnouv	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 2 Sambour	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 3 Veal	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 4 Chrei	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
12- 5 Ta kong	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Kandaek														**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial					**0**	**0%**	**0**							**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
13- 1 Kouk Tlouk	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 2 Trapang Tem	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 3 Khun Mouk	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 4 Chras	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 5 Ou	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 6 Spean Ka ek	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 7 Trang	×	×	△(○)											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 8 Chrei	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 9 Kouk Tanot	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
13- 10 Lo ork	×	×	○											**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Domestic				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial				0%	0	0%	0	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0	0	0	0	0	0

* Notice *
○ : All Area Covered
△ : Partial Area Covered
× : All Area Not Covered
( ) : Means Servis coverage of population

SR 4.18 Distribution Pipeline Length (Existing, LTDP, F/S, KTC)

1) Distribution Pipeline Length (Q = 56,000 m^3/d)

Distribution Pipe Length (Long Term Development Plan)

Category	Material	Diameter	Existing					Feasibility Study					Long Term Development Plan									Total (= F/S + LTDP)								
			Ceantal Zone					Ceantal Zone					Ceantal Zone					East Zone			West Zone		Ceantal Zone					East Zone			West Zone	
			Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Q7	Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Q7	Total
Main	DCIP	1,000																													
Main	DCIP	900																													
Main	DCIP	800							3,250		4,450	**7,700**				4,450	**4,450**					**4,450**		3,250		8,900	**12,150**					**12,150**
Main	DCIP	700						3,620	5,210	4,110	11,040	**23,980**				2,610	**2,610**				**12,670**	**15,280**	3,620	5,210	4,110	13,650	**26,590**				12,670	**39,260**
Main	DCIP	600																													
Main	DCIP	500	3,186				**3,186**						3,620	8,460	4,110	8,430	**24,620**					**24,620**	3,620	8,460	4,110	8,430	**24,620**					**24,620**
Sub Total	-	-	**3,186**				**3,186**	**3,620**	**8,460**	**4,110**	**15,490**	**31,680**	**3,620**	**8,460**	**4,110**	**15,490**	**31,680**				**12,670**	**44,350**	**7,240**	**16,920**	**8,220**	**30,980**	**63,360**				**12,670**	**76,030**
Sub Main	DCIP	450		2,099			**2,099**																								
Sub Main	DCIP	400																11,290	7,720	**19,010**		**19,010**						11,290	7,720	**19,010**		**19,010**
Sub Main	DCIP	350		2,430			**2,430**																								
Sub Main	DCIP	300						10	10	10	10	**40**	10	25,800	4,580	10	**30,400**					**30,400**	20	25,810	4,590	20	**30,440**					**30,400**
Sub Main	DCIP	250	4,409	896			**5,305**	1,230	16,530	710		**18,470**	930				**930**					**930**	2,160	16,530	710		**19,400**					**19,400**
Sub Main	PE/uPVC	200	1,003	1,329	131	1,124	**3,587**	12,160				**12,160**	18,200	16,530	11,700	33,920	**80,350**	20	10	**30**	**25,760**	**106,140**	30,360	16,530	11,700	33,920	**92,510**	20	10	**30**	25,760	**118,300**
Sub Main	PE/uPVC	150	5,411	2,415	1,916	1,648	**11,390**	2,810		27,110	29,520	**59,440**	2,810		27,110	30,340	**60,260**	7,640	5,230	**12,870**		**73,130**	5,620		54,220	59,860	**119,700**	7,640	5,230	**12,870**		**132,570**
Sub Total	-	-	**10,823**	**9,169**	**2,047**	**2,772**	**24,811**	**16,210**	**16,540**	**27,830**	**29,530**	**90,110**	**21,950**	**42,330**	**43,390**	**64,270**	**171,940**	**18,950**	**12,960**	**31,910**	**25,760**	**229,610**	**38,160**	**58,870**	**71,220**	**93,800**	**262,050**	**18,950**	**12,960**	**31,910**	**25,760**	**319,720**
Branch	PE/uPVC	100	3,871	2,008	3,198	4,979	**14,056**		250		1,150	**1,400**				1,010	**1,010**					**1,010**		250		2,160	**2,410**					**2,410**
Branch	PE/uPVC	80	1,262	3,541	489	1,363	**6,655**	88,720	46,980	112,190	112,310	**360,200**	49,570	26,250	62,690	62,750	**201,260**					**201,260**	138,290	73,230	174,880	175,060	**561,460**					**561,460**
Branch	PE/uPVC	50	293	191	204	1,667	**2,355**						100	50	130	130	**410**	17,200	11,760	**28,960**	**57,910**	**87,280**	100	50	130	130	**410**	17,200	11,760	**28,960**	57,910	**87,280**
Sub Total	-	-	**5,426**	**5,740**	**3,891**	**8,009**	**23,066**	**88,720**	**47,230**	**112,190**	**113,460**	**361,600**	**49,670**	**26,300**	**62,820**	**63,890**	**202,680**	**17,200**	**11,760**	**28,960**	**57,910**	**289,550**	**138,390**	**73,530**	**175,010**	**177,350**	**564,280**	**17,200**	**11,760**	**28,960**	**57,910**	**651,150**
Total	-	-	**19,435**	**14,909**	**5,938**	**10,781**	**51,063**	**108,550**	**72,230**	**144,130**	**158,480**	**483,390**	**75,240**	**77,090**	**110,320**	**143,650**	**406,300**	**36,150**	**24,720**	**60,870**	**96,340**	**563,510**	**183,790**	**149,320**	**254,450**	**302,130**	**889,690**	**36,150**	**24,720**	**60,870**	**96,340**	**1,046,900**

Distribution Pipe Length (Feasibility Study)

Category	Material	Diameter	F/S (JICA)					F/S (KTC)					F/S Total					
			Ceantal Zone					Ceantal Zone					Ceantal Zone					
			Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	
Main	DCIP	1,000																OK
Main	DCIP	900																OK
Main	DCIP	800				4,450	**4,450**		3,250			**3,250**		3,250		4,450	**7,700**	OK
Main	DCIP	700		5,210		11,040	**16,250**	3,620		4,110		**7,730**	3,620	5,210	4,110	11,040	**23,980**	OK
Main	DCIP	600																OK
Main	DCIP	500																OK
Sub Total	-	-		**5,210**		**15,490**	**20,700**	**3,620**	**3,250**	**4,110**		**10,980**	**3,620**	**8,460**	**4,110**	**15,490**	**31,680**	OK
Sub Main	DCIP	450																OK
Sub Main	DCIP	400																OK
Sub Main	DCIP	350																OK
Sub Main	DCIP	300		10		10	**20**	10		10		**20**	10	10	10	10	**40**	OK
Sub Main	DCIP	250	100	12,430	710		**13,240**	1,130	4,100			**5,230**	1,230	16,530	710		**18,470**	OK
Sub Main	PE	200	10,440				**10,440**	1,720				**1,720**	12,160				**12,160**	OK
Sub Main	PE	150	990		17,440	23,390	**41,820**	1,820		9,670	6,130	**17,620**	2,810		27,110	29,520	**59,440**	OK
Sub Total	-	-	**11,530**	**12,440**	**18,150**	**23,400**	**65,520**	**4,680**	**4,100**	**9,680**	**6,130**	**24,590**	**16,210**	**16,540**	**27,830**	**29,530**	**90,110**	OK
Branch	PE	100		250		1,150	**1,400**							250		1,150	**1,400**	OK
Branch	PE	80	72,150	29,140	79,550	91,310	**272,150**	16,570	17,840	32,640	21,000	**88,050**	88,720	46,980	112,190	112,310	**360,200**	OK
Branch	PE	50																OK
Sub Total	-	-	**72,150**	**29,390**	**79,550**	**92,460**	**273,550**	**16,570**	**17,840**	**32,640**	**21,000**	**88,050**	**88,720**	**47,230**	**112,190**	**113,460**	**361,600**	OK
Total	-	-	**83,680**	**47,040**	**97,700**	**131,350**	**359,770**	**24,870**	**25,190**	**46,430**	**27,130**	**123,620**	**108,550**	**72,230**	**144,130**	**158,480**	**483,390**	OK

2) Applied Design Conditions for Distribution Network from 69,380 m^3/d to 56,000 m^3/d.

○Water distribution amount rate

Distribution Capacity of Long Term Development Plan

WTP / Zone	Existing WTP	KTC WTP	Proposed WTP			Grand Total
			Phase1	Phase2	Total	
Central Zone	9,000	17,000	30,000	13,380	43,380	69,380
East Zone	0	0	0	5,930	5,930	5,930
West Zone	0	0	0	10,940	10,940	10,940
Total for WTP	9,000	17,000	30,000	30,250	60,250	86,250
Total for Phase	56,000			30,250	-	86,250

Item	F/S	LTDP	Total
Central Zone water amount	56,000	13,380	69,380
Central Zone water amount rate	**0.8**	0.2	1.0

○Combination Pipe for Distribution Pipe

Category	Branch Pipe				Sub Main Pipe							Main Pipe					
Dia	**50**	**60**	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**	**700**	**800**	**900**	**1,000**
Phase1	**50**	**60**	**60**	**80**	**150**	**150**	**200**	**250**	**300**	**300**	**350**	**400**	**500**	**600**	**700**	**700**	**800**
Phase2	-	-	60	80	-	150	200	200	250	300	350	350	400	450	500	700	800

※Blue : Target of F/S

	50	**60**	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**	**700**	**800**	**900**	**1,000**
50	66	73	89	106	154	202	252	302	351	401	451	501	601	701	801	901	1,001
60		79	93	110	155	204	253	302	352	402	451	501	601	701	801	901	1,001
80			105	119	161	207	255	304	353	403	452	502	602	701	801	901	1,001
100				131	168	212	259	307	355	404	454	503	603	702	802	902	1,001
150					**196**	232	274	318	364	412	460	508	606	705	804	904	1,003
200						**261**	**296**	336	379	424	470	517	613	710	808	907	1,006
250							326	**361**	400	441	485	530	623	718	815	912	1,010
300								**391**	426	464	504	547	636	728	823	919	1,016
350									**456**	**490**	528	567	652	742	834	928	1,024
400										521	555	**592**	672	758	847	940	1,034
450											586	620	**695**	777	863	953	1,045
500												651	721	**799**	882	969	1,059
600													781	851	927	1,008	1,093
700														**912**	980	1,055	1,134
800															**1,042**	1,110	1,184
900																1,172	1,240
1,000																	1,302

$D_1^{2.63}+D_2^{2.63}=D_{1+2}^{2.63}$

$(D_{1+2}=(D_1^{2.63}+D_2^{2.63})^{1/2.63})$

3) Distribution Pipeline Length (Q = 69,380 m^3/d)

Distribution Pipe Length (Long Term Development Plan)

Category	Material	Diameter	Existing					Feasibility Study					Long Term Development Plan									Total (= F/S + LTDP)								
			Ceantal Zone					Ceantal Zone					Ceantal Zone					East Zone			West Zone	Total	Ceantal Zone					East Zone			West Zone	Total
			Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Q7		Q1	Q2	Q3	Q4	Sub Total	Q5	Q6	Sub Total	Q7	
Main	DCIP	1,000									4,450	**4,450**													4,450	**4,450**					**4,450**
Main	DCIP	900									2,610	**2,610**													2,610	**2,610**					**2,610**
Main	DCIP	800						3,620	8,460	4,110	8,430	**24,620**										3,620	8,460	4,110	8,430	**24,620**					**24,620**
Main	DCIP	600																			**12,670**	**12,670**									12,670	**12,670**
Main	DCIP	500	3,186				**3,186**																3,186				**3,186**					**3,186**
Sub Total	-	-	**3,186**				**3,186**	**3,620**	**8,460**	**4,110**	**15,490**	**31,680**									**12,670**	**12,670**	**6,806**	**8,460**	**4,110**	**15,490**	**34,866**				**12,670**	**47,536**
Sub Main	DCIP	450		2,099			**2,099**																	2,099		**2,099**					**2,099**
Sub Main	DCIP	400																11,290	7,720	**19,010**		**19,010**						11,290	7,720	**19,010**		**19,010**
Sub Main	DCIP	350		2,430			**2,430**																	2,430		**2,430**					**2,430**
Sub Main	DCIP	300						1,240	16,540	720	10	**18,510**		25,790	4,570		**30,360**					**30,360**	1,240	42,330	5,290	10	**48,870**					**48,870**
Sub Main	DCIP	250	4,409	896			**5,305**	12,160				**12,160**	14,320				**14,320**					**14,320**	30,889	896			**31,785**					**31,785**
Sub Main	PE/uPVC	200	1,003	1,329	131	1,124	**3,587**	2,810		27,110	27,700	**57,620**	4,810		10,990	33,920	**49,720**	20	10	**30**	**25,760**	**75,510**	8,623	1,329	38,231	62,744	**110,927**	20	10	**30**	25,760	**136,717**
Sub Main	PE/uPVC	150	5,411	2,415	1,916	1,648	**11,390**				1,820	**1,820**				2,640	**2,640**	7,640	5,230	**12,870**		**15,510**	5,411	2,415	1,916	6,108	**15,850**	7,640	5,230	**12,870**		**28,720**
Sub Total	-	-	**10,823**	**9,169**	**2,047**	**2,772**	**24,811**	**16,210**	**16,540**	**27,830**	**29,530**	**90,110**	**19,130**	**25,790**	**15,560**	**36,560**	**97,040**	**18,950**	**12,960**	**31,910**	**25,760**	**154,710**	**46,163**	**51,499**	**45,437**	**68,862**	**211,961**	**18,950**	**12,960**	**31,910**	**25,760**	**269,631**
Branch	PE/uPVC	100	3,871	2,008	3,198	4,979	**14,056**		250		1,150	**1,400**				1,010	**1,010**					**1,010**	3,871	2,258	3,198	7,139	**16,466**					**16,466**
Branch	PE/uPVC	80	1,262	3,541	489	1,363	**6,655**	88,720	46,980	112,190	112,310	**360,200**	49,570	26,250	62,690	62,750	**201,260**					**201,260**	139,552	76,771	175,369	176,423	**568,115**					**568,115**
Branch	PE/uPVC	50	293	191	204	1,667	**2,355**						100	50	130	130	**410**	17,200	11,760	**28,960**	**57,910**	**87,280**	393	241	334	1,797	**2,765**	17,200	11,760	**28,960**	57,910	**89,635**
Sub Total	-	-	**5,426**	**5,740**	**3,891**	**8,009**	**23,066**	**88,720**	**47,230**	**112,190**	**113,460**	**361,600**	**49,670**	**26,300**	**62,820**	**63,890**	**202,680**	**17,200**	**11,760**	**28,960**	**57,910**	**289,550**	**143,816**	**79,270**	**178,901**	**185,359**	**587,346**	**17,200**	**11,760**	**28,960**	**57,910**	**674,216**
Total	-	-	**19,435**	**14,909**	**5,938**	**10,781**	**51,063**	**108,550**	**72,230**	**144,130**	**158,480**	**483,390**	**68,800**	**52,090**	**78,380**	**100,450**	**299,720**	**36,150**	**24,720**	**60,870**	**96,340**	**456,930**	**196,785**	**139,229**	**228,448**	**269,711**	**834,173**	**36,150**	**24,720**	**60,870**	**96,340**	**991,383**

Distribution Pipe Length (Feasibility Study)

Category	Material	Diameter	F/S (JICA)					F/S (KTC)					F/S Total				
			Existing					Existing					Existing				
			Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
Main	DCIP	1,000				4,450	**4,450**									4,450	**4,450**
Main	DCIP	900				2,610	**2,610**									2,610	**2,610**
Main	DCIP	800		5,210		8,430	**13,640**	3,620	3,250	4,110		**10,980**	3,620	8,460	4,110	8,430	**24,620**
Main	DCIP	600															
Main	DCIP	500															
Sub Total	-	-		**5,210**		**15,490**	**20,700**	**3,620**	**3,250**	**4,110**		**10,980**	**3,620**	**8,460**	**4,110**	**15,490**	**31,680**
Sub Main	DCIP	450															
Sub Main	DCIP	400															
Sub Main	DCIP	350															
Sub Main	DCIP	300	100	12,440	710	10	**13,260**	1,140	4,100	10		**5,250**	1,240	16,540	720	10	**18,510**
Sub Main	DCIP	250	10,440				**10,440**	1,720				**1,720**	12,160				**12,160**
Sub Main	PE	200	990		17,440	21,570	**40,000**	1,820		9,670	6,130	**17,620**	2,810		27,110	27,700	**57,620**
Sub Main	PE	150				1,820	**1,820**									1,820	**1,820**
Sub Total	-	-	**11,530**	**12,440**	**18,150**	**23,400**	**65,520**	**4,680**	**4,100**	**9,680**	**6,130**	**24,590**	**16,210**	**16,540**	**27,830**	**29,530**	**90,110**
Branch	PE	100		250		1,150	**1,400**							250		1,150	**1,400**
Branch	PE	80	72,150	29,140	79,550	91,310	**272,150**	16,570	17,840	32,640	21,000	**88,050**	88,720	46,980	112,190	112,310	**360,200**
Branch	PE	50															
Sub Total	-	-	**72,150**	**29,390**	**79,550**	**92,460**	**273,550**	**16,570**	**17,840**	**32,640**	**21,000**	**88,050**	**88,720**	**47,230**	**112,190**	**113,460**	**361,600**
Total	-	-	**83,680**	**47,040**	**97,700**	**131,350**	**359,770**	**24,870**	**25,190**	**46,430**	**27,130**	**123,620**	**108,550**	**72,230**	**144,130**	**158,480**	**483,390**

Supporting Report

Chapter 5
Institutional and Managerial Considerations

SR 5.1 DEPARTMENT OF PRODUCTION AND WATER SUPPLY

WATER PRODUCTION OFFICE		
Position title	**# Personnel**	
Department Director *Mr. Kong Sokvan*	**1**	None given
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Water Production Office *Mr. Kot Nimol*	1	• Responsible for water treatment plant operation • Responsible for well operations • Responsible for production planning • Manages eight people of the production office • Does reports
Production Staff (1) *Siek Chanthan*	7	• Maintains equipment and facilities • Maintains all wells • Checks and control treatment plant processes • Checks all materials/supplies in WTP such as lime • Checks well level, control data • Makes daily documentary reports
Production Staff (2) *Horm Sophany*		• Takes good care of all instruments and panels in the waterworks • Puts lime • Maintains all wells in good operation
Production Staff (3) *Touch Ratha*		• Putting lime; clean building in facility and production plant • Takes care of electrical machine and wells • Checks buildings for problem in appearance • Making daily record • Making total report during morning meetings
Production Staff (4) *Sem Yong*		• Takes care of each equipment in production facility • Checks and controls wells' levels • Checks and controls work process • Takes care and repairs equipment or material
Production Staff (5) *An Vichena*		• Takes care of each equipment • Takes care and controls 8 wells • Checks and controls all generation processes • Checks well level • Controls data, document, equipment and lime • Checks monitoring and makes daily report
Production Staff (6) *Chhut Monoram*		• Water quality analysis and production • Check and control water quality, clean water in treatment plant and at people's homes and pipeline • Daily, weekly, monthly, quarterly and yearly water control, laboratory and production • Does calibration on some water check equipment and cleans them • Other jobs that SRWSA requests for production
Production Staff (7) *Van Somanet*		• Maintains equipment and facilities • Maintains all wells, Checks well level, control data • Checks and controls treatment plant processes • Checks all materials/supplies in WTP such as lime • Makes daily documentary reports
Worker *Larg Chorn*	1	Gardening and grounds maintenance
WATER DISTRIBUTION OFFICE		
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Water Distribution Office *Mr. Doeun Rada*	1	Responsible for main distribution pipeline and the expansion of the main pipeline

Network (1) *Som Pich*	2	• Maintenance of V, A and wash valve • Repair of broken water pipes
Network (2) *Ngut Phalleap*		• Maintenance of air valve and wash valve • Repair of water pipe leakages
Personnel (1) *Pok Pech*	2	New connections pipes; repairs water leaks, takes care of stop tab, air tab and cleans these
Personnel (2) *Van No*		Makes new connection, repair water leaks, takes care of stop tab, air tab and cleans these
Staff (1) *Kong Sovoan*	1	Construction management, network calculation, water leakage detection, pipeline design
CUSTOMER OFFICE		
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Customer Office *Mr. Heng Rattana*	1	• Manages and controls work related to customer service such as connection of households to SRWSA • Checks and measures location of household • Links water supply • Advertises about SRWSA's service to the public
Meter Reader (1) *Ty Vannak*	3	• Meter reading and preparation of invoice • Change of old meter • Repair of old meter
Meter Reader (2) *Mak Pol*		• Reads the water meter and prepares water bill • Reports changes of meter readings
Meter Reader (3) *Loam Khloke*		• Read the meters monthly • Divide the invoice • Report change of customer meter • Tell customer to pay the bill
Customer Service (1) *Thap Sara*	2	• Relates to customer service • Network to house connection
Customer Service (2) *Van Sosamneang*		• Relate to customer service • Prepare report of customer office • Take care of customer documents
Staff (1) *Khouen Chantom*	2	• Digging for new pipeline • Change water meter • Repairs leaks
Staff (2) Cheav Savy		• Digging for new pipeline • Changes water meter • Repairs leaks
No answer *Ly Sna*	1	• Repairs of water leaks; digging pipes • Repairs water meter • Connection of mains to water meter
No answer *Douen Douem*	1	• Digs for pipeline • Changes water meter • Repairs leaks
SUMMARY		
Title		**Total Number of Personnel**
Department Director		1
Office Chief		3
Personnel		22
TOTAL		**26**

SR 5.2 DEPARTMENT OF PLANNING AND TECHNICAL

Position Title	# Personnel	Brief Job Function
Department Director Mr. AM Marady on concurrent basis	(1)*	None given
PLANNING OFFICE		
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Planning Office Mr. Sok Hout	1	• Stock in, stock out • Accounting • Planning
TECHNICAL AND PROJECT OFFICE		
Position Title	**No. of Personnel**	**Brief Job Function / Description**
Office Chief, Technical and Project Office Mr. Chea Chandara	1	• Study plan for yearly connection of pipeline investment • Check and balance of technical evaluation • Revise and update plans

SUMMARY	
Title	**Total Number of Personnel**
Department Director	(1)*
Office Chief	2
Personnel	0
TOTAL	**2**

* *Already counted in Financial Office*

SR 5.3 DEPARTMENT OF ADMINISTRATION AND FINANCIAL

Position Title	# Personnel	Brief Job Function
Department Director *Mr. Yay Monirath*	1	• Over-all in charge of administration and finance of the Authority • Over-all in charge of customer billings • Chief of the procurement unit, prepares documents for bidding and valuation
ADMINISTRATION AND HUMAN RESOURCES OFFICE		
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Administration and Human Resource Office *Ms Hou Sinoun*	1	• **General Administration** - Weekly, monthly and annual reports of Authority's activities - Protocol, safety and security of SRWSA - Payroll
		• **Human Resource Management and Development** - Assists departments in conducting semestral and annual personal performance assessments - Recommends personnel promotion and discipline at end of year - Updates personnel documents - Prepares annual TNS and develops annual training plan
		• **Affairs of Board of Directors** - Prepares meeting arrangements, minutes, and monitors implementation of BOD and GD decisions by departments
Administration *Haun Sokha*	1	• Lists down supply requests of other departments • List down for in and out • Prepare for proposal of lacking water meters • Makes weekly reports
FINANCIAL AND ACCOUNTING OFFICE		
Position Title	**# Personnel**	**Brief Job Function / Description**
Office Chief, Financial and Accounting Office *Mr. Am Marady*	1	Supervises the accounting office and personnel
Cashier *Vath Sovin*	1	• Records expense and income • Deposits in the bank • Gets payment from household consumers
Asst Accountant *Sitha Malin*	1	• Typing journal into Excel to double check with income statement • Completes overtime of staff
Employee *Moas Vichna*	1	• Receives payment from customer • Makes balance sheet • Prepares list of customer payment
Billing *Soun Samnang* *Kong Kun*	1	• Inputs the meter reading data to the billing system • Prints out billing, manage billing data and accounting, • Checks customer
	1	• Inputs data (Records sale, batch reading, customer payment) • Prints customer bills and reports • Checks billing list and customer payment • Backs up data from WT once a month

SUMMARY	
Title	**Total Number of Personnel**
Department Director	1
Office Chief	2
Personnel	6
TOTAL	**9**

SR 5.4 COST FOR CAPACITY DEELOPMENT

	SPECIALIST	M/M	YEAR/S	REMUNERATION		PER DIEM		TRAVEL		OTHERS	TOTAL
				Per M/M	Total	Per M/M	Total	# Trips	Total		
1.	Team Leader for Capacity Development	3	2012-2016	30,000	90,000	3,000	9,000	3	7,500	15,000	
2.	HR and Training Specialist	4	2012-13	25,000	100,000	3,000	12,000	2	5,000		
3.	Water Utilities Planning Specialist	3	2012-13	25,000	75,000	3,000	9,000	1	2,500	Lump sum for training materials and reports	
4.	Strategic Business Consultant	3	2012-13	25,000	75,000	3,000	9,000	1	2,500		
5.	Commercial Practices Specialist	3	2012-13	25,000	75,000	3,000	9,000	1	2,500		
6.	Financial Management Specialist	3	2012-13	25,000	75,000	3,000	9,000	1	2,500		
7.	Water Supply (Production) Specialist	3	2016	25,000	75,000	3,000	9,000	1	2,500		
8.	Water Supply (Distribution) Specialist	3	2015-16	25,000	75,000	3,000	9,000	1	2,500		
9.	Training Specialist/Translator (Local)	6	2012-2016	10,000	60,000	None		None	None		
	TOTAL	**31**			**700,000**		**75,000**		**27,500**	**15,000**	**817,500**

SR 5.5 COST OF SPECIALIZED TRAINING

DEPARTMENT	TITLE OF TRAINING	NO OF TRAINEES	COST OF TRAINING USD	PHASE
Top Management	City Water Utilities Planning	7	50,000.00	2012-13
Top Management Department Directors and Office Heads	Strategic Management and Leadership	15	10,000.00	2012-13
Commercial Office	Customer Services and Customer Satisfaction	7	5,000.00	2-12=13
Finance and Accounting Department	Accounting for Non-Accountants	5	5,000.00	2012-13
Administrative Department and Water Production Office	Inventory and Asset Management	7	5,000.00	2013-14
Planning / Technical Production / Water Supply Departments	Project Management	7	7,500.00	2013-14
Water Production Office	Operation and Maintenance of Sources / Facilities	12	10,000.00	2015-2016
Water Distribution Office and Service Connection Office	Network Installation and Rehabilitation	12	10,000.00	2015-2016
		SUB-TOTAL	102,500.00	

SR 5.6 HUMAN RESOURCE INVENTORY SURVEY RESULTS

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
1 Mr Ty Vannak	26	University Level	5	Permanent	Meter Reader	Customer Office	Heng Rattana	• Meter reading and preparation of invoice • Change of old meter • Repair of old meter	7 days Staff Training Course by PPWSA 7 days (2005)	Knowledge of meter reading, input data reading process technology and repair of meter problems
2 Mr Kong Kun	24	University Level	5	Permanent	Billing	Accounting	Am Marady	• Input data (Records sale, batch reading, customer payment) • Prints customer bills and reports • Checks billing list and customer payment • Back ups data from WT one day of a month	None	Wants a better and updated billing system because system is slow Wants to compare billing system with other companies
3 Mr Larg Chom	69	Secondary	45	Permanent	Worker	Production and Distribution	Kot Nimol	• Gardening	None	None
4 Mr Som Pich	29	High School	1	Permanent	Network	Water Distribution	Douen Rada	• Maintenance of V, A and wash valve • Repair of broken water pipe	None	Continue with technical training because technical knowledge is “little”
5 Ms Sitha Malin	27	High School	1	Permanent	Asst Accountant	Finance	Am Marady	• Typing journal into window Excel to double check with income statement • Complete overtime of staff	None	Training on accounting
6 Moas Vichna	28	High School	5	Permanent	Employee	Accounting and Finance	Am Marady	• Receives payment from customer • Makes balance sheet • Prepares list of customer payment	26 days Staff Training for Water Supply by PPWSA and JICA 7 days (2005) Basic Business Mgt Training by SILAKA 19 days (2005)	None
7 Mr. Am Marady	47	High School	4	Permanent	Accountant	Accounting and Finance	Chan SengLa	• Accounting	2 days Finance by JICA 2 days (2006)	Training on accounting

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
8 Yay Monirath	40	University Graduate	No answer	Permanent	Dept Director	Administration and Finance	Chan SengLa	• In charge of administration and finance, customer billing • Chief procurement unit, prepares document for bidding and valuation	Several training	Short course in water utility or enterprise management Planning city water supply projects
9 Thap Sara	27	Master's	5	Permanent	Customer Service	Customer Office	Heng Rattana	• Relate to customer service • Network to house connection	13 days Special Staff Training Course by JICA 5 days (2005) Outline of Waterworks by JICA 5 days (2005) Distribution Network Calculation and Non Revenue Water Reduction by JICA 3 days (2009)	Get technology update for SRWSA
10 Ms. Hou Sinoun	28	University Graduate	5	Permanent	Office Chief	Administration and Human Resource	Yay Monirath	• **General Administration** - weekly, monthly and annual reports of Authority's activities - Protocol, safety and security of SRWSA - Payroll • **Human Resource Management and Development** - Assists departments in conducting semestral and annual personal performance assessments - Recommends personnel promotion and discipline at end of year - Updates personnel documents - Prepares annual TNS and develops annual training plan • Affairs of Board of Directors - Prepares meeting arrangements, minutes, and monitors implementation of BOD and GD decisions by departments	7 days Special Staff Training Course by PPWSA and JICA 5 days (2005) Administration and Human Resources by PPWSA and JICA 2 days (2006)	Short training course in HR management Training on HR planning and staff development for the short, medium and long term

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
11 Sok Hout	36	University Graduate	10	Permanent	Plan and Statistics / Other Stock Merchandise	Technical and Planning	No Answer	• Stock in, stock out • Accounting • Planning	36 days Basic Business Mgt by SILAKA 19 days (2005) Conical Hat Acctg by JICA 5 days (20059 Conical Hat Payroll by JICA 5 days (2005) Special Training course by PPWSA 7 days (2005)	Training on Planning
12 Mr Soun Samnang	28	University Graduate	5	No answer	Billing	Accounting	Am Marady	• Input the meter reading data to the billing system • Print out billing, manage billing data and accounting, • Check customer	7 days Special Training Course by PPWSA 7 days (2005)	Wants to know other billing systems Training on IT to repair computers on the company Wants updated billing system
13 Van Sosamneang	23	University Graduate	3	Permanent	Customer Service	Customer Office	Heng Rattana	• Relate to customer service • Prepare report of customer office • Take care of customer documents	None	Training of network to house connection: Skills training to operate with customer Training on document management Technology update on water supply production knowledge on water quality
14 Mr. Kot Nimol	26	University Graduate (BBA)	5	Permanent	Office Chief	Production and Distribution	Kong Sokvan	• Responsible for water treatment plant operation • Production planning • Manage 8 people of the production office • Do reports	78 days Special Training Course for SR Waterworks by PPWSA and JICA 5 days (2005) Safety on Chlorination System by PPWSA and JICA 1 day (2005) Operation of Water Treatment Plant by PPWSA and JICA 5 days (2005) Operation and Management of WTP by Kitakyoshu Waterworks 60 days (2008) Operation of WTP by JICA 5 days (2008) Water Quality Monitoring by JICA 2 days (2008)	Training course for electrical, electronic and mechanical equipment of WTP

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
15 Ly Sna	31	Primary	10	Permanent	No Answer	Customer Office	Heng Rattana	• Repair of water leaks; digging pipes • Repair water meter • Collection of main water meter	None	Repair of water meter Long-term care of water system
16 Chea Chandara	29	University Graduate	5 years	Permanent	Technical and Project Officer	Office of Planning and Technical	AM Marady	• Study and plan for yearly connection of pipeline investment • Check and balance of technical evaluation • Revise and update plans	14 days Special Training for SRWSA by PPWSA 5 days (2005) Care for Pipeline System by PPWSA 4 days (2008) Drawing of location Plan by MIME 5 days (2008)	Training on drawing Organization and Plan management on SR connection line and new methods for developing and improving working processes
17 Ngut Phalleap	24	High School	5	Permanent	Network	Water Distribution Office	Douen Rada	• Maintenance of air valve and wash valve • Repair of water pipe leakages	10 days Special Training course for SRWSA by PPWSA/JICA 5 days (2005) How to Restore Pipe and Security during Work by JICA 5 days (2009)	Request that training continues
18 Mak Pol	59	Primary School	31	Contractual	Water Meter Reader	Customer Office	Heng Rattana	• Read the water meter and prepares water bill • Reports changes of meter readings	5 days Special Training for SRWSA by PPWSA 5 days (2005)	Training on causes of broken water meters
19 Haun Sokha	22	High School	No answer	Permanent	Administration	Administration and Finance Office	Hou Sinoun	• Lists down supply requests of other departments • List down for in and out • Prepare for proposal of lacking water meters • Makes weekly reports	None	Give more training to admin personnel
20 Pok Oech	26	Primary School	1	Contractual	No Answer	Main Pipe (?)	Doeun Rada	• New connections pipes; repairs water leaks, takes care of stop tab, air tab and cleans these	None	Give more training on main pipes
21 Van No	26	Secondary School	1	Contractual	No answer	Main Pipe (?)	Doeun Rada	• Makes new connection, repair water leaks, takes care of stop tab, air tab and cleans these	None	Give more training on main pipes

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
22 Doeun Rada	46	High School	14	Permanent	Main Pipeline	Production	Kong Sokvan	• Responsible for main pipeline and expansion of main pipeline	21 days Special Training on SRWSA by PPWSA and JICA 5 days (2005) Repair of Pipeline System by JICA 2 days (2006) Caring for Equipment and Connection System by JICA 4 days (2006) Caring for water connection by JICA 5 days (2008) How to Manage Main Pipes by JICA 5 days (2009)	Operate equipment that could detect water leaks How to use the computer in design
23 Siek Chanthan	27	High School	5	Permanent	Production Staff	Production and Distribution	Kot Nimol	• Maintains equipment and facilities • Maintains all wells • Check and control treatment plant processes • Check all materials/supplies in WTP such as lime • Check well level, control data • Makes daily documentary reports	14 days Procedure of Maintaining Generator by JICA 3 days (2008) Procedure of Maintaining Electrical Generator by JICA 7 days (2008) Operational Maintenance of Filter by JICA 2 days (2009) How to Manage Document and Check Well Levels by JICA 2 days (2010)	Training on generators and similar electrical equipment to control the treatment plant process well
24 Horm Sophany	27	University Level	5	Permanent	Production Staff	Production and Distribution	Kot Nimol	• Takes good care of all instruments and panels in the waterworks • Puts lime • Maintains all wells in good operation	14 days Special Training Course for SRWSA by JICA 5 days (2005) Maintenance of Panel by JICA 5 days (2008) O&M of Filter by JICA 2 days (2009) Check and Maintenance of Document by JICA 2 days (2010)	Training on generator and electrical machines, the control of such equipment to avoid problems

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
25 Touch Ratha	26	University Graduate	3	Permanent	Production Staff	Production and Distribution	Kot Nimal	• Putting lime; clean building in facility and production plant • Take care of electrical machine and wells • Check buildings for problem in appearance • Making daily record • Making total report during morning meetings	20 days Installation of New Panel by JICA 10 days (2009) Basic Electrical Construction Management by JICA 5 days (2009) Installation of New Transformer by JICA 5 days (2009)	More training on electrical to make SRWSA work better
26 Sem Yong	25	High School	2	Permanent	Production Staff	Production and Distribution	Kot Nimol	• Takes care of each equipment in production facility • Check and control wells' levels • Check and control work process • Take care and repair equipment or material	4 days Operation and Maintenance of Filter by JICA 2 days (2009) How to Manage Document and Check Well Levels by JICA 2 days (2010)	More training in electrical and electrical materials that I don't know about
27 An Vichena	29	High School	5	Permanent	Production Staff	Production and Distribution	Kot Niimol	• Takes care of each equipment • Takes care and controls 8 wells • Checks and controls all generation processes • Check well level • Control data, document, equipment and lime • Check monitoring and makes daily report	14 days Special Training Course for SRWSA by JICA 7 days (2005) Procedure of Maintenance of Generator by JICA 3 days (2008) Operation and Maintenance of Filter by JICA 2 days (2009) Document by JICA 2 days (2010)	Training on generators, electrical machines specific to the water treatment plant process

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
28 Chhut Monorom	27	No Answer	5	Permanent	Production Staff	Production and Distribution	Kot Nimol	• Water quality analysis and production • Check and control water quality, clean water in treatment plant and at people's homes and pipeline • Daily, weekly, monthly quarterly and yearly water control, laboratory and production • Do calibration on some water check equipment and clean them • Other jobs that SRWSA requests for production	32 days Special Training Course for SRWSA by JICA 5 days (2005) Water Quality Management by JICA 10 days (2006) Water Quality Monitoring by JICA 2 days (2008) The Basic Theory of Chlorination by JICA 4 days (2008) Water Treatment Plant Operation by JICA 6 days (2008) Foundation of Electricity – In-House Training 2 days (2009) Operation and Maintenance of Filter by JICA 2 days (2009) How to Manage Document and Check Well Levels by JICA 2 days (2010)	More training on use or calibration machine. Training on how to check for virus, moss, arsenic to control sustainability of water quality so there is no need to send water for analysis in Phnom Penh
29 Vath Sovin	50	Secondary School	21	Permanent	Cashier	Administration and Accounting	No Answer	• Records expense and income • Deposits in the bank • Gets payment from household consumers	24 days Special Training for SRWSA by PPWSA and JICA 5 days (2005) Foundation of Business Management by SILAKA 19 days (2005)	None
30 Heng Rattana	29	University Graduate	5	Permanent	Office Chief	Customer Office	Kong Sokvan	• Advertise about SRWSA's service • Check and measure location of household to propose to department • Manage, control and repair household pipeline • Links water supply	10 days Special Training for SRWSA by PPWSA and JICA 5 days (2005) Method of Accounting by PPWSA and JICA 5 days	Need more training and experience in managing pipeline system
31 Khuoen Chantorn	31	Secondary School	2	Contractual	Staff	Customer Office	Heng Rattana	• Digging for new pipeline • Change water meter • Repairs leaks	None	Need more technical skills
32 Cheav Savy	36	High School	1	Contractual	Staff	Customer Office	Heng Rattana	• Digging for new pipeline • Repair leaks • Checks water meter	None	None

Name Code	Age	Educ Attainment	Years with SRWSA	Status	Post	Department / Office	Supervisor	Job Description	Training	Comments
33 Kong Sovoan	31	High School	5	Permanent	Staff	Production and Water Supply	Doeun Rada	• Construction management, network calculation, water leakage detection, pipeline design	65 days Special Training for SRWSA by PPWSA and JICA 5 days (2005) Management and Maintenance of Network Distribution by JICA Kyushu 60 days (2008)	Need more training and experience to improve water works
34 Cheav Channy	46	MBA	3	Permanent	DGD		GD Som Kunthea	• Manages technical (water supply) operations of SRWSA	90 days Water Supply Engineering II	None
35 Loam Khloke	25	Graduate	5 years	Permanent	Meter Reader Invoice Prep	Customer Office	Heng Rattana	• Reads meters monthly • Prepares invoice • Report Change in customer meter • Tell customer to pay bill	5 days Special Training course for SRWSA by JICA 5 days (2005)	Change all old water meters of all the customers in SRWSA
36 Van Somanit	26	University Level	5	Permanent	Production Staff	Production	Kot Nimol	• Takes care of equipment in facility • Check 8 wells • Check lime and process of facility	8 days (2009) Filter care by JICA Motor and Pump by JICA Organizing Documents by JICA	More training on computer system Training about motors and their limitation
37 Doun Deoum	No Answer	Secondary	2	Contractual	None	Customer Service	Heng Rattana	• Dig for pipeline, change water meter, repair leaks	None	None
38 Kong Sokvan	NONE							•		
39 Chan SengLa	NONE							•		
40 Som Kunthea	NONE							•		

SR 5.7
TERMS OF REFERENCE
FOR INTERNATIONAL AND LOCAL CONSULTANTS

TEAM LEADER FOR CAPACITY DEVELOPMENT PROJECT

Qualifications: Degree in Civil of Environmental Engineering

Experience: 10 years experience in water supply in Asian water utilities as a manager of a water utility with high degree of involvement in training

Input: 2.0 Person months

Objectives: (i) To develop general capacity building approaches for selected SRWSA officers/staff on water utility business management and water supply operations who will be trained by a multi-discipline team of Consultants; and (ii) To supervise the preparation of written systems and procedures and/or operations manuals, as well as various training materials by the Consultants.

Scope: The team leader will address the following:

(1) Establishing and/or improving, and then codifying systems and procedures in five utility functional areas – (i) financial management, (ii) human resources management, (iii) commercial practices, and (iv) production and distribution (v) planning and development.

(2) Establishing the knowledge management bank of SRWSA starting with the codification of the systems and procedures and the completed training materials

Implementation: On staggered basis

Deliverables:

(1) Inception Report
(2) Interim Report
(3) Final Report

STRATEGIC BUSINESS MANAGEMENT CONSULTANT

Qualifications: Degree in Business

Experience: 10 years experience in water supply industry, managing an Asian water utility, with high degree of involvement in training

Input: 1.0 Person month

Objective: To prepare training plan for SRWSA counterpart on how to develop SRWSA medium term strategic business plan, together with the development of appropriate training materials.

Scope: The Consultant will address the following:

(1) Establishing and codifying the systems and procedures in preparing the SRWSA business plan.

(2) Training with topics to include: Vision, Mission, Objectives and Strategies for SRWSA's functional areas, Strategic water utility management, Key performance indicators and measurements, Management and leadership

Implementation: 1.0 person-month

Deliverables:

(1) The Strategic Business Plan for SRWSA
(2) Training Materials on Strategic Water Utility Management

INSTITUTION AND HUMAN RESOURCES SPECIALIST

Qualifications: Degree in Business Management or Human Resources

Experience: 10 years experience in water supply in Asian water utilities, as HR practitioner or with high degree of involvement in water utilities' training

Input: 3.5 Person months

Objectives: (i) To develop job standards and job descriptions for all positions; and (ii) To develop an improved employee performance appraisal system that links with the job standards

Scope: The Consultant will address the following:

(1) Defining job standards and job descriptions, as well as setting the duties and responsibilities for all positions;
(2) Improvement of performance appraisal system aligned with the job standards and job description of each employee;
(3) Training with the following topics: Human Resource Management, Recruitment, selection and placement, Performance appraisal, Employee training and development, Human Behavior in Organizations, Change management

Implementation: 3.5 person months

Deliverables:

SRWSA Human Resources Framework

Job Descriptions

Performance Appraisal

Training Materials

FINANCIAL MANAGEMENT SPECIALIST

Qualifications: Degree in Economics, or Finance and Accounting

Experience: 10 years experience in water supply in Asian water utilities, as finance manager / practitioner or as financial management specialist with high degree of involvement in water utilities' training

Input: 3.0 Person months

Objective: To develop SRWSA financial management systems and procedures and codify into a finance manual

Scope: The Consultant will address the following:

(1) Defining and codifying SRWSA's financial management system based on Cambodian accounting standards but designed for water utility operations;

(2) Training on the following topics: water utility operations' accounting, bookkeeping, budgeting, cash management, accounts receivables; Project accounting and project FIRRs; Tariffs, tariff policies, tariff structures; Connection and disconnection fees; Auditing of accounts, Publishing an annual report.

Implementation: 3.0 person months

Deliverables:

Financial Management Manual

Training Materials

COMMERCIAL PRACTICES SPECIALIST

Qualifications: Degree in Economics, or Finance and Accounting, Business Management

Experience: 10 years experience in water supply in Asian water utilities, as commercial manager / practitioner or as commercial practices specialist with high degree of involvement in water utilities' training

Input: 3.0 Person months

Objective: To develop SRWSA commercial practices systems and procedures and codify into a commercial practices manual

Scope: The Consultant will address the following:

(1) Defining and codifying SRWSA's commercial practices system
(2) Training on the following topics: Customer services and customer accounts; Handling of new connections, reconnections, disconnections and customer complaints; Metering and meter reading; Billing and collection; Analysis of sales; Public consultations; Water education such as conservation and hygiene; Consumer surveys; Service coverage to the poor and disadvantaged; Monitoring large business consumers

Implementation: 3.0 person months

Deliverables:

Commercial Practices Manual

Training Materials

WATER SUPPLY SPECIALIST (WATER UTILITY PLANNING)

Qualifications: Degree in Civil Engineering

Experience: 10 years experience in water supply planning in Asian water utilities with high degree of involvement in water utilities' training

Input: 2.0 Person months

Objective: To develop water supply planning and development frameworks for SRWSA

Scope: The Consultant will address the following:

Training on the following topics: Project schemes and basic water supply system master planning and feasibility studies, Structure of water sources, Water resource assessment; Service coverage and service levels from utility; Intermittent water supply; Water quality and water treatment; Water supply and the urban poor; Willingness-to-pay and willingness-to-connect; Consumer surveys, Demand estimation; Procurement and specifications; Construction supervision; Project management; Contract administration; Government policy, and Funding sources

Implementation: 2.0 person months

Deliverables:

Training Materials

WATER SUPPLY SPECIALIST (PRODUCTION AND TREATMENT)

Qualifications: Degree in Civil Engineering

Experience: 10 years experience in water supply production, operations and maintenance in Asian water utilities with high degree of involvement in water utilities' training

Input: 2.0 Person months

Objective: To develop operations and maintenance manuals for SRWSA

Scope: The Consultant will address the following:

(1) Codifying operation and maintenance of water supply facilities through an Operations Manual;

(2) Training on the following topics: Structure of water source, materials, intake water volume, and allocation of water intake facility; Water theory of treatment process and hydraulic capacity; Structure, material and allocation of chemical facility; Raw water quality and annual fluctuation of water level of Tonle Sap Lake; Operation methodology of raw water intake dependent on the required water demand; Operation the intake pumps dependent on the required water demand; Operation methodology for the water treatment process dependent on the required water demand and raw water quality; Methodology for investigation the process water qualities (iron, manganese, turbidity, color, pH and residual chlorine); Methodology of the sludge treatment; Required maintenance for water treatment plant; Preventive maintenance; Workshop and stores; Vehicles and transport; O&M cost estimation; Water sources' production and records keeping.

Implementation: 2.0 person months

Deliverables:

Operation and Maintenance Manual

Training Materials

WATER SUPPLY SPECIALIST (DISTRIBUTION AND NETWORK INSTALLATION)

Qualifications: Degree in Civil Engineering

Experience: 10 years experience in water supply distribution and network installation and maintenance in Asian water utilities with high degree of involvement in water utilities' training

Input: 2.0 Person months

Objective: To develop distribution and network installation manual for SRWSA

Scope: The Consultant will address the following:

(1) Codifying water supply distribution through an Distribution and Network Installation Manual;
(2) Training on the following topics: Project scheme and basic of water supply system; Theory of water distribution; SRWSA's distribution network system, diameter of pipe, pipe material and hydraulic capacity; NRW control, measurement and reduction program and methodology of investigation for leakage volume; Methodology of distribution the required water amount into each distributing block; Installation method of consumer flow meter; Operating the tools for installation of consumer flow meter; Mapping, records and reports.

Implementation: 2.0 person months

Deliverables:

Operation and Maintenance Manual

Training Materials

TRAINING SPECIALIST AND TRANSLATOR

Qualifications: Degree in Business, or Human Resources Management, or English

Experience: Three years relevant work experience

Input: 6.0 Person months

Objective: To translate all training materials and documents (systems and procedures / manuals) from English to Khmer

Scope: The local consultants will address the following:

(1) Translate codified systems and procedures, manuals and training materials;
(2) Assist in conduct of training.

Implementation: 2 persons at 3.0 person months each

Deliverables:

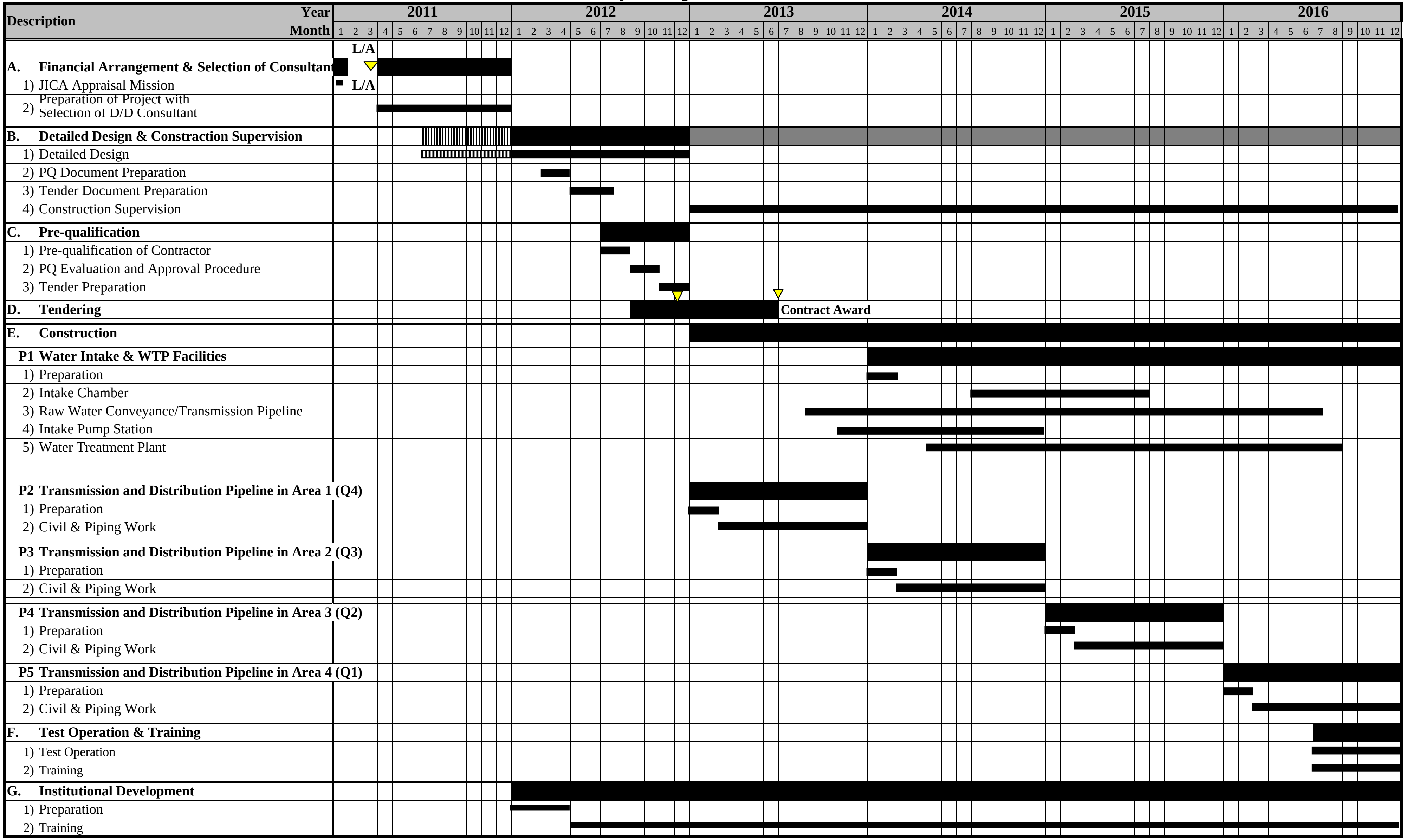
Translated Business Plan, Commercial Practices Manual, Financial Management Manual, Job Descriptions and Performance Appraisal, Production, Distribution and Planning Manuals

Translated Training Materials

Supporting Report

Chapter 6
Implementation Plan

SR 6.1 Project Implementation Schedule



SR 6.2 Detailed Disbursement Schedule

Disbursement Schedule of Priority Project

Item No.	Descriptions	2010		2011		2012		2013		2014		2015		2016		Subtotal
		FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	
1	Civil Works	0	0	0	0	0	0	6989	3781	3051	8029	4578	8636	2314	5293	42,672
2	M&E Works	0	0	0	0	0	0	298	41	3520	520	2598	413	1732	276	9,397
3	Engineering Service	0	0	436	109	873	218	873	218	873	218	873	218	272	69	5,250
4	Institutional Development	0	0	0	0	172	11	172	11	172	11	172	11	172	16	920
5	Land Acquisition	0	0	0	300	0	0	0	0	0	0	0	0	0	0	300
6	Social Compensation	0	0	0	91	0	0	0	0	0	0	0	0	0	0	91
7	Project Administration	0	0	0	1	0	1	0	203	0	275	0	296	0	175	951
8	Physical Contingency	0	0	22	35	52	11	781	394	709	866	770	916	427	561	5,545
9	Price Contingency	0	0	8	42	40	39	501	1139	616	3428	839	4716	556	3593	15,516
Total		0	0	466	579	1,137	281	9,614	5,785	8,940	13,348	9,830	15,207	5,473	9,982	**80,642**

Disbursement Schedule of Direct Construction Cost

Item No.	Descriptions	2010		2011		2012		2013		2014		2015		2016		Subtotal
		FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	
1	Intake Chamber	0	0	0	0	0	0	0	0	7	61	10	85	0	0	162
2	Water conveyance pipelines	0	0	0	0	0	0	165	1,472	496	4,416	496	4,416	290	2,576	14,328
3	Intake Pumping Station	0	0	0	0	0	0	79	116	476	697	0	0	0	0	1,368
4	Water Treatment Plant	0	0	0	0	0	0	0	0	716	1,769	1,075	2,653	716	1,769	8,697
5	Elevated Water Tank	0	0	0	0	0	0	0	0	0	0	228	608	0	0	836
6	Transmission/Distribution Pipelines Area	0	0	0	0	0	0	6,744	2,193	0	0	0	0	0	0	8,937
7	Transmission/Distribution Pipelines Area	0	0	0	0	0	0	0	0	1,355	1,087	0	0	0	0	2,442
8	Transmission/Distribution Pipelines Area	0	0	0	0	0	0	0	0	0	0	2,770	874	0	0	3,644
9	Transmission/Distribution Pipelines Area	0	0	0	0	0	0	0	0	0	0	0	0	1,308	949	2,257
10	M&E works for intake	0	0	0	0	0	0	298	41	1,788	244	0	0	0	0	2,371
11	M&E for WTP	0	0	0	0	0	0	0	0	1,732	276	2,598	413	1,732	276	7,027
Total		0	0	0	0	0	0	7,287	3,821	6,570	8,549	7,177	9,050	4,046	5,569	**52,069**

Supporting Report

Chapter 7
Project Cost Estimates

THE PREPARATORY STUDY ON THE SIEM REAP WATER SUPPLY EXPANSION PROJECT IN THE KINGDOM OF CAMBODIA

ENGINEER'S COST ESTIMATE

AS OF DECEMBER 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CONSULTANTS CO., LTD.
KOKUSAI KOGYO CO., LTD.

Priority Project

Summary

Direct Construction Cost w/ Preliminaries/General

Items	Priority Project Cost in US$ (for F/S)		
	FC	LC	Total
<Water Supply Projects>			
110 Siem Reap WTP (= 111+112+113+114)	**12,381,642**	**21,181,605**	**33,564,000**
111 Intake Chamber (for Siem Reap WTP)	15,359	145,008	161,000
Civil/Building Works	15,359	145,008	161,000
112 Water Conveyance Pipe(ϕ 1,200 & ϕ 800)	1,354,220	12,817,967	14,173,000
From Intake Chamber to Pumping Station	0	11,625,228	11,626,000
From Pumping Station to WTP	1,354,220	1,192,739	2,547,000
113 Intake Pumping Station	2,604,633	1,094,000	3,699,000
Civil/Building Works	519,000	809,000	1,328,000
Mechanical Works	874,449	116,780	992,000
Electrical Works	1,211,184	168,220	1,380,000
Intake Total (= 111+112+113)	3,974,212	14,056,975	18,032,000
114 Siem Reap WTP	8,407,431	7,124,630	15,533,000
Civil/Building Works	2,345,310	6,159,900	8,506,000
Mechanical Works	3,225,681	430,780	3,657,000
Electrical Works	2,836,440	533,950	3,371,000
120 Water Tank	**213,000**	**605,000**	**818,000**
121 Siem Reap Elevated Water Tank	213,000	605,000	818,000
Civil/Building Works	213,000	605,000	818,000
WTP Total (=114+120)	8,620,431	7,729,630	**16,351,000**
130 Transmission/Distribution Pipe	**11,390,765**	**5,077,429**	**16,468,000**
131 Distribution Pipe	11,390,765	5,077,429	16,468,000
Distribution Pipe Part I	6,308,122	2,181,924	8,491,000
Distribution Pipe Part II	1,267,861	1,081,417	2,350,000
Distribution Pipe Part III	2,591,096	870,078	3,462,000
Distribution Pipe Part IV	1,223,686	944,010	2,168,000
000 Preliminaries and General	**1,094,544**	**125,007**	**1,220,000**
Preliminaries and General	1,094,544	125,007	1,220,000
Total (=110+120+130+000)	**25,079,951**	**26,989,041**	**52,068,992**

Direct Construction Cost for Financial Analysis

Items	Priority Project Cost in US$ (for F/S)		
	FC	LC	Total
<Water Supply Projects>			
110 Siem Reap WTP (= 111+112+113+114)	**12,674,247**	**21,278,880**	**33,953,000**
111 Intake Chamber (for Siem Reap WTP)	16,420	145,716	163,000
Civil/Building Works	16,420	145,716	163,000
112 Water Conveyance Pipe(ϕ 1,200 & ϕ 800)	1,447,810	12,880,523	14,329,000
From Intake Chamber to Pumping Station	0	11,681,963	11,682,000
From Pumping Station to WTP	1,447,810	1,198,560	2,647,000
113 Intake Pumping Station	2,640,501	1,097,948	3,739,000
Civil/Building Works	554,868	812,948	1,368,000
Mechanical Works	874,449	116,780	992,000
Electrical Works	1,211,184	168,220	1,380,000
Intake Total (= 111+112+113)	4,104,732	14,124,187	18,229,000
114 Siem Reap WTP	8,569,516	7,154,693	15,725,000
Civil/Building Works	2,507,395	6,189,963	8,698,000
Mechanical Works	3,225,681	430,780	3,657,000
Electrical Works	2,836,440	533,950	3,371,000
120 Water Tank	**227,720**	**607,953**	**836,000**
121 Siem Reap Elevated Water Tank	227,720	607,953	836,000
Civil/Building Works	227,720	607,953	836,000
WTP Total (=114+120)	8,797,236	7,762,645	16,560,000
130 Transmission/Distribution Pipe (KTC Exclusiv	**12,177,983**	**5,102,209**	**17,280,000**
131 Distribution Pipe (KTC Exclusive)	12,177,983	5,102,209	17,281,000
Distribution Pipe Part I	6,744,078	2,192,573	8,937,000
Distribution Pipe Part II	1,355,483	1,086,695	2,443,000
Distribution Pipe Part III	2,770,167	874,324	3,645,000
Distribution Pipe Part IV	1,308,255	948,617	2,257,000
Total (=110+120+130)	**25,079,951**	**26,989,041**	**52,068,992**

Breakdown of Project Cost in US$ w/ Preliminaries/General

Descriptions	Priority Project		
	FC Portion	LC Portion	Sub Total
100			
CIVIL WORKS (A)	**16,932,198**	**25,739,311**	**42,672,000**
110 Siem Reap WTP	**4,233,889**	**19,931,875**	**24,166,000**
111 Intake Chamber (for Siem Reap WTP)	15,359	145,008	161,000
112 Water Conveyance Pipe	1,354,220	12,817,967	14,173,000
From Intake Chamber to Pumping Station	0	11,625,228	11,626,000
From Pumping Station to WTP	1,354,220	1,192,739	2,547,000
113 Intake Pumping Station	519,000	809,000	1,328,000
114 Siem Reap WTP	2,345,310	6,159,900	8,506,000
120 Water Tank	**213,000**	**605,000**	**818,000**
121 Siem Reap Elevated Water Tank	213,000	605,000	818,000
130 Transmission/Distribution Pipe	**11,390,765**	**5,077,429**	**16,468,000**
131 Distribution Complex	0	0	0
132 Transmission Pipe	0	0	0
133 Distribution Pipe	11,390,765	5,077,429	16,468,000
000 Preliminaries and General	**1,094,544**	**125,007**	**1,220,000**
MECHANICAL ELECTRICAL WORKS (B)	**8,147,753**	**1,249,730**	**9,397,000**
110 Siem Reap WTP	**8,147,753**	**1,249,730**	**9,397,000**
113 Intake Pumping Station	2,085,633	285,000	2,371,000
Mechanical Works	874,449	116,780	992,000
Electrical Works	1,211,184	168,220	1,380,000
114 Siem Reap WTP	6,062,121	964,730	7,027,000
Mechanical Works	3,225,681	430,780	3,657,000
Electrical Works	2,836,440	533,950	3,371,000
Total (= A + B)	**25,079,951**	**26,989,041**	**52,068,992**

Direct Construction Cost in US$ for Financial Analysis

Phase	Priority Project		
	FC Portion	LC Portion	Sub Total
100			
CIVIL WORKS (Prelim Included with Proportional Ratio, A	**16,932,198**	**25,739,311**	**42,673,000**
110 Siem Reap WTP	**4,526,494**	**20,029,150**	**24,556,000**
111 Intake Chamber (for Siem Reap WTP)	16,420	145,716	163,000
112 Water Conveyance Pipe	1,447,810	12,880,523	14,329,000
From Intake Chamber to Pumping Station	0	11,681,963	11,682,000
From Pumping Station to WTP	1,447,810	1,198,560	2,647,000
113 Intake Pumping Station	554,868	812,948	1,368,000
114 Siem Reap WTP	2,507,395	6,189,963	8,698,000
120 Water Tank	**227,720**	**607,953**	**836,000**
121 Siem Reap Elevated Water Tank	227,720	607,953	836,000
130 Transmission/Distribution Pipe	**12,177,983**	**5,102,209**	**17,281,000**
131 Distribution Complex	0	0	0
132 Transmission Pipe	0	0	0
133 Distribution Pipe	12,177,983	5,102,209	17,281,000
MECHANICAL ELECTRICAL WORKS (B)	**8,147,753**	**1,249,730**	**9,397,000**
110 Siem Reap WTP	**8,147,753**	**1,249,730**	**9,397,000**
113 Intake Pumping Station	2,085,633	285,000	2,371,000
Mechanical Works	874,449	116,780	992,000
Electrical Works	1,211,184	168,220	1,380,000
114 Siem Reap WTP	6,062,121	964,730	7,027,000
Mechanical Works	3,225,681	430,780	3,657,000
Electrical Works	2,836,440	533,950	3,371,000
Total (= A+ B)	**25,079,951**	**26,989,041**	**52,068,992**
Direct Construction Cost	**52,068,992**		

Intake Facilities

Breakdown of Construction Cost for Feasibility Study

111 Tonle Sap Intake Chamber (Civil/Building Work) For Q=60,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Total Portion	Reference
					Unit Price	Amount	Unit Price	Amount		
Cofferdam		m^3	1,616	14.50	0.00	0.00	14.50	23,432.00	23,432.00	
Excavation		m^3	2,332	2.50	0.00	0.00	2.50	5,830.00	5,830.00	
Backfilling		m^3	2,189	5.10	0.00	0.00	5.10	11,163.90	11,163.90	Use of excavated soil
Surplus Soil Transport		m^3	143	4.50	0.00	0.00	4.50	643.50	643.50	
Pile Material	400×400, L = 10m	m^3	56	88.00	0.00	0.00	88.00	4,928.00	4,928.00	
Pile Driving Work	400×400, L = 10m	m	350	20.00	0.00	0.00	20.00	7,000.00	7,000.00	
Pile Head Treatment	400×400	pcs	56	25.00	0.00	0.00	25.00	1,400.00	1,400.00	
Gravel for Intake Chamber		m^3	18	19.00	0.00	0.00	19.00	342.00	342.00	
Mass Concrete		m^3	4	82.50	0.00	0.00	82.50	330.00	330.00	
Dewatering		Ls	1	-	-	0.00	-	27,534.70	27,534.70	Above Earth Workse of 50%
Reinforced Concrete for Inatke Pool		m^3	91	88.00	0.00	0.00	88.00	8,008.00	8,008.00	RC Chamber B:7.75m x W: 6.5m x H: 3.86m
Formwork		m^2	176	12.00	0.00	0.00	12.00	2,112.00	2,112.00	
Supporting Works for Formwork		m^3	161	11.00	0.00	0.00	11.00	1,771.00	1,771.00	
Rebar Fabrication and Assembly		t	11	880.00	792.00	8,712.00	88.00	968.00	9,680.00	R-bar/Concrete = 120kg/m3
Gabion Protection		m^3	53	22.80	0.00	0.00	22.80	1,208.40	1,208.40	
Reinforced Concrete for Inatke Tower		m^3	43	88.00	0.00	0.00	88.00	3,784.00	3,784.00	RC Rahmen Stracture B:6.5m x W: 6.5m x H: 14.3m
Formwork		m^2	421	12.00	0.00	0.00	12.00	5,052.00	5,052.00	
Rebar Fabrication and Assembly		t	5	880.00	792.00	4,086.72	88.00	454.08	4,540.80	R-bar/Concrete = 120kg/m3
Removal of Cofferdam		m^3	1,616	7.00	0.00	0.00	7.00	11,312.00	11,312.00	Including Transport
Other Works		Ls	1	-	-	2,559.74	0.00	6,933.90	9,493.64	Above Structure of 20%
Building Work	5th Floor + Roof	m^2	120	100.00	0.00	0.00	100.00	12,000.00	12,000.00	Including Roofing
Pantoon Rental	12m×36m	Ls	1	8800.00	0.00	0.00	8800.00	8,800.00	8,800.00	
Gate	Included in Pumping Station								160,365.94	
Total Cost						**15,359**		**145,008**		
Total Cost (FC+LC)						**161,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

112-1 Water Conveyance Pipe from Intake Chamber to Pumping Station (Civil/Building Work) For Q=60,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Sand Base for Construction Road	L=8,600 m	m^3	51,600	14.5	0.0	0.00	14.5	748,200.00	
Sand Base for Construction Road	L=1,000 m	m^3	12,499	14.5	0.0	0.00	14.5	181,235.50	
Gravel for Access Road	t=0.30m, L=1,000m	m^3	1,500	19.0	0.0	0.00	19.0	28,500.00	
Excavation	L=8,600m (from Pumping ST toward Intake)	m^3	672,954	2.5	0.0	0.00	2.5	1,682,385.00	708,285
Excavation	L=1,000m (from Intake toward Pumping ST)	m^3	35,331	2.5	0.0	0.00	2.5	88,327.50	
Embankment for pipe installation	L=1,000m (from Intake toward Pumping ST)	m^3	6,094	5.1	0.0	0.00	5.1	31,079.40	
Sand Base	L=9,600m (from Pumping ST toward Intake)	m^3	67,949	14.5	0.0	0.00	14.5	985,260.50	
Pipe Installation Work	RC, φ1,200mm, L=2m	m	19,200	16.2	0.0	0.00	16.2	311,040.00	2 Lines:9,600m x 2
Pipe Material	RC, φ1,200mm, L=2m	m	19,200	144.0	0.0	0.00	144.0	2,764,800.00	2 Lines:9,600m x 2, Unit Cost; per 1m
Pipe Joint Work	RC, φ1,200mm, L=2m	m	19,200	1.6	0.0	0.00	1.6	30,720.00	2m each
Backfilling	L=8,600m (from Pumping ST toward Intake)	m^3	583,308	5.1	0.0	0.00	5.1	2,974,870.80	Use of excavated soil
Backfilling	L=1,000m (from Intake toward Pumping ST)	m^3	4,612	5.1	0.0	0.00	5.1	23,521.20	Use of excavated soil
Surplus Soil Transport		m^3	120,365	4.5	0.0	0.00	4.5	541,642.50	Excavation Soil - Backfilling Soil - Cover Soil
Dewatering		Ls	1	-	-	0.00	-	1,225,440.88	Above Earth & Piping Works of 20%
Removal of Temporal Dike	L=1,000 m	m^3	1,482	2.5	0.0	0.00	2.5	3,705.00	
Removal of Gravel	t=0.30m, L=1,000m	m^3	1,500	3.0	0.0	0.00	3.0	4,500.00	
Total						**0**		**11,625,228**	1,211 US$/m
				Exclusive of Pipes		**0**		**8,860,428**	923 US$/m
Total Cost (FC+LC)					**11,626,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

112-2 Water Conveyance Pipe from Pumping Station to WTP (Civil/Building Work) For Q=30,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation	L=3,400m	m^3	18,312	2.5	0.0	0.00	2.5	45,780.00	
Pipe Installation Work	DCIP φ800mm	m	3,400	31.7	0.0	0.00	31.7	107,780.00	1 Lines: 3,400 m x 1
Pipe	DCIP φ800mm	m	3,400	398.3	398.3	1,354,220.00	0.0	0.00	1 Lines: 3,400 m x 1
Pipe Joint Work	φ800mm	m	618	18.0	0.0	0.00	18.0	11,127.28	5.5m each
Backfilling	L=3,400m	m^3	14,912	5.1	0.0	0.00	5.1	76,051.20	Use of excavated soil
Surplus Soil Transport		m^3	3,400	4.5	0.0	0.00	4.5	15,300.00	
Sand Base for Access Road	L=3,000m	m^3	64,600	14.5	0.0	0.00	14.5	936,700.00	
Total						**1,354,220**		**1,192,739**	749 US$/m
				Exclusive of Pipes		**0**		**1,192,739**	351 US$/m
Total Cost (FC+LC)					**2,546,959**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

113 Intake Pumping Station (Civil/Building Work) For Q=60,000 m3/d

Code	Items	Specification	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
113-1	Intake Pumping Station		pc	1	489,000	489,000	740,000	740,000	
113-2	Electrical Building		pc	1	30,000	30,000	69,000	69,000	
	Total Cost					**519,000**		**809,000**	
	Total Cost (roundup)					**1,328,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

113 Intake Pumping Station (Mechanical and Electrical Work) For Q=30,000 m3/d

Code	Items	Specification	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
113-3	Mechanical Work					874,449		116,780	
113-4	Electrical Work					1,211,184		168,220	
	Total Cost					**2,085,633**		**285,000**	
	Total Cost (roundup)					**2,371,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

113-1 Intake Pumping Station

For Q=60,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Total Portion	Reference
					Unit Price	Amount	Unit Price	Amount		
Pile Driving Work	400×400, L = 10m	m	2009	20.00	0.00	0.00	20.00	40180.00	40180.00	
Pile Material	400×400, L = 10m	m^3	321	88.00	0.00	0.00	88.00	28248.00	28248.00	
Pile Head Treatment	400×400	pcs	201	25.00	0.00	0.00	25.00	5025.00	5025.00	
Sheet Pile Driving Work	Type III, L = 20m	m	2400	22.00	0.00	0.00	22.00	52800.00	52800.00	
Sheet Pile	Type III, L = 20m, Remain	t	144	206.00	206.00	29664.00	0.00	0.00	29664.00	
Supporting Works		t	58	260.00	0.00	0.00	260.00	14976.00	14976.00	
Support		t	58	290.00	290.00	16704.00	0.00	0.00	16704.00	
Excavation		m^3	20412	2.50	0.00	0.00	2.50	51030.00	51030.00	
Backfilling		m^3	15494	5.10	0.00	0.00	5.10	79019.40	79019.40	
Surplus Soil Transport		m^3	4918	4.50	0.00	0.00	4.50	22131.00	22131.00	
Gravel		m^3	61	19.00	0.00	0.00	19.00	1159.00	1159.00	
Concrete		m^3	21	82.50	0.00	0.00	82.50	1732.50	1732.50	
Reinforced Concrete		m^3	3283	88.00	0.00	0.00	88.00	288904.00	288904.00	
Formwork		m^2	3415	12.00	0.00	0.00	12.00	40980.00	40980.00	
Supporting Works for Formwork		m^3	3555	11.00	0.00	0.00	11.00	39105.00	39105.00	
Rebar Fabrication and Assembly		t	558	880.00	792.00	442023.12	88.00	49113.68	491136.80	R-bar/Concrete = 170kg/m3
Building Works		m^2	251	100.00	0.00	0.00	100.00	25,100.00	25,100.00	
Total Cost						**488,391.12**		**739,503.58**		
Total Cost (FC+LC)					**1,228,000**					1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

113-2 Electrical Building

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	396	2.50	0.00	0.00	2.50	990.00	
Backfilling		m^3	36	5.10	0.00	0.00	5.10	183.60	
Surplus Soil Transport		m^3	360	4.50	0.00	0.00	4.50	1,620.00	
Gravel		m^3	36	19.00	0.00	0.00	19.00	684.00	
Concrete		m^3	12	82.50	0.00	0.00	82.50	990.00	
Reinforced Concrete		m^3	216	88.00	0.00	0.00	88.00	19,008.00	
Formwork		m^2	710	12.00	0.00	0.00	12.00	8,520.00	
Rebar Fabrication and Assembly		t	37	880.00	792.00	29,304.00	88.00	3,256.00	R-bar/Concrete = 170kg/m3
Building Work		m^2	342	100.00	0.00	0.00	100.00	34,200.00	
Total Cost						**29,304.00**		**69,451.60**	
Total Cost (FC+LC)						**99,000**			1000 US$ roundup

Water Treatment Plant

Breakdown of Construction Cost for Feasibility Study

114 Siem Reap WTP (Civil/Building Work) For Q=30,000 m3/d

Code	Items	Specification	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
114-1	Distribution Chamber		pc	1	21,000	21,000	159,000	159,000	
114-2	Sedimentation Basin		pc	1	273,000	273,000	485,000	485,000	Including Flocculation Basin
114-3	Rapid Sand Filter		pc	1	237,000	237,000	434,000	434,000	
114-4	Clear Water Reservoir		pc	1	747,000	747,000	1,017,000	1,017,000	
114-5	Backwash Recovery Tank		Ls	1	63,000	63,000	100,000	100,000	
114-6	Sludge Drying Bed		Ls	1	156,000	156,000	556,000	556,000	
114-7	Chemical Building		pc	1	99,000	99,000	179,000	179,000	
114-8	Sludge Discharge Tank		pc	1	57,000	57,000	93,000	93,000	
114-9	Electrical Building		pc	1	37,000	37,000	79,000	79,000	
114-10	Administration Building		pc	1	21,000	21,000	98,000	98,000	
114-11	Store Building		pc	1	31,000	31,000	96,000	96,000	
114-12	Guard House		pc	1	1,000	1,000	6,000	6,000	
114-13	Yard Pipe		pc	1	534,000	534,000	28,000	28,000	
114-14	Access Road		pc	1	0	0	890,000	890,000	4 km
114-15	Inplant Work		m^2	1	0	0	1,840,000	1,840,000	
114-16	Inplant Pipe		Ls	1	-	68,310	-	99,900	Above of 3%
	Total Cost					**2,345,310**		**6,159,900**	
	Total Cost (roundup)					**8,506,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114 Siem Reap WTP (Mechanical and Electrical Work) For Q=30,000 m3/d

Code	Items	Specification	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
114-17	Mechanical Works					3,225,681		430,780	
114-18	Electrical Works					2,836,440		533,950	
	Total Cost					**6,062,121**		**964,730**	
	Total Cost (roundup)					**7,027,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-1 Distribution Chamber

For Q=30,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Embankment		m^3	8,960	14.50	0.00	0.00	14.50	129,920.00	
Pile Driving Work	400×400	m	161	20.00	0.00	0.00	20.00	3,220.00	
Pile Material	400×400	m^3	26	88.00	0.00	0.00	88.00	2,288.00	
Pile Head Treatment	400×400	pcs	7	25.00	0.00	0.00	25.00	175.00	
Gravel		m^3	9	19.00	0.00	0.00	19.00	171.00	
Reinforced Concrete		m^3	151	88.00	0.00	0.00	88.00	13,288.00	
Formwork		m^2	504	12.00	0.00	0.00	12.00	6,048.00	
Supporting Works for Formwork		m^3	155	11.00	0.00	0.00	11.00	1,705.00	
Rebar Fabrication and Assembly		t	26	880.00	792.00	20,330.64	88.00	2,258.96	R-bar/Concrete = 170kg/m3
Excavation		m^3	0	2.50	0.00	0.00	2.50	0.00	
Total Cost						**20,330.64**		**159,073.96**	
Total Cost (FC+LC)						**180,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-2 Sedimentation Basin

For Q=30,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Pile Driving Work	400×400	m	2,622	20.00	0.00	0.00	20.00	52,440.00	
Pile Material	400×400	m^3	420	88.00	0.00	0.00	88.00	36,960.00	
Pile Head Treatment	400×400	pcs	138	25.00	0.00	0.00	25.00	3,450.00	
Sheet Pile Driving Work	Type III, L = 20m	m	0	22.00	0.00	0.00	22.00	0.00	
Sheet Pile	Type III, L = 20m, Remain	t	0	206.00	206.00	0.00	0.00	0.00	
Supporting Works		t	0	260.00	0.00	0.00	260.00	0.00	
Support		t	0	290.00	290.00	0.00	0.00	0.00	
Embankment		m^3	3,246	14.50	0.00	0.00	14.50	47,067.00	
Excavation		m^3	0	2.50	0.00	0.00	2.50	0.00	
Backfilling		m^3	0	5.10	0.00	0.00	5.10	0.00	
Surplus Soil Transport		m^3	0	4.50	0.00	0.00	4.50	0.00	
Gravel		m^3	275	19.00	0.00	0.00	19.00	5,225.00	
Concrete		m^3	92	82.50	0.00	0.00	82.50	7,590.00	
Reinforced Concrete		m^3	2,026	88.00	0.00	0.00	88.00	178,288.00	
Formwork		m^2	5,739	12.00	0.00	0.00	12.00	68,868.00	
Supporting Works for Formwork		m^3	2,005	11.00	0.00	0.00	11.00	22,055.00	
Rebar Fabrication and Assembly		t	344	880.00	792.00	272,780.64	88.00	30,308.96	R-bar/Concrete = 170kg/m3
Embankment		m^3	2,287	14.50	0.00	0.00	14.50	33,161.50	
Total Cost						**272,780.64**		**485,413.46**	
Total Cost (FC+LC)					**759,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-3 Rapid Sand Filter

For Q=30,000 m3/d

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Pile Driving Work	400×400	m	1,693	20.00	0.00	0.00	20.00	33,860.00	
Pile Material	400×400	m^3	271	88.00	0.00	0.00	88.00	23,848.00	
Pile Head Treatment	400×400	pcs	83	25.00	0.00	0.00	25.00	2,075.00	
Sheet Pile Driving Work	Type III, L = 20m	m	0	22.00	0.00	0.00	22.00	0.00	
Sheet Pile	Type III, L = 20m, Remain	t	0	206.00	206.00	0.00	0.00	0.00	
Supporting Works		t	0	260.00	0.00	0.00	260.00	0.00	
Support		t	0	290.00	290.00	0.00	0.00	0.00	
Excavation		m^3	0	2.50	0.00	0.00	2.50	0.00	
Backfilling		m^3	0	5.10	0.00	0.00	5.10	0.00	
Surplus Soil Transport		m^3	0	4.50	0.00	0.00	4.50	0.00	
Gravel		m^3	138	19.00	0.00	0.00	19.00	2,622.00	
Concrete		m^3	46	82.50	0.00	0.00	82.50	3,795.00	
Reinforced Concrete		m^3	1,759	88.00	0.00	0.00	88.00	154,792.00	
Formwork		m^2	5,394	12.00	0.00	0.00	12.00	64,728.00	
Supporting Works for Formwork		m^3	2,546	11.00	0.00	0.00	11.00	28,006.00	
Rebar Fabrication and Assembly		t	299	880.00	792.00	236,831.76	88.00	26,314.64	R-bar/Concrete = 170kg/m3
Filter Operation Gallery		m^2	318	100.00	0.00	0.00	100.00	31,800.00	
			4,280	14.50	0.00	0.00	14.50	62,060.00	
Total Cost						**236,831.76**		**433,900.64**	
Total Cost (FC+LC)					**671,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-4 Clear Water Reservoir and High Lift Pump Station

For V=30,000m3 (8 hours)

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Pile Driving Work	400×400	m	4,108	20.00	0.00	0.00	20.00	82,160.00	
Pile Material	400×400	m^3	657	88.00	0.00	0.00	88.00	57,816.00	
Pile Head Treatment	400×400	pcs	260	25.00	0.00	0.00	25.00	6,500.00	
Sheet Pile Driving Work	III型, L = 15m	m	2,420	22.00	0.00	0.00	22.00	53,240.00	
Sheet Pile	Type III, L = 15m, Removal	t	146	206.00	206.00	30,076.00	0.00	0.00	
Supporting Works		t	59	260.00	0.00	0.00	260.00	15,340.00	
Support		t	59	290.00	290.00	17,110.00	0.00	0.00	
Excavation		m^3	9,467	2.50	0.00	0.00	2.50	23,667.50	
Backfilling		m^3	7,460	5.10	0.00	0.00	5.10	38,046.00	
Surplus Soil Transport		m^3	2,007	4.50	0.00	0.00	4.50	9,031.50	
Gravel		m^3	317	19.00	0.00	0.00	19.00	6,023.00	
Concrete		m^3	106	82.50	0.00	0.00	82.50	8,745.00	
Reinforced Concrete		m^3	5,196	88.00	0.00	0.00	88.00	457,248.00	
Formwork		m^2	8,777	12.00	0.00	0.00	12.00	105,324.00	
Supporting Works for Formwork		m^3	6,912	11.00	0.00	0.00	11.00	76,032.00	
Rebar Fabrication and Assembly		t	883	880.00	792.00	699,589.44	88.00	77,732.16	R-bar/Concrete = 170kg/m3
Total Cost						**746,775.44**		**1,016,905.16**	
Total Cost (FC+LC)					**1,764,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-5 Backwash Recovery Tank 270.4 For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Embankment		m^3	1,532	14.50	0.00	0.00	14.50	22,214.00	
Pile Driving Work	400×400	m	267	20.00	0.00	0.00	20.00	5,340.00	
Pile Material	400×400	m^3	43	88.00	0.00	0.00	88.00	3,784.00	
Pile Head Treatment	400×400	pcs	16	25.00	0.00	0.00	25.00	400.00	
Sheet Pile Driving Work	III型, L = 15m	m	0	22.00	0.00	0.00	22.00	0.00	
Sheet Pile	III型, L = 15m, Remain	t	0	206.00	0.00	0.00	206.00	0.00	
Supporting Works		t	0	260.00	0.00	0.00	260.00	0.00	
Supporting		t	0	290.00	0.00	0.00	290.00	0.00	
Excavation		m^3	59	2.50	0.00	0.00	2.50	147.50	
Backfilling		m^3	38	5.10	0.00	0.00	5.10	193.80	
Surplus Soil Transport		m^3	21	4.50	0.00	0.00	4.50	94.50	
Gravel		m^3	30	19.00	0.00	0.00	19.00	570.00	
Concrete		m^3	10	82.50	0.00	0.00	82.50	825.00	
Reinforced Concrete		m^3	461	88.00	0.00	0.00	88.00	40,568.00	
Formwork		m^2	1,125	12.00	0.00	0.00	12.00	13,500.00	
Supporting Works for Formwork		m^3	273	11.00	0.00	0.00	11.00	3,003.00	
Rebar Fabrication and Assembly		t	78	880.00	792.00	62,069.04	88.00	6,896.56	R-bar/Concrete = 170kg/m3
Building Work		m^2	19	100.00	0.00	0.00	100.00	1,900.00	
Total Cost						**62,069.04**		**99,436.36**	
Total Cost (FC+LC)					**162,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-6 Sludge Drying Bed

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Embankment		m^3	23,646	14.50	0.00	0.00	14.50	342,867.00	
Pile Driving Work	400×400	m	1,575	20.00	0.00	0.00	20.00	31,500.00	
Pile Material	400×400	m^3	252	88.00	0.00	0.00	88.00	22,176.00	
Pile Head Treatment	400×400	pcs	70	25.00	0.00	0.00	25.00	1,750.00	
Gravel		m^3	286	19.00	0.00	0.00	19.00	5,434.00	
Concrete		m^3	96	82.50	0.00	0.00	82.50	7,920.00	
Reinforced Concrete		m^3	1,154	88.00	0.00	0.00	88.00	101,552.00	
Formwork		m^2	1,863	12.00	0.00	0.00	12.00	22,356.00	
Supporting Works for Formwork		m^3	221	11.00	0.00	0.00	11.00	2,431.00	
Rebar Fabrication and Assembly		t	196	880.00	792.00	155,374.56	88.00	17,263.84	R-bar/Concrete = 170kg/m3
Total Cost						**155,374.56**		**555,249.84**	
Total Cost (FC+LC)					**711,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-7 Chemical Building

Structure for V=66,000m3, Mechanical for V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	792	2.50	0.00	0.00	2.50	1,980.00	
Backfilling		m^3	72	5.10	0.00	0.00	5.10	367.20	
Surplus Soil Transport		m^3	720	4.50	0.00	0.00	4.50	3,240.00	
Gravel		m^3	72	19.00	0.00	0.00	19.00	1,368.00	
Concrete		m^3	24	82.50	0.00	0.00	82.50	1,980.00	
Reinforced Concrete		m^3	732	88.00	0.00	0.00	88.00	64,416.00	
Formwork		m^2	816	12.00	0.00	0.00	12.00	9,792.00	
Rebar Fabrication and Assembly		t	124	880.00	792.00	98,556.48	88.00	10,950.72	R-bar/Concrete = 170kg/m3
Building Work		m^2	845	100.00	0.00	0.00	100.00	84,500.00	
Total Cost						**98,556.48**		**178,593.92**	
Total Cost (FC+LC)						**278,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-8 Sludge Discharge Tank

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Pile Driving Work	400x400	m	231	20.00	0.00	0.00	20.00	4,620.00	
Pile Material	400×400	m^3	37	88.00	0.00	0.00	88.00	3,256.00	
Pile Head Treatment	400×400	pcs	14	25.00	0.00	0.00	25.00	350.00	
Sheet Pile Driving Work	III型, L = 15m	m	0	22.00	0.00	0.00	22.00	0.00	
Sheet Pile	III型, L = 15m, Remain	t	0	206.00	206.00	0.00	0.00	0.00	
Supporting Works		t	0	260.00	0.00	0.00	260.00	0.00	
Support		t	0	290.00	290.00	0.00	0.00	0.00	
Embankment		m^3	1,432	14.50	0.00	0.00	14.50	20,764.00	
Excavation		m^3	158	2.50	0.00	0.00	2.50	395.00	
Backfilling		m^3	107	5.10	0.00	0.00	5.10	545.70	
Surplus Soil Transport		m^3	51	4.50	0.00	0.00	4.50	229.50	
Gravel		m^3	25	19.00	0.00	0.00	19.00	475.00	
Concrete		m^3	9	82.50	0.00	0.00	82.50	742.50	
Reinforced Concrete		m^3	425	88.00	0.00	0.00	88.00	37,400.00	
Formwork		m^2	1,029	12.00	0.00	0.00	12.00	12,348.00	
Supporting Works for Formwork		m^3	284	11.00	0.00	0.00	11.00	3,124.00	
Rebar Fabrication and Assembly		t	72	880.00	792.00	57,222.00	88.00	6,358.00	R-bar/Concrete = 170kg/m3
Building Work		m^2	19	100.00	0.00	0.00	100.00	1,900.00	
Total Cost						**57,222.00**		**92,507.70**	
Total Cost (FC+LC)					**150,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-9 Electrical Building

Structure for V=66,000m3, Mechanical for V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	495	2.50	0.00	0.00	2.50	1,237.50	
Backfilling		m^3	45	5.10	0.00	0.00	5.10	229.50	
Surplus Soil Transport		m^3	450	4.50	0.00	0.00	4.50	2,025.00	
Gravel		m^3	45	19.00	0.00	0.00	19.00	855.00	
Concrete		m^3	15	82.50	0.00	0.00	82.50	1,237.50	
Reinforced Concrete		m^3	270	88.00	0.00	0.00	88.00	23,760.00	
Formwork		m^2	888	12.00	0.00	0.00	12.00	10,656.00	
Rebar Fabrication and Assembly		t	46	880.00	792.00	36,432.00	88.00	4,048.00	R-bar/Concrete = 170kg/m3
Building Work		m^2	342	100.00	0.00	0.00	100.00	34,200.00	
Total Cost						**36,432.00**		**78,248.50**	
Total Cost (FC+LC)					**115,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-10 Administration Building

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	97	2.50	0.00	0.00	2.50	242.21	
Backfilling		m^3	0	5.10	0.00	0.00	5.10	0.00	
Surplus Soil Transport		m^3	97	4.50	0.00	0.00	4.50	435.97	
Gravel		m^3	186	19.00	0.00	0.00	19.00	3,536.93	
Concrete		m^3	37	82.50	0.00	0.00	82.50	3,082.97	
Reinforced Concrete		m^3	159	88.00	0.00	0.00	88.00	14,006.56	
Formwork		m^2	2,805	12.00	0.00	0.00	12.00	33,657.27	
Rebar Fabrication and Assembly		t	27	880.00	792.00	21,430.04	88.00	2,381.12	R-bar/Concrete = 170kg/m3
Building Work		m^2	408	100.00	0.00	0.00	100.00	40,829.40	
Total Cost						**21,430.04**		**98,172.42**	
Total Cost (FC+LC)						**120,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-11 Store Building

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	713	2.50	0.00	0.00	2.50	1,782.50	
Backfilling		m^3	65	5.10	0.00	0.00	5.10	331.50	
Surplus Soil Transport		m^3	648	4.50	0.00	0.00	4.50	2,916.00	
Gravel		m^3	65	19.00	0.00	0.00	19.00	1,235.00	
Concrete		m^3	22	82.50	0.00	0.00	82.50	1,815.00	
Reinforced Concrete		m^3	230	88.00	0.00	0.00	88.00	20,240.00	
Formwork		m^2	1,652	12.00	0.00	0.00	12.00	19,824.00	
Rebar Fabrication and Assembly		t	39	880.00	792.00	30,888.00	88.00	3,432.00	R-bar/Concrete = 170kg/m3
Building Work		m^2	444	100.00	0.00	0.00	100.00	44,400.00	
Total Cost						**30,888.00**		**95,976.00**	
Total Cost (FC+LC)						**127,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-12 Guard House

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Excavation		m^3	11	2.50	0.00	0.00	2.50	27.50	
Surplus Soil Transport		m^3	11	4.50	0.00	0.00	4.50	49.50	
Gravel		m^3	13	19.00	0.00	0.00	19.00	247.00	
Concrete		m^3	3	82.50	0.00	0.00	82.50	247.50	
Reinforced Concrete		m^3	7	88.00	0.00	0.00	88.00	616.00	
Formwork		m^2	200	12.00	0.00	0.00	12.00	2,400.00	
Rebar Fabrication and Assembly		t	1	880.00	792.00	942.48	88.00	104.72	R-bar/Concrete = 170kg/m3
Building Work		m^2	25	100.00	0.00	0.00	100.00	2,500.00	
Total Cost						**942.48**		**6,192.22**	
Total Cost (FC+LC)						**8,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-13 Siem Reap Water Treatment Plant Yard Pipe

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Yard Pipe Laying	ND 1400 incl. Material & Fittings	m	100	1,885.00	1,790.75	179,075.00	94.25	9,425.00	DCIP
	ND 1200 incl. Material & Fittings	m	10	1,417.40	1,346.53	13,465.30	70.87	708.70	DCIP
	ND 1100 incl. Material & Fittings	m	10	1,221.50	1,160.43	11,604.25	61.08	610.75	DCIP
	ND 1000 incl. Material & Fittings	m	200	1,038.10	986.20	197,239.00	51.91	10,381.00	DCIP
	ND 900 incl. Material & Fittings	m	10	859.50	816.53	8,165.25	42.98	429.75	DCIP
	ND 800 incl. Material & Fittings	m	130	426.10	404.80	52,623.35	21.31	2,769.65	DCIP
	ND 700 incl. Material & Fittings	m	10	342.70	325.57	3,255.65	17.14	171.35	DCIP
	ND 600 incl. Material & Fittings	m	10	266.10	252.80	2,527.95	13.31	133.05	DCIP
	ND 500 incl. Material & Fittings	m	70	201.50	191.43	13,399.75	10.08	705.25	DCIP
	ND 400 incl. Material & Fittings	m	10	144.80	137.56	1,375.60	7.24	72.40	DCIP
	ND 300 incl. Material & Fittings	m	530	95.40	90.63	48,033.90	4.77	2,528.10	DCIP
	ND 200 incl. Material & Fittings	m	10	52.80	50.16	501.60	2.64	26.40	HDPE
	ND 150 incl. Material & Fittings	m	10	34.60	32.87	328.70	1.73	17.30	HDPE
	ND 100 incl. Material & Fittings	m	150	16.60	15.77	2,365.50	0.83	124.50	HDPE
Total Cost						**533,960.80**		**28,103.20**	
Total Cost (FC+LC)					**563,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-14 Siem Reap Water Treatment Plant Access Road from Main Road to WTP

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Sand Base	L=4,000 m	m^3	24,000	14.5	0.0	0.00	14.5	348,000.00	
Cement for Soil Improvement	50kg/m3	kg	3,600,000	0.1	0.0	0.00	0.1	450,000.00	1 bag (40 kg) of Cement = 5 US$
Soil Improvement Work	Cement Mixing with soil	m^3	24,000	3.8	0.0	0.00	3.8	91,200.00	
Total Cost						**0.00**		**889,200.00**	
Total Cost (FC+LC)					**890,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

114-15 Inplant Work

For V=60,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Grading Civil Work		m^3	105,812	14.50	0.00	0.00	14.50	1,534,274.00	Grading to +12.00 A.M.S.L.
Hard Scaping - Paving		m^2	5,126	27.00	0.00	0.00	27.00	138,402.00	Asphalt, 7 m width
Drain Outfall Structures		Ls	1	-	-	0.00	-	167,267.60	Structure of 10%
Total Cost						**0.00**		**1,839,943.60**	
Total Cost (FC+LC)						**1,840,000**			1000 US$ roundup

Elevated Water Tank

Breakdown of Construction Cost for Feasibility Study

121 Elevated Water Tank in WTP (Civil/Building Work)

Code	Items	Specification	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
121-1	Water Tower		Ls	1	156,000	156,000	494,000	494,000	
121-2	Pipe Work		Ls	1	57,000	57,000	11,000	11,000	
121-3	Tower Crane		Ls	1	0	0	100,000	100,000	
	Total					**213,000**		**605,000**	
	Total (FC+LC)				**818,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

121-1 1,000 cum Elevated Water Tank in WTP - Structure

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Total Portion	Reference
					Unit Price	Amount	Unit Price	Amount		
Pile Driving Work	400×400	m	925	20.00	0.00	0.00	20.00	18,500.00	18,500.00	
Pile Material	400×400	m^3	148	88.00	0.00	0.00	88.00	13,024.00	13,024.00	
Pile Head Treatment	400×400	pcs	50	25.00	0.00	0.00	25.00	1,250.00	1,250.00	
Sheet Pile Driving Work	Type III, L = 15m	m	0	22.00	0.00	0.00	22.00	0.00	0.00	
Sheet Pile	Type III, L = 15m, Remain	t	0	206.00	206.00	0.00	0.00	0.00	0.00	
Supporting Works		t	0	260.00	0.00	0.00	260.00	0.00	0.00	
Support		t	0	290.00	290.00	0.00	0.00	0.00	0.00	
Excavation		m^3	0	2.50	0.00	0.00	2.50	0.00	0.00	
Backfilling	Backhoe	m^3	0	5.10	0.00	0.00	5.10	0.00	0.00	
Embankment		m^3	2,088	14.50	0.00	0.00	14.50	30,277.45	30,277.45	
Surplus Soil Transport		m^3	0	4.50	0.00	0.00	4.50	0.00	0.00	
Gravel		m^3	35	19.00	0.00	0.00	19.00	665.00	665.00	
Concrete		m^3	12	82.50	0.00	0.00	82.50	990.00	990.00	
Reinforced Concrete		m^3	1,156	88.00	0.00	0.00	88.00	101,728.00	101,728.00	
Formwork		m^2	2,096	12.00	0.00	0.00	12.00	25,152.00	25,152.00	
Rebar Fabrication and Assembly		t	197	880.00	792.00	155,643.84	88.00	17,293.76	172,937.60	R-bar/Concrete = 170kg/m3
Scaffolding/Supporting		m^3	25,853	11.00	0.00	0.00	11.00	284,384.50	284,384.50	
Building Work		m^2	5	100.00	0.00	0.00	100.00	500.00	500.00	
Total Cost						**155,643.84**		**493,764.71**		
Total Cost (FC+LC)					**650,000**					1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

121-2 Elevated Water Tank in WTP - Pipe

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Pipe	Dia 500mm DCIP	m	200	188.80	188.80	37,760.00	0.00	0.00	
Pipe Fitting		Ls	1	1	1.00	18,880.00	0.00	0.00	Pipe of 50%
Pipe Installation		Ls	1	1	0.00	0.00	1.00	11,328.00	Pipe of 20%
Total Cost						**56,640.00**		**11,328.00**	
Total Cost (FC+LC)						**68,000**			1000 US$ roundup

Transmission and Distribution Facilities

Preliminaries and General

131 TTL of Distribution Pipe

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Distribution Pipe	ND 800 incl. Material & Fittings	m	4,450	321.69	305.61	1,359,964.50	16.08	71,556.00	DCIP
	ND 700 incl. Material & Fittings	m	16,250	322.74	306.60	4,982,250.00	16.14	262,275.00	DCIP
	ND 300 incl. Material & Fittings	m	20	190.26	180.75	3,615.00	9.51	190.20	DCIP
	ND 250 incl. Material & Fittings	m	13,240	45.01	42.76	566,142.40	2.25	29,790.00	DCIP
	ND 200 incl. Material & Fittings	m	10,440	41.07	39.02	407,368.80	2.05	21,402.00	HDPE
	ND 150 incl. Material & Fittings	m	41,820	21.95	20.85	871,947.00	1.10	46,002.00	HDPE
	ND 100 incl. Material & Fittings	m	1,400	13.15	12.49	17,486.00	0.66	924.00	HDPE
	ND 80 incl. Material & Fittings	m	272,150	10.63	10.10	2,748,715.00	0.53	144,239.50	HDPE
Valve & Valve Box	ND 800 Butterfly	No	0	7,677.00	7,293.15	0.00	383.85	0.00	
	ND 700 Butterfly	No	6	6,280.00	5,966.00	35,796.00	314.00	1,884.00	
	ND 500 Butterfly	No	9	3,801.00	3,610.95	32,498.55	190.05	1,710.45	
	ND 250 Butterfly	No	34	1,818.00	1,727.10	58,721.40	90.90	3,090.60	
	ND 300 Slice	No	2	764.00	725.80	1,451.60	38.20	76.40	
	ND 200 Slice	No	34	374.00	355.30	12,080.20	18.70	635.80	
	ND 150 Slice	No	75	252.00	239.40	17,955.00	12.60	945.00	
	ND 100 Slice	No	28	145.00	137.75	3,857.00	7.25	203.00	
	ND 80 Slice	No	1,043	112.00	106.40	110,975.20	5.60	5,840.80	
Flow Meter	ND 500	No	3	26,882.00	25,537.90	76,613.70	1,344.10	4,032.30	
Box for Flow Meter	RC	No	3	2,151.00	2,043.45	6,130.35	107.55	322.65	
Check Valve	ND 500	No	0	16,129.00	15,322.55	0.00	806.45	0.00	
Check Valve Chamber	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Air Valve	ND 25	No	30	364.00	345.80	10,374.00	18.20	546.00	
Air Valve Box	RC	No	30	323.00	306.85	9,205.50	16.15	484.50	
Fire Hydrant	ND 80	No	14	553.00	525.35	7,354.90	27.65	387.10	
Fire Hydrant Box		No	14	323.00	306.85	4,295.90	16.15	226.10	
Pipe Bridge	ND 700	No	1	48,387.00	45,967.65	45,967.65	2,419.35	2,419.35	
Excavation		m^3	241,620	5.20	0.00	0.00	5.20	1,256,424.00	
Backfilling		m^3	86,870	5.10	0.00	0.00	5.10	443,037.00	
Surplus Soil Transport		m^3	78,630	4.50	0.00	0.00	4.50	353,835.00	
Sand Base		m^3	92,700	14.50	0.00	0.00	14.50	1,344,150.00	
Pavement Works		m^2	77,200	14.00	0.00	0.00	14.00	1,080,800.00	
Total Cost						**11,390,766.00**		**5,077,429.00**	
Total Cost (FC+LC)					**16,468,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

131 Distribution Pipe （Q4 as Area 1)

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Distribution Pipe	ND 800 incl. Material & Fittings	m	4,450	321.69	305.61	1,359,964.50	16.08	71,556.00	DCIP
	ND 700 incl. Material & Fittings	m	11,040	322.74	306.60	3,384,864.00	16.14	178,185.60	DCIP
	ND 300 incl. Material & Fittings	m	10	190.26	180.75	1,807.50	9.51	95.10	DCIP
	ND 250 incl. Material & Fittings	m	0	45.01	42.76	0.00	2.25	0.00	DCIP
	ND 200 incl. Material & Fittings	m	0	41.07	39.02	0.00	2.05	0.00	HDPE
	ND 150 incl. Material & Fittings	m	23,390	21.95	20.85	487,681.50	1.10	25,729.00	HDPE
	ND 100 incl. Material & Fittings	m	1,150	13.15	12.49	14,363.50	0.66	759.00	HDPE
	ND 80 incl. Material & Fittings	m	91,310	10.63	10.10	922,231.00	0.53	48,394.30	HDPE
Valve & Valve Box	ND 800 Butterfly	No	0	7,677.00	7,293.15	0.00	383.85	0.00	
	ND 700 Butterfly	No	4	6,280.00	5,966.00	23,864.00	314.00	1,256.00	
	ND 500 Butterfly	No	3	3,801.00	3,610.95	10,832.85	190.05	570.15	
	ND 250 Butterfly	No	0	1,818.00	1,727.10	0.00	90.90	0.00	
	ND 300 Slice	No	1	764.00	725.80	725.80	38.20	38.20	
	ND 200 Slice	No	0	374.00	355.30	0.00	18.70	0.00	
	ND 150 Slice	No	52	252.00	239.40	12,448.80	12.60	655.20	
	ND 100 Slice	No	24	145.00	137.75	3,306.00	7.25	174.00	
	ND 80 Slice	No	469	112.00	106.40	49,901.60	5.60	2,626.40	
Flow Meter	ND 500	No	1	26,882.00	25,537.90	25,537.90	1,344.10	1,344.10	
Box for Flow Meter	RC	No	1	2,151.00	2,043.45	2,043.45	107.55	107.55	
Check Valve	ND 500	No	0	16,129.00	15,322.55	0.00	806.45	0.00	
Check Valve Chamber	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Air Valve	ND 25	No	8	364.00	345.80	2,766.40	18.20	145.60	
Air Valve Box	RC	No	8	323.00	306.85	2,454.80	16.15	129.20	
Fire Hydrant	ND 80	No	4	553.00	525.35	2,101.40	27.65	110.60	
Fire Hydrant Box		No	4	323.00	306.85	1,227.40	16.15	64.60	
Pipe Bridge	ND 700	No	0	48,387.00	45,967.65	0.00	2,419.35	0.00	
Excavation		m^3	104,340	5.20	0.00	0.00	5.20	542,568.00	
Backfilling		m^3	37,560	5.10	0.00	0.00	5.10	191,556.00	
Surplus Soil Transport		m^3	37,410	4.50	0.00	0.00	4.50	168,345.00	
Sand Base		m^3	38,350	14.50	0.00	0.00	14.50	556,075.00	
Pavement Works		m^2	27,960	14.00	0.00	0.00	14.00	391,440.00	
Total Cost						**6,308,122.00**		**2,181,924.00**	
Total Cost (FC+LC)						**8,491,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

131 Distribution Pipe （Q3 as Area 2)

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Distribution Pipe	ND 800 incl. Material & Fittings	m	0	321.69	305.61	0.00	16.08	0.00	DCIP
	ND 700 incl. Material & Fittings	m	0	322.74	306.60	0.00	16.14	0.00	DCIP
	ND 300 incl. Material & Fittings	m	0	190.26	180.75	0.00	9.51	0.00	DCIP
	ND 250 incl. Material & Fittings	m	710	45.01	42.76	30,359.60	2.25	1,597.50	DCIP
	ND 200 incl. Material & Fittings	m	0	41.07	39.02	0.00	2.05	0.00	HDPE
	ND 150 incl. Material & Fittings	m	17,440	21.95	20.85	363,624.00	1.10	19,184.00	HDPE
	ND 100 incl. Material & Fittings	m	0	13.15	12.49	0.00	0.66	0.00	HDPE
	ND 80 incl. Material & Fittings	m	79,550	10.63	10.10	803,455.00	0.53	42,161.50	HDPE
Valve & Valve Box	ND 800 Butterfly	No	0	7,677.00	7,293.15	0.00	383.85	0.00	
	ND 700 Butterfly	No	0	6,280.00	5,966.00	0.00	314.00	0.00	
	ND 500 Butterfly	No	3	3,801.00	3,610.95	10,832.85	190.05	570.15	
	ND 250 Butterfly	No	4	1,818.00	1,727.10	6,908.40	90.90	363.60	
	ND 300 Slice	No	0	764.00	725.80	0.00	38.20	0.00	
	ND 200 Slice	No	0	374.00	355.30	0.00	18.70	0.00	
	ND 150 Slice	No	18	252.00	239.40	4,309.20	12.60	226.80	
	ND 100 Slice	No	0	145.00	137.75	0.00	7.25	0.00	
	ND 80 Slice	No	129	112.00	106.40	13,725.60	5.60	722.40	
Flow Meter	ND 500	No	1	26,882.00	25,537.90	25,537.90	1,344.10	1,344.10	
Box for Flow Meter	RC	No	1	2,151.00	2,043.45	2,043.45	107.55	107.55	
Check Valve	ND 500	No	0	16,129.00	15,322.55	0.00	806.45	0.00	
Check Valve Chamber	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Air Valve	ND 25	No	7	364.00	345.80	2,420.60	18.20	127.40	
Air Valve Box	RC	No	7	323.00	306.85	2,147.95	16.15	113.05	
Fire Hydrant	ND 80	No	3	553.00	525.35	1,576.05	27.65	82.95	
Fire Hydrant Box		No	3	323.00	306.85	920.55	16.15	48.45	
Pipe Bridge	ND 700	No	0	48,387.00	45,967.65	0.00	2,419.35	0.00	
Excavation		m^3	52,620	5.20	0.00	0.00	5.20	273,624.00	
Backfilling		m^3	19,530	5.10	0.00	0.00	5.10	99,603.00	
Surplus Soil Transport		m^3	13,530	4.50	0.00	0.00	4.50	60,885.00	
Sand Base		m^3	21,430	14.50	0.00	0.00	14.50	310,735.00	
Pavement Works		m^2	19,280	14.00	0.00	0.00	14.00	269,920.00	
Total Cost						**1,267,861.00**		**1,081,417.00**	
Total Cost (FC+LC)						**2,350,000**			1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

131 Distribution Pipe （Q2 as Area 3)

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Distribution Pipe	ND 800 incl. Material & Fittings	m	0	321.69	305.61	0.00	16.08	0.00	DCIP
	ND 700 incl. Material & Fittings	m	5,210	322.74	306.60	1,597,386.00	16.14	84,089.40	DCIP
	ND 300 incl. Material & Fittings	m	10	190.26	180.75	1,807.50	9.51	95.10	DCIP
	ND 250 incl. Material & Fittings	m	12,430	45.01	42.76	531,506.80	2.25	27,967.50	DCIP
	ND 200 incl. Material & Fittings	m	0	41.07	39.02	0.00	2.05	0.00	HDPE
	ND 150 incl. Material & Fittings	m	0	21.95	20.85	0.00	1.10	0.00	HDPE
	ND 100 incl. Material & Fittings	m	250	13.15	12.49	3,122.50	0.66	165.00	HDPE
	ND 80 incl. Material & Fittings	m	29,140	10.63	10.10	294,314.00	0.53	15,444.20	HDPE
Valve & Valve Box	ND 800 Butterfly	No	0	7,677.00	7,293.15	0.00	383.85	0.00	
	ND 700 Butterfly	No	2	6,280.00	5,966.00	11,932.00	314.00	628.00	
	ND 500 Butterfly	No	3	3,801.00	3,610.95	10,832.85	190.05	570.15	
	ND 250 Butterfly	No	30	1,818.00	1,727.10	51,813.00	90.90	2,727.00	
	ND 300 Slice	No	1	764.00	725.80	725.80	38.20	38.20	
	ND 200 Slice	No	0	374.00	355.30	0.00	18.70	0.00	
	ND 150 Slice	No	0	252.00	239.40	0.00	12.60	0.00	
	ND 100 Slice	No	4	145.00	137.75	551.00	7.25	29.00	
	ND 80 Slice	No	61	112.00	106.40	6,490.40	5.60	341.60	
Flow Meter	ND 500	No	1	26,882.00	25,537.90	25,537.90	1,344.10	1,344.10	
Box for Flow Meter	RC	No	1	2,151.00	2,043.45	2,043.45	107.55	107.55	
Check Valve	ND 500	No	0	16,129.00	15,322.55	0.00	806.45	0.00	
Check Valve Chamber	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Air Valve	ND 25	No	7	364.00	345.80	2,420.60	18.20	127.40	
Air Valve Box	RC	No	7	323.00	306.85	2,147.95	16.15	113.05	
Fire Hydrant	ND 80	No	3	553.00	525.35	1,576.05	27.65	82.95	
Fire Hydrant Box		No	3	323.00	306.85	920.55	16.15	48.45	
Pipe Bridge	ND 700	No	1	48,387.00	45,967.65	45,967.65	2,419.35	2,419.35	
Excavation		m^3	39,450	5.20	0.00	0.00	5.20	205,140.00	
Backfilling		m^3	13,050	5.10	0.00	0.00	5.10	66,555.00	
Surplus Soil Transport		m^3	15,950	4.50	0.00	0.00	4.50	71,775.00	
Sand Base		m^3	15,020	14.50	0.00	0.00	14.50	217,790.00	
Pavement Works		m^2	12,320	14.00	0.00	0.00	14.00	172,480.00	
Total Cost						**2,591,096.00**		**870,078.00**	
Total Cost (FC+LC)					**3,462,000**				1000 US$ roundup

Breakdown of Construction Cost for Feasibility Study

131 Distribution Pipe （Q1 as Area 4)

For V=30,000m3

Items	Specification	Unit	Qty	Unit Cost	FC Portion (US$)		LC Portion (US$)		Reference
					Unit Price	Amount	Unit Price	Amount	
Distribution Pipe	ND 800 incl. Material & Fittings	m	0	321.69	305.61	0.00	16.08	0.00	DCIP
	ND 700 incl. Material & Fittings	m	0	322.74	306.60	0.00	16.14	0.00	DCIP
	ND 300 incl. Material & Fittings	m	0	190.26	180.75	0.00	9.51	0.00	DCIP
	ND 250 incl. Material & Fittings	m	100	45.01	42.76	4,276.00	2.25	225.00	DCIP
	ND 200 incl. Material & Fittings	m	10,440	41.07	39.02	407,368.80	2.05	21,402.00	HDPE
	ND 150 incl. Material & Fittings	m	990	21.95	20.85	20,641.50	1.10	1,089.00	HDPE
	ND 100 incl. Material & Fittings	m	0	13.15	12.49	0.00	0.66	0.00	HDPE
	ND 80 incl. Material & Fittings	m	72,150	10.63	10.10	728,715.00	0.53	38,239.50	HDPE
Valve & Valve Box	ND 800 Butterfly	No	0	7,677.00	7,293.15	0.00	383.85	0.00	
	ND 700 Butterfly	No	0	6,280.00	5,966.00	0.00	314.00	0.00	
	ND 500 Butterfly	No	0	3,801.00	3,610.95	0.00	190.05	0.00	
	ND 250 Butterfly	No	0	1,818.00	1,727.10	0.00	90.90	0.00	
	ND 300 Slice	No	0	764.00	725.80	0.00	38.20	0.00	
	ND 200 Slice	No	34	374.00	355.30	12,080.20	18.70	635.80	
	ND 150 Slice	No	5	252.00	239.40	1,197.00	12.60	63.00	
	ND 100 Slice	No	0	145.00	137.75	0.00	7.25	0.00	
	ND 80 Slice	No	384	112.00	106.40	40,857.60	5.60	2,150.40	
Flow Meter	ND 500	No	0	26,882.00	25,537.90	0.00	1,344.10	0.00	
Box for Flow Meter	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Check Valve	ND 500	No	0	16,129.00	15,322.55	0.00	806.45	0.00	
Check Valve Chamber	RC	No	0	2,151.00	2,043.45	0.00	107.55	0.00	
Air Valve	ND 25	No	8	364.00	345.80	2,766.40	18.20	145.60	
Air Valve Box	RC	No	8	323.00	306.85	2,454.80	16.15	129.20	
Fire Hydrant	ND 80	No	4	553.00	525.35	2,101.40	27.65	110.60	
Fire Hydrant Box		No	4	323.00	306.85	1,227.40	16.15	64.60	
Pipe Bridge	ND 700	No	0	48,387.00	45,967.65	0.00	2,419.35	0.00	
Excavation		m^3	45,210	5.20	0.00	0.00	5.20	235,092.00	
Backfilling		m^3	16,730	5.10	0.00	0.00	5.10	85,323.00	
Surplus Soil Transport		m^3	11,740	4.50	0.00	0.00	4.50	52,830.00	
Sand Base		m^3	17,900	14.50	0.00	0.00	14.50	259,550.00	
Pavement Works		m^2	17,640	14.00	0.00	0.00	14.00	246,960.00	
Total Cost						**1,223,686.00**		**944,010.00**	
Total Cost (FC+LC)						**2,168,000**			1000 US$ roundup

Preliminaries and General

Breakdown of Construction Cost for Feasibility Study

000-1 Preliminaries and General for Priority Project

Items	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
			Unit Price	Amount	Unit Price	Amount	
All insurance in accordance with the conditions of contract	Item	1	136,682.1	136,682.12	15,864.9	15,864.89	0.3% of Direct Total Construction Cost
Advance Payment Guarantee, Performance Security, Domestic Preference security cost	Item	1	227,803.5	227,803.52	26,441.5	26,441.48	0.5% of Direct Total Construction Cost
Contractor's Temporary site facility (Removal/Completion)	Item	1	227,803.5	227,803.52	26,441.5	26,441.48	0.5% of Direct Total Construction Cost
Provide complete facilities for engineers	Item	1	45,560.7	45,560.71	5,288.3	5,288.30	0.1% of Direct Total Construction Cost
Initial Photographs and Pre-condition survey compiled in report	Item	1	1,344.0	1,344.00	150.0	150.00	
Monthly progress photographs	Month	48	448.0	21,504.00	50.0	2,400.00	Stage-1; 2.5 years, Stage-2; 3.0 years
Main project signboard at WTP site	No	1	2,365.4	2,365.44	264.0	264.00	
Project signboard at PS site	No	1	1,182.7	1,182.72	132.0	132.00	
Project identification signboard according to pipe line	Item	4	768.8	3,075.08	85.8	343.20	
Mobile or Stationary project identification signboard under construction	Item	1	4,730.9	4,730.88	528.0	528.00	
Main Safety signboard, all other safety and directional signboard	Item	1	3,449.6	3,449.60	385.0	385.00	
Site Security	Item	1	136,682.1	136,682.12	15,254.7	15,254.70	0.3% of Direct Total Construction Cost
Shop and construction drawings by Contractor including all required engineering design	Item	1	3,942.4	3,942.40	440.0	440.00	
Testing and Commissioning of all works	Item	1	3,942.4	3,942.40	440.0	440.00	
As build drawing, records, manuals, and Operation and Maintenance Manuals	Item	1	1,971.2	1,971.20	220.0	220.00	
Allowance for trial operating and training period upon issuance of initial Taking-Over Certificate.	Day	90	98.6	8,870.40	11.0	990.00	
Payment to Relevant Road Authority for permanent reinstatement roads	m2	15,440	12.5	193,679.36	1.4	21,616.00	Based on Distance of Distribution&Transmission pipe line
Contractor's percentage on the above item for payment to relevant road authority for permanent reinstatement of roads.	%	15	-	29,052.00	0	3,242.00	

Breakdown of Construction Cost for Feasibility Study

000-2 Preliminaries and General for Priority Project

Items	Unit	Qty	FC Portion (US$)		LC Portion (US$)		Reference
			Unit Price	Amount	Unit Price	Amount	
Contractor's topographic, setting out and all other land surveys including a pre-construction surveys of the WTP and PS	Item	1	4,928.0	4,928.00	550.0	550.00	
Field Engineering for checking of all existing pipelines within the project area	Item	1	1,971.2	1,971.20	220.0	220.00	
Contractor's Geotechnical investigations by bore holing, analysis, recommendations, report including engagement of the Geotechnical firm and submission to the Engineer	Nr	11	1,971.2	21,683.20	220.0	2,420.00	1 borehole (20m)/1 building including
Engineer's instruction for additional soil investigation	m	110	98.6	10,841.60	11.0	1,210.00	10 m for each boreholes
Environmental Management and Protection of the Environment in accordance with all environmental laws, regulations and the specific requirements of the Contract	Month	1	1,478.4	1,478.40	165.0	165.00	
				1,094,544		**125,007**	
Total Cost (FC+LC)			**1,220,000**				1000 US$ roundup

Unit Price for Civil Works in US$

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
<Civil/Architecture for Building>											
1	Excavation	by backhoe of 0.5m3 (refer to EX120)	m^3	2.50	exclusive of transportation cost for Machinary to the site	4.50	labor and equipment			1.00	
2	Surplus Soil Transport		m^3	4.50	handling distance ; approx.5km	6.80	labor and equipment			3.50	
3	Backfilling	by Backhoe with tamping rammer	m^3	5.10	exclusive of materials	8.00	reused soil			4.00	
4	Backfilling	by Bulldozer	m^3	2.50	(not so major method)	14.80	imported soil			2.00	
5	Pile Driving Work	Concrete square pile; 400x400x20m(10m+10m)	m	20.00	exclusive of pile	73.90	labor and materiel			50.00	
6	Pile Driving Work	Concrete square pile; 300x300x20m(10m+10m)	m	16.00	exclusive of pile	62.50	labor and materiel			30.00	
7	Pile Head Treatment	400 x 400	pc	25.00	Chipping pile head and chipping out deformed bar for anchoring	13.60	labor and equipment			15.00	
8	Pile Head Treatment	300 x 300	pc	16.00	Chipping pile head and chipping out deformed bar for anchoring	11.40	labor and equipment			9.00	
9	Gravel bedding	Less than Diaz 40mm for ex.(Crusher run C-	m^3	4.00	exclusive of materials	37.50	labor and materiel			35.00	
10	Gravel	Less than Diaz 40mm for ex.(Crusher run C-40)	m^3	15.00	material cost						
11	Reinforced Concrete	by concrete Pump	m^3	16.00	exclusive of materials	119.30	labor and materiel			80.00	
12	Plain Concrete (L.C.)	Manpower placing	m^3	18.00	exclusive of materials, for leveling concrete	85.20	labor and materiel			75.00	
13	Formwork	using of form tie, separator, plywood t=12mm etc.	m^2	24.00	inclusive of materials exclusive of supports	34.10	labor and materiel			15.00	
14	Support for Formworks		m^3	10.30	2010 March 03 Reviced					10.00	
15	Rebar Fabrication and Assembly	manpower for rebar work and transportation in the site	t	170.00	exclusive of materials	1,534.10	labor and materiel			800.00	labor and materiel
16	Sheet Pile Driving Work	III-type	m	22.00	driving and removal	39.80	labor and equipment			12.00	
17	Sheet Pile	III-type	t	1,030.00	CIF Phnom Penh site /2008	1,875.00	labor and materiel			900.00	
18	Support Installation Works		t	130.00	manpower and welding materials	1,875.00	labor and materiel			60.00	
19	Support Removal Works		t	130.00	manpower and welding materials	170.50	labor and equipment			35.00	
20	H Section Steel		t	1,450.00	CIF Phnom Penh site /2008	1,875.00	labor and materiel			800.00	
<Civil for Pipe Installation>											
1	Pavement Cutting Work	Less than 20cm of thickness	m	6.10	object: Asphalt pavement inclusive of blade hire	11.40	labor and equipment			0.30	
2	Pavement Break Work	Less than 10cm	m^3	10.00		34.10	labor and equipment			1.50	
3	Excavation for Pipe laying Works	by backhoe of 0.5m3 (refer to EX120)	m^3	5.20		5.70	labor			4.00	
4	Sand Backfilling	砂 Sand for backfilling	m^3	14.50	materials, transport and works	20.50	labor and materil			11.00	
5	Backfilling work (small volume)	by good soil	m^3	12.00	materials and works	8.00	re-use existing soil			7.00	
6	Asphalt Piece Disposal	L= 5 km	m^3	8.00	transportation and disposal	11.40	labor			3.50	
7	Base Course	Fine Aggregate t = 150mm	m^2	7.50	materials and works	9.10	labor and materil			7.00	labor and materil
8	Sub base Course	Crusher-run t = 250mm	m^2	9.50	materials and works						
9	Laterite Soil for Road Bedding		m^3	12.00	material cost only						
10	Pavement Work	t = 70mm	m^2	19.50	inclusive of Prime Coat	25.00	labor and materil			14.00	
11	~~Timber Retaining Wall~~	H=1.5m W=250	pcs ~~m~~	8.00	driving and removal	79.50	labor and materil			18.00	
12	~~Timber Retaining Wall~~	H=2.0m W=250	pcs ~~m~~	9.00	driving and removal	90.90	labor and materil			20.00	
13	~~Timber Retaining Wall~~	H=2.5m W=250	pcs ~~m~~	10.00	driving and removal	102.30	labor and materil			22.00	
<Pipe Material>											
1	HDPE Pipe	Dia 63(13.5)	m	6.00	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	4.10	PN 16 FOB from Taiwan			3.50	
2	HDPE Pipe	Dia 90 (13.5)	m	11.50	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	8.30	PN16 FOB from Taiwan			7.00	

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
3	HDPE Pipe	Dia 110 (13.5)	m	11.50	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	12.30	PN16 FOB from Taiwan			11.00	
4	HDPE Pipe	Dia 150 (13.5)	m	N/A		N/A				20.00	
5	HDPE Pipe	Dia 160 (13.5)	m	36.00	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	26.10	PN 16 FOB from Taiwan			22.00	
6	HDPE Pipe	Dia 200 (13.5)	m	56.20	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	40.10	PN 16 FOB from Taiwan			35.00	
7	HDPE Pipe	Dia 250 (8.5)	m	78.20	PN 12.5 Price in Phnom Penh 2010 March 05 Reviced	51.20	PN 16 FOB from Taiwan			45.00	
8	PVC Pipe	Dia 63(13.5)	m	3.40	material cost only (Made in Thailand)						
9	PVC Pipe	Dia 90 (13.5)	m	7.00	material cost only (Made in Thailand)						
10	PVC Pipe	Dia 110 (13.5)	m	10.40	material cost only (Made in Thailand)						
11	PVC Pipe	Dia 150 (13.5)	m	N/A							
12	PVC Pipe	Dia 160 (13.5)	m	22.00	material cost only (Made in Thailand)						
13	PVC Pipe	Dia 200 (13.5)	m	32.00	material cost only (Made in Thailand)						
14	PVC Pipe	Dia 250 (8.5)	m	40.00	material cost only (Made in Thailand)						
15	Steel Pipe	Dia50	m	147.75	SGP	8.50	Ex-Works in Thailand				
16	Steel Pipe	Dia80	m	225.49	〃	14.00	Ex-Works in Thailand				
17	Steel Pipe	Dia100	m	295.47	〃	19.40	Ex-Works in Thailand				
18	Steel Pipe	Dia125	m	358.30	〃	23.90	Ex-Works in Thailand				
19	Steel Pipe	Dia150	m	447.47	〃	31.40	Ex-Works in Thailand				
20	Steel Pipe	Dia 200	m	595.78	〃	47.90	Ex-Works in Thailand				
21	Steel Pipe	Dia 250	m	798.91	〃	69.50	Ex-Works in Thailand	34.60	FOB		
22	Steel Pipe	Dia 300	m	969.97	〃	84.40	Ex-Works in Thailand	41.39	FOB		
23	Steel Pipe	Dia 350	m	1,158.85	〃	107.80	Ex-Works in Thailand	54.00	FOB		
24	Steel Pipe	Dia 400	m	1,327.27	〃	123.50	Ex-Works in Thailand	61.28	FOB		
25	Steel Pipe	Dia 450	m	1,496.52	〃	139.30	Ex-Works in Thailand	61.36	FOB		
26	Steel Pipe	Dia 500	m	1,665.74	〃	155.00	Ex-Works in Thailand	76.50	FOB		
27	Steel Pipe	Dia 600	m	2,655.96	STPY400 7.9t	186.50	Ex-Works in Thailand	101.18	FOB		
28	Steel Pipe	Dia 700	m	3,029.59	〃	239.80	Ex-Works in Thailand	116.34	FOB		
29	Steel Pipe	Dia 800	m	3,575.18	〃	274.40	Ex-Works in Thailand	158.23	FOB	395.14	
30	Steel Pipe	Dia 900	m	4,028.13	〃	337.20	Ex-Works in Thailand	177.82	FOB		
31	Steel Pipe	Dia 1,000	m	4,243.93	〃	406.40	Ex-Works in Thailand	197.40	FOB		
32	Steel Pipe	Dia 1,100	m	4,847.58	STPY400 9.5t	477.40	Ex-Works in Thailand	181.13	FOB		
33	Steel Pipe	Dia 1,200	m	5,301.61	〃	530.40	Ex-Works in Thailand	236.58	FOB		
34	Steel Pipe	Dia 1,250	m	6,019.28	SS400	N/A	Ex-Works in Thailand				
35	Steel Pipe	Dia 1,300	m	6,291.37	〃	637.10	Ex-Works in Thailand				
36	Steel Pipe	Dia 1,400	m	6,695.98	〃	N/A	Ex-Works in Thailand	275.76	FOB		
37	Steel Pipe	Dia 1,500	m	7,084.06	〃	730.70	Ex-Works in Thailand	295.35	FOB		
38	Steel Pipe	Dia 1,600	m	7,347.96	〃	897.80	Ex-Works in Thailand	366.95	FOB		

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
39	Steel Pipe	Dia 1,700	m	8,471.13	〃	N/A	Ex-Works in Thailand				
40	Steel Pipe	Dia 1,800	m	9,015.45	〃	1,011.10	Ex-Works in Thailand				
41	Steel Pipe	Dia 1,900	m	9,716.36	〃	N/A	Ex-Works in Thailand				
42	Steel Pipe	Dia 2,000	m	10,055.31	〃	1,183.40	Ex-Works in Thailand				
43	Ductile Cast Iron Pipe	Dia 250	m	66.56 ~~101.4~~	CIF Sianoukville Port 2010,Feb,15 Revised	61.30	FOB from China	20.42	FOB from China	75.00	
44	Ductile Cast Iron Pipe	Dia 300	m	84.39 ~~127.4~~	CIF Sianoukville Port 2010,Feb,15 Revised	77.90	FOB from China	33.18	FOB from China	100.00	
45	Ductile Cast Iron Pipe	Dia 350	m	107.56 ~~150~~	CIF Sianoukville Port 2010,Feb,15 Revised	97.20	FOB from China			115.00	
46	Ductile Cast Iron Pipe	Dia 400	m	128.65 ~~183.3~~	CIF Sianoukville Port 2010,Feb,15 Revised	116.50	FOB from China	49.51	FOB from China	140.00	
47	Ductile Cast Iron Pipe	Dia 450	m	153.46 ~~219.7~~	CIF Sianoukville Port 2010,Feb,15 Revised	139.10	FOB from China	68.54	FOB from China	170.00	
48	Ductile Cast Iron Pipe	Dia 500	m	178.75 ~~259.5~~	CIF Sianoukville Port 2010,Feb,15 Revised	161.90	FOB from China	82.24	FOB from China	200.00	
49	Ductile Cast Iron Pipe	Dia 600	m	235.82 ~~347.9~~	CIF Sianoukville Port 2010,Feb,15 Revised	214.20	FOB from China	106.55	FOB from China	260.00	
50	Ductile Cast Iron Pipe	Dia 700	m	303.64 ~~450.6~~	CIF Sianoukville Port 2010,Feb,15 Revised	274.80	FOB from China	137.88	FOB from China	320.00	
51	Ductile Cast Iron Pipe	Dia 800	m	377.13 ~~567.6~~	CIF Sianoukville Port 2010,Feb,15 Revised	343.10	FOB from China	160.03	FOB from China	400.00	
52	Ductile Cast Iron Pipe	Dia 900	m	781.49 ~~697.5~~	CIF Sianoukville Port 2010,Feb,15 Revised	432.70	FOB from China	201.81	FOB from China	490.00	
53	Ductile Cast Iron Pipe	Dia 1,000	m	943.97 ~~840.5~~	CIF Sianoukville Port 2010,Feb,15 Revised	516.00	FOB from China	246.24	FOB from China	600.00	
54	Ductile Cast Iron Pipe	Dia 1,100	m	1,110.37 ~~996.6~~	CIF Sianoukville Port 2010,Feb,15 Revised	624.30	FOB from China			700.00	
55	Ductile Cast Iron Pipe	Dia 1,200	m	1,288.27 ~~1161.4~~	CIF Sianoukville Port 2010,Feb,15 Revised	727.20	FOB from China	350.75	FOB from China	800.00	
56	Ductile Cast Iron Pipe	Dia 1,250	m		nothing 2010,Feb,15 Revised	N/A	FOB from China				
57	Ductile Cast Iron Pipe	Dia 1,350	m	~~1,447.40~~	nothing 2010,Feb,15 Revised	N/A	FOB from China				
58	Ductile Cast Iron Pipe	Dia 1,400	m	1,710.45	CIF Sianoukville Port 2010,Feb,15 Revised	1,011.12	FOB from China				
59	Ductile Cast Iron Pipe	Dia 1,500	m	1,938.87 ~~1763.6~~	CIF Sianoukville Port 2010,Feb,15 Revised	N/A	FOB from China				
60	Ductile Cast Iron Pipe	Dia 1,600	m	2,186.06 ~~2017.6~~	CIF Sianoukville Port 2010,Feb,15 Revised	1,374.20	FOB from China				
61	Concrete Pipe	Dia 1,000	m	91.50	Price in Phnom Phen			72.00	Price in Phnom Phen		
62	Concrete Pipe	Dia 1,100	m								
63	Concrete Pipe	Dia 1,200	m	136.50	Price in Phnom Phen						
64	Concrete Pipe	Dia 1,300	m								
65	Concrete Pipe	Dia 1,400	m								
66	Concrete Pipe	Dia 1,500	m	210.00	Price in Phnom Phen						
67	Concrete Pipe	Dia 1,600	m								
68	Concrete Pipe	Dia 1,700	m								
69	Concrete Pipe	Dia 1,800	m	395.00	Price in Phnom Phen						
<Pipe Laying Works>											
1	HDPE Pipe Laying Work (PVC Pipe)	Dia 60	m	1.00	exclusive of pipe	13.60	labor and equipment			0.40	
2	HDPE Pipe Laying Work (PVC Pipe)	Dia 100	m	1.20	exclusive of pipe	14.20	labor and equipment			0.50	
3	HDPE Pipe Laying Work (PVC Pipe)	Dia 110	m	1.20	exclusive of pipe	14.80	labor and equipment			0.50	
4	HDPE Pipe Laying Work (PVC Pipe)	Dia 150	m	1.70	exclusive of pipe	15.30	labor and equipment			0.60	
5	HDPE Pipe Laying Work (PVC Pipe)	Dia 160	m	1.80	exclusive of pipe	15.90	labor and equipment			0.70	

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
6	HDPE Pipe Laying Work (PVC Pipe)	Dia 200	m	2.30	exclusive of pipe	16.50	labor and equipment			1.00	
7	HDPE Pipe Laying Work (PVC Pipe)	Dia 225	m	3.00	exclusive of pipe	17.00	labor and equipment			1.30	
8	Steel Pipe Laying Work	Dia 63	m			17.00	labor and equipment				
9	Steel Pipe Laying Work	Dia 90	m			18.20	labor and equipment				
10	Steel Pipe Laying Work	Dia 110	m			19.30	labor and equipment				
11	Steel Pipe Laying Work	Dia 150	m			20.50	labor and equipment				
12	Steel Pipe Laying Work	Dia 160	m			21.60	labor and equipment				
13	Steel Pipe Laying Work	Dia 200	m			26.10	labor and equipment				
14	Steel Pipe Laying Work	Dia 225	m			26.70	labor and equipment				
15	Steel Pipe Laying Work	Dia 250	m			27.30	labor and equipment				
16	Steel Pipe Laying Work	Dia 300	m			27.80	labor and equipment				
17	Steel Pipe Laying Work	Dia 350	m			28.40	labor and equipment				
18	Steel Pipe Laying Work	Dia 400	m			29.00	labor and equipment				
19	Steel Pipe Laying Work	Dia 450	m			29.50	labor and equipment				
20	Steel Pipe Laying Work	Dia 500	m			30.10	labor and equipment				
21	Steel Pipe Laying Work	Dia 600	m			31.30	labor and equipment				
22	Steel Pipe Laying Work	Dia 700	m			32.40	labor and equipment				
23	Steel Pipe Laying Work	Dia 800	m			33.50	labor and equipment				
24	Steel Pipe Laying Work	Dia 900	m			34.70	labor and equipment				
25	Steel Pipe Laying Work	Dia 1,000	m			35.80	labor and equipment				
26	Steel Pipe Laying Work	Dia 1,100	m			36.90	labor and equipment				
27	Steel Pipe Laying Work	Dia 1,200	m			38.10	labor and equipment				
28	Steel Pipe Laying Work	Dia 1,250	m			38.60	labor and equipment				
29	Steel Pipe Laying Work	Dia 1,350	m			39.20	labor and equipment				
30	Steel Pipe Laying Work	Dia 1,400	m			39.80	labor and equipment				
31	Steel Pipe Laying Work	Dia 1,500	m			40.90	labor and equipment				
32	Steel Pipe Laying Work	Dia 1,600	m			42.00	labor and equipment				
33	Steel Pipe Laying Work	Dia 1,700	m			42.60	labor and equipment				
34	Steel Pipe Laying Work	Dia 1,800	m			43.20	labor and equipment				
35	Steel Pipe Laying Work	Dia 1,900	m			43.80	labor and equipment				
36	Steel Pipe Laying Work	Dia 2,000	m			44.30	labor and equipment				
37	Cast Iron Pipe Laying Work	Dia 250	m	5.70	Only manpower of pipe laying work exclusive of excavation and backfilling	19.30	labor and equipment			4.30	
38	Cast Iron Pipe Laying Work	Dia 300	m	7.10	Only manpower of pipe laying work exclusive of excavation and backfilling	20.50	labor and equipment			4.50	
39	Cast Iron Pipe Laying Work	Dia 350	m	8.40	Only manpower of pipe laying work exclusive of excavation and backfilling	21.60	labor and equipment			5.00	
40	Cast Iron Pipe Laying Work	Dia 400	m	10.20	Only manpower of pipe laying work exclusive of excavation and backfilling	22.70	labor and equipment			6.00	
41	Cast Iron Pipe Laying Work	Dia 450	m	12.20	Only manpower of pipe laying work exclusive of excavation and backfilling	23.90	labor and equipment	28.00		7.00	

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
42	Cast Iron Pipe Laying Work	Dia 500	m	14.50	Only manpower of pipe laying work exclusive of excavation and backfilling	25.00	labor and equipment	30.00		8.00	
43	Cast Iron Pipe Laying Work	Dia 600	m	19.40	Only manpower of pipe laying work exclusive of excavation and backfilling	26.10	labor and equipment	32.00		9.00	
44	Cast Iron Pipe Laying Work	Dia 700	m	25.10	Only manpower of pipe laying work exclusive of excavation and backfilling	27.30	labor and equipment	40.00		10.00	
45	Cast Iron Pipe Laying Work	Dia 800	m	31.70	Only manpower of pipe laying work exclusive of excavation and backfilling	28.40	labor and equipment			11.00	
46	Cast Iron Pipe Laying Work	Dia 900	m	38.90	Only manpower of pipe laying work exclusive of excavation and backfilling	29.50	labor and equipment			12.00	
47	Cast Iron Pipe Laying Work	Dia 1,000	m	46.90	Only manpower of pipe laying work exclusive of excavation and backfilling	30.70	labor and equipment			13.00	
48	Cast Iron Pipe Laying Work	Dia 1,100	m	55.60	Only manpower of pipe laying work exclusive of excavation and backfilling	31.80	labor and equipment			15.00	
49	Cast Iron Pipe Laying Work	Dia 1,200	m	64.80	Only manpower of pipe laying work exclusive of excavation and backfilling	33.00	labor and equipment			17.00	
50	Cast Iron Pipe Laying Work	Dia 1,250	m		Only manpower of pipe laying work exclusive of excavation and backfilling	34.10	labor and equipment				
51	Cast Iron Pipe Laying Work	Dia 1,350	m	80.70	Only manpower of pipe laying work exclusive of excavation and backfilling	35.20	labor and equipment				
52	Cast Iron Pipe Laying Work	Dia 1,400	m		Only manpower of pipe laying work exclusive of excavation and backfilling	36.40	labor and equipment				
53	Cast Iron Pipe Laying Work	Dia 1,500	m	98.40	Only manpower of pipe laying work exclusive of excavation and backfilling	37.50	labor and equipment				
54	Cast Iron Pipe Laying Work	Dia 1,600	m	112.50	Only manpower of pipe laying work exclusive of excavation and backfilling	38.60	labor and equipment				
55	Concrete Pipe Installation	Dia 1,000	m					33.00	labor and equipment		
56	Concrete Pipe Installation	Dia 1,100	m					35.00	labor and equipment		
57	Concrete Pipe Installation	Dia 1,200	m	300.00	Inclusive Sheet pile supporting works, excavation, backfilling, pavement recovery and pipe joint works			38.00	labor and equipment		
58	Concrete Pipe Installation	Dia 1,300	m								
59	Concrete Pipe Installation	Dia 1,400	m								
60	Concrete Pipe Installation	Dia 1,500	m	380.00	Inclusive Sheet pile supporting works, excavation, backfilling, pavement recovery and pipe joint works						
61	Concrete Pipe Installation	Dia 1,600	m								
62	Concrete Pipe Installation	Dia 1,700	m								
63	Concrete Pipe Installation	Dia 1,800	m	900.00	Inclusive Sheet pile supporting works, excavation, backfilling, pavement recovery and pipe joint works						

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
<Pipe Connection Works>											
1	Steel Pipe Joint Work	Dia 63	pc			17.00	labor and equipment				
2	Steel Pipe Joint Work	Dia 90	pc			22.70	labor and equipment				
3	Steel Pipe Joint Work	Dia 110	pc			28.40	labor and equipment				
4	Steel Pipe Joint Work	Dia 150	pc			34.10	labor and equipment				
5	Steel Pipe Joint Work	Dia 160	pc			39.80	labor and equipment				
6	Steel Pipe Joint Work	Dia 200	pc			45.50	labor and equipment				
7	Steel Pipe Joint Work	Dia 225	pc			51.10	labor and equipment				
8	Steel Pipe Joint Work	Dia 250	pc			56.80	labor and equipment				
9	Steel Pipe Joint Work	Dia 300	pc			62.50	labor and equipment				
10	Steel Pipe Joint Work	Dia 350	pc			68.20	labor and equipment				
11	Steel Pipe Joint Work	Dia 400	pc			73.90	labor and equipment				
12	Steel Pipe Joint Work	Dia 450	pc			79.50	labor and equipment				
13	Steel Pipe Joint Work	Dia 500	pc			85.20	labor and equipment				
14	Steel Pipe Joint Work	Dia 600	pc			90.90	labor and equipment				
15	Steel Pipe Joint Work	Dia 700	pc			96.60	labor and equipment				
16	Steel Pipe Joint Work	Dia 800	pc			102.30	labor and equipment				
17	Steel Pipe Joint Work	Dia 900	pc			108.00	labor and equipment				
18	Steel Pipe Joint Work	Dia 1,000	pc			113.60	labor and equipment				
19	Steel Pipe Joint Work	Dia 1,100	pc			119.30	labor and equipment				
20	Steel Pipe Joint Work	Dia 1,200	pc			125.00	labor and equipment				
21	Steel Pipe Joint Work	Dia 1,250	pc			130.70	labor and equipment				
22	Steel Pipe Joint Work	Dia 1,350	pc			136.40	labor and equipment				
23	Steel Pipe Joint Work	Dia 1,400	pc			142.00	labor and equipment				
24	Steel Pipe Joint Work	Dia 1,500	pc			147.70	labor and equipment				
25	Steel Pipe Joint Work	Dia 1,600	pc			153.40	labor and equipment				
26	Steel Pipe Joint Work	Dia 1,700	pc			159.10	labor and equipment				
27	Steel Pipe Joint Work	Dia 1,800	pc			164.80	labor and equipment				
28	Steel Pipe Joint Work	Dia 1,900	pc			170.50	labor and equipment				
29	Steel Pipe Joint Work	Dia 2,000	pc			176.10	labor and equipment				
30	Mechanical Joint Work	Normal gland / Retainer gland Dia 250	pc	4.65 / 6.04	only manpower	68.20	labor and equipment				
31	Mechanical Joint Work	Normal gland / Retainer gland Dia 300	pc	5.23 / 6.81	only manpower	73.90	labor and equipment				
32	Mechanical Joint Work	Normal gland / Retainer gland Dia 350	pc	5.23 / 6.81	only manpower	79.50	labor and equipment				
33	Mechanical Joint Work	Normal gland / Retainer gland Dia 400	pc	5.81 / 7.55	only manpower	85.20	labor and equipment				
34	Mechanical Joint Work	Normal gland / Retainer gland Dia 450	pc	6.39 / 8.31	only manpower	90.90	labor and equipment				
35	Mechanical Joint Work	Normal gland / Retainer gland Dia 500	pc	6.98 / 9.06	only manpower	96.60	labor and equipment				
36	Mechanical Joint Work	Normal gland / Retainer gland Dia 600	pc	8.13 / 10.58	only manpower	102.30	labor and equipment				

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
37	Mechanical Joint Work	Normal gland / Retainer gland Dia 700	pc	9.29 / 12.08	only manpower	108.00	labor and equipment				
38	Mechanical Joint Work	Dia 800	pc	18.00		113.60	labor and equipment				
39	Mechanical Joint Work	Dia 900	pc	22.00		119.30	labor and equipment				
40	Mechanical Joint Work	Dia 1,000	pc	25.00	only manpower	125.00	labor and equipment				
41	Mechanical Joint Work	Dia 1,100	pc	28.00	only manpower	130.70	labor and equipment				
42	Mechanical Joint Work	Dia 1,200	pc	32.00	only manpower	136.40	labor and equipment				
43	Mechanical Joint Work	Dia 1,250	pc			142.00	labor and equipment				
44	Mechanical Joint Work	Dia 1,350	pc	40.00	only manpower	147.70	labor and equipment				
45	Mechanical Joint Work	Dia 1,400	pc			153.40	labor and equipment				
46	Mechanical Joint Work	Dia 1,500	pc	50.00	only manpower	159.10	labor and equipment				
47	Mechanical Joint Work	Dia 1,600	pc	55.00	only manpower	164.80	labor and equipment				
48	Flange Joint Work	Dia 250	pc	8.36	only manpower	62.50	labor and equipment				
49	Flange Joint Work	Dia 300	pc	9.48	only manpower	68.20	labor and equipment				
50	Flange Joint Work	Dia 350	pc	9.48	only manpower	73.90	labor and equipment				
51	Flange Joint Work	Dia 400	pc	10.03	only manpower	79.50	labor and equipment				
52	Flange Joint Work	Dia 450	pc	11.71	only manpower	85.20	labor and equipment				
53	Flange Joint Work	Dia 500	pc	12.26	only manpower	90.90	labor and equipment				
54	Flange Joint Work	Dia 600	pc	14.40	only manpower	96.60	labor and equipment				
55	Flange Joint Work	Dia 700	pc	18.00	only manpower	102.30	labor and equipment				
56	Flange Joint Work	Dia 800	pc	21.50	only manpower	108.00	labor and equipment				
57	Flange Joint Work	Dia 900	pc	26.00	only manpower	113.60	labor and equipment				
58	Flange Joint Work	Dia 1,000	pc	30.00	only manpower	119.30	labor and equipment				
59	Flange Joint Work	Dia 1,100	pc	33.00	only manpower	125.00	labor and equipment				
60	Flange Joint Work	Dia 1,200	pc	38.00	only manpower	130.70	labor and equipment				
61	Flange Joint Work	Dia 1,250	pc			136.40	labor and equipment				
62	Flange Joint Work	Dia 1,350	pc	48.00	only manpower	142.00	labor and equipment				
63	Flange Joint Work	Dia 1,400	pc			147.70	labor and equipment				
64	Flange Joint Work	Dia 1,500	pc	60.00	only manpower	153.40	labor and equipment				
65	Flange Joint Work	Dia 1,600	pc	65.00	only manpower	159.10	labor and equipment				
66	Valve Instration Works	Dia 60	pc	15.00	only manpower	90.90	labor and equipment				
67	Valve Instration Works	Dia 100	pc	15.00	only manpower	96.60	labor and equipment				
68	Valve Instration Works	Dia 110	pc			102.30	labor and equipment				
69	Valve Instration Works	Dia 150	pc	18.50	only manpower	108.00	labor and equipment				
70	Valve Instration Works	Dia 160	pc			113.60	labor and equipment				
71	Valve Instration Works	Dia 200	pc	21.80	only manpower	119.30	labor and equipment				
72	Valve Instration Works	Dia 225	pc			125.00	labor and equipment				

Unit Price

No	Items	Specification	unit	Company A (Aug 2009)		Company B (Sep 2009)		Company C (Sep 2009)		Phnom Penh Project (Mr.Yagi 2005)	
				Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference	Direct Cost	Remarks / Reference
73	Valve Instration Works	Dia 250	pc	27.74	only manpower	130.70	labor and equipment				
74	Valve Instration Works	Dia 300	pc	36.76	only manpower	181.80	labor and equipment				
75	Valve Instration Works	Dia 350	pc	51.08	only manpower	193.20	labor and equipment				
76	Valve Instration Works	Sluice valve / Butterfly valveDia 400	pc	105.48 / 103.19	only manpower	204.50	labor and equipment				
77	Valve Instration Works	Sluice valve / Butterfly valve Dia 450	pc	133.49 / 123.00	only manpower	215.90	labor and equipment				
78	Valve Instration Works	Sluice valve / Butterfly valve Dia 500	pc	156.18 / 141.79	only manpower	227.30	labor and equipment				
79	Valve Instration Works	Sluice valve / Butterfly valve Dia 600	pc	196.80 / 176.59	only manpower	238.60	labor and equipment				
80	Valve Instration Works	Sluice valve / Butterfly valveDia 700	pc	225.34 / 200.68	only manpower	250.00	labor and equipment				
81	Valve Instration Works	Dia 800	pc	250.00	only manpower	261.40	labor and equipment				
82	Valve Instration Works	Dia 900	pc	319.00	only manpower	272.70	labor and equipment				
83	Valve Instration Works	Dia 1,000	pc	380.00	only manpower	284.10	labor and equipment				
84	Valve Instration Works	Dia 1,100	pc			295.50	labor and equipment				
85	Valve Instration Works	Dia 1,200	pc	530.00	only manpower	306.80	labor and equipment				
86	Valve Instration Works	Dia 1,250	pc			318.20	labor and equipment				
87	Valve Instration Works	Dia 1,350	pc			329.50	labor and equipment				
88	Valve Instration Works	Dia 1,400	pc	605.00	only manpower	340.90	labor and equipment				
89	Valve Instration Works	Dia 1,500	pc			352.30	labor and equipment				
90	Valve Instration Works	Dia 1,600	pc			363.60	labor and equipment				

SR 7.2 Breakdown of Operation and Maintenance Cost

(1) Calculation of Power Consumption for Intake Facilities

Intake Pump station; Priority project 33,000m3/day

Not include standby and manual Mechanical Equipment below.

Facility/Equipment	Specification	Power (kW/unit)	Q'ty	Output	Load factor	Total Load	Remarks
			Duty	kW	(/24hr)	kWh	
01. Intake Facility							
Raw Water Pump	Horizontal Double Volute Centrifugal (VSD, split casing) 11.5 m3/min	68	2	136	1.0	118	Consider VSD factor
Discharge Valve	Motorized Butterfly Dia.300mm	0.2	2	0.4	0.02	0.008	
Sump Drainage Pump	Submersible 0.3m3/min x 15m	2.2	2	4.4	0.02	0.088	
Floor Drainage Pump	Submersible 0.3m3/min x 20m	4	1	4	0.02	0.080	
Overhead Crane(1)	Motorized bridge crane 3ton	3	1	3	0.02	0.060	
Sub Total						119	
Others(Lighting and Ventilation)						12	
Total						130	

(2) Calculation of Power Consumption for Water Treatment Plant

Water Treatment Plant; Priority Project 30,000m3/day (Product water)

Not include standby and manual Mechanical Equipment below.

Facility/Equipment	Tag No.	Specification	Power (kW)	Q'ty	Total Output	Load factor	Total Load	Remarks
				Duty	kW	(/24hr)	kWh	
03. Flocculation / Sedimentation Basin								
De-sludge Valve.1	03MV11 to 43	Electrically operated , Eccentric DN 150mm	0.08	6	0.48	0.02	0.01	
Sump Drainage Pump	03DP11 to 41	Submersible 0.2m3/min x 15m	1.5	1	1.5	0.02	0.03	
Sampling Pump	03SP11 to 21	Self-priming Centrifugal 0.06m3/min x 12 m	0.4	1	0.4	0.02	0.008	
04. Filters								
Filter Inflow Gate	04MV11 to 81	Motorized Sluice Gate with head stock 400mmW x 400Hmm	0.4	4	1.6	0.02	0.03	
Backwash Water Discharge Gate	04MV12 to 82	Motorized Sluice Gate with head stock 700mmW x 700mmH	0.75	4	3	0.02	0.06	
Backwash Valve	04MV14 to 84	Motorized Butterfly Dia.500mm	0.4	4	1.6	0.02	0.03	
Air Scour Valve	04MV15 to 85	Motorized Butterfly Dia.400mm	0.2	4	0.8	0.02	0.02	
Effluent Valve	04MV17 to 87	Motorized Butterfly Dia.400mm	0.2	4	0.8	0.02	0.02	
Backwash Pump	04BP11 to 31	Horizontal Centrifugal 17m3/min x 8m	37	1	37	0.02	0.74	
Air Blower	04AB 11 to 31	Roots Blower 68Nm3/min x 3500mmAq	75	1	75	0.02	1.5	
Sump Drainage Pump	04DP01/02	Submersible 0.3m3/min x 15m	2.2	1	2.2	0.02	0.04	
Sampling Pump	04SP01/02	Self-priming Centrifugal 0.06m3/min x 12 m	0.125	1	0.125	0.02	0.003	
05. Clear Water Reservoir and High Lift Pump Station								
High Lift Pump	05HP11 to 51	Horizontal Double VoluteCentrifugal 17m3/min (split casing)	200	2	400	0.5864	235	Consider Average Flow
Discharge Valve	05MV11 to 51	Motorized Butterfly Dia.400mm	0.2	2	0.4	0.02	0.008	
Sump Drainage Pump	05DP01/02	Submersible 0.1m3/min x 12m	2	1	2	0.02	0.04	
Plant Water Supply Unit	05PU01	Horizontal Centrifugal Pumps with Pressure tank 1.5m3/min x 35m	9	1	9	0.5	4.5	
Chlorination Booster Pump	05BP11 to 31	Horizontal Centrifugal 0.4m3/min x 52m	7.5	1	7.5	1.0	7.5	
Overhead Crane	05HC01	Motorized bridge crane 3Ton	3	1	3	0.02	0.06	

06.Chemical Building								
Alum Dosing System								
Alum Mixer	06ALM11 to 41	Vertical (2.8m x 2.3m x 3.5mH,	4	1	4	0.49	1.96	
Alum Pump	06ALP11 to 31	Diaphgram Pump (Manually stroke control type) 70-790L/h x 20m	2.2	1	2.2	0.98	2.16	
Alum Dust Collector	06ADC11 to 41	Filter Type, Approx.9.0m2, Filtreration Air 10m3/min	1.5	1	1.5	0.02	0.03	
Portable Belt Conveyor	06BC11	Portable Belt Conveyer W350 x 5m	1	1	1	0.02	0.02	
Sump Drainage Pump	06DP11/21	Stainless Steel Submersible 0.24m3/min x 15m	2	1	2	0.02	0.04	
Lime Dosing System								
Lime Mixer	06LM11 to 41	Vertical (2.8m x 2.3m x 3.5mH, W.D. 2.5m)	4	1	4	0.49	1.96	
Lime Pump	06LP11 to 61	Diaphgram Pump (Manually stroke control type) 39-390L/h x 20m	2.2	2	4.4	0.98	4.31	
Lime Dust Collector	06LDC11 to 41	Filter Type, Approx.9.0m2, Filtreration Air 10m3/min	1.5	1	1.5	0.02	0.03	
Chemical Crane	06MC01	Motorized with Trolley 2.0 Ton	1.15	1	1.15	0.02	0.02	
Sump Drainage Pump	06DP13/23	Stainless Steel Submersible 0.24m3/min x 15m	2	1	2	0.02	0.04	
Chlorination System								
Chlorinator-Pre	06CL11 to 13	Auto Vacuum solution feed type (include ejector) 10kg/hr	0.025	1	0.025	1	0.03	
Chlorinator-Post	06CL21 to 23	Auto Vacuum solution feed type (include ejector) 10kg/hr	0.025	1	0.025	1	0.03	
Chlorine Crane	06MC02	Motorized with Trolley 2.0 Ton	1.15	1	1.15	0.02	0.02	
07.Backwash Recovery Tank								
Backwash Recovery Pump	07WP11/31	Centrifugal Pump 0.78m3/min x 15m	4	1	4	0.67	2.67	
Sump Drainage Pump	07DP01/02	Submersible 0.3m3/min x 15m	2.2	1	2.2	0.02	0.04	
08.Sludge Discharge Tank								
Sludge Discharge Pump	08WP11/31	Centrifugal Pump 1m3/min x 15m	5.5	1	5.5	0.5	2.75	
Sump Drainage Pump	08DP01/02	Submersible 0.3m3/min x 15m	2.2	1	2.2	0.02	0.04	
Sub Total							265.3	
Others(Lighting and Ventilation)							29	
Total							294	

Supporting Report

Chapter 8
Financial and Economic Aspect

SR 8.1

ANALYSIS ON WATER PRODUCTION COST FOR THE EXISTING GROUNDWATER USERS

In the inventory survey, the cost of operating and maintaining various types of water supply facilities of each establishment was estimated by the interviewers by using the information they obtained during the site visits. The monthly operation and maintenance cost estimated here consists of labor cost and energy cost in addition to other regular running costs such as the cost for chlorine (disinfectant) and minor repair costs. The obtained data for monthly average O/M cost and installation cost of water supply facilities were used to estimate the unit water production cost (US$ per one cubic meter of water) for each category of the five establishments. Since the total cost of unit water production over a long period (15 years) is considered, major maintenance cost was included in the calculation. The following two cases of different ratios of major maintenance cost were evaluated.

Case A : Major maintenance cost is 30% of the total installation cost, 3 times over 15 years

Case B : Major maintenance cost is 35% of the total installation cost, 3 times over 15 years

Prerequisite for estimation of major maintenance cost:

Durable years of water supply system including wells is designated as 15 years by government's handling notification and during its period, major maintenance of equipment is roughly supposed to be conducted three times by major maintenance period of 5 year that is designated by technical manual, as showed below.

- Durable years of water supply system including wells : 15 years

  (Handling notification by Japanese Government on application of durable years, March 2000)

- Major maintenance period such as submersible pump: every 5 year

  (Technical manual for operation and maintenance of motors and pumps including wells, Japan water works association, 1999)

The results are shown in the tables below along with the average water use amounts, the O/M cost, facilities installation cost obtained in the survey, and the calculated major repair cost for the category. The unit water production costs are shown in the bottom (row F).

SR 8.2 MAIN INPUT SHEET

Project Cost Components

All figures are in USD x 1000

Figures Created by Engineering Cost Estimates Appearing in Table 7.7 of Project Working Papers

Project Cost Components	Total	2009	2010	2011	2012	2013	2014	2015	2016
Civil Works									
Intake Chamber									
- Foreign Component	16	-	-	-	-	-	7	10	-
- Local Component	132	-	-	-	-	-	55	77	-
- Tax on Local Component	13	-	-	-	-	-	6	8	-
Total	**162**	**-**	**-**	**-**	**-**	**-**	**68**	**95**	**-**
Water conveyance pipe									
- Foreign Component	1,448	-	-	-	-	165	496	496	290
- Local Component	11,710	-	-	-	-	1,338	4,015	4,015	2,342
- Tax on Local Component	1,171	-	-	-	-	134	401	401	234
Total	**14,328**	**-**	**-**	**-**	**-**	**1,638**	**4,913**	**4,913**	**2,866**
Intake Pumping Station									
- Foreign Component	555	-	-	-	-	79	476	-	-
- Local Component	739	-	-	-	-	106	633	-	-
- Tax on Local Component	74	-	-	-	-	11	63	-	-
Total	**1,368**	**-**	**-**	**-**	**-**	**195**	**1,172**	**-**	**-**
Water Treatment Plant									
- Foreign Component	2,507	-	-	-	-	-	716	1,075	716
- Local Component	5,627	-	-	-	-	-	1,608	2,412	1,608
- Tax on Local Component	563	-	-	-	-	-	161	241	161
Total	**8,697**	**-**	**-**	**-**	**-**	**-**	**2,485**	**3,727**	**2,485**
Elevated Water Reservoir									
- Foreign Component	228	-	-	-	-	-	-	228	-
- Local Component	553	-	-	-	-	-	-	553	-
- Tax on Local Component	55	-	-	-	-	-	-	55	-
Total	**836**	**-**	**-**	**-**	**-**	**-**	**-**	**836**	**-**
Transmission/Distribution Pipelines									
- Foreign Component	12,178	-	-	-	-	6,744	1,355	2,770	1,308
- Local Component	4,638	-	-	-	-	1,993	988	795	862
- Tax on Local Component	464	-	-	-	-	199	99	79	86
Total	**17,280**	**-**	**-**	**-**	**-**	**8,937**	**2,442**	**3,644**	**2,257**
Summary									
- Foreign Component	16,932	-	-	-	-	6,989	3,051	4,578	2,314
- Local Component	23,399	-	-	-	-	3,437	7,299	7,851	4,812
- Tax on Local Component	2,340	-	-	-	-	344	730	785	481
- Total Civil Works	**42,672**	**-**	**-**	**-**	**-**	**10,770**	**11,080**	**13,215**	**7,607**

Project Cost Components	Total	2009	2010	2011	2012	2013	2014	2015	2016
Mechanical/Electrical Works									
Intake Pumping Station									
- Foreign Component	2,086	-	-	-	-	298	1,788	-	-
- Local Component	259	-	-	-	-	37	222	-	-
- Tax on Local Component	26	-	-	-	-	4	22	-	-
Total	**2,371**	**-**	**-**	**-**	**-**	**339**	**2,032**	**-**	**-**
Water Treatment Plant									
- Foreign Component	6,062	-	-	-	-	-	1,732	2,598	1,732
- Local Component	877	-	-	-	-	-	251	376	251
- Tax on Local Component	88	-	-	-	-	-	25	38	25
Total	**7,027**	**-**	**-**	**-**	**-**	**-**	**2,008**	**3,012**	**2,008**
Summary									
- Foreign Component	8,148	-	-	-	-	298	3,520	2,598	1,732
- Local Component	1,136	-	-	-	-	37	473	376	251
- Tax on Local Comp	114	-	-	-	-	4	47	38	25
- Total Mechanical/Electrical Work	**9,397**	**-**	**-**	**-**	**-**	**339**	**4,040**	**3,012**	**2,008**
Direct Construction Cost									
- Foreign Component	25,080	-	-	-	-	7,287	6,570	7,177	4,046
- Local Component	24,535	-	-	-	-	3,474	7,772	8,227	5,063
- Tax on Local Component	2,454	-	-	-	-	347	777	823	506
Total	**52,069**	**-**	**-**	**-**	**-**	**11,108**	**15,119**	**16,226**	**9,615**
Physcial Contingency									
- Foreign Component	2,508	-	-	-	-	729	657	718	405
- Local Component	2,454	-	-	-	-	347	777	823	506
- Tax on Local Component	245	-	-	-	-	35	78	82	51
Total	**5,207**	**-**	**-**	**-**	**-**	**1,111**	**1,512**	**1,623**	**962**
Subtotal Direct Construction Costs									
- Foreign Component	27,588	-	-	-	-	8,015	7,227	7,894	4,451
- Local Component	26,989	-	-	-	-	3,821	8,549	9,050	5,569
- Tax on Local Component	2,699	-	-	-	-	382	855	905	557
Total	**57,276**	**-**	**-**	**-**	**-**	**12,219**	**16,631**	**17,849**	**10,577**
Price Contingency									
- Foreign Component	2,215	-	-	-	-	441	535	737	503
- Local Component	11,423	-	-	-	-	979	3,039	4,186	3,219
- Tax on Local Component	1,142	-	-	-	-	98	304	419	322
Total	**14,780**	**-**	**-**	**-**	**-**	**1,518**	**3,877**	**5,341**	**4,044**
Summary									
- Foreign Component	29,803	-	-	-	-	8,456	7,762	8,631	4,954
- Local Component	38,412	-	-	-	-	4,801	11,588	13,236	8,788
- Tax on Local Component	3,841	-	-	-	-	480	1,159	1,324	879
Total Direct Construction Cost	**72,056**	**-**	**-**	**-**	**-**	**13,737**	**20,508**	**23,190**	**14,621**

Project Cost Components	Total	2009	2010	2011	2012	2013	2014	2015	2016
Engineering Services									
- Foreign Component	4,200	-	-	436	873	873	873	873	272
- Local Component	954	-	-	99	198	198	198	198	63
- Tax on Local Comp	96	-	-	10	20	20	20	20	6
Total Basic Cost	**5,250**	**-**	**-**	**545**	**1,091**	**1,091**	**1,091**	**1,091**	**341**
Physical Contingency									
- Foreign Component	210	-	-	22	44	44	44	44	14
- Local Component	48	-	-	5	10	10	10	10	3
- Tax on Local Component	5	-	-	1	1	1	1	1	0
Total	263	-	-	27	55	55	55	55	17
Subtotal									
- Foreign Component	4,410	-	-	458	917	917	917	917	286
- Local Component	1,002	-	-	104	208	208	208	208	66
- Tax on Local Component	101	-	-	11	21	21	21	21	6
Total	**5,513**	**-**	**-**	**572**	**1,146**	**1,146**	**1,146**	**1,146**	**358**
Price Contingency									
- Foreign Component	278	-	-	8	33	50	68	86	32
- Local Component	304	-	-	8	34	53	74	96	38
- Tax on Local Component	30	-	-	1	3	5	7	10	4
Total	**612**	**-**	**-**	**17**	**71**	**109**	**149**	**191**	**74**
Summary									
- Foreign Component	4,688	-	-	466	950	967	984	1,002	318
- Local Component	1,306	-	-	112	242	261	282	304	104
- Tax on Local Comp	131	-	-	11	24	26	28	31	10
- Total Engineering Services	**6,124**	**-**	**-**	**590**	**1,216**	**1,255**	**1,295**	**1,337**	**432**
Institutional Capacity Building (ICB)									
- Foreign Component	860	-	-	-	172	172	172	172	172
- Local Component	55	-	-	-	10	10	10	10	15
- Tax on Local Comp	5	-	-	-	1	1	1	1	1
- Total Basic Cost	**920**	**-**	**-**	**-**	**183**	**183**	**183**	**183**	**188**
Physical Contingency									
- Foreign Component	43	-	-	-	9	9	9	9	9
- Local Component	3	-	-	-	0.5	0.5	0.5	0.5	0.7
- Tax on Local Component	0	-	-	-	0	0	0	0	0
Total	**46**	**-**	**-**	**-**	**9**	**9**	**9**	**9**	**9**
Subtotal									
- Foreign Component	903	-	-	-	181	181	181	181	181
- Local Component	57	-	-	-	11	11	11	11	15
- Tax on Local Component	6	-	-	-	1	1	1	1	2
Total	**966**	**-**	**-**	**-**	**192**	**192**	**192**	**192**	**197**
Price Contingency									
- Foreign Component	67	-	-	-	7	10	13	17	20
- Local Component	22	-	-	-	1.72	2.69	3.73	4.86	8.83
- Tax on Local Component	2	-	-	-	0	0	0	0	1
Total	**91**	**-**	**-**	**-**	**8**	**13**	**17**	**22**	**30**

Project Cost Components	Total	2009	2010	2011	2012	2013	2014	2015	2016
Summary									
- Foreign Component	970	-	-	-	187	191	194	197	201
- Local Component	79	-	-	-	12	13	14	15	24
- Tax on Local Comp	8	-	-	-	1	1	1	2	2
- Total Institutional Cap Bldg	**1,057**	**-**	**-**	**-**	**201**	**205**	**210**	**214**	**228**
Land Acquisition									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	273	-	-	273	-	-	-	-	-
- Tax on Local Comp	27	-	-	27	-	-	-	-	-
Total Basic Cost	**300**	**-**	**-**	**300**	**-**	**-**	**-**	**-**	**-**
Physical Contingency									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	27	-	-	27	-	-	-	-	-
- Tax on Local Component	3	-	-	3	-	-	-	-	-
Total	**30**	**-**	**-**	**30**	**-**	**-**	**-**	**-**	**-**
Subtotal									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	300	-	-	300	-	-	-	-	-
- Tax on Local Component	30	-	-	30	-	-	-	-	-
Total	**330**	**-**	**-**	**330**	**-**	**-**	**-**	**-**	**-**
Price Contingency									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	24	-	-	24	-	-	-	-	-
- Tax on Local Component	2	-	-	2	-	-	-	-	-
Total	**26**	**-**	**-**	**26**	**-**	**-**	**-**	**-**	**-**
Summary									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	324	-	-	324	-	-	-	-	-
- Tax on Local Component	32	-	-	32	-	-	-	-	-
Total Land Acquisition	**356**	**-**	**-**	**356**	**-**	**-**	**-**	**-**	**-**
Social Compensation									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	83	-	-	83	-	-	-	-	-
- Tax on Local Component	8	-	-	8	-	-	-	-	-
Total Basic Cost	**91**	**-**	**-**	**91**	**-**	**-**	**-**	**-**	**-**
Physical Contingency									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	-	-	-	-	-	-	-	-	-
- Tax on Local Component	-	-	-	-	-	-	-	-	-
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Subtotal									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	83	-	-	83	-	-	-	-	-
- Tax on Local Component	8	-	-	8	-	-	-	-	-
Total	**91**	**-**	**-**	**91**	**-**	**-**	**-**	**-**	**-**

Project Cost Components	Total	2009	2010	2011	2012	2013	2014	2015	2016
Price Contingency									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	7	-	-	7	-	-	-	-	-
- Tax on Local Component	1	-	-	1	-	-	-	-	-
Total	**7**	**-**	**-**	**7**	**-**	**-**	**-**	**-**	**-**
Summary									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	89	-	-	89	-	-	-	-	-
- Tax on Local Component	9	-	-	9	-	-	-	-	-
Total Social Compensation	**98**	**-**	**-**	**98**	**-**	**-**	**-**	**-**	**-**
Project Administration									
- Foreign Component	-	-	-	-	-	-	-	-	-
- Local Component	864	-	-	1	1	184	250	269	159
- Tax on Local Component	86	-	-	0	0	18	25	27	16
Total Project Administration	**951**	**-**	**-**	**1**	**1**	**203**	**275**	**296**	**175**
Total Project Cost									
- Foreign Component	35,460	-	-	466	1,137	9,614	8,940	9,830	5,473
- Local Component	41,074	-	-	526	255	5,259	12,134	13,824	9,076
- Tax on Local Component	4,108	-	-	53	26	526	1,214	1,383	907
Total Project Cost	**80,642**	**-**	**-**	**1,045**	**1,418**	**15,399**	**22,288**	**25,037**	**15,456**
	15,516	*Price Cntingencies ->*		51	79	1,640	4,044	5,554	4,148
Assumption				535	1,253	12,014	15,595	16,657	9,630

1/ Land acquisition is estimated at 5.00 per square meter with required 60,000 square meters

4/ Physical contingency

Basic construction cost	10%
engineering	5%
institutional capacity building	5%
Land Acquisition	10%
Base Price Year	2010
Price Escalation	
Foreign component	1.80%
Local component	7.90%

SR 8.3

Opening Positions

Opening Positions Are Expressed in: USD Million

ASSETS	2009	LIABILITIES & EQUITY	2009
Cash & Equivalents	0.67	Acc/Payables	0.20
Savings Accounts		Taxes Payable	0.13
Accounts & Other Receivables	0.10	Interest Payble	
Other current assets	0.04	Other Current Liabilities	
Inventories	0.22	Customer Deposits	0.11
Land	1.85	Grants	
Utility Plant in Service	2.42	Loan 1	
Common Assets		Loan 2	
Construction in Progress	0.16	Loan 3	
Other Assets	-	Oustanding Loans	
Accumulated Depreciation	0.36	Other Liabilities	
		Capital Owed/Government	
		Equity	4.36
		Retained Earnings	0.31
Total	5.11	Total	5.11

SR8.4
BALANCE SHEET

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

USD Million

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ASSETS											
CURRENT ASSETS											
Cash	0.03	0.03	0.05	0.06	0.08	0.08	0.09	0.10	0.11	0.12	0.13
Short-Term Deposits	0.70	0.27	1.59	1.74	1.07	0.10	0.06	0.15	0.86	2.13	4.07
Prepaid Expenses	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06
Customer Receivable (Net)	0.07	0.08	0.27	0.23	0.27	0.31	0.35	0.50	0.56	0.63	0.70
Inventories of Spares	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36	0.38
TOTAL CURRENT ASSETS	0.92	0.49	2.08	2.25	1.69	0.77	0.80	1.09	1.91	3.29	5.34
FIXED ASSETS											
Land	1.85	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Plant in Service	2.42	4.17	9.17	27.91	54.80	81.37	98.98	98.98	98.98	98.98	98.98
Less: Acc. Depreciation	0.43	0.50	0.61	0.82	1.12	1.52	1.93	5.00	8.08	11.16	14.24
Net Fixed Assets	3.84	5.87	10.78	29.31	55.89	82.06	99.26	96.18	93.11	90.03	86.95
Work in Process	0.16	-	-	-	-	-	-	-	-	-	-
TOTAL FIXED ASSETS	4.00	5.87	10.78	29.31	55.89	82.06	99.26	96.18	93.11	90.03	86.95
Other Assets	-	-	-	-	-	-	-	-	-	-	-
TOTAL ASSETS	4.92	6.36	12.86	31.56	57.58	82.83	100.06	97.28	95.01	93.32	92.29
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Accounts Payable	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36	0.38
Interest Payable	-	-	-	-	-	-	-	-	-	-	-
Guarantee Deposits	0.11	0.11	0.28	0.33	0.38	0.44	0.49	0.55	0.62	0.68	0.75
Taxes Payable	-	-	-	-	-	-	-	-	-	-	-
Other Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Current Portion of Long Term Debt	-	-	-	-	0.13	0.14	0.15	0.16	0.17	0.19	1.69
TOTAL CURRENT LIABILITIES	0.20	0.20	0.43	0.52	0.75	0.82	0.90	1.02	1.12	1.23	2.83
BORROWINGS											
Outstanding Loans	-	-	-	-	-	-	-	-	-	-	-
Loan 1 - Priority Project	-	0.59	2.02	16.99	38.65	63.57	80.11	80.11	80.11	80.11	80.11
Loan 2 - KTC Project	-	0.80	4.02	6.81	10.27	10.14	10.00	9.85	9.69	9.51	9.33
Loan3	-	-	-	-	-	-	-	-	-	-	-
Other Liabilities	-	-	-	-	-	-	-	-	-	-	-
Less: Current Portion of Long Term Debt	-	-	-	-	0.13	0.14	0.15	0.16	0.17	0.19	1.69
TOTAL BORROWINGS	-	1.39	6.04	23.80	48.79	73.57	89.96	89.80	89.63	89.44	87.75
EQUITY											
Paid In Capital	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Retained Earnings	0.36	0.41	2.03	2.88	3.68	4.08	4.84	2.10	(0.09)	(1.71)	(2.64)
Grants & Other Contributions	-	-	-	-	-	-	-	-	-	-	-
TOTAL NET WORTH	4.72	4.77	6.39	7.24	8.04	8.44	9.20	6.46	4.27	2.65	1.71
TOTAL LIABS. & NET WORTH	4.92	6.36	12.86	31.56	57.58	82.83	100.06	97.28	95.01	93.32	92.29

SR8.4
BALANCE SHEET

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

USD Million

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ASSETS										
CURRENT ASSETS										
Cash	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16
Short-Term Deposits	4.12	4.76	5.91	7.45	9.40	11.71	13.76	15.41	13.00	11.72
Prepaid Expenses	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08
Customer Receivable (Net)	0.72	0.79	0.84	0.89	0.95	1.00	0.98	0.98	0.98	0.98
Inventories of Spares	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49	0.49
TOTAL CURRENT ASSETS	5.44	6.19	7.40	9.02	11.04	13.43	15.47	17.12	14.71	13.43
FIXED ASSETS										
Land	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Plant in Service	98.98	98.98	98.98	98.98	98.98	98.98	98.98	99.35	103.80	107.11
Less: Acc. Depreciation	17.32	20.40	23.48	26.56	29.64	32.72	35.80	38.89	42.13	45.48
Net Fixed Assets	83.87	80.79	77.71	74.63	71.55	68.47	65.39	62.67	63.88	63.84
Work in Process	-	-	-	-	-	-	-	-	-	-
TOTAL FIXED ASSETS	83.87	80.79	77.71	74.63	71.55	68.47	65.39	62.67	63.88	63.84
Other Assets	-	-	-	-	-	-	-	-	-	-
TOTAL ASSETS	89.30	86.97	85.11	83.65	82.59	81.90	80.86	79.79	78.58	77.26
LIABILITIES & NET WORTH										
CURRENT LIABILITIES										
Accounts Payable	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49	0.49
Interest Payable	-	-	-	-	-	-	-	-	-	-
Guarantee Deposits	0.79	0.83	0.86	0.90	0.94	0.99	0.99	0.99	0.99	0.99
Taxes Payable	-	-	-	-	-	-	-	-	-	-
Other Current Liabilities	-	-	-	-	-	-	-	-	-	-
Current Portion of Long Term Debt	1.77	1.84	1.92	2.00	2.09	2.18	2.28	2.38	2.48	1.88
TOTAL CURRENT LIABILITIES	2.95	3.09	3.22	3.36	3.50	3.65	3.75	3.85	3.96	3.36
BORROWINGS										
Outstanding Loans	-	-	-	-	-	-	-	-	-	-
Loan 1 - Priority Project	78.62	77.08	75.48	73.81	72.09	70.30	68.44	66.51	64.51	62.44
Loan 2 - KTC Project	9.12	8.90	8.66	8.41	8.13	7.83	7.51	7.16	6.78	6.37
Loan3	-	-	-	-	-	-	-	-	-	-
Other Liabilities	-	-	-	-	-	-	-	-	-	-
Less: Current Portion of Long Term Debt	1.77	1.84	1.92	2.00	2.09	2.18	2.28	2.38	2.48	1.88
TOTAL BORROWINGS	85.98	84.14	82.22	80.22	78.13	75.95	73.67	71.30	68.81	66.93
EQUITY										
Paid In Capital	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Retained Earnings	(3.99)	(4.61)	(4.69)	(4.28)	(3.39)	(2.06)	(0.92)	0.28	1.45	2.61
Grants & Other Contributions	-	-	-	-	-	-	-	-	-	-
TOTAL NET WORTH	0.37	(0.26)	(0.33)	0.08	0.96	2.30	3.44	4.64	5.81	6.97
TOTAL LIABS. & NET WORTH	89.30	86.97	85.11	83.65	82.59	81.90	80.86	79.79	78.58	77.26

SR8.4

BALANCE SHEET

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

USD Million

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ASSETS										
CURRENT ASSETS										
Cash	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Short-Term Deposits	10.20	10.81	11.42	12.04	12.65	13.27	13.80	14.28	14.72	15.11
Prepaid Expenses	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Customer Receivable (Net)	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Inventories of Spares	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51
TOTAL CURRENT ASSETS	11.91	12.53	13.15	13.76	14.38	14.99	15.53	16.02	16.46	16.85
FIXED ASSETS										
Land	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Plant in Service	109.32	109.32	109.32	109.32	109.32	109.32	109.32	109.32	109.32	109.32
Less: Acc. Depreciation	48.90	52.33	55.75	59.18	62.60	66.02	69.45	72.87	76.30	79.72
Net Fixed Assets	62.62	59.20	55.77	52.35	48.93	45.50	42.08	38.65	35.23	31.81
Work in Process	-	-	-	-	-	-	-	-	-	-
TOTAL FIXED ASSETS	62.62	59.20	55.77	52.35	48.93	45.50	42.08	38.65	35.23	31.81
Other Assets	-	-	-	-	-	-	-	-	-	-
TOTAL ASSETS	74.53	71.73	68.92	66.11	63.30	60.49	57.61	54.67	51.69	48.66
LIABILITIES & NET WORTH										
CURRENT LIABILITIES										
Accounts Payable	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51
Interest Payable	-	-	-	-	-	-	-	-	-	-
Guarantee Deposits	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Taxes Payable	-	-	-	-	-	-	-	-	-	-
Other Current Liabilities	-	-	-	-	-	-	-	-	-	-
Current Portion of Long Term Debt	2.03	2.18	2.35	2.52	2.72	2.92	3.15	3.39	3.64	2.59
TOTAL CURRENT LIABILITIES	3.50	3.67	3.83	4.01	4.20	4.41	4.64	4.88	5.14	4.08
BORROWINGS										
Outstanding Loans	-	-	-	-	-	-	-	-	-	-
Loan 1 - Priority Project	61.00	59.45	57.78	55.99	54.07	52.00	49.77	47.38	44.81	42.04
Loan 2 - KTC Project	5.93	5.46	4.95	4.39	3.79	3.15	2.45	1.69	0.88	-
Loan3	-	-	-	-	-	-	-	-	-	-
Other Liabilities	-	-	-	-	-	-	-	-	-	-
Less: Current Portion of Long Term Debt	2.03	2.18	2.35	2.52	2.72	2.92	3.15	3.39	3.64	2.59
TOTAL BORROWINGS	64.91	62.73	60.38	57.86	55.14	52.22	49.07	45.69	42.04	39.45
EQUITY										
Paid In Capital	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Retained Earnings	1.76	0.98	0.35	(0.12)	(0.40)	(0.49)	(0.46)	(0.25)	0.15	0.76
Grants & Other Contributions	-	-	-	-	-	-	-	-	-	-
TOTAL NET WORTH	6.12	5.33	4.71	4.24	3.96	3.86	3.90	4.11	4.51	5.12
TOTAL LIABS. & NET WORTH	74.53	71.73	68.92	66.11	63.30	60.49	57.61	54.67	51.69	48.66

SR8.5
Computation of Tariffs

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
From Financial Study 9 of Trial Run 1											
Revenue Requirements, 5 years											
A. O&M			8.594					14.170			
B. Depreciation			1.421					15.397			
C. Interest Payments			1.633					16.488			
D. Provision for Income Tax			0.986					-			
E. Net Profit (Loss)			3.944					(9.986)			
F. Total Cash Requirement 1/			16.578					36.069			
Less: G. Other Revenue 2/			2.690					2.253			
H. Required Revenue 3/			13.887					33.816			
I. Total Volume Sold, 5 years 4/			30.190					57.316			
J. Required Tariff, US$/m3 5/			0.460					0.590			
From Financial Study 12 of Trial Run 2											
Revenue Requirements, 5 years											
A. O&M			8.594					14.170			
B. Depreciation			1.421					15.397			
C. Interest Payments			1.633					16.488			
D. Provision for Income Tax			1.047					-			
E. Net Profit (Loss)			4.188					(9.407)			
F. Total Cash Requirement 1/			16.883					36.648			
Less: G. Other Revenue 2/			2.693					2.259			
H. Required Revenue 3/			14.189					34.389			
I. Total Volume Sold, 5 years 4/			30.190					57.316			
J. Required Tariff, US$/m3 5/			0.470					0.600			
From Financial Study 15 of Trial Run 3											
Revenue Requirements, 5 years											
A. O&M			8.594					14.170			
B. Depreciation			1.421					15.397			
C. Interest Payments			1.633					16.488			
D. Provision for Income Tax			1.108					-			
E. Net Profit (Loss)			4.432					(8.249)			
F. Total Cash Requirement 1/			17.188					37.806			
Less: G. Other Revenue 2/			2.696					2.270			
H. Required Revenue 3/			14.491					35.536			
I. Total Volume Sold, 5 years 4/			30.190					57.316			
J. Required Tariff, US$/m3 5/			0.480					0.620			
From Financial Study 18 of Trial Run 4											
Revenue Requirements, 5 years											
A. O&M			8.594					14.170			
B. Depreciation			1.421					15.397			
C. Interest Payments			1.633					16.488			
D. Provision for Income Tax			1.108					-			
E. Net Profit (Loss)			4.432					(8.828)			
F. Total Cash Requirement 1/			17.188					37.227			
Less: G. Other Revenue 2/			2.696					2.265			
H. Required Revenue 3/			14.491					34.962			
I. Total Volume Sold, 5 years 4/			30.190					57.316			
J. Required Tariff, US$/m3 5/			0.48					0.61			

Notes

1/ F = sum (A,B,C,DE).
2/ Sum of penalties/fines and connection fees/charges.
3/ H = F - G
4/ I = sum of billed volume for 5 years
5/ J = H / I
6/ Detailes are referred to Financial Study 9, 12, 15, and 18 in the Main Report.

SR8.5
Computation of Tariffs

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
From Financial Study 9 of Trial Run 1										
Revenue Requirements, 5 years										
A. O&M		18.146					19.705			
B. Depreciation		15.397					16.185			
C. Interest Payments		17.598					17.651			
D. Provision for Income Tax		0.266					0.573			
E. Net Profit (Loss)		(1.011)					0.696			
F. Total Cash Requirement 1/		50.396					54.811			
Less: G. Other Revenue 2/		1.734					0.543			
H. Required Revenue 3/		48.662					54.268			
I. Total Volume Sold, 5 years 4/		82.478					91.980			
J. Required Tariff, US$/m3 5/		0.590					0.590			
From Financial Study 12 of Trial Run 2										
Revenue Requirements, 5 years										
A. O&M		18.146					19.705			
B. Depreciation		15.397					16.185			
C. Interest Payments		17.598					17.651			
D. Provision for Income Tax		0.340					0.722			
E. Net Profit (Loss)		(0.252)					1.476			
F. Total Cash Requirement 1/		51.230					55.740			
Less: G. Other Revenue 2/		1.743					0.552			
H. Required Revenue 3/		49.487					55.188			
I. Total Volume Sold, 5 years 4/		82.478					91.980			
J. Required Tariff, US$/m3 5/		0.600					0.600			
From Financial Study 15 of Trial Run 3										
Revenue Requirements, 5 years										
A. O&M		18.146					19.705			
B. Depreciation		15.397					16.185			
C. Interest Payments		17.598					17.651			
D. Provision for Income Tax		0.552					1.019			
E. Net Profit (Loss)		1.203					3.037			
F. Total Cash Requirement 1/		52.896					57.598			
Less: G. Other Revenue 2/		1.759					0.570			
H. Required Revenue 3/		51.136					57.028			
I. Total Volume Sold, 5 years 4/		82.478					91.980			
J. Required Tariff, US$/m3 5/		0.620					0.620			
From Financial Study 18 of Trial Run 4										
Revenue Requirements, 5 years										
A. O&M		18.146					19.705			
B. Depreciation		15.397					16.185			
C. Interest Payments		17.598					17.651			
D. Provision for Income Tax		0.658					1.167			
E. Net Profit (Loss)		1.930					3.817			
F. Total Cash Requirement 1/		53.729					58.527			
Less: G. Other Revenue 2/		1.767					0.579			
H. Required Revenue 3/		51.961					57.947			
I. Total Volume Sold, 5 years 4/		82.478					91.980			
J. Required Tariff, US$/m3 5/		0.63					0.63			

Notes

1/ F = sum (A,B,C,DE).
2/ Sum of penalties/fines and connection fee
3/ H = F - G
4/ I = sum of billed volume for 5 years
5/ J = H / I
6/ Detailes are referred to Financial Study 9,

SR8.5
Computation of Tariffs

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
From Financial Study 9 of Trial Run 1										
Revenue Requirements, 5 years										
A. O&M		20.078					16.360			
B. Depreciation		17.120					13.696			
C. Interest Payments		23.583					15.200			
D. Provision for Income Tax		-					0.003			
E. Net Profit (Loss)		(5.970)					(1.411)			
F. Total Cash Requirement 1/		54.811					43.849			
Less: G. Other Revenue 2/		0.543					0.434			
H. Required Revenue 3/		54.268					43.415			
I. Total Volume Sold, 5 years 4/		91.980					73.584			
J. Required Tariff, US$/m3 5/		0.590					0.590			
From Financial Study 12 of Trial Run 2										
Revenue Requirements, 5 years										
A. O&M		20.078					16.360			
B. Depreciation		17.120					13.696			
C. Interest Payments		23.583					15.200			
D. Provision for Income Tax		-					0.041			
E. Net Profit (Loss)		(5.041)					(0.704)			
F. Total Cash Requirement 1/		55.740					44.592			
Less: G. Other Revenue 2/		0.552					0.442			
H. Required Revenue 3/		55.188					44.150			
I. Total Volume Sold, 5 years 4/		91.980					73.584			
J. Required Tariff, US$/m3 5/		0.600					0.600			
From Financial Study 15 of Trial Run 3										
Revenue Requirements, 5 years										
A. O&M		20.078					16.360			
B. Depreciation		17.120					13.696			
C. Interest Payments		23.583					15.200			
D. Provision for Income Tax		-					0.194			
E. Net Profit (Loss)		(3.183)					0.629			
F. Total Cash Requirement 1/		57.598					46.078			
Less: G. Other Revenue 2/		0.570					0.456			
H. Required Revenue 3/		57.028					45.622			
I. Total Volume Sold, 5 years 4/		91.980					73.584			
J. Required Tariff, US$/m3 5/		0.620					0.620			
From Financial Study 18 of Trial Run 4										
Revenue Requirements, 5 years										
A. O&M		20.078					16.360			
B. Depreciation		17.120					13.696			
C. Interest Payments		23.583					15.200			
D. Provision for Income Tax		-					0.313			
E. Net Profit (Loss)		(2.254)					1.253			
F. Total Cash Requirement 1/		58.527					46.821			
Less: G. Other Revenue 2/		0.579					0.464			
H. Required Revenue 3/		57.947					46.358			
I. Total Volume Sold, 5 years 4/		91.980					73.584			
J. Required Tariff, US$/m3 5/		0.63					0.63			

Notes

1/ F = sum (A,B,C,DE).
2/ Sum of penalties/fines and connection fee
3/ H = F - G
4/ I = sum of billed volume for 5 years
5/ J = H / I
6/ Detailes are referred to Financial Study 9,

SR8.6
Supporting Schedules 2
Proposed Tariff Study 2

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
FIXED ASSETS											
Beginning Balance	2.42	2.42	4.13	8.90	26.92	52.29	77.33	92.78	92.78	92.78	92.78
Additions	-	1.71	4.77	18.02	25.37	25.04	15.46	-	-	-	-
Deletions	-	-	-	-	-	-	-	-	-	-	-
Ending Balance	2.42	4.13	8.90	26.92	52.29	77.33	92.78	92.78	92.78	92.78	92.78
WORK IN PROCESS											
Beginning Balance	0.16	0.16	-	-	-	-	-	-	-	-	-
Additions	-	1.55	4.77	18.02	25.37	25.04	15.46	-	-	-	-
Tranfers To Plant	-	1.71	4.77	18.02	25.37	25.04	15.46	-	-	-	-
Ending Bal	0.16	-	-	-	-	-	-	-	-	-	-
LAND											
Beginning Balance	1.85	1.85	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Inc/Dec)	-	0.36	-	-	-	-	-	-	-	-	-
Ending Balance	1.85	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
DEPRECIATION	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Existing Assets, USD million	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42
Depreciation on Old Assets	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of Existing Assets	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
New Assets											
KTC project	-	0.86	3.36	2.62	3.08	-	-	-	-	-	-
Priority Project	-	0.69	1.42	15.40	22.29	25.04	15.46	-	-	-	-
Others	-	-	-	-	-	-	-	-	-	-	-
Purchase of Land	-	0.36	-	-	-	-	-	-	-	-	-
Project Costs in Process	-	1.55	4.77	18.02	25.37	25.04	15.46	-	-	-	-
Transfers to Fixed Assets	-	1.71	4.77	18.02	25.37	25.04	15.46	-	-	-	-
Depreciation on New Projects	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of New Projects	-	-	0.03	0.14	0.23	0.33	0.33	3.01	3.01	3.01	3.01
Total Depreciation Expense	0.07	0.07	0.10	0.21	0.30	0.40	0.40	3.08	3.08	3.08	3.08
ACCUMULATED DEPRECIATION											
Beginning Balance	0.36	0.43	0.50	0.61	0.82	1.12	1.52	1.93	5.00	8.08	11.16
Depreciation Exp on Exisitng Plant	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Depreciation Exp on New Sub-Projects	-	-	0.03	0.14	0.23	0.33	0.33	3.01	3.01	3.01	3.01
Amort/Cap Int	-	-	-	-	-	-	-	-	-	-	-
Ending Balance	0.43	0.50	0.61	0.82	1.12	1.52	1.93	5.00	8.08	11.16	14.24
CAPITALIZED INTEREST											
Beginning Balance	-	-	0.04	0.27	0.99	2.51	4.04	6.20	6.20	6.20	6.20
Capitalized Interest	-	0.04	0.23	0.72	1.52	1.53	2.16	-	-	-	-
Ending Balance	-	0.04	0.27	0.99	2.51	4.04	6.20	6.20	6.20	6.20	6.20
CUSTOMER GUARANTEE DEPOSITS											
Beginning Balance	0.11	0.11	0.11	0.28	0.33	0.38	0.44	0.49	0.55	0.62	0.68
Guarantee Deposits											
- New Residential connections		-	0.18	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.07
- New commercial connections		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Increase/(Decrease)	-	0.00	0.18	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07
Ending Balance	0.11	0.11	0.28	0.33	0.38	0.44	0.49	0.55	0.62	0.68	0.75

SR8.6
Supporting Schedules 2
Proposed Tariff Study 2

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
FIXED ASSETS										
Beginning Balance	92.78	92.78	92.78	92.78	92.78	92.78	92.78	92.78	93.15	97.60
Additions	-	-	-	-	-	-	-	0.37	4.44	3.31
Deletions	-	-	-	-	-	-	-	-	-	-
Ending Balance	92.78	92.78	92.78	92.78	92.78	92.78	92.78	93.15	97.60	100.91
WORK IN PROCESS										
Beginning Balance	-	-	-	-	-	-	-	-	-	-
Additions	-	-	-	-	-	-	-	0.37	4.44	3.31
Tranfers To Plant	-	-	-	-	-	-	-	0.37	4.44	3.31
Ending Bal	-	-	-	-	-	-	-	-	-	-
LAND										
Beginning Balance	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Inc/Dec)	-	-	-	-	-	-	-	-	-	-
Ending Balance	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
DEPRECIATION	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Existing Assets, USD million	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42
Depreciation on Old Assets	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of Existing Assets	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
New Assets										
KTC project	-	-	-	-	-	-	-	-	-	-
Priority Project	-	-	-	-	-	-	-	0.37	4.44	3.31
Others	-	-	-	-	-	-	-	-	-	-
Purchase of Land	-	-	-	-	-	-	-	-	-	-
Project Costs in Process	-	-	-	-	-	-	-	0.37	4.44	3.31
Transfers to Fixed Assets	-	-	-	-	-	-	-	0.37	4.44	3.31
Depreciation on New Projects	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of New Projects	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.02	3.17	3.28
Total Depreciation Expense	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.09	3.24	3.35
ACCUMULATED DEPRECIATION										
Beginning Balance	14.24	17.32	20.40	23.48	26.56	29.64	32.72	35.80	38.89	42.13
Depreciation Exp on Exisitng Plant	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Depreciation Exp on New Sub-Projects	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.02	3.17	3.28
Amort/Cap Int	-	-	-	-	-	-	-	-	-	-
Ending Balance	17.32	20.40	23.48	26.56	29.64	32.72	35.80	38.89	42.13	45.48
CAPITALIZED INTEREST										
Beginning Balance	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20
Capitalized Interest	-	-	-	-	-	-	-	-	-	-
Ending Balance	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20
CUSTOMER GUARANTEE DEPOSITS										
Beginning Balance	0.75	0.79	0.83	0.86	0.90	0.94	0.99	0.99	0.99	0.99
Guarantee Deposits										
- New Residential connections	0.03	0.03	0.03	0.03	0.04	0.04	-	-	-	-
- New commercial connections	0.00	0.00	0.00	0.00	0.00	0.01	-	-	-	-
Total Increase/(Decrease)	0.04	0.04	0.04	0.04	0.04	0.04	-	-	-	-
Ending Balance	0.79	0.83	0.86	0.90	0.94	0.99	0.99	0.99	0.99	0.99

SR8.6
Supporting Schedules 2
Proposed Tariff Study 2

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

In US$ Million

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FIXED ASSETS										
Beginning Balance	100.91	103.12	103.12	103.12	103.12	103.12	103.12	103.12	103.12	103.12
Additions	2.21	-	-	-	-	-	-	-	-	-
Deletions	-	-	-	-	-	-	-	-	-	-
Ending Balance	103.12	103.12	103.12	103.12	103.12	103.12	103.12	103.12	103.12	103.12
WORK IN PROCESS										
Beginning Balance	-	-	-	-	-	-	-	-	-	-
Additions	2.21	-	-	-	-	-	-	-	-	-
Tranfers To Plant	2.21	-	-	-	-	-	-	-	-	-
Ending Bal	-	-	-	-	-	-	-	-	-	-
LAND										
Beginning Balance	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Inc/Dec)	-	-	-	-	-	-	-	-	-	-
Ending Balance	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
DEPRECIATION	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Existing Assets, USD million	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42
Depreciation on Old Assets	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of Existing Assets	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
New Assets										
KTC project	-	-	-	-	-	-	-	-	-	-
Priority Project	2.21	-	-	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	-	-	-
Purchase of Land	-	-	-	-	-	-	-	-	-	-
Project Costs in Process	2.21	-	-	-	-	-	-	-	-	-
Transfers to Fixed Assets	2.21	-	-	-	-	-	-	-	-	-
Depreciation on New Projects	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Depreciation of New Projects	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35
Total Depreciation Expense	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42
ACCUMULATED DEPRECIATION										
Beginning Balance	45.48	48.90	52.33	55.75	59.18	62.60	66.02	69.45	72.87	76.30
Depreciation Exp on Exisitng Plant	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Depreciation Exp on New Sub-Projects	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35
Amort/Cap Int	-	-	-	-	-	-	-	-	-	-
Ending Balance	48.90	52.33	55.75	59.18	62.60	66.02	69.45	72.87	76.30	79.72
CAPITALIZED INTEREST										
Beginning Balance	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20
Capitalized Interest	-	-	-	-	-	-	-	-	-	-
Ending Balance	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20
CUSTOMER GUARANTEE DEPOSITS										
Beginning Balance	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Guarantee Deposits										
- New Residential connections	-	-	-	-	-	-	-	-	-	-
- New commercial connections	-	-	-	-	-	-	-	-	-	-
Total Increase/(Decrease)	-	-	-	-	-	-	-	-	-	-
Ending Balance	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

SR8.7

Supporting Schedules 3
Proposed Tariff Study 2

Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%

MOVEMENT OF ACCOUNTS

US$ Million

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ACCOUNTS & CONNECTIONS RECEIVABLE											
Beginning Balance	0.10	0.07	0.08	0.27	0.23	0.27	0.31	0.35	0.50	0.56	0.63
Bad Debt Write-Offs	-	-	-	-	-	-	-	-	-	-	-
Ending Balance	0.07	0.08	0.27	0.23	0.27	0.31	0.35	0.50	0.56	0.63	0.70
Inc/(Dec)	(0.03)	0.00	0.20	(0.04)	0.04	0.04	0.04	0.15	0.06	0.07	0.07
INVENTORIES											
Beginning Balance	0.22	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36
Ending Balance	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36	0.38
Inc/(Dec)	(0.12)	-	0.05	0.04	0.05	0.01	0.01	0.05	0.03	0.03	0.02
ACCOUNTS PAYABLE											
Beginning Balance	0.34	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36
Ending Balance	0.10	0.10	0.14	0.19	0.24	0.25	0.26	0.30	0.33	0.36	0.38
Inc/(Dec)	(0.24)	-	0.05	0.04	0.05	0.01	0.01	0.05	0.03	0.03	0.02
CASH ACCOUNT											
Beginning Balance	0.67	0.03	0.03	0.05	0.06	0.08	0.08	0.09	0.10	0.11	0.12
Ending Balance	0.03	0.03	0.05	0.06	0.08	0.08	0.09	0.10	0.11	0.12	0.13
Inc/(Dec)	(0.64)	-	0.02	0.01	0.02	0.00	0.00	0.02	0.01	0.01	0.01
SAVINGS ACCOUNTS											
Beginning Balance	-	0.70	0.27	1.59	1.74	1.07	0.10	0.06	0.15	0.86	2.13
Ending Balance	0.70	0.27	1.59	1.74	1.07	0.10	0.06	0.15	0.86	2.13	4.07
Inc/(Dec)	0.70	(0.43)	1.32	0.15	(0.68)	(0.97)	(0.03)	0.08	0.71	1.27	1.94
PREPAID EXPENSES & ADVANCE PAYMENTS											
Beginning Balance	0.04	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.06
Ending Balance	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06
Inc/(Dec)	(0.03)	-	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00
INCOME TAX PAYABLE											
Beginning Balance		-	-	-	-	-	-	-	-	-	-
Additions	0.01	0.01	0.41	0.21	0.20	0.10	0.19	-	-	-	-
Payments	0.01	0.01	0.41	0.21	0.20	0.10	0.19	-	-	-	-
Ending Balance	-	-	-	-	-	-	-	-	-	-	-
CAPITAL ACCOUNT											
Beginning Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Capital Contributions	-	-	-	-	-	-	-	-	-	-	-
Ending Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
RETAINED EARNINGS											
Beginning Balance	0.31	0.36	0.41	2.03	2.88	3.68	4.08	4.84	2.10	(0.09)	(1.71)
Net Income	0.05	0.05	1.62	0.84	0.81	0.40	0.76	(2.74)	(2.19)	(1.62)	(0.93)
Distributions											
Ending Balance	0.36	0.41	2.03	2.88	3.68	4.08	4.84	2.10	(0.09)	(1.71)	(2.64)

SR8.7

Supporting Schedules **Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%**

Proposed Tariff Study 2

MOVEMENT OF ACCOUNTS

US$ Million

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ACCOUNTS & CONNECTIONS										
Beginning Balance	0.70	0.72	0.79	0.84	0.89	0.95	1.00	0.98	0.98	0.98
Bad Debt Write-Offs	-	-	-	-	-	-	-	-	-	-
Ending Balance	0.72	0.79	0.84	0.89	0.95	1.00	0.98	0.98	0.98	0.98
Inc/(Dec)	0.03	0.07	0.05	0.05	0.05	0.05	(0.02)	-	-	-
INVENTORIES										
Beginning Balance	0.38	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49
Ending Balance	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49	0.49
Inc/(Dec)	0.02	0.03	0.01	0.02	0.02	0.01	0.01	-	-	-
ACCOUNTS PAYABLE										
Beginning Balance	0.38	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49
Ending Balance	0.40	0.42	0.44	0.45	0.47	0.48	0.49	0.49	0.49	0.49
Inc/(Dec)	0.02	0.03	0.01	0.02	0.02	0.01	0.01	-	-	-
CASH ACCOUNT										
Beginning Balance	0.13	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.16	0.16
Ending Balance	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16
Inc/(Dec)	0.01	0.01	0.00	0.01	0.01	0.00	0.00	-	-	-
SAVINGS ACCOUNTS										
Beginning Balance	4.07	4.12	4.76	5.91	7.45	9.40	11.71	13.76	15.41	13.00
Ending Balance	4.12	4.76	5.91	7.45	9.40	11.71	13.76	15.41	13.00	11.72
Inc/(Dec)	0.05	0.64	1.15	1.54	1.94	2.31	2.05	1.65	(2.41)	(1.28)
PREPAID EXPENSES & ADVA										
Beginning Balance	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Ending Balance	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08
Inc/(Dec)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-
INCOME TAX PAYABLE										
Beginning Balance	-	-	-	-	-	-	-	-	-	-
Additions	-	-	-	0.10	0.22	0.33	0.28	0.30	0.29	0.29
Payments	-	-	-	0.10	0.22	0.33	0.28	0.30	0.29	0.29
Ending Balance	-	-	-	-	-	-	-	-	-	-
CAPITAL ACCOUNT										
Beginning Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Capital Contributions	-	-	-	-	-	-	-	-	-	-
Ending Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
RETAINED EARNINGS										
Beginning Balance	(2.64)	(3.99)	(4.61)	(4.69)	(4.28)	(3.39)	(2.06)	(0.92)	0.28	1.45
Net Income	(1.34)	(0.63)	(0.07)	0.40	0.89	1.34	1.14	1.20	1.17	1.16
Distributions										
Ending Balance	(3.99)	(4.61)	(4.69)	(4.28)	(3.39)	(2.06)	(0.92)	0.28	1.45	2.61

SR8.7

Supporting Schedules **Interest NPV=4.5%: Grace period @3%, IDC 100% capitalized and Repayment 1st 10 years @3.75%, next 10 years @7.50% and last 10 years @10.405%**

Proposed Tariff Study 2

MOVEMENT OF ACCOUNTS

US$ Million

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ACCOUNTS & CONNECTIONS										
Beginning Balance	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Bad Debt Write-Offs	-	-	-	-	-	-	-	-	-	-
Ending Balance	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Inc/(Dec)	-	-	-	-	-	-	-	-	-	-
INVENTORIES										
Beginning Balance	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51
Ending Balance	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51
Inc/(Dec)	-	0.01	-	-	-	-	0.01	-	-	-
ACCOUNTS PAYABLE										
Beginning Balance	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51
Ending Balance	0.49	0.50	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51
Inc/(Dec)	-	0.01	-	-	-	-	0.01	-	-	-
CASH ACCOUNT										
Beginning Balance	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Ending Balance	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Inc/(Dec)	-	0.00	-	-	-	-	0.00	-	-	-
SAVINGS ACCOUNTS										
Beginning Balance	11.72	10.20	10.81	11.42	12.04	12.65	13.27	13.80	14.28	14.72
Ending Balance	10.20	10.81	11.42	12.04	12.65	13.27	13.80	14.28	14.72	15.11
Inc/(Dec)	(1.52)	0.61	0.62	0.62	0.62	0.62	0.53	0.49	0.44	0.39
PREPAID EXPENSES & ADVA										
Beginning Balance	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Ending Balance	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Inc/(Dec)	-	0.00	-	-	-	-	0.00	-	-	-
INCOME TAX PAYABLE										
Beginning Balance	-	-	-	-	-	-	-	-	-	-
Additions	-	-	-	-	-	-	0.01	0.05	0.10	0.15
Payments	-	-	-	-	-	-	0.01	0.05	0.10	0.15
Ending Balance	-	-	-	-	-	-	-	-	-	-
CAPITAL ACCOUNT										
Beginning Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
Capital Contributions	-	-	-	-	-	-	-	-	-	-
Ending Balance	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
RETAINED EARNINGS										
Beginning Balance	2.61	1.76	0.98	0.35	(0.12)	(0.40)	(0.49)	(0.46)	(0.25)	0.15
Net Income	(0.85)	(0.78)	(0.63)	(0.46)	(0.28)	(0.09)	0.03	0.21	0.40	0.61
Distributions										
Ending Balance	1.76	0.98	0.35	(0.12)	(0.40)	(0.49)	(0.46)	(0.25)	0.15	0.76

Supporting Report

Chapter 10
Environmental and Social Considerations

Chapter 1. Environmental Impact Assessment

1-1 Project Summary

1-1-1 Project Title

The Siem Reap Water Supply Expansion Project in The Kingdom of Cambodia

1-1-2 Type of the Study

In Cambodia Initial Environmental Impact Assessment (IEIA) / Environmental Impact Assessment (EIA) should be conducted for the project whose purpose is to supply drinking water to more than 10,000 people (Sub-Decree on EIA Process NO.72, 1999). At the same time EIA should be conducted for the project whose site is located in Zone 5 of protected area designated by APSARA. Zone 5 comprises whole area of Siem Reap Province. The region is to be managed as a multiple-use area with an emphasis on economic and social development of cultural tourism. Development activities which could potentially damage the archaeological, the natural, or the social heritage harbored in the province are regulated by comprehensive coordination policies. Environmental impact assessments are to be carried out in advance of any project proposed in the region. The Type of the Study is a feasibility study. Environmental Impact Assessment (EIA) shall be conducted for Feasibility Study on the priority project to be implemented in short term.

1-1-3 Methodology and Result of Screening

Department of EIA Review and Monitoring, Ministry of Environment (MOE) in Cambodia is preparing "Guideline for conducting EIA Report" and the draft Guideline proposes the composition of EIA Report shown in **Table 1-1**.

Table 1-1 Composition of EIA Report in Draft Guideline in Cambodia

1. Project Summary
2. Introduction
3. Purpose of the Project
4. Project Description
5. Description of Environmental Resources
   - 5.1 Physical resources (Air, Water, Land/Soil/Geology)
   - 5.2 Ecological resources (Biodiversity, Fauna, Flora, Forest)
   - 5.3 Socio-economical resources (Population, Infrastructure, Land use, Public health and welfare, Economic condition, Custom, Tradition, Ethnic group
6. Public Participation
7. Environmental Impact Analysis (Construction, Operation, Closure)
8. Environmental Impact Mitigation Measures
9. Economical Analysis and the Environmental value
10. Environmental Management Plan (Monitoring Program)
11. Institutional capacity
12. Conclusion and Suggestion
13. Reference

Since the following environmental items should be considered additionally in EIA report for this project compared with JICA/JBIC Guideline, EIA for this project should be prepared to fit the requirement of JICA/JBIC Guideline, based on the draft Guideline of Cambodia. (**Figure 1-1**)

- Wastes
- Noise & Vibration
- Subsidence
- Protected Areas
- Resettlement
- Living & Livelihood
- Heritage
- Landscape
- Working Conditions

According to the advice from the Department of EIA, MOE, screening system for EIA is now under consideration in Cambodia and it may be a similar type of JICA/JBIC Guideline. Therefore, for this project screening was carried out based on mainly JBIC Guidelines because the project is intended for a Japanese Yen loan.

The criteria of JBIC are as follows;

Category A: likely to have significant adverse impacts

Category B: potential adverse impacts are less than those of Category A projects

Category C: likely to have minimal or little adverse impacts

The project is classified as 'Category B' because the mitigation measures can be considered although the project may give some impact on environmental and social situation.

The result of screening is as shown in Table 1-2.

There may be possibility of twelve (12) impacts on environmental and social situation as follows:

i) Air Quality
ii) Water Quality
iii) Wastes
iv) Noise & Vibration
v) Hydrology
vi) Protected Areas
vii) Ecosystem and Biota
viii) Living & Livelihood
ix) Heritage
x) Landscape
xi) Impacts during Construction
xii) Monitoring

Draft Guideline of Cambodia	
NO	Items
Physical resources	
1.	Air
2.	Water
3.	Land/Soil/Geology
Ecological resources	
4.	Biodiversity
5.	Fauna
6.	Flora
7.	Forest
Socio-economical resources	
8.	Population
9.	Infrastructure
10.	Land use
11.	Public health & welfare
12.	Economic condition
13.	Custom
14.	Tradition
15.	Ethnic group
16.	Public participation
17.	Economic analysis
18.	Monitoring program
19.	Institutional capacity

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Guideline of JBIC	
NO	Items
Mitigation measures	
1.	Air quality
2.	Water quality
3.	Wastes
4.	Noise & Vibration
5.	Subsidence
6.	Hydrology
Natural environment	
7.	Protected area
8.	Ecosystem & biota
Social Environment	
9.	Resettlement
10.	Living & livelihood
11.	Heritage
12.	Landscape
13.	Ethnic minorities & Indigenous peoples
Others	
14.	Impacts during construction
15.	Monitoring

=

Items for this Project	
NO	Items
Physical resources	
1.	Air quality
2.	Water quality
3.	Wastes
4.	Noise & Vibration
5.	Subsidence
6.	Hydrology
7.	Land
Ecological resources	
8.	Protected area
9.	Flora & Forest
10.	Fauna
Socio-economical resources	
11.	Resettlement
12.	Population
13.	Infrastructure
14.	Land use
15.	Public health & welfare
16.	Economic condition (Living & livelihood)
17.	Heritage
18.	Land acquisition
19.	Public participation
Others	
20.	Impacts during construction
21.	Monitoring
22.	Economic analysis
23.	Institutional capacity

Figure 1-1 Items to be studied for Environmental and Social Considerations in this study

Table 1-2 The Result of Screening

NO	Environmental Item	Impact	Description
Mitigation Measures			
(1)	Air Quality	x	Although the project owner has an experience with treatment of chlorine, the management plan of chlorine during operation of water treatment facility shall be checked.
(2)	Water Quality	x	Preliminary design of effluent discharged from water treatment facility shall be checked.
(3)	Wastes	x	Sludge disposal plan shall be checked based on the preliminary design.
(4)	Noise & Vibration	x	Design element for noise and vibration shall be checked as well as land use around the pumping station and water treatment facility.
(5)	Subsidence		Extraction of a large volume of groundwater is not planned for this project because surface water from Tonle Sap Lake is utilized for water source.
(6)	Hydrology	x	Wastewater volume will increase due to expansion of water supply system and it might be source of water pollution.
Natural Environment			
(1)	Protected Areas	x	Although there are many kind of protected areas designated by Cambodian laws in the study area, the project site can be located outside of the protected areas. The preliminary design shall be checked and mitigation measures shall be introduced to reduce environmental impact on the protected areas.
(2)	Ecosystem and biota	x	Since the project site will encompass inundated forests where fish produces eggs, the area to be altered should be minimized by proper design, and flora and fauna shall be examined by field survey to assess impact on ecosystem.
Social Environment			
(1)	Resettlement		Involuntary resettlement will not be caused by project implementation.
(2)	Living and Livelihood	x	Efforts should be made to minimize the impacts caused by land acquisition. There might be a possibility that the project adversely affects the water area uses if water intake disturbs the current navigation and fishing. The preliminary design of water intake shall be checked.
(3)	Heritage	x	There will be little possibility that the project damages the local archeological, historical, cultural and religious heritage sites. However, construction of the facility for the project should be conducted with caution not to give impact on the heritage site after it is uncovered.
(4)	Landscape	x	The appearance of water intake tower may give some impact on the landscape.
(5)	Ethnic Minorities and Indigenous Peoples		The Khmer is dominant race in the study area. The Vietnamese and the Cham are living in and around Tonle Sap Lake. The Kuy is ethnic minority living in northern part of Siem Reap Province. There is little impact on ethnic minorities and indigenous peoples.
(6)	Working Conditions		There is little adverse impact on working condition of SRWSA.
Others			
(1)	Imapcts during Construction	x	Noise, vibrations, turbid water, dust, exhaust gases and wastes, impact on ecosystem and social environment, health and safety education for traffic safety, accident, public health, infectious diseases shall be checked based on preliminary design and basic plan.
(2)	Monitoring	x	SRWSA must develop and implement monitoring program for the environmental items that are considered to have potential impacts, including accident.

x means that some impact may be expected.

1-1-4 Responsible agencies which implement the project

Siem Reap Water Supply Authority

1-1-5 Background of the Project

1-1-5-1 Background

The town of Siem Reap, the object area of this Study, with a population of 173,000 (in 2008) is located approximately 5 km south to the Angkor World Heritage Site and about 2,000,000 tourists visit the city yearly. The existing water treatment facility which was constructed under Japanese grant aid in 2006 has a capacity of 8,000m^3/d. This water supply capacity is too small compared with 43,200m^3/day which is the water demand in 2015 projected by SRWSA. In addition, Siem Reap is under threat of land subsidence which is a social problem, caused largely by the many hotels operating around the heritage site coupled with a sharp increase in tourism related industries which has resulted in uncontrolled abstraction of groundwater sources in the area. As a result of the circumstances mentioned above, JICA decided to conduct this Study for the expansion of the water supply system in Siem Reap Town.

1-1-5-2 Study Area

The study area covers all the communes of the newly established Siem Reap City and one adjacent commune, Kandaek, of the City, a total of 14 communes as shown in the map of the Study Area.

1-1-5-3 Target Year

The target year for Feasibility Study is 2022.

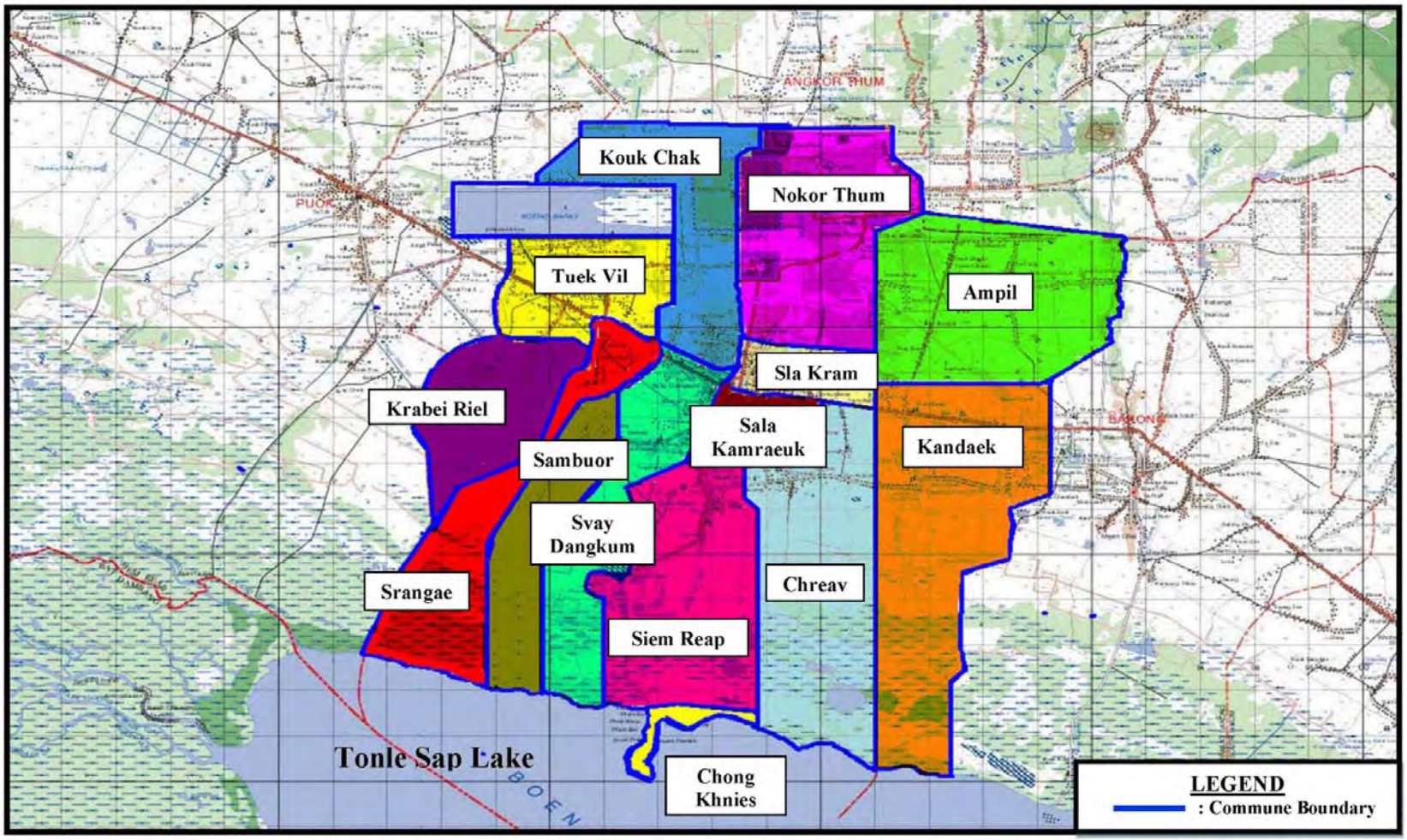


Figure 1-2 Study Area (13 Communes in Siem Reap City+ Kandaek Commune) ***(Source: JICA Study Team)***

1-2 Project Description

Feasibility Study (F/S = Priority Project) shall provide a new intake facility, a treatment plant, a transmission/distribution systems to supply additional water required for the existing Siem Reap service area, elevated water tank with clear water lifting pump facilities, distribution pipelines from the proposed elevated water tank to the existing distribution system, and expansion of distribution network to un-served areas. Facilities provided in this project are as shown in Table 1-3 and **Figure 1-3**.

Although the nominal design capacity for Priority Project is 30,000m^3/day which will meet the water demand in 2022, main part of raw water conveyance pipelines, water intake structure, and administrative common facilities will be sized for Long Term Development Plan (target year 2030) capacity, which nominal design capacity would be 60,000m^3/day. Ten percent allowances will be added to design the works for loss through the works. Distribution of water to Siem Reap service areas under Priority Project will be for those communes as Sla Kram, Svay Dangkum, Sala Kamraeuk, Kouk Chak, Siem Reap, Chreav, and Nokor Thum.

The population served by the project will be 232 thousand of residents and 27 thousand of tourists, respectively.

Tonle Sap Lake water was selected as the most appropriate raw water for the proposed water supply development scheme among three alternatives, Tonle Sap Lake water, the water from the West Baray and Groundwater.

Table 1-3 Facilities provided in the F/S Project

NO	Facility	Description
a)	Raw water conveyance pipelines	Capacity of raw water conveyance pipelines; D=1,200mm, 66,000 m^3/day including 10% allowances for the nominal design capacity for the Long Term Development Plan
b)	Raw water intake pump station	Space of the pump station is sized for the Long Term Development Plan. Priority Project facilities includes only for capacity of 33,000m^3/day (additional pumps will be expanded in further construction)
c)	Raw water intake pipe	Pipes used for raw water transmission main from raw water transmission pump station to WTP, D=800mm. DI pipes of 3,400m length to satisfy a capacity of 33,000 m^3/day
d)	WTP	Production capacity of 30,000 m^3/day
e)	Clear water pumps	Deliver 30,000 m^3/day to the elevated water tank
f)	Clear water pump station, chemical building, administration building, etc.	
g)	Elevated water tank	2,000 m^3 will be allocated in WTP
h)	Distribution main from treatment plant to service areas	Approximately 62 km. of distribution main system. DI pipes from D=250mm to 1,000mm, and PE/uPVC pipes from D=50mm to 200mm
i)	Distribution pipelines	In the distribution system 421 km of PE and uPVC pipes will be used, dependent on pipe sizes
j)	Communication and power supply to intake, pumping station and WTP	

k)	Plant and equipment necessary for operation and maintenance

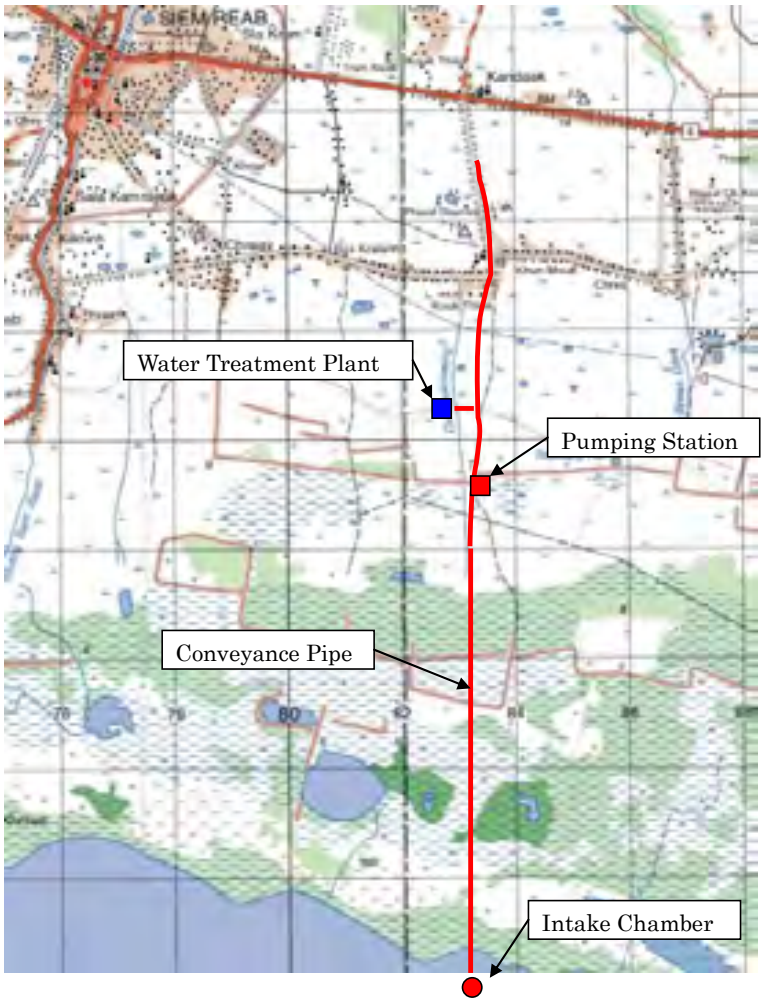


Figure 1-3 Location of Facilities

1-2-1 Water Intake System

Raw water intake system and intake chamber are as shown in **Figure 1-4**. The raw water conveyance pipes are of 1,200mm diameter and the trench for the pipes will be excavated approximately 30m wide. Configuration of intake chamber is 10,000 mm wide x 11,000 mm long x 4,370mm deep.

1-2-2 Intake Pump Station

Three units will be required, one as a standby unit. With each unit pumping at 16,500 m^3/day (0.191 m^3/s), two units will meet 33,000 m^3/day flow with a third as standby and space will be left for three more pumps to meet the demand for the Long Term Development Plan.

As the Lake water level fluctuates about 10 m during the year, the pump motors need to be safe

from the high water level and the pump impeller and suction need to be located below low water level. As the length of raw water transmission main is approximately 3.4 km from the raw water intake pump station to the WTP, a pipe of 800 mm diameter is to be used.

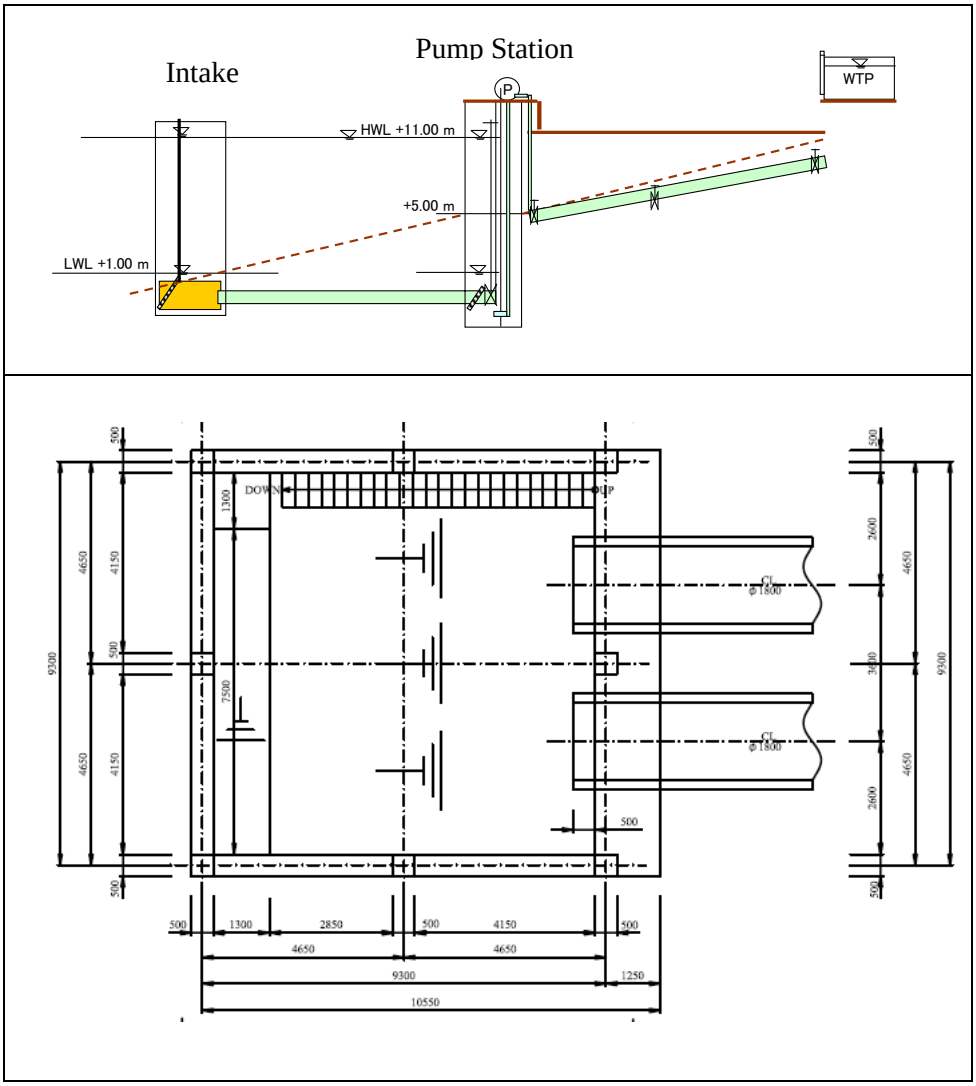


Figure 1-4 Raw Water Intake System & Plan of Chamber

1-2-3 Raw Water Intake Pipe

Pipes used for raw water transmission main from raw water transmission pump station to WTP should be of 800 mm dia. DI pipes of 3,400 m length to satisfy the capacity of 33,000 m^3/day.

1-2-4 Water Treatment Plant

The plan of Water Treatment Plant is as shown in **Figure 1-5**.

Pretreatment

Coagulation, as a pre-treatment process will be provided in the distribution chamber at the head of the plant so that the destabilization of charges on colloids and suspended solids, including bacteria and viruses, may be achieved. The coagulation process will be achieved by a rapid mixing system which will disperse 10 percent alum sulphate solution, $Al_2 (SO_4)_3 \cdot 18H_2O$ as a coagulant uniformly throughout the water as rapidly as possible.

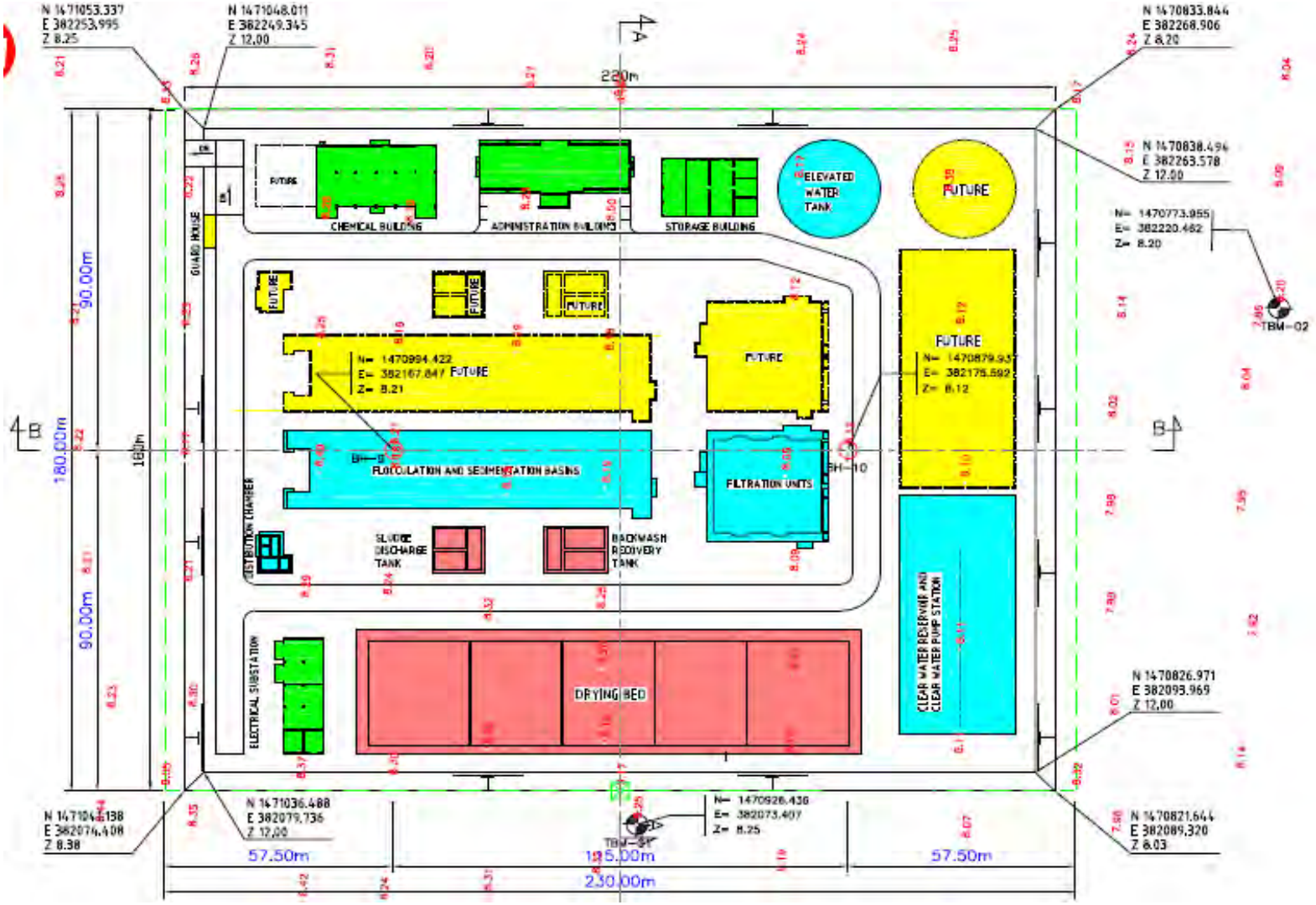


Figure 1-5 Plan of Water Treatment Plant

Flocculation

Flocculation is the process of gentle and continuous agitation, during which suspended particles in the water coalesce into larger masses so that they may be removed from the water in subsequent treatment processes, particularly by sedimentation. Flocculation follows directly after the rapid mix process and, like rapid mixing, the agitation may be induced either by mechanical or hydraulic means.

As gravity flow is available, the proposed approach for this project is to use hydraulic flocculators that do not require mechanical equipment nor a continuous power supply. They can be built primarily from local materials including concrete, brick, wood, or masonry at relative low cost.

Sedimentation

The sedimentation, or clarification, process in water treatment provides for the settling and removal of a majority of the heavier and larger settleable solids and suspended particles from water prior to the filtration process.

Chemical Applications and Chlorination

Alum as a coagulant, lime for pH control, and liquid chlorine as a disinfectant or oxidant will be employed on the Project, the same as the existing Phum Prek or other PPWSA WTPs.

Chlorine will be supplied in tonne containers of liquid chlorine. The facilities will include all equipment for storage, handling, dosage and injection of chlorine, together with safety equipment. The operation of the chlorinators will be controlled on a "START-STOP" basis according to the level in the distribution chamber and/or clear water reservoir, similar to that detailed for the existing facilities of SRWSA or PPWSA WTPs.

Sludge Treatment

Sludge from the sedimentation basins is conveyed to sludge discharge tank by gravity and pumped to sludge drying bed. Five sludge drying bed, of each 25 m x 23 m x 0.6 m effective depth, are provided at the low elevated area of the site. Each bed has a volume of 345 m^3 which allows two month's storage of sludge. During the first two month, No. 1 bed will receive the sludge from the sludge discharge tank. The following four months will be a period for drying the sludge and extracting the dried sludge.

1-2-5 Transmission/Distribution Pipelines

The initial network model incorporates 4 blocks representing a total length of 490km of distribution pipelines. The analysis focused on pipes with diameters greater than 50mm up to 1,000mm, which increase to a total of 490km pipelines by 2017, including 32km of main

pipelines from 400mm up to 1,000mm, 91 km of sub-main pipelines between 150mm and 350mm, and 362km of branch pipelines from 50mm to 100mm.

1-2-6 Outline of Construction

The wet season occurs from May till November. The dry season occurs from December to April. The water level of Tonle Sap Lake in the wet season becomes high which reaches 11 meter above MSL. The construction works of Intake Chamber, Conveyance Pipeline and Intake Pumping Station should be completed within the dry season, otherwise some auxiliary work will increase the construction cost and extend the construction period.

The ground water level is high in connection with the water level of Tonle Sap Lake. The intake chamber, a part of the proposed water conveyance pipeline and the proposed intake pumping station, will be installed completely under the groundwater. Dewatering should be necessary for earth works.

The field office will control the construction works for the intake chamber, raw water conveyance pipelines, raw water intake pump station, and raw water conveyance mains. A temporary and/or access roads will be required to maintain the daily activities of the Contractors around the site. The Contractor is recommended to provide a temporary filed office to supervise the following sophisticated construction works effectively in close collaboration with the construction works.

(1) General

- Construct access road to the site by cutting and/or filling with imported earth and/or gravels
- Provide temporary fencing
- Clear site and provide site office, stores, workshop, and parking area for vehicles, plant and equipment
- Establish water, electricity and telephone services
- Divert waterways as required
- Remove the trees from the route of access road

(2) Raw Water Intake Chamber, Raw Water Conveyance Pipelines, Raw Water Intake Pump Station, Raw Water Conveyance Main

- Place access road to the Tonle Sap lake site and pump station site
- Place coffer dam at the construction area within the Tonle Sap Lake
- Provide dewatering and excavate soil to the required formation level
- Cast the concrete structure with openings left for pipe works, penstocks etc.
- Install pipes, gates, penstocks, ladders, pumps and other M & E works.
- Test for water tightness and repair if there are leakages.
- Remove coffer dam
- Remove surplus earth, debris etc. and dispose of at an approved location
- Test run the plant
- Provide landscaping
- Commission the plant.

1-3 Description of Environmental Resources

1-3-1 Physical resources

1-3-1-1 Air Quality

It is presumed that emissions from small-scale power generators and traffic mainly contribute to air pollution in Siem Reap City because no other pollution sources, such as large-scale factories, exist in the area. Ambient concentrations of some air pollutants in the City are shown in **Table 1-4**. The concentration of NO_2 is much lower than the standard of Cambodia both in dry and rainy seasons. It is estimated that the concentrations of SO_2 and CO are also below the standard though the comparison between the standards and the detected cannot be done because the exposing time of detectors were not consistent with the standard time. No data is available on particulate matters (PM) or total suspended particulate (TSP), but the City is dusty because traffic lifts dusts mainly derived from unpaved roads. (*Source*: *The Study on Integrated Master Plan For Sustainable Development of Siem Reap / Angkor Town, JICA, 2006)*
Also because Siem Reap is part of the alluvial plains, sandstone deposits from the escarpment make the surface ground sandy. However, during rainy season, TSP in the air is washed down by daily heavy rain.

Table 1-4 Air Quality in Siem Reap City (2004)

Parameter	February 2004				July 2004				Standard
	Angkor Heritage Area		South of Heritage Area		Angkor Heritage Area		South of Heritage Area		
	1 week average	max	1week average	max	1 week average	max	1week average	max	
NO2 (mg/m3) 24hrs average	0.026	0.043	0.021	0.043	0.028	0.043	0.009	0.009	0.1
SO2 (mg/m3) 10hrs average	<0.06	–	<0.06	–	<0.06	–	<0.06	–	0.3 (24 hrs average)
CO (mg/m3) (24hrs average)	1.20	1.60	0.86	1.00	1.00	1.60	0.68	1.00	20 (8 hrs average)

(*Source*: *The Study on Integrated Master Plan For Sustainable Development of Siem Reap / Angkor Town, JICA, 2006)*

1-3-1-2 Water Quality

It is necessary to grasp the situation of three kinds of water like surface water of river and lake and groundwater.

Siem Reap River

Domestic sewage, commercial waste, agricultural run-off, and untreated solid waste pollute surface and groundwater in the country. Increasing concentrations of coliform bacteria, a presence in water that indicates fecal contamination, represent a serious health risk, especially during April and July. Sedimentation from land clearing, from both commercial and subsistence

farming, also contribute to overall decrease in water quality (World Bank 2003). While other survey samples of groundwater have shown no heavy metal contamination of groundwater in Siem Reap City, iron and manganese content is higher than permitted by the World Health Organization (JICA 2005 survey, JICA 2006). The cause is likely corrosion of iron pipes and pumps. This high iron content, while without direct health effects, does affect taste and color, and is associated with higher cleaning and repair costs. The same survey shows high levels of pH (acidity), nitrate, and fluoride which make water unsafe to drink without treatment, while shallow aquifers are often contaminated with microbes (JICA 2005). Siem Reap River and Tonle Sap Lake are contaminated with effluents as both are the final discharge points for the drainage system. The volume loads of these water bodies dilute pollutants that become less harmful to human and animal life. Water quality of water bodies also vary by season and by flood level. However, high volumes of feces, urine and gray water are released daily in inland and groundwater bodies in the country. There are regional differences in BOD. Although Siem Reap River contains chemical and biological pollutants due to domestic waste discharged into it, water can be flushed out with upstream water during the rainy season.

Tonle Sap Lake

i) Result of Water Quality Analysis by JICA Study Team

A water quality analysis was undertaken by JICA Study Team to examine the safety and appropriateness of the water for potable use and also to give reference data for the design of water treatment facilities. The general conditions of water sampling and analyses are summarized in Table 1-5 and Table 1-6.

Table 1-5 Summary of Water Sampling and Analysis Survey Method

Items	Descriptions
Location (See **Figure 1-6**)	Tonle Sap Lake (near the tentatively proposed intake site, Area name: Kbal Chhroy Mleangiem, Chong Khneas Commune, Siem Reap City, Approx 11 km from Phnom Krom, approx15 km from the central zone of the Province (Phsar Leu), and approx 4 km from the outlet of the existing canal)
Coordinates of sampling site	X:378209, Y:1462006
Sub contractor	Key Consultants Cambodia, Team Leader: Mr. Taing Sophannara
Laboratory for the test	Ministry of Environment
Sampling Frequency and Time	2 times (Low water season and High water season)
Methods of measurement and analysis	Followed by the Japanese and Cambodia standard (Note: Examination method of each parameter is shown in the table below)
Examination items	32 items in total (See the tables for the results of examination)

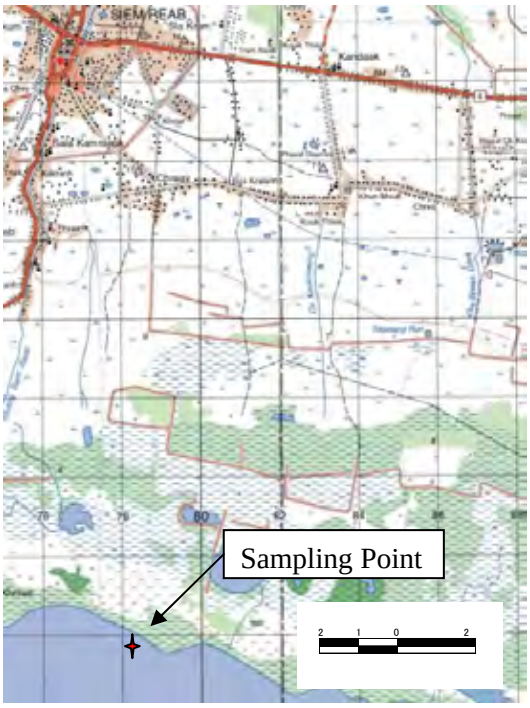


Figure 1-6 Location of water sampling point

Table 1-6 Examination Method for Each Parameter

N°	Items	Method
1	Dissolved Oxygen (DO)	DO Meter
2	Total Suspended Solid (TSS)	Dried at 105^0C
3	pH	pH Meter
4	Odour	Directly inhale
5	Taste	Directly drinking
6	Colour	Nephelometric
7	Turbidity	Photometer
8	Transparency	Shechi dist
9	Nitrite (NO_2)	IC (Anion) ICS 90 Dionec
10	Nitrate (NO_3)	IC (Anion) ICS 90 Dionec
11	Ammonium-N	IC (Cation) ICS 90 Dionec
12	Chloride	IC (Anion) ICS 90 Dionec
13	Total nitrogen	$K_2S_2O_8$ Decomposition UV
14	Total phosphate	$K_2S_2O_8$ Decomposition Molybdenum blue
15	Iron	EPA – ICP MS (ELAN 9000)
16	Manganese	EPA – ICP MS (ELAN 9000)
17	Hardness	Titration
18	Total Dissolved Solid (TDS)	TDS Meter
19	Total coliform	MPN Multiple Tubes
20	E-coli	Microplate
21	Alkalinity	Titration
22	Cyanide	Pyridin – Pyrazolons Spectrophotometer
23	Mercury	EPA – ICP MS (ELAN 9000)
24	Copper	EPA – ICP MS (ELAN 9000)
25	Zinc	EPA – ICP MS (ELAN 9000)
26	Lead	EPA – ICP MS (ELAN 9000)
27	Hexavalent chromium	Diphenylcarbazide (Spectrophotometer)
28	Cadmium	EPA – ICP MS (ELAN 9000)
29	Arsenic	EPA – ICP MS (ELAN 9000)
30	Fluoride	IC (Anion) ICS 90 Dionec
31	Phenols	Distitation
32	Chlorophyll a	Aceton-Methanol Extraction Spectrophotometer

The results of water quality examination which has been carried out two times in 2009 are shown in Table 1-7 and Table 1-8.

Table 1-7 Water Quality Data by The Team (June 29, 2009)

No.	Description of Item	Unit	MIME-DWQS	S1
A	**Microbiological Test**			
1	Total coliform	Count/100ml	0	9.3×10^2
2	E.coli	MPN/100ml	0	56
B	**Physical and Chemical Test**			
3	pH		6.5-8.5	7.7
4	DO	mg/l	>6	5.4
5	Total Suspended Solid (TSS)	mg/l		498
6	Odour	-		Slight muddy
7	Taste (Threshold taste)	-		Acceptable
8	Color	Pt-4		100
9	Turbidity	NTU	5	200
10	Transparency	Dept (cm)		2.5
11	Nitrite (NO_2)	mg/l	3	ND<0.1
12	Nitrate (NO_3)	mg/l	50	2.53
13	Ammonium-N	mg/l	1.5	0.05
14	Chloride	mg/l	250	6.81
15	Total nitrogen	mg/l		3.50
16	Total phosphate	mg/l		1.04
17	Iron	mg/l	0.3	3.333
18	Manganese	mg/l	0.1	0.05604
19	Hardness	mg/l	300*	107
20	Total Dissolve solid (TDS)	mg/l	800	55.50
21	Alkalinity	mg/l		190.00
22	Cyanide	mg/l	0.07	ND<0.04
23	Mercury	mg/l	1	0.0018
24	Copper	mg/l	1	ND<0.0003
25	Zinc	mg/l	3	0.00648
26	Lead	μg/l	10	2.57
27	Hexavalent chromium	μg/l	50	10
28	Cadmium	μg/l	3	ND<0.2
29	Arsenic	μg/l	50	0.94
30	Fluoride	mg/l	1.5	0.23
31	Phenols	mg/l		ND<0.025
32	Chlorophyll a	μg/l		5.80

MIME DWQS: Ministry of Industry Mines and Energy, Drinking Water Quality Standard, Jan. 2004
* Hardness is expressed as mg/L $CaCO_3$

Table 1-8 Water Quality Data by The Team (October 6, 2009)

No.	Description of Items	Unit	MIME-DWQS	S1
A	**Microbiological Test**			
1	Total coliform	Count/100ml	0	<30
2	E.coli	MPN/100ml	0	0
B	**Physical and Chemical Test**			
3	Temperature	^{0}C	-	29.40
4	pH	-	6.5-8.5	7.80
5	Odor	-	-	Normal
6	Taste	-	-	Normal
7	Transparency	Dept (cm)	-	74.50
8	Dissolved Oxygen (DO)	mg/l	>6	7.30
9	Turbidity	NTU	5	3.5
10	Color	Pt-4	-	30
11	Total Suspended Solid (TSS)	mg/l	-	44.00
12	Total Dissolved Solid (TDS)	mg/l	800	51.30
13	Hardness	mg/l	300	83.30
14	Alkalinity	mg/l	-	4.20
15	Nitrite (NO2)	mg/l	3	<0.10
16	Nitrate (NO3)	mg/l	50	<0.10
17	Ammonium (NH4)	mg/l	1.5	0.24
18	Chloride (Cl)	mg/l	250	4.02
19	Total Nitrogen (T-N)	mg/l	-	0.58
20	Total Phosphorus (T-P)	mg/l	-	0.26
21	Iron (Fe)	μg/l	0.3 (mg/l)	0.51
22	Manganese (Mn)	μg/l	0.1 (mg/l)	ND<0.3

ii) Existing Water Quality Data

The team for Project on Capacity Building for Water Supply System in Cambodia Phase 2 carried out the water quality sampling and analysis from March to June (late of dry season to early of rainy season) in 2009 weekly at 2 points, which are both located almost in the same area of tentatively proposed intake site (Sampling Point NO.1) and the water sampling site by this JICA Study Team (Sampling Point NO.2) as shown in Figure 1-7.

.The sampling point of NO.1 is located approximately 200m north and 50 m east from NO.2. The sampling was carried out 13 times in total and the analysis was made for 9 parameters every time. The test results are summarized in **Table 1-9** and **Table 1-10**. Iron, turbidity and color exceed the standard compared with water quality standard for drinking water in **Table 1-11**.

Figure 1-7 Water Sampling Points

Table 1-9 Water Quality Data by JICA Capacity Building Project (1)

Testing Date	Sample N. 1, Location N = 1313574, E = 10352277, Depth = 0.33m								
	Fe mg/L	Mn mg/L	NH3 - N mg/L	SO4 mg/L	Turbidity (NTU)	Alkalinity (mg/L)	Color (TCU)	pH	Conduc. (µs/cm)
03/25/09	3.01	0.10	0.15	< 2	240.00	26.30	149.38	7.60	81.00
04/03/09	2.67	0.10	0.17	< 2	99.60	21.33	154.29	7.66	69.00
04/09/09	3.22	0.20	0.28	4.00	457.00	19.33	240.83	6.81	64.90
04/22/09	3.29	0.40	0.48	8.00	1860.00	22.67	271.15	6.66	88.80
04/29/09	2.09	0.30	0.36	8.00	356.00	69.33	131.80	6.81	172.50
05/05/09	2.94	0.00	0.21	4.00	546.00	44.67	75.36	7.24	139.30
05/18/09	3.40	1.00	0.43	6.00	1618.00	43.33	167.12	7.05	122.30
05/20/09	6.13	0.00	0.33	4.00	618.00	34.66	570.67	7.28	115.70
05/27/09	4.91	0.30	0.41	< 2	589.00	34.67	570.67	6.91	117.00
06/02/09	6.87	0.10	0.46	< 2	873.00	28.00	108.45	6.85	94.50
06/08/09	7.14	4.20	0.32	< 2	570.00	38.67	74.40	7.47	115.50
06/16/09	6.60	0.90	0.27	< 2	393.00	45.33	82.01	7.43	129.50
06/23/09	6.01	0.10	0.26	2.00	386.00	48.67	99.65	7.38	123.20
AVERAGE	4.48	0.59	0.32	2.77	661.97	36.69	207.37	7.17	110.25

Table 1-10 Water Quality Data by JICA Capacity Building Project (2)

Testing Date	Sample N.2, Location N = 1313370, E = 10352232, Average Depth = 0.80m								
	Fe mg/L	Mn mg/L	NH3 - N mg/L	SO4 mg/L	Turbidity (NTU)	Alkalinity (mg/L)	Color (TCU)	pH	Conduc. (µs/cm)
03/25/09	3.78	0.30	0.28	< 2	239.00	28.00	135.41	7.50	82.00
04/03/09	2.71	0.00	0.03	< 2	154.00	22.00	182.89	7.88	75.90
04/09/09	3.67	0.10	0.28	3.00	309.00	21.66	267.07	7.08	65.60
04/22/09	6.57	0.40	0.70	6.00	813.00	25.33	570.67	6.71	101.90
04/29/09	5.47	0.10	0.25	4.00	439.00	46.66	429.48	7.59	138.00
05/05/09	3.52	0.20	0.49	5.00	411.00	46.67	138.44	7.53	136.40
05/18/09	1.33	0.60	0.03	5.00	485.00	42.00	61.03	7.34	124.20
05/20/09	6.26	0.00	0.30	< 2	543.00	36.00	570.67	7.75	112.50
05/27/09	5.58	0.20	0.29	< 2	746.00	28.67	570.67	6.99	110.00
06/02/09	13.20	0.50	0.24	< 2	548.00	33.33	85.37	6.94	107.40
06/08/09	6.99	3.60	0.20	< 2	457.00	53.33	94.94	7.65	137.70
06/16/09	6.99	0.50	0.39	< 2	571.00	44.67	63.92	7.46	120.30
06/23/09	6.01	0.50	0.36	< 2	496.00	45.33	105.62	7.81	117.10
AVERAGE	5.55	0.54	0.30	1.77	477.77	36.43	252.01	7.40	109.92

Table 1-11 Comparison with the Water Quality Standards of Drinking water

Item	Parameter	Unit	Sample 1	Sample 2	MIME, DWQS
1	Iron, Fe	mg/L	**4.48**	**5.55**	0.3
2	Manganese, Mn	mg/L	0.59	0.54	0.1
3	Ammonia, NH3	mg/L	0.32	0.30	1.5
4	Sulfate, SO4	mg/L	3.69	3.00	250
5	Turbidity	FTU	**661.97**	**477.77**	5
6	Alkalinity	mg/L	36.69	36.43	-
7	Color	TCU	**207.38**	**252.02**	5
8	pH	-	7.17	7.40	6.5-8.5
9	Conductivity	µS/cm	110.25	109.92	1600

The JICA Study on Integrated Master Plan for Sustainable Development of Siem Reap (2006) carried out the water quality survey in the Tonle Sap Lake and the results are summarized in **Table 1-12**. The concentrations of SS, COD and Total Coliform exceed the standard in Cambodia.

Table 1-12 Water Quality of Tonle Sap Lake (December 2004), by JICA Study

Parameter	Tonel Sap	Cambodia Standards
pH	7.2	6.5-8.5
DO (mg/L)	6.0	2.0-7.5
SS (mg/L)	**102.**	2 1-15
COD (mg/L)	**23.06**	1-8
Total-N (mg/L)	1.123	0.1-0.6
Total-P (mg/L)	0.048	0.005-0.05
Total Coliform (MPN/100ml)	**11000**	<1000

1-3-1-3 Wastes

The amount of municipal solid waste discharged from the central district including 5 communes of Siem Reap City is approximately 150 tons/day and the solid waste management company, Gaea, collects 110 tons every day based on the contract for 50 years since 2007. Municipal solid waste is collected from hotels, restaurants, guest houses, markets and private houses in central area mainly at night and in outskirt at day time. They have collection vehicles shown in Table 1-13 and transport the waste to the final disposal site located 25km distant east from the center of the City.

Collection fees of municipal waste are 1～2.5 US$/month for Cambodian people and 5～25 US$/month for foreigners. On the other hand the company does not pay disposal fee because the finial disposal site is owned and operated by the waste management company itself.

The staff of the company consists of 160 members including 57 street sweepers and the streets in Siem Reap City are cleaned regularly. The local government responsible for municipal solid waste management is not Department of Public Works and Transport, but both of Siem Reap Municipality and Provincial Department of Environment. The former rules operation and maintenance of the solid waste management, and the latter does technical aspects.

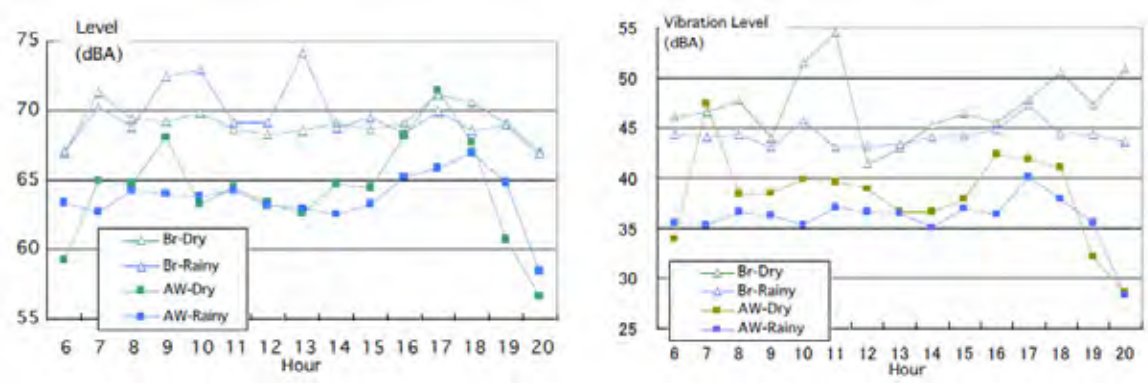
Table 1-13 Collection Vehicle owned by Waste Management Company

NO	Vehicle	Capacity (ton)	Unit
1.	Compacter Truck	11	5
2.	Open Container Truck	4.5	6
3.	Large Container Truck	16	2

Source: Hearing from the municipal solid waste management company

1-3-1-4 Noise and Vibration

The JICA Study Team conducted noise and vibration surveys both in dry and rainy seasons in 2005, at the intersection of National Road No.6 and the bridge, and at the entrance of Angkor Heritage (Refer to the location map at right side). The noise and vibration levels were monitored for 14 hours from 6:00 a.m. to 8 p.m. based on the Japanese Industrial Standard (JIS). **Figure 1-8** shows the results of surveys.



Br: Intersection of NR 6 and Bridge
AW: the Entrance of Angkor Wat

Figure 1-8 Noise and Vibration in Siem Reap City

(*Source*: *The Study on Integrated Master Plan For Sustainable Development of Siem Reap / Angkor Town, JICA, 2006)*

The result of noise survey shows that the noise levels in the dry and the rainy seasons are almost same. The noise level stabilizes at 65dBA in the daytime and goes below 60dBA at night in the Angkor Heritage Area. The range of vibration level is 40dBA to 50dBA along Route 6. The vibration level reaches at 55dBA in a moment when the traffic passes and the level is predicted to be higher inevitably when the heavy traffic passes.

1-3-1-5 Hydrology

Siem Reap City is located in a very flat and low-laying area close to Tonle Sap Lake. The Siem Reap River flows through the city dividing it into East and West drainage areas and main river system further to east and west are the Roulous River and the Puok River, respectively. The rivers and all stormwater drainage flow into Tonle Sap Lake. The Siem Reap River has natural gradient of about 1/1,000 from North to South towards Tonle Sap Lake. During rainy season, the river carries significant flows. In September 2009, the river flow was estimated to be 133 m_3/sec and many areas adjacent to the river were flooded for a period.

The current stormwater drainage infrastructure cannot deal with heavy storm. Heavy storms can cause widespread flooding and water levels in drain and in Siem Reap River rise considerably. In poorly drained areas, urban runoff mixes with sewage from overflowing latrines and sewers, causing pollution. Due to the flat topography, the existing drainage system does not have sufficient gradient and this makes it vulnerable to blockage from settled solids and dumped wastes.

National road N0.6 acts as a hydraulic bottleneck causing flooding, due to insufficient and clogged culverts and drains installed beneath the road over most of its entire length from east to west in the city area.

Irrigation Canal

A number of existing agricultural irrigation canals, some of them date back to ancient Angkor civilizations, cross the project area. Though many of these are in a state of disuse, others are still functioning and carry water to agricultural areas located in southwest and southeast of the city. This canal network has a base flow even during dry season and consequently reduces the capacity for stormwater drainage.

Stormwater Drainage in Western Siem Reap District

There are two major drainage called Town Center Drain (TCD) and the Western Drain. Neither has sufficient capacity for the flows generated in their catchment area but TCD was reconstructed through Mekong Tourism Development Project Siem Reap Wastewater Management (ADB) to have sufficient hydraulic capacity.

The northern part of the Western Drain currently connects into inadequate system located in the south of NR 6 and as the road acts like dike, large areas have been suffered by chronic flooding.

Stormwater Drainage of Eastern Siem Reap District

On the eastern bank of the river, there are three major existing drains, namely D7, D2 and D10. However, since these drains are connected to inadequate systems crossing or located in the south of national road No.6, road acts like dike and large areas have been suffered by chronic flooding.

1-3-1-6 Land

The Study area is generally covered by alluvial fan deposits on the surface and the layers below the surface is composed of diluvial deposits, Pleistocene sediments, Plicene clay stones, Mesozoic sedimentary rocks, and Paleogene volcanic rocks in order from the surface to the deeper part. Top soils are generally classified by their potential use. The acid lithosols are found in the northern area of Kulen mountains and suitable for forest. Alluvial lithosols and cultural hydromorphics exist mainly along the rivers and good for agricultural use. Plinthicite and red-yellow podzols are seen widely in the flat lowland and suitable for plantation of agro-forestry. Coarse sandy alluvial deposits are found generally in the northern part of the study area, and fine sand to silt deposits is found in the area near Tonle Sap Lake. Top soil of cultivated upland, paddy field and the bottom of the barays is generally composed of organic clay and silty clay. Total thickness of alluvial deposits is 10-20m in the northern area and 20-30m in the southern area. Diluvial deposits layer underling the alluvial deposits is composed of coaser particle than that of alluvial deposits in general and the thickness is 20m in most part.

1-3-2 Ecological resources

1-3-2-1 Protected Area

(1) The Protected Area stipulated by MOE

MOE stipulates five kinds of natural protected areas, National Park, Wildlife Sanctuary, Landscape Protected Area, Multiple Use Area and Heritage Protected Area. Within the study area there are two kinds of protected areas, Angkor Landscape Protected Area and Tonle Sap Multiple Use Area. The location is shown in **Figure 1-9** and the definitions are as follows;

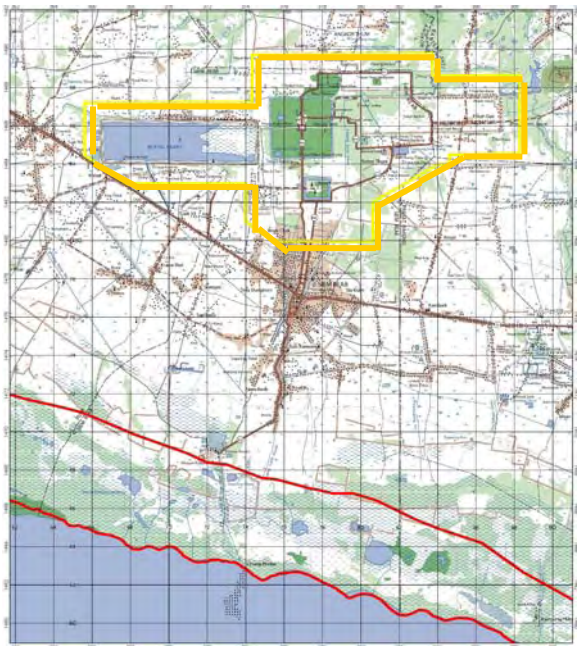
Landscape Protected Area

A land or water area where the nature, ecosystem and cultural heritage should be protected from destruction by human beings and there is a special beautiful area, and normally there is rich biodiversity. To prevent this traditional area from destruction or to conserve this area is more important than to develop it for human beings' lives.

Multiple Use Area

The land or the water area, which has much natural system and needs to be managed for protection of biodiversity and sustainable ecosystem. More over, it can give natural products and services for community's use demand.

The facility for the project like water treatment facility should not be constructed in these areas.



	Landscape Protected Area
	Multiple Use Area

Figure 1-9 Natural Protected Area by MOE

(Source: Natural Resource Assessment and Environmental Data Management Department, MOE)

(2) The Protected Area stipulated by MOAFF

The Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries (MOAFF) stipulates Fish Sanctuary, Community Fisheries, Fishing Lot and Strictly Protected Inundated Forest Area. Within the study area there are three kinds of areas, Community Fisheries, Fishing Lot and Strictly Protected Inundated Forest Area. The location is shown in **Figure 1-10**.

The targets of the Community Fisheries are as follows;

- To manage fisheries resources in a sustainable manner and ensure equitable sharing of benefits from fisheries resources,
- To increase understanding and recognition of the benefits and importance of fisheries resources through direct participation in managing, using and protecting fisheries resources, and
- To improve the standard of living in order to contribute to poverty reduction.

The fishery domain is the state property. It can cover public or private land in the flooding season (management of these fisheries does not affect the ownership of the lands). (Article 9, Law on Fisheries)

There are about 37 Fishing Lots in Tonle Sap Lake at present although there were more than 50 lots before. In 2001, the government embarked on an extensive reform of the fisheries sector by improving access by the poor to the Fishing Lots. The government repealed 495,000 ha of officially auctioned Fishing Lots, a reduction of 53% in the size of the official Fishing Lots to allow the poor to access common fisheries resources. Industrial fishing is based on the Fishing Lots or concessions which were allocated through an auction system for exclusive exploitation over a two-year period. The Fishing Lot, NO.4, only one belonging to the Siem Reap Provincial area, can be leased for as much as 80 million Riels (US$200,000) a year (source: Provincial Department of Fisheries). The artisanal and family fishermen are not permitted to enter the Lot and fish outside it during an open season of fishing from October to May.

Strictly Protected Inundated Forest Area is set for sustainability of fishery resources and for important aquatic habitats to feed, spawn and breed since 1962.

The facility for the project like water treatment facility should not be constructed in these areas and pipeline should not be set through the heavily wooded areas

Department of Forest stipulates Community Forests which can fulfill same function as Community Fisheries. They prepare Community Forest Management Plan and Community Forest Agreement for implementing the sustainable use and development of forest resources. There is no Community Forest in the study area, although there are some Community Forests in northern mountainous area.

There is no protected area designated by Department of Agriculture in the study area.

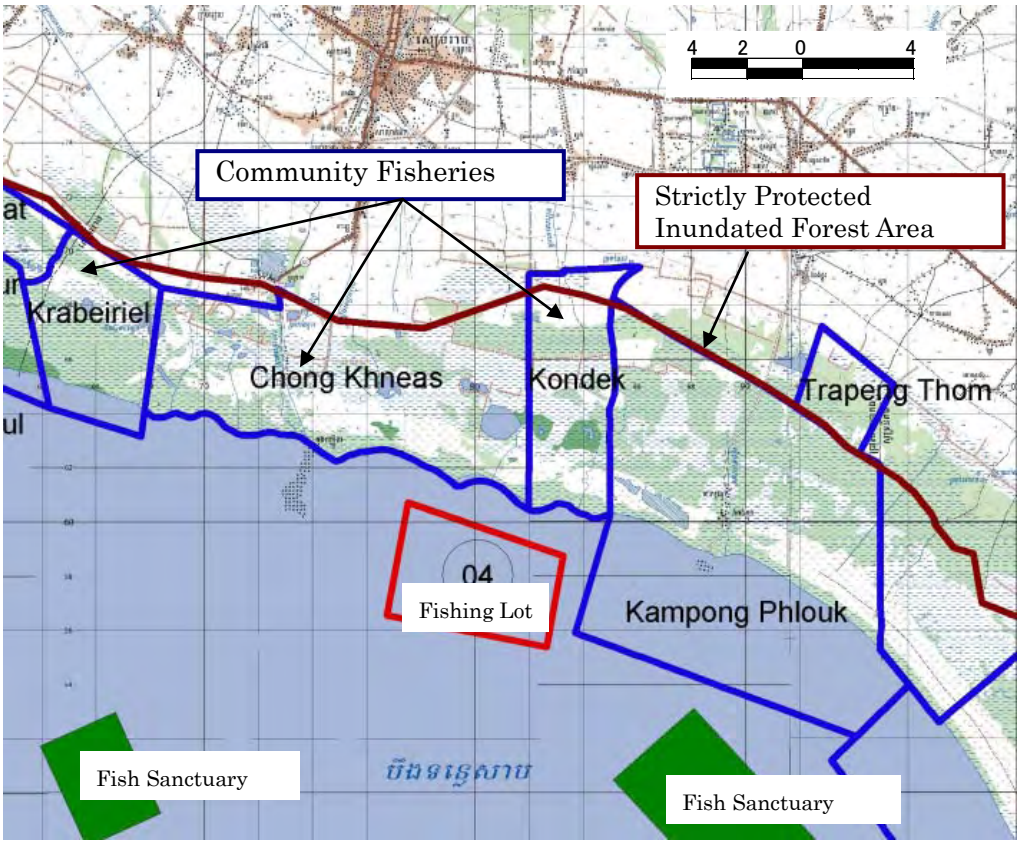


Figure 1-10 The Protected Areas by Department of Fisheries
(Source: Fisheries Administration, MOAFF)

(3) The World Cultural Heritage Area inscribed by UNESCO

On 14th December 1992, Angkor was inscribed in the World Heritage List and the World Heritage in Danger covering the area of 401km2 with 90 temples as shown in Table 1-14.

Angkor was inscribed on the basis of the following criteria:

a) it represents a unique artistic achievement, a master piece of creative genius;
b) it has exerted great influence over a span of time, within a cultural area of the world, on developments in architecture, monumental arts, and landscaping;
c) it bears a unique exceptional testimony to a civilization which has disappeared; and
d) it is an outstanding example of an architectural ensemble which illustrates a significant stage in history.

Also the Angkor Park was inscribed under five conditions as below:

(a) Enact adequate protective legislation

(b) Establish an adequately staffed national protection agency

(c) Establish permanent boundaries based on the UNDP project

(d) Define meaningful buffer zones

(e) Establish monitoring and coordination of the internationally conservation effort.

These conditions were successively fulfilled. A Royal decree of 19th February 1995 providing a legal basis for the creation of the Autorité pour la Protection du Site et l'Aménagement de la Région d'Angkor (the National Authority for the Protection of the Site and Development of Angkor called APSARA Authority– conditions (a) and (b)). This acronym is a Khmer common word and signifies "celestial dancer".

Table 1-14 The Temples inscribed in World Cultural Heritage List

No	Name	METERIAL	No	Name	METERIAL
Monument inside Angkor Thom 26			49	Pr. Top	brick & sandstone
1	Baphuon	sandstone	50	Pr. Top 2	laterite
2	Bayon	sandstone	51	Pr. Tor	brick & sandstone
3	Porte de la Victoire, Angkor Tom	sandstone	52	Spean Tor	laterite
4	Porte des morts, Angkor Tom	sandstone	53	Pre Rup	brick laterite & sandstone
5	Porte Nord, Angkor Tom	sandstone	54	Prei Prasat (720 or 745)	laterite & sandstone
6	Porte Ouest, Angkor Tom	sandstone	55	Spean Thmar	laterite & sandstone
7	Porte Sud, Angkor Tom	sandstone	56	Ta Keo	laterite & sandstone
8	Khleang nord	laterite & sandstone	57	Ta Nei	laterite & sandstone
9	Khleang Sud	laterite & sandstone	58	Ta Prohm	laterite & sandstone
10	Palais Royal	laterite & sandstone	59	Thommanon	laterite & sandstone
11	Pr. Chrung nord est	laterite & sandstone	Monument to the north of Angkor Thom 10		
12	Pr. Chrung nord ouest	laterite & sandstone	60	Banteay Prei	laterite & sandstone
13	Pr. Chrung sud est	laterite & sandstone	61	Krol Ko	bricl & sandstone
14	Pr. Chrung sud ouest	laterite & sandstone	62	Krol Romeas	laterite & sandstone
15	Mangalartha 487	sandstone	63	Neak Poan	laterite & sandstone
16	Monument 486	laterite & sandstone	64	Banteay Thom	laterite & sandstone
17	Pr. Sour Prat	laterite & sandstone	65	Pr. Prei Prasat	laterite & sandstone
18	Prah Palilay	laterite & sandstone	66	Pr. Tonlé Snguot	sandstone
19	Prah Pithu tour T	laterite & sandstone	67	Preah Khan	laterite & sandstone
20	Prah Pithu tour U	sandstone	68	Prah Pithu	laterite & sandstone
21	Prah Pithu tour V	sandstone	69	Ta Som	laterite & sandstone
22	Prah Pithu tour X	sandstone	Monuments to the West of Angkor Thom 12		
23	Prah Pithu tour Y	sandstone	70	Ak Yum	brick & sandstone
24	Tep Pranam	laterite & sandstone	71	Baray Occidental	
25	Terrasse des Elephants	sandstone	72	Chapelle de l'Hopital Ouest, Angkor Thom	laterite & sandstone
26	Terrasse du Roi Lépreux	sandstone	73	Mebon Occidental	laterite & sandstone
Monuments to the South of Angkor Thom 10			74	Kas Ho	brick & sandstone
27	Angkor Vat	sandstone	75	Kuk Khpop	brick & sandstone
28	Baksei Chamkrong	brick laterite & sandstone	76	Phnom Rung	brick & sandstone
29	Phnom Bakheng	brick & sandstone	77	Pr. Trapeang Ropou	
30	Bay Kaek 499	brick & sandstone	78	Pr. Trapaang Sen	
31	Pr. Bei	laterite & sandstone	79	Prei Khmeng	brick & sandstone
32	Pr. Kuk Chak	laterite & sandstone	80	Pr. Prei Prasat	brick & sandstone
33	Pr. Patri	brick & sandstone	81	Vat Khnat	brick laterite & sandstone
34	Pr. Kantal Preah Chantol	brick & sandstone	Monument close to the Siem Reap river 3		
35	Pr. Taset	brick & sandstone	82	Phnom Krom	brick & sandstone
36	Ta Prohm Kel	sandstone	83	Peah Enn Kosei	brick laterite & sandstone
Monument to the East of Angkor Thom 23			84	Vat Atvear	laterite & sandstone
37	Banteay Kdei	laterite & sandstone	Group Rolous 6		
38	Sras Srang	laterite & sandstone	85	Bakong	brick laterite & sandstone
39	Banteay Samrè	laterite & sandstone	86	Lolei	brick & sandstone
40	Baray Orientale	brick & sandstone	87	Prei Monti	laterite & sandstone
41	Bat Chum	brick laterite & sandstone	88	Pr. Trpeang Torteung Thngay	brick & sandstone
42	Chapelle de l'Hopital Est	laterite & sandstone	89	Pr. O Kaek	brick & sandstone
43	Chau Say Tevoda	sandstone	Group Banteay Srei 1		
44	Kuthvara	laterite & sandstone	90	Banteay Srei	brick, laterite & sandstone
45	Leak Neang	laterite & sandstone			
46	Mebon Oriental	brick laterite & sandstone			
47	Pr. Kamnap	laterite			
48	Pr. Kravann	brick & sandstone			

(Source: UNESCO Phnom Penh Office)

(4) The Protected Area designated by APSARA

Angkor Archaeological Area is protected by APSARA shown in **Figure 1-11**, in accordance with the recommendation of UNESCO.

The definition of four kinds of zones is as follows; (source; APSARA homepage)

Zone1: Monumental Sites

Areas which contain the most significant archaeological site in the country and therefore deserve the highest level of protection.

Zone 2: Protected Archaeological Reserves

Areas rich in archaeological remains which need to be protected from damaging land use practices and inappropriate development. They will most frequently surround monumental Sites, providing protection to adjacent areas of known or likely archaeological importance. Zone 1 and 2 require intensive management aimed at integrating archaeological and visitor interests with local interests and needs.

Three main Monumental Sites identified in the region are those of Angkor, Rolous and Banteay Srei. Each lies within a Protected Archaeological Reserve which, in the case of the Angkor site, acts as a buffer zone. Additional sites could be added at a later date to protect and manage areas such as Beng Mealea, Koh Ker, or Preah Khan in Kompong Svay.
The three sites, including their Archaeological Reserves zones, cover the areas with the highest density of archaeological remains, including the original sites of the ancient Angkorian capital, with most of the well-known temples and many ancient hydrological structures such as the barays, canals and dikes. The Protected Archaeological Reserve around the Angkor site also contains a large local population whose interests are to be protected.
The Angkor Monument Site and its Archaeological Reserve comprises an area of more than 350 square kilometers. It contains:

/the original Angkor Park as designated in 1925 and reconfirmed with minor modifications during the subsequent decades;
/additional areas which together constitute the core of the Angkor Monumental Site;
/a protection zone to safeguard archaeological sites in the surrounding landscape (zone2); and buffer areas, particularly between Siem Reap and Angkor Vat, which are necessary to conserve the integrity of the Monumental Sites, Preserve the area as a tourist attraction and prevent all development not essential to the protection of the cultural heritage.

Zone 3: Protected Cultural Landscapes

Areas with distinctive landscape characteristics which should be protected on a account of their traditional features, land use practices, varied habitats, historic building, or man-made features from the past or of recent origin that contribute to the cultural value or reflect traditional lifestyles and patterns of land use. Cultural Landscapes may also serve to safeguard visual perspectives and relationships between significant features which contribute to their historic or aesthetic value. Protected Cultural Landscapes are subject to regulations aimed at controlling damaging and disruptive activities.

The ancient canalized river valleys of the Stung Siem Reap and Stung Roluos from where they flow off the Phnom Kulen to their mouths at the Tonle Sap have been designated Protected Cultural Landscapes. The ancient causeways running from the Angkor site northwest to Banteay Srei are Cultural Landscapes extending the protected areas of the Angkorian heritage and further into the surrounding environment. These areas may be expanded and other areas zoned for protection at a later date.

Zone 4: Sites of Archaeological, Anthropological or Historic Interest

Including all other important archaeological sites, but of less significance than Monumental Sites, that require protection for research, education or tourist interest. The sites and areas are subject to regulations aimed at controlling damaging activities similar to those applying to Protected Archaeological Reserves.

A number of the more important below and above-ground archaeological sites identified within the Siem Reap region, such as Phnom Krom, Wat Athvea and Chau Srei Vibol are indicative of the areas included in Zone 4. Other sites may be included in the future.

Zone 5: The Socio-economic and Cultural Development Zone of the Siem Reap region, comprising the whole of Siem Reap Province, is the largest zone to which protective policies apply.

This comprehensive zone covers an area of 10,000 square kilometers including the Phnom Kulen, the shores of the Tonle Sap and the Angkor plain. It conforms largely to the catchment area of greater metropolitan Angkor during the ancient period and is rich in remains of both prehistoric and historic civilization. The region also contains important natural areas which are to be protected and others to be developed in a sustainable manner.

The region is to be managed as a multiple-use area with an emphasis on economic and social development of cultural tourism. Development activities which could potentially damage the archaeological, the natural, or the social heritage harbored in the province are regulated by

comprehensive coordination policies. Archaeological and environmental impact assessments are to be carried out in advance of any project proposed in the region. The intention is not to hold back development but to ensure that it be appropriately located and directed, at all times taking into consideration the requirements of heritage conservation.

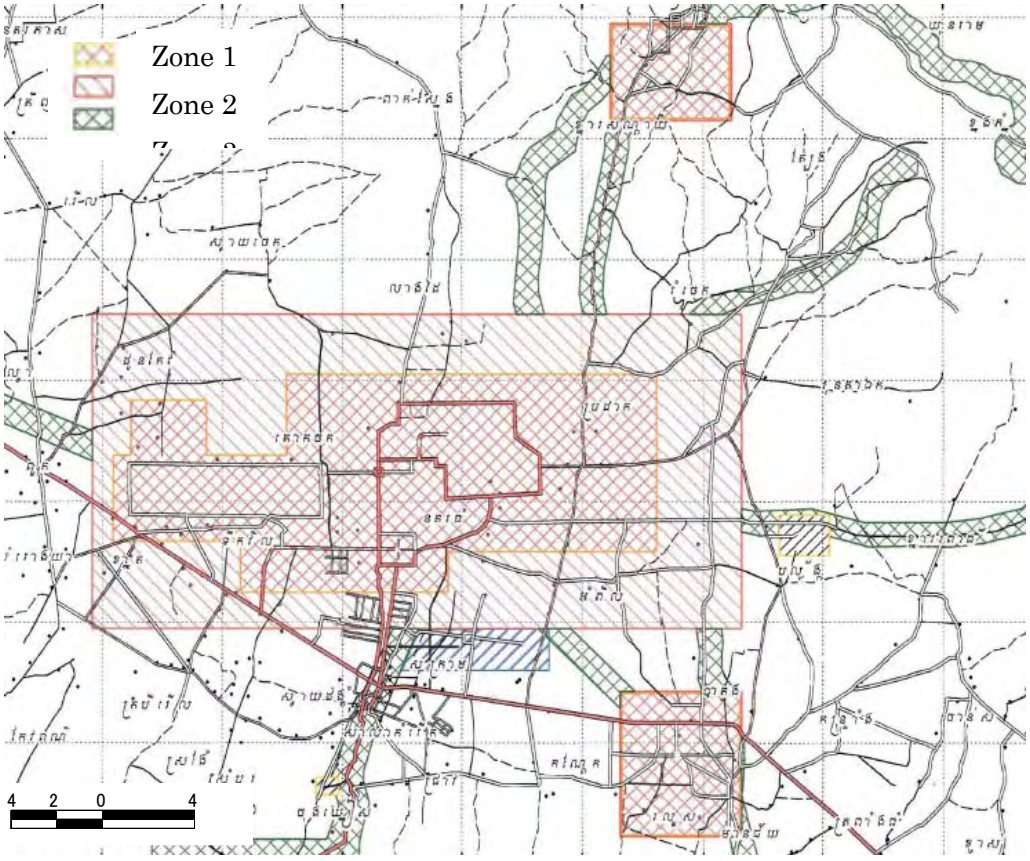


Figure 1-11 APSARA Protected Area
(Source: APSARA)

(5) Tonle Sap Biosphere Reserve Area by UNESCO

Tonle Sap Biosphere Reserve is divided into core areas, a buffer zone and a flexible transition zone. Within the study area there are transition area and buffer zone as shown in **Figure 1-12**. There is no core zone which is defined likewise national park or wildlife sanctuary.

The transition area is limited between the outer boundary of the buffer zone and National Road NO.5 and NO.6. It is the integrated economic zone, which is managed for sustainable agriculture, human settlement and land use, without having adverse effects on the flooded forest, water quality and soils of the region around the Tonle Sap Lake.

The buffer zone covers the area of 541,482ha. Its boundary corresponds to the outer boundary of the Tonle Sap Multiple Use Area.

The buffer zone surrounding such core areas which are covered by flooded forest of a variety of species. Activities are managed to be consistent to the protection and conservation plan of the core areas. Fishery activities and other development plans will be managed based on existing law and regulations in a coordinated and cooperative manner. The buffer zone is also subject to experimental research and discovery of method for the management of flooded forest, fishery, agriculture, housing settlement, land use, water resources, navigation and tourism to ensure their sustainability, increased production, while preserving the environmental quality and fish.

The facility for the project like water treatment facility should not be constructed in the buffer zone area.

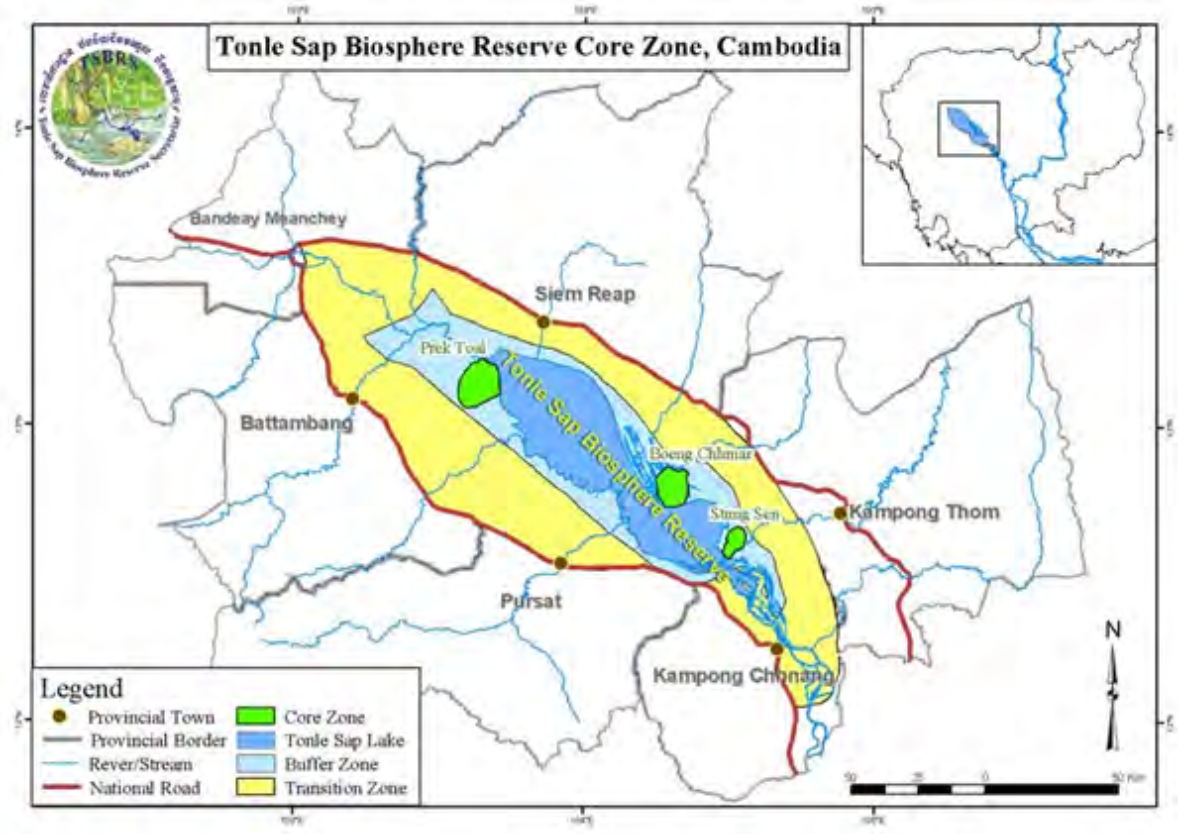


Figure 1-12 Tonle Sap Biosphere Reserve
(Source: Website)

(6) Provincial Conservation Area protected by Community

The Boeng Peareang Lake had been protected by the community. In 2006 the biodiversity of the area was studied by experts involving Department of Environment in Province (DOE). There are big trees in inundated forest and many kinds of bird build their nest on the trees. DOE prepared a document to submit to MOE and got approval of Boeng Peareang Natural Conservation Area including the lake with signatures of Minister of Environment and Provincial

Governor in 2008. Total area is 3,098ha as shown in **Figure 1-13**. The pipelines of water supply expansion project should not be laid down through Boeng Peareang Lake itself in the conservation area, while it can be set through the conservation area, according to the opinion of relevant persons.

The Polav Lake had been protected by Kandeak Community Fisheries. In 2008 the lake of 4 ha was decided as Fish Conservation Area (Sanctuary) signed by Minister of Agriculture, Forest and Fisheries as shown in **Figure 1-13**.

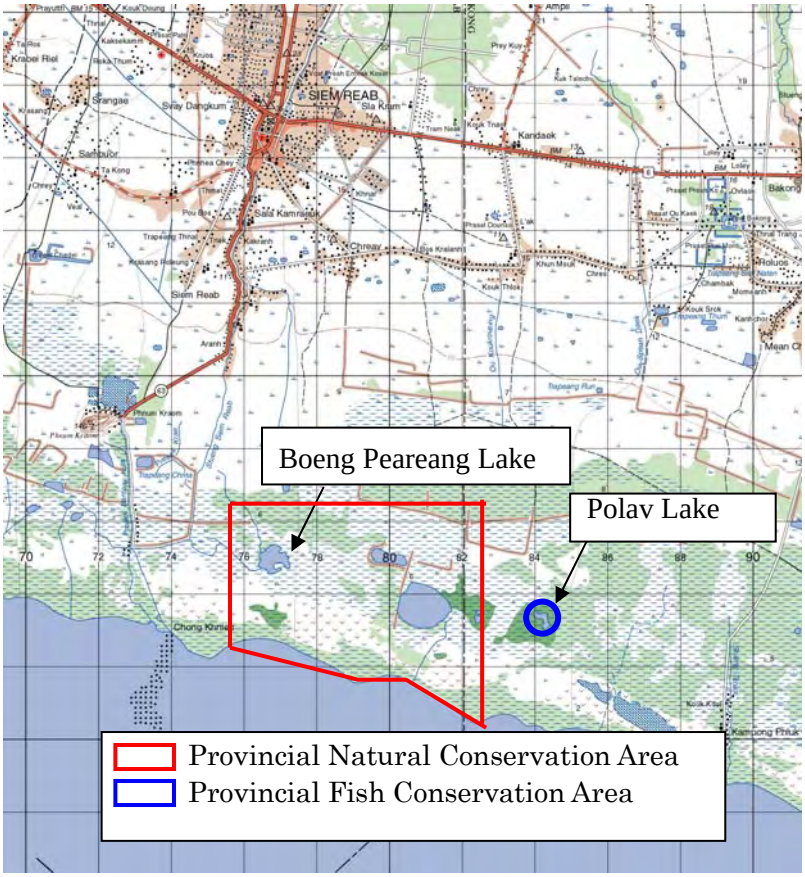


Figure 1-13 Provincial Conservation Area
(Source: Siem Reap Provincial Department of Environment and Kandeak Community Fisheries)

1-3-2-2 Ecological resources

The survey on Flora and Fauna for this project was conducted with the aim to get a better understanding on the current status of flora and fauna species and assess potential impacts of future expansion of water supply on their survival and regeneration. The field study was conducted 5 days in December 2009 and January 2010.

(1) Study Method

The study is based on the review of existing reports and literatures, and field survey in the proposed location of Route B. The visual observation with guiding manuals is carried out along the predetermined route and interview is undertaken with more than forty key informants, mainly the fishermen and the rice farmers to supplement the observation. Due to different schedule and specific requirements of flora and fauna specialists, three teams were set up, forest and mammal team, fishery and amphibian, and waterbird and reptile team. Acting as the team leader, Ph.D. Bonheur Neou, former Deputy Secretary General of Tonle Sap Basin Authority, provided an overall guidance on methodology being used and ensured accuracy of the survey across all the flora and fauna features. The survey methodology for each flora and fauna is summarized below.

1) Flora (Inundated Forest)

Inventory of flora species was based on random selection of main plots with size 10m by 10m and sub-plots (2m by 2m) in each type of forest cover along study route. Visual observation was undertaken to define forest classification based on general forest distribution pattern (Andrew McDonald, 1996), and ortho-photomap made in 2005 by the Tonle Sap Environmental Management Project. Interview with local floating villagers was conducted to identify current management practice and threats to the flooded forest in the study areas. Individual large plants in each plot and plants in subplots were identified and counted. In some cases, the numbers of smaller aquatic plants which covered a large part of the plot could not be counted accurately; in this case their area extent was estimated as percentage of the plot surface area. The collected data includes forest species, number of trees, diameter and density. Species with diameter more than three centimeters were counted in the main plot, while species with diameters less than three centimeters were counted in subplot. The plots were selected based on four vegetation type, namely gallery forest, degraded forest/recession rice areas, bush/shrub in the reservoir, and recession rice field. Photos in each plot were taken for illustration of the actual forest type visited. Qualitative and quantitative data analysis of the survey was carried out using SPSS version.

2) Mammal

Direct visual observation assisted by local guides was conducted along the pre-determined route during the forest inventory in late November and December 2009. Interview with local fishermen and floating villagers was supplemented to complement the direct field observation. Boat was a major transport but a transect walk was made, especially in recession rice fields and along the dam leading to O Smoan and Dam 78 on 23 December 2009. Location of observed species was recorded using GPS and digital photos were taken.

3) Fish

Sampling was undertaken along the line of route B in the map. Fish samples were collected from different fishing gears (seine net, cast net, gill net, arrow shaped trap, hook line, bamboo trap and other gears) operated by local fishermen along or nearby the study line. As the line passes by near the Boeng Pear Reang Community Fishery Organizations (CFO) and directs to fishing lot No4 at the Tonle Sap shoreline, fish samples in the CFOs and fishing lot were also collected to enrich species list. Fish species were identified using check list or fish identification manuals (Rainboth, 1996) in the field, but in case of not recognition, specimens were transferred to lab analysis in the Inland Fishery Research and Development Institute (IFReDI) of the General Directorate of Fisheries (GDOF) in Phnom Penh. Location of collected samples was recorded using GPS, and digital photos were taken as records of the field survey. Interview with the members of CFO and local villagers was also conducted to identify current management practice and threats to the fishery resources. Fish samples collected in December 2009 from different fishing gears as the following:

- Gillnet (Mong) with mast size range from 2cm to 17 cm; about 90% of total fishermen family has one to two gillnet.
- Hook long line (Santouch ronong); about 50-60% of total fishermen practiced with 45 to 100 hooks per household
- Cast net (Samnanh); about 50% of villagers use this fishing gear, the mesh size range from 2.5 to 10cm
- Bor is made from net and bamboo; it is illegal fishing gear used along the line of route B

Fish samples were preserved in the 10% formalin solution and transported to laboratory in IFReDI for analysis. Fish taxonomy was identified in reference to (Rainboth, 1996, Kottelat, 2001a).

4) Amphibians

Visual observation was conducted along the pre-determined line of route B during the collection of fish samples. Interview with local fishermen and floating villagers was undertaken to complement the direct field observation. A check list of amphibian species identified elsewhere in the Tonle Sap Lake areas was used to facilitate field observation and interview. Boat was a major transport but a

transect walk was made where possible, especially in the recession rice fields. Location of observed species was also recorded using GPS and digital photos were taken.

5) Waterbird

Direct visual observation was conducted along the pre-determined line. Interview with local fishermen and floating villagers was undertaken to supplement the direct field observation. As the study line passes by near the Boeng Pear Reang Conservation Areas and directs to the Tonle Sap shoreline, visual observation was conducted in these areas to enrich species list. A guide book "Bird of Thailand 1991 and Birds of Cambodia 1998" were used to facilitate field work. Boat was a major transport as the study areas remained flooded during November-December, but a transect walk was complemented on 24 December especially in the upper part of the study area starting from O Smoan canal up to Kon Mourng Village of Kandek commune, Prasat Bakorng district. Location of observed bird species was recorded using GPS. Digital photos were taken.

6) Reptile

Visual observation assisted by a local guide was conducted along the pre-determined line of rouet B. Interview with local fishermen and floating villagers was the main study method as time for survey was very short and the area remained flooded. That is why boat was used, but a transect walk was complemented on 24 December especially in the upper part of the study area starting from O Smoan canal up to Kon Mourng Village of Kandek commune, Prasat Bakorng district. Location of reptile species was recorded using GPS whenever spotted. Digital photos were taken.

(2) Feature of the Study Area

1) Introduction

The Tonle Sap Lake of Cambodia is known for her biological richness and high productivity owing to her unique hydrological phenomenon. The Tonle Sap Lake area has a minimum area of about 2,500 km2 in the dry season when it drains water into the Mekong River through the Tonle Sap River, and expands gradually from June till October when the Mekong flood waters reverse its flow back to the Tonle Sap Lake reaching a maximum area of about 15,000 km2 during the peak of the flooding season. In October-November, the Tonle Sap Lake reaches a maximum level of about 9-10 m above sea level (MRCS, 2009), which floods a large Tonle Sap floodplain areas of diverse flooded forest ecosystems and agricultural land for a period of several months (6-8 month) annually. This endless hydrological cycle provides unique ecological and climate conditions supporting an extraordinary diversity of life and their abundance, which are the resources base for Cambodian livelihoods and country economy for many hundreds of years. The flood cycle of the Tonle Sap Lake and the Mekong River plays a

significant role not only in the perpetuation of productive biodiversity, such as fish, wildlife, and forest, but also in shaping the present land use pattern and diverse cultural landscapes. Cambodian culture has adapted to and flourished in harmony with the flood pulse of the Tonle Sap Lake and the Mekong River, characterizing the present farming, fishing, and traditions. The carvings in the bas-relieve of the Angkor Wat and Bayon temples provide ample evidence of the links between past Cambodian civilization and the richness of Tonle Sap Biosphere Reserve.

The Tonle Sap Lake is considered one of the most important wetlands in the world due to the presence of flora and fauna species of global significance. Sixteen waterbird species are considered of global significance which seasonally migrates to the Tonle Sap Biosphere Reserve for breading and nourishment. Other species of global significance include mammals, fishes, and reptiles.

The Tonle Sap Lake is under growing pressure posed by uncontrolled developments and socio-economic needs at national and regional level, resulting in degradation of flooded forests and habitats, decline in diversity and abundance of flora and fauna species, including species of global significance. Poverty remains a challenging factor in balancing resources sustainability and poverty eradication as the majority of the poor depends on natural resources for livelihoods.

In response to the multi-facet threats faced by the Tonle Sap Lake, and in recognition of her biodiversity, economic, and socio-cultural values, the Royal Government of Cambodia enlisted the Tonle Sap Lake in the list of the World Network of Biosphere Reserve as part of UNESCO's MAB by a Royal Decree in April 2001. The Tonle Sap Biosphere Reserve (TSBR) provides a management concept based on zoning the whole Tonle Sap Lake into three zones with different management purpose. The three zones are the core areas, buffer zone and transition zone. There are three core areas, namely Prek Toal, Boeng Chhmar, and Stoung Sen, which are set aside for conservation of biodiversity and habitats of global significance. The buffer zone is designated for sustainable fishery management where flooded forest and fish can be used in a sustainable manner in consistence with the conservation of biodiversity in the core areas. The transition zone is a multiple land use areas where land use practice must not encroach into the flooded forest and cause water quality deterioration in the Tonle Sap Lake.

2) Location of the Study Area

The study area is located in the upper part of the TSBR of Siem Reap province, which falls within the buffer zone of the TSBR and mainly located in the three administrative boundaries of three communes, namely Chong Kneas, Chreav and Kandek communes of Siem Reap and Prasat Bakorng districts respectively. The areas are subject to two main management regimes: the Royal Decree on TSBR (2001) and the Fishery Law (2006). The Lake Peareang was set aside as a provincial biodiversity conservation area (BPCA) in 2009 following the TSBR

concept. Besides, the study area has been allocated for community-based management where several Community Fisheries have been established and they are demarcated. At the end of lake's shore, fishing lot No 4 has been granted for exclusive fishing rights where its operation commences in January and ends in May. There is confusion over responsibility of different actors in imposing different management practices.

The study area is subject to seasonal flooding for about 6 months beginning from July to February. At the time of survey (early December), the area was fully flooded and boat was the only means for transport. But late December and January a portion from O Smoan reservoir was free for walking. It was informed that the area would dry up in February and March, when the recession rice would start. It would be more useful if the area is revisited again when flood water fully recedes.

Due to its flooding regime like in other part of the Tonle Sap Lake, fishing and recession rice are the main economic activities. Family fishing is allowed in the Community Fisheries areas with a few artisanal fishing in the form of Bor or Arrow shape fishing. Large scale fishing in the form of fishing lot is licensed to private group, which is located in the Lot No 4.

Recession rice is practiced there by building an irrigation system composed of dams, reservoirs and canals. The dam 78 was constructed during Khmer Rouge era and O Smoan reservoir and the canal could be built much early in the middle of last century, which are used to contain water during flooding for irrigation in the dry period. The dry season rice is cultivated mainly by the villagers from Kan Dek commune. Other activities may include firewood collection, hunting, and collection of non-wood products such rattan, sbov, and bees.

(3) Flora

1) Overview

Unlike continental forest, information on flooded forest in Cambodia is relatively scarce due probably to low timber value, although it is mainly used for domestic cooking and brick kilns. The only first sort of inventory of flooded forest was undertaken by Andrew McDonald in 1997 under the support of UNESCO. Several flooded forest species have been described in the work of Dy Phon Pauline (2000), but this publication is again principally devoted to upland forest. Since then no major study has ever been conducted, except a few student thesis's studies.

The variation and distribution of flooded forest species owes mainly to the flood pulse of the Tonle Sap Lake, characterized by a seasonal change of water level and flooding duration. About two hundred species was identified (McDonal, 1997), which can be classified into three groups: the gallery forest with the height up to 15-20m, the bushes and shrubs with the height of 4-6m, and the herbaceous community (floating and submerging herbs). The shrubs and bush groups cover about 80% of the flooded vegetation, while the gallery forest occupies only about 10%

generally along the Lake's shore line. Unlike mangrove forest, all flooded forests have very small leaf and have no aerial rooting system. The flooded forest is deciduous with leaf falling during submergence. Good cover of flooded vegetation is observed in Battambang, Kampong Thom, while in Kampong Chhnang, Siem Reap and Pursat the forest is under constant encroachment for conversion to dry season rice and reservoir development.

The general distribution of tall forest species is characterized by dominance of *barringtonia acutangula* throughout the Tonle Sap floodplain, due to its fast germination and spreading. A typical nature of the flooded forest is its resiliency to the human disturbance, which can regenerate fast within a few years if burning is not practiced after clearing. There is growing concern over the rapid replacement of degraded forest with *Memosa pigra*, a thorny herb that can reduce diversity of forest species and may have effects on the habitats of some fauna species.

2) Survey Result

The flooded forest in the study area is a typical secondary forest which is much disturbed by the communities living in Chong Kneas, Chreav and Kandek communes. Recession rice farming is the main encroachment causing large clearing of flooded forest. Other forest use is firewood collection and cutting for fishing gears.

Based on observed forest composition and density, the present flooded forest pattern in this study area can be divided into four zones of forest type: i) a mixture of gallery forest with bush/shrubs extending from the lake shore until the location (approx 1.7 km); ii) degraded area with scattering stands of trees, recession rice and large floating water hyacinth extending up to the point (approx 3.8 km); iii) a reservoir O Smoan where a good mixture of bush/shrubs present (approx 2.0 km) and iv) a recession rice up to Dam 78 (approx 1.3 km). North of dam 78 is again wet season rice fields. Plot 1 and plot 2 represent zone (i), plot 3 corresponds to zone (ii), plot 5 represents reservoir forest of zone (iii), and plot 7 and 8 represent zone (iv).(**Figure 1-14**)

Observation and plot measurements indicate that zones (i) and (iii) are of special interest as there remains good forest cover in both diversity and density. Of particular interest is O Smoan reservoir which extends between recession rice fields with approximate length of 2.0 km along the route B. The reservoir is built for the purpose of recession rice, but somehow the flooded forest is also protected. It was reported that O Smoan and the canal were built before Khmer Rouge regime in around 1950s. Building pipeline across this reservoir must be considered carefully as it would destroy large forest area and make the area exposed to more encroachment.

At least over 40 forest species were identified from the 8 plots selected.

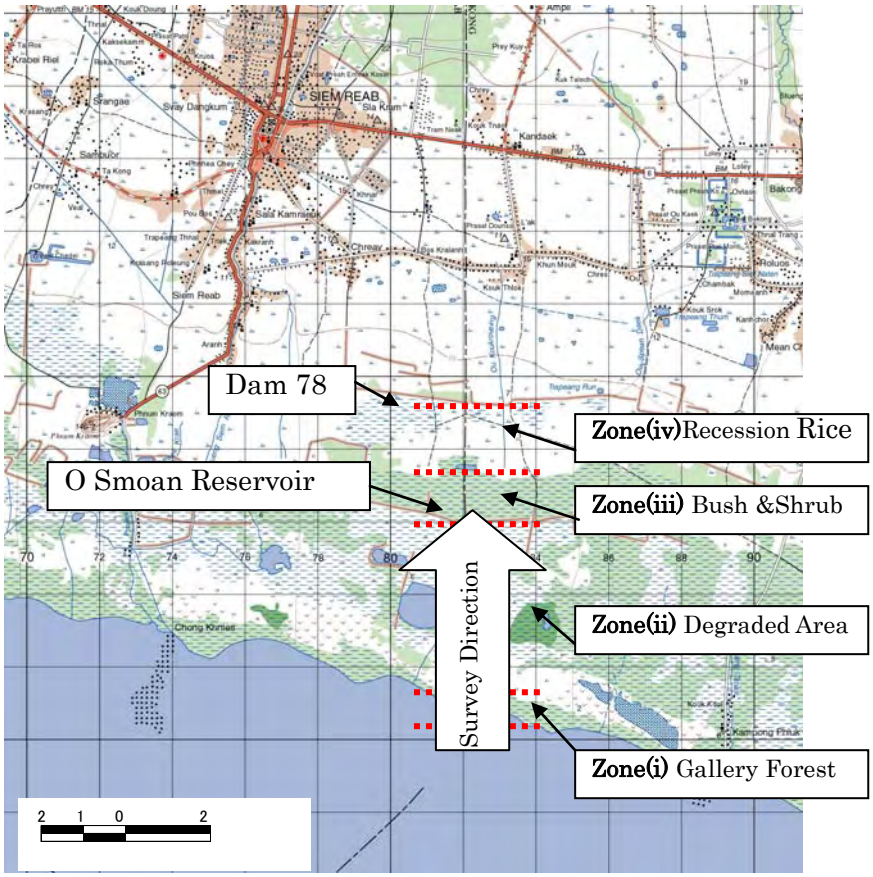


Figure 1-14 Location of Forest Type

(4) Fauna

1) Mammal

Overview

The Tonle Sap Biosphere Reserve is home to many mammal species owing to its rich habitats regulated by the flood pulse of the Tonle Sap-Mekong River system. Knowledge on mammal species in the Tonle Sap Lake is limited as no systematic inventory has ever been conducted, although there have been several reports based on desk study or limited field observation by several organizations such as WCS, Nedeco, Forest Administration, and UNDP/GEF. A total of 46 mammal species is likely to be found in the Tonle Sap Lake and its floodplain areas (CNMC/Nedeco, 1998), mostly in the areas of good mixture of diverse flooded forest types (grass land, shrubs, gallery forest, aquatic herbs) such as in the three Core Areas of the Tonle Sap Biosphere Reserve (Prek Toal, Boeng Chhmar, and Stung Sen) and in the new established biodiversity conservation areas (Dei Roneat in Pursat, Prey Kos in Kampong Chhnang). According to the IUCN classification, at least 13 mammal species of global significance are likely found in the TSBR as shown in Table 1-15 particularly in the core areas, though their population status is under growing pressure.

The study area is unlikely an important habitat for significant number of mammal species though

four or five species from the table below may be found on a declining number. Like in other areas of the TSBR, dry season rice, firewood collection, forest degradation, fishing and wildlife hunting cause major threats to the population of mammal species. There is an effort by the Ministry of Environment to set up a Boeng Peareang Biodiversity Conservation area as part of the Tonle Sap Biosphere Reserve principles in cooperation with Provincial Governor to restore habitats and promote conservation of forest and wildlife species. A management plan has been prepared, but due to the lack of funding and skills, this conservation area is still exposed to illegal activities. There is also unclear arrangement among different management regime as the areas have been also given for community-based management – Community Fisheries.

Table 1-15 List of Mammal species of Global Conservation likely found in the TSBR

No	Common Name	Scientific Name	IUCN Status	Current status in TSBR
1	Irrawaddy Dolphin	*Orcaella brevirostris*	EN	Extinct
2	Asian Elephant	*Elephas maximus*	EN	Extinct
3	Eurasian Otter	*Lutra lutra*	EN	Very rare
4	Hairy nosed Otter	*Lutra sumatrana*	GNT	Rare
5	Smooth Otter	*Lutrogale perspicillata*	GNT	Rare
6	Oriental Small-clawed Otter	*Aonyx cinerea*	GNT	Rare
7	Fishing Cat	*Prionnailurus viverrinus*	GNT	Very rare
8	Leopard Cat	*Prionailurus bengalensis*	GNT	Very rare
9	Slow Loris	*Nycticebus coucang*	GNT	Very rare
10	Silvered Langur	*Semnopithecus pileatus*	GNT	Rare
11	Long tailed macaque	*Macaca fascicularis*	GNT	Common
12	Treeshrew	*Dengdrogale murina*	GNT	Rare
13	Lyle's flying fox	*Pteropus lylei*	GNT	Common

EN; Endangered, GNT; Globally Threatened, Source: Cambodia Biodiversity Status Report, 2001 and Wildlife Identification for Law Enforcement, 2002.

Survey Result

Mammal faunal diversity of the survey area by both track-sign survey along transects and interview is not particularly high due to high human disturbance as areas are easily accessible from Chong

Kneas and Kandeak communes for fishing, resources foraging, hunting and rice farming. Only one species of primate (O. Primates) has been recorded during interview using mammal field guide of Cambodia (Men et al., 2000). Long-tailed Macaque *Macaca fascicularis* is reported by fishermen but not seen by our survey, meaning its number is significantly declining due to hunting for commercial purpose (for Chinese Macaque farming). Silvered Langur is rarely seen by local fishermen. Hairy-nosed Otter *Lutra Sumatran* has been spotted on a rare case and was informed to migrate across the Lake in the direction to Prek Toal. It is reported their skin is used for traditional medicine. Other species include Mainland Slender-tailed Treeshrew *Dendrogale murina*, Squirrel *Callosciurus finlaysonii*, Berdmore's Squirrel *Menetes berdmorei*, small Asian Mongoose *Herpestes javanicus*, Common Palm Civet *Paradoxurus hermaphroditus*, and Leopard Cat *Prionailurus bengalensis* have been reported by hunters with declining population. Only mainland Slender-tailed Treeshrew was sighted during the survey at the first plot. In the past the study area served as feeding habitats for Asian Elephant *Elephas maximus* which seasonally descended here from upland Tonle Sap watershed for food. Irrawaddy Dolphins *Orcaella brevirostris* were also common in the area but now fully extinct due to especially widespread killing by Khmer Rouge officers for making oil for diesel engine in 1976-78. Villagers informed that dolphin flesh is not commonly used as food, only their fat is useful.

2) Fish

Overview

The Tonle Sap Lake is one of the most productive freshwater ecosystems in the World due to its unique flood pulse regulated by the water regime of the Mekong River and Tonle Sap tributaries. Of the total 1200 fish species identified in the regional Mekong waters, 500 fish species are likely to be found in the Cambodian Mekong (Rainboth, 1998). It is not yet fully known how many fish species actually occur in the Great Lake, though it is believed many fishes migrate between the Mekong and the Lake. Kottelat (1985) recorded 215 fish species from the Tonle Sap Lake. According to Nao Thouk, these fish species can be classified into three categories: white fish, black fish and small fish according to their adaptation to the environmental aquatic conditions.

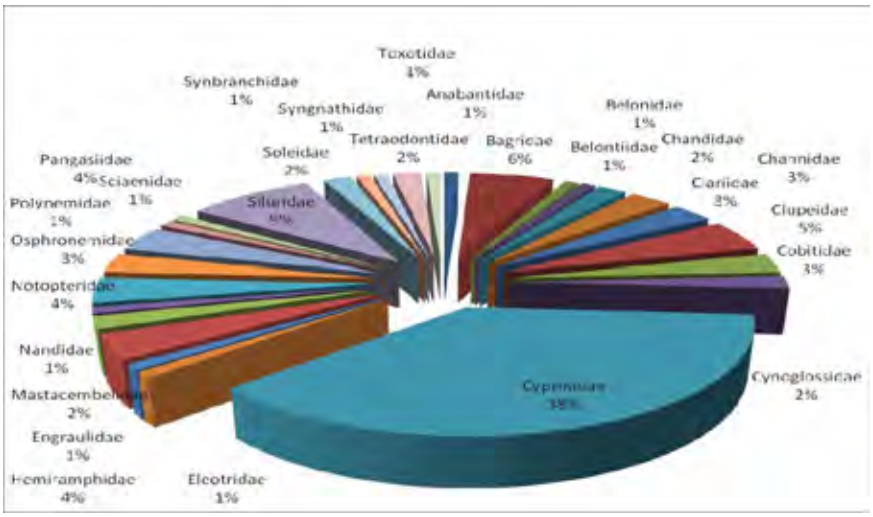
Table 1-16 List of Fish Species of Conservation Value

No	Cambodian Status	Common name	Scientific name
1	GNT	Asian Bonytongue	Scheleropages formosus
2	NT	Mekong Giant Catfish	Pangasionodon gigas
3	NT	Giant barb	Catlocarpio siamensis
4	NT	Thicklip barb	Probabus labemajor
5	NT	Seven line barb	Probarbus jullieni
6	NT	Thinlib barb	Probabus labeminor
7	NT		*Puntius partipentazona*
8	NT		*Wallago micropogon*
9	NT		*Lycothrissa crocodilus*

GNT; Globally Threatened, NT; Near-Threatened, Source: Soun Phalla, 2002, "Wildlife Identification for Law Enforcement".

Survey Result

A total of 104 indigenous fish species belonging to 56 genus, 27 families and 10 orders were identified. Species composition was determined based on number of species counted from all collected samples. Fish species of Cyprinidae family were found most abundant comprising of 39 species or 38%, followed by species of Siluridae (9%), Clupeidae (5%), Channidae (4%), Clariidae (4%), Osphronemidae (4%) and Cobitidae (4%). The remaining percentage is constituted by species of other families.



Endangered species were identified through interviews with fishermen in the communities in the study area. The interview was conducted directly with individual fisherman in each village by using fish poster (published by FiA 2009, WWW.fia.maff.gov.kh). 47 fish species in total were identified from the interview, and 57 species were caught in Bor and gill net from

fisherman in December. At least 5 species were classified as threatened species as shown in Table 1-17, while the habitats are not identified.

Table 1-17 Endangered fish species

Order	Family	Species	Local name
Cypriniformes	Cyprinidae	*Probarbus jullieni*	Trey trawsak
Cypriniformes	Cyprinidae	*Probarbus labeamajor*	Trey trawsak
Cypriniformes	Cyprinidae	*Puntius partipentazona*	Trey kla
Siluriformes	Siluridae	*Wallago micropogon*	Trey stuak
Clupeiformes	Engraulidae	*Lycothrissa crocodilus*	Trey chhmar kror poeu

3) Amphibians

Overview

Amphibians are the least studied of vertebrate fauna in Cambodia. There has been little contemporary herpetological research, and the principle publications on Cambodia's amphibian fauna remain a series of classic works by French researchers (Bourret 1936, 1942) and a monograph on Cambodia snakes (Siant Girons 1972). Frog species likely found in the Tonle Sap Lake area are the Bullfrog *Rana tigrina* and Blyth's Frog *Rana Blythii* (CNMC/Nedeco, 1998).

Survey Result

As the areas were flooded at the time of survey, poster was used to interview fishermen. It was reported only 3 species of amphibians have been recorded in this site, namely *Bufo macrotis, Kaloula pulchra* and *Rana erythraea.* A short field study can be supplemented in Feb-March when the areas fully dry up. Farmers of dry rice reported abundance of frogs during dry season when water recedes and dry rice is cultivated. In fact all these species are abundant in the Tonle Sap Lake and are not really significant species of concern.

4) Waterbird

Overview

The TSL is well known for rich diversity of bird species and is considered the most important wetlands of international significance. Over one hundred bird spcies has been identified and new species are being discovered. Knowledge on bird population and species diversity is better studied than any faunal species (Bonheur, 2001), especially since regular work of MoE and WCS on bird monitoring has been undertaken as part of the conservation activities in the core areas of TSBR. Of particular importance is the continued increase of waterbird of SGS in both diversity and population (Table 1-18).

Survey Result

Direct field observation and interview were conducted with the assistance of Mr. Hong Chamnan, an ornithologist from General Directorate of Forestry and Wildlife. He identified 67 bird species. A photograph of comb ducks was taken during field visit as shown in the photo. Bird nests were not found, indicating that the study area is not a particular important site for breeding like in Perk Toil. Nevertheless flock of bird colonies visit the areas for food during dry season from February. Birds are often caught for food as their meats are of particular delicacy.

Table 1-18 List of threatened large migratory waterbirds and estimated minimum population

English name	Khmer Name	Scientific name	Location of abundance	Population 1998-2007	IUCN Status
1. Spot-billed pelican	Tong Prapheh	*Pelicanus philipensis*	Prek Toal and Boeng Chhmar	2,592	**GNT**
2. Greater Adjutant	Tra Dak Thum	*Leptoptilos dubius,*	Prek Toal Boeng chhmar	77	**EN**
3. White-winged duck	Tea Prey	*Cairina scutulata*	Prek Toal Boeng Chhmar	-	**GT**
4. Milky stork	Ro neal sar	*Mycteria cinerea*	Boeng Chhmar, Prek Toal	10+	**VU**
5. Lesser adjutant	Tradak Touch	*Leptoptilos javanicus*	Prek Toal Boeng Chhmar	253	**VU**
6. Painted stork	Roneal Por	*Mycteria leucocephala*	Prek Toal Boeng Chhmar	3,121	**GNT**
7. Asian open bill	Kreal kchang	*Anastomus oscitans*	Prek Toal Boeng Chhmar	7,682	**GNT**
8. Black headed ibis	Kngar kloun sar	*Threskiornis melanocephalus*	Prek Toal	1,000	**GNT**
9. Glossy ibis	Kngar kloun rolong	*Plegadis falcinellus*	Prek Toal	50	**NT**
10. Masked fin foot		*Heliopais personata*	Prek Toal, Boeng Chhmar	100 +	**GT**
11. Grey-headed fish eagle	Ak trei kbal prapheh	*Icthyophaga ichthyaetus*	Prek Toal Boeng Chhmar	15	**GNT**
12. Black-neck stork	Angkot khmao	*Ephippiorhynchus asiaticus*	Boeng chhmar	6	**GNT**
13. Bengal florican	Sat ksep	*Houbaropsis bengalensis*	Srayov commune (Kampong Thum)	15+	**EN**
14. Oriental darter	Smaonh	*Anhinga melanogaster*	Boeng Chhmar Prek Toal	4,053	**GNT**
15. Comb duck	Tea Kapa	*Sarkidiornis melanotos*	Prek Toal and Prey Kos	NA	**EN**
16.		*Pseudibis davisoni*	NA	NA	**EN**

GNT; Globally Near Threatened, EN; Endangered, GT; Globally Threatened, VU; Vulnerable, NT; Near Threatened, Source: Biodiversity, Society and Environmental Governance in the TSBR, 2001.

5) Reptile

Overview

Information on diversity and abundance of reptile species in the Tonle Sap Biosphere Reserve is poorly understood, due to lack of systematic inventory, limited human resources and funding. The only good study was conducted in 1998 by the Tonle Sap Coordination Unit of the Ministry of Environment under the support of Support Program to Environment in Cambodia (SPEC) funded by European Commission. The study identified at least 40 reptile species, including 23 snake species (10 water snake species), 8 turtles, 1 Siamese crocodile (*Crocodylus siamenses*), 6 lizard species (*Gecko gecko, hemydacrylus garnoti, Cosymbotus platyrurus, hemidoctylus frenatus, Physignathus cocincinus, Calotes mystaceus*), monitor lizard (*Varanus salvator*) and 2 skink species (*Mabuya septemtaeniata and Mabuya Mabouya*) in the flooded forest of the Tonle Sap Lake (Nicolai Doroshenko, 1998).

Water snakes are subject to heavy harvest for crocodile feeding and human consumption. According to Bryan L.S, an estimated amount of 7000 –14,000 kg of snakes were caught for sale every week at the Chong Kneas port in Siem Reap province (Bryan L. Stuart, Jady Smith, 1999). 5 water snake species of colubrid subfamily Homalopsinae (*Enhydris enhydris, Cerberus rynchops, enhidris bocourti, Homalopsis buccata and Erpeton tentaculatum*) are found common, of which *Enhydris enhydris* is the most abundant species accounted for 80% in the market sample. Nicolai Doroshenko approximately estimated the density of these 5 species in Prek Toal, Boeng Chhmar, and Stoeng Sen at 50-100/ha, 20-30/ha, 20-30/ha respectively, indicating that Prek Toal is the most important breeding areas for water snakes. King cobra (*Ophiophagus hannah*), asiatic cobra (*Naja naja*), rock python (*Python molurus*) and reticulated python are also found though their population is in rapid decline as they are also targeted for commercial trade.

8 turtle species are found, of which 3 species (*Malayemys subtrijuga, Hieremys annandalii and Cuora amboinensis*) are very common (Bonheur, 2001). The most abundant species is *Malayemys*, which accounts for 88% of the catch sample. Their population is on the steady decline. The surplus products of turtles and water snakes are also exported to China and Vietnam.

Though number of crocodile in the wilderness is dramatically reduced, a large number of crocodiles are found in captivity due to successful breeding by farmers around Tonle Sap Lake.

Survey Result

Due to pressure caused by human activities such as forest destruction, rice farming, and hunting, no turtle species were observed or found during the survey. However, interview with fishermen indicated existence of some turtle species though their number is on the dramatic decline. Three species reported to be found are *Malayemys subtrijuga, Hieremys annandalii, Cuara amboinensis*, which are classified as near threatened species (Table 1-19).

Crocodile was not expected to be found here either as this species is very sensitive to any human disturbance.

Table 1-19 List of Turtle Species and Crocodile Species Likely Found in Tonle Sap Biosphere Reserve

No	IUCN Status	Common name	Scientific name
1		Siamese crocodile	*Crocodylus siamenses*
2	GNT	Estuarine terrapin	*Batagur baska*
3	GNT	Box turtle	*Cuara amboinensis*
4	GNT	Snail-eating turtle	*Malayemys subtrijuga*
5		Black terrapin	*Siebenrockiella crassicollis*
6	GNT	Yellow-headed temple turtle	*Hieremys annandalii*
7		Keel-backed terrapin	*Pyxidea mouhotii*
8	GNT	Elongated tortoise	*Indotestudo elongata*
9		Asian giant terrapin	*Heosemys grandis*
10		Black giant tortoise	*Testudo nutapundi*
11		Brown giant tortoise	*Testudo emys*
12	GNT	Asian giant soft-shelled turtle	*Pelochelys bibroni*
13	GNT	Southeast asian soft-shelled turtle	*Amyda cartilagineus*
14		Chinese soft-shelled turtle	*Trionyx sinnensis*
15		Yellow-spotted soft-shelled turtle	*Trionyx nakornsrithammarajensis*
16		Malayan soft-shelled turtle	*Dogania subplana*
17		Common siamense soft-shelled Turtle	*Trionyx cartilageneus*

GNT; Globally Near Threatened, Source: Bonheur Neou, 2001, Tonle Sap Case Study "Biodiversity, Human Security, Environmental Governance", Tonle Sap Biosphere Reserve.

Water snakes are reported found in the areas as the species can still reproduce well in the mix of mosaic vegetation and rice fields. They are often caught by gillnet and used for household consumption and crocodile feeding. Five species confirmed by fishermen include *Enhydris enhydris, Cerberus rynchops, enhidris bocourti, Homalopsis buccata and Erpeton tentaculatum*, of which two species were collected by our team.

Lizard species as shown in the table were reported to exist in the areas and one skink species was also seen by our team.

1-3-3 Socio-economical resources:

1-3-3-1 Population

Table 1-20 presents the recorded data from 2003 through 2009 of 13 communes of Siem Reap City plus one adjacent commune Kandaek commune in Prasat Bakong District in the Study Area. The data shows the population increase trend of the City is quite different from that of the province. The population growth rate varies from 2.8 % to 7.8 % dependent on status of each commune, which is much higher than 2.4 to 2.5 % of the Provincial growth rate. For example, the populations in Sla Kram commune and Svay Dangkum commune have increased over 14,000 and 10,000 or 7.7 % and 6.5 % of annual average growth rate, in the last six years. A total of 53,515 populations (annual average 4.9 %) in the study area have increased from 2003 through 2009. This trend shows a typical population increase in urban areas in Cambodia. The population increase is caused by migration into Siem Reap City due to that sharp increase of economic activities through tourism industries would be taken place in the Study Area.

Table 1-20 Recorded Population 2003 to 2009

No.	Year / Commune	2003	2004	2005	2006	2007	2008	2009	2003 -2009
1	Sla Kram	26,079	26,550	27,910	31,130	33,824	38,475	40,473	14,394
2	Svay Dangkum	24,493	27,333	26,267	26,985	27,630	34,778	34,878	10,385
3	Sala Kamraeuk	14,960	15,655	17,319	17,781	18,293	20,435	21,600	6,640
4	Kouk Chak	16,228	16,523	18,068	18,230	18,578	19,214	19,367	3,139
5	Siem Reap	14,374	14,654	14,820	16,756	17,018	17,296	17,564	3,190
6	Tuek Vil	7,568	7,854	8,285	8,629	8,934	9,514	9,890	2,322
7	Chreav	7,402	7,607	7,790	7,907	9,407	9,164	9,492	2,090
8	Krabei Riel	6,464	7,152	6,919	6,958	7,357	7,464	7,604	1,140
9	Chong Khnies	4,678	5,812	6,057	6,210	5,857	6,167	6,866	2,188
10	Ampil	5,705	5,946	6,065	6,055	6,062	6,412	6,788	1,083
11	Nokor Thum	4,259	4,612	5,332	5,752	6,072	6,279	6,644	2,385
12	Srangae	4,822	5,109	5,165	5,391	6,405	6,153	6,430	1,608
13	Sambour	2,796	2,965	3,160	3,316	3,295	3,487	3,553	757
14	Kandaek	10,142	10,674	11,027	11,472	11,468	11,960	12,334	2,192
Total		**149,970**	**158,446**	**164,184**	**172,572**	**180,200**	**196,798**	**203,483**	**53,515**

Source : Department of Planning Siem Reap Province.

Table 1-21 Recorded Population Growth Rate of Each Commune 2003 to 2009

No.	Year / Commune	2003	2004	2005	2006	2007	2008	2009-2003 Ave
1	Sla Kram	1.8%	5.1%	11.5%	8.7%	13.8%	5.2%	7.7%
2	Svay Dangkum	11.6%	-3.9%	2.7%	2.4%	25.9%	0.3%	6.5%
3	Sala Kamraeuk	4.6%	10.6%	2.7%	2.9%	11.7%	5.7%	6.4%
4	Kouk Chak	1.8%	9.4%	0.9%	1.9%	3.4%	0.3%	3.0%
5	Siem Reap	1.9%	1.1%	13.1%	1.6%	1.6%	1.5%	3.5%
6	Tuek Vil	3.8%	5.5%	4.2%	3.5%	6.5%	4.0%	4.6%
7	Chreav	2.8%	2.4%	1.5%	19.0%	-2.6%	3.6%	4.4%
8	Krabei Riel	10.6%	-3.3%	0.6%	5.7%	1.5%	1.9%	2.8%
9	Chong Khnies	24.2%	4.2%	2.5%	-5.7%	5.3%	11.3%	7.0%
10	Ampil	4.2%	2.0%	-0.2%	0.1%	5.8%	5.9%	3.0%
11	Nokor Thum	8.3%	15.6%	7.9%	5.6%	3.4%	5.8%	7.8%
12	Srangae	6.0%	1.1%	4.4%	18.8%	-3.9%	4.5%	5.1%
13	Sambour	6.0%	6.6%	4.9%	-0.6%	5.8%	1.9%	4.1%
14	Kandaek	5.2%	3.3%	4.0%	0.0%	4.3%	3.1%	3.3%
Total		**5.7%**	**3.6%**	**5.1%**	**4.4%**	**9.2%**	**3.4%**	**4.9%**

Source : Department of Planning Siem Reap Province.

The number of people seeking employment and therefore migrating from other districts or provinces into Siem Reap City as well as global economic crises, epidemics of bird flu and swain flu, and the border conflict between Thailand and Cambodia has influenced the fluctuation of the population.

The population by village in the study area is as shown in Table 1-22. It is made up in order to descending prevalence of population except both of Kanndeak Commune situated outside of Siem Reap City and Chong Kheas where many people are living in the floating village. The commune with the largest population is Sla Kram, 40,473 and next one is Svay Dangkum, 34,878, and Siem Reap Commune ranks fifth, 17,564 among twelve communes.

Based on the hearing from the representative of each commune, population in the local area consists of farmers, fishermen, workers for building construction, local government staff and the rest. Around the project candidate site from raw water intake to water treatment plant through the pumping station there is no residential area. The site has a higher portion of rice field and abandoned bare land.

Table 1-22 Population by village in Study Area (2009)

Commune / Village		Population	Commune / Village		Population	Commune / Village		Population
1 Sla Kram		**40,473**	5- 4	Korkragn	2,426	9- 7	Bang Koung	1,133
1- 1	Slor Kram	2,740	5- 5	Kra Sangroleung	856	9- 8	Kiri manon	1,162
1- 2	Boeng dunpa	5,951	5- 6	Spean Chreav	2,647	9- 9	Bos tom	283
1- 3	Chong Kavsu	12,679	5- 7	Arragn	3,406	9- 10	Trach chrom	403
1- 4	Dork pou	3,518	5- 8	Treak	1,412	**10 Norkor Thum**		**6,644**
1- 5	Bantay chas	6,334	**6 Teuk Vil**		**9,890**	10- 1	Rohal	1,143
1- 6	Trang	3,473	6- 1	Kouk doung	1,648	10- 2	Sras srang	1,004
1- 7	Mondol 3	5,778	6- 2	Sandan	1,731	10- 3	Sras srang	735
2 Svay Dangkum		**34,878**	6- 3	Chrei	1,174	10- 4	Kravan	938
2- 1	Pngea Chei	941	6- 4	Prayut	564	10- 5	Arak svay	548
2- 2	Kantrork	2,098	6- 5	Bantay Cheu	955	10- 6	Ang Chang	2,276
2- 3	Kouk Krasang	891	6- 6	Teuk Vil	517	**11 Srangae**		**6,430**
2- 4	Svay Chrei	882	6- 7	Pri Chas	761	11- 1	Kasikam	1,698
2- 5	Pou Bos	680	6- 8	Tuek Tla	520	11- 2	Tnal	1,468
2- 6	Tmei	1,357	6- 9	Pri Tmei	988	11- 3	Roka Thom	534
2- 7	Svay Dangkum	1,758	6- 10	Chei	1,032	11- 4	Prei Thom	672
2- 8	Salakanseng	10,977	**7 Chreav**		**9,492**	11- 5	Srangie	828
2- 9	Krous	3,072	7- 1	Chreav	770	11- 6	Chanlong	765
2- 10	Vihear Chin	4,874	7- 2	Knar	3,617	11- 7	Ta Chouk	465
2- 11	Steng Tmei	2,272	7- 3	Bos Kralang	1,214	**12 Sambour**		**3,553**
2- 12	Mondol 1	2,197	7- 4	Ta Chek	634	12- 1	Pnouv	760
2- 13	Mondol 2	338	7- 5	Veal	1,262	12- 2	Sambour	884
2- 14	Ta phoul	2,541	7- 6	Kra sang	1,183	12- 3	Veal	649
3 Sala Kamraeuk		**21,600**	7- 7	Boeng	812	12- 4	Chrei	574
3- 1	Vat Bo	5,886	**8 Krabei Riel**		**7,604**	12- 5	Ta kong	686
3- 2	Vat Svay	4,659	8- 1	Ta Ros	610	**13 Kanndeak**		**12,334**
3- 3	Vat Damnak	3,939	8- 2	RoKa	899	13- 1	Kouk Tlouk	1,468
3- 4	Sala Kam reak	1,790	8- 3	Prei Pou	398	13- 2	Trapang Tem	1,209
3- 5	Chun long	1,025	8- 4	To tear	507	13- 3	Khun Mouk	981
3- 6	Ta Vean	3,585	8- 5	Krasang	556	13- 4	Chras	1,004
3- 7	Trapang Treng	716	8- 6	Popil	423	13- 5	Ou	1,351
4 Kouk Chak		**19,367**	8- 7	Trapang veng	499	13- 6	Spean Ka ek	1,508
4- 1	Trapang Ses	3,561	8- 8	Kouk doung	677	13- 7	Trang	930
4- 2	Veal	2,937	8- 9	Boeng	961	13- 8	Chrei	1,859
4- 3	Kasin tabong	3,228	8- 10	Prorma	826	13- 9	Kouk Tanot	1,261
4- 4	Kouk Chan	1,331	8- 11	Khnar	562	13- 10	Lo ork	763
4- 5	Khatean	1,723	8- 12	Prei kroch	686	**14 Chong Khneas**		**6,866**
4- 6	Kouk Beng	1,281	**9 Ampil**		**6,788**	14- 1	Phum Pir	812
4- 7	Kouk Tanot	2,125	9- 1	Kouk Chan	780	14- 2	Phum Muoy	971
4- 8	Nokor krav	3,181	9- 2	Thnal Chak	375	14- 3	Phum Bei	845
5 Siem Reap		**17,564**	9- 3	Tanot	469	14- 4	Phum Buon	737
5- 1	Pou	2,774	9- 4	Trapang Run	751	14- 5	Phum Pram	571
5- 2	Phnom krom	3,204	9- 5	Ta pang	532	14- 6	Phum Prammuoy	826
5- 3	Pror Lay	839	9- 6	Prei kuy	900	14- 7	Phum Prampir	2,104
						Total (14Commune-118Villages)		203,483

1-3-3-2 Infrastructure

Road

Over $800 million has been invested in rehabilitating the country's roadways since the mid-1990s since the royal government identified rehabilitation as a stimulus to sustainable economic recovery. The road network is the principal mode through which people and goods move and covers approximately 39,000km throughout the country. There are seven national roads that make up the primary highways or 4,800km (NR 1 to 7) of roadways. Of this, 2,700km have been rehabilitated. Primary highways split off into secondary highways, also considered provincial roads of which 2% are paved. The conditions on lesser roads can be quite poor with some areas in effect isolated during the rainy season. Many unpaved roads in the peri-urban area of Siem Reap are made of laterite, a reddish clay-like material that is hard when dry and slippery when wet, or macadam, broken stone used in compact layers for road surfacing. Poor road conditions are related to drainage problems that afflict the city. *(Source: Chapter V. Urban Infrastructure and Environmental Management, Siem Reap: Urban Development in the Shadow of Angkor, 2008)*

Major road network in Siem Reap District consists of Route 6, Route 63 and Route 66. Route 6 connecting Phnom Penh and Siem Reap and running east-west direction is a main corridor in the city. Route 63 runs north-south direction linking from the center of the city to the Tonle Sap Lake, and Route 66 also runs north-south direction linking from the Angkor heritage area to the city center. Branch roads are stemmed from these trunk roads towards residential and tourist area. Road construction and rehabilitation have been implemented in the city, but rapid traffic increase outpaces and traffic congestion arises at some bottleneck points in peak hours. *(Source: The Study on Integrated Master Plan For Sustainable Development of Siem Reap / Angkor Town, JICA, 2006)*

When the study team visited every Commune Center to conduct public hearing from the representative of Commune, it was found that community roads had not been developed enough to transport goods easily by motorcycle and car, and sometimes a usual passenger car could not pass the road after heavy rain. Some representatives of Commune say they have been requesting budget for road improvement to Provincial Governor.

Wastewater Treatment System

Waste water Treatment Plant with capacity 2,776m3/day was constructed in December 2009 by Mekong Tourism Development Project Part A1, Siem Reap Wastewater Management（ADB）,

and ADB is now promoting construction of another plant with the same capacity 2,776m3/day of target year 2015, resulting 5,552m3/day of capacity in total.

On the other hand, for the project of Siem Reap Sewerage System and Improvement of Siem Reap River in the Kingdom of Cambodia funded by KOICA, detail design of the WWTP with capacity 10,000m3/day started targeting completion in 2015.

Therefore, WWTP with capacity 15,552m3/day will come into existence in 2015. Moreover, Draft Report is already completed for Drainage & Sewerage Master Plan for the District of Siem Reap Priority Works funded by AFD.

Electricity

Two Communes of Krabei Riel and Ampil in the study area have been waiting for supply of electricity. Although they are included in the service area with water supply system, they will also have to wait for it until second phase of target year 2030.

1-3-3-3 Land use

The soils in the floodplain of the Tonle Sap are generally poor in fertility. The three major soil types found in this area are a) young lacustrine alluvial soils, b) alluvial soils, c) acid sulphate soils. The young lacustrine soils were formed from colluvial and alluvial outwash from acidic and basic rocks from the upland areas bordering the Tonle Sap Lake, and from silt and clay deposits carried by the floods of the Mekong River. (*Source:3.Fisheries and Floodplain Agriculture in the Tonle Sap Region, National Environmental Action Plan 1998-2002*)

Current land spread from southern part of Siem Reap City to Tonle Sap Lake is occupied with wet season rice[1] field for the most part, and partly with flooded rise[2] field and abandoned field covered by grass. According to the information from Provincial Department of Agriculture, the productivity of the land is 3～3.5 ton/ha and it is fertile compared with that of poor land, 1.5～2.0 ton/ha. The chief of Kandaek Commune says that it is 4.0 ton/ha in the recession rice area in the Commune.

In addition here is little floating rice[3] (deep-water rice) area in Siem Reap Province, while there are floating rice areas in Kompong Thom Province.

[1] Wet season rice: the rice is grown in the rainy season during May and October/November
[2] Flooded rice: the rice is grown in dry season during December/January and May/June. It is also called as recession rice since it grows in recession water.
[3] Floating rice: the rice with stem more than 3m grows in deep water.

There is inundated forest along the Tonle Sap Lake shore and a majority of this forest has been logged over at least once.

1-3-3-4 Public health and welfare

In majority of communes in study area drinking water is provided from well and water quality is not good enough to drink directly. They use water from well after boiling.

No information of public health and welfare could be obtained from Commune representative except Chong Kneas where floating village is located. Most of all people in floating village drink water from Tonle Sap Lake after boiling. There is concern of water-borne diseases and chief of the commune requests improvement of Community Health Center.

High percentage of latrine indicates better living standards and knowledge about health care in the community. However, based on the result of social survey conducted by JICA Study Team in August 2009, 31% of interviewed households, all of which consists of 34 poor income households, 33 medium income households and 33 better-off households in the area without water supply service, have no sanitary latrine and defecate around their house compounds by digging and burying human waste.

Traffic accidents are the second biggest public health concern after HIV/AIDS according to the secretary of state of MPWT (*Phnom Penh Post* 28 August 2008). Road improvement and motorization have led to a greater number of accidents and causalities. Most accidents in Siem Reap involve motorbikes, which are also the most popular form of transport. *(Source:Chapter V. Urban Infrastructure and Environmental Management, Siem Reap: Urban Development in the Shadow of Angkor, 2008)*

1-3-3-5 Economic condition

There are many Communes which have a higher proportion of farmers in the study area. They are also affected by worldwide economic depression, and construction workers in some Communes have lost their job because of hanging up of new building construction.

According to the result of social survey conducted by JICA Study Team in August 2009, the average monthly income of low income households is 91US$/m (Table 1-23). If the family consists of four members, they are living along under poverty line. (91/30/4=0.7US$/day/capita < 1 US$/day/capita).

Table 1-23 Average Income of Household in the Study Area (2009)

	Water Supply Service (Amount of Consumed Water)			No Water Supply Service (Income)		
Category	Low (27)	Medium (38)	High (35)	Low (34)	Medium (33)	Better-off (33)
(1,000 Riel)	1,577	2,729	2,641	363	824	1,229
(US$)	394	682	660	91	206	307

( ) shows number of interviewed households

1-3-3-6 Heritage

Mr. Christophe Pottier at Centre of l'EFEO in Siem Reap had been contributing for conservation of cultural heritages for a long time and recently went back to Sydney University in Australia. At present Mr. Damian Evans is working for it as a subsequent researcher. Based on the GIS data from Australian Research Centre, distribution of cultural heritages was studied in the related area, where facilities like water intake, conveyance pipeline, pumping station, water treatment plant and main distribution pipeline to the existing road are constructed and closed between lines of latitude 1,460,000 and 1,476,000 and longitude 378,000 and 386,000 shown in **Figure 1-15**. Forty-five (45) cultural heritages are found in the area, while there are more than 3,000 cultural heritages registered in GIS Database in the Study Area. The location map of cultural heritages in the related area is as shown in **Figure 1-15** and the name and type of the heritages are as shown in Table 1-24. Table 1-25 shows type of heritage site including road, canal, reservoir, temple and bridge, etc. There are four kinds of types in the area, i.e. No.2 "Linear (Canal)", No.3" Reservoir", No.4 "Temple" and No. 14 "Significant Mound". However, there is no Linear (Road) and no Linear (Dyke/Dam) in the area.

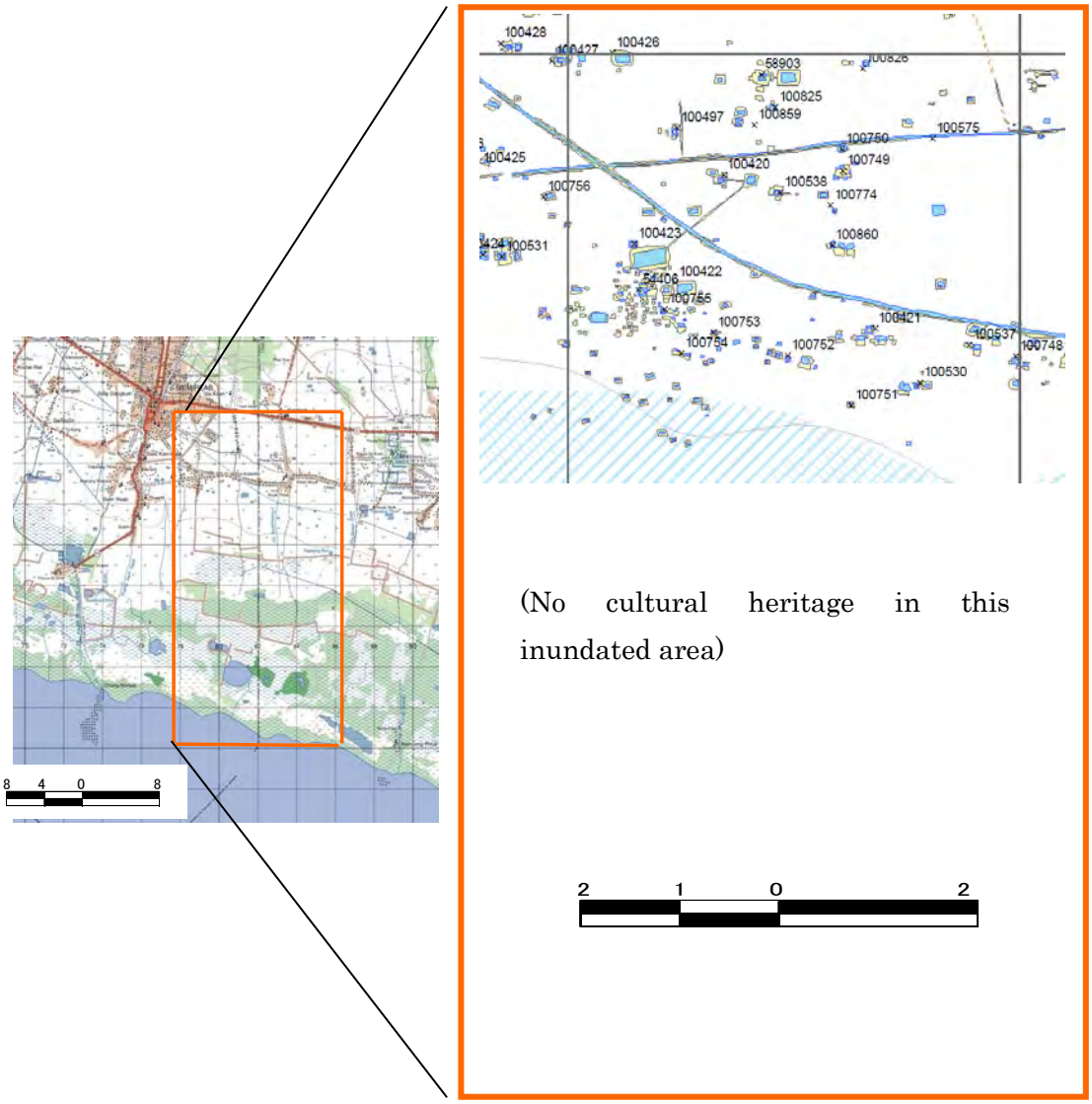


Figure 1-15 Location Map of Cultural Heritage in related area
(latitude 1,460,000 and 1,476,000 / longitude 378,000 and 386,000)
(Source: Mr. Damian Evans, Australian Research Centre)

Table 1-24 List of Cultural Heritages in the Related Area

Site ID	Site Name	Keyword	Type	Longitude	Latitude
54406	He Phka (Pr.)	He Phka (Pr.), Prasat Hê Phka, Pr. He Phka, Prasat, Prasat, Pr. He Phka	4	103.899346	13.316349
58903	Daun So	Daun So, Prasat Daun Sô, Daun So, Daun So	4	103.911796	13.337975
100370	Trapéang Prei Dâmrei	Trapéang Prei Dâmrei, Trapéang Prei Dâmrei, undete, undetermined	3	103.946185	13.342921
100412	Kôk Krüs	Kôk Krüs, Kôk Krüs, Pr. Pouoch, Prasat, Pr. Pouoch	4	103.930991	13.344277
100413	Prei Roka	Prei Roka, Prei Roka, undetermined, undetermined	4	103.917446	13.348288
100414	Trapéang Popoul	Trapéang Popoul, Trapéang Popoul, undetermined, undetermined	4	103.921107	13.349433
100419	Tuol Ta Méak	Tuol Ta Méak, Tuol Ta Méak, Trapeang Arak Svay, Trapeang Arak Svay	4	103.904072	13.34521
100420	Prasat Kuk Thlok	Prasat Kuk Thlok, Prasat Kuk Thlok, Pr. Kuk Thlok,, Pr. Kuk Thlok, Pr. Kuk Thlok	4	103.907982	13.32786
100421	Kôk Ta Meun	Kôk Ta Meun, Kôk Ta Meun, undetermined, undetermined	4	103.923532	13.312574
100422	Trapéang Boeng	Trapéang Boeng, Trapéang Boeng, Trapeang Beng, Trapeang Beng	3	103.903091	13.31708
100423	Tuol Koa	Tuol Koa, Tuol Koa, Trapeang Hem Ka, Trapeang Hem Ka	4	103.898854	13.320967
100424	Prasat Kuk Deum	Prasat Kuk Deum, Prasat Kuk Deum, Pr. Kuk Daum (In, Pr. Kuk Daum (InÄdit)	4	103.883386	13.319887
100425	Kôk Trapéang Khchav	Kôk Trapéang Khchav, Kôk Trapéang Khchav, Pr. Srok, Pr. Srok Rosei, Pr. Srok Rosei	14	103.882984	13.329098
100426	Trapéang Khna	Trapéang Khna, Trapéang Khna, undetermined, undetermined	14	103.896561	13.340115
100427	Prasat Trapéang Klong	Prasat Trapéang Klong, Prasat Trapéang Klong, unde, undetermined	4	103.890361	13.339256
100428	Trapéang Thlok Bau	Trapéang Thlok Bau	4	103.88509	13.340924
100429	Trapéang Kum Bau	Trapéang Kum Bau, Trapéang Kum Bau, Trapeang Kum B, Trapeang Kum Bau	14	103.876337	13.339131
100430	Trapéang Trèng	Trapéang Trèng	3	103.875631	13.339878
100497	Kôk Krüs	Kôk Krüs	4	103.903234	13.332577
100510	Prasat Phum Prasat	Prasat Phum Prasat	4	103.87336	13.325882
100515	Prasat Srok Rüssei	Prasat Srok Rüssei	4	103.872234	13.329927
100516	sans nom	sans nom	4	103.878688	13.329838
100530	Tuol Kôk Srah	Tuol Kôk Srah	4	103.9282	13.307169
100531	Kôk Deum	Kôk Deum	4	103.885326	13.319633
100537	Kôk Ta Sok	Kôk Ta Sok	4	103.933214	13.310997
100538	Kôk Srah	Kôk Srah	4	103.913833	13.326176
100552	Kôk Ta Mel	Kôk Ta Mel	14	103.876435	13.331881
100575	canal dans l'axe ouest du Bakong	canal dans l'axe ouest du Bakong	2	103.9294	13.33162
100746	Tuol Kngôk	Tuol Kngôk	4	103.943665	13.308699
100748	Kôk Trâbèk	Kôk Trâbèk	4	103.938001	13.30985
100749	Vat Loâk	Vat Loâk,Wat	4	103.920222	13.328418
100750	Tuol Kânchân Ta Em	Tuol Kânchân Ta Em	4	103.920111	13.33056
100751	Trapéang Sva Keüs	Trapéang Sva Keüs	4	103.921157	13.304834
100752	Kôk Khlôk	Kôk Khlôk	4	103.914608	13.30986
100753	Tuol Ta Kat Tbal	Tuol Ta Kat Tbal	14	103.907074	13.312097
100754	Kôk Trâ Méng Kông	Kôk Trâ Méng Kông	14	103.903769	13.310003
100755	Tuol Krâpeu Slap	Tuol Krâpeu Slap	4	103.902041	13.314417
100756	Trapéang Ta Taut	Trapéang Ta Taut	14	103.889611	13.325574
100774	sans nom	sans nom	4	103.918954	13.324905
100825	Kôk Lvei	Kôk Lvei	4	103.913214	13.334744
100826	Kôk Ta Sao	Kôk Ta Sao	4	103.922134	13.338634
100845	Kôk Khlôk	Kôk Khlôk	4	103.90676	13.347003
100846	Trapéang Kâmpot	Trapéang Kâmpot	3	103.888389	13.348524
100859	Trapéang Thlok Daun Ampéo	Trapéang Thlok Daun Ampéo	4	103.911089	13.332972
100860	Trapéang Tim	Trapéang Tim	4	103.91911	13.320964

Table 1-25 Type of Cultural Heritage

NO	Items
1	*Linear (Ambiguous/Multi)*
2	**Linear (Canal)**
3	**Reservoir**
4	**Temple**
5	*Bridge*
6	*Grid*
7	*Linear (Road)*
8	*Linear (Dyke/Dam)*
9	*Water Control Structure*
10	*Circular Site*
11	*Linear (Undefined)*
12	*Quarry*
13	*Kiln*
14	**Significant Mound**
15	*Linear (Embankment)*
16	*Enclosure*

1-3-3-7 Land Acquisition

Although the system of land acquisition seems to be generally complicated and difficult in Cambodia, buying and selling of land is easy according to the opinion of Department of Agriculture and Department of Land Management in Siem Reap Province. Change of land use from agricultural land to another kind of land is not strictly limited and implemented based on a contract agreement between a seller and a buyer. Local governmental organization has no power to control private dealing. It is said that a coordination committee, consisting of the representative from relevant organization, would be set up by Provincial Governor if some conflict rises up between a seller and a buyer, and that forced transfer of local people is difficult even for development of infrastructure in case they are living legally on their own land.

The candidate site for conveyance pipeline from raw water intake to the pumping station is owned by government because it belongs almost to the Strictly Protected Inundated Area and the site for transmission pipeline from the pumping station to the water treatment plant consists of privately-owned areas. The project owner should buy the lands for PS and WTP because they are private properties.

1-4 Public Participation

1-4-1 First Phase of Public Participation

1-4-1-1 Public Hearing from Local People

According to advice from MOE, the study team conducted public hearing from representative of community level, like Chief, Deputy Chief and/or Secretary of 14 Communes. After explanation of the project summary, interview was carried out. The main questions are as follows:

1. Population of the commune
2. How to get drinking water at present
3. Quality of drinking water
4. Opinion of water supply system expansion
5. Willingness to pay
6. Environmental issue
7. Opinion on water source

The result of hearing is summarized in Table 1-27. There are some Communes without electricity, and some chiefs say it would be so hard for local people to pay water charge although they have been waiting for safe and clean drinking water provided by a new system.

In addition to this, Stakeholder Hearing from the representative of three Community Fisheries was carried out in the study area. They have been managing their Community Fisheries in accordance to Community Fishing Area Management Plan. (Table 1-26) They hope the project facility would not be an obstacle against navigation of fishing boat and not give a significant impact on fishing area.

Most of all people the study team conducted stakeholder hearing from expressed that they have been waiting for introduction of water supply system. Particularly chiefs from Commune are expecting water supply by pipe because they have not got out of trouble for supply of safe water from wells to local people.

Table 1-26 Community Fisheries in the study area

NO	Name of Community Fisheries	Member	
		Family	Total
1.	Krabeiriel	867	1,385
2.	Chong Khneas	706	1,116
3.	Kodeck	1,083	1,550

1-4-1-2 Public Hearing from Other Stakeholders like Provincial and Central Government

The public hearing from other stakeholders than local people was conducted. Each opinion was collected after study team member explained the outline of the project and showed three kinds of alternatives of water source, a) surface water from Tonle Sap Lake, b) surface water from the canal of West Baray, and c) groundwater from the area near Tonle Sap Lake. The result is as shown in Table 1-28 &Table 1-29.

Most of officials recommend that the water supply expansion project should be implemented in Siem Reap City and that surface water form Tonle Sap Lake should be used for source of water supply system. Tonle Sap Authority thinks water sources from West Baray and groundwater are not enough for future demand and UNESCO advises the project owner should conduct archaeological excavation at the bottom of West Baray prior to construction of relevant facilities. It takes a long time to get approval for planning and designing of the project. MOE and MOAFF consider it is difficult to construct a big open canal through the protected area of Multiple Use Area and Strictly Protected Inundated Forest because the open canal may give a significant impact on the protected area due to extensive alteration of the land and they recommend use of pipeline laid down under the ground to mitigate impact on the natural condition in the protected area.

Table 1-27 Public Consultation (1) Stakeholder Hearing from Commune in Project Site

NO	Commune	Water source	Water Quality	Mitigation Measures	Tap Water	Fee	Environmental Problem	Electri city	Others	Profession	Popula tion	Stakeholder
1.	Sla Kram	Well 90% Tab 10%	No good /iron	Boiling	More than 50% waiting for a long time	No problem	Water pollution of SR River /Market odor /Wastewater		Water from Tonle Sap is best /Groundwater not available /APSARA Zone 60%	Business 40% /Government 20% /Construction 10%	36,111	Chief (1)
2.	Svay Dangkum	Well 70% Tab 30%	Usable /No good	Digging new wells	Very happy /Waiting for a long time	No problem /Having experience	Solid waste in the river		Groundwater far from Angkor is better.		29,173	Deputy, Secretary, Village Chiefs (12)
3.	Kouk Chak	Well 99% Tab 0.2% (1 well for 10 households)	No good	Boiling /International NGO	Very happy (groundwater is restricted)	Should be paid	Solid waste in the river			Farmer 80% Shop 15%	27,444	Chief Secretary (5)
4.	Sala Kumraeuk	Well 90% Tab 10%	No good /Red/yellow due to iron	No mitigation measures /Claim for water to Radio station from local people	Very happy/ Saving time	Same as electricity	Odor from Toilet /Solid waste /Noise /Water pollution in waterway		Under construction of drainage by AFD		23,635	Chief (1)
5.	Nokor Thom	Well 100%	Red due to Iron in two villages	/Boiling & Filtering /NGO digging new wells	Very happy (wells give impact to Angkor)	No problem	Low awareness for environment /No toilet		Water source from Siem Reap is better	Farmer 70% /Handicraft /Construction worker	6,639	Chief /Commune council member (9)
6.	Chreav	Pump 85% Haul well 15%	Good 30% No good 55% (iron/oil)	Filtering No boiling NGO from Japan analyzing	Happy	Should be paid	Solid waste /Air pollution from company & Bus /Odor from slaughter		Tonle Sap Lake water is polluted, but pumping groundwater gives impact.	Farmer 80% Some fishermen	9,492	Chief, /Deputy /Deputy (3)
7.	Chong Khneas	On land; buying (1,000riel/30ltr) On water; buying 10% Using Lake water 40%	Tonle Sap Lake water is polluted.	Boiling /RACHA(NGO) advises for filtering.	Happy /Good chance to move on land	Easy (daily paying for drinking water now)	No space for waste site /No toilet /Noise of Boat		250 families are extremely poor. /Medical service level by Health Center is very low.	Fishermen 70% Boat driver 15% Shop 10% No farmer	5,970 Floating village (50%)	Chief (1)
8.	Sambour	Pump 482 Haul well l62	Usable /No good	Boiling /Help by ADRA, MONTHI, RESUT	Very happy	Should be paid	No				3,622	Chief /Deputy /Secretary (4)

NO	Commune	Water source	Water Quality	Mitigation Measures	Tap Water	Fee	Environmental Problem	Electri city	Others	Profession	Popula tion	Stakeholder
1.	Sla Kram	Well 90% Tab 10%	No good /iron	Boiling	More than 50% waiting for a long time	No problem	Water pollution of SR River /Market odor /Wastewater		Water from Tonle Sap is best /Groundwater not available /APSARA Zone 60%	Business 40% /Government 20% /Construction 10%	36,111	Chief (1)
2.	Siem Reap	Well /Rainwater /Mineral water (20ltr)	Good/No good (yellow due to iron & oil)		Very Happy	No problem	Solid waste Low awareness of local people /Water pollution in Siem Reap River		Pumping groundwater gives impact on Angkor and water from Baray gives impact on agriculture. Tonle Sap Lake water is best.	Farmer 70～75%	17,898	Chief (1)
3.	Srangae	Well /Buying 30% $1.5/24ltr	Usable /No good 30%	Getting from other good well	Very happy	Should be paid	Economy	Yes, but hard to pay		Farmer	6,566	Deputy (1)
4.	Teuk Vil	Well 80% Tab 20%	Good	－	Unknown	Should be paid	Noise from Aircraft & traffic			Farmer 80%	9,898	Chief (1)
5.	Krabei Real	Well 80%	No good Brown/ Yellow due to iron & oil	NGO from Japan adivises.	Happy	Very Hard (Small income)	No good road condition /Economy	No electri city		Farmer	7,621	Secretary (3)
6.	Ampil	Well	No problem	Education by Rotary International Organization	Better than well	The poor cannot pay.	No odor due to remove of disposal site to other commune	No electri city		Farmer 100%	6,671	Chief Secretary (4)
7.	Kanndeak	Well	No good	Boiling /Filtering /Rotary International Organization sets 70 filters.	Useful in the future	Hard	Noise from national road	User 20%		Farmer 80% /Fishermen /Construction worker	12,059	Chief Deputy (4)

(Source: JICA Study Team)

Table 1-28 Public Consultation (2) Stakeholder Hearing from Local Government

NO	Provincial Department	Position	Name	Access	Opinion
1.	Environment	Director	Mr. Lun KANEL	012-406-555	IEIA and EIA should be conducted consulting with DOE and The project owner, SRWSA should submit the IEIA and EIA report not to MOE directly, but to DOE at first. Pumping –up of groundwater may give some impact on cultural site.
2.	Land Management	Deputy Manager	Mr. Poch NATH	012-717-279 /011-577-799	If the dispute between land owner and project owner comes about, provincial governor sets up committee for the land.
3.	Fisheries	Deputy of Cantonment	Mr. Prin SAVIN	012-821-584	The protected areas set by MAFF should be paid attention not to give a significant impact on fisheries. Negotiation regarding construction of new open canal in Strictly Protected Inundated Forest Area may take a long time.
4.	Agriculture	Director	Mr. Moeurng SONITYA	011-927-000 /012-927-000	It is not so difficult to change the land use from agriculture to other use. It depends on negotiation and contract between sellers and a buyer.
5.	Forest	Director of Cantonment	Mr. Chheang TOLA	012-881-877	When the location of the project is planned concretely, the project owner should come to consult with local government before any decision.

Table 1-29 Public Consultation (3) Stakeholder Hearing from Central Government and Others

NO	Organization	Department	Name	Access	Opinion
1.	Tonle Sap Authority	Permanent Vice-Chairman, Secretary General	Mr. Say SAMAL	089-719-007	Planning for long term more than 20 years is most important. Both of water source from West Baray and groundwater are not enough to supply drinking water in the future. Surface water should be utilized in the foreseeable future.
2.	MOE	Deputy Director, EIA	Mr. Duong SAMKEAT	012-880-240	Public consultation should be conducted after completion of EIA report and opinions from stakeholders should be attached to the EIA report when it is submitted to MOE.
3.	MOE	Deputy, Natural Resource assessment	Mr. Suon MEAN	011-873-993	Multiple Use Area can be used for some projects, in consideration of giving no significant impact on natural resources.
4.	MOE	Director, National Park	Mr. Meng Mony REAK	012-943-909	Multiple Use Area should be utilized to improve the poor local people's living. Pipeline for safe drinking water may be able to be set in the Multiple Use Area.
5.	MOAFF	Deputy Director General, Fisheries Administration	Mr. Ing TRY	012-735-099	Fishing Lot should not be disturbed even due to the project of public infrastructure improvement. As regarding Community Fisheries, project owner should explain clearly content of the project to members of the Community Fisheries in advance and get their agreement.
6.	UNESCO	National Programme Officer, Culture Unit	Mr. Bun Hok, LIM	012-556-277	Project owner should conduct archaeological excavation if he wants to use water from West Baray as water source. Whether pumping-up of groundwater give impact on the cultural site or not depends on the distance between water wells and the site.

1-4-1-3 First Stakeholder Meeting

The first stakeholder meeting was organized by the project owner, SRWSA, at Pacific Hotel Siem Reap on 21st October 2009. The report on the meeting is as follows.

- Date & Time: 8:30-12:40 21st October 2009
- Place for Meeting: Pacific Hotel Siem Reap
- Method of Public Information: Invitation Letter, E-mail & Mobile phone
- Manner of Presentation: Power point, Microphone, Distribution of Handout
- Number of participant: 44 persons (Governor's Office, Dpt. of Agriculture, Forestry, Fisheries, Land Management, Public Works and Transportation, Water Resources and Meteorology, Environment, AFD, ADB, GTZ, APSARA, Communes, JICA Headquarter and Cambodia, others)
- Facilitator: Mr. Kong SOKVAN, Director of Production & Commercial
- Interpreter: Mr. Cheav CHANNY, Deputy General Director, SRWSA / Ms. Reath Kanha, Assistant of JICA Study Team
- Program of the Meeting

NO	Time	Theme	Presenter
	8:30- 9:00	Registration	Staff of SRWSA
	9:00- 9:10	Opening Address	Mr. Som KUNTHEA General Director, SRWSA
	9:10- 9:40	Outline of Project	Mr. Yoshihiko SATO Leader, JICA Study Team
	9:40-10:20	Process of Water Source Selection	Mr. Hiroshi OKADA JICA Study Team
	10:20-10:30	Coffee Break	Staff of SRWSA
	10:30-11:10	Initial Environmental Impact Assessment & Scoping for EIA	Mr. Shinya KAWADA JICA Study Team
	11:10-11:30	Question and Answer	Mr. Cheav CHANNY Deputy General Director, SRWSA
	11:30-11:40	Closing Address	Mr. Bun THARITH Vice Governor of Siem Reap Province
	11:50-12:40	Lunch Time	

- Minutes of Meeting

Question and Answer
1. Cost of construction for tap water Question: How much cost should be burdened by each house for connecting newly to water pipe? Answer: 520,000 riels (approximately 130 US$) 2. Disposal of Sludge Question: Where do you thaw the sludge discharged from water treatment facility? Answer: At present water treatment facility the sludge is dried up in the pit and then stored in the premises.

1-4-2 Second Phase of Public Participation

1-4-2-1 Public Hearing from Local People

(1) Agriculture in the Strictly Protected Inundated Forest

Public hearing from the chief of Kandaek Commune, where conveyance pipeline may be laid, was conducted regarding agricultural activities in the Strictly Protected Inundated Forest Area according to the questionnaire in Table 1-30. As a result, the followings came out.

- Recession rice starts in December every year.
- Recession rice area is dried up in March, April and May.
- Local people in the Commune should understand the necessity of water supply project and the chief of the Commune can persuade local people not to raise a claim against public works.
- Since local people had been growing rice for a long time before MOAFF designated Strictly Protected Inundated Forest Area in 1968, they have continued their activities at present as same as before. Therefore, they do not think it is illegal.
- Project owner should offer compensation to the farmers during construction, although they have to understand the importance of the project.
- The price of rice is 800～1,000 riel/kg (approx 0.2～0.25 US$/kg) and the yield of rice is 2.5～4.0 tons/ha.

(2) Impact on Community Fisheries

Public hearing from the chief of Kanndeak Community Fisheries, where conveyance pipeline may be laid, was conducted regarding impact on Community Fisheries according to the questionnaire in Table 1-31. As a result, the followings came out.

- The peak time of fisheries is form July to August.
- Family fishermen act during rainy season from June to December, while fishing companies are prohibited to catch fish during rainy season when fish produces eggs.

Table 1-30 Questionnaire of Farming in the Strictly Protected Inundated Forest Area

1. When do you start to grow recession rice, January or February?
2. Is it depending on the distance from Tonle Sap Lake?
3. Which month does the recession rice area dry up, i.e. no water, April, May or June?
4. What do you think construction of drinking water pipeline passing through the recession rice area?
5. According to explanation of Provincial Department of Fisheries, it is prohibited for local people to cultivate the land in strictly protected flooded forest area. Do you know it?
6. Is it illegal to grow rice there?
7. If it is illegal, we are afraid that you may not be able to complain about public works in the recession rice area.
8. What should the project owner do for local people who grow rice in recession rice area when the water supply project is implemented and some part of farm land is used for construction of pipeline?
9. The project owner should give some compensation to the farmers whose rice land is disturbed and harvest is not given. What do you think about illegal cultivation?
10. One or two years later after construction you can grow rice again same as at present because the pipeline is laid 2 or 3 m deep under the ground. Is there any problem about it?
11. Do you want anything regarding construction of the pipeline?
12. Do you want anything regarding the water supply system expansion project?
13. How much is price of rice?
14. How many kilograms of rice can you get from the area of one ha?

Table 1-31 Questionnaire of impact on Community Fisheries

1. When is the peak of fishing?
2. When is the fishing season, from_____to_____?
3. How many members are acting for fishery in Kandaek Community Fisheries?
4. How many tonnes can your Community Fisheries catch fish for one season?
5. Could you explain how to catch fish?
6. Do you have any trouble due to construction of intake?
7. Do you have any trouble due to construction of pipeline?
8. Do you think the project owner should pay compensation to your Community Fisheries?

- The members of Kandaek Community Fisheries are 5,550 and the committee consists of 11 members.
- The members own 30～40 boats only and yield of fish is only three (3) tons / Community Fisheries/season.
- The chief of the Community Fisheries insists that project owner should give compensation to them because there are impacts on fish and fishing area due to cutting protected inundated forest.

1-4-2-2 Second Stakeholder Meeting

- Date & Time: 8:30-13:30 24th March 2010
- Place for Meeting: Prince D' Angkor Hotel
- Method of Public Information: Invitation Letter, E-mail & Mobile phone
- Manner of Presentation: Power point, Microphone, Distribution of Handout
- Number of participant: 46 persons (Provincial Governor, Vice Governor, Governor's Office, Dpt. of Agriculture, Land Management, Public Works and Transportation, Water Resources and Meteorology, Environment, Health, Tourism,

Human Resources and Industry, Mines and Energy, Tonle Sap Authority, MOAFF (Fisheries Directorate), APSARA, UNESCO, Communes, Community Fisheries and others)

- Facilitator: Mr. Kong SOKVAN, Director of Production & Commercial
- Interpreter: Mr. Cheav CHANNY, Deputy General Director, SRWSA / Ms. Reath Kanha, Assistant of JICA Study Team
- Program of the Meeting

NO	Time	Theme	Presenter
	8:30- 9:00	Registration	Staff of SRWSA
	9:00- 9:10	Opening Address	Mr. Som KUNTHEA General Director, SRWSA
	9:10- 9:35	Summary of Feasibility Study for Siem Reap Water Supply Expansion Project	Mr. Yoshihiko SATO, Leader of JICA Study Team
	9:35-10:35	Preliminary Design of Facilities and Construction Scheme for Siem Reap Water Supply Expansion Project	Mr. Kentaro SATO & Mr. Atsushi KANAYA
	10:35-10:45	Coffee Break	Staff of SRWSA
	10:45-11:25	Environmental Impact Assessment of Siem Reap Water Supply Expansion Project	Mr. Shinya KAWADA, JICA Study Team
	11:25-12:00	Question and Answer	Mr. Cheav CHANNY Deputy General Director, SRWSA
	12:00-12:10	Closing Address	Mr. Bun THARITH Governor of Siem Reap Province
	12:10-13:30	Lunch Time	

- Minutes of Meeting

Question and Answer
H.E. Srun Limsong, Deputy Secretary General of ESCAP / The Council of Ministry of Fisheries Directorate I would like to suggest two things concerned with inundated forest and wastewater discharge. As you know we have exported fish to other countries and it means that Tonle Sap Lake has saved life of human beings for many years. Therefore, the inundated forest should be cut at minimum because it is very important for fisheries and the quality of wastewater discharged from water treatment plant should be careful. We know the development is necessary, but don't forget sustainability of natural resources. Sustainable development should be taken into consideration. **Mr. Kachi, JICA Study Team Member**

Q: Can the project owner get approval from MOE regarding EIA based on the content which JICA Study Team explained today by power point and how many days does it take to get approval for EIA from MOE after submission of EIA Report?

A: Mr. Siem Piseth, Dep. Provincial Department of Environment

We cannot but wait for direction from MOE. I did not know detail about this project including the situation of the project site. I just now know it after receiving an explanation from JICA Study Team. I think this project has no problem, but I don't know whether MOE give approval for EIA of this project or not. I know that development always gives impact on surrounding area. We have to check impact due to noise and vibration. There is no impact on people because there is no house around project site, but vibration could give impact on the nature. So we should find the way to reduce vibration.

Also we should protect environment from solid waste and wastewater that flows into Tonle Sap Lake and should find a good solution.

We are happy to get JICA's help. I hope the project could be realized as soon as possible. Conservation and development must go together harmonized. If we are insistent too much strictly on conservation of environment, it would make the development late.

Sou Platong, Deputy Governor

Changing from district to city is natural trend for human life. It means that water to be supplied and sewage to be treated increase. Number of tourists, local people and immigrants need to be well organized according to water supply system. Supply of safe drinking water is very important, but 20% of people in Siem Reap city can share in bounty of water supply system. Therefore, expansion of the system is necessary. I support this project 100% in order to get safe drinking water.

In master plan water supply to the eastern area of Siem Reap River is considered and the eastern area needs water supply more than other area. Even Zone 1 and Zone2 of APSARA might need some water supply if there is no impact without using groundwater. I think development gives more benefit than effect. As you know, Siem Reap is covered with the protected sites from north to south. Development and Conservation must go together well. Local authority should tell their people to understand how important water supply system is. We must co-operate for this project.

Mr. Channy, Deputy General Director, SRWSA

A: JICA also thinks about supplying water in Zone II as well.

Mr. Siem Piseth, Department of Environment

Q: As you know, expansion of water supply would increase wastewater volume. What do you think about control system of wastewater? Do you have any plan for this problem?

Mr. Channy

A1: It is under the control of Provincial Department of Public Work and Transportation. SRWSA is responsible for only clean water or fresh water supply. Ministry of Public Work and Transportation controls whole country about this matter. So I would like to transfer this question to DPWT.

Mr. Ang Kimsoun, Deputy Chief of PublicWork Office, DPWT

A2: ADB have conducted the project for the west site of Siem Reap River, but for the east site the project for wastewater is not conducted. We don't have any project for wastewater in eastern area.

Mr. Siem Piseth

Discussion at stakeholder meeting should be made after preparing the agenda for discussion about the impact on wastewater. We should help each other to find a good solution.

Mr. Channy

A: The JICA study has been conducted very careful and detail about any impact is examined. There is not much impact on environment. Trees would grow again 2 or 3 years later. As you saw on their presentation, they are very careful for impact and avoid for both conservation areas for the pipe line.

(Since the content of this question and answer became clear unfortunately after the stakeholder meeting, Study Team visited Office of DPWT the next day to explain wastewater treatment projects in detail to be implemented and discuss it with Mr. Kimsoun. He had no information of the waste treatment project because he is an engineer of road, and he understood the project proceeding in eastern area of Siem Reap River and apologized for his careless remarks at the second stakeholder meeting.)

Facilitator, Mr. Kong SOKVAN, Director of Production & Commercial

Most of people at the meeting would like to get water supply, especially representative of Governor Mr. Buntharith. He wants to get water as soon as possible, one or two years later or as soon as tomorrow. He thinks completion of the project in 2017 is late because he has to wait for a long time. However, he thanks Japanese government for helping Cambodia. He wishes JICA Study Team succeeds in this project. All participants should bring all the theme of meeting today to their people in authorities and organizations.

1-5 Environmental Impact Analysis and Mitigation Measures

1-5-1 Methodology

According to an advice from Department of EIA in MOE, Environmental Impact Assessment was conducted based on JBIC Guideline for Environmental and Social Considerations. In reference to current environmental situation obtained from existing reports, impact due to implementation of the project was assessed and evaluated. Since the project owner, Siem Reap Water Supply Authority, has been operating a water supply system, similar environmental impacts given by the existing facility, like air pollution of chlorine, water pollution of wastewater and noise emitted from facility, were studied as regards construction phase and operation phase. The environmental items are as follows:

i) Air Quality
ii) Water Quality
iii) Wastes
iv) Noise & Vibration
v) Hydrology
vi) Protected Areas
vii) Ecosystem and Biota
viii) Living & Livelihood
ix) Heritage
x) Landscape
xi) Monitoring

(Impacts during Construction

1-5-2 Air Quality

Construction phase (Air Quality)

Construction during dry season may give impact on air quality. From water intake to water treatment plant through pumping station, little impact is expected due to dust on living condition of local people because there is no residential area along the pipeline. However, construction of distribution pipe along the existing road in the town area might give some impact with dust because there are many houses along the road. Consideration should be made to lay down the pipe and fill in the trench in a short while after excavation and not to leave it open for a long time.

Air pollution gas is emitted from heavy machines like a bulldozer and a damp truck in construction site. Although the number of heavy machines operating at the same place is not large in case of construction of distribution pipe and little impact is expected on surrounding area. Regular maintenance of heavy machine is necessary because much pollutant is emitted from an engine in poor condition.

Operation phase (Air Quality)

There is possibility of impact on air quality due to chlorine in operation and emission gas from power generator. However, the latter gas is emitted at the emergency of blackout and the case is very rare and lasts only a short time. In order to avoid risk by accident of chlorine treatment a trench is planned next to gas container and the container can be thrown into the water in the trench in case of emergency to dis-acidify chlorine with CaCO3.

There is little air pollution while chlorine gas is used normally in operation. The staffs of project owner, SRWSA, have been operating the water treatment plant with capacity 8,000m3/day since 2006 and they have already accumulated know-how. Much chlorine has never leaked accidentally at the existing water treatment plant and it has been managed appropriately every day. Little impact is expected on air quality by operation of this new water treatment plant.

Manual for countermeasures in an emergency is shown in **Table 1-32** and the training has been carried out once every two months in SRWSA.

Table 1-32 Manual for Countermeasures in an Emergency

Step 1

Move to non-contaminated area of chlorine promptly.

- Try not to inhale chlorine.
- Move to windward area to escape from leaked chlorine gas.
- Warn to persons if they are around the chlorination plant and take them to windward area

Step 2

Inform to the administration department that chlorine is leaking at chlorination plant.

Step 3

Wear a gas mask.

- Operators should know where the gas masks are kept.
- As a usual training, operators must periodically practice the training of how to use the gas mask in an emergency case

Step 4

Close the valve that is just upstream side of the leaking point on the pipeline.

- If leak has occurred on a chlorine gas piping or chlorinator, close all the container main valves.
- If leak has occurred at screwed part of a container main valve, leakage should be stopped with emergency kit B

Then immediately inform to the chlorine supplier to ask for a suitable treatment. In case the leaking point is liquid side, rotate the container so that the leaking valve comes to upper side.

Step 5

Start the chlorine injection with maximum flow rate so that chlorinator extracts chlorine remaining inside the pipe.

Step 6

The leaking chlorine in chlorination plant area must finally be diffused to the atmosphere. Operate the ventilation fan for emergency use.

1-5-3 Water Quality

Construction phase (Water Quality)

It is possible to minimize impact on water quality by implementing construction on the land during dry season in a concentrated manner. However, turbid water might be discharged from the construction site of water intake and conveyance pipeline in the water.

Prior to construction of water intake, a sheet pile coffer dam is constructed and water is pumped out of the coffer dam. Since the water discharged into Tonle Sap Lake from the coffer dam is the same as that of Tonle Sap Lake, little impact is given on the lake water. The upwelling water is pumped out of the coffer dam continuously into Tonle Sap Lake during construction of the intake. Although the water discharged from the coffer dam might be turbid, the amount is not much and little impact is expected on the surrounding water area in the lake.

As regards construction of conveyance pipe in the water, at first the dyke approximately 30m wide is constructed and water inside the dyke is discharged into Tonle Sap Lake. If much turbid

water is discharged, the water will be discharged once into a lagoon prepared on the land and flown away to the lake to prevent turbid water from spreading out directly in the lake and to promote particle settling down.

Operation phase (Water Quality)

There is usually no significant impact on river water except a critical incident because pollutants, such as SS, BOD and COD contained in effluents discharged from water treatment facility can comply with the effluent standards in Cambodia and originally raw water quality is not so polluted because it is taken from Tonle Sap Lake. Moreover, environmental management (monitoring) plan will be developed by SRWSA to prevent water pollution due to unusual discharge of polluted water. The effluent standards of SS, BOD and COD in Cambodia are 50mg/l, 30mg/l and 50mg/l respectively as shown in **Table 1-33**.

Table 1-33 Standard of Wastewater

NO	Para meters	Unit	Allowable limits for pollutant substance discharging to Protected public water area
1	SS	mg/l	<50
2	BOD	mg/l	<30
3	COD	mg/l	<50

Total volume of water consumption will drastically increase according to expansion of water supply system in Siem Reap City. It means that wastewater discharged from households would increase also according to the amount of water consumption and that water quality in the rivers and the lakes would be polluted unless the wastewater treatment system is improved. Impact on water body in Tonle Sap Basin and on the Lake itself due to increase of wastewater will be minimized because wastewater treatment system is improved around the same time. (Refer to 11-5-6 Hydrology)

1-5-4 Wastes

Construction phase (Wastes)

Prior to construction of facilities some forest trees are cut and the roots taken up, and the site for the facilities are excavated. The trees can be sold as material for buildings or firewood, while the roots and surplus soil will be disposed on the proper disposal site.

If waste generated during construction of relevant facilities for this project is treated and disposed properly in accordance with the regulation、Sub-Decree on Solid Waste Management No. 36, little impact is expected on surrounding area.

Operation phase (Wastes)

The sludge, which is not hazardous and not toxic, is discharged from water treatment plant. The staffs of project owner, SRWSA, take away the sludge from lagoon to the storage pit, dry it up and dispose of it on a premise at present. In the future the sludge will increase according to water volume to be supplied and it will be difficult to dispose it on a premise and it should be transported to a proper disposal site. In Siem Reap City a municipal solid waste management company collects solid waste daily from central district at a charge of 1～2.5 US$/kg. The project owner can prepare budgets and order the company to collect and transport the sludge to the final disposal site when necessary.

1-5-5 Noise & Vibration

Construction phase (Noise & Vibration)

Little impact is expected on local people's daily life due to noise and vibration emitted from construction of intake, conveyance pipeline, pumping station, transmission pipe and water treatment plant, because there is no residential area along the construction site. However, since construction sites of distribution pipe are mainly located in urban area, construction near private houses in urban area should be stopped at night and on holiday to reduce impact due to noise and vibration on the surrounding area. Particularly consideration should be made not to give significant impact on tourists. In some cases it might be necessary to adopt low-noise-machines near main archaeological temples.

Operation phase (Noise & Vibration)

Noise emitted from pumping station and water treatment plant gives little impact on surrounding area because it is usually not so big. Even if power supply is cut off and power generators start running and emit noise, little impact is expected on local people's living because they will be stored in the closed room to prevent strong noise from getting out directly and there is no residential area around them.

Table 1-34 Standard of Noise

Unit; dB(A)

NO	Area	Period of time		
		6:00-18:00	18:00-22:00	22:00-6:00
1	Quiet area	45	40	35
	Hospitals			
	Libraries			
	School			
	Kindergarden			
2	Residential area	60	50	45
	Hotels			
	Administration Offices			
	House			
3	Commercial and service area and mix	70	65	50
4	Small industrial factories intermingling in residential areas	75	70	55

1-5-6 Hydrology

Wastewater Treatment Plant with capacity 2,776m3/day was constructed in December 2009 by the project funded by ADB and construction of another plant with the same capacity 2,776m3/day is to be planned in target year 2015, resulting 5,552m3/day of capacity in total. And the detail design of the Wastewater Treatment Plant with capacity 10,000m3/day started targeting completion in 2015, funded by KOICA. Therefore, Wastewater Treatment Plant with capacity 15,552m3/day will come into existence in 2015. On the other hand, a draft report is already completed for Drainage & Sewerage Master Plan for the District of Siem Reap Priority Works funded by AFD. The areas covered by each project are as shown in **Figure 1-16**. The wastewater discharged from central district of the area covered by Siem Reap Water Supply Expansion Project is collected and treated by the wastewater treatment system improved by ADB and KOICA projects and the rest of the area will be almost covered by the project of AFD. Although the wastewater after going through the treatment system will flow finally into Tonle Sap Lake, there may be little impact on the lake if the wastewater is discharged meeting the standards for effluent in Cambodia, because the surface water from the lake is utilized as the water source for this project and it means that the water from the lake is circulated and the amount of water is basically balanced.

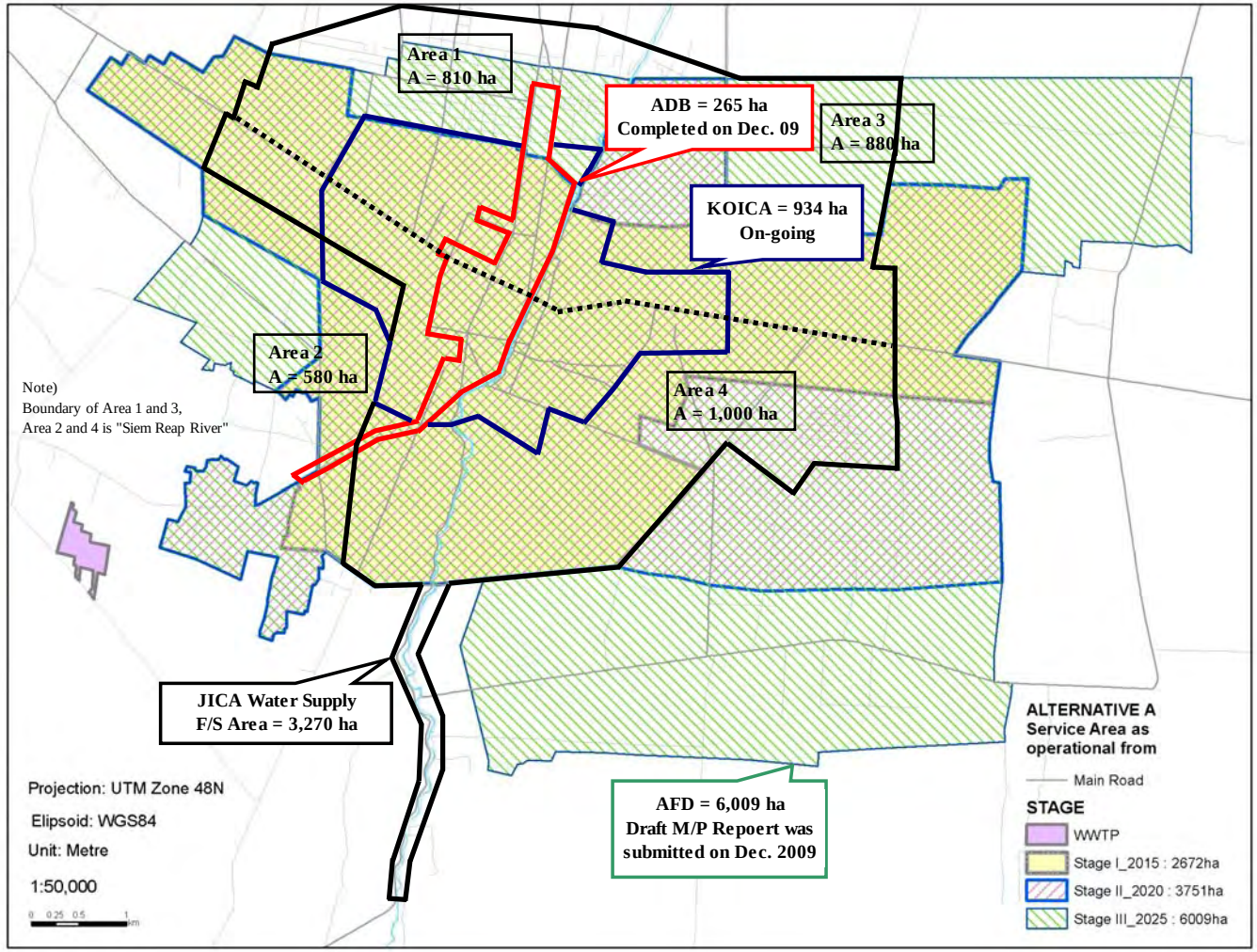


Figure 1-16 The Areas covered by the Wastewater Treatment System Improvement Projects

1-5-7 Protected Areas

There are many protected areas in study area. Plans and designs were reviewed to prevent the element of the project disturbing the protected areas. The conveyance pipeline route from raw water intake to pumping station is planned bypassing provincial conservation areas of Boeng Peareang Natural Conservation Area and Polav Fish Conservation Area after review of alternatives. However, the project cannot keep from the protected areas as shown in **Figure 1-17**, **Figure 1-18** and **Table 1-35**.

Strictly Protected Inundated Forest Area (MOAFF)

Pipeline is laid down 8km long in the protected area, 1.7km in gallery forest and 2km in the area mixed with bush and shrub of O Smoan Reservoir. At first an open canal was planned from Tonle Sap Lake to the pumping station from the viewpoint of technology, economy and maintenance. The width of the open canal would be up to 50m because water level in Tonle Sap Lake is very low in the dry season and a deep canal should be excavated. It means that forest area more than 70m wide is lost including the site for disposal of waste soil and that 1.7km gallery forest and 2km bush and shrub area would be lost and not reforested permanently. The impact on natural resources around Tonle Sap Lake might be too significant. Therefore, in the second place pipeline system was taken into consideration although maintenance of conveyance pipe under the ground is not easy. The forest area would be disturbed only 30m wide including whole construction site and the forest area would be reforested some years later after the trench is filled with soil as same as before.

As trees are cut down approx 30m wide, some tall trees in the inundated forest area are lost and there might be some impact on forest, but it is impossible to lay down the conveyance pipe without cutting the trees because the forest area continues along the lakeside. Therefore the project owner should minimize the alteration of the forest for the project site, and for a few years after construction, set up a barrier which prevents people from passing through the water area over the pipeline for fishing and also prevents them from cutting trees for firewood, in order to keep the area not disturbed by people and promote the reforestation.

The project owner has to submit the application to Fisheries Administration, MOAFF, to get an approval for development in this area.

Multiple Use Area (MOE)

Pipeline is laid down 4km long in the Multiple Use Area. Since it is laid down 2-3m deep under ground, little impact on land use is expected after construction. The project owner has to submit the application to Department of National Park, MOE, to get an approval for development in this area. A relevant official from MOE says it is not difficult to use the area for improvement of local

people's living condition around Tonle Sap Lake like this project because the area should be used for multipurpose considering environmental condition.

Community Fisheries (MOAFF)

Trees in the inundated protected forest are cut down. Some impact may be expected on fishery domain. Although the project owner, SRWSA, explained the project to the chief of Kandaek Community Fisheries and it is ready to offer compensation to the Community Fisheries, the project owner has to submit the agreement with members of the Fisheries, to Fisheries Administration, MOAFF, to get an approval for development in this area from MOAFF.

Buffer Zone of Tonle Sap Biosphere Reserve (UNESCO)

Pipeline is laid down 4km long in the buffer zone. Since it is laid down 2-3m deep under ground, little impact on core zones is expected. The project owner has to submit the application to Tonle Sap Biosphere Reserve Office in MOE, to get an approval for development in this area.

APSARA Protected Area (APSARA)

Distribution pipes are laid down mainly along the existing road. Little impact on protected area is expected. When the pipes are laid down outside of the existing road in APSARA Zone 2 and Zone 3, the project owner should inform APSARA of the construction schedule and location prior to construction, to get some advice.

Landscape Protected Area (MOE)

Distribution pipes are laid down mainly along the existing road. Little impact on landscape protected area is expected. When the pipes are laid down outside of the existing road in this area, the project owner should inform the Department of Protected Area, MOE, of the construction schedule and location prior to construction, to get an approval.

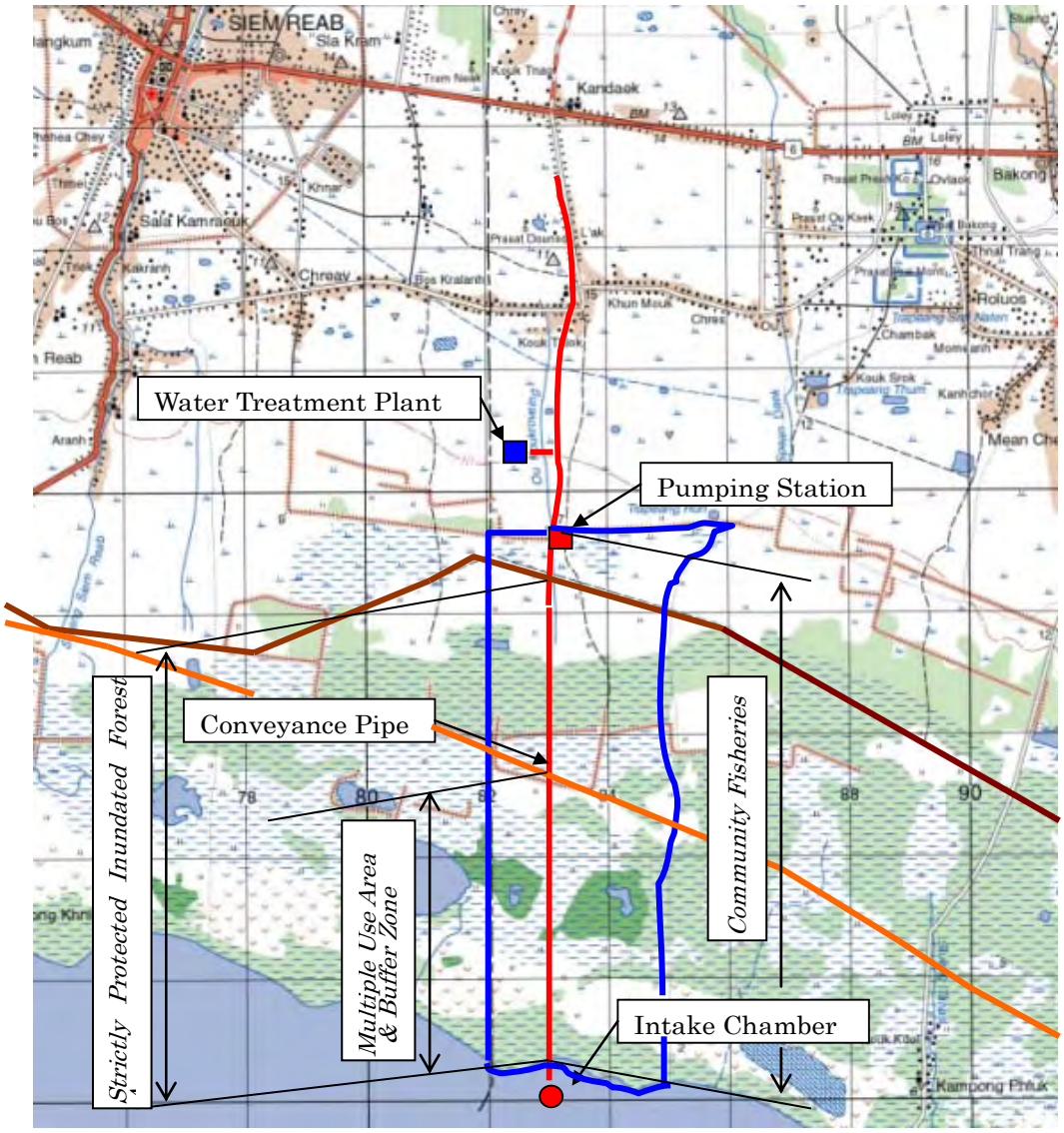


Figure 1-17 Location Map of Protected Areas and Facilities (*from Intake to WTP*) (*MOE, MOAFF & UNESCO*)

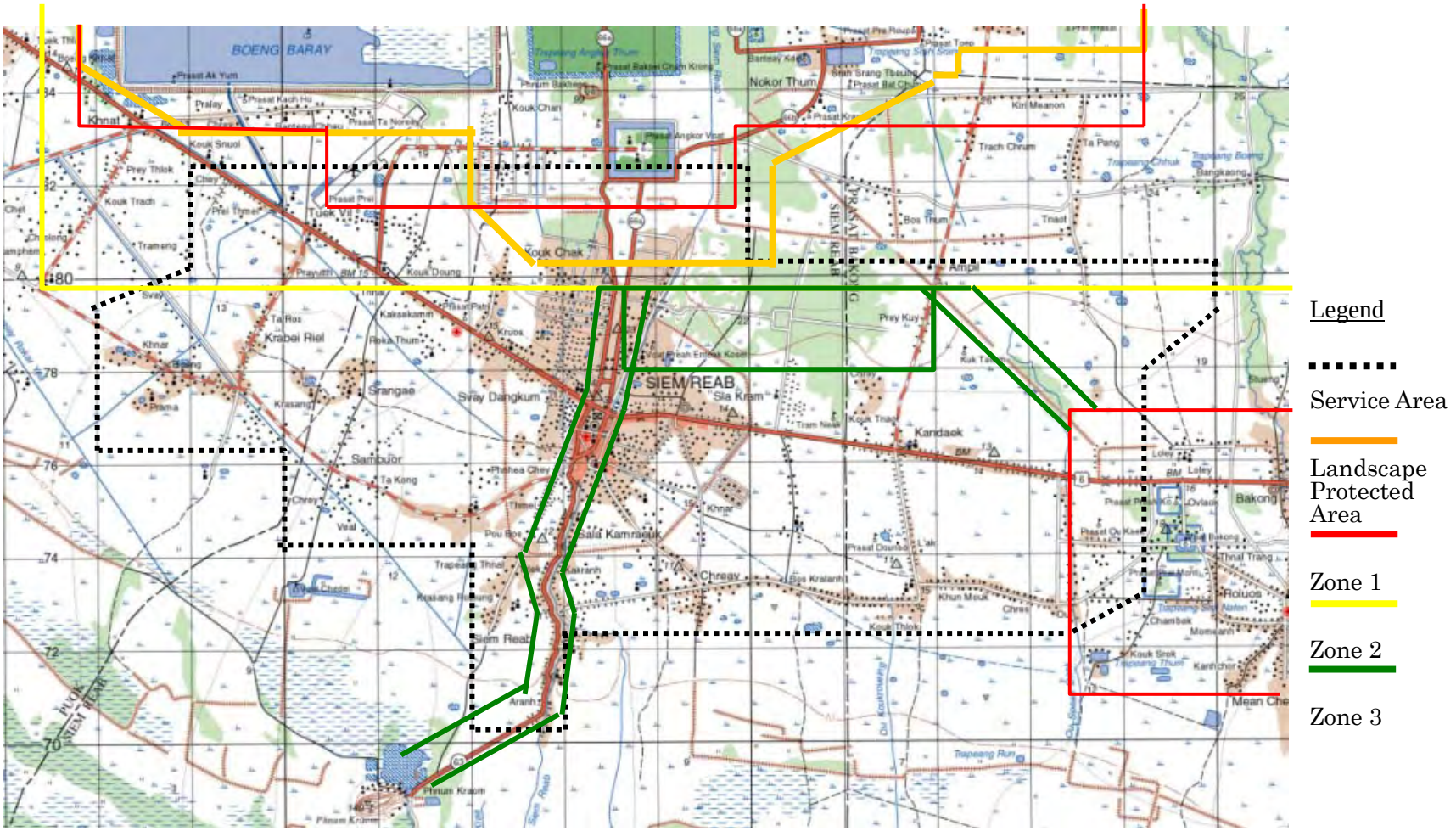


Figure 1-18 Location Map of Protected Areas for Distribution Area (*MOE & APSARA*)

Table 1-35 Protected Area influenced by the project

NO	Name of Protected Area	Authority	Definition	Impact	Mitigation Measures
1.	Strictly Protected Inundated Forest Area	MOAFF	Conservation of Inundated Forest Area for fishery	Pipeline is laid down 8km long in the protected area, and 1.7km in gallery forest and 2km in the area mixed with bush and shrub of O Smoan Reservoir Trees are cut down approx 30m wide.	Since it is impossible for water pipeline to avoid gallery forest along lake coast and bush/shrub area in O Smoan Reservoir, construction site shall be minimized to reduce impact on the flora and fauna. Although the project owner is not obligated to plant trees and the forest will be restored back in a few years after construction, it is better to carry out forestation if it is possible.
2.	Multiple Use Area	MOE	Conservation of biodiversity and ecosystem. Multiple use for local people in the community	Pipeline is laid down 4km long in the Multiple Use Area. Since it is 2-3m deep under ground, little impact on land use is expected.	The area is used for improvement of local people's living condition. Construction site shall be minimized since the project owner is not obligated to plant trees. After construction the project site will go back to the prior land use.
3.	Community Fisheries	DOFi	Zone where fishing is managed sustainably according to management plan in community	Trees in the Inundated protected forest are cut down. Some impact may be expected on fishery.	Compensation to Community Fisheries should be considered. Construction site shall be minimized since the project owner is not obligated to plant trees. After construction the project site will go back to the prior situation.
4.	Buffer Zone of Tonle Sap Biosphere Reserve	UNESCO	Buffer zone to protect core zone.	Pipeline is laid down 4km long in the buffer zone. Since it is 2-3m deep under ground, little impact on core zones is expected.	Construction site shall be minimized since the project owner is not obligated to plant trees. After construction the project site will go back to the prior condition.
5.	APSARA Protected Area	APSARA	Conservation of archaeological site Zone 1～4	Mainly along the roads, distribution pipes are laid down. Little impact on protected area is expected.	Prior consultation should be conducted in case of construction outside right-of-way.
6.	Landscape Protected Area	MOE	Conservation of landscape	Mainly along the roads, distribution pipes are laid down. Little impact on landscape protected area is expected.	Prior consultation should be conducted in case of construction outside right-of-way.

1-5-8 Ecosystem and Biota

Flooded Forest

Construction of water pipeline may give impact on forest ecosystem in zone (i) and zone (iii) as it needs removal of some forest trees. At the same time it may have impact on dams and canal associated with the O Smoan reservoir. The dykes and dams of the reservoir should be restored after completion of construction. At the same time, the pipeline will cross recession rice area also and discussion with farmers for appropriate compensation is needed to avoid social conflicts. Small funding can be provided for reforestation of degraded areas on the pipeline route in the vicinity of Boeng Peareang Conservation Area and in the O Smoan reservoir.

Fish

There is no major concern over the possible impact of the project on the fishery ecology or species loss as pipeline will not cause any change in terms of obstruction of migratory route or disturbance to fish reproduction. Funding can be provided to Community Fisheries for conservation of forest and conservation areas.

Amphibian

No major impact of the project is foreseen as many amphibians reproduce quickly even in this much disturbed areas.

Mammal

The study areas are not significant habitats for mammal species, including species of global conservation as the areas are highly disturbed by human activities such as dry season rice, forest encroachment, firewood collection, wildlife hunting and fishing. However, there are some portions of good forest habitats, especially in the area near the shore line (near fishing lot 4) and in O Smoan Reservoir located between small dyke and dam 78 where diversity of forest species is observed. In addition Boeng Peareang Conservation Area is a potential corridor for species migration connecting one area with another. Possible major impact is associated with the laying of the water pipes across these two habitats, especially the portion of O Smoan reservoir and the Lake shore gallery forest.

Less frequent maintenance along the pipeline is better. The pipeline has to go across the lake shore gallery forest as there is no other way, but the effects are only temporary during construction, and the flooded forest will come back to its original form after completion of laying the pipes.

Bird

Like other fauna species, the study area is not the breeding area for water birds of global significance. Many birds, including those of international significance such as spot-bill pelicans

Philippoussis, comb ducks *Sarkidiornis melanotos*, open-billed storks *Anastomus oscitans*, migrate here during the dry season for food and are mainly concentrated in Boeng Peareang where water is permanently available year round. Boeng Peareang is also under management of Community Fisheries and may become attractive for tourism visit if road is easily accessible during dry season.

Small funding support can be provided for conservation and reforestation of degraded areas in Boeng Peareang.

Reptile

The study area is much disturbed and can not be a major habitat for reptile species; therefore no major impact is expected to happen from the construction of water pipes. There is, however, a number of turtle species of conservation value in the study area although their number is in dramatic decline. Although a small portion of forest will be cut for laying pipeline, the forest will be restored back in a few years after construction.

Conclusion

The study areas are under heavy disturbance and therefore cannot be a significant area for conservation. However, a number of issues need careful consideration as the following:

- The pipeline can cross some good forest areas, especially gallery forest zone and bush/shrub zone which may be affected,
- Pipeline may cross the recession rice fields and disturb rice farmers, causing conflicts,
- Disturbance to some faunal species such as birds and reptiles.

The above mentioned issues can be addressed based on the following recommendation:

- Reforestation of the Boeng Peareang Conservation Aear will help to restore habitats for many fauna species, especially waterbirds and reptile,
- Small funding can be allocated to Community Fisheries to promote forest planting and conservation of Community Fisheries areas.

The study area is not rich in species of global significance due to high pressure caused by recession rice framing, forest clearing for firewood and fishing, and wildlife hunting. However, project owner should not use this as a pretext to go ahead without due consideration, and rather use this project as an opportunity for both water supply and improved management of natural resources and environment in the areas. The survey reveals presence of relatively large portion of flooded forest which should be carefully removed. Additional study should be conducted to get additional information for defining the optimal route for laying the pipeline at the stage of detail design. Principally, the project owner can be supported as it does not have major impact

on flora and fauna ecosystem, and natural forest will come back after completion of construction.

1-5-9 Living & Livelihood

Construction phase (Living & Livelihood)

Construction of water intake is implemented in the water of Tonle Sap Lake even if it is during dry season. On the other hand members of Community Fisheries fish during rainy season although fishing in the wet season is illegal. Therefore, construction in the water of Tonle Sap Lake gives little impact on fishing activities. Despite this, project owner has to show information of the construction and what fishermen should be careful about on a sign board to prevent accident of fishing boats. The intake is constructed at the point approximately 1km offshore from gallery forest and the construction site of pipeline 1km long blocks out transportation of fishing boats during construction. Although fishing boats have to take a detour, significant impact might not be given on fishermen.

Construction during dry season gives some impact on recession rice area between intake and pumping station because recession rice is grown in dry season, from December to April/May. The project owner, SRWSA, is ready to offer compensation to the farmers influenced by construction. No compensation is necessary next year after pipe is laid down, because the trench is filled with soil and farming is possible same as usual.

Since farmers growing wet season rice do no farming during dry season, project owner, SRWSA, needs not to pay compensation to them, if the pipe construction finishes by the beginning of wet season, June, and it gives no damage on farming.

As the transmission pipe from pumping station to water treatment plant and the distribution pipe from water treatment plant to existing road are planned to be laid down under the existing dyke and bank as much as possible and the case that pipeline cuts through agricultural land will be minimized, it might give little impact on farmers' living condition. However, project owner, SRWSA, should take the compensation into consideration for them whenever pipeline is changed and they are influenced.

Candidate site for pumping station is located on recession rice area, and the site for water treatment plant on abandoned land at present. The areas necessary for two sites are 0.5 ha and 4ha only respectively and little impact might be on the land owner if he can sell the land at a reasonable price.

Operation phase (Living & Livelihood)

In the dry season the water level of Tonle Sap Lake goes down and intake facility may come out in the way of fishing boats. In order to prevent accident by boats, a tower will be built on the

intake and even in rainy season local people can identify the location of the intake and prevent accident from occurring. Therefore, little impact may be given on fishing and transportation by water.

1-5-10 Heritage

From the raw water intake to Water Treatment Plant through the Pumping Station there is no cultural heritage. However, there are two cultural heritages with ID No. 100752 and old canal on the way from the Water Treatment Plant to existing road as shown in **Figure 1-19**. If the distribution pipeline is laid down straight forward north from the Water Treatment Plant, the pipeline would come across both of them and give impact on them. Therefore, the straight pipeline should be avoided and it is possible to get around ID No. 100752. As regards the old canal, project owner should inform construction schedule to relevant authorities like APSARA and obtain approval from them prior to excavating the old canal. Archaeological expert will have a good opportunity for knowing the situation of the heritage, collecting artifacts and making a report by drawing a cross-section of the old canal.

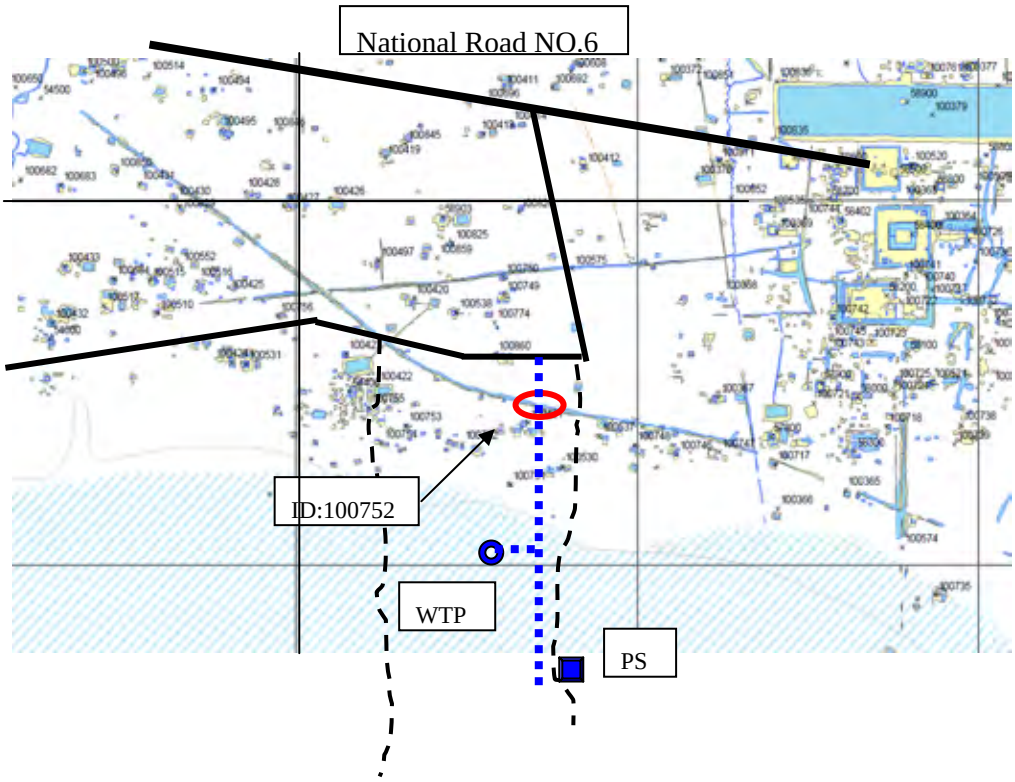


Figure 1-19 Location of Cultural Heritage

1-5-11 Landscape

New facilities appear after completion of the project and may give some impacts to the existing landscape. The appearance should be harmonized with the surrounding area. Tonle Sap Lake is

one of resources of tourism owing to beautiful inundated forest. The design which might give significant impact on the landscape viewed from offshore should be avoided. Although an intake tower will appear outside of inundated forest area, there would be little impact of the landscape because at present there is a large building outside of the area as shown in Figure 1-20. A small tower in the figure shows relatively a scale of intake tower image.

A new pumping station and a new water treatment plant will give little impact on the surrounding landscape because two sites are located in the recession rice area and degraded area on plain land respectively, far from residential area.

Figure 1-20 Existing Towers located outside of Inundated Forest Area
(A small tower in the figure shows relatively a scale of intake tower image)

1-5-12 Monitoring

Environmental monitoring plan for construction and operation of this project is as shown in

Table 1-36.

Construction phase (Monitoring)

At the phase of construction, impacts on water quality, noise & vibration, ecosystem & biota, living & livelihood and heritage should be monitored. The quantity and quality of turbid water discharged from construction site of intake and conveyance pipe into Tonle Sap Lake should be monitored by visual observation once a week by project manager and some mitigation measures should be introduced in case that there is significant impact on the lake.

Noise emitted from heavy machine may give an impact on tourist sightseeing in a quiet cultural heritage. Noise should be checked by ears and mitigation measures should be introduced if necessary when construction is implemented near a main cultural heritage.

Since tall trees to be cut down should be minimized, the number of felled tall trees should be recorded. The data will be of help to reforestation in the future.

The area of recession rice field where rice cannot be grown during construction, and also the area of community fisheries disturbed by construction, should be identified accurately to ensure consistency with compensation.

Prior to excavation of old canal, project manager should request APSARA to inspect the situation of archaeological site and to propose how to proceed excavation of trench for pipeline. All information should be transferred to APSARA whenever a cultural heritage is found during construction.

Operation phase (Monitoring)

At the phase of operation, impact on water quality should be monitored. Once a month the quality of wastewater discharged from the Water Treatment Plant should be analyzed by SS, BOD and COD. The analysis has not been conducted for wastewater discharged from the existing Water Treatment Plant owned by SRWSA because raw water is pumped up from underground and the quality of groundwater is stable relatively. However, for the new water supply system surface water form Tonle Sap Lake is used as raw water and the quality may vary according to natural condition. The budget for the analysis should be prepared every year.

Table 1-36 Environmental Monitoring Plan for Construction and Operation

No.	Environmental Items	Item to be measured	Construction Phase		Operation Phase		Cost
			Times	Point	Times	Point	
1.	Air Quality	Chlorine	—	—	• Check system for leaked chlorine will be equipped.		Project cost
2.	Water Quality	SS, BOD, COD	• 1 time/week by visual observation (Turbidity)		1 time /month	1 point at outlet	3x12x20 =720US$
3.	Noise & Vibration	Noise	• Noise check by ears at main temple near construction site		—	—	—
4.	Ecosystem & Biota	Forest	• Count the number of tall trees felled in gallery forest		—	—	Project cost
5.	Living & Livelihood	Area to be disturbed	• Area of Recession rice • Area of Community Fisheries		—	—	Project cost (Compensation)
6.	Heritage	Evaluation	• 1 time at the old Canal • Anytime at heritage site		—	—	Project cost

1-5-13 Confirmation of Environmental Consideration based on Environmental Checklist of JBIC

Confirmation of Environmental Consideration was conducted based on Environmental Checklist of JBIC since this project will be implemented on the base of JBIC Loan. The result is as shown in **Table 1-37**. Significant impact will not be expected due to implementation of the project.

Table 1-37 Confirmation of Environmental Considerations by JBIC Checklist

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1. Permits and Explanation	(1) EIA and Environmental Permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country's government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	① No, but it will be completed by the end of May in 2010. ② No, but it will be approved by the end of June in 2010. ③ Conditions will not be imposed on the approval of EIA report. ④ Other environmental permits will not be necessary.
	(2) Explanation to the Public	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	① Before completion of EIA report stakeholder meetings were held two times. At first meeting the information of water source selection process was disclosed adequately to the public and at second stakeholer meeting design of relevant facilities and environmental impacts incuding mitigation measures were disclosed before completion of draft EIA report. On the other hand, stakeholder hearings from local people of each commune in the study area, local gevernment and central government were conducted respectively. The understanding of the project and environmental impact was obtained from the public. ② There were only two questions at the first stakeholder meeting regarding the individual cost of connection to the water supply pipeline and how to treat sludge discharged from water treatment facility. At the second stakeholder meeting, participants expressed concern about felling of protected inundated forest and increase of wastewater according to expansion of water supply system. Proper responses and explanation were made to the question.

<table>
<tr><td rowspan="2">2 Mitigation Measures</td><td>(1)Air Quality</td><td>① Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Do chlorine concentrations within the working environments comply with the country’s occupational health and safety standards?</td><td>① There is little air pollution while chlorine gas is used normally in operation. The staffs of project owner, SRWSA, have been operating the water treatment plant with capacity 8,000m3/day since 2006 and they have already accumulated know-how. Much chlorine has never leaked accidentally at the existing water treatment plant and it has been managed appropriately every day. Little impact is expected on air quality by operation of this new water treatment plant.
Manual for countermeasures in an emergency is prepared and the training has been carried out once every two months in SRWSA.</td></tr>
<tr><td>(2)Water Quality</td><td>① Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?</td><td>①There is usually no significant impact on river water except a critical incident because pollutants, such as SS, BOD and COD contained in effluents discharged from water treatment plant can comply with the effluent standards in Cambodia and originally raw water quality is not so polluted because it is taken from Tonle Sap Lake. Moreover, environmental monitoring plan will be developed by SRWSA to prevent water pollution due to unusual discharge of polluted water. The effluent standards of SS, BOD and COD in Cambodia are 50mg/l, 30mg/l and 50mg/l respectively as shown in the table.
<table>
<tr><th rowspan="2">NO</th><th rowspan="2">Para meters</th><th rowspan="2">Unit</th><th colspan="2">Allowable limits for pollutant substance discharging to</th></tr>
<tr><th>Protected public water area</th><th>public water area and sewer</th></tr>
<tr><td>1</td><td>SS</td><td>mg/l</td><td><50</td><td><80</td></tr>
<tr><td>2</td><td>BOD</td><td>mg/l</td><td><30</td><td><80</td></tr>
<tr><td>3</td><td>COD</td><td>mg/l</td><td><50</td><td><100</td></tr>
</table></td></tr>
</table>

<table>
<tr><td rowspan="2">2 Mitigation Measures</td><td>(3)Wastes</td><td>① Are wastes, such as sludges generated by the facility operations properly treated and disposed of in accordance with the country's standards?</td><td>① The sludge, which is not hazardous and not toxic, is discharged from water treatment plant. The staffs of project owner, SRWSA, take away the sludge from lagoon to the storage pit, dry it up and dispose of it on a premise at present. In the future the sludge will increase according to water volume to be supplied and it will be difficult to dispose it on a premise and it should be transported to a proper disposal site. In Siem Reap City a municipal solid waste management company collects solid waste daily from central district at a charge of 1～2.5 US$/kg. The project owner can prepare budgets and order the company to collect and transport the sludge to the final disposal site when necessary.</td></tr>
<tr><td>(4)Noise & Vibration</td><td>① Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?</td><td>①Noise emitted from pumping station and water treatment plant gives little impact on surrounding area because it is usually not so big. Even if power supply is cut off and power generators start running and emit noise, little impact is expected on local people’s living because they will be stored in the closed room to prevent strong noise from getting out directly and there is no residential area around them.
Unit; dB(A)
<table>
<tr><th rowspan="2">NO</th><th rowspan="2">Area</th><th colspan="3">Period of time</th></tr>
<tr><th>6:00-18:00</th><th>18:00-22:00</th><th>22:00-6:00</th></tr>
<tr><td rowspan="5">1</td><td>Quiet area</td><td rowspan="5">45</td><td rowspan="5">40</td><td rowspan="5">35</td></tr>
<tr><td>Hospitals</td></tr>
<tr><td>Libraries</td></tr>
<tr><td>School</td></tr>
<tr><td>Kindergarden</td></tr>
<tr><td rowspan="5">2</td><td>Residential area</td><td rowspan="5">60</td><td rowspan="5">50</td><td rowspan="5">45</td></tr>
<tr><td>Hotels</td></tr>
<tr><td>Administration Offices</td></tr>
<tr><td>House</td></tr>
<tr><td>3</td><td>Commercial and service area and mix</td><td>70</td><td>65</td><td>50</td></tr>
<tr><td>4</td><td>Small industrial factories intermingling in residential areas</td><td>75</td><td>70</td><td>55</td></tr>
</table></td></tr>
</table>

<table>
<tr><td rowspan="2">2 Mitigation Measures</td><td>(5)Subsidence</td><td colspan="2">① In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?</td><td>①Extraction of a large volume of groundwater is not planned for this project because surface water from Tonle Sap Lake is utilized for water source.</td></tr>
<tr><td>(6)Hydrology</td><td colspan="2">①Is there any impact on water body like a river and a lake due to increase of wastewater subsequent to the introduction of new water supply system?</td><td>①Wastewater Treatment Plant with capacity 2,776m3/day was constructed already by ADB and another plant with the same capacity is to be planned in target year 2015. And the detail design of the Wastewater Treatment Plant with capacity 10,000m3/day started targeting completion in 2015, funded by KOICA. Therefore,the wastewater discharged from central district of the area covered by Siem Reap Water Supply Expansion Project is collected and treated by the new wastewater treatment system.</td></tr>
<tr><td>3. Natural Environment</td><td>(1)Protected Areas</td><td>① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?</td><td colspan="2">①There are many protected areas in study area. Plans and designs were reviewed to prevent the element of the project disturbing the protected areas. Significant impact will not be expected although the project cannot keep from the protected areas as shown in the table.</td></tr>
</table>

NO	Name of Protected Area	Authority	Definition	Impact	Mitigation Measures
1.	Strictly Protected Inundated Forest Area	MOAFF	Conservation of Inundated Forest Area for fishery	Pipeline is laid down 8km long in the protected area, and 1.7km in gallery forest and 2km in the area mixed with bush and shrub of O Smoan Reservoir Trees are cut down approx 30m wide.	Since it is impossible for water pipeline to avoid gallery forest along lake coast and bush/shrub area in O Smoan Reservoir, construction site shall be minimized to reduce impact on the flora and fauna. The forest will be restored back in a few years after construction.
2.	Multiple Use Area	MOE	Conservation of biodiversity and ecosystem. Multiple use for local people in the community	Pipeline is laid down 4km long in the Multiple Use Area. Since it is 2-3m deep under ground, little impact on land use is expected.	The area is used for improvement of local people's living condition. Construction site shall be minimized.
3.	Community Fisheries	DOFi	Zone where fishing is managed sustainably according to management plan in community	Trees in the Inundated protected forest are cut down. Some impact may be expected on fishery.	Compensation to Community Fisheries should be considered. Construction site shall be minimized.
4.	Buffer Zone of Tonle Sap Biosphere Reserve	UNESCO	Buffer zone to protect core zone.	Pipeline is laid down 4km long in the buffer zone. Since it is 2-3m deep under ground, little impact on core zones is expected.	Construction site shall be minimized.
5.	APSARA Protected Area	APSARA	Conservation of archaeological site Zone 1 ～4	Mainly along the roads, distribution pipes are laid down. Little impact on protected area is expected.	Prior consultation should be conducted in case of construction outside right-of-way.
6.	Landscape Protected Area	MOE	Conservation of landscape	Mainly along the roads, distribution pipes are laid down. Little impact on landscape protected area is expected.	Prior consultation should be conducted in case of construction outside right-of-way.

3. Natural Environment	(2)Ecosystem and biota	① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	① Since the project site does not encompass primeval forests, tropical rain forests and ecologically valuable habitats, but gallery forest and the area mixed with bush and shrub, where fish produces eggs and grow up small fish, the area to be altered should be minimized. ② The project site does not encompass the protected habitats (Core zones of Tonle Sap Biosphere Reserve) of endangered species designated by Cambodian laws or international treaties and conventions. ③ Significant ecological impacts will not be anticipated because the construction site of pipeline is minimized and filled with soil after laying down pipe. ④ Although there is little possibility that the amount of surface water used by the project will adversely affect aquatic environments because water body of Tonle Sap Lake is huge and garting is set on the intake.
4. Social Environment	(1)Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, estoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impacts of resettlement?	① ②③④⑤⑥⑦Involuntary resettlement is not be caused by project implementation. Compensation will be prepared by project owner, SRWSA, for recession rice area and Community Fisheries influenced by construction of pipeline.

4. Social Environment	(2)Living and Livelihood	① Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? ② Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	① There will be a possibility that the project affects not adversely but positively the living conditions of inhabitants because safe drinking water is supplied. ② In the dry season the water level of Tonle Sap Lake goes down and intake facility may come out in the way of fishing boats. In order to prevent accident by boats, a tower will be built on the intake and even in rainy season local people can identify the location of the intake and prevent accident from occurring. Therefore, little impact may be given on fishing and transportation by water.
	(3)Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	① There are two cultural heritages of an old temple and old canal on the way from the Water Treatment Plant to existing road. As regards the old canal, project owner should inform construction schedule to relevant authorities like APSARA and obtain approval from them prior to excavating the old canal. Archaeological expert says he can have a good opportunity for knowing the situation of the heritage, collecting artifacts and making a report by drawing a cross-section of the old canal.
	(4)Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	① Although an intake tower will appear outside of inundated forest area, there would be little impact of the landscape because at present there is a large building outside of the area.
	(5) Ethnic Minorities and Indigenous Peoples	① Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? ② Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	①② There is little impact on ethnic minorities and indigenous peoples.

4. Social Environment	(6) Working Conditions	① Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? ② Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? ③ Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program,an d safety training (including traffic safety and public sanitation) for workers etc.? ④ Are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individuals involved, or local residents?	①②③④The project owner has experinces for operation of water supply system since 1996. they have never been violating any lwas and ordinances associated with the working conditions of Cambodia.

5. Other	Imapcts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g.,noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem),are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? ④ If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	①**Air quailty**; Construction of distribution pipe along the existing road in the town area might give some impact with dust because there are many houses along the road. Consideration should be made to lay down the pipe and fill in the trench in a short while after excavation and not to leave it open for a long time. Regular maintenance of heavy machine is necessary. **Water quality**; If much turbid water is discharged, a fence or curtain wall will be set in the water surrounding the discharge point to prevent turbid water from spreading out and to promote particle settling down. **Waste**; If waste generated during construction of relevant facilities for this project is treated and disposed properly in accordance with the regulation, little impact is expected on surrounding area. **Noise & Vibration**; Construction near private houses in urban area should be stopped at night and on holiday to reduce impact due to noise and vibration on the surrounding area. Particularly consideration should be made not to give significant impact on tourists. In some cases it might be necessary to adopt low-noise-machines near main archaeological temple ② Construction site in gallery forest and the area mixed with bush & shru will be minimized. ③ Compensation for reccesion rice area and Community Fisheries will be prepered by project owner, SRWSA. ④ Health and safety education for project personnel including workers will be planned and included in contract conditions.

<table>
<tr>
<td rowspan="2">5. Other</td>
<td>(2)Monitoring</td>
<td>① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?
② Are the items, methods and frequencies included in the monitoring program judged to be appropriate?
③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?
④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?</td>
<td>①②③④ SRWSA will implement monitoring program for the environmental items as follows;
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Environmental Items</th><th rowspan="2">Item to be measured</th><th colspan="2">Construction Phase</th><th colspan="2">Operation Phase</th><th rowspan="2">Cost</th></tr>
<tr><th>Times</th><th>Point</th><th>Times</th><th>Point</th></tr>
<tr><td>1.</td><td>Air Quality</td><td>Chlorine</td><td>—</td><td>—</td><td>• Check system for leaked chlorine will be equipped.</td><td></td><td>Project cost</td></tr>
<tr><td>2.</td><td>Water Quality</td><td>SS, BOD, COD</td><td colspan="2">• 1 time/week by visual observation (Turbidity)</td><td>1 time /month</td><td>1 point at outlet</td><td>3x12x20 =720US$</td></tr>
<tr><td>3.</td><td>Noise & Vibration</td><td>Noise</td><td colspan="2">• Noise check by ears at main temple near construction site</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>4.</td><td>Ecosystem & Biota</td><td>Forest</td><td colspan="2">• Count the number of tall trees felled in gallery forest</td><td>—</td><td>—</td><td>Project cost</td></tr>
<tr><td>5.</td><td>Living & Livelihood</td><td>Area to be disturbed</td><td colspan="2">• Area of Recession rice
• Area of Community Fisheries</td><td>—</td><td>—</td><td>Project cost (Compensation)</td></tr>
<tr><td>6.</td><td>Heritage</td><td>Evaluation</td><td colspan="2">• 1 time at the old Canal
• Anytime at heritage site</td><td>—</td><td>—</td><td>Project cost</td></tr>
</table>
</td>
</tr>
<tr>
<td>Note on Using Environmental Checklist</td>
<td colspan="2">① If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).</td>
<td>① The impacts to transboundary or global issues will be little.</td>
</tr>
</table>

1-6 Economical Analysis

Government assistance and support is necessary in order that SRWSA may be able to expand its water services and fulfill its mandate of providing potable water service in the entire province of Siem Reap.

Such government assistance may be in the form of an interest-free loan-assistance to SRWSA that shall fund its water supply expansion project. Under this scheme, Royal Government of Cambodia on-lends the JICA loan to SRWSA free of interest during the 10-year grace period of the 40-year loan maturity period of said loan. Before the end of the 10-year grace period, the MOEF and MIME shall meet and review the financial condition of the SRWSA for the purpose of fixing the interest rate to be applied for computing the annual debt service of the JICA loan beginning on the 11th year.

With an interest-free project loan during the 10-year grace period, required periodic adjustment of water tariffs shall be lower and more acceptable as can be seen from the following schedule of tariffs and results of the affordability tests.

Required Tariff Schedule for Residential Connections (riel/m3)

Residential/Government Tariffs	Existing	2020	2030	2040	2050
1 - 7 m3	1,100	2,000	3,000	5,000	7,000
8 - 15 m3	1,500	2,250	4,500	6,000	8,500
16 - 30 m3	1,800	3,000	6,000	9,000	14,000
Over 30 m3	2,000	4,000	7,500	13,000	20,000

Required Tariff Adjustments for Commercial Connections (riel/m3)

Commercial Tariffs	2013	2017	2020	2025	2030	2035	2040
1 - 30 m3	2,000	2,000	3,000	4,700	6,500	7,500	12,000
31 - 50 m3	2,200	2,200	4,000	5,500	7,500	9,000	13,000
Over 50 m3	2,500	2,500	4,700	6,150	8,200	11,000	14,500

The recommended development program for the Priority Project expansion of the water supply system of the SRWSA is financially viable on the condition that periodic adjustment of water tariffs for both residential and commercial be effected as assumed in this study.

It is however recommended that the Royal Government of Cambodia considers on-lending the JICA loan to SRWSA free of interest charges at least for a limited period equivalent to the 10-year grace period under the JICA loan terms. (For details, refer to Feasibility Study Report on Siem Reap Water Supply Expansion Project)

1-7 Institutional Capacity

Project implementation and management must address the full range of activities from the beginning to the end of a project and the management of multiple sub-activities within the Project. SRWSA will become involved in the entire cycle of the Project as reflected in the

whole range of services to be provided by the Consultant. Providing day-to-day supervision over the implementation of the Project means addressing technical skills like scheduling, cost estimating, and risk management; and also encompasses other disciplines such as scope definition, procurement management, financial management, asset management, human resource management, environmental and social considerations, and communications.

The SRWSA will set up the Project management Unit (PMU) within the Department of Planning and Technical Department (to be renamed Department of Planning and Development). Therefore, it is proposed that a full-time department director should be recruited before the start of the design phase of the Project. Right now, the department director is holding the position of the chief of the Financial and Accounting Office, albeit on a concurrent basis; but his primary responsibility lies with the latter. The proper functioning of the department will benefit SRWSA in addition to being a necessity for the design and construction phases of the Project. The department director to be recruited for should possess the required and approved qualifications for the position. The department director will also be the project manager of the Project. He will be assisted by a full time staff hired for the duration of the Project – a project engineer, an assistant engineer and an administrative assistant.

The human resource requirement for SRWSA will grow from 40 to 141 when water becomes available by 2017 (target year 2022) owing to this project, including 38 staff for KTC project (2012/13) as shown in Table 1-38.

Table 1-38 Human Resource Requirement for F/S Project

D E P A R T M E N T	CURRENT	KTC BULK	PHASE 1	GRAND TOTAL
	2010	2012/13	2017	
Top Management	**3**	**0**	**3**	**3**
General Director	1			
Deputy General Director	2			
Production and Water Supply	**26**	**12**		**38**
Water Supply Operations Department			**33**	**33**
Department Deputy	1			
Office Chief	3			
Personnel	22	12	33	
Department of Planning and Technical	**2**	**7**		**9**
Planning and Development Department			**2**	**2**
Department Deputy		1		
Office Chief	2			
Personnel	0	5	2	
Department of Administration and Financial	**9**	**6**	**0**	**15**
Administration and Finance Department				
Department Deputy	1			
Office Chief	2			
Personnel	6	6		
Accounting and Finance Department			**4**	**4**
Department Deputy			1	
Office Chief			1	
Personnel			3	
Administrative Department			**6**	**6**
Department Deputy				
Office Chief			1	
Personnel			5	
Office of Commercial Operations		**13**		**13**
Office Chief		1		
Personnel		12		
Commercial Operations Department			**14**	**14**
Department Deputy			1	
Office Chief			1	
Personnel			12	
Management Services Office			**4**	**4**
Office Chief			1	
Personnel			3	
TOTALS	**40**	**38**	**63**	**141**

1-8 Conclusion and Recommendation

The Siem Reap City is surrounded with the World Heritage sites of Angkor and there are many protected areas to conserve natural resources. This is the project of the expansion of the water supply system in Siem Reap City. Therefore, those protected areas should be taken into account to implement the project.

Local people have been having difficulty with getting safe water for drinking because the water pumped up from a well sometimes is not suitable for drinking and should be boiled and/or filtered. It means that provision of safe water for drinking is a pressing issue for local people to improve their living condition. On the other hand, every year approximately 2 million tourists visit the city and new hotels dig wells and pump up groundwater to get drinking water, which resulted in uncontrolled abstraction of groundwater sources and the heritage site is under threat of land subsidence. However, the existing water treatment facility which was constructed under Japanese grant aid in 2006 is not large enough to fill the demand. Therefore, expansion of water supply system is urgent necessity.

In this Study, the alternatives of water supply from groundwater, west baray, river and Tonle Sap Lake were examined and finally surface water from Tonle Sap Lake was selected as a water source because little impact would be expected on World Heritage of Angkor. From intake in the Tonle Sap Lake to pump station, conveyance pipes go through several protected areas and some impacts cannot be set aside, while the impacts can be minimized by paying attention for adoption of mitigation measures of minimization of construction site in protected areas and the project, as a sustainable development, will be able to support local people to improve their living and livelihood condition.

1-9 Photographs

Photographs of 1st Stakeholder Meeting

Address of Vice Governor

Address of General Director of SRWSA

Main Guests

Participants

Leader of JICA Study Team

Process of Water Source Selection

Photographs of 2nd Stakeholder Meeting

Address of Governor

Address of General Director of SRWSA

Main Guests

Participants

Leader of JICA Study Team

Plan & Design of Facilities

Distribution System

Environmental and Social Considerations

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