

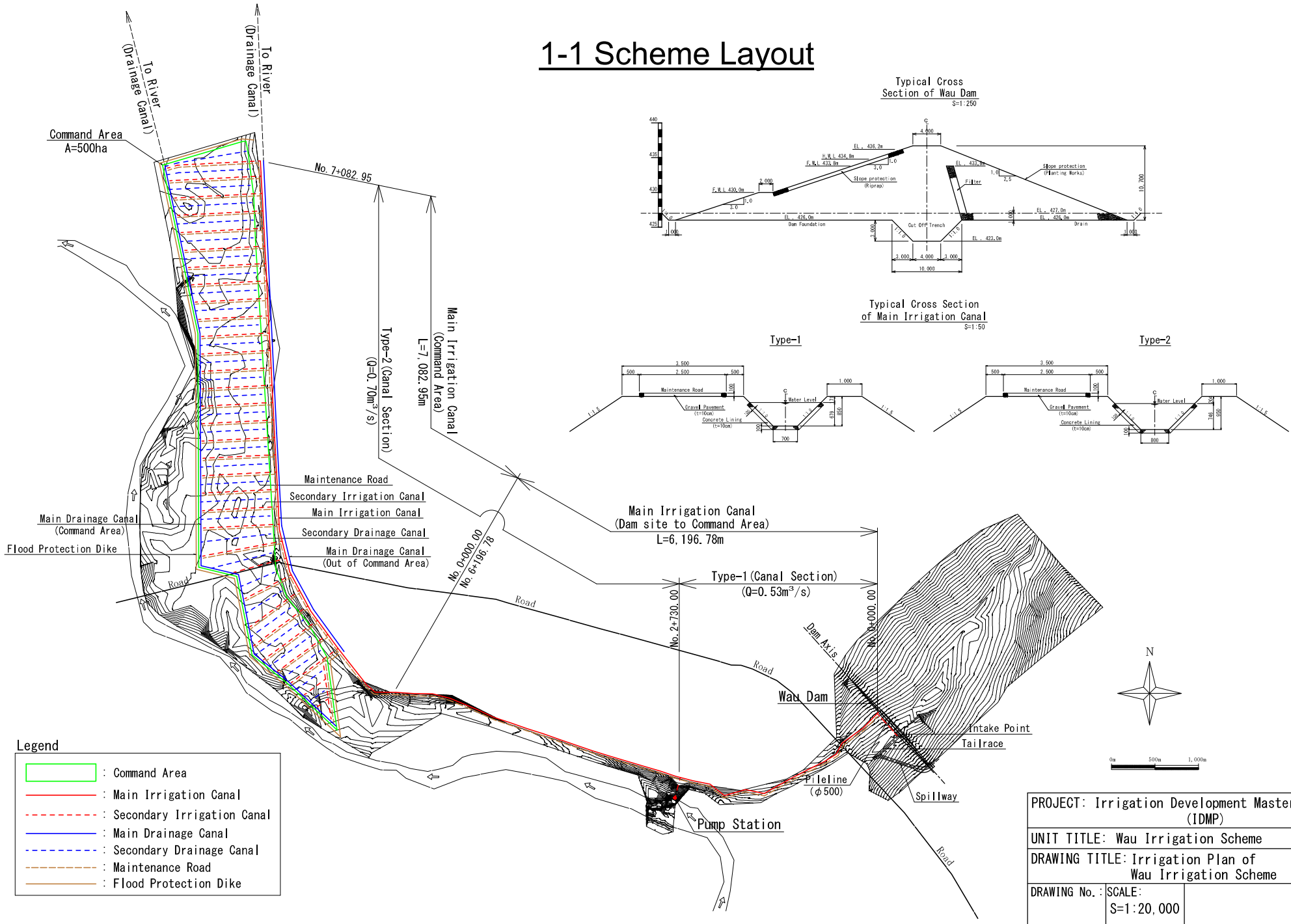
APPENDIX - 2

DRAWINGS

List of Drawings: Wau Irrigation Scheme

No.	Name of Drawing	Sheet
1. Irrigation Plan		
1-1	Scheme Layout	1
1-2	Scheme Layout (Command Area)	1
2. Dam		
2-1	Plain Map of Dam	1
2-2	Longitudinal Section of Dam	1
2-3	Typical Cross Section of Dam	1
2-4 - 2-7	Cross Section of Dam (1/4) - (4/5)	4
2-8 - 2-11	Spillway (1/4) - (4/4)	4
2-12	Intake	1
3. Pump Station		
3-1	Connection Channel	1
3-2	Pump Station	1
3-3	Discharge Chamber	1
4. Main Irrigation Canal		
4-1	Profile -Dam Site to Command Area-	1
4-2	Profile -Command Area-	1
4-3	Typical Cross Section	1
4-4 - 4-6	Cross Section (1/3) ~ (3/3)	3
5. Secondary Canal & Drainage Canal		
5-1	Typical Cross Section of Secondary Canal and Drainage Canal	1
5-2	Typical Cross Section of Main Drainage Canal	1
6. Flood Protection Dike		
6-1	Plan of Flood Protection Dike	1
6-2	Typical Cross Section of Flood Protection Dike	1
	Total	27

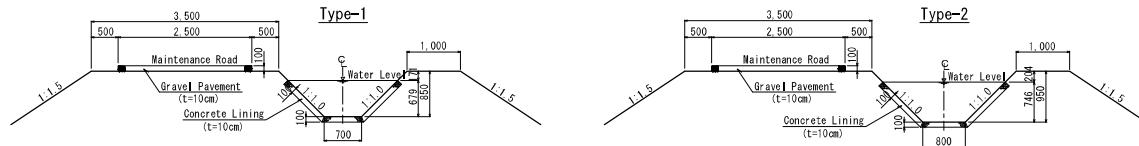
1-1 Scheme Layout



ANN9-1: APP2/W-2

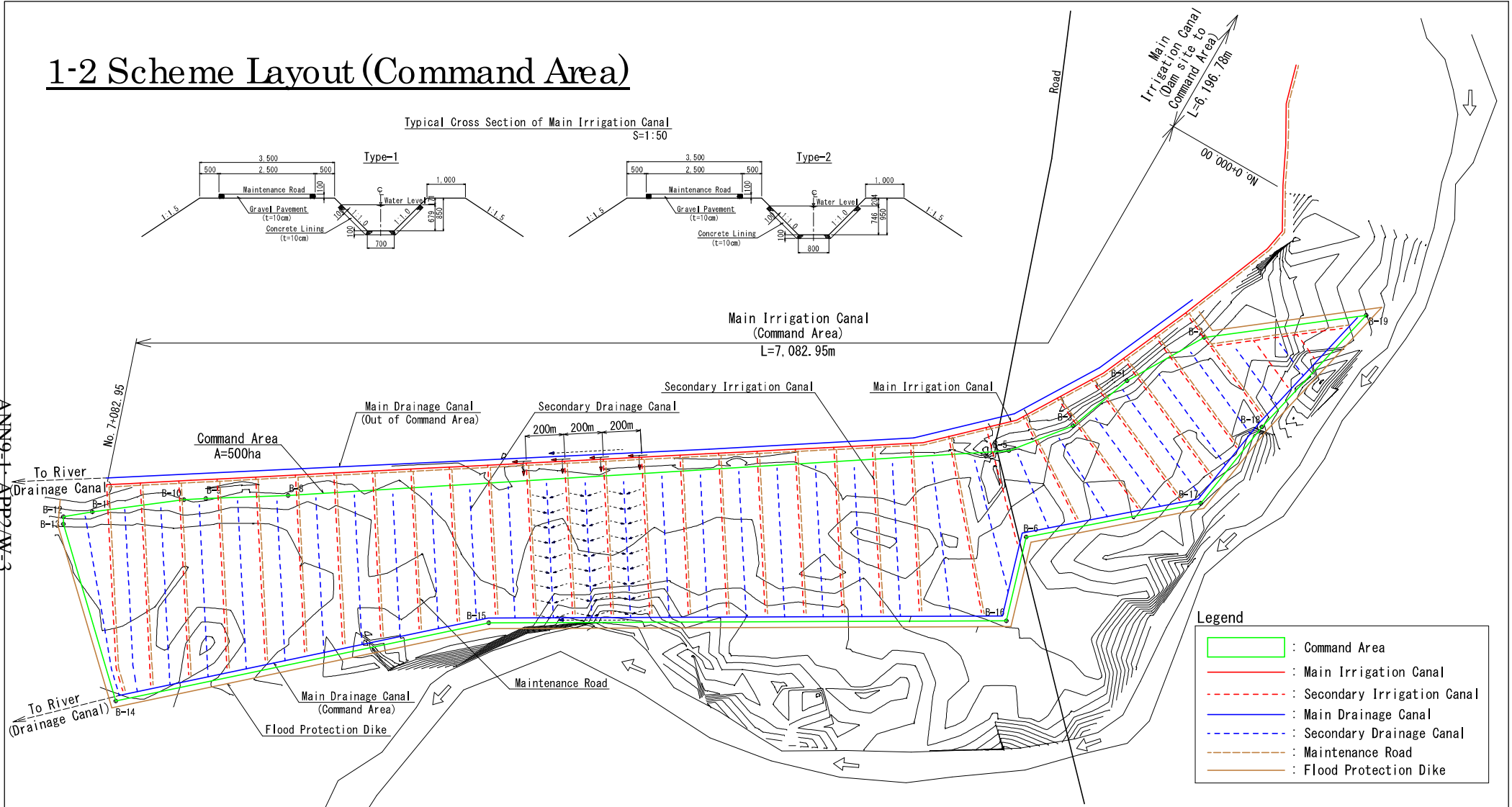
1-2 Scheme Layout (Command Area)

Typical Cross Section of Main Irrigation Canal
S=1:50



Main Irrigation Canal
(Command Area)
L=7,082.95m

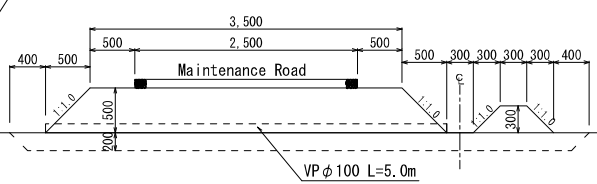
ANN9-1-APP2-W-3



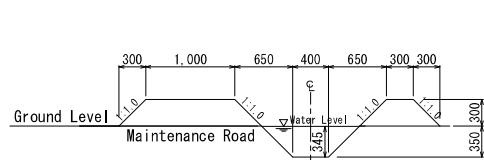
Legend

- : Command Area
- : Main Irrigation Canal
- : Secondary Irrigation Canal
- : Main Drainage Canal
- : Secondary Drainage Canal
- : Maintenance Road
- : Flood Protection Dike

Typical Cross Section of Secondary Canal
S=1:30



Typical Cross Section of Drainage Canal
S=1:30

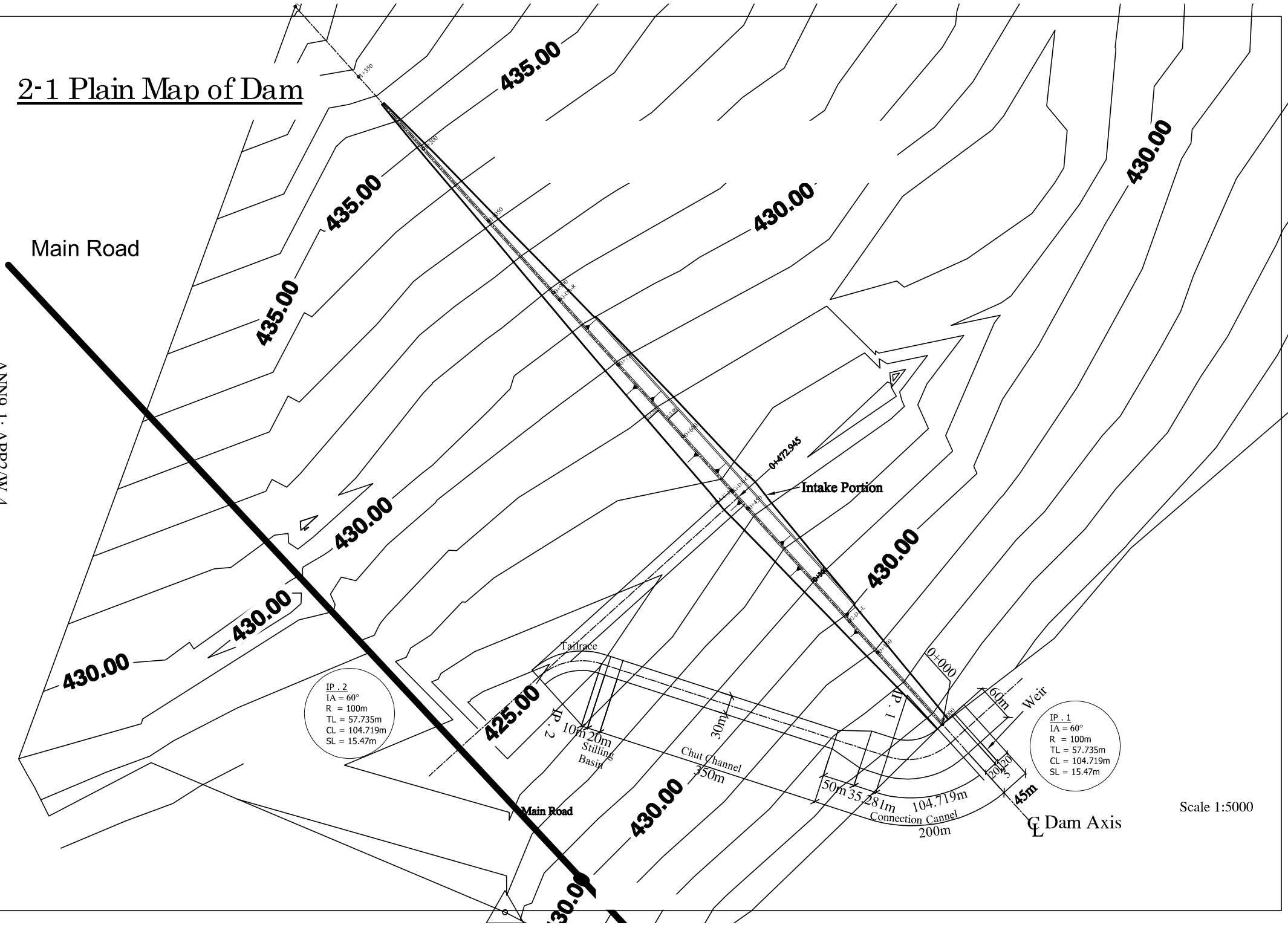


PROJECT: Irrigation Development Master Plan (IDMP)	
UNIT TITLE: Wau Irrigation Scheme	
DRAWING TITLE: Irrigation Plan of Command Area	
DRAWING No.:	SCALE: S=1:10,000

2-1 Plain Map of Dam

ANN9-1: APP2/W-4

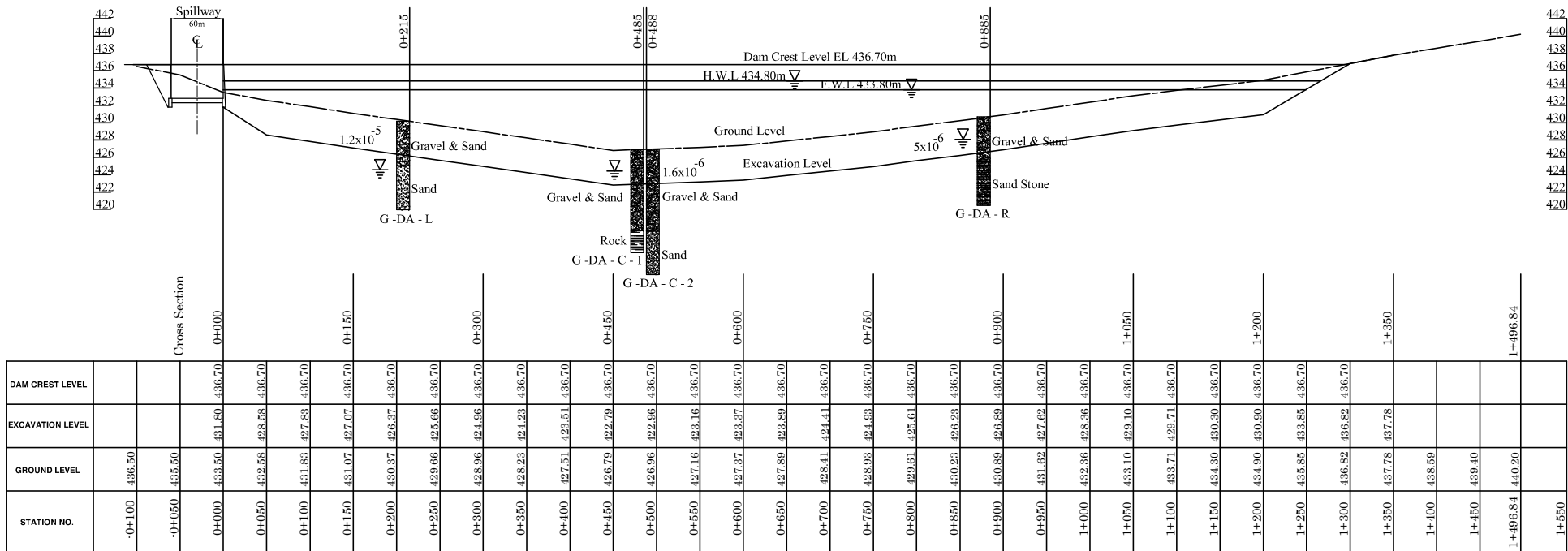
Main Road



Scale 1:5000

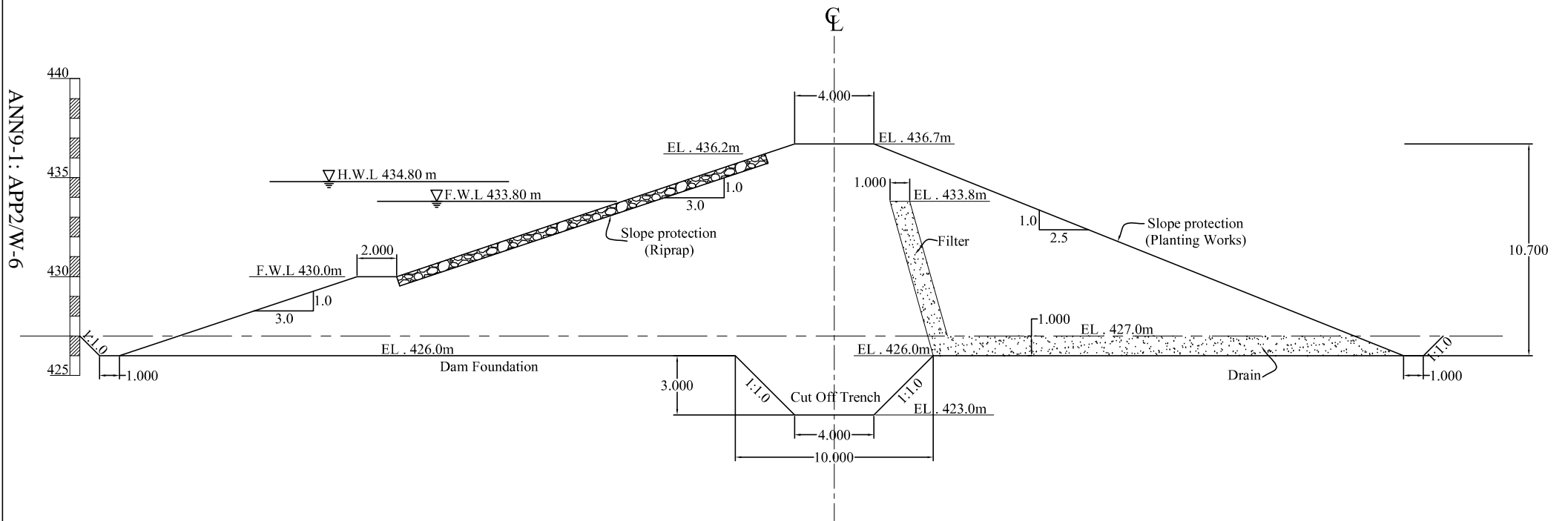
2-2 Longitudinal Section of Dam

ANN9-1: APP2/W-5



Scale 1:5000

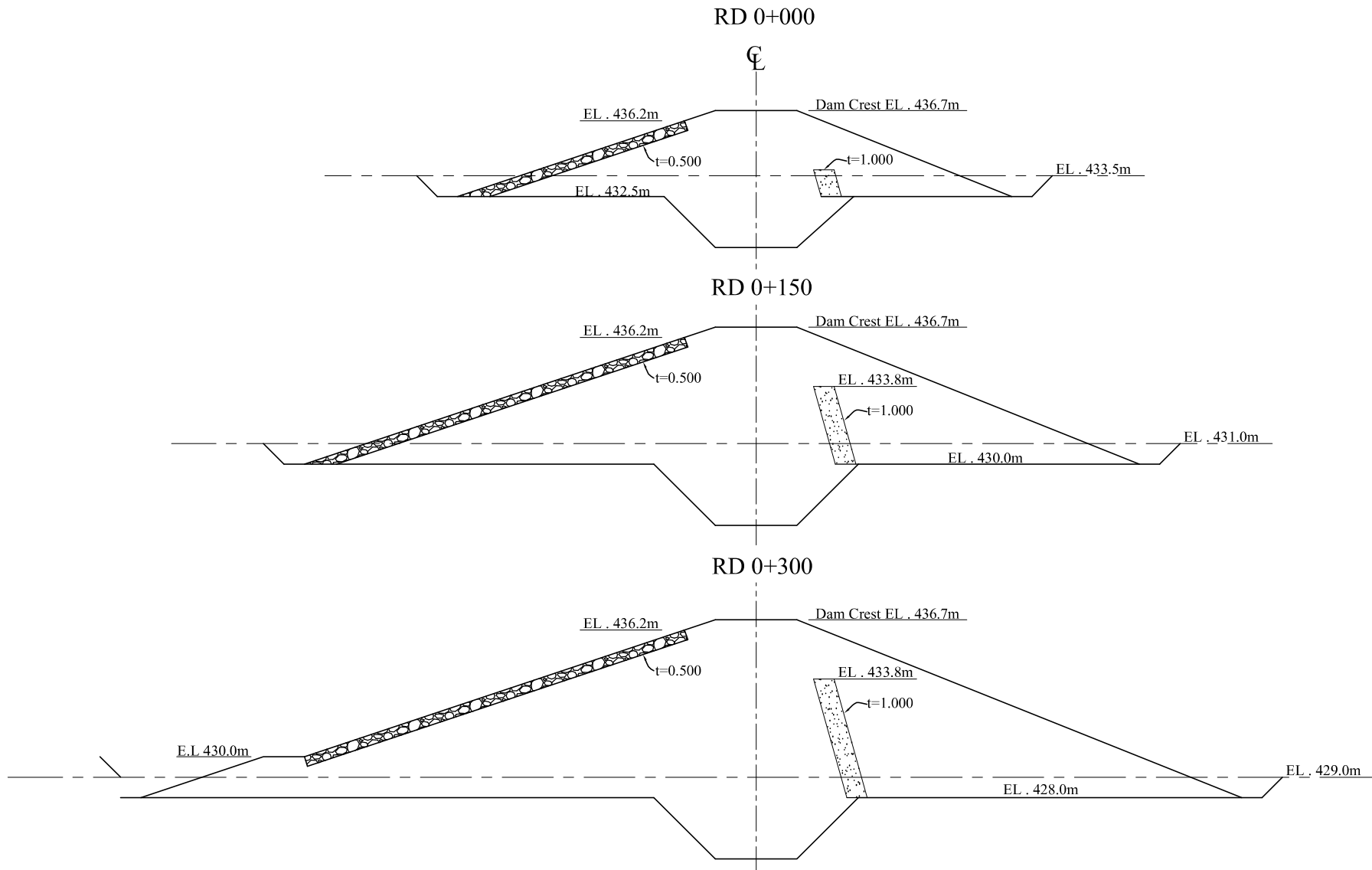
2-3 Typical Cross Section of Dam



ANN9-1: APP2/W-6

Scale 1:200

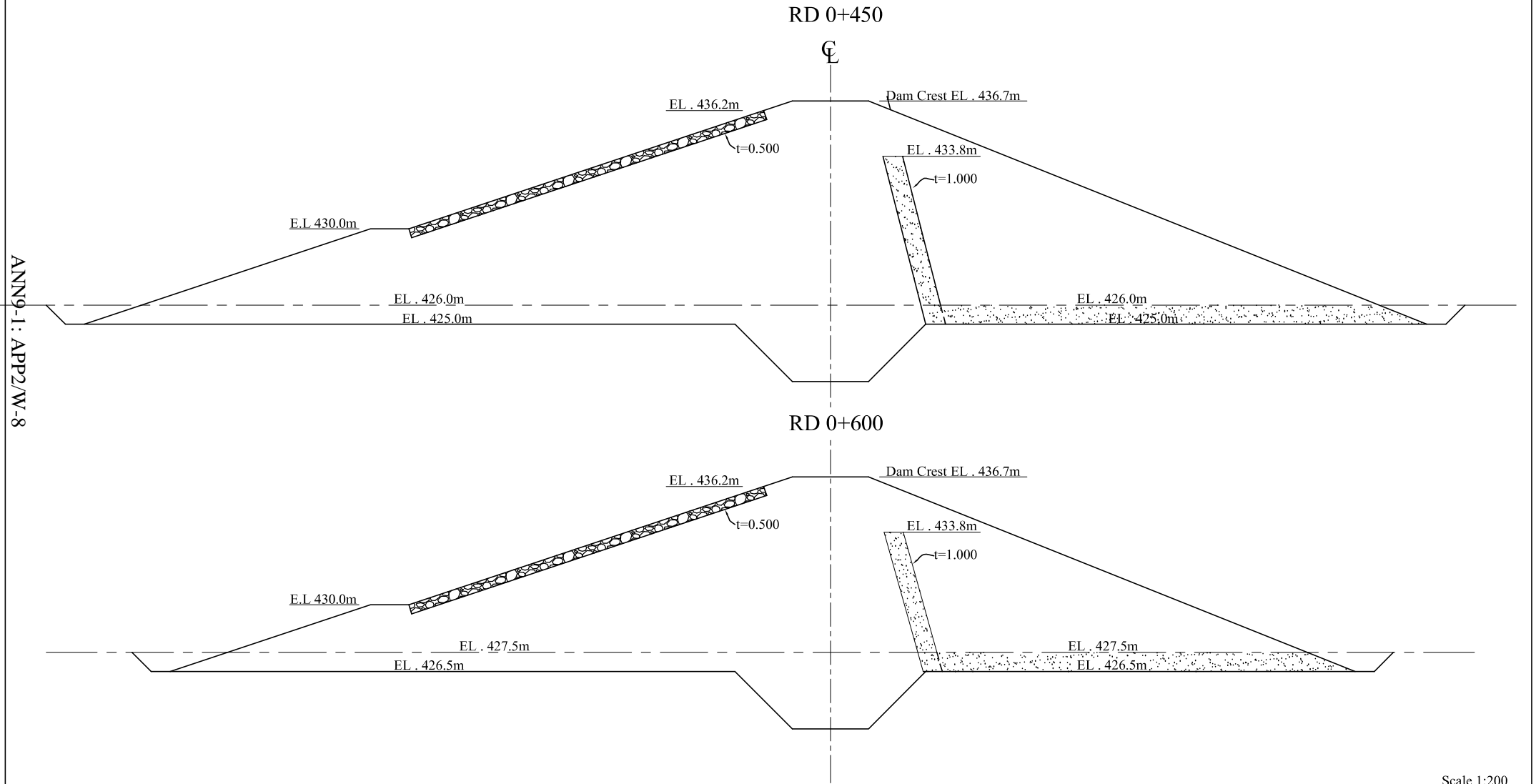
2-4 Cross Section of Dam (1/4)



ANN9-1: APP2/W-7

Scale 1:200

2-5 Cross Section of Dam (2/4)



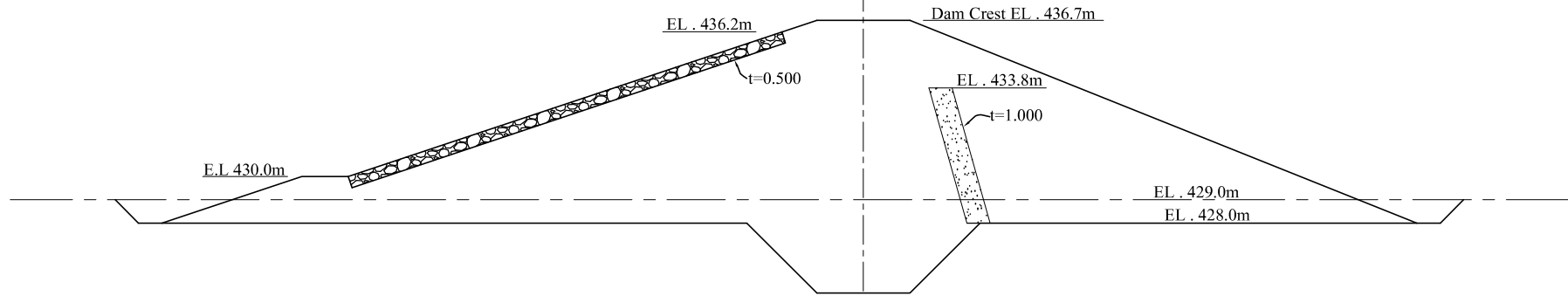
ANN9-1: APP2/W-8

Scale 1:200

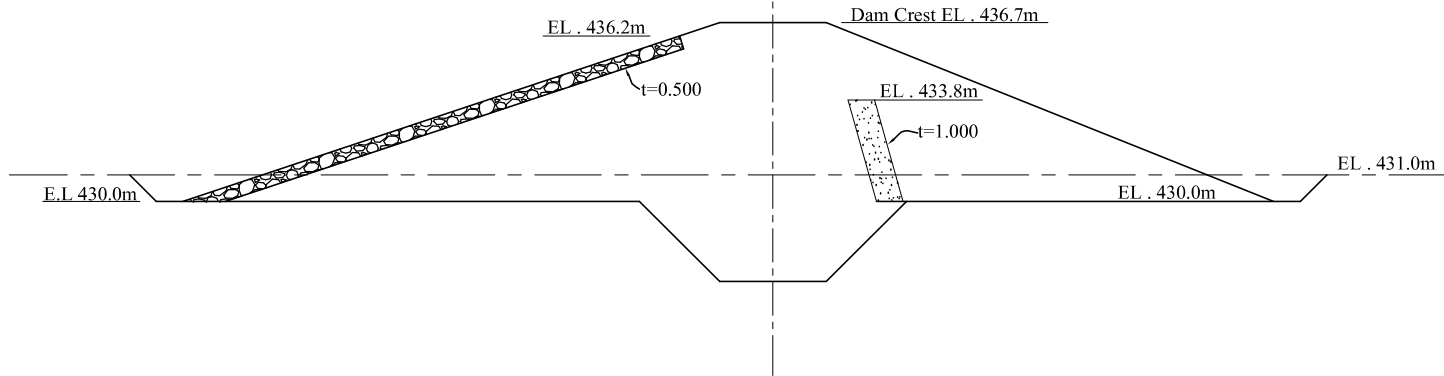
2-6 Cross Section of Dam (3/4)

RD 0+750

℄



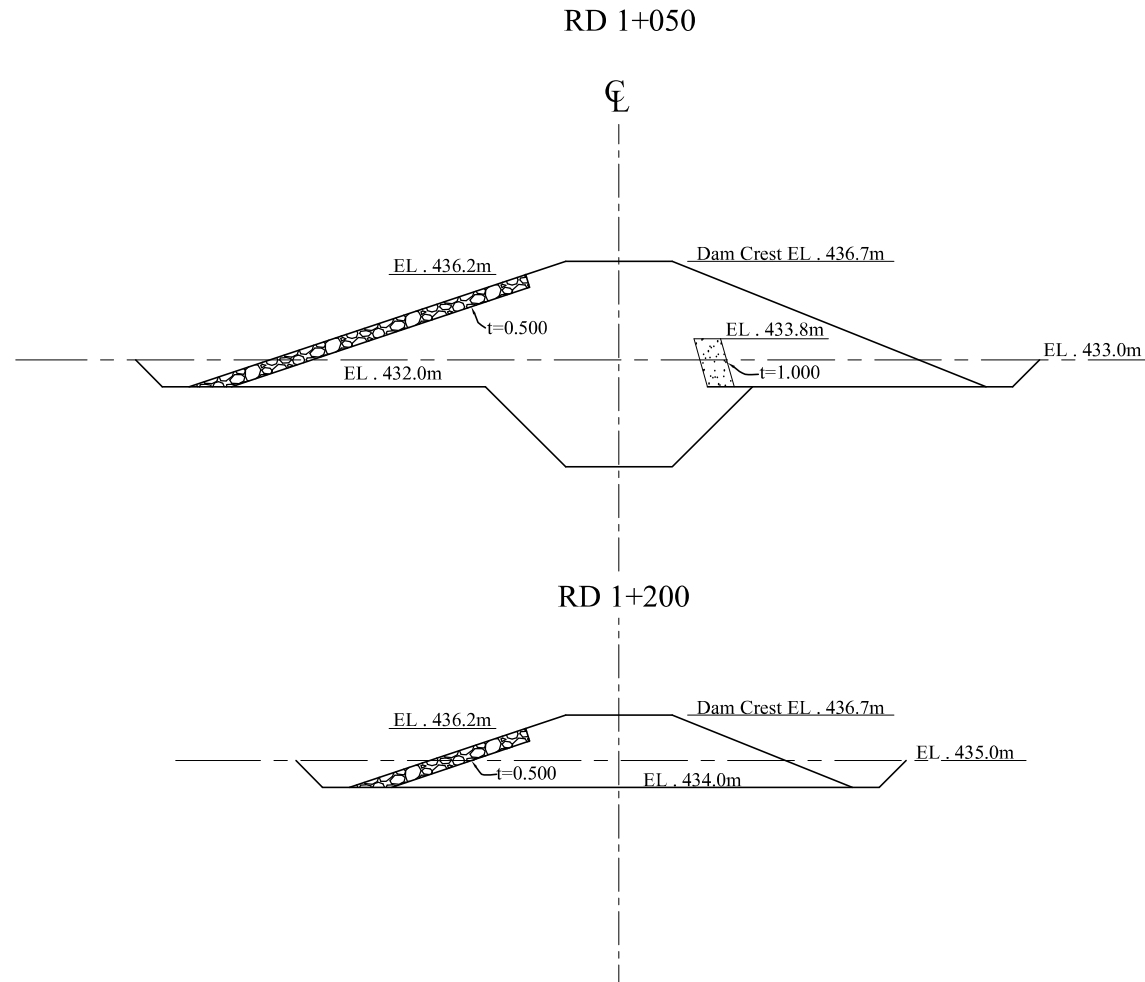
RD 0+900



ANN9-1: APP2/W-9

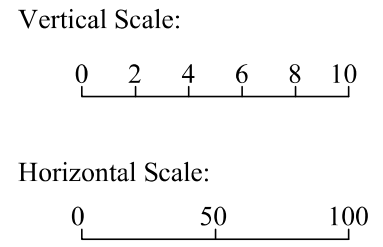
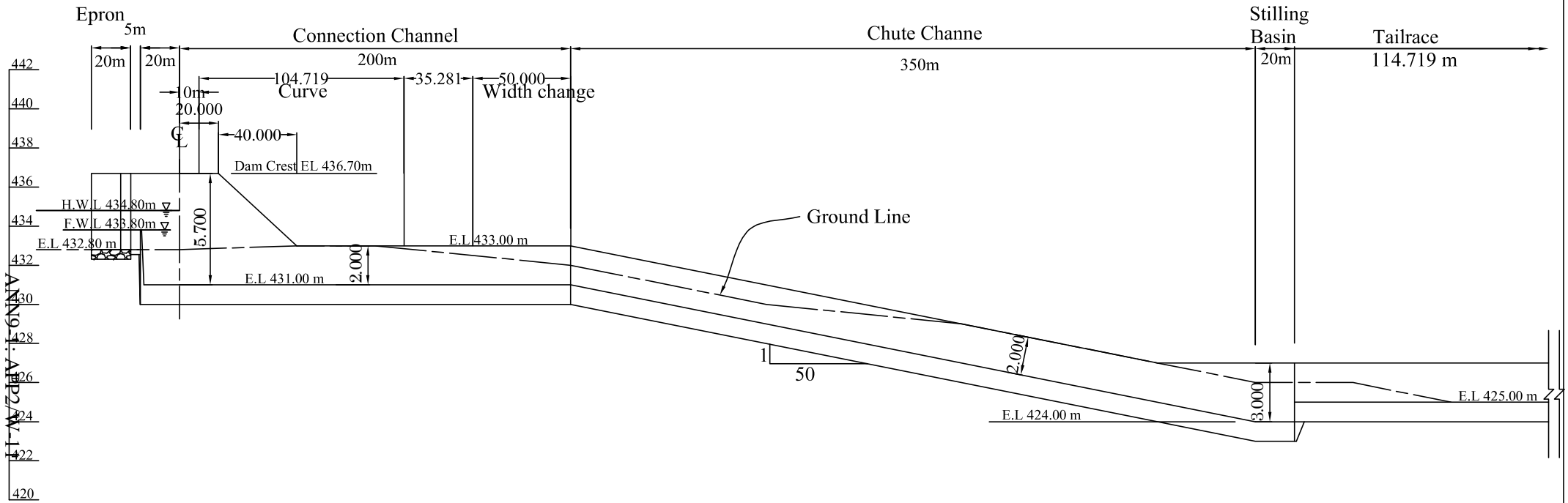
Scale 1:200

2-7 Cross Section of Dam (4/4)



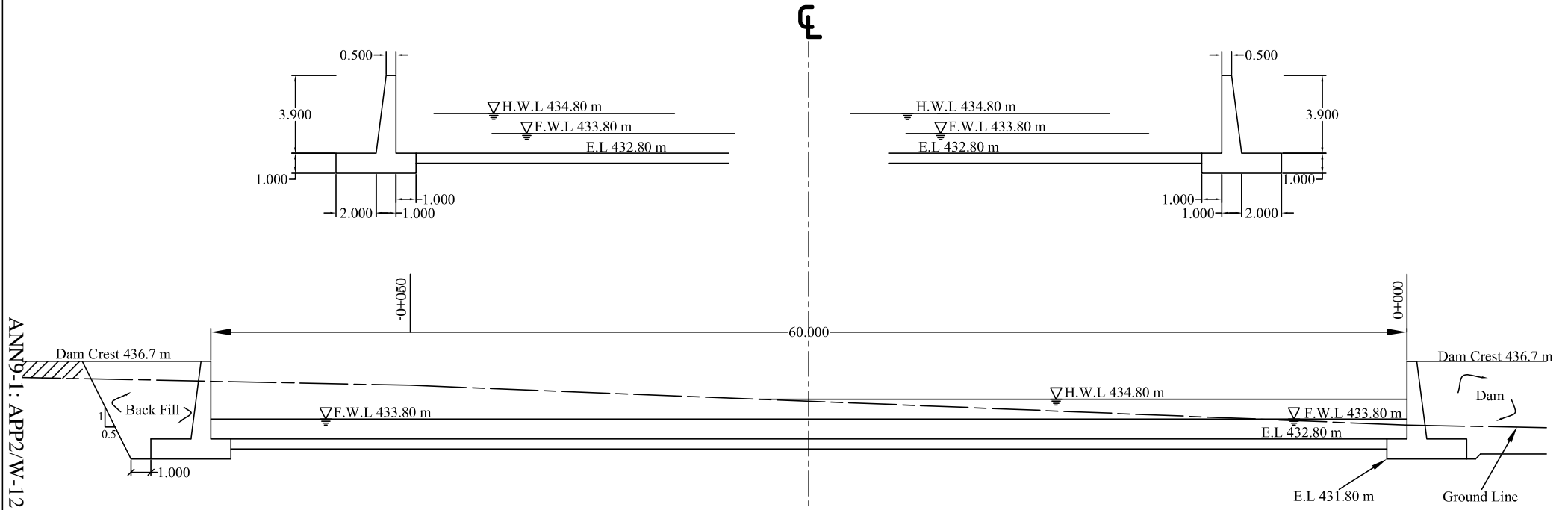
ANN9-1: APP2/W-10

2-8 Spillway (1/4)

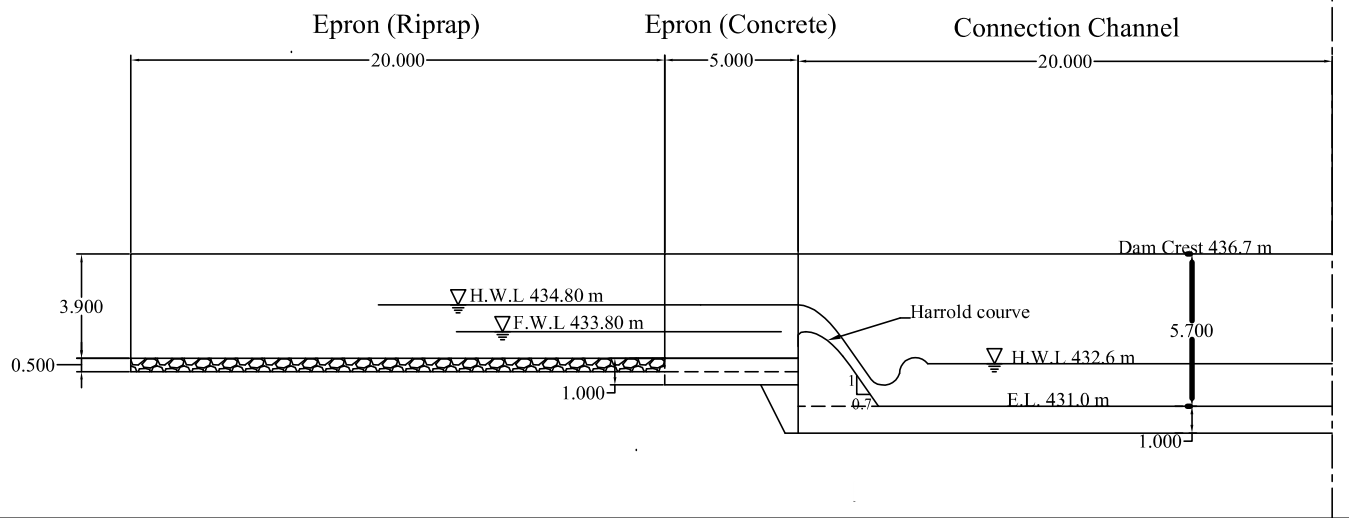


Scale 1:2000

2-9 Spillway (2/4)



Longitudinal section at Weir

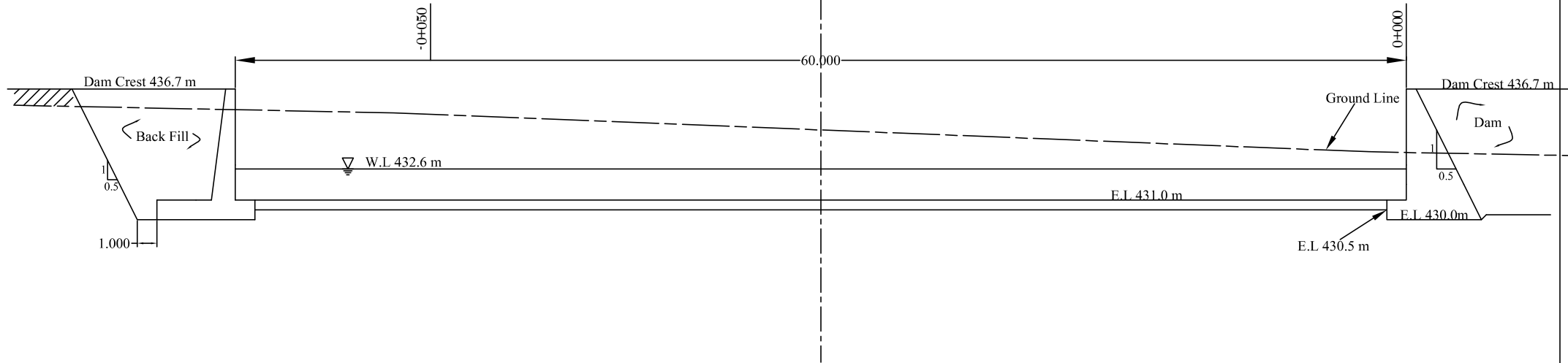
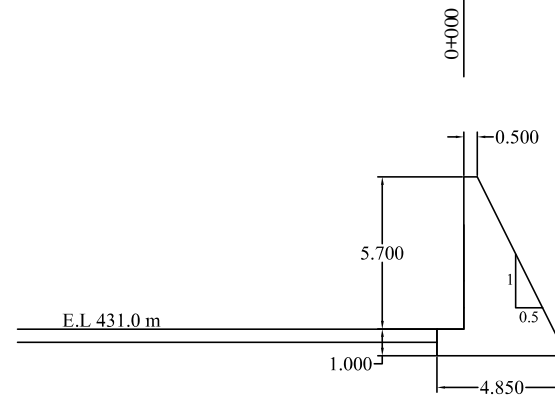
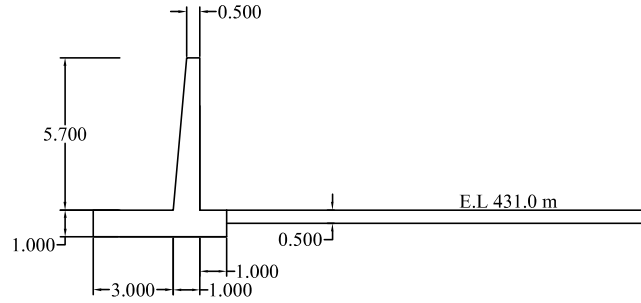


ANN9-1: App2/W-12

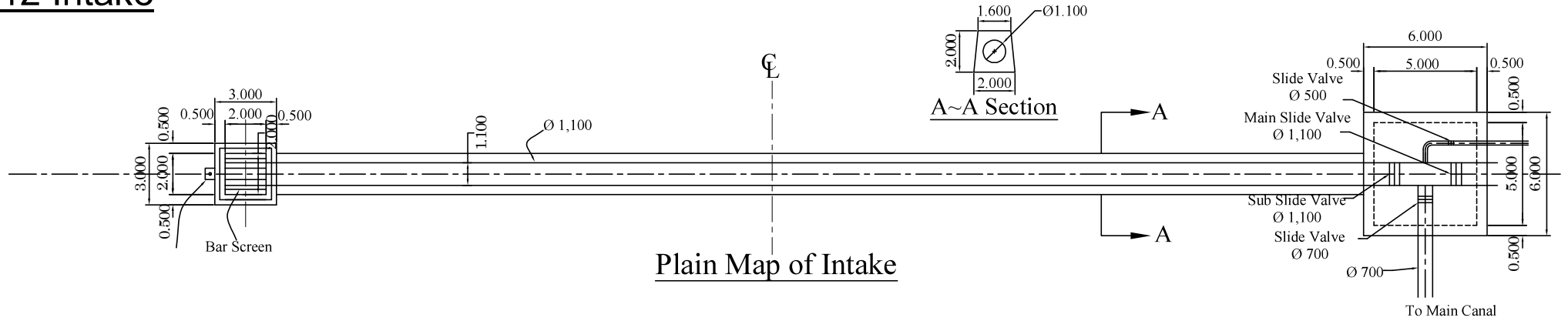
2-10 Spillway (3/4)

ANN9-1: APP2/W-13

CF

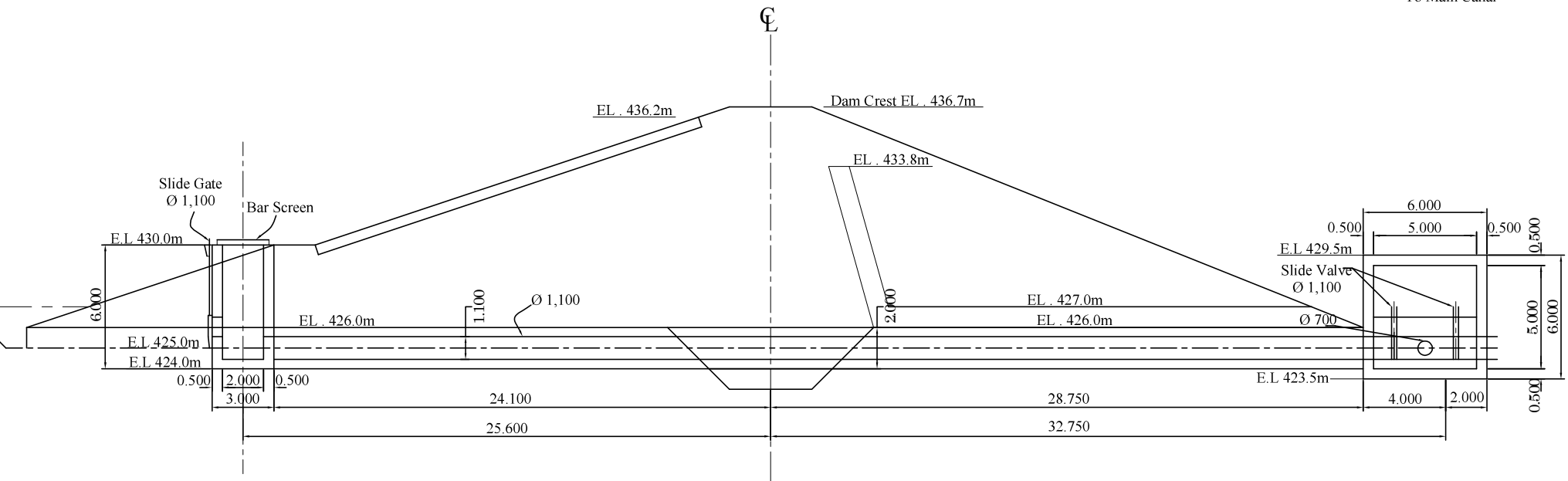


2-12 Intake



Plain Map of Intake

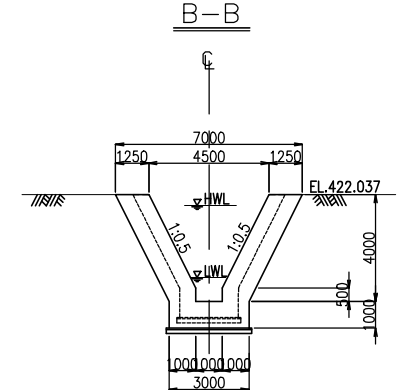
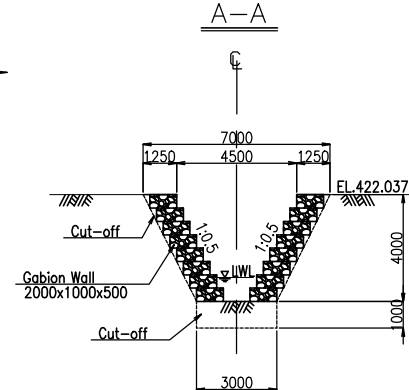
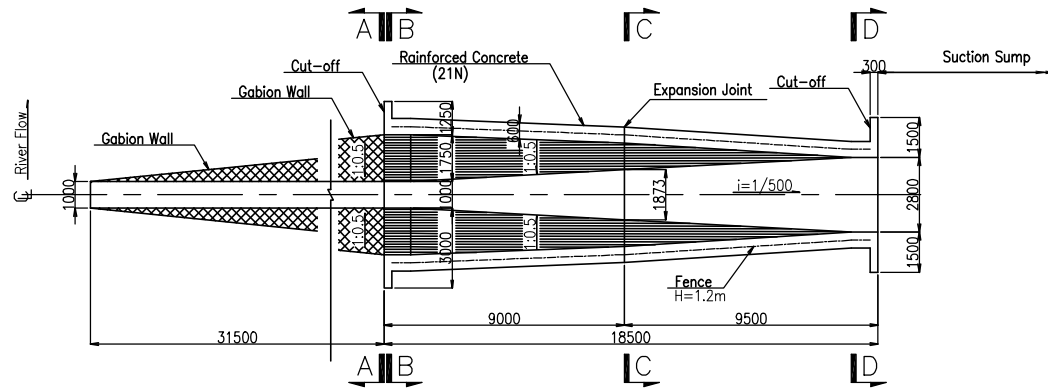
ANN9-1: APP2/W-15



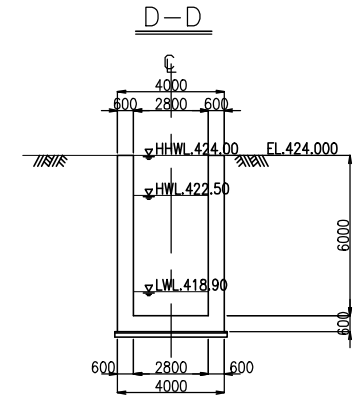
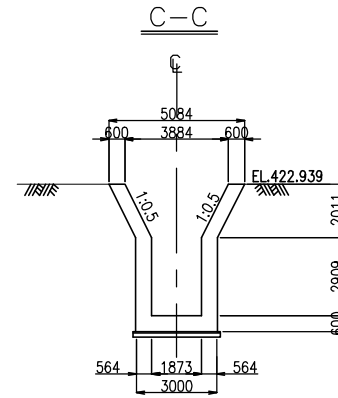
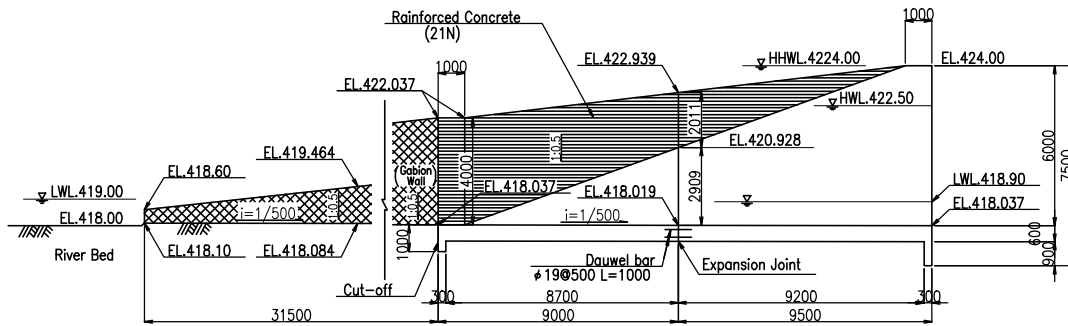
Longitudinal Section of Intake

3-1 Connection Channel

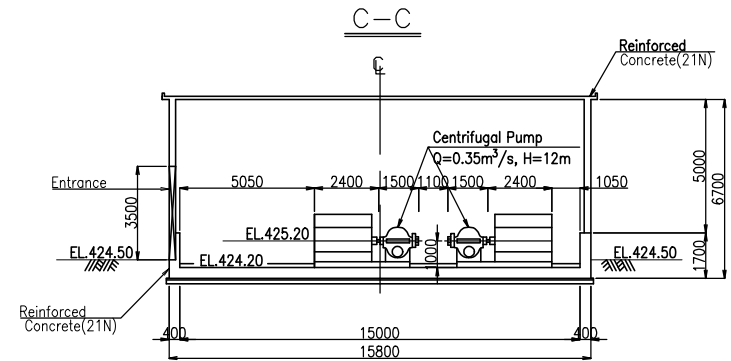
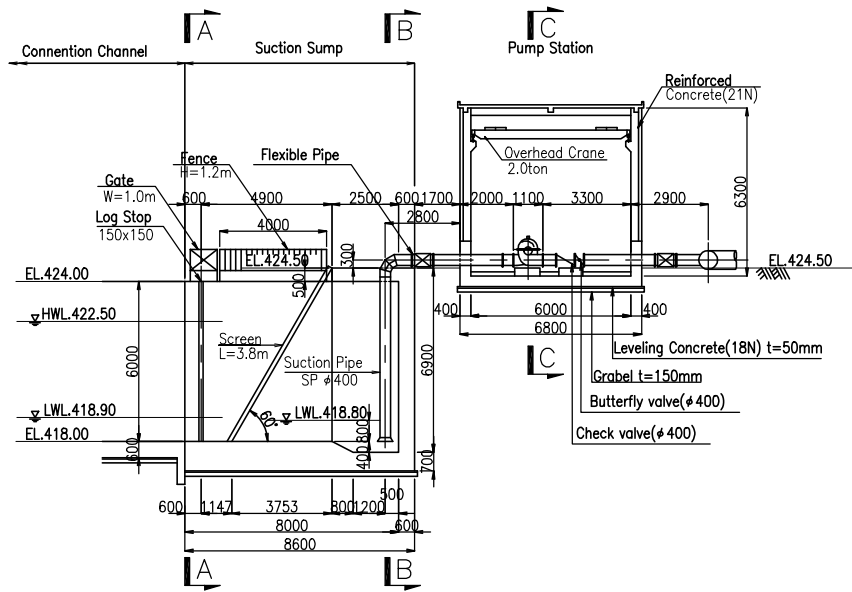
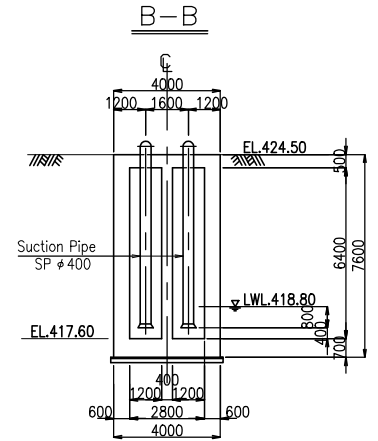
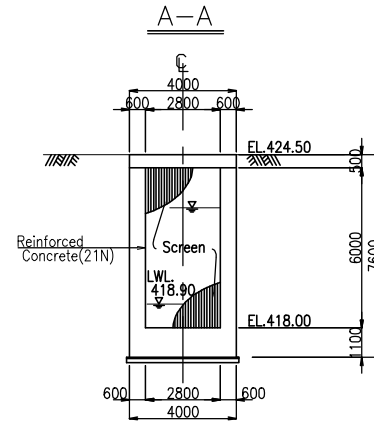
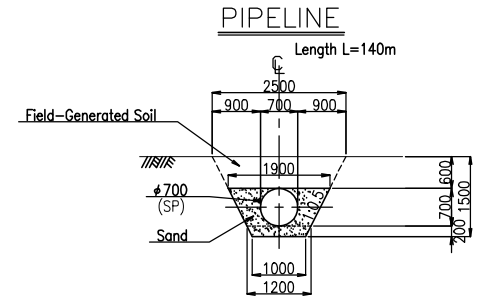
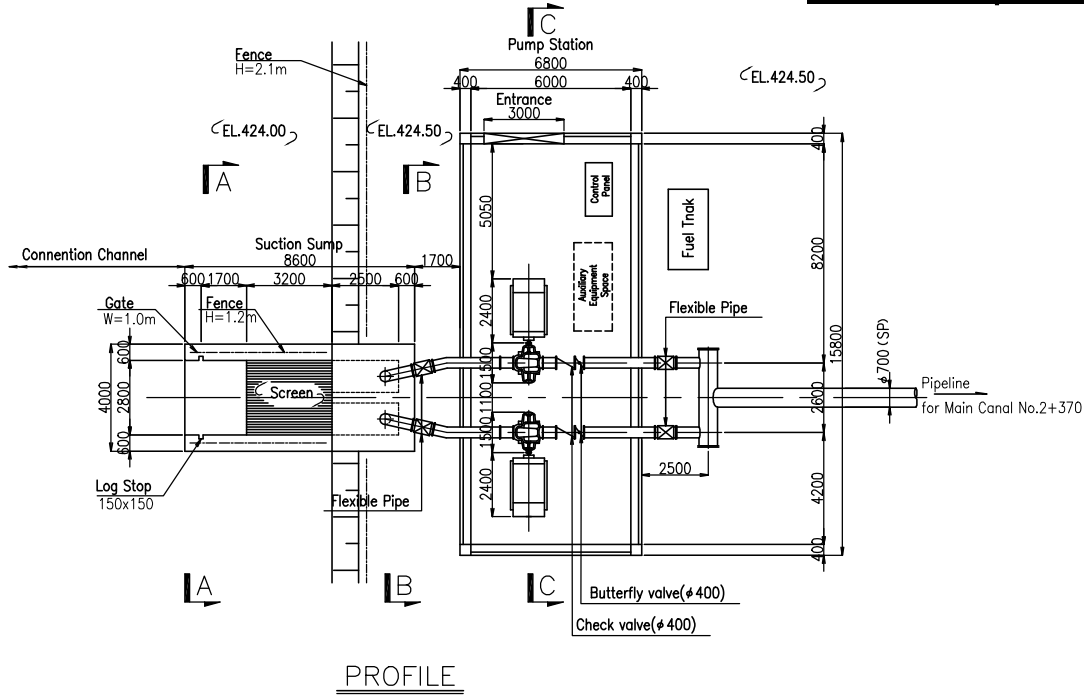
PLAN



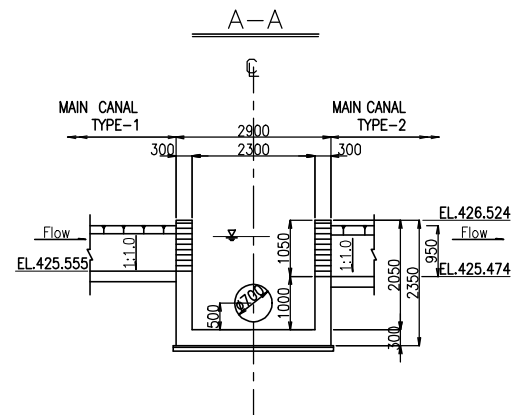
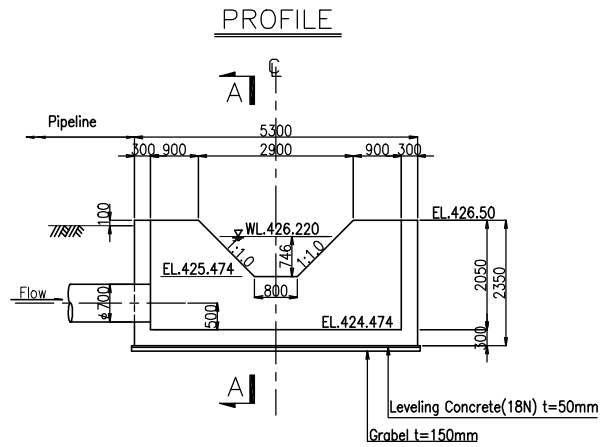
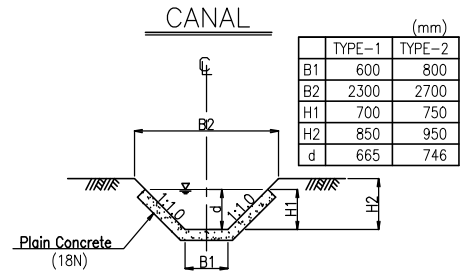
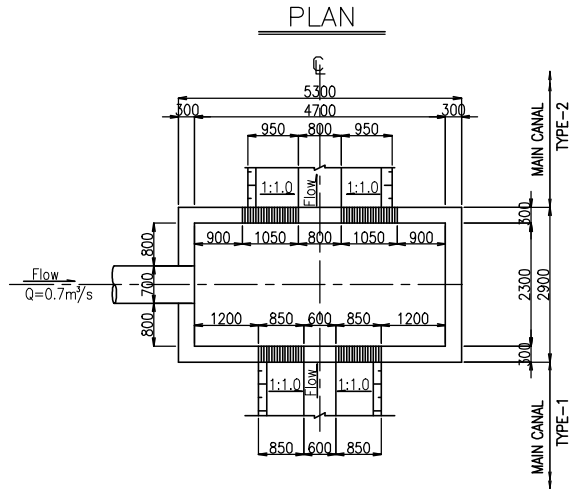
PROFILE



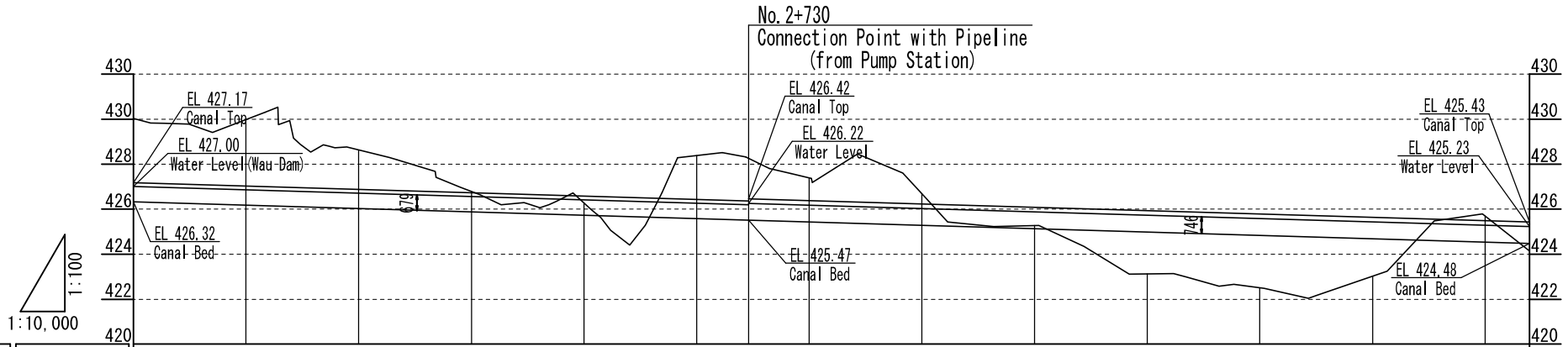
3-2 Pump Station



3-3 Discharge Chamber

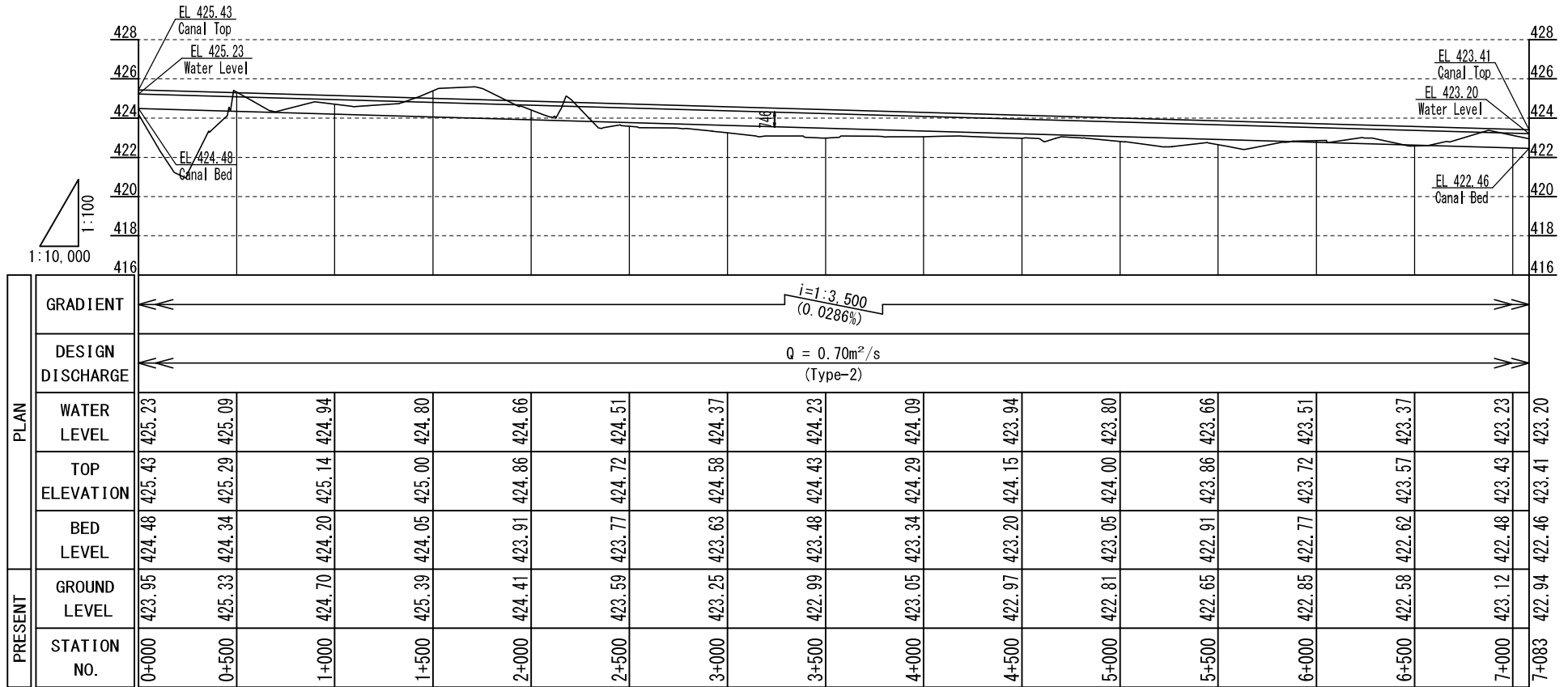


4-1 Profile -Dam Site to Command Area-

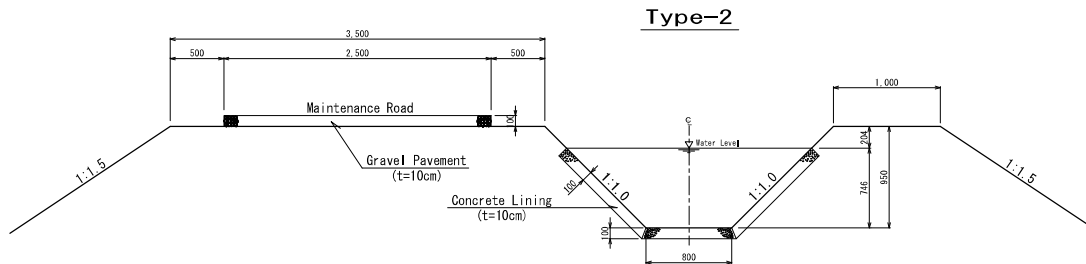
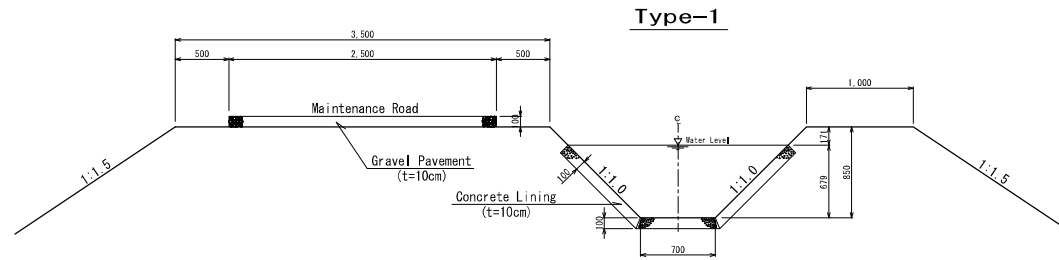


PRESENT	PLAN					
	STATION NO.	GROUND LEVEL	BED LEVEL	TOP ELEVATION	WATER LEVEL	DESIGN DISCHARGE
	0+000	430.03	426.32	427.17	427.00	$Q = 0.53\text{m}^2/\text{s}$ (Type-1)
	0+500	429.99	426.18	427.03	426.86	
	1+000	428.63	426.04	426.89	426.71	$Q = 0.53\text{m}^2/\text{s}$ (Type-1)
	1+500	426.78	425.89	426.74	426.57	
	2+000	426.27	425.75	426.60	426.43	$Q = 0.53\text{m}^2/\text{s}$ (Type-1)
	2+500	428.38	425.61	426.46	426.29	
	2+730	428.16	425.54	426.39	426.22	$Q = 0.53\text{m}^2/\text{s}$ (Type-1)
	3+000	427.39	425.40	426.35	426.14	
	3+500	426.68	425.25	426.20	426.00	$Q = 0.70\text{m}^2/\text{s}$ (Type-2)
	4+000	425.57	425.11	426.06	425.86	
	4+500	423.13	424.97	425.92	425.72	$Q = 0.70\text{m}^2/\text{s}$ (Type-2)
	5+000	422.51	424.83	425.78	425.57	
	5+500	423.03	424.68	425.63	425.43	$Q = 0.70\text{m}^2/\text{s}$ (Type-2)
	6+000	425.70	424.54	425.49	425.29	
	6+199	424.14	424.48	425.43	425.23	

4-2 Profile -Command Area-



4-3 Typical Cross Section



ANN9-1:APP2/W-21

PROJECT: Irrigation Development Master Plan (IDMP)

UNIT TITLE: Wau Irrigation Scheme

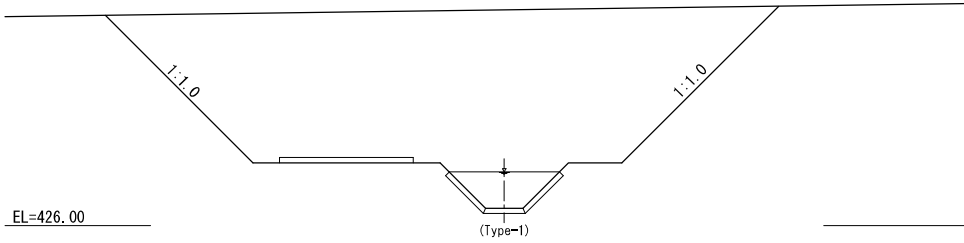
DRAWING TITLE: Typical Cross Section

DRAWING No. :

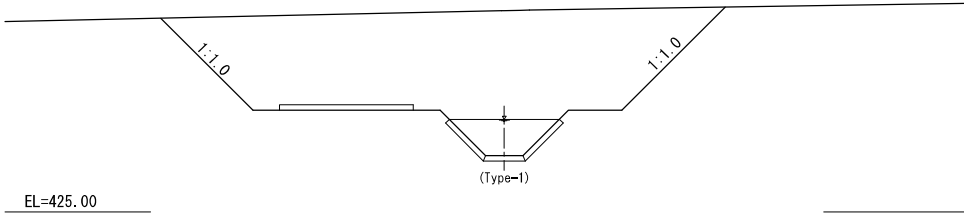
SCALE:
S=1:25

4-4 Cross Section (1/3)

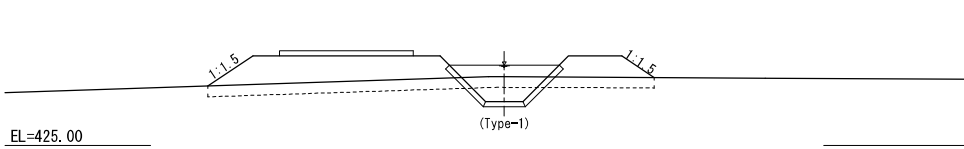
0+000.00
(Dam site to Command Area)



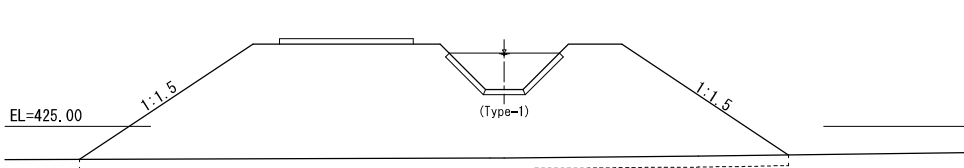
0+946.26
(Dam site to Command Area)



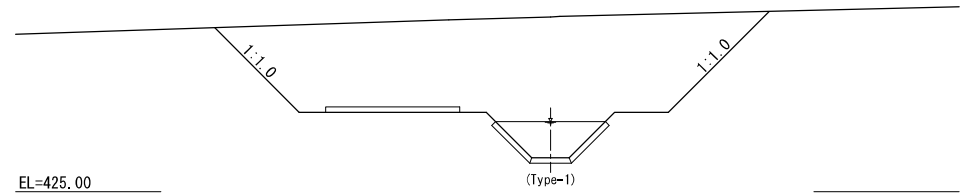
1+731.30
(Dam site to Command Area)



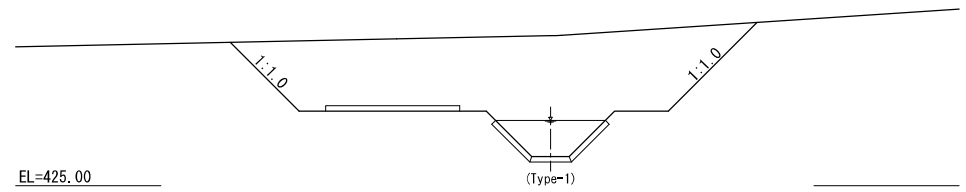
2+201.77
(Dam site to Command Area)



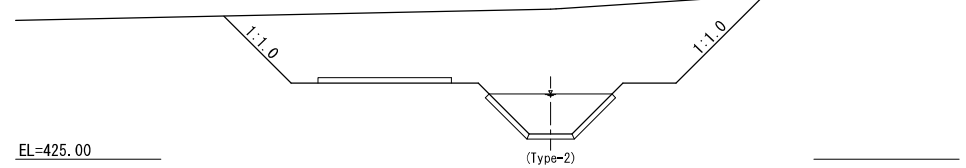
2+414.11
(Dam site to Command Area)



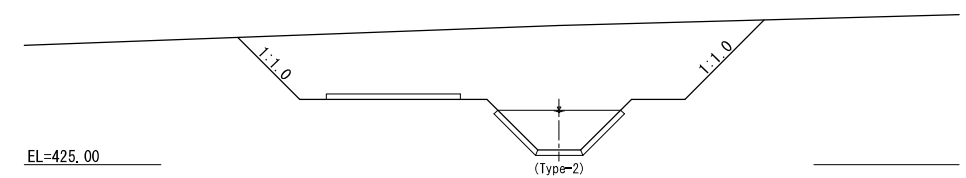
2+730.00
(Dam site to Command Area)



2+730.00
(Dam site to Command Area)



3+415.23
(Dam site to Command Area)



ANN9-1: App2/W-22

PROJECT: Irrigation Development Master Plan
(IDMP)

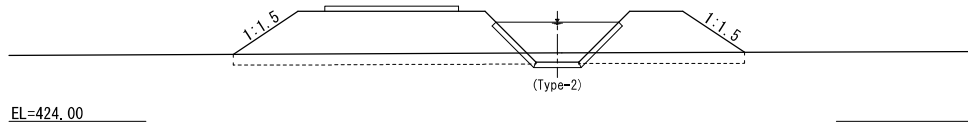
UNIT TITLE: Wau Irrigation Scheme

DRAWING TITLE: Cross Section (1/3)

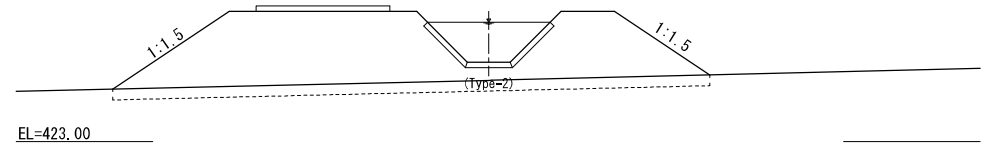
DRAWING No. : SCALE:
S=1:50

4-5 Cross Section (2/3)

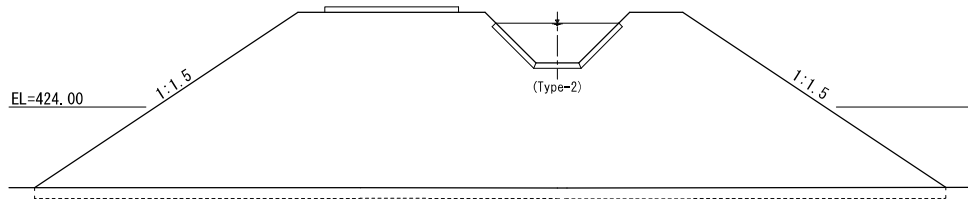
4+018.22
(Dam site to Command Area)



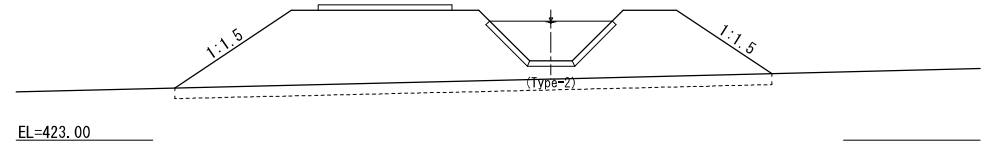
6+198.78
(Dam site to Command Area)



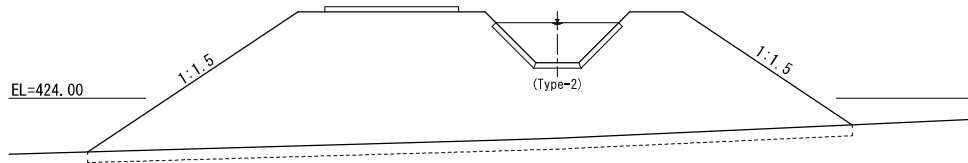
5+018.23
(Dam site to Command Area)



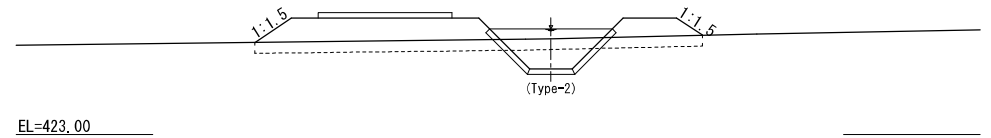
6+198.78
(Command Area)



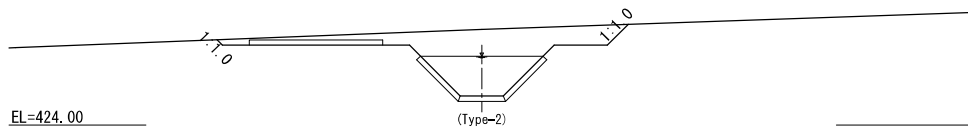
5+565.04
(Dam site to Command Area)



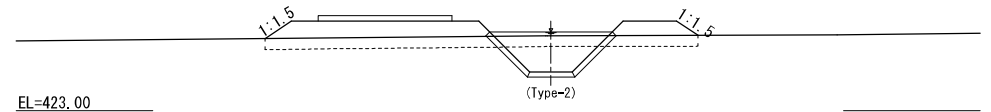
0+898.08
(Command Area)



5+987.22
(Dam site to Command Area)



1+941.21
(Command Area)



ANN9-1: App2/W-23

PROJECT: Irrigation Development Master Plan (IDMP)

UNIT TITLE: Wau Irrigation Scheme

DRAWING TITLE: Cross Section (2/3)

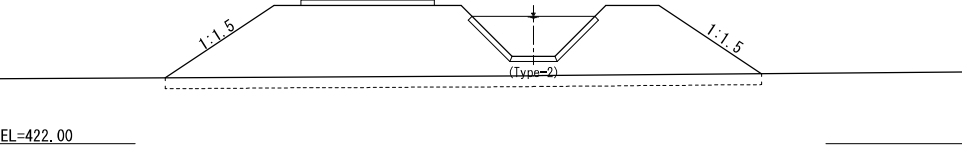
DRAWING No.:

SCALE:

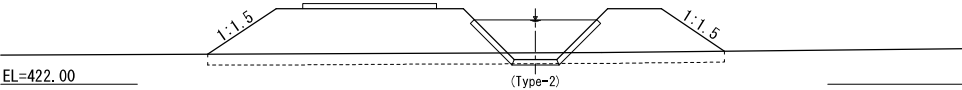
S=1:50

4-6 Cross Section (3/3)

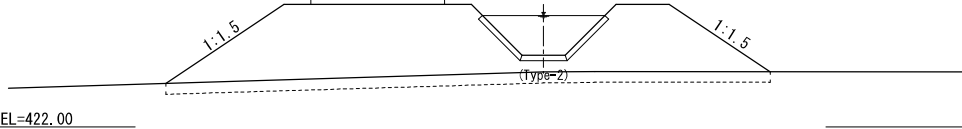
2+968.48
(Command Area)



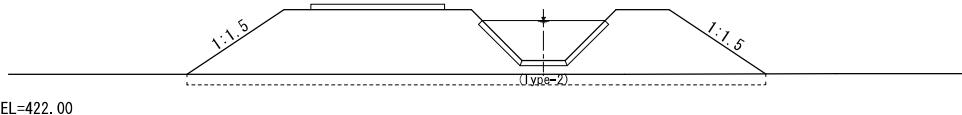
7+082.95
(Command Area)



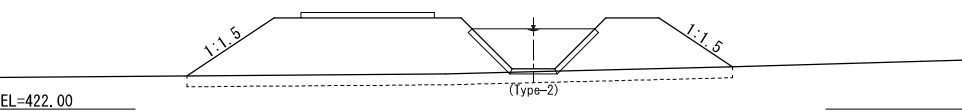
3+997.15
(Command Area)



5+025.56
(Command Area)



6+054.09
(Command Area)



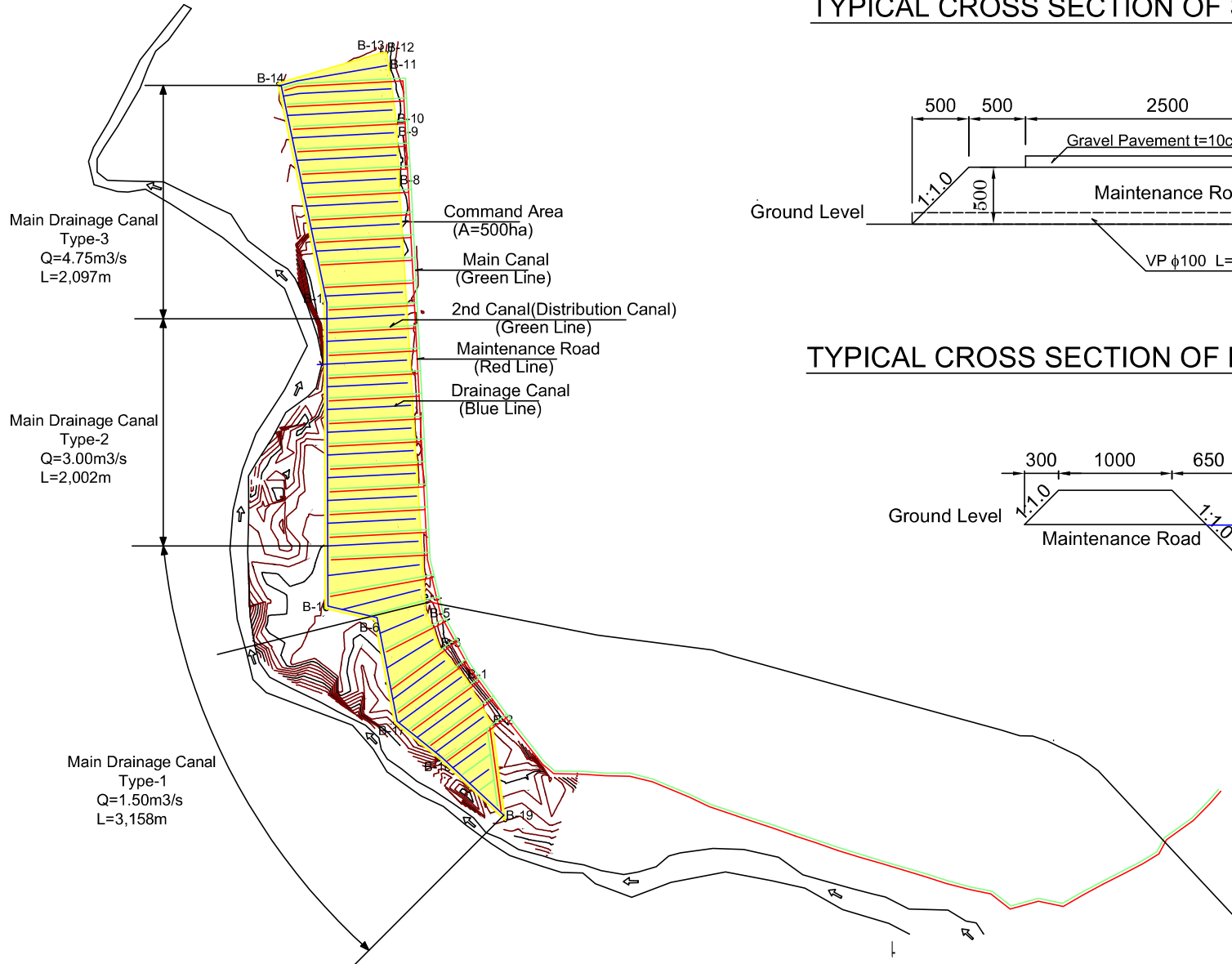
ANN9-1: App2/W-24

PROJECT: Irrigation Development Master Plan (IDMP)		
UNIT TITLE: Wau Irrigation Scheme		
DRAWING TITLE: Cross Section (3/3)		
DRAWING No. :	SCALE:	
	S=1:50	

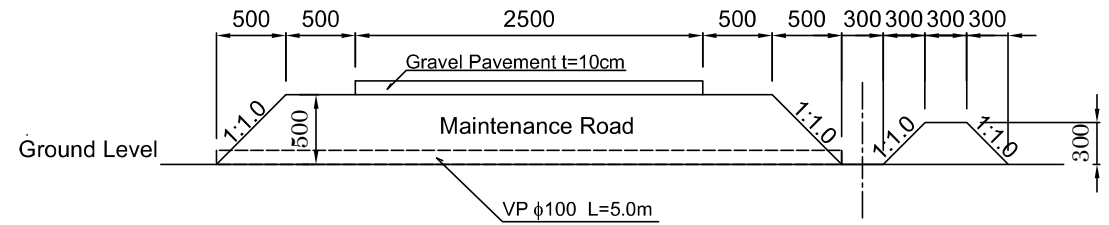
5-1 Typical Cross Section of Secondary Canal and Drainage Canal

CANAL DISTRIBUTION (S=1:40,000)

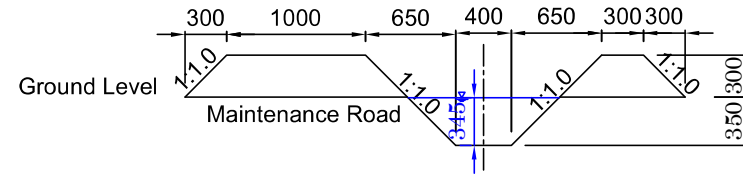
ANN9-1: APP2/W-25



TYPICAL CROSS SECTION OF SECONDARY CANAL (S=1:40)

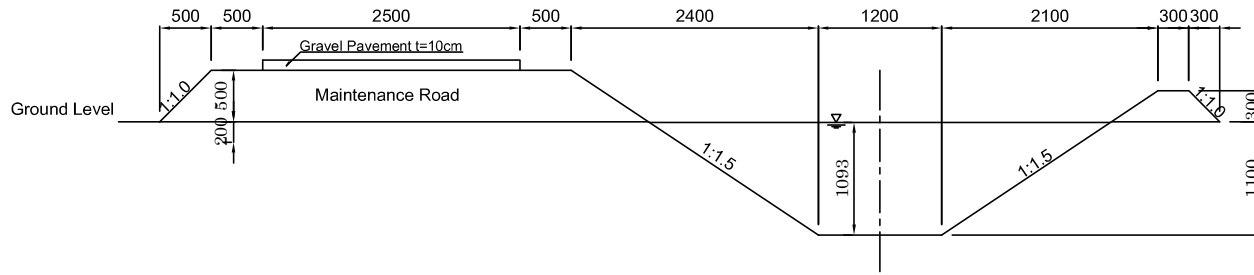


TYPICAL CROSS SECTION OF DRAINAGE CANAL (S=1:40)

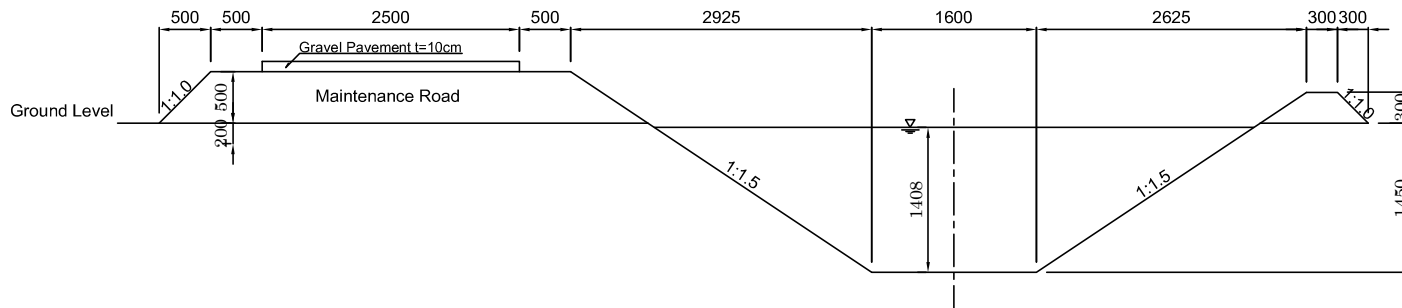


5-2 Typical Cross Section of Main Drainage Canal

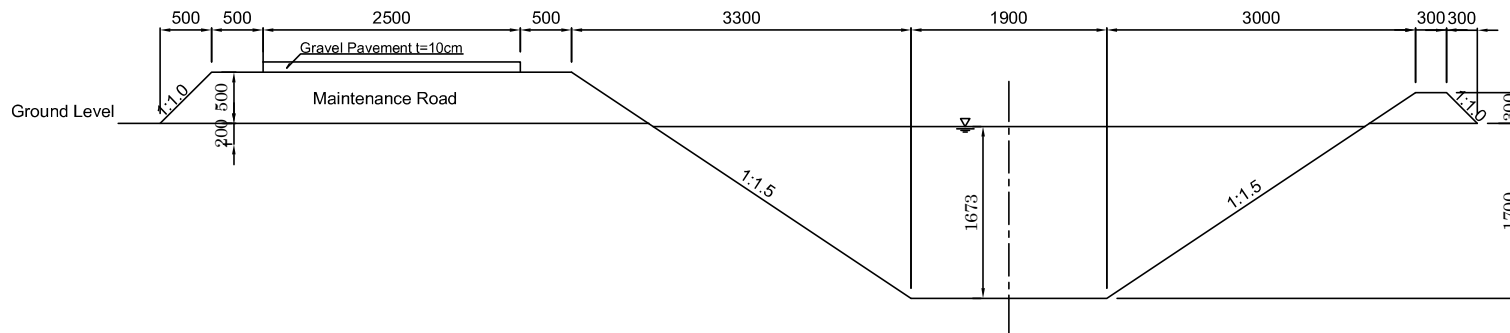
Main Drainage Canal (Type-1) $Q=1.5\text{m}^3/\text{s}$ $L=3,158\text{m}$



Main Drainage Canal (Type-2) $Q=3.0\text{m}^3/\text{s}$ $L=2,002\text{m}$

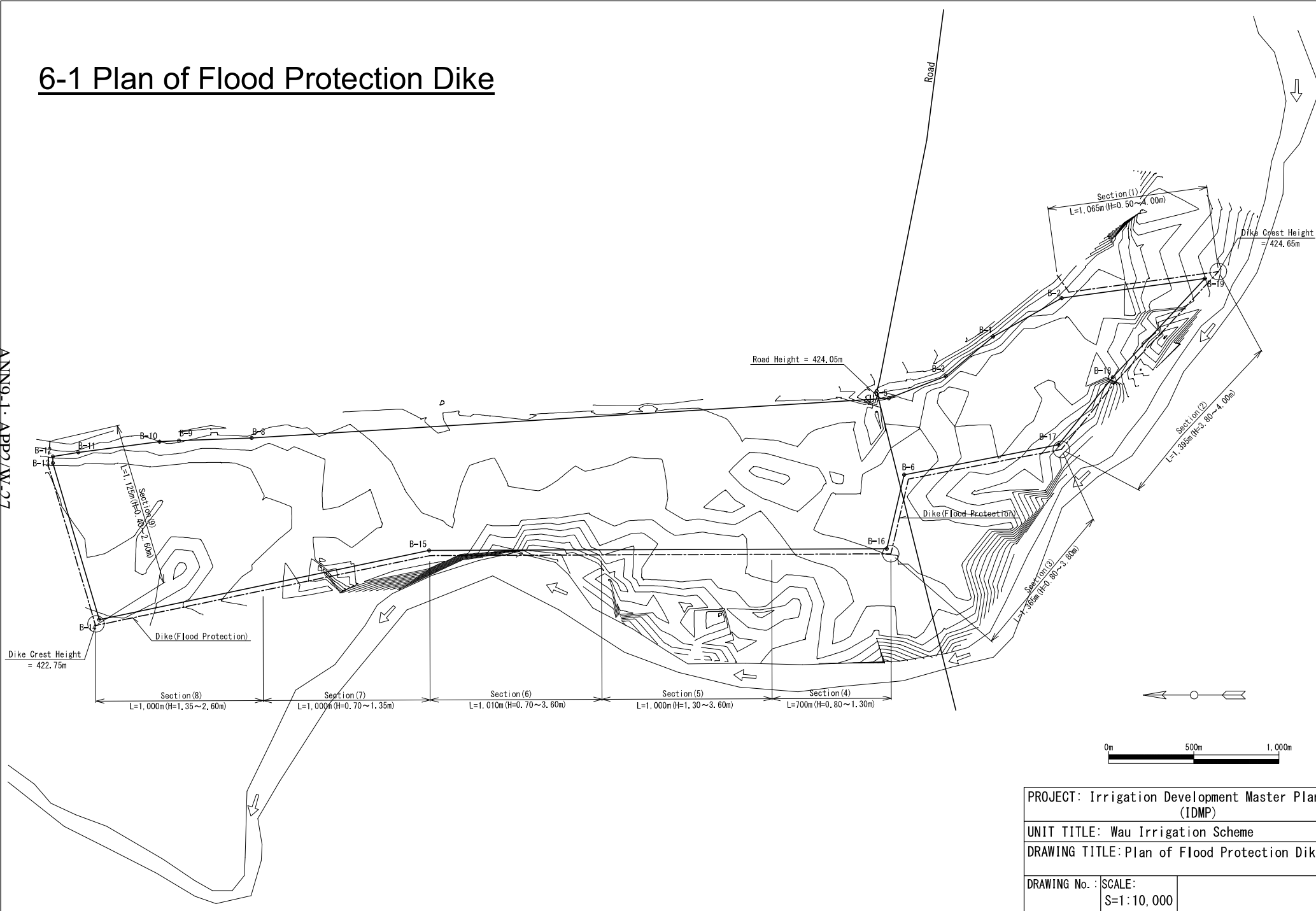


Main Drainage Canal (Type-3) $Q=4.75\text{m}^3/\text{s}$ $L=2,097\text{m}$



6-1 Plan of Flood Protection Dike

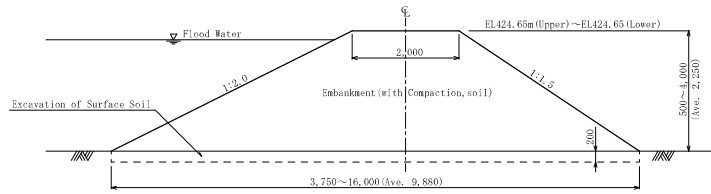
ANN9-1:APP2/W-27



PROJECT: Irrigation Development Master Plan (IDMP)	
UNIT TITLE: Wau Irrigation Scheme	
DRAWING TITLE: Plan of Flood Protection Dike	
DRAWING No. :	SCALE: S=1:10,000

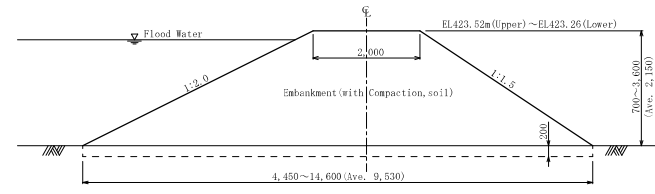
Section (1)

(L=1,065m)



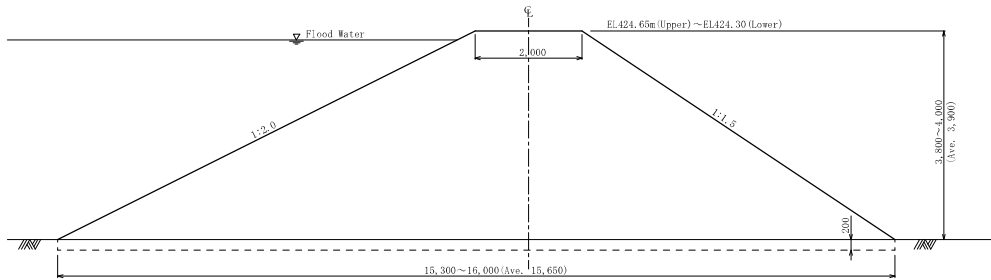
Section (6)

(L=1,010m)



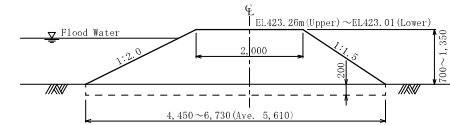
Section (2)

(L=1,395m)



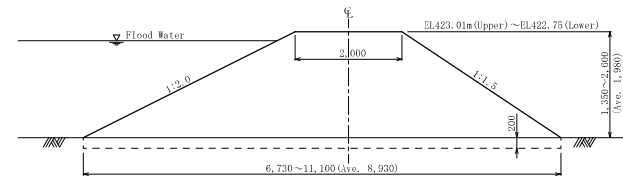
Section (7)

(L=1,000m)



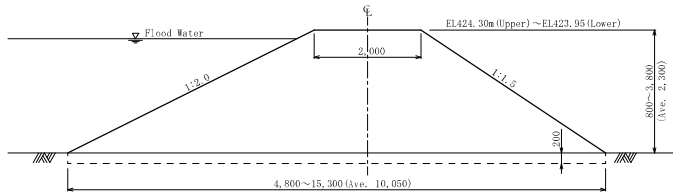
Section (8)

(L=1,000m)



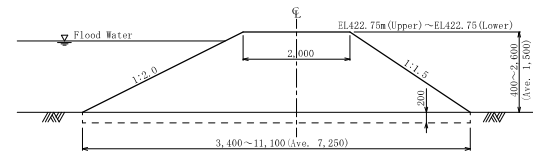
Section (3)

(L=1,365m)



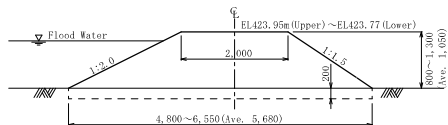
Section (9)

(L=1,125m)



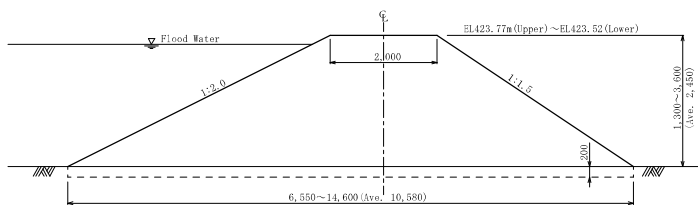
Section (4)

(L=700m)



Section (5)

(L=1,000m)



6-2 Typical Cross Section of Flood Protection Dike

PROJECT: Irrigation Development Master Plan (IDMP)	
UNIT TITLE: Wau Irrigation Scheme	
DRAWING TITLE: Typical Section of Flood Protection Dike	
DRAWING No.:	SCALE: S=1:50

APPENDIX - 3

PROJECT INVESTMENT COST

3.2 Dam Works

Wau Rice Scheme

Dam Works 21.1 million US\$

No.	Item	unit	Quantity	Unit Price (US\$)	Total Price (US\$)
	Dam				
1.	Earth Works				
1-1.	Excavation	m ³	83,407	10.0	\$834,070
1-2.	Embankment	m ³	256,012	36.0	\$9,216,432
1-3.	Filter	m ³	5,722	40.0	\$228,880
1-4.	Drain	m ³	6,990	40.0	\$279,600
1-5.	Slope Protection (Up stream)	m ³	10,500	50.0	\$525,000
1-6.	Slope Protection (Down stream)	m ²	24,757	9.0	\$222,813
				Sub total	\$11,306,795
2.	Spillway				
2-1.	Excavation	m ³	67874.5	10.0	\$678,745
2-2.	Riprap	m ³	600.0	50.0	\$30,000
2-3.	Weir (Concrete C20)	m ³	1529.0	440.0	\$672,751
2-4.	Base plate (Concrete C20)	m ³	6897.9	440.0	\$3,035,074
2-5.	Retaining Wall (Concrete C20)	m ³	7233.3	440.0	\$3,182,644
2-6.	Backfill	m ³	6170.9	11.0	\$67,880
				Sub total	\$7,667,094
3.	Intake				
3-1.	Concrete (C20)	m ³	278.7	440.0	\$122,638
3-2.	Slice gate 1100	nos	1	20,000.0	\$20,000
3-3.	Bar screen 2.5m×2.5m	nos	1	5,000.0	\$5,000
3-4.	Steel Pipe 1100, length 59.4m	m	59.4	1,000.0	\$59,400
3-5.	Slice valve 1100	nos	1	20,000.0	\$20,000
3-6.	Slice valve 700	nos	1	15,000.0	\$15,000
3-7.	Steel pipe 700	m	100	500.0	\$50,000
				Sub total	\$169,400
	Direct Construction Cost			Total	\$19,143,289
4.	Temporary works (10% of Above)	%	10		\$1,914,329
				Total	\$21,057,618

Calculation of Quantity

Item	Calculating Formula	Quantity	unit	Note
Dam				
1. Earth Works				
1)Excavation	See Table 1	83,407	m ³	
2) Embankment	See Table 1	256,012	m ³	
3) Filter	See Table 1	5,722	m ³	
4) Drain	See Table 2	6,990	m ³	
5) Slope Protection	See Table 2 (Riprap)	10,500	m ³	
(Up stream)				
6) Slope Protection	See Table 2 (Plant works)	24,757	m ²	
(Down stream)				

Table 1 Calculation of Earth Works

RD	Distance	Excavation	m ³		Embankment	m ³		Filter	m ³	
0+000		30.1			75.1			1.3		
0+150	150	64.8	47.45	7117.5	158.0	116.55	17482.5	3.8	2.55	382.5
0+300	150	77.8	71.3	10695	252.3	205.15	30772.5	5.8	4.8	720
0+450	150	94.3	86.05	12907.5	410.1	331.2	49680	9	7.4	1110
0+600	150	86.1	90.2	13530	319.7	364.9	54735	7.3	8.15	1922.5
0+750	150	77.8	81.95	12292.5	251.6	285.65	42847.5	5.8	6.55	982.5
0+900	150	64.6	71.2	10680	157.2	204.4	30660	4	4.9	735
1+050	150	53.8	59.2	8880	92.6	124.9	18735	1.8	2.9	435
1+200	150	21.8	37.8	5670	27.7	60.15	9022.5	0	0.9	135
1+350	150	0	10.9	1635	0	13.85	2077.5		0	0
Total				83407.5			256012.5			5722.5

Table 2 Calculation of Earth Works

RD	Distance	Drain	m ³		Slope protection (US)	m ³		Slope protection (DS)	m ²	
0+000					5.4			10.5		
0+150	150				9.4	7.4	1110	18	14.25	2137.5
0+300	150	0	0	0	9.8	9.6	1440	23.4	20.7	3105
0+450	150	25.1	12.55	1882.5	9.8	9.8	1470	31.5	27.45	4117.5
0+600	150	21.5	23.3	3495	9.8	9.8	1470	27.4	29.45	4417.5
0+750	150	0	10.75	1612.5	9.8	9.8	1470	21.7	24.55	3692.5
0+900	150				9.4	9.6	1440	18	19.85	2977.5
1+050	150				6.2	7.8	1170	12.6	15.3	2295
1+200	150				3.1	4.65	697.5	7.2	9.9	1495
1+350	150				0	1.55	232.5	0	3.6	540
Total				6990			10600			24757.5

2.Spillway				
1) Epron (Riprap)	length 20m, width 60m			
Excavation	166m ² ×20m=	3320.0	m ³	
Riprap	Gravel 0.5m×60m×20m=	600.0	m ³	
Retaining Wall	Concrete 6.925m ² ×2×20m=	277.0	m ³	
Back fill	Left side 19.7m ² ×20m=	394.0	m ³	

2) Wing	at bigining point, length 10m×2 (both side)			
Excavation	166m ² ×20m=		3320.0	m ³
Retaining Wall	Concrete 6.925m ² ×20m=		138.5	m ³
Back fill	Left side 19.7m ² ×20m=		394.0	m ³
3) Epron (Concrete)	length 5m, width 60m, base plate: concrete			
Excavation	166m ² ×5m=		830.0	m ³
Base plate	Concrete 0.25m×60m×5m=		75.0	m ³
Retaining Wall	Concrete 6.925m ² ×2×5m=		69.3	m ³
Back fill	Left side 19.7m ² ×5m=		98.5	m ³
4) Weir	length 10m, width 60m, till Dam center			
Weir	25.483m ² ×60m=		1529.0	m ³
Excavation	293.4m ² ×10m=		1660.0	m ³
Base plate	Concrete 0.5m×60m×10m=		300.0	m ³
Retaining Wall	Left side Concrete 9.948m ² ×10m=		69.3	m ³
Back fill	Left side 36m ² ×10m=		360.0	m ³
Retaining Wall	Right side Concrete 15.57m ² ×10m=		155.7	m ³
Back fill	dam embankment		-	m ³
5) Connection Channel	length 30m, width 60m, 10m~dam center~20			
Excavation	293.4m ² ×30m=		4980.0	m ³
Base plate	Concrete 0.25m×60m×30m=		450.0	m ³
Retaining Wall	Left side Concrete 9.948m ² ×30m=		207.8	m ³
Back fill	Left side 36m ² ×30m=		1080.0	m ³
Retaining Wall	Right side Concrete 15.57m ² ×30m=		467.1	m ³
Back fill	dam embankment		-	m ³
6) Connection Channel	length 40m, width 60m, Wall Height 5.7m~2m			
Excavation	(293.4m ² +103.2m ²)/2×40m×2=		15864.0	m ³
Base plate	Concrete 0.25m×60m×40m=		600.0	m ³
Retaining Wall	Concrete (9.948m ² +4.435m ²)/2×40m=		288.4	m ³
Back fill	3.8m ² ×40m=		76.0	m ³
7) Connection Channel	length 100m, width 60m, Wall Height 2m			
Excavation	103.2m ² ×100m=		10320.0	m ³
Base plate	Concrete 0.25m×60m×100m=		1500.0	m ³
Retaining Wall	Concrete 4.435m ² ×100m×2=		887.0	m ³
Back fill	3.8m ² ×100m=		380.0	m ³
8) Connection Channel	length 50m, width 60m~30m, Wall Height 2m			
Excavation	(103.2m ² +56.9)/2×50m=		4002.5	m ³
Base plate	Concrete 0.25m×(60m+30m)/2×50m=		562.5	m ³
Retaining Wall	Concrete 4.435m ² ×52.2m×2=		463.0	m ³
Back fill	3.8m ² ×50m=		190.0	m ³
8) Chute Channel	length 325m, width 30m, Wall Height 2m			
Excavation	56.0m ² ×325m=		18492.5	m ³
Base plate	Concrete 0.25m×30m×325m=		2437.5	m ³
Retaining Wall	Concrete 4.435m ² ×325m×2=		2882.8	m ³
Back fill	3.8m ² ×325m×2=		2470.0	m ³

9) Stilling Basin	length 45m, width 30m, Wall Height 3m			
Excavation	$56.9\text{m}^2 \times 45\text{m} =$		2560.5	m^3
Base plate	Concrete $0.50\text{m} \times 30\text{m} \times 45\text{m} =$		675.0	m^3
Retaining Wall	Concrete $5.281\text{m}^2 \times 45\text{m} \times 2 =$		475.3	m^3
Back fill	$3.8\text{m}^2 \times 45\text{m} \times 2 =$		342.0	m^3
10) Tailrace	length 114.719m, width 30m, Wall Height 2m			
Excavation	$56.9\text{m}^2 \times 114.719\text{m} =$		6527.5	m^3
Base plate	Concrete $0.25\text{m} \times 30\text{m} \times 114.719\text{m} =$		860.4	m^3
Retaining Wall	Concrete $4.435\text{m}^2 \times 114.719\text{m} \times 2 =$		1211.7	m^3
Back fill	$3.8\text{m}^2 \times 114.719\text{m} \times 2 =$		871.9	m^3
Total				
Excavation		67874.5	67874.5	m^3
Riprap		600.0	600.0	m^3
Weir (Concrete)		1529.0		
Base plate (Concrete)		6897.9	Total concrete	
Retaining Wall (Concrete)		7233.3	15660.2	m^3
Backfill		6170.9	6170.9	m^3
3. Intake				
1) Drop inlet				
Base plate	$3.0\text{m} \times 3.0\text{m} \times 0.5\text{m} =$		4.5	m^3
Box	$(3.0\text{m} \times 3.0\text{m} - 2.0\text{m} \times 2.0\text{m}) \times 5.5\text{m} - 1.1 \times 3.14^2/4$		24.8	m^3
			29.3	m^3
	Concrete total			
Slice gate	1100		1	
Bar screen	$2.5\text{m} \times 2.5\text{m}$		1	
2) Pen stock				
Pipe protection	Concrete area $(1.6\text{m} + 2.0\text{m})/2 \times 2.0 - 1.1 \times 3.14^2/4$		2.7	m^3
	length $24.1 + 28.75 + 4 + 2 + 0.5 =$		59.4	m^3
	Concrete volume $2.7 \times 59.4 =$		162.4	m^3
Steel Pipe	1100, length 59.4m		59.4	m
3) Outlet				
Base plate	$6.0\text{m} \times 6.0\text{m} \times 0.5\text{m} =$		18.0	m^3
Top plate	$6.0\text{m} \times 6.0\text{m} \times 0.6\text{m} =$		18.0	m^3
Box	$(6.0\text{m} \times 6.0\text{m} - 5.0\text{m} \times 5.0\text{m}) \times 5.0\text{m} - (1.1 + 0.5) \times 3.14^2/4$		51.1	m^3
			87.1	m^3
	Concrete total			
Slice valve	1100		1	
Slice valve	500		1	
Steel pipe	500 Irrigation		100	m
Concrete			278.7	m^3
Slice gate	1100		1	nos
Bar screen	$2.5\text{m} \times 2.5\text{m}$		1	nos
Steel Pipe	1100, length 59.4m		59.4	m
Slice valve	1100		1	nos
Slice valve	700		1	nos
Steel pipe	700		100	m

3.3 Pump Station Works

Wau Rice Scheme

Pump Statoin Works

1.4 million US\$

No.	Work Description	Unit	Quantity	Unit Price (US\$)	Total (US\$)
1. Connection Channel Work					
1-1.	Gabion Wall				
1-1-1.	Common Excavation	m3	130	10.0	1,299
1-1-2.	Embankment with Compaction (Manual Work)	m3	35	26.0	921
1-1-3.	Gabion Wall	m2	142	250.0	35,438
				Subtotal	37,658
1-2.	Channel Structure				
1-2-1.	Common Excavation	m3	1,045	10.0	10,451
1-2-2.	Leveling Concrete	m3	3	350.0	1,127
1-2-3.	Gravel	m3	10	50.0	482
1-2-4.	Backfill	m3	891	11.0	9,800
1-2-5.	Concrete (C20)	m3	141	440.0	62,198
				Subtotal	84,058
2. Pump Station Work					
2-1.	Suction Sump				
2-1-1.	Common Excavation	m3	1,616	10.0	16,156
2-1-2.	Leveling Concrete	m3	2	350.0	641
2-1-3.	Gravel	m3	5	50.0	274
2-1-4.	Backfill	m3	1,481	11.0	16,291
2-1-5.	Concrete (C20)	m3	120	440.0	52,813
				Subtotal	86,175
2-2.	Pump Building				
2-2-1.	Common Excavation	m3	127	10.0	1,269
2-2-2.	Leveling Concrete	m3	6	350.0	1,960
2-2-3.	Gravel	m3	17	50.0	840
2-2-4.	Backfill	m3	29	11.0	322
2-2-5.	Building	m2	107	2,800.0	300,832
				Subtotal	305,223
2-3.	Pump Facilities				
2-3-1.	Pump Facilities (Pump, Engne & Auxiliary equipment)	nos	2	280,000.0	560,000
2-3-2.	Pipe(SP, 400)	m	36	300.0	10,680
2-3-3.	Control Panel	nos	1	86,500.0	86,500
2-3-4.	Overhead Crane	nos	1	22,300.0	22,300
2-3-5.	Butterfly valve	nos	2	17,000.0	34,000
2-3-6.	Check valve	nos	2	15,000.0	30,000
2-3-7.	Flexible tube	nos	4	5,000.0	20,000
2-3-8.	Screen	kg	1,064	1.0	1,064
				Subtotal	764,544
3.Pipeline Work					
3-1.	Pipeline				
3-1-1.	Common Excavation	m3	368	10.0	3,675
3-1-2.	Sand(under)	m3	31	24.0	739
3-1-3.	Sand(around)	m3	98	24.0	2,353
3-1-4.	Backfill	m3	185	11.0	2,033

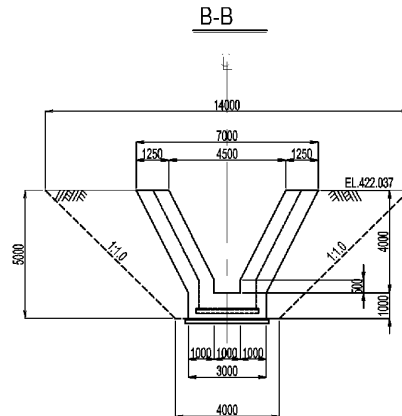
Quantity Calculation

Irrigation Scheme : Wau Rice Scheme

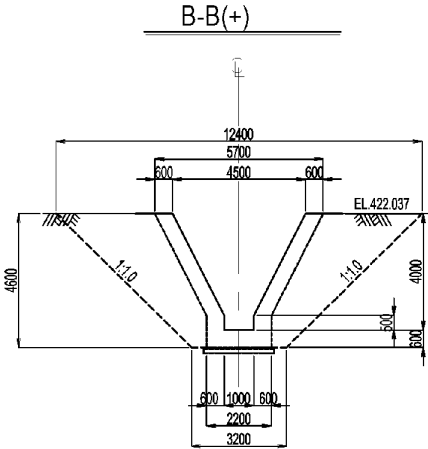
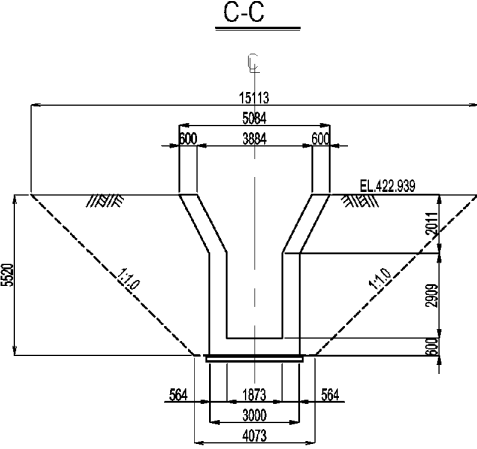
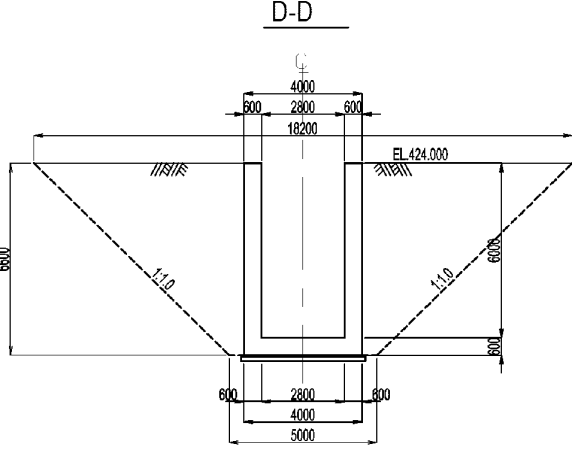
Item of Work : Channel Work

Page : 1 / 4

Item	Calculation	Quantity	Unit	Remark
1. Connection Channel Work				
1-1. Gabion Wall				
1-1-1. Common Excavation	$1/2 * (3.00 + 3.00 + 2 * 0.50 * 0.5) = 3.25$ $1/2 * (3.00 + 3.00 + 2 * 4.00 * 0.5) = 5.00$ $1/2 * (3.25 + 5.00) * 31.50 =$	129.94	m3	
1-1-2. Embankment with Compaction (Manual Work)	$1/2 * 2 * (0.50 * 0.5) * 1 = 0.25$ $1/2 * 2 * (0.50 * 0.5) * 8 = 2.00$ $1/2 * (0.25 + 2.00) * 31.50 =$	35.44	m3	
1-1-3. Gabio Wall	$1/2 * (0.50 + 4.00) * 31.50 * 2 =$	141.75	m2	L2,000*B1,000*H500
1-2. Channel Structure				
1-2-1. Common Excavation Section B-B(Cut-off)	$1/2 * (14.00 + 4.00) * 5.00 * 0.30 + 0.20 * 3.20 * 0.30 =$	13.69	m3	



Irrigation Scheme : Wau Rice Scheme
 Item of Work : Channel Work

Item	Calculation	Quantity	Unit	Remark
Section B-B to D-D	Section B-B(+) $1/2 * (12.40 + 3.20) * 4.60 + 0.20 * 2.40 = 36.36$ Section C-C $1/2 * (15.113 + 4.073) * 5.52 + 0.20 * 3.20 = 53.59$ Section D-D $1/2 * (18.20 + 5.00) * 6.60 + 0.20 * 4.20 = 77.40$			
				
	$36.36 * 0.70 = 25.45$ $1/2 * (36.36 + 53.59) * 8.00 = 359.80$ $1/2 * (53.59 + 77.40) * 8.50 = 556.71$ $77.40 * 0.70 = 54.18$ <hr/> 996.14	996.14	m3	

Item	Calculation	Quantity	Unit	Remark
Section D-D(Cut-off)	$1/2*(23.00+8.00)*7.50*0.30+0.20*7.20*0.30$ =	35.31	m3	
<p>The diagram shows a trapezoidal channel cut-off. The top width is 23.00m, and the bottom width is 8.00m. The height of the channel is 7.50m. The side slopes are 1:1.0. The channel is centered on a 23.00m wide section. The bottom width is 8.00m, with 2.10m on each side of a 3.80m wide base. The channel is 0.20m wide at the bottom. The elevation at the top of the channel is EL 424.000. The diagram is labeled 'D-D(+)'.</p>				
Total		1,045.14	m3	
1-2-2. Leveling Concrete				18N, t=50
Section B-B(Cut-off)	$3.20*0.05*0.30$ = 0.05			
Section B-B to C-C	$1/2*(2.40+3.20)*0.05*9.70$ = 1.36			
Section C-C to D-D	$1/2*(3.20+4.20)*0.05*9.20$ = 1.70			
Section D-D(Cut-off)	$7.20*0.05*0.30$ = 0.11			
	3.22	3.22	m3	
1-2-3. Gravel				t=150
Section B-B(Cut-off)	$3.20*0.15*0.30$ = 0.14			
Section B-B to C-C	$1/2*(2.40+3.20)*0.15*9.70$ = 4.07			
Section C-C to D-D	$1/2*(3.20+4.20)*0.15*9.20$ = 5.11			
Section D-D(Cut-off)	$7.20*0.15*0.30$ = 0.32			
	9.64	9.64	m3	

Irrigation Scheme : Wau Rice Scheme
 Item of Work : Channel Work

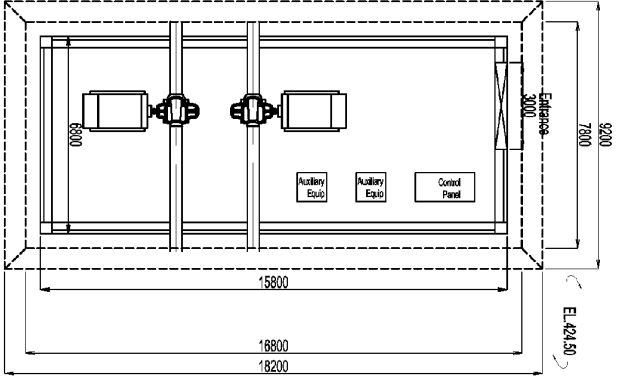
Item	Calculation	Quantity	Unit	Remark
1-2-4. Backfill	1,045.14-3.22-9.64-141.36	890.92	m3	
1-2-5. Concrete				21N
Section B-B(Cut-off)	$1/2*(7.00+3.00)*4.00 = 20.00$ $3.00*1.00 = 3.00$ $-1/2*(4.50+1.00)*3.50 = -9.63$ $-1.00*0.50 = -0.50$ <hr/> 12.87 $12.87*0.30 =$	3.86	m3	
Section B-B to D-D	Section B-B $1/2*(5.70+2.20)*3.50 = 13.83$ $2.20*(0.50+0.60) = 2.42$ $-1/2*(4.50+1.00)*3.50 = -9.63$ $-1.00*0.50 = -0.50$ <hr/> 6.12 Section C-C $1/2*(5.084+3.00)*2.011 = 8.13$ $3.00*(2.909+0.60) = 10.53$ $-1/2*(3.884+1.873)*2.011 = -5.79$ $-1.873*2.909 = -5.45$ <hr/> 7.42 Section D-D $4.00*6.60 = 26.40$ $-2.80*6.00 = -16.80$ <hr/> 9.60 $6.12*0.70 = 4.28$ $1/2*(6.12+7.42)*8.00 = 54.16$ $1/2*(7.42+9.60)*8.50 = 72.34$ $9.60*0.70 = 6.72$ <hr/> 137.50	137.50	m3	
	Total	141.36	m3	

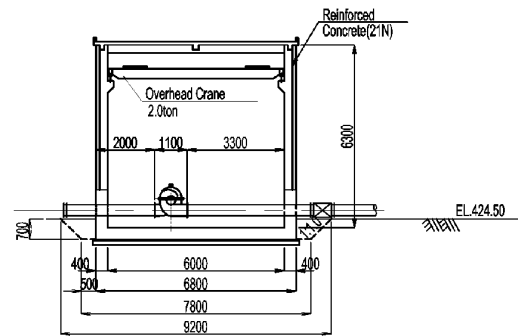
Quantity Calculation

Irrigation Scheme : Wau Rice Scheme
 Item of Work : Pump Station Work

Item	Calculation	Quantity	Unit	Remark
2. Pump Station Work 2-1. Suction Sump 2-1-1. Common Excavation	$1/2 * \{(9.10 * 5.00) + (18.70 * 20.20)\} * 7.60 + (4.20 * 8.70 * 0.20) =$	1,615.62	m3	
2-1-2. Leveling Concrete	$4.20 * 8.70 * 0.05 =$	1.83	m3	
2-1-3. Gravel	$4.20 * 8.70 * 0.15 =$	5.48	m3	
2-1-4. Backfill	$1,615.62 - 1.83 - 5.48 - 120.03 - (4.20 * 8.70 * 0.20) =$	1,480.97	m3	
2-1-5. Concrete	$\{2 * (0.60 * 6.00) + 4.00 * 1.10\} * (0.60 + 1.70 + 3.20) = 63.80$ $4.00 * 7.60 * (2.50 + 0.60) = 94.24$ $- 1/2 * (6.00 + 6.40) * 0.80 * 2 * 1.20 = -11.90$ $- 6.40 * (1.20 + 0.50) * 2 * 1.20 = -26.11$ <hr style="width: 10%; margin-left: auto; margin-right: 0;"/> 120.03	120.03	m3	

Irrigation Scheme : Wau Rice Scheme
 Item of Work : Pump Station Work

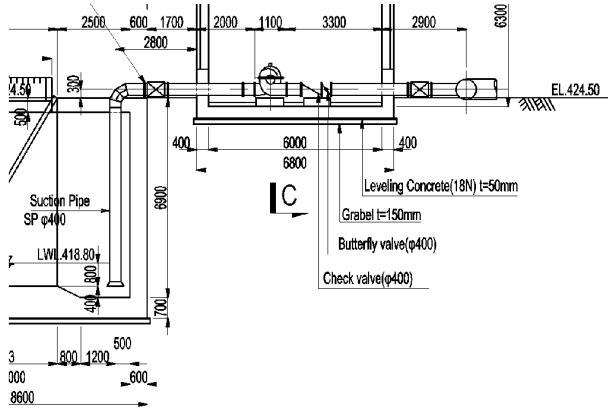
Item	Calculation	Quantity	Unit	Remark
2-2. Pump Building 2-2-1. Common Excavation				
	$1/2*(7.80*16.80+9.20*18.20)*0.70+(7.00*16.00*0.20)$	= 126.87	m3	
2-1-2. Leveling Concrete	7.00*16.00*0.05	= 5.60	m3	
2-1-3. Gravel	7.00*16.00*0.15	= 16.80	m3	
2-1-4. Backfill	126.87-5.60-16.80-(6.80*15.80*0.70)	= 29.26	m3	
2-1-5. Building	6.80*15.80	= 107.44	m2	
2-1-6. Pump Facilities (Pump, Engne & Auxiliary equipment)		2.00	nos	



ANN9-1: APP3/W-13

RSS, MEDWR, Water Sector, Irrigation Development Master Plan (IDMP)

Irrigation Scheme : Wau Rice Scheme
 Item of Work : Pump Station Work

Item	Calculation	Quantity	Unit	Remark
2-1-7. Pipe(SP, φ 400)	$2*(6.90-0.40+0.3+2.80+2.00+3.30+2.90) =$ 	35.60	m	φ400, SP
2-1-8. Control Panel		1.00	nos	
2-1-9. Overhead Crane		1.00	nos	
2-1-10. Butterfly valve		2.00	nos	
2-1-11. Check valve		2.00	nos	
2-1-12. Flexible tube		4.00	nos	
2-1-13. Screen	2.80*3.80*100	1,064.00	kg	W=100 kg/m2

Quantity Calculation

Irrigation Scheme : Wau Rice Scheme

Item of Work : Pipeline Work

Page : 1 / 1

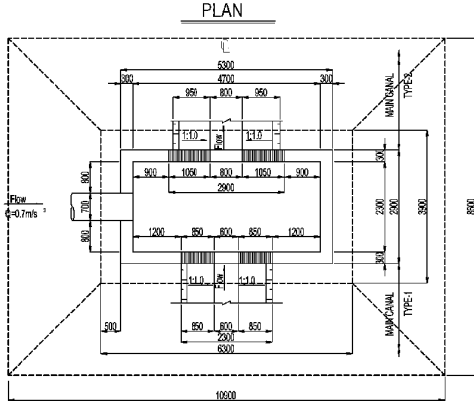
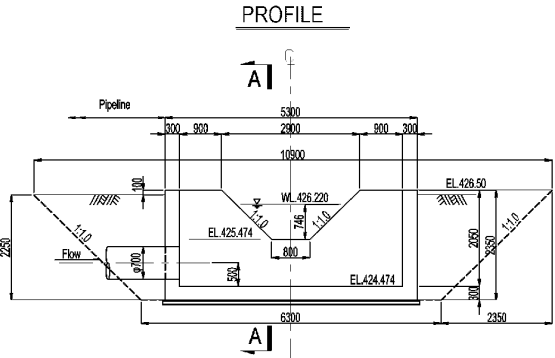
Item	Calculation	Quantity	Unit	Remark
3. Pipeline Work				
3-1. Pipeline				
3-1-1. Common Excavation	$1/2 * (2.50 + 1.00) * 1.50 * 140.00 =$ <div style="text-align: center; margin-top: 10px;"> </div>	367.50	m3	
3-1-2. Sand(under)	$1/2 * (1.20 + 1.00) * 0.20 * 140.00 =$	30.80	m3	
3-1-3. Sand(around)	$\{1/2 * (1.90 + 1.20) * 0.70 - 0.70^2 * \pi / 4\} * 140.00 =$	98.05	m3	
3-1-4. Backfill	$1/2 * (2.50 + 1.90) * 0.60 * 140.00 =$	184.80	m3	
3-1-5. Pipe(SP, φ 700)	$=$	140.00	m	

Quantity Calculation

Irrigation Scheme : Wau Rice Scheme

Item of Work : Discharge Chamber Work

Page : 1 / 1

Item	Calculation	Quantity	Unit	Remark
4. Discharge Chamber Work				
4-1. Discharge Chamber				
4-1-1. Common Excavation	$1/2 * \{(6.30 * 3.90) + (10.90 * 8.60)\} * 2.25 + (5.50 * 3.10 * 0.20) =$	136.51	m3	
				
4-1-2. Leveling Concrete	$4.10 * 5.50 * 0.05 =$	1.13	m3	
4-1-3. Gravel	$4.10 * 5.50 * 0.15 =$	3.38	m3	
4-1-4. Backfill	$136.51 - 1.13 - 3.38 - (5.30 * 2.90 * 2.25) =$	97.42	m3	
4-1-5. Concrete	$5.30 * 2.90 * 2.35 = 36.12$ $- 4.70 * 2.30 * 2.05 = -22.16$ $- 1/2 * (2.90 + 0.80) * 1.05 * 0.30 = -0.58$ $- 1/2 * (2.30 + 0.60) * 0.95 * 0.30 = -0.41$ <hr style="width: 50%; margin-left: 0;"/> 12.97	12.97	m3	

3.4 Irrigation Canal Works

Wau Rice Scheme

Irrigation Canal Works 8.7 million US\$

No.	Work Description	Unit	Quantity	Unit Price (US\$)	Total (US\$)
1. Preparatory Work					
1-1.	Site Clearing (Cutting & Clearing of Grass, Bushes)	ha	13.3	11,900.0	158,270
				Sub-total	158,270
2. Earth Work					
2-1.	Excavation of Surface Soil (200mm Depth)	m3	21,860	8.0	174,880
2-2.	Excavation for Common Soil	m3	50,647	10.0	506,470
2-3.	Embankment with Compaction	m3	104,524	14.0	1,463,336
2-4.	Spreading	m3	104,524	13.0	1,358,812
2-5.	Soil (Banking Material)	m3	75,737	7.6	575,601
2-6.	Hauling by Dump Truck (Banking Material)	m3	75,737	9.0	681,633
2-7.	Aggregate, Crushed, 2-4cm (Gravel Pavement)	m3	3,320	50.0	166,000
2-8.	Spreading of Aggregate (Bulldozer)	m3	3,320	13.0	43,160
				Sub-total	4,969,892
3. Canal Work (Main Canal)					
3-1.	Class 18 Concrete (include Form Work)	m3	3,903	350.0	1,366,050
				Sub-total	1,366,050
4. Canal Structure (Main Canal)					
4-1.	Turnout (Slide Gate, B=0.3m, H=0.3m)	unit	30	220.0	6,600
				Sub-total	6,600
5. Secondary Canal					
5-1.	Stripping	m3	33,091	8.0	264,728
5-2.	Excavation	m3	18,069	10.0	180,690
5-3.	Embankment	m3	90,344	14.0	1,264,816
5-4.	Aggregate, Crushed, 2-4cm (Gravel Pavement)	m3	6,566	50.0	328,300
5-5.	Spreading of Aggregate (Bulldozer)	m3	6,566	13.0	85,358
5-6.	PVC Pipe (f100) L=5.0m	nos	876	63.0	55,188
				Sub-total	2,179,080
				Total	8,679,892
Main Canal Length					
	Dam Site to Command Area =			6,198.78	m
	Command Area =			7,082.95	m
			Total	13,281.73	m
Secondary Canal Length					
				26,263.00	m

Quantity Calculation

Irrigation Scheme : Wau Irrigation Scheme

Item	Calculation	Quantity	Unit	Remark
1. Preparatory Work				
1-1. Site Clearing (Cutting & Clearing of Grass, Bushes)	$(6,198.78 + 7,082.95) * 10.0 =$	132,817		
		132,817	m ²	
	Total	13.3	ha	
2. Earth Work				
2-1. Excavation of Surface Soil (200mm Depth)		21,860	m ³	
2-2. Excavation for Common Soil		50,647	m ³	
2-3. Embankment with Compaction		104,524	m ³	
2-4. Soil (Banking Material)	$104,524 - 50,647 + 21,860 =$	75,737	m ³	
2-5. Hauling by Dump Truck (Banking Material)		75,737	m ³	L=7km
2-6. Aggregate, Crushed, 2-4cm (Gravel Pavement)		3,320	m ³	Maintenance Road
2-7. Spreading of Aggregate (Bulldozer)		3,320	m ³	Maintenance Road
3. Canal Work (Main Canal)				
3-1. Class 18 Concrete (include Form Work)		3,903	m ³	Canal Lining
4. Canal Structure (Main Canal)				
4-1. Turnout (Slide Gate, B=0.3m, H=0.3m)		30	unit	

Quantity Calculation

Irrigation Scheme : Wau Irrigation Scheme

Item of Work : Secondary Canal

Page : 1 / 4

Item	Calculation	Quantity	Unit	Remark
1. Earth Works of Secondary Canal				
1-1. Stripping	Section (6.5 + 6.1) x 0.2 x 0.5 x 26,263	33,091	m3	
1-2. Excavation	20% of Embankment 90,344 x 0.2	18,069	m3	
1-3. Embankment	Section(1) Same as Stripping Section(2) Section (3.5 + 4.5) x 0.5 x 0.5 x 26,263 Section(3) Section (0.3 + 0.9) x 0.3 x 0.5 x 26,263	33,091 52,526 4,727	m3 m3 m3	
	Total	90,344	m3	
1-4. Gravel Pavement	Section Total Length 2.5 x 0.1 x 26,263	6,566	m3	
1-5. PVC Pipe (f100) L=5.0m	Total Length 26,263 / 30 + 1 (*1pipe per 30m)	876	nos	

ANN9-1: APP3/W-19

RSS, MEDWR, Water Sector, Irrigation Development Master Plan (IDMP)

Quantity Calculation of Main Canal (Wau Irrigation Scheme) 2/2

Location	Station No.(m)	Distance(m)	Surface Soil		Excavation		Embankment		Gravel (Pavement)		Concrete Lining	
			Area (m2)	Volume (m3)	Area (m2)	Volume (m3)	Area (m2)	Volume (m3)	Area (m2)	Volume (m3)	Area (m2)	Volume (m3)
Main Canal (Command Area)	0 + 0.00		2.23		0.00		10.44		0.25		0.30	
		898.08		1,751.3		193.1		5,684.8		224.5		269.4
	0 + 898.08		1.67		0.43		2.22		0.25		0.30	
		1,043.13		1,715.9		542.4		1,961.1		260.8		312.9
	1 + 941.21		1.62		0.61		1.54		0.25		0.30	
		1,027.27		1,977.5		313.3		6,153.3		256.8		308.2
	2 + 968.48		2.23		0.00		10.44		0.25		0.30	
		1,028.67		2,309.4		0.0		10,775.3		257.2		308.6
	3 + 997.15		2.26		0.00		10.51		0.25		0.30	
	1,028.41		2,272.8		0.0		10,145.3		257.1		308.5	
5 + 25.56		2.16		0.00		9.22		0.25		0.30		
	1,028.53		2,159.9		0.0		8,469.9		257.1		308.6	
6 + 54.09		2.04		0.00		7.25		0.25		0.30		
	1,028.86		2,042.3		61.7		6,517.8		257.2		308.7	
7 + 82.95		1.93		0.12		5.42		0.25		0.30		
	Sub-total	7,082.95	-	14,229.1	-	1,110.5	-	49,707.5	-	1,770.7	-	2,124.9
	Total	13,281.73	-	21,859.6	-	50,646.6	-	104,524.4	-	3,320.4	-	3,902.7

Quantity Calculation

Irrigation Scheme : Wau Irrigation Scheme

Item of Work : Sedondary Canal

Page : 1 / 3

Item	Calculation	Quantity	Unit	Remark
1. Earth Works of Drainaga Canal				
1-1. Stripping		0	m3	
1-2. Excavatin	Section (0.4 + 1.1) x 0.35 x 0.5 x 22,623	5,939	m3	
1-3. Embankment	Section(1) Section (1 + 1.6) x 0.3 x 0.5 x 22,623	8,823	m3	
	Section(2) Section (0.3 + 0.9) x 0.3 x 0.5 x 22,623	4,072	m3	
	Total	12,895	m3	

Item	Calculation	Quantity	Unit	Remark
2. Earth Works of Main Drainage Canal				
2-1. Type-1: Q=0.15 m ³ /s				
2-1-1. Stripping	Section (5.15 + 5.25) x 0.2 x 0.5 x 3,158	3,284	m ³	
2-1-2. Excavation	Section (4.5 + 1.2) x 1.1 x 0.5 x 3,158	9,900	m ³	
2-1-3. Embankment	Section(1) Same as Stripping	3,284	m ³	
	Section(2) Section (3.5 + 4.75) x 0.5 x 0.5 x 3,158	6,513	m ³	
	Section(3) Section (0.3 + 1.05) x 0.3 x 0.5 x 3,158	639	m ³	
	Total	10,436	m³	
2-2. Type-2: Q=0.30 m ³ /s				
2-2-1. Stripping	Section (5.15 + 5.25) x 0.2 x 0.5 x 2,002	2,082	m ³	
2-2-2. Excavation	Section (5.95 + 1.6) x 1.45 x 0.5 x 2,002	10,958	m ³	
2-2-3. Embankment	Section(1) Same as Stripping	2,082	m ³	
	Section(2) Section (3.5 + 4.75) x 0.5 x 0.5 x 2,002	4,129	m ³	
	Section(3) Section (0.3 + 1.05) x 0.3 x 0.5 x 2,002	405	m ³	

Irrigation Scheme : Wau Irrigation Scheme

Item of Work : Secondary Canal

Item	Calculation	Quantity	Unit	Remark
	Total	6,616	m3	
2-3. Type-3: Q=0.475 m3/s				
2-3-1. Stripping	Section (5.15 + 5.25) x 0.2 x 0.5 x Total Length 2,097	2,181	m3	
2-3-2. Excavation	Section (7 + 1.9) x 1.7 x 0.5 x Total Length 2,097	15,864	m3	
2-3-3. Embankment	Section(1) Same as Stripping	2,181	m3	
	Section(2) Section (3.5 + 4.75) x 0.5 x 0.5 x Total Length 2,097	4,325	m3	
	Section(3) Section (0.3 + 1.05) x 0.3 x 0.5 x Total Length 2,097	425	m3	
	Total	6,931	m3	
3. Total				
Stripping	<u>1-1</u> + 0 + <u>2-1-1</u> + 3,284 + <u>2-2-1</u> + 2,082 + <u>2-3-1</u> + 2,181	7,547	m3	
Excavation	<u>1-2</u> + 5,939 + <u>2-1-2</u> + 9,900 + <u>2-2-2</u> + 10,958 + <u>2-3-2</u> + 15,864	42,661	m3	
Embankment	<u>1-3</u> + 12,895 + <u>2-1-3</u> + 10,436 + <u>2-2-3</u> + 6,616 + <u>2-3-3</u> + 6,931	36,878	m3	

Quantity Calculation

Irrigation Scheme :
Item of Work :Wau Irrigation Scheme
Secondary Canal

Length of Secondary Canal	
No.	Length (m)
SC-1-1	669
SC-1-2	302
SC-1-3	155
SC-1-4	692
SC-2	720
SC-3	768
SC-4	778
SC-5	706
SC-6	599
SC-7	625
SC-8	930
SC-9	872
SC-10	872
SC-11	861
SC-12	851
SC-13	836
SC-14	837
SC-15	824
SC-16	817
SC-17	806
SC-18	795
SC-19	790
SC-20	777
SC-21	802
SC-22	832
SC-23	862
SC-24	891
SC-25	921
SC-26	951
SC-27	984
SC-28	1,008
SC-29	1,051
SC-30	1,077
Total	26,263
(km)	(26)

Length of Secondary Canal	
No.	Length (m)
DC-1	207
DC-2	354
DC-3	525
DC-4	585
DC-5	682
DC-6	566
DC-7	479
DC-8	416
DC-9	709
DC-10	809
DC-11	796
DC-12	776
DC-13	786
DC-14	774
DC-15	757
DC-16	740
DC-17	735
DC-18	707
DC-19	702
DC-20	701
DC-21	682
DC-22	680
DC-23	708
DC-24	742
DC-25	778
DC-26	805
DC-27	831
DC-28	874
DC-29	895
DC-30	922
DC-31	950
DC-32	949
Total	22,623
(km)	(23)

Command Area		
No.	Area	
	(m ²)	(ha)
CA-1-1	73,694	7
CA-1-2	80,246	8
CA-1-3	107,460	11
CA-2	124,403	12
CA-3	139,840	14
CA-4	138,406	14
CA-5	137,162	14
CA-6	132,900	13
CA-7	145,027	15
CA-8	236,128	24
CA-9	200,386	20
CA-10	168,923	17
CA-11	166,584	17
CA-12	164,244	16
CA-13	161,905	16
CA-14	159,565	16
CA-15	157,226	16
CA-16	154,887	15
CA-17	150,873	15
CA-18	151,882	15
CA-19	147,868	15
CA-20	145,939	15
CA-21	149,861	15
CA-22	155,689	16
CA-23	161,517	16
CA-24	167,345	17
CA-25	176,143	18
CA-26	182,934	18
CA-27	186,809	19
CA-28	192,634	19
CA-29	181,982	18
CA-30	214,400	21
Total	5,014,859	501

typical

Irrigation Water Requirement (IWR) (m ³ /s)	
Unit IWR	0.001 m ³ /s/ha
0.010	
0.011	
0.015	
0.017	
0.020	
0.019	
0.019	
0.020	
0.033	
0.028	
0.024	
0.023	
0.023	
0.023	
0.022	
0.022	
0.022	
0.021	
0.021	
0.021	
0.020	
0.021	
0.022	
0.023	
0.023	
0.025	
0.026	
0.026	
0.027	
0.025	
0.030	

Discharge from Command Area (m ³ /s)		
Unit discharge 0.00950 m ³ /s/ha		
From each area	Accumulated	
0.07	0.07	Type-1 3157.5295m
0.08	0.15	
0.10	0.25	
0.12	0.37	
0.13	0.50	
0.13	0.63	
0.13	0.76	
0.13	0.89	
0.14	1.03	
0.22	1.25	
0.19	1.44	Type-2 2002.1867m
0.16	1.60	
0.16	1.76	
0.16	1.91	
0.15	2.07	
0.15	2.22	
0.15	2.37	
0.15	2.52	
0.14	2.66	
0.14	2.80	
0.14	2.94	Type-3 2096.7261m
0.14	3.08	
0.14	3.23	
0.15	3.37	
0.15	3.53	
0.16	3.69	
0.17	3.85	
0.17	4.03	
0.18	4.20	
0.18	4.39	
0.17	4.56	
0.20	4.76	

Quantity Calculation

Irrigation Scheme : Wau Irrigation Scheme

Item	Calculation	Quantity	Unit	Remark
1. Earth Work				
1-1. Excavation of Surface Soil (200mm Depth)		26,894	m3	
1-2. Embankment with Compaction		134,467	m3	
1-3. Soil (Banking Material)	26,894 + 134,467 =	161,361	m3	
1-4. Hauling by Dump Truck (Banking Material)		161,361	m3	L=7km

Earth Work of Dike

	Distance	Height			Crest Width	Dike Width	Section Area	Embankment	Excavation of Surface Soil
		Minimum	Minimum	Average					
Section(1)	1,065 m	0.50 m	4.00 m	2.25 m	2.00 m	9.88 m	13.37 m ²	14,239 m ³	2,848 m ³
Section(2)	1,395 m	3.80 m	4.00 m	3.90 m	2.00 m	15.65 m	34.42 m ²	48,016 m ³	9,603 m ³
Section(3)	1,365 m	0.80 m	3.80 m	2.30 m	2.00 m	10.05 m	13.86 m ²	18,919 m ³	3,784 m ³
Section(4)	700 m	0.80 m	1.30 m	1.05 m	2.00 m	5.68 m	4.03 m ²	2,821 m ³	564 m ³
Section(5)	1,000 m	1.30 m	3.60 m	2.45 m	2.00 m	10.58 m	15.41 m ²	15,410 m ³	3,082 m ³
Section(6)	1,010 m	0.70 m	3.60 m	2.15 m	2.00 m	9.53 m	12.39 m ²	12,514 m ³	2,503 m ³
Section(7)	1,000 m	0.70 m	1.35 m	1.03 m	2.00 m	5.61 m	3.92 m ²	3,920 m ³	784 m ³
Section(8)	1,000 m	1.35 m	2.60 m	1.98 m	2.00 m	8.93 m	10.82 m ²	10,820 m ³	2,164 m ³
Section(9)	1,125 m	0.40 m	2.60 m	1.50 m	2.00 m	7.25 m	6.94 m ²	7,808 m ³	1,562 m ³
Total	9,660 m							134,467 m³	26,894 m³

Dike Height

	Distance	Crest Height		Crest Width	Height			Dike Width		
		Upper	Lower		Minimum	Minimum	Average	Minimum	Minimum	Average
Section(1)	1,065 m	424.65 m	424.65 m	2.00 m	0.50 m	4.00 m	2.25 m	3.75 m	16.00 m	9.88 m
Section(2)	1,395 m	424.65 m	424.30 m	2.00 m	3.80 m	4.00 m	3.90 m	15.30 m	16.00 m	15.65 m
Section(3)	1,365 m	424.30 m	423.95 m	2.00 m	0.80 m	3.80 m	2.30 m	4.80 m	15.30 m	10.05 m
Section(4)	700 m	423.95 m	423.77 m	2.00 m	0.80 m	1.30 m	1.05 m	4.80 m	6.55 m	5.68 m
Section(5)	1,000 m	423.77 m	423.52 m	2.00 m	1.30 m	3.60 m	2.45 m	6.55 m	14.60 m	10.58 m
Section(6)	1,010 m	423.52 m	423.26 m	2.00 m	0.70 m	3.60 m	2.15 m	4.45 m	14.60 m	9.53 m
Section(7)	1,000 m	423.26 m	423.01 m	2.00 m	0.70 m	1.35 m	1.03 m	4.45 m	6.73 m	5.61 m
Section(8)	1,000 m	423.01 m	422.75 m	2.00 m	1.35 m	2.60 m	1.98 m	6.73 m	11.10 m	8.93 m
Section(9)	1,125 m	422.75 m	422.75 m	2.00 m	0.40 m	2.60 m	1.50 m	3.40 m	11.10 m	7.25 m
Total	9,660 m									

APPENDIX - 4

OPERATION AND MAINTENANCE PLAN COST

4.1 Unit Cost of Personnel Expenses (SSP/month)

Department	Staffing and Specialization	Grade	Basic Pay (SSP per Month)	Average Pay (SSP per Month)	Accom. Allo. (SSP per Month)	Cost of Living Allo. (SSP per Month)	Respon. Allo.	Represen. Allo. (SSP per Month)	Job Specific (SSP per Month)	Gross Pay (SSP per Month)	Pension Contri. (5% of Gross)	Income Tax: 10% of (Gross-300-Pension)	Net Pay
1. Management staff	Manager (Irrigation/Dam Eng.)	3	1,625/2,000	1,813	1,800	75	88	88	810	4,674	234	414	4,026
	Deputy Manager (Electromechanical Eng.)	4	1525/1714	1620	1200	75	75	75	730	3,775	189	329	3258
	Senior Accountant	7	1188/1388	1,288	630	63			650	2,631	132	220	2280
	Assistant Accountant	9	925/1125	1,025	630	50			450	2,155	108	175	1873
	Cooperative/Marketing Officer	8	1075/1200	1,138	630	50			580	2,398	120	198	2080
	Asst. Cooperative/Marketing Officer	9	925/1125	1,025	630	50			450	2,155	108	175	1873
	Tariff Collector (Book-keeper)	12	375/440	408	450	38			400	1,296	65	93	1138
	Messenger/Guard/Driver	13	313/378	346	450	38			390	1,224	61	86	1077
2. Irrigation/Dam Operations and Maintenance	Senior Irri./Dam Eng. (Dam/Pump)	7	1188/1388	1,288	630	63			650	2,631	132	220	2280
	Electro-mechanical Eng.	8	1075/1200	1,138	630	50			580	2,398	120	198	2080
	Planning and Budgeting Officer	8	1075/1200	1,138	630	50			580	2,398	120	198	2080
	Asst. Irrigation/Dam Eng.	9	925/1125	1,025	630	50			450	2,155	108	175	1873
	Asst. Planning and Budgeting Officer	9	925/1125	1,025	630	50			450	2,155	108	175	1873
	Irrigation Technician	10	825/950	888	450	38			440	1,816	91	142	1582
	Pump operator	11	500/565	533	450	38			410	1,431	72	106	1254
	Irrigation Water Control Gate Operator	11	500/565	533	450	38			410	1,431	72	106	1254
3. Farm Level Operations	Facilities' Guards	11	500/565	533	450	38			410	1,431	72	106	1254
	Senior Agronomist	7	1188/1388	1,288	630	63			650	2,631	132	220	2280
	Agronomist	8	1075/1200	1,138	630	50			580	2,398	120	198	2080
	Agricultural Engineer	8	1075/1200	1,138	630	50			580	2,398	120	198	2080
	Asst. Agricultural Engineer	9	925/1125	1,025	630	50			450	2,155	108	175	1873
	Extension Worker	10	825/950	888	450	38			440	1,816	91	142	1582
	Tractor Operator	11	500/565	533	450	38			410	1,431	72	106	1254
4. Processing Operations	Asst. Tractor Operator	13	313/378	346	450	38			390	1,224	61	86	1077
	Rice mill operator	10	825/950	888	450	38			440	1,816	91	142	1582
	Asst. Rice mill operator	11	500/565	533	450	38			410	1,431	72	106	1254
Total per month				24,540	16,140	1,257	163	163	13,190	55,453	2,773	4,488	48,192
Total per year				294,474	193,680	15,084	1,956	1,956	158,280	665,430	33,272	53,856	578,303

4.2 Annual Personnel Expenses (SSP/year)

Department	Required Staff and Specialization	Grade	Wau Rice Irrigation Scheme	
			Proposed Number of Staff	Salary Budget (Gross in SSP)
Management staff	Manager (Irrigation/Dam Eng.)	3	1	4,674
	Deputy Manager (Electromechanical Eng.)	4	1	3,775
	Senior Accountant	7	1	2,631
	Cooperative/Marketing Officer	8	1	2,155
	Assistant Accountant	9	1	2,398
	Asst. Cooperative/Marketing Officer	9	1	2,155
	Tariff Collector	12	2	1,296
	Messenger/Guard/Driver	13	6	1,224
Irrigation/Dam Operations and Maintenance	Senior Irri./Dam Eng. (Dam/Pump)	7	1	2,631
	Electromechanical Eng.	8	1	2,398
	Planning and Budgeting Officer	8	1	2,398
	Asst. Irrigation/Dam Eng.	9	1	2,155
	Asst. Planning and Budgeting Officer	9	1	2,155
	Irrigation Technician	10	2	1,816
	Pump operator	11	2	1,431
	Irrigation Water Control Gate Operator	11	2	1,431
	Facilities' Guards	11	4	1,431
Farm Level Operations	Senior Agronomist	7	1	2,631
	Agronomist	8	1	2,398
	Agricultural Engineer	8	1	2,398
	Asst. Agricultural Engineer	9	1	2,155
	Extension Worker	10	2	1,816
	Tractor Operator	11	1	1,431
	Asst. Tractor Operator	13	1	1,224
Processing Operations	Rice mill operator	10	1	1,816
	Asst. Rice mill operator	11	1	1,431
Total per month			39	55,453
Total per year				665,430

Note: W = Wau, JL = Jebel Lado and RE = Rejaf East

4.3 Equipment and Machinery Investment Cost

Cost Item	Grade/Spec	Unit Cost (SSP/unit) /a	Depreciation Schedule /b	Depreciation Cost /c	Wau Rice Irrigation	
					Number	Cost (SSP/year)
Equipment/Machineries						
Motor Grader	220HP (John Deere)	2,141,480	15	128,500	1	128,500
Backhoe Loader	422F (Caterpillar)	953,304	15	57,200	1	57,200
Wheel Loaders	938H (Caterpillar)	2,030,952	15	121,900	1	121,900
Dump Truck	6 × 4 18CUM (Caterpillar)	863,500	15	51,800	1	51,800
Motor Bike		10,000	10	900	2	1,800
Tractor /d	75HP, 4WD (John Deere)	203,786	10	18,300	3	54,900
Attachment (plough)	3-disc (John Deere)	27,632	10	2,500	3	7,500
Attachment (harrow)	20-disc manually operated (John	43,175	10	3,900	3	11,700
Attachment (levellers)		3,600	10	300	3	900
Attachment (sprayer)	400ml, 8M (John Deere)	46,974	10	4,200	3	12,600
Attachment (fertilizer distributor)		13,816	10	1,200	3	3,600
Attachment (trailer)	5 tonne (John Deere)	58,718	10	5,300	3	15,900
Combine Harvester		81,000	10	7,300	3	21,900
Working machines (Workshop)						
Pick-up Truck	Single Cabine (4DW)	20,900	10	1,900	2	3,800
Portable Generator	240V Capacity	112,545	8	12,700	2	25,400
Battery Charger	72V Capacity	500	8	100	2	200
Generator	Perkins Type 1500RPM 150 kVA (380-54\415V)	357,441	8	40,200	1	40,200
Lathe Machine	Universal High Precision	54,600	8	6,100	1	6,100
Power Saw		6,400	5	1,200	1	1,200
Welding Machine	Arc	2,700	5	500	2	1,000
Welding Machine	Acetylene Gas Welding	1,800	5	300	2	600
Power Drill	Portable Heavy Duty Hand Drill	500	5	100	1	100
Rice Mill						
Rice Mill	2.0\hr	409,500	15	24,600	2	49,200
Grain Threshing Machine	Vicon Type 1 tonne/hr	7,300	15	400	4	1,600
Drying Machine		36,400	15	2,200	2	4,400
Warehouse		41,000	15	2,500	1	2,500
Total					53	626,500

Note: a/ Price quotations are obtained from Lonagro South Sudan Ltd. (John Deere), Ezentus (Caterpillar), and Aweil Irrigation Rehabilitation Project.

b/ Depreciation schedule is quoted from water supply project in South Asia.

c/ 10% of residual value is taken into account in estimation of depreciation cost.

4.4 Equipment and Machinery O&M Cost

Cost Item	Grade/Spec	Unit Cost (SSP/unit) /a	O&M Cost (1% of Unit Cost)	Wau Rice Irrigation Scheme	
				Number	Cost (SSP/year)
Equipment/Machineries					
Motor Grader	150-160HP	2,141,480	21,410	1	21,410
Backhoe Loader	90HP	953,304	9,530	1	9,530
Wheel Loaders	80HP	2,030,952	20,310	1	20,310
Dump Truck	160HP	863,500	8,640	1	8,640
Motor Bike		10,000	100	2	200
Tractor /d	75HP, 4WD	203,786	2,040	3	6,120
Attachment (plough)	3-disc	27,632	280	3	840
Attachment (harrow)	20-disc manually operated	43,175	430	3	1,290
Attachment (levellers)		3,600	40	3	120
Attachment (sprayer)	400ml, 8M	46,974	470	3	1,410
Attachment (fertilizer distributor)		13,816	140	3	420
Attachment (trailer)	5 tonne	58,718	590	3	1,770
Combine Harvester		81,000	810	3	2,430
Working machines (Workshop)					
Pick-up Truck	Single Cabine (4DW)	20,900	210	2	420
Portable Generator	240V Capacity	112,545	1,130	2	2,260
Battery Charger	72V Capacity	500	10	2	20
Generator	Perkins Type 1500RPM 150 kVA (380-54\415V)	357,441	3,570	1	3,570
Lathe Machine	Universal High Precision	54,600	550	1	550
Power Saw		6,400	60	1	60
Welding Machine	Arc	2,700	30	2	60
Welding Machine	Acetylene Gas Welding	1,800	20	2	40
Power Drill	Portable Heavy Duty Hand Drill	500	10	1	10
Rice Mill					
Rice Mill	1.0-2.0#/hr	409,500	4,100	2	8,200
Grain Threshing Machine	Vicon Type 1 tonne/hr	7,300	70	4	280
Drying Machine		36,400	360	2	720
Warehouse		41,000	410	1	410
Total				53	91,090

Note: a/ Price quotations are obtained from Lonagro South Sudan Ltd. (Jhon Deere), Ezentus (Catepillar), and Aweil Irrigation Rehabilitation Project.

b/ Depreciation schedule is quoted from water supply project in South Asia.

c/ 10% of residual value is taken into account in estimation of depreciation cost.

4.5 Water Tariff Estimation

	Wau Irrigation Scheme	
	Detail	SSP
A. Project Cost (SSP)	USD 62,000,000	181,571,429
B. Depreciation Cost (SSP/year)		7,444,277
Project Facility	1,922,319	5,629,648
Equipment and Machinery		626,500
C. Annual O&M Cost (SSP/year)		
Personnel Expenses		665,430
Pump Operation	USD 85,379	250,039
Equipment and Machinery (1% of Procurement Cost)		91,090
Maintenance Cost (0.1% of Project Cost)		181,571
Sub-total (Annual Operation Cost)		1,188,130
D. Irrigable Area (ha)		500
Annual O&M Cost per Irrigable Area (SSP/ha)		2,376
Minimum Area for Feeding Family (ha/HH/year) /a		0.42
Number of Lot for Distribution (1lot = 1feddan = 0.42ha)		1,190
E. Water Consumption (m ³ /season)	Total	10,108,800
Crop 1	Rice	5,119,200
Crop 2	Leaf Vegetable	2,384,640
Crop 3	Fruits Vegetable	2,604,960
F. Water Tariff Estimation		
Area-based Pricing (SSP/lot, or SSP/feddan)		SSP 1,000 fd
Volumetric Pricing 1 (SSP/m ³)	Total	SSP 0.12 m ³
Crop 1	Rice	SSP 0.23 m ³
Crop 2	Leaf Vegetable	SSP 0.50 m ³
Crop 3	Fruits Vegetable	SSP 0.46 m ³
Volumetric Pricing 2 (SSP/season/feddan)		
Crop 1	1,190 ac	SSP 500 fd
Crop 2	595 ac	SSP 500 fd
Crop 3	595 ac	SSP 500 fd
Volumetric Pricing 2 (SSP/season/ha)		
Crop 1	500 ha	SSP 1,200 ha
Crop 2	250 ha	SSP 1,100 ha
Crop 3	250 ha	SSP 1,200 ha
Member's Fee (SSP/lot) /b		SSP 1,074 /ha
Member's Fee (In Kind = Labor Work in days) /c		27 days/year

Note: a/ Necessary area for feeding family members (7person/HH) by planting maize is estimated at 0.21ha. Planned yield of maize is 3t/ha.

b/ Members' fee is estimated by dividing number of lot into depreciation cost of equipment/machinery (exclude rice mill).

c/ In kind is equivalent to labor cost of SSP40/ha.

4.6 Affordability to Pay (ATP)

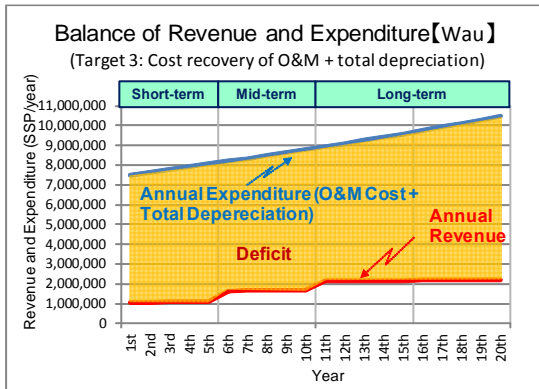
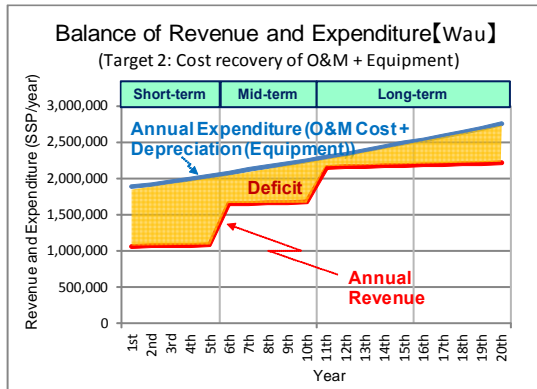
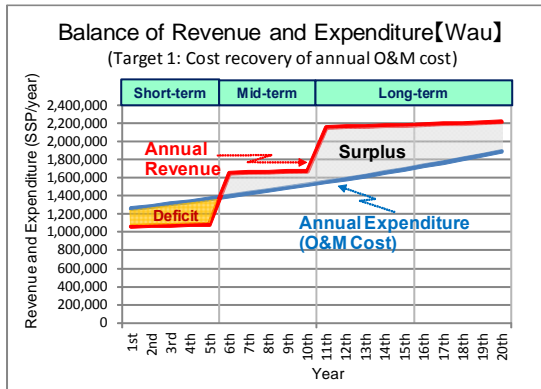
Term	Crops	Net Income /a (SSP/ha)	Cropped Area (ha)	Total Net Income (SSP/ha)	Affordability Rate (%)	ATP (SSP/ha)	Estimated ISF (SSP/ha)	ISF Adjustd (SSP/ha)
Short-term	Rice	8,234	500	4,117,000	3%	250	1,190	250
	Leaf Vegetable	5,393	250	1,348,250	3%	160	1,190	160
	Fruits Vegetable	62,579	250	15,644,750	3%	1,880	1,190	1,190
	Weighted Average	21,110	1,000	21,110,000	3%	630	1,000	630
Mid-term	Rice	8,234	500	4,117,000	5%	410	1,190	410
	Leaf Vegetable	5,393	150	808,950	5%	270	1,190	270
	Fruits Vegetable	62,579	350	21,902,650	5%	3,130	1,190	1,190
	Weighted Average	26,829	1,000	26,828,600	5%	1,340	1,000	1,000
Long-term	Rice	8,234	500	4,117,000	5%	410	1,190	410
	Leaf Vegetable	5,393	0	0	5%	270	1,190	270
	Fruits Vegetable	62,579	500	31,289,500	5%	3,130	1,190	1,190
	Weighted Average	35,407	1,000	35,406,500	5%	1,770	1,000	1,000

Note: a/ "Net income" is not considered in family labor cost.

4.7 Cash Flow Analysis

	Short-term					Mid-term					Long-term										
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	11th Year	12th Year	13th Year	14th Year	15th Year	16th Year	17th Year	18th Year	19th Year	20th Year	
Revenue																					
Member Fee /a	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690	536,690
Irrigation Service Fee /b	619,048	619,048	619,048	619,048	619,048	1,333,333	1,333,333	1,333,333	1,333,333	1,333,333	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905	1,761,905
ISF Collection Rate	60%	60%	60%	60%	60%	70%	70%	70%	70%	70%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Amount of ISF Collected	371,429	371,429	371,429	371,429	371,429	933,333	933,333	933,333	933,333	933,333	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524	1,409,524
Tractor Service Fee /c	100,000	103,340	106,792	110,358	114,044	117,853	121,790	125,858	130,061	134,405	138,894	143,533	148,327	153,282	158,401	163,692	169,159	174,809	180,648	186,681	192,904
Rice Mill Service Income /d	57,700	58,664	59,643	60,639	61,652	62,682	63,728	64,793	65,875	66,975	68,093	69,230	70,387	71,562	72,757	73,972	75,207	76,463	77,740	79,039	80,362
Sub-total	1,065,819	1,070,122	1,074,553	1,079,116	1,083,815	1,650,558	1,655,541	1,660,673	1,665,959	1,671,403	2,153,201	2,158,978	2,164,928	2,171,057	2,177,372	2,183,878	2,190,580	2,197,486	2,204,602	2,211,934	2,219,486
Expenditure																					
Annual O&M Cost (SSP/year)																					
Personnel Expenses	732,800	745,038	757,480	770,130	782,991	796,067	809,361	822,878	836,620	850,591	864,796	879,238	893,921	908,850	924,028	939,459	955,148	971,099	987,316	1,003,804	1,020,577
Pump Operation	250,039	258,390	267,020	275,938	285,155	294,679	304,521	314,692	325,203	336,065	347,289	358,889	370,876	383,263	396,064	409,292	422,963	437,090	451,689	466,775	482,340
Equipment and Machinery (1% of Procurement Cost)	91,090	94,132	97,276	100,525	103,883	107,353	110,938	114,644	118,473	122,430	126,519	130,745	135,111	139,624	144,288	149,107	154,087	159,234	164,552	170,048	175,740
Maintenance Cost (0.1% of Project Cost)	181,571	184,604	187,687	190,821	194,008	197,248	200,542	203,891	207,296	210,757	214,277	217,856	221,494	225,193	228,953	232,777	236,664	240,617	244,635	248,720	252,871
Sub-total	1,255,500	1,282,164	1,309,463	1,337,415	1,366,036	1,395,346	1,425,362	1,456,104	1,487,591	1,519,843	1,552,881	1,586,727	1,621,402	1,656,930	1,693,333	1,730,635	1,768,862	1,808,039	1,848,192	1,889,348	1,931,504
Depreciation Cost (SSP/year)																					
Project Facility	5,629,648	5,723,663	5,819,248	5,916,429	6,015,234	6,115,688	6,217,820	6,321,658	6,427,229	6,534,564	6,643,691	6,754,641	6,867,443	6,982,130	7,098,731	7,217,280	7,337,809	7,460,350	7,584,938	7,711,606	7,841,284
Equipment and Machinery	626,500	636,963	647,600	658,415	669,410	680,589	691,955	703,511	715,260	727,204	739,349	751,696	764,249	777,012	789,988	803,181	816,594	830,231	844,096	858,193	872,524
Sub-total	6,256,148	6,360,625	6,466,848	6,574,844	6,684,644	6,796,277	6,909,775	7,025,169	7,142,489	7,261,768	7,383,040	7,506,337	7,631,693	7,759,142	7,888,719	8,020,461	8,154,403	8,290,581	8,429,034	8,569,799	8,712,808
Annual O&M + Depreciation (Equipment)	1,882,000	1,919,126	1,957,063	1,995,829	2,035,447	2,075,936	2,117,318	2,159,615	2,202,851	2,247,047	2,292,230	2,338,423	2,385,651	2,433,942	2,483,321	2,533,816	2,585,456	2,638,270	2,692,288	2,747,540	2,804,032
Annual O&M + Depreciation (Total)	7,511,647	7,642,789	7,776,311	7,912,259	8,050,680	8,191,624	8,335,138	8,481,273	8,630,080	8,781,611	8,935,921	9,093,064	9,253,095	9,416,071	9,582,052	9,751,096	9,923,265	10,098,620	10,277,226	10,459,146	10,644,488
Balance																					
Target 1: Annual O&M Cost	-189,681	-212,041	-234,909	-258,298	-282,222	255,212	230,179	204,569	178,368	151,560	600,320	572,251	543,526	514,128	484,039	453,243	421,718	389,447	356,410	322,586	289,000
Subsidy (SSP/year)	189,681	212,041	234,909	258,298	282,222	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subsidy (%)	15%	17%	18%	19%	21%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Target 2: Annual O&M Cost + Depreciation (Equipment)	-816,181	-849,004	-882,509	-916,713	-951,632	-425,377	-461,776	-498,942	-536,891	-575,644	-139,029	-179,445	-220,724	-262,884	-305,949	-349,938	-394,876	-440,784	-487,686	-535,606	-585,440
Subsidy (SSP/year)	816,181	849,004	882,509	916,713	951,632	425,377	461,776	498,942	536,891	575,644	139,029	179,445	220,724	262,884	305,949	349,938	394,876	440,784	487,686	535,606	585,440
Subsidy (%)	43%	44%	45%	46%	47%	20%	22%	23%	24%	26%	6%	8%	9%	11%	12%	14%	15%	17%	18%	19%	20%
Target 3: Annual O&M Cost + Depreciation (Total)	-6,445,829	-6,572,667	-6,701,757	-6,833,142	-6,966,865	-6,541,065	-6,679,596	-6,820,599	-6,964,121	-7,110,208	-6,782,720	-6,934,086	-7,088,167	-7,245,014	-7,404,680	-7,567,218	-7,732,684	-7,901,134	-8,072,624	-8,247,213	-8,424,901
Subsidy (SSP/year)	6,445,829	6,572,667	6,701,757	6,833,142	6,966,865	6,541,065	6,679,596	6,820,599	6,964,121	7,110,208	6,782,720	6,934,086	7,088,167	7,245,014	7,404,680	7,567,218	7,732,684	7,901,134	8,072,624	8,247,213	8,424,901
Subsidy (%)	86%	86%	86%	86%	87%	80%	80%	80%	81%	81%	76%	76%	77%	77%	77%	78%	78%	78%	79%	79%	79%

Note: a/ Member fee (fixed charge per year) is estimated by dividing procurement cost of equipment by number of lot (=1feddan). In Wau, milling facility is excluded from the procurement cost.
 b/ Irrigation service fee (ISF) is estimated by dividing total water consumption volume by each crops' water consumption volume in a season.
 c/ Unit price of tractor service fee is SSP200/feddan, quoted from Socio-economic Survey conducted by IDMP-TT in 2015.
 d/ Milling fee (SSP0.75/kg) is estimated to cover depreciation cost of milling equipment, and each household keep 187kg of paddy for home consumption which is target of the service.



APPENDIX - 5

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Evaluation Sheet for Alternatives

Project Title: Irrigation Development in Wau

Evaluation Method

Evaluation method	<p>Evaluation criteria: 5: Exceptionally suitable, 4: Suitable, 3: Negligible/ Neutral 2: Not suggestible, 1: Suggest avoiding</p> <p>Evaluation items</p> <hr/> <p> öPollutionö includes: öAir Pollution ö, öWater Pollution ö, öWasteö, öSoil/Sediment Contaminationö, öNoise and Vibrationö, öOdourö, öGlobal Warmingö öBiodiversityö includes: öProtected Areasö öEcosystemö öNature, disastersö includes: öHydrologyö, öTopography and Geology ö, öSubsidence / Erosionö, öLandscapeö öLand occupies resettlementö includes: öResettlementö. öLand Useö öSocial conflictö includes: öVulnerable Groupsö, öWater Use / Rightsö öLiving conditionö includes: öLiving and Livelihood ö, öLocal Economy ö, öHistorical / Cultural Heritageö öSocial Infrastructure / Servicesö, öInfectious Diseasesö öEconomy, developmentö means: contribution to economic improvement in the RSS öConsistencyö means: consistency / harmonization with the RSS policies </p>
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Project Summary

	Alternative A	Alternative B	Zero option
Project Summary	Combination of dam and pump irrigation	Pump irrigation with whole-year operation No project	

Evaluation

Valuation Items		Alternative A	Alternative B	Zero option
Natural Environment	Average of a), b), c) ----- (1)	2.7	2.7	3.0
	a) Pollution 3 3 3			
	b) Ecosystem 2 2 3			
	c) Nature, disasters 3 3 3			
Reason	Though the project site is not located adjacent protected areas, wildlife are possibly living in the site.	Disturbance on ecosystem will be smaller than alternative A because of no dam site.		
Social Environment	Average of a), b), c) ----- (2)	2.3	2.7	3.0
	a) Land occupies, resettlement	2 3 3		
	b) Social conflict	2 2 3		
	c) Living condition	3 3 3		
Reason	Since dam site occupies larger land than alternative B, resettlement, e.g. may become more considerable,			
Economy, development	Average of a), b), c) ----- (3)	4.0	4.0	2.5
	a) Economy, development	4 4 2		
	b) Consistency	4 4 3		
	Reason	The project can contribute to improvement of agricultural production, and enhance food security in the RSS.	Same as left	

Results

	Alternative A	Alternative B	Zero option
Total score (1) + (2) + (3)	9.0 9.4 8.5		
Ranking	2 1 3		
Overall	Although land occupation generates considerable impacts such as resettlement; economic improvement through encouraging food security can provide much benefit. Existence of dam site may give disadvantage on land occupation.		

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Pre-construction
Land preparation

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																			
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																				
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.																									
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-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																
-A	-B or -C		D or ±C		+B or +C		+A																		
Pollution	Air Pollution	-1	-1	-1	-1	-1	-5/D																		
	Water Pollution	-1	-1	-1	-1	-1	-5/-C																		
	Waste	-1	-2	-1	-1	-1	-6/-C																		
	Soil/Sediment Contamination	no	no	no	no	no	D																		
	Noise and Vibration	-1	-1	-1	-1	-1	-5/-C																		
	Odour	no	no	no	no	no	D																		
Natural Environment	Protected Areas	no	no	no	no	no	D																		
	Ecosystem	-1	-1	-2	-1	-1	-6/-B																		
	Hydrology	-1	-1	-1	-1	-1	-5/-C																		
	Topography and Geology	no	no	no	no	no	D																		
	Subsidence / Erosion	-1	-1	-1	-1	-1	-5/-C																		
	Global Warming	no	no	no	no	no	D																		
	Landscape	no	no	no	no	no	D																		
Social Environment	Resettlement	-3	-2	-2	-1	-3	-11/-B																		
	Living and Livelihood	-3	-1	-2	-1	-1	-8/-B																		
	Local Economy	+1	+1	+1	+1	+1	+5/D																		
	Historical / Cultural Heritage	no	no	no	no	no	D																		
	Land Use	-3	-1	-2	-1	-3	-10/-B																		
	Vulnerable Groups	no	no	no	no	no	D																		
	Local Conflict	-2	-1	-2	-1	-1	-7/-C																		
	Water Use / Right	-2	-2	-2	-1	-1	-8/-B																		
	Social Infrastructure / Services	-1	-1	-1	-1	-1	-5/-C																		
Infectious Diseases	no	no	no	no	no	D																			
Remark	Land preparation / block may affect community / wildlife.																								

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Construction

Construction of dam site

Environmental Items		Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank				
		Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3					
		Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.									
		-15	-12	-11	-7	-6	+6	+7	+11	+12	+15
		-A	-B or -C		D or ±C		+B or +C		+A		
Pollution	Air Pollution	-1	-1	-1	-1	-1	-1	-1	-5/D		
	Water Pollution	-1	-2	-1	-1	-1	-1	-1	-6/-C		
	Waste	-2	-1	-2	-1	-1	-2	-2	-7/-B		
	Soil/Sediment Contamination	no	no	No	no	no	no	no	/D		
	Noise and Vibration	-2	-2	-1	-1	-1	-1	-1	-7/-B		
	Odour	no	no	no	no	no	no	no	D		
Natural Environment	Protected Areas	no	no	no	no	no	no	no	D		
	Ecosystem	-3	-2	-2	-1	-1	-3	-3	-11/-B		
	Hydrology	-3	-2	-2	-1	-1	-3	-3	-11/-B		
	Topography and Geology	-3	-1	-1	-1	-1	-3	-3	-9/-C		
	Subsidence / Erosion	no	no	no	no	no	no	no	D		
	Global Warming	no	no	no	no	no	no	no	D		
Social Environment	Landscape	-3	-1	-1	-1	-1	-3	-3	-9/-C		
	Resettlement	-1	-1	-1	-1	-1	-1	-1	-5/-C		
	Living and Livelihood	-1	-1	-1	-1	-1	-1	-1	-5/-C		
	Local Economy	+2	+2	+1	+3	+3	+1	+1	+9/+B		
	Historical / Cultural Heritage	no	no	no	no	no	no	no	D		
	Land Use	no	no	no	no	no	no	no	D		
	Vulnerable Groups	no	no	no	no	no	no	no	D		
	Local Conflict	-1	-1	-1	-1	-1	-1	-1	-5/-C		
	Water Use / Right	-1	-1	-1	-1	-1	-1	-1	-5/-C		
Social Infrastructure / Services	no	no	no	no	no	no	no	D			
Infectious Diseases	no	no	no	no	no	no	no	D			
Remark	Existence of dam site may disturb habitats and watering/feeding area for wildlife. Construction activities will raise job opportunity.										

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Construction
Construction of pump station

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																				
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																					
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.																										
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-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																	
-A		-B or -C		D or ±C		+B or +C		+A																		
Pollution	Air Pollution	-1	-1	-1	-1	-1	-5/-C																			
	Water Pollution	-1	-1	-1	-1	-1	-5/-C																			
	Waste	-1	-1	-1	-1	-1	-5/-C																			
	Soil/Sediment Contamination	no	no	no	no	no	D																			
	Noise and Vibration	-1	-1	-1	-1	-1	-5/-C																			
	Odour	no	no	no	no	no	D																			
Natural Environment	Protected Areas	no	no	no	no	no	D																			
	Ecosystem	-1	-1	-1	-1	-1	-5/-C																			
	Hydrology	no	no	no	no	no	D																			
	Topography and Geology	no	no	no	no	no	D																			
	Subsidence / Erosion	no	no	no	no	no	D																			
	Global Warming	no	no	no	no	no	D																			
	Landscape	no	no	no	no	no	D																			
Social Environment	Resettlement	-1	-1	-1	-1	-1	-5/-C																			
	Living and Livelihood	no	no	no	no	no	D																			
	Local Economy	+1	+1	+1	+1	+1	+5/+C																			
	Historical / Cultural Heritage	no	no	no	no	no	D																			
	Land Use	no	no	no	no	no	D																			
	Vulnerable Groups	no	no	no	no	no	D																			
	Local Conflict	no	no	no	no	no	D																			
	Water Use / Right	-1	-1	-1	-1	-1	-5/-C																			
	Social Infrastructure / Services	-1	-1	-1	-1	-1	-5/-C																			
Infectious Diseases	no	no	no	no	no	D																				
Remark																										

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Construction

Installation of canal

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																			
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																				
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking. <table style="margin: 10px auto; border-collapse: collapse;"> <tr> <td style="background-color: #d9ead3; padding: 2px;">-15</td> <td style="background-color: #d9ead3; padding: 2px;">-12</td> <td style="background-color: #d9ead3; padding: 2px;">-11</td> <td style="background-color: #d9ead3; padding: 2px;">-7</td> <td style="background-color: #d9ead3; padding: 2px;">-6</td> <td style="background-color: #d9ead3; padding: 2px;">+6</td> <td style="background-color: #d9ead3; padding: 2px;">+7</td> <td style="background-color: #d9ead3; padding: 2px;">+11</td> <td style="background-color: #d9ead3; padding: 2px;">+12</td> <td style="background-color: #d9ead3; padding: 2px;">+15</td> </tr> <tr> <td style="background-color: #d9ead3; padding: 2px;">-A</td> <td colspan="2" style="background-color: #d9ead3; padding: 2px;">-B or -C</td> <td colspan="2" style="background-color: #d9ead3; padding: 2px;">D or ±C</td> <td colspan="2" style="background-color: #d9ead3; padding: 2px;">+B or +C</td> <td colspan="2" style="background-color: #d9ead3; padding: 2px;">+A</td> </tr> </table>							-15	-12	-11	-7	-6	+6	+7	+11	+12	+15	-A	-B or -C		D or ±C		+B or +C		+A	
-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																
-A	-B or -C		D or ±C		+B or +C		+A																		
Pollution	Air Pollution	-1	-1	-1	-1	-1	-5/-C																		
	Water Pollution	no	no	no	no	no	D																		
	Waste	-1	-1	-1	-1	-1	-5/-C																		
	Soil/Sediment Contamination	no	no	no	no	no	D																		
	Noise and Vibration	-1	-1	-1	-1	-1	-5/-C																		
	Odour	no	no	no	no	no	D																		
Natural Environment	Protected Areas	no	no	no	no	no	D																		
	Ecosystem	-1	-1	-2	-1	-3	-8/-B																		
	Hydrology	no	no	no	no	no	D																		
	Topography and Geology	no	no	no	no	no	D																		
	Subsidence / Erosion	no	no	no	no	no	D																		
	Global Warming	no	no	no	no	no	D																		
	Landscape	-1	-1	-1	-1	-1	-5/-C																		
Social Environment	Resettlement	-1	-1	-1	-1	-1	-5/-C																		
	Living and Livelihood	+3	+1	+2	+1	+3	+10/+B																		
	Local Economy	+1	+1	+1	+1	+1	+5/+C																		
	Historical / Cultural Heritage	no	no	no	no	no	D																		
	Land Use	no	no	no	no	no	D																		
	Vulnerable Groups	no	no	no	no	no	D																		
	Local Conflict	no	no	no	no	no	D																		
	Water Use / Right	+1	+1	+1	+1	+1	+5/+C																		
	Social Infrastructure / Services	-1	-1	-1	-1	-1	-5/-C																		
	Infectious Diseases	no	no	no	no	no	D																		
Remark	Canal alignment may cut wildlife corridors. While, it is expected to raise job opportunity.																								

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Construction

Land clearance and leveling in command area

Environmental Items		Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank				
		Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3					
		Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.									
		-15	-12	-11	-7	-6	+6	+7	+11	+12	+15
		-A	-B or -C		D or ±C		+B or +C		+A		
Pollution	Air Pollution	-1	-1	-1	-1	-1	-1	-5/D			
	Water Pollution	-1	-1	-2	-1	-1	-1	-6/-C			
	Waste	-1	-1	-2	-1	-1	-1	-6/-C			
	Soil/Sediment Contamination	-1	-1	-1	-1	-1	-1	-5/-C			
	Noise and Vibration	-1	-1	-1	-1	-1	-1	-5/D			
	Odour	no	no	no	no	no	no	D			
Natural Environment	Protected Areas	no	no	no	no	no	no	D			
	Ecosystem	-3	-1	-2	-1	-1	-3	-10/-B			
	Hydrology	-1	-1	-1	-1	-1	-1	-5/-C			
	Topography and Geology	no	no	no	no	no	no	D			
	Subsidence / Erosion	-3	-2	-2	-1	-1	-3	-11/-B			
	Global Warming	no	no	no	no	no	no	D			
	Landscape	-1	-1	-1	-1	-1	-1	-5/-C			
Social Environment	Resettlement	-3	-1	-1	-1	-1	-1	-7/-C			
	Living and Livelihood	+1	+1	+1	+1	+1	+1	+5/+C			
	Local Economy	+2	+1	+1	+1	+1	+1	+6/+B			
	Historical / Cultural Heritage	no	no	no	no	no	no	D			
	Land Use	-1	-1	-1	-1	-1	-3	-7/-C			
	Vulnerable Groups	no	no	no	no	no	no	D			
	Local Conflict	-2	-1	-1	-1	-1	-1	-6/-B			
	Water Use / Right	-3	-1	-2	-1	-1	-1	-8/-C			
	Social Infrastructure / Services	no	no	no	no	no	no	D			
	Infectious Diseases	no	no	no	no	no	no	D			
Remark	Land occupation in the dry river bed may disturb watering/feeding. Change of corridor may change river flow.										

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Operation and Maintenance

Operation of dam

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																				
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																					
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.																										
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-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																	
-A		-B or -C			D or ±C		+B or +C		+A																	
Pollution	Air Pollution	no	no	no	no	no	D																			
	Water Pollution	no	no	no	no	no	D																			
	Waste	no	no	no	no	no	D																			
	Soil/Sediment Contamination	no	no	no	no	no	D																			
	Noise and Vibration	no	no	no	no	no	D																			
	Odour	no	no	no	no	no	D																			
Natural Environment	Protected Areas	no	no	no	no	no	D																			
	Ecosystem	+3	+1	+1	+1	+3	+7/+B																			
	Hydrology	+3	+2	+2	+1	+3	+11/+B																			
	Topography and Geology	+3	+2	+2	+1	+3	+11/+B																			
	Subsidence / Erosion	no	no	no	no	no	D																			
	Global Warming	no	no	no	no	no	D																			
	Landscape	+3	+2	+2	+1	+3	+11/+B																			
Social Environment	Resettlement	no	no	no	no	no	D																			
	Living and Livelihood	+3	+1	+2	+3	+3	+12/+B																			
	Local Economy	no	no	no	no	no	D																			
	Historical / Cultural Heritage	no	no	no	no	no	D																			
	Land Use	no	no	no	no	no	D																			
	Vulnerable Groups	no	no	no	no	no	D																			
	Local Conflict	no	no	no	no	no	D																			
	Water Use / Right	-1	-1	-1	-1	-1	-5/-C																			
	Social Infrastructure / Services	no	no	no	no	no	D																			
	Infectious Diseases	no	no	no	no	no	D																			
Remark	Existing of new water area can create new aquatic ecosystem. Water body and fishery condition can improve local living condition.																									

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Operation and Maintenance

Operation of pump

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																				
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																					
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking.																										
<table border="1" style="width:100%; text-align:center;"> <tr> <td>-15</td><td>-12</td><td>-11</td><td>-7</td><td>-6</td><td>+6</td><td>+7</td><td>+11</td><td>+12</td><td>+15</td> </tr> <tr> <td colspan="2">-A</td><td colspan="2">-B or -C</td><td colspan="2">D or ±C</td><td colspan="2">+B or +C</td><td colspan="2">+A</td> </tr> </table>							-15	-12	-11	-7	-6	+6	+7	+11	+12	+15	-A		-B or -C		D or ±C		+B or +C		+A	
-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																	
-A		-B or -C		D or ±C		+B or +C		+A																		
Pollution	Air Pollution	-1	-1	-2	-1	-1	-6/-C																			
	Water Pollution	-1	-1	-2	-1	-1	-5/-C																			
	Waste	no	no	no	no	no	D																			
	Soil/Sediment Contamination	-1	-1	-2	-1	-1	-5/C																			
	Noise and Vibration	-1	-1	-2	-1	-1	-6/-C																			
	Odour	no	no	no	no	no	D																			
Natural Environment	Protected Areas	no	no	no	no	no	D																			
	Ecosystem	no	no	no	no	no	D																			
	Hydrology	-2	-2	-1	-1	-3	-9/-C																			
	Topography and Geology	-1	-1	-1	-1	-1	-5/-C																			
	Subsidence / Erosion	no	no	no	no	no	D																			
	Global Warming	-1	-1	-1	-1	-1	-5/-C																			
	Landscape	no	no	no	no	no	D																			
Social Environment	Resettlement	no	no	no	no	no	D																			
	Living and Livelihood	no	no	no	no	no	D																			
	Local Economy	no	no	no	no	no	D																			
	Historical / Cultural Heritage	no	no	no	no	no	D																			
	Land Use	no	no	no	no	no	D																			
	Vulnerable Groups	no	no	no	no	no	D																			
	Local Conflict	no	no	no	no	no	D																			
	Water Use / Right	no	no	no	no	no	D																			
	Social Infrastructure / Services	no	no	no	no	no	D																			
	Infectious Diseases	no	no	no	no	no	D																			
Remark																										

Preliminary Scoping Check Sheet

Project Title: Irrigation Development in Wau

Project Activity: Operation and Maintenance

Farming

Environmental Items	Duration a)	Extent b)	Intensity c)	Cumulative d)	Reversible e)	Total Score (T) a)+b)+c)+d)+e) / Rank																			
	Short: 1 Medium: 2 Long: 3	Limited: 1 Medium: 2 Wide: 3	Small/Negligible: 1 Medium: 2 Big: 3	Non-Cumulative: 1 Cumulative: 3	Reversible: 1 Irreversible: 3																				
Indication: no: no impact, +: positive -: negative Rough indication for ranking: The score is rough value. Your judgement based on your experiences / knowledge will be reflected to the ranking. <table border="1" style="margin: 10px auto; width: 80%; text-align: center;"> <tr> <td style="background-color: #c6e0b4;">-15</td> <td style="background-color: #c6e0b4;">-12</td> <td style="background-color: #c6e0b4;">-11</td> <td style="background-color: #c6e0b4;">-7</td> <td style="background-color: #c6e0b4;">-6</td> <td style="background-color: #c6e0b4;">+6</td> <td style="background-color: #c6e0b4;">+7</td> <td style="background-color: #c6e0b4;">+11</td> <td style="background-color: #c6e0b4;">+12</td> <td style="background-color: #c6e0b4;">+15</td> </tr> <tr> <td style="background-color: #c6e0b4;">-A</td> <td colspan="2" style="background-color: #c6e0b4;">-B or -C</td> <td colspan="2" style="background-color: #c6e0b4;">D or ±C</td> <td colspan="2" style="background-color: #c6e0b4;">+B or +C</td> <td colspan="2" style="background-color: #c6e0b4;">+A</td> </tr> </table>							-15	-12	-11	-7	-6	+6	+7	+11	+12	+15	-A	-B or -C		D or ±C		+B or +C		+A	
-15	-12	-11	-7	-6	+6	+7	+11	+12	+15																
-A	-B or -C		D or ±C		+B or +C		+A																		
Pollution	Air Pollution	no	no	no	no	no	D																		
	Water Pollution	-2	-2	-2	-1	-1	-8/-B																		
	Waste	-1	-1	-1	-1	-1	-5/-C																		
	Soil/Sediment Contamination	-1	-1	-1	-1	-1	-5/-C																		
	Noise and Vibration	no	no	no	no	no	D																		
	Odour	no	no	no	no	no	D																		
Natural Environment	Protected Areas	no	no	no	no	no	D																		
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	Hydrology	no	no	no	no	no	D																		
	Topography and Geology	no	no	no	no	no	D																		
	Subsidence / Erosion	no	no	no	no	no	D																		
	Global Warming	no	no	no	no	no	D																		
	Landscape	no	no	no	no	no	D																		
Social Environment	Resettlement	no	no	no	no	no	D																		
	Living and Livelihood	+3	+1	+2	+1	+3	+10/+B																		
	Local Economy	+3	+2	+3	+3	+3	+14/+A																		
	Historical / Cultural Heritage	no	no	no	no	no	D																		
	Land Use	-3	-2	-1	-1	-1	-8/-B																		
	Vulnerable Groups	-1	-1	-1	-1	-1	-5/-C																		
	Local Conflict	-2	-1	-2	-3	-1	-9/-B																		
	Water Use / Right	-2	-1	-2	-1	-1	-7/-C																		
	Social Infrastructure / Services	no	no	no	no	no	D																		
	Infectious Diseases	-1	-1	-1	-1	-1	-5/-C																		
Remark	Agricultural production can contribute to economic improvement. Water / soil pollution may occur if pesticide, fertilize is not properly used.																								

Scoping Matrix

Project Title: Irrigation Development in Wau

Environmental Parameters		Pre-construction		Construction								Operation & Maintenance				Overall	
		Land preparation		Construction of dam site	Construction of pump station	Installation of canals	Land clearance and levelling, in command area						Operation of dam including pump station	Operation of pump	Farming		
Remark		positive: +, negative: - A: Significant impact is expected, B: Moderate impact is expected, C: Level of impact unknown, D: No / negligible impact is															
Pollution	Air Pollution	D		D	-C	-C	D						D	-C	D		-C
	Water Pollution	-C		-C	-C	D	-C						D	-C	-B		-C
	Waste	-C		-B	-C	-C	-C						D	D	-C		-C
	Soil/Sediment Contamination	D		D	D	D	-C						D	-C	-C		-C
	Noise and Vibration	-C		-B	-C	-C	D						D	-C	D		-C
	Odour	D		D	D	D	D						D	D	D		D
Natural Environment	Protected Areas	D		D	D	D	D						D	D	D		D
	Ecosystem	-B		-B	-C	-B	-B						+B	D	+C		-B
	Hydrology	-C		-B	D	D	-C						+B	-C	D		-C
	Topography and Geology	D		-C	D	D	D						+B	-C	D		+C

Environmental Parameters	Pre-construction		Construction									Operation & Maintenance				Overall	
	Land preparation		Construction of dam site	Construction of pump station	Installation of canals	Land clearance and levelling, in command area						Operation of dam including pump station	Operation of pump	Farming			
Remark	positive: +, negative: - A: Significant impact is expected, B: Moderate impact is expected, C: Level of impact unknown, D: No / negligible impact is																
	Subsidence / Erosion	-C		D	D	D	-B						D	D	D		-C
	Global Warming	D		D	D	D	D						D	-C	D		D
	Landscape	D		-C	D	-C	-C						+B	D	D		-C

Scoping Matrix

Environmental Parameters		Pre-construction		Construction								Operation & Maintenance				Overall		
		Land preparation		Construction of dam site	Construction of pump station	Installation of canals	Land clearance and levelling, in command area						Operation of dam including pump station	Operation of pump	Farming			
Remark		positive: +, negative: - A: Significant impact is expected, B: Moderate impact is expected, C: Level of impact unknown, D: No / negligible impact is																
Social Environment	Resettlement	-B		-C	-C	-C	-C							D	D	D		-B
	Living and Livelihood	-B		-C	D	+B	+C							+B	D	+B		+B
	Local Economy	D		+B	+C	+C	+B							D	D	+A		+A
	Historical / Cultural Heritage	D		D	D	D	D							D	D	D		D
	Land Use	-B		D	D	D	-C							D	D	-B		-B
	Vulnerable Groups	D		D	D	D	D							D	D	-C		D
	Local Conflict	-C		-C	D	D	-B							D	D	-B		-B
	Water Use / Right	-B		-C	-C	+C	-C							-C	D	-C		-C
	Social Infrastructure / Services	-C		D	-C	-C	D							D	D	D		-C
	Infectious Diseases	D		D	D	D	D							D	D	-C		D

Outline of Scoping Results

Project Title: Irrigation Development in Wau

Type of Impact and Score		Outline of Impact	Expected Mitigations	Study Items for EIA	Recommended Method
(1) Pollution					
Air pollution	-C	<ul style="list-style-type: none"> - Exhaust gas generated by construction works and operation of pump 	<ul style="list-style-type: none"> - Use low-emission equipment with proper maintenance 	<ul style="list-style-type: none"> - Air quality conditions - Construction plan, pump operation plan 	<ul style="list-style-type: none"> - Check of quality of construction equipment and pump in terms of prevention from exhaust gas - Site survey on location of possible sensitive zones against air pollution such as residential area, school zone, etc.
Water pollution, Soil / sediment contamination	-C	<ul style="list-style-type: none"> - Turbid water from construction site - Oil leakage - Pesticide and fertilizers in farming 	<ul style="list-style-type: none"> - Proper temporary drainage - Storage of used oil - Proper use of pesticide and fertilizers 	<ul style="list-style-type: none"> - Water quality conditions - arming plan in terms of use of pesticide, fertilizer, etc. 	<ul style="list-style-type: none"> - Measure of current water quality - Examine of possible pollution sources by the project
Waste	-C	<ul style="list-style-type: none"> - Construction waste - Agricultural waste 	<ul style="list-style-type: none"> - Proper use of waste disposal site - Proper waste storage - Waste recycle, reuse and reduction 	<ul style="list-style-type: none"> - Disposal site - Waste type 	<ul style="list-style-type: none"> - Investigation of possible disposal site for construction waste - Estimation approximate waste volume
Noise	-C	<ul style="list-style-type: none"> - Construction noise by equipment, truck - Noise form generator during pump operation 	<ul style="list-style-type: none"> - Noise barriro - Select low-noise generator, equipment, truck, etc. - Adjust construction time avoiding night time 	<ul style="list-style-type: none"> - Noise measurement - Sensitive zone 	<ul style="list-style-type: none"> - Check of quality of construction equipment and pump in terms of prevention from noise / vibration - Site survey on possible sensitive zones against noise / vibration such as residential area, school zone, etc.
(2) Natural Environment					
Ecosystem	-B	<ul style="list-style-type: none"> - Possible habitats, feeding / nurturing area for wildlife - Secondary forest, plantation 	<ul style="list-style-type: none"> - Canal arraignment avoiding wildlife corridor 	<ul style="list-style-type: none"> - Location of wildlife habitats, feeding / nurturing area - Forest, plantation 	<ul style="list-style-type: none"> - Interview with local communities - Direct observation on wildlife habitats, migration, etc. - Trap survey

Type of Impact and Score		Outline of Impact	Expected Mitigations	Study Items for EIA	Recommended Method
Hydrology, Floods / erosion	-C	- Obstruction of river water flow by command area	- Proper design of command area - Flood prevention	- River water flow - Possible flood prone area	- Historical records of disasters - Measure of river flow - Simulation on change of river flow
Geology	+C	- Possible encouragement on underground water reserve by dam	- Monitoring of well water	- Underground water monitoring	- Underground water survey
Land scape	-C	- Change of topographic feature	- Encourage sightseeing	- Public consultation, interview	- Interview with local people, e.g. about possible demand on sightseeing
(3) Social Environment					
Resettlement	-B	- Land occupation - Several houses located in/near dam site	- Agreement on resettlement with proper compensation plan	- Land use - Public consultation - Resettlement plan	- Survey on land use, land status, land ownership, etc. - Estimation of land and asset price - Public consultation for consensus building
Living and livelihood	+B	- Land occupation - Job / business opportunity be construction works, farming	- Public announcement, consensus building - Priority recruitment to local community	- Community and local job profile - Public consultation	- Investigation of community living condition and livelihood - Interview with communities
Local economy	+A	- Job / business opportunity be construction works, farming	- Priority procurement from local - Proper farming plan to increase agricultural production	- Business profile in local	- Investigation of local economic profile - Investigation of future plans, developments, investments
Land use	-B	- Land occupancy - Obstruction of existing business	- Consensus building - Encourage alternative improvement	- Existing and future land use plan - Public consultation	- Survey on land use, land status, land ownership - Investigation of land use plan - Public consultation
Local Conflict	-B	- Gap of benefits among communities	- Consensus building - Income recovery plan - Proper compensation	- Public consultation - Compensation plan	- Investigation of job profile, income level and sources - Public consultation
Water use / right	-C	- Change of water resource condition especially in command area	- Consensus building - Proper rules on fair water use	- Public consultation - Legal status on water use / right	- Investigation of water use / right - Public consultation

Type of Impact and Score		Outline of Impact	Expected Mitigations	Study Items for EIA	Recommended Method
Social Infrastructure / Services	-C	<ul style="list-style-type: none">- School near dam site- Water supply facility in command area- Scattered grave yards in the project site	<ul style="list-style-type: none">- Proper design avoiding those facilities, relocation if possible and necessary	<ul style="list-style-type: none">- Land use- Mapping	<ul style="list-style-type: none">- Site survey on location of social infrastructures- Interview with local communities, etc.

Irrigation Development Master Plan (IDMP)

Initial Environmental Examination Survey

Wau Rice Scheme

Western Bahr el Ghazal State

Field report

June 2015

Contents:

- 1. Introduction**
- 2. Objectives**
- 3. Environmental related issues**
 - 3.1. Wildlife
 - 3.2. Forestry
 - 3.3. Mining
 - 3.4. Land evaluation
- 4. Communities living in project areas**
 - 4.1. Kuanya community
 - 4.2. Eastern Bank Community
 - 4.3. Koum Community
- 5. Annexes**
 - 5.1. Meeting memo
 - 5.2. List of people met
 - 5.3. Activities schedule
 - 5.4. Type of wildlife animal inhabitant in western Bhar el Ghazal state, Listed by Office of wildlife services in Wau :
 - 5.5. Photos

1. Introduction

It is realized that the irrigation development creates a risk on environmental and social condition, either negative or positive impacts. In order to overcome such impacts, the alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any aforementioned measures. The initial environmental examination (IEE) is to be applied to all selected priority projects, during IDMP studies.

2. Objectives

The objectives of the IEE

1. To identify the environmental condition in the pilot project site proposed under the pre-feasibility study (Jebel Lado, Wau and Rejaf East)
2. To preliminary assess the environmental impacts likely caused by the proposed plan, and propose an environmental impact assessment study which is legally required under the RSS.
3. To test the Guideline for Environmental and Social Considerations for Irrigation Development (ESCID Guideline) for reviewing and finalizing.

3. Environmental related issues

3.1. Wildlife

The state office for wildlife service provided the team vital information about wildlife inhabitant in the project area. During interview, the director of wildlife service deliberated different animal species living in the area in past, but they migrated to other the area due to insecurity and human activities such as forestry cutting and grass burning in the area, those animal such as Dithid, Elephants, Greif, white rhino and buffalo migrated area to the North West Namtina area.

In river, the project will affect Hoopoes (Fras el bahr) which live in the flood plain for feeding. Their territory is in distance of around 1,000m. The islands in rivers are also used by some animal such as Crocodile for putting eggs.

Also animals in the area are Ghazal, Zioef, Morfen, Namir, Monkey observed. Brds, Abu Markob, also live in the area; they migrate between the project area and southern parks and Nimatina Park. Most of the animals are watering in Rivers Jur, Sue and Bussari, also use water in some deeper reach of small streams and ponds. Most of grass-eating animals are grassing in bushes and river flood area.

Illegal hunting and funds are main constrains facing wildlife services office to protect the animals in the area

3.2. Forestry

During meeting with director of forestry in Ministry of Agriculture and forestry, he explained that the reserved area for forestry was along the river bussari. The office stops plantation of trees due to extension of Wau town and financial limitation.

Most of the wild fruit trees were cut out for construction of house / road, making charcoal and fire wood. The wild fruit trees in the area are Lulu, Kurnyonk, Naback, Delib, Lалуob, and Mongo. Other important trees like Mohgani, Tek Sahab and Durot (use for dokan) are also found.

Reserved forests near the project area are Garenti, Nai Akok (1931), Nahamtina (1947) Kur Ganda and Tonj one.

3.3. Mining

The director of mining in Ministry of finance and industry explained that there are few industries in state, one factory is state-company for ice production, it is located on the left bank of river Jur, and also there is one state water factory operated.

The bricks makers are found along the river Bussuri, Sue and Jur. The directorate of mining allocates places to bricks makers, bricks makers are licensed for only one year (5 to 6 months in dry season). Around 70 people are registered in the project area, one lot for one maker is 30 x 30 m, license fee is 300 ssp per one year.

There four areas along Jur river are identified for bricks making area namely Eastern banks, Garanti, Molem and Madan Abu Ajajach

The price of brick making 1,000 bricks costs around 50 ssp, while one person can make between 50,000 to 180,000 bricks in one season, so that the bricks maker can get benefit of 50,000 to 150,000 ssp per year.

The sand and clay mining for construction materials is approved by local authority while aggregate is approved by directorate of IM. Now those are illegally operated in the command area even though the commissioner of Wau has given an order in 2013 to stop brick making and sand mining in the area.

3.4. Land evaluation

Base on land law, the land belong to local community as an owner and it management by government. The Land is evaluated base on classes such as 3rd class, 2nd class, 1st class and addition to investment land and agricultural land

3rd class land/plot evaluation:

- Land charge fees = 350 ssp
- Land form = 50 ssp
- Survey fee = 50 ssp
- Administration fee = 50 ssp
- Sketch Drawing = 60 ssp
- Total = 560 ssp

2nd class/plot evaluation:

- Land charge fees = 350 ssp
- Land form = 50 ssp
- Survey fee = 50 ssp
- Administration fee = 20 ssp
- Sketch Drawing = 20 ssp
- Total = 810 ssp

1st class/plot evaluation:

- Land charge fees = 800 ssp
- Land form = 150 ssp

- Survey fee = 150 ssp
- Administration fee = 40 ssp
- Sketch Drawing = 20 ssp
- Total = 1060 ssp

Investment land inside Wau city council area (green bill)

- 1m2 = 125 ssp
- Land size is around 2,500 m2

Investment land outside Wau city council area

- 1m2 is between 5 to 10 ssp

Requirements for investment land

- Nationality
- Type of investment
- Location
- Investment capital
- Environmental grantee for any impact occur

Land evaluation for bank loan:

- Free land or open land in 3rd class 50,000 to 60,000 ssp
- Land with buildings is 100,000 to 500,000 ssp

Land investment in village area

- Is under county authority
- Wau city radius is around 7 to 8 km
- Directorate of land has staff at county level

Town planning

- Base on land community request
- Base on number of applications submitted to director of land

Agricultural land

- Application to ministry of agriculture and forestry
- Land confirm from local community
- Agriculture land list for 1 feddan is 500 ssp for around 2 to 10 years

Plans / projects in / around the project site:

- Oil station
- Prison mongo trees
- Investment land for hotels
- Water treatment plant
- Water distribution pipeline
- Football stadium for FIFA

Flood:

- In 1970s big flood killed some people and destroyed local houses in Wau town

4. Communities living in project areas

4.1. Kuanya community

The community are living within dam side and surrounding, the number of people living in the area are around 3,000 persons and number of household member per house are between 5 to 11 people. The village was established long time ago since war between community of Kuanya and Bongo community in warrap state, around 6 generation Kuanya community chief attended

They are coming from Nile River following the rivers course and we call Jur Chol (in Dinka language) because during their migration they spent the whole day in one place and at night they moved to other place. The land is belong to government and is responsibility of community to protect land also the land is manage by leaders of community

No graves yard in the area, the people dig graves for die body of their relatives at their homes; there is no clinic nor health centre, but schools is in project area

The community has exercised in some businesses such as farming and sale crops, charcoal, woods and also some small shop for sale oil, salt and sugar etc. also community makes some tools like maloda, Harba using steels.

Fishermen do fishing in rivers Sue, Jur and along the Kuanya stream (dam site). The Kinds of fishes are: Quth, Yath, Bolta, Rial, Auar, Lik, etc. Also it was found Gormod, bulta in stream (dam site), Rou, Janang, Aganang (Warol) and Granti.

The people do hunting in bush / forest around dam site and along the river site. They use rope and knife, and some people may use gun.

The kinds of wildlife animal hunted in the area are Dideth, Gazala, (Loij), etc.

There no flood in area but Kuanya stream received water from Jur River during high flood time and water flow back to high land

The Kuayna community people believe in some animal and trees, also there are wild fruits trees in area use as food during food shortage time

4.2. Eastern Bank Community :

The number of people living in community is estimated around 7,500 persons based on referendum election, but new it may reach to 11,000. Number of family member is 5 to 9 people in one house.

Main businesses activities in the area are farming and sale agricultural products, fishing (fishermen can get 150 ssp a day) and Sale tea, food and alcohols and Sale smoking wood. Those are mainly taken by women. Some people sale grass, fire wood, house wood and charcoals, also a few people are working in bricks making,

Fish the fishermen catching in river Jur and Kinds are Ator, Ngok, Lak, Kawara, Atiek, Aluei, Luoth; also some animal such as Rou, Nhair, Agangany are caught in rivers.

The hunting place is far from residences in bush, trees. Animals hunted are Amonk, Pair, dharei, Boal, Anynjir.

The floods were near overtopping to the main road in 2007, 2013 and 2014.

NB: community request to extend the irrigation project to include also high land

4.3. Koum Community

People living in village are around 6,805 people, based on the 2008 statistics, but new number is increase due to returnees come back from Khartoum after separation, number of household member is between 5 to 12 people. History of village has started since long time ago, but people were displaced during the war.

The land is belong to government, but is under Red chief of community, the border of land is managed through chiefs, but the lands, in generally, is managed through discussion between communities to agree on issue related to land use, or to allot land to new comers. If someone needs large land, all related communities gather and discuss the matters.

Several old houses are found inside the command area, some of them have been damaged with no people residing. Previously a cattle camp was inside, but it was stopped since 1999 when rice cultivation was started. There were conflicts between rice farmers and cattle keepers.

The main business activities is farming and selling agricultural products, also fishing, charcoals making, wood honey hunting, animal hunting (one person has 100 dogs for hunting), selling cattle, making hand tools wooden chair and other wooden things, mining sand and aggregate in river, making bricks, selling tea, food and alcohols. Some of them are managed by women. Also some communities are working government as office staff and policemen.

The fishermen fishing in river Jur and types of fish are Kawara, Atoor, Luath, Aguar, Reial, Ateik, Aluei, Yath, Gauth, Chuor also animal such as Raw, Aganany, Nyayal, and Arou

The hunting place is in very far area in bush forestry called Aliay Nhom. Kinds of animal are Aluhal, Boal, awen, agwar, abil thowr, angorei, Amonk, Luach, Kawei, thanik, Agongei, pair, Dhaiar, Wood (bird), wal (bird), Awayich (bird), ajath bod (bird), Lolok (bird), monk (bird), Amayok (bird) etc.

Other animal migrating from other places are Zebra, Buffalo Aluel wang, Elephant, thonak, Kaiel, Lion, Aboak, gaik reial, bam monkey, and also migratory birds such as Awet marial, Maril bek, Gal, Arom gony are found.

Some houses along the river Jur were damaged due to floods in years 1998, 2012, and 2013. The floods damaged houses and farmland. The water spread to residential area and covered main road.

Annexes

Annex 1 Meeting memo

Meeting with wildlife services office:

Maboir Rulrac 0956889484 ó Director

Sisto Mapol 0956132155

- Our animal will not affect the project
- Animal called Dithidid is inhabitant in area
- In river the project will affect by Hoopoes (Fras el bahr) which use the floodplain as place for feeding distance of around 1,000m is used
- Monkey and elephant are also in the area
- The islands in rivers are also use by some animal in river for putting their eggs
- Also other animal in area are: Ghazal, Zioef, Morfen, Namir,
- Q1: Brides known as Abu Markob is also in the area and most of animal in the area migrated due to insecurity and human, also white rhino has been in area but now is only find in shambi
- Q2: the animals like Buffalo migrated the area due to the insecurity and diseases also some animal migrated due to forestry and grass burning in the area
- Due to the fiery the land loss fertility and rain decrease, also for some other bed human activity rives was silted up and flow decrease

Meeting with BGU:

Attend by : deputy Vice chancellor, Anthony Julu, director of institute of public and environmental health (0955786278/0911405124), Leonard George Shelli, economic and RD (0955502570) and Elizabeth Alberto Tiringu director of rural development (0956313723/0922122990)

- The all appreciate the effort for carry out studies for IDMP
- The university has not any study or research in field of environment due to financial constraints
- Their also premise to directed study to carry out their graduate study in such field

Meeting with Director of forestry

Mr. Abd el Rihim Adress (0913509328)

- The reserved area for forestry is along the river bussari
- We stop plantation due to extension of Wau town and financial limitation
- Most of wild trees fruit was cut out due to develop of land for purpose of house, road or making charcoal and fire wood.
- The wild fruit trees in the area are: Lulu, Kurjonk, Naback, Delib, Luluob, Mongo,
- Other important trees like Mohgani, Tek Sahab and Durot (use for dokan)
- Issue of the funding for new trees planting is big problem
- Burning trees law is still not out
- Takic trees reserved area are 12 in No. in state
- The forestry reserved area near to project area are: Garenti, Nai Akok(1931), Nahamtina (1947) Kur Ganda and Tonj one, but they cannot affect by project
- Any agriculture project need trees plantation to increase production

Meeting with Directorate of Industry and Mining

Mr. Alfatah Ahemed óDirector of Mining (09122955275)

Mr. Mobarak Mohammed Alieas ó inspector for Mining (0955704487)

- There is the ice industry in left bank of river Jur
- The bricks makers are easily to be relocated to other place as we have many other places
- We allocated places to bricks makers
- The places is distributing to bricks maker by directorate of industry and mining office and license is given for only year only (5 to 6 months dry season)
- Around 70 people are registered and are given land for bricks making in project area
- The land given is 30x30 m for one person
- The commissioner of Wau gives order in 2013 to stop brick making in project area
- Four areas are identified for bricks making in along jur river named Eastern banks, Garanti, Molem and Madan Abu Ajajach
- License fees is 300 ssp per one year
- The price of brick making 1,000 bricks is cost around 50 ssp
- One person can make between 50,000 to 180,000 brick in one season
- Bricks maker can get benefit of 50,000 to 150,000 ssp per year
- The sand and clay for construction is approved by local authority but aggregate is approved by directorate of IM
- Some people dig and get sand and clay with go to local authority.

Meeting with Director of Land in MPI

Mr. Karlo Vitale (0956854441)

- Base on land law is give the to local community as land owner and it management by government
- Land is evaluated base on classes there is 3rd class, 2nd class, 1st class and addition to investment land and agricultural land

3rd class land/plot evaluation:

- Land charge fees = 350 ssp
- Land form = 50 ssp
- Survey fee = 50 ssp
- Administration fee = 20 ssp
- Sketch Drawing = 20 ssp
- Total = 560 ssp

2nd class/plot evaluation :

- Land charge fees = 350 ssp
- Land form = 50 ssp
- Survey fee = 50 ssp
- Administration fee = 20 ssp
- Sketch Drawing = 20 ssp
- Total = 810 ssp

1st class/plot evaluation:

- Land charge fees = 800 ssp
- Land form = 150 ssp
- Survey fee = 150 ssp
- Administration fee = 40 ssp
- Sketch Drawing = 20 ssp

- Total = 1060 ssp

Investment land inside Wau city council area (green bill)

- 1m2 = 125 ssp
- Land size is around 2,500 m2

Investment land outside Wau city council area

- 1m2 is between 5 to 10 ssp

Requirements for investment land

- Nationality
- Type of investment
- Location
- Investment capital
- Environmental grantee for any impact occur

Land evaluation for bank loan:

- Free land or open land in 3rd class 50,000 to 60,000 ssp
- Land with buildings is 100,000 to 500,000 ssp

Land investment in village area

- Is under county authority
- Wau city radius is around 7 to 8 km
- Directorate of land has staff at county level

Town planning

- Base on land community request
- Based on number of applications submitted to director of land

Agricultural land

- Application to ministry of agriculture and forestry
- Land confirm from local community
- Agriculture land list for 1 feddan is 500 ssp for around 2 to 10 years

IDMP project land

- Oil station
- Prison monga trees
- Investment land for hotels
- Water treatment plant
- Water distribution pipeline
- Football stadium for FIFA

Flood:

- In 1970s big flood displaced some people with local houses in Wau town

Meeting with area manager of south Sudan urban water corporation- Wau

Mr. Olwak Mugo Yowin (0911069282)

- The project for water supply for eastern bank area is for rice cultivation from beginning and change to water for livestock and final is become water treatment plant for supplying residents of eastern bank.
- The project will has steel pipe
- The area manger complain about steel pipe and joints due to maintenances and soil humid in area
- He said the area is flooding so the humidity is high
- Design capacity is 150m³ per hour which has 4,500 m³ per day
- Level tank for storage water and also ground storage
- Steel pipe with 6 inch and length of around 1,200 m
- Pump station at right bank of river jur

Meeting with Kanunya community

Q1: number of people living in the area around 3,000 person and No. of people in one household are between 5 to 11 people

Q2: the area was established long time ago since war between community of Kuanya and Bongo community in warrap, around 6 generation chief attended

We are coming from Nile river following the rivers course and call Jur Chol (in Dinka language)because during our migration we use to spent the whole day in one place and at night we move to other place

Q3: the land is belong to government and is responsibility of community to protect land also the land is manage by leaders of community

Q4: no graves yard in the area, the people dig graves for body of their people in their homes, we not clinic or health centre but we have schools, no in project area

Q5: our business is farming and sale crops, charcoal, woods

Also some small shop for sale oil, slat sugar etc.

Also we make some tools like maloda, Harba using steels

Q6: yes there is fishermen fishing in river jur and long the Kuanya stream (dam site)

Kinds of fishes:

Quth, Yath, Bolta, Rial, Auar, Lik, in river

Gormod, bulta in stream (dam site)

Rou, Janang, Aganang (Warol) and Granti ó animal

Q7: hunting in push forestry around dam site, far from dam site also and along the river site

We use rob to put in animal passage and also Hraba and some people may use gun

Q8: Dideth, Gazala, (Loij) around dam site or far away

Pair, Namir, and loin

Q9: there no flood in area but Kuanya stream recived water from Jur River during flood time and water flow back to high land

Yes there people believe in some animal and trees

There also wild fruits trees in area use as food during food shortage time

Meeting with Eastern bank community:

Q1: No. of people living in community are around 7,500 person base on referendum election, but new it may reach to 11,000

The number of people in one household is between 5 and 9 people

Q2: in 1944 my grandfather came to this area, (Malang Aguar) and he find someone call Akwoyo in area, the area is call wond hok due to cow use to vaccinated in area

Malang Akuar came for place call Khor Malang in west bank of river Jur

Q3: UN plan land belong to community and government own land planed inside town area, but all land is for government

Community manage land through local authority

Q4: there no any infrastructures in the project area

Q5: main businesses activities area: farming and sale agricultural products, fishing (fishermen can get 150 ssp a day)

Sale tea, food and alcohols by women

Sale grass, fire wood, house wood and charcoals

Bricks making

Sale smoking wood by women

Q6: yes there is fishermen fishing in river Jur

Kinds of fish are: Ator, Ngok, Lak, Kawara, Atiek, Aluei, Luoth,

Animal are: Rou, Nhair, Agangany

Q7: the hunting place is far away from home in bush trees

Q8: type of animal hunting: Amonk, Pair, dharei, Boal, Anynjir

Q9: the flood of last year is near to overtopping the main road

2007 flood was overtopping the main road in some places the 2013 and 2014 flood damage some places along the canal route area, in place call Nai Gair, in Abociboc

The flood of 1975 reached to monga trees

NB: community requested to extend the irrigation project to include also high land

Meeting with Koum community:

Q1: people living in area are around 6,805 people, bas on 2008 statistics, but new number is increase

Number of household member is between 5 and 12 people

Q2: the area start long time ago, but people were displace during the war, but new people came back again

This village is there before Sudan independent

Chief Makuac Akec is founder of the area

People said they are coming for tree call chuai allocated in east side

But in realty people are originated from Wau town

Q3: land is belong to government, but is under Red chief of community

The border land is manage through chiefs

The land is manage through discussion between community to agree on issue raise to land use, or to allot land to new comes

If someone needs big land, all people can be call to meet and discussed

Q4: we have old house inside the command area, some house has people and some are damage no people

Previously we have cattle camp in the command area; we stop use that cattle camp in 1999 during the rice cultivation in the area, due to conflicts between rice farmers and cattle keepers

Q5: the main business activities is farming and sale agricultural products

Fishing, Charcoals, wood honey hunting, animal hunting (one person has 100 dogs for hunting), sale cattle, making hand tools using steel, making wooden chair and other wooden things, mining sand and aggregate in river, making bricks, sale tea, food and alcohols by women, working with government as office staff and policemen

Q6: yes there is fishermen fishing in river Jur

Kinds of fish: Kawara, Atoor, Luath, Aguar, Reial, Ateik, Aluei, Yath, Gauth, Chuor

Kinds of animal: Raw, Aganany, Nyayal, Arou

Q7: the hunting place is in very far area in bush forestry called Aliay Nhom

Q8: Kinds of animal: Aluhal, Boal, awen, agwar, abil thowr, angorei, Amonk, Luach, Kawei, thanik, Agongei, pair, Dhaiar, Wood (bird), wal (bird), Awayich(bird), ajath bod(bird), Lolok(bird), monk(bird),Amayok(bird)

Other animals migrating to the area are: Zibra, Buoffla Aluel wang, Elephant, thonak, Kael, Lion, Aboak, gaik reial, bam monkey,

Migrated birds: Awet marial, Maril bek, Gal, Arom gony

Q9: the houses along the river Jur in our area got damage due to flood in years 1998, 2012, and 2013, the flood damage house and farms land

The river Jur overtopping during the flood time is spelling to residential area

The main road is about to overtopping is only around 5 to 10 cms

NB: when the project will start (question from Kuom chief)

People waiting for project to get job

Issues of tractors is raise

Don't allow politicians to diverted the project to another area

Annex 2: List of people met

Name	Title	Institution
Maboir Rulrac	Director General	wildlife services office
Sisto Mapol	Director for administration	wildlife services office
Mamour	deputy Vice chancellor	Meeting with BGU:
Anthony Julu, Leonard	director of institute of public and environmental health	
George Shelli	economic and RD	
Elizabeth Alberto Tiringu	director of rural development	
Mr. Abd el Rihim Adress	Director of forestry	Ministry of Agriculture and forestry
Mr. Alfatah Ahemed	Director of Mining	Ministry of finance and industry
Mr. Mobarak Mohammed Alieas	inspector for Mining	
Mr. Karlo Vitale	Director of Land	Ministry of physical infrastructure
Mr. Olwak Mugo Yowin	Area manager of south Sudan urban water corporation- Wau	

Annex 3: Activities schedule

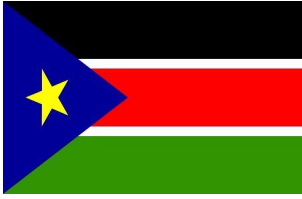
Date	Activity	Time	Issues	Findings
22/06-2015	Departure from Juba airport	10:00 am	Flight delay	
	Arrival to wau airport	11:00 am	Delay at wau airport	
	Meeting with D.G Ministry of physical infrastructure	12:20 PM	Discussion about ministry plan project at IDMP project sites	No plan from ministry in project site as site belong to ministry of agriculture
			Arranged meetings with other environmental authorities concern	Environmental authorities concern: Directorate of tourism and hotels in MPI, Directorate of Environment MAF, institute of public health BGU, Directorate of industry and mining in ministry of Finance, wildlife office
	Meeting with ministry of MAF consultant	1:30 pm	Appointment for meeting with directorate of environment	At 9:00 am on 23/06/2015
	Meeting with deputy vice chancellor	3:00 pm	Discussed research studies on environment and college concern environment	Appointment to meeting head of institute of public health and important individual with wide knowledge about environment at 11:00 am on 23/06/2015
23/06/2015	Meeting with wildlife services director			

Date	Activity	Time	Issues to discussed
Mon. 22/06/2015	Arrival	11:30 AM	
	Meeting with DG MPI	12:00 PM	Introduction Debriefing about mission Discussion about environmental issues and authorities concern Appointment with authorities concern
	Meeting with ministry of	1:20 PM	Appointment with directorate of environment

	Agriculture consultant		
	Meeting with Deputy vice chancellor	3:00 PM	Appointment with institute of public health
Tue. 23/06/2015	Meeting with directorate of environment MAF	09:00 AM	
	Meeting with institute of public health BGU	11:00 AM	
	Appointment with wildlife office		
	Ministry of finance directorate of industry and mining		
	Meeting with James Adam boy		Flood
	Appointment with three local communities		
Wed. 24/06/2015	Meeting with directorate of land MPI		
	Meeting with Kuanya community		
	Visiting dam site		
Thus. 25/06/2015	Meeting with community along canal route		
	Observation of environment issues along canal route		
Fri. 26/06/2015	Meeting with community at command area block C		
	Observation at command area and brick make area		
Sat. 27/06/2015	Meeting with koum community		
Sun. 28/06/2015	Back to Juba		

Annex 4: Type of wildlife animal inhabitant in western Bhar el Ghazal state, Listed by Office of wildlife services in Wau :

- | | |
|------------------------|---------------|
| 1. Ostrich | 1. Jacal |
| 2. Porcupine | 2. Retal |
| 3. Pancoline | 3. Carcal |
| 4. Aardvark | 4. Til-thiil |
| 5. Pastas Monkey | 5. Lelwel |
| 6. Colobus monkey | 6. Tiang |
| 7. Chambazee | 7. Physons |
| 8. Jacal | 8. Crocodile |
| 9. African hunting dog | 9. Hippo |
| 10. Spotted Hyena | 10. Warthog |
| 11. Strip Hyena | 11. Push pig |
| 12. Cheetah | 12. Grief |
| 13. Serval cat | 13. Buffalo |
| 14. Leopard | 14. Buga |
| 15. Lion | 15. Bush back |
| 16. Orbi | 16. Bohor |
| 17. Whiter buck | 17. Baboon |
| 18. Roan antelope | |



THE REPUBLIC OF SOUTH SUDAN

MINISTRY OF ELECTRICITY, DAMS, IRRIGATION & WATER RESOURCES



WATER SECTOR

IRRIGATION DEVELOPMENT MASTER PLAN

(FINAL REPORT)

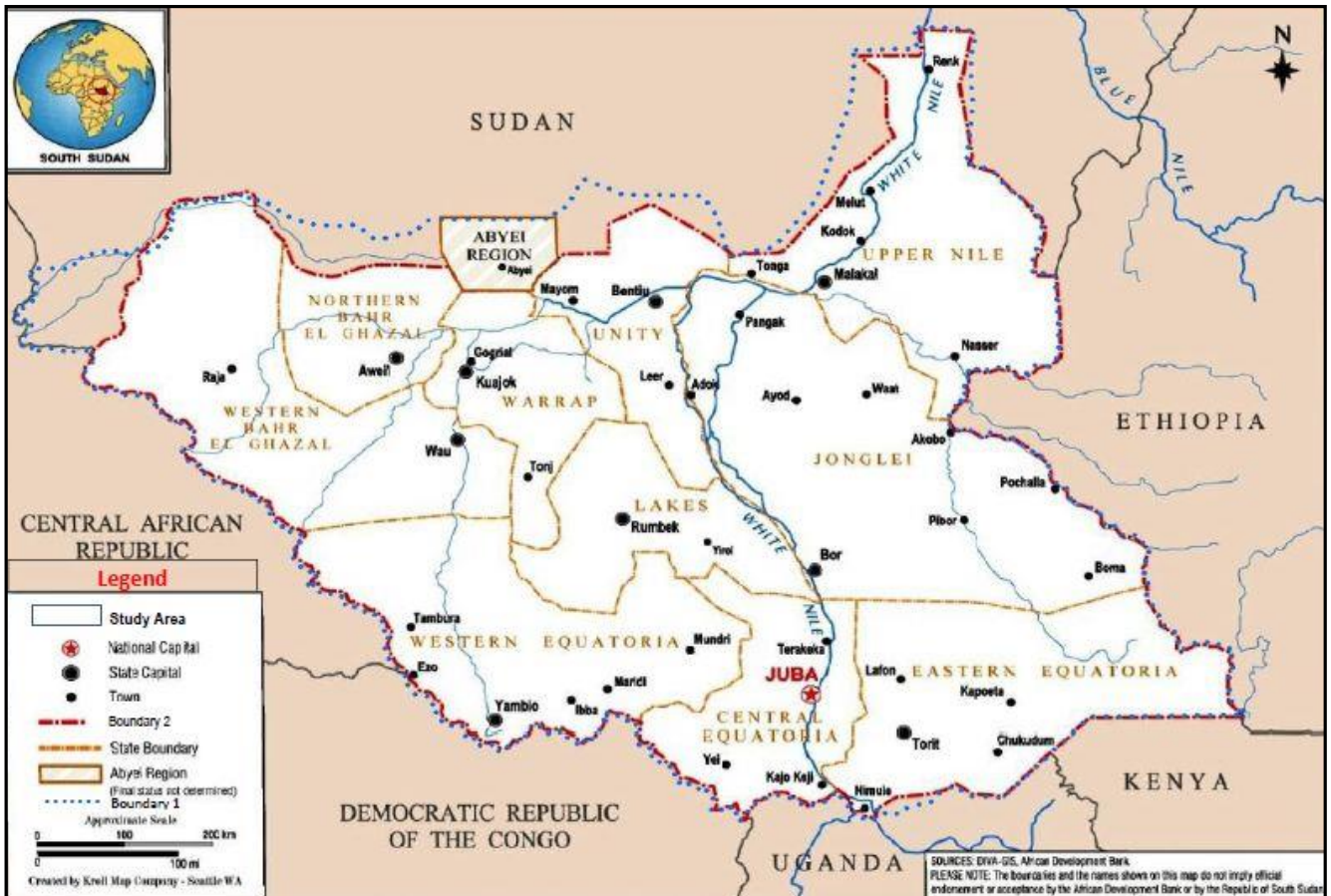
***ANNEX 9: IMPLEMENTATION PLANS FOR PRIORITY
PROJECTS***

9-2: Pre-Feasibility Study of Jebel Lado Irrigation Scheme

NOVEMBER 2015

THE PROJECT FOR IRRIGATION DEVELOPMENT MASTER PLAN IN THE REPUBLIC OF SOUTH SUDAN (RSS) LOCATION MAP

Map of the Republic of South Sudan



Location Map: Adopted from African Development Bank

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PART 1 PRESENT SITUATION OF THE PROJECT AREA

CHAPTER 1 SITE PROFILE

1.1 Location

Jebel Lado proposed project site is located in pre-urban area, around 20km from Juba, where high demand of food supply due to its large population. Hence, there is a large potential to generate cash income by producing cash crops including vegetables. Especially, production of leafy vegetables, which are not imported from foreign countries because of its perishability, is likely to make a good profit. In addition, low humidity in dry season can lead to reduction of risk caused by fungi or disease.



Source: IDMP TT

Figure 1.1.1 Location of Project Area

1.2 Beneficiary Area and Communities

There are two (2) communities residing in the project area namely Nyuwa and Piete. The irrigable area lies between the White Nile River and a seasonal stream; the land is tenured under above communities.

1.3 Basic Community Profile

(1) Basic information about the communities

Table 1.3.1 shows the basic information of the communities, such as administrative organization, population, the number of the households, tribe and the means of livelihoods.

Table 1.3.1. Basic Information of the Communities

Name of community	Nyuwa	Piete
Key information (Administrative organization and population, etc.)		
State ^{*1}	CES	CES
County	Juba	Juba
Payam	Northern Bari	Northern Bari
Boma	Jebel-Lado East	Jebel-Lado East
Population	2,026	800
No. of HHs	875	197
No. of HHs/peoples engaged in agriculture ^{*2}	(985)	197
Name of Tribe	Bari	Bari
Means of the Livelihoods	✓ ^{*3} Ranking/% ^{*4}	✓ ^{*3} Ranking/% ^{*4}
Grazing		✓ 2
Farming	✓ 1	✓ 1
Fishery	✓ 2	✓ 2
Hunting	✓ 3	✓ 4
Remittance		
Full-time/Permanent Wage Labour		
Part-time/Temporarily Wage Labour	✓ 3	✓ 3
Business owner	✓ 4	✓ 5
Livestock	✓ ^{*3} Ranking ^{*4}	✓ ^{*3} Ranking ^{*4}
Cattle		✓ 2
Goat		✓ 1
Sheep		✓ 2
Chicken	✓ 1	✓ 1

*1 CES stands for Central Equatoria State.

*2 The number with parentheses shows the number of people engaged in agriculture.

*3 Check mark (✓) is put to the option found in community.

*4 Ranking per number

The population is approximately 2,000 persons and 800 persons in Nyuwa and Piete respectively. Most of the communities have farming as the main means of their livelihoods, and fishing is next major livelihood. Cattle grazing are operated in Piete community area only. The two communities belong to Bari tribe.

Farmers in the community have an experience of irrigated farming along river using buckets in dry season cultivating tomato, egg plant and okra. They are currently cultivating cereals such as maize, millet, sorghum and rice and cash crops such as sesame and vegetables. Their production is sometimes not enough for their own consumption because their farmland is too small.

According to the above situation, assurance of crop production for farmers themselves would have to be considered. Also cash generation by cultivating cash crops including vegetables should be considered in the farming plan.

(2) Basic agricultural status

1) Average farming land per household

Average farming land per household in Nyuwa community counted for 1 feddan/HH, and Peiti community was 0.5 ó 2.0 feddan/HH.

2) Produced crops

Following questions are asked to the heads of communities regarding each crop in the questionnaire;

Q1: Is the crop cultivated in your community?

- Q2: Ranking of the crop as per production volume.
- Q3: Production of the crop is enough for self-consumption?
- Q4: Is the produced crop for selling, consumption or both?
- Q5: Which is the priority purpose of the produced crop, selling or consumption?
- Q6: How much was farm gate price of the crop?
- Q7: What market was the crop sold to?

Table 1.3.2 shows the produced crops based on the interview. In the surveyed two (2) communities produce sorghum, maize and ground nut, those are produced for mainly for self-consumption and also for selling. Communities answered those production are not enough for their consumption.

Sesame is popular in the communities and cultivated mainly for selling. Farm gate price of sesame is much higher than that of cereals. The communities answered production of sesame is not enough, which means that sesame is in high demand for generating cash and also for their consumption.

Cassava is produced mainly for self-consumption in the communities. Even its production is relatively lower than sorghum, maize, ground nut and sesame; it is one of staple food for the community members.

Rice is cultivated in Nyuwa community; its production is less lower than other crops.

Major vegetables in the communities are tomato, okra and Jewø mallow. All of the vegetables produced in the communities are mainly for selling in Jebel Lado. Vegetable production as per ranking in Peite was relatively higher than other crops compared to the other communities.

Table 1.3.2 Produced Crops

	Sorghum							Maize							Ground nut						
	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7
Nyuwa	✓	1	Y	B	C	120 SSP/50kg	Libiay	✓	2	N	B	C	120 SSP/50kg	Libiay	✓	2	Y	B	C	150 SSP/50kg	Libiay
Piete	✓	1	Y	B	C	120 SSP/50kg	Juba	✓	2	Y	B	C	120 SSP/50kg	Juba	✓	2	Y	B	C	150 SSP/50kg	Juba
	Millet							Sesame							Cassava						
	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7
Nyuwa			N					✓	4	N	S	S	250 SSP/50kg	Libiay	✓	5	N	C	C		
Piete								✓	3	N	S	S	250 SSP/50kg	Juba	✓	4	N	C	C		
	Wheat							Rice							Tomato						
	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7
Nyuwa			N					✓	n/a	N					✓	3	Y	S	S	100 SSP/box	Libiay
Piete			N							N					✓	2	Y	S	S	100 SSP/box	Juba
	Okra							Jew's mallow							Cow pea						
	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7
Nyuwa	✓	3	Y	S	S	50 SSP/box	Libiay	✓	3	Y	S	S	70 SSP/box	Libiay							
Piete	✓	2	Y	S	S	50 SSP/box	Juba	✓	2	Y	S	S	70 SSP/box	Juba	✓	2					
	Egg plant							Onion													
	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7	Q1 ²	Q2	Q3 ³	Q4 ⁴	Q5 ⁵	Q6	Q7
Nyuwa																					
Piete																					

*1 Eastern Bank is an abbreviation of "Eastern Bank of Wau Municipality."
 *2 Check mark (✓) is put to crop cultivated in the community.
 *3 If answer was "Yes", put "Y" and if it was "No", put "N".
 *4 If answer was "Selling", put "S", if it was "Consumption", put "C" and if it was "Both", put "B".
 *5 If answer was "Selling", put "S", if it was "Consumption", put "C".

3) Current farming calendar

Current farming operation calendars in two (2) communities show similar aspects as described in Table 1.3.3. Farming operation in Jebel Lado starts from May.



Table 1.3.3 Current Farming Operation Calendar**Nyuwa Community**

Month			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
No	Crops	Rain												
1	Sorghum		○	○	○ ▲	▲			□	□		×	×	×
2	Maize		○	○	▲		□	□				×	×	×
3	Groundnut		○	○	○	▲	□	□	□			×	×	×
4	Millet													
5	Sesame		○	○	▲			□	□					×
6	Cassava		×	□		▲								
			□	○		○								

Peti Community

Month			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
No	Crops	Rain												
1	Sorghum		○	○	○ ▲	▲			□	□		×	×	×
2	Maize		○	○	▲		□	□				×	×	×
3	Groundnut		○	○	○	▲	□	□	□			×	×	×
4	Millet													
5	Sesame		○	○	▲			□	□			×	×	×
6	Cassava		×	□		▲								
			□	○		○								

〈Legend〉

Heavy Rain:  Light Rain: 
 Land Preparation: × Seed sowing: ○ Transplanting: △
 Weeding: ▲ Fertilizer application: ■ Harvesting: □

4) Other information regarding farming systems**i) Farming systems**

All of the communities practice shifting cultivation, because of the influence from stranger or soil condition.

ii) Experience of irrigated agriculture

The communities in Nyuwa and Piti have less experience on irrigated agriculture unlike communities in Wau.

iii) Use of agricultural inputs

Also they don't have experience of use of manure and pesticides.

iv) Constraints affecting agricultural production and income generation

All of the communities agreed that they have major constraints in RSS; flood, draught, birds/animals and insects.

v) Crops for irrigation scheme in future

Cash crops including vegetable are raised as the crops farmers in the community wish to cultivate in the irrigation scheme in future. All of the communities answered they are willing to accept the crop cultivation recommended by the government.

CHAPTER 2 NATURAL CONDITIONS

2.1 Topographic Survey

(1) Scope of works

For topographic survey, the following equipment was used:

- Total station Sokkia set 510;
- Global positioning system (GPS) receiver (Sokkia GRX1 , Trimble 5800);
- Level and
- AutoCAD system (Autocad civil 3D).

Survey structure contains:

1) PIPELINE:

- Establishment of temporary benchmark (TBM)
- Longitudinal profile survey: in drawing profile use the Auto cad civil 3d and layout in (A3) paper (plan & profile in one sheet Scale: V=1/100, H=1/1,000)
- Cross-sectional Survey: any 100 m, width of section 200m, 15sections (scale: V=1/100, H=1/100)
- Plane Survey: area (1500*3300 m²) create contour map by scale 1:4000

2) Canal route survey:

- Establishment of temporary benchmark (TBM)
- Longitudinal profile survey: in drawing profile use the Auto cad civil 3d and layout in (A3) paper (plan & profile in one sheet Scale: V=1/100, H=1/1,000)
- Cross-sectional Survey: any 200m, width of section 200m, 15sections (scale: V=1/100, H=1/100)
- Plane Survey: 4 area (200*200 m²) create contour map by scale 1:4000

3) Command area survey:

- Establishment of temporary benchmark (TBM)
- Longitudinal profile survey: in drawing profile use the Auto cad civil 3d and layout in (A3) paper (plan & profile in one sheet Scale: V=1/100, H=1/1,000)
- Cross-sectional Survey: any 100m, width of section 200m, 15sections (scale: V=1/100, H=1/100)
- Plane Survey: area (6500*2000 m²) create contour map by scale 1:4000

4) Pumping station survey:

- Establishment of temporary benchmark (TBM)
- Cross-sectional Survey: any 500m, width of section 500m, 15sections (scale: V=1/100, H=1/100)
- Plane Survey: area (500*300 m²) create contour map by scale 1:4000

The survey area is described as below:

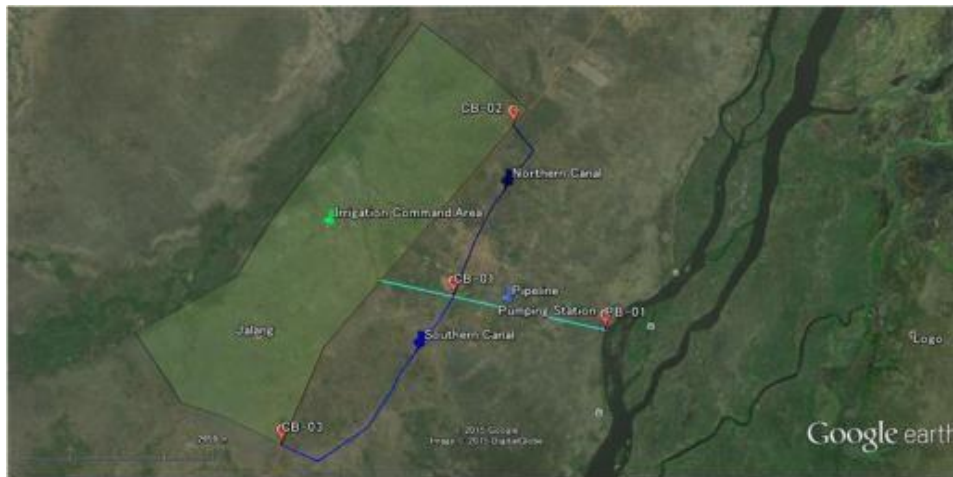
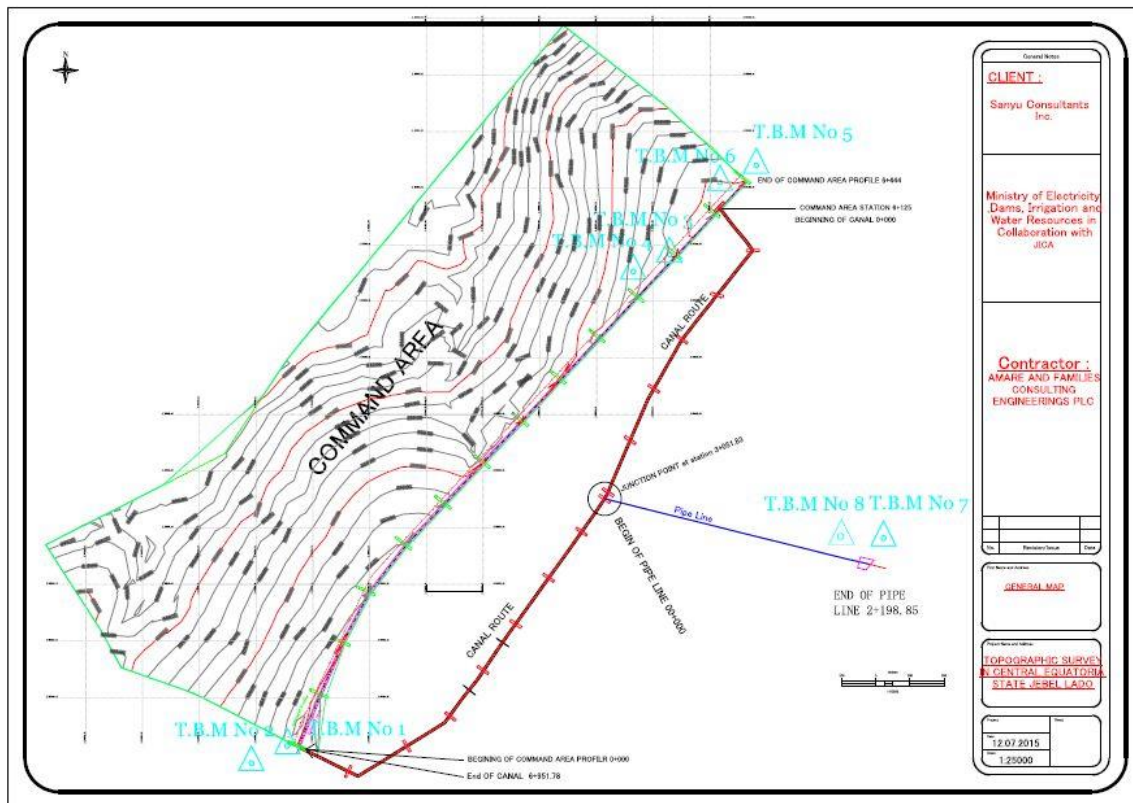


Figure 2.1.1 Overview of Survey Area

(2) Topographical profile

Topographic feature is drawn in Figure 2.1.2.



Source: IDMP TT

Figure 2.1.2 Topographic Map

Command area is located 3.5km from Bahr el Jebel. Bushes, trees and grasses dominate in the site. The terrain is almost flat and the land gradient toward the west shows around 0.9%. Pump station site is located beside Bahr el Jebel. The land is almost bare and some trees are shown. In the pipe line and canal line, there are community road among some small communities, bushes and trees etc. along the line.

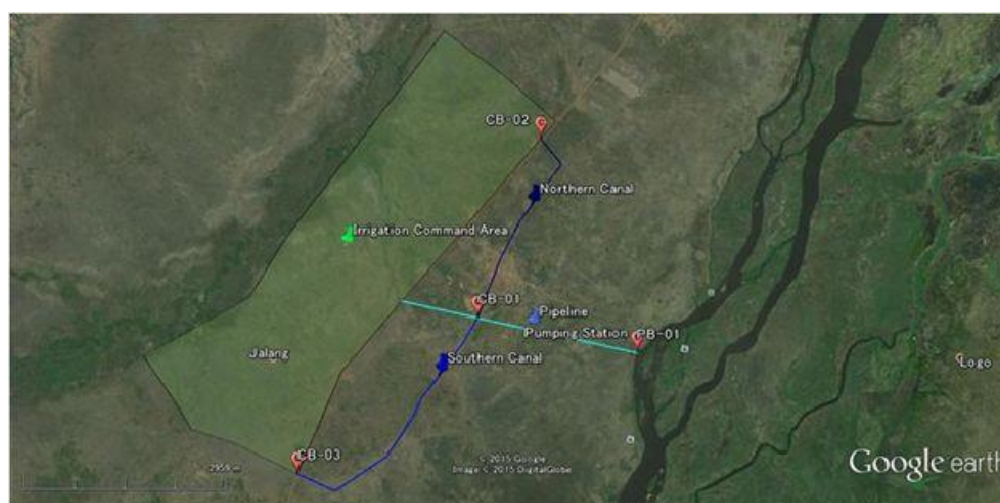
2.2 Geological Survey

(1) Scope of works

Geological survey and soil mechanical Investigation was made at the proposed project area in Jebel Lado by drilling four (4) boreholes.

- 1) Boring 4no.holes to depths between 5.0m (for3No.holes) and10.0m (for1No.hole) at the proposed site.
- 2) Visual description of soils within the soil profile and carrying out Laboratory soil tests to classify the soil.
- 3) Observing and stating the depth of the water table within the soil profile for each borehole.
- 4) Conducting Standard Penetration Tests at an interval of 1.0m in each borehole
- 5) Retrieving of Soil samples in each borehole respectively.
- 6) Obtaining the safe bearing capacity based on the field SPT Values.
- 7 Compiling a Geotechnical Investigations report

Locations of boreholes are shown in Figure 2.2.1.



Source: IDMP TT

Figure 2.2.1 Locations of Boreholes in the Survey Area

(2) Geological profile

In the pump station site, the subsurface soils are predominantly clayey sands (SC) and poorly graded sands (SP). Bearing capacity is low/ middle for the foundation structures. In the canal line, the subsurface soils are various by area, such as sands (SP and SC) to gravels (GW) , Inorganic clays of high plasticity (CH)) and silty sands (SM). Bearing capacity is high for the foundation of structures.

2.3 Hydrology

Annual rainfall is about 1000mm. Bahr el Jebel has plenty of water for irrigation water. According to the soil survey, soil there is relatively fertile with high content of humus and CEC. It allows cultivation of various kinds of crops with appropriate control of soil pH.

High temperature especially in dry season (maximum temperature is above 35°C) should be considered in crop selection in dry season. So, crops that are able to grow under high temperature should be selected for dry season such as soybean, egg plant, okra etc.

2.4 Soil Investigation

Soil survey was conducted in the priority project areas by RSS-TTs to grasp soil condition in the command area.

(1) Methodology

Generally, there are two (2) ways to select survey points in certain area. The first way is just to choose points to cover the area equally, for instance by covering square mesh with certain distance and selecting the crossing as survey points. This way is applied in case no specific geological or topographic information is available.

On the other hand, the second way is to select survey points according to the existing information regarding soil type distribution in the area, which is applicable only in case there is available information got on the ground. In case of Jebel Lado, the first way was applied, because there was no detailed information obtained on the ground.

Figure 2.4.1 shows the survey points planned in consultation with RSS-TT, and 18 points were determined as a result. However, some points were skipped due to the limited time frame then 14 points were surveyed after all.

(2) Result of field observation (soil conditions)

The greater part of soil has dark brown colour and its texture ranges from clay loam to high clay, while soil near from small stream running through No.10 to No.4 (see Figure 2.4.1) has relatively yellowish brown colour and its texture ranges from sandy loam to silt loam. Soil with high clay content, which widely spreads over the command area, is very hard and compact and many small cracks were observed on the soil surface and cross section. It seems cracks are generated under the condition of continual contraction and expansion.

On one hand, soil along No.10 to 4 (See Figure 2.4.1) is relatively fluffy. Clear vertical change of soil type was not observed with no appearing stone/gravels or ground water coming up., namely, clayish soil is filling up to at least 1m depth in the command area as a whole.

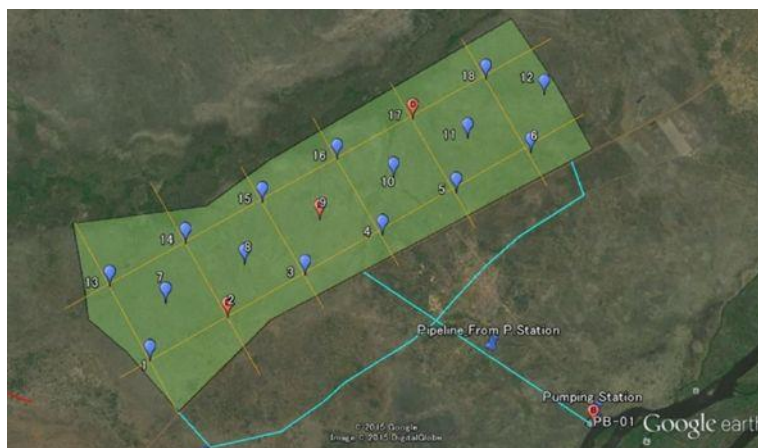


Figure.2.4.1 Soil Survey Points

- * Blue points are for 50 cm depth cross section survey, and red ones are for 1 m depth.
- * Distance of mesh covered over the command area is 1 km.



Figure 2.4.2 Land Landscape in Command Area



Figure 2.4.3 Soil Profile in Command Area

Photo on the left shows the profile at No.4 and that on right shows that at No.8. Location of each point is shown in Figure.2.4.1

(3) Result of chemical analysis and consideration (soil chemistry)

Table 2.4.1 shows the result of chemical analysis of soil in Jebel Lado. Humus ratio seems fairly well, 2.2 % on average, ranging from 0.7 to 3.9 %. Estimated CEC ranges from 6.8 to 18.2 me/100g. Normally, more than 20 me/100g is ideal for farming, so there is still room for improvement regarding CEC, even though it is not so bad. Nutrient contents are high as a whole in the command area, therefore, possible obstacle in farming would not be lack of nutrient, but excess. Especially, Calcium and Magnesium seems to be accumulated in the soil resulting in unbalanced base ratio. Even though generally nutrient is abundant in the command area, some of elements such as Potassium and Phosphorus contained very few at some points. It would have to be taken care with observation of crop growth. Soil pH tends to be alkaline, which may be partially effected by people's activities. People from the communities near from the command area sometimes burn bushes in the command area to hunt wild animals, then remained ashes with alkalinity probably affect soil some. It should be taken in to consideration for actual farming practice.

Table 2.4.1 Chemical Analysis Results

	Average	Minimum value	Maximum value
Humus ratio (%)	2.2	0.7	3.9
CEC (me/100g) ^{*1 *2}	12.2	6.8	18.2
NO ₃ -N (mg/100g)	2.0	0	3.1
Fe ₂ O ₃ (ppm)	10.1	0	27
P ₂ O ₅ (mg/100g)	103.6	0	342
K ₂ O (mg/100g)	89.6	1	323
CaO (mg/100g)	516.6	241	829
MgO (mg/100g)	169.1	47	274
Mn (mg/100g)	2.0	0	5
pH	7.2	6.1	8.2
EC ^{*3}	0.0	0	0.08
Total N (%) ^{*2}	0.2	0.07	0.28
CN ratio ^{*2}	7.0	5.7	7.6
Base ratio			
CaO/MgO ^{*2}	2.5	0.9	7.1
MgO/K ₂ O ^{*2}	61.9	0.3	644.1
CaO/K ₂ O ^{*2}	98.1	1.1	960.8

Source: IDMP TT (Soil survey 2015)

*1 CEC is an abbreviation of Cation Exchange Capacity, which was estimated based on humus ratio.

*2 Estimated value.

*3 EC is an abbreviation of Electric conductivity.

CHAPTER 3 AGRICULTURE AND SOCIO-ECONOMIC

3.1 Methods of Agriculture and Socio-Economic Survey

Agriculture and Socio-Economic Survey was conducted by interview with a questionnaire in the project area. The related two (2) communities were targeted; Nyuwa and Piete. Both of communities are under Jebel lado East Boma, Northern Bari payam, Juba county. The survey aimed to take necessary data for making the farming plan and evaluating the priority projects from the viewpoints of socio-economic and marketing. The contents of the questionnaire consisted of 14 items, centralizing the related questions to the situation of farming and household.

The enumerators in pairs were going to hold two interviews a day, target interviewees counted 26 households. It is necessary to previously explain the survey method to the interviewees since the questions include private points, such as household income, expenditure, etc. Grasping the current situation of the target communities is indispensable for the planning of the priority projects. Hence, a preliminary workshop was held before the survey. Days of workshop and number of interviewees are given as below:

Days of Workshops : Middle of May, 2015

Number of interviewees : 23 persons (Breakdown is shown in the table below)

Table 3.1.1 Interviewees' Information

Community	Male	Female	Total
Nyuwa	14	1	15
Piete	7	1	8
Total	21	2	23

Source: IDMP TT (Socio-economic survey, 2015)

The contents of the questionnaire are divided into the 14 items; 1) Background of household, 2) Land holding and land tenure, 3) Inventory of farm machinery and hiring cost of farming power, 4) Crop production and farming practices, 5) Income from other crops in home garden, livestock and other products, 6) Wages/ salary, leasing, business and other income, 7) Living expenses, 8) Present farming situation, 9) Selling of agriculture products, 10) Existing farmers' group and farmers' organization, 11) Irrigation service charge / activity of WUA or WG, 12) Loan, 13) Agricultural services / agricultural activities, and 14) Gender/ roles and responsibilities.

In terms of the social sector, questions, such as land tenure, gender issues/roles, drinking water, cooking fuel, etc., were set in the questionnaire, referring *Handbook on Community Engagement*, April 2012, South Sudan Law Society. Though there is enough development potential of the land use, some issues, such as dealing of community land, land utilizing division of tribes, etc., have to be treated carefully.

From the viewpoints of making the planting plan, the enumerators asked the interviewees about their views for future crops based on the existing planting model. In addition to the question, the enumerators also asked their intention of the crop selection in order to grasp the needs of an irrigation project and reflect to the farming plan. Also, as for the introduction of fertilizer, concerned questions were made based on the results of the sales conditions survey in Juba to make the agriculture input plan for the priority projects in accordance with the actual conditions.

3.2 Socio-Economic Indicators

(1) Household members

Table 3.2.1 shows the average household members with the number of children under 14 years old in Jebel lado. The total average number of family members is 7.4 persons/ household.

Table 3.2.1 Average Household Members

Community	Adults equal/above 14			Children under 14			Total
	Male	Female	Sub Total	Male	Female	Sub Total	
Nyuwa	2.3	1.8	4.1	2.0	1.5	3.5	7.6
Piete	2.5	1.6	4.1	1.5	1.5	3.0	7.1
Total	2.3	1.7	4.1	1.8	1.5	3.3	7.4

Source: IDMP TT (Socio-economic survey, 2015)

Interviewees' education experiences were also asked in the questionnaire. In Jebel lado, 14 persons answered to this question. Among them, three (3) have no educational experience, eight (8) have graduated only from primary school and three (3) have secondary or higher grade educational backgrounds. In addition, their wives have no educational experience at all and sometimes their children either.

(2) Income from farming and others

Table 3.2.2 shows the average income per annum from farming in Jebel lado. The annual net cash income from farming is about four (4) thousand SSP and annual SSP and annual net income is about nine (9) thousand SSP, respectively. More than half of net income is consumed within household. Major components of net cash income are those from Okra, Jew's mallow and Tomato followed by Sorghum and Ground nut. On the other hand, major components of net income are those from Sorghum, Okra, and Maize, followed by Ground nut and Jew's mallow.

Table 3.2.2 Net Cash/ Inputted Income from Farming

	Area (ha/HH)	Yield (t/ha)	Production (kg/HH)	ratio for sale	Farm gate price (SSP/kg)	Production cost (SSP/ha)	Net Cash income (SSP/HH)	Net income (SSP/HH)
	(a)	(b)	(c)=(a)*(b)	(d)	(e)	(f)	(g) =(c)*(d)-(a)*(f)	(h) =(c)*(e)-(a)*(f)
Maize	0.52	0.7	356.7	21.2%	3.9	149	217	1,314
Sorghum	0.51	1.2	624.8	15.5%	3.3	100	269	2,011
Cassava	0.03	1.6	54.5	43.6%	6	280	133	318
Common bean	0.08	0.9	71.7	48.2%	5.1	93	169	358
G nut	0.22	1.7	385.8	23.9%	3.4	261	255	1,253
Sesame	0.05	0.3	11.9	-	(4.8)	48	-2	55
Vegetables								
Okra	0.12	2.8	343.8	87.8%	5.4	440	1,576	1,803
Tomato	0.04	2.6	98.7	88.3%	5.2	721	425	485
Cucumber	0.01	0.1	1.4	66.7%	8	476	3	6
Jew's mallow	0.06	5.0	294.2	93.6%	3.5	421	939	1,005
Amaranthus	0.01	3.2	36.8	100.0%	0	524	-6	-6
Cowpea	0.04	0.8	34.8	83.3%	3.1	143	84	102
Bean	0.005	1.4	6.8	66.7%	5	0	23	34
Total							4,084	8,738

Source: IDMP TT (Socio-economic survey, 2015)

Note: Farm-gate price in () is the average of other sites due to lack of data in this site

Next table shows annual average household income from other than farming in each area. We can find that only the salary income from other occupation, such as government official, company employee, driver, etc. is appropriated in Jebel Lado as non-farming income.

Table 3.2.3 Average Household Income from Non-farming (SSP/year)

Areas	Salary of other occupations	Wages as casual worker	Gifts and remittance	Lease of farm land	Total
Wau	317	162	462	-	940
Jebel Lado	706	-	-	-	706
Rejaf East	3,005	-	462	38	3,505
Total	1,299	53	320	13	1,685

Source: IDMP TT (Socio-economic survey, 2015)

(3) Living expenses

Next table shows average household expenditure in a year. The annual total outlay is about 16 thousand SSP. Outlay for foods is about six thousand SSP, which occupies 40 % of the total expenditure. Outlay for education is SSP 29 hundred, which is the biggest item and occupies 18 % of the total expenditure. The following big items are purchase of clothing, SSP 23 hundred (15%), outlay for medical care, SSP 22 hundred (14%), and purchase of meat and eggs, SSP 12 hundred (7%).

Table 3.2.4 Average Household Expenditure

Foods	(SSP/HH)	(%)	Other than foods	(SSP/HH)	(%)
Maize	942	5.9	Tobacco and Cigarettes	356	2.2
Sorghum	859	5.3	Soap, Shampoo	447	2.8
Cassava	132	0.8	Electricity charges	13	0.1
Common Beans	316	2.0	Firewood, cooking fuel and LP-gas	1	0.0
Ground nut	372	2.3	Lighting fuel	17	0.1
Sesame	9	0.1	Household furnishing and equipment	554	3.4
Other tubers and Roots	-	0.0	Repair and maintenance of house	19	0.1
Fish	701	4.4	Clothing	2,347	14.6
Meat and Eggs	1,155	7.2	Medical care	2,245	14.0
Vegetables	301	1.9	Education	2,947	18.3
Flour	-	0.0	Recreation	65	0.4
Bread	-	0.0	Ceremonial Occasions	73	0.5
Tea and Coffee	575	3.6	Transportation and communication	474	2.9
Milk and Yogurt	-	0.0	Remittance to relatives	100	0.6
Liquor and Soft drinks	13	0.1	Land and house rent	18	0.1
Cooking oil	597	3.7	Taxes	-	0.0
Sugar and Salt	420	2.6	Loan repayment	12	0.1
Spice and other foods	-	0.0	Sub total	9,689	60.3
Sub total	6,392	39.7	Grand total	16,080	100.0

Source: IDMP TT (Socio-economic survey, 2015)

(4) Loans

Question regarding loan was made in the questionnaire and 21 interviewees answered to the question. Four (4) of them borrow money from their relatives. Two (2) of them borrow less than 140 SSP currently and one (1) is borrowing more than 1,400 SSP.

Their purposes of borrowing money were 1) To hire agricultural labor, 2) To obtain food and 3) because of emergency such as illness or injury.

On the other hand, majority of the interviewees are not borrowing money. The most major reason of not borrowing money was lack of opportunity/ place to borrow money.

(5) Farmers' groups/organizations

There was no interviewee who was a member of an existing farmers' group/organization or water group / water users association though 23 interviewees answered to concerned questions.

(6) Roles of males, females and children

Next table shows gender rates of selling cereals in each area. We can find that the ratio of female only is higher and the ratio of male only is lower than those of other areas. The reason is considered that selling amount of cereals in Jebel Lado is smaller than the total average so that the sales do not require male power so much. The ratio of 'With Children' means that children participate in the sales in 9 % of the total households which answered concerned questions in Jebel Lado.

Table 3.2.5 Gender Rates of Selling Cereals (%)

Area	Male only	Female only	Both M&F	With Children
Wau	42	19	38	12
Jebel Lado	13	65	22	9
Rejaf East	19	50	31	13
Total	26	43	31	11

Source: IDMP TT (Socio-economic survey, 2015)

Next table shows gender rates of selling vegetables. The ratio of female only is higher than that of male only. The reason is considered that selling vegetables does not require male power so much.

Table 3.2.6 Gender Rates of Selling Vegetables (%)

Area	Male only	Female only	Both M&F	With Children
Wau	36	48	16	8
Jebel Lado	9	78	13	9
Rejaf East	25	56	19	6
Total	23	61	16	8

Source: IDMP TT (Socio-economic survey, 2015)

Next table shows gender rates of selling livestock. We can find that almost all sales of livestock are conducted by men. The reasons are considered that selling livestock requires male power and that provide comparatively big money.

Table 3.2.7 Gender Rates of Selling Livestock(%)

Area	Male only	Female only	Both M&F	With Children
Wau	92	0	8	0
Jebel Lado	100	0	0	0
Rejaf East	88	0	13	19
Total	94	0	6	5

Source: IDMP TT (Socio-economic survey, 2015)

To grasp the situation of money management in households, gender rates of managing incomes are arranged in tables below. We can find that ratios of male only are higher than those of female only; especially, most income management of livestock is conducted by men. Item whose ratio of female only is comparatively high is non-farming.

Table 3.2.8 Managing Income of Cereals (%)

Area	Male only	Female only	Both M&F
Wau	46	8	46
Jebel Lado	78	13	9
Rejaf East	44	25	31
Total	57	14	29

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.2.9 Managing Income of Vegetables (%)

Area	Male only	Female only	Both M&F
Wau	42	25	33
Jebel Lado	70	13	17
Rejaf East	38	31	31
Total	51	22	27

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.2.10 Managing Income of Livestock (%)

Area	Male only	Female only	Both M&F
Wau	71	4	25
Jebel Lado	100	0	0
Rejaf East	53	0	47
Total	76	2	22

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.2.11 Managing Income of Non-farming (%)

Area	Male only	Female only	Both M&F
Wau	42	23	35
Jebel Lado	22	17	61
Rejaf East	38	25	38
Total	34	22	45

Source: IDMP TT (Socio-economic survey, 2015)

On the other hand, almost all works of water taking and collecting firewood are conducted by women as showing tables below.

Table 3.2.12 Gender Rates of Water Taking (%)

Area	Male only	Female only	Both M&F	With Children
Wau	4	92	4	35
Jebel Lado	0	96	4	57
Rejaf East	7	93	0	33
Total	3	94	3	42

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.2.13 Gender Rates of Collecting Firewood (%)

Area	Male only	Female only	Both M&F	With Children
Wau	4	96	0	44
Jebel Lado	0	100	0	59
Rejaf East	6	94	0	31
Total	3	97	0	46

Source: IDMP TT (Socio-economic survey, 2015)

Next tables show average distances from houses to water source / collecting point of firewood, and necessary times per day/week for the works.

Table 3.2.14 Basic Data on Water Taking

Area	Distance (meter)	Times per day	Hours per time	Hours per day
Wau	830	3.1	0.7	2.1
Jebel Lado	447	3.3	0.4	1.4
Rejaf East	266	2.9	0.4	1.2
Total	556	3.1	0.5	1.7

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.2.15 Basic Data on Collecting Firewood

Area	Distance (meter)	Times per week	Hours per time	Hours per week
Wau	660	3.4	2.2	7.6
Jebel Lado	820	2.1	1.5	3.3
Rejaf East	920	2.5	1.4	3.4
Total	780	2.7	1.7	4.7

Source: IDMP TT (Socio-economic survey, 2015)

(7) Land lease/borrow and land ownership

There was no interviewee who leased/ borrowed land in the case of Jebel Lado. Basically, farmers cultivate their own land and leasing/ borrowing of land are seldom conducted.

Additional interview related land ownership was conducted, however, no information was obtained in case of Jebel lado.

(8) Effect caused by the conflict

The answers to the question of problems that caused by the conflict occurred in December 2013, are summarized into three points below. We can understand the second point since the unusual price hike is still going on. The third point mentions shortage of labor for farming because some residents have evacuated from the riverside village to islands in Nile.

- No problem
- Price of commodities became high after the crisis
- Not able to cultivate because villagers have gone to islands

3.3 Farm Land and Cropping Pattern

(1) Farm land area

Table 3.3.1 shows the total farm land holding area with its breakdowns; 1) irrigated, 2) non-irrigated

and 3) homestead. More than three (3) quarters of total farmland area is non-irrigated land (72.0%). Total farmland extent is 4.3 feddans (nearly equal to 1.8 ha) on average in the site.

Table 3.3.1 Average of Farm Land Area (fed/HH)

	Total area			
		Irrigated	Non-irrigated	Homestead
Jebel Lado	4.3	0.6 (14.0%)	3.1 (72.0%)	0.6 (14.0%)
Wau	6.7	0.2 (3.0%)	5.6 (83.6%)	0.9 (13.4%)
Rejaf East	5.5	2.7 (49.1%)	1.6 (29.1%)	1.2 (21.8%)

Source: IDMP TT (Socio-economic survey, 2015)

(2) Cropping pattern

Figure 3.3.1 shows the cropping pattern in Jebel Lado, which is estimated based on the socio-economic survey results and Figure 3.3.2 shows summarized land use ratio of crops in three (3) priority project sites. The overall cropping intensity is 95.0 % scoring higher ratio compared to the other two (2) sites. Maize and Sorghum are cultivated as major crops in the site, whose land use ratio are 28.7 % and 28.2 % respectively, and total land use ratio of these two (2) crops is more than half of overall cropping intensity in the site. There are some farmers interviewed who are cultivating maize twice a year. It seems they are planting short term maize which needs only 3 months of growth period to harvest. Other popular crops in the site are Ground nut and Okra, whose land use ratio were 12.4 % and 6.7 % respectively.

Maize, Sorghum, Ground nut and Sesame are cultivated mainly during rainy season. The farmers start land preparation before rainy season comes then start sowing the crops and harvest them around the end of rainy season. On the other hand, some of vegetables and cash crops are cultivated not only in dry season but also dry season. Vegetables and cash crops tend to be cultivated in dry season, which is same among three (3) sites. However, the land use ratio of staple food crops such as maize and sorghum is higher than other two (2) sites, which indicates production of these kind of staple crops is prioritized in the site comparing to the other two (2) sites.

Month	Rainy season	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	No. of ^{*2} Answers
Land ^{*1} use %														
Crop name														
Maize	28.7%		L	L	L	S	W	W	H	H				21 (1) (1)
Sorghum	28.2%	L	L	L	S	W	W	W	H	H				19
Cassava	1.9%	H	H	H	L	L	S	W	W					4
Common bean	4.5%		L	L	L	S	W	W	H	H				7 (1)
Ground nut	12.4%	L	L	L	S	W	W	W	H	H				15
Sesame	2.6%	L	L	L	S	W	W	W	H	H				7
Vegetables/Cash crops	16.6%													
Okra	(6.7%)													18
Tomato	(2.1%)													7
Cucumber	(0.5%)													1
Jew's mallow	(3.2%)													12
Amaranthus	(0.6%)													4
Cowpea	(2.4%)													3
Bean	(0.3%)													1
Others	(0.7%)													3

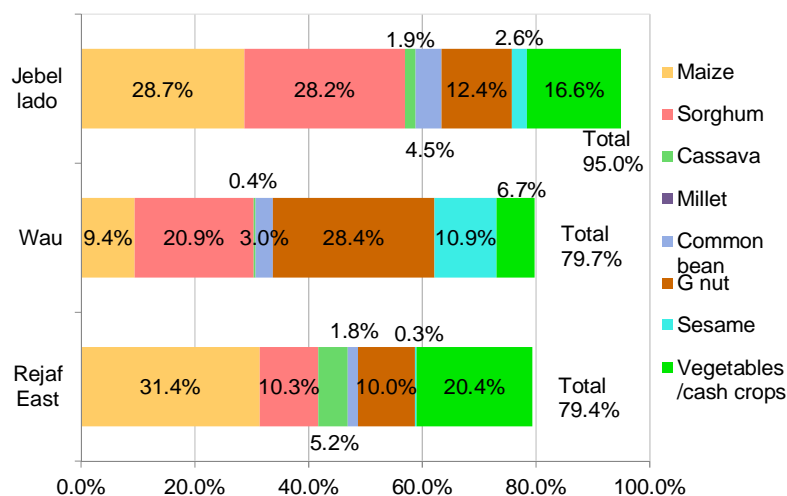
Source: IDMP TT (Socio-economic survey, 2015)

*1: Parenthesized numbers show the breakdown of the above percentage.

*2: Parenthesized numbers shows the breakdown of the above number

*3: Cultivation period of vegetables shown in the figure above, is the average period of each cropsqsamples.

Figure 3.3.1 Cropping Pattern



Source: IDMP TT (Socio-economic survey, 2015)

Figure 3.3.2 Land Use Ratio in 3 Priority Project Sites

3.4 Farming Practices

(1) Agricultural inputs procurement

Table 3.4.1 shows the sources of agricultural inputs procurement. Information regarding agro-chemicals, fertilizer and fuel for tractor is few due to those limited use among the interviewees.

The most common way to obtain cereal seed is to make it by themselves, and the second one is to get it from other farmers. Some farmers obtain cereal seeds from government, NGO, Village shop or trader. On the other hand, seed of bean and vegetables tend to be purchased more from town shop compared to that of cereals.

Table 3.4.1 Sources of Agricultural Inputs Procurement (no. of Answers)

	Agro-chemicals	Fertilizer	Seed (Cereal)	Seed (Bean)	Seed (vegetables)	Fuel for tractor
Government	-	-	1	-	1	-
NGO	-	-	1	-	1	-
Town shop	-	-	-	6	11	-
Village shop	-	-	1	-	1	-
Trader	-	-	1	-	4	-
Other farmers	-	-	8	6	8	-
FarmersqOrganization	-	-	-	-	-	-
Others	-	-	-	-	-	-
Made by themselves	1	-	15	7	12	-
Total	1	-	27	20	37	-

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee.

Table 3.4.2 shows the problems in obtaining farm inputs expressed by the interviewee. Availability is mentioned by the farmers as major issue of almost all of the items. Regarding cereal seed, its low quality is considered as problem. It can be one of the major causes that the farmers get cereal seed mainly from neighbours or make it by themselves (See table 3.4.2). On the other hand, the noticeable problem in obtaining bean and vegetable seeds is that these are too expensive for the farmers.

Table 3.4.2 Problems in Obtaining Farm Inputs (no. of Answers)

	Agro-chemicals	Fertilizer	Seed (Cereal)	Seed (Bean)	Seed (vegetables)	Fuel for tractor
Non availability	-	-	4	1	1	-
Not available when needed	1	9	-	-	7	1
Available in small quantities only	-	-	6	-	1	-
Expensive	-	-	3	7	9	1
Transport problems	-	-	-	-	-	-
Lack of finance	-	-	4	-	1	1
Low quality	-	-	6	-	-	-
Total	1	9	23	8	19	3

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee

(2) Agro chemicals use

There are very few farmers using agro-chemicals such as fertilizers or pesticide. Among the interviewees, one (1) farmer in Nyuwa community answered he makes agro-chemicals by himself, and it might be a kind of bio-chemical. In addition, there are several farmers who use agro-chemicals for vegetable cultivation. It seems there is almost no use of agro-chemicals as general in farming practice in Jebel Lado. However, the farmers expressed they have difficulty in obtaining agro-chemicals including fertilizer, that is to say, it is unavailability of such agro-chemicals on time. It should be noted that they do not mention "Expensive" as a problem they have in obtaining agro chemicals (See Table 3.4.2). The main problem might not be affordability but availability.

(3) Labour

Necessary labour for farming operation is supplied mainly from family, but sometimes farmers work as group. In other word, they help each other without any physical payment. Required working days for major farming operation was surveyed in the socio-economic survey. Declared working days vary widely and tend to be longer than that is considered as normal, because farmers repeatedly practice same operation such as land preparation or seeding with trial and error. Farmers often failed to start or continue cultivation due to deficit of rainfall or unexpected delay of rainy season.

(4) Farm machinery/tools

Table 3.4.3 shows the inventory of farm machinery and tools the farmers own. No farmer possess tractor or water pump. Only general hand tools for manual operation such as hoe and shovel are their major possessions.

One (1) farmer in Piete community has an experience in hiring tractor from the government to plow three (3) feddans of his farmland and. Its fee was 300 SSP/feddan. Even though the tractor rental service from the government is available in the site, few farmers seem to be able to utilize it. Actually, it seems they cannot afford to access it in spite of their willingness.

Regarding other farming equipment, almost no farmer borrowed or hired any other equipment such as weeder or water pump, which means almost all of their agricultural practices are done manually. However, there was one (1) farmer who borrowed a weeder from the government for a day with 200 SSP/day of payment as its rental fee.

Table 3.4.3 Inventory of Owned Farm Machinery/Tools

	No. of HHs owning machineries (no.)			Average no. of machinery (no./HH)
	Total			Total
	Nyuwa	Piete		
4-wheel tractor	-	-	-	-
Hand tractor	-	-	-	-
Hand sprayer	-	-	-	-
Engine sprayer	-	-	-	-
Weeder	-	-	-	-
Seeder	-	-	-	-
Hoe	14	8	22	2.4
Shovel	8	3	11	0.8
Manual thresher	5	4	9	2.6
Engine thresher	-	-	-	-
Oxen-drawn plow	-	-	-	-
Water pump(Oil)	-	-	-	-
Water pump (Electric)	-	-	-	-
Milling machine	1	-	1	1.0
Agro well	-	-	-	-
Mobile phone	7	3	10	1.1
Spade	5	1	6	2.3
Ax	9	4	13	1.7
Panga	6	4	10	1.7
Moloda	7	4	11	2.0
Gudum	-	1	1	1.0
Knife	-	-	-	-

Source: IDMP TT (Socio-economic survey, 2015)

(5) Livestock raising

Average numbers of livestock in the owners and average numbers of livestock in the total of samples are shown in the tables below. Cow and goats in Jebel Lado are much less than those in Wau, so that we can clearly find weight of crop cultivation in Jebel Lado is higher than that of Wau.

Table 3.4.4 Average Number of Livestock with the Owners

Area	Cow	Bull/Ox	Sheep	Goats	Pigs	Chicken	Ducks
Wau	14.9	3.5	8.9	13.2	-	12.3	-
Jebel Lado	3.0	-	6.4	8.8	-	14.0	2.0
Rejaf East	2.0	-	11.3	5.9	1.0	8.4	10.0
3 areas	12.7	3.5	8.7	10.3	1.0	12.4	6.0

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.4.5 Average Number of Livestock in the Samples

Area	Cow	Bull/Ox	Sheep	Goats	Pigs	Chicken	Ducks
Wau	8.0	1.1	5.2	9.2	-	8.0	-
Jebel Lado	0.3	-	1.4	3.4	-	11.0	0.1
Rejaf East	0.1	-	1.3	2.0	0.0	2.3	0.4
3 areas	2.9	0.4	2.7	4.9	0.0	6.9	0.2

Source: IDMP TT (Socio-economic survey, 2015)

3.5 Productivity

(1) Crop yields

Table 3.5.1 shows average crop yield in Jebel Lado. Yield ranges widely, for instance, the minimum yield is 0.2 t/ha and the maximum yield reaches 2.4 t/ha. As a whole, crop yield in Jebel Lado is nearly equal to or more than the average of three (3) sites. Some farmer achieve considerably high yield, for

instance Okra and Jew's mallow, those maximum estimated yield is 11.9 and 14.3 t/ha.

Table 3.5.1 Crop Yields

Crop	Average Yield (t/ha)	Minimum Yield (t/ha)	Maximum Yield (t/ha)	No. of sample	(Average yield of 3 sites) (t/ha)
Maize	0.7	0.2	2.4	21	0.7
Sorghum	1.2	0.1	2.9	19	1.2
Cassava	1.6	0.5	2.4	3	1.6
Common bean	0.9	0.2	2.4	4	0.6
Ground nut	1.7	0.2	3.8	13	1.5
Sesame	0.3	0.1	0.4	2	0.6
Vegetables					
Okra	2.8	0.2	11.9	18	1.8
Tomato	2.4	0.1	5.2	7	2.8
Cucumber	0.1	0.1	0.1	1	0.1
Jew's mallow	5.0	0.6	14.3	11	3.1
Amaranthus	3.2	1.9	5.7	4	3.2
Cowpea	0.8	0.2	1.7	3	0.8
Bean	1.4	1.4	1.4	1	1.4

Source: IDMP TT (Socio-economic survey, 2015)

Table 3.5.2 shows the important causes of pre-harvest damage or loss in cereal and other crops cultivation which was expressed by the farmers in Jebel Lado. Problems caused by wild domestic/wild animals are mentioned as most striking constraint on both of cereal and other crop cultivation. Disease is also mentioned as important problem. Compared to the above problems, issues relevant to water supply is expressed by fewer interviewees.

Table 3.5.2 Important Causes of Pre-harvest Damage or Loss (no. of Answers)

	Cereal	Other crop
Domestic animals	14	14
Birds	14	13
Other wild animals	14	13
Pest	6	4
Disease	13	10
Too much rain	9	4
Too little rain	8	3
Shortage of irrigation water	2	1
Others	2	1
Total	82	63

Source: IDMP TT (Socio-economic survey, 2015)

*1 :The questionnaire allowed multiple answers to the interviewee

*2 %Others+were not specified.

(2) Produce use

Table 3.5.3 shows crop products use in Jebel Lado. More than half of the Maize, Sorghum and Sesame are for self-consumption. Including other use in household, more than three (3) quarters of produce of Maize, Sorghum, Ground nut, and Sesame are consumed in household. Cassava and common beans are used almost half for household and selling respectively. On the other hand, vegetables are produced mainly for selling. Post-harvest losses of Maize, Sorghum and Cassava were mentioned, especially that of Cassava was relatively higher than others.

Table 3.5.3 Crop Produces Use

	Household use	Self-consumption	Stock for seed	Loan payment	Land tenant fee	Post-harvest losses	Others	Sold to market	No. of samples
Maize	78.8%	58.9%	11.1%	-	-	0.7%	8.1%	21.2%	21
Sorghum	84.5%	63.9%	10.8%	-	-	1.1%	8.7%	15.5%	18
Cassava	56.4%	39.4%	6.4%	-	-	10.6%	-	43.6%	3
Common bean	51.8%	25.0%	18.0%	-	-	-	8.8%	48.2%	4
Ground nut	76.1%	42.6%	22.2%	-	-	-	11.3%	23.9%	13
Sesame	100.0%	94.4%	5.6%	-	-	-	-	-	2
Vegetables									
Okra	13.6%							87.8%	18
Tomato	11.7%							88.3%	7
Cucumber	33.3%							66.7%	1
Jew's mallow	6.4%							93.6%	12
Amaranthus	0.0%							100.0%	4
Cowpea	16.7%							83.3%	3
Bean	33.3%							66.7%	1

Source: IDMP TT (Socio-economic survey, 2015)

(3) Profitability

Table 3.5.4 shows net / gross cash income and production cost per ha in Jebel Lado. Net / gross cash income can only reflect the amount of cash sale, without inputted income to household such as self-consumption supply. Hence, the crops with high household use in Jebel Lado, like Maize, Sorghum and Ground nut tend to show lower net cash income compared to overall average of three (3) sites. Vegetables show high profitability because they are cultivated mainly for selling in Jebel Lado. In addition, unit production costs of vegetables in Jebel Lado are lower than the overall average as a whole.

Table 3.5.4 Net Cash Income, Gross Cash Income and Production Cost per ha

	Net cash income (SSP/ha)		Gross cash income (SSP/ha)		Production cost (SSP/ha)		No. of samples
	Jebel Lado	(Average of 3 sites)	Jebel Lado	(Average of 3 sites)	Jebel Lado	(Average of 3 sites)	
Maize	359	(791)	508	(917)	149	(125)	18
Sorghum	502	(959)	602	(1,058)	100	(99)	19
Cassava	3,608	(1,537)	3,889	(1,958)	280	(420)	3
Common bean	1,891	(1,064)	1,984	(1,139)	93	(75)	4
Ground nut	973	(1,713)	1,234	(1,955)	261	(242)	13
Sesame	-48	(643)	0	(735)	48	(92)	2
Vegetables							
Okra	15,258	(10,058)	15,699	(10,661)	440	(603)	18
Tomato	9,932	(10,335)	10,653	(10,949)	721	(614)	7
Cucumber	286	(286)	762	(762)	476	(476)	1
Jew's mallow	16,354	(9,557)	16,775	(10,112)	421	(555)	11
Amaranthus	8,167	(7,110)	8,690	(7,696)	524	(586)	4
Cowpea	1,317	(1,838)	1,460	(2,000)	143	(162)	3
Bean	4,762	(4,762)	4,762	(4,762)	0	(0)	1

Source: IDMP TT (Socio-economic survey, 2015)

*1 Each unit values of net cash income, gross cash income and production cost were calculated respectively excluding invalid/unavailable values, hence net cash income value is not equivalent to the remainder after deducting unit production cost from unit gross income.

*2 Breakdown of vegetable production cost are Seed, fertilizer and agro-chemical obtains.

*3 No. of samples are only that of Jebel Lado.

In addition to net cash income, the results of net income calculated are listed in the following table:

Table 3.5.5 Net Income Estimate

Crop	Yield (t/ha)	Farm-gate Price SSP/kg	Gross Income SSP/ha	Production Cost SSP/ha	Net Income SSP/ha
Maize	0.7	3.9	2,730	149	2,581
Sorghum	1.2	3.3	3,960	100	3,860
Cassava	1.6	6	9,600	280	9,320
Common bean	0.9	5.1	4,590	93	4,497
Groundnut	1.7	3.4	5,780	261	5,519
Sesame	0.3	(4.8)	1,440	48	1,392
Vegetables					
Okra	2.8	5.4	15,120	440	14,680
Tomato	2.4	5.2	12,480	721	11,759
Jew's mallow	5	3.5	17,500	421	17,079
Amaranthus	3.2	2.6	8,320	524	7,796
Cowpea	0.8	3.1	2,480	143	2,337
Cucumber	0.1	8	800	476	324

Source: IDMP TT (Socio-economic survey, 2015)

Note: Farm-gate price in () is the average of other sites due to lack of data in this site

3.6 Selling of Produce

Farmers in Jebel Lado are selling their produce mainly at the markets; Libia, Konyokonyo, and New site markets, where is located about 20 km away from the two (2) communities. In Nyuwa community, there are some farmers selling their produce to traders or collectors directly.

Table 3.6.1 shows the mode of transport the farmers in Jebel Lado use. Major ways of transport are public bus and motorbike and some of the farmers transport their produce by foot.

Table 3.6.1 Mode of Transport

Mode of transport	No. of answers
Public bus	19
Tractor	-
Private car	-
Motorbike	13
Bicycle	-
On foot	7
No need	-
Total	39

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee

Table 3.6.2 shows the problems in marketing of produce mentioned by the farmers in Jebel Lado. The farmers particularly feel difficulty with low market prices, lack of facilities for transportation and storage and high transportation cost.

Table 3.6.2 Problems in Marketing of Produce

Problems in marketing of produce	No. of answers
Low selling prices	17
Lack of transportation facilities	15
High cost of transportation	16
Lack of storage facilities	15
Quality problems of products	11
Lack of packing material	7
Total	81

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee

CHAPTER 4 DEVELOPMENT CONSTRAINTS AND POTENTIALS

Table 4.1.1 shows the problems related to farming practices in Jebel Lado. As same as other two (2) sites, damages caused by pests /diseases and wild/domestic animals are most highly recognized as obstacles. Secondly highly recognized problems are water shortage and lack of farm roads. Some of farmers said hunger is the most serious challenge to practice farming.

Table 4.1.1 Problems in Farming

Problems in farming	No. of answers
Water shortage	17
Drought damage	10
Low yield of crops	15
Drainage problems	8
Damage by pests and diseases	19
Weed damage	9
Damage by wild animal	19
Difficulty in hiring animal/mechanical power	10
Labour shortage	4
Difficulty in obtaining seeds	10
Difficulty in purchasing agro-chemicals	14
Difficulty in purchasing fertilizer	6
Lack of farm roads	17
Damage by domestic animal	19
Shortage of selling opportunity	15
Lack of storage facilities	10
Problems related to loans	5
Others	1
Total	208

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee

Table 4.1.2 shows the items recognized as necessarily improved in farming practice in Jebel Lado. Corresponding to the Table 4.1.1, protection from pests/diseases and animals are high recognized as required improvement as same as other two (2) sites. Improvement of seeds and mechanization are also considered as in need by the farmers in Jebel Lado.

Table 4.1.2. Items Needed to be Improved

Items needed to be improved	No. of answers
To acquire irrigation water	16
To improve irrigation facilities	12
To drain out excess water	9
To prevent pests and diseases	21
To prevent damage by animal	20
To prevent weed damage	16
To improve supplying system of farm inputs	16
To improve farm road	15
To improve transportation of products	12
To introduce improved seed/plant varieties	19
To improve farming practices	20
To introduce mechanized farming	21
To strengthen agricultural extension services	14
To improve and expand agricultural credit	8
To construct drying yard	8
To construct processing facilities	14
To construct storage facilities	11
Others	1
Total	253

Source: IDMP TT (Socio-economic survey, 2015)

* The questionnaire allowed multiple answers to the interviewee

Summarized findings/features in the present agricultural situation in Jebel Lado

- ✓ More than half of farmland are used for maize and sorghum, which is higher share compared to other 2 sites. In addition, those crops' share of self-consumption to total production is higher, which implies they prioritize staple crops production for self-supply.
- ✓ Vegetable cultivation generating cash income is fairly well practiced with relatively high profitability, while farmers feel much difficulty on low market price.
- ✓ Estimated crop yield is fairly good compared to other sites as a whole.
- ✓ There are few farmers having an experience in using agricultural machinery and agro-chemicals.